

Customer Energy Efficiency Program
Measurement and Evaluation Program

**IMPACT EVALUATION OF
PACIFIC GAS & ELECTRIC COMPANY'S
1995 INDUSTRIAL SECTOR
ENERGY EFFICIENCY INCENTIVES PROGRAMS:
LIGHTING; HVAC; PROCESS**

PG&E Study ID numbers:

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328: Process

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As part of its Customer Energy Efficiency Programs, Pacific Gas and Electric Company (PG&E) has engaged consultants to conduct a series of studies designed to increase the certainty of and confidence in the energy savings delivered by the programs. This report describes one of those studies. It represents the findings and views of the consultant employed to conduct the study and not of PG&E itself.

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All inquiries should be directed to:

Lisa K. Lieu
Revenue Requirements
Pacific Gas and Electric Company
P. O. Box 770000, Mail Code B9A
San Francisco, CA 94177

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FINAL REPORT

**1995 Nonresidential Retrofit Programs:
Industrial Sector Study**

PG&E Study ID Numbers 325, 327, 328

Submitted to

PACIFIC GAS & ELECTRIC CO.
123 Mission Street
San Francisco, CA 94105

Submitted by

SBW CONSULTING, INC.
2820 Northup Way, Suite 230
Bellevue, WA 98004

in conjunction with

RIDGE AND ASSOCIATES

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Executive Summary

This study evaluated the gross and net energy savings from efficiency measures for which rebates were paid in 1995 by Pacific Gas and Electric Company's (PG&E) industrial retrofit energy efficiency programs. This research was designed to satisfy PG&E's regulatory requirement to provide ex post measurements of program impact and to provide information which could be used to improve the design and operation of future programs. The products of this research include estimates of gross and net electric consumption, electric peak demand, and gas consumption savings, as well as program-level net to-gross ratios (NTGR) adjusted for spillover effects. We developed savings estimates and NTGRs for the overall program, as well as for four end uses (lighting, HVAC, process, and miscellaneous). Estimates of program impact were based upon data collected from program participants via on-site surveys, short-term end-use metering, and telephone surveys.

Background

PG&E offers rebates to industrial customers who adopt energy-efficient measures that reduce energy consumption and demand in existing industrial facilities. In 1995, 862 customer applications containing 1,668 measures were approved for rebates through the REO, Retrofit Express, and Customized Programs covered by this evaluation. The goal of this evaluation was to determine the load impacts associated with PG&E's investment in these measures.

Methodology

We completed evaluations for two samples. The project-specific sample provided a census of 70% of the program database savings for the lighting, process, and HVAC end uses. These projects were of greatest interest to PG&E and therefore required the most rigorous analysis. Since these included a very diverse group of industrial facilities and customized applications of the program measures, the project specific data collection and analysis methods were tailored to the complexity of the measure and the value of each projects savings to PG&E. We developed customized data collection and analysis procedures for each process and HVAC project-specific evaluation, and used standardized procedures for lighting projects.

The verification sample completed a census for the HVAC and process domains and brought the total lighting sample count up to 150 projects. For projects in this sample, we located and inspected the equipment associated with each paid item¹. We also determined the fraction of the equipment described in the program application that was installed and what portion of the installed equipment was operational.

To calculate net savings, we implemented three levels of free-ridership analysis. The most detailed level of analysis (customized project-specific analysis) was applied to the largest project-specific HVAC, process, project-specific lighting projects. A somewhat less detailed level of analysis (standard project specific analysis) was applied to the balance of the project-specific lighting projects. The least detailed analysis (verification analysis) was applied to the verification evaluations of projects in the lighting,

¹ An item is defined as a unique combination of a particular energy efficiency measure installed at a specific customer location.

HVAC, and process end uses. There were four sources of free-ridership information in this study. Each level of analysis relied on information from one or more of these sources. These sources included program files, interviews with operations staff most familiar with measures, interviews with customer contacts who made the decision to participate in the program, and surveys of vendors who recommended the efficiency equipment. Figure 1 provides an overview of the evaluation process for each site.

To create a program-level estimates of gross savings, we extrapolated the findings from the completed project-specific evaluation group to the other projects in each end use, then summing the savings for all items. To determine the program NTGR, we extrapolated measure-level NTGRs for evaluated measures to non-evaluated measures. We then weighted both net and gross savings for all measures by their dollarized impacts, then summed both the net and gross dollarized impacts. The ratio of the net and gross impacts yielded the program NTGR.

Results

The methods described above were used to estimate gross and net savings for the 1995 paid measures. The results of these analyses are summarized below.

Gross Realization Rates

Tables 1 and 2 show estimates of gross realization rates broken out by end use and PG&E program, respectively. These tables provide two sets of results for kW savings to provide a range of realization rates, with the connected load realization rate representing the highest possible savings estimate and the average summer on-peak period realization rate providing a significantly more conservative estimate. The PG&E program was inconsistent in calculating kW savings, thus adding uncertainty to our kW realization rate estimates. Each table also lists the confidence interval for the realization rates at a 90% confidence level. The confidence interval states the upper and lower limits within which one could be 90% confident the true realization rate lies.

As Table 1 shows, we estimated a connected load realization rate of 1.37, an average summer on-peak kW realization rate of 0.88, a kWh realization rate of 0.81, and a therm realization rate of 1.17. Lighting measures had the highest realization rates, followed by HVAC measures. Process measures accounted for the largest portion of program savings out of all the end uses, but yielded the lowest realization. The low process kWh realization rate significantly offset the high kWh realization rates for lighting and HVAC.

The bulk of the program items fell within the Retrofit Express program, which, as Table 2 shows, had realization rates of 0.84, 0.98, and -61.05 for kW, kWh, and therms, respectively. The large negative realization rate for therms reflects the large number of lighting measures in this program. For many of the lighting measure evaluations, we calculated a therm takeback, that is, the increase in gas consumption for heating systems that results because the more efficient lighting produces less heat. The PG&E program did not take this effect into account, and as a result, the realization rate is unusually low. The Customized program accounted for only about a tenth as many measures as the Retrofit Express program, but was responsible for the majority of PG&E's estimate of program savings. About 63% and 75% of the total program kW and kWh savings, respectively, fell within the Customized program. The average kW, kWh, and therm realization rates for this program were 0.90, 0.76, and 1.17.

We also examined the effect of interactions between measures, as well as between lighting measures and HVAC consumption. In general, we found both effects to be negligible in the overall program.

Net Savings Estimates

Table 3 presents net-to-gross ratios for the program overall and for each of the four end uses. The table provides three sets of ratios, one using NTGRs resulting from the standard free-ridership analysis, another incorporating customized analysis results, and the last also including spillover effects. Overall, the customized, spillover-adjusted program NTGR was 0.668. On an end use level, the lighting end use yielded the largest NTGRs, followed by HVAC, miscellaneous, and process end uses.

The customized analyses raised the overall NTGR from 0.650 to 0.655. Including spillover raised the NTGR further to 0.668. Apparently, the customized analyses had little effect on the standard NTGRs, primarily because little information was available in the program files about customer motivations and the extent of PG&E's influence. In addition, open-ended questions in the decision-maker interviews yielded little information.

Figure 1: Summary of Site Evaluation Process

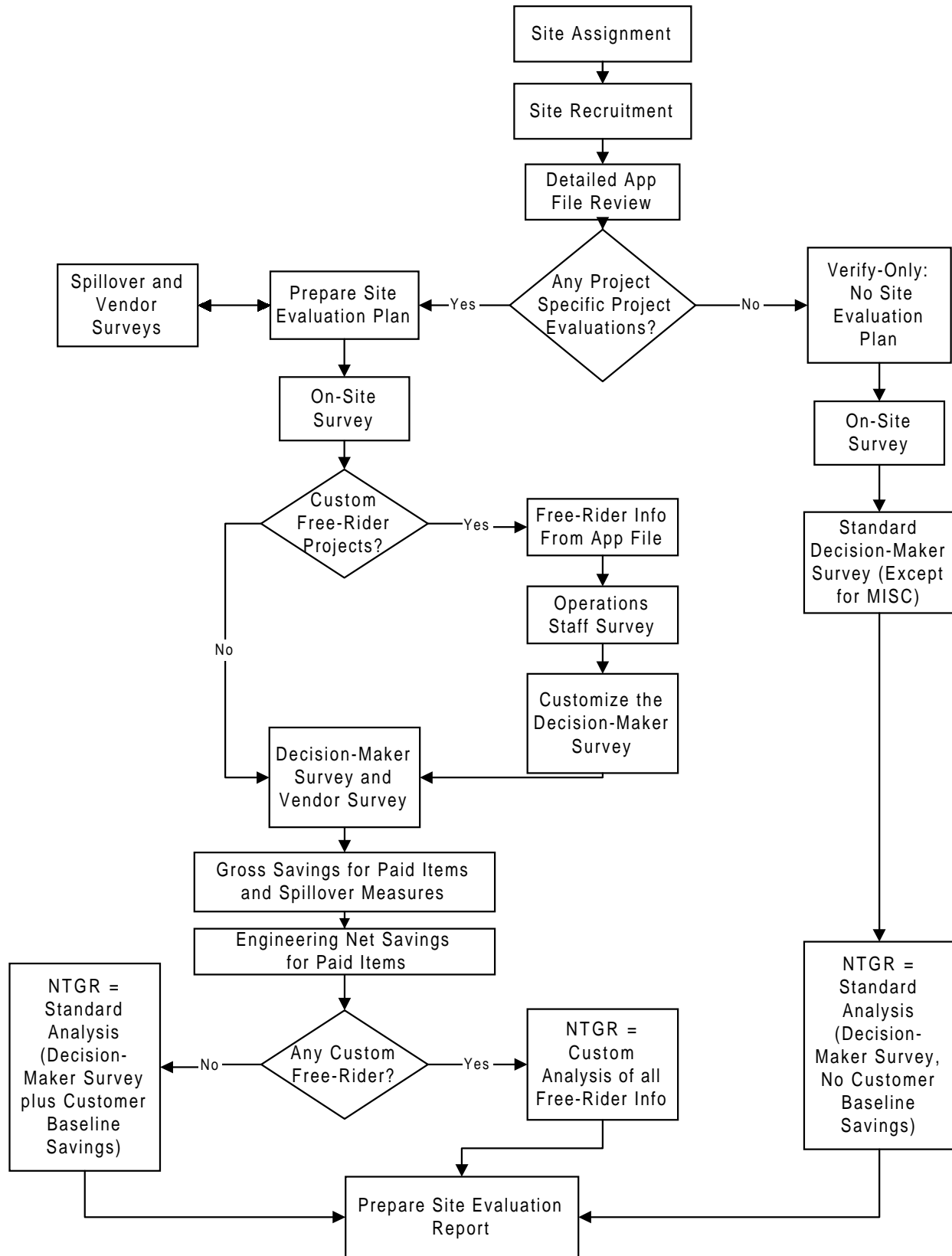


Table 1: Gross Realization Rates (Overall and by End Use)

	Connected Load kW	Avg. Summer Peak kW ¹	kWh	Therms
Total				
No. of Items	1,668	1,668	1,668	1,668
MDSS Program Savings ²	14,492	14,492	116,989,843	13,346,509
Evaluation Savings	19,811	12,708	95,168,014	15,601,245
Realization Rate	1.37	0.88	0.81	1.17
90% Confidence interval	0.52	0.49	0.56	0.83
HVA				
No. of Items	225	225	225	225
MDSS Program Savings	2,023	2,023	17,853,268	551,701
Evaluation Savings	4,411	1,687	17,292,602	537,989
Realization Rate	2.18	0.83	0.97	0.98
90% Confidence interval	1.78	1.39	0.79	0.73
Lighting				
No. of Items	1,010	1,010	1,010	1,010
MDSS Program Savings	4,836	4,836	30,356,944	0
Evaluation Savings	5,152	4,646	30,146,866	-83,195
Realization Rate	1.07	0.96	0.99	N/A
90% Confidence interval	0.50	0.50	0.59	N/A
Miscellaneous				
No. of Items	337	337	337	337
MDSS Program Savings ²	2,457	2,457	15,090,746	361,064
Evaluation Savings	3,378	2,151	12,303,606	419,983
Realization Rate	1.37	0.88	0.82	1.16
90% Confidence interval	N/A	N/A	N/A	N/A
Process				
No. of Items	96	96	96	96
MDSS Program Savings ²	5,176	5,176	53,688,885	12,433,743
Evaluation Savings	6,870	4,225	35,424,940	14,726,469
Realization Rate	1.33	0.82	0.66	1.18
90% Confidence interval	0.84	0.68	0.51	1.01

¹ Defined as the average hourly kW savings during the summer on-peak costing period (May 1 - October 31, weekdays from 12 P.M. to 6 P.M.).

² Process and miscellaneous therm program savings were reduced by 10%, and the therm savings for Shell Wester (Project 969) were reduced by an additional 25% to match the E-tables submitted in December 1996.

Table 2: Gross Realization Rates (Overall and by Program)

	Connected Load kW	Avg. Summer Peak kW ¹	kWh	Therms
Total				
No. of Items	1,668	1,668	1,668	1,668
MDSS Program Savings ²	14,492	14,492	116,989,843	13,346,509
Evaluation Savings	19,811	12,708	95,168,014	15,601,245
Realization Rate	1.37	0.88	0.81	1.17
90% Confidence interval	0.52	0.49	0.56	0.83
REO				
No. of Items	6	6	6	6
MDSS Program Savings ²	71	71	256,139	0
Evaluation Savings	124	59	191,473	0
Realization Rate	1.74	0.83	0.75	N/A
90% Confidence interval	N/A	N/A	N/A	N/A
Retrofit Express				
No. of Items	1,484	1,484	1,484	1,484
MDSS Program Savings ²	5,148	5,148	28,368,604	1,270
Evaluation Savings	5,461	4,314	27,913,937	-77,514
Realization Rate	1.06	0.84	0.98	-61.05
90% Confidence interval	0.51	0.50	0.59	N/A
Customized				
No. of Items	148	148	148	148
MDSS Program Savings ²	9,195	9,195	88,134,977	13,345,239
Evaluation Savings	14,143	8,260	66,834,073	15,678,759
Realization Rate	1.54	0.90	0.76	1.17
90% Confidence interval	1.19	0.92	0.44	0.83
Other Programs				
No. of Items	30	30	30	30
MDSS Program Savings ²	78	78	230,123	0
Evaluation Savings	83	75	228,530	0
Realization Rate	1.07	0.96	0.99	N/A
90% Confidence interval	N/A	N/A	N/A	N/A

¹ Defined as the average hourly kW savings during the summer on-peak costing period (May 1 - October 31, weekdays from 12 P.M. to 6 P.M.).

² Process and miscellaneous therm program savings were reduced by 10%, and the therm savings for Shell Wester (Project 969) were reduced by an additional 25% to match the E-tables submitted in December 1996.

Table 3: NTGR--Overall and by End Use

	Overall	HVAC	Lighting	Miscellaneous	Process
w/Standard Item NTGR	0.650	0.667	0.817	0.612	0.581
w/Custom Item NTGR	0.655	0.649	0.833	0.613	0.588
90% Confidence Interval	+/- .012	+/- .019	+/- .011	N/A	+/- .040
95% Confidence Interval	+/- .014	+/- .022	+/- .014	N/A	+/- .047
w/Custom NTGR & Spillover	0.668	0.732	0.844	0.613	0.588
90% Confidence Interval	+/- .012	+/- .019	+/- .011	N/A	+/- .040
95% Confidence Interval	+/- .014	+/- .022	+/- .014	N/A	+/- .047

1. Introduction

Pacific Gas and Electric offers rebates to its industrial customers for the adoption of energy-efficient measures that reduce energy consumption and demand in industrial facilities. During 1995 these incentives were paid for efficiency measures described in 862 program applications, processed by the Customized, Express, REO and Thermal Storage industrial programs. The research documented in this report was undertaken to determine the gross and net energy and demand impacts associated with PG&E's investment in these measures. This report presents the methodology and results of the evaluation of PG&E's 1995 Non-Residential Retrofit Industrial Sector programs.

1.1 Research Goals and Objectives

The goal of this research was to perform an impact evaluation of all efficiency measures funded under PG&E's 1995 industrial programs. The impact evaluation was conducted in strict accord with the CPUC adopted statewide Measurement and Evaluation protocols (M&E Protocols) for ex post measurement of program savings. The objectives of this evaluation were to:

- Determine the gross and net kWh, kW and Therm savings from each of four categories of efficiency measures: lighting, HVAC, process, and miscellaneous for which rebates were paid during 1995.
- Conduct project-specific evaluations of measure savings for projects that account for 70 percent of the savings in the lighting, HVAC and process end uses.
- Conduct verification evaluations of projects so that the total number of both project-specific and verification evaluations equal either 150 or a census for the lighting, HVAC, process and miscellaneous¹ end uses.
- Account for the effects of free-ridership on both project-specific and verification evaluations.
- Account for the effects of participant spillover.
- Estimate gross and net savings for each of PG&E's costing periods.
- Explain any discrepancies between the results of this study and estimates of savings prepared by PG&E's programs.
- Produce a database of measure-specific equipment characteristics that will meet the needs of future retention studies.

1.2 Units of Analysis

A wide variety of data were collected to support the estimates of gross and net savings. These data provide information for a number of different units of analysis. These units of analysis were defined as follows:

¹ Part way through this study, PG&E determined that it was not necessary to satisfy this objective for the miscellaneous end use.

- **Application.** PG&E's programs provided incentives after processing was complete for an application submitted by a customer. As each application was processed, an application file was created. PG&E's MDSS program data base maintained information from these application files in electronic form. One or more application files could have been processed for the same customer at a single location. Some applications covered measures installed at more than one location controlled by the same customer. Each application file was assigned an application number and a program year. Program year refers to the year of the program's operation under which the application was received, not the year that the rebate was paid. Thus, the paid applications that were evaluated included applications received during 1992, 1993, 1994, and 1995.
- **Item.** Each of the application files described energy efficiency measures paid for by the program. Each type of equipment, e.g., energy management system or cooling tower, installed at a specific customer location, is referred to as an "item" in the MDSS data base. Each item was assigned a measure code in the data base to indicate the type of equipment involved. Each item was also assigned to a control number, indicating the PG&E meter affected by the equipment installation. However, more than one item may have been assigned to the same control number. It is also possible that an item affected more than one control number, even though the program data base allowed for only one.
- **End Use.** PG&E assigned each item a measure code and a description of the measure. For the purpose of its earnings claim, PG&E grouped measure codes by the following end uses: HVAC, LIGHT, PROCESS, and MISCELLANEOUS.
- **Project.** A project was defined as the set of items listed on a single paid application that were assigned to the same end-use and control number.
- **Corporation.** The MDSS database contained the name of the organization that was paid the rebate. These names were grouped and matched to identify each unique corporation involved in the 1995 program.
- **Site.** A site was defined as one or more contiguous structures operated by the same corporation. Sites were identified by comparing the name of the organization paid the rebate and the service address associated with the control number or found in the application file. In some cases, multiple projects were associated with the same site, and multiple sites were associated with the same corporation.

2. Overview of Research Design

2.1 Sample Selection and Recruitment

The sample frame for this study was developed from PG&E program database entries for the 1645 items associated with the 862 applications paid in 1995 by the Customized, Express, REO, and Thermal Energy Storage industrial programs. We assigned a measure code, indicating a specific type of efficiency technology, to each item. In addition, we assigned an end use code to group measures according to the four study domains for this evaluation: (1) Lighting (interior only), (2) Process, (3) HVAC, and (4) Miscellaneous (which includes refrigeration, motors, and exterior lighting).

We aggregated the item-level entries from the PG&E data base to form a list of projects. Projects were defined as the set of items listed on a single paid application that were assigned to the same end-use and control number. Applying this definition, the item-level program database was aggregated to form a participant sample frame consisting of 922 projects, associated with 703 control numbers (a unique identifier which PG&E assigns to each billing meter location). 167 of these projects were in the HVAC domain, 479 were in lighting, 182 were in miscellaneous, and 94 were in process.

We completed evaluations for two samples. The first sample (referred to in this report as the project specific sample) provided a census of 70% of the program database kW, kWh, and therm savings for the light, process, and HVAC domains. Data collection and evaluation techniques tailored specifically for each project were applied to this sample. The second sample (referred to as the verification sample) completed a census for the HVAC and process domains, since these domains contained fewer than 150 projects. For the lighting domain, the second sample contained enough projects to bring the total sample count for the domain up to 150. (The requirement for 150 completions did not apply to the miscellaneous domain). To this second sample we applied a simpler level of data collection and analysis to verify the entries in the program database.

2.2 Site Evaluation Process

Figure 2-1 provides an overview of the evaluation process for a sampled site. The first step in the process was to assign the site to a lead engineer. If a site was owned by a corporation that owns other sampled sites, all of the sites for that corporation were assigned to the same lead engineer. By doing so, we avoided contacting the same customer corporate contact multiple times regarding projects at different sites.

The next step was recruitment. The lead engineer was responsible for obtaining permission for the data collection activities necessary to evaluate all of the projects and spillover measures located at the site. We recruited about forty sites with the largest savings before assigning a lead engineer. Once a site was recruited the lead engineer was responsible for conducting a detailed review of the relevant application files and thoroughly understanding the projects present at the site.

Following recruitment and the detailed file review, the steps required to complete the evaluation work depended on the type of projects that were installed under the program. We defined three types of projects. The first type required project-specific estimates of gross savings and a customized evaluation of free-ridership. A site that contains one or more of this type of project was designated a custom project specific (CPS) site. The second type required project-specific estimates of gross savings and a standardized evaluation of free-ridership. A site containing at least one such project, but no projects requiring a customized free-ridership evaluation, we designated as a standard project-specific (SPS) site. The third type of project, required a verification evaluation and were referred to as verify projects. For

verify projects in the HVAC, lighting, and process end uses, we assessed the number, type, location and operational status of the equipment, and completed a standardized evaluation of free-ridership. No free ridership evaluation was required for miscellaneous verify projects. Sites that only contained verify projects were designated verify-only (VO) sites.

For CPS sites, we completed the following steps:

- **Prepared an evaluation plan which described the measures installed and how savings were to be estimated.** We also conducted a spillover survey, designed to identify participant spillover projects, and when appropriate, vendor surveys² to provide additional information for the plan. Each evaluation plan was designed to fit within a target budget allotted to the site. The data collection included short-term metering and one-time measurements at some sites. We then submitted the plans to PG&E for approval, and when necessary, revised them. Appendix F contains the evaluation plan template which served to standardize our documentation for each evaluation plan.
- **Completed the data collection described in the evaluation plan.** If the operations staff contact³ was different than the decision-maker⁴, we completed an operations staff survey. A custom decision-maker survey was completed for custom project-specific projects. We completed standardized decision-maker surveys for all projects, except those in the miscellaneous end use.
- **Completed the energy savings analysis described in the evaluation plan.** This included an estimate of first-year gross electric and gas savings for project-specific projects and spillover measures. This also included estimates of electrical savings by PG&E-defined costing periods. In addition, the standard net-to-gross ratio (NTGR) was calculated for all project-specific and HVAC, process and lighting verify projects. When appropriate, this NTGR analysis included an engineering estimate of customer baseline savings (discussed further in Section 6 of this report). Once all CPS sites were completed, we performed custom free-ridership analyses and adjusted the NTGR as necessary.

