PRE-1998 COMMERCIAL ENERGY EFFICIENCY INCENTIVE PROGRAM 1998 CARRY OVER IMPACT EVALUATION

Process End Use, PG&E Study ID number: 404C

March 1, 2000

Measurement and Evaluation
Customer Energy Efficiency Policy & Evaluation Section
Pacific Gas and Electric Company
San Francisco, California

All inquiries should be directed to:

Janice Frazier-Hampton
Revenue Requirements
Pacific Gas and Electric Company
P. O. Box 770000, Mail Code B9A
San Francisco, CA 94177

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Purpose of Study

This study was conducted in compliance with the requirements specified in "Protocols and Procedures for the Verification of Costs, Benefits, and Shareholders Earnings from Demand-Side Management Programs", as adopted by California Public Utilities Commission Decision 93-05-063, revised March, 1998, pursuant to Decisions 94-05-063, 94-10-059, 94-12-021, 95-12-054, 96-12-079, and 98-03-063.

This study evaluated the ex post gross and net kW, kWh, and therm savings from the installation of energy efficiency measures in the Process end uses for which rebates were paid in 1998 by the following Pacific Gas & Electric Pre-1998 Company Commercial Energy Efficiency Incentive Programs that were offered from 1994 to 1997: Advanced Performance Options (APO) and Retrofit Efficiency Options (REO).

Methodology

The impact evaluation utilized calibrated engineering analysis to determine gross impacts. Net impacts were derived using the gross impact estimates and net-to-gross ratios estimated using a customer self-report method. This approach is consistent with methods outlined in Table C-5 of the M&E Protocols.

Project-specific analyses were developed for census of Process end use projects. Analyses were supported by on-site data collection for each project. A project-specific report was developed for each of the 19 projects.

A standardized net-to-gross (NTG) survey was administered for all projects, provided the customer was willing to cooperate with the survey and a customer representative who was reasonably familiar with the project decision was available. A total of 17 projects were included in the standardized NTG analysis. A scoring algorithm was applied to this survey to develop NTG ratios for each project.

In addition, each relevant project received a customized NTG analysis. The customized analysis built upon the standardized NTG approach and included information from project files, additional customer interviews, vendor interviews, and PG&E Representative interviews. The goal of the customized NTG analysis was to provide the best possible NTG ratio for each large project by incorporating data from multiple sources, resolving inconsistencies among sources, and providing a narrative documenting the assigned project NTG ratio.

Study Results

The results of the commercial sector evaluation for the Process end use are summarized below. Overall, net Program savings are estimated to be 369 kW, 2,467,472 kWh, and 195,032 therms on an annual basis. Approximately 58% of PG&E's ex ante net kW savings, 49% of the ex ante net kWh savings, and 121% of the ex ante net therm savings are being realized. Ninety percent confidence intervals are ±1% for net kW and kWh impacts and ±0% for net therm impacts.

PG&E Pre-1998 Commercial Energy Efficiency Incentives Pre-1998 Program Carry-Over
Summary of Evaluation Gross and Net Load Impacts
Process End Uses

	Gross Savings	Gross Realization Rate	Net-To-Gross 1-FR*	Net-To-Gross SO*	Net Savings	Net Realization Rate
EX ANTE						
kW	841		0.75	-	631	
kWh	6,681,881		0.75	-	5,011,411	
Therms	215,558		0.75	-	161,669	
EX POST						
kW	585	0.695	0.63	0.0000	369	0.585
kWh	3,858,481	0.577	0.64	0.0000	2,467,472	0.492
Therms	226,812	1.052	0.86	0.0000	195,032	1.206

* FR: free-ridership rate; SO: spillover rate

The primary reason for discrepancies between ex ante estimates and ex post results is different operation conditions. Equipment is often operated in a manner that is different from the ex ante predictions. For example, production hours or rates are constantly changing. Significantly different conditions were observed for most of the REO Program projects. Generally, the projects involved motors that were retrofitted with adjustable speed drives. In most cases operating hours were much lower than those used in the standardized REO calculations.

Regulatory Waivers and Filing Variances

A retroactive waiver was filed and approved for this project (see Appendix D of the report).

The purpose of this waiver was to garner approval to use methods described in the Protocols, Table C-5 for industrial end uses for impact measurement for the pre-1998 Commercial Process Program first year study.

There were no E-Table variances.

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Process End Use: PG&E Study ID #404C

FINAL REPORT

Prepared for

Pacific Gas and Electric Company
San Francisco, California

Prepared by

XENERGY Inc.
Oakland, California

March 1, 2000

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E EXECUTIVE SUMMARY

This report presents results for the impact evaluation of Process measures covered in Pacific Gas and Electric's (PG&E's) Pre-1998 Commercial Energy Efficiency Incentives (CEEI) Program Carry-Over. The programs include the Retrofit Efficiency Options (REO) Program and the Advanced Performance Options (APO) Program, offered from 1994 to 1997.

Both gross and net Program impacts were developed for electric consumption (kWh), electric demand (kW), and natural gas consumption (therms). The evaluation approach was designed to meet the requirements of the Measurement and Evaluation (M&E) Protocols[1]. Site-specific engineering estimates of energy impacts for a sample of Program participants were utilized to determine gross impacts. Where applicable, short-term metering and monitoring were used to support the analyses. A census of Program projects were included in the analysis. Net-to-gross (NTG) ratios were developed from customer self-report data and were applied to gross impacts to determine net Program impacts.

E.1 BACKGROUND

In past years, PG&E has offered rebates to customers who adopt energy-efficiency measures to reduce energy consumption and demand. In 1998, a total of 19 customer projects targeting the commercial process end use were paid rebates through the pre-1998 REO and APO programs. Table E-1 shows a breakdown of ex ante impacts by program. Measures installed through these programs included adjustable speed drive motor controls, compressed air systems, energy efficient motors, process controls, and process heat recovery systems. The goal of the evaluation was to determine the load impacts associated with PG&E's investment in these programs in a manner consistent with the M&E Protocols.

Table E-1
Ex Ante Impacts by Program

Program	Gross kWh	%	Gross kW	%	Gross Therms	%	Avoided Costs	%
APO	4,585,861	69%	600	71%	215,558	100%	$2,547,113	76%
REO	2,096,020	31%	241	29%	0	0%	$809,599	24%
Total	6,681,881	100%	841	100%	215,558	100%	$3,356,713	100%

[1] Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings for Demand-Side Management Programs, as adopted by California Public Utilities Commission Decision 93-05-063, revised March 1998.

E.2 METHODOLOGY

The impact evaluation utilized calibrated engineering analysis to determine gross impacts. Net impacts were derived using the gross impact estimates and NTG ratios that were estimated using a customer self-report method. This approach is consistent with methods outlined in the M&E Protocols for process end-use projects. Because the commercial process end use has similar characteristics to the industrial process end use, PG&E requested and received a waiver to use methods for industrial end uses for this evaluation project (see Appendix D). These methods are described in the M&E Protocols, Table C-5.

Project-specific analyses were developed for a census of program projects. Analyses were supported by on-site data collection for each project, and a project-specific report was developed for each of the 19 studied projects. A summary of the sample disposition is provided in Table E-2.

Table E-2
Process Projects Included in the Evaluation

	Number of Projects	Number of Customers
Total Projects	19	16
Projects Analyzed for Gross Impacts	19	16
Projects in Net-to-Gross Analysis	17	14

As shown in Table E-2, a standardized NTG survey was administered for all but 2 of the projects. One of the excluded projects had zero gross impacts, so the NTG analysis wasn't required; the decision-maker for the second excluded project had left the organization, and an informed associate could not be located. A scoring algorithm was applied to this survey to develop NTG ratios for each project.

In addition, each relevant project received a customized follow-up NTG analysis. The customized analysis built upon the standardized NTG approach and included information from project files, additional customer interviews, vendor interviews, and PG&E Representative interviews. The goal of the customized NTG analysis was to provide the best possible NTG ratio for each project by incorporating data from multiple sources, resolving inconsistencies among sources, and providing a narrative documenting the assigned project NTG ratio.

E.3 KEY FINDINGS

Ex post evaluation estimates of Program Impacts, relative to ex ante estimates, are summarized in Table E-3. Overall, net Program savings are estimated to be 369 kW, 2,467,472 kWh, and 195,032 therms on an annual basis. Approximately 58% of PG&E's ex ante net kW savings, 49% of the ex ante net kWh savings, and 121% of the ex ante net therm savings are being realized. Ninety percent confidence intervals are ±1% for net kW and kWh impacts and ±0% for net therm impacts.

Table E-3
PG&E 1997 Industrial Energy Efficiency Incentives Programs
Summary of Evaluation Gross and Net Load Impacts
Process End Use

	Gross Savings	Gross Realization Rate	Net-To-Gross		Net Savings	Net Realization Rate
			1-FR*	SO*		
EX ANTE						
kW	841		0.75	-	631	
kWh	6,681,881		0.75	-	5,011,411	
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EX POST						
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kWh	3,858,481	0.577	0.64	0.0000	2,467,472	0.492
Therms	226,812	1.052	0.86	0.0000	195,032	1.206

* FR: free-ridership rate; SO: spillover rate

Table E-4 summarizes gross realization rates for the analyzed projects. As the table shows, a majority of the electric projects have realization rates outside the 0.70 to 1.30 range, which indicates that the ex post results were often in disagreement with the ex ante estimates. In the majority of cases, projects that fell outside the 0.70 to 1.30 range tended to have low realization rates.

Table E-4
Distribution of Gross Realization Rates

Gross Realization Rate	Number of Projects					
	kWh	% Projects	kW	% Projects	Therms	% Projects
> 1.30	2	11%	4	25%	0	0%
0.70 - 1.30	6	33%	3	19%	3	75%
< 0.70	10	56%	9	56%	1	25%
Totals	18	100%	16	100%	4	100%

Key reasons for gross impact discrepancies include:

- Measures Not in Place: For one wastewater treatment project, equipment that was disconnected as part of the project was reinitiated when performance of the post-retrofit system didn't meet expectations. For a duct insulation project, the length of insulated ducts was less than expected.
- Equipment/system performance that was different from projections: This factor involves equipment not performing as expected—such as when a motor's operational efficiency falls below its rated efficiency. The largest performance discrepancies involved an aeration mixing system installed at a wastewater treatment plant. The measured performance of the system was less efficient than expected: mixers ran more frequently and drew more load than predicted.
- Different operating conditions: Equipment is often operated in a manner that is different from the ex ante predictions. For example, production hours or rates are constantly changing.

This was the biggest factor contributing to discrepancies between ex ante estimates and ex post results. Significantly different conditions were observed for most of the REO Program projects. Generally, the projects involved motors that were retrofitted with adjustable speed drives. In most cases operating hours were much lower than those used in the standardized REO calculations. Table E-5 shows that the REO Program realization rates were much lower than APO Program realization rates, mostly as a result of the lower operating conditions.

Table E-5
APO Program and REO Program Realization Rates

	Realization Rate	
	APO	REO
Annual kWh	0.73	0.24
Summer On-peak kW	0.87	0.25
Annual Therms	1.05	-

Operating hours and/or hourly profiles differed for a number of APO projects as well, albeit to a lesser extent. In one case, ambient temperature conditions were determined to be different than those used in the ex ante estimates.

- Base case differences: The ex ante base case was accepted for most projects. The primary exception was for a compressor project where the ex ante analysis utilized an older compressor for the base case, but the evaluation determined that the new compressor system served entirely different loads than the older compressor (which had been replaced by two non-rebate compressors). For several REO projects savings were based on the conversion of "throttling valve" controls to VFDs, but the evaluation determined that the pre-retrofit control equipment was an ASD.
- Methodology differences: In several cases, the ex ante kW impact estimates were based on the difference in connected or maximum load, while the evaluation estimates were based on the difference in loads that were expected to occur at the time of the system peak. In one REO project, the VFD savings methodology was inappropriately applied to three pumps that were set up in a redundant system such that the program guidelines indicate only one-pump should be rebated.

Table E-6 presents the distribution of NTG ratios for the process projects. A majority of projects are in the 0.30 - 0.70 NTG ratios range, reflecting the fact that many customers were uncertain about what they would have done in the absence of the PG&E programs.

Table E-6
Distribution of Net-to-Gross Ratios

NTGR Range	# Projects	% Projects
1.00	1	6%
0.71-0.99	5	29%
0.30-0.70	8	47%
0.01-0.29	0	0%
0.00	3	18%

1 INTRODUCTION

In past years, Pacific Gas and Electric Company (PG&E) has offered rebates to customers who adopt energy-efficiency measures to reduce energy consumption and demand. The focus of this evaluation is on Commercial sector energy efficiency projects directed at the Process end use prior to 1998. In 1998, PG&E paid rebates on a total of 19 Commercial Process projects committed under the Retrofit Efficiency Options (REO) and Advanced Performance Options (APO) Programs that were offered from 1994 to 1997. The research documented in this report was undertaken to determine the ex post gross and net energy and demand impacts associated with these 19 projects.

1.1 REBATE PROGRAM DESCRIPTIONS

The two rebate programs covered by this evaluation are summarized below.

1.1.1 Retrofit Efficiency Options (REO)

This program offered incentives to nonresidential customers who install specific energy efficiency measures not included in PG&E's other prescriptive rebate program, the Retrofit Express Program. Cash incentives could range from a minimum of $250 to a maximum of $100,000.

The REO Program was designed to provide a prescriptive path for relatively complex measures where energy performance is determined largely by response to variables such as production, weather, and hours of operation. The REO program was relatively narrow in scope, covering only those items where reasonable simplifying assumptions could be made. The two commercial process measures rebated during 1998 both involved variable frequency drive (VFD) controls for water pumping motors.

1.1.2 Advanced Performance Options (APO)

This program offered financial incentives of $125/kW, $0.06/kWh, and $0.20/therm of first-year energy savings to customers undertaking large or complex projects not covered under other PG&E programs. These customers worked with their PG&E Customer Representative to identify potentially viable projects. PG&E was then responsible for calculating energy savings, which was often accomplished by using energy consultants. Maximum total incentive amounts for the APO Program were $500,000 per account. The minimum qualifying incentive amount was $5,000 per project.

1.2 PROJECT OVERVIEW

1.2.1 Evaluation Objectives

The primary objectives of the impact evaluation are to:

- Determine estimates of the gross and net impacts (kW, kWh, and therms) resulting from commercial process measures installed through PG&E's pre-1998 incentive programs and rebated during 1998;
- Identify any discrepancies between estimated and measured impacts at the measure level and the end-use level;
- Suggest reasons for such discrepancies, such as differences between planning assumptions and what is found on-site for factors such as number of measures installed, connected load, and hours of operation;
- Conduct all analyses in a manner consistent with the California M&E Protocols; and
- Provide complete project documentation and databases required for regulatory replication of the study.

1.2.2 Evaluation Approach

The evaluation approach was designed to meet the requirements of the M&E Protocols for Process end-use energy efficiency projects. Site-specific engineering estimates of energy impacts for a census of Program participants were utilized to determine gross impacts. Where applicable, short-term metering and monitoring were used to support the analyses. Customer production and metering data was also used.

Net-to-gross ratios (NTGRs) were developed from customer self-report data and were applied to gross impacts to determine net Program impacts. All customer project contacts were targeted for both standard and custom NTG surveys. A scoring algorithm was used to establish NTGRs for each project based on the standard survey results. A follow-up customized survey and analysis were implemented to refine the initial NTGRs.

1.3 REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 discusses the evaluation methodology. The study design, analysis methods, and data collection procedures are described.
- Section 3 presents evaluation results. Gross and net impacts are presented and discussed.
- Appendices include: (A) site-specific evaluation results, (B) sample data collection forms, (C) site report template, (D) waiver to apply industrial evaluation methods to the commercial process end use, (E) M&E Protocols Tables 6 and 7, and (F) a description of the evaluation database.

2 METHODOLOGY

This section describes the methodology used for this study. First, the study design is presented. Second, gross impact analysis methods are discussed. Third, net impact calculation methods are described. Finally, the project data collection approach is presented.

2.1 STUDY DESIGN

The impact evaluation focused on the Process end-use components of PG&E's Pre-1998 Commercial Program Carry-Over. Project-specific analyses were utilized to estimate gross and net impacts for a census of projects. Gross impacts were developed using an engineering approach, supported when appropriate by short-term metering.

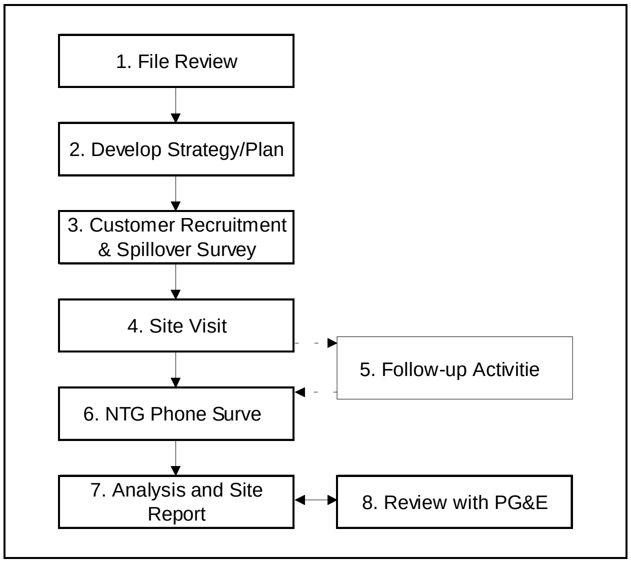
Net impacts were estimated for each project by combining gross savings results with net-to-gross ratios (NTGRs). The NTGRs were developed on a project-specific basis. A standard net-to-gross (NTG) survey was administered to participants for all but two studied projects. (For one project, the customer decision-maker was no longer with the organization, and an informed associate was not available. The other project had zero gross savings and a NTGR was not required.) A scoring algorithm was applied to this survey to develop NTGRs for each project. In addition, a follow-up customized NTG analysis was conducted. The customized analysis built upon the standardized NTG approach and included information from project files and additional interviews with customers, vendors, and PG&E representatives.

The evaluation approach is consistent with methods outlined in the M&E Protocols for process end-use projects. Because the commercial process end use has similar characteristics to the industrial process end use, PG&E requested and received a waiver (Appendix D) to use methods described in the Protocols, Table C-5 for industrial end uses for this evaluation project.

2.1.1 Project Analysis Process

The focus of the impact evaluation was on the project analysis. Each project designated for analysis was approached in a similar fashion. Figure 2-1 presents a schematic of the analysis process; this process is described more completely below. Paths indicated with dotted lines in the figure show optional steps or steps that were not required for all projects.

