San Diego Gas & Electric
Marketing Programs & Planning
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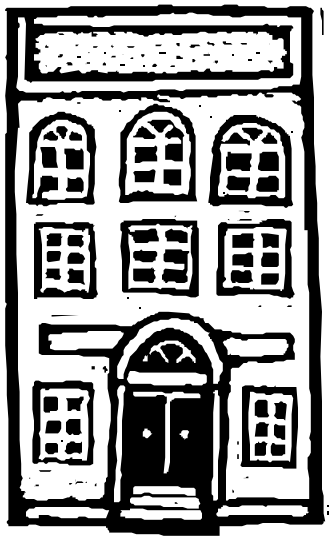
1997 Commercial Energy Efficiency Incentives Program

First Year Load Impact Evaluation

March 1999



Study ID No. 1025

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Section 1
Executive Summary

This is an evaluation of the Program Year 1997 (PY97) first year load impacts for SDG&E's commercial customers, who are a subset of the nonresidential customers who participated in SDG&E's Commercial/Industrial/ Agricultural (C/I/A) Energy Efficiency Incentives (EEI) Programs. The C/I/A EEI Programs help customers reduce energy costs and increase energy efficiency at their facilities. There are two major end uses covered by this report: (1) indoor lighting and (2) space cooling (HVAC). The total number of CEEI Program participants with these end uses are shown below:

Table 1
Number of Commercial Customers

End Use	Sector	Number of Participants
Lighting	Nonmilitary	2,070
	Military	14
	Total	**2,084**
HVAC	Nonmilitary	112
	Military	0
	Total	**112**

SDG&E obtained a retroactive waiver (see Appendix A) to the "Protocols and Procedures for Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs" (M&E Protocols) for evaluating the energy efficiency measures installed by military customers. This waiver allows for the evaluation of all measures installed in military bases under M&E Protocols Table C-5, instead of Table C-4. This allows the use of engineering estimates with *ex post* verification of the assumptions in the engineering model. SDG&E contracted with XENERGY, Inc. to conduct the military study, which is provided in Section 4 of this report.

Load Impact Regression Models were used to determine the load impacts for lighting and HVAC for nonmilitary commercial participants.

The PY97 CEEI Program study results, shown in the designated unit of measurement (DUOM), each end use are as follows:

Table 2
Study Results of CEEI Programs

Lighting Results

Study Group	Energy Savings[1] (kWh)	Realization Rate[2]	Demand Savings[1] (kW)	Realization Rate	Net-to-Gross Ratio (kWh)	Net-to-Gross Ratio (kW)
Nonmilitary	0.0909	0.751	0.0997	0.773	1.147	0.909
Military	0.0479	0.869	0.0608	1.100	1.000	1.000

HVAC Results

Study Group	Energy Savings[3] (kWh)	Realization Rate[4]	Demand Savings[1] (kW)	Realization Rate	Net-to-Gross Ratio (kWh)	Net-to-Gross Ratio (kW)
Nonmilitary	1.5081	1.063	.00035	2.215	0.757	0.777

[1] Lighting DUOM: load impact per square foot per 1,000 hours of operation
HVAC DUOM: load impact per square foot

[2] The Realization Rate is defined at the end use level as the load impacts estimated by the study, divided by the utility's first year earnings claim.

[3] Lighting DUOM: load impact per square foot per 1,000 hours of operation
HVAC DUOM: load impact per square foot

[4] The Realization Rate is defined at the end use level as the load impacts estimated by the study, divided by the utility's first year earnings claim.

Organization of Report

The report is organized into several sections.

Section 2 - Study Overview: This section presents the program description and a discussion of the participant database, nonparticipant group, and data collection efforts.

Section 3 - Nonmilitary Lighting & HVAC Studies: This section discusses the regression models and results obtained for the first year load impact study for nonmilitary lighting and HVAC.

Section 4 - Military Sector Study by XENERGY: This section contains the first year load impact study conducted by XENERGY on the military bases.

Appendices: This section contains all the appendices referenced throughout the report, and the M&E Protocols Reporting Requirements Tables 6 and 7 for the various end uses.

Section 2
Nonmilitary Study Overview

Program Description

San Diego Gas & Electric offers the Commercial/Industrial/Agricultural (C/I/A) Energy Efficiency Incentives (EEI) Programs to help customers reduce energy costs and increase energy efficiency at their facilities. The C/I/A EEI Programs, supported through audit programs, energy services representatives, and account executives, provide cost-effective DSM energy savings when existing customers have retrofit opportunities. SDG&E has three main market delivery mechanisms for providing incentives for retrofit or replace-on-burnout applications: (1) Commercial/Industrial (C/I) Incentives Program, (2) Power to Save Program, and (3) Commercial Rebates Program. Through this marketing strategy, SDG&E is provided the flexibility needed to encourage the adoption of energy efficient measures that would not otherwise be installed by customers due to economic market barriers.

C/I Incentives. This program typically targets large customers where SDG&E's account executives are involved in assisting customers with major retrofit applications. This program offers incentives to customers for the installation of standard mechanical and complex custom energy efficient measures. Energy efficient measures that have been identified as cost-effective when applied to specific building types are categorized as standard measures. Incentives are also available for measures on a customized basis, providing the project meets the program cost-effectiveness tests.

Energy savings are determined and reviewed by SDG&E's engineering staff. Additionally, for further verification, an outside consulting engineering firm performs semi-annual reviews of the completed job files.

Power to Save. This marketing strategy offers incentives to customers for the installation of energy efficient lighting and mechanical technologies. This full service strategy focuses on standard and custom lighting applications, as well as less complex standard and custom mechanical applications for all sizes of commercial and industrial customers, but tends to accommodate medium/small commercial/industrial customers.

Customer participation begins with an energy audit and recommendations for energy efficient equipment based on audit results. Customers are encouraged to participate in this program by installing cost-effective energy efficient measures and receiving incentives for those measures.

Commercial Rebates. These rebates are delivered through retailers/wholesalers who give the commercial/industrial/agricultural customer an instant incentive at the point of purchase. This program offers rebates to these customers for the following measures: (1) high efficiency refrigerators, (2) compact fluorescent lamps, (3) other energy efficient lighting technologies, (4) energy efficient motors, and (5) HVAC measures.

Sampling & Data Collection for the Lighting and HVAC End Uses

This section describes only the nonmilitary sector of SDG&E's Commercial EEI Program. A thorough discussion of the military section is contained in Section 4 on Military Installations by XENERGY.

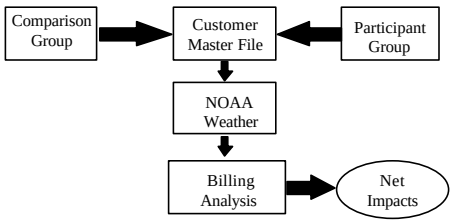
Data Collection

Data for the impact analysis were obtained from the following major sources:

- Customer name, address, affected square footage, lighting hours of operation, and installation date from the program tracking database;
- Comparison group (nonparticipants) was selected from the Customer Master File after the participants were determined;
- Consumption history from the Customer Master File;
- Data on floor stock, square footage, hours of operation, installation of energy efficient equipment, and occupancy from on-site audits for the nonparticipant group;
- Hourly weather data from NOAA files for the SDG&E climate zones: Maritime, Coastal and Transitional.

The following diagram describes the flow of data into the final new impact results:

Data Flow Diagram



Participant Database

A total of 2,182 commercial contracts (excluding the military bases) were identified in the 1997 commercial database for the lighting and HVAC load impact studies. An attempt was made to include all participants who were identified to have only indoor lighting or only HVAC installations in the analysis. These contracts were signed by 1,607 customers

Contracts used in the study are broken down by end use as follows:

Table 3
Study Participants by End Use

Commercial Indoor Lighting Only	2,070
Commercial HVAC Only	112

Nonparticipant Sample

The M&E Protocols require a nonparticipant sample for the evaluation of the Commercial EEI Programs under Table C-4. The nonparticipant sample was developed from SDG&E's Customer Master File by obtaining a list of commercial customers and their associated unique Premise ID numbers (generally a unique customer address). This nonparticipant group was determined not to have participated in any of the 1997 DSM nonresidential programs. For the purpose of selecting the nonparticipant sample, the participants were grouped by annual kWh and the ten building types defined by the CEC. The comparison group was then stratified by the same building types and consumption levels in order to match them to the participant group. Three hundred fifty customers were selected as the sample. Replacements were selected if a sample point could not be surveyed. This group was intended to serve as the comparison group for both the lighting and HVAC studies.

A summary of the participant group and the nonparticipant sampling frame by building type and size is given below. Note that a small building's consumption is less than 10,000 kWh per year; a medium building's consumption is 10,000 to 40,000 kWh; and a large building's consumption is greater than 40,000 kWh per year.

Table 4
Commercial Customers By Study Groups

	Small		Medium		Large	
Segment	Participant	Nonparticipant	Participant	Nonparticipant	Participant	Nonparticipant
College	16	201	0	30	7	16
Grocery	29	1,202	14	432	12	106
Hospital	7	106	5	35	8	36
Lodging	35	455	29	201	17	62
Nursing Homes	2	51	4	44	3	28
Restaurant	188	3,613	66	877	10	56
School	82	706	82	247	30	72
Retail	123	7,216	43	894	13	160
Offices	291	21,643	83	1,367	46	355
Com'l Bldg	227	14,369	56	854	33	195
Other Com'l	24	6,016	11	226	8	145
Other	1	1,567	2	158	0	69
Total	**1025**	**57,145**	**395**	**5,365**	**187**	**1300**

On Site Audits of Nonparticipants

VIEWtech conducted the on-site surveys of the nonparticipant sample for SDG&E. Detailed on-site audits were conducted on 350 sites. The primary purpose of the audits was to collect information on floor stock, lighted and conditioned square footage, hours of operation, occupancy, and information on any energy efficiency installations the customer may have done including the date of installation. A copy of the survey instrument is provided in Appendix C.

Billing and Weather Data

Hourly weather data were estimated from daily highs and lows from NOAA data files and converted to heating and cooling degreehours (with a base of 65 degrees Fahrenheit). These were matched to consumption data from the Customer Master File by billing cycle and climate zone for each household.

Long-term averages for cooling degree hours are used for weather-normalization purposes in the regression models. These are the average cooling degree hours covering a period of 12 years dating back to December 1985 through November 1997.

The following are special cases eliminated in the analysis:

1. Participants who also participated in the Nonresidential New Construction Program were eliminated from the analysis.

2. Participants who subscribed to the commercial programs both as an individual customer and as part of a multi-customer contract (e.g., chain stores, branches of corporate customers) were eliminated. Savings in multi-customer contracts are not disaggregated by individual customer. This multi-customer contract savings aggregation makes it difficult to estimate the individual contract savings without double counting the savings from the multi-customer contracts.

