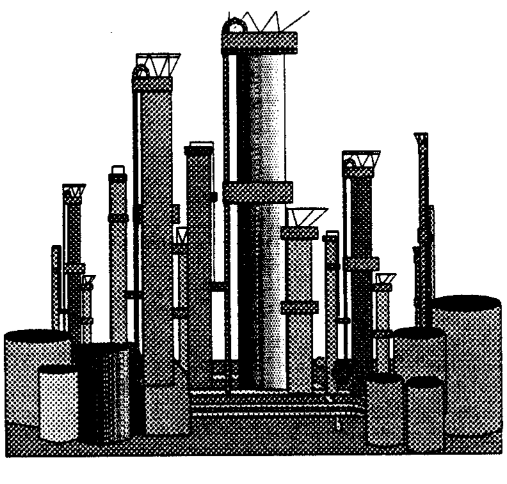
San Diego Gas & Electric
Marketing Programs & Planning
8306 Century Park Court
San Diego, California 92123

1994 Industrial Energy Efficiency Incentives Program

First Year Load Impact Evaluation and Retention Studies

February 1996



MPAP-94-P98-926-R607
Study ID No. 926

San Diego Gas & Electric
Marketing Programs & Planning

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Executive Summary

These studies were conducted to determine the first year load impacts for SDG&E's industrial customers only, who are a subset of all the nonresidential customers who participated in SDG&E's 1994 Commercial/Industrial/Agricultural (C/I/A) Energy Efficiency Incentives Programs. The C/I/A Energy Efficiency Incentives Program helps customers reduce energy costs and increase energy efficiency at their facilities. There are four major end uses covered by this report. They are (1) lighting, (2) motors, (3) process, and (4) miscellaneous measures. The total number of industrial participants can be disaggregated by end use as follows:

Industrial Participants	No. of Participants
Lighting Only	61
Motor	38
Process	12
Miscellaneous	79
Total	**190**

The lighting study employed a load impact regression model. The results show that the realization rate for the gross load impacts was 119.8%. The net-to-gross ratio was derived using the commercial lighting results from SDG&E's 1994 Commercial Energy Efficiency Incentives Program First Year Load Impact Evaluation and Retention Studies, Study ID No. 923 (February 1996). This resulted in a realization rate of the net load impacts of 89.5%.

The motors study showed a realization rate of approximately 72%. This drop is being accounted for only by the change in the total run hours based on the customer's reported usage.

The process study shows an overall realization rate of approximately 86% for gross energy savings and approximately 90% for the gross demand savings.

The retention rate for the miscellaneous measures was estimated to be 100%.

Organization of Report

The report is organized into several sections.

Overview:	This section presents the program description, a discussion of the participant database and data collection.
Lighting:	This section discusses the regression models and results obtained for the first year load impact study for lighting.
Motors:	This section contains the first year load impact study for industrial motors
Process:	This section contains the first year load impact study for industrial processes conducted by Xenergy
Miscellaneous Measures:	This section contains the first year retention study conducted by Xenergy, Inc. on miscellaneous measures.
Appendices:	This section contains all the appendices referenced throughout the report.
Reporting Requirements:	This section contains M&E Protocols Tables 6 and 7 for the various end uses.

OVERVIEW

Overview

Program Description

San Diego Gas & Electric offers the Commercial/Industrial/Agricultural (C/I/A) Energy Efficiency Incentives Program to help nonresidential 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, provides cost-effective DSM energy savings when existing customers have retrofit opportunities. SDG&E has three main marketing delivery mechanisms for providing incentives for retrofit or replace-on-burnout applications: (1) Commercial/Industrial 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 the large customer where SDG&E's Account Executives are involved in assisting customers with major retrofit applications. This program offers customers incentives 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 custom basis providing the project meets the program cost-effectiveness tests.

Power to Save. This marketing strategy offers customers incentives 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.

Commercial Rebates. These rebates are delivered through retailers/wholesalers who give commercial/industrial/agricultural customers 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, and (3) energy efficient motors.

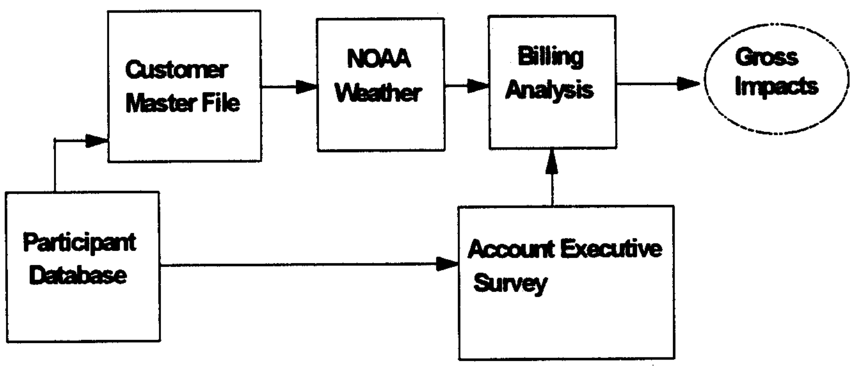
Sampling & Data Collection for the Lighting Study

Data Collection

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

- Customer name, address, and installation date from the program tracking database;
- Consumption history from the Customer Master File;
- Information on other changes for all assigned customers in the Participant Group were obtained from a survey conducted on the account executives
- Hourly weather data for three climate zones from NOAA files; and
- Retention information on "miscellaneous measures."

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



Participant Database

A total of 61 industrial customers were identified in the 1994 Commercial/Industrial database. The 61 participants installed a total of 131,608 installed measures. An attempt was made to include all participants in the analysis.

Account Executive Survey

SDG&E conducted an internal survey of all Account Executives who had 1994 DSM Program Participants. The survey was used to identify any impacts on consumption due to any changes (DSM or non-DSM) with respect to the company that may impact the way the company used energy from January 1993 through September 1995, covering the study period. This survey covered both commercial and industrial customers.

Approximately 793 surveys were sent out to 27 Account Executives with a cover letter explaining the survey. A total of 416 surveys or 52% indicated that there was "no change at all" to the company or how the company does business. There were 37 (5%) non responses. Forty-three percent of the responses reported some type of change to the company (hiring, layoffs, elimination of shifts, addition of shifts, or other) or changes to equipment (HVAC, lighting, process, refrigeration, or other). This information was incorporated in the analyses for lighting and HVAC.

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. For each customer in the participant and comparison groups, consumption data and weather data covered the period beginning January 1993 through October 1995.

Discussion of M&E Issues

Tables 6 & 7 of the M&E Protocols Reporting Requirements

Table 6 and Table 7 for Motors, Process and Miscellaneous Measures were not completed. The motors and process verified all industrial participants for these end uses. The results of these studies are documented in their respective sections.

Industrial Lighting Net-to-Gross Ratio

The M&E Protocols do not require a comparison group to determine the net-to-gross ratio for the load impacts of industrial end uses. SDG&E has derived a net-to-gross ratio in its 1994 Commercial Energy Efficiency Incentives Program First Year Load Impact Evaluation and Retention Studies, Study ID No. 923 (February 1996). This was the net-to-gross ratio that was applied to derive the net-to-gross ratio for the industrial lighting load impacts.

Industrial Motor End Use

Industrial motors, as a stand alone end use, is difficult to identify since motors are typically associated with another end use such as pumping, HVAC, or process. On site engineering analysis and verifications or customer surveys provide more accurate information as to the true end use associated with the motor. However, in the first earnings claim, when the E Tables are being completed, this kind of information may not be available. These results do not apply to motors that have been identified as part of another end use, such as pumping, HVAC, or process.

LIGHTING

Industrial Lighting End Use

The Regression Model

The General Model

The Individual Elements of the General Model

Regressions will be constructed for customers indexed by i, using monthly data (indexed by t). Equation 1 is the broadest form of the customer regression equation, with three right-hand side components X, W, and S, and the usual disturbance term ε_{it}. Special cases of this general regression model will be applied for participants, for the lighting and HVAC end uses.

Equation 1 (The General Structure of the Regression Equation)

$$kWh_{it} = X_{it} + W_{it} + S_{it} + \varepsilon_{it}$$

Monthly electricity consumption (in kWh), is on the left-hand side of Equation 1 (adjusted for the length of the billing cycle). The right-hand side of the equation is more complicated. The regression element X will have the structure,

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

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

X_{it} contains the intercept for the regression (β_{0i}) and a trend term. In addition, if there is a change in the regression equation (apart from the DSM activity yet to be discussed), the change to the intercept ($\Delta\beta_{0i}$) can be included in the equation using the zero-one indicator variable d_{it}. As shown in Equation 3, W_{it} is simply proportional to the cooling degreehour variable cdh_{it}.

Equation 3 (The Weather Portion of the Regression Equation)

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

Equation 4 gives the key element of the equation—the DSM impact on the regression equation:

Equation 4 (The DSM Savings Portion of the Regression Equation)

$$S_{it} = \rho_{it}(s_{it})$$

Equation 4 is consistent with a variety of well-known regression specifications for DSM impacts. The exact structure of the variable s_{it} is the heart of this report, and as such will be treated thoroughly later, for both participants and nonparticipants. For now we will point out that s_{it} can play the role of an *ex ante* calculation for energy savings, in which case s_{it} would take the form of an indicator variable scaled by the *ex ante* estimate of savings.

At this point we introduce the rho function ρ_{it}. In the case of space-cooling savings we let rho vary with cooling degreehours, as in Equation 5:

Equation 5 (The General Structure of the rho Function)

$$\rho_{it} = \rho_{i0t} + \rho_{i1}(cdh_{it})$$

The rho function can play the role of the realization rate (defined as estimated savings as a fraction of the *ex ante* calculation), although we will maintain a more flexible point of view.

If the realization rate is increasing over time (due, for example, to increases in the occupancy rate at a customer's site), we would have a true constant (ρ_{i0}^{A}) and a trend term:

Equation 6 (The Non-Weather Portion of the rho Function)

$$\rho_{i0t} = \rho_{i0}^{A} + \rho_{i0}^{B}(t)$$

This yields the final structure for the rho function:

Equation 7 (The Final Structure of the rho Function)

$$\rho_{it} = \rho_{i0}^{A} + \rho_{i0}^{B}(t) + \rho_{i1}(cdh_{it})$$

The Final Form of the General Model

Using Equation 2 through Equation 6 in Equation 1, we have the final regression equation that will be used throughout the report (regressors are given in curly brackets):

Equation 8 (The Final Regression Equation)

$$kWh_{it} = \beta_{0i} + \beta_{1i}\{t\} + \Delta\beta_{0i}\{d_{it}\} + \beta_{2i}\{cdh_{it}\} + \rho_{i0}^{A}\{s_{it}\} + \rho_{i0}^{B}\{(t)(s_{it})\} + \rho_{i1}\{(cdh_{it})(s_{it})\} + \varepsilon_{it}$$

Equation 8 is a well-defined regression equation in seven coefficients. In general, the equation allows for non-DSM changes in the intercept, a general trend, weather influences, and weather-related and trended realization rates. We now turn to special cases of this model.