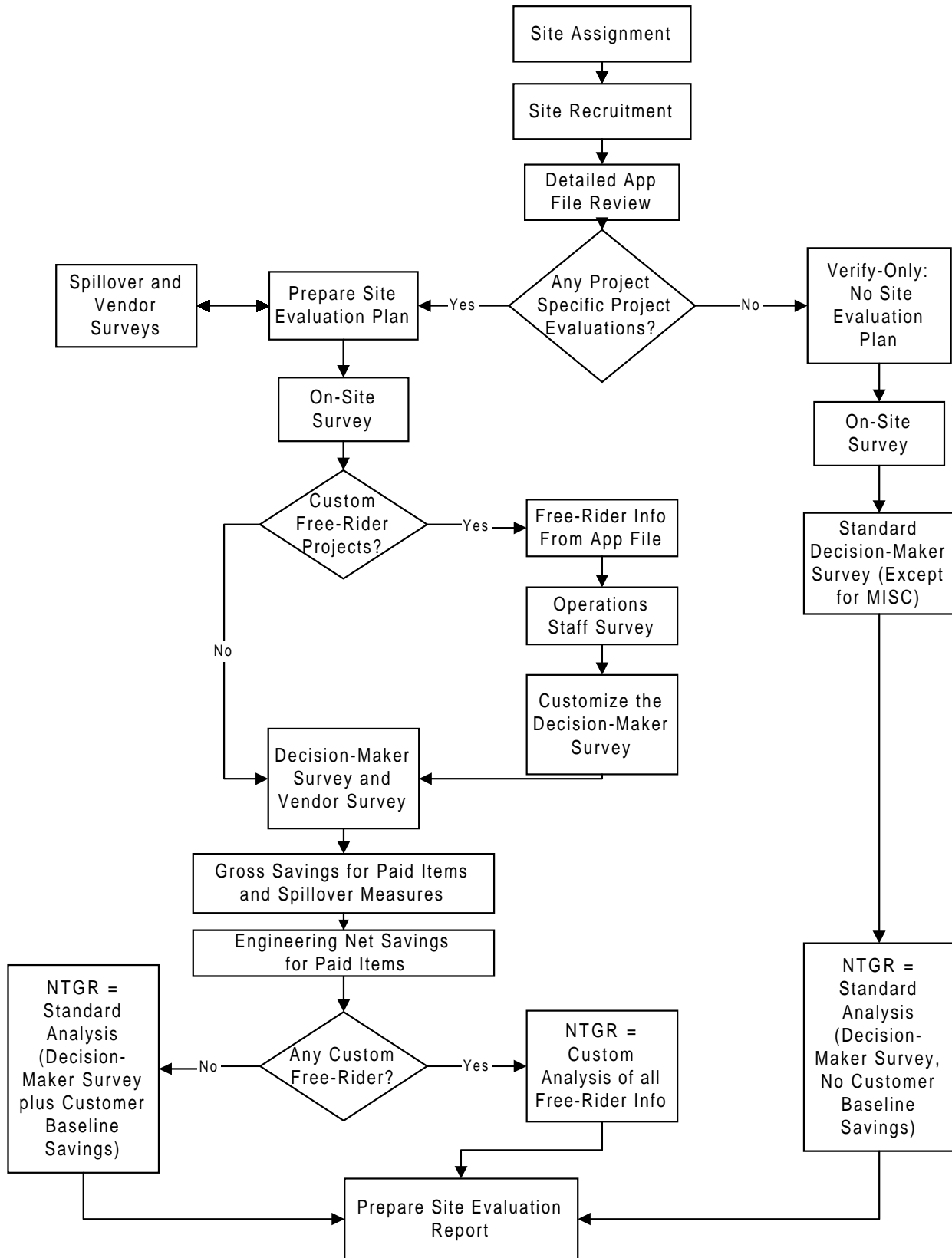
SPS sites were completed in the same way as CPS sites except we did not conduct the data collection and analysis needed to complete the custom NTGR evaluation.

² The Vendor survey was used to determine whether PG&E's energy efficiency programs influenced the customer's decision to adopt the spillover measure. This influence can be indirect, i.e., the vendor's recommendations to the customer are influenced by PG&E. Thus the customer's decision is influenced by PG&E without the customer realizing this influence has occurred.

³ Person at the site familiar with the operation of the items paid in 1995.

⁴ Person who knows how and why the decision was made to install the items paid in 1995.

Figure 2-1: Summary of Site Evaluation Process



For VO sites, we completed the following steps:

- **Collected data verifying the type and operation of the rebated equipment** . For all projects except those in the miscellaneous end use, we conducted a standardized decision maker survey.
- **Computed the standardized decision-maker-based NTGR for all projects except those in the miscellaneous end use.** These NTGR estimates were not adjusted to account for customer baseline savings.

Finally, for all sites we prepared a site evaluation report. This evaluation report described the results of the gross savings and NTGR analyses. Appendix L contains the template which served to standardize the documentation provided in the report developed for each CPS and SPS site.

2.3 Program-Level Impact Analysis

The project-specific evaluations estimated gross savings for at least 70 percent of the savings in the lighting, HVAC, and process end uses. To create a program-level estimate of gross savings, we extrapolated the findings from this group to the other projects in each end use. The items for which savings were extrapolated included (1) items installed at sites that we could not recruit, (2) items included in projects we did not sample, and (3) items included projects that only received verification evaluations. To estimate gross savings for these projects, we first determined the savings realization rates for kWh, kW, and therms for all evaluated project-specific items, for each end use. We then applied these realization rates, by end use, to the program data base estimates of kWh, kW, and therms savings for all items that were not included in the project-specific evaluations. This provided an estimate of what the evaluation savings would have been if these items had been covered by a project-specific evaluation. For the miscellaneous end use, we computed a realization rate based on all project-specific evaluations, regardless of end use, and applied that to the program data base estimates of savings. Once the extrapolation for all end uses was complete, we estimated program-level gross savings by summing the savings for all items.

To calculate program-level net savings, the average NTGR for all SPS and all verify items, within an end use, was applied to the end-use level gross savings of non-evaluated items, to produce that group's net savings by end use. Next, the net savings over all groups were summed to the program level. The program-level NTGR was calculated by first translating both gross and net kWh, kW, and therm impacts into dollar amounts using PG&E's marginal cost data and the distribution of savings by costing periods. This resulted in a dollarized version of net and (adjusted) gross savings. The dollarized net savings, divided by the dollarized (adjusted) gross savings formed the program-level NTGR. Net spillover savings were also identified and added to the total program net savings which was then included as the numerator of a program-level NTGR that reflected both rebated and spillover savings.

2.4 Compliance with M&E Protocols

Program year 1995 marks the second year of the ex post measurement era under the *Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs* (Protocols), adopted by the California Public Utilities Commission in May of 1993 and most recently revised in January of 1997. For any utility to successfully apply for DSM earnings, they must adhere strictly to these Protocols. Therefore, this evaluation is in strict compliance with the requirements contained in the relevant Protocol tables presented in Table 2-1 below. Appendix O presents the results of this evaluation as required by tables 6 and 7 of the Protocols.

Table 2-1: Relevant Protocol Tables for the Evaluation of Industrial Incentive Programs

Table	Pertaining To:
5	General approach to load impact measurement
6	Requirements for reporting results
7	Requirements for documentation of data quality & processing
11	Reporting of load impact results for use in planning & forecasting
8A & 9A	Persistence (retention)
C-5	Measurement requirements for industrial incentive programs
C-9	Measurement requirements for miscellaneous measures
C-12	Treatment of data perturbations

3. Sample Design

3.1 Sample Frame and Study Domains

The sample frame for this study has been developed from PG&E's MDSS program database entries for the 1645⁵ items which are associated with the 862 applications paid in 1995 by the Customized, Express, REO and Thermal Energy Storage industrial programs. A measure code, indicating a specific type of efficiency technology, is assigned to each item. An end use code is also assigned which can be used to group measures according to the four end uses which define the four domains of study for this evaluation: lighting (interior only), process, HVAC and miscellaneous (includes refrigeration and motors).

The item-level entries from MDSS were aggregated to form the sample frame, which is a list of projects. A project is defined as follows:

A project is the set of items, listed on a single paid application which are assigned to the same end use and control number.

Applying this definition, the item-level program database was aggregated to form a participant sample frame consisting of 922 projects, associated with 703 control numbers (unique identifier which PG&E assigns to each billing meter location). As shown in Table 1, 166 of these projects are in the HVAC domain, 479 are in light, 182 are miscellaneous, and 95 are process.

3.2 Sampling Requirements

The M&E Protocol specifications for this study require that two samples be completed. The first sample provides a census of 70% of the program database savings for the light, process and HVAC domains. Project-specific data collection and evaluation techniques are to be applied to this sample. The second sample either completes a census for a domain, if the domain contains 150 or fewer projects, or brings the total sample for the domain to 150. (The requirement for 150 completions applies to all domains, except miscellaneous) A simpler level of data collection and analysis is required for the second sample, which serves to verify the entries found in the program data base. The first sample is referred to as the Project-Specific sample and the second as the Verify sample.

3.3 Stratification

In most studies, the technique of stratification, i.e., dividing the population within a domain into subcategories, is generally used to improve the efficiency of a random sample. In this design, it served that purpose for a portion of one domain, but generally it was used as an aid in identifying the verification sample and to allow for a phased recruitment of the project-specific and verification samples. The phased recruitment shortened the typical time between first contact with a customer and the completion of data collection and analysis for the customer's sites.

⁵ This count of items comes from the initial release of the MDSS program data base. The initial release was used in the design of the sample for this study. However, the database was revised twice. The first revision reclassified the end use of three items. The second revision added a small number of items, collectively accounting for less than .1% of kWh savings, .5% of kW savings, and 0% of therm savings.

Although a similar procedure is used, unique stratification designs were developed for each domain. The procedure and results for each domain are as follows:

1. **HVAC.** As shown in Table 3-1, the HVAC domain was divided into four strata. The first stratum contains 17 projects which collectively account for at least 70% of kWh, kW and therm savings for this domain. These 17 projects were identified by successively sorting the 166 HVAC projects in descending order, first by kWh, then kW and finally by their savings. After the sort by kWh savings, a cumulative sum of kWh savings was computed, moving down the list until 70% of total HVAC kWh savings was included in the cumulative sum. Each of these projects was flagged. The same process was repeated for kW and therms. All of the flagged projects were then placed in the first stratum, which in Table 1 is labeled "Top 70% Project Specific."

The second stratum was created to provide replacements for the project specific sample, which were needed when customers associated with the first stratum refused to participate. Any project in this stratum which was not needed as a replacement became part of the verification sample. However, nothing was done with projects in this stratum until the savings associated with customers which refused to participate was known for the first stratum. The first and second stratum account for 87% of kWh savings, 86% of kW savings and 100% of therm savings. The third stratum contains the next largest group in terms of average savings. These were all designated as part of the verification sample. The last stratum was also assigned to the verification sample. It contains 36 projects which account for less than 1 percent of savings. At least 20 fourth stratum projects would have been completed if there had been no refusals in any other stratum. Given the small savings associated with this group it made no practical difference which of them was completed.

2. **LIGHT.** The first strata containing 71 projects was identified in the same fashion described for HVAC, except that none of these projects have therm savings, and thus the 479 projects in this domain were sorted and scanned only twice. The second strata played the same role of providing a replacement pool for the project-specific sample. This left 359 projects from which to select the balance of the verification sample. 30 projects would have been needed if there had been no refusals in the first two strata. A random sample of these projects was selected. Before drawing this sample, the smallest projects, accounting for less than 1 percent of savings were eliminated (125 projects in the stratum labeled "Excluded"). This imposed a negligible bias on the design, and substantially improved the precision of the sample in representing the sum of savings for stratum 3.
3. **MISC.** There is no requirement for a project-specific sample of MISC, therefore all of these projects are grouped in one strata assigned to the verification sample. There were 182 projects in total. The first 150 projects, sorted by energy savings (BTU equivalent of kWh and therm savings) were the primary sample. The remaining smaller projects were used as replacements. However, these remaining projects comprise less than 1 percent of savings, and thus they can be used in any order.
4. **PROCESS.** This domain contained less than 150 projects, therefore all were included in either the project-specific or verification sample. The first stratum was defined as described for HVAC. The second stratum contains the project-specific replacements. Any projects which were not used for that purpose were assigned to the verification sample. This stratum was not used until refusals in the first stratum were identified. The third stratum contains the balance of the projects which are assigned to the verification sample.

Table 3-1: Program Database Savings and Number of Projects by Domain and Strata⁶

Domain	Strata	Number of		% of End		% of End		% of End	
		Projects	MWh	Use	kW	Use	KTherms	Use	
HVAC	Top 70% Project Specific	17	12,582	71%	1,656	73%	548	99%	
	Proj. Spec. Replacements or Verify	10	2,869	16%	300	13%	4	1%	
	Verify All	103	2,317	13%	287	13%	0	0%	
	Verify up to 150	36	64	0%	18	1%	0	0%	
Total		166	17,831	100%	2,261	100%	552	100%	
LIGHT	Top 70% Project Specific	71	27,197	71%	4,293	70%	0		
	Proj. Spec. Replacements or Verify	49	4,753	12%	799	13%	0		
	Verify up to 150 (sample 30)	234	5,803	15%	976	16%	0		
	Exclude	125	365	1%	59	1%	0		
Total		479	38,118	100%	6,127	100%	0	0%	
MISC	Verify up to 150	182	13,014	100%	2,153	100%	401	100%	
PROCESS	Top 70% Project Specific	24	39,939	72%	3,647	70%	12,086	74%	
	Proj. Spec. Replacements or Verify	16	8,364	15%	807	16%	1,910	12%	
	Verify All	55	7,333	13%	722	14%	2,299	14%	
Total		95	55,636	100%	5,176	100%	16,295	100%	
		922	124,600		15,717		17,248		

3.4 Recruitment

A four phase recruitment process was used. This process minimized the time between first contact with a customer and the completion of data collection and analysis for the customer's sites. It is also minimized the number of contacts with each customer. A major concern of this recruitment process were the sites which have more than one paid measure and the customers who have more than one paid site. Both of these situations could have resulted in multiple contacts with the customer, which had to be avoided.

Unfortunately, the program database did not contain either a corporate or a site code for each paid item. However, it did contain the name of the firm that received the rebate check and the service address for each item's control number. Using these two data elements it was possible to create, for 1623 out of 1645 items, reliable corporation and site codes. The 922 projects in the sample frame are associated with 670 unique sites and these sites are operated by 604 unique corporations.

Using the sample frame, coded by strata, corporation and site, the following four-phase recruitment process was implemented:

1. A set of corporations was recruited for a pre-test, which were collectively associated with 6 projects. They were selected from the smallest projects in the first stratum of the light, HVAC and process domains. Each of these corporations had projects at only one site.

⁶ Values presented in this table are based on the initial release of the program data base, which was used in the design of the sample. The end use of three projects was subsequently modified and a small number of small projects added to the population. However, adjustments were made as necessary to ensure that 70% of the savings were accounted for by the project-specific evaluations in the HVAC, light and process end uses.

2. Next, all corporations which were associated with one of the top 40 projects were recruited. The top 40 projects were identified by sorting the projects in the first stratum of HVAC, light and process by energy savings (BTU equivalent of kWh and therm savings), and selecting the 40 projects with the largest savings. These projects were associated with 32 unique corporations. Rebates for 83 projects were paid to these corporations in 1995, as shown in Table 3-2. Once these corporations were recruited, project-specific or verification data collection and analysis was implemented. All projects in the first and second stratum of the HVAC, light, and process domains were assigned to the project-specific sample. All other projects, except those in the excluded strata of light were assigned to the verification sample.
3. Once recruitment was complete for the top 40 projects, we proceeded with recruitment of the balance of the strata 1 project-specific sample (HVAC, light and process) and the strata which were entirely devoted to the verification sample ⁷. This included stratum 3 in the HVAC and process domains and the first 30 projects in the sample representing stratum 3 of the light domain. This also included all projects in the MISC domain except for 32 projects with the smallest saving (reserved for replacements).
4. The final phase of recruitment included all of the projects needed for either project-specific sample replacement or needed to complete 150 projects in each domain.

3.5 Sample Disposition

As shown in Table 3-3, there are 1668 items in the final program database ⁸. The table shows the disposition of these items. 487 (29.2 %) comprise the excluded stratum of lighting. Collectively, these account for approximately 1% of the estimated lighting savings, and their exclusion has virtually no effect on the results of this study. A total of 29 items were reserved as replacements but never used. These replacement items also account for a very small portion of total savings. Of the remaining 1152 items, 17 were removed from the sample because they were associated with sensitive customers or were installed at sites covered by the evaluation of PG&E's commercial efficiency programs. In addition, 193 were lost due to customers refusing to participate in the study. Table 3-3 itemizes the number of refusals by type, with the most common reason being "No time for evaluation." As shown in the table, evaluation work was completed for 852 items.

Table 3-4 provides a number of descriptive statistics for the completed sample. The table is organized in three panels. The first describes the project-specific project sample, by end use. The next panel provides the same description for the verify sample. The third panel describes the combination of the two samples. Each panel shows the number of projects and items completed by end use, the sum of savings for those items and the percent of the program database end use consumption. The first panel demonstrates that the Protocol requirement to complete project-specific evaluations for 70 percent of savings (kWh, kW and Therms) was accomplished for all end uses.

⁷ One class of projects were excluded from this phase of recruitment. These were associated with corporations which had another paid project in a stratum not yet released for recruitment.

⁸ Revised to match the E-Table filing.

Table 3-2: All Projects Completed for Corporations Associated with the Top 40 Projects

Domain	Strata	Number of			
		Projects	MWH	kW	kTherms
HVAC	Top 70% Project Specific	10	9,736	821	548
	Proj. Spec. Replacements or Verify	4	1,013	204	4
	Verify All	3	273	0	0
	% of Domain		61.8%	45.3%	100.0%
LIGHT	Top 70% Project Specific	19	13,426	1,897	0
	Proj. Spec. Replacements or Verify	3	272	49	0
	Verify up to 150 (sample 30)	6	248	41	0
	Exclude	5	15	3	0
	% of Domain		36.6%	32.5%	
MISC	Verify up to 150	7	257	39	0
% of Domain			2.0%	1.8%	0.0%
PROCESS	Top 70% Project Specific	22	39,475	3,403	12,086
	Proj. Spec. Replacements or Verify	1	0	0	908
	Verify All	3	560	75	0
	% of Domain		72.0%	67.2%	79.7%

Table 3-3: Final Sample Disposition

<u>Disposition Categories</u>	<u>No. of Sites</u>	<u>No. of Items</u>	<u>Popul. Items</u>	<u>Sample Items</u>
Total population	--	1668	100.0	--
Excluded lighting items	--	487	29.2	--
Unused replacement items	--	29	1.7	--
Starting sample	455	1152	69.1	100.0
Out of sample				
Sensitive customer	7	83	5.0	7.2
In commercial evaluation	10	24	1.4	2.1
Adjusted sample	438	1045	62.6	90.7
Refusals				
Business gone	7	16	1.0	1.4
No time for evaluation	25	79	4.7	6.9
No one knowledgeable	8	23	1.4	2.0
Other	19	75	4.5	6.5
Final sample	379	852	51.1	74.0

Table 3-4: Project and Item Counts and Energy Use for Completed Items

Domain	End Use			
	HVA	Lighting	Miscellaneous	Process
Project Specific				
No. of Projects	21	115	--	24
No. of Items	22	353	--	24
Program Savings				
kWh	12,692,144	21,856,993	--	37,810,067
kW	1,454	3,383	--	3,740
therms (see note)	551,701	0	--	8,810,752
% of Total End Use Savings				
kWh	70.6	70.0	--	70.4
kW	69.5	68.0	--	72.2
therms	100.0	N/A	--	54.1
Verify				
No. of Projects	115	35	119	58
No. of Items	141	72	180	60
Program Savings				
kWh	2,424,238	764,561	13,226,043	10,760,394
kW	305	128	2,322	1,015
therms (see note)	0	0	1,270	3,083,959
% of Total End Use Savings				
kWh	13.5	2.4	76.6	20.0
kW	14.6	2.6	94.5	19.6
therms	0.0	N/A	0.3	18.9
TOTALS				
No. of Projects	136	150	119	82
No. of Items	163	425	180	84
Program Savings				
kWh	15,116,382	22,621,554	13,226,043	48,570,461
kW	1,759	3,512	2,322	4,755
therms (see note)	551,701	0	1,270	11,894,711
% of Total End Use Savings				
kWh	84.1	72.5	76.6	90.5
kW	84.1	70.6	94.5	91.9
therms	100.0	N/A	0.3	73.0

Note: Process and miscellaneous them program savings were reduced by 10%, and the them savings for Shell Western (Project 969) were reduced by an additional 25% to match the E-tables submitted in December 1996.

4. Data Collection and Application

This section describes the primary sources of data for this evaluation, as well as how we acquired and applied the data.

4.1 PG&E's Program Data Base

Extracts from the application and item tables from PG&E's MDSS program data base provided basic information for each application paid in 1995 and the associated items. Key variables included the following:

1. Application number
2. Control number
3. Program year
4. Measure description
5. End use code
6. PG&E sales engineer
7. PG&E division
8. Billing name
9. Service address
10. Date and amount of payment (PG&E rebate check)
11. Code indicating the program which processed the application
12. Estimate of kWh, kW, and therm savings developed by PG&E's program staff

We used the application number, program year, end use, and control number variables in this data base to assign project identification numbers. The service address, control number, and billing name permitted us to group items by site and corporation, thus streamlining the customer recruitment process. Early on in evaluation, we developed a preliminary list of participants to evaluate, which was distributed to PG&E' division staff and major account representatives, in order to identify sensitive customers.

We also obtained historical information on rebates paid during the years prior to 1995. We used this information during the recruitment process to help program participants clarify measures for which they received a rebate in 1995.

4.2 PG&E's Program Files

A list of sampled participants was submitted to PG&E. PG&E provided a copy of the files maintained by the program for the participants. These files normally contained copies of the rebate applications as well as additional documentation, such as selected design drawings and manufacturer equipment specifications. Reviewing the application files allowed us to confirm the description of each paid item, to compile information on the customer contact, and for particularly complex items, to learn about the program's approach to estimating savings. Contact names, phone numbers, and PG&E representative names were not provided in the program data base, so this information was taken from the program files.

4.3 Spillover Survey

At all sites with project-specific projects, the lead engineer for the site administered this survey to the customer contact most knowledgeable about any potential spillover measures. The engineer first interviewed the contact to identify potential spillover measures, then asked questions to verify that the measures were indeed spillover. Descriptions of the potential spillover measures and answers to the questions about them were entered into a spillover response matrix. Appendix D contains instructions for and a copy of the survey instrument.

4.4 Vendor Survey

This survey elicited information from vendors for determining whether PG&E's efficiency programs influenced their recommendations to customers. It was applicable in two situations: (1) when the lead engineer found a spillover measure where PG&E exerted little direct influence on the decision to install the measure, and (2) when data from the decision-maker survey (discussed below) resulted in a net-to-gross ratio (NTGR) for the measure less than or equal to 0.3, indicating minimal PG&E influence. Information from the vendor survey provides data for adjusting the standard NTGR to account for indirect vendor influence. Appendix E contains instructions for and a copy of the survey instrument.

4.5 On-Site Survey

Once PG&E approved the evaluation plan for a site, the engineer assigned to conduct the on-site survey scheduled a visit. The site scheduling form, as well as the contact log he or she used to record all conversations with the customer, are included in Appendix C. If necessary, the engineer informed division staff of the time and place for the survey.

During the on-site survey, the engineer collected all information necessary to complete the savings evaluation. For verification projects, this simply meant filling out the verification on-site survey forms (included in Appendix H). Since HVAC and process project-specific projects varied widely in their scope and complexity, we did not develop standardized procedures, but instead followed the data collection methodology documented in each site's evaluation plan. Lighting project-specific projects, on the other hand, generally required a fairly similar approach, so engineers used the survey forms shown in Appendix G to collect information about lighting fixture counts, "on" fractions, and schedules. Both sets of forms were first field-tested on several sites, and feedback from these pre-tests was incorporated into the final form designs. If required in the evaluation plan, engineers took one-time measurements of power consumption for key equipment to support the savings analysis.

For all project-specific projects that required short-term metering, engineers developed a measurement plan and filled out the measurement specification forms shown in Appendix I. They also made arrangements for any follow-up visits needed to install or remove metering equipment. For projects receiving a custom free-ridership analysis, the engineer conducted an operations staff survey (described below), if the operations staff contact was than the decision-maker contact. When feasible, he or she also completed the decision-maker survey at the conclusion of the on-site visit.

4.6 Operations Staff Survey

This survey collected information from the operations staff contact to be used in customizing the free ridership analysis. Engineers administered this survey during the on-site survey when the site included a custom project-specific project and the customer contact most familiar with the measure(s) was not the

person who made the decision to participate in the PG&E rebate program. Appendix J contains instructions for and a copy of the survey instrument.

4.7 Weather Data

For HVAC projects where savings were dependent on weather conditions, we used hourly weather data from PG&E and the National Oceanic and Atmospheric Administration (NOAA) as necessary. PG&E maintains 33 stations that record hourly temperature and relative humidity. PG&E also provided information for matching these weather stations with participant sites based on the PG&E local office associated with the site. In general, we used PG&E 1995 and 1996 weather data to obtain a statistical correlation between outdoor air temperatures and short-term measurements of cooling characteristics (such as cooling loads or chiller electrical demand).

NOAA maintains seven long-term climatic measurement station throughout PG&E's service territory. We used Typical Meteorological Year (TMY) weather data from these sites to estimate gross savings over long-term conditions.

4.8 Decision-Maker Survey

This survey collected information from the decision-maker, that is, the person who made the decision to participate in the PG&E rebate program. These data formed the basis for calculating the standardized net-to-gross ratio for each item. For custom project-specific projects, the survey also gathered additional information for customizing the free-ridership analysis. Engineers administered this survey either at the end of or after the on-site survey for all HVAC, process, and lighting projects (both project-specific and verify). Appendix K contains instructions for and a copy of the survey instrument.

5. Methodology for Engineering Estimates of Gross Impact

Gross impacts were estimated for project-specific projects, by implementing site-specific evaluation plans approved by PG&E for a group of projects in the HVAC, light and process end uses which accounted for more than 70 percent of the savings in each end use. The evaluation plans provided a detailed description of the paid items at each site and specified the data collection and engineering analysis procedures for evaluating gross impact. After PG&E approval of each plan, we implemented the data collection via an on-site survey and reestimated gross savings using these data and the engineering algorithm specified in the plan. In addition, we conducted a simpler analysis to verify a sample of paid items representing the balance of the savings in each end use. For these items, we located and inspected the installed equipment and determined the fraction of the equipment described in the program application that was installed, as well as what portion of the installed equipment was operational. For both project-specific and verify items, we noted the location of the equipment and, as necessary for the retention database, the equipment make and model. Our project-specific and verification analyses are discussed in more detail below, along with the procedure we used for estimating program-level gross savings.