3. Surveyed nonparticipants who did not have lighting square footage information were eliminated from the lighting nonparticipant group. Surveyed nonparticipants who did not have HVAC square footage were eliminated from the HVAC nonparticipant group.

For each customer in the participant and comparison groups, consumption data and weather data gathered for use in the analysis covered the period beginning January 1996 through December 1998. Each customer's consumption and weather data were further screened to meet the M&E Protocols data requirement of twelve months pre-installation and nine months post-installation data. Customers that did not meet this data requirement were eliminated from the analysis. Table 5 illustrates data attrition for the participant group and the nonparticipant group.

Table 5
Study Group Pre-Regression Attrition

	Lighting		HVAC	
Status	Participants	Nonparticipants	Participants	Nonparticipants
Starting Study Group	1902	350	107	350
Special Cases Eliminated	88	5	16	16
Billing Data Available	1814	345	91	334
Sufficient Pre/Post Data	1515	313	72	305

Incorporation of the Nonmilitary and Military Load Impacts for Table E-3

The results from the XENERGY study (see section 4) were used to modify the load impacts for the lighting end use installed by the military participants. The study results from the Indoor Lighting and HVAC Studies section were used to modify the load impacts for the lighting and HVAC end uses installed by the nonmilitary participants. The total load impact parameter for the entire commercial group is then the weighted sum of the study group load impacts. Weights for each parameter (energy and demand) were determined by the contribution of each study group (military and nonmilitary) to the total value of each parameter. The following table shows the weights for each parameter by end use and study group.

Table 6
Load Impact Weights by Study Group

		Nonmilitary		Military	
Parameter		Lighting	HVAC	Lighting	HVAC
Energy Load Impact (kWh)	Gross	0.9646	1.0000	0.0354	0.0000
Demand Load Impact (kW)	Gross	0.9552	1.0000	0.0448	0.0000

Commercial Miscellaneous End Use

The 15% cap of total net resource benefits (modified by the net-to-gross ratio) for miscellaneous measures for this program was not exceeded. Therefore, no additional load impact studies other than the required end uses, indoor lighting and HVAC, were conducted for the CEEI Program.

Section 3
Nonmilitary Lighting and HVAC Studies
The General Model

The Individual Elements of the General Model

For customer i and month t, the general regression model is,

Equation 1 (The General Structure of the Regression Equation)

$$kWh_{it} = X_{it} + W_{it} + S_{it} + e_{it}$$

The dependent variable kWh_{it} is the monthly energy consumption for customer i, normalized for the length of the billing cycle. A constant and a simple trend term make up the non-weather/non-DSM portion of the regression equation:

Equation 2 (The Non-Weather/Non-DSM Portion of the Regression Equation)

$$X_{it} = \beta_{0i} + \beta_{1i}(t)$$

Cooling degreehours make up the weather-sensitive portion of the model:

Equation 3 (The Weather Portion of the Regression Equation)

$$W_{it} = \beta_{2i}(cdh_{it})$$

The cooling degreehour variable is the sum of the cooling degrees for the corresponding normalized billing month.

For customer i, DSM contract j is associated with the weather-normalized *ex ante* estimate of monthly energy savings F_{ij}. The statistical estimate for monthly savings S_{ijt} is,

Equation 4 (The DSM Portion of the Model)

$$S_{it} = \sum_{j} S_{ijt}$$

$$S_{ijt} = (\gamma_{1ij} + \gamma_{2ij} cdh_{it}) d_{ijt} F_{ij}$$

The term, $(\gamma_{1ij} + \gamma_{2ij} cdh_{it})$ is the estimated realization rate for contract j, generated in the regression by the indicator variable depending on the date of DSM installation.

The Lighting Regression Model

For the lighting model, the cooling-degreehour variable is suppressed, so that $\gamma_{2ij} = 0$. We assume that the realization rate is constant across contracts (within customers): $\gamma_{1ij} = \gamma_{1i}$. After a rearrangement of terms,

$$S_{it} = \gamma_{1i} \sum_{j} d_{ijt} F_{ij}$$

A final transformation of the DSM portion of the model will allow us to maintain consistency between the participant regression results and the nonparticipant regression results. We define the scaled *ex ante* estimate F_{ij}^{*},

Equation 5 (Normalizing the *Ex Ante* Estimes and Finding the Maximum of *Ex Ante* Savings)

$$F_{ij}^{*} = \frac{F_{ij}}{k_i}, \quad k_i = \max_{t} \sum_{j} d_{ijt} F_{ij}$$

Equation 6 (The Transformed DSM Portion of the Regression Model)

$$S_{it} = \gamma_{1i} k_i \sum_{j} d_{ijt} F_{ij}^{*}$$

When a single customer has only a single contract, it follows that $F_{ij}^{*} = 1$, and the model degenerates into a fairly simple model based on a straightforward zero-one indicator variable. However, the real importance of this last transformation stems from the fact that the regression coefficient $\gamma_{1i} k_i$ is in units of monthly kWh. This allows for consistency when we move on to the nonparticipant model where there are no *ex ante* estimates of savings.

Final Regression Components with Transformed Variables

Further linear transformations of the regressors in the model gives,

Equation 7 (The Transformed Non-Weather/Non-DSM Portion of the Lighting Regression Equation)

$$X_{it} = \beta_{0i}^{*} + \beta_{1i}(t - t^{*})$$

Equation 8 (The Transformed Weather Portion of the Lighting Regression Equation)

$$W_{it} = \beta_{2i}\left(\frac{cdh_{it}}{\overline{cdh}_i} - 1\right)$$

where β_{0i}^{*} is the new intercept determined by the various transformations. Clearly, β_{0i}^{*} can be interpreted as the weather-normalized value for monthly kWh consumption, prior to the DSM installation, evaluated along the trend at month t^{*} (in this case, taken to last possible month in the program year: December 1997).

Derivation of the Designated Unit of Measurement (DUOM) from the Lighting Gross-Impact Regression Model

The key regression result will be the single regression coefficient $\gamma_{1i}k_i$, generated by the regressor $\sum_j d_{ijt} F_{ij}^{*}$. This coefficient represents the estimated monthly kWh load impact. The sample-wide realization rate for the *ex ante* energy estimates can also be calculated:

$$\rho = -\frac{\sum_{i \in part} \gamma_{1i} k_i}{\sum_{i \in part} k_i}$$

As a result, the load impact, per square foot, per thousand hours of operation is,

Equation 9 (The Designated Unit of Measurement for Lighting Participants)

$$DUOM_{lighting}^{part} = \rho \times DUOM_{lighting}^{part,\,ex\ ante}$$

<u>The Lighting Impact Regression for Nonparticipants</u>

Among nonparticipants who have installed lighting measures, data is not available for obtaining *ex ante* estimates. In addition, no multiple DSM lighting installations existed within the sample of nonparticipants. As a result, for the DSM portion of the nonparticipant lighting model, $\sum_j d_{ijt} F_{ij}^{*} = d_{it}$, so that,

$$X_{it} = \beta_{0i}^{*} + \beta_{1i}(t - t^{*})$$

$$W_{it} = \beta_{2i}\left(\frac{cdh_{it}}{\overline{cdh_i}} - 1\right)$$

Equation 10 (The DSM portion of the nonparticipant lighting model)

$$S_{it} = \gamma_{1i} k_i (d_{it})$$

With respect to nonparticipants, there is a major question concerning the role of the regressor d_{it}. When survey results indicated that a nonparticipant had undertaken a lighting retrofit job, the structure of d_{it} is naturally that of a standard zero-one indicator variable. However, when there is no retrofit, the natural step—in keeping the participant and nonparticipant models parallel—would be to impose the constraint $\gamma_{1i}k_i = 0$, while keeping data on square footage and hours of operation within the analysis. However, it is important to deal with nonlighting events, such as broad based changes in economic activity, political, and social phenomena, or any discrete events not accounted for in the model which are coincident with the retrofit, and, as such, affect the gross impact model. Estimating the impact of these effects is part of adjusting the gross impact and, eventually, deriving estimates of net impact. The nonparticipant model can assist us in this estimation task, provided that the variable d_{it} is specified accordingly. As a result, when a nonparticipant in the database had not undertaken a lighting retrofit, d_{it} and the associated regressor $\gamma_{1i}k_i$ were maintained in the model, with d_{it} associated with an average installation date among participants. This average installation date was determined to be November 1997 (and September 1997 for HVAC).

Derivation of the Designated Unit of Measurement (DUOM) for Nonparticipants

Based on the previous section, results are available for nonparticipants that are analogous to Equation 9:

Equation 11 (The Designated Unit of Measurement for Lighting Nonparticipants)

$$\mathrm{DUOM}_{\mathrm{lighting}}^{\mathrm{nonpart}} = \frac{(12\mathrm{months})\times(1{,}000\mathrm{hours})\sum_{i\in\mathrm{nonpart}}\gamma_{1i}k_i}{\left(\overline{\mathrm{hours}}^{\mathrm{nonpart}}\right)\sum_{i\in\mathrm{nonpart}}\mathrm{sqft}_i}$$

Estimation

Data

The billing data for participants and nonparticipants were checked for kWh data that were missing or were most likely inconsistent with the specification for the regression equation. When these data were eliminated and the resulting data allowed for 12 months of pre-installation data and 9 months of post-installation data, the customer was included in the analysis (1514 and 313 customers, for participants and nonparticipants, respectively). In addition, a portion of the sample (321 and 54, for participants and nonparticipants, respectively) did not satisfy a root-mean-squared-error (RMSE) criterion, explained in the next section.

Estimation Methods

The model specified in Equation 1, and Equation 6-Equation 8 was estimated at the customer level for participants. To add some flexibility to the model, as was done in previous year's models, the month for the retrofit, and the month just after this point, were weighted out of the regression. In addition, both a trended model ($X_{it} = \beta^{*}_{0i} + \beta_{1i}(t - t^{*})$, in Equation 7) and a nontrended model ($X_{it} = \beta^{*}_{0i}$, in Equation 7) were estimated. When the absolute value of the t-statistic for the trended term (in the trended model) was less than two, the trended results were rejected in favor of the nontrended results.

Once the regressions were completed, an additional filter--the RMSE criterion--was applied, as was done in last year's study. Within the broad and complicated setting of commercial and industrial energy consumption, a fairly simple tool like regression analysis will not perform with uniform success; a fraction of the regressions simply 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. Along these lines, a ratio was calculated for each customer by dividing the root-mean-squared error for the regression by the intercept β^{*}_{0i}. This ratio is very likely to be large when the regression simply fails, since inadequacies in the specification of the model for a particular customer will result in excessively large estimated regression errors. Within the analysis, regressions were omitted where this ratio was greater than 15%.