Industrial Lighting End Use

The Participant Regression Model

The Regression Equation

At this point we will specify Equation 8 for lighting participants. In this context, there will be two exact specifications. First, cdh_{it} will be removed from the DSM portion of the model by imposing the constraint $\rho_{i1} = 0$, so that we now have the following regression equation for lighting participants:

Equation 9 (Lighting Participants--The Final Regression Equation)

$$kWh_{it} = \beta_{0i} + \beta_{1i}\{t\} + \Delta\beta_{0i}\{d_{it}\} + \beta_{2i}\{cdh_{it}\} + \rho_{i0}^{A}\{s_{it}\} + \rho_{i0}^{B}\{(t)(s_{it})\} + \varepsilon_{it}$$

Second, we must exactly specify the DSM savings function s_{it}.

The exact specification for s_{it} can best be understood by considering two important cases:

Case 1. The lighting participant experienced a single lighting retrofit.

Case 2. There has been more than one lighting retrofit at a site within the relevant time period.

In either case, the structure of the s_{it} variable begins with the *ex ante* estimate of energy savings, available from the program database. In Case 1, we have a single *ex ante* estimate S_i^{annual} (annual kWh), in which case the savings function (based on an equal distribution of annual hours over time),

Equation 10 (The Savings Function-Case 1)

$$s_{it} = \left(\frac{S_i^{annual}}{12}\right)\left(d_{it}^{lighting}\right) = (S_i)\left(d_{it}^{lighting}\right)$$

where $d_{it}^{lighting}$ is a standard zero-one indicator variable determined by the month of the lighting retrofit. In this setting the monthly savings figure S_i is simply a constant (at the customer level), so that we have the option of estimating savings directly based on the indicator variable.

However, in Case 2 the aggregate *ex ante* monthly savings estimate is simply the sum of the individual *ex ante* (indexed by j):

$$S_i = \sum_j S_{ij}$$

Consistent with this, we would have several expressions with the same structure as Equation 10:

Equation 11 (An Element of the Savings Function-Case 2)

$$s_{ijt} = \left(\frac{S_{ij}^{annual}}{12}\right)\left(d_{ijt}^{lighting}\right) = \left(S_{ij}\right)\left(d_{ijt}^{lighting}\right),$$

However, if we impose the assumption that the relevant regression coefficients are constant across j (this will amount to assuming a constant realization rate for each job at the customer level), we have the aggregate savings function,

Equation 12 (The Savings Function-Case 2)

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

Deriving Statistical Estimates of Customer Savings That are Comparable to *Ex Ante* Estimates

Ex ante savings estimates are certainly derived with a set of circumstances in mind (e.g., normal weather conditions, a given level of building occupancy, etc.). When there is no variation over time in the DSM savings portion of the model (when, for example, $\rho_{i0}^{B} = 0$ in the lighting model) this matter is inconsequential. However, when there is trending we must make an assumption concerning the point in time at which the *ex ante* estimate of savings applies. The statistical estimate for customer savings—based on the regression model—will have the form,

Equation 13 (The Statistical Estimate of Customer Savings)

$$\hat{S}_i = \left\{\rho_{i0}^{A} + \rho_{i0}^{B}\left(t^{*}\right)\right\}S_i$$

where, in this study, t^{*} was taken to be the latest month in the customer's sample (typically late 1995). We note from this, that in this setting, the rho function in Equation 7 (recalling the constraint $\rho_{i1} = 0$) is the realization rate at the customer level, since the realization rate has the structure, $\hat{S}_i / S_i$.

Accounting for Other Reported Changes

The last element of the regression is the simple indicator variable d_{it}. Most of the major lighting retrofit jobs are associated with one of the company's account executives. The account executives constitute a rich source of information, available at reasonable expense and on a timely basis. The account executives were given a survey concerning each of their retrofit jobs. The survey questions centered around non-DSM ("other") energy-consumption changes at the customer site in question. Nearly half of the surveys resulted in reports of other changes. As a result, the goal was to find some systematic means of enveloping the impact of these changes on the regression model, ending with a simple modification of the intercept term in $\Delta\beta_{0i}$ in Equation 8. The timing of the other change was actually estimated; the month during which the associated indicator variable d_{it} took on the value one (versus zero in prior months) was determined on a best-fit basis (along with the rest of the regression parameters). However, in Case 1 above, the variables d_{it} and s_{it} could be collinear if they were associated with the same point in time. As a result, the search activity for d_{it} (the process of minimizing the regression's residual sum-of-squares by searching across months) was limited to outside of two months of the installation date (before and after).

Estimation Methods

All regression equations were estimated at the customer level using ordinary least-squares estimation methods. Based on general experience, data on retrofit completion dates (used in constructing the indicator variable $d_{it}^{lighting}$) were "discounted" somewhat: three months of data prior to the recorded inspection date were excluded from the regression. This keeps the uncertainty associated with the completion date from seriously biasing the estimation results. Equation 9 was the exact regression equation that was estimated, with Equation 13 the final result.

Although the details of the data will be discussed later, customer-specific regressions most often included 36 months of consumption, weather, and miscellaneous data, with a minimum of 12 months of pre-installation data and a minimum of 9 months of post-installation data.

Designated Units of Measurement

The M&E Protocols require that the estimation results be combined with square footage data, hours of operation data, and *ex ante* estimates of savings. Based on reported customer square footage data F_i, savings per square foot, per 1,000 hours of operation would simply be (for an average annual hours of operation figure $\overline{H}$),

Equation 14 (Savings per Square Foot per 1,000 Hours of Operation)

$$\overline{w} = -\frac{12 \times \sum_i \hat{S}_i}{\sum_i F_i}\left(\frac{1{,}000}{\overline{H}}\right)$$

The annual energy impact per square foot is a similar expression:

Equation 15 (Annual Savings per Square Foot)

$$\overline{SSQFT} = -\frac{12 \times \sum_i \hat{S}_i}{\sum_i F_i}$$

Finally, the average impact over participants is,

Equation 16 (Annual Savings per Participant)

$$\bar{S} = \frac{12 \times \sum_{i=1}^{n} \hat{S}_i}{n}$$

The M&E Protocols contain a requirement for the savings realization rate. At the gross-impact level, the realization rate for lighting participants can be calculated according to,

Equation 17 (The Realization Rate for Lighting Participants)

$$\rho = \frac{\sum_i \hat{S}_i}{\sum_i S_i}$$

Results

SDG&E believes that the regression models contained in this report proved to be effective in supporting a large majority of the *ex ante* estimates of energy savings. However, the results from the models are disaggregated by groups of electricity customers in a way that provides, SDG&E believes, the greatest amount of insight in terms of both the strengths and shortcomings of the model. This group of customers is summarized as follows: customers were grouped into those with estimated monthly kWh exceeding 300,000 kWh, and those below this mark. It should be made clear that these groups were defined only after the regression results were examined. However, SDG&E believes that these groupings are made in good faith, and in a way that shines the greatest light on the empirical evidence for energy savings. SDG&E has attempted to undertake an intelligent line of research, consistent with this position. It should also be noted that in the Results section which follows, enough information is contained so that the reader can construct the relevant results in the absence of the disaggregation of customers into groups.

Table 1 gives overall lighting results for the industrial sector, disaggregated into the two groups already mentioned. The focus here will be on the main group where estimated monthly kWh consumption is below the 300,000 kWh level. The 51 participants in this study group were actually a 93% majority in an original group of 55 participants installing lighting measures (among those who had also met the criterion of less than 300,000 estimated kWh monthly consumption). Four participants were eliminated due to insufficient pre-retrofit or post-retrofit data. The data attrition is summarized in the M&E Reporting Requirements Table 7, section B, part 3(a).

Conditioned on the 300,000 kWh breakout, the lighting results are fairly strong, although given the standard errors, the estimates are more uncertain than in the commercial[1] case. According to Table 1, 119.8% of gross kWh savings were verified within the group of 51, although the standard error around this figure is a sizable 37%. The gross impact per designated unit of measurement (kWh per square foot, per 1,000 hours of operation) is 0.71, somewhat higher (as a point estimate) than the commercial estimate.

Table 1 Industrial Lighting Results (Gross Impact)

	Estimated Monthly kWh (< 300,000)	Estimated Monthly kWh (> 300,000)
Participant Group		
Estimated Impact (kWh per month)	(377,915)	(324,754)
Variance of Estimate	13,660,580,820	8,241,525,802
Ex Ante Estimate of Savings (kWh per month)	315,423	151,797
Total Lighting Square Footage	1,598,124	488,000
Count	51	4
Annual Hours	3,984	3,513
Realization Rate (Gross Impact)	119.8%	213.9%
Standard Error	37.1%	59.8%
Impact per Square Foot per 1,000 Hours	0.71	2.27
Impact per Square Foot (Annual kWh)	2.84	7.99
Average Impact (Annual kWh)	88,921	974,262

[1] 1994 Commercial Energy Efficiency Incentives Program First Year Load Impact Evaluation and Retention Studies, Study ID No. 923 (February 1996).

MOTORS

Industrial Motor End Use

High efficiency motor measures are designed to target the nonresidential market in San Diego. Incentives for these measures are provided through the three marketing strategies: C/I Incentives, Power to Save, or the Commercial Rebates. The measures examined in this section are those that were incentivized through the Energy Efficient Motor Rebate Program. This program provided rebates for Open Drip-Proof (ODP) and Totally Enclosed Fan-Cooled (TEFC), 1200, 1800, and 3600 RPM, with a horsepower range of 1 to 200. Rebates were provided for high efficiency motors that were immediately installed or placed in inventory. A total of 1,170 motors was sold through this program for PY94; but only 64 motors bought by 38 customers qualified as industrial motors.

The number of participating motors for this study was so small that the scope of this study is limited to verifying the *ex ante* assumption of the total annual run hours. All other *ex ante* assumptions were retained. All these motors were assumed to have a total annual run hours of 4,000 in the first earnings claim. The methodology used here is limited to the use of customer self-reported data and an inspection of the purchased motors at the customer site.

Each customer provides the retailer at the point-of-purchase with the following information on the Customer Enrollment Form: the end use for which the motor will be used and the total annual operating hours. An inspector employed by SDG&E then verifies at a later date that the motor is indeed located on the customer's premise. The purchased motor must either be installed or in inventory. A copy of the Customer Enrollment Form and the Inspection Form are provided in Appendix B.

The analysis shows that after recalculating the energy savings using the customer's self-reported hours of operation, it was determined that the overall realization rate, defined as the ratio of *ex post* estimate to the *ex ante* estimate, is approximately 72%. The following table shows the recalculated estimated energy savings.

This analysis is limited in scope given the small number of motors that fall into this end use category and the small energy and demand savings. Motor logger information would provide a more fine-tuned estimate of hour-of-operation and diversity factor. Should this category be expanded in future program years, it may be prudent to invest in more detailed follow-up of the these motors.