5.1 Project-Specific Analysis

As discussed in Section 3 (Sample Design) of this report, the project specific analysis was applied to a sample of projects representing 70 percent of the 1995 program savings in each of the lighting, HVAC and process end uses. These projects were of greatest interest to PG&E and therefore required the most rigorous analysis. A total of 160 projects located at 130 sites received this level of analysis. Since the sites included in this sample included a very diverse group of industrial facilities and customized applications of the program measures, the project-specific data collection and analysis methods were tailored to the complexity of the measure and the value of the savings to PG&E for the project under consideration.

We developed customized data collection and analysis procedures for each process and HVAC project specific evaluation, and used standardized procedures for lighting projects. These procedures were documented in a site-specific evaluation plan. For each project at a given site, the evaluation plan contained the following elements:

- **Measure Description:** This section first described the program measure(s), how they resulted in kWh, kW or therm savings, and their general location. Following this were preliminary descriptions of both the baseline and as-built equipment and operating conditions, including the effects of Title 20 and/or Title 24 efficiency standards, when applicable. Finally, this section documented the primary business and product at the site, as well as any annual variations in schedules or production levels.
- **Engineering Algorithms:** This section discussed the equations or computer model that PG&E used to estimate program savings. It also described the proposed approach for estimating savings in the evaluation, as well as the method by which these savings were to be disaggregated into five PG&E-defined costing periods.
- **Data Collection:** This section described the parameters that were obtained during the on-site survey for the evaluation, along with the data sources and measurement methods. If short-term metering was recommended, this section also described the metering plan.

- **Customer Cost/Benefit Analysis:** For projects subjected to a custom free-ridership analysis, this section listed the estimated cost of the measure(s) to the customer and the estimated payback of the measure(s), based on the customer's electric and gas rates. When applicable, this section also included a preliminary description of any non-energy benefits the measure(s) provided.
- **Free-Ridership Issues:** For projects subjected to a custom free-ridership analysis, this section detailed any alternative equipment described in the PG&E application that the customer might have considered. It also provided a preliminary opinion of whether PG&E assumed an appropriate baseline in their analysis. The section also addressed the customer's motivation for installing the measure(s) and any other issues relevant to free-ridership.

In addition, each evaluation plan contained the following site-level elements:

- **General Site Information:** This included the company name and address, customer contact and PG&E representative information, and a listing of projects and items at the site, from the program data base.
- **Spillover Evaluation Plan:** At sites for which the spillover survey revealed spillover measures, the evaluation plan contained a technical plan similar to those for rebated measures. This plan first discussed how the evaluation determined the measure was spillover. It then described the spillover measure(s) and how they saved energy. Following this were descriptions of both the baseline and as-built equipment, operating conditions, the appropriate evaluation algorithm, and the data collection methodology.
- **Proposed staffing plan, schedule and budget:** This section lists proposed staff for the key elements of the evaluation. In addition, it proposes dates for major evaluation milestones and a site-level budget for the evaluation.

PG&E reviewed and approved each evaluation plan prior to the scheduling of the on-site survey. Appendix F contains a evaluation plan template with more detailed descriptions of the contents of a plan. Depending on the end uses represented at a given site, each evaluation plan incorporated different technical approaches. A general description of the approaches for each of the three project-specific end uses follows below:

5.1.1 Process

A total of seven program measure categories (measure codes) were included in the 24 project-specific process projects. However, within certain broad categories, such as process controls and process other, there were a variety of different types of measures. All process projects were paid through PG&E's Customized Incentive Program and, therefore, a customized set of engineering analysis procedures were developed during program implementation by the program consultant. Because of the custom nature of the program procedures, significantly different approaches were used to estimate savings for similar measures.

For all project-specific process projects, a custom evaluation algorithm and corresponding data collection procedures were proposed in the evaluation plan. The proposed procedures were consistent with the budget assigned to the project. Because the budget allocation was based upon the contribution of each project to the program shareholder benefits (by end use), the proposed methodology for a particular measure often varied across projects. We determined the specific approach recommended for each

measure after conducting a detailed review of the project file. This review provided us with necessary background information regarding the measure definition and program analysis techniques. For complex process projects, we called upon process technology experts to review and critique the original calculations and propose a methodology for data collection and analysis in the evaluation.

We developed an evaluation approach based upon the information in the project file, recommendations of our technology experts, and, in some instances, additional information that we collected from PG&E representatives and/or the customer. Examples of this additional information include whether or not production log data exist, whether metering is feasible, or whether data from an energy management system are available. Based on all of the available information, we developed specific algorithms to estimate savings and defined the algorithm inputs to be obtained during the on-site survey.

Some of the alternative approaches we used during plan development included:

1. Relatively simple algorithms, similar to what PG&E used to develop the original estimate of savings, that were recalculated with as-built and as-operated conditions.
2. Spreadsheet-based bin analyses using load information obtained from interviews, logs, or in some cases, one-time or short-term metering.
3. Extrapolation of short-term measurement data to estimate annual consumption, with appropriate adjustments for seasonal variations.
4. DOE-2 modeling of process chillers and boilers with load data derived from interviews, logs, metering.

The measure performance data required to support the algorithm selected for each project were collected during or immediately after the on-site survey. We used metered data in lieu of observations and interview information when it was economically feasible. Metered data included one-time measurements of power, short-term measurements of operating hours using time-of-use loggers, and short-term measurements of power using multi-channel loggers. The forms for developing measurement plans can be found in Appendix I.

5.1.2 HVAC

A total of 13 program measure categories (measure codes) were included in the 21 project-specific HVAC projects. Within these categories, we found a variety of site-specific measure applications across the project sample. Most of these measures were paid through the 1993/94 Customized Incentive Program and, therefore, a customized set of engineering analysis procedures were developed during program implementation by the program consultant. A few of these HVAC measures were paid through the 1995 Retrofit Express program and therefore used standardized engineering algorithms developed by PG&E.

For all project-specific HVAC projects, we proposed a custom evaluation algorithm and corresponding data collection procedures in the evaluation plan. The proposed procedures were consistent with the budget assigned to the project. Because the budget allocation was based upon the contribution of each project to the program shareholder benefits (by end use), the proposed methodology for a particular measure varied across projects. We determined the specific approach for each measure after conducting a detailed review of the application files associated with each project. The file review provided us with necessary background information about measure definition and program analysis techniques.

The most accurate and desirable analysis method for all HVAC measures was to develop a DOE2.1E building thermal performance model. Consequently, we used DOE2.1E modeling whenever the evaluation budget permitted. When the budget was sufficient to do so, we performed short-term metering of important end uses such as lighting and internal equipment, and used these data to develop the internal loads schedules for DOE-2. The calibrated model was then run with and without the rebated measure to quantify the measure's energy savings. For a handful of projects, the PG&E program consultant developed a DOE-2.1E model as the basis for the original program estimate of savings. During detailed file review, we found the original model to be acceptable for one project. For this project we developed an as-built version of their model.

In cases where DOE2.1E modeling was deemed too expensive or the model used in the original analysis was unsuitable, one of the four alternatives listed below were used:

1. Recalculating savings with the original program savings algorithm, using as-built and as operated conditions. In some cases, short-term measurements helped define the as-built condition.
2. Taking short term measurements (2-4 weeks) of equipment energy consumption and local weather data to support a regression analysis and extrapolation to annual consumption. The short-term measurements were obtained from EMCS trend logs, chiller logs, or special metering.
3. Developing a bin analysis spreadsheet for HVAC measures whose savings were weather dependent. The spreadsheet calculations were based upon the appropriate California climate zone weather data.
4. Performing an annual extrapolation of short term (1 to 2 week) performance measurements for HVAC measures whose savings were not weather-dependent. Time-of-use data loggers and/or C-180 multi-channel recorders were installed during or shortly after the on-site survey. We adjusted the annual extrapolation for seasonality of measured loads by incorporating schedule information collected during the on-site survey.

For projects where DOE-2 was not appropriate, we selected the method from among these options that best fit the characteristics of the measure under consideration and the project's evaluation budget.

5.1.3 Lighting

We found two categories of internal lighting measures in the 115 project-specific lighting projects. The measures either effectively reduced the lighting power density of the facility (capacity reduction) or reduced the number of hours that the lighting system operates (controls). Within these two categories were a wide variety of measures. For instance, to reduce capacity, program participants could have replaced lamps and/or lighting fixtures with lower wattage devices or removed lamps in conjunction with the installation of reflectors or diffusers. To control lighting system operation, participants could have installed occupancy sensors or photocells.

We used the following algorithms to quantify the first year gross savings for internal lighting capacity reduction and control measures:

Capacity reduction measures:

$$kW_{\text{savings}} = \# \text{ fixtures} \times (\text{Watts} / \text{fixture}_{\text{base}} - \text{Watts} / \text{fixture}_{\text{as-built}}) \times \text{Utilization_factor}$$

$$kWh_{\text{savings}} = kW_{\text{savings}} \times \text{hours}_{\text{as-built}} \times HCIF_{kW}$$

$$\text{therm}_{\text{takeback}} = kW_{\text{savings}} \times 0.034 \times \text{hours} \times HCIF_{\text{heat}} / \text{heating_efficiency}$$

where HCIF = Heat/Cool Interaction Factor

The as-built conditions (such as fixture count, fixture wattage and operating hours) that were input to these equations reflected observations and measurements made during the on-site survey. The baseline conditions for these equations for a given measure depended on whether the measure was classified as early or normal replacement. If the measure was early replacement (i.e., no action would have been taken had the program not existed), then the baseline conditions reflected the pre-retrofit configuration that existed prior to the measure installation. If the measure was classified as normal replacement (i.e., a less efficient version of the measure would have been installed had the program not existed), the baseline conditions also reflected the pre-retrofit configuration, with the following exceptions:

1. the program measure replaced entire lighting fixtures or ballasts
2. the program measure required Title 24 lighting LPD compliance

When either or both of these situations occurred at a site, the baseline conditions in the equations were adjusted to reflect Title 20 and Title 24 requirements.

Control measures:

$$kW_{\text{savings}} = \# \text{ fixtures_controlled} \times \text{Watts} / \text{fixture}_{\text{as-built}}$$

$$kWh_{\text{savings}} = kW_{\text{savings}} \times (\text{hours}_{\text{baseline}} - \text{hours}_{\text{as-built}}) \times HCIF_{kW}$$

$$\text{therm}_{\text{takeback}} = kW_{\text{savings}} \times (\text{hours}_{\text{baseline}} - \text{hours}_{\text{as-built}}) \times 0.034 \times HCIF_{\text{heat}} / \text{heating_efficiency}$$

where HCIF = Heat/Cool Interaction Factor

The as-built conditions (such as fixture count, fixture wattage and operating hours) that were input to these equations reflected observations and measurements made during the on-site survey. The baseline conditions input to these equations for a particular measure application generally reflected the pre-retrofit configuration and schedule that existed prior to the measure installation. In situations where the lighting modification should have been subject to Title 24 control measure mandates, the baseline conditions in the equations were adjusted to reflect these requirements.

The data collection and analysis forms that we developed to support the evaluation of project-specific internal lighting measures are provided in Appendix G. The forms for developing measurement plans can be found in Appendix I.

5.1.4 Estimation of Savings by Costing Period

In addition to annual kWh impacts, PG&E also needs to know how the impact is distributed across five standard electric energy costing periods, which are defined as follows:

1. **Summer Peak.** May 1 to Oct. 31, 12pm-6pm weekdays.
2. **Summer Partial-Peak.** May 1 to Oct. 31, 8:30am - noon, 6pm -9:30pm weekdays.
3. **Summer Off-Peak.** May 1 to Oct. 31, 9:30pm - 8:30am weekdays, all day weekends.
4. **Winter Peak.** Nov. 1 to Apr. 30, 8:30am-9:30pm, weekdays.
5. **Winter Off-Peak.** Nov. 1 to Apr. 30, 9:30pm-8:30am weekdays and all day on weekends.

Our analysis of savings for each item was conducted at the hourly-level, to support the estimation of kWh impacts by costing period. In many cases this was achieved by extracting the hourly output of the DOE 2.1E simulation runs. In other instances, where DOE 2.1E had no role in the analysis of savings, a supplemental analysis of savings was performed using SAS to allocate the savings to each hour of the year. The combination of these two methods resulted in hourly estimates of kWh savings for all items. SAS was used to summarize these savings for each of the five costing periods defined above.

5.1.5 Heating and Cooling Interactions for Lighting Measures

Under certain circumstances, the savings for lighting measures may be decreased or increased due to interaction with the heating and cooling systems of an industrial facility. If the area of the facility affected by a lighting measure is cooled, the reduction in lighting consumption results in lower internal loads and thus smaller consumption for cooling. If the affected area is heated, the opposite effect occurs, i.e., consumption for heating is increased. The magnitude of these effects are determined by a number of factors including:

1. Efficiency of the gas heating system.
2. Type of building, e.g., office, storage.
3. Type of cooling system
4. Presence of an economizer
5. Climate zone.

A series of DOE 2.1E simulations were run to develop an HCIF (Heating/Cooling Interaction Factors) table. Each of the cells in the table provide a coefficient that can be used to compute the magnitude of the interactive gain or loss, due to the change in lighting consumption. This table has cells which represent a range of conditions for the factors listed above (except gas heating efficiency which is directly represented in the calculation of kWh savings and increased in therm consumption.). Using this table, the SAS job which summarizes savings by costing period, applies the appropriate factor to adjust the lighting savings for the effect of these interactions.

5.1.6 Adjustments for Measure Interactions

In a number of cases, the effects of separate measures installed at the same facility can interact in such a way as to result in less savings than had the measures been installed at separate locations. For example, if a program participant installed both efficient lighting and occupancy sensors in the same building, the occupancy sensors would reduce the operating hours of the efficient lighting, thus reducing the savings

attributable to the new lighting. By the same token, the efficient lighting would reduce the lighting kW load, diminishing the savings resulting from the occupancy sensors turning off the lights. An analysis of this effect was performed for each site. For most sites no adjustment to savings was needed because the items were either installed in separate portions of the facility or they did not interact. However, at a small number of sites, interactive groups of items were identified.

The savings for each item in the interactive groups were adjusted. The first step in the adjustment process was to assess the overall savings attributable to the group, as if it were all one measure. This total group savings was always smaller than the sum of the savings computed for each individual item. Adjustment ratios were computed, by costing period, equal to each item's savings divided by the savings for the group. Each individual item's savings were multiplied by the respective ratio to produce an estimate of item savings which were adjusted for measure interaction.

5.2 Verification Analysis

Verification analyses were performed for projects in the process, HVAC, and lighting end uses as needed to achieve a census or 150 projects in each end use. A total of 327 projects (58 process, 115 HVAC, 35 lighting, and 119 miscellaneous projects) received this level of analysis. For these projects, we located and inspected the installed measure equipment. We determine the fraction of the equipment described in the program application that was installed and what portion of the installed equipment was operational. We also noted the location of the equipment and, as necessary for the retention database, the equipment make and model. The data collection forms that we developed to support the verification analyses are provided in Appendix H.

5.3 Program-Level Gross Impacts

The project-specific evaluations estimated gross savings for at least 70 percent of the savings in the lighting, HVAC, and process end uses. To create a program-level estimate of gross savings, we extrapolated the findings from this group to the other projects in each end use. The items for which savings were extrapolated included (1) items installed at sites that we could not recruit, (2) items included in projects we did not sample, and (3) items included in projects that only received verification evaluations. To estimate gross savings for these projects, we first determined the savings realization rates for kWh, kW and therms for all evaluated project-specific items, for each end use. We then applied these realization rates, by end use, to the program data base estimates of kWh, kW and therms savings for all items that were not included in the project-specific evaluations. This provided an estimate of what the evaluation savings would have been if these items had been covered by a project-specific evaluation. For the miscellaneous end use, we computed a realization rate based on all project-specific evaluations, regardless of end use, and applied that to the program data base estimates of savings. Once the extrapolation for all end uses was complete, we estimated program-level gross savings by summing the savings for all items.

In addition, we made a number of adjustments to the original PG&E MDSS program data base so that the sum of the program estimates of savings would match PG&E's program savings summary tables (E-tables). To reconcile the evaluation data base with the one PG&E used to develop the December 1996 version of the E-tables, we made the following three sets of modifications to the program data base:

1. Reduced therm savings estimates for all process and miscellaneous items by 10%. This change reduced overall program therm savings significantly, since process and miscellaneous items account for nearly all of the program therm savings.

2. Reduced therm savings for the Shell Western process project (Site 619, Project 969, Item 1) by an additional 25% (reflecting three out of 12 months of savings). Since this project accounted for 60% of all process therm savings, this change reduced the overall program therm savings significantly.
3. Added 28 items, deleted five others, and adjusted savings estimates downward for 22 other items to account for realization rates less than one and project lives less than one year. None of the affected items received project-specific or verify analyses, and indeed, their effect on the overall progra savings is very small: less than 0.1% of kWh savings, 0.5% of kW savings, and no change to ther savings.

6. Methodology for Estimates of Net Impact

In addition to the gross savings analysis, described in the preceding section, we also performed three types of analyses that allowed us to assess the net impact of the program. The first type of analysis examined the effect of free-ridership on the gross savings for each sampled efficiency measure. The second type of analysis examined spillover savings found at each site. The third type of analysis was conducted at the program level and resulted in net impact estimates that included the effects of both free ridership and spillover.

6.1 Item-Level Free-Ridership Data Collection and Analysis

Free-ridership refers to participating customers who receive rebates even though they would have implemented an efficiency measure without the rebate; hence, they are getting a “free ride” on the incentive program. In the context of the terminology used here for net savings calculations, a participant may be called a “free rider” if that participant implements a measure that is included in the gross savings of the program, but would have implemented the measure even if the program had not existed.

In some cases PG&E’s programs motivate customers to replace equipment prior to the end of its useful life. This will be referred to as an “early replacement” action. In other cases, the program motivates the customer to select more efficient equipment when replacing equipment that has reached the end of its useful life. This will be referred to as a “normal replacement” action. The program may also motivate the customer to use more efficient new equipment when production capacity is increased or when new controls are added, e.g., EMCS, to existing equipment. This will be referred to as a “new equipment” action. Free ridership can only occur when customers undertake “normal replacement” or “new equipment” actions. By definition, “early replacement” actions are those that the customer had no plans to undertake for at least a year, therefore there is no possibility of a free ride on the program.

We identify full free-ridership, i.e., the participant would have implemented the **same** measure even if the program had not existed, as well as partial free-ridership in this study. Partial free-ridership can be defined from both a **decision-analysis** perspective and from an **engineering** perspective. From a decision-analysis perspective, partial free-ridership occurs when the probability of the customer’s adopting the same measure as was installed under the program is greater than 0 but less than 1. From an engineering perspective, **partial free-ridership** occurs when the customer would have installed equipment which was more efficient than the equipment it replaces (or which is required by Title 24/20), without a rebate. However, that equipment would not have been as efficient as the equipment installed with the rebate. The equipment that they would have installed without the rebate constitutes the **customer baseline**. Full free-ridership for the engineering calculation occurs when the customer baseline is the same as the observed as-built conditions of the measure for which PG&E paid a rebate.

6.1.1 Free-ridership Analysis for each Class of Projects

We implemented three levels of free-ridership analysis. The most detailed level of analysis was applied to all project-specific HVAC and Process projects and project-specific Lighting projects where the program database estimate of savings exceeded 50 kW. This is referred to as the **custom project-specific** free-ridership analysis. The second (and less detailed) level of analysis was applied to the balance of the Lighting projects. This is referred to as the **standard project-specific** free-ridership analysis. The least detailed analysis was applied to the verification evaluations of projects in the Lighting, HVAC or Process end uses. This level of analysis is referred to as the **verification** free ridership analysis.

6.1.2 Sources of information on Free-ridership

There are four sources of free-ridership information in this study. Each level of analysis relied on information from one or more of these sources. These sources are described below.

1. **Program Files.** As described in previous sections of this report, the program maintains a paper file for each paid application. These can contain various pieces of information which are relevant to the analysis of free-ridership, such as letters written by PG&E customer representatives which document what the customer had planned to do in the absence of the rebate and the customer's motivation for implementing the efficiency measure. Information on the measure payback with and without the rebate may also be available.
2. **Operations Staff Survey.** When a site was recruited we determined who was most familiar with the operation of the measure and asked that person to assist us in conducting the on-site survey. Appendix J contains the survey we used to obtain information related to free ridership from that member of the customer's staff. Information obtained included a description of what the customer would have installed, if anything, in the absence of the rebate and the motivations for this action. Note that there were many cases in which the operations staff person was also the decision-maker. In such cases, only the decision-maker survey was administered.
3. **Decision-Maker Survey.** When a site was recruited we also determined who was involved in the decision-making process which led to the installation of measures under the 1995 program. Appendix K contains the standard form of the survey that was completed with these decision-makers. The survey obtained highly structured responses concerning the probability that the customer would have installed the same measure in the absence of the program. In addition, the survey obtained a description of what the customer would have done in the absence of the program, beginning with whether the installation was an early replacement action. If it was not, the decision maker was asked to provide a description of what equipment would have been installed in the absence of the program, which was used to define the customer baseline for the engineering calculation of net savings. If the decision maker could not be sufficiently specific about the customer baseline equipment, we sought clarification from the person who participated earlier in the Operations Staff survey. The decision-maker was also asked to explain the customer's motivations for installing the efficiency measure.

Additional questions were added to this survey for **custom project-specific** sites. These questions were based on information obtained either from program files or the Operations Staff survey, and were designed to confirm, clarify, supplement, or reconcile differences in the information obtained from these sources and to provide a deeper understanding of the decision making process.

4. **On-Site Survey.** During the On-Site survey our engineers observed the as-built and as operated characteristics of the measures and the systems affected by the measures. With this information we modeled the efficient case energy use of the affected systems. Information from operations staff and the program file, along with applicable Title 24/20 standards, allowed us to model the pre-condition baseline. Information from the Decision-Maker survey allowed us to model the customer baseline, i.e., what they would have installed in the absence of the program.

5. **Vendor Survey.** In some instances, vendors were contacted following the decision-maker survey or the spillover survey (as explained on page 15). Some customers are not always aware that they are implementing energy saving measures that they otherwise would not have done in the absence of the program. This is most obviously the case when there is a participant who is not aware that vendors' recommendations have been affected by a DSM program. In this situation, the customer is not able to reliably self-report the influence of the program. We used the survey in Appendix E to obtain information concerning the program's influence through the vendors that recommended or installed the equipment comprising the measure. The survey was completed for those respondents who indicate that PG&E exerted little influence (i.e., NTGR \leq .3) on their decisions to install the items for which they received rebates.

The vendors contacted as part of this study were distributors, selectors, and installers. These are some of the members of what is often referred to as the distribution channel. Table 6-1 provides definitions of each of these three members as well as other member types of the distribution channel.

Table 6-1: Definitions of Distribution Channel Members

MEMBER	FUNCTION
Manufacturer	Companies that produce finished energy efficient equipment
Distributors	The middle-men who purchase the equipment from the manufacturers, warehouse the inventory, and provide the products for sale within a given geographical area.
Installers	Agents that are retained to install and service the equipment. They frequently serve as the final link between suppliers and end users.
Selectors - Developers - Engineers - Energy Consultants - Architects	Agents that guide or influence end users in their purchase decisions for electric equipment. Installers sometimes select the specific equipment for the end user.
Non-User Purchasers	Agents that buy and install electric equipment for the end users without incorporating the end users' preferences in the purchase decision.

Table 6-2 shows the data sources used in each of the three levels of free-ridership analysis. Although more than one level of analysis may share the same source, the amount of information that is utilized in the analysis may vary. For example, all three levels of analysis obtain data from the Decision-Maker

interview. However, in the case of the custom project-specific analysis, the Decision-Maker interview contains additional site-specific questions that were used to clarify, confirm or reconcile information from other sources. The *standard* Decision-Maker survey is used for the other two levels of analysis.