Figure 2-1
Project Analysis Process



As diagrammed above, the project analysis process consisted of the following steps:

1. Review program files. Project technical files and support documentation provided useful information on the measure scope, equipment efficiency assumptions, operation conditions, and base case assumptions. This information was usually sufficient to develop an initial measurement plan without a customer site visit. Key technical data and free-ridership information were extracted from the files.
2. Develop an initial evaluation strategy/plan. The strategy included overall analytical approach, data collection activities (and instruments), and, where necessary, a proposed monitoring plan. The goal of the strategy was to leverage the initial analysis conducted for program approval by identifying and verifying key assumptions through surveys, modeling, and monitoring.
3. Contact the customer to recruit participation, identify potential spillover, develop a preliminary understanding of data availability, and access for monitoring, as well as tentatively schedule site activities. Request that logs or other operating information be retained for use in the evaluation. Adjust the evaluation plan as necessary.
4. Implement data collection activities. Conduct on-site surveys, perform measurements, and install monitoring equipment as needed.
5. If necessary, return to the site to remove monitoring equipment. Conduct other follow-up activities, as necessary. (If measures were not in place, PG&E representatives were contacted to investigate further.)
6. Conduct necessary NTG telephone interviews of the appropriate decision makers. Interviews may have included additional customer staff, vendors, and/or PG&E reps.

7. Carry out analyses and prepare a site report. A discrepancy analysis with tracking system estimates and assumptions is included in the site report.
8. Review site report and results with PG&E. PG&E representatives reviewed all site reports and provided comments and questions. This input was then integrated into final site reports.

2.1.2 Site Evaluation Reports

A concise site report was prepared documenting the evaluation analysis, summarizing and documenting the gross savings results, explaining any discrepancies and discussing the net-to-gross findings. The report includes a table that summarizes the key annual and time-of-use impact results for each rebated measure. Individual site results typically included both a text document and supporting data and analysis, usually in the form of an Excel spreadsheet. The raw and reduced site data, the analytical model input and output, and the analysis results are provided as attachments to the final site evaluation report in electronic format. A site-specific evaluation report template is provided in the appendices. Attributes of the site reports include:

- Consistent format
- Summary of evaluation results vs. PG&E's ex ante estimates
- Categorical explanation of discrepancies
- Detailed description of the energy efficiency project, including pre-retrofit and post-retrofit equipment
- Summary of the ex ante methodology and calculations
- Full documentation of the ex post analysis approach and calculations, including a separate discussion of the base case technology and operating conditions determined for the analysis
- Findings of the net-to-gross analysis
- Appendices containing relevant data collected during the study

2.1.3 Projects Included in the Evaluation

Table 2-1 summarizes the Process projects included in the evaluation. Overall 19 projects involving 16 customers were analyzed. This was a census of available projects. All but two of these projects were included in the net-to-gross analysis. One of the excluded projects had zero gross impacts, so the net-to-gross analysis wasn't required; the decision-maker for the second excluded project had left the organization.

Table 2-1
Process Projects Included in the Evaluation

	Number of Projects	Number of Customers
Total Projects	19	16
Projects Analyzed for Gross Impacts	19	16
Projects in Net-to-Gross Analysis	17	14

2.2 GROSS MEASURE SAVINGS METHODOLOGY

Gross measure savings were developed on a project-specific (and measure-specific) basis for each site in the study. The process projects are, by definition, specialized and unique so the engineering approach for calculating gross impacts varied for each project and site. Data requirements and sources of data varied depending on the technology, complexity of the process, the nature of the site, and the degree of support and cooperation of the customer. General principles analysis techniques utilized for the process analyses are discussed next followed by a summary of the analysis approaches used for developing gross impacts for the largest projects.

2.2.1 Principles

This section discusses general issues and principles which were used in the project-specific analyses of process measures. While engineering approaches and data collection requirements varied from site to site, there were certain common principles that were applied to evaluate these sites in assessing gross savings. These principles included the following:

Technical Validity: Evaluation analysis was based on strict adherence to engineering principles and the underlying laws of electricity and physics. All methods used accepted engineering techniques. Sources of the methods used and documentation supporting their validity were provided as part of the site reports. Any models used were based on accepted, equipment-specific or system-specific, engineering calculation methods (ASHRAE, AIEEE, ASME, ARI, etc.) using algorithms that are accepted by industry, utility groups, and regulatory bodies.

The PG&E project files included an engineering analysis which was reviewed during the site planning process. When possible, the same methodology was utilized in the evaluation, while verifying key engineering model inputs during the on-site surveys. Alternate methods were used when the PG&E method was deemed not appropriate or when availability of site data supported a more accurate methodology. Use of a consistent method helped to facilitate the explanation of discrepancies between the PG&E project impact estimates and the evaluation results.

Base Case Identification: The base case selection is usually crucial to the evaluation result. Many times, the base case selected can have a greater influence on the evaluation result than the performance of the systems that are modified. The base case for each measure was thoroughly documented and clearly presented in each site report. For most process sites in the project-specific analysis sample for this evaluation, the base case consisted of the *pre*-project equipment or system performance, operating under verified *post*-project operating conditions and service levels. The basic principles of base case specification included the following:

1. Title 20/24 does not apply to any of the process measures being evaluated. A hypothetical "Code" base case was not an issue.
2. When the process measure consisted of a process modification that changed the system completely, the pre-project system configuration was used as the base case. Information regarding the other benefits and motivations for the project were noted in the project review file for the customized free-ridership analysis.

3. When a direct replacement occurred, the evaluation attempted to make a determination of the age and state of repair of the equipment that was replaced. Customer interviews regarding the remaining useful life of the retrofitted equipment were incorporated into this determination. If the equipment that was replaced was at the end of its effective service life, then the base case was defined as a "standard" system that represents the "typical current industry practice." Where the PG&E project file provides an incremental cost, the standard system used as the base case was defined as the equipment or system which could have been purchased for the incremental amount below the total project identified in the project file.
4. An attempt was made to adjust impacts for level of service or production output for all process measures. This analysis was carried out with reference to the principles expressed in the "Quality Assurance Guidelines and Self-Report Methods for Estimating DSM Program Impacts" (California DSM Measurement Advisory Committee (CADMAC) Study 2001M, April 1998). Customers were asked to provide information indicating the level of production before and after the measure implementation. When such information was available, an attempt was made to adjust results to reflect production changes on impact in accordance with the principles of Section 3.4 of CADMAC 2001M. Customer interviews were used to assess whether or not the rebate was directly responsible for changes in production. If the rebate was responsible for production changes, then pre-retrofit production levels were used in the impact assessment. Otherwise, post-retrofit production levels were utilized.
5. Adjustments for level of service were based on *actual* production output rather than *rated* equipment output.

Power Measurements: On-site monitoring and measurements were carried out in accord with procedures recommended in PG&E/CADMAC Document "Development of Statewide Metering/Monitoring Protocols: Monitoring Protocols" (May 1994) and with reference to the "NAESCO Standard for Measurement of Energy Savings for Electric Utility Demand-Side Management Projects" (November 1993).

Most site-specific evaluations required measurement of key equipment operating and performance parameters to support analysis—unless suitable data were available from the customer monitoring or operating logs. Direct measure of true RMS power was used whenever possible, consistent with the project budget and the availability of equipment. When equipment was not available, amperage was measured as a surrogate and power calculated from the amperage measurements. When amperage was monitored, spot readings of voltage and power factor were taken within the range of amperage readings to ensure that power factor was properly considered in the power calculation.

Load Measurements: Data necessary to calculate output loads were measured to allow assessment of equipment performance when individual equipment efficiency or performance was a key aspect of the evaluation strategy. Where possible and practical within the analysis budget, loads were calculated from measured parameters rather than using manufacturer's performance curves. If load data could not be measured with reasonable accuracy, manufacturer's performance curves were used to develop the evaluation output load profile for the equipment.

Annualization of Results: The Protocols call for evaluations to identify first-year project savings. Results for all measures were annualized to a representative annual period. All results and impacts were normalized to a "typical" operating year. An annualization methodology was identified in each site specific evaluation report. The methodology identified the method and algorithms used to extrapolate the monitoring period results to annual results. Daily, weekly, monthly, and seasonal variances in production, weather, and operating schedule were considered in developing the annualization strategy. Whenever possible, hourly data were used to calculate the first year savings. When hourly data were not available, an annualization strategy was developed and described in the evaluation report. The strategy attempted to use actual hours of system operation for each seasonal period if such data were available. When hours were not available, customer interviews indicating relative intensity of operations over the annual period were used. Where possible, secondary data such as shift hours, production units, man hours, etc. were used to indicate seasonal variations in operations (and hence energy impacts).

Program measures at several analysis sites involved technology applications that are affected by ambient weather conditions. For these measures, pre-project and post-project energy use were related to ambient conditions. The results were then extrapolated to an annual period by relating the impacts to the appropriate "typical meteorological year" (TMY) weather data for the weather station deemed most representative for the customer location.

Time Period Aggregation of Impacts: The annual results were aggregated into PG&E's five time-of-use periods. Generally, impacts were calculated for 8760 annual hours using a weather or loading/performance file for each operating hour of the year. The time-of-use period impacts were then aggregated by summation of hourly impacts into the appropriate PG&E time-of-use periods. If daily and weekly or seasonal operating patterns could not be clearly distinguished, a rational means based on customer estimates of relative operating intensity was developed. The method is described in the specific evaluation report for each site.

2.2.2 General Analytical Technique

This section describes the general analytical approach used for Process analysis sites. In general, the procedure identified an hourly load profile and system performance for the monitoring period. The performance for the monitoring period was related to an independent variable by which the monitoring period impacts could be annualized. If annual data were available from customer records or logs, these data were used as the basis for the annual impact results. Once the hourly results were determined, they were summarized and aggregated into the PG&E time-of-use periods. The major steps of this approach are described in further detail below.

1. Measure Energy Input Profile for Evaluation Period: The actual system energy use (or power) each hour comprises the unadjusted post-project power and energy use. An equipment submeter which records actual kW or parameters from which input power may be calculated, such as % full load, amps, etc., was used as documentation of the post-project energy use. For items where measurement of the rate of energy or fuel input was not appropriate or was impractical, measurements of parameters that provide a secondary indication of power and energy input were used.

2. Measure System Load Profile for Evaluation Period: The equipment or system loading or output for the period was calculated using measured operating factors whenever possible. Loading might be expressed as chiller tons, compressed air flow (at a given pressure), water flow rate (pump output), etc. (Note: Loading was calculated directly from measured operating parameters or "backed into" using known manufacturer's operating performance from equipment submittals, etc.) For example, fan air flow (cfm) may be calculated using monitored fan kW and manufacturer's previously measured cfm/kW. If these variables are not known, the system output for the monitoring period may be developed from the manufacturer's performance curves for the equipment. In the absence of data, the customer was asked to estimate the relative output of the system at various power input levels, or an engineering estimate based on typical performance for the type and configuration of equipment was made by the evaluation engineer.

3. Identify System Performance Profile for Evaluation Period: The operating efficacy was calculated by dividing the input energy developed in Step 1 by the output identified in Step 2.

4. Identify Profile of Key Operating Variable(s): Key variables that affect system load and performance and which are known or can be estimated with reasonable confidence were identified. Functional relationships of the system loading and performance to the key variables were then identified. For the projects in the sample group, these variables are described below:

a. Compressors: Air demand profile and operating schedule, air flow rates and pressure at various demand levels

b. Conveyors and Process Drive Systems: Mass flow rates for solids and process fluids, speed and torque profile for rotating machinery

c. Variable Speed Drives on Fans/Pumps: Ambient temperature, process cooling requirements, and fluid flow rates and pressures, operating schedule

d. Thermal Process Projects: Mass flow rates, specific heat or other thermodynamic properties of primary and secondary fluids, and secondary process stream impacts (operating schedule is constant)

5. Extrapolation to Annual Period: The extrapolation to the annual period which is representative of the "first-year savings" was performed by extrapolating the base case and post-installation energy use measured during the monitoring period using the functional relationships defined in the previous step. Attempts were made to assess the degree of relationship and confidence level of the relationship through standard statistical techniques. Relationships with a low confidence level were not used or suitable justification for their use was provided in the site reports. If no relationship was identified between system performance/load and annualizing variable, then a simple load-duration profile (i.e., direct time at various levels of load), average loads, or a production output relationship defined in consultation with the customer was used. For projects whose impacts were determined to be significantly related to weather, the impacts were extrapolated to annual period using TMY data for the nearest or most representative weather station.

2.2.3 Site-Specific Analyses

Site-specific analysis approaches for the largest process analysis projects are outlined in Table 2-2 on the next page.

2.2.4 Program-Level Gross Impact

Since a census of projects was completed, program-level gross impacts were simply the sum of the project-specific gross impacts.

2.3 NET PROGRAM SAVINGS METHODOLOGY

Net program savings were developed by applying NTGRs to gross program impacts. The NTGRs were developed at the project level and then expanded to the program population using appropriate statistical techniques. Two levels of analysis were used to assign project-level NTGRs: first, a standard NTG analysis, using survey data collected at the time of the site visit, was applied to all projects ; second, a customized NTG analysis, utilizing information from a follow-up telephone survey, built upon the standard NTG analysis to better characterize project decision making.

2.3.1 Project Analyses

The standard and custom project-specific NTG analyses are discussed next.

Standard NTG Analysis

In the standard project-specific NTG analysis, customer surveys were used to develop NTG probabilities. Multiple choice survey questions were used to divide into distinct categories customers' stated intentions regarding measure installation. For each category, a probability that the program caused the action is assigned. For example, a probability of 0.8 would indicate there is an 80% probability that the program was responsible for the customer's action. In addition, the program could be given credit for accelerating energy efficiency purchases and promoting higher efficiency measures for customers who indicate they would have installed some measures anyway. The probabilities are interpreted as the project-specific NTGRs.

Initial Ratios

The "stated intentions" question (Question C7 of the standard NTG survey included in Appendix B) was used to derive initial NTGRs for each surveyed facility and technology, based on what respondents state they would have done in the absence of the PG&E Program. Table 2-3 shows how the initial ratios were calculated. NTGR #1 is a simple zero/one determination depending on whether or not the customer was likely to install measures without the PG&E incentive.

Table 2-2
Site-Specific Process Analysis Approaches

Cntl #	Appl. Code	Prog	Ex Ante Gross kWh	kW	Therms	Measure Descriptions (Evaluation)	Evaluation Approach
0264206	AVT1005	APO	62,310	10.0	0	Replace 3-25 hp pumps with 3-10 hp efficiency pumps.	Engineering calculation supported by spot volt amp meas. Base case calculated using post and rated pre-retrofit pump and motor
0494637	ATK6014	APO	0	0.0	83,957	Install dampers & controls to recirculate air in raisin drying ovens.	Engineering calculation using ex ante updated for observed operating profile and weather data.
0721869	AJQ0003	APO	176,033	106.0	0	Replace 1 250 hp air compressor with 1-50 and 3-25 hp compressors and	Base case determined to be identical to postcase - further analysis
0905080	AXT0026	APO	105,860	0.0	116,462	Replace 1 dryer and 2 moisture extractors HE units.	Engineering analysis using load profiles with monitoring and rated equipment
0954126	ENR7723	REO	434,070	50.4	0	Install VFDs on 11 water pumps.	Engineering calculations using spot measurements and on daily flow and pump records; base case used EPRI part load curves.
1016273	AJN1011	APO	208,387	74.3	0	Replace 2-100 hp pumps and 1-25 hp with 4-20 hp pumps w/HE motors and	Engineering analysis with monitoring of pump vs. water flow; base case fit to postcase profile manufacturer's performance curves.
1113940	EVT2050	REO	310,050	36.0	0	Install VFDs on 3-75 hp	Engineering analysis with monitoring of pump basecase fit to postcase profile using curves.
3900088	EVT2051	REO	137,800	16.0	0	Install a VFD on one 100 hp	Engineering analysis with monitoring of pump basecase fit to postcase profile using curves.
3912667	EVT2049	REO	137,800	16.0	0	Install a VFD on one 100 hp	Engineering analysis with monitoring of pump basecase fit to postcase profile using curves.
4245782	ABT1008	APO	303,769	0.0	0	Replace 6 air motors with electric motors.	Engineering calculations based on monitoring of compressors and nameplate data for electric
4305676	EJG3188	REO	876,000	100.0	0	Install HE motors and VFDs on 2-100 hp and 400 hp sewage pumps.	Billing analysis - comparison of pre and post use - normalized by production (flow).
4348634	ERN7106	REO	68,900	8.0	0	Install VFDs on 2-25 hp recycled water	Engineering analysis with monitoring of pump basecase calculated for constant speed
4698012	ATR6047	APO	933,159	141.0	0	Replace 5-75 hp mechanical aerators with 75 hp biomixer aeration mixing systems.	Engineering analysis with post retrofit compared against pre-retrofit constant-speed running under programmed timing
4741313	ANY7025	APO	432,105	19.7	0	Install VFD's on 4-125 hp recycled water pumps	Engineering analysis using customer power and data; basecase fit to postcase profile using pre-control strategy.
4741313	ENY7026	REO	131,400	15.0	0	Install VFD's on 3-50 hp sewage	Engineering analysis using customer power and data; basecase fit to postcase profile efficiency estimates.
5844090	ATK6023	APO	0	0.0	15,139	Insulate cotton gin dryer/conveyor	Engineering heat loss
6151420	ABM0010	APO	1,208,817	139.5	0	Install 1-150 hp blower and controls to 3-250 hp blowers; install VFDs on 2-50 sludge recirculation pumps.	Engineering analysis utilizing billed kWh customer flow records; VFD analysis based on postcase and basecase part load
6398135	ATK6009	APO	224,671	21.0	0	Install 1-150 hp pump/motor/VFD to replace 150 hp wound-rotor-motor-driven	Engineering analysis based on post-retrofit profile (via monitoring); basecase fit to profile using pre-retrofit measured
6467854	ATN6031	APO	930,750	88.1	0	Install sensors, controls, revise valves, piping to combine 2 wastewater facilities.	Engineering comparison of post-retrofit (monitoring) and pre-retrofit operations inteviews and power

NTGR #2 allows for a variation in the NTG score depending upon how certain the customer was about their decision to install measures. NTGR #2 was used for the final calculations, and NTGR #1 was calculated as a cross-check on how the intermediate values in NTGR #2 affect the score.

Table 2-3
Net-to-Gross Ratio Assignments Based on Participants' Stated Intentions

Install measures without Program? (Question C7)	NTGR #1	NTGR #2
Definitely would not install without Program	1.0	1.0
Probably would not install without Program	1.0	0.7
Probably would install without Program	0.0	0.3
Definitely would install without Program	0.0	0.0

For customers who indicated that they would "probably install" or "probably not install" the same measures without the program, an additional question (C7a) was asked to assess the likelihood, on a zero to ten scale, that they would have installed the same measures without the program. This question provided additional information to modify NTGR #2 in cases where the customer is not certain about what their actions would have been without the program.