INDUSTRIAL MOTORS

PARTICIPANT	MANUFACTURER	MODEL	QUANTITY	HORSE POWER PER MOTOR	EX ANTE ANNUAL RUN HOURS	REPORTED ANNUAL RUN HOURS	GROSS DEMAND SAVINGS (KW)	NET DEMAND SAVINGS (KW)	EX ANTE GROSS ENERGY SAVINGS (KWH)	EX POST GROSS ENERGY SAVINGS (KWH)	REALIZATION RATE	EX POST NET ENERGY SAVINGS	NET TO GROSS RATIO
P0000037	US Elec	7980	1	50.0	4000	4160	0.955	0.764	2106.55	2190.8	104.0%	1291.57	0.59
P0000038	US Elec	H327	2	30.0	4000	2080	1.146	0.917	2527.85	1314.5	52.0%	774.94	0.59
P0007846	Toshiba	B0102FLF2UMH	1	10.0	4000	2000	0.356	0.285	1149.63	574.8	50.0%	494.50	0.86
P0012060	Toshiba	S284903H2050	1	50.0	4000	1500	0.955	0.764	2106.55	790.0	37.5%	465.71	0.59
P0014979	US Elec	A437	1	10.0	4000	8760	0.356	0.285	1149.63	2517.7	219.0%	2165.93	0.86
P0014979	US Elec	R-G235	1	50.0	4000	8760	0.955	0.764	2106.55	4613.3	219.0%	2719.75	0.59
P0014979	US Elec	G2358	1	50.0	4000	4380	0.955	0.764	2106.55	2306.7	109.5%	1359.88	0.59
P0015132	Toshiba	BOO54FLFAMH01	1	5.0	4000	3600	0.178	0.142	574.81	517.3	90.0%	445.05	0.86
P0015132	Toshiba	B0054FLF2USA01	1	5.0	4000	3600	0.178	0.142	574.81	517.3	90.0%	445.05	0.86
P0020565	G.E.	5KS213E20SD8	1	7.5	4000	0	0.267	0.214	862.22	0.0	0.0%	0.00	0.86
P0020588	Marathon	RB182TTFS6601	1	3.0	4000	5600	0.107	0.085	344.89	482.8	140.0%	415.38	0.86
P0020588	Reliance	P18G3338	1	5.0	4000	4160	0.178	0.142	574.81	597.8	104.0%	514.28	0.86
P0021982	US Elec	E906	1	20.0	4000	2600	0.382	0.306	842.62	547.7	65.0%	322.89	0.59
P0033814	Dayton	5N254	1	10.0	4000	0	0.356	0.285	1149.63	0.0	0.0%	0.00	0.86
P0034198	Toshiba	B0024FLF2AMH	1	2.0	4000	0	0.051	0.041	165.74	0.0	0.0%	0.00	0.87
P0034198	Toshiba	B0034FLF2AMH	1	3.0	4000	3600	0.107	0.085	344.89	310.4	90.0%	267.03	0.86
P0034198	Toshiba	B0034FLF2AMH	1	3.0	4000	600	0.107	0.085	344.89	51.7	15.0%	44.51	0.86
P0048028	Baldor	EM4115T	1	50.0	4000	2000	0.955	0.764	2106.55	1053.3	50.0%	620.95	0.59
P0054527	Toshiba	BY754ULF2USH	1	7.5	4000	5590	0.267	0.214	862.22	1205.0	139.8%	1036.60	0.86
P0054527	Toshiba	B0104FLF2USH02	1	10.0	4000	4380	0.356	0.285	1149.63	1258.8	109.5%	1082.96	0.86
P0054527	Century	E451636214901	1	15.0	4000	2600	0.287	0.229	631.96	410.8	65.0%	242.17	0.59
P0054527	Toshiba	B0204DLF2MH	1	20.0	4000	4900	0.382	0.306	842.62	1032.2	122.5%	608.53	0.59
P0057221	Reliance	P25G3316	1	15.0	4000	1200	0.287	0.229	631.96	189.6	30.0%	111.77	0.59
P0060433	US Elec	A429	1	3.0	4000	2080	0.107	0.085	344.89	179.3	52.0%	154.29	0.86
P0060433	US Elec	E86FB	1	3.0	4000	0	0.107	0.085	344.89	0.0	0.0%	0.00	0.86
P0060433	US Elec	A431	1	5.0	4000	780	0.178	0.142	574.81	112.1	19.5%	96.43	0.86
P0072570	Toshiba	B0054FLF2AMH	1	5.0	4000	3650	0.178	0.142	574.81	524.5	91.3%	451.23	0.86
P0077706	US Elec	H330	1	40.0	4000	5304	0.764	0.611	1685.24	2234.6	132.6%	1317.40	0.59
P0077845	Baldor	EM7054T	1	15.0	4000	2000	0.287	0.229	631.96	316.0	50.0%	186.28	0.59
P0081030	US Elec	E891A	1	5.0	4000	7080	0.178	0.142	574.81	1017.4	177.0%	875.27	0.86
P0082102	Toshiba	B0104DLF2USH	1	10.0	4000	0	0.356	0.285	1149.63	0.0	0.0%	0.00	0.86
P0082569	Reliance	P21G3360	1	10.0	4000	2400	0.356	0.285	1149.63	689.8	60.0%	593.40	0.86
P0082569	Reliance	P25G3330	1	15.0	4000	2400	0.287	0.229	631.96	379.2	60.0%	223.54	0.59
P0082569	Reliance	P28G3335	1	25.0	4000	2100	0.478	0.382	1053.27	553.0	52.5%	326.00	0.59
P0082569	Relleance	P28G4551	1	30.0	4000	2100	0.573	0.458	1263.93	663.6	52.5%	391.20	0.59
P0082569	Reliance	D28G3316	1	30.0	4000	2100	0.573	0.458	1263.93	663.6	52.5%	391.20	0.59
P0082569	Reliance	P32G4551	1	50.0	4000	2100	0.955	0.764	2106.55	1105.9	52.5%	652.00	0.59
P0093954	US Elec	A425	1	2.0	4000	4160	0.051	0.041	165.74	172.4	104.0%	150.00	0.87
P0099916	Dayton	5N299	1	10.0	4000	1000	0.356	0.285	1149.63	287.4	25.0%	247.25	0.86
P0101038	Teco	ASHE000400300H	1	30.0	4000	2100	0.573	0.458	1263.93	663.6	52.5%	391.20	0.59
P0104445	Toshiba	B0104DLF2USH	1	10.0	4000	520	0.356	0.285	1149.63	149.5	13.0%	128.57	0.86
P0113210	US Elec	E899B	1	10.0	4000	4160	0.356	0.285	1149.63	1195.6	104.0%	1028.57	0.86
P0113210	US Elec	E899B	1	10.0	4000	4160	0.356	0.285	1149.63	1195.6	104.0%	1028.57	0.86
P0122927	Dayton	5N256	1	15.0	4000	6000	0.287	0.229	631.96	947.9	150.0%	558.85	0.59
P0123022	G.E.	D5KS215SE205D8	1	10.0	4000	2600	0.356	0.285	1149.63	747.3	65.0%	642.85	0.86
P0129885	Reliance	P21G3360	1	10.0	4000	2080	0.356	0.285	1149.63	597.8	52.0%	514.28	0.86
P0143867	Reliance	P25G3330	1	15.0	4000	1560	0.287	0.229	631.96	246.5	39.0%	145.30	0.59
P0143867	Baldor	EM4108T	1	30.0	4000	2000	0.573	0.458	1263.93	632.0	50.0%	372.57	0.59
P0151642	Toshiba	B024FLFUSH01	1	20.0	4000	2000	0.382	0.306	842.62	421.3	50.0%	248.38	0.59
P0151642	Toshiba	B0254FLF3UMH	1	25.0	4000	1500	0.478	0.382	1053.27	395.0	37.5%	232.86	0.59
P0154593	Reliance	P28G3335	1	25.0	4000	2200	0.478	0.382	1053.27	579.3	55.0%	341.52	0.59
P0154593	Reliance	P28G3335	1	25.0	4000	2000	0.478	0.382	1053.27	526.6	50.0%	310.47	0.59
P0154593	Reliance	P28G3316	1	30.0	4000	2000	0.573	0.458	1263.93	632.0	50.0%	372.57	0.59
P0157030	US Elec	A435	1	7.5	4000	5100	0.267	0.214	862.22	1099.3	127.5%	945.74	0.86
P0167068	Reliance	P56X1531	1	1.0	4000	6240	0.025	0.020	82.87	129.3	156.0%	112.50	0.87
P0167068	Reliance	P56X1531	1	1.0	4000	6240	0.025	0.020	82.87	129.3	156.0%	112.50	0.87
P0167068	Reliance	P36G3326H	1	60.0	4000	3640	0.846	0.677	2598.84	2364.9	91.0%	1919.24	0.81
P0168641	US Elec	7973	1	50.0	4000	3650	0.955	0.764	2106.55	1922.2	91.3%	1133.23	0.59
P0177277	US Elec	E891B	1	5.0	4000	1248	0.178	0.142	574.81	179.3	31.2%	154.29	0.86
P0181292	Teco	AEHE-8P	1	125.0	4000	3000	1.763	1.410	5414.24	4060.7	75.0%	3295.40	0.81
P0188324	Toshiba	B0154FLF2USHO1	1	15.0	4000	2080	0.287	0.229	631.96	328.6	52.0%	193.74	0.59
P0188324	Toshiba	B0604FLF3UMH	1	60.0	4000	0	0.846	0.677	2598.84	0.0	0.0%	0.00	0.81
P0188324	Teco	MAXE-1AEHEBP	1	200.0	4000	2600	2.820	2.256	8662.79	5630.8	65.0%	4569.62	0.81
TOTAL			64				29.801	23.841	78345.45	56155.6	71.7%	40237.78	

Ex Post Gross Energy Savings = Ex Ante Gross Energy Savings * Ex Ante Annual Run Hours / Reported Annual Run Hours

PROCESS

1994 INDUSTRIAL ENERGY EFFICIENCY INCENTIVES PROGRAM

FIRST YEAR LOAD IMPACT STUDY OF INDUSTRIAL PROCESS MEASURES

Prepared for

San Diego Gas & Electric
San Diego, California

Prepared by

XENERGY Inc.
San Diego, California

February 1996

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1 INTRODUCTION

San Diego Gas & Electric (SDG&E) commissioned XENERGY Inc. to conduct load impacts of its *1994 Industrial Energy Efficiency Incentives Program* (*IEEI Program*). The measures were installed to provide resource value by improving the energy efficiency of the facilities that participated in the *IEEI Program*. XENERGY conducted the *1994 Industrial Energy Efficiency Incentives Program First Year Load Impact Study of Industrial Process Measures*, was the evaluation of the load impacts of those industrial measures categorized as *Process* measures.

The overall objectives of the *First Year Load Impact Study of Industrial Process Measures* were to:

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

The remainder of this report is organized as follows:

Section 2	Results and findings
Section 3	Study methodology
Appendix A	Net-to-gross interview guide
Appendices B-S	Site specific analysis reports

2 RESULTS

This section presents the results of the *First Year Load Impact Study of Industrial Process Measures* conducted for San Diego Gas & Electric for industrial measures installed during the Program Year 1994 (PY94).

