IMPACT EVALUATION OF COMMERCIAL SECTOR MISCELLANEOUS MEASURES IN PG&E'S 1994 RETROFIT ENERGY EFFICIENCY PROGRAMS

Final Report

Prepared for

Pacific Gas and Electric Company
San Francisco, California

Prepared by

XENERGY Inc.
Oakland, California

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EXECUTIVE SUMMARY

This report presents the 1994 impact evaluation results for the commercial sector miscellaneous measures in Pacific Gas and Electric's (PG&E) retrofit energy efficiency programs. This is one of four separate reports documenting the methodology, results, and recommendations of an evaluation of selected projects that received incentives in 1994 through PG&E's Commercial, Industrial, and Agricultural Programs (the CIA Programs). Other reports address the following end uses: Industrial Process, Industrial Miscellaneous, and Commercial Miscellaneous.

E.1 BACKGROUND

In 1994, PG&E provided retrofit incentives to commercial, industrial, and agricultural customers through two incentive programs:

- The CIA Retrofit Customized Program (the Customized Program); and
- The CIA Retrofit Express Program (the Express Program).

In 1994, a total of 183 sites installed miscellaneous measures through these programs. Measures installed affected four primary end uses: motors, food service, process, and refrigeration. PG&E estimated total ex ante impacts at these sites to be 5,772 kW, 35,065,085 kWh, and 431,615 therms.

Each of the programs is described briefly below.

E.1.1 The Customized Program

The Customized Program provides incentives to commercial, industrial, and agricultural customers to install custom-designed energy-efficiency measures. The program covers both new construction and retrofit projects. Both electric and gas projects are covered by the Customized Program, although the majority of projects are electric. Any measures covered under the Express Program cannot be included in the Customized Program.

E.1.2 The Express Program

The Express Program provides incentives for commercial, industrial, and agricultural customers to retrofit their facilities with energy-

efficient equipment from a pre-specified list of measures. Incentives are provided for equipment in the areas of air conditioning, agricultural, food service, refrigeration, lighting, and motors.

E.2 PROJECT OVERVIEW

E.2.1 Evaluation Objectives

The primary objectives of the evaluation were to:

- Determine defensible estimates of the gross and net impacts (kW, kWh, and therm) resulting from commercial miscellaneous measures installed through PG&E's incentive programs;
- Identify any discrepancies between estimated and measured impacts; and
- Determine 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.

E.2.2 Gross Savings Analysis

The evaluation employed an enhanced engineering approach to quantify gross measure impacts for each study site. The principal source of data for the study came from on-site surveys. This data was supplemented with strategic monitoring data as well as data from existing data sources, including PG&E project files, customer's facility management systems, manufacturer's equipment performance data, and billing data.

For the miscellaneous measures (primarily refrigeration, motors, process, and commercial food service) both site-specific analyses and engineering models were used. Refrigeration and process sites generally received a customized analysis due to the large variation in measures and facilities included in the study. Efficient motors were evaluated using a time-of-use engineering analysis model that relied on measured motor performance and customer-supplied operating schedules. Food service measures (mostly refrigerator door closers and gaskets) were analyzed using a spreadsheet-based engineering model as data observed during on-site inspections.

E.2.3 Net-to-Gross Analysis

No net-to-gross analysis was performed for miscellaneous measures. Rather, a net-to-gross ratio of 0.75 was utilized. This net-to-gross ratio is prescribed in the Protocols for miscellaneous measures.

E.3 KEY FINDINGS

Based on the results of the impact evaluation, the 1994 commercial miscellaneous measures are achieving net electric energy savings of 28.0 GWh per year, net summer peak demand savings of 4.140 MW, and net natural gas savings of 245,989 therms per year. Table E-1 presents key gross and net evaluation impacts.

Table E-1
1994 Commercial Miscellaneous Measures
Gross and Net Savings Estimates

	Annual kWh	Summer Peak kW	Annual Therms
1. PG&E Gross Savings	35,065,085	5,772	431,615
2. PG&E Net-to-Gross Ratio*	0.73	0.74	0.75
3. PG&E Net Savings (1×2)	25,597,512	4,271	323,711
4. Evaluation Gross Realization Rate	1.06	0.96	*0.76***
5. Evaluation Gross Savings (1×4)	37,322,432	5,520	327,985****
6. Evaluation Net-to-Gross Ratio	0.75	0.75	0.75
7. Evaluation Net Savings (5×6)	27,991,824	4,140	245,989
8. Net Savings Realization Rate (7÷3)	1.09	0.97	0.76

* Based on a weighted average of motors @ 0.78, refrigeration @ 0.65, and other miscellaneous @ 0.75.
** Implied
*** Evaluation results for one large therm site were added to PG&E results at other therm sites.

The table reveals the following key findings:

- One hundred six percent of gross kWh savings and 96 percent of gross summer peak kW savings are being realized;
- Gross natural gas savings, based on a combination of evaluation results for the largest program site and PG&E estimates for the smaller sites, are 76 percent of the initial tracking system estimate; and
- Net electric savings are similar to PG&E's ex ante estimates: somewhat higher for kWh and slightly lower for kW.

Evaluation results for kWh and kW are displayed graphically in Figures E-1 and E-2.

Figure E-1
PG&E 1994 Commercial Miscellaneous Measures
Comparison of Annual Energy Impacts

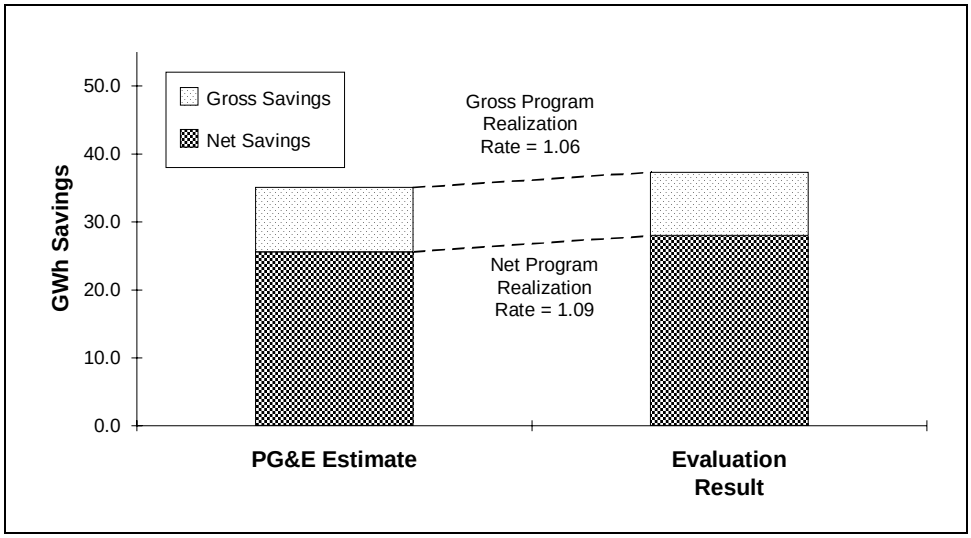
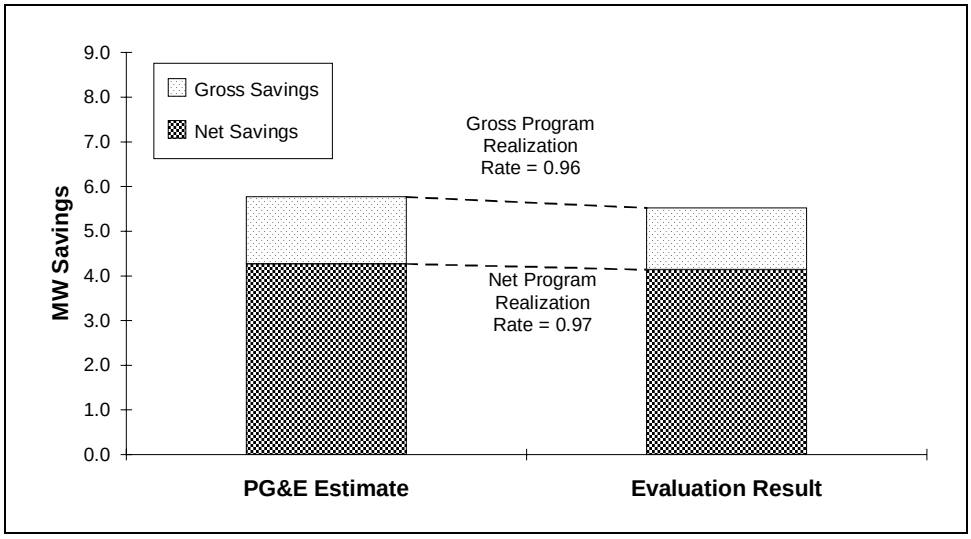


Figure E-2
PG&E 1994 Commercial Miscellaneous Measures
Comparison of Summer Peak Demand Impacts



Evaluation results were similar to PG&E's due to the effects of offsetting factors. Some key factors include:

- Operating hours for motors measures were higher that those assumed for Express Program calculations for a number of the larger impact sites, thus increasing realization rates;
- Motor load factors and on peak usage also were higher than originally estimated;
- Peak kW savings for one very large process site were estimated to be zero in the evaluation because the customer's operations are seasonal and do not include the peak summer months; and
- Refrigeration peak kW savings were higher than the initial PG&E estimates, based on evaluation analyses that incorporated site-specific data to improve on PG&E's generalized models and assumptions.

E.4 RECOMMENDATIONS

During the course of the evaluation, the project team was able to identify several factors that could lead to improvements in the PG&E programs and aid in future evaluations of this type. Key evaluation results indicate that program savings were overestimated, especially for kW impacts. In addition, about half of the program participants appear to be free riders. Recommendations for improving the program follow.

Applicability of Express Measures to Large Sites

For large savings sites, use of the Express Program with its standardized savings estimates and standardized operating estimates can lead to large errors in initial impact estimates. For several large sites, the Express Program estimates were very low, due to higher load factor and increased operating hours at these sites.

Recommendation: Set a savings size limit for the Express Program to ensure that large sites receive Custom applications that are site specific.

Use of Equipment Performance Data

Collection of equipment performance data for some types of equipment, such as chillers, is very difficult during the evaluation, although this information can greatly improve impact estimates. Manufacturers are not inclined to release this information unless one is in the process of purchasing equipment. For larger savings sites,

acquisition and use of equipment-specific performance data during the program application process could greatly improve the savings estimates associated with the customized rebate applications.

Recommendation: Require that equipment performance data be obtained and used in rebate application savings calculations for large impact sites.

Monitoring Activities

For sites where pre- and post-retrofit monitoring/metering data exist, evaluation analysis activities often can be greatly simplified. In some cases, the evaluation becomes a verification that the monitoring/metering results are still valid after the equipment has been in the field for some time. Use of monitoring/metering data in the rebate application also can greatly improve the accuracy of the impact estimates.

Recommendation: For larger sites, PG&E should consider guidelines for when monitoring/metering activities for both pre- and post-retrofit periods might be considered or required as part of the application.

1 INTRODUCTION

1.1 INTRODUCTION

This report presents the 1994 impact evaluation results for the commercial sector miscellaneous measures in Pacific Gas and Electric's (PG&E) retrofit energy-efficiency programs. This is one of four separate reports documenting the methodology, results, and recommendations of an evaluation of selected projects that received incentives in 1994 through PG&E's Commercial, Industrial, and Agricultural Programs (the CIA Programs). The evaluation reports are segmented into the following four categories:

- Industrial Process measures;
- Industrial HVAC measures;
- Industrial Miscellaneous measures; and
- Commercial Miscellaneous measures.

1.2 PROJECT OVERVIEW

1.2.1 Evaluation Objectives

The primary objectives of the overall evaluation were to:

- Determine defensible estimates of the gross and net impacts (kW, kWh, and therm) resulting from industrial process, boiler, refrigeration, and commercial/industrial miscellaneous measures installed through PG&E's incentive programs;
- Identify any discrepancies between the evaluation results and PG&E's ex ante impact estimates; and
- Determine the 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.

1.2.2 Description

The evaluation employed an enhanced engineering approach to quantify gross measure impacts for each study site. The principal source of data for the study came from on-site surveys. This data was

supplemented with strategic monitoring data as well as data from existing data sources, including PG&E project files, customer's facility management systems, manufacturer's equipment performance data, and billing data.

For process measure sites and other "customized" applications, a site-specific engineering approach was used to the analysis. For HVAC sites, an hourly building model (DOE-2) or simpler "bin analysis" models were used, depending on the complexity of the site. For other measures such as efficient motors and refrigerator door closers/gaskets, spreadsheet-based engineering models were developed to calculate savings based on equipment performance and customer-supplied operating schedules.

To determine net program savings for the industrial process and industrial HVAC measures, a site-specific net-to-gross analysis was conducted. This analysis primarily focused on free-ridership and was based on on-site findings and structured follow-up telephone surveys of key participant decision makers.

1.3 PROGRAM DESCRIPTION

The industrial and commercial measures addressed in the overall evaluation were covered by separate PG&E incentive programs:

- The CIA Retrofit Customized Program (the Customized Program); and
- The CIA Retrofit Express Program (the Express Program).