Consistency Checks

Next, consistency checks were used to limit the NTG probabilities when respondents' answers appeared to be inconsistent. Table 2-4 outlines the consistency checks used to adjust NTG probabilities. These checks were based on customers' responses to questions relating to sources of energy efficiency information, steps in the decision process, and significance of the PG&E Program in influencing customer decisions.

Table 2-4
Consistency Checks

Check	Survey Question	Consistency Check	Assigned Probability Limit
1	C2	If customer first heard of efficient technologies from PG&E	Minimum of 0.5
2	C5	If customer had already been planning to purchase the measures before hearing about the Program	Maximum of 0.5
3	C6	If the Program was rated extremely significant in customer's decision to install energy efficiency measures	Minimum of 0.85
4	C6	If the Program was rated very significant in customer's decision to install energy efficiency measures	Minimum of 0.7
5	C6	If the Program was rated somewhat significant in customer's decision to install DSM measures	Minimum of 0.5
6	C6	If the Program was rated insignificant in customer's decision to install DSM measures	Maximum of 0.3

Check #1 provides some NTG credit to PG&E for informing the customer about the energy efficiency measure. There is at least some doubt about whether or not the measures would have been installed if the customer had not learned about them from PG&E. Check #2 limits the NTGR to a maximum of 0.5 if customer first heard about the PG&E Program after planning to purchase specific measures. The limit is not set to zero in this case because purchase plans are not always implemented.

Checks #3 - #6 limit the NTGRs based on the significance of the Program on the customer's decision to install measures (as determined in Question C6 of the standard survey). If the Program was "extremely significant," the NTGR *minimum* is set at 0.85, which is halfway between the "definitely would not install" and "probably would not install" probabilities shown in Table 2-3. A "very significant" rating equates to a *minimum* "probably would not install" NTGR of 0.7 in Table 2-3. A "somewhat significant" rating is equated to a *minimum* NTG probability of 0.5 which gives the PG&E Program partial credit for the measure installation. Finally, an "insignificant" rating limits the NTG probability to a *maximum* of 0.3, consistent with a "probably would install anyway" assignment in Table 2-3.

Assessing Partial Free-ridership

Partial free-ridership occurs when, in the absence of the Program, the customer would have installed equipment that is more efficient than was assumed for the baseline efficiency but not as efficient as the equipment that was actually installed as a result of the Program. To address partial free-ridership in the standard NTG analysis, an additional benefit or penalty was added to the initial NTGRs based on what the customer said they would have installed without the Program.

Customers who were likely to have installed measures anyway without the Program are asked if the nonprogram equipment would have been as energy efficient as the equipment that was actually installed under the Program (Question C8 of the standard NTG survey). If the customer indicated the equipment would not have been as efficient, the initial NTGR was incremented by 0.2 to give the Program some credit for increasing the customer's energy efficiency.

Customers who were not likely to have installed measures anyway without the Program are asked if the equipment they otherwise would have installed would have been of standard efficiency or some intermediate level of efficiency (Question C9 of the survey). If the customer indicated the equipment would have been of intermediate efficiency, the initial NTGR was decreased by 0.2 to account for the fact that the gross savings estimate, which is based on standard efficiencies, overstates impacts that would have occurred without the Program. Table 2-5 summarizes the adjusted NTGR assignments after accounting for partial free-ridership.

Table 2-5
Adjusted NTGRs Based on Efficiency of Nonprogram Equipment That Would Have Been Installed Without the Program

Install measures without Program? (Question C7)	NTGR #2 from Table 2-2	Efficiency of nonprogram equipment that would have been installed (Qs C8 & C9)	Adjusted NTGR
Definitely would not install without Program	1.0	Standard efficiency	1.0
		Above-standard efficiency	0.8
Probably would not install without Program	0.7	Standard efficiency	0.7
		Above-standard efficiency	0.5
Probably would install without Program	0.3	Not as efficient as Program equipment	0.5
		As efficient as Program equipment	0.3
Definitely would install without Program	0.0	Not as efficient as Program equipment	0.2
		As efficient as Program equipment	0.0

The choice of an increment/decrement of ±0.2 to address partial free-ridership was made for the following reasons:

- The adjustment provides for a fairly smooth progression in the adjusted NTGR based on a combination of the customer's initial stated intentions and the type of equipment they may have installed without the Program;
- The adjustment gives more weight to the "would not/would have installed" question (Question C7 of the survey) versus the "not as/as efficient" questions (Questions C8 and C9); this is preferable because, under the hypothetical situation the survey respondent is being put in, the "would not/would have installed" question is one level less abstract that the "not as/as efficient" questions; and
- For the largest Program projects that received custom NTG analyses, the issue of partial free-ridership was explicitly addressed by trying to determine the actual equipment that would have been installed without the Program.

Accounting for Deferred Free-ridership

Deferred free riders are those customers who would have installed equipment in the absence of the Program but would have installed it at a later date. Therefore, the Program is responsible for accelerating the installation of the energy efficient equipment.

For customers who indicated that they probably or definitely would have installed the same equipment without the program (question C7 equaling 3 or 4 and question C8 equaling 2), the possibility that the program may have accelerated their project was factored into the analysis. If the customer indicated that they would have, in the absence of the incentive, installed the equipment over a year later (question C10), a NTGR from the following forecast conversion table[1] was developed.

[1] Spanner, G., and Riewer, S., "The Energy Savings Plan: Incentives for Efficiency Improvements in the Industrial Sector." Proceedings of the ACEEE Summer Study. Washington D.C., 1990 pp. 7.251-7.260.

Table 2-6
Forecast Conversion

Forecast Installation of Same Equipment	Implied NTGR
Less than 1 year	0.00
1 to 2 years	0.25
2 to 3 years	0.50
3 to 4 years	0.75
4 or more years	1.00
Never	1.00

For the affected customers, the implied NTGR was averaged with the NTGR developed from the motivation questioning sequence to provide the standard NTGR.

Additional Survey Questions

A number of additional questions that are not directly factored into the NTGR calculations were included in the Standard NTG survey. The questions mainly involved customer satisfaction with the measures and the program, sources of customer knowledge about the program, and factors affecting the decision and timing of the measure installation. These questions were included to get the customer thinking about the decisions surrounding the measure installation and to serve as a warm-up for the customer prior to asking them the questions that directly affect the NTGRs.

Non-Responses and "Don't Know's"

The customer decision-maker for one project was no longer available, and it was not possible to field the NTG survey. The general approach for this sites was to drop them from the NTG analysis and to calculate the Program NTGRs using savings-weighted averages of customers who did complete the surveys (see the subsection below on calculating Program NTGRs).

Each site that was dropped from the NTG analysis due to non-response was reviewed to determine if the site should receive special treatment such as the assignment of a NTGR based on other sources such as discussions with customer operations staff, discussions with vendors, and/or reviews of project economics as contained in the hardcopy project files.

A number of NTG surveys were completed but contained "Don't Know" responses to analysis questions. In general, NTGRs were calculated for each survey where there was a legitimate response to either the "Program significance" question (Question C6 of the standard NTG survey) or the "what would have happened without the Program" question (Question C7). For this evaluation, all available customers responded to these core questions. Other survey questions were more auxiliary in nature and were not as central to the determination of free-ridership.

Custom NTG Analysis

The goals of the custom NTG analysis were to establish accurate project NTGRs, minimize uncertainty in the assigned NTGRs, and develop narratives documenting the justification for the assigned NTGR.

The custom NTG analysis was designed to build upon the information obtained in the standard NTG analysis. In preparation for custom NTG interviews with customers and vendors, data elements were carefully reviewed to identify key issues that could affect the NTG ratio. Sources of data included:

- The standard NTG surveys
- Project files
- Relevant material from the gross impact analysis

The custom NTG interviews were open-ended. Trained XENERGY analysts worked with the customer to establish an understanding of the project decision-making process and the role of the PG&E Program in that process. Issues that were considered in conducting the custom NTG interviews and analysis included:

- Where the customer got information on the technology (PG&E, vendor, other)
- Primary motivation for installation of the equipment (energy savings, production quality, retooling)
- Motivation for selection of the high-efficiency versus base equipment
- Perspectives of different players (engineer, CFO, plant manager)
- Influence from outside parties (ESCOs, contractors)
- Alternatives considered, past practices of the customer, project economics, non-energy benefits, project timing, project planning process, and project approval process

Inconsistencies identified during the standard NTG survey analysis (i.e., where the consistency checks are activated) and in various other data components (discussions with PG&E staff and vendors, project files, information obtained during the gross impact analysis) were isolated and explored. For example, during the standard NTG survey, some customers may have said the Program was significant in their decision to install measures but also have said they would have installed measures without the Program. During the follow-up NTG interview, the customer would be asked to clarify or revise these statements.

In conducting the custom NTG analysis, the starting point was the result of the standard NTG analysis. If the information behind the standard NTG ratio was not contradicted or improved upon during the custom NTG analysis, the standard NTG ratio was used for a particular project. In cases where additional or different information was developed during the custom NTG analysis process, the standard NTG ratio was adjusted and the factors contributing to this adjustment were explained as part of the site report. In cases where the custom process simply provided better data for elements of the standard NTG survey, the standard NTG analysis was updated using the better data.

2.3.2 Program-Level Net Impacts

Program-level net impacts were developed separately for kWh, kW, and therms by applying project-specific net-to-gross ratios to project-specific impacts and then summing over all projects, as follows:

$$NI_A = \sum_{j \in A} I_j \times NTGR_j$$

where:

NI = Net impacts
I_j = Gross Impacts for project j (kWh, kW, or therms)
$NTGR_j$ = Net-to-gross ratio for project j

For the one project with non-zero impacts that didn't receive a net-to-gross analysis, the program-level weighted average net-to-gross ratio was used. Ex post impacts were used as the weights to develop separate kWh, kW, and therm net-to-gross ratios for this project.

2.4 Data Collection

This section presents a review of the data collection process employed for the evaluation, some data requirements specific to this project, a discussion of the data collection instruments, and surveyor training and safety considerations.

2.4.1 The Data Collection Process

The data collection process began with extraction of data from the program tracking system and PG&E billing system. Pertinent data for each site and project was isolated and reported in a consistent fashion for each study site. Key variables included site location, key contacts, measure descriptions and counts, ex ante savings estimates, project costs, rebate amounts, key dates, etc. For this exercise, data were loaded into a Microsoft Excel spreadsheet and linked electronically to site forms in Microsoft Word using "mail merge" techniques. (Some of the key data are contained on page 1 of the site reports shown in Appendix C.)

Next, a hardcopy project file review was conducted. This review built upon information developed from the tracking data extraction. For example, if multiple project contacts were available, they were added to the one contact that was extracted electronically. The file review was most important for the Process analysis sites where customized savings methodologies were presented.

After the file review was complete and a general understanding of each project was developed, PG&E Division Reps and other key PG&E staff were contacted as necessary to discuss the project and to develop a strategy for contacting the customer. Customer recruitment and administration of the spillover survey provided additional information.

Next, after completion of project-specific evaluation planning, the key data collection element of the gross impact portion of the study, the on-site survey, was conducted. Observation of equipment, necessary measurements, collection of customer-provided data, and interviews with the customer took place during the survey. All site data outlined in the evaluation plan were collected, if feasible, or alternative approaches for the evaluation were developed, based on facility logistics.

To complete the gross impact analysis for projects, it was sometimes necessary to contact vendors, equipment manufacturers, or other secondary sources. These telephone requests for information depended on project-specific circumstances.

Finally, the NTG follow-up interviews took place, as necessary. For smaller sites, it was usually possible to implement the standard NTG surveys during the on-site process. For larger sites customized NTG surveys necessitated at least one telephone call to a customer decision-maker.

2.4.2 Data Collection Requirements

Some of the key data collection requirements and associated issues are discussed next.

Project-Specific Analysis Sites

General Data Requirements:

For each different type of equipment and technology, the specific parameters that the PG&E estimates and evaluation of savings are based on varied. In general, the factors addressed in the evaluation included:

- Operating Schedule: daily, weekly, monthly, and seasonal
- Input Power vs. Output service level: full and part load
- System Efficiency: full and part load
- Control setpoints and control strategy
- Operating conditions (e.g., temperatures, pressures)
- Output rates and total output (e.g., gallons per minute and gallons, cubic feet per minute and total cubic feet at a given pressure, Btu's per hour and total Btu's of cooling)
- External loading factors (e.g., service level, weather)
- Equipment annual load profile

On-Site Monitoring and Measurement

On-site monitoring and measurement of key operating parameters were used where the methodology included site measurements as the most reliable, accurate and cost-effective means of identifying the true impacts, and where the customer agreed to allow it. The following instrumentation was used where appropriate. All of the listed devices have computer interfaces which allow downloading of data into an Excel or other useful format for graphic presentation or statistical analysis, and for permanent documentation:

- *Motor Time-of-Use Loggers*: Pacific Science & Technology
- *Power Monitoring/Logging*: Pacific Science & Technology "Elite"; Fluke; Summit PowerSight Energy Analyzer, PS3000, Power Logger
- *Current/Temperature Loggers*: ACR "Trend Reader"
- *Temperature Logging*: HOBO "Stow Away"

Data obtained by logging equipment were retained in Excel readable format. It is summarized or presented in truncated form in the site-specific analysis reports for the sample sites.

Data Sources and Data Collection Strategies

The evaluation focused on making maximum use of available resources and using as much easily and readily available customer information as possible at the site visits. Data sources that were used include:

- Focused interviews with customer operating management and line operating staff
- Customer measurements
- Customer data from SCADA or EMS systems
- Customer data from hand-written operating logs
- Plans, specifications, balancing or commissioning reports obtained from the customer or vendor
- Previous consultant studies and measurements
- Customer submetering or observations of submeters
- Spot measurements during site visit
- Short-term monitoring of input amps or power and key load parameters

A portion of the initial customer contact included a discussion of data available from the customer. The data requirements and the source of each data item are provided in the site-specific analysis plan for sampled sites.

Net-to-Gross Surveys

The NTG or Decision Analysis data collection script consisted of a series of questions designed to isolate the motivation for, and the timing of, equipment installations. To increase the probability that unbiased and accurate decision-related data were collected, the questions were designed to:

- Help the customer separate their current thoughts about the project from their decision process at the time of program participation;
- Prevent the customer from giving defensive or manipulated answers;
- Identify and justify apparent inconsistencies in respondents' answers;
- Ensure responses are obtained from a financial decision-maker or that such a person's opinion is at least taken into account; and

- Provide additional insight about the project decision-making, current satisfaction, and possible spillover 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 bias 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, respondents may recognize the purpose of the question, and give the answer they think will have the desired effect on the Program. An additional concern was that, while the main contact might have wanted to pursue the project even without PG&E incentives, the investment might not actually have been approved under these conditions. Thus, a part of the interview focused on identifying the key decision-maker who should address the net-to-gross issues.

2.4.3 Summary of Data Collection Instruments

Project data collection forms are contained in Appendix B. Following is a brief description of each form.

Recruitment and Spillover Survey

The recruitment form and spillover survey was utilized during the early customer contact process. The recruitment form was utilized to log initial attempts to contact the customer and provided an explanation if a customer did not wish to participate in the study.

The spillover survey was utilized to determine if participants had installed additional measures during the study period that: 1) are not included in PG&E rebate programs, and 2) can be shown to have been installed as a result (or partial result) of the PG&E program.

Process Equipment Surveys

Because of the diversity of projects in the process end use, a generic survey instrument would only capture some of the information required for the process analyses. The basic instrument was used to record verification/retention data and related factors. General plant scheduling and metering equipment identification was also collected on the standard form.

For process-specific data collection needs, a customized equipment-specific survey instrument was utilized, as appropriate. An example set of survey instruments, indicating the data that would be required for some of the equipment expected at the sample sites is included in Appendix B. These forms were modified to meet the specific site circumstances.

Net-to-Gross Surveys

The NTG survey instruments (standard and custom) were designed to collect key elements necessary to assess the impact of the PG&E program on customers' decisions to install energy efficiency measures, including:

- Identification of the primary decision-maker(s);
- Source of the customer's knowledge about the installed measures;
- Timing of the measure installation decision process relative to learning about the rebate program;
- Significance of the program in the decision to install efficient equipment;
- Whether the measures would have been installed without the program; and
- Whether the program affected the timing or the level of the measure installations.

The standard and custom NTG survey instruments were designed to collect similar information. The standard instrument is a multiple-choice style instrument while the custom instrument is open-ended. The custom instrument also contains questions that address project economics.

In addition, a vendor survey was used when it was established that the vendor was the entity primarily responsible for the decision to install the rebated measures. This determination was primarily made using data from the custom survey.

3 RESULTS

3.1 OVERVIEW

This section presents results of the impact evaluation of the Commercial Process portion of PG&E's Pre-1998 Energy Efficiency Incentives Program Carry-Over. Overall net electric energy impacts are estimated to be 2.5 GWh; net summer on-peak demand savings are estimated to be 369 kW; and net natural gas savings are estimated to be 0.2 million therms per year.

The following impact results are presented below:

- Gross Program savings; and
- Net-to-gross findings and Net Program savings.

3.2 GROSS PROGRAM SAVINGS

Gross savings estimates were based on detailed site-specific engineering analyses of a census of the Program sites. This section first presents overall results, followed by a more detailed discussion of results by program (APO and REO) and by measure. A discussion of discrepancies between ex ante estimates and ex post findings is also included. Finally, gross impacts by PG&E costing period are shown.

3.2.1 Program-Level Results

Table 3-1 presents aggregate energy and demand impacts and realization rates. As these numbers indicate, the projects affected by the PG&E programs are realizing about 58% of ex ante kWh savings, 70% of ex ante kW savings, and 105% of ex ante therm savings.

Table 3-1
Summary of Gross Impact Results

	Ex Ante Estimates	Ex Post Results	Realization Rate
Annual kWh	6,681,881	3,858,481	0.577
Summer On-peak kW	841	585	0.695
Annual Therms	215,558	226,812	1.052

The relatively low kWh realization rate is largely a result of several large prescriptive rebate (REO) projects that had operating conditions that were significantly different than the standardized REO methodology predicted. Summer on-peak kW savings for these same projects were also much lower than predicted; however, higher than expected kW savings for some other sites partially offset this shortfall resulting in a higher overall kW realization rate. Therm savings for the three largest gas projects were somewhat greater than expected, driving the therm realization rate above 1.0.

3.2.2 Results by Program

Overall, 19 projects involving 21 measures were rebated in 1998 and are included in the study. (Two projects involved the installation of 2 measures each.) Twelve of the 19 projects were rebated through the APO program, which provided customized ex ante impact calculations based on the project design. Seven projects were rebated through the REO program where ex ante impacts were based on standardized calculations that reflected only the type and size of equipment that was installed. As Table 3-2 shows, realization rates were much better for the APO program, where ex ante impacts reflect actual operating conditions at the site.