Lighting Load Impact Results

Table 7 summarizes estimated lighting energy load impacts based on the participant and nonparticipant model.

Table 7
Lighting Energy Load Impact Estimates--Participants and Nonparticipants

Participants			
	RMSE		
	Satisfies RMSE Criterion	Does Not Satisfy RMSE Criterion	Grand Total
Total Estimated Impact (kWh per month)	-1,962,902	328,659	-1,634,242
Variance of Estimate	55,907,921,720	7,700,429,622	63,608,351,342
Total *Ex Ante* Estimate (kWh per month)	2,613,019	221,777	2,834,796
Sample Size	1,193	321	1,514
Total Lighted Square Footage	34,810,537		
Estimated Designated Unit of Measurement	-0.0909		
Realization Rate Based on *Ex Ante* Estimates[5]	-75.1%		
Nonparticipants			
	RMSE		
	Satisfies RMSE Criterion	Does Not Satisfy RMSE Criterion	Grand Total
Total Estimated Impact (kWh per month)	33,930	82,260	116,191
Variance of Estimate	1,578,594,302	1,035,783,774	2,614,378,076
Total Lighted Square Footage	6,640,345	2,237,927	8,878,272
Sample Size	259	54	313
Average Hours of Operation	4,578	3,113	4,325
Estimated Designated Unit of Measurement	0.0134		
Estimated Net-to-Gross Ratio	114.7%		

[5] The realization rate is defined as the sample ex post total estimated impacts to the sample ex ante total impacts.

Lighting Demand Load Impact Estimates

The lighting gross demand estimate was derived using the gross energy estimate from the regression analysis adjusted by the system coincident peak load factor obtained from the 1998 Load Research lighting end use recorder data. This system coincident peak load factor is defined as the ratio of the average demand (or the total annual energy consumption divided by 8760 hours) and the system coincident peak demand for the lighting end use. The system coincident peak load factor for commercial lighting was determined to be 0.77446. The estimated gross demand savings is estimated by Equation 12:

Equation 12 (Estimated Participant Demand Savings)

$$\text{Est.Total Demand Savings} = \frac{(1{,}962{,}902\,\text{kWh}) * 12}{8760\,\text{hours} * 0.77446} = 3{,}471.98\,\text{kW}$$

$$\text{Demand Savings (DUOM)} = \frac{1000 * 3{,}471.98\,\text{kW}}{34{,}810{,}537\,\text{sq.ft}} = 0.09974\,\text{kW per square foot}$$

with a realization rate of 77.29% (*ex ante* DUOM is 0.12904).

Equation 13 (Estimated Nonparticipant Demand Savings)

$$\text{Est. Total Demand Savings} = \frac{(33{,}930\,\text{kWh}) * 12}{8760\,\text{hours} * 0.77446} = 60.02\,\text{kW}$$

$$\text{Demand Savings (DUOM)} = \frac{1000 * 60.02\,\text{kW}}{6{,}640{,}345\,\text{sq.ft}} = 0.00904\,\text{kW per square foot}$$

Therefore, the average net impact is 0.0907 kW with a net-to-gross ratio of 90.94%.

The Space Cooling Regression Model

For space cooling, taking the model in Equation 1-Equation 4, and imposing the same sort of transformations that were imposed in the case of lighting gives,

Equation 14 (The Transformed Non-Weather/Non-DSM Portion of the Space Cooling Regression Equation)

$$X_{it} = \beta^{*}_{0i} + \beta_{1i}(t - t^{*})$$

Equation 15 (The Transformed Weather Portion of the Space Cooling Regression Equation)

$$W_{it} = \beta_{2i}\left(\frac{cdh_{it}}{\overline{cdh}_{i}} - 1\right)$$

Equation 16 (The Transformed DSM Portion of the Space Cooling Regression Model)

$$S_{it} = \left\{\gamma_{1i} + \gamma_{2i}\left(\overline{cdh}_{i}\right)\right\}k_{i}\left(\sum_{j} d_{ijt} F^{*}_{ij}\right) + \left\{\gamma_{2i}\left(\overline{cdh}_{i}\right)k_{i}\right\}\left(\frac{cdh_{it}}{\overline{cdh}_{i}} - 1\right)\left(\sum_{j} d_{ijt} F^{*}_{ij}\right)$$

For deriving the DUOM for space cooling,

Equation 17 (The Designated Unit of Measurement for Space Cooling Participants)

$$DUOM^{part}_{cooling} = \rho \times DUOM^{part,ex\ ante}_{cooling}$$

For nonparticipants,

Equation 18 (The Designated Unit of Measurement for Space Cooling Nonparticipants)

$$DUOM^{nonpart}_{cooling} = \frac{(12\ \text{months}) \times \sum_{i \in nonpart}\left\{\gamma_{1i} + \gamma_{2i}\left(\overline{cdh}_{i}\right)\right\}k_{i}}{\sum_{i \in nonpart} sqft_{i}}$$

Estimation

The model specified in Equation 14-Equation 16 was estimated at the customer level for participants (in the trended and nontrended form, as in the lighting case). Once the regressions were completed and the t-statistics evaluated, the RMSE criterion was applied.

Space-Cooling Impact Results

Table 8
Space-Cooling Energy Load Impact Estimates--Participants and Nonparticipants

Participants			
	RMSE		
	Satisfies RMSE Criterion	Does Not Satisfy RMSE Criterion	Grand Total
Total Estimated Impact (kWh per month)	-785,135	-87,241	-872,375
Variance of Estimate	31,052,839,137	25,107,606,057	56,160,445,194
Total *Ex Ante* Estimate	738,482	43,536	782,018
Total HVAC Square Footage	5,749,835		
Sample Size	60	11	71
Estimated Designated Unit of Measurement	-1.5081		
Realization Rate Based on *Ex Ante* Estimates[6]	-106.3%		
Nonparticipants			
	RMSE		
Data	Satisfies RMSE Criterion	Does Not Satisfy RMSE Criterion	Grand Total
Total Estimated Impact	-205,027	157,026	-48,000
Variance of Estimate	1,291,549,298	1,426,317,564	2,717,866,862
Total HVAC Square Footage	6,705,073	1,357,803	8,062,876
Sample Size	267	38	305
Estimated Designated Unit of Measurement	-0.3669		
Estimated Net-to-Gross Ratio	0.757		

Space Cooling Demand Load Impact Estimates

The space cooling gross demand estimate was derived using the gross energy estimate from the regression analysis adjusted by the system coincident peak load factor obtained from the 1998 Load Research space cooling end use recorder data. This system coincident peak load factor is defined as the ratio of the average demand (or the total annual energy consumption divided by 8760 hours) and the system coincident peak demand for the space cooling end use. The system coincident peak load factor for commercial space cooling was determined to be 0.53845.

The estimated gross demand savings is estimated by Equation 19:

Equation 19 (Estimated Participant Demand Savings)

$$\text{Est. Total Demand Savings} = \frac{(785{,}135\text{kWh}) * 12}{8760\,\text{hours} * 0.53845} = 1{,}997.451\,\text{kW}$$

$$\text{Demand Savings (DUOM)} = \frac{1{,}997.451\text{kW}}{5{,}749{,}835\text{sq. ft}} = 0.00035\,\text{kW per square foot}$$

with a realization rate of 221.5% (*ex ante* DUOM is 0.000158).

Equation 20 (Estimated Nonparticipant Demand Savings)

$$\text{Est. Total Demand Savings} = \frac{(205{,}027\text{kWh}) * 12}{8760\,\text{hours} * 0.53845} = 521.606\,\text{kW}$$

$$\text{Demand Savings (DUOM)} = \frac{521.606\,\text{kW}}{6{,}705{,}703\text{sq.ft}} = 0.000078\,\text{kW per square foot}$$

The net impact is 0.00027 kW with a net-to-gross ratio of 77.7%.

[6] The realization rate is defined as the sample ex post total estimated impacts to the sample ex ante total impacts.

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Military Sector By XENERGY

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1 INTRODUCTION

1.1 INTRODUCTION

San Diego Gas & Electric (SDG&E) commissioned XENERGY Inc. to evaluate the first year load impacts of measures installed under its *1997 Commercial Energy Efficiency Incentives* (*CEEI*) *Program* in the military sector. These measures were installed to provide resource value by improving the energy efficiency of the facilities that participated in the *CEEI Program*.

The overall objectives of SDG&E's *1997 Commercial Energy Efficiency Incentives Program First Year Load Impact Evaluation for the Military Sector* were to:

- evaluate the gross and net load impacts of the measures installed at these facilities; and
- verify the physical installation of the measures identified in the program tracking system.

These objectives were accomplished using the following methodology:

- verifying the physical installation of the measures identified in the program tracking system (electronic and hard copy);
- gathering data through direct measurement, observation, and interviews with site personnel; and
- performing simplified engineering analysis of energy impacts based on the data.

1.2 DESCRIPTION OF SDG&E'S PROGRAM SUPPORT

SDG&E has worked with the U.S. Navy for a number of years to develop a positive working relationship that enabled the U.S. Navy to identify and quantify energy saving opportunities, seek funding and install energy efficient lighting projects at military bases located throughout SDG&E's service area over a number of years. SDG&E worked with the Navy under a Basic Ordering Agreement (BOA) where SDG&E served as the prime contractor and worked on behalf of its client, the Navy. SDG&E hired subcontractors on a competitive basis, as required by the BOA, for the purpose of identifying energy saving opportunities and implementing them in the most cost-effective manner possible.

Through the CEEI program SDG&E developed the enabling infrastructure to assist the military in meeting its energy efficiency goals. SDG&E provided support to the military in the form of:

- audits and technical analysis that identified energy efficiency opportunities;
- assistance in documenting the savings necessary to apply for Department of Defense funding, including cost analysis with available financial incentives, preparation of Federal forms and supporting documentation;

- bid solicitation; including conducting pre-bid walkthroughs of sites, addressing questions from subcontractors, etc.; and
- project management, including construction management and post-retrofit quality assurance and compliance documentation required by the Government.

The documentation required by the military for funding such projects is extensive and exhaustive. SDG&E developed systems to produce these documents in a rather expeditious manner. The schedules tended to be very tight and labor intensive. SDG&E worked closely with the military to understand the requirements of the military both locally and nationally. In doing so, SDG&E was able to provide the level and intensity of effort necessary to enable the local efforts to be completed.