Each of the programs is described briefly below.

1.3.1 The Customized Program

The Customized Program provides incentives to commercial, industrial, and agricultural customers to install custom-designed energy-efficiency measures. The program covers both new construction and retrofit projects. Both electric and gas projects are covered by the Customized Program, although the majority of projects are electric. Any measures covered under the Express Program cannot be included in the Customized Program.

1.3.2 The Express Program

The Express Program provides incentives for commercial, industrial, and agricultural customers to retrofit their facilities with energy-

efficient equipment from a pre-specified list of measures. Incentives are provided for equipment in the areas of air conditioning, agricultural, food service, refrigeration, lighting, and motors.

1.3.3 PG&E Savings Estimates

The number of sites and the initial PG&E savings estimates for the measure segments analyzed in this evaluation are presented in Table 1-1.

Table 1-1
Sites and Savings Estimates by Category
1994 CIA Programs

Category	# Sites	kWh	kW	Therms
Industrial Process	85	42,664,463	6,286	8,565,548
Industrial HVAC	170	12,751,077	3,889	118,026
Industrial Misc.	183	11,987,050	1,740	0
Commercial Misc.	1288	35,065,085	5,772	431,615
Total	1726	102,467,675	17,687	9,115,189

The methodology and results for commercial sector miscellaneous measures are discussed in this report.

1.4 REPORT ORGANIZATION

The remainder of the report focuses on the evaluation of the commercial sector miscellaneous measures and is organized as follows:

- Section 2 discussed the evaluation methodology;
- Section 3 presents the evaluation results;
- Appendix A includes detailed site data;
- Appendix B presents savings by PG&E costing period; and
- Appendix C presents results consistent with Tables 6 and 7 of the Protocols.

2 EVALUATION METHODOLOGY

2.1 OVERVIEW

This section presents the evaluation approach used for this study. Key topics covered are:

- Research design
- Estimating gross savings

2.2 RESEARCH DESIGN

The research design is based on the principle that evaluation, field, and analytical resources would be allocated to measure type segments and sites with those segments based on their expected resource value. The design reflects the fact that most of the expected savings come from a minority of the sites.

In the evaluation, "sites" refer to one or more process measures assigned to a PG&E control number. The control number is a unique identifier in the PG&E billing system that represents an account. It is possible to have multiple control number for a given physical site and to have multiple rebate applications per control number. For larger commerical sites, it often difficult to link multiple control numbers at a given physical site (because the site often can cover multiple street addresses); therefore to simplify the research design, each control number was designated as a "site."

As table 2-1 indicates, 6 large sites provide 26% of the expected avoided cost savings. The next smaller 866 sites contribute 69% to savings, and the remaining small sites contribute only 5% to savings. (The "Small-2" category in Table 2-1 consists of sites in the smaller end-use categories -- boilers and hot water -- and the smallest sites in the larger end use categories.) Detailed site-specific evaluations were conducted for 4 of the 6 largest sites (a census was attempted). A combination of site-specific analyses and model-based analyses were utilized to analyze a sample of 116 "Small-1" sites. The remaining "Small-2" sites were not included in the analysis sample.

Table 2-1
Size Distribution of Commercial Miscellaneous Savings

Size	# Sites	Avoided Cost	Percent of Total
Large	6	$4,242,895	26%
Small - 1	866	$11,155,460	69%
Small - 2	416	$884,023	5%
Total	1,288	$16,282,378	100%

2.2.1 Program Statistics

This section summarizes 1994 PG&E Commercial Miscellaneous project tracking data as extracted from the PG&E MDSS system. The program savings totaled 35,065 annual MWh, 5,772 peak kW, and 431,615 annual Therms. Overall, there were 1990 program measure line items installed at 1,288 sites. Sixty-one Customized measures were installed. The remainder of the measures were installed under the Express Program.

Table 2-2 presents expected energy and demand savings total for both the Customized and Express Programs. At the table indicates, the Customized Program accounted for 26% of the kWh savings, 22% of the kW savings, and 92% of the therm savings.

Table 2-2
Commercial Miscellaneous Energy Savings by Program

		Annual kWh		Summer Peak kW		Annual Therms	
Program	# of Measures	Amount	% of Total	Amount	% of Total	Amount	% of Total
Customized	61	8,950,134	26%	1,283.7	22%	398,531	92%
Express	1,929	26,114,951	74%	4,488.4	78%	33,084	8%
TOTAL	1,990	35,065,085	100%	5,772.1	100%	431,615	100%

Table 2-3 presents expected energy savings by program end use category. The Food Service end use (primarily refrigeration door closers and gaskets) accounts for the majority of kWh and kW savings, while the Process end use accounts for the majority of therm savings. Although the Hot Water end use contributes to 30% of the expected therm savings, its contribution to electricity savings is very small, and it contributes to less than 2% of Program avoided cost savings.

Table 2-3
Commercial Miscellaneous Energy Savings by Measure Category

Measure Category	# of Measures	Annual kWh		Summer Peak kW		Annual Therms	
		Amount	% of Total	Amount	% of Total	Amount	% of Total
Food Service	1,261	19,418,455	55%	3,664.4	63%	33,084	8%
Process	23	6,424,389	18%	1,157.8	20%	231,036	54%
Refrigeration	375	7,533,216	21%	622.6	11%	0	0%
Motors	310	1,511,533	4%	235.9	4%	0	0%
Hot Water	16	177,492	1%	91.5	2%	127,427	30%
Boilers	5	0	0%	0.0	0%	40,068	9%
Total	1,990	35,065,085	100%	5,772.1	100%	431,615	100%

2.2.2 Sample Design

The sample design utilized information on the distribution of savings across sites and across end uses. Sites were categorized by size of savings and by end use. Avoided costs were used to determine the level of detail planned for the data collection and the depth of analysis required to define energy and demand impacts to a reasonable degree of precision, and hence the amount of project budget allocated to each site. The technology (measure) guides the technical approach to the site review and the method of analysis.

The first step in the sample design was to develop the "Group A" large sites. These are the largest sites for end uses that are dominated by large sites. The six Group A sites account for 26% of the total avoided costs for the commercial study. Five of the sites are Process sites and one site is a large Refrigeration site.

The next step of the design was to develop sampling segments for the remaining sites. These sites were divided into end use and key measure-type categories. A sample was then drawn for the important program segments.

Table 2-4 summarizes the research design and sample plan for the Commercial Miscellaneous evaluation project. A discussion of each end use and measure group follows.

Table 2-4
Commercial Miscellaneous Research Design Summary

End Use	Sub-Segment	Population				Sample		
		# of Sites	Avoided Cost	% of End Use Av. Cost	% of Total Av. Cost	# of Sites	Avoided Cost	% of End Use Av. Cost
Process	P-A	5	$3,827,449	62.4%	23.5%	3	$1,503,471	24.5%
	P-1	17	$2,305,645	37.6%	14.2%	3	$350,311	5.7%
	P-V					13	$1,748,340	28.5%
	Total	22	$6,133,094		37.7%	19	$3,602,122	58.7%
Boilers	Total	5	$198,665		1.2%	0	$0	0%
Refrigeration	R-A	1	$415,445	12.7%	2.6%	1	$415,445	12.7%
	R-2	30	$1,110,742	33.9%	6.8%	8	$474,907	14.5%
	R-3	11	$869,611	26.5%	5.3%	4	$517,169	15.8%
	R-4	25	$672,421	20.5%	4.1%	6	$175,473	5.4%
	R-X	219	$208,846	6.4%	1.3%	0	$0	0%
	Total	286	$3,277,065		20.1%	19	$1,582,994	48.3%
Food Service	F-1	395	$4,820,774	88.4%	29.6%	43	$669,181	12.3%
	F-2	278	$474,789	8.7%	2.9%	24	$57,069	1.0%
	F-X	130	$154,790	2.8%	1.0%	0	$0	0%
	Total	803	$5,450,353		33.5%	67	$726,250	13.3%
Motors	M-1	110	$901,479	97.6%	5.5%	20	$380,853	41.2%
	M-X	46	$22,230	2.4%	0.1%	0	$0	0%
	Total	156	$923,709		5.7%	20	$380,853	41.2%
Hot Water	Total	16	$299,493		1.8%	0	$0	0%
Total Commercial		1,288	$16,282,379		100%	125	$6,292,218	38.6%

Group A - Large Sites

Generally, each site included in the “Large” category contributes significantly to total program savings. These sites each have total avoided costs greater than $350,000. The measures at the large sites tend to be “Customized” and are not easily placed into sampling groups. Six of the large sites are Process sites. The remaining site is a Refrigeration site.

A census of the Group A sites were targeted to receive a detailed site-specific analysis of savings, including detailed on-site surveys, engineering analysis and/or modeling, on-site monitoring where appropriate, and a detailed site report. Two of the sites could not be recruited; thus, four of the sites (three Process and one Refrigeration) were included in the final study.

Process Sites

Five of the Process sites are included in Group A, the Large category. The remaining 17 sites are smaller in size and quite diverse in the measures implemented.

An additional sample of 3 of these smaller Process sites were selected for site-specific studies, similar in scope to the large sites but somewhat less detailed. The results from these sample sites then will be applied to the smaller Process group as a whole.

For the 13 of the remaining 14 sites, verification visits were conducted. (We were unable to recruit the remaining 7 sites.) In these visits, we verified that the program measures are still installed and are being operated consistent with the energy savings claim that was provided to PG&E with the incentive application.

Boilers

Boiler measures account for only 1.2% of the program avoided costs. As a result of the extremely low impact, these sites were not specifically addressed in the evaluation. The program realization rate was applied to the tracking system savings estimates.

Refrigeration

The largest refrigeration site are included in the Group A detailed site-specific analysis group. Savings for this site were about twice as large as savings for the next largest site.

The remaining refrigeration project sites were segmented into the following measure groups: R-2 (primarily Commercial R-4-case replacement sites); R-3 (customized Controls measure 451/453 sites); R-4 (remaining medium sized sites, with avoided costs greater than $5,000); and R-X (remaining small sites). A sample was selected from the total population of the R-2 through R-4 groups. The results from each sample group were applied to the entire population of each subgroup in a single ratio methodology. (An R-1 segment was created for industrial sites, and this group was included in the Industrial Miscellaneous evaluation.)

Food Service

Food Service measures are Express measures consisting of a mixture of cooking and commercial refrigeration measures including insulated

cooking equipment, replacement cooking equipment, and four types of improvements to refrigerated coolers (door gaskets, auto closer, condense heaters and non-electric evaporators). This last category accounts for $5.45 million in avoided cost (about 33% of total program avoided cost).

The food service end use is divided into two sample groups. Sample F-1 includes all sites that have both F8 (door gaskets) and F9 (auto closer) measures installed. This sample also includes sites that have F9 measures only. Sample R-2 consists of F8-only sites. The number of remaining items that provide the rest of the savings is very small. These measures and sites will not be addressed in a quantitative manner in the evaluation.

Motors

The Motors measures consist of replacing existing Process and/or HVAC motors with high-efficiency equivalents. These are Express Program measures. Program data list the number of motors of each size replaced under the program. PG&E savings estimates generally are based on the difference in power required for a given motor size for an efficient motor vs. a standard motor.

A sample of 20 sites was selected for analysis from sites with motors of 15 horsepower or greater were installed (sample M-1). Site-surveys were carried out at the sampled sites to verify installation and to identify schedule and load profiles for the sample group. Spot amperage measurements also were taken. Savings results for the sample then were applied to the entire motor population to determine program savings.

Domestic Hot Water (DHW)

These measures consist of a variety of measures that reduce domestic hot water energy consumption. These measures comprise only 1.8% of the program avoided costs. As a result of the extremely low impact, these sites were not specifically addressed in the evaluation. The program realization rate was applied to the tracking system savings estimates.

Final Sample

Overall, the final sites included in the analysis account for 30% of total kWh savings, 28% of total kW savings, and 32% of total therm savings; see Table 2-5.