Table 3-2
Results by Program Type

Program	# of Projects		Ex Ante Estimates	Ex Post Results	Realization Rate
APO	12	Annual kWh	4,585,861	3,346,905	0.73
		Summer On-peak kW	600	524	0.87
		Annual Therms	215,558	226,812	1.05
REO	7	Annual kWh	2,096,020	511,576	0.24
		Summer On-peak kW	241	61	0.25
		Annual Therms	0	0	-

Key factors causing the kWh realization rate for the APO program to fall below 1.0 are: (1) measure performance at one site is less efficient than expected, causing post-retrofit kWh to be much higher than predicted; (2) customer operations of post-retrofit equipment at one wastewater treatment site are more intensive that predicted (because the customer is concerned about under-treatment of effluent) and post-retrofit energy use is higher than expected; and (3) post-retrofit equipment at one project was determined to be no more efficient than standard equipment that would have been installed without the program and savings were set to zero.

3.2.3 Results by Measure Category

Evaluation results by measure category are shown in Table 3-3. Measures “P9” and “P10” are delivered through the REO Program, and the other measures are delivered through the APO Program.

In general, the APO Adjustable Speed Drive, Energy Efficient Motor, and Heat Recovery measures had the highest kWh realization rates; they performed as expected or better than expected. These same measures, and also the Process Control measure, performed well in terms of summer peak kW realization rates. High kW realization rates were most often the result of very conservative ex ante kW impact estimates. The gas measures all performed about as expected.

Table 3-3
Results by Measure Group

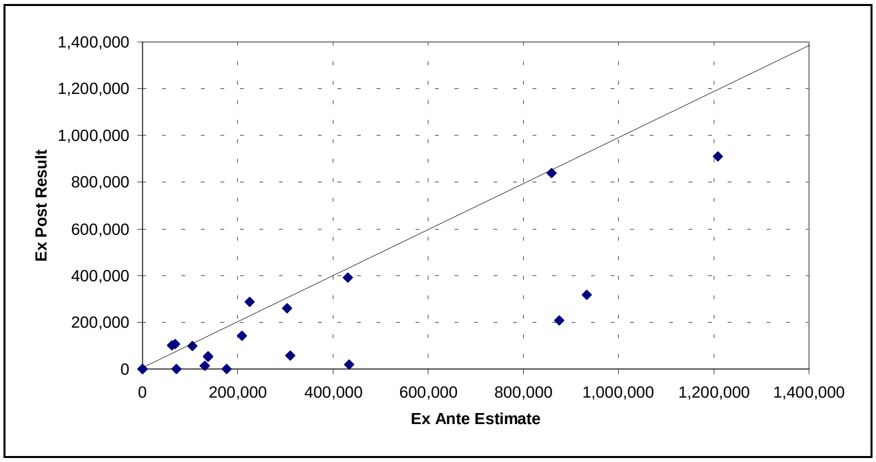
Measure Category	# of Projects	kWh Ex Ante	kWh Ex Post	kWh RR	kW Ex Ante	kW Ex Post	kW RR	Therms Ex Ante	Therms Ex Post	Therms RR
P9: Variable Frequency Drive: Water Pumping: Throttling Valve to VFD	5	1,088,620	289,747	0.266	126	38	0.302	0	0	-
P10: Variable Frequency Drive: Water Pumping: ASD to VFD	2	1,007,400	221,830	0.220	115	23	0.196	0	0	-
550: Process Controls	2	176,816	99,315	0.562	8	16	1.914	96,096	96,096	1.000
560: Process Heat Recovery	3	859,794	839,275	0.976	80	120	1.495	99,096	108,701	1.097
569: Process Change/Add Equipment	1	0	0	-	0	0	-	20,366	22,015	1.081
574: Process Energy Efficient Motor	1	62,310	99,875	1.603	10	11	1.140	0	0	-
578: Process Adjustable Speed Drive	3	865,163	820,124	0.948	115	107	0.929	0	0	-
580: Process Change Physical	1	933,159	316,390	0.339	141	118	0.835	0	0	-
589: Air Compresser System Change/Modify	2	479,802	260,228	0.542	106	46	0.437	0	0	-
599: Process Other	1	1,208,817	911,699	0.754	140	106	0.763	0	0	-
Totals		6,681,881	3,858,481	0.577	841	585	0.695	215,558	226,812	1.052

RR = Realization Rate

3.2.4 Discussion of Discrepancies

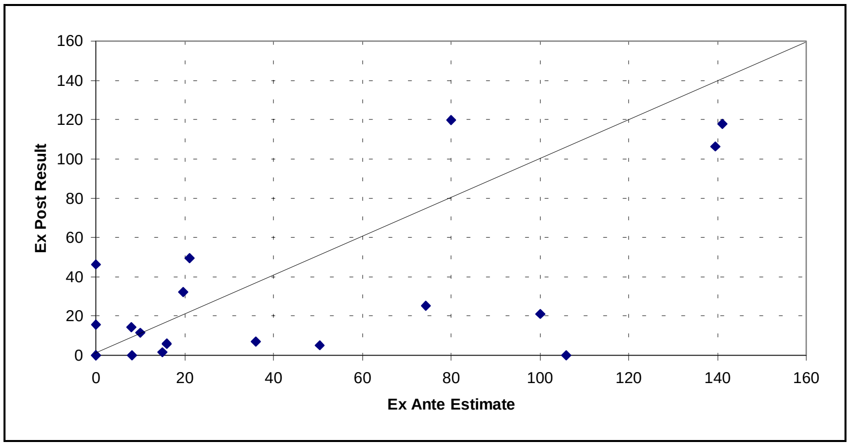
Discrepancies between ex ante estimates and ex post findings are explored further in this section. Figures 3-1 and 3-2 compare ex post evaluation results to ex ante savings estimates for kWh and kW. The diagonal lines represent points at which ex post results and ex ante estimates are equal (realization rates equal to 1.0). Therm impacts are compared in Table 3-4 because only four therm impact projects were analyzed.

Figure 3-1
Annual kWh Savings - Ex Ante vs. Ex Post



As Figure 3-1 shows, ex post kWh results are similar to ex ante estimates for a number of projects; however, ex post results fall below ex ante estimates in the majority of cases. The majority of smaller projects where the ex post result is much lower than the ex ante estimate are the REO projects where operating conditions are different from the standardized assumptions. The two larger projects where ex post results are much less than ex ante estimates are: (1) an REO project at a wastewater treatment facility where actual operating hours are only 27% of the hours assumed in the ex ante calculations; and (2) an APO project at another wastewater treatment plant where equipment must run more than anticipated to process the given amount of wastewater. Ex post results fall below ex ante estimates for the largest kWh project at another wastewater treatment plant because the plant operator is unwilling to reduce post retrofit equipment operations to the degree anticipated in the application. The operator is concerned that effluent quality will be reduced to unacceptable levels if the initial energy saving strategy is carried out.

Figure 3-2
Process Summer On-Peak kW Savings - Ex Ante vs. Ex Post



As Figure 3-2 shows, ex post kW results generally differ from ex ante projections. Most of the cases where ex post results are significantly below ex ante estimates involve the REO projects that utilize standardized impact calculations. Three of the four largest kW projects (based on ex ante estimates) were the wastewater treatment facilities discussed in the preceding paragraph. The other large kW project (ex ante impact of 106 kW) shows zero ex post kW impacts because the post-retrofit compressor system was installed to serve new loads and the new system was no more efficient than an “industry standard” system.

Table 3-4 presents gross therm impacts for the four gas measures involving three projects. For one project, ex post results exceed ex ante estimates by 20% for a food drying project because the ex post analysis utilized ambient temperatures which were much lower than the ex ante calculations. At lower temperatures, the food drying system requires more heat input and benefits more from the heat recovery retrofit. For the smallest project, a duct insulation project for a cotton drying operation, ex post impacts were only 55% of ex ante projections because duct lines were shorter and operating hours were lower than those used in the ex ante calculations.

Table 3-4
Annual Therm Savings - Ex Ante vs. Ex Post

Gas Project/Measure		Ex Ante	Ex Post	Realization Rate
1	560: Process Heat Recovery	83,957	100,396	1.196
2	560: Process Heat Recovery	15,139	8,305	0.549
3	550: Process Controls	96,096	96,096	1.000
4	569: Process Change/Add Equipment	20,366	22,015	1.081

Table 3-5 presents the distribution of realization rates for the studied projects. This table summarizes some of the relationships displayed graphically above.

Table 3-5
Distribution of Realization Rates

Gross Realization Rate	Number of Projects kWh	% Projects	kW	% Projects	Therms	% Projects
> 1.30	2	11%	4	25%	0	0%
0.70 - 1.30	6	33%	3	19%	3	75%
< 0.70	10	56%	9	56%	1	25%
Totals	18	100%	16	100%	4	100%

Discrepancy Factors

As part of the project analyses, key factors leading to discrepancies between ex post evaluation results and PG&E's ex ante impacts were identified. Table 3-6 lists key factors causing discrepancies and the number of sites associated with each discrepancy. The approximate magnitude of each discrepancy is also indicated and is broken out for cases where the discrepancy led to higher impacts (where the ex post result was higher than the ex ante prediction) and lower impacts (where the ex post result was lower than the ex ante prediction). Following is a brief discussion of each discrepancy factor.

Table 3-6
Summary of Discrepancy Factors

Discrepancy Facto	Number of Projects	Energ Units	Magnitute of Discrepancies: Where Ex Post > Ex Ante	Where Ex Post < Ex Ante	Net
Measures not in place	1	kWh	0	-70,956	-70,956
	1	kW	0	-8	-8
	1	Therms	0	-5,809	-5,809
Equipment/system performance different from projection	5	kWh	49,441	-666,855	-617,414
	4	kW	20	-30	-9
	1	Therms	1,367	0	1,367
Different operating condition	13	kWh	105,362	-1,498,771	-1,393,410
	10	kW	55	-178	-123
	1	Therms	16,439	0	16,439
Basecase differences	6	kWh	0	-506,559	-506,559
	6	kW	16	-135	-120
	2	Therms	1,649	-2,392	-743
Methodolog differences	2	kWh	0	-235,061	-235,061
	5	kW	67	-64	3
	0	Therms	0	0	0

Measures Not in Place: For one wastewater treatment project, equipment that was disconnected as part of the project was reinitiated when performance of the post-retrofit system didn't meet expectations. For a duct insulation project, the length of insulated ducts was less than expected.

Equipment/System Performance Different From Projections: The ex ante energy savings estimates are assumptions based on how installed equipment will perform at specified operating conditions. Performance factors include such items as operating kW at certain load conditions (motors or pumps/fans), rated efficiency at certain loads (water extractors, compressors), control system behavior in unloaded or at specified part-load conditions (compressors), and the effectiveness of controls to optimize cycling or control strategies (aerator controls). At some sites, the evaluation was able to collect data on actual post-retrofit performance via metering/monitoring and review of customer data. The evaluation was able to improve on the initial estimates by using actual versus predicted performance in savings calculations/models. The largest performance discrepancies involved an aeration mixing system installed at a wastewater treatment plant. The measured performance of the system was less efficient than expected: mixers ran more frequently and drew more load than predicted.

Different Operating Conditions: Different operating conditions reflect the fact that equipment is being operated in a manner that is different from the ex ante predictions. This may include total production quantities, production rates, operating schedules/hours, or other factors that affect equipment performance such as operating temperature and pressures.

In some cases, equipment is installed as part of a system and the relationship of the equipment within the system is changed, either as a result of the retrofit project or because of operating changes made subsequent to the retrofit project (such as the new compressor becoming the "lead" compressor when replacing an older "lag" compressor, due to its age). In many cases, the desired outcome from the equipment does not change (i.e., the air flow and pressure in the case of a compressor), but the operating conditions or equipment operating strategy used to produce that outcome does change.

Significantly different conditions were observed for most of the REO Program projects. Generally, the projects involved motors that were retrofitted with adjustable speed drives. In most cases operating hours were much lower than those used in the standardized REO calculations. Operating hours and or hourly profiles differed for a number of APO projects as well. In one case, ambient temperature conditions were determined to be different than those used in the ex ante estimates.

Base case Differences: As part of the evaluation, an assessment was made of the appropriateness of the ex ante base case. The ex ante base case was accepted for most projects. The primary exception was for a compressor project where the ex ante analysis utilized an older compressor for the base case, but the evaluation determined that the new compressor system served entirely different loads than the older compressor (which had been replace by two non-rebate compressors). For several REO projects savings were based on the conversion of "throttling valve" controls to VFDs, but the evaluation determined that the pre-retrofit control equipment was an ASD.

Methodology Differences: This category covers two types of projects: 1) projects that used an ex ante savings estimation methodology that was so different from the evaluation methodology that the reasons for impact differences were difficult to discern; and 2) projects where errors in the ex ante method were discovered. There were a couple of projects where the initial savings analysis consisted of an engineering approach and the evaluation used a production/measurement method. In addition, for several projects, ex ante peak kW impacts were based on the difference in connected load, while the ex post evaluation approach was based on the difference between loads that were expected to occur at the time of the system peak. Finally, for one REO project, the VFD savings methodology was inappropriately applied to three pumps that were set up in a redundant system such that the program guidelines indicate only one-pump should be rebated.

3.2.5 Gross Impacts by PG&E Costing Period

As part of the gross impact analysis, program savings were allocated to PG&E time-of-use periods. Results are presented in Table 3-7 on the following page.

Table 3-7
Gross Impacts by PG&E Costing Period

Costing Period	Avg. kW Savings	Avg. kW Savings Coincident with System Maximum	kW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load k Savings
Summer On Peak	581	585	1.000	446,333	0.116	3,858,481	204
Summer Part Peak	535	481	0.823	479,524	0.124	3,858,481	204
Summer Off Peak	389	465	0.795	1,070,638	0.277	3,858,481	204
Winter Part Peak	540	463	0.791	884,139	0.229	3,858,481	204
Winter Off Peak	361	606	1.036	977,848	0.253	3,858,481	204

Summer On Peak: May 1 to Oct. 31 Noon-6 p.m. Weekdays (Coincid. Peak: 3-4 PM Weekdays)
Summer Part Peak: May 1 to Oct. 31 8:30 a.m. - Noon & 6-9:30 p.m. Weekdays (Coincid. Peak: 6-7 PM Weekdays)
Summer Off Peak: May 1 to Oct. 31 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday (Coincid. Peak: 9-10 PM Weekdays)
Winter Part Peak: Nov. 1 to Apr. 30 8:30 a.m. - 9:30 p.m. (Coincid. Peak: 6-7 PM Weekdays)
Winter Off Peak: Nov. 1 to Apr. 30 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday (Coincid. Peak: 8-9 AM Weekdays)

3.3 NET PROGRAM SAVINGS

This subsection presents net Program savings results. First, the results of the net-to-gross (NTG) analysis are discussed. Next, the net-to-gross ratios (NTGRs) are applied to gross program savings to provide estimates of net program savings.

3.3.1 Net-to-Gross Analysis

The objective of the net-to-gross analysis is to determine what equipment purchase decisions would have occurred without the PG&E pre-1998 Commercial Process Programs. As discussed in Section 2 of this report, both free-ridership and spillover are taken into account, with a primary emphasis on free-ridership.

Standard Net-to-Gross Survey

All but two studied projects received a standard NTG survey. (One project received zero gross savings and the NTG survey was not required; the other project decision-maker could not be contacted.) Program participants were asked a series of survey questions to probe their decision process with respect to the installation of energy-efficient measures. The results of these questions were then used to construct NTGRs. Key survey results are presented below.

An important aspect of an energy efficiency program is its ability to inform customers of the availability of efficient technologies. To understand the information impact of the program, the participants were asked how they first learned about the energy-efficient technologies installed through the program. Table 3-8 presents the results. As shown, 29% of the surveyed participants first learned about relevant technologies from PG&E.

Table 3-8
How Participants First Heard About Efficient Technologies

	Percentage of Respondents
From a contractor/architect/engineer	18%
From a vendor	6%
From PG&E	29%
From previous installation	29%
From other sources	18%
Total	100%

The further along a customer is in the decision-making process before hearing about the rebate program, the less likely it is that the program affected his/her purchase decision. Participants were queried about how far along they were in the decision process to purchase energy efficient equipment when they first learned of the Program. The key questions were:

- *When did you first learn about the PG&E Program? Was it **BEFORE** or was it **AFTER** you first began to think about installing **Energy Efficient Equipment**?* and
- *Did you learn about the PG&E Program **BEFORE** or **AFTER** you decided to purchase the **specific Energy Efficient Equipment** that was eventually installed?*

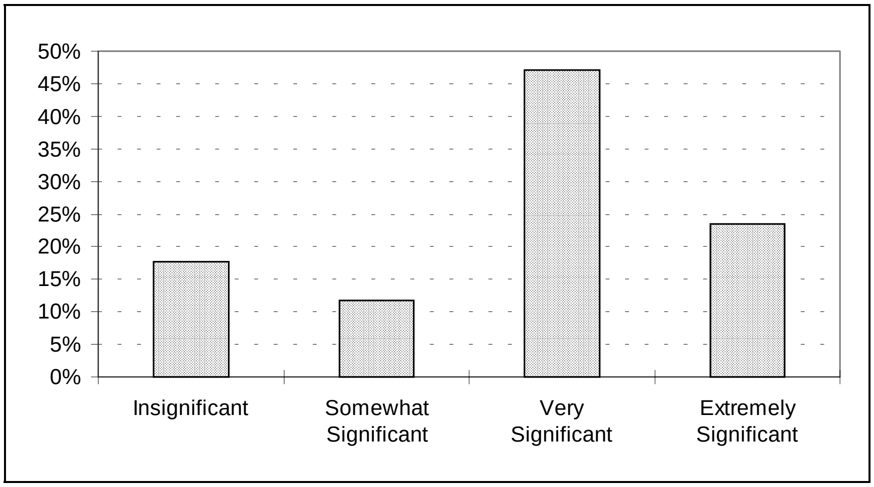
Only one customer out of the 17 surveyed (6%) indicated that they had learned about the program after they began to think about installing the energy efficient equipment, and no customers indicated that they had learned about the PG&E program after they had decided to purchase specific equipment.

To test Program importance, the question was:

- *How significant was the PG&E Program in influencing your decision to install the energy- efficient equipment?*

Responses are shown in Figure 3-3. About 70% of the respondents indicated the Program was very significant or extremely significant in influencing the energy efficiency installations. Less than 20% of the respondents indicated the Program was insignificant.