2.1 OVERVIEW

Each of the 18 industrial process measures installed during PY94 were included in this study. These measures were installed at 13 sites in SDG&E's service territory. This section provides a summary of the engineering analysis conducted for each measure. The detailed analysis for each site can be found in Appendices B through S. The measures are identified by a four digit identification number.

2.2 GROSS IMPACTS

This section presents the estimation of gross impacts of the *Impact Evaluation of Industrial Process Measures.* Site specific engineering models and analysis were used to estimate the impacts for the 18 industrial process measures installed under SDG&E's 1994 Commercial and Industrial Energy Efficiency Incentives Program.

The gross impacts for energy, demand, and natural gas were estimated *ex post*, where appropriate. The *ex post* gross impacts were compared to *ex ante* impact estimates through realization rates for each site.

2.2.1 Measure Descriptions

Table 2-1 provides a description of each of the 18 measures evaluated. Six installations were considered new installations, five were retrofits of existing equipment, four were replacements of worn equipment, and three were early replacements of existing equipment. The primary reason for the retrofit of 13 measures was to reduce energy use. The remaining five measures were installed to increase production or decrease non-energy operating costs.

As would be expected, a variety of measure types were installed. These ranged from straightforward insulation of solution tanks to chemical machining processes to new applications for thermal energy storage.

The measures accounted for almost 5.6 MWh's in total electricity savings, 839 kW's in demand benefits, and natural gas savings of 58,687 Therms per year.

Table 2-1
Industrial Process Measure Project Descriptions

I.D. #	Project Description	Type of Project	Reason for Retrofit
1141	Salt Water Crossover Piping	Retrofit Existing System	Reduce Energy/Power Consumption
1196	Ingot Loader	New Installation	Increase Production/Decrease Production Cost
1356	High Efficiency Motor	New Installation	Reduce Energy/Power Consumption
1357	Air Drier	New Installation	Reduce Energy/Power Consumption
1360	Insulate Molding Machines	Retrofit Existing System	Reduce Energy/Power Consumption
1365	CO_2 Vaporizer	Early Replacement	Increase Production/Decrease Production Cost
1366	Ventilation Modification	Replacement Due to Wear & Tear	Reduce Energy/Power Consumption
1393	Air Compressor	New Installation	Reduce Energy/Power Consumption
1425	Thermal Energy Storage	Replacement Due to Wear & Tear	Increase Production/Decrease Production Cost
1427	Boiler Stack Heat Recovery	New Installation	Reduce Energy/Power Consumption
1451	50 Cycle Power Converter	Early Replacement	Reduce Operating Cost (Other than energy)
1462	Stoichiometric Burners	Replacement Due to Wear & Tear	Reduce Energy/Power Consumption
1467	Recuperative Burners	Replacement Due to Wear & Tear	Reduce Energy/Power Consumption
1471	Insulate Dip Tanks	Retrofit Existing System	Reduce Energy/Power Consumption
1495	Replace Machining Eqmt.	Early Replacement	Increase Production/Decrease Production Cost
1524	Econo-Disk Flow Regulator	New Installation	Reduce Energy/Power Consumption
1545	VSD on CHW Pump	Retrofit Existing System	Reduce Energy/Power Consumption
1614	Repair Air Lines	Retrofit Existing System	Reduce Energy/Power Consumption

2.2.2 Impact Analysis

The gross impact analysis was conducted using site specific engineering models. The analysis used inputs that were verified by XENERGY's project engineer through observation, measurement, monitoring, site interviews, or other records provided during the evaluation. The analysis for each site may be found in Appendices B through S.

Table 2-2 provides a summary of the gross impact analysis. The *ex ante* impact estimates were obtained from the program tracking database and the *ex post* estimates were developed through the engineering analysis of this study.

Realization rates were estimated using the equation 2.1.

$$R = \frac{P}{A} \qquad \textit{(Eq. 2-1)}$$

where,

R = Realization rate for the measure,

P = Ex Post impact estimate for the measure, and

A = Ex Ante impact estimate for the measure.

As shown in Table 2-2, the realization rates range from 0.00 to over 3.00. Overall, a total of savings of almost 4.8 MWh's was estimated *ex post*. Thus, approximately 86 percent of the *ex ante* electricity energy savings, 5.6 MWh's, were realized during 1994 as measured through this study. Similar results were found for electric demand benefits and natural gas savings.

Four sites comprised 75 percent of the energy savings. The realization rates for these four measures were fairly high, ranging from 0.86 to 1.15.

Table 2-2
Summary of Impacts

		Energy (kWh)			Demand (kW)			Gas (Therms/yr)		
I.D. #	Project Description	Ex Ante	Ex Post	Real. Rate	Ex Ante	Ex Post	Real. Rate	Ex Ante	Ex Post	Real. Rate
1141	Salt Water Crossover Piping	1,294,068	1,117,065	0.86	147.7	162.2	1.10	0	0	N/A
1196	Ingot Loader	291,600	267,264	0.92	48	0	0.00	0	0	N/A
1356	High Efficiency Motor	53,059	42,053	0.79	6.1	6.1	1.00	0	0	N/A
1357	Air Drier	275,084	90,743	0.33	19.64	-13.7	-1.70	0	0	N/A
1360	Insulate Molding Machines	609,869	703,745	1.15	98.3	115.9	1.18	0	0	N/A
1365	CO_2 Vaporizer	446,471	415,666	0.93	78.1	75	0.96	0	3,300	N/A
1366	Ventilation Modification	53,503	52,184	0.98	8.57	8.57	1.00	0	0	N/A
1393	Air Compressor	202,261	27,277	0.13	28.8	30.6	1.06	0	0	N/A
1425	Thermal Energy Storage	0	15,688	N/A	125	125	1.00	0	0	N/A
1427	Boiler Stack Heat Recovery	-1,492	-1,518	1.02	-0.25	-0.25	1.00	12,250	13,956	1.14
1451	50 Cycle Power Converter	20,160	67,452	3.35	0	7.7	N/A	0	0	N/A
1462	Stoichiometric Burners	0	0	N/A	0	0	N/A	9,333	30,658	3.29
1467	Recuperative Burners	0	0	N/A	0	0	N/A	13,880	12,485	0.90
1471	Insulate Dip Tanks	0	0	N/A	0	0	N/A	23,224	24,273	1.05
1495	Replace Machining Eqmt.	385,151	126,072	0.33	56.6	18.5	0.33	0	0	N/A
1524	Econo-Disk Flow Regulator	16,516	0	0.00	1.9	0	0.00	0	0	N/A
1545	VSD on CHW Pump	167,486	162,315	0.97	16.4	-1.1	N/A	0	0	N/A
1614	Repair Air Lines	1,790,634	1,712,580	0.96	204.4	217.3	1.06	0	0	N/A
Total		5,604,370	4,798,586		839.2	751.8		58,687	84,672	

2.2.3 Deviations

The reasons for deviations between the *ex ante* and the *ex post* impact estimates are shown in Table 2-3. The primary reasons for the measures with realization rates with larger deviations from 1.00, e.g., less than 0.80 or greater than 1.10, are differences in the hours of operation or other operational changes.

Five measures had realization rates less than 0.80 for energy (kWh). In one case, I.D. # 1524 (realization rate=0.00), the site was unoccupied and the measure was not in use. In another, I.D. # 1495 (realization rate=0.33), one of two machines retrofit is not being used due to the lower production requirements. For I.D. # 1393, the hours of operation were reduced from 6,000 to 4,000. This reduction represented an operational change from the assumed mode of operation used for the *ex ante* estimate. Also, the compressor loading was underestimated and the control unit doesn't modulate as was expected. These factors combined to reduce the savings, thus resulting in a low realization rate. An electric heater required for an air drier system for I.D. # 1357 (realization rate=0.33), was not accounted for in the *ex ante* estimate. The hours of operation for I.D. # 1356 (realization rate=0.79) were overestimated, 8,760 versus 8,400, and the duty cycle was high, 100% versus the 80% that was measured.

Two sites had realization rates greater than 1.10. In one case, I.D. # 1360 (realization rate=1.15), there were some differences in calculating the loads through measured pre-retrofit data. There were several factors used to convert the logger data to electrical load (kW) that were not consistently described during our analysis, thus resulting in differences in the realization rate. For a second site, I.D. # 1451, the manner in which the measure was used resulted in an underestimation of the hours of operation. Thus, the measure is always producing savings.

Table 2-3
Reasons for Deviations Between *Ex Ante* and *Ex Post* Estimates

I.D. #	Project Description	Realization Rate Demand (kW)	Energy (kWh)	Gas (Thm)	Reason For Deviation Between *Ex Ante* and *Ex Post* Estimates
1141	Salt Water Crossover Piping	1.10	0.86	N/A	SDG&E methodology does not reflect system operation
1196	Ingot Loader	0.00	0.92	N/A	Very small difference
1356	High Efficiency Motor	1.00	0.79	N/A	Operating hours different from SDG&E estimates Operating conditions different from SDG&E projections
1357	Air Drier	N/A	0.33	N/A	SDG&E methodology does not reflect system operation
1360	Insulate Molding Machines	1.18	1.15	N/A	Operating hours different from SDG&E estimates
1365	CO_2 Vaporizer	0.96	0.93	N/A	Very small difference
1366	Ventilation Modification	1.00	0.98	N/A	SDG&E methodology does not reflect system operation
1393	Air Compressor	1.06	0.13	N/A	Operating hours different from SDG&E estimates Equipment or system performance different from SDG&E projections
1425	Thermal Energy Storage	1.00	N/A	N/A	Equipment or system performance different from SDG&E projections
1427	Boiler Stack Heat Recovery	1.00	1.02	1.14	Equipment or system performance different from SDG&E projections
1451	50 Cycle Power Converter	N/A	3.35	N/A	Operating conditions different from SDG&E projections
1462	Stoichiometric Burners	N/A	N/A	3.29	Operating hours different from SDG&E estimates Operating conditions different from SDG&E projections
1467	Recuperative Burners	N/A	N/A	0.90	Operating conditions different from SDG&E projections
1471	Insulate Dip Tanks	N/A	N/A	1.05	Very small difference
1495	Replace Machining Eqmt.	0.33	0.33	N/A	Operating hours different from SDG&E estimates
1524	Econo-Disk Flow Regulator	0.00	0.00	N/A	Operating hours different from SDG&E estimates
1545	VSD on CHW Pump	N/A	0.97	N/A	Very small difference
1614	Repair Air Lines	1.06	0.96	N/A	Very small difference

2.3 Net-To-Gross

As specified in the M&E Protocols, "Each utility must conduct an assessment of the extent to which major measures that are being promoted in the Industrial EEI Program may have been installed by some customers in the absence of a program. These studies should estimate the net-to-gross ratios for the measures or end uses that comprise over 50% of the expected savings from this program. These studies do not have to employ comparison group analysis. Other measures can use the following default ratios: 1.0 for projects with a demonstrated payback of two years or more, 0.75 if the payback is more than 6 months and less than 2 years, and 0.4 if the payback period is 6 months or less."

The rules described in Table 2-4 were applied to each site for estimating the net-to-gross ratios for each site. Information gathered through interviews with site staff and project documentation were compiled to estimate the net-to-gross.