Table 2-5
Expected Savings: Analysis Sites vs. Program Population

	# Sites	kWh	kW	Therms
Program Total	1,288	35,065,085	5,772	431,615
Analysis Sites	125	10,366,143	1,615	137,575
% of Total	54%	30%	28%	32%

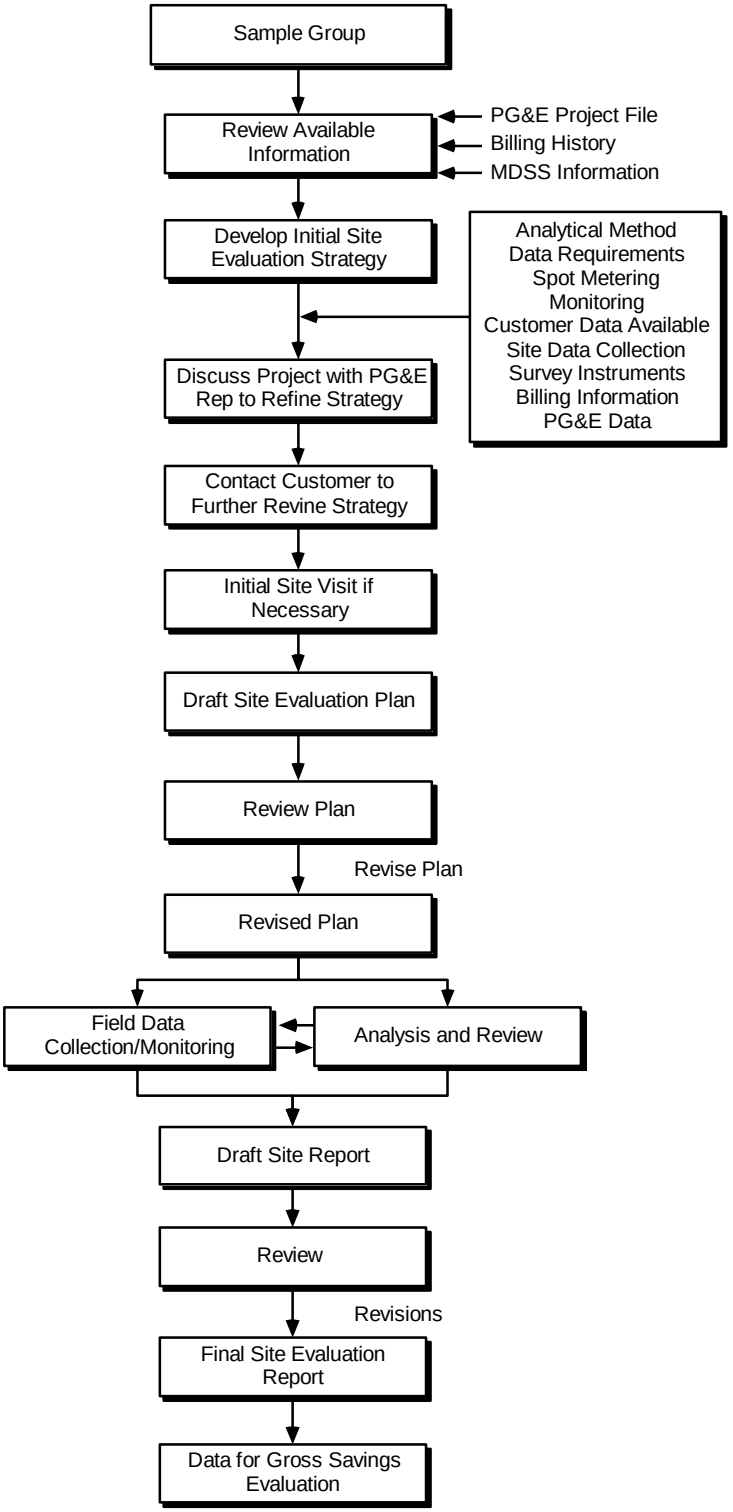
2.3 ESTIMATING GROSS SAVINGS

2.3.1 Site Analysis Procedures

As noted above, the evaluation followed a site-specific approach. Each site was evaluated somewhat differently, based on the information available, the measures installed, the size of the savings, and other pertinent factors.

All sites, however, followed two primary stages: a planning stage and an implementation stage. Figure 2-1 summarizes the site procedures. A discussion of the site analysis procedures follows.

Figure 2-1
Site Procedures



Review of Available Site Information

The first step in the site evaluation process was to review all existing data. Existing data sources include information from MDSS, hard copy of applications, and billing histories. XENERGY then assessed the type of site evaluation required for each site. The primary focus of the initial review was to obtain an understanding of the measures installed and the key assumptions made in the initial impact estimates.

Draft and Review of Site Evaluation Plan

For larger sites included in the evaluation, XENERGY developed a preliminary evaluation plan specific to the site. The strategy took into consideration any previous analyses and engineering performed, possible metering and/or monitoring strategies, data requirements, data collection approaches, billing history, amount of rebate, total energy savings, and the cost of the proposed evaluation. It then was determined what type of analysis would probably be required and what types of data collection activities would considered.

The strategy was refined after discussions with the appropriate PG&E representative. The customer then was contacted to further refine the evaluation strategy. Site logistics and customer convenience issues were factored into the evaluation plans. An initial site visit was performed at this time if it was required for development of the plans. After contact with the customer, XENERGY submitted a draft evaluation plan that was reviewed and finalized.

For the smaller sites, the smaller refrigeration sites and all the motors and food service sites, a general analysis plan was developed by key sample segment. These plans included general data acquisition strategies and outlined the analysis methodology. The plans were not subject to as detailed a review as were the large site plans.

Implementation Stage

In coordination with the customer, all data collection and monitoring activities were scheduled and performed. The data were analyzed and evaluated and a draft site report was produced. The draft site report then was review for completeness, correctness, and clarity by the lead engineer and project managers. Revisions, if needed, were made, and a final site report then was developed. The results from the individual site evaluations were used in the Gross Savings Evaluation.

For the motors analysis, site specific reports were developed based on an approved template. Because the site analyses were similar, these reports mainly focused on identifying reasons for differences between the evaluation results and PG&E's ex ante savings estimates.

For the food service analysis, one report was produced showing the results of an aggregate model analysis.

2.3.2 Analysis Approach

From an analytical point of view, two types of evaluations were utilized for the Commercial Miscellaneous study:

1. In-depth site-specific engineering evaluations;
2. Engineering model-based analyses; and
3. Verification surveys.

Detailed Site-Specific Engineering Evaluations

The detailed studies began with a review of the project files and billing records. A site evaluation strategy then was developed and implemented. The final result of this process was a detailed evaluation report.

Several characteristics determined the specific analytical approach for the large and very large sites. Key factors included:

- End use (Process and Refrigeration)
- Savings Units: kW, kWh, and Therm (kW and kWh savings were more readily monitored);
- Absolute level of savings and level of savings relative to the total metered consumption;
- Pre- and post-project documentation available;
- Site data and information available and customer cooperation;
- Verifiability of pre-and post-project equipment performance and operating assumptions. This relates to the need for spot or short term measurements to verify pre-and post-project analytical assumptions, and the resources available to take these measurements; and
- Timing/seasonality issues related to production and operating load profiles of the facility or the modified systems;

The site-specific evaluation methodology took all these factors into account. In general, the approach was to review the application documents to identify the technological mechanism through which the savings are achieved, identify an analytical methodology based on accepted engineering principles which would document the savings, identify the key operating assumptions or measurements required to utilize the methodology with confidence, determine the best way to confirm the measurements or assumptions, conduct the site work to gather the required information, and finally to analyze the results and present the results.

A detailed site specific summary report for each site was produced. The report included a summary of the measure, a breakout of the savings by PG&E time periods, a description of the PG&E methodology and the evaluation methodology, a description of the results from the two analyses, and an explanation for any discrepancies.

Engineering Model Analysis

Engineering models were utilized to analyze measure savings in the Food Service and Motors end uses. The engineering model analysis entailed the development of models that use readily observable/verifiable performance and operating parameters. Site surveys at sampled sites were used to collect information on site-specific equipment inventories. Actual equipment performance characteristics from manufacturers will be used whenever available. Spot measurement of performance and operating parameters also was performed. Additionally, operating profiles were developed from interviews and customer-supplied data.

Food Service

The food service study utilized PG&E's basic methodology for calculating refrigeration gasket/closer savings and focused on verifying key parameters of the PG&E model.

The PG&E methodology for this measure assumes that a worn gasket on a walk-in cooler or freezer will be replaced with a new gasket or a door will be fitted with an automatic closer. Other key assumptions include:

- Doors are completely closed and gasket savings are realized for 5,750 hr./yr.; and/or door closer savings are realized for 1,915 hr./yr
- Door width is 2 feet and height is 6 feet

- Cooler temperature is 40°F and freezer temperature is 0°F
- Heat loss for weak gaskets equals 3% of open door heat loss and heat loss for ajar door equals 20%
- Typical cooler performance factor is 1.6 kW/ton and typical freezer performance factor of 2.4 kW/ton
- 80% of the installations are coolers and 20% of the installations are freezers.

The basic relationship for heat gain through doorways from temperature induced air exchange comes from the 1990 ASHRAE Handbook-Refrigeration, 27.3.

$$q_t = q \times D_t \times D_f$$

$$q = 3{,}790 \times W \times H^{1.5} \times \frac{Q_s}{A} \times \frac{1}{R_s}$$

Where

D_t = doorway open time factor

D_f = doorway flow factor

W = door width (2 feet)

H = door height (6 feet)

Q_s/A = sensible heat load of infiltration air per sq.ft. of doorway opening (0.155 for coolers, 0.62 for freezers)

R_s = sensible heat ratio of the infiltration heat gain (0.59 for coolers, 0.63 for freezers)

The evaluation method focused on confirming measurable factors that affect savings estimates, including:

- Verification of the measure;
- Case physical dimensions - height and width;
- The fraction of cases that are coolers vs. freezers;
- The presence of door closers (for all cases receiving gasket measures); and
- Current gasket and door closer conditions.

Using the actual site conditions and PG&E's savings methodology, an independent estimate of energy savings was developed for each site.

Motors

Site data were collected for each motor measure at the sampled sites. Data included:

- Manufacturers' ratings and performance curves where available for both new and existing equipment;
- Observed nameplate data for new motors including, where possible, serial numbers for future retention surveys;
- Seasonal and daily operating schedules and operator's estimate of motor loading profile during the operating period (gathered via interview); and
- Spot confirmation of actual operating volts and amps at the time of visit-at several points within the load profile-for one motor of each size at each site (where possible and where customer agrees).

A spreadsheet engineering model was developed in which the part load performance data for the post-retrofit motor was taken from the field data. The performance data for a standard motor of the same type was taken from manufacturers' literature. Both motors' performances were run against the observed load profile to define peak kW and time-of-use period kWh for the post-retrofit high efficiency motor and the standard motor under the same load profile. The savings for each period was calculated as the difference between the standard and the new high-efficiency equipment.

Verification Surveys

Verification surveys were conducted for most Process sites not receiving a full analysis.

The Verification surveys confirmed (or refuted) the installation of the measure at the sample sites and determined it the equipment was being utilized in a manner consistent with documentation in the Program application.

Study Emphasis

The primary emphasis on the analysis was to improve upon PG&E's initial impact estimates by focusing project resources on four key areas:

1. Verification of measure installations;
2. Determination of actual post-installation operating conditions versus predicted operation conditions;
3. Measurement of important operation parameters versus use of assumed values; and

4. Improvement in the analysis methodology.

Verification

As part of the on site process, measures were confirmed to be installed in a manner consistent with the Program application. For one motors site measures had been removed, and savings were therefore set to zero. For three smaller refrigeration sites, measure counts were less than indicated in the tracking system, and saving were reduced accordingly.

Post-installation Operations

Because the evaluation was conducted during the post-retrofit period, actual operating conditions and equipment usage patterns could be ascertained via monitoring, observation of equipment logs, and interviews with customers. PG&E's estimated impacts were based on forecast or assumed operations which could differ significantly from actual conditions due to changes at the site involving factors such as occupancy patterns and internal loads. Additionally, Express Program savings calculations utilized standardized operating assumptions while the evaluation used site-specific data.

Measurement of Key Parameters

In many cases, PG&E savings estimates were based on assumptions about key operating parameters. During the evaluation, measurements of these parameters were made on a site-specific basis utilizing equipment logs, metering, and monitoring. Key measurements included motor loadings, chiller and condenser supply and return water temperatures, and building control temperature set points. In some cases, manufacturer's performance specifications, particular to the given equipment application, were collected and used to support calculations for the post-retrofit and base case technologies.

Methodology

For the evaluation, PG&E's impact methodologies were reviewed for adequacy on a site-by-site basis. Where possible, the evaluation improved upon this methodology. Often the evaluation methodology was adjusted to make the best use of available data. For example, if both pre-retrofit and post-retrofit submetered data was available, the analysis methodology could be simplified into a comparison of the metered data (with adjustments for any changes in operations).

In many cases, and especially for Express Program measures, PG&E savings were based on simplified calculations that utilized

standardized efficiency changes per equipment unit (such as motor horsepower or chiller tons) times the number of units times full load hours. In these cases, evaluation methods were better able to address actual efficiency gains over a range of part load conditions and for the particular size of equipment being analyzed.

For some of the Customized Program projects, a very thorough, detailed methodology was employed to develop initial savings estimates for the Program application. In these cases, this same methodology was used for the evaluation but was updated to reflect actual post-retrofit conditions.

Key Analysis Issues

A number of important evaluation issues had to be addressed in this study, including: 1) defining baseline energy use; 2) normalizing results to the post-retrofit level of service; 3) annualization of results; 4) model calibration; and 5) locating and verifying equipment. These issues are discussed in this subsection.

Defining the Baseline Technology

Because energy savings are defined as the difference between post-retrofit energy use and baseline energy use, identifying the appropriate baseline technology/process is an important component of the analysis. For the most part, the baseline equipment used to calculate gross savings was set to be consistent with the assumptions used in the original rebate calculation. PG&E chose this approach to provide important feedback to their engineers and program staff about the accuracy of their gross savings calculations for the given baseline equipment.