Figure 3-3
Significance of Program on Decision to Install Measures

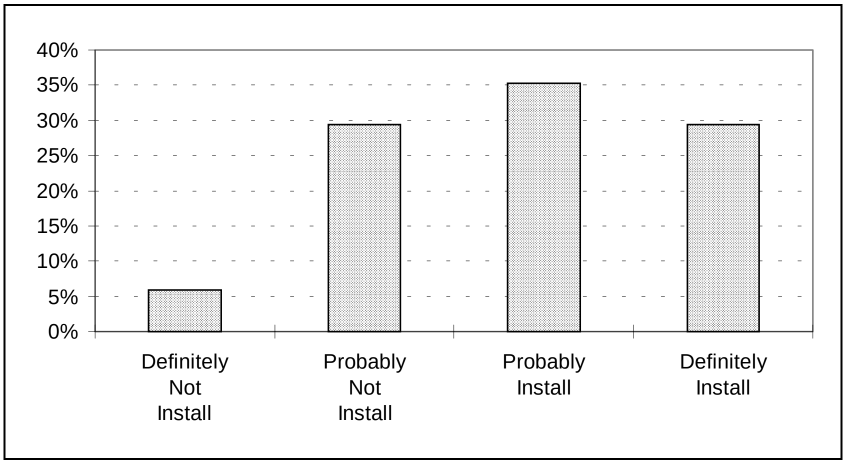


In addition to the significance question, the stated intentions question was a key question used to construct the standard self-report NTGRs. The primary stated intentions question was:

- *If the PG&E incentive had not been available, how likely is it that you would have installed the energy-efficient equipment?*

Responses are shown in Figure 3-4. About 35% of the respondents indicated they definitely or probably would *not* have installed the measures without the rebate. While a large number of participants indicated that they *probably* would have installed the measures anyway, it is generally believed that some of these customers interpret the question as: "*If you could do the project over again, would you?"* Customers who are happy with their project (now that performance uncertainty is no longer a threat) are likely to say they would do the project again. About half of the respondents who state they probably would have installed the measures anyway also indicate that the Program was very significant or extremely significant in their decision to install measures. The problems with respondents accurately responding to the hypothetical "what if" question is a major reason consistency checks are used in the standard NTG calculations (see Section 2).

Figure 3-4
Likelihood Customer Would Have Installed Measure If Incentive Was Not Available



Customers who were likely to have installed measures anyway without the rebate were asked if those measures would have been as efficient. Alternatively, customers who would not have installed measures without the rebate were asked if they would have installed equipment with above-standard efficiency. Results are tabulated in Table 3-10. This table indicates that most customers who first indicated that they would install measures anyway would probably have installed equipment of the same efficiency (9 out of 11 customers). Most (if not all) of customers who would not have installed measures without the rebate would not have undertaken any project.

Table 3-9
Type of Equipment That Would Have Been Installed Without Rebate

	Percentage of Respondents
Efficiency of equipment that would have been installed for customers who would have installed measures anyway	
Probably NOT as efficient	9%
Probably as efficient	82%
Don't Know	9%
Type of equipment that would have been installed by customers who would *not* have installed measures with incentives	
Standard Efficiency Equipment	0%
Intermediate Efficiency Equipment	0%
Would not have installed anything	83%
Don't Know	17%

Standard Net-to-Gross Results

Using results of the standard NTG survey and the scoring method described in Section 2 of this report, standard NTGRs were calculated for each project. Table 3-11 shows the distribution of

NTGRs. Table 3-12 shows the weighted-average standard NTGRs calculated for kW, kWh, and therms.

Table 3-10
Distribution of Standard Net-to-Gross Ratios

NTGR Range	# Projects	% Projects
1.00	1	6%
0.71-0.99	8	47%
0.30-0.70	5	29%
0.01-0.29	0	0%
0.00	3	18%

Table 3-11
Impact-Weighted Average Standard Net-to-Gross Ratios

	NTGR
Annual kWh	0.69
Summer On-peak kW	0.68
Annual Therms	0.86

Custom Net-to-Gross Ratios for Large Projects

The custom NTGRs were designed to improve upon the standard NTGRs by incorporating additional information from project files, additional customer interviews, and other sources such as vendors and PG&E customer representatives. Table 3-12 shows how the distribution of NTGRs varied between the standard and custom analyses. Table 3-13 compares weighted-average NTGRs developed using the standard and custom analyses.

In general, the custom NTG process tended to lower a number of NTGRs that were initially in the 0.71 to 0.99 range. A number of customers indicated that the program was "very significant" but that they "probably would have installed measures anyway." Most of these customers were not sure what they would have done in the absence of the program. The custom NTG process tended to move these customers down into the 0.5 NTGR range, better reflecting their uncertainty.

When combined with energy impact weights, the custom NTGRs were somewhat lower than the standard NTGRs.

Table 3-12
Distribution of Standard and Custom Net-to-Gross Ratios for Large Impact Projects

NTGR Range	% of Projects	
	Standard	Custom
1.00	6%	6%
0.71-0.99	47%	29%
0.30-0.70	29%	47%
0.01-0.29	0%	0%
0.00	18%	18%

Table 3-13
Energy-Weighted Average Standard and Custom Net-to-Gross Ratios - Large Projects

	Standard	Custom	Difference
Annual kWh	0.69	0.64	-0.05
Summer On-peak kW	0.68	0.63	-0.05
Annual Therms	0.86	0.86	0.00

Spillover

As part of the project-specific analyses, screening surveys were conducted to assess the effects of Program spillover—installations of energy-efficient equipment installed outside the Program but induced by the Program. No spillover projects were identified.

3.3.2 Net Impacts

Net impacts were developed by applying the custom NTGRs from the previous table to ex post gross impacts. The net impact results are summarized in Table 3-14. The net kWh, kW, and therm realization rates are 0.49, 0.58, and 1.21, respectively. The low net kW and kWh realization rates are the combined effects of gross realization rates averaging below 1.0 and ex post NTGRs that are below ex ante NTGRs. The net therm realization rate of 1.21 reflects a gross realization rate of 1.05 and a NTGR that is greater than the ex ante NTGR of 0.75.

Table 3-14
Summary of Net Impact Results

	Ex Ante Estimates		Ex Post Results			Net Realization Rate
	Net Impacts	Net-to-Gross Ratio	Net Impacts	Net-to-Gross Ratio	90% Confidence Interval	
Annual kWh	5,011,411	0.75	2,467,472	0.64	±0.011	0.492
Summer On-peak kW	631	0.75	369	0.63	±0.012	0.585
Annual Therms	161,669	0.75	195,032	0.86	±0.000	1.206

Net Impacts by PG&E Costing Period

Net program impacts are shown by PG&E costing period in Table 3-15.

Table 3-15
Net Impacts by PG&E Costing Period

Costing Period	Avg. kW Savings	Avg. kW Savings Coincident with System Maximum	kW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load k Savings
Summer On-Peak	372	369	1.000	285,427	0.116	2,467,472	129
Summer Part Peak	342	304	0.823	306,652	0.124	2,467,472	129
Summer Of- Peak	249	293	0.795	684,665	0.277	2,467,472	129
Winter Part-Peak	345	292	0.791	565,401	0.229	2,467,472	129
Winter Off-Peak	231	382	1.036	625,327	0.253	2,467,472	129

Summer On-Peak: May 1 to Oct. 31 Noon-6 p.m. Weekdays (Coincid. Peak: 3-4 PM Weekdays)
Summer Part-Peak: May 1 to Oct. 31 8:30 a.m. - Noon & 6-9:30 p.m. Weekdays (Coincid. Peak: 6-7 PM Weekdays)
Summer Off-Peak: May 1 to Oct. 31 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday (Coincid. Peak: 9-10 PM Weekdays)
Winter Part-Peak: Nov. 1 to Apr. 30 8:30 a.m. - 9:30 p.m. (Coincid. Peak: 6-7 PM Weekdays)
Winter Off-Peak: Nov. 1 to Apr. 30 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday (Coincid. Peak: 8-9 AM Weekdays)

A

PROJECT-SPECIFIC RESULTS

This appendix presents project-specific impact results for projects analyzed as part of the evaluation. First, ex ante impacts are summarized and compared in Table A-1. Next, the evaluation approach and discrepancies between ex ante estimates and ex post results are summarized in Table A-2.

Table A-1
Process Project Results

Cntl #	App Code	Prog	Measure	Ex Ante Gross			Ex Ante	Ex Ante Net			Ex Post Gross			Ex Post	Ex Post Net			Gross RR			Net RR		
				kWh	kW	Therms	NTGR	kWh	kW	Therms	kWh	kW	Therms	NTGR	kWh	kW	Therms	kWh	kW	Therms	kWh	kW	Therms
0264206	AVT1005	APO	574: Process Energy Efficient Motor	62,310	10.0	0	0.75	46,733	7.5	0	99,875	11.4	0	0.80	79,900	9.1	0	1.60	1.14	-	1.71	1.22	-
0494637	ATK6014	APO	560: Process Heat Recovery	0	0.0	83,957	0.75	0	0.0	62,968	0	0.0	100,396	0.70	0	0.0	70,278	-	-	1.20	-	-	1.12
0721869	AJQ0003	APO	589: Air Compresser System Change/Modify	176,033	106.0	0	0.75	132,025	79.5	0	0	0.0	0	0.00	0	0.0	0	0.00	0.00	-	0.00	0.00	-
0905080	AXT0026	APO	550: Process Controls	105,860	0.0	96,096	0.75	79,395	0.0	72,072	99,315	15.5	96,096	1.00	99,315	15.5	96,096	0.94	-	1.00	1.25	-	1.33
0905080	AXT0026	APO	569: Process Change/Add Equipment	0	0.0	20,366	0.75	0	0.0	15,275	0	0.0	22,015	1.00	0	0.0	22,015	-	-	1.08	-	-	1.44
0954126	ENR7723	REO	P9: Variable Frequency Drive: Water Pumping: Throttling Valve to VFD	434,070	50.4	0	0.75	325,553	37.8	0	19,270	5.2	0	0.70	13,489	3.7	0	0.04	0.10	-	0.04	0.10	-
1016273	AJN1011	APO	578: Process Adjustable Speed Drive	208,387	74.3	0	0.75	156,290	55.8	0	142,821	25.2	0	0.50	71,410	12.6	0	0.69	0.34	-	0.46	0.23	-
1113940	EVT2050	REO	P9: Variable Frequency Drive: Water Pumping: Throttling Valve to VFD	310,050	36.0	0	0.75	232,538	27.0	0	56,656	7.0	0	0.00	0	0.0	0	0.18	0.19	-	0.00	0.00	-
3900088	EVT2051	REO	P9: Variable Frequency Drive: Water Pumping: Throttling Valve to VFD	137,800	16.0	0	0.75	103,350	12.0	0	52,406	5.7	0	0.00	0	0.0	0	0.38	0.36	-	0.00	0.00	-
3912667	EVT2049	REO	P9: Variable Frequency Drive: Water Pumping: Throttling Valve to VFD	137,800	16.0	0	0.75	103,350	12.0	0	54,118	5.9	0	0.00	0	0.0	0	0.39	0.37	-	0.00	0.00	-
4245782	ABT1008	APO	589: Air Compresser System Change/Modify	303,769	0.0	0	0.75	227,827	0.0	0	260,228	46.3	0	0.85	221,194	39.4	0	0.86	-	-	0.97	-	-
4305676	EJG3188	REO	P10: Variable Frequency Drive: Water Pumping: ASD to VFD	876,000	100.0	0	0.75	657,000	75.0	0	208,943	20.9	0	0.63	131,634	13.2	0	0.24	0.21	-	0.20	0.18	-
4348634	ERN7106	REO	P9: Variable Frequency Drive: Water Pumping: Throttling Valve to VFD	68,900	8.0	0	0.75	51,675	6.0	0	107,296	14.3	0	0.73	78,326	10.5	0	1.56	1.79	-	1.52	1.74	-
4698012	ATR6047	APO	580: Process Change Physical	933,159	141.0	0	0.75	699,869	105.8	0	316,390	117.8	0	0.50	158,195	58.9	0	0.34	0.84	-	0.23	0.56	-
4741313	ANY7025	APO	578: Process Adjustable Speed Drive	432,105	19.7	0	0.75	324,079	14.8	0	391,416	32.3	0	0.63	246,592	20.4	0	0.91	1.64	-	0.76	1.38	-
4741313	ENY7026	REO	P10: Variable Frequency Drive: Water Pumping: ASD to VFD	131,400	15.0	0	0.75	98,550	11.3	0	12,886	1.6	0	0.63	8,118	1.0	0	0.10	0.11	-	0.08	0.09	-
5844090	ATK6023	APO	560: Process Heat Recovery	0	0.0	15,139	0.75	0	0.0	11,354	0	0.0	8,305	0.80	0	0.0	6,644	-	-	0.55	-	-	0.59
6151420	ABM0010	APO	599: Process Other	1,208,817	139.5	0	0.75	906,613	104.6	0	911,699	106.4	0	0.60	547,019	63.9	0	0.75	0.76	-	0.60	0.61	-
6398135	ATK6009	APO	578: Process Adjustable Speed Drive	224,671	21.0	0	0.75	168,503	15.8	0	285,887	49.4	0	n/a	182,822	31.2	0	1.27	2.35	-	1.08	1.98	-
6467854	ATN6031	APO	550: Process Controls	70,956	8.1	0	0.75	53,217	6.1	0	0	0.0	0	0.75	0	0.0	0	0.00	0.00	-	0.00	0.00	-
6467854	ATN6031	APO	560: Process Heat Recovery	859,794	80.0	0	0.75	644,846	60.0	0	839,275	119.6	0	0.75	629,456	89.7	0	0.98	1.50	-	0.98	1.50	-

Table A-2
Summary of Project Evaluation Approaches and Ex Ante - Ex Post Discrepancies

Cntl #	Appl. Code	Prog	Measure Description (Tracking)	Measure Descriptions (Evaluation)	Evaluation Approach	Summary of Discrepancies
0264206	AVT1005	APO	574: Process Energy Efficient Motor	Replace 3-25 hp pumps with 3-10 hp efficiency pumps.	Engineering calculation supported by spot volt and meas. Base case calculated using post power and pre-retrofit pump and motor	Higher operating hours; measured power savings that rated savings.
0494637	ATK6014	APO	560: Process Heat Recovery	Install dampers & controls to recirculate air in raisin drying ovens.	Engineering calculation using ex ante updated for observed operating profile and TMY data.	Use of colder ambient temperatures reflected equipment usasge and more
0721869	AJQ0003	APO	589: Air Compresser System Change/Modify	Replace 1 250 hp air compressor with 1-50 and 3-25 hp compressors and	Base case determined to be identical to postcase - further analysis	Postcase provided no additional savings over standard system which would have been
0905080	AXT0026	APO	550: Process Controls; 569: Process Change/Add Equipment	Replace 1 dryer and 2 moisture extractors HE units.	Engineering analysis using load profiles determined monitoring and rated equipment	Performance of postcase moisture extractors efficient than
0954126	ENR7723	REO	P9: Variable Frequency Drive: Water Throttling Valve to VFD	Install VFDs on 11 water pumps.	Engineering calculations using spot measurements and on daily flow and pump records; basecase used EPRI part load curves.	Pumps operate much less than standardized
1016273	AJN1011	APO	578: Process Adjustable Speed Drive	Replace 2-100 hp pumps and 1-25 hp with 4-20 hp pumps w/HE motors and	Engineering analysis with monitoring of pump power water flow; basecase fit to postcase profile manufacturer's performance curves.	Lower operating hours. Ex post utilizes expected time kW impacts; ex ante uses full load
1113940	EVT2050	REO	P9: Variable Frequency Drive: Water Throttling Valve to VFD	Install VFDs on 3-75 hp	Engineering analysis with monitoring of pump basecase fit to postcase profile using curves.	REO method should have rebated 1 pump not operating hours less than predicted; basecase was wound rotor motor not throttling
3900088	EVT2051	REO	P9: Variable Frequency Drive: Water Throttling Valve to VFD	Install a VFD on one 100 hp	Engineering analysis with monitoring of pump basecase fit to postcase profile using curves.	Operating hours less than predicted; basecase was wound rotor motor not throttling
3912667	EVT2049	REO	P9: Variable Frequency Drive: Water Throttling Valve to VFD	Install a VFD on one 100 hp	Engineering analysis with monitoring of pump basecase fit to postcase profile using curves.	Operating hours less than predicted; basecase was wound rotor motor not throttling
4245782	ABT1008	APO	589: Air Compresser System Change/Modify	Replace 6 air motors with electric motors.	Engineering calculations based on monitoring of compressors and nameplate data for electric	Basecase system was more efficient that shown in ante calculaitons. Ex ante kW impact of 0.0 was conservative and didn't reflect peak period
4305676	EJG3188	REO	P10: Variable Frequency Drive: Water ASD to VFD	Install HE motors and VFDs on 2-100 hp and 400 hp sewage pumps.	Billing analysis - comparison of pre and post energy use normalized by production (flow).	Operating hours much less that assumed in prescriptive methodology.
4348634	ERN7106	REO	P9: Variable Frequency Drive: Water Throttling Valve to VFD	Install VFDs on 2-25 hp recycled water	Engineering analysis with monitoring of pump basecase calculated for constant speed	Actual operating conditions were different prescriptive assumptions.
4698012	ATR6047	APO	580: Process Change Physical	Replace 5-75 hp mechanical aerators with 3-hp biomixer aeration mixing systems.	Engineering analysis with post retrofit compared against pre-retrofit constant-speed running under programmed timing	Post-retrofit system must operate more intensively predicted for proper aeration.
4741313	ANY7025	APO	578: Process Adjustable Speed Drive	Install VFD's on 4-125 hp recycled water pumps	Engineering analysis using customer power and data; basecase fit to postcase profile using pre-control strategy.	Control strategy different than predicted causing kWh savings; ex post kW impacts reflect expected hour differences while ex ante kW reflects max differences.
4741313	ENY7026	REO	P10: Variable Frequency Drive: Water ASD to VFD	Install VFD's on 3-50 hp sewage	Engineering analysis using customer power and data; basecase fit to postcase profile efficiency estimates.	Basecase system was more much more efficient that shown in ex ante calculaitons; operating hours were much lower.
5844090	ATK6023	APO	560: Process Heat Recovery	Insulate cotton gin dryer/conveyor	Engineering heat loss	Length of insulated pipe less than expected; hours less than
6151420	ABM0010	APO	599: Process Other	Install 1-150 hp blower and controls to replace 250 hp blowers; install VFDs on 2-50 hp recirculation pumps.	Engineering analysis utilizing billed kWh and flow records; VFD analysis based on postcase basecase part load	Post-retrofit operations are more conservative than predicted - relative to basecase
6398135	ATK6009	APO	578: Process Adjustable Speed Drive	Install 1-150 hp pump/motor/VFD to replace 150 hp wound-rotor-motor-driven	Engineering analysis based on post-retrofit pump (via monitoring); basecase fit to postcase profile pre-retrofit measured efficiencies.	Post-retrofit equipment performance is better expected; operating profile is somewhat
6467854	ATN6031	APO	550: Process Controls; 560: Process Recovery	Install sensors, controls, revise valves, piping to combine 2 wastewater facilities.	Engineering comparison of post-retrofit (monitoring) and pre-retrofit operations inteviews and power	Equipment that was disconnected during the retrofit back in operation; post-retrofit operating conditions different than

B

DATA COLLECTION FORMS

This appendix presents survey forms used in the data collection process. Forms are shown in the following order:

- Telephone recruitment and spillover form
- On-site data collection forms
  - ◊ Equipment forms
  - ◊ Operations survey
- Net-to-gross forms
  - ◊ Standard net-to-gross questionnaire
  - ◊ Custom net-to-gross questionnaire

Telephone Recruitment and Spillover Form

B.1 COMMERCIAL PROCESS QUESTIONNAIRE

XENERGY / Pacific Gas and Electric
Commercial Process Program Impact Evaluation
Recruitment Guidelines and Spillover Questionnaire

INTRODUCTION

INTRO Hello, my name is _________________ from ________________________, and I'm calling on behalf of Pacific Gas and Electric Company.