Table 6-2: Information Sources for Three Analysis Levels

Level of Free-Ridership Analysis	Sources of Information					
	Program File	Operations Staff Survey	Decision-Maker Survey	On-Site Survey	Vendor Survey	Spillover Survey
Standard Project-Specific	■		■	■	■	■
Customized Project-Specific	■	■	■	■	■	■
Verification			■		■	

6.1.3 NTGR Framework

6.1.3.1 Background

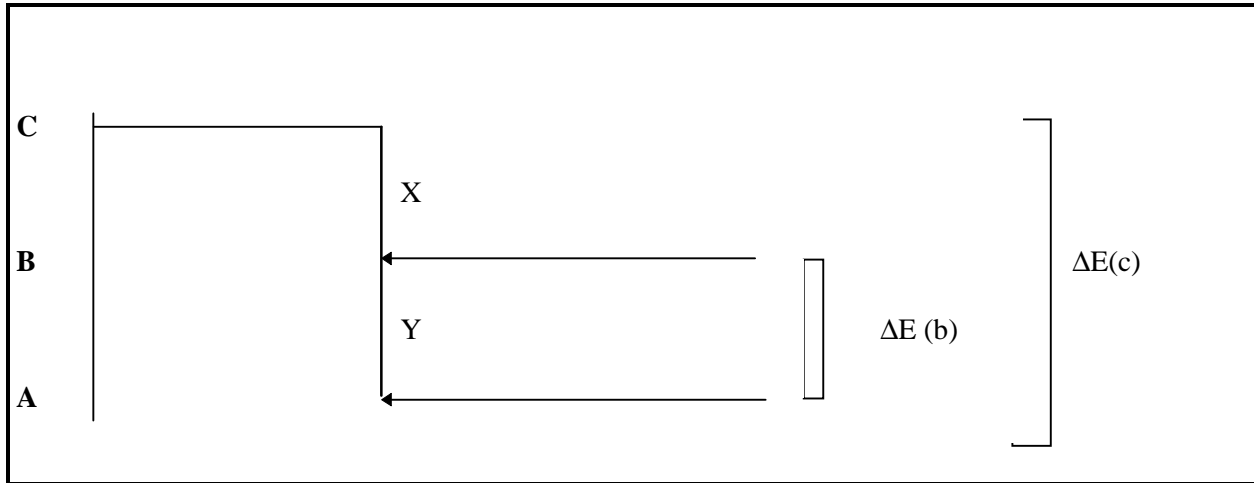
The type of method employed for estimating the NTGR depends on the type of information available. For all sites, the NTGR was first calculated using responses from the person who was involved in the decision to install the efficient equipment. This method, referred to as the "self-report" NTGR, is fairly common in situations in which a comparison group is not available. The calculation of the SR_NTGR (note that "SR_NTGR" is used to represent both the process and the outcome of this method of calculating the net-to-gross ratio) is described later in this research plan. Next, except in cases of early replacement where the SR_NTGR is set to 1, the SR_NTGR is adjusted to produce what we call the Adjusted SR_NTGR or simply the ASR_NTGR. In the case of project specific sites, this adjustment is based on an engineering evaluation of customer baseline savings, i.e., savings the customer would have achieved, if any, in the absence of the rebate. The evaluation of customer baseline savings provides a unique opportunity to adjust the SR_NTGR in order to produce a more accurate estimate of net kWh impacts than is normally possible.

What inaccuracies arise when the *unadjusted* SR_NTGR is used? Figure 6-1 presents the three basic options for any program participant. "C" refers to the old equipment, "B" refers to equipment of intermediate efficiency, and "A" refers to the efficient equipment that the customer installed through the program. "X" refers to the difference in usage between "C" and "B" while "Y" refers to the difference in usage between "B" and "A". The gross savings are defined as X + Y. Now, in the typical evaluation, once the NTGR is estimated using the standard SR_NTGR approach, this NTGR is then multiplied by an estimate of gross savings. However, while this is appropriate in some situations, it is not appropriate in many others.

Consider a customer whose NTGR, as calculated by the more typical SR_NTGR method, is 1. If the rebate induced the customer to switch to the efficient equipment rather than keep the old equipment, (early replacement), then the NTGR is 1, and gross savings equal net savings. However, not every situation is early replacement. We know that, in the absence of the rebate, some customers face a normal replacement situation in which they must replace their old equipment and are considering equipment of varying efficiencies. If, in the absence of the rebate, a customer would have installed equipment less efficient than what it installed through the program, then the greatest kWh savings that PG&E can legitimately claim is Y. Thus, multiplying the gross savings ("X" + "Y") by the SR_NTGR of 1 will

overestimate the net savings since the rebate caused the customer only to go beyond the equipment with intermediate efficiency. An adjustment must be made in the SR_NTGR that reflects the fact that equipment of intermediate efficiency would have been installed in the absence of the program.

Figure 6-1: Three Basic Customer Options



6.1.3.2 The Solution

This section describes the method we have chosen for adjusting SR_NTGR. First, a few definitions:

E(a) = Energy use of as-built equipment.

E(b) = Energy use of alternative equipment, if considered by customer

E(c) = Energy use of pre-retrofit equipment

Next, various energy savings can be defined using these terms.

$\Delta E(a) = E(a) - E(a)$. This represents the savings experienced by a customer who would have installed the *same efficient equipment* in the absence of the rebate. Such free-ridership reduces the net savings to zero.

$\Delta E(b) = E(b) - E(a)$. This represents the gross savings assuming the baseline is the *alternate equipment*, i.e., what they would have installed in the absence of the rebate.

$\Delta E(c) = E(c) - E(a)$. This represents the savings experienced by a customer who would have kept its old equipment in the absence of the program. This is the gross savings assuming that the baseline is the *pre-retrofit equipment*.

Each of these three options has a probability of selection and they are defined as:

P(a) = probability of customer selecting as-built equipment without the rebate.

P(b) = probability of customer selecting alternative equipment without the rebate.

P(c) = probability of customer keeping pre-retrofit equipment without the rebate.

Using the above information, an ASR_NTGR can be calculated under the simplifying assumption that the as-built equipment, the alternative equipment, and the pre-retrofit equipment are the *only* alternatives. Under this assumption:

$$P(a) + P(b) + P(c) = 1 \tag{1}$$

The ASR_NTGR can then be calculated as:

$$ASR_NTGR = P(a) [\Delta E(a)/\Delta E(c)] + P(b) [\Delta E(b)/\Delta E(c)] + P(c) [\Delta E(c)/\Delta E(c)] \tag{2}$$

This reduces to the following:

$$ASR_NTGR = P(a) [0/\Delta E(c)] + P(b) [\Delta E(b)/\Delta E(c)] + P(c) [1] \tag{3}$$

or

$$ASR_NTGR = P(b) [\Delta E(b)/\Delta E(c)] + P(c) \tag{4}$$

What is needed now are estimates of P(a), P(b), P(c), and $\Delta E(b)/\Delta E(c)$. The estimate of P(a) is derived as 1 minus the SR_NTGR. At this point, it should be emphasized that we recognize the superior reliability and validity of the information contributing to the calculation of P(a) over P(b) and P(c) since it is based on the SR_NTGR. This SR_NTGR is based on questions 5, 6, 7, and 11 of the Decision-Maker Survey (Appendix K) that have evolved out of a number of previous large-scale program evaluations. Question 8 on the decision-maker survey asks customers whether they considered any other alternatives to the equipment that they installed through the program. The options are basically two: 1) replacing old equipment with equipment that was not as efficient as the equipment installed through the program, and 2) keeping the old, pre-retrofit equipment. If option #1 is chosen, then P(b) is derived as 1 - P(a). If option #2 is chosen, then P(c) is derived as 1 - P(a). The advantage of this approach is that the information contributing to P(a) is allowed to drive the calculation of P(b) or P(c) in all situations. Of course, $\Delta E(b)/\Delta E(c)$ is based on engineering information obtained from customers regarding their old pre-retrofit equipment and what equipment they would have installed, if any, in the absence of the rebate.

6.1.3.3 Examples

Consider the following examples. These examples are not meant to be exhaustive but are used only to illustrate the basic concept.

The first example is a customer who installs a central air conditioner with a SEER of 13 that consumes 50 kWh/yr. For this customer, assume we have calculated a SR_NTGR of .8. This customer also indicates that in the absence of the rebate it would have installed a central air conditioner with a SEER of 10, which we calculate would have consumed 60 kWh/yr. It also states that the old, pre-retrofit central air conditioner had a SEER of 8, which we estimate consumed 80 kWh/yr. The customer also tells us in the decision-maker interview that, of the two options - keeping the old air conditioner and installing the intermediate air conditioner - it was more likely to have installed the intermediate air conditioner. We now calculate the following:

$$P(a) = .2 \qquad \qquad \qquad [Note: P(a) = 1 - SR_NTGR]$$

$$P(b) = .8 \quad [\text{Note: } P(b) = 1 - P(a) \text{ Therefore } P(b) = \text{SR_NTGR}]$$

$$P(c) = 0$$

$$\Delta E(b)/\Delta E(c) = 10/30 = .33$$

$$\text{ASR_NTGR} = .8 * .33 = .277 \quad [\text{Note: } \text{ASR_NTGR} = P(b)[\Delta E(b)/\Delta E(c)]]$$

$$\text{Net kWh Savings} = .277 * 30 \text{ kWh} = 8.3 \text{ kWh.}$$

A variation on the first example is a customer who installs a central air conditioner with a SEER of 13 that consumes 50 kWh/yr. For this customer, assume that we have calculated a SR_NTGR of 1. This customer also indicates that in the absence of the rebate it would have installed a central air conditioner with a SEER of 10, which we calculate would have consumed 60 kWh/yr. The customer also states that the old, pre-retrofit central air conditioner had a SEER of 8, which we estimate consumed 80 kWh/yr. The customer also tells us in the decision-maker interview that of the two options - keeping the old air conditioner and installing the intermediate air conditioner - it was more likely to have installed the intermediate air conditioner. We now calculate the following:

$$P(a) = 0$$

$$P(b) = 1$$

$$P(c) = 0$$

$$\Delta E(b)/\Delta E(c) = 10/30 = .33$$

$$\text{ASR_NTGR} = 1 * .33 = .33$$

$$\text{Net kWh Savings} = .33 * 30 \text{ kWh} = 9.9 \text{ kWh.}$$

A third example is a customer who installs a central air conditioner with a SEER of 13 that consumes 50 kWh/yr. For this customer, assume that we have calculated a self-report-based SR_NTGR of 0. This customer also indicates that in the absence of the rebate it would have installed a central air conditioner with a SEER of 10, which we calculate would have consumed 60 kWh/yr. It states that the old, pre retrofit central air conditioner had a SEER 8, which we estimate consumed 80 kWh/yr. The customer also tells us in the decision maker interview that of the two options - keeping the old air conditioner and installing the intermediate air conditioner - it was more likely to have installed the intermediate air conditioner. We now calculate the following:

$$P(a) = 1$$

$$P(b) = 0$$

$$P(c) = 0$$

$$\Delta E(b)/\Delta E(c) = 10/30 = .33$$

$$\text{ASR_NTGR} = 0 * .33 = 0$$

$$\text{Net kWh Savings} = 0 * 30 \text{ kWh} = 0 \text{ kWh.}$$

A fourth example is a customer who installs a central air conditioner with a SEER of 13 that consumes 50 kWh/yr. For this customer, assume that we have calculated a SR_NTGR of 1 because the customer indicated that the installation was a case of early replacement. It also states that the old, pre-retrofit central air conditioner had a SEER 8, which we estimate consumed 80 kWh/yr. The customer also tells us in the decision maker interview that of the two options - keeping their old air conditioner and installing the intermediate air conditioner - it was more likely to have kept the old, pre-retrofit air conditioner, a statement which is consistent with the claim of early replacement. We now calculate the following:

$$P(a) = 0 \text{ [Note: } P(a) = 1 - \text{SR_NTGR]}$$

$$P(b) = 0$$

$$P(c) = 1 \quad \text{[Note: } P(c) = 1 - P(a) \text{ Therefore } P(c) = \text{SR_NTGR]}$$

$$\Delta E(c)/\Delta E(c) = 30/30 = 1$$

$$\text{ASR_NTGR} = 1 * 1 = 1 \quad \text{[Note: ASR_NTGR} = P(c)[\Delta E(c)/\Delta E(c)] \text{Net kWh Savings} = 1 * 30 \text{ kWh} = 30 \text{ kWh.}$$

Another example illustrates a customer who installs a central air conditioner with a SEER of 13 that consumes 50 kWh/yr. For this customer, assume that we have calculated a SR_NTGR of .8. This customer also indicates that in the absence of the rebate it would have retained the existing equipment which has a SEER 8, consuming an estimated 80 kWh/yr. We now calculate the following:

$$P(a) = .2$$

$$P(b) = 0$$

$$P(c) = .8$$

$$\Delta E(c)/\Delta E(c) = 30/30 = 1$$

$$\text{ASR_NTGR} = .8 * 1 = .8 \quad \text{[Note: ASR_NTGR} = P(c)[\Delta E(c)/\Delta E(c)]$$

$$\text{Net kWh Savings} = .8 * 30 \text{ kWh} = 24 \text{ kWh.}$$

6.1.4 Implementation of the NTGR Framework

All levels of free ridership analysis were organized around the standard NTGR framework described above. The specific method of implementation of this framework varies only in the amount of information brought to bear on the core inputs. Each level of analysis is described below, beginning with the standard, project-specific level of analysis.

6.1.4.1 Standard Project-Specific Free-Ridership Analysis

The standard project-specific free-ridership analysis draws on information obtained from the standard version of the Decision-Maker survey, the On-Site and the Vendor surveys. In addition, an analysis of closed-ended questions included in the Decision-Maker and Vendor surveys is carried out in order to derive a SR_NTGR which is used to derive P(a) from which P(b) or P(c) can subsequently be derived.

Using this information, the NTGR is calculated and then multiplied by the estimated gross savings to estimate the net kWh savings.

The central inputs to the calculation of P(b) or P(c) come from the decision-maker survey question numbers 5, 6, 7, and 11. The core of the calculation is formed by an average of questions 6 and 7, with question 7 values transposed to cause the large values to have the same meaning as the large values of question 6, i.e., a large value means a high P(b) or P(c). This average is adjusted by the answer to question 5, if that answer implies that the customer did not learn about the program until after installing the equipment, which would imply a P(b) or P(c) of 0. When this response pattern occurs, the average of questions 6 and 7 is divided by 2.

Question 11 was designed to capture installation timing and identify early replacement. Therefore, a response to question 11 that indicates that the customer would have installed the same equipment, but at least one year later than actually occurred, P(b) or P(c) is set to 1. However, if the response to question 11 indicates that the customer would “never” have installed the equipment that was installed, the answer is taken out of the realm of timing, and into the realm of motivation. In this situation, the answer implies a P(b) or P(c) of 1. When this occurs, that value of “1” is averaged with the values for questions 6 and 7 (and 5, if appropriate).

One of the potential shortcomings of this method is the possibility of respondent misunderstandings of one or more questions. Specifically, it is known that question 7 is subject to misunderstanding because of the necessarily negative phrasing of the question. It was necessary to ask if the customer would have made the same installation if the program had *not* been in effect. This negative in the question sometimes causes misunderstandings and, therefore, answers that imply the opposite of what the respondent wanted to communicate. This potential was handled by incorporating automatic checks into the survey form that detected clear contradictions between questions 6 and 7 since this is where such a misunderstanding would become visible. Where there was a contradiction between these two answers, the interviewer is instructed in how to resolve the contradiction with suggested phrasing for presenting the apparent conflict to the respondent and requesting resolution.

There is a special situation involving timing that merits mentioning. If the customer installs new, additional equipment that adds load, there can be, by definition, no early replacement even though the answer to question 11 indicates that, in the absence of the PG&E program, the customer would not have installed the new equipment until at least a year later. In this case, the NTGR would be unaffected by the answer to question 11. However, if the new equipment is something that does not consume energy but makes the existing equipment run more efficiently such as VAVs or EMSs, then the issue of timing becomes relevant in spite of the fact that it is not, by definition, early replacement. In the absence of the PG&E Program, if the customer indicates that it would not have installed this new equipment until at least a year later, then the NTGR is converted to 1 since PG&E’s influence has caused savings to be present at least a year before they would have in the absence of the program.

Figure 6-2 presents a flow diagram of the process for deriving the SR_NTGR from the standard Decision-Maker survey. To summarize the process, probabilities were assigned in this manner:

The probability associated with the general question regarding the likelihood of installing the same equipment or the same equipment with the same efficiency in the absence of the program is averaged with the question regarding the influence of the rebate in decision making. This average constitutes the core probability score. There are two exceptions:

- If the decision-maker reports learning of the program after selecting the equipment, the response to the core net-to-gross questions is averaged with 0.
- If the company would have installed the equipment one year or more later than it did, the net-to-gross probability is set to 1.

Once the SR_NTGR is calculated at the item-level, it sometimes needs to be adjusted in order to take into account the vendor interview results. This process is illustrated in Figure 6-3. If a SR_NTGR was estimated to be less than or equal to .3, then the vendor involved was contacted. The threshold of .3 was chosen because it indicates a low customer awareness of any PG&E influence thereby raising the possibility of PG&E's earlier influence on vendors.

We will provide two scenarios that will illustrate how the customer's original SR_NTGR was modified using information from the vendor.

First, consider a customer who, based on responses to the decision maker interview, has an SR_NTGR of .25. Because this SR_NTGR is less than .3, we call the vendor involved. If the vendor states that the probability that PG&E caused him to recommend the efficient equipment to the customer is greater than .25, then we set the SR_NTGR (and therefore the value of P(b)) to the greater value which will then be multiplied by $\Delta E(b)/\Delta E(c)$ to produce the ASR_NTGR. The rationale for this is that, since the vendor was the only one the customer contacted *and* the vendor knows something about the dynamics of the distribution channel of which the customer is unaware, then it can be argued that PG&E, working through the vendor, drove the decision.

Next, consider a customer who, based on the decision-maker interview, has a SR_NTGR of .25. Because this SR_NTGR is less than .3, we call the vendor involved. If the vendor states that the probability that PG&E caused him to recommend the efficient equipment to the customer is less than .3, then we choose the customer's SR_NTGR. The rationale for this is that the customer *does* exert some control over the decision-making process and has assessed the impact of PG&E insofar as he/she understands that influence. That part of the world of which the customer is unaware does not matter because PG&E, according to the vendor, had little or no influence on the vendor's recommendation to the customer. Put another way, we shouldn't ignore the customer's perception of PG&E's influence at the customer level when the part of the world of which the customer is unaware was not influenced by PG&E.

These scenarios assume that the vendor remembers selling the equipment and making the recommendation to the specific customer under consideration. If the vendor cannot recall these events, then we use responses to other questions on the vendor questionnaire. If a vendor does not remember the purchase and/or the recommendation, then we use the response to the more general question about the probability of selling or recommending the same equipment to *any* customer in 1995 in the absence of the PG&E programs. If the vendor states that the probability that PG&E caused him to recommend the efficient equipment to any customer is greater than the SR_NTGR, we set the value of SR_NTGR (and therefore the value of P(b) or P(c)) to this greater value. On the other hand, if the vendor's probability is less than the SR_NTGR, we ignore the vendor's probability and take the customer's SR_NTGR (and therefore the value of P(b) or P(c)), *except in the case of custom project-specific sites where the vendor mentioned by the decision maker is a distributor*. This case is described below.

Figure 6-2: Derivation of Net-To-Gross Ratio for Decision-Maker Interview

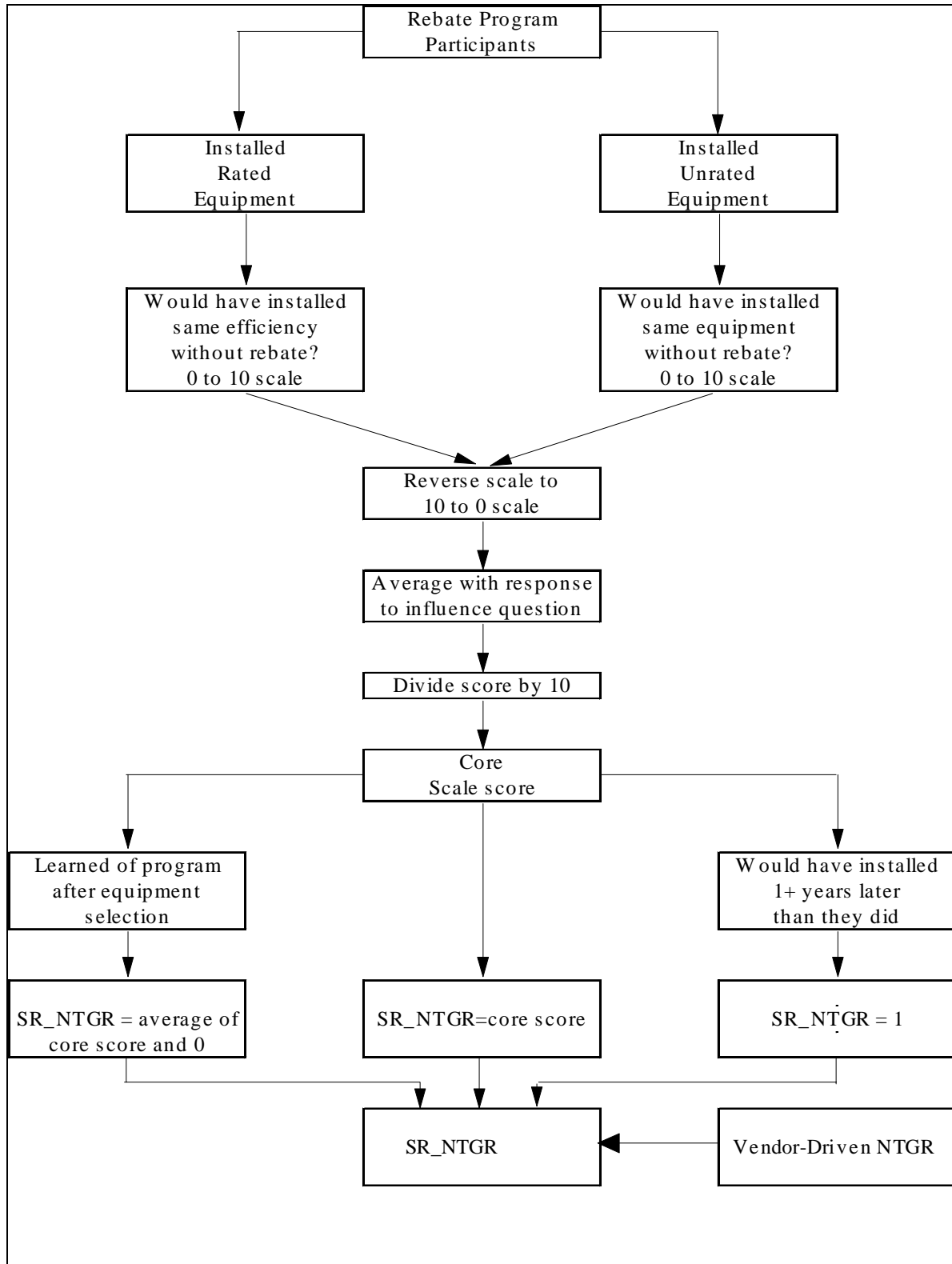
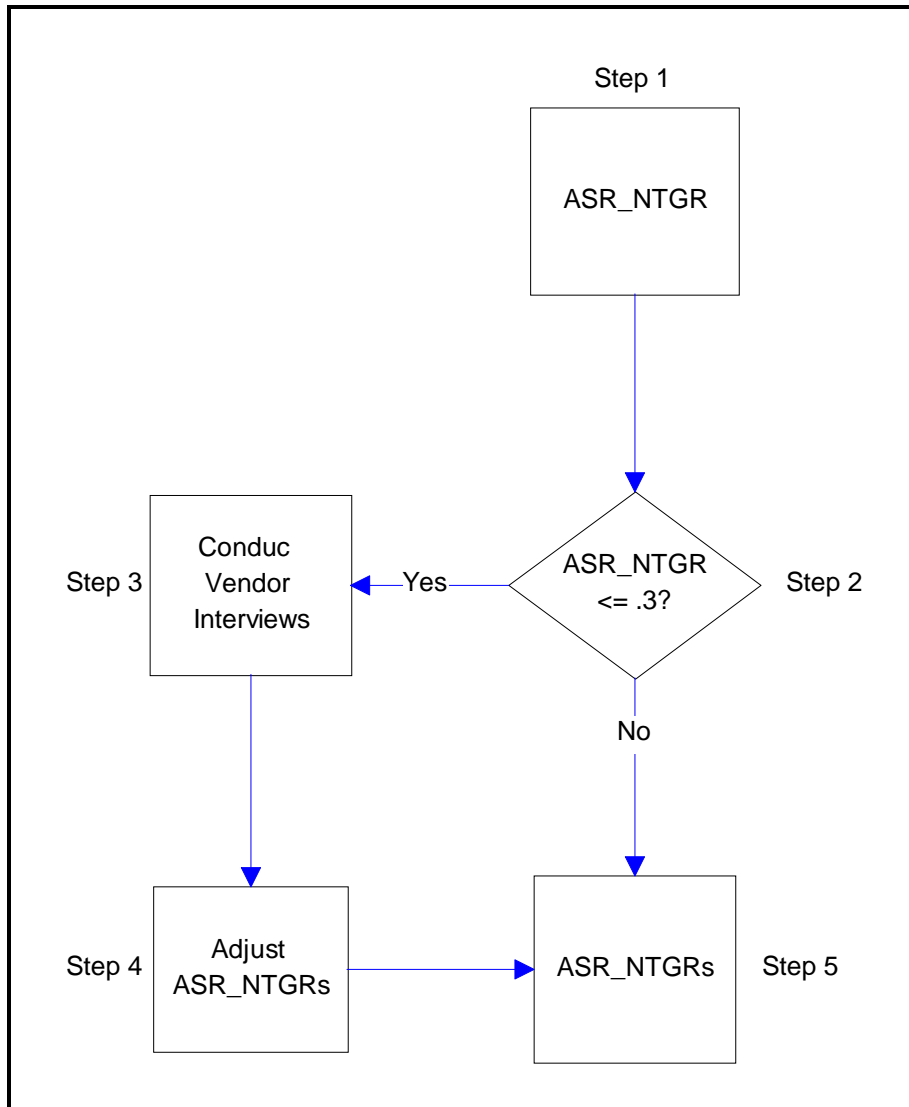


Figure 6-3: Adjustment of Decision-Maker NTGR Using Vendor Information



This is a situation that applies only to *custom project-specific sites where the vendor mentioned by the decision maker is a distributor*. In such a case, even if the distributor respondent cannot recall the specific customer, or the probability that he would have recommended this specific equipment to the specific customer, or the probability that he would have recommended this specific equipment to *any* customer, he is asked a follow-up question because the distributor may *still* have played a significant role in the customer's decision. To determine whether this is the case, we first determine, for the equipment under investigation, the percentage of the distributor's stock that is efficient. Next, we determine the probability that this percentage was influenced by PG&E.