For some Express Program measures, where little to no site specific information was available from the project files, the baseline determination involved setting the baseline technology *and* the baseline operating characteristics of the affected equipment. In these cases, the site evaluator utilized information from customer and/or installation contractor interviews to gain an understanding of how the pre-retrofit equipment or standard equipment was or would be operated. This data then was used to characterize the baseline technology and its application. For example with cooling towers, PG&E Express calculations assume standard approach temperature set points that may not be applicable to a given site. For the evaluation, site-specific baseline set points were determined and used in energy impact calculations.

Normalizing Results to Post-Retrofit Service Levels

Consistent with the Protocols, energy impacts for this study were normalized to reflect post-retrofit levels of service. For the normalization process, energy usage was related to some measure of site activity (such as production levels, operating hours, or air/fluid flow rates). Then, using this relationship, baseline energy consumption was adjusted to the post-retrofit activity level.

In some cases, this approach was relatively straight forward, especially when the project was a straight retrofit with relatively similar equipment capacities and site activity levels. (The availability of pre-retrofit and/or on-site personnel knowledgeable about pre-retrofit conditions greatly facilitated this effort.)

However, many of the rebate projects were associated with significant production/operating changes at the site. In some of these cases, baseline operating levels were extrapolated past the physical limits of the pre-retrofit equipment by associating the pre-retrofit energy intensity with the new production/operating level. The guideline followed during this normalization process was to establish an adjusted baseline that maintained the efficiency of PG&E's initial baseline technology (which was usually developed based on pre-retrofit operating levels) but scaled energy usage to post-retrofit service levels.

Annualization of Results

In many cases, equipment performance and operating conditions were observed/monitored over a relatively short time frame; whereas the savings must be extrapolated to provide annual results. Similar to the normalization process, energy usage (or savings) per unit of output during the observation period is multiplied by annual output to determine annual energy usage (or savings).

At times, operating records were available to assist in the annualization process. In other cases, hourly load models (such as DOE-2) were used in the analysis and relate building energy usage to typical meteorological year conditions. For some sites, however, annualization of savings was based on interviews with the customers and judgmental adjustments. Annualization with limited data increased the uncertainty of the evaluation results.

Locating and Verifying Equipment

In order to analyze or verify measure savings, the retrofitted equipment had to be located by the on-site surveyor. In very limited instances, it

was not possible to locate the equipment. When equipment could not be located, the site surveyor made a determination about the likelihood that the measure was installed, based on discussions with site personnel, the thoroughness of the search given the customer's time constraints, and his assessment of the size of the measure relative to the size of the site. If it was determined that the measure was probably in place, the site was not included in the analysis but was verified as probably being installed and did not count against program savings. It was determined that the measure was not in place, site savings were set to zero.

2.3.3 Aggregation of Site Findings to Program Findings

This section presents the approach for development of gross savings estimates for the overall project. The primary objective was to combine site and sample information and extrapolate to the population. The gross savings analysis was conducted for the total end use and for each measure group. Savings are reported for kWh, kW, and Therms for each group.

Ratio estimation and stratification were used to extrapolate the results from the detailed site analysis and verifications to the overall program. Because analysis was conducted for 100% of Group A sites, estimation is not required for this group. Extrapolation is required for the other groups in which only a sample of sites were evaluated.

The process involves assigning all participants to an analysis strata. The analysis strata could be the same strata used for sampling or could be based on other characteristics that are known for all members of the population. In this case, the sampling strata were used.

Once the stratification is done, a ratio estimator is developed by comparing the initial estimates of savings to the enhanced estimate obtained from site analysis. The total gross impact is derived from the following equation.

$$TOTSAV = \sum_{i} TOTSAV_i$$

$$TOTSAV_i = \sum_{j \in i} T_j * \frac{\sum_{k \in samp(i)} E_k}{\sum_{k \in samp(i)} T_k}$$

where:

TOTSAV = the total gross energy or demand impact;

$TOTSAV_i$ = the total gross impact for strata i;

T_k = the tracking system impact estimate for site k; and

E_k = the evaluation result for site k.

The sampling precision level is calculated using the standard formula for a ratio estimator. The standard error of sampling is primarily a function of the correlation between T and E, the sample size, and the portion of expected savings in the sample. This standard error will under-estimate the overall uncertainty of the total gross impact, however. This under-estimation occurs because the standard error only considers the error from sampling and does not consider any inaccuracy in the enhanced engineering estimate.

3 EVALUATION RESULTS

3.1 OVERVIEW

This section presents 1994 impact results for the commercial sector miscellaneous measures in PG&E's energy-efficiency programs. The primary end uses addressed in the study were refrigeration and motors. Overall net electric energy savings are estimated to be 28.0 GWh per year, net summer on-peak demand savings are estimated to be 4.1 MW, and net natural gas savings are estimated to be 245,989 therms per year.

The following impact results are presented below:

- Gross Program savings;
- Net Program savings; and
- Other findings and recommendations.

3.2 GROSS PROGRAM SAVINGS

Gross savings estimates were based on detailed site-specific engineering analyses (refrigeration and process) and site-specific model-based analyses (motors and food service) for a sample of Program sites. Results from these studies were generalized to the population using a ratio approach. This section first presents overall results, followed by a more detailed discussion of results for sites analyzed in the study, including a discussion of discrepancies.

3.2.1 Program Results

Table 3-1 presents aggregate energy impacts and realization rates. As these numbers indicate, the kWh realization rate slightly about 1.0 while the kWh realization rate was significantly higher at 1.86.

Table 3-1
Summary of Gross Impact Results

	PG&E Estimates	Gross Realization Rate	90% Conf. Interval	Gross Evaluation Results
Annual kWh	35,065,085	1.07	±0.20	37,322,432
Summer On-Peak kW	5,772	0.96	±0.25	5,520
Annual Therms	431,615	*0.76**	-	*245,989***

* Implied

** Evaluation results for one large therm site were added to PG&E results at other therm sites.

For the Commercial Miscellaneous programs, 29 sites reported therms savings for the boiler, food service, process, and hot water end uses. Of the 431,615 expected therm savings, only one process site, accounting for 135,575 therms, was evaluated. It was not felt that this site was representative of the other sites, and instead of generalizing this result to the Commercial programs, the evaluation savings for this site were added to the PG&E estimates to develop program savings. Based on evaluation verification results in other evaluated end uses, it was reasonable to believe that the measures were installed and were operating in a manner consistent with the rebate application.

Prior to Program aggregation, realization rates and savings estimates were developed for the key program end uses. Results for the end use segments are presented in Table 3-2.

Table 3-2
Realization Rates by Key End Use

Segment	#Program Sites	Annual kWh		Summer Peak kW		Annual Therms	
		PG&E Estimate	Realiz Rate	PG&E Estimate	Realiz Rate	PG&E Estimate	Realiz Rate
Process	22	6,424,389	1.16	1,158	0.61	231,036	-
Food Service	803	19,418,455	1.02	3,664	1.02	33,084	-
Motors	156	1,511,533	1.42	236	1.32	0	-
Refrigeration	286	7,533,216	1.03	623	1.10	0	-
			1.07		0.96		-

The food service end use accounts for 55 percent of the expected kWh and 63 percent kW savings. The kWh and kW realization rates of 1.02 were the major contributors to the overall program realization rates. The next largest contributors were refrigeration and process; both have

kWh realization rates near one. The low process kW realization rate of 0.61 offsets higher refrigeration and motors kW realization rates.

3.2.2 Study Sites

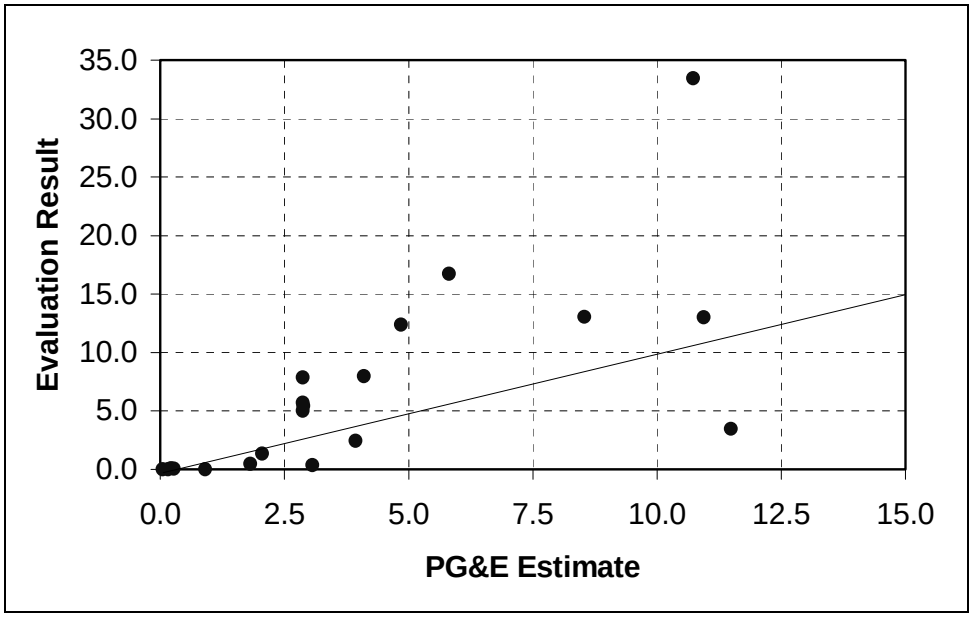
This subsection focuses on study sites that received site-specific analyses. Overall, 67 food service, six process, 20 motor, and 19 refrigeration sites were included in the study (recall that a site is defined as a PG&E control number).

Figures 3-1 through 3-4 compare evaluation results to PG&E savings estimates for kW and kWh. Results are presented by end use. The diagonal lines represent points where evaluation results and PG&E estimates are equal (realization rates equal to 1.0).

Motors

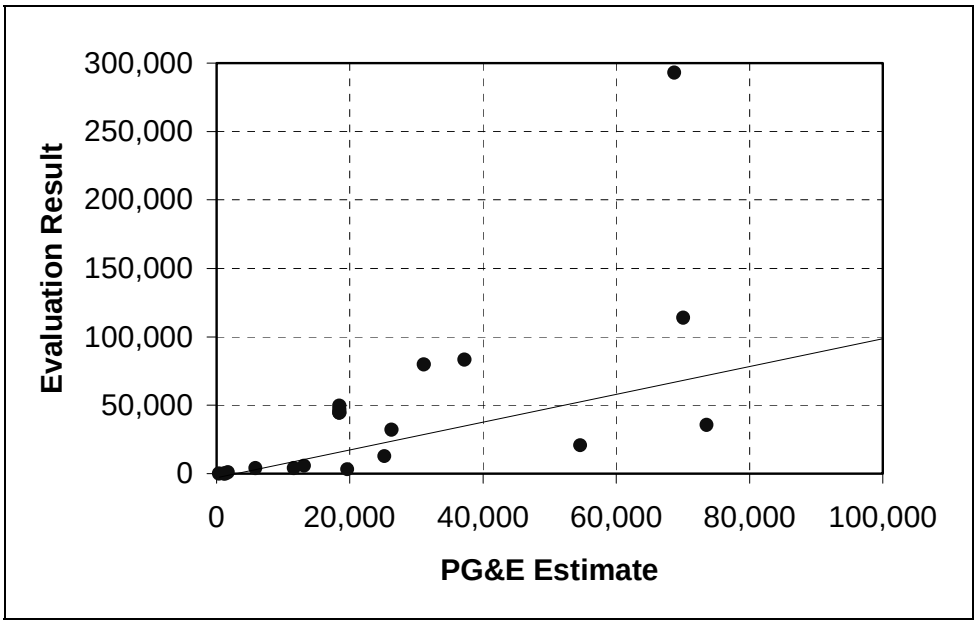
For kW savings (Figure 3-1), most of the points for the larger impact sites fall well above the diagonal line. The PG&E Express savings calculations that apply to these motors assume average load factors of 65 percent and average peak coincidence factors of 64 percent. For the evaluation, a number of motors were measured to have higher load factors and subsequently higher kW savings. More importantly, most of the motors were operating continuously during the summer peak hours, and the estimated coincidence factors were much higher that assumed by PG&E. (Many of the motors were associated with air handler units.) The one large impact site with lower than expected savings has several rebated motors that are seldom operated.

Figure 3-1
Summer Peak kW Savings - Motors - PG&E vs. Evaluation



The comparison of annual kWh savings (Figure 3-2) shows results similar to the kW results. Most of the points lie above the diagonal line, indicating higher than expected savings. In addition to higher measured load factors, the evaluation found that the motors tended to be in operation much more that expected by PG&E. The PG&E Express calculations assume 4,100 operating hours per year, but in many cases the evaluation found that the motors operated continuously or near continuously. The two large impact sites with lower than expected savings have fan motors that are not frequently used. One site uses the fans only during the summer months.