Table 2-4
Decision Rules For Estimating Net-To-Gross Ratio

	Decision Parameters	
Net-To Gross Ratio	**#1**	**#2**
1.00	If incentive reduced the simple payback from an unacceptable level to one that is acceptable in the customer's decision making process.	If customer stated that SDG&E made the recommendation to install or consider the measure, or there was evidence that SDG&E was involved in the decision making process, regardless of the payback.
0.75	If simple payback was less than 2.0 years but greater than six months, without incentives.	If simple payback was not reduced to the customers acceptable range for energy saving projects, but the measure was installed.
0.50	If simple payback was less than 2.0 years but greater than six months, without incentives, but there were other, non-energy saving reasons identified for the replacement.	
0.40	If payback is less than 0.5 years without incentives.	
0.00	If measure was installed prior to contact with SDG&E or if the customer indicates that SDG&E was not involved in the decision making process.	

Table 2-5 provides a summary of the net-to-gross estimation. The payback values were those estimated during the project analysis phase.

Table 2-5
Net-To-Gross Summary

I.D. #	Project Description	Interview Summary	Payback	Net-To-Gross Ratio and Rationale
1141	Salt Water Crossover Piping	One of the General Foremen indicated in an interview that the reason for retrofitting the salt water circulation system was to save pump energy. The Crossover Piping System was the measure of choice by the yard personnel, and we do not believe that they considered any other alternatives. The facility uses a two-year payback threshold for energy projects.	1.44 w/o incentive. 1.11 w/ incentive	0.75 Based on payback period.
1196	Ingot Loader	Interview with the Plant Casting Engineer indicated that the retrofit was done to increase production and to lower scrap rates. Energy conservation was a secondary consideration. Customer's criterion for energy conservation projects is two-year simple payback.	3.87 w/o incentive. 3.59 w/ incentive.	0.75 Payback not reduced to customer's payback threshold.
1356	High Efficiency Motor	According to information gained in an interview with the, Senior Plant Engineer at the facility, changing of the motor to an energy efficient one was done to save energy. The company uses a two-year simple payback criterion for projects of this type.	2.85 w/o incentive. 1.96 w/ incentive.	1.00 The incentive reduced the payback to within the customer's acceptable range.
1357	Air Drier	Interview with the Senior Plant Engineer for the facility provided the following information: An Air Dryer was required for plant operations. The more efficient unit was specified to improve energy efficiency. Various types of Desiccant Dryers were apparently the only alternatives considered. Unable to get a clear answer regarding the company's payback threshold for this type of project. Same customer as I.D. # 1356, where two-year simple payback criteria was adopted for an energy efficient motor.	3.1 w/o incentive. 2.4 w/ incentive.	0.75 Payback not reduced to acceptable range for customer, based on a one-year payback criteria.
1360	Insulate Molding Machines	The change was made to save energy on the recommendation of SDG&E. It represents the only viable technology for this situation. The normal payback threshold applied by the company is two-years.	0.24 w/o incentive.	1.00 In spite of short payback, the recommendation by SDG&E was instrumental in installing the measure.

Table 2-5 (continued)
Net-To-Gross Summary

I.D. #	Project Description	Interview Summary	Payback	Net-To-Gross Ratio and Rationale
1365	CO_2 Vaporizer	No interview was conducted with anyone from the plant regarding the net-to-gross issues or the payback criteria. Since the existing unit was in poor condition, and did not have the capacity to meet the plant's peak demand, it would seem that a replacement of the existing unit would have been imminent. Whether the current configuration would have been chosen cannot be answered.	1.86 w/o incentive. 1.49 w/ incentive.	0.75 Based on payback less than two years and greater than six months.
1366	Ventilation Modification	Based on an interview with the Casting Engineer at the facility, the existing unit was replaced because: it was in poor condition and required high maintenance; it was no longer effective at removing mist from the air; the device had caused a fire; The change to spot ventilation improved performance; and the two smaller units had a lower capital cost than one large one.	3.55 w/o incentive. 3.27 w/ incentive	0.75 Payback probably did not meet customers payback criteria, but measure was installed during a period when another measure was installed at the same site (I.D. # 1196), indicating possible SDG&E influence.
1393	Air Compressor	An interview with the Facilities Engineering Manager for the plant yielded the following information: The new compressor was installed to improve efficiency and reliability of the compressed air system. This particular compressor was chosen because it offered the lowest annual energy consumption of several units considered. Reliability and efficiency considerations drove the replacement project. The company generally uses a two-year payback threshold for this type of project.	1.26 w/o incentive. 0.46 w/ incentive.	0.75 Simple payback was within customer's threshold.
1425	Thermal Energy Storage	Interviews with the Facilities Manager for the Plant, indicated the following: The reason to install the Thermal Storage unit instead of the Refrigerated Chiller was to shift load away from on-peak time of use periods and lower the cost of electricity. Thermal Storage was determined to be the lowest life cycle cost of the alternatives considered. The company uses a two-year payback threshold.	1.15 w/o incentive. 0.79 w/ incentive.	0.75 Simple payback was within customer's threshold.

Table 2-5 (continued)
Net-To-Gross Summary

I.D. #	Project Description	Interview Summary	Payback	Net-To-Gross Ratio and Rationale
1427	Boiler Stack Heat Recovery	Interview with the Plant Manager, indicated the sole purpose of the retrofit was to save energy. There was no other viable technology available so none was considered. The company uses a payback threshold of two years. It would have probably been done even if no rebate had been available.	2.8 w/o incentives. 2.27 w/ incentives.	1.0 SDG&E received the proposal from equipment contractor and apparently was involved in the decision process.
1451	50 Cycle Power Converter	According to the Plant Engineer the retrofit was made to eliminate the noise and maintenance requirements of the motor-generator set, to relieve plant space, and to improve operating efficiency. The company uses a criterion of two-year simple payback for projects of this type. This project shows 2.25 year simple payback without rebate and 1.61 with rebate so the rebate probably raised the priority of the project.	2.25 w/o incentive. 1.61 w/ incentive.	1.00 The incentive reduced payback to the customer's acceptable range, and increased the customer's decision making priority.
1462	Stoichiometric Burners	The change was made to save energy on the recommendation of SDG&E. The customer has a two-year payback threshold.	0.48 w/o incentive. 0.37 w/ incentive.	0.40 Short paybacks
1467	Recuperative Burners	The change was made to save energy on the recommendation of SDG&E. The customer uses a two-year normal payback threshold.	1.41 w/o incentive. 1.08 w/ incentive.	1.00 SDG&E's recommendation was instrumental to implementing the project.
1471	Insulate Dip Tanks	Interview with the Plant Engineer indicated that the retrofit was done to save energy. The customer has a two-year payback criteria. With the rebate included, the payback was 0.61 years, which moved it up in priority. As this was the most practical technology for the application, other alternatives were not considered.	0.85 w/o incentive. 0.61 w/ incentive.	0.75 The payback fell within the customer's acceptable range and the incentive affected the customer's decision making.
1495	Replace Machining Equipment	In the course of the interview with Plant Personnel, we were told the retrofit was made to increase production and to lower costs. It was noted that there are substantial benefits in addition to those related to energy. This was the technology best suited to the customer's needs.	3.83 w/o incentive. 3.34 w/ incentive.	0.50 Other criteria were involved in the decision making as well as energy costs.

Table 2-5 (continued)
Net-To-Gross Summary

I.D. #	Project Description	Interview Summary	Payback	Net-To-Gross Ratio and Rationale
1524	Econo-Disk Flow Regulator	Site not operating at time of study. The plant was closed down. There are no plans to re-open.	0.47 w/o incentive. 0.36 w/ incentive.	0.4 Payback less than six months.
1545	VSD on CHW Pump	Interview with the Senior Plant Engineer for the facility indicated the retrofit was made to save energy. No other alternatives were considered The company uses a two-year simple payback criterion for this type of projects. This project would not have met the payback threshold if it did not receive a rebate.	2.07 w/o incentive. 1.57 w/ incentive	1.0 The incentive reduced the payback to within the customer's acceptable range.
1614	Repair Air Lines	The change was made to reduce operating costs and incidentally the result eliminated the need to add compressed air capacity. The availability of rebate had little effect on the decision to implement the measure. Repair of the leaks was the only viable approach Customer letter indicates that SDG&E made the recommendation to investigate and repair leaks to reduce costs.	0.01 w/o incentive.	1.0 Customer utilized SDG&E's recommendation to repair system.

2.4 Net Impacts

This section presents the net impacts of the 1994 Industrial Energy Efficiency Incentives Program. The net-to-gross ratios estimated in Section 2.3 are applied to the gross impacts estimated in Section 2.2.

Table 2-6 shows the net kWh impacts for the eighteen measures.

Table 2-6
Net Energy (kWh) Impacts

I.D. #	Project Description	Net-To-Gross Ratio	Ex Ante kWh Savings	Ex Post kWh Savings	Real. Rate	Net Savings (kWh)	Net Real. Rate
1614	Repair Air Lines	1.00	1,790,634	1,712,580	0.96	1,712,580	0.96
1360	Insulate Molding Machines	1.00	609,869	703,745	1.15	703,745	1.15
1545	VSD on CHW Pump	1.00	167,486	162,315	0.97	162,315	0.97
1451	50 Cycle Power Converter	1.00	20,160	67,452	3.35	67,452	3.35
1356	High Efficiency Motor	1.00	53,059	42,053	0.79	42,053	0.79
1467	Recuperative Burners	1.00	0	0	N/A	N/A	N/A
1427	Boiler Stack Heat Recovery	1.00	-1,492	-1,518	1.02	-1,518	1.02
1141	Salt Water Crossover Piping	0.75	1,294,068	1,117,065	0.86	837,799	0.65
1365	CO_2 Vaporizer	0.75	446,471	415,666	0.93	311,750	0.70
1196	Ingot Loader	0.75	291,600	267,264	0.92	200,448	0.69
1357	Air Drier	0.75	275,084	90,743	0.33	68,057	0.25
1366	Ventilation Modification	0.75	53,503	52,184	0.98	39,138	0.73
1393	Air Compressor	0.75	202,261	27,277	0.13	20,458	0.10
1425	Thermal Energy Storage	0.75	0	15,688	N/A	11,766	N/A
1471	Insulate Dip Tanks	0.75	0	0	N/A	N/A	N/A
1495	Replace Machining Eqmt.	0.50	385,151	126,072	0.33	63,036	0.16
1462	Stoichiometric Burners	0.40	0	0	N/A	N/A	N/A
1524	Econo-Disk Flow Regulator	0.40	16,516	0	0	0	0.00
Total			5,604,370	4,798,586		4,239,078	

Table 2-7 shows the net kW impacts.