PS1 Ask to speak with **CONTACT** from recruitment form.

1 YES **[SKIPTO PS3]**
2 NO / NO LONGER WITH ORGANIZATION / NO CONTACT SHOWN
3 NO / NOT AVAILABLE NOW [SCHEDULE CALLBACK]
9 NO / IMMEDIATE REFUSAL **[SKIPTO THANK]**

PS2 If **CONTACT** is no longer available ask to speak with someone who is familiar with the operation of the facility particularly as it pertains to energy usage. Note NAME and PHONE NUMBER of the new contact.

New Contact:: ____

Phone Number: ____

PS3 PG&E is conducting a study to assess the effectiveness of the industrial energy efficiency programs they offer. PG&E records indicate that your organization received financial incentives to install energy saving measures in the facility at **(SERVICE ADDRESS)** during 1997. To help determine the impact of this program, we would like to ask your cooperation in this evaluation. Your responses will be held in the strictest of confidence.

[Indicate program measures from recruitment sheet if necessary.]

PS4 I would like to ask you a few questions related to your participation in the PG&E program and set a *tentative* date for a site visit. This survey should take about **XXX** hour(s) and will involve data collection activities to assess the impacts of the measures installed at your facility. [Explain site activities]

Tentative visit: ____

PS5 Summarize recruitment activities

1 Successful recruitment
2 Could not reach customer (minimum 3 attempts)
3 Customer refused to participate For analysis sites notify XENERGY project manager
4 Other, List: ____

IDENTIFICATION OF KEY CONTACT PERSONNEL

PS6 Determine who key contact personnel are:

Function	Name	Title	Phone
Site Contact			
Project Decision Maker			
Spillover Respondent			
Other staff ______________________			
Other staff ______________________			

ANALYSIS DISCUSSION

Review site analysis strategy with customer in order to prepare plan. If necessary schedule callback to appropriate contact person to get best input possible and test feasibility of approach and acceptance of potential monitoring equipment installations.

SPILLOVER SURVEY

Conduct survey with identified spillover contact.

S1 In addition to the measures installed as part of the PG&E program, did you install or replace any equipment or take any actions to reduce you energy consumption during 1997?

1 YES
2 NO (End Survey)
9 DON'T KNOW / REFUSED (End Survey)

S2 Did PG&E influence your decision to install any of these measures?

1 No influence (End Survey)
2 Some influence
3 Significant influence
4 Extremely significant influence
9 DON'T KNOW / REFUSED (End Survey)

S3 How did PG&E influence your decision? (list multiple responses)

1 Provided information/project analysis
2 Past PG&E program participation
3 Recommended a vendor
4 Other, List: ____
9 DON'T KNOW / REFUSED

S4 Describe measures installed and influenced by PG&E?

Measure 1: ____

____

____

Measure 2: ____

____

____

Measure 3: ____

____

____

S4 Did you apply for a rebate for any of these measures?

1 YES
2 NO (End Survey)
9 DON'T KNOW / REFUSED (End Survey)

If rebate received or pending, eliminate measure from consideration

On-Site Data Collection Forms

PG&E COMMERCIAL PROCESS IMPACT STUDY

Application Number	*Program Year*	*Control Number*	*Meter Rate*	*Strata*	*Check Number*
Check paid to			*Rebate*		*Check Date*
PG&E Representative					*SIC Code*
Contact Person					*Site Survey Type*
Complex					*Surveyor*
Site Address					*Survey Date*
City		*State*	*ZIP*		*Circle one:*

Site Visit Notes:

Review Notes:

1 2 3 4 5

Control Num	Application Num	Check Num	Check Date	Check paid to
Complex				

Location: ____

Paid Savings: _________________ kWh _________________ kW _________________ therms Rebate: $_____________

Measure Attribute Measure Number →	
Measure Code	
Install Date	
Customer Equipment Name	
Manufacturer	
Model Number	
Serial Number	
Number Expected	*1*
Number Observed	
Rated Output Capacity / Size	
Rated Input Volts / RL Amps / therms	
Percent in Working Condition	
Normal Service ☐	*Standby/ Back up*
Discrepancy Code *see table below*	
Removal Code *see table below*	
Months Since Removal	

Schedule		Wkdy	Sat	Sun
Monthly Schedule	Jan			
	Feb			
	Mar			
	Apr			
	May			
	Jun			
	Jul			
	Aug			
	Sep			
	Oct			
	Nov			
	Dec			
OR...		Wkdy	Sat	Sun
Seasonal Schedule	Sum			
	Win			
OR...		Wkdy	Sat	Sun
Annual Schedule	All Yr			

Cooling	*Chilled Water* ☐	*Pkg Unit* ☐	*Evap* ☐	*HP* ☐	*None* ☐
Heating	*Gas Boiler* ☐	*Gas Burner* ☐	*Elect Resist* ☐	*HP* ☐	*None* ☐

Were power loggers installed? *Circle one:* Y / N

How many were installed? _____________

Please describe the locations sufficiently well in the space at right so that another surveyor can locate the loggers if needed.

Logger ID	**Location**

1 2 3 4 5

Discrepancy Codes

D	1	Removed, not replaced
	2	Removed, replaced with different (describe)
	4	Never installed
	5	Temporarily taken out of operation
	6	Could not locate
	7	Other (describe)

Removal Codes

R	1	Equipment failed, not replaced
	2	Remodeled / Equip Replaced
	3	Unable to locate equivalent replacement
	4	Change of use
	5	Other (describe)

B.2 OPERATIONS SURVEY

XENERGY / PG&E Commercial Process Program Impact Evaluation

SURVEYOR NAME: ___________________________ **PG&E CONTROL NUMBER:** _____________

INTERVIEWEE NAME: _________________________ **CHECK NUMBER** _____________

ALTERNATIVE PROJECTS

A1. Were alternative, less efficient, projects considered?

1 YES
2 NO **[SKIP TO NEXT SECTION]**
9 DON'T KNOW **[SKIP TO NEXT SECTION]**

A2. Describe the alternatives

1 ____

____

2 ____

____

3 ____

____

A3. What role did the PG&E rebate have in the decision to install the current equipment versus the alternatives?

____

____

____

A4. (If applicable) What alternative would most likely have been installed without the PG&E rebate?

____

PRODUCTION INCREASES

P1. Was there a significant increase in production associated with the installation of the rebated measure?

1 YES
2 NO **[SKIP TO NEXT SECTION]**

P2. Were there plans to increase production regardless of the efficiency of the new equipment?

1 YES
2 NO
9 DON'T KNOW

P3. Would the production increase have occurred anyway, without the installation of the specific rebated equipment (possibly utilizing a less efficient technology)?

1 Definitely would have occurred anyway
2 Probably would have occurred anyway
3 Probably would **NOT** to have occurred anyway
4 Definitely would **NOT** to have occurred anyway
9 DON'T KNOW [GET NAME AND PHONE NUMBER OF PERSON WHO WOULD KNOW]

Name:______________________________________

Phone:______________________________________

EARLY REPLACEMENT

E1 Did the rebated equipment replace existing equipment?

1 YES
2 NO **[SKIP REMAINDER OF THIS SECTION]**

E2 What was the condition of the equipment that was replaced?

1 In good working condition
2 In working condition but no longer meeting our needs
3 Near the end of its useful life
9 DON'T KNOW

E3 Without the PG&E rebate, how long would you have operated on the older equipment?

1 Less than one more year
2 Over more than one more year Approximately how many more years ? _____________
9 DON'T KNOW

Net-to-Gross Forms

IDENTIFICATION OF DECISION MAKERS

Enter name of interviewee (person primarily responsible for decision to participate in PG&E program)

Name:____ Title:____

Phone:____ Date:____

A1. Who else at your company was involved in authorizing the decision to enter the PG&E program, and what were their roles in the decision making?

Name:____ Name:____

Role:____ Role:____

Phone:____ Phone:____

A2. Who was primarily responsible for the specification of the installed equipment?

Equipment type:__________________________________ Equipment type:__________________________________

Name:____ Name:____

Phone:____ Phone:____

Equipment type:__________________________________ Equipment type:__________________________________

Name:____ Name:____

Phone:____ Phone:____

MEASURE IDENTIFICATION

(Discuss with interviewee the measures you are going to ask questions about. Determine which measures they are familiar with and whether they or someone else is the more appropriate person to answer the questions. If necessary, conduct additional interviews with others to accurately answer the questions on the following pages.)

Interviewee Name (if different from interviewee on pg. 1): ____

Measures covered by this section.
Use additional sections as necessary for different interviewees or for breakout of answers by measure types.

Process Measures (describe)	
1.	3.
2.	4.

Section # ___________ **of #**__________ **sections** for this PG&E Control Number.

Remind the interviewee that the following questions pertain to the particular energy efficiency measures that were installed as part of the PG&E Program and are identified in the above tables.

MEASURE & PROGRAM PERFORMANCE SATISFACTION

(CIRCLE ANSWER NUMBERS)

S1 Were you satisfied with the overall performance of the ***Energy Efficiency Equipment*** that was installed?

1 Yes
2 No
3 Different for different measures,
[**Explain]**
____
9 DON'T KNOW / REFUSED

S2 What specific aspects of the ***Energy Efficiency Equipment*** performance (if any) were a source of dissatisfaction?

[OPEN END] ____

S3 Overall were you satisfied with the ***PG&E Energy Efficiency Program***?

1 Yes
2 No
9 DON'T KNOW / REFUSED

S4 What specific aspects of the ***Program*** (if any) were a source of dissatisfaction?

[OPEN END] ____

ENERGY EFFICIENCY DECISION MAKING SECTION

[Again, make sure interviewee is aware that you are talking about specific technologies that were installed through the PG&E Program and referred to in the Measure Identification Section above.]

C1 Which of the following statements best describes the situation that led you to install ***Program-Related Equipment***?

1 Needed to replace older equipment.
2 Needed to add equipment because of a remodel , build-out, or expansion.
3 Wanted to reduce our energy costs
4 Wanted more control over how the equipment was used.
5 NONE OF THE ABOVE
9 DON'T KNOW / REFUSED

C2 How did you first hear about the ***Energy Efficiency Equipment*** that was installed as part of the Program?

[SELECT SINGLE BEST RESPONSE]

1 Contractor
2 Architect / Engineer
3 Vendor
4 PG&E Information (Customer representative / literature / marketing materials)
5 Other non-PG&E literature
6 Friend / Business colleague / Professional association
7 Previous installation
8 OTHER **[SPECIFY]** ____________________
9 DON'T KNOW / REFUSED

C3 How did you first learn of the PG&E Energy Efficiency Program?

[SELECT SINGLE BEST RESPONSE]

1 Contractor
2 Architect / Engineer
3 Vendor
4 *PG&E* representative
5 Friend / Business colleague / Professional association
6 PG&E marketing materials / advertising
7 OTHER **[SPECIFY]**
____
9 DON'T KNOW / REFUSED

C4 When did you first learn about the PG&E Program? Was it **BEFORE** or was it **AFTER** you first began to think about installing ***Energy Efficient Equipment***?

1 BEFORE

2 AFTER

9 DON'T KNOW / REFUSED

C5 Did you learn about the PG&E Program **BEFORE** or **AFTER** you decided to purchase the ***specific Energy Efficient Equipment*** that was eventually installed?

1 BEFORE

2 AFTER

9 DON'T KNOW / REFUSED

C6 How significant was the PG&E program in influencing your decision to install the ***Energy Efficient Equipment***? Would you say . . .

1 Insignificant

2 Somewhat Significant

3 Very Significant

4 Extremely Significant

9 DON'T KNOW / REFUSED

C7 If the PG&E incentive had not been available, how likely is it you would have installed the ***specific Energy Efficient Equipment***? Would you say . . .

1 Definitely would NOT HAVE installed **[SKIP TO C9]**

2 Probably would NOT HAVE installed **[SKIP TO C9]**

3 Probably would HAVE installed

4 Definitely would HAVE installed

9 DON'T KNOW / REFUSED

[IF C7 = 2 OR C7 = 3 THEN ASK C7a]

C7a How likely is it you would have installed the ***specific Energy Efficient Equipment*** without the PG&E incentive? This time using a scale from 0 to 10, with 0 meaning you definitely would NOT have installed the equipement and 10 meaning you definitely would have installed the equipment.

0 1 2 3 4 5 6 7 8 9 10

[IF C7 = 3 OR C7 = 4 THEN ASK C8]

C8 Without the incentive, how likely is it that the equipment you purchased would have been as energy efficient as the equipment you installed with the incentive? Would you say . . .

1 Probably NOT as efficient

2 Probably as efficient

9 DON'T KNOW / REFUSED

[IF C7 = 1 OR C7 = 2 THEN ASK C9]

C9 Without the incentive, what type of equipment would you have most likely installed? Would you say. . .

1 Standard efficiency equipment

2 Equipment with above-standard efficiency but with lower efficiency than the equipment that was actually installed

3 Would not have installed anything

9 DON'T KNOW / REFUSED

C10 If the PG&E incentive had not been available, would you have installed the ***Energy Efficient Equipment*** at about the same time or at a later date?

[IF AT A LATER DATE, PROBE: "Would that be less than 1 year later, or over 1 year later?", AND SELECT APPROPRIATE RESPONSE. If over 1 year later, probe for best estimate of how many years later.]

1 Same Time To Less Than 1 Year

2 Over 1 Year LaterApproximately how many years later? _____________

9 DON'T KNOW / REFUSED

CONCLUSION

Thank you for your cooperation.

DECISION MAKER

Interviewee Name: ____

Title: ____ **Date:** _______/_________/_______

Measures covered by this section.

Use additional sections as necessary for different interviewees or for breakout of answers by measure types.

Process Measures (describe)	
1.	3.
2.	4.

A1. Who else was involved in authorizing the decisions to enter the PG&E program and to specify and purchase the installed equipment? ...what were their roles in the decision making? (If an equipment vendor was involved, get a name and phone.)

Name:____________________________________ Name:____________________________________

Dept:____________________________________ Dept:____________________________________

Role:____________________________________ Role:____________________________________

Phone:____________________________________ Phone:____________________________________

MEASURE & PROGRAM PERFORMANCE SATISFACTION

Note: if decision maker is the same person who completed a standard survey, do NOT ask each question from scratch; ask this person to confirm results of standard survey - and probe for inconsistencies, etc.

S1 Were you satisfied with the overall performance of the measures that were installed?

____

____

S2 What specific aspects of the measure performance (if any) were a source of dissatisfaction?

____

____

S3 Overall were you satisfied with the PG&E incentive program?

____

____

S4 What specific aspects of the program (if any) were a source of dissatisfaction?

____

____

ENERGY EFFICIENCY DECISION-MAKING SECTION

C1 What led you to consider installing the **energy-efficient equipment**? (If an eqpt vendor was involved, get a name and phone.) (If prompting needed, e.g. old eqpt worn out or didn't meet needs, remodeling/expanding and almost time for eqpt replacement anyhow, wanted to reduce energy costs.)

____

____

____

C2 What non-energy benefits did you expect from installing the **energy-efficient equipment**? (if prompting needed, e.g. better control of eqpt, brighter lighting of areas, reduced eqpt maintenance, reduced labor)

____

____

____

C3 Did you expect to lower your energy bill by installing the **energy-efficient equipment**? ...by how much did you expect to lower your bill per month?

____

____

____

C4 When did you first learn about the PG&E program? Was it **BEFORE** you first started to <u>think about installing</u> the **energy-efficient equipment**? (If an eqpt vendor was involved, get a name and phone.)

____

____

____

C5 How did you first hear about the **energy efficiency technologies** that were installed as part of the program? (If an equipment vendor was involved, get a name and phone.)

____

____

____

C6 Did you consider other equipment before selecting the **energy-efficient equipment**? ....what other equipment? (If alternate projects identified in the file or on-site, probe further)

____

____

____

C7 Had you been planning to purchase energy-efficient equipment before hearing about the PG&E program?

____

____

____

C8 How significant was the PG&E program in influencing your decision to install the energy efficient equipment?

____

____

____

C9 If the PG&E incentive had not been available, would you have specified equipment with the same efficiency? ...how efficient would it have been?

____

____

____

C10 ***[Only ask if State efficiency codes exist for installed Measure—list applicable Measures]*** Without the PG&E incentive, would you have specified equipment efficient enough to meet state efficiency codes? Would equipment been more efficient that for code?

____

____

____

C11 Without the PG&E incentive, would you have installed the energy-efficient equipment at the same time or at a later date? ....if later, how much later?

____

____

____

C12 Without the incentive, would you have installed the **same quantity** of energy-efficient equipment? ...how much less would you have installed?

____

____

____

Financial considerations: Review project economic data and probe where necessary (look at payback, size of rebate relative to project cost, etc.)

C13 Did your firm use any financial criteria to evaluate this energy-efficiency investment? (for example, payback, net present value, return on investment, break-even analysis, etc.) IF SO, indicate what criteria was used and what decision cut-off point was utilized:

Investment Criteria: ____

Decision cut-off point: ____

____

C14 What was the result of this calculation for this project, with and without the PG&E rebate?

With rebate: ____

Without rebate: ____

____

C15 How important were the financial calculations in you decision to install the measure(s)?
Not / Somewhat / Very / Extremely

____

____

____

C16 Where there any other financial considerations utilized in the decision? (examples include cash flow issues, tax considerations, etc.)