1.3 REPORT ORGANIZATION

The remainder of this report is organized as follows:

Section 2	Lighting Measure Impact Estimation
Section 3	Net-To-Gross Decision Analysis
Appendix A	Table 6: Lighting Measures: Protocols for Reporting of Results of Impact Measurement Studies Used to Support an Earnings Claim
Appendix B	Table 7: Documentation Protocols for Data Quality and Processing

2 LIGHTING MEASURES

2.1 OVERVIEW

During PY97 San Diego Gas & Electric installed lighting measures as part of its *Commercial Energy Efficiency Incentives Program (Commercial EEI Program)*. A significant portion of these measures were installed at military facilities in SDG&E's service area. Due to the highly aggregated nature of utility services to the primary participants in the military sector, namely military bases throughout the SDG&E service area, SDG&E applied for a retroactive waiver to seek approval of an alternate approach to estimating *ex post* load impacts to those required for CEEI programs. Thus, as allowed by the retroactive waiver for SDG&E's Commercial EEI Program for measures installed in the military sector, Table C-5 of the *M&E Protocols* for Industrial Energy Efficiency Incentives Programs were applied to the military sector participants of SDG&E's 1997 Commercial EEI Program.

This section describes the methodology and presents the results of the first year *ex post* load impact evaluation of the lighting measures installed through the Commercial EEI Program during PY97. Table 2-1 shows an *ex ante* summary of the program under a broad definition of participant. This shows that 19,071 individual measures were installed saving an estimated 1,651,139 kWh per year at the sites of 11 facilities defined as participants. A participant is defined as a premise served by an electric meter. This definition of a participant does not provide a meaningful level of identification of the measure locations at military bases. The measures as described in the rest of this evaluation are identified at the building level for nonresidential buildings as identified by a unique program contract. The ID No. is a unique variable that was used to identify specific buildings. There were no domestic residential buildings in the program for PY97.

The number of lighting retrofit projects for PY97 was far less than what had been done in previous years in the military sector. For example, during PY96 a total of 212,816 measures saving approximately 20 million kWh (ex ante) in over 600 buildings. Tables 3-1 and 3-2 show that for PY97 just over 19,000 measures were installed saving 1.6 million kWh (ex ante) in 173 buildings. The reason for this reduced figure is the long-term process implemented at military facilities by SDG&E. This was essentially the last year in a multi-year effort to install energy efficient lighting in as many facilities as possible at military bases. This was termed a "clean-up" year. In past years specific bases or commands had been the subject of lighting retrofits. As of PY96, virtually every base and command had participated. With the large number of facilities, however, there were some buildings that were missed in the initial program effort. These buildings were identified and targeted for the PY97 program. In effect, these buildings were "stragglers" that were planned to be captured in the "clean-up" process.

Table 2-1
Summary of *Ex Ante* Load Impacts By Participant
PY97 Commercial EEI Program
Military Sector
Lighting Measures

		Ex Ante Gross		Ex Ante Net	
Participant	**Measure Quantity**	**kWh Savings**	**kW Reduced**	**kWh Savings**	**kW Reduced**
1	2	505	0.06	404	0.05
2	1,540	82,945	11.09	68,907	9.16
3	3	758	0.09	606	0.07
4	21	5,306	0.61	4,245	0.49
5	14,840	1,270,364	270.04	1,026,877	219.22
6	1,086	194,657	55.71	155,726	44.57
7	751	45,278	9.53	37,513	7.86
8	770	36,249	9.09	28,999	7.28
9	17	4,296	0.49	3,436	0.39
10	26	6,570	0.75	5,256	0.60
11	15	4,211	0.48	4,211	0.48
Total	**19,071**	**1,651,139**	**357.94**	**1,336,180**	**290.16**

Table 2-2 shows there were 173 buildings where measures were installed, comprising almost 6.5 million square feet. The average hours of operation used for DUOM calculations was 4,612.43 hours per year.

Table 2-2
Nonresidential Building Summary
PY96 Commercial EEI Program
Military Sector
Lighting Measures

Number of Buildings	173
Total Square Feet (SF)	6,499,140
Smallest Building, SF	38
Largest Building, SF	2,059,520

Table 2-3 shows the distribution of measure categories installed through the program. It can be seen that T8 Fluorescent and CFLs account for almost 90% of the total ex ante kWh savings.

Table 2-3
***Ex Ante* Load Impacts by Measure Category**
PY97 Commercial EEI Program
Military Sector
Lighting Measures

Measure Type	Measure Quantity	Gross Ex Ante kWh Savings	Gross Ex Ante kW Reduced	Percent of Total kWh Savings
T8 Fluorescents	16,827	1,187,544	251.1	71.9%
CFL	1,574	295,890	82.45	17.9%
LED Exit Signs	571	144,703	16.52	8.8%
Halogen PAR	99	23,002	7.87	1.4%
Total	**19,071**	**1,651,139**	**357.94**	**100.0%**

2.2 SUMMARY OF EX POST LOAD IMPACT ESTIMATES

Table 2-4 shows a summary of the ex post load impacts for the Military Sector Lighting Measures installed during PY97.

Table 2-4
Summary of Ex Post Load Impacts
PY97 Commercial EEI Program
Military Sector
Lighting Measures

		kWh Savings	kW Reduced	
Ex Ante	Total Gross	1,651,155	357.94	
	Total Net kWh Savings	1,336,180	290.16	
Ex Post	Total Gross	1,435,215	395.147	
	Gross Realization Rate	0.8692	1.10	
	Net-To-Gross Ratio	1.00	1.00	
	Total Net Impacts	1,435,215	395.15	
	Net Realization Rate	1.0741	1.36	
Square Footage				6,499,140

2.3 *EX POST* EVALUATION APPROACH

To evaluate the lighting measures on-site verification visits were conducted at a sample of buildings. During these visits:

- the installation of the measures was verified and quantified;

- light loggers were installed and remained in place for a period of time to estimate hours of operation and/or interviews conducted to verify operating characteristics if logging was not possible; and
- spot measurements of a sample of fixtures were taken to estimate *ex post* connected watts.

The data collected were used to estimate adjustment factors for:

- measure installation
- hours of operation
- post-retrofit connected watts

These factors were combined to provide ex post adjustment factors that were used to extrapolate the sample ex post load impacts to the program population.

The resulting gross kWh impacts were then multiplied by the net-to-to-gross ratio that was estimated using the method described in Section 3 to estimate the net load impacts.

Building lighted square footage was verified in these buildings by observation. The Navy has a comprehensive list of accurate building square footage that was the basis for the *ex ante* square footage figures. Thus, there was no deviation found in the field with the observed square footage.

2.4 *EX POST* LOAD IMPACT ESTIMATES

A simplified engineering approach with verified inputs was used to evaluate the lighting program. On-site surveys of measure installation, spot measurement of post-retrofit fixture Wattages, and the monitoring of the hours of operation were data collection methods used.

2.4.1 Sampling

The sample for lighting measures was selected at the building level, as identified by the ID No. (known as the *site_nbr* on the tracking system datasets), with individual lighting measures being aggregated by building. Total load impacts for each building were used as the sampling variable. A stratified sample was developed using the Dalenius-Hodges approach. A sample design with three strata was used. Buildings to be surveyed in Strata 1 and 2 were randomly selected. Stratum 3 was a certainty group. Table 2-5 provides an overview of the sample design.

Table 2-5
Ex Ante Load Impacts by Measure Category
PY97 Commercial EEI Program
Military Sector
Lighting Measures

Stratum	N	Ex Ante kWh Savings	n	Min. kWh Savings	Max kWh Savings
1	101	59,279	3	35	1,717
2	42	191,276	3	2,023	7,784
3	30	1,400,583	30	8,159	309,416
Total	**173**	**1,651,138**	**36**		

2.4.2 Ex Post kWh Savings for Nonresidential Buildings

This section presents the estimation of *ex post* kWh savings for the measures installed in nonresidential buildings during PY96.

Estimation of Adjustment Factors

Several adjustment factors were estimated for hours of operation, measure installation and post-retrofit connected watts, as described previously. These factors were developed to ultimately adjust the gross *ex ante* load impacts to reflect the conditions observed during the *ex post* on-site verification survey. This section describes the estimation of these adjustment factors.

Measure Installation

Measure installations were verified and quantified. A total of 19,071 measures were installed under the program during PY97. A total of 14,692 measures (ex ante count) were installed at sites that were included in the survey. An adjustment factor was calculated for each measure in each building surveyed by the following equation:

$$\text{RR Measure Installation}_{\text{Measure Level}} = \frac{\text{Verified Ex Post Measure Counts}}{\text{Ex Ante Measure Count}}$$

An adjustment factor for each building surveyed was estimated by calculating the weighted average of $\text{RR Measure Installation}_{\text{Measures Level}}$ based on ex ante kWh savings.

$$\text{RR Measure Installation}_{\text{Building}} = \sum \left(\text{RR Measure Installation}_{\text{Measure Level}} \times \frac{\text{Ex Ante kWh for Measure}}{\text{Ex Ante kWh for Building}} \right)$$

Table 2-6 shows these calculations for two buildings.

Table 2-6
Example of Calculation of Adjustment Factor Measure Installation
PY97 Commercial EEI Program
Military Sector
Lighting Measures

ID No.	Strata	Measure Description	Ex Ante Quan.	Verified Quan.	RR Meas. Installation Measure Level	Ex Ante kWh for Measure	Ex Ante kWh (Bldg)	kWh Meas. ¸ kWh Bldg	AF Meas ´ (kWh Meas ¸ kWh Bldg)	AF Meas. Installation Building Level
41488	1	T-8 El Bal (4ft/2la)	4	4.00	1.0000	138	163	0.8466	0.8466	
41488	1	32 Watt lamp	4	4.00	1.0000	25		0.1534	0.1534	
41488 Total							**163**	**1.0000**		**1.0000**
41498	3	T-8 El Bal (4ft/2la)	94	94.00	1.0000	3252	17,749	0.1832	0.1832	
41498	3	T-8 El Bal (4ft/2la)	36	14.00	0.3889	1245		0.0701	0.0273	
41498	3	Opt Refl(4ft/1dlamp)	36	14.00	0.3889	4132		0.2328	0.0905	
41498	3	Electronic Bal (8ft)	9	9.00	1.0000	311		0.0175	0.0175	
41498	3	T-8 El Bal (4ft/2la)	2	0.00	0.0000	69		0.0039	0.0000	
41498	3	T-8 El Bal (4ft/2la)	13	0.00	0.0000	450		0.0254	0.0000	
41498	3	Opt Refl(4ft/2dlamp)	13	0.00	0.0000	2984		0.1681	0.0000	
41498	3	Exit Sign Replacement	21	21.00	1.0000	5306		0.2989	0.2989	
41498 Total							**17,749**	**1.0000**		**0.6175**

Table 2-7 shows the RR Measure Installation Building Level for each of the surveyed buildings.