Thus, in order to use the distributor's probability, two conditions must be met:

- the distributor only stocks the efficient version of the type of equipment that the customer installed, and

- the distributor states that the probability that PG&E influenced the stocking of this efficient variety is 1.0.

If both conditions are met, we set the value of the SR_NTGR (and therefore the value of P(b)) to 1. On the other hand, if the vendor's probability is less than 1, we ignore the vendor's probability and use the customer's SR_NTGR (and therefore the value of P(b)).

Using the information collected during the on-site survey for the as-built conditions and the information obtained from the decision-maker on what they were planning to do in the absence of the program (customer baseline) we calculated $\Delta E(b)/\Delta E(c)$. We used algorithms similar to those that were used to calculate the gross savings for the rebated measure.

For normal replacement situations which would have been governed by Title 20, net savings were calculated only if the customer was planning to install something beyond Title 20 requirements, but not as efficient as what was installed under the PG&E program. The gross savings estimate has already used the Title 20 minimum requirements as the baseline rather than the pre-condition.

For early replacement situations, cases where the decision-maker says, in response to question 11, that the customer was not planning to do anything for at least a year, in the absence of the program, there is no free-ridership and therefore no calculation is necessary since the net savings are equal to the gross savings.

6.1.5 Custom Project-Specific Free-ridership Analysis

The custom project-specific free-ridership analysis includes all of the features described above in the standard project-specific analysis, plus substantial additional data collection and analysis. The largest projects are usually the most complex. This fact raises the concern that the ASR_NTGR questions could miss some critical pieces of the decision process that bear on the ASR_NTGR. It is important to understand the entire story of the process of thinking about the change, considering alternatives, balancing costs and benefits, making decisions, etc. The change that PG&E has rebated could be a small part of a larger project, or it may be the entire project. Energy efficiency could be the single reason for the change or it could be a small part of a larger picture. Because of these complexities and potential differences across customers, a different approach was taken for this group. The thrust of the method is to reconstruct the entire "story" (a comprehensive, internally consistent description), of the decision process. This means gathering information from more sources than were employed in the standard project-specific analysis, as well as more detailed and narrative descriptions of the processes.

The descriptions in Section 6.1.4 show how these questions of the pre-quantified decision-maker questionnaire were integrated to form the basic value of P(b) or P(c). However, the methods employed by this study team provide for the alteration of this basic P(b) or P(c) based on additional information that can shed further light on the probability of installing program-recommended equipment. Sometimes these few pre-quantified questions cannot capture all of the influences on the decision to install. Therefore, additional information that could influence the assessment of P(b) or P(c) was gathered. Following is a description of how that information was integrated in the calculation *specifically* for the custom projects.

6.1.5.1 Payback Information

In the majority of cases, the PG&E representative presented the customer with simple payback information on each item under consideration for installation. Where that information was included in the PG&E file, it was taken into account in the assessment of P(b) or P(c). The manner in which this

occurred was through custom probing, as appropriate, in the decision-maker interview. Specifically, before decision-maker interviews were conducted, instructions to the interviewer were prepared that helped identify where a respondent's answer to question 7 would apparently contradict what was implied by the payback period for the item. The assumption behind these custom probes was that items with paybacks of two years or less, without a rebate, would likely have been considered cost effective by a customer, so a rebate should not have been required to motivate it. Conversely, where the pre-rebate payback was over two years, and the post-rebate payback was under two years, the assumption was that the rebate would be expected to have had an effect on the motivation to install. On the other hand, when both the pre- and post-rebate payback was substantially over two years, it was assumed that the motivating impact of the rebate should be low, all else being equal.

Instructions were provided to interviewers, prior to the interviews, that defined for them the answers to question 7 that would constitute a contradiction. If the defined contradiction occurred during the interview, the interviewer was prepared to probe the apparent contradiction. When the respondent claimed more influence from the rebate than would seem appropriate given the payback period, the apparent contradiction was mentioned and an explanation was requested. Likewise, when the customer claimed little or no influence from the rebate, and the payback implied that there should have been a substantial impact, the respondent was questioned about this. In actual practice, few contradictions occurred. When they did, respondents generally either gave adequate explanations or they changed the initial answers given to question 7.

6.1.5.2 File Information

It was expected that information from the PG&E file could provide insight into the motivations of customers for the installation of the equipment. Similar to the role of the payback calculation, the expectation was that motivational information in the file could be used to customize probes in the decision-maker interview where apparent contradictions were revealed. However, no such contradictions were revealed by this information.

6.1.5.3 Operations Staff Pre-Quantified Interview Questions

Most often, the decision-maker and the operations person were the same person. When this was not the case, a separate interview was conducted with the operations staff. The information obtained from the operations staff was of two types: pre-quantified interview questions that were the same as the pre-quantified questions on the decision-maker survey (and could serve as the inputs to a P(b) or P(c) algorithm), and open-ended questions similar to those asked of decision-makers. This section discusses only the pre-quantified questions. This additional information was used in two ways. First, if the decision-maker was unable to answer a question and the operations staff was able to provide the answer, the operations staff answer was used in place of the missing information from the decision-maker.

The second use involved employing the operations staff answers to customize the decision-maker interview, which always occurred after the operations staff interview. The answers to the operations staff interview were recorded in the margins of the blank decision-maker interview instrument. Attention was called to critical answers and answers that seemed ambiguous. Then, in the course of the decision-maker interview, contradictions between the operations staff and the decision-maker answers were brought to the attention of the decision-maker to resolve. The decision-maker's resolution to the contradiction was accepted; the resolution could, of course, be that the decision-maker deferred to the knowledge of the operations staff.

6.1.5.4 Decision-Maker Open-Ended Interview Questions

This type of question had two uses. The first was to contribute to painting the whole picture of the decision process related to the rebated equipment. The second, was to detect misunderstandings embedded in the decision-maker's answers to the structured questions or to pick up complexities in the process that could not fit into structured categories, thus producing unexpected combinations of answers, including contradictory ones. Therefore, the answers to these questions could be compared to the pre-quantified answers to see if there were contradictions across those types of questions.

6.1.5.5 Engineering Ratio

The core inputs to the engineering ratio came from the on-site surveys. In these visits, the appropriate customer baseline was determined. However, provision was made for detecting any contradictions to that assessment by asking questions in the decision-maker and operations staff interviews concerning the customer baseline. Specifically, the respondent was asked if alternatives to the as-built equipment were considered. If the answer was "yes," the respondent was asked to describe the alternative considered. Finally, the respondent was asked whether the company was more likely to install this alternative or nothing at all. This last question allows us to determine whether the customer's alternative equipment or the old equipment would be used to calculate E(b) or E(c) respectively. In the context of the current discussion, however, these questions, together with all other open-ended questions on the decision-maker and the operations staff survey, were inspected for indications that the engineering ratio was based on an incorrect customer baseline.

6.1.5.6 Interviews with Lead Engineers

Provision was made in the custom project process for the engineer in charge of each site to call the net-to-gross ratio team to discuss ambiguities that arose in the course of data collection *and* for the net-to-gross team to call the engineer for clarifications. This occurred for several sites and decisions were made on how to resolve the ambiguities. These instances and the resolutions achieved are described in the narrative description of each custom site.

6.1.6 Verification Free-ridership Analysis

The simplest form of free-ridership analysis was performed for HVAC, PROCESS and LIGHTING projects located at sites that do not contain any project-specific evaluations. For these sites we completed the Decision-Maker survey and calculated a SR_NTGR.

6.1.7 Summary of NTGR Types

As described in previous sections, various NTGRs were calculated using a variety of data depending on whether a simple Self-Report NTGR (SR_NTGR), a Standard NTGR (ASR_NTGR), or a Custom NTGR (CASR_NTGR) was required. Table 6-3 presents the type of NTGR that could be supported as a function of the type of free-ridership analysis employed. Table 6-4 shows the number of installed items for which each type of data was actually available and for which each type of NTGR was calculated.

Table 6-3: NTGR Supported by Type of Free-Ridership Analysis

Type of Free-Ridership Analysis	Type of NTGR Supported
Custom Project Specific	Custom (CASR_NTGR)
Standard Project Specific	Standard (ASR_NTGR)
Verification	Self-Report (SR_NTGR)

Table 6-4: Number of Items for Which Data Were Available to Support Three Types of NTGRs

	Self-Report NTGR	Standard NTGR	Custom NTGR	Total
Decision Maker Interviews	273	253	137	663
Operations Staff Interviews	N/C*	N/C*	26	26
Vendor Interviews	1	10	15	27
On-Sites	N/C*	253	146	399
PG&E Files	273	253	146	672
Spillover Interviews	N/C*	28	100	128

*N/C indicates that the data collection procedure was not conducted for the type of free-ridership analysis. Note that for nine items in the standard NTGR analysis, the NTGR could not be calculated because the decision maker was no longer employed at the site and current staff were unfamiliar with the decision to install the rebated equipment.

6.1.8 Reliability of the Customization Process

For the custom analysis, there was a combination of quantitative and qualitative data from a variety of sources that was integrated in order to produce a final NTGR. Of course, it was essential that all the custom projects be evaluated consistently using the same instrument. However, in a situation involving both quantitative and qualitative data, different interpretations of the data may vary from one item to another which means that, in effect, the measurement instrument may vary from one item to another. Thus, the central issue here is one of reliability, which can be defined as obtaining consistent results over repeated measurements of the same items. Put another way, we did not want to use an elastic ruler to measure the NTGR for custom items. The following section describes the process by which consistency was maximized. Following that is a discussion of how reliability was measured for the processing of these items.

6.1.8.1 The Data Integration Process

To insure reliability, several steps were taken. First, each of the two members of the net-to-gross team examined a sample of the first 25 projects evaluated to develop an explicit set of rules for integrating qualitative and quantitative data. The rules developed at that time were as follows:

1. **Decision maker versus operations staff contradictions** . When there is a contradiction between information obtained from the decision-maker versus the operations staff survey, the decision-maker information will prevail.
2. **Use of operations staff survey** . Information from the operations staff survey is used only to fill in missing information from the decision maker, or to help understand the entire process (of course it was also used to customize the decision-maker interview, but the focus here is on post-interview processing).
3. **Use of qualitative information** . Qualitative information is to be used to alter core inputs only if contradictions were found with the quantified information. Further elaborations on this rule were expected, but were unnecessary as no contradictions of this type were found. However, situations were found where qualitative information (sometimes written in the margin) made it clear that a quantified question was misunderstood and should, therefore, be disregarded.

The formation of rules in this process was important, but the rules can never cover everything. It is always true that judgment has to be used in the application of the rules, and could be a source of unreliability. Judgments fell into three categories.

1. **Determining what constituted a contradiction** . It was agreed between the raters that a quite high level of contradiction must be reached before alterations of the quantified question responses would be employed. Nevertheless, judgment had to be exercised in deciding what constituted a high level of contradiction.
2. **Interpretation of ambiguous responses** . A few times the response categories provided were not entirely comfortable for the respondent, so marginal notes were supplied instead of, or in addition to, firm responses. An example is where the respondent could not decide how much delay there would have been in installing equipment if the rebate had not been offered. "One or two years" was the best response possible for that respondent. In this type of situation, judgment had to be exercised in how to use this answer. Rules might be developed to cover these situations, but there were too few instances to form the basis of rules.
3. **Using text to fill in missing quantified responses** . The opportunity to exercise this type of judgment occurred on a few occasions. However, on each occasion, the decision was not to fill in missing responses. Nevertheless, this decision, in itself, was based on judgment, and happened so few times that rules could not be developed.

These rules and judgments were applied independently by each member of the team to the sample of 25 projects to derive NTGRs. Next, the resulting NTGRs for the sample of projects were compared, with the extent of agreement being a preliminary measure of reliability. Of the first set of 25 sites, disagreements were discovered on four sites producing an inter-rater reliability of 84% (21 out of 25). Three of these differences were the result of one or both of the raters not applying agreed-upon standards because certain information was overlooked; i.e., they represented errors. The remaining difference was simply a

matter of judgment, and an agreement was reached to remain on the conservative side of the decision, i.e., to not change the standard NTGR.

With this experience in hand, the remaining 47 custom projects were assessed independently by each member of the team. The resulting NTGRs for *all* the projects were compared. The result was that on the remaining 47 projects, differences emerged on a only one site. In all, there were only five instances (4 from the first 25 projects and 1 from the remaining 47 projects) of disagreement. The overall inter-rater reliability rating is therefore very high at 93% (67/72).

6.2 Site-Level Spillover Assessment

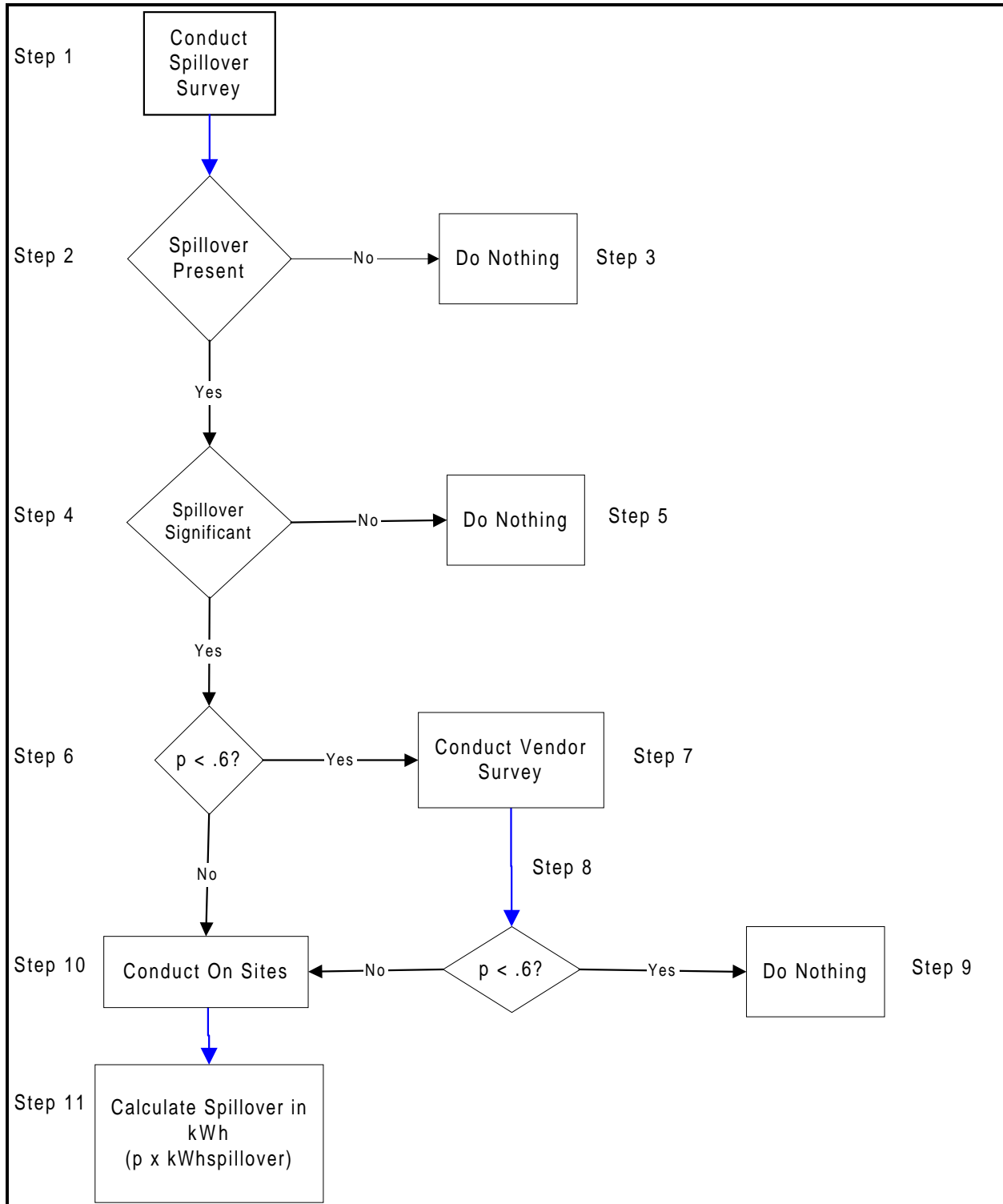
Spillover is defined as the gross savings of measures that are not counted as part of the gross program savings and yet would not have been taken if the PG&E DSM programs had not existed. Unless these savings are accounted for, utilities cannot receive full credit for the influence of their programs. What follows is a method for identifying and evaluating spillover measures installed in 1995 by participants in PG&E's 1995 Retrofit Industrial Program. Spillover was only evaluated at those sites where a project specific evaluation was performed. During development of each site evaluation plan, the customer was interviewed to determine if spillover was present. The objective of this spillover interview was to determine if other efficiency measures were implemented in 1995 due to the influence of PG&E programs, but were not rebated under the programs. The instructions for this interview and the questions are in Appendix D.

In some instances, more than one person had to be contacted to make this determination. And, as in the case for the decision analysis of free-ridership, a vendor interview was sometimes necessary to assess the level of influence of PG&E programs. Figure 6-4 displays the decision process for identifying spillover.

In order to measure the kWh savings associated with the spillover item, an on-site survey was required. However, given time and budget constraints, in order for a piece of equipment to be examined during the on-site as an instance of spillover, we had to be at least 60% certain that PG&E caused this installation to occur. This probability was provided by the respondent's answer to question 5 of the spillover survey. On the other hand, if this probability was less than .6, it might have meant that the respondent was unaware of the role that PG&E's influence on the vendor may have played in the selection of the efficient equipment. That is, customers are not always aware that they are implementing energy-saving measures that they otherwise would not have done. As with other types of measures, discussed earlier, this is most obviously the case when there is a participant who is not aware that vendors' suggestions have been affected by a DSM program. In this situation, the customer is not able to reliably self-report the incidence of spillover for non-program installations of efficient equipment. For those participant respondents who indicated that there was less than a .6 probability that PG&E caused them to install their *non-rebated* installations, we asked them the name the person who recommended the measure (a distributor, selector, or installer) and proceeded to contact this vendor. If information obtained from the vendor increased the probability that PG&E caused this installation to go above .6, then an attempt was made to gather information on the spillover measure during the on-site survey.

Before pursuing data collection during the on-site survey for spillover measures with probabilities greater than .6, we performed a preliminary engineering review to determine if the savings of the spillover measure could be "significant." This is a conservative approach to estimating the impact of spillover measures because we were only including those that were most apparent and which were likely to result in large savings.

Figure 6-4: Spillover Identification Process



For spillover measures with probability greater than .6 and for which savings were likely to be large, we developed engineering savings algorithms using methodologies similar to those used for calculating the savings of program measures described in Section 5. We inspected the spillover measures and collected the necessary data during the on-site survey and developed an engineering estimate of spillover savings using the defined algorithms. For the purpose of individual site reports, we show the *full amount* of the estimated spillover savings.

If these savings were treated in the same way as rebated gross savings, they would be adjusted by the decision-maker survey net-to-gross results, and adjusted for partial free-ridership using the engineering ratio as well. The spillover savings estimates were adjusted by a somewhat less sophisticated version of a NTGR, the customer-stated probability that the installation was influenced by PG&E. However, since there was no effort to determine a customer baseline other than the pre-existing equipment, no adjustment was made for partial free-ridership. This is unlikely to have produced a noticeable difference since alternative baselines were so rare among the rebated items. It was not considered cost effective to invest in determining these baselines for the spillover savings.

Table 6-5 below lists the sites at which we found significant spillover, as well as the end use and the amount of PG&E influence (expressed as a probability) determined during the spillover survey.

Table 6-5 Sites with Spillover

Site No.	Spillover Item No.	End Use	Influence Probability
67	1	HVAC	0.8
108	1	LIGHT	1
127	1	LIGHT	0.8
149	1	PROCESS	0.8
163	1	LIGHT	0.7
203	1	LIGHT	0.9
224	1	LIGHT	1
313	1	LIGHT	0.8
313	2	LIGHT	0.8
313	3	LIGHT	0.8
313	4	LIGHT	0.8
322	1	LIGHT	1
323	1	LIGHT	1
325	1	LIGHT	0.8

6.3 Program-Level Net Impacts

In this section we will describe the methods used to derive two types of estimates: net savings and the NTGR. This process involves several steps and several components. First, we will discuss the use of site and site results to determine the basic program-level impacts without consideration of spillover. These involve considering the three evaluated groups, the methods used for each, and how their results were generalized to the unevaluated group of items. Next, we discuss the inclusion of spillover savings and how they were integrated into the rebated savings. These issues are treated in a general, narrative way first, and then presented in algebraic form. Also in algebraic form, is a description of the conversion of

kWh, kW, and therm savings into dollar impacts through the combined use of costing periods and marginal costs. This method allows for the summing of all types of impacts into a single, dollarized form. The final subsections describe the methods used for calculation of the confidence intervals for the program- and end-use-level NTGR and the Realization Rates.

6.3.1 Net Impact Estimation Without Spillover

Before describing the specific methods for producing program-level net impact estimates, it will be helpful to review the data that were available for this analysis for each of the four evaluation groups:

1. custom project-specific,
2. standard project-specific,
3. verification, and
4. excluded or rejected projects.

Each of these groups has a unique configuration of data available for the net impact analysis. Overall, the approach to the program-level analysis was to sum the net kWh, kW and therms that were derived for each group to produce a total for the program. It was also possible, using the total net savings and the total gross savings to generate a program-level net-to-gross ratio. Below is described the approach to estimating net impacts for each of the four groups.

Group 1: Custom Project-Specific Items. The decision-maker survey, the partial free-ridership analysis, and the custom decision information (additional information gathered for custom project specific evaluations from program files, operations staff interviews, and additional questions addressed to the decision-maker) produced net savings estimates for each custom project-specific item.

Group 2: Standard Project-Specific Items. The same process, as was used for *custom* project-specific items, was used to produce savings estimates for the standard project-specific items but *without* the custom decision information.

The items contained in these two evaluation groups cover 70 percent of the program savings. Thus, they are sampled with a probability of 1. Therefore, the project-specific and custom project-specific procedures mentioned here cover all of the largest projects, with the exception of those customers who refused access to the evaluation staff. Even considering refusals, 70 percent of the program savings were covered by one or the other of the two methods of net impact estimation just described because other projects were added to the evaluation list to bring coverage up to 70 percent as refusals were encountered. The result of each of these processes is a direct estimate of net savings per project. The process for the first two groups is now presented in algebraic form.

For custom and standard items, the net kWh, kW, and therms are calculated in four steps.

1. For each item within each end use, the gross kWh, kW, and therms are adjusted by the associated realization rates to produce AGKWH, AGKW, and AGTHERMS,
2. for each item within each end use, this product is in turn multiplied by the final NTGR⁹,

⁹ Note that for custom and standard projects, the NTGR is the product of P(b) and the engineering ratio, $\Delta E(b)/\Delta E(c)$, which is defined in Section 6.1.3.2.

3. item-level impacts are then summed within each end use, and
4. the end use impacts are then summed across all end uses.

For custom and standard projects, equations 5, 6, and 7 are provided as another way of looking at these calculations.

$$NetkWh = \sum_{e=1}^N \sum_{i=1}^N [NTGR_{e,i} * AGKW_{e,i}] \quad (5)$$

$$NetkW = \sum_{e=1}^N \sum_{i=1}^N [NTGR_{e,i} * AGKW_{e,i}] \quad (6)$$

$$NetTherms = \sum_{e=1}^N \sum_{i=1}^N [NTGR_{e,i} * AGTHERMS_{e,i}] \quad (7)$$

where¹⁰

- NTGR_{e,i} = the NTGR for the ith item in the eth end use
- AGKWH_{e,i} = the adjusted gross kWh impacts for the ith item in the eth end use
- AGKW_{e,i} = the adjusted gross kW impacts for the ith item in the eth end use
- AGTHERMS_{e,i} = the adjusted gross therm impacts for the ith item in the eth end use

For those custom and standard projects where data could not be obtained, net impacts had to be calculated in another fashion. This was done by taking the average realization rate observed in the respondents for each end use and multiplying it by the gross impacts for each item (for which data are available) within each end use contained in the Program Database. Next, this product was multiplied by the average NTGR observed in the respondents for the same end use to produce net kWh, kW, and therm impacts. Finally, the net impacts were summed across all end uses.