Figure 3-2
Annual kWh Savings - Motors - PG&E vs. Evaluation



Refrigeration

The comparison of summer peak kW savings is presented in Table 3-3. For most sites, the evaluation result exceeds the PG&E estimate. One large site shows lower than expected savings because the increased energy use of associated equipment offset much of the measure savings.

Figure 3-3
Summer Peak kW Savings - Refrigeration - PG&E vs. Evaluation

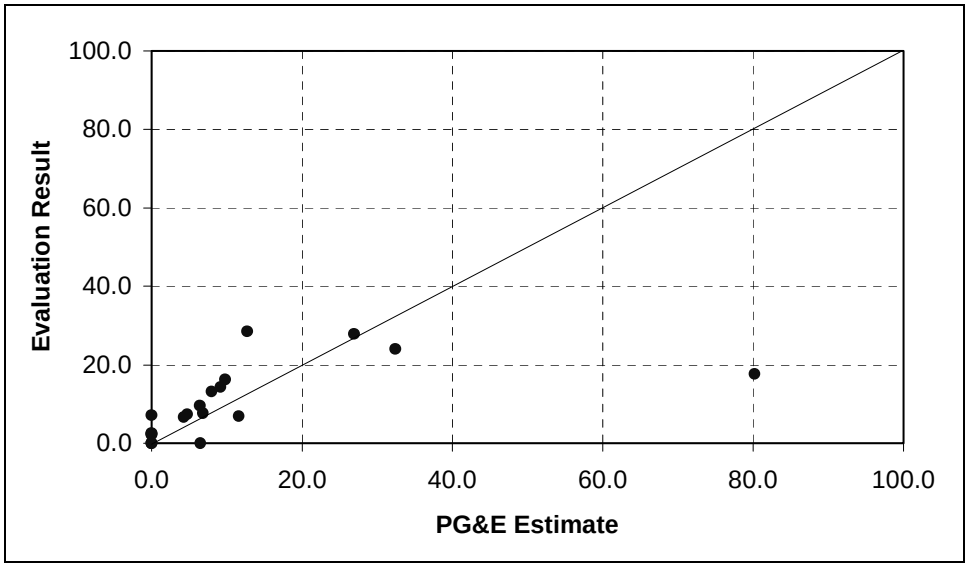
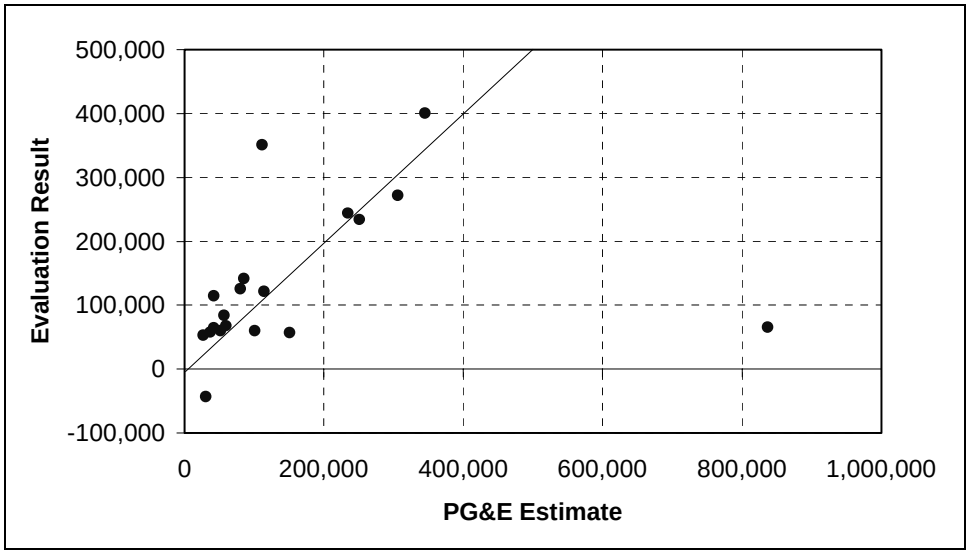


Figure 3-4 compares annual kWh savings. Most of the sites are grouped near the diagonal line where realization rates are equal to one. The largest impact site shows lower than expected savings for two reasons: low kW savings as discussed above and low operating hours because the facility is seasonal. The negative evaluation savings result occurs at a site where an oversized condenser is operating at much less than its design load; its associated equipment cause an increase in energy use.

Figure 3-4
Annual kWh Savings - Refrigeration - PG&E vs. Evaluation



Process

Table 3-5 presents a comparison of kW savings estimates. Five of the six sites show differences that are offsetting. The sixth site shows an evaluation kW savings of zero because the customer's operations are seasonal and do not include the peak summer months.

Figure 3-5
Summer Peak kW Savings - Process - PG&E vs. Evaluation

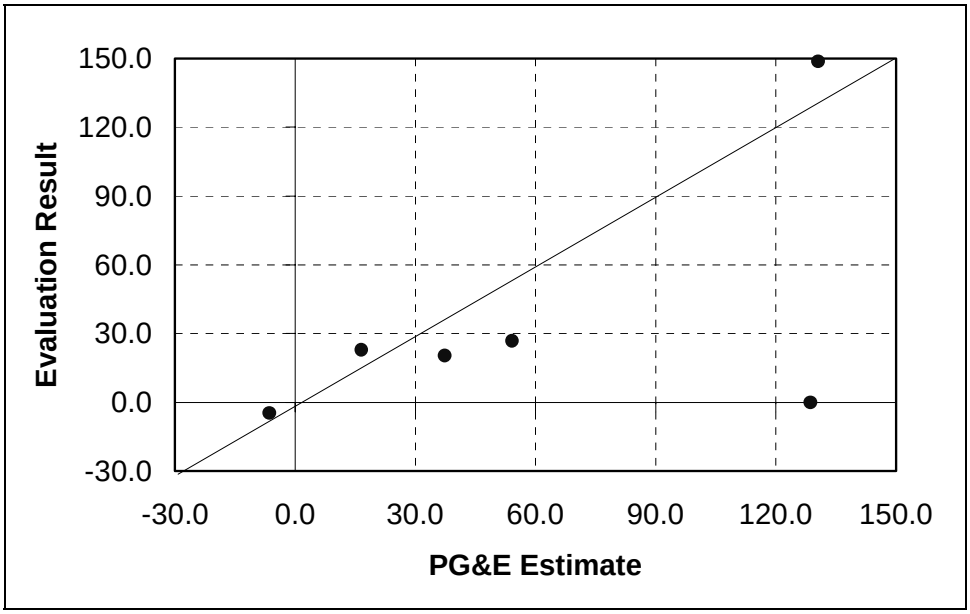
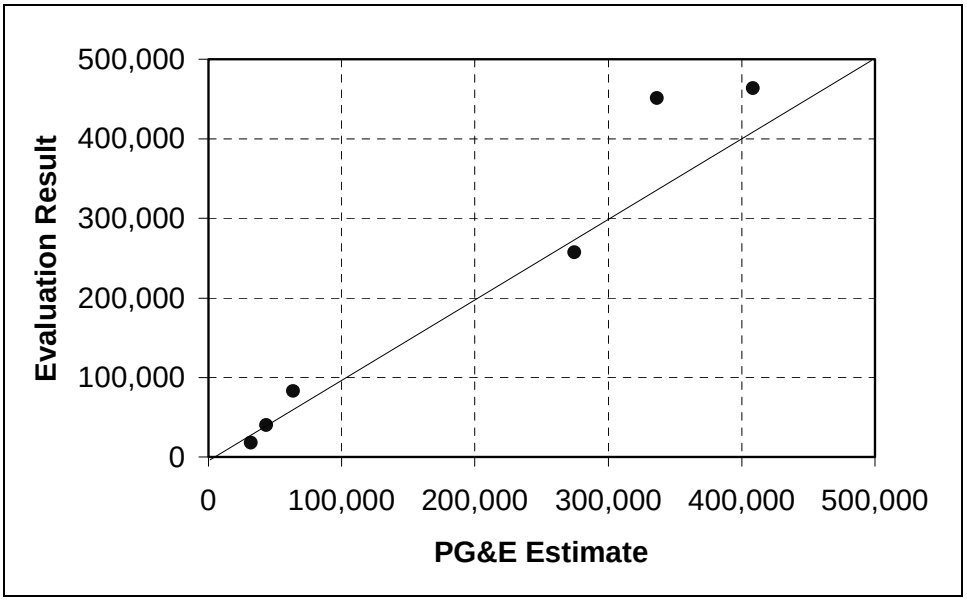


Table 3-6 compares kWh savings estimates. PG&E estimates and evaluation results are relatively similar. For the one site with the largest difference, an unexpected operations increase took place during the post-retrofit period.

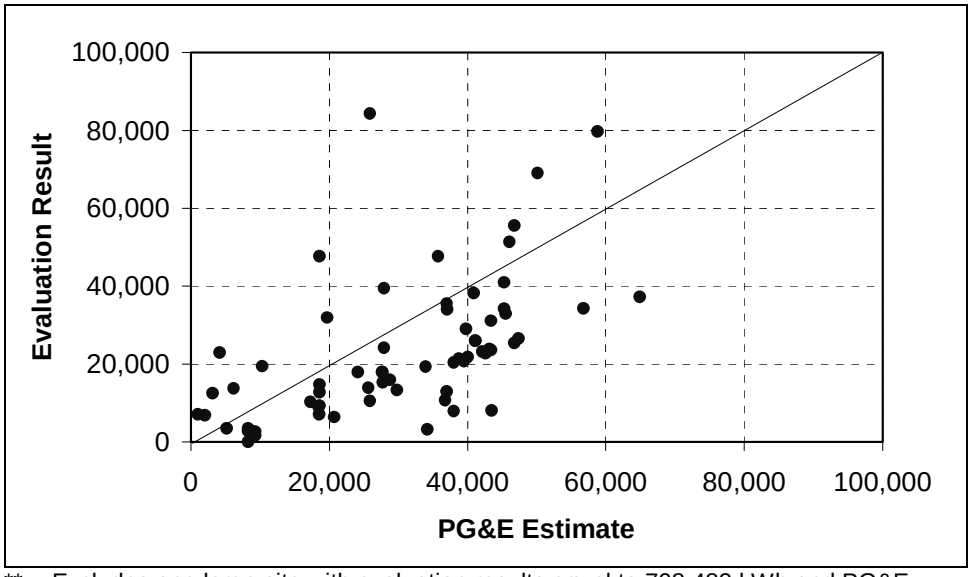
Figure 3-6
Annual kWh Savings - Process - PG&E vs. Evaluation



Food Service

Table 3-7 shows kWh savings estimates for the food service sites that installed refrigeration door closers and gaskets. (The PG&E relationship between kW and kWh was used in the evaluation, thus the kW comparison is similar.) Many of the sites fall below the diagonal line, mostly because a lower percentage of freezers were retrofitted than the 20 percent expected in the Express calculations (freezer savings are six times as great as refrigerator savings). These results are offset by one large site (not shown on the graph) with evaluation savings 2.2 times greater than PG&E estimate because more freezers were retrofitted. Other key factors causing savings differences include increased hours of applicability for the door gaskets (increasing savings estimates) and missing or severely degraded measures (leading to a decrease in savings).

Figure 3-7
Annual kWh Savings - Food Service - PG&E vs. Evaluation **



** Excludes one large site with evaluation results equal to 708,482 kWh and PG&E estimates equal to 350,208 kWh.

Table 3-3 presents distributions of realization rates for the Process projects. All projects for which PG&E and/or the evaluation calculated impacts are included. This table summarizes some of the relationships displayed graphically above:

- A relatively small number of sites had realization rates in the 0.75-1.25 range, indicating that the PG&E estimates did not do very well at predicting savings; this result reflects that most of the measures were Express Program measures and initial savings estimates did not incorporate site-specific data;

- A large number of site had realization rates in the 0.25-0.75 range; these are mostly smaller food service sites;
- Just under one-third of the projects had realization rates greater than 1.25; these tended to be larger impact sites and the results offset the lower realization rates of the more numerous smaller projects; and
- Secondary kW impacts were calculated at four refrigeration sites that showed zero PG&E savings.

Table 3-3
Distribution of Realization Rates

Realization Rate	Number of Sites					
	kW	% Sites	kWh	% Sites	Therms	% Sites
> 1.75	18	16%	19	17%		
1.26 - 1.75	13	12%	13	12%		
0.76 - 1.25	13	12%	20	18%		
0.25 - 0.75	49	45%	49	44%		
< 0.25	13	12%	11	10%	1	100%
PG&E Impact=0 / Eval Impact>0	4	4%				
PG&E Impact=0 / Eval Impact<0						
Totals	110	100%	112	100%	1	100%

3.3 NET PROGRAM SAVINGS

This subsection present net Program savings results. A net-to-gross analysis was not conducted for the miscellaneous measures. Instead, the net-to-gross ratio of 0.75 prescribed in the Protocols for miscellaneous measures was used.

Evaluation net savings are determined by applying the net-to-gross ratio to evaluation gross savings. Table 3-5 presents the results for annual kWh, summer peak kW, and annual therms.