Table 2-7
Adjustment Factor Measure Installation - Building Level
PY97 Commercial EEI Program
Military Sector
Lighting Measures

ID No.	Stratum	AF Meas. Installation Building Level
41488	1	1.0000
41524	1	0.8333
44567	1	1.0000
41548	2	0.9448
41566	2	1.0000
44570	2	1.0000
41498	3	0.6175
41502	3	1.0000
41506	3	1.0000
41509	3	1.0000
41510	3	0.8337
41553	3	1.0000
41557	3	1.0000
41565	3	1.0000
41567	3	1.0000
41568	3	0.9282
41570	3	0.8279
41578	3	1.0000
41580	3	1.0000
42664	3	1.0000
42665	3	1.0000
42669	3	0.8418
44569	3	1.0000
44619	3	1.0000
44628	3	1.0000
44629	3	0.0000
46842	3	1.0000
50930	3	1.0000
50937	3	1.0000
50941	3	1.2967
51028	3	1.0000
51051	3	1.0000
51058	3	1.0000
51066	3	1.0000
51290	3	1.0000
51309	3	1.0000

Hours of Operation

The *ex post* hours of operation for the lighting fixtures was estimated using light loggers that record the number of hours the light fixtures are on. Two types of light loggers were used: (1) run-time loggers that gather data on an aggregate basis; and (2) time-of-use (TOU) loggers that collect data allowing the estimation of the number of hours a fixture is turned-on on a time differentiated basis. The TOU logger data were downloaded from the logger via a serial port of a PC, and are accessible through proprietary software called SmartWare Ver. 3.2 from Pacific Science & Technology, Inc.

The *ex post* hours of operation was estimated for each site through the installation of light loggers at each facility, except for LED Exit Sign measures. In most cases several loggers were installed throughout the building. Each building was surveyed for the space use, as determined by the homogeneity of lighting use within the space use type. For example, open office space is used differently from private office space, thus, they would be logged separately. The percent of building space by space type was recorded for each logger installed. The percent of time the lights are on (*percent on*) was calculated for each logger. *Building-specific percent on* were calculated by taking a weighted average of the logger *percent on* within a building, weighting by the space use type. The ex post hours of operation for each building was calculated by multiplying the *building-specific percent on* by 8,760 hours per year. Ex ante building-specific weighted average hours of operation was calculated for using *ex ante* gross kWh savings as the weight, to account for the magnitude of impacts of the individual measures. Adjustment factors were calculated for each building by dividing the *ex post* hours by *ex ante* hours.

Table 2-8 shows examples of the calculations for the RR Hours.

Table 2-8
Example of Calculation of Adjustment Factor for Hours
PY97 Commercial EEI Program
Military Sector
Lighting Measures

ID No.	Space Use	Space Use Weight	Percent On	Weighted Part Percent On	Weighted Percent On	Ex Post Hours	Ex Ante Hours	Adjustment Factor Hours - Building
41578	sales	0.400	0.971	0.3885				
41578	sales	0.400	0.959	0.3837				
41578	private office	0.025	0.260	0.0065				
41578	open office	0.025	1.000	0.0250				
41578	production	0.100	0.866	0.0866				
41578	stock	0.025	0.914	0.0228				
41578	stock	0.025	1.000	0.0250				
41578	**Total**				**0.9381**	**8,218**	**7,558**	**1.0874**
41580	dining	0.700	0.573	0.4008				
41580	kitchen	0.250	0.879	0.2197				
41580	open office	0.050	0.630	0.0315				
41580	**Total**				**0.6520**	**5,711**	**4,885**	**1.1693**
51028	private office	0.500	0.628	0.3138				
51028	kitchen	0.250	0.590	0.1475				
51028	private	0.250	0.532	0.1330				
51028	**Total**				**0.5944**	**5,207**	**5,173**	**1.0065**

Table 2-9 shows the adjustment factors for hours at the building level for each surveyed building.

Table 2-9
Adjustment Factor for Hours - Building
PY97 Commercial EEI Program
Military Sector
Lighting Measures

Stratum	ID No.	Adjustment Factor Hours
1	41488	0.0343
1	41524	0.0000
1	44567	0.0007
2	41548	0.8294
2	41566	2.4920
2	44570	1.0782
3	41498	0.2424
3	41502	0.2329
3	41506	0.7486
3	41509	0.5618
3	41510	0.6045
3	41553	0.6456
3	41557	0.5000
3	41565	1.0782
3	41567	0.4163
3	41568	0.5452
3	41570	1.0159
3	41578	1.0874
3	41580	1.1693
3	42664	0.5166
3	42665	0.8270
3	42669	1.1431
3	44569	0.5122
3	44619	1.4926
3	44628	1.0000
3	44629	0.0000
3	46842	1.0000
3	50930	1.0446
3	50937	0.5622
3	50941	0.3096
3	51028	1.0065
3	51051	0.7214
3	51058	0.6078
3	51066	0.9729
3	51290	0.1205
3	51309	1.0898

Post-Retrofit Connected Watts

The connected watts of postcase light fixtures were measured ex post. These spot measurements were used to estimate the adjustment factor for connected watts for the fixtures installed under the

program for each building surveyed. These measurements were divided by the *ex ante* assumptions of the connected watts of post-retrofit fixtures to estimate the adjustment factor for connected watts.

Volts and amps were measured. The power factor was assumed to be 1.00.

An adjustment factor for connected watts was estimated for each measure in each building. The adjustment factor was calculated by dividing the *ex ante* watts by the *ex post* watts for each measurement. Thus, if *ex post* watts is greater than *ex ante*, then the *ex post* load impacts will be less than the *ex ante* and the adjustment factor would be less than 1.0. Conversely, if the *ex post* watts were less than *ex ante*, then the *ex post* load impacts will be greater than the *ex ante*, and the adjustment factor would be greater than 1.0. A weighted average adjustment factor was estimated for each building. The weights were based on the kWh savings for each measure. Table 2-10 shows an example of the calculation of the adjustment factor for connected watts at the building level.

Table 2-10
Example of Calculation of Adjustment Factor for Connected Watts - Building Level
PY97 Commercial EEI Program
Military Sector
Lighting Measures

ID No.	Fixture Description	Ex Ante kWh Savings	No. Fix.	Meas. Volts	Meas. Amps	Power Factor	Ex Post Watts	Ex Ante Watts	AF Watts EA/EP Measure Level	Ex Ante kWh Savings per Measure	Ex Ante kWh Savings per Bldg	AF Watts Bldg Level
41506	EXIT SIGN (LED)	8,086	1	7.8	0.950	1.00	**7.4**	**8**	1.0796	8,086	74,962	
41506	3FT2LT8EL	40,879	1	117.6	0.410	1.00	**48.2**	**46**	0.9540	40,879	74,962	
41506	4FT2LT8ELR	12,999	2	118.9	0.950	1.00	**56.5**	**58**	1.0270	12,999	74,962	
41506	4FT2LT8ELR	12,999	1	118.9	0.490	1.00	**58.3**	**58**	0.9955	12,999	74,962	
41506	**Total**											**0.9874**

Calculation of Ex Post kWh Impacts

The ex post kWh savings were estimated by calculating an overall adjustment factor for each surveyed building. The following equation was used:

$$\text{Adjustment Factor}_{\text{Overall, Building}} = \text{Adjustment Factor}_{\text{Measure Installation}} \times \text{Adjustment Factor}_{\text{Hours}} \times \text{Adjustment Factor}_{\text{Watts}}$$

For the surveyed buildings in Strata 1 and 2, the average of the Adjustment Factor$_{\text{Overall, Building}}$ was calculated for each stratum, resulting in the Adjustment Factor$_{\text{Overall, Stratum}}$. The ex post kWh impacts for each stratum were estimated by multiplying the Adjustment Factor$_{\text{Overall, Stratum}}$ by the total ex ante kWh savings for the stratum.

$$\text{Adjustment Factor}_{\text{Overall, Stratum i}} = \frac{\sum_{j=1}^{n} \text{Adjustment Factor}_{\text{Overall, Building in Stratum i}}}{n}$$

where:

n = number of surveyed buildings in Stratum i

For the Stratum 3, the certainty stratum, the ex post kWh savings for all thirty buildings in the stratum were estimated by multiplying the Adjustment Factor$_{\text{Overall, Building}}$ by the ex ante kWh savings.

The total program ex post kWh savings was calculated by summing the ex post kWh savings for the three strata.

The results of these calculations is shown in Table 2-11.

Table 2-11
Ex Post Gross kWh Savings Estimate
PY97 Commercial EEI Program
Military Sector
Lighting Measures

ID No.	Stratum	Ex Ante kWh Savings	Adj. Factor Measures Installed	Adj. Factor Hours of Operation	Adj. Factor Connected Watts	Overall Adj. Factor Bldg (Meas x Hours x Watts)	Overall Adj. Factor Stratum	Ex Ante kWh Savings - Stratum	Ex Post Gross kWh Savings
41488	1	163	1.0000	0.0343	0.9740	0.0335			
41524	1	283	0.8333	0.0000	0.9470	0.0000			
44567	1	679	1.0000	0.0007	0.9740	0.0007			
Stratum 1 Total							**0.0114**	**59,123**	**673**
41548	2	2,717	0.9448	0.8294	1.0908	0.8548			
41566	2	2,877	1.0000	2.4920	1.0908	2.7183			
44570	2	2,103	1.0000	1.0782	0.9740	1.0501			
Stratum 2 Total							**1.5411**	**191,444**	**295,027**
41498	3	17,749	0.6175	0.2424	1.0000	0.1497		17,749	2,657
41502	3	168,086	1.0000	0.2329	1.0000	0.2329		168,086	39,147
41506	3	74,962	1.0000	0.7486	1.0000	0.7486		74,962	56,117
41509	3	8,338	1.0000	0.5618	1.0000	0.5618		8,338	4,684
41510	3	40,843	0.8337	0.6045	1.0000	0.5040		40,843	20,584
41553	3	51,216	1.0000	0.6456	1.0908	0.7042		51,216	36,068
41557	3	16,203	1.0000	0.5000	1.0908	0.5454		16,203	8,837
41565	3	51,652	1.0000	1.0782	1.0908	1.1761		51,652	60,749
41567	3	14,150	1.0000	0.4163	1.0908	0.4541		14,150	6,426
41568	3	9,686	0.9282	0.5452	1.0908	0.5520		9,686	5,347
41570	3	61,950	0.8279	1.0159	1.0341	0.8698		61,950	53,881
41578	3	309,416	1.0000	1.0874	1.0203	1.1094		309,416	343,277
41580	3	58,729	1.0000	1.1693	0.9975	1.1664		58,729	68,503
42664	3	10,012	1.0000	0.5166	0.9857	0.5092		10,012	5,098
42665	3	64,684	1.0000	0.8270	0.9791	0.8097		64,684	52,375
42669	3	54,184	0.8418	1.1431	0.9740	0.9372		54,184	50,782
44569	3	9,066	1.0000	0.5122	0.9740	0.4989		9,066	4,523
44619	3	8,897	1.0000	1.4926	0.9740	1.4537		8,897	12,934
44628	3	9,602	1.0000	1.0000	0.9740	0.9740		9,602	9,352
44629	3	9,487	0.0000	0.0000	0.9740	0.0000		9,487	0
46842	3	9,602	1.0000	1.0000	0.9740	0.9740		9,602	9,352
50930	3	194,657	1.0000	1.0446	0.9740	1.0174		194,657	198,045
50937	3	50,335	1.0000	0.5622	0.9740	0.5476		50,335	27,562
50941	3	30,185	1.2967	0.3096	0.9740	0.3910		30,185	11,803
51028	3	14,343	1.0000	1.0065	0.9740	0.9803		14,343	14,060
51051	3	8,737	1.0000	0.7214	0.9740	0.7026		8,737	6,139
51058	3	8,158	1.0000	0.6078	0.9740	0.5920		8,158	4,829
51066	3	9,690	1.0000	0.9729	0.9726	0.9462		9,690	9,169
51290	3	8,737	1.0000	0.1205	0.8681	0.1046		8,737	914
51309	3	17,232	1.0000	1.0898	0.8681	0.9461		17,232	16,303
Total Gross Ex Post kWh Savings									**1,435,215**

Table 2-12 shows a comparison of the ex post kWh impact estimate with the ex ante estimate for PY97.