Group 3: Verification Items. The third group of evaluated projects is the group of projects, sampled from those which account for the remaining 30 percent of savings in the Lighting, Process, and HVAC end uses, that received verification treatment. For this group, the decision-maker interview and the program database estimates of gross savings are the only pieces of information available, so there is no direct way of assessing the accuracy of the *ex-ante* gross savings estimates or of adjusting them. However, the program database gross savings were adjusted by applying the average realization rates, derived from project-specific evaluations. These realization rates were calculated and applied by end use. To these adjusted gross estimates were applied the decision-maker net-to-gross ratio, specific to each project, to produce net savings estimates for evaluated items. The process for the *non-evaluated* verification items is presented in algebraic form.

For non-evaluated verification items in the Lighting, Process, and HVAC end uses, the net kWh, kW, and therm impacts were calculated in three steps.

¹⁰ Only terms that have not been previously defined will be defined following each equation.

1. For each item within each end use, the gross kWh, kW, and therms obtained from the Progra Database were adjusted by the average realization rate for all items within each end use observed for the *project-specific* items,
2. for each item within each end use, this product was then multiplied by the average NTGR for all items within each end use observed for the project-specific items and the sampled verification items, and
3. the result of Step 2 is then summed across all end uses.

For non-evaluated verification items in the Lighting, Process and HVAC end uses, equations 8, 9, and 10 are provided as another way of looking at these calculations.

$$NetkWh = \sum_{e=1}^N \sum_{i=1}^N \left[\overline{NTGR}_{e,psv} * \left(\overline{RR}_{e,ps} * PDKWh_{e,i} \right) \right] \quad (8)$$

$$NetkW = \sum_{e=1}^N \sum_{i=1}^N \left[\overline{NTGR}_{e,psv} * \left(\overline{RR}_{e,ps} * PDKW_{e,i} \right) \right] \quad (9)$$

$$NetTherms = \sum_{e=1}^N \sum_{i=1}^N \left[\overline{NTGR}_{e,psv} * \left(\overline{RR}_{e,ps} * PDTherms_{e,i} \right) \right] \quad (10)$$

where

- $\overline{NTGR}_{e,psv}$ = the average NTGR for project specific and sampled verification measures for the eth end use.
- $\overline{RR}_{e,ps}$ = the average realization rate for eth end use for project-specific measures
- PD = the prefix PD indicates that the source of the value is PG&E's Program Database.

For non-evaluated verification items that were in the Miscellaneous end use category such as motors and refrigeration, the net kWh, kW, and therm impacts were calculated in three steps.

1. For each item, the gross kWh, kW, and therms obtained from the Program Database were adjusted by the average realization rate for all items observed for the project specific measures,
2. for each item, this product was then multiplied by the average NTGR for all items observed for the sampled project-specific and verification projects, and
3. the result of Step 2 was then summed across all items.

For verification items in the Miscellaneous end use (none of which were evaluated), equations 11, 12, and 13 were provided as another way of looking at these calculations.

$$NetkWh = \sum_{i=1}^N \left[\overline{NTGR}_{psv} * \left(\overline{RR}_{ps} * PDKWH_{e,i} \right) \right] \quad (11)$$

$$NetkW = \sum_{i=1}^N \left[\overline{NTGR}_{psv} * \left(\overline{RR}_{ps} * PDKW_{e,i} \right) \right] \quad (12)$$

$$NetTherms = \sum_{i=1}^N \left[\overline{NTGR}_{psv} * \left(\overline{RR}_{ps} * PDTherms_{e,i} \right) \right] \quad (13)$$

\overline{NTGR}_{psv} = the average NTGR for project specific and sampled verification measures
 \overline{RR}_{ps} = the average realization rate for all project-specific measures

Group 4: Excluded or Rejected Items: This group of non-evaluated lighting items lacks both realization rate estimates and NTGRs. Gross savings were estimated by adjusting the program database estimates to reflect the realization rates observed for project-specific and verification items within the same end use category. Similarly, NTGRs were taken from the project-specific and verification items for which we were able to compute a NTGR. An average, weighted by impacts, was calculated and applied to these non-evaluated items in the program database. The process for the excluded or rejected items is now presented in algebraic form.

For excluded projects, the net kWh and kW are calculated in three steps.

1. For each item, the gross kWh and kW obtained from the Program Database were adjusted by the average realization rate for all lighting items observed in the project-specific lighting items,
2. for each item, this product was then multiplied by the average NTGR for all lighting items observed in the sampled verification projects, and
3. the result of Step 2 was then summed across all items.

For excluded projects, equations 14 and 15 are provided as another way of looking at these calculations.

$$NetkWh = \sum_{i=1}^N \left[\overline{NTGR}_{1,v} * \left(\overline{RR}_{1,ps} * PDKWH_i \right) \right] \quad (14)$$

$$NetkW = \sum_{i=1}^N \left[\overline{NTGR}_{1,v} * \left(\overline{RR}_{1,ps} * PDKW_i \right) \right] \quad (15)$$

$\overline{NTGR}_{1,v}$ = the average NTGR for verification lighting measures
 $\overline{RR}_{1,ps}$ = the average realization rate for all project-specific lighting measures
 $PDKWH_i$ = the kWh impact for the ith excluded lighting measure in the Progra

Database.

The procedures described above produced net savings estimates for all four evaluation groups. All that remained was to add the savings across groups to produce program-level and end-use net savings, and NTGRs without adjustment for spillover for the same groups.

6.3.2 Net Impact Estimation With Spillover Adjustments

Spillover-related contributions to net savings were handled in a way similar to direct net savings, with some exceptions. Specifically, item-level net savings were calculated based on the engineering estimates of gross, adjusted by the self-reported probability that the item was installed in 1995 because of a PG&E program. This adjustment leads to the net savings for the item. Item savings from spillover installations were totaled over all project-specific evaluation sites to calculate total 1995 program spillover savings. This component of net savings were added to the program-level net savings resulting directly from rebated equipment to comprise the total program net savings. Total program net savings was then divided by the total program gross savings described in earlier sections, to yield a net-to-gross ratio. Note that, theoretically, the net-to-gross ratio could be higher than 1 since the gross savings does not, by definition, include spillover.

The major difference in the handling of spillover savings compared to regular net savings is that, for spillover savings, identified savings based on project-specific evaluations are not generalized to the verification sites nor to the non-evaluated sites. While that type of generalization has a reasonable basis for the realization rates and NTGRs coming from rebated equipment, there is less basis for it for spillover impact. Recall that the generalization to verification and non-evaluated sites was based on similarities in equipment type. It is difficult to make the argument that rebated equipment type is a good representative of the savings associated with a potential spillover installation. There may be little or no connection between the rebated equipment type and the spillover equipment. Therefore, it seems imprudent to assume a level of spillover savings on a verification site based on average savings for project-specific evaluation sites with similar equipment. This approach is, of course, very conservative. It is virtually certain to underestimate spillover savings. The alternative, however, is to be very unsure of the claimed savings. The process of adjusting for spillover items is now presented in algebraic form. This adjustment required three steps.

1. For each spillover item, the gross spillover is multiplied by the NTGR¹¹ to produce net spillover impacts,
2. the item-level spillover impacts were then summed to the program level, and
3. the program-level spillover was then added to the program-level impacts calculated in Section 6.3.1 above to produce program-level impacts adjusted for spillover.

For spillover measures, equations 16, 17, and 18 are provided as another way of looking at these calculations.

¹¹ This NTGR is based on a respondent's estimate of PG&E's influence on the installation of the spillover measures. See question 6 on the Spillover Survey.

$$ND_{\text{kWh Spillover}} = \sum_{e=1}^N \sum_{i=1}^N \left[NTGR_{e,i} * (SPILLKWH_{e,i}) \right] \quad (16)$$

$$ND_{\text{kW Spillover}} = \sum_{e=1}^N \sum_{i=1}^N \left[NTGR_{e,i} * (SPILLKW_{e,i}) \right] \quad (17)$$

$$ND_{\text{Therm Spillover}} = \sum_{e=1}^N \sum_{i=1}^N \left[NTGR_{e,i} * (SPILLTHERM_{e,i}) \right] \quad (18)$$

where

SPILL (Prefix) = kWh, kW, or therms impacts associated with a spillover measure(s)

6.3.3 Net Impact Estimation by Costing Period

Net program-level kWh and kW impacts were also calculated by costing period. These costing periods have been determined for all custom projects and are shown in Tables 6-5 and 6-6. These same costing periods were also used for all non-custom projects. With respect to therm impacts, there is an assumption that the therm load is flat, making any allocations to costing periods unnecessary.

6.3.4 Program-Level NTGR

The program-level NTGR was calculated by first converting both gross and net kWh, kW, and therm impacts into a common unit, dollars. This was accomplished by first multiplying each kWh, kW, and therm term in equations 5 through 18 by the marginal costs to produce dollarized gross impacts. Performing the remaining operations in each equation yields the net dollarized impacts (NDI) for kWh, kW, and therms for custom, standard, verification, and excluded items. Once calculated, these NDI impacts were summed across custom, standard, verification, and excluded items to produce program-level NDI impacts. Finally, the program-level NDI divided by the dollarized adjusted gross impacts yields the program-level NTGR.

Before kWh and kW impacts could be multiplied by the marginal energy and capacity costs, these impacts had to be allocated to the various costing periods presented in Tables 6-6 and 6-7. Once the kWh and kW impacts were allocated to costing periods, they were multiplied by the marginal cost associated with each costing period. Appropriate marginal costs were obtained from Table TA-1.2 and TA-1.3 in PG&E's Annual Summary Report on Demand Side Management Programs in 1995: Technical Appendix. Table 6-8 shows the marginal energy costs, and Table 6-9 displays the marginal capacity costs. Table 6-10 presents the 1995 marginal gas costs used for the industrial sector by season.

Table 6-6: Costing Period Allocations for Energy

End Use	Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
Total	0.11	0.12	0.30	0.21	0.26
HVAC	0.08	0.11	0.34	0.17	0.30
LIGHTING	0.14	0.14	0.25	0.24	0.24
MISC	0.11	0.12	0.30	0.20	0.26
PROCESS	0.09	0.11	0.33	0.19	0.27

Table 6-7: Costing Period Allocations for Capacity

End Use	Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
Total	0.83	0.82	0.73	0.80	0.69
HVAC	0.51	0.62	0.66	0.57	0.62
LIGHTING	0.94	0.88	0.67	0.90	0.66
MISC	0.81	0.81	0.74	0.79	0.69
PROCESS	0.84	0.85	0.83	0.79	0.75

Table 6-8: Marginal Energy Costs

Costing Period	\$/kWh
Summer On Peak	.05496
Summer Partial Peak	.04490
Summer Off Peak	.03753
Winter Partial Peak	.05763
Winter Off Peak	.04318

Table 6-9: Marginal Capacity Costs

Costing Period	\$/kW
Summer On Peak	46.75
Summer Partial Peak	18.43
Summer Off Peak	5.02
Winter Partial Peak	20.52
Winter Off Peak	3.13

Table 6-10: Industrial Natural Gas Marginal Costs for 1995

Summer (\$/therm)	Winter (\$/therm)
.25728	.37296

The process for the spillover adjustment for the NTGR is now presented in algebraic form. This adjustment required five steps.

1. For each spillover item for each end use, the gross spillover is multiplied by the NTGR¹² to produce net spillover impacts,
2. for each spillover item for each end use, the net spillover impacts were then multiplied by the marginal energy, capacity, and therm costs to convert the impacts into dollars, the net dollarized impacts (NDI),
3. the spillover NDI was then summed within each end use,
4. the end-use spillover NDI was then summed across end uses, and
5. the spillover NDI was then added to the program-level NDI calculated in Section 6.3.3 above to produce program-level, spillover-adjusted NDI.

For spillover measures, equations 19, 20, and 21 are provided as another way of looking at these calculations.

$$ND_{kWh\ Spillover} = \sum_{e=1}^N \sum_{i=1}^N \left[NTGR_{e,i} * (SPILLKWH_{e,i} * MC) \right] \quad (19)$$

$$ND_{kW\ Spillover} = \sum_{e=1}^N \sum_{i=1}^N \left[NTGR_{e,i} * (SPILLKW_{e,i} * MC) \right] \quad (20)$$

¹² This NTGR is based on a respondent's estimate of PG&E's influence on the installation of the spillover measures. See question 6 on the Spillover Survey.

$$ND_{\text{Therm Spillover}} = \sum_{e=1}^N \sum_{i=1}^N \left[NTGR_{e,i} * (SPILLTHERM_{e,i} * MC) \right] \quad (21)$$

where

SPILL (prefix) = kWh, kW, or therms impacts associated with a spillover measure(s)

MC = marginal cost

6.3.5 Program-Level, Spillover-Adjusted NTGR

Finally, the program-level, spillover-adjusted dollarized net impacts were then divided by the program-level, dollarized adjusted gross impacts for custom, standard, verification, and excluded projects, to produce the program-level, spillover-adjusted NTGR.

6.3.6 Confidence Intervals

Both the 90% and 95% confidence intervals were calculated at the program and end use levels. The calculation for the realization rate confidence intervals differ from that used for the NTGR.

6.3.6.1 Realization Rate Confidence Intervals

For the realization rate, data were available for *all* of the project-specific items, representing the top 70% of program savings, i.e., these were not a random sample of all items in the program database. Using these realization rates, a mean and standard error were calculated. The 90% and 95% confidence interval were then calculated as follows:

$$\bar{y} \pm t s_{\bar{y}} \quad (22)$$

where t = the critical value from the t distribution

s = the standard error of \bar{y} , the realization rate.

The critical values of t for the 90% and 95% levels of confidence are 1.64 and 1.96 respectively. Note that in spite of the fact that all project-specific items are not a random sample of all items in the program database, the weighted mean realization rate was generalized by end use to all items for which realization rates were never calculated. The assumption here is that there is no reason to suspect that realization rates observed in the top 70% are systematically different than those for items for which realization rates are unavailable.

6.3.6.2 NTGR Confidence Intervals

For the NTGR, data were available for *all* project-specific items and a sample of verification items. One can think of this as a stratified random sample with a census being taken from the top strata that represents 70% of the program savings. With stratified random sampling, an unbiased estimate of the Variance of \bar{y}_{st} is:

$$s^2(\bar{y}_{st}) = \sum_{h=1}^L \frac{W_h^2 s_h^2}{n_h} - \sum_{h=1}^L \frac{W_h s_h^2}{N} \quad (23)$$

where

W_h = the stratum weight or $\frac{N_h}{N}$

N_h = total number of units in the h^{th} stratum

N = number of units in the population

W_h^2 = square of the stratum weight, W_h

s_h^2 = Variance within the h^{th} stratum

n_h = number of units in sample for h^{th} stratum

Note that the second term in equation 23 represents the finite population correction.

The confidence intervals are calculated as follows.

$$\bar{y}_{st} \pm ts(\bar{y}_{st}) \quad (24)$$

where t = the critical value from the t distribution

s = the standard error of \bar{y}_{st} , the mean NTGR for the stratified sample (st) .

The critical values for the 90% and 95% levels of confidence are 1.64 and 1.96 respectively.

7. Results of the Engineering Analysis of Gross Impact

7.1 Summary of Methodology

Gross impacts were estimated for project-specific projects, by implementing site-specific evaluation plans approved by PG&E for a group of projects in the HVAC, light and process end uses which accounted for more than 70 percent of the savings in each end use. The site-specific evaluations plans provided a detailed description of the paid items at each site and specified the data collection and engineering analysis procedures for evaluating gross impact. After PG&E approval of each plan, we implemented the data collection via an on-site survey and reestimated gross savings using these data and the engineering algorithm specified in the plan. In addition, we conducted a simpler analysis to verify a sample of paid items representing the balance of the savings in each end use. For these items, we located and inspected the installed equipment and determined the fraction of the equipment described in the program application that was installed, as well as what portion of the installed equipment was operational. For both project-specific and verify items, we noted the location of the equipment and, as necessary for the retention database, the equipment make and model. The results of our project-specific and verification analyses are discussed in more detail below, along with estimates for program-level gross savings.

Project-Specific Analysis: The project specific analysis was applied to a sample of projects representing 70 percent of the 1995 program savings in each of the lighting, HVAC and process end uses. These projects were of greatest interest to PG&E and therefore required the most rigorous analysis. A total of 160 projects (21 HVAC, 115 lighting, and 24 process projects), located at 130 sites, received this level of analysis. Since the sites included in this sample included a very diverse group of industrial facilities and custom applications of the program measures, the project-specific data collection and analysis methods were tailored to the complexity of the measure and the value of the savings to PG&E for the project under consideration. We developed custom data collection and analysis procedures for each process and HVAC project-specific evaluation, and used standardized procedures for lighting projects. Because of the custom nature of the program procedures, significantly different approaches were used to estimate savings for similar measures. In brief, the major technical approaches we took for each end use were as follows:

Process

1. Simple algorithms recalculated with as-built conditions.
2. Spreadsheet-based bin analyses.
3. Extrapolation of short-term measurement data to estimate annual consumption.
4. DOE-2.1E modeling of process chillers and boilers.

HVAC

1. DOE-2.1E modeling of HVAC equipment and site loads.
2. Program savings algorithms recalculated with as-built conditions.
3. Regression analysis and extrapolation using short term measurements.

4. Spreadsheet-based bin analyses.
5. Annual extrapolation of short-term HVAC equipment performance measurements.

Lighting

1. Standardized lighting capacity reduction savings algorithms.
2. Standardized lighting control savings algorithms.

Verification Analysis: Verification analyses were performed for projects in the process, HVAC, and lighting end uses as needed to achieve a census of 150 projects in each end use. A total of 327 projects (58 process, 115 HVAC, 35 lighting, and 119 miscellaneous projects) received this level of analysis. For these projects, we located and inspected the equipment associated with each paid item. We determined the fraction of the equipment described in the program application that was installed and what portion of the installed equipment was operational.

Program-Level Gross Impacts: To create a program-level estimate of gross savings, we extrapolated the findings from the completed project-specific evaluation group to the other projects in each end use. To estimate gross savings for these projects, we first determined the savings realization rates for kWh, kW and therms for all evaluated project-specific items, for each end use. We then applied these realization rates, by end use, to the program data base estimates of kWh, kW and therms savings for all items that were not included in the project-specific evaluations. This provided an estimate of what the evaluation savings would have been if these items had been covered by a project-specific evaluation. For the miscellaneous end use, we computed a realization rate based on all project-specific evaluations, regardless of end use, and applied that to the program data base estimates of savings. Once the extrapolation for all end uses was complete, we estimated program-level gross savings by summing the savings for all items.

7.2 Project-Specific Evaluation Baseline Assumptions

Part of the project-specific gross savings evaluation required engineers to determine the most appropriate baseline against which to estimate savings. During telephone conversations and on-site visits with program participants, engineers determined whether or not the evaluated items were early or normal replacement. For early replacement situations, engineers selected the pre-condition equipment as the baseline. For normal replacement situations, if the participant would have otherwise specified equipment meeting either Title 20, Title 24, or another industry-wide standard practice, then the applicable standard was chosen as the baseline. Table 7-1 below categorizes these baseline assumptions, both overall and by end use. Overall, the vast majority of items (87%) used a pre-condition equipment baseline. We ultimately analyzed 91% of the HVAC items, 86% of the lighting items, and 92% of the process items with a pre-condition baseline.

7.3 Project-Specific On-Site Measurements

The project-specific evaluations included short-term and/or one-time measurements of loads, operating hours, and power consumption when appropriate and when the site evaluation budget permitted. Examples of situations which typically called for measurements include analyses of lighting fixtures on occupancy sensors, chillers meeting space cooling loads, or motors running at nearly constant load. As Table 7-2 below shows, on a percentage basis, HVAC items required the most short-term measurements (18% of all project-specific HVAC items), even though the bulk of these measurements (51 of 57) were

for lighting items. Process items most frequently relied upon one-time measurements (71% of all project-specific process items) and in fact accounted for 17 of the 24 items that received such measurements.

Table 7-1 Breakdown of Baseline Assumptions

End Use	Baseline	No. of items	% of total items
Total			
	Not applicable	1	0.3
	Pre-condition	347	87.0
	Standard practice	3	0.8
	Title 20	28	7.0
	Title 24	20	5.0
HVA			
	Pre-condition	20	90.9
	Title 20	1	4.5
	Title 24	1	4.5
Lighting			
	Not applicable	1	0.3
	Pre-condition	305	86.4
	Standard practice	2	0.6
	Title 20	27	7.6
	Title 24	18	5.1
Process			
	Pre-condition	22	91.7
	Standard practice	1	4.2
	Title 24	1	4.2

Table 7-2 Number of Items Receiving On-site Measurements

End Use	Total No. of Proj-Spec Items	Short-term Measurements		One-time Measurements	
		No. of items	% of PS total	No. of items	% of PS total
Total	399	57	14.3	24	6.0
HVAC	22	4	18.2	6	27.3
Light	353	51	14.4	1	0.3
Process	24	2	8.3	17	70.8

7.4 Counts of Installed and Operational Measure Units

Table 7-3 shows, for all project-specific items, the number of measure units we found recorded in the application and compares it against the actual number we found installed and operational during the on site survey. Examples of measure units are: fixtures for a lighting item or tons for an HVAC item. Note that the measure units sums shown in the tables below add together very different types of units. For HVAC items, the number of units installed and operational corresponded almost exactly to totals stated in the applications. The installed and operational percentages drop significantly for the lighting and process items.

Table 7-4 is similar to Table 7-3 above, except that it only shows results for verify items. It also sums up for each end use the number of units we found recorded in the application and compares it against the actual number we found installed and operational during the on-site survey. In general, the installed and operational percentages are quite high, with the lowest occurring for lighting items (about 96%) and the highest for miscellaneous items (nearly 100%). Table 7-5 combines the results for Tables 7-3 and 7-4, showing installed and operational percentages for all evaluated items. As with the verify item subtotals, the lowest percentage occurs for lighting (about 91-92%) and the highest for miscellaneous (100%).

Table 7-3 Counts of Installed and Operational Units (project-specific only)

End Use	No. of Eval. Items	No. of Measure Units			% of App. Units	
		From Applic.	Installed	Operational	Installed	Operational
Total	399	162,394	151,744	150,558	93.4	92.7
HVAC	22	32,071	32,071	32,070	100.0	100.0
Lighting	353	129,251	118,799	117,629	91.9	91.0
Process	24	1,072	874	859	81.5	80.1

Table 7-4 Counts of Installed and Operational Units (verify only)

End Use	No. of Eval. Items	No. of Measure Units			% of App. Units	
		From Applic.	Installed	Operational	Installed	Operational
Total	453	254,946	254,268	254,244	99.7	99.7
HVAC	141	17,834	17,320	17,320	97.1	97.1
Lighting	72	3,152	3,038	3,022	96.4	95.9
Miscellaneous	180	230,311	230,266	230,258	99.98	99.98
Process	60	3,649	3,644	3,644	99.9	99.9

Table 7-5 Counts of Installed and Operational Units (all items)

End Use	No. of Eval. Items	No. of Measure Units			% of App. Units	
		From Applic.	Installed	Operational	Installed	Operational
Total	852	417,340	406,012	404,801	97.3	97.0
HVAC	163	49,905	49,391	49,390	99.0	99.0
Lighting	425	132,403	121,837	120,651	92.0	91.1
Miscellaneous	180	230,311	230,266	230,258	99.98	99.98
Process	84	4,721	4,518	4,503	95.7	95.4

7.5 Gross Realization Rates

Tables 7-6 and 7-7 show estimates of connected load demand savings (kW), average summer on-peak electric demand savings (kW), annual electric consumption savings (kWh), and gas consumption savings (therm), as well as gross realization rates for each of these categories. The connected load demand savings represents the highest possible kW savings estimate, while the average summer on-peak demand savings realization rate providing a significantly more conservative estimate. The PG&E program was inconsistent in calculating kW savings, thus adding uncertainty to our kW realization rate estimates.

Table 7-6 breaks savings results down by end use, while Table 7-7 breaks them down by PG&E program. Each table also lists the confidence interval for the realization rates at a 90% confidence level. The confidence interval states the upper and lower limits within which one could be 90% confident the true realization rate lies.