Table 2-7
Net Demand (kW) Impacts

I.D. #	Project Description	Net-To-Gross Ratio	Ex Ante kW Reduction	Ex Post kW Reduction	Real. Rate	Net kW Reduction	Net Real. Rate
1614	Repair Air Lines	1.00	204.4	217.3	1.06	217.3	1.06
1360	Insulate Molding Machines	1.00	98.3	115.9	1.18	115.9	1.18
1451	50 Cycle Power Converter	1.00	0	7.7	Could not calculate	7.7	Could not calculate
1356	High Efficiency Motor	1.00	6.1	6.1	1	6.1	1.00
1467	Recuperative Burners	1.00	0	0	N/A	0.0	N/A
1427	Boiler Stack Heat Recovery	1.00	-0.25	-0.25	1	-0.3	1.00
1545	VSD on CHW Pump	1.00	16.4	-1.1	N/A	-1.1	-0.07
1141	Salt Water Crossover Piping	0.75	147.7	162.2	1.1	121.7	0.82
1425	Thermal Energy Storage	0.75	125.0	125.0	1	93.8	0.75
1365	CO_2 Vaporizer	0.75	78.1	75	0.96	56.3	0.72
1393	Air Compressor	0.75	28.8	30.6	1.06	23.0	0.80
1366	Ventilation Modification	0.75	8.57	8.57	1	6.4	0.75
1196	Ingot Loader	0.75	48	0	0	0.0	0.00
1471	Insulate Dip Tanks	0.75	0	0	N/A	0.0	N/A
1357	Air Drier	0.75	19.64	-13.7	-1.70	-10.3	-1.52
1495	Replace Machining Eqmt.	0.50	56.6	18.5	0.33	9.3	0.16
1462	Stoichiometric Burners	0.40	0	0	N/A	0.0	N/A
1524	Econo-Disk Flow Regulator	0.40	1.9	0	0	0.0	0.00
Total			839.3	751.8		645.7	

Table 2-8 shows the net Therm impacts.

Table 2-8
Net Therm Impacts

I.D. #	Project Description	Net-To-Gross Ratio	Ex Ante	Ex Post	Real. Rate	Net Therm Savings	Net Real. Rate
1471	Insulate Dip Tanks	0.75	23,224	24,273	1.05	18,204.8	0.78
1427	Boiler Stack Heat Recovery	1.00	12,250	13,956	1.14	13,956.0	1.14
1467	Recuperative Burners	1.00	13,880	12,485	0.9	12,485.0	0.90
1462	Stoichiometric Burners	0.40	9,333	30,658	3.29	12,263.2	1.31
1365	CO_2 Vaporizer	0.75	0	3,300	N/A	2,475.0	Could not calculate
1141	Salt Water Crossover Piping	0.75	0	0	N/A	0.0	N/A
1196	Ingot Loader	0.75	0	0	N/A	0.0	N/A
1356	High Efficiency Motor	1.00	0	0	N/A	0.0	N/A
1357	Air Drier	0.75	0	0	N/A	0.0	N/A
1360	Insulate Molding Machines	1.00	0	0	N/A	0.0	N/A
1366	Ventilation Modification	0.75	0	0	N/A	0.0	N/A
1393	Air Compressor	0.75	0	0	N/A	0.0	N/A
1425	Thermal Energy Storage	0.75	0	0	N/A	0.0	N/A
1451	50 Cycle Power Converter	1.00	0	0	N/A	0.0	N/A
1495	Replace Machining Eqmt.	0.50	0	0	N/A	0.0	N/A
1524	Econo-Disk Flow Regulator	0.40	0	0	N/A	0.0	N/A
1545	VSD on CHW Pump	1.00	0	0	N/A	0.0	N/A
1614	Repair Air Lines	1.00	0	0	N/A	0.0	N/A
Total			58,687	84,672		59,384	

3 METHODOLOGY

This section describes the methodology used by XENERGY in conducting SDG&E's *First Year Load Impact Study of Industrial Process Measures.*

3.1 OVERVIEW

The approach used to conduct the *Study* was the use of end-use **engineering models** with verified input assumptions. Measurements of equipment performance and monitoring of equipment operations were performed to refine the inputs into the engineering models developed for each measure.

3.2 SCOPE OF WORK

This section describes the scope of work XENERGY used to conduct SDG&E's *First Year Impact Study of Industrial Process Measures.*

3.2.1 Task 1: Gather Available Site Data

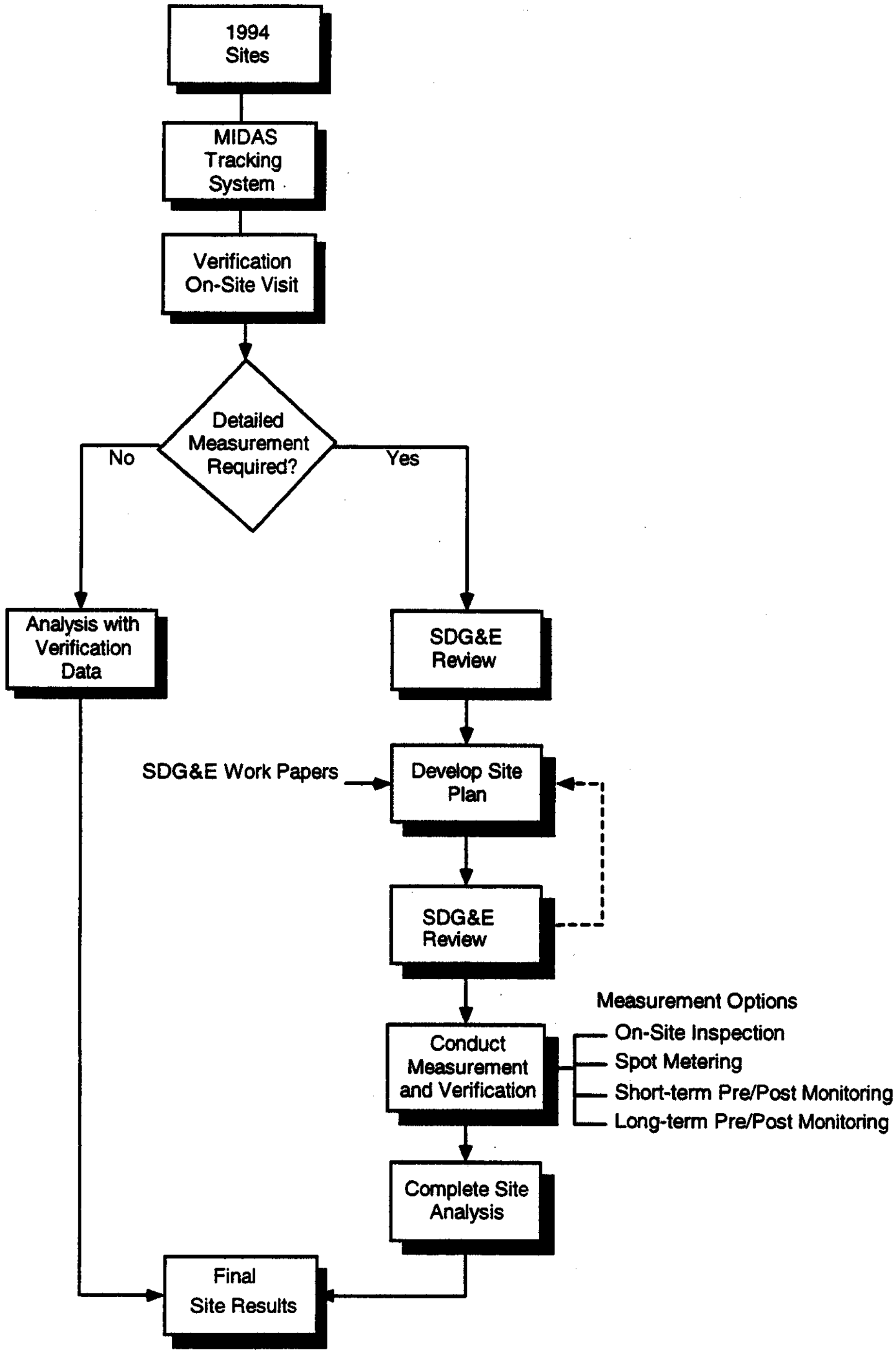
Site data were gathered and compiled from available sources. Typically, these sources included hard copies of customer applications, SDG&E work papers, design reports, invoices, and pre-and post-field surveys. A site profile was developed from which an evaluation plan was developed.

3.2.2 Task 2: Develop Site Evaluation Plan

The initial evaluation plan for each site was developed by XENERGY, and submitted to SDG&E for review.

An example of the *general* work flow is displayed as Figure 3-1.

Figure 3-1
General Study Work Flow



Evaluation Approach and Methodologies

When dealing with industrial customers, it is very important to use a site-by-site custom approach to measure the impacts of DSM measures. The measurement strategy must take into account the various types of processes, technologies, production output and operation schedules found in the industrial sector.

To meet the impact measurement needs of this project, XENERGY utilized appropriate combinations of the following:

- Engineering models and analysis;
- Equipment data collection tools and methods;
- On-site surveys; and
- Short term metering and spot measurements.

We had planned on conducting post-installation on-site data collection and verification visits to each site, but could not in one case, where the customer refused. In this case, detailed discussions with SDG&E's project engineer indicated the equipment installation was verified and helped to ascertain the operating conditions at the facility.

On-site surveys were conducted to verify the installation of the measures and to verify or improve the engineering assumptions that were made to estimate energy savings. We used previously collected data to help reduce the scope of the on-site data collection efforts, where feasible. Project documentation provided by SDG&E was the primary source for engineering calculations of initial energy savings estimates in most cases.

Engineering models were based primarily on those used determine energy savings during the program implementation phase. Billing data analysis was supported the analysis.

Short-term post-retrofit metering was used to gather data on equipment performance, motor part-load and operation schedules. Short term metering was performed in most process and motor applications to help determine the load characteristics.

The first step in determining the strategy for a customer was to assess the value of available information. We then determined what is known about the customer's pre-installation equipment and operating schedules, what billing information is available, and if any pre-installation equipment metering was performed.

3.2.3 Task 3: Conduct Project-Specific Evaluations of Enhanced Program Projects

XENERGY conducted project-specific evaluations for all participants of *SDG&E's Commercial-Industrial Incentive Program* that installed measures classified as industrial process. A total of eighteen measures was evaluated.

Sub-Task 3a: Develop Project-Specific Evaluation Plan

Individual evaluation plans were developed for each Program participant and summarized in spreadsheet form. Each site plan was developed individually using the appropriate methodology as discussed in Section 3.2.1 of this proposal.

The plan included:

- Description of the measure;
- Description of the verification methodology;
- Description of the verification data requirements; and
- Description of the data acquisition plan.

The summaries of the plans were reviewed by SDG&E prior to implementation.

Sub-Task 3b: Determine Gross Project-Specific Impacts

All data collection activities were conducted between November 1995 and January 1996. Gross impacts were calculated on an individual project basis.

A site analysis was developed for each project. The report includes the following for each site:

- Description of project;
- Evaluation methodology;
- SDG&E's analytical methodology;
- Discussion of differences in methodologies;
- Data collection;
- Data sources; and
- Comparison of evaluation results to SDG&E's initial estimates.

3.2.4 Task 4: Estimate Total Gross Impacts

Gross impacts were estimated for the 1994 industrial DSM measures. This includes total gross kW, kWh and therm impacts, as appropriate.

Integrate Individual Gross Impacts

After the individual impacts from each project were estimated, XENERGY aggregated the results to estimate total program gross impacts.