Table 3-4
1994 Commercial Miscellaneous Programs
Net Savings Estimates

	Annual kWh	Summer Peak kW	Annual Therms
1. PG&E Gross Savings	35,065,085	5,772	431,615
2. PG&E Net-to-Gross Ratio*	0.73	0.74	0.75
3. PG&E Net Savings (1×2)	25,597,512	4,271	323,711
4. Evaluation Gross Realization Rate	1.06	0.96	*0.76***
5. Evaluation Gross Savings (1×4)	37,322,432	5,520	327,985****
6. Evaluation Net-to-Gross Ratio	0.75	0.75	0.75
7. Evaluation Net Savings (5×6)	27,991,824	4,140	245,989
8. Net Savings Realization Rate (7÷3)	1.09	0.97	0.76

* Based on a weighted average of motors @ 0.78, refrigeration @ 0.65, and other miscellaneous @ 0.75.
** Implied
*** Evaluation results for one large therm site were added to PG&E results at other therm sites.

3.4 OTHER FINDINGS AND RECOMMENDATIONS

During the course of the evaluation, the project team was able to identify several factors that could lead to improvements in the PG&E programs and aid in future evaluations of this type. Key evaluation results indicate that program savings were overestimated, especially for kW impacts. In addition, about half of the program participants appear to be free riders. Recommendations for improving the program follow.

Applicability of Express Measures to Large Sites

For large savings sites, use of the Express Program with its standardized savings estimates and standardized operating estimates can lead to large errors in initial impact estimates. For several large sites, the Express Program estimates were very low, due to higher load factor and increased operating hours at these sites.

Recommendation: Set a savings size limit for the Express Program to ensure that large sites receive Custom applications that are site specific.

Use of Equipment Performance Data

Collection of equipment performance data for some types of equipment, such as chillers, is very difficult during the evaluation, although this information can greatly improve impact estimates. Manufacturers are not inclined to release this information unless one is in the process of purchasing equipment. For larger savings sites, acquisition and use of equipment-specific performance data during the program application process could greatly improve the savings estimates associated with the customized rebate applications.

Recommendation: Require that equipment performance data be obtained and used in rebate application savings calculations for large impact sites.

Monitoring Activities

For sites where pre- and post-retrofit monitoring/metering data exist, evaluation analysis activities often can be greatly simplified. In some cases, the evaluation becomes a verification that the monitoring/metering results are still valid after the equipment has been in the field for some time. Use of monitoring/metering data in the rebate application also can greatly improve the accuracy of the impact estimates.

Recommendation: For larger sites, PG&E should consider guidelines for when monitoring/metering activities for both pre- and post-retrofit periods might be considered or required as part of the application.

A

SITE SPECIFIC RESULTS

This appendix presents gross savings impact results for the analysis sites included in the study.

Site Specific Data

				kW Savings			kWh Savings			Therm Savings		
Sample Group	Site ID	SIC Code	Measure Type	PG&E	Evaluation	Realization Rate	PG&E	Evaluation	Realization Rate	PG&E	Evaluation	Realization Rate
F-1	397758	54	Food Service	8.7	3.0	0.35	36,963	12,966	0.35	0	0	
F-1	405261	54	Food Service	8.8	4.7	0.54	37,998	20,469	0.54	0	0	
F-1	538819	54	Food Service	6.7	3.8	0.57	33,957	19,335	0.57	0	0	
F-1	608164	54	Food Service	8.4	4.6	0.55	38,799	21,380	0.55	0	0	
F-1	748504	54	Food Service	6.3	2.8	0.45	29,817	13,392	0.45	0	0	
F-1	797491	54	Food Service	7.8	5.1	0.65	27,648	17,935	0.65	0	0	
F-1	861707	54	Food Service	6.2	3.4	0.55	28,782	15,922	0.55	0	0	
F-1	894349	54	Food Service	9.0	4.9	0.54	40,068	21,834	0.54	0	0	
F-1	919693	54	Food Service	8.7	8.3	0.96	36,963	35,542	0.96	0	0	
F-1	922490	54	Food Service	9.4	8.6	0.91	45,243	41,013	0.91	0	0	
F-1	937461	54	Food Service	6.9	6.4	0.92	37,062	33,995	0.92	0	0	
F-1	944271	54	Food Service	8.6	8.1	0.94	40,869	38,259	0.94	0	0	
F-1	946408	54	Food Service	6.1	3.3	0.55	27,747	15,240	0.55	0	0	
F-1	979256	54	Food Service	8.1	10.8	1.33	35,694	47,590	1.33	0	0	
F-1	990789	54	Food Service	5.2	2.6	0.49	18,432	9,096	0.49	0	0	
F-1	1001271	54	Food Service	8.7	3.0	0.35	36,963	12,966	0.35	0	0	
F-1	1008600	54	Food Service	9.3	5.1	0.55	43,173	23,882	0.55	0	0	
F-1	1025598	59	Food Service	3.5	1.3	0.38	18,531	7,027	0.38	0	0	
F-1	1032629	54	Food Service	9.9	7.2	0.72	45,477	32,889	0.72	0	0	
F-1	1037691	54	Food Service	5.9	3.2	0.54	25,677	13,874	0.54	0	0	
F-1	1063816	54	Food Service	2.9	1.7	0.59	17,262	10,237	0.59	0	0	
F-1	1068169	54	Food Service	8.2	2.4	0.29	36,729	10,688	0.29	0	0	
F-1	1080916	54	Food Service	9.7	7.0	0.72	43,407	31,094	0.72	0	0	
F-1	1087363	54	Food Service	9.2	5.0	0.55	42,138	23,200	0.55	0	0	
F-1	1095315	54	Food Service	8.8	1.8	0.21	37,998	7,850	0.21	0	0	
F-1	1099782	54	Food Service	10.5	12.4	1.19	46,746	55,583	1.19	0	0	
F-1	3728056	54	Food Service	4.9	3.6	0.74	24,174	17,940	0.74	0	0	
F-1	4338162	54	Food Service	9.1	5.7	0.63	41,103	25,978	0.63	0	0	
F-1	4408895	54	Food Service	9.1	10.1	1.12	46,044	51,383	1.12	0	0	
F-1	4426907	54	Food Service	9.4	7.1	0.76	45,243	34,175	0.76	0	0	
F-1	4593124	54	Food Service	10.1	5.4	0.53	42,606	22,743	0.53	0	0	
F-1	4723292	54	Food Service	12.7	7.7	0.60	56,763	34,310	0.60	0	0	
F-1	4751474	54	Food Service	9.1	5.7	0.63	41,103	25,978	0.63	0	0	
F-1	4875155	54	Food Service	7.9	4.4	0.56	47,412	26,494	0.56	0	0	
F-1	4911143	54	Food Service	10.5	5.7	0.54	46,746	25,474	0.54	0	0	
F-1	4916151	54	Food Service	7.8	5.1	0.65	27,648	17,935	0.65	0	0	
F-1	4943498	54	Food Service	9.8	5.1	0.52	39,501	20,695	0.52	0	0	
F-1	4964201	59	Food Service	8.5	6.2	0.73	39,834	29,002	0.73	0	0	
F-1	4976463	54	Food Service	12.9	17.5	1.36	58,833	79,746	1.36	0	0	
F-1	5035278	54	Food Service	11.3	6.5	0.57	64,908	37,177	0.57	0	0	
F-1	5099234	54	Food Service	9.7	5.3	0.54	43,407	23,654	0.54	0	0	
F-1	5105796	53	Food Service	113.5	253.7	2.23	507,528	1,133,849	2.23	0	0	
F-1	5345130	54	Food Service	11.2	15.4	1.38	50,085	69,023	1.38	0	0	
F-2	351048	59	Food Service	0.5	0.3	0.66	5,175	3,413	0.66	0	0	
F-2	650009	54	Food Service	0.6	1.3	2.22	6,210	13,811	2.22	0	0	
F-2	926452	54	Food Service	0.1	0.7	6.91	1,035	7,150	6.91	0	0	
F-2	932638	58	Food Service	1.7	1.2	0.69	18,630	12,834	0.69	0	0	
F-2	964228	58	Food Service	0.9	0.2	0.28	9,315	2,638	0.28	0	0	
F-2	999176	59	Food Service	2.6	3.7	1.41	27,945	39,451	1.41	0	0	
F-2	1038416	54	Food Service	0.3	1.2	4.01	3,105	12,457	4.01	0	0	
F-2	3777627	58	Food Service	0.2	0.6	3.26	2,070	6,738	3.26	0	0	
F-2	3813129	58	Food Service	1.9	0.6	0.31	20,700	6,446	0.31	0	0	
F-2	3904753	58	Food Service	2.4	1.0	0.41	25,875	10,593	0.41	0	0	
F-2	4394680	54	Food Service	1.8	3.0	1.62	19,665	31,888	1.62	0	0	
F-2	4540314	54	Food Service	2.4	7.9	3.26	25,875	84,318	3.26	0	0	
F-2	4640675	42	Food Service	0.4	2.1	5.53	4,140	22,879	5.53	0	0	
F-2	4969233	58	Food Service	0.8	0.3	0.42	8,280	3,518	0.42	0	0	
F-2	5353515	54	Food Service	1.0	1.8	1.88	10,350	19,438	1.88	0	0	
F-2	5375671	54	Food Service	2.6	2.3	0.87	27,945	24,228	0.87	0	0	
F-2	5497121	58	Food Service	1.7	1.4	0.79	18,630	14,754	0.79	0	0	
F-2	5539431	58	Food Service	1.7	0.9	0.50	18,630	9,338	0.50	0	0	
F-2	5619568	58	Food Service	0.8	0.3	0.34	8,280	2,798	0.34	0	0	
F-2	5651465	58	Food Service	4.1	0.7	0.18	43,470	7,996	0.18	0	0	
F-2	5749132	54	Food Service	1.7	4.5	2.55	18,630	47,585	2.55	0	0	
F-2	5913483	58	Food Service	0.8	0.0	0.00	8,280	0	0.00	0	0	
F-2	5923931	58	Food Service	3.2	0.3	0.09	34,155	3,141	0.09	0	0	
F-2	6103846	58	Food Service	0.9	0.2	0.18	9,315	1,711	0.18	0	0	

Site Specific Data

				kW Savings			kWh Savings			Therm Savings		
Sample Group	Site ID	SIC Code	Measure Type	PG&E	Evaluation	Realization Rate	PG&E	Evaluation	Realization Rate	PG&E	Evaluation	Realization Rate
M-1	57560	75	Motors	0.2	0.1	0.50	1,311	217	0.17	0	0	
M-1	374146	80	Motors	4.9	9.1	1.86	31,092	79,601	2.56	0	0	
M-1	637320	79	Motors	0.9	0	0.00	5,817	3,920	0.67	0	0	
M-1	676960	65	Motors	4.1	8	1.95	26,298	31,913	1.21	0	0	
M-1	870021	42	Motors	130.6	148.8	1.14	408,552	463,845	1.14	0	0	
M-1	871100	49	Motors	2.9	4.5	1.55	18,398	44,162	2.40	0	0	
M-1	885870	53	Motors	5.8	16.7	2.88	37,245	83,372	2.24	0	0	
M-1	889142	47	Motors	0.2	0	0.00	1,039	0	0.00	0	0	
M-1	960599	82	Motors	10.7	33.5	3.13	68,695	293,051	4.27	0	0	
M-1	3861848	7	Motors	0.3	0.1	0.33	1,748	790	0.45	0	0	
M-1	3957187	7	Motors	3.9	2.5	0.64	25,173	12,531	0.50	0	0	
M-1	3986463	49	Motors	10.9	13	1.19	70,077	113,774	1.62	0	0	
M-1	4127640	49	Motors	11.5	3.5	0.30	73,592	35,461	0.48	0	0	
M-1	4403101	59	Motors	2.9	7.9	2.72	18,398	44,665	2.43	0	0	
M-1	4450394	65	Motors	2.1	1.4	0.67	13,149	5,700	0.43	0	0	
M-1	5043453	70	Motors	2.9	5.5	1.90	18,470	46,720	2.53	0	0	
M-1	5276764	49	Motors	2.9	5.1	1.76	18,398	49,691	2.70	0	0	
M-1	5523165	44	Motors	1.8	0.5	0.28	11,559	4,109	0.36	0	0	
M-1	5564540	65	Motors	8.5	15.8	1.86	54,550	20,651	0.38	0	0	
M-1	5739013	42	Motors	0.1	0	0.00	342	47	0.14	0	0	
M-1	6200623	49	Motors	3.1	0.4	0.13	19,615	3,228	0.16	0	0	
P-1	124250	75	Process	16.6	22.9	1.38	43,338	39,572	0.91	0	0	
P-1	600136	49	Process	37.4	20.4	0.55	336,419	451,252	1.34	0	0	
P-1	857767	75	Process	54.2	26.8	0.49	31,846	18,038	0.57	0	0	
P-A	870021	42	Process	130.6	148.8	1.14	408,552	463,845	1.14	0	0	
P-A	1053926	7	Process	128.6	0	0.00	274,689	257,175	0.94	0	0	
P-A	5849787	72	Process	-6.5	-4.7	0.72	63,532	82,522	1.30	137,575	33,945	0.25
R-2	503636	54	Refrigeration	4.8	7.5	1.56	41,552	65,206	1.57	0	0	
R-2	940854	54	Refrigeration	6.8	7.7	1.13	59,360	67,535	1.14	0	0	
R-2	1010626	54	Refrigeration	12.8	28.6	2.23	111,300	351,246	3.16	0	0	
R-2	1116695	54	Refrigeration	11.6	6.9	0.59	100,912	60,549	0.60	0	0	
R-2	3814302	54	Refrigeration	9.8	16.2	1.65	85,330	142,057	1.66	0	0	
R-2	4852134	54	Refrigeration	9.2	14.4	1.57	80,136	125,755	1.57	0	0	
R-2	6029261	54	Refrigeration	6.5	9.6	1.48	56,392	83,837	1.49	0	0	
R-2	6121266	54	Refrigeration	26.9	27.9	1.04	234,472	244,524	1.04	0	0	
R-3	145384	54	Refrigeration	0	0		344,732	400,823	1.16	0	0	
R-3	925027	54	Refrigeration	0	2.6		306,005	272,073	0.89	0	0	
R-3	3828744	54	Refrigeration	0	2.4		250,483	234,296	0.94	0	0	
R-3	4353199	54	Refrigeration	0	2.1		114,150	121,635	1.07	0	0	
R-4	93831	54	Refrigeration	0	0		42,025	114,944	2.74	0	0	
R-4	849783	54	Refrigeration	4.3	6.7	1.56	37,100	58,254	1.57	0	0	
R-4	904080	42	Refrigeration	6.5	0	0.00	30,328	-43,122	-1.42	0	0	
R-4	5429334	42	Refrigeration	0	7.2		51,827	60,331	1.16	0	0	
R-4	5968080	42	Refrigeration	32.4	24	0.74	150,612	56,975	0.38	0	0	
R-4	6195680	54	Refrigeration	8	13.2	1.65	26,795	53,518	2.00	0	0	
R-A	381902	42	Refrigeration	80.2	17.7	0.22	837,291	65,884	0.08	0	0	
R-X	3728056	54	Refrigeration	0	0		24,174	17,940	0.74	0	0	
R-X	4540314	54	Refrigeration	0	0		25,875	84,318	3.26	0	0	
R-X	4640675	42	Refrigeration	0	0		4,140	22,879	5.53	0	0	