Overall, we estimated an average summer on-peak kW realization rate of 0.88 (confidence interval of 0.49), a kWh realization rate of 0.81 (confidence interval of 0.56), and a therm realization rate of 1.17 (confidence interval of 0.83) for the 1995 Industrial Retrofit Program. Table 7-6 shows that on an end use basis, lighting measures had the highest realization rates (0.99 for kWh and 0.96 for average kW). The program did not estimate savings or takebacks for lighting measure, so the lighting therm realization rate did not apply. The next highest set of realization rates were for HVAC measures (0.97 for kWh, 0.83 for average kW, and 0.98 for therms). Process measures accounted for the largest portion of program savings out of all the end uses, making up 46%, 36%, and 80% of the total program kWh, kW, therm savings, respectively. These measures, however, yielded the lowest realization rates (0.66 for kWh, 0.82 for average kW, and 1.18 for therms). The low process kWh realization rate significantly offset the high kWh realization rates for lighting and HVAC.

Table 7-7 provides realization rates for each of the major industrial retrofit programs, including the REO, Retrofit Express, and Customized programs. In addition, it also contains a category for “Other Programs.” This category included the Thermal Energy Storage program, for which only one item existed in the evaluated population, as well as 30 other items that fell under the Commercial and Agricultural Retrofit programs. The items in the “Other Programs” contributed negligibly to the overall program savings: we included them for the sake of completeness.

Table 7-6 Gross Realization Rates (Overall and by End Use)

	Connected Load kW	Avg. Summer Peak kW ¹	kWh	Therms
Total				
No. of Items	1,668	1,668	1,668	1,668
MDSS Program Savings ²	14,492	14,492	116,989,843	13,346,509
Evaluation Savings	19,811	12,708	95,168,014	15,601,245
Realization Rate	1.37	0.88	0.81	1.17
90% Confidence interval	0.52	0.49	0.56	0.83
HVA				
No. of Items	225	225	225	225
MDSS Program Savings	2,023	2,023	17,853,268	551,701
Evaluation Savings	4,411	1,687	17,292,602	537,989
Realization Rate	2.18	0.83	0.97	0.98
90% Confidence interval	1.78	1.39	0.79	0.73
Lighting				
No. of Items	1,010	1,010	1,010	1,010
MDSS Program Savings	4,836	4,836	30,356,944	0
Evaluation Savings	5,152	4,646	30,146,866	-83,195
Realization Rate	1.07	0.96	0.99	N/A
90% Confidence interval	0.50	0.50	0.59	N/A
Miscellaneous				
No. of Items	337	337	337	337
MDSS Program Savings ²	2,457	2,457	15,090,746	361,064
Evaluation Savings	3,378	2,151	12,303,606	419,983
Realization Rate	1.37	0.88	0.82	1.16
90% Confidence interval	N/A	N/A	N/A	N/A
Process				
No. of Items	96	96	96	96
MDSS Program Savings ²	5,176	5,176	53,688,885	12,433,743
Evaluation Savings	6,870	4,225	35,424,940	14,726,469
Realization Rate	1.33	0.82	0.66	1.18
90% Confidence interval	0.84	0.68	0.51	1.01

¹ Defined as the average hourly kW savings during the summer on-peak costing period (May 1 - October 31, weekdays from 12 P.M. to 6 P.M.).

² Process and miscellaneous therm program savings were reduced by 10%, and the therm savings for Shell Wester (Project 969) were reduced by an additional 25% to match the E-tables submitted in December 1996.

Table 7-7 Gross Realization Rates (Overall and by Program)

	Connected Load kW	Avg. Summer Peak kW ¹	kWh	Therms
Total				
No. of Items	1,668	1,668	1,668	1,668
MDSS Program Savings ²	14,492	14,492	116,989,843	13,346,509
Evaluation Savings	19,811	12,708	95,168,014	15,601,245
Realization Rate	1.37	0.88	0.81	1.17
90% Confidence interval	0.52	0.49	0.56	0.83
REO				
No. of Items	6	6	6	6
MDSS Program Savings ²	71	71	256,139	0
Evaluation Savings	124	59	191,473	0
Realization Rate	1.74	0.83	0.75	N/A
90% Confidence interval	N/A	N/A	N/A	N/A
Retrofit Express				
No. of Items	1,484	1,484	1,484	1,484
MDSS Program Savings ²	5,148	5,148	28,368,604	1,270
Evaluation Savings	5,461	4,314	27,913,937	-77,514
Realization Rate	1.06	0.84	0.98	-61.05
90% Confidence interval	0.51	0.50	0.59	N/A
Customized				
No. of Items	148	148	148	148
MDSS Program Savings ²	9,195	9,195	88,134,977	13,345,239
Evaluation Savings	14,143	8,260	66,834,073	15,678,759
Realization Rate	1.54	0.90	0.76	1.17
90% Confidence interval	1.19	0.92	0.44	0.83
Other Programs				
No. of Items	30	30	30	30
MDSS Program Savings ²	78	78	230,123	0
Evaluation Savings	83	75	228,530	0
Realization Rate	1.07	0.96	0.99	N/A
90% Confidence interval	N/A	N/A	N/A	N/A

¹ Defined as the average hourly kW savings during the summer on-peak costing period (May 1 - October 31, weekdays from 12 P.M. to 6 P.M.).

² Process and miscellaneous therm program savings were reduced by 10%, and the therm savings for Shell Wester (Project 969) were reduced by an additional 25% to match the E-tables submitted in December 1996.

The bulk of the items (89% of the total) fell within the Retrofit Express program, which had realization rates of 0.84, 0.98, and -61.05 for kW, kWh, and therms, respectively. The large negative realization rate for therms reflects the large number of lighting measures in this program. For many of the lighting measure evaluations, we calculated a therm takeback, that is, the increase in gas consumption for heating systems that results because the more efficient lighting produces less heat. The PG&E program did not take this effect into account, and as a result, the realization rate is unusually low.

The Customized program accounted for only about a tenth as many measures as the Retrofit Express program, but was responsible for the majority of PG&E's estimates of program savings. About 63% and 73% of the total program kW and kWh savings, respectively, fell within the Customized program. The average kW, kWh, and therm realization rates for this program were 0.90, 0.76, and 1.17. This kW realization rate is slightly higher than the Retrofit Express realization rate, but the kWh is significantly lower than the Retrofit Express rate.

The remaining program categories had minimal effects on the overall realization rates. The REO program included only six items, which yielded average kW and kWh realization rates of 0.83 and 0.75, respectively. Items falling in the "Other Programs" category had average kW and kWh realization rates of 0.96 and 0.99, respectively.

7.6 Gross Savings by Costing Period

The project-specific evaluations produced estimates of maximum kW demand and kWh consumption for each of the five PG&E costing periods. Definitions for these costing periods appear in Table 7-8 below. From the project-specific evaluations, we developed an average costing period kWh distribution for the HVAC, lighting, and process end uses. We also calculated an aggregate distribution across all project specific end uses and applied this to the miscellaneous end use items. For each end use and overall, we calculated the annual kWh fraction for each costing period, defined as the ratio of the kWh consumption during the costing period to the kWh consumption for the entire year. Table 7-9 shows the annual kWh fraction for each of the costing periods, as well as the total kWh savings falling within each period. Figure 7-1 shows these same numbers graphically.

Table 7-8 PG&E Costing Periods

Costing Period	Dates	Hours
Summer On-Peak	May 1 - Oct 31	12 PM - 6 PM weekdays
Summer Partial Peak	May 1 - Oct 31	8:30 AM - 12 PM, 6 PM - 9:30 PM weekdays
Summer Off-Peak	May 1 - Oct 31	9:30 PM - 8:30 AM weekdays, all day weekends
Winter Partial Peak	Nov 1 - Apr 30	8:30 AM- 9:30 PM weekdays, all day weekends
Winter Off-Peak	Nov 1 - Apr 30	9:30 PM- 8:30 AM weekdays

Overall, kWh savings are split fairly evenly between seasons. 53% of the kWh savings occur in summer, and 47% occurs in winter. Within the summer period, 57% of the savings are in the off-peak period, with 23% and 20% of savings in the partial-peak and on-peak periods. In winter, 45% of the savings are in the partial-peak period, with the remaining 55% in the off-peak period. As Figure 7-1 shows, kWh savings for lighting falls more in the on- and partial-peak periods than they do for other end uses.

Table 7-9 Gross kWh Savings by Costing Period

End Use	Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
Fraction of annual hours in costing per.	0.09	0.09	0.32	0.18	0.32
Total					
Annual kWh fraction	0.11	0.12	0.30	0.20	0.26
H-factor	0.11	0.12	0.30	0.20	0.26
kWh	10,070,199	11,557,404	28,859,753	19,484,835	25,195,822
HVA					
Annual kWh fraction	0.08	0.11	0.34	0.17	0.30
H-factor	0.08	0.11	0.34	0.17	0.30
kWh	1,343,637	1,988,259	5,937,406	2,896,657	5,126,643
Lighting					
Annual kWh fraction	0.14	0.14	0.25	0.24	0.24
H-factor	0.14	0.14	0.25	0.24	0.24
kWh	4,104,683	4,094,995	7,471,117	7,351,153	7,124,918
Miscellaneous					
Annual kWh fraction	0.11	0.12	0.30	0.20	0.26
H-factor	0.11	0.12	0.30	0.20	0.26
kWh	1,303,943	1,495,128	3,727,377	2,521,685	3,255,473
Process					
Annual kWh fraction	0.09	0.11	0.33	0.19	0.27
H-factor	0.09	0.11	0.33	0.19	0.27
kWh	3,317,937	3,979,022	11,723,854	6,715,339	9,688,788

Figure 7-1 Gross kWh Savings by Costing Period

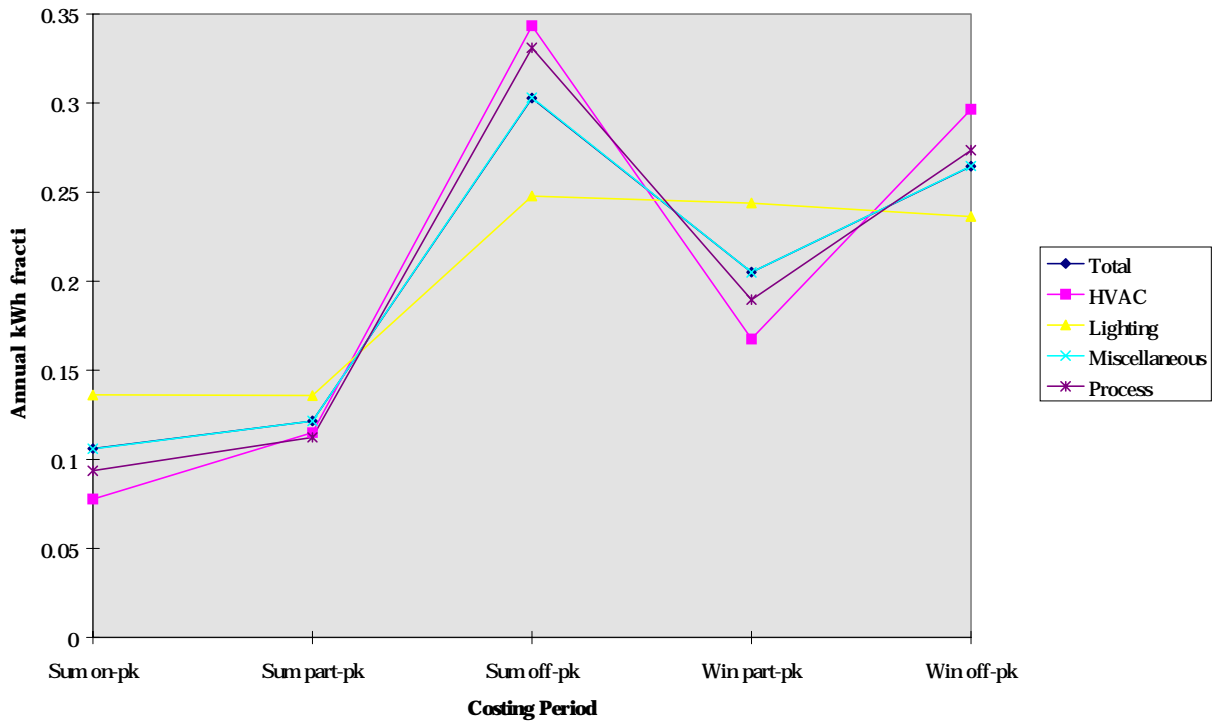
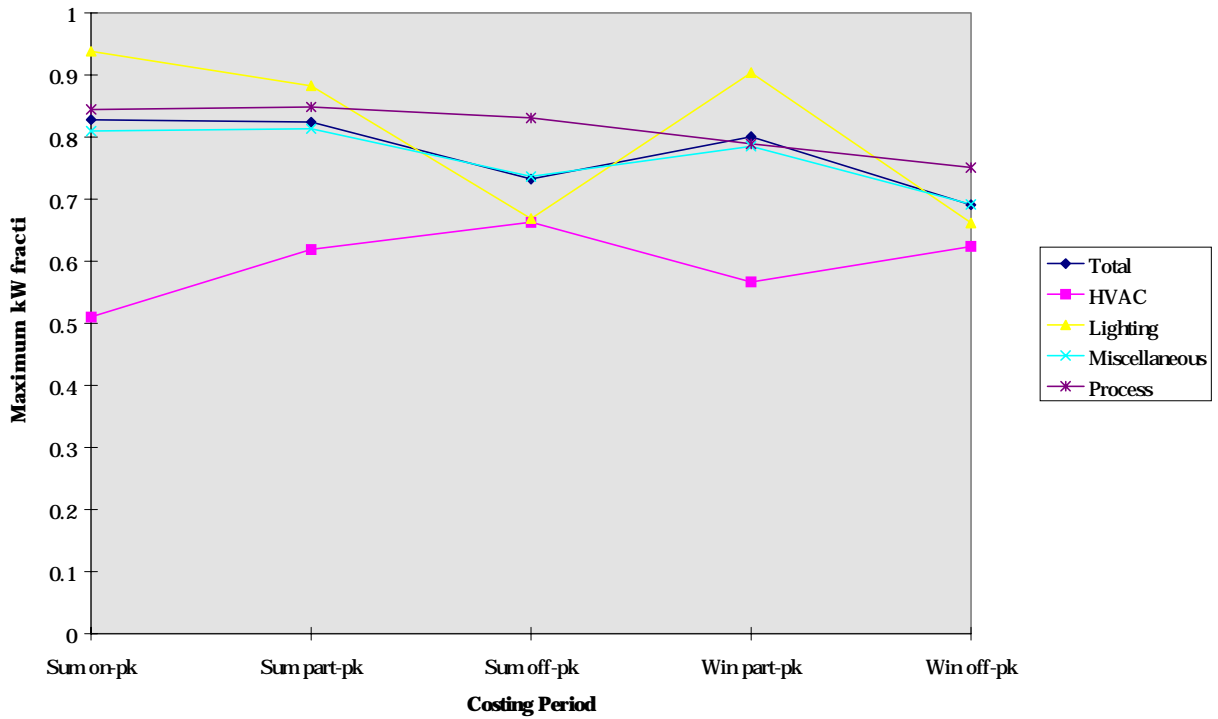


Table 7-10 Gross kW Savings by Costing Period

End Use	Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
Total					
Max. kW fraction	0.83	0.82	0.73	0.80	0.69
H-factor	1.00	1.00	0.89	0.97	0.83
kW	10,529	10,480	9,319	10,178	8,788
HVA					
Max. kW fraction	0.51	0.62	0.66	0.57	0.62
H-factor	1.00	1.21	1.30	1.11	1.22
kW	861	1,044	1,118	956	1,052
Lighting					
Max. kW fraction	0.94	0.88	0.67	0.90	0.66
H-factor	1.00	0.94	0.71	0.96	0.71
kW	4,358	4,101	3,108	4,200	3,074
Miscellaneous					
Max. kW fraction	0.81	0.81	0.74	0.79	0.69
H-factor	1.00	1.00	0.91	0.97	0.85
kW	1,741	1,750	1,584	1,689	1,488
Process					
Max. kW fraction	0.84	0.85	0.83	0.79	0.75
H-factor	1.00	1.00	0.98	0.93	0.89
kW	3,568	3,585	3,510	3,334	3,173

Figure 7-2 Gross kW Savings by Costing Period



The project-specific evaluations also produced maximum kW savings results for each costing period. For the HVAC, lighting, and process end uses, we calculated the maximum kW fraction for each costing period, defined as the ratio of the peak kW savings during the costing period to connected load kW savings (the peak kW savings over the entire year). We also calculated an aggregate maximum kW fractions across all project-specific end uses and applied these to miscellaneous end use items. Table 7-10 shows the maximum kW fraction for each of the costing periods, as well as the maximum kW savings falling within each period. Figure 7-2 shows these same numbers graphically.

Overall, the highest maximum kW fraction (0.83) occurs during the summer on-peak period, although the fractions during the summer partial-peak (0.82) and winter partial-peak (0.80) are only slightly lower. Off-peak kW fractions are significantly lower (0.73 in summer, 0.69 in winter). This distribution varies dramatically among end uses. Lighting, for instance, shows very high maximum kW fractions during the summer on-peak and winter partial-peak periods, when lighting is generally on at industrial facilities. HVAC, on the other hand, shows the opposite tendency, with highest maximum kW fractions during the off-peak periods. This may result from the significant number of EMS and setback thermostat measures, which produce savings in large part by turning off HVAC equipment during off-peak hours. The process distribution is fairly flat, not surprising considering that many of the process measures affected equipment that operated steadily around the clock.

7.7 Reasons for Differences

In the four sections below we document some of the key reasons for differences between estimates of savings prepared by PG&E's programs and the estimates of savings developed in this evaluation.

7.7.1 Program Data Base and Application Discrepancies

While reviewing the application files and comparing them with information extracted from the MDSS data base, we discovered a number of items where savings estimates from the two sources did not agree. In some cases the reason for the discrepancy was obvious, such as a keypunch error while entering numbers from the application into the data base. In other cases, the reasons were less apparent. Table 7-11 below shows the number of items where we identified differences in savings estimates, along with their effect on the total program savings. Overall, the applications documented 5.2% and 6.2% higher kWh and kW savings, respectively, than in the data base. The therm difference overall was a negligible 0.01%. The vast majority of these items with differences were in the lighting end use. Originally, PG&E's savings algorithm had incorrectly applied a set kW savings per lamp for certain measures, which it should have been savings per fixture. This caused the applications to overstate savings for many items, for which corrected values appeared in the PG&E data base. Aside from this large-scale discrepancy, however, we still found instances where major differences existed between the file and the data base. As Table 7-11 reveals, for the HVAC end use, a discrepancy in one item caused a 1.8% difference in kWh savings. For the process end use, three items caused a 7% difference in kW savings.

7.7.2 Differences in Key Assumptions

During the project-specific evaluations, we often discovered that the actual number of installed units, operating hours, and/or savings per unit differed from what PG&E assumed for calculating progra savings. In addition, we also found other reasons for differences, such as additional savings resulting from lighting measures reducing cooling consumption. Table 7-12 below shows frequency distributions for the percentage difference in our and PG&E's estimates of three key assumptions, (1) capacity or number of units, (2) operating hours, and (3) savings per unit. To give a hypothetical example, if the application listed 100 fixtures, but we only found 80, then the percent difference would be -20%. In

Table 7-12, this item would be tallied in the “-1 to -25 % difference” row. In addition, the bottom of Table 7-12 documents the number of items where the engineer indicated that there were additional reasons for differences between the savings estimates.

The table in general shows that differences in operating hours were the most significant of the three reason for savings differences. Of the 372 items to which operating hours applied, nearly all the items had differences in operating hour assumptions. In fact, 14% had a greater than 100% difference in operating hour estimates and 22% had a -26% to -50% difference. Savings per unit assumptions also differed, although to a somewhat lesser degree: for 45% of the items, the savings per unit assumptions fell within 25% of each other. Capacity or number of units appeared to be the least significant reason for differences: for 295 out of 395 items (75%), engineers found no difference.

For 86% of the evaluated items, engineers indicated there were other reasons for savings differences. Many of these cases were lighting items, where heating-cooling interactions often resulted in differences. These interactions are discussed in the next paragraphs.

7.7.3 Heating and Cooling Interactions

Interactions between lighting and HVAC systems can affect energy savings in two ways. Energy efficient lighting produces less heat than inefficient lighting, thus both (1) reducing the load on cooling equipment and thereby reducing cooling energy consumption at sites with space cooling, and (2) increasing the amount of heat the heating system must provide, thereby increasing gas consumption at facilities with gas space heating. Our savings evaluations quantified these interactive effects for each lighting measure that had been installed in a conditioned area. The results are summarized in Table 7-13 below. About 26% of the lighting measures (259 items) had heating and/or cooling interactions. The cooling interaction increased total lighting kWh savings by about 3.2%, which represented about 1.0% of all kWh savings. The heating interaction decreased total therm savings by about 0.5%.

7.7.4 Measure Interactions

In a number of cases, the effects of separate measures installed at the same facility can interact in such a way as to result in less savings than had the measures been installed at separate locations. For example, if a program participant installed both efficient lighting and occupancy sensors in the same building, the occupancy sensors would reduce the operating hours of the efficient lighting, thus reducing the savings attributable to the new lighting. By the same token, the efficient lighting would reduce the lighting kW load, diminishing the savings resulting from the occupancy sensors turning off the lights. We identified 35 lighting items and 3 HVAC items where such interactions occurred, as shown in Table 7-14. The table also lists the effects of the interactions on evaluation savings estimates. Lighting measure interactions reduced total lighting kW and kWh savings by 6.6% and 1.3%, respectively. In addition, lighting interaction reduced the lighting therm takeback (increased therm savings) by 3.4%. The HVAC measure interactions reduced HVAC kW and kWh savings by 1.0% and 0.01%, respectively. Overall, measure interactions across all end uses reduced kW savings by 1.9%, reduced kWh savings by 0.4%, and increased therm savings by 0.02%.

Table 7-11 Comparison of Program Data Base and Application Savings Estimates

End Use	MDSS Data Base Savings^{1,2}	Program Application Savings	Percent difference	No. of items w/ difference	Percent of eval. items w/difference
Total					
kWh	99,572,604	104,751,258	5.2	124	14.6
kW	12,350	13,116	6.2	122	14.3
therms	16,249,332	16,247,021	-0.01	3	0.4
HVAC					
kWh	15,116,382	14,850,982	-1.8	1	0.6
kW	1,759	1,759	0.0	0	0.0
therms	551,701	550,104	-0.3	1	0.6
Lighting					
kWh	22,625,364	29,029,064	28.3	117	27.5
kW	3,513	4,577	30.3	117	27.5
therms	0	0	N/A	N/A	N/A
Miscellaneous					
kWh	13,260,396	12,746,872	-3.9	2	1.1
kW	2,323	2,357	1.5	2	1.1
therms	1,411	1,924	36.4	1	0.6
Process					
kWh	48,570,461	48,124,340	-0.9	4	4.8
kW	4,755	4,422	-7.0	3	3.6
therms	15,696,221	15,694,994	-0.01	1	1.2

¹ Only includes items for which we reviewed the application, so these numbers are lower than program totals.

² These are the original MDSS data base numbers, and were not adjusted to match the E-tables.