____

____

____

Potential Inconsistencies: Review data collected to date, identify potential inconsistencies in data, and explore - for example, where standard consistency check were activated or where different contacts provided different opinions about how important the Program was.

Inconsistency 1: ____

____

Response 1: ____

____

____

Inconsistency 2: ____

____

Response 2: ____

____

____

Inconsistency 3: ____

____

Response 3: ____

____

____

NOTES:

____

____

____

____

____

____

____

____

____

____

CONCLUSION

Thank you for your cooperation.

C

SITE REPORT TEMPLATES

This appendix contains the template used to develop the site reports.

Site Specific Project Impact Evaluation Report
Control #_______

Check Address *Site Address*

File Principal Contact:

File Secondary Contact:

PG&E Recommended Contact:

PG&E Div. Mktg. Rep:

Summary of Program Activity:

Projects Paid By 1998 Programs

Application Number	Program Year	Control Number	Account Number	End Use	PG&E Program	Project Type

Measures Within Each Project

Application Num	Meas ID	Measure Description	kWh	kW	Therms	Rebate	Project Type

Program and Evaluation Savings Estimate Summary

			Energy Savings						Net to	Realization Rate					
Applic.	Meas.		Gross			Net			Gross	Gross			Net		
Num	ID	Source	kWh	kW	Therms	kWh	kW	Therms	Ratio	kWh	kW	Therms	kWh	kW	Therms
		Ex Ante	0	0.0	0	0	0.0	0	0.00						
		Ex Post	0	0.0	0	0	0.0	0	0.00	-	-	-	-	-	-

1 2 3 4 5

C.1 Summary of Findings

- *Summarize gross impact results.*
- *Compare to ex post results to ex ante; explain why there are differences.*
- *Address net impacts relative to gross impacts.*

C.2 Facility Description

Describe the facility and the process that is impacted by the measure. Include: type of business, product, brief description of facility and how rebate project relates to overall facility and operation.

C.3 Overview of Facility Schedule

- *Provide general description of the facility's operating schedule.*
    - *Daily, weekly, monthly, and seasonally*
- *If equipment operations differ from general schedule then provide additional information.*

C.4 Measure Description

- *Describe the installed measure as determined in the analysis.*
- *Explain if different from the ex ante description.*

For pre and post conditions - use what we know to be true; indicate using "[Note:]" format where initial information from the project file/plan is different.

C.4.1 Pre-Retrofit Conditions

- *Identify all pre-retrofit conditions pertaining to the measure.*
- *Specifically identify equipment when information is available:*
    - *Equipment manufacturer, model number, capacity, rated input power, efficiency and other key descriptive and performance data*
    - *Number of units*
    - *Power and energy consumption (measured of rated)*
    - *Operating schedule: daily, weekly seasonal for full year*
    - *Production output or activity metric*

C.4.2 Post-Retrofit Conditions

- *Identify all post-retrofit conditions pertaining to the measure.*
- *Specifically identify equipment when information is available:*

- *Equipment manufacturer, model number, capacity, rated input power, efficiency and other key descriptive and performance data*
- *Number of units*
- *Power and energy consumption (measured of rated)*
- *Operating schedule: daily, weekly seasonal for full year*
- *Production output, activity or level of service metric*
- *Technical and economic aspects of project: (maintenance costs, quality improvements, etc.)*

C.5 EX ANTE METHODOLOGY

C.5.1 Ex Ante Analysis Approach

Provide a general description of the ex ante analysis approach, based on the file review.

C.5.2 Ex Ante Algorithms

Present algorithms used in the ex ante analysis.

Re-create calculations in a spreadsheet, and include as a table.

C.5.3 Ex Ante Base case

Summarize the base case used in the ex ante analysis.

C.5.4 Ex Ante Operating Schedule

Present the operating schedule used for the ex ante analysis. This may differ from the facility schedule shown above.

C.5.5 Ex Ante Key Assumptions

- *List key assumptions that were made as part of the ex ante analysis.*

C.5.6 Ex Ante Data Sources

- *Identify all data sources used in the ex ante analysis.*

C.6 PROPOSED EX POST EVALUATION METHODOLOGY

C.6.1 Ex Post Analysis Approach

- *Provide general overview of the proposed analysis approach.*
- *Identify alternative approaches if necessary.*

C.6.2 Ex Post Base case

Explain if ex ante base case is deemed appropriate.

- *If not, describe alternative base case or intermediate base case and discuss rationale for choosing.*

C.6.3 Ex Post Operating Schedule

Describe operating schedule used in the analysis. Identify differences from ex ante schedule.

Production Level Changes

Identify if production levels have changed.

- *If so, address whether or not the rebate caused the production changes and subsequent effect on the choice of base case and production level used in the analysis.*

C.6.4 Collected Data Ex Post

- *Identify key data items required for methodology and sources.*

C.6.5 Monitoring Requirements

If monitoring was utilized, describe. Present monitoring results - graphically.

C.6.6 Ex Post Algorithms

Present specific algorithms used.
Provide table showing execution of the analysis approach.

C.6.7 Annualization of Results

- *Explain how impact results were annualized.*
    - *Direct extrapolation, weather extrapolation, production activity indexing, etc.*
- *Address seasonality and how any seasonal operations were taken into account.*

C.6.8 PG&E Costing Period Impact Calculations

Describe how each element of PG&E's costing period table was calculated:

- *Gross kWh Impacts*
- *Annual Gross kWh Impact*
- *Average Gross kW Impacts*
- *Gross kW Impact Coincident with System Maximum (Hour)*
- *Connected Load Gross kW Impact*

C.7 SUMMARY OF GROSS IMPACTS

- *Results and comparison of ex post vs. ex ante - mainly compare annual kWh/therms and summer peak.*
- *Discussion of discrepancies - why the ex ante was wrong.*
- *Provide results by costing period.*

C.7.1 Ex Ante - Ex Post Discrepancies

Ex Ante vs. Ex Post Discrepancies

	Percent of total difference		
Discrepancy Factor	kWh	kW	Therms
Measures not in place			
Equipment/system performance different from projections			
Different operating conditions			
Basecase differences			
Methodology differences			
Secondary impacts not addressed			

C.7.2 Results by Costing Period

Costing Period	Avg. kW Savings	Avg. kW Savings Coincident with System Maximum	kW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW Savings
Summer On Peak	0.0	0.0	0.000	0	0.000	0	0.0
Summer Part Peak	0.0	0.0	0.000	0	0.000	0	0.0
Summer Off Peak	0.0	0.0	0.000	0	0.000	0	0.0
Winter Part Peak	0.0	0.0	0.000	0	0.000	0	0.0
Winter Off Peak	0.0	0.0	0.000	0	0.000	0	0.0

Summer On Peak: May 1 to Oct. 31 Noon-6 p.m. Weekdays (Coincid. Peak: 3-4 PM Weekdays)
Summer Part Peak: May 1 to Oct. 31 8:30 a.m. - Noon & 6-9:30 p.m. Weekdays (Coincid. Peak: 6-7 PM Weekdays)
Summer Off Peak: May 1 to Oct. 31 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday (Coincid. Peak: 10-11 PM Weekdays)
Winter Part Peak: Nov. 1 to Apr. 30 8:30 a.m. - 9:30 p.m. (Coincid. Peak: 6-7 PM Weekdays)
Winter Off Peak: Nov. 1 to Apr. 30 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday (Coincid. Peak: 8-9 AM Weekdays)

C.8 SPILLOVER

- *Identification of spillover measures*
- *Analysis of impacts*
- *Results*

C.9 NET-TO-GROSS RESULTS

Project net-to-gross ratio: ___

C.9.1 Standard Net-to-Gross Analysis

Discussion of survey results leading to the standard net-to-gross ratio.

C.9.2 Custom Net-to-Gross Analysis

Discussion of custom survey results and rationale for recommending a specific project net-to-gross ratio.

C.10 ATTACHMENTS

C.10.1 Included in This Report

Identify any tables, figures etc. that are included in the report.

C.10.2 Electronic

Spreadsheet containing detailed calculations and report tables: 0000000A.xls

D

WAIVER

PACIFIC GAS & ELECTRIC COMPANY
REQUEST FOR RETROACTIVE WAIVER FOR
Pre-1998 CEEI PROGRAM CARRY-OVER: PROCESS END USE
Study ID # 404c
Date Approved: 5/20/99

Program Background

Pacific Gas & Electric Company's (PG&E's) pre-1998 Commercial sector process end-use DSM programs were designed to promote the installation of energy efficient equipment in commercial process applications. Rebated measures included adjustable speed drive motors, new compressors, efficient pumps and motors, insulation, and controls.

The pre-1998 program carry-overs are being evaluated by PG&E, with one of the objectives being to assess the actual load impacts resulting from the process measures committed under the pre-1998 programs but rebated during 1998 (Carry-Over).

Pre-1998 Program Carry-Over Summary: Process End Use

Technology	Projects	Avoided Cost	Percentage of Avoided Cost
PROCESS (CUSTOMIZED)	12	2,547,113	75.9%
Variable Frequency Drive: Water Pump	7	809,599	24.1%
TOTAL (Unique Sites)	19	3,356,713	100.0%

Proposed Waiver

The purpose of this waiver is to state PG&E's interpretation of the Protocols[1] for use in conducting the pre-1998 Commercial Sector EEI Evaluation of the Process End Use (Commercial Process Program) Carry-Over. PG&E seeks the California DSM Measurement Advisory Committee's (CADMAC's) approval to use methods described in the Protocols, Table C-5 for industrial end uses for impact measurement for the pre-1998 Commercial Process Program first year study. This approach will be used instead of the methods described in the Protocols Table C-4 for commercial end uses. In particular the following methods from Protocols Table C-5 will be applied in this study:

1. For the estimation of first year gross kW, kWh, and therm impacts, project-specific engineering models will be utilized. The engineering analysis will be applied to projects representing at least 70% of the total kW, kWh, and therm savings for the process end use. In addition, verification of installation will be conducted for all projects in the evaluation sample. This approach is consistent with acceptable methods outlined in the Protocols Table C-5 for the Industrial process end use.

[1] Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings for Demand-Side Management Programs, as adopted by California Public Utilities Commission Decision 93-05-063, revised March 1998.

2. For the estimation of first year net impacts, customer self-report data will be used to construct project-specific net-to-gross ratios. These net-to-gross ratios will be multiplied by gross impacts to provide net impact estimates. A comparison group will not be used. This approach is consistent with acceptable methods outlined in the Protocols Table C-5 for the Industrial process end use.

Furthermore, PG&E would like to obtain approval from the CADMAC to define the DUOM for the process end use as the number of projects rebated, where a project is uniquely defined as the combination of customer control number and application number.

Rationale

The following reasons are provided to explain why PG&E feels their recommended approach described above is justified under the Protocols.

1. The Protocols Table C-4 for Commercial end uses focuses on evaluation methods for the indoor lighting, HVAC, and gas cooking end uses. The Protocols Table C-5 for Industrial end uses addresses evaluation methods for the process end use.

2. For the estimation of first year gross kW, kWh, and therm impacts, project-specific engineering models will be utilized. As stated in Protocols Table C-4, Item 2 for Commercial end uses, the end use consumption and load impact model should be either a LIRM or CE. Protocols Table C-5, Item 2 for industrial end uses indicates that LIRM, CE, or Engineering Models should be used. Table C-5, Item 2 also states that engineering analysis must be applied to projects representing at least 70% of the total kW, kWh, and therm savings. The engineering models we propose to use will be premises-specific engineering analysis representing at least 70% of the total kW, kWh, and therm savings. This approach is consistent with the accepted approaches outlined in Protocols Table C-5.

3. For the estimation of first year net impacts, customer self-report data will be used to construct project-specific net-to-gross ratios. These net-to-gross ratios will be multiplied by gross impacts to provide net impact estimates. Protocols Table C-4 for Commercial end uses indicates that a comparison group should be used in the determination of net impacts. Protocols Table C-5 for Industrial end uses indicates that a comparison group is not required. We propose to use a self-report net-to-gross method to develop net impact estimates. This approach does not utilize a comparison group.

4. The DUOM for the Industrial process end use is also the number of projects rebated, where a project is uniquely defined as the combination of customer control number and application number.

We believe that there are a number of advantages to using the methods specified for the Industrial process end use in this evaluation of the Commercial process end use:

- There are only 19 projects included in the pre-1998 Commercial process end use population carry-over. It is generally not feasible to apply statistical models, such as LIRM or CE, to such a small sample. On the other hand, the limited number of projects is well suited for the application of a project-specific analysis approach.

- The type of projects to be evaluated include measures such as adjustable speed drive motors, new compressors, efficient pumps and motors, insulation, and controls that are installed in commercial process applications such as waste water treatment facilities, water pumping facilities, prisons, and wholesale distribution facilities. These measures and applications are more similar to measures and applications found in the industrial process end use than they are to measures and applications typically evaluated in the commercial sector. Thus, an industrial evaluation approach is more appropriate for these measures and applications.
- Given the customization of the projects being considered in this evaluation, it will not be possible to locate an appropriate control group for the net-to-gross analysis. Therefore, a self-report net-to-gross method is the only reasonable approach for determining if rebated measures would have been installed by some customers in the absence of the program.

Conclusion

PG&E is seeking a waiver to clearly define, in advance, acceptable methods for performing the pre-1998 Commercial Process Program Carry-Over evaluation. Recommendations in this waiver are designed to maximize the quality and value of evaluation results. The waiver allowing the use of industrial evaluation techniques will allow for the most cost-effective and reliable set of first year load impact estimates.

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E

PROTOCOLS TABLES 6 AND 7

This appendix contains Tables 6 and 7 required to comply with the CPUC M&E Protocols. The tables are presented in the following order:

1. Table 6 - Process
2. Table 7 - Process

Table 6 - Process

M&E PROTOCOLS TABLE 6 **Commercial Energy Efficiency Incentive Program**

ENDUSE: Process
Designated Unit of Measurement: Project

1. Average Participant Group and Average Comaprison Group		**Participant**	**Comparison**								
A. Pre-install usage:	Pre-install kW	na	na								
	Pre-install kWh	na	na								
	Pre-install Therms	na	na								
	Base kW	na	na								
	Base kWh	na	na								
	Base Therms	na	na								
	Base kW/ designated unit of measuremen	na	na								
	Base kWh/ designated unit of measurement	na	na								
	Base Therms/ designated unit of measurement	na	na								
B. Impact year usage:	Impact Yr kW	na	na								
	Impact Yr kWh	na	na								
	Impact Yr Therms	na	na								
	Impact Yr kW/designated unit	na	na								
	Impact Yr kWh/designated unit	na	na	**5. A. 90% CONFIDENCE LEVEL**				**5. B. 80% CONFIDENCE LEVEL**			
	Impact Yr Therms/designated unit	na	na	**LOW BND**	**UP BND**	**LOW BND**	**UP BND**	**LOW BND**	**UP BND**	**LOW BND**	**UP BND**
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 - k	585	369	585	585	362	376	585	585	364	374
	A. ii. Load Impacts - kWh	3,858,481	2,467,472	3,858,481	3,858,481	2,425,029	2,509,915	3,858,481	3,858,481	2,434,395	2,500,549
	A. iii. Load Impacts - Therms	226,812	195,032	226,812	226,812	195,032	195,032	226,812	226,812	195,032	195,032
	B. i. Load Impacts/designated unit - k	31	19	31	31	19	20	31	31	19	20
	B. ii. Load Impacts/designated unit - kWh	203,078	129,867	203,078	203,078	127,633	132,101	203,078	203,078	128,126	131,608
	B. iii. Load Impacts/designated unit - Therms	11,937	10,265	11,937	11,937	10,265	10,265	11,937	11,937	10,265	10,265
	C. i. a. % change in usage - Part Grp - k	na	na	na	na	na	na	na	na	na	na
	C. i. b. % change in usage - Part Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. i. c. % change in usage - Part Grp - Therms	na	na	na	na	na	na	na	na	na	na
	C. ii. a. % change in usage - Comp Grp - k	na	na	na	na	na	na	na	na	na	na
	C. ii. b. % change in usage - Comp Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. ii. c. % change in usage - Comp Grp - Therms	na	na	na	na	na	na	na	na	na	na
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	0.695	0.585	0.695	0.695	0.574	0.596	0.695	0.695	0.576	0.594
	D.A. ii. Load Impacts - kWh, realization rate	0.577	0.492	0.577	0.577	0.484	0.500	0.577	0.577	0.485	0.499
	D.A. iii. Load Impacts - Therms, realization rate	1.052	1.206	1.052	1.052	1.206	1.206	1.052	1.052	1.206	1.206
	D.B. i. Load Impacts/designated unit - kW, real rate	0.695	0.585	0.695	0.695	0.574	0.596	0.695	0.695	0.576	0.594
	D.B. ii. Load Impacts/designated unit - kWh, real rate	0.577	0.492	0.577	0.577	0.484	0.500	0.577	0.577	0.485	0.499
	D.B. iii. Load Impacts/designated unit - Therms, real rate	1.052	1.206	1.052	1.052	1.206	1.206	1.052	1.052	1.206	1.206
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**			**RATIO**	**RATIO**		
	A. i. Average Load Impacts - k	0.63		0.62	0.64			0.62	0.64		
	A. ii. Average Load Impacts - kWh	0.64		0.63	0.65			0.63	0.65		
	A. iii. Average Load Impacts - Therms	0.86		0.86	0.86			0.86	0.86		
	B. i. Avg Load Impacts/designated unit of measurement - kW	0.63		0.62	0.64			0.62	0.64		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	0.64		0.63	0.65			0.63	0.65		
	B. iii. Avg Load Impacts/designated unit of measurement - Therms	0.86		0.86	0.86			0.86	0.86		
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - k	na		na	na			na	na		
	C. ii. Avg Load Impacts based on % chg in usage in Impac year relative to Base usage in Impact year - kWh	na		na	na			na	na		
	C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms	na		na	na			na	na		
4. Designated Unit Intermediate Data		**PART GRP**	**NP GRP**					**PART GRP**	**PART GRP**		
	A. Pre-install average value	19	na					na	na		
	B. Post-install average value	19	na					na	na		
6. Measure Count Data		**NUMBER**									
	Group	See next page									
	B. Number of measures installed by all program participants in the 12 months of the program year	See next page									
	C. Number of measures installed by Comp Group	na									
7. Market Segment Data											
	B. Distribution of participants by 3 digit SIC	See next page									

M&E PROTOCOLS TABLE 6 (CONTINUED)

6A/6B Measure Count Data

Measure Code	Measure Description	Participant Group	Population
550	Process Controls	2	2
560	Process Heat Recovery	3	3
569	Process Change/Add Equipment	1	1
574	Process Energy Efficient Motor	1	1
578	Process Adjustable Speed Drive	3	3
580	Process Change Physical	1	1
589	Air Compresser System Change/Modify	2	2
599	Process Other	1	1
P9	Variable Frequency Drive: Water Pumping: Throttling Valve to VFD	17	17
P10	Variable Frequency Drive: Water Pumping: ASD to VFD	5	5
	Totals	36	36

7B Distribution of 3 Digit SICs

SIC3	Percent
72	15.8%
401	5.3%
494	5.3%
495	63.2%
721	5.3%
922	5.3%

Table 7 - Process

M&E PROTOCOLS TABLE 7

The purpose of this section is to provide the documentation for data quality and processing as required in Table 7 of the California Public Utility Commission (CPUC) Evaluation and Measurement Protocols (the Protocols). Major topics are organized and presented in the same order as they are listed in Table 7 for ease of reference and review. When responses to the items are discussed in detail elsewhere in the report, only a brief summary will be given in this section to avoid redundancy.