B

SAVINGS BY COSTING PERIOD

This appendix presents gross savings by PG&E costing period. Tables are presented in the following order:

- Total commercial miscellaneous measure savings
- Food Service Measures
- Motor Measures
- Process Measures
- Refrigeration Measures

Gross Savings by Costing Period
Total Commercial Miscellaneous Savings

Costing Period	Average kW Savings (1)	kW Savings Coincident with System Maximum in Period (2)	kW Adjustment Factor (3)	kWh Savings (4)	kWh Adjustment Factor (5)
Summer On Peak:	4,773	5,433	1.00	3,665,287	0.10
Summer Partial Peak:	4,274	4,987	0.92	3,829,091	0.10
Summer Off Peak:	4,215	5,416	1.00	11,599,370	0.31
Winter Partial Peak:	4,203	5,514	1.01	6,775,214	0.18
Winter Off Peak:	4,123	5,371	0.99	11,264,552	0.30

Annual kWh Savings (6)	37,133,514
Connected load kW Savings (7)	1,700
Summer Therm Savings	0
Winter Therm Savings	0

Costing Period Definitions

· Summer On Peak: May 1 to Oct. 31, Noon-6 p.m. Weekdays
· Summer Partial Peak: May 1 to Oct. 31, 8:30 a.m.-Noon and 6-9:30 p.m. Weekdays
· Summer Off Peak: May 1 to Oct. 31, 9:30 p.m.-8:30 a.m. Weekdays and All Saturdays/Sundays/Holidays
· Winter Partial Peak: Nov. 1 to Apr. 31, 8:30 a.m.-9:30 p.m.
· Winter Off Peak: Nov. 1 to Apr. 30, 9:30 p.m.-8:30 a.m.

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(1) For end-uses limited to either "on" or "off" operation (e.g. lighting):
(Connected load kW savings (7)* number of hours end-use is on in the costing period)/(total number of hours in the costing period)
For end-uses with part-load operating conditions (e.g. HVAC) :
(Summation for all hours in the costing period {full or part load kW savings * number of hours end-use is operating at that full or part load setting}) / (total number of hours in the costing period)
For example, for a chiller for a costing period with 10 hours, if the chiller operates 1 hour with 10 kW savings, 4 hours with 5 kW savings, and 5 hours a 0% load (with no kW savings), the average kW savings would be (1*10+4*5+5*0)/10= 3 kW
(2) The kW savings for the targeted end-use at the time of PG&E's system maximum for the costing period.
(3) (Coincident kW savings for the costing period)/ (coincident kW savings for the summer on-peak costing period)
(4) Average kW savings (1) * number of annual operating hours in period
(5) (Annual kWh savings in costing period (4)) / (total annual kWh savings (6))
(6) Total annual kWh savings
(7) Connected load kW savings

Gross Savings by Costing Period
Commercial Miscellaneous: Food Service

Costing Period	Average kW Savings (1)	kW Savings Coincident with System Maximum in Period (2)	kW Adjustment Factor (3)	kWh Savings (4)	kWh Adjustment Factor (5)
Summer On Peak:	3,581	3,734	1.00	2,750,105	0.14
Summer Partial Peak:	2,937	3,621	0.97	2,631,384	0.13
Summer Off Peak:	1,833	2,800	0.75	5,045,146	0.25
Winter Partial Peak:	2,909	3,512	0.94	4,689,027	0.24
Winter Off Peak:	1,709	2,838	0.76	4,669,238	0.24

Annual kWh Savings (6)	19,784,900
Connected load kW Savings (7)	0
Summer Therm Savings	0
Winter Therm Savings	0

Costing Period Definitions

- Summer On Peak: May 1 to Oct. 31, Noon-6 p.m. Weekdays
- Summer Partial Peak: May 1 to Oct. 31, 8:30 a.m.-Noon and 6-9:30 p.m. Weekdays
- Summer Off Peak: May 1 to Oct. 31, 9:30 p.m.-8:30 a.m. Weekdays and All Saturdays/Sundays/Holidays
- Winter Partial Peak: Nov. 1 to Apr. 31, 8:30 a.m.-9:30 p.m.
- Winter Off Peak: Nov. 1 to Apr. 30, 9:30 p.m.-8:30 a.m.

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(1) For end-uses limited to either "on" or "off" operation (e.g. lighting):
(Connected load kW savings (7)* number of hours end-use is on in the costing period)/(total number of hours in the costing period)
For end-uses with part-load operating conditions (e.g. HVAC) :
(Summation for all hours in the costing period {full or part load kW savings * number of hours end-use is operating at that full or part load setting}) / (total number of hours in the costing period)
For example, for a chiller for a costing period with 10 hours, if the chiller operates 1 hour with 10 kW savings, 4 hours with 5 kW savings, and 5 hours a 0% load (with no kW savings), the average kW savings would be (1*10+4*5+5*0)/10= 3 kW
(2) The kW savings for the targeted end-use at the time of PG&E's system maximum for the costing period.
(3) (Coincident kW savings for the costing period)/ (coincident kW savings for the summer on-peak costing period)
(4) Average kW savings (1) * number of annual operating hours in period
(5) (Annual kWh savings in costing period (4)) / (total annual kWh savings (6))
(6) Total annual kWh savings
(7) Connected load kW savings

Gross Savings by Costing Period
Commercial Miscellaneous: Motors

Costing Period	Average kW Savings (1)	kW Savings Coincident with System Maximum in Period (2)	kW Adjustment Factor (3)	kWh Savings (4)	kWh Adjustment Factor (5)
Summer On Peak:	259	312	1.00	198,679	0.09
Summer Partial Peak:	252	312	1.00	225,777	0.11
Summer Off Peak:	245	304	0.97	674,484	0.31
Winter Partial Peak:	248	308	0.99	399,728	0.19
Winter Off Peak:	238	306	0.98	651,534	0.30

Annual kWh Savings (6)	2,150,201
Connected load kW Savings (7)	74
Summer Therm Savings	0
Winter Therm Savings	0

Costing Period Definitions

· Summer On Peak: May 1 to Oct. 31, Noon-6 p.m. Weekdays
· Summer Partial Peak: May 1 to Oct. 31, 8:30 a.m.-Noon and 6-9:30 p.m. Weekdays
· Summer Off Peak: May 1 to Oct. 31, 9:30 p.m.-8:30 a.m. Weekdays and All Saturdays/Sundays/Holidays
· Winter Partial Peak: Nov. 1 to Apr. 31, 8:30 a.m.-9:30 p.m.
· Winter Off Peak: Nov. 1 to Apr. 30, 9:30 p.m.-8:30 a.m.

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(1) For end-uses limited to either "on" or "off" operation (e.g. lighting):
(Connected load kW savings (7)* number of hours end-use is on in the costing period)/(total number of hours in the costing period)
For end-uses with part-load operating conditions (e.g. HVAC) :
(Summation for all hours in the costing period {full or part load kW savings * number of hours end-use is operating at that full or part load setting}) / (total number of hours in the costing period)
For example, for a chiller for a costing period with 10 hours, if the chiller operates 1 hour with 10 kW savings, 4 hours with 5 kW savings, and 5 hours a 0% load (with no kW savings), the average kW savings would be (1*10+4*5+5*0)/10= 3 kW
(2) The kW savings for the targeted end-use at the time of PG&E's system maximum for the costing period.
(3) (Coincident kW savings for the costing period)/ (coincident kW savings for the summer on-peak costing period)
(4) Average kW savings (1) * number of annual operating hours in period
(5) (Annual kWh savings in costing period (4)) / (total annual kWh savings (6))
(6) Total annual kWh savings
(7) Connected load kW savings

Gross Savings by Costing Period
Commercial Miscellaneous: Process

Costing Period	Average kW Savings (1)	kW Savings Coincident with System Maximum in Period (2)	kW Adjustment Factor (3)	kWh Savings (4)	kWh Adjustment Factor (5)
Summer On Peak:	992	704	1.00	762,218	0.10
Summer Partial Peak:	901	546	0.78	807,412	0.11
Summer Off Peak:	795	525	0.75	2,187,675	0.29
Winter Partial Peak:	930	1,028	1.46	1,498,963	0.20
Winter Off Peak:	801	998	1.42	2,188,012	0.29

Annual kWh Savings (6)	7,444,279
Connected load kW Savings (7)	748
Summer Therm Savings	0
Winter Therm Savings	0

Costing Period Definitions

· Summer On Peak: May 1 to Oct. 31, Noon-6 p.m. Weekdays
· Summer Partial Peak: May 1 to Oct. 31, 8:30 a.m.-Noon and 6-9:30 p.m. Weekdays
· Summer Off Peak: May 1 to Oct. 31, 9:30 p.m.-8:30 a.m. Weekdays and All Saturdays/Sundays/Holidays
· Winter Partial Peak: Nov. 1 to Apr. 31, 8:30 a.m.-9:30 p.m.
· Winter Off Peak: Nov. 1 to Apr. 30, 9:30 p.m.-8:30 a.m.

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(1) For end-uses limited to either "on" or "off" operation (e.g. lighting):
(Connected load kW savings (7)* number of hours end-use is on in the costing period)/(total number of hours in the costing period)
For end-uses with part-load operating conditions (e.g. HVAC) :
(Summation for all hours in the costing period {full or part load kW savings * number of hours end-use is operating at that full or part load setting}) / (total number of hours in the costing period)
For example, for a chiller for a costing period with 10 hours, if the chiller operates 1 hour with 10 kW savings, 4 hours with 5 kW savings, and 5 hours a 0% load (with no kW savings), the average kW savings would be (1*10+4*5+5*0)/10= 3 kW
(2) The kW savings for the targeted end-use at the time of PG&E's system maximum for the costing period.
(3) (Coincident kW savings for the costing period)/ (coincident kW savings for the summer on-peak costing period)
(4) Average kW savings (1) * number of annual operating hours in period
(5) (Annual kWh savings in costing period (4)) / (total annual kWh savings (6))
(6) Total annual kWh savings
(7) Connected load kW savings

Gross Savings by Costing Period
Commercial Miscellaneous: Refrigeration

Costing Period	Average kW Savings (1)	kW Savings Coincident with System Maximum in Period (2)	kW Adjustment Factor (3)	kWh Savings (4)	kWh Adjustment Factor (5)
Summer On Peak:	968	683	1.00	743,550	0.10
Summer Partial Peak:	767	464	0.68	686,784	0.09
Summer Off Peak:	964	943	1.38	2,652,999	0.34
Winter Partial Peak:	702	505	0.74	1,130,861	0.15
Winter Off Peak:	930	457	0.67	2,539,940	0.33

Annual kWh Savings (6)	7,754,134
Connected load kW Savings (7)	4
Summer Therm Savings	0
Winter Therm Savings	0

Costing Period Definitions

- Summer On Peak: May 1 to Oct. 31, Noon-6 p.m. Weekdays
- Summer Partial Peak: May 1 to Oct. 31, 8:30 a.m.-Noon and 6-9:30 p.m. Weekdays
- Summer Off Peak: May 1 to Oct. 31, 9:30 p.m.-8:30 a.m. Weekdays and All Saturdays/Sundays/Holidays
- Winter Partial Peak: Nov. 1 to Apr. 31, 8:30 a.m.-9:30 p.m.
- Winter Off Peak: Nov. 1 to Apr. 30, 9:30 p.m.-8:30 a.m.