Table 2-12
Ex Post Gross kWh Savings Estimate
PY97 Commercial EEI Program
Military Sector
Lighting Measures

		kWh Savings
Ex Ante	Total Gross	1,651,155
	Total Net kWh Savings	1,336,180
Ex Post	Total Gross	1,435,215
	Gross Realization Rate	0.8692
	Net-To-Gross Ratio	1.00
	Total Net kWh Savings	1,435,215
	Net Realization Rate	1.0741

2.4.3 Ex Post kW Impacts

The *ex post* kW impact estimate was based on data from TOU loggers. The question that needed to be addressed was to determine whether the lights at a given building would have been turned on at the time of SDG&E system peak. In this case the system peak took place on August 31, 1998 at 15:30. Since the loggers were installed on a short-term basis, the measurement of the actual peak coincidence was not possible, i.e., whether the lights were on at 15:30 on August 31, 1997. The approach used to determine whether a set of monitored lights was turned on was to examine the TOU logger data and determine whether the lights of the logger would be on during the time from 13:00 to 15:00 on a weekday. This was done using the proprietary software called SmartWare Ver. 3.2 from Pacific Science & Technology, Inc. Table 2-13 shows a peak coincidence factor of 0.839. This compares with peak coincidence factor of 0.819 for the PY96 program.

Table 2-13
Ex Post Peak Coincidence Factor
PY97 Commercial EEI Program
Military Sector
Lighting Measures

Status	Frequency	Percent
Off	9	16.1%
On	47	83.9%
Total	56	100.0%
Peak Coincidence Factor		0.839

This factor was applied to the total connected kW, that was calculated by dividing the total *ex ante* kW impacts by the *ex ante* coincidence factor. The results are shown in Table 2-14.

Table 2-14
***Ex Post* Peak Coincident kW**
PY97 Commercial EEI Program
Military Sector
Lighting Measures

Ex Ante kW Impacts	357.94
Ex Ante Coincidence Factor	0.76
Total Ex Ante Connected kW	470.974
Ex Post kW Coincidence Factor	0.839
Ex Post Gross kW Impacts	**395.147**
Gross Realization Rate	**1.10**
Net-to-Gross	1.00
Ex Post Net kW Impacts	395.15
Ex Ante Net kW Impacts	290.16
Net Realization Rate	1.36

3 NET-TO-GROSS ANALYSIS

3.1 OVERVIEW

XENERGY uses a consistent method for assessing whether a customer is a free rider with regard to a particular measure. The specific questions for a given measure are fitted to the way in which that measure is purchased and used. To be classified as a free rider, a customer must:

- have been aware of the availability of the efficient measure prior to hearing of the program;
- planned to implement the efficient measure within the time frame of the program; and
- been willing to pay the market price for the measure.

In addition to these conditions, XENERGY also seeks corroborating evidence regarding the customer's interest in the measure. For example, participants who reported that they had planned to implement the measure prior to the program were asked whether they had sought bids on the project.

The Decision Analysis data collection script consists of a series of questions designed to isolate the motivation for, and the timing of, installation of energy conservation equipment. To increase the probability that unbiased and accurate decision related data are collected, the questions are designed:

1. to help the customer separate their current thoughts about the project from their decision process at the time of program participation;
2. to prevent the customer from giving defensive or manipulated answers;
3. to identify and justify apparent inconsistencies in respondent's answers;
4. to ensure responses are obtained from a financial decision maker or that such a person's opinion is at least taken into account; and
5. to provide additional insight about the project decision-making, current satisfaction, and possible free driver effects.

Experience indicates that biased answers are likely to be obtained if surveyors simply ask participants if they would have undertaken similar equipment installations in the program's absence. One reason for this is that respondents tend to answer as if the question were "if you had it to do over again, would you do the same project, even if you couldn't get financing or had not received information?" Customers who are happy with their projects will tend to reply in the affirmative. Another reason is that if this is the only question asked, the respondent may recognize the purpose of the question, and give the answer they think will have the desired effect on the program. An additional concern is that, while the main contact might have wanted to pursue the

project even without utility involvement the investment might not actually have been approved under these conditions.

3.2 DESCRIPTION OF SDG&E'S PROGRAM SUPPORT

SDG&E has worked with the U.S. Navy for a period of time to develop a positive working relationship that enabled the U.S. Navy to identify and quantify energy saving opportunities, seek funding and install energy efficient lighting projects at military bases located throughout SDG&E's service area over the past several years. SDG&E worked with the Navy under a Basic Ordering Agreement (BOA) where SDG&E served as the prime contractor and worked on behalf of its client, the Navy. SDG&E hired subcontractors on a competitive basis, as required by the BOA, for the purpose of identifying energy saving opportunities and implementing them in the most cost-effective manner possible.

Through the CEEI program SDG&E developed the enabling infrastructure to assist the military in meeting its energy efficiency goals. SDG&E provided support to the military in the form of:

- audits and technical analysis that identified energy efficiency opportunities;
- assistance in documenting the savings necessary to apply for Department of Defense funding, including cost analysis with available financial incentives, preparation of Federal forms and supporting documentation;
- bid solicitation; including conducting pre-bid walkthroughs of sites, addressing questions from subcontractors, etc.; and
- project management, including construction management and post-retrofit quality assurance and compliance documentation required by the Government.

The documentation required by the military for funding such projects is extensive and exhaustive. SDG&E developed systems to produce these documents in a rather expeditious manner. The schedules tended to be very tight and labor intensive. SDG&E worked closely with the military to understand the requirements of the military both locally and nationally. In doing so, SDG&E was able to provide the level and intensity of effort necessary to enable the local efforts to be completed.

3.3 LIGHTING MEASURES

The Navy and SDG&E had been engaged in an intensive effort to identify opportunities to install energy efficient lighting at virtually all of its bases in the SDG&E service area over a number of year. Under this program thousands of buildings had been retrofit with energy efficient lighting. During the course of the implementation process there had been buildings that were not retrofit for one reason or another. It was known that a number of buildings remained to be retrofit, thus, it was planned to use 1997 as a "clean-up" year, the time when these buildings would be retrofit.

Responses of the Navy's point of contact when interviewed indicated that the activities conducted during 1997 were actually an extension of the previous work effort with SDG&E support. It was obvious that the effect SDG&E had on the installation was due to more than just the incentives. The respondent mentioned that, prior to these projects, the infrastructure was not available to do major retrofits. The respondent said that, without the SDG&E program, it would have been necessary to hire additional staff, and the SDG&E assistance made for "effective utilization of resources."

A respondent is considered a pure free rider if the customer would have installed the same equipment in the same time frame without the program. A respondent is considered a pure participant, the opposite of a free rider, if the customer would not have installed any of the measures and if the money would not have been approved without the program.

This respondent indicated that it was possible that if they had the SDG&E assistance with writing the technical specifications, doing the energy audits, etc. that 10 to 20 percent of the funds may have been approved without the incentive, but without the non-incentive assistance none of the lighting would have been installed. The respondent indicated that any lighting that would have been installed without the incentive may not have been as efficient. The participant said that the incentive improved the benefit-cost ratio and allowed the funding to be approved. Without the assistance of SDG&E in conducting the program support activities, none of the funding would have been approved and none of the high efficiency lighting would have been installed. The respondent said that the program support activities, such as performing the energy audits, was necessary and without it none of the lighting would have been installed. These responses make it clear that the SDG&E assistance was necessary if the high efficiency lighting systems were going to be installed in any reasonable period of time. Therefore, the SDG&E program should be credited with all of the high efficiency lighting impacts.

The net-to-gross for lighting measures installed in the military sector for PY97 is 1.00.

A

TABLE 6 - MILITARY LIGHTING

SAN DIEGO GAS & ELECTRIC
M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY97 SECOND EARNINGS CLAIM FOR COMMERCIAL ENERGY EFFICIENCY INCENTIVES PROGRAM, MILITARY SECTOR
FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1999, STUDY ID NO. 1025

Designated Unit of Measurement: LOAD IMPACTS PER AFFECTED SQUARE FOOT PER 1000 HOURS OF OPERATION.
End Use: Interior Lighting (Military)

				5. A. 90% CONFIDENCE LEVEL				5. B. 80% CONFIDENCE LEVEL			
				LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND
1. Average Participant Group and Average Comparison Group		**PART GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**
A. Pre-install usage:	Pre-install kW	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
	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 kW/ designated unit of measurement	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 measurement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B. Impact year usage:	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 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
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	35.9225	35.9225	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	A. ii. Load Impacts - kWh	130,474	130,474	100226.8837	160721.2981	100226.8837	160721.2981	106938.2701	154009.9117	106938.2701	154009.9117
	B. i. Load Impacts/designated unit - kW	0.0608	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	B. ii. Load Impacts/designated unit - kWh	0.0479	N/A	0.0033	0.0054	0.0033	0.0054	0.0036	0.0051	0.0036	0.0051
	C. i. a. % change in usage - Part Grp - kW	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 Grp - kWh	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 Grp - kW	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 Grp - kWh	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	1.1039	1.3618	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	D.A. ii. Load Impacts - kWh, realization rate	0.8692	1.0741	0.6677	1.0707	N/A	N/A	0.7124	1.0260	N/A	N/A
	D.B. i. Load Impacts/designated unit - kW, real rate	1.1040	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	D.B. ii. Load Impacts/designated unit - kWh, real rate	0.8692	N/A	0.6677	1.0707	N/A	N/A	0.7124	1.0260	N/A	N/A
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**			**RATIO**	**RATIO**		
	A. i. Average Load Impacts - kW	1.00		N/A	N/A			N/A	N/A		
	A. ii. Average Load Impacts - kWh	1.00		N/A	N/A			N/A	N/A		
	B. i. Avg Load Impacts/designated unit of measurement - kW	1.00		N/A	N/A			N/A	N/A		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	1.00		N/A	N/A			N/A	N/A		
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	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		
4. Designated Unit Intermediate Data		**PART GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**
	A. Pre-install average value	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	B. Post-install average value	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	14,692									
	B. Number of measures installed by all program participants in the 12 months of the program year	19,071									
	C. Number of measures installed by Comp Group	N/A									
7. Market Segment Data		**SIC or CZ**	**PERCENT**								
	Distribution by 3 digit SIC - Commercial/Industrial	606	0.6								
		971	99.4								