E.1 OVERVIEW INFORMATION

E.1.1 Study Title and ID Number

Pre-1998 Commercial Energy Efficiency Incentive Program 1998 Carry-Over Impact Evaluation, Process End Use, PG&E Study ID # 404C

E.1.2 Program, Program Year, and Program Description

PG&E's Commercial Energy Efficiency Incentives Programs

Program Year 1998 (carry-over from previous years)

The Programs provide incentives to commercial customers to install energy-efficiency measures. The Programs addressed in this evaluation include the Retrofit Efficiency Options Program (REO) and the Advanced Performance Options Program (APO).

E.1.3 End Uses Covered

Commercial Process

E.1.4 Methods Used

Site-specific engineering approach

E.1.5 Participant and Comparison Group Definitions

Participants: Commercial customers who received rebate checks in 1998 for installing Process measures

Comparison Group: None

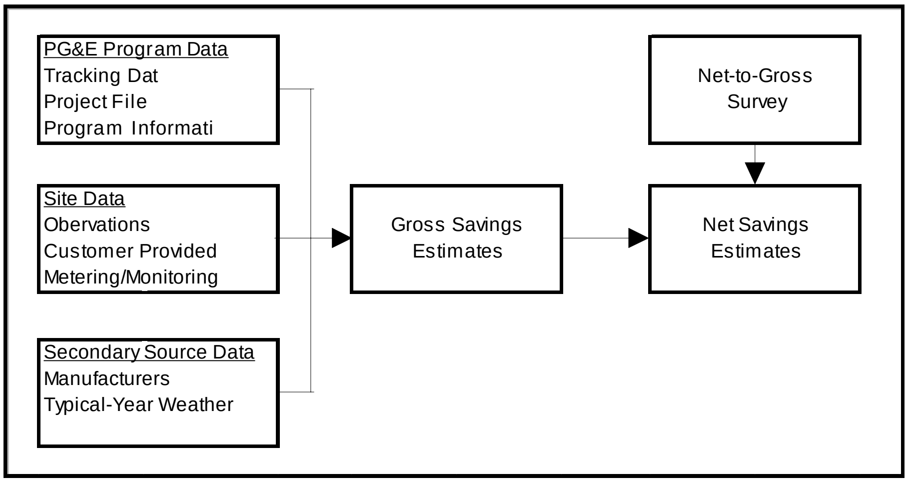
E.1.6 Analysis sample size

16 customers, 19 installations, 36 measures installed, 19 observations (project installation level); these sites accounted for 100% of the kW, kWh, and therm savings.

E.2 DATABASE MANAGEMENT

E.2.1 Data Flow Chart

Following is a flow chart describing the project data flow.



E.2.2 Data Sources

See flowchart provided above for Item B.1.

E.2.3 Sample Attrition

Nineteen projects were identified for possible site analyses; all 19 projects were analyzed for gross savings.

Seventeen projects were included in the net savings analysis. Thus, 2 projects were excluded from the portion of the analysis. One excluded project had zero gross impacts, and a net savings analysis was not required. The decision-maker for the second excluded project had left the organization, and an informed associate could not be located.

E.2.4 Quality Checks

Each site analysis was assigned to a senior engineer. The site analysis was planned and conducted, and a report was produced documenting all site-specific evaluation analyses and results. The site report was reviewed by the an evaluation engineer, the evaluation project manager, and PG&E staff for completeness.

E.2.5 Data Not Used

N/A

E.3 SAMPLING

E.3.1 Sampling Procedures and Protocols

Population/sampling frame: 19 commercial process projects.

Sampling strategy: A census was attempted (and completed) for the 19 projects.

Sampling basis: N/A

Stratification criteria: N/A

E.3.2 Survey Information

Instruments - see Appendix B of this report for survey instruments;
Response rates - see Item B.3 above for response rates.
Non-response bias - no attempts were made to account for non-response bias.

E.3.3 Statistical Descriptions

N/A

E.4 DATA SCREENING AND ANALYSIS

1. *Outliers*: N/A
2. *Background Variables*: N/A
3. *Data Screening*: N/A, all visited sites were included.
4. *Regression Statistics*: N/A; analysis method was site-specific engineering calculation supported by metering/monitoring.
5. *Specification*: N/A; regression model was not used.
6. *Error in Measuring Variables*: Complex site studies made the best use of available data and the analysis approach was chosen to minimize measurement errors. Multiple levels of site analysis review were utilized to identify potential anomalies which were further researched.
7. *Autocorrelation*: N/A
8. *Heteroskedasticity*: N/A
9. *Collinerarity*: N/A
10. *Influential Data Points*: N/A
11. *Missing Data*: N/A

12. *Precision*: Gross savings - the population of commercial process projects was included in the analysis, there was no sampling variance. Net-to-gross: the standard error of the mean net-to-gross ratio was utilized in the precision calculations.

13. *Engineering Analysis*: The engineering analyses used for this evaluation followed the general guidelines provided in Section 3 of Appendix J of the M&E Protocols. Several key aspects of the guidelines are addressed here:
    Data collection: On-site surveys conducted by senior engineering staff were used as the primary source of data collection. In many cases, the analysis was supported by metering/monitoring of post-retrofit equipment. Metering periods ranged from one week to four weeks. In addition, spot measurements or observation of customer's control-panel read-outs were used to ascertain equipment performance.
    Base case definition: For each analyzed project, the ex ante base case assumptions contained in the PG&E project file were carefully reviewed for reasonableness. Discussions with customer staff were utilized to support the review. For all projects, pre-retrofit equipment/system specifications were available in the project file. In some necessary cases, pre-retrofit system measurements were also available. In most cases, the ex ante base case assumptions were deemed appropriate and used for the ex post analysis. In several cases where pre-retrofit equipment was at the end of its useful life, the base case equipment specifications were adjusted to conform with industry standards. For one project that involved construction of a new compressor system, the base case was determined to be the same as the postcase, and savings were set to zero.
    Interactive effects: Engineering calculations were based on simple, equipment-specific models and did not included interactive effects. While the analyses did address impacts on the relevant process *systems* at each site, secondary effects on other end uses were not deemed significant and were not addressed.
    Changes in production: Changes in production occurred at a number of analysis sites. In each case, the influence of the PG&E incentive on the production increase was assessed. In all cases, it was determined (through customer interview or technical assessment of the measure, i.e. for control measures) that the production increases would have occurred anyway. In these cases, the post-retrofit production levels was used as the basis of the impact calculation.

14. *Net-to-Gross Analysis*: As self-report method was utilized for this study. All projects received a standard net-to-gross survey, and a follow-up custom survey and analysis. Key aspects of the net-to-gross analysis are discussed next:
    Identifying the correct respondent: The initial customer contact was asked to identify the appropriate net-to-gross respondent as part of the on-site survey.
    Set-up questions: Set-up questions regarding customer satisfaction with the measures and the program and the customer's sources of measure and program information were used to get the customer thinking about the measure installation decision.
    Use of multiple net-to-gross measures: Two primary questions were used to assess net-to-gross in the standard analysis. The questions addressed the significance of the program in the customer's decision to install measures and what the customer would have done in the absence of the incentive. The intended actions questions was the primary question is setting

up the net-to-gross ratio. The program significance question was used as a consistency check to adjust the net-to-gross ratio when the intended actions question appeared inconsistent with other responses. In addition, the timing of the program influence with respect to purchase decisions was used as an additional consistency check to identify free-riders. For the custom surveys, additional questions regarding financial assessment criteria and non-energy benefits were also factored into the net-to-gross analysis.

Use of multiple respondents: The custom net-to-gross analysis incorporated, when relevant, the input of multiple customer respondents. The most weight in the analysis was placed on the responses of the primary decision maker.

Partial and deferred free-ridership: Survey questions and analysis addressed both partial and deferred free-ridership.

Third party influence: For the custom net-to-gross analyses, if the customer respondent indicated a vendor was influential in the measure installation decision, an attempt was made to survey the vendor.

Non-responses and don't knows: customers who did not respond to the survey were dropped from the net-to-gross analysis. They essentially received the average net-to-gross ratio.

Weighting: Impact weighted-average net-to-gross ratios were calculated separately for kW, kWh, and therm impacts.

Spillover: Spillover was calculated for a project if: (1) the customer indicated they installed additional measures that were not included in the PG&E tracking records; (2) the measures were installed as a result of the PG&E program; and (3) the customer did not plan to apply for a rebate for these additional measures.

E.5 DATA INTERPRETATION AND APPLICATION

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

E

PROTOCOLS TABLES 6 AND 7

This appendix contains Tables 6 and 7 required to comply with the CPUC M&E Protocols. The tables are presented in the following order:

1. Table 6 - Process
2. Table 7 - Process

Table 6 - Process

Table 7 - Process

F EVALUATION DATABASE

This appendix describes the final data products associated with this evaluation. First the directory structure is show. Next each file is described. Finally the variables in the final evaluation dataset are described. All data are provided on CD-ROM.

F.1 DIRECTORY STRUCTURE

The directory structure for the electronic data provided in conjunction with this evaluation is provided in Table E-1.

Table F-1
Electronic Data Directory Structure

Subdirectory	Description
FINAL DATA	Final evaluation dataset in Excel format
PROGRAM	Tracking, billing, and summarization data for all program projects
SITES	Process project reports and analysis spreadsheets
\REPORTS	Reports
\SPREADSHEETS	Analysis spreadsheets

F.2 DESCRIPTION OF ELECTRONIC FILES

Table E-2 on the following page presents the electronic files supporting the evaluation. Descriptions of each file are provided.

Table F-2
Electronic Files

DATASET	DESCRIPTION
FINAL DATA	Subdirectory containing the final evaluation datasets
FNLDATA.XLS	Excel dataset
PROGRAM	Subdirectory with data/summarization for all program sites
Tracking Data.xls	PG&E program tracking system data
Billing Data.xls	PG&E billing sytem data
Results Summary.xls	Summarization of site results to the program level
PROCSITES\REPORTS	Subdirectory of Process site reports
R*******.DOC	21 project reports; ******* identifies the PG&E Control Number for the analyzed site
PROCSITES\SPREADSHEETS	Subdirectory of Process site spreadsheets
*******.XLS	21 project spreadsheets; ******* identifies the PG&E Control Number for the analyzed site

F.3 DESCRIPTION OF EVALUATION DATASET VARIABLES

Table E-3 on the following page presents the variables provided in the final evaluation dataset. Descriptions are also provided.

Table F-3
Final Evaluation Dataset Variables

DATA TYPE	VARIABLE NAME	DESCRIPTION
IDENTIFICATION	APPLCODE	APPLICATION NUMBER
	CONTROL	CONTROL NUMBER FOR ITEM
	ENDUSE	SORTED END USE CODE
	MEAS_COD	MEASURE CODE
TRACKING	ACCOUNT	ACCOUNT CODE FOR ITEM
	BILLNAME	CUSTOMER BILLING NAME
	CHECKNUM	NUMBER OF REBATE CHECK
	CHK_CITY	CITY OF REBATE RECIPIENT
	CHK_ST	STATE OF REBATE RECIPIENT
	CHK_STRT	STREET ADDRESS OF REBATE RECIPIENT
	CHK_ZIP	ZIP CODE OF REBATE RECIPIENT
	CLI_ZONE	CEC CLIMATE ZONE
	CONTAREA	PRIMARY MDSS PHONE AREA CODE
	CONTFNAM	CONTACT'S FIRST NAME
	CONTLNAM	CONTACT'S LAST NAME
	CONTPHON	PRIMARY MDSS PHONE
	CORPID	CORPORATE ID CODE
	DIV_CODE	DIVISION CODE FOR ITEM
	DT_CHKIS	MMDDYY8. ACTUAL ISSUE DATE FOR REBATE CHECK
	DT_PREFD	MMDDYY8. DATE OF SITE PRE-INSTALL INSPECTION
	DT_PSTFD	MMDDYY8. DATE OF SITE POST-INSTALL INSPECTION
	DT_RECVD	MMDDYY8. DATE APPLICATION RECEIVED
	DTPRJCMP	MMDDYY8. DATE PROJECT IS COMPLETED
	FEDTAXID	CUSTOMER FEDERAL TAX NUMBER
	KWH97	ANNUALIZED 97 USAGE
	MEASURE	MEASURE DESCRIPTION
	NETKW	ITEM NET KW IMPACT
	NETKWH	ITEM NET KWH IMPACT
	NETTHM	ITEM NET THM IMPACT
	PAVDCST1	AVOIDED COST OF PAID SAVINGS FOR ITEM
	PAY_TO	NAME OF REBATE RECIPIENT
	PCMPDTE1	MMDDYY8. COMPLETION DATE OF PAID PROJECT
	PINCCST1	PAID INCREMENTAL COST OF ITEM
	PKW1	PAID TOTAL KW SAVINGS FOR ITEM
	PKWH1	PAID TOTAL KWH SAVINGS FOR ITEM
	PNTG1	PAID NET-TO-GROSS RATION
	PNUMPUR1	PAID NUMBER OF ITEM PURCHASED
	PPJ_LIF1	PAID PROJECT LIFE OF ITEM
	PPRJCST1	PAID PROJECT COST OF ITEM
	PREBATE1	PAID REBATE TO CUSTOMER FOR ITEM
	PRG_YEAR	YEAR APPLICATION SUBMITTED
	PRJDESC1	PROJECT DESCRIPT. FOR APPLICATION - 1
	PRJDESC2	PROJECT DESCRIPT. FOR APPLICATION - 2
	PROG_COD	PROGRAM CODE - CR/CRE/REO/TESN
	PSHRHLD1	SHAREHOLDER $ OF PAID SAVIONGS/EXP.

Table F-3
Final Evaluation Dataset Variables

DATA TYPE	VARIABLE NAME	DESCRIPTION
TRACKING (cont.)	PTHM1	PAID TOTAL THM SAVINGS FOR ITEM
	SERVADDR	SERVICE ADDRESS
	SERVCITY	SERVICE CITY
	SERVZIP	SERVICE ADDR ZIP CODE
	SIC_CODE	SIC CODE FOR ITEM
	SQ_FOOT	SQUARE FOOTAGE FROM APPLICATION
SURVEY	C1	STD NTG SURVEY QUESTION 1
	C10	STD NTG SURVEY QUESTION 10
	C10YRLAT	STD NTG SURVEY QUESTION 11
	C2	STD NTG SURVEY QUESTION 2
	C3	STD NTG SURVEY QUESTION 3
	C4	STD NTG SURVEY QUESTION 4
	C5	STD NTG SURVEY QUESTION 5
	C6	STD NTG SURVEY QUESTION 6
	C7	STD NTG SURVEY QUESTION 7
	C8	STD NTG SURVEY QUESTION 8
	C9	STD NTG SURVEY QUESTION 9
	CUSTEQP	CUSTOMER EQUIPMENT DESCRIPTOR
	DISCREP	DISCREP
	EQPDUTY	EQUIPMENT USAGE DUTY
	EQPMFR	EQUIPMENT MANUFACTURER
	EQPPOWER	EQUIPMENT NAMPLATE POWER
	EQPSIZE	SIZE OF PROCESS EQUIPMENT
	EXPECT	NUMBER EXPECTED
	INST_DT	MEASURE INSTALL DATE (PER CUSTOMER)
	MODELNUM	EQUIPMENT MODEL NUMBER
	OBSERV	NUMBER OBSERVED
	PRJNOTES	PROJECT NOTES
	REM_DT	MEASURE REMOVE DATE
	REMOVE	REMOVAL CODE
	SURVDATE	SURVEY DATE
	SURVEYOR	SURVEYOR
	WORKING	PERCENT WORKING
ANALYSIS	CNTGR	CUSTOM NET-TO-GROSS RATIO
	NPSTKW	NET KW SAVINGS - EX POST
	NPSTKWH	NET KWH SAVINGS - EX POST
	NPSTTHM	NET THM SAVINGS - EX POST
	PSTANKWH	GROSS ANNUAL KWH SAVINGS - EX POST
	PSTANTHM	GROSS ANNUAL THM SAVINGS - EX POST
	PSTNOCKW	CHANGE IN CONNECTED LOAD PER UNIT
	PSTPKKW	GROSS PEAK KW SAVINGS - EX POST
	RRGKW	GROSS REALIZ RATE KWH
	RRGKWH	GROSS REALIZ RATE KWH
	RRGTHM	GROSS REALIZ RATE KWH
	RRNKW	NET REALIZ RATE KWH
	RRNKWH	NET REALIZ RATE KWH
	RRNTHM	NET REALIZ RATE KWH
	SNTGR	STANDARD NET-TO-GROSS RATIO
	SOFFAKW	SUMMER OFF-PEAK AVG KW SAVINGS
	SOFFKWH	SUMMER OFF-PEAK KWH SAVINGS

Table F-3
Final Evaluation Dataset Variables

DATA TYPE	VARIABLE NAME	DESCRIPTION
ANALYSIS (cont.)	SOFFPKW	SUMMER OFF-PEAK PEAK KW SAVINGS
	SOPAKW	SUMMER ON-PEAK AVG KW SAVINGS
	SOPKWH	SUMMER ON-PEAK KWH SAVINGS
	SOPPKW	SUMMER ON-PEAK PEAK KW SAVINGS
	SPPAKW	SUMMER PARTIAL-PEAK AVG KW SAVINGS
	SPPKWH	SUMMER PARTIAL-PEAK KWH SAVINGS
	SPPPKW	SUMMER PARTIAL-PEAK PEAK KW SAVINGS
	WOFFAKW	WINTER OFF-PEAK AVG KW SAVINGS
	WOFFKWH	WINTER OFF-PEAK KWH SAVINGS
	WOFFPKW	WINTER OFF-PEAK PEAK KW SAVINGS
	WPPAKW	WINTER PARTIAL-PEAK AVG KW SAVINGS
	WPPKWH	WINTER PARTIAL-PEAK KWH SAVINGS
	WPPPKW	WINTER PARTIAL-PEAK PEAK KW SAVINGS