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(1) For end-uses limited to either "on" or "off" operation (e.g. lighting):
(Connected load kW savings (7)* number of hours end-use is on in the costing period)/(total number of hours in the costing period)
For end-uses with part-load operating conditions (e.g. HVAC) :
(Summation for all hours in the costing period {full or part load kW savings * number of hours end-use is operating at that full or part load setting}) / (total number of hours in the costing period)
For example, for a chiller for a costing period with 10 hours, if the chiller operates 1 hour with 10 kW savings, 4 hours with 5 kW savings, and 5 hours a 0% load (with no kW savings), the average kW savings would be (1*10+4*5+5*0)/10= 3 kW
(2) The kW savings for the targeted end-use at the time of PG&E's system maximum for the costing period.
(3) (Coincident kW savings for the costing period)/ (coincident kW savings for the summer on-peak costing period)
(4) Average kW savings (1) * number of annual operating hours in period
(5) (Annual kWh savings in costing period (4)) / (total annual kWh savings (6))
(6) Total annual kWh savings
(7) Connected load kW savings

C

PROTOCOLS TABLES 6 AND 7

This appendix presents Tables 6 and 7 of the M&E Protocols for the commercial miscellaneous measure evaluation.

M&E PROTOCOLS TABLE 6

Designated Unit of Measurement: LOAD IMPACTS PER PROJECT
ENDUSE: COMMERCIAL MISCELLANEOUS

1. Average Participant Group and Average Comaprison Group											
A. Pre-install usage:	Pre-install kW	na									
	Pre-install kWh	na									
	Pre-install Therms	na									
	Base kW	na									
	Base kWh	na									
	Base Therms	na									
	Base kW/ designated unit of measurement	na									
	Base kWh/ designated unit of measurement	na									
	Base Therms/ designated unit of measurement	na									
B. Impact year usage:	Impact Yr kW	na									
	Impact Yr kWh	na									
	Impact Yr Therms	na									
	Impact Yr kW/designated unit	na									
	Impact Yr kWh/designated unit	na			**5. A. 90% CONFIDENCE LEVEL**				**5. B. 80% CONFIDENCE LEVEL**		
	Impact Yr Therms/designated unit	na		**LOWER BOUND**	**UPPER BOUND**	**LOWER BOUND**	**UPPER BOUND**	**LOWER BOUND**	**UPPER BOUND**	**LOWER BOUND**	**UPPER BOUND**
2. Average Net and Gross End Use Load Impacts		**AVG GROSS**	**AVG NET**	**AVG GROSS**	**AVG GROSS**	**AVG NET**	**AVG NET**	**AVG GROSS**	**AVG GROSS**	**AVG NET**	**AVG NET**
	A. i. Load Impacts - kW	5,520	2,815	4,083	6,958	2,090	3,541	4,400	6,640	2,729	3,381
	A. ii. Load Impacts - kWh	37,322,432	19,034,440	30,346,276	44,298,588	15,541,882	22,526,998	31,885,696	42,759,168	18,703,515	21,756,300
	A. iii. Load Impacts - Therms	327,985	167,272	327,985	327,985	167,272	167,272	327,985	327,985	167,272	167,272
	B. i. Load Impacts/designated unit - kW	4	2	3	5	2	3	3	5	2	3
	B. ii. Load Impacts/designated unit - kWh	28,977	14,778	23,561	34,393	12,067	17,490	24,756	33,198	14,521	16,892
	B. iii. Load Impacts/designated unit - Therms	255	130	255	255	130	130	255	255	130	130
	C. i. a. % change in usage - Part Grp - kW	na	na	na	na	na	na	na	na	na	na
	C. i. b. % change in usage - Part Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. i. c. % change in usage - Part Grp - Therms	na	na	na	na	na	na	na	na	na	na
	C. ii. a. % change in usage - Comp Grp - kW	na	na	na	na	na	na	na	na	na	na
	C. ii. b. % change in usage - Comp Grp - kWh	na	na	na	na	na	na	na	na	na	na
	C. ii. c. % change in usage - Comp Grp - Therms	na	na	na	na	na	na	na	na	na	na
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	0.96	0.97	0.71	1.21	0.72	1.22	0.77	1.15	0.94	1.16
	D.A. ii. Load Impacts - kWh, realization rate	1.07	1.09	0.87	1.27	0.89	1.29	0.91	1.23	1.07	1.25
	D.A. iii. Load Impacts - Therms, realization rate	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
	D.B. i. Load Impacts/designated unit - kW, real rate	0.96	0.97	0.71	1.21	0.72	1.22	0.77	1.15	0.94	1.16
	D.B. ii. Load Impacts/designated unit - kWh, real rate	1.07	1.09	0.87	1.27	0.89	1.29	0.91	1.23	1.07	1.25
	D.B. iii. Load Impacts/designated unit - Therms, real rate	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**			**RATIO**	**RATIO**		
	A. i. Average Load Impacts - kW	0.75		0.75	0.75			0.75	0.75		
	A. ii. Average Load Impacts - kWh	0.75		0.75	0.75			0.75	0.75		
	A. iii. Average Load Impacts - Therms	0.75		0.75	0.75			0.75	0.75		
	B. i. Avg Load Impacts/designated unit of measurement - kW	0.75		0.75	0.75			0.75	0.75		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	0.75		0.75	0.75			0.75	0.75		
	B. iii. Avg Load Impacts/designated unit of measurement - Therms	0.75		0.75	0.75			0.75	0.75		
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	na		na	na			na	na		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	na		na	na			na	na		
	C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms	na		na	na			na	na		
4. Designated Unit Intermediate Data				**PART GRP**	**PART GRP**			**PART GRP**	**PART GRP**		
	A. Pre-install average value	1		na	na			na	na		
	B. Post-install average value	1		na	na			na	na		
6. Measure Count Data		**NUMBER**									
	A. Number of measures installed by participants in Part Group	7480									
	B. Number of measures installed by all program participants in the 12 months of the program year	38955									
	C. Number of measures installed by Comp Group	na									
7. Market Segment Data											
	B. Distribution of participants by 3 digit SIC code	See next page									

Table 6 (Cont.)
7.B. Market segment data: distribution of participants by SIC code

SIC3	percent
0	0.1
2	0.1
19	0.1
72	1.9
203	0.1
208	0.1
327	0.1
422	1.7
431	0.1
449	0.2
478	0.1
481	0.1
483	0.3
490	0.2
494	1.3
495	1.6
498	0.1
503	0.1
506	0.1
508	0.1
509	0.4
514	0.5
521	0.1
526	0.1
531	0.3
533	0.5
539	0.2
540	0.1
541	49
542	0.7
543	0.7
545	0.2
546	2
549	1.1
554	0.7
581	18.4
592	4
594	0.2
599	0.2
602	0.2
633	0.1
652	2.3
655	0.1
701	1.1
704	0.1
721	0.6
737	0.2
751	0.1
753	0.3
754	0.2
769	0.1
784	0.1
793	0.1
799	0.6
805	0.2
806	0.7
811	0.2
821	2.7
822	0.8
832	0.3
835	0.2
836	0.2
864	0.2
866	0.5
871	0.1
873	0.3
919	0.1
943	0.1

M&E PROTOCOLS TABLE 7

A. OVERVIEW INFORMATION

1. Study Title and ID No: Evaluation of 1994 Commercial Miscellaneous Energy-Efficiency Projects, #319

2. Program, Program Year, and Program Description: PG&E's Commercial, Industrial, and Agricultural Programs (the CIA Programs): CIA Customized Retrofit Program and CIA Express Retrofit Program; 1994. The Customized Program provides incentives to commercial, industrial, and agricultural customers to install custom-designed energy-efficiency measures. The Express Program provides incentives for commercial, industrial, and agricultural customers to retrofit their facilities with energy-efficient equipment from a pre-specified list of measures.

3. End Uses Covered: Commercial Miscellaneous Measures

4. Methods Used: Site-specific engineering approach

5. Program Participants: Commercial customers who received rebate checks in 1994 for installing miscellaneous measures

6. Analysis sample size: 112 customers, 193 installations, 7480 measures installed, 112 observations (at the site/customer level)

B. DATABASE MANAGEMENT

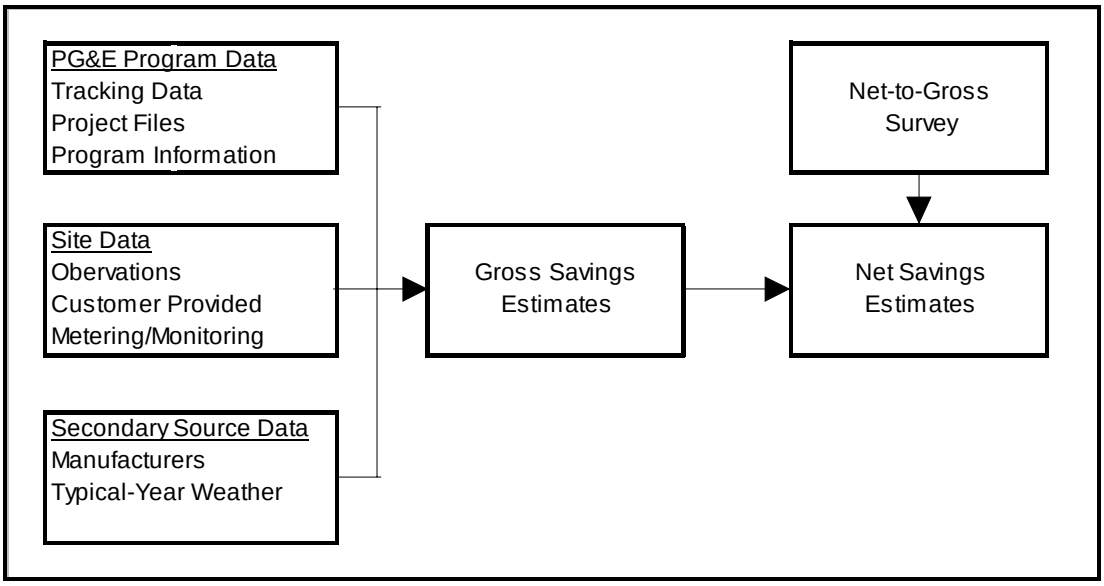
1. Data Flow Chart: See Figure C-1 for a flow chart describing the project data flow.

2. Data Sources: See Figure C-1

3. Sample Attrition: A census of 5 large process sites was attempted; 2 of these sites were dropped at PG&E's request for sensitivity reasons not associated with the rebate programs (overcontacting for studies, rate negotiations, reliability problems, etc.). Other customer segments were sampled; all visited sites were included in the analysis.

4. Quality Checks: Each site analysis was assigned to a senior engineer. This person was responsible for putting together a site analysis plan that made appropriate use of project data. The plan was reviewed by the lead evaluation engineer and the PG&E project manager. The site analysis was then conducted and a report was produced documenting all site-specific evaluation

Figure C-1



analyses and results. The site report was reviewed by the lead engineer and the PG&E project manager for completeness.

5. Data not used: N/A

C. SAMPLING

1. Sampling procedures and protocols: Sampling frame - 1288 commercial miscellaneous measure sites; Sampling strategy: 3 of 5 large process sites were selected (a census was attempted, see above on attrition); the largest refrigeration site was selected; a stratified random sample of 18 of the 66 remaining refrigeration sites with case replacement, customized controls, or avoided costs greater than $5,000 was utilized; a random sample of 20 of the 110 motors sites that installed motor of 15 hp or greater was taken; 67 of the 673 sites with refrigeration door measures were selected via a statified random sample. Sampling basis: the site as defined by PG&E control number; Stratification criteria: avoided cost savings and measure type.

2: Survey information: na

3. Statistical descriptions: na

D. DATA SCREENING AND ANALYSIS

1. Outliers: na
2. Background variables: na

3. Data screening: na, all visited sites were included.
4. Regression statistics: na; analysis method was site-specific engineering calculation supported by metering/monitoring.
5. Specification: na; regression model was not used.
6. Error in measuring variables: na, complex site studies made the best use of available data an the analysis approach was chosed to minimize measurement errors.
7: Autocorrelation: na
8: Heteroskedasticity: na
9: Collinerarity: na
10: Influential data points: na
11: Missing data: na
12: Precision: Gross savings - single ratio estimators were utilized; the standard approach for calculating the variance of a ratio estimator was utilized. Net-to-gross: the standard error of the mean net-to-gross ratio was utilized in the precision calculations.

E. DATA INTERPRETATION AND APPLICATION

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