B

TABLE 7 - MILITARY LIGHTING

M&E PROTOCOLS TABLE 7
DATA QUALITY AND PROCESSING DOCUMENTATION
For 1997 Commercial Energy Efficiency Incentives Program
Military Sector
Lighting Measures
First Year Load Impact Evaluation
February 1999
Study ID No. 1016

A. OVERVIEW INFORMATION

1. **Study Title and Study ID:** 1997 Commercial Energy Efficiency Incentives Program: First Year Load Impact Evaluation, Lighting Measures, February 1999, Study ID No. 1016.

2. **Program, Program Year(s), and Program Description (design):** 1997 Commercial Energy Efficiency Incentives Program for the 1997 program year. The Program is designed to help commercial customers control energy costs by providing incentives for the installation of energy efficient equipment at their facilities.

3. **End Uses and/or Measures Covered:** Commercial lighting.

4. **Methods and models used:** Site-specific simplified engineering with verified inputs.

5. **Participant and comparison group definition:** For the load impact analysis, the participants in the 1997 Commercial Energy Efficiency Incentives Program in the military sector are defined as having at least one of the aforementioned measures installed. A comparison group was not required for this evaluation.

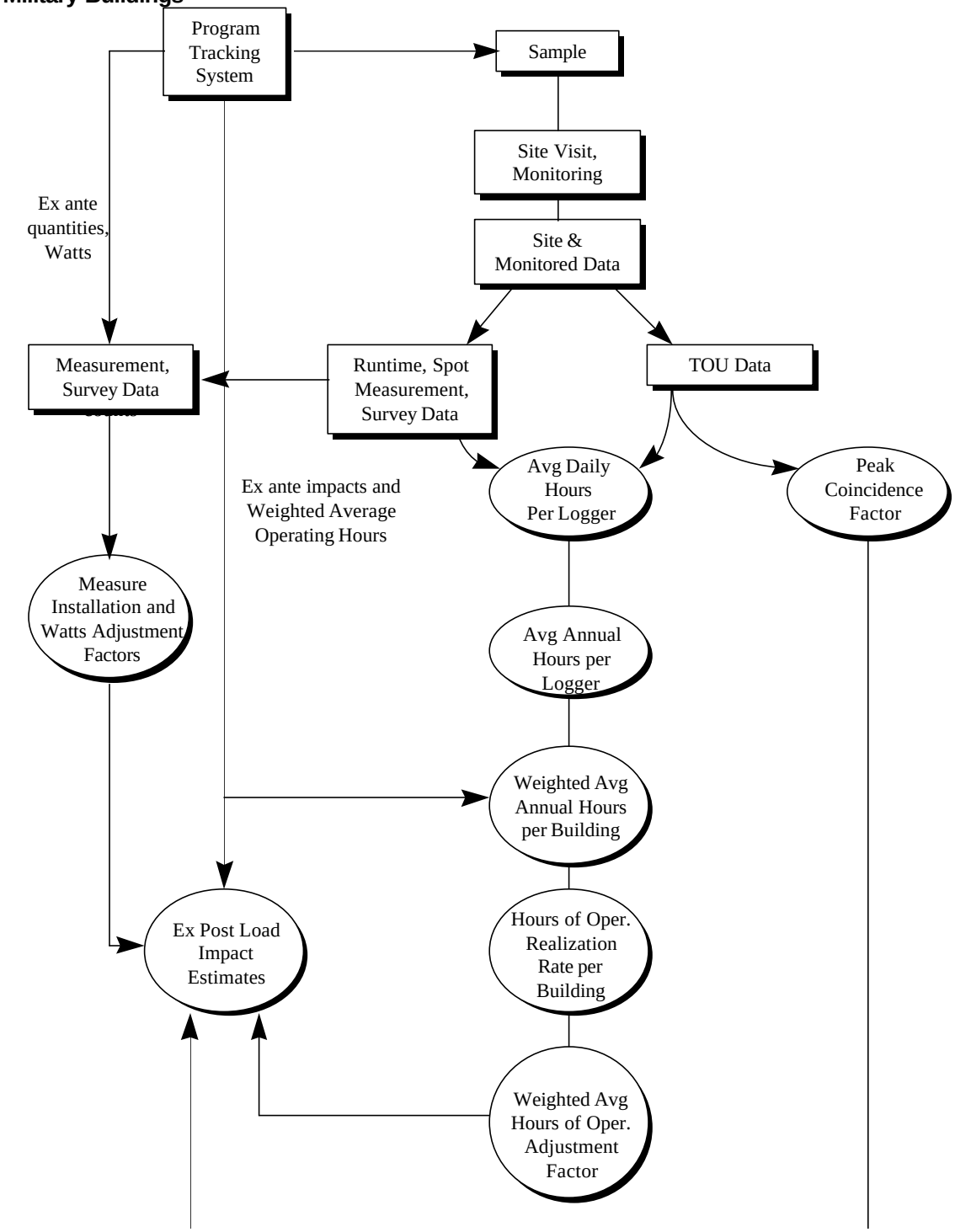
6. **Analysis sample size:**

Electric Participant Sample for 1997 Commercial Energy Efficiency Incentives Program Military Sector			**Gas Participant Sample for 1997 Commercial Energy Efficiency Incentives Program Military Sector**		
Measure Type	**No. of Participants**	**No. of Measures**	**Measure Type**	**No. of Participants**	**No. of Measures**
Lighting	11 (in 36 Buildings)	14,692	**Lighting**	0	0
Total	11 (in 36 Buildings)	14,692	**Total**	0	0

B. DATABASE MANAGEMENT

1. Flow Charts:

Military Buildings



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

- Customer name, address, appliance saturation, installed measures, and participation date from the program tracking database.
- Electric and gas consumption history, where applicable, from the Customer Master File.
- Site-specific data gathered on-site through measurements and monitoring..
- *Ex ante* engineering assumptions and analyses from program project files.
- *Ex post* on-site survey data.

3. Data Attrition:

a. Participant Sample - Load Impact Analysis

There was no attrition of loggers and there were no non-respondents.

b. Nonparticipant Sample - Load Impact Analysis

Not applicable.

4. Data Quality Checks

Not applicable for this evaluation.

5. All data collected for this analysis were utilized.

C. SAMPLING

1. Sampling procedures and protocols:

The sample for lighting measures was selected at the building level, as identified by the ID No. (known as the *site_nbr* on the tracking system datasets), with individual lighting measures being aggregated by building. Total load impacts for each building were used as the sampling variable. A stratified sample was developed using the Dalenius-Hodges approach. A sample design with three strata was used. Buildings to be surveyed in Strata 1 and 2 were randomly selected. Stratum 3 was a certainty group. Table b-1 provides an overview of the sample design.

Table B-1
Ex Ante Load Impacts by Measure Category
PY97 Commercial EEI Program
Military Sector
Lighting Measures

Stratum	N	Ex Ante kWh Savings	n	Min. kWh Savings	Max kWh Savings
1	101	59,279	3	35	1,717
2	42	191,276	3	2,023	7,784
3	30	1,400,583	30	8,159	309,416
Total	**173**	**1,651,138**	**36**		

2. Survey information: On-site inspections of installed measures were conducted including interviews of on-site staff, and hours of operation logging of the lighting measures.

3. Statistical Descriptions: Not applicable.

D. DATA SCREENING AND ANALYSIS

1. Outliers: Not applicable.

Missing data points: Not applicable.

Weather adjustments: Not applicable.

2. "Background" variables: Not applicable.

3. Screening procedures: Not applicable.

4. Regression statistics: Not applicable.

5. Specification:

a. Not applicable.

b. Not applicable.

c. Not applicable.

d. Not applicable.

e. Not applicable.

6. Error in measuring variables: On-site observation of measure installation and on-site measurements were taken to mitigate possible errors from project files.

7. Autocorrelation: Not applicable.

8. Heteroskedasticity: Not applicable.

9. Collinearity: Not applicable.

10. Influential data points: Not applicable.

11. Missing Data: Not applicable.

12. Precision: Not applicable. Standard errors and other statistically based measures of precision are not applicable to the site-specific engineering analyses employed in this analysis.

E. DATA INTERPRETATION AND APPLICATION

1. Calculation of net impacts: Not applicable.

2. Processes, choices made and rationale for E.1: Not applicable.

Appendix A

Retroactive Waiver for CEEI Program, Measures in Military Bases

SAN DIEGO GAS & ELECTRIC
RETROACTIVE WAIVER FOR
1997 COMMERCIAL ENERGY EFFICIENCY INCENTIVES PROGRAM
MEASURES IN MILITARY BASES

(Study ID No. 1025)

Approved by CADMAC on October 21, 1998

BACKGROUND

Every DSM program participant belongs to a certain business sector (i.e., Commercial, Industrial, and Agricultural) based on its assigned SIC code. Under this classification scheme, military bases fall under the Commercial sector category. The M&E Protocols have a set of prescribed methods for determining load impacts for specific end uses in each business sector. This waiver requests that SDG&E be allowed to apply the Industrial M&E Protocols (Table C-5) in place of the Commercial M&E Protocols (Table C-4), for the purpose of evaluating the load impacts and the net-to-gross ratio of DSM measures installed in the San Diego military bases for Program Year 1997.

RATIONALE

The primary focus of the Commercial M&E Protocols is the application of billing analysis using regression techniques to measure load impacts for the lighting and HVAC end uses. This method is not generally applicable in the case of a military base. Each military base is usually a transmission customer and is master-metered. This means that the flow of electricity into the bases as supplied by SDG&E is measured at a highly aggregated level. The effects of the DSM installations may not be reliably detected in a regression analysis using billing information from a master meter. Another contributing factor to the difficulty of measurement is the fluctuating occupancy rates of the base as caused, for example, by troop deployments, training, and transfers of military personnel.