3.2.5 Task 5: Determine Total Net Impacts

Net impacts were addressed through an assessment of free-ridership. An interview was conducted with each site contact as part of the on-site post-installation field visit. Assessment of free-riders was done through self-reported responses to questions about customer behavior, as well as supporting documentation found in project files.

A net-to-gross ratio was estimated for each measure installed. The decision rules for estimating the net-to-gross are shown in Table 2-4. Data from information gathered from the site contact during on-site visits, project specific program files on each measure.

The results were combined with the gross savings estimate per site to estimate the net impacts on site specific basis.

M&E PROTOCOLS TABLE 6

RESULTS USED TO SUPPORT PY94 SECOND EARNINGS CLAIM

FOR

INDUSTRIAL ENERGY EFFICIENCY INCENTIVES PROGRAMS
FIRST YEAR LOAD IMPACT EVALUATION

FEBRUARY 1996

STUDY ID NO. 926

SAN DIEGO GAS & ELECTRIC
M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY94 SECOND EARNINGS CLAIM FOR THE INDUSTRIAL ENERGY EFFICIENCY INCENTIVES PROGRAM
FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1996, STUDY ID NO. 923

Designated Unit of Measurement: LOAD IMPACTS PER SQUARE FOOT PER 1,000 HOURS OF OPERATION
END USE: INDOOR LIGHTING ONLY

				5. A. 90% CONFIDENCE LEVEL				5. B. 80% CONFIDENCE LEVEL			
				LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND
1. Average Participant Group and Average Comaprison Group		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	22.32	N/A	10.96	33.67	N/A	N/A	13.47	31.17	N/A	N/A
	A. ii. Load Impacts - kWh	88,921	N/A	43,682	134,160	N/A	N/A	53,665	124,177	N/A	N/A
	B. i. Load Impacts/designated unit - kW	0.000710	N/A	0.000348	0.001072	N/A	N/A	0.000428	0.000992	N/A	N/A
	B. ii. Load Impacts/designated unit - kWh	0.71	N/A	0.35	1.07	N/A	N/A	0.43	0.99	N/A	N/A
	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	119.8%	N/A	58.8%	180.8%	N/A	N/A	72.2%	167.4%	N/A	N/A
	D.A. ii. Load Impacts - kWh, realization rate	119.8%	N/A	58.8%	180.8%	N/A	N/A	72.2%	167.4%	N/A	N/A
	D.B. i. Load Impacts/designated unit - kW, real rate	119.8%	N/A	58.8%	180.8%	N/A	N/A	72.2%	167.4%	N/A	N/A
	D.B. ii. Load Impacts/designated unit - kWh, real rate	119.8%	N/A	58.8%	180.8%	N/A	N/A	72.2%	167.4%	N/A	N/A
3. Net-to-Gross Ratios		RATIO		RATIO	RATIO			RATIO	RATIO		
	A. i. Average Load Impacts - kW	89.5%		79.2%	99.8%			81.5%	97.5%		
	A. ii. Average Load Impacts - kWh	89.5%		79.2%	99.8%			81.5%	97.5%		
	B. i. Avg Load Impacts/designated unit of measurement - kW	88.6%		81.5%	95.8%			83.0%	94.2%		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	88.6%		81.5%	95.8%			83.0%	94.2%		
	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 SQUARE FOOTAGE	31,336	N/A	22,488	40,184	N/A	N/A	24,440	38,231	N/A	N/A
	B. Post-install average value HOURS OF OPERATION	3,984	N/A	3,667	4,301	N/A	N/A	3,737	4,231	N/A	N/A
6. Measure Count Data		NUMBER									
	A. Number of measures installed by participants in Part Group	***									
	B. Number of measures installed by all program participants in the 12 months of the program year	***									
	C. Number of measures installed by Comp Group	N/A									
7. Market Segment Data		SIC	PERCENT								
	Distribution by 3 digit SIC - Commercial/Industrial	***	***								

NOTE: Realization rate was calculated from the impact evaluation as the estimated impact divided by the *ex ante* estimate; NOT as the load impact fom the study divided by the first year earnings claim.
This was done because of an error in the DUOM calculation in the first year earnings claim; it will be corrected in the MAY 1, 1996 AEAP Filing.
NOTE: Since there is no Industrial Comparison Group, the Net-to-gross ratios are assumed to be equal to the NTG of commercial lighting.
*** Due to the volume of information, Measure Count Data and Market Segment Data are presented on the following pages.

Industrial Energy Efficiency Incentives Program

Measure Cost Data:

LIGHTING:

Quantity	Total Cost	Measure Descriptions	
5	$325.00	Install Ocupancy Sensor, Restrooms and Storage Ar	
12	$1,733.00	Metal Halide HID Lamps	
12	$4,876.00	Metal Halide Lighting System	
86	$7,015.00	Occupancy Sensors	
3	$1,050.00	Skylights	
2	$70.00	Twist Timer	
5	$167.55	Twist Timers	
2	($291.93)	0F96/4DLAMP8	
105	($2,228.73)	0F96E/0B8-ST/2DLAMP8	
182	($9,121.70)	0F96H/0B8-HO/2DLAMP8	
1	($97.01)	0MV400	
1	$9,373.15	1 Set Switch Lighting Control System	
61	$1,432.35	1CFQ13H	
12	$379.93	1CFQ13S	
15	$532.21	1CFQ22H	
22	$1,611.46	1CFQ26H	
4	$1.62	1CFQ28H	
210	($7,096.96)	1CF13H	
40	$640.91	1CF9H	
60	$1,725.39	1FO25/.5B3-EL	
11	$315.21	1FO25/1B3-EL	
365	$10,966.04	1FO32/1B4T8-2L	
31	$11,895.46	1HP150	
293	$60,525.47	1MH250	
7	($199.52)	1XCF5K	
40	($150.35)	1XLED1	
32	$1,135.52	2CF13H	
35	($5,779.15)	2CF5H	
70	($4,721.94)	2CF7H	
8	$207.31	2CF9H	
4	$165.72	2CF9S	
60	$1,521.82	2FO17/1B2-17T8	
80	$2,696.20	2FO17/1B2-17T8/1R2-D2	
14	$522.36	2FO25/1B3-EL	
2942	$100,031.72	2FO32/1B4T8-2L	
68	$1,384.57	2FO32/1B4T8-2L/1DLAMP	
70	$3,763.46	2FO32/1B4T8-2L/1R4-D1	
267	$17,011.43	2FO32/1B4T8-2L/1R4-D2	
4	$290.10	2FO32/1B4T8-2L/1R8-D0	
336	$7,513.40	2FO32/1B4T8-2L/1R8-D1	
6	$462.46	2FO32/1B4T8-2L/2R4-D1	
11	$2,462.58	2FO72/1B6-EL	
12	$936.00	2F96HE/1B8-ELHO	
243	$19,050.06	2F96HE/1B8-HO/1R8-D0	
21	($1,361.80)	2XLED1	
455	$6,897.87	3FO17/1B2-17T8/1R2-D3	
52	$2,111.98	3FO32/1B4T8-3L	
1794	$80,676.00	4Ft. Fluorescent Fixtures	
2	$639.25	4FO25/1B3-EL	
933	$40,630.28	4FO32/1B4T8-4L	
1	$35.87	4FO32/1B4T8-4L/1R4-D2	
294	$19,682.86	4FO32/1B4T8-4L/1R8-D0	
60	$5,717.54	4FO32/1B4T8-4L/1R8-D1	
36	$2,137.24	4FO32/1B4T8-4L/1R8-D2	
55	$94.74	4FO32/1B4T8-4L/2DLAMP	
181	$13,251.55	4FO32/1B4T8-4L/2R4-D0	
1	$80.72	4FO32/1B4T8-4L/2R4-D2	
50	$816.91	8FO32/2B4T8-4L/1R8-D0	
1	$17.28	Occupancy Sensors	
1,219	$9.06	Optical Reflector	(34)
1,675	$29.78	F17T8 Electronic Ballast	(35)
3,281	$3.19	F17T8 Lamp	(36)
61	$25.54	FB31T8 Electronic Ballast	(37)
121	$7.87	FB31T8 U-Lamp	(38)
0	$25.53	FB40T12 Electronic Ballast	(39)
0	$5.62	FB40T12/ES U-Lamp	(40)
0	$28.60	F40W/T5CF Electronic Ballast	(41)
0	$7.39	F40W/T5CF Lamp	(42)
55	($4.45)	Delamping	(43) ??
0	$12.71	Replace Hybr Ballast (1992)	(44)
108	$24.52	Replace Elect Ballast (1992)	(45)
48,971	$24.58	High Eff Ballast T-8 (1992)	(46)
35,261	$2.25	Low Wattage Bulbs (32 Watt) (1992)	(47)

MOTORS:

Quantity	Total Cost	Measure Descriptions
232	$103,727.00	5818 HP

PROCESS:

Quantity	Total Cost	Measure Descriptions
1	$13,818.00	Air Compressor with High Efficiency Motor
3	$96,000.00	Automatic Ingot Loaders w/ Rotary Accuater
1	$15,780.92	Boiler Heat Recovery System
1	$10,599.00	Energy Eff Motor on Air Compressor
1	$59,825.00	External Heater w/ PPR Desiccant Recharge
2	$156,449.50	EDM Machines-Electrical Discharge Machining
1	$18,481.90	Hydromizer TES System
4	$11,278.00	Insulation Solution Tanks @ 180 degrees (2.5"x30"
2	$16,483.00	Mist Collectors-Air Filter Unit (2x5HP)
30	$11,810.01	Molding machine insulating blankets
1	$11,914.56	Recuperative Burner in endothermic furnace
	$1,000.00	Repaired Compressed Air System Leaks
1	$2,592.93	Stoichiometric Burner
1	$128,964.00	10" Crossover Piping & Valve Controls
1	$105,799.00	5000#/Hr. Co2 Vaporizer (FCWB 6x8x10)

MISC:

Quantity	Total Cost	Measure Descriptions
	$22,716.43	Automatic Controls for Gas Tunnel Oven
3	$249.00	install timeclocks to control the air conditioning
1	$10,498.00	A/C: high effiency heat pumps
3	$9,474.00	A/C: DX High Efficiency Unit
1	$516.00	Air Handler with an Econo-Disk
1	$4,065.00	ASD on Cooling Tower Fan Motor
1	$9,421.00	ASD on Fan Motor
8	$38,100.00	ASDs on Fans (6x2HP, 2x7 5HP)
1	$124,330.00	Chiller Conversion Kit
2	$5,216.00	Condenser coils on heat pumps
2	$1,750.00	Economizer
7	$4,786.05	Economizer Installation
1	$1,835.00	Heat Pump: AirSrc 24-65 MBH
1	$72,501.20	Hi-Eff Air Cooled Chiller
1	$1,328.00	High Efficiency Package Airconditioning
2	$259,950.00	High Efficiency Water Cooled Chillers
1	$2,855.00	Insulation
	$9,791.00	New piping for relocated outside condensers
1	$8,100.00	Programable timers on Fan Units 9-16(Bld
8	$4,000.00	Timeclocks
1	$5,740.00	Tinted Glazing
1	$19,160.00	VSD for Chilled Water Pump
1	$530.40	5-ton gas package unit
2	$550.00	Efficient Temperature Control Unit
1	$3,480.00	50 Hertz Solid-State Converter
1	$183.66	Gas Pack DX Rooftop Unit
1	$257.12	High Efficiency HVAC Unit <5.4 Ton
45	$13,836.02	Economizer system for roof top A/C units 45x5 ton)
2	$10,222.30	Economizer Repair (1x25Ton & 1x50Ton)-Sn
1	$470.00	A/C: DX High Efficiency Unit
3	$1,322.35	A/C: DX High Efficiency Unit