The 1997 recorded total lifecycle earnings for the military sector are $0.482 million out of the whole commercial sector earnings of $6.061 million.

No. of Participants	Total Resource Benefits	Earnings
26	$2,364,469	$482,681

CONCLUSION

Measuring the effects of DSM installations for military bases in SDG&E's service territory cannot be done reliably using billing analysis as specified by the Commercial M&E Protocols. SDG&E plans to use the more applicable Industrial M&E Protocols for the 1997 program year. This would be a better method for the verification of program load impacts for customers on military installations.

Appendix B

Nonresidential Nonparticipant Survey Results and Instrument by VIEWtech

Appendix C

Table 6
Results Used to Support PY97 Second Earnings Claim

Calculation of the *Ex Ante* DUOM for the Nonmilitary Group

Lighting Load Impacts:

$$\text{Demand} = \frac{\text{Total ex ante kW}}{\text{No. of Units}} = \frac{7{,}623.36}{63{,}034.23} = 0.12094\ \text{kW}$$

$$\text{Energy} = \frac{\text{Total ex ante kWh}}{\text{No. of Units}} = \frac{45{,}037{,}358}{372{,}394{,}228.54} = 0.12094\ \text{kWh}$$

Calculation of the *Ex Ante* DUOM for the Military Group

Lighting Load Impacts:

$$\text{Demand} = \frac{\text{Total exante kW}}{\text{No. of Units}} = \frac{357.94}{6{,}498.55} = 0.05508\,\text{kW}$$

$$\text{Energy} = \frac{\text{Total exante kWh}}{\text{No. of Units}} = \frac{1{,}651{,}139}{29{,}977{,}106.03} = 0.05508\,\text{kWh}$$

Appendix D

Table 7
Data Quality and Processing Documentation

Table 7

Data Quality and Processing Documentation for Nonmilitary End Uses

A. Overview Information

1. **Study Title and Study ID:** 1997 Commercial Energy Efficiency Incentives Program: First Year Load Impact Evaluation, March 1998, Study ID No. 1016

2. **Program, Program Year, and Program Description:** San Diego Gas & Electric offers the PY97 Commercial/Industrial/Agricultural (C/I/A) Energy Efficiency Incentives Program to help customers reduce energy costs and increase energy efficiency at their facilities. The C/I/A Energy Efficiency Incentives Program, supported through audit programs, Energy Services Representatives, and account executives, provide cost-effective DSM energy savings when existing customers have retrofit opportunities. SDG&E has three main market delivery mechanisms for providing incentives for retrofit or replace-on-burnout applications: (1) Commercial/Industrial (C/I) Incentives Program, (2) Power to Save Program, and (3) Commercial Rebates Programs. Through this marketing strategy, SDG&E is provided the flexibility needed to encourage the adoption of energy efficient measures that would not otherwise be installed by customers due to economic market barriers.

3. **End Uses and/or Measures Covered:** The end uses covered by this report are indoor lighting and space cooling.

4. **Methods and Models Used:** The main statistical model used is ordinary least squares regression analysis, applied at the customer level, for participants and nonparticipants. See the modeling section of the report for a complete discussion on the models used.

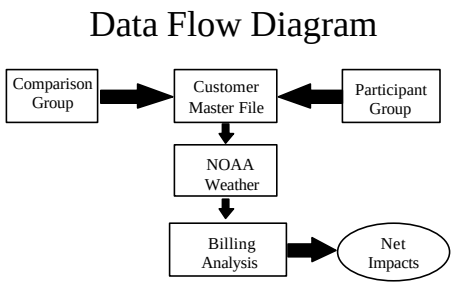
5. **Participant and Comparison Group Definition:** For the load impact analysis of the lighting and HVAC end uses, a participant was defined as a customer or a group of customers with a common contract for DSM measures who completed installation by December 31, 1997. A nonparticipant was defined as a customer who did not participate in any of SDG&E's PY97 nonresidential DSM programs. The comparison group was selected from the population of nonparticipants.

6. **Analysis Sample Size:**

	Indoor Lighting		HVAC	
	Participants	Nonparticipants	Participants	Nonparticipants
Study Group	3515	350	128	350
No. of Measures Installed	742,347	NA	449	NA
Avg. No. of Billing Months	22	22	22	22

B. Database Management

1. **Data Flow Chart:** The following diagram illustrates the relationship of the data elements used in the analysis:



2. **Data Sources:** Data for the impact analysis were obtained from the following major sources:

   a. Customer name, address, affected square footage, lighting hours of operation, and installation date from the program tracking database;

   b. Comparison group (nonparticipants) was selected from the Customer Master File after the participants were determined;

   c. Consumption history from the Customer Master File;

   d. Data on floor stock, square footage, hours of operation, installation of energy efficient equipment, and occupancy from on-site audits for the nonparticipant group;

   e. Hourly weather data from NOAA files for the SDG&E climate zones: Maritime, Coastal and Transitional.

3. **Data Attrition:** An attempt was made to use all participants and nonparticipants in the regression analysis.

	Lighting		HVAC	
Status	Participants	Nonparticipants	Participants	Nonparticipants
Starting Study Group	1902	350	107	350
Special Cases Eliminated	88	5	16	16
Billing Data Available	1814	345	91	334
Sufficient Pre/Post Data	1515	313	72	305

4. **Data Quality Checks:** The data sets used in the regression analysis were merged in SAS by the appropriate key variables. Counts of data before and after data merges were verified to ensure accurate merging. Surveys, billing data and other relevant information were merge by premise Id number. Weather data were merge by billing cycle and climate zone.

5. **Data Collection:** For nonparticipants, only square footage, hours of operation and installation dates of energy efficient measures were used. All other data collected was done to add to SDG&E's Commercial End Use Surveys database (CEUS) that is required for the CEC Data Collection Plan.

C. <u>Sampling</u>

1. **Sampling Procedures and Protocols:** An attempt to use all program participants with the end use of interest was made. Nonparticipants were selected as described in the Overview section (p. 3).

2. **Survey Information:** The relevant survey instrument is in Appendix B. Replacements for nonparticipants for which attempts to acquire information failed were replaced with sample points that were similar in consumption size and SIC code to minimize nonresponse bias.

3. **Statistical Descriptions:**

Lighting Energy Load Impacts

Participants			
	RMSE		
	Satisfies RMSE Criterion	Does Not Satisfy RMSE Criterion	Grand Total
Total Estimated Impact (kWh per month)	-1,962,902	328,659	-1,634,242
Variance of Estimate	55,907,921,720	7,700,429,622	63,608,351,342
Total *Ex Ante* Estimate (kWh per month)	2,613,019	221,777	2,834,796
Sample Size	1,193	321	1,514
Estimated Designated Unit of Measurement	-0.0909		
Realization Rate Based on *Ex Ante* Estimates[7]	-75.1%		
Nonparticipants			
	RMSE		
	Satisfies RMSE Criterion	Does Not Satisfy RMSE Criterion	Grand Total
Total Estimated Impact (kWh per month)	33,930	82,260	116,191
Variance of Estimate	1,578,594,302	1,035,783,774	2,614,378,076
Total Lighted Square Footage	6,640,345	2,237,927	8,878,272
Sample Size	259	54	313
Average Hours of Operation	4,578	3,113	4,325
Estimated Designated Unit of Measurement	0.0134		
Estimated Net-to-Gross Ratio	114.7%		

[7] The realization rate is defined as the sample ex post total estimated impacts to the sample ex ante total impacts.

Space Cooling Energy Load Impacts

Participants			
	RMSE		
	Satisfies RMSE Criterion	Does Not Satisfy RMSE Criterion	Grand Total
Total Estimated Impact (kWh per month)	-785,135	-87,241	-872,375
Variance of Estimate	31,052,839,137	25,107,606,057	56,160,445,194
Total *Ex Ante* Estimate	738,482	43,536	782,018
Sample Size	60	11	71
Estimated Designated Unit of Measurement	-1.5081		
Realization Rate Based on *Ex Ante* Estimates[8]	-106.3%		
Nonparticipants			
	RMSE		
Data	Satisfies RMSE Criterion	Does Not Satisfy RMSE Criterion	Grand Total
Total Estimated Impact	-205,027	157,026	-48,000
Variance of Estimate	1,291,549,298	1,426,317,564	2,717,866,862
Total HVAC Square Footage	6,705,073	1,357,803	8,062,876
Sample Size	267	38	305
Estimated Designated Unit of Measurement	-0.3669		
Estimated Net-to-Gross Ratio	0.757		

[8] The realization rate is defined as the sample ex post total estimated impacts to the sample ex ante total impacts.

D. Data Screening and Analysis

1. **Treatment for Outliers:** Outliers were determined using the RMSE criterion. See Estimation Methods on page 5 (for lighting) and page 8 (for HVAC) of Section 3.

   Customers with missing billing information were deleted from the analysis if the missing data caused the participant/nonparticipant to fail the billing data requirement.

2. A trend variable was included to account for any changes that occurred outside the DSM activity but could potentially affect the load impact estimate. See the discussion on the Non-Weather/Non-DSM Portion of the Regression Equation on page 1 of Section 3.

3. See above item B.3. on Data Attrition.

4. **Regression Statistics:** See item C.3.

5. **Specification:**

   a. Individual regressions were estimated for each customer in the participant and nonparticipant groups. This accounts for customer heterogeneity.
   b. Weather and trends were accounted for in each customer regression analysis. See the General Model Section on page 1 of Section 3.
   c. No explicit accounting for self-selection bias was used in the model.
   d. SDG&E does not believe that any regressors of any consequence have been omitted from the analysis.
   e. This is discussed on page 6 for the lighting end use and on page 8 for the space cooling end use of Section 3.

6. **Errors in Measuring Variables:** This was not addressed.

7. **Autocorrelation:** This was not accounted for in the model specification. It is SDG&E's opinion that when autocorrelation is not corrected, the analysis does not produce a biased estimate but may cause the estimator to be inefficient.

8. **Heteroskedacity:** Since ordinary least squares regression analysis when applied at the customer level, the variance of the regression disturbance terms can vary at the customer level, and the estimator will still be efficient.

9. **Collinearity:** Not significant.

10. **Influential Data Points:** Influential data points were determined based on the RMSE criterion described in Estimation Methods on page 5 of Section 3.

11. **Missing Data:** Sample points (participants and nonparticipants) that did not meet the billing data requirements were eliminated from the analysis.

12. **Precision:** Standard errors are reported in the results tables provided above.

E. **Data Interpretation and Application:**

1. **Calculation of Net Impacts:** Method A was used to determine net impacts.

2. Method A is allowed by the M&E Protocols.