Industrial Energy Efficiency Incentives Program

Measure Cost Data:

LIGHTING:

Quantity	*Total Cost*	*Measure Descriptions*	
0	$0.74	Replace LW Bulb (34 WATT) (1992)	(48)
7,679	$12.38	Delamp 1/Opt Reflect (1992)	(49)
17,243	$14.12	Delamp 2/Opt Reflect (1992)	(50)
145	$3.38	Delamp (1992)	(51)
612	$17.46	4 Lamp Ballast	(52)
1,222	$18.41	3 Lamp Ballast	(53)
2,987	$29.20	High Eff Ballast 8ft (1992)	(54)
438	$30.78	Opt Reflector (1 LMP) - 8ft (1992)	(55)
0	$39.97	CF - 13 Q Downlight	(30A)
670	$20.00	CF - PL-9 Downlight	(30B)
19	$20.00	CF - PL-7 Downlight	(30C)
0	$49.00	Exit Sign 14w CF	
56	$20.00	CF - PL-5 Downlight	(30D)

MOTORS:

Quantity	*Total Cost*	*Measure Descriptions*

PROCESS:

Quantity	*Total Cost*	*Measure Descriptions*

MISC:

Quantity	*Total Cost*	*Measure Descriptions*

Frequency Distribution of Three Digit SIC for Industrial Sector
By Study and Enduse

Study: Lighting	SIC		Frequency
Enduse: *Motors*	355		1
		Subtotal:	1

Study: Lighting	SIC		Frequency
Enduse: *Lighting*	152		4
	162		2
	171		2
	173		2
	179		1
	239		1
	249		1
	259		1
	264		1
	272		1
	274		3
	275		6
	283		1
	289		1
	308		5
	316		1
	326		2
	342		1
	346		1
	353		1
	354		1
	355		1
	357		2
	358		1
	359		1
	364		1
	366		1
	367		5
	372		1
	382		3
	384		2
	394		3
	399		1
		Subtotal:	61
		Total:	62

Study: Motors	SIC		Frequency
Enduse: *Motors*	144		5
	162		1
	203		1
	204		1
	205		1
	209		1
	243		1
	254		1
	275		1
	285		1
	287		1
	299		1
	305		1
	308		1
	323		1
	327		1
	328		1
	335		1
	343		1
	344		2
	358		1
	359		2
	367		5
	369		1
	372		1
	384		1
	394		1
	399		1
		Subtotal:	38
		Total:	38

Study: Process	SIC		Frequency
Enduse: *Motors*	208		1
		Subtotal:	1

Study: Process	SIC		Frequency
Enduse: *Process*	208		1
	306		2
	308		1
	335		1
	339		1
	358		1
	365		1
	367		1
	372		1
	373		1
		Subtotal:	11

Study: Process	SIC		Frequency
Enduse: *Misc*	372		1
		Subtotal:	1
		Total:	13

Study: Misc	SIC		Frequency
Enduse: *Misc*	305		1
		Subtotal:	1
		Total:	1

M&E PROTOCOLS TABLE 7

DATA QUALITY AND PROCESSING DOCUMENTATION

FOR

INDUSTRIAL ENERGY EFFICIENCY INCENTIVES PROGRAMS
FIRST YEAR LOAD IMPACT EVALUATION

FEBRUARY 1996

STUDY ID NO. 926

M&E PROTOCOLS TABLE 7
DATA QUALITY AND PROCESSING DOCUMENTATION
For 1994 Industrial Energy Efficiency Incentives Program
First Year Load Impact Evaluation
February 1996
Study ID No. 926

A. OVERVIEW INFORMATION

1. **Study Title and Study ID:** 1994 Industrial Energy Efficiency Incentives Program: First Year Load Impact Evaluation and Retention Studies, February 1996, MPAP-94-P98-926-R607, Study ID No. 926

2. **Program, Program Year, and Program Description:** SDG&E offers the 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 marketing delivery mechanisms for providing incentives for retrofit or replace-on-burnout applications: (1) Commercial/Industrial 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 use is lighting.

4. **Methods and Models Used:** The main statistical method used is *ordinary least-squares regression analysis,* applied at the customer level, for participants and nonparticipants. See the modeling sections of the report for a complete detailed description of the final model specifications.

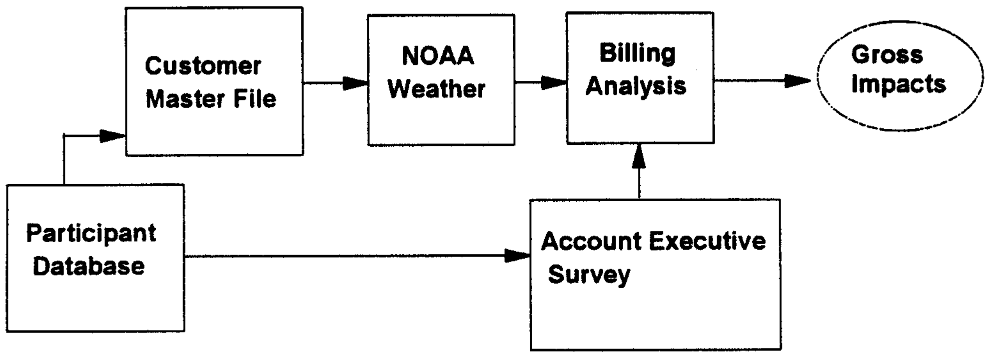
5. **Participant and Comparison Group Definition:** For the load impact analysis of the lighting and HVAC end uses, a participant was defined as a customer or group of customers with a common contract for DSM installations who completed the installation of the high efficiency measures by December 31, 1994. A non-participant is not required for this study.

6. **Analysis Sample Size:**

End Use	No. of Participants	No. of Measures	Average No. of Billing Months
Lighting Only	61	131,608	35.5

B. DATABASE MANAGEMENT

1. **Flow Chart:** The following diagram describes the flow of data into the final new impact results:



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

- Customer name, address, and installation date from the program tracking database;
- Consumption history from the Customer Master File;
- Information on other changes for all assigned customers in the Participant Group were obtained from a survey conducted on the account executives
- Hourly weather data for three climate zones from NOAA files; and
- Retention information on "miscellaneous measures."

3. **Data Attrition:**

a. **Participant Group:** an attempt was made to use all program participants identified with each end use. Attrition was primarily due to insufficient pre-retrofit or post-retrofit billing data per Table C-12.

Number of Participants in the Industrial Lighting Load Impact Analysis	
Number of participants in the database	61
Estimable regression parameters	59
Participants in relevant stratum	55
Relevant stratum participants with sufficient billing data	51

b. **Nonparticipant Group:** NA

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 insure accurate merging. Surveys and billing data were merged by premise ID number. Weather data were merged by billing cycle and climate zone.

5. **For impact analyses,** only square footage was used from the on-site surveys. The complete surveys for all sites will be added to SDG&E's database of commercial end use surveys (CEUS). Survey data are in PC format on diskettes.

C. **SAMPLING**

1. **Sampling Procedures and Protocols:** An attempt to use all program participants with the end use of interest was made

2. **Survey Information:** See discussion on the Account Executive Survey, p. 6.

3. **Statistical Descriptions:**

Table 1 Industrial Lighting Results (Gross Impact)

	Estimated Monthly kWh (< 300,000)	Estimated Monthly kWh (> 300,000)
PARTICIPANT GROUP		
Estimated Impact (kWh per month)	(377,915)	(324,754)
Variance of Estimate	13,660,580,820	8,241,525,802
Ex Ante Estimate of Savings (kWh per month)	315,423	151,797
Total Lighting Square Footage	1,598,124	488,000
Count	51	4
Annual Hours	3,984	3,513
Realization Rate (Gross Impact)	119.8%	213.9%
Standard Error	37.1%	59.8%
Impact per Square Foot per 1,000 Hours	0.71	2.27
Impact per Square Foot (Annual kWh)	2.84	7.99
Average Impact (Annual kWh)	88,921	974,262

D. DATA SCREENING AND ANALYSIS

1. These issues are discussed in detail in the modeling and results sections of the report.

2. Adjustments were made to the regressions (regressors were added) in line with Account Executive survey results. The modeling portion of the report gives details.

3. All participants were part of the analysis regardless of the amount of billing information available since individual regression models were constructed for individual customers. All results were reviewed and decisions made. See Results (pp. 13-14) under Industrial Lighting End Use.

4. **Regression Statistics:** See item 3. under Sampling.

5. **Specification:**

a. Regressions were run at the customer level. This accounts for customer heterogeneity to the maximum.

b. Weather and trends were accounted for in the model. Also, customer-specific changes (described by SDG&E account executives) were embedded in the regression model. See the modeling portion of the report for details.

c. No explicit measures were taken for self-selection.

d. SDG&E believes that no regressors of any consequence have been omitted from the analysis.

e. The framework is discussed in great detail in the modeling section of the report.

6. **Errors in Measuring Variables:** Errors in variables is not a factor in the study.

7. **Autocorrelation** was not included as an element of the specification. For one, correcting for autocorrelation prohibits the use of SAS package weighting functions, which is used in the regressions to eliminate data in the neighborhood of the installation date (see the report for details). Second, autocorrelation--when left uncorrected--leaves no bias and only (in our view) a minor inefficiency in the estimates.

8. **Heteroskedasticity:** Since *ordinary least-squares regression analysis* is applied at the customer level, the variance of the regression disturbance terms can vary at the customer level, and the estimator will be efficient. No other forms of heteroskedasticity were considered.

9. **Collinearity** was a factor to some extent, especially in the cooling model. Indicator variables, trend-based regressors, and weather data, when included in the same regression, can easily lead to collinearity problems. However, this issue was not serious in the lighting model, since weather data were not a part of the DSM portion of the specification.

10. **Influential Data Points:** These issues are discussed in great detail in the Results (pp. 13-14) under Industrial Lighting End Use.

11. **Missing Data:** No significant amount of data were missing, except for a portion of the sample for which there was insufficient pre-installation data or insufficient post-retrofit data. See the Results (pp. 13-14) under Industrial Lighting End Use.

12. **Precision:** Standard errors are given in the Results section of the report, and in Table 6.

E. DATA INTERPRETATION AND APPLICATION

1. **Calculation of Net Impacts:** Since no comparison group was required for this study, the net-to-gross ratio estimated in SDG&E's 1994 Commercial Energy Efficiency Incentives Program First Year Load Impact Evaluation and Retention Studies, Study ID No. 923 (February 1996) was used.

2. It is reasonable to assume that customers make the same choices regarding standard lighting measures.