Table 7-12 Differences in Key Assumptions Used in Program and Evaluation Savings Estimates

% difference betw. eval. & program (negative=eval < program)	Reason for difference in savings estimate							
	Capacity or number of unit		Operating Hours		kW or Btu/h Savings per uni		Other	
	# items	% items	# items	% items	# items	% items	# items	% items
less than 100					18	5.0		
-76 to -100	11	2.8	6	1.6	14	3.9		
-51 to -75	8	2.0	20	5.4	38	10.6		
-26 to -50	17	4.3	83	22.3	55	15.3		
-1 to -25	64	16.2	73	19.6	80	22.2		
No difference	295	74.7	27	7.3	11	3.1		
1 to -25			38	10.2	70	19.4		
26 to 50			30	8.1	30	8.3		
51 to 75			21	5.6	25	6.9		
76 to 100			23	6.2	4	1.1		
greater than 100			51	13.7	15	4.2		
Other reasons for differences?								
Yes							342	85.7
No							57	14.3
Totals	395	100	372	100	360	100	399	100

Table 7-13 Effect of Heating-Cooling Interactions

	Lighting	All End Uses
No. of measures	1,010	1,668
No. of measures w/heat-cool interaction	259	259
% of total measures	25.6	15.5
Total evaluated kWh savings	30,146,866	95,168,014
Interaction kWh savings	995,918	995,918
% of total kWh savings	3.30	1.05
Total evaluated therm savings	0	15,601,245
Interaction therm takeback	-83,233	-83,233
% of total therm savings	N/A	-0.53

Table 7-14 Effect of Measure Interactions

End Use	No. of Measures	No. of Measure Interactions	Evaluated Savings			Measure Interactions			% Interactive Effect		
			kW	kWh	therms	kW	kWh	therms	kW	kWh	therms
Total	1668	38	19,811	95,168,014	15,601,245	383	381,251	-2,809	1.93	0.40	-0.02
HVAC	225	3	4,411	17,292,602	537,989	46	2,465	0	1.03	0.01	0.00
Lighting	1010	35	5,152	30,146,866	-83,195	337	378,787	-2,809	6.55	1.26	3.38
Misc.	337	0	3,378	12,303,606	419,983	0	0	0	0.00	0.00	0.00
Process	96	0	6,870	35,424,940	14,726,469	0	0	0	0.00	0.00	0.00

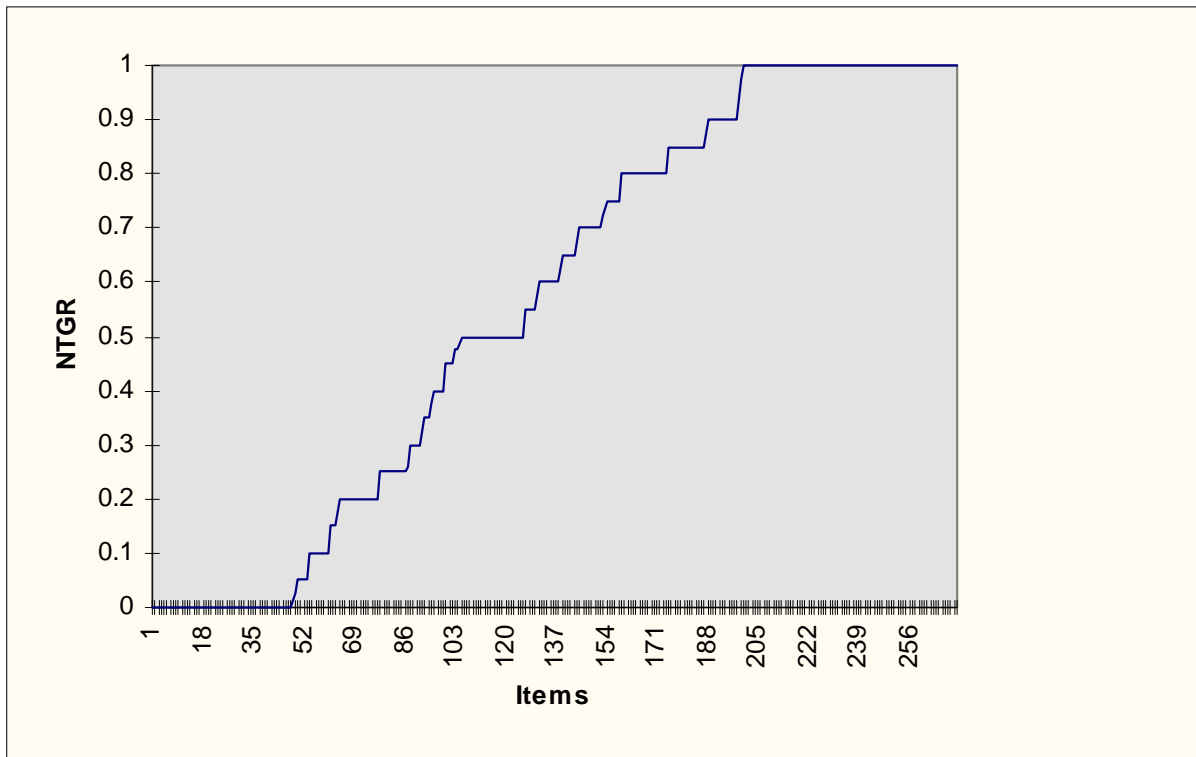
8. Results of Net Impact Analysis

In this section, the net impacts and NTGRs for kWh, kW, and therms will be presented at both the end use and program level for the custom project-specific, standard project-specific, and the verification groups. Both unweighted and marginal-cost-weighted NTGRs will be presented that incorporate the results of the custom analysis and spillover.

8.1 Verification NTGR Results

For the 273 verification items, the SR_NTGR or Self-Report NTGR was calculated. The SR_NTGR was based *only* on the responses to the decision-maker survey. The unweighted, overall SR_NTGR based on information for all 273 verification items is .56 with a standard deviation of .38. Figure 8-1 presents the distribution of the NTGRs.

Figure 8-1: Distribution of NTGRs for Verification Items

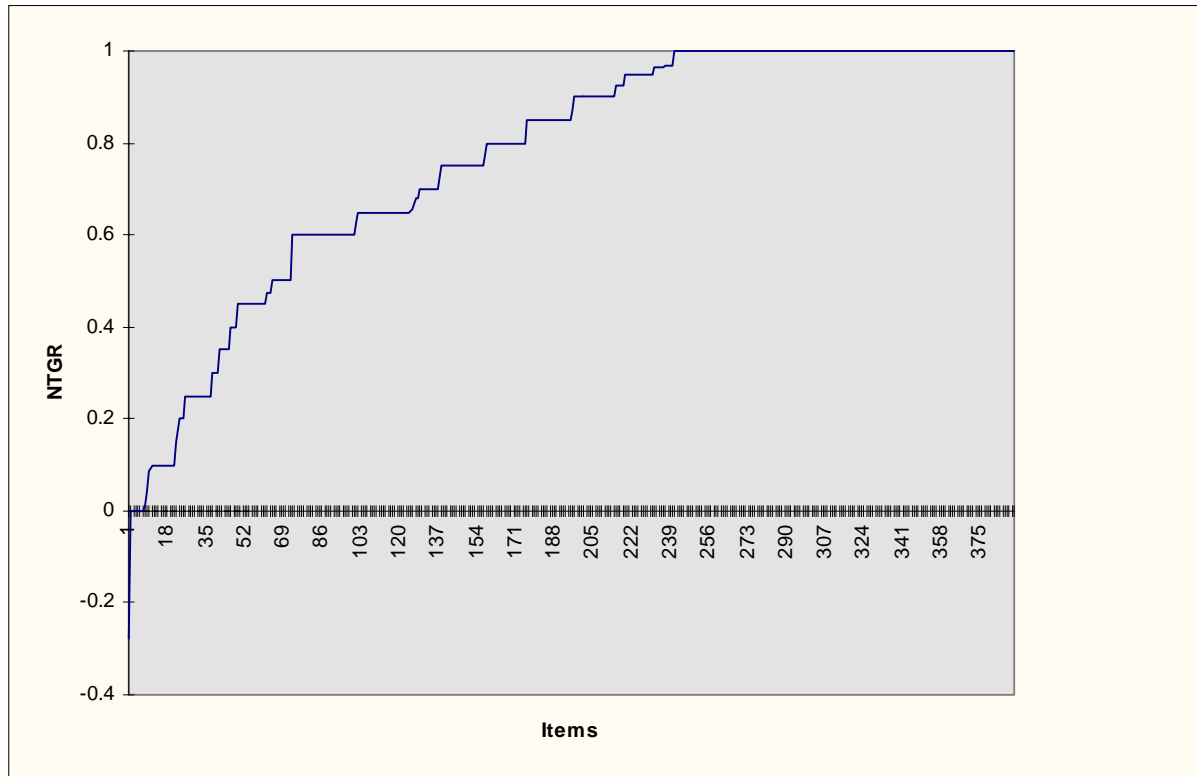


8.2 Standard Project-Specific NTGR Results

For all 390 project-specific items, the SR_NTGR was first calculated and then adjusted for partial free ridership to produce the ASR_NTGR or Standard NTGR. The ASR_NTGR was based on the responses to the decision-maker survey, plus information collected, when necessary, from vendors, and baseline information collected on site that was used to calculate the engineering ratio. The assessment of the appropriate baseline was carried out in order to take into account partial free-ridership (i.e., in the absence of the PG&E program, the customer would have installed equipment with a rated efficiency somewhere between the existing equipment and the as-built equipment). The unweighted, overall

Standard NTGR based on information for 390 items is .77 with a standard deviation of .28. Figure 8-2 presents the distribution of the NTGR for the 390 items¹³.

Figure 8-2: Distribution of NTGRs for Project-Specific Items



An important question is whether the adjustment for partial free-ridership was significant or not. For 32 of the 390 project-specific items, decision makers indicated that in the absence of the PG&E Program, it was more likely that they would have installed an alternative piece of equipment. However, for only 7 (1.7%) of these items at three sites was it possible to calculate the customer baseline and therefore the engineering ratio necessary to adjust for partial free-ridership. Recall that a large ratio means little adjustment and a small ratio means a large adjustment. These ratios ranged from .07 to .93, with 5 of the 7 greater than .65. For the two cases in which the adjustment was large, the gross savings were small. Thus, the adjustment for partial free-ridership was trivial.

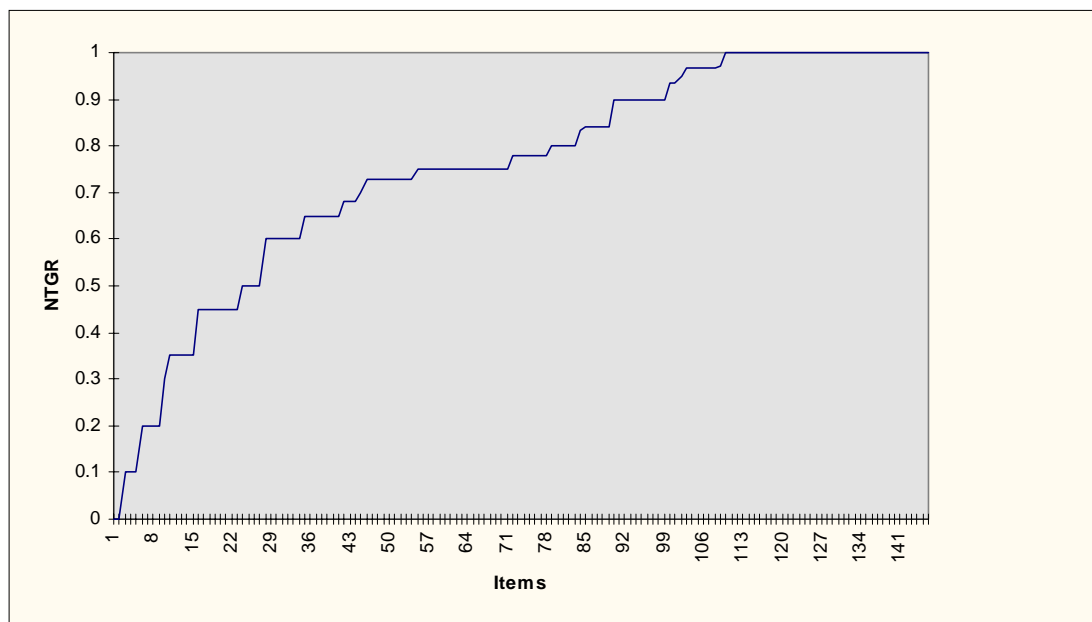
Note that it was not that respondents could not remember whether they considered alternatives; only 24 gave “don’t know” as their answer. The overwhelming majority, 80%, specifically stated they did not consider any alternatives. If these program participants are unique in this respect, then future studies may be able to measure more partial free-ridership. However, if they are not unique in this respect, then partial free-ridership may be a relatively minor issue.

¹³ For the 9 items at three sites, the Standard NTGR could not be calculated. These values were determined as a part of the custom analysis.

8.3 Custom NTGR Results

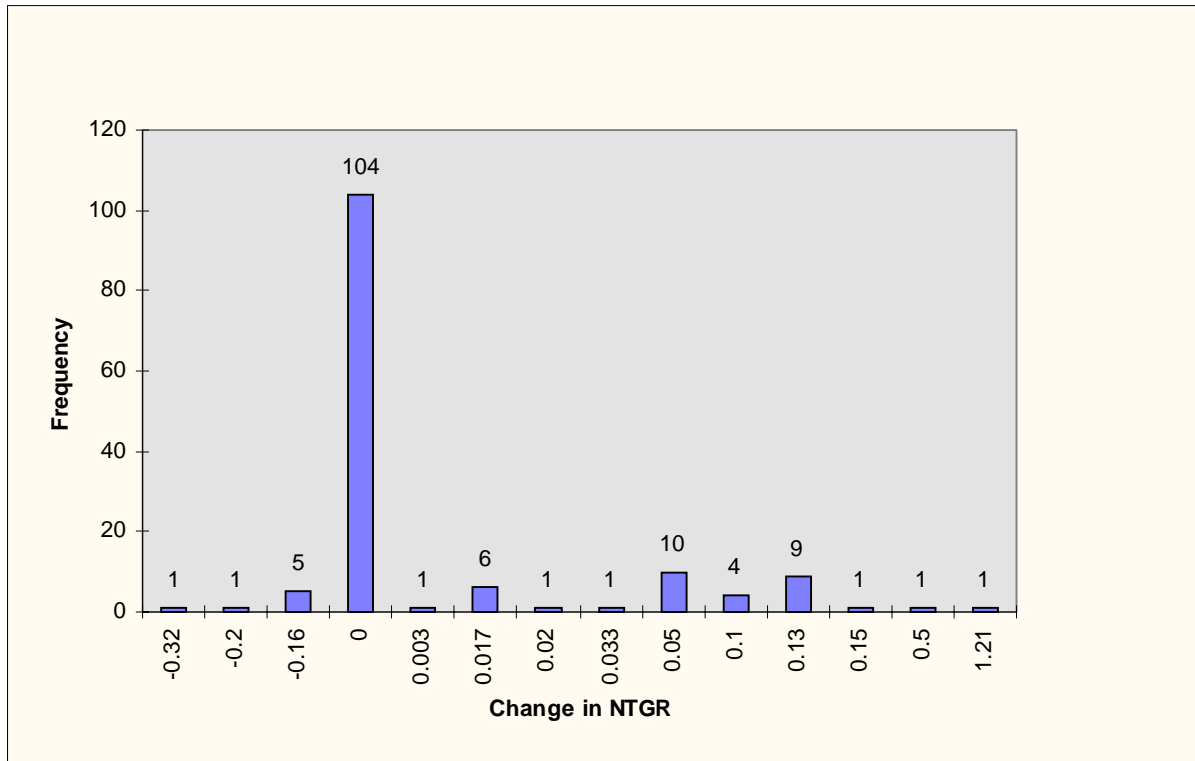
The primary purpose of the custom analysis was to seek additional information for the larger sites so that a more complete picture of the conditions surrounding the installation of the efficient equipment could be gained. This additional information could then be used to *modify* the Standard NTGR or *strengthen* the Standard NTGR. Figure 8-3 presents the distribution of the NTGRs for this group. For the 146 custo items for which data were available, the unweighted Standard NTGR was .735 with a standard deviation of .25. Figure 8-3 presents the distribution of the NTGRs.

Figure 8-3: Distribution of NTGRs for Custom Items



In the custom analysis of the 146 items examined, the Standard NTGR was modified for 42 items. Of these modifications, 35 were increases and 7 were decreases. Across all items, the changes produced a small *increase* of .019 in the overall, raw, unweighted Standard NTGR thus yielding a Custom NTGR of .754. Approximately half of this increase is due to one site, #402. At this site, the NTGR changed from -.26 to .95 (a change of 1.21) for reasons having to do more with the baseline than with our estimate of PG&E's influence. If one ignores this case, this increase of .019 is reduced to .009 producing a raw, unweighted NTGR of .744. For the remaining 104 items, the Standard NTGR did not change since any information identified provided insufficient grounds for *changing* the Standard NTGR or served only to *confirm* the Standard NTGR. Figure 8-4 presents the distribution of the changes resulting from the custom analysis for the 146 items.

Figure 8-4: Distribution of Changes in Standard NTGR Resulting from Custom Analysis



8.4 Early Replacement

All decision makers associated with the 672 items were asked a question concerning the timing of the installation. We were attempting to determine whether PG&E, in effect, caused the customer to accelerate the installation of the equipment. In cases where the installation was accelerated (early replacement) by at least one year, the NTGR was set to 1. Of the 672 items, 130 (19.3%) were early replacement.

8.5 Net Savings by End Use and Program

Table 8-1 presents the number of items, evaluated gross impacts, evaluated net impacts and the unweighted NTGR, including the custom analysis, broken down by the four end uses, HVAC, Lighting, Process, and Miscellaneous. As one can see, Lighting has the greatest absolute net connected load kW, average summer on-peak kW, and kWh impacts, while Miscellaneous has the smallest. On a net impact per-item basis, Process has the largest collected load kW, average summer on-peak kW, kWh, and their impacts while, in general, Lighting has the smallest. To assist in understanding the effects of net total and per-item impacts, Table 8-3 is presented. In this table, each end use is first ranked from 1 to 4 with respect to connected load kW, average summer on-peak kW, kWh, and therm impacts and then ranked again in per-item terms.

Another way of looking at these results is to view them by the REO, Retrofit Express, Customized, and Other Programs. Table 8-2 presents the number of items, evaluated gross impacts, evaluated net impacts and the NTGR (using the custom analysis, but not weighted by dollarized impacts) broken down by these

four programs. Clearly, the Customized Program achieved the greatest impacts both in absolute and per item terms with the Other Programs achieving the least. To assist in understanding the effects of net total and per-item impacts, Table 8-4 is presented. In this table, each program is first ranked from 1 to 4 with respect to connected load kW, average summer on-peak kW, kWh, and therm impacts and then ranked again in per-item terms. From this table one can see that overall both at the total net and per-item levels, the REO and Retrofit Express program have similar rankings.

Table 8-1: Net Impacts by End Use

	Connected Load kW	Avg. Summer Peak kW ¹	kWh	Therms
Total				
No. of items	1,668	1,668	1,668	1,668
Evaluated Gross Savings	19,811	12,708	95,168,014	15,601,245
Evaluated Net Savings (custom analysis NTGR)	12,972	8,440	62,301,342	10,004,799
Program Net-to-Gross Ratio	0.75	0.75	0.75	0.75
Unweighted NTGR (custom analysis)²	0.65	0.66	0.65	0.64
HVAC				
No. of items	225	225	225	225
Evaluated Gross Savings	4,411	1,687	17,292,602	537,989
Evaluated Net Savings (custom analysis NTGR)	2,768	1,132	11,336,138	250,686
Program Net-to-Gross Ratio	0.71	0.71	0.74	0.75
Unweighted NTGR (custom analysis)²	0.63	0.67	0.66	0.47
Lighting				
No. of items	1,010	1,010	1,010	1,010
Evaluated Gross Savings	5,152	4,646	30,146,866	-83,195
Evaluated Net Savings (custom analysis NTGR)	4,210	3,821	25,215,200	-70,124
Program Net-to-Gross Ratio	0.77	0.77	0.77	N/A
Unweighted NTGR (custom analysis)²	0.82	0.82	0.84	N/A
Miscellaneous				
No. of items	337	337	337	337
Evaluated Gross Savings	3,378	2,151	12,303,606	419,983
Evaluated Net Savings (custom analysis NTGR)	2,070	1,318	7,549,418	257,324
Program Net-to-Gross Ratio	0.75	0.75	0.75	0.75
Unweighted NTGR (custom analysis)²	0.61	0.61	0.61	0.61
Process				
No. of items	96	96	96	96
Evaluated Gross Savings	6,870	4,225	35,424,940	14,726,469
Evaluated Net Savings (custom analysis NTGR)	3,925	2,169	18,200,586	9,566,912
Program Net-to-Gross Ratio	0.75	0.75	0.75	0.75
Unweighted NTGR (custom analysis)²	0.57	0.51	0.51	0.65

¹ Defined as the average hourly kW savings during the summer on-peak costing period (May 1 - October 31, weekdays from 12 P.M. to 6 P.M.)

² This NTGR is based on (1) raw net savings before weighting by marginal costs, and (2) item-level NTGRs from the custom free-ridership analysis.

Table 8-2: Net Savings by Program

	Connected Load kW	Avg. Summer Peak kW ¹	kWh	Therms
Total				
No. of items	1,668	1,668	1,668	1,668
Evaluated Gross Savings	19,811	12,708	95,168,014	15,601,245
Evaluated Net Savings (custom analysis NTGR)	12,972	8,440	62,301,342	10,004,799
Program Net-to-Gross Ratio	0.75	0.75	0.75	0.75
Unweighted NTGR (custom analysis)²	0.65	0.66	0.65	0.64
REO				
No. of items	6	6	6	6
Evaluated Gross Savings	124	59	191,473	0
Evaluated Net Savings (custom analysis NTGR)	71	34	113,831	0
Program Net-to-Gross Ratio	0.70	0.70	0.71	0.00
Unweighted NTGR (custom analysis)²	0.57	0.58	0.59	N/A
Retrofit Express				
No. of items	1,484	1,484	1,484	1,484
Evaluated Gross Savings	5,461	4,314	27,913,937	-77,514
Evaluated Net Savings (custom analysis NTGR)	4,043	3,300	21,335,113	-65,540
Program Net-to-Gross Ratio	0.75	0.75	0.76	0.79
Unweighted NTGR (custom analysis)²	0.74	0.77	0.76	0.85
Customized				
No. of items	148	148	148	148
Evaluated Gross Savings	14,143	8,260	66,834,073	15,678,759
Evaluated Net Savings (custom analysis NTGR)	8,792	5,046	40,669,416	10,070,339
Program Net-to-Gross Ratio	0.75	0.75	0.75	0.75
Unweighted NTGR (custom analysis)²	0.62	0.61	0.61	0.64
Other Programs				
No. of items	30	30	30	30
Evaluated Gross Savings	83	75	199,879	28,651
Evaluated Net Savings (custom analysis NTGR)	66	60	160,041	22,941
Program Net-to-Gross Ratio	0.68	0.68	0.71	N/A
Unweighted NTGR (custom analysis)²	0.80	0.80	0.80	0.80

¹ Defined as the average hourly kW savings during the summer on-peak costing period (May 1 - October 31, weekdays from 12 P.M. to 6 P.M.)

² This NTGR is based on (1) raw net savings before weighting by marginal costs, and (2) item-level NTGRs from the custom free-ridership analysis.

Table 8-3: End-Use Rankings by Total Net and Per-Item Impact

End Use	Max kW	Avg kW	kWh	Therms
HVAC				
Total	3	3	3	2
Per-Item	2	2	2	2
Lighting				
Total	1	1	1	4
Per-Item	4	4	3	4
Miscellaneous				
Total	4	4	4	3
Per-Item	3	3	4	3
Process				
Total	2	2	2	1
Per-Item	1	1	1	1

Table 8-4: Program Rankings by Total Net and Per-Item Impact

Program	Max kW	Avg kW	kWh	Therms
REO				
Total	3	4	4	3
Per-Item	2	2	2	3
Retrofit Express				
Total	2	2	2	4
Per-Item	3	3	3	4
Customized				
Total	1	1	1	1
Per-Item	1	1	1	1
Other Programs				
Total	4	3	3	2
Per-Item	4	4	4	2

8.6 Net Impacts by Costing Period

Net program-level kWh and kW impacts were also calculated by costing period. Table 8-5 presents the net kWh impacts by costing period, and Table 8-6 presents the net kW impacts by costing period. With respect to therm impacts, it has been assumed that the therm load is flat, making any allocations to costing periods unnecessary. The annual kWh fractions and maximum kW fractions shown on these tables correspond to those for the gross savings costing period breakdown shown in Tables 7-9 and 7-10.

Table 8-5: Net kWh Impacts by Costing Period

End Use	Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
Fraction of annual hours in costing per.	0.09	0.09	0.32	0.18	0.32
Total					
Annual kWh fraction	0.11	0.12	0.30	0.20	0.26
H-Factor	0.11	0.12	0.30	0.20	0.26
kWh	6,818,802	7,690,242	18,451,753	13,044,982	16,295,563
HVA					
Annual kWh fraction	0.08	0.11	0.34	0.17	0.30
H-Factor	0.08	0.11	0.34	0.17	0.30
kWh	880,819	1,303,400	3,892,257	1,898,899	3,360,763
Lighting					
Annual kWh fraction	0.14	0.14	0.25	0.24	0.24
H-Factor	0.14	0.14	0.25	0.24	0.24
kWh	3,433,206	3,425,103	6,248,931	6,148,593	5,959,367
Miscellaneous					
Annual kWh fraction	0.11	0.12	0.30	0.20	0.26
H-Factor	0.11	0.12	0.30	0.20	0.26
kWh	800,091	917,402	2,287,096	1,547,291	1,997,538
Process					
Annual kWh fraction	0.09	0.11	0.33	0.19	0.27
H-Factor	0.09	0.11	0.33	0.19	0.27
kWh	1,704,686	2,044,337	6,023,469	3,450,199	4,977,895

Table 8-6: Net kW Impacts by Costing Period¹⁴

End Use	Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
Total					
Max. kW fraction	0.83	0.82	0.73	0.80	0.69
H-Factor	1.00	1.00	0.89	0.97	0.83
kW	7,061	6,987	6,079	6,842	5,776
HVA					
Max. kW fraction	0.51	0.62	0.66	0.57	0.62
H-Factor	1.00	1.21	1.30	1.11	1.22
kW	578	701	751	642	706
Lighting					
Max. kW fraction	0.94	0.88	0.67	0.90	0.66
H-Factor	1.00	0.94	0.71	0.96	0.71
kW	3,584	3,373	2,556	3,455	2,529
Miscellaneous					
Max. kW fraction	0.81	0.81	0.74	0.79	0.69
H-Factor	1.00	1.00	0.91	0.97	0.85
kW	1,067	1,072	971	1,035	912
Process					
Max. kW fraction	0.84	0.85	0.83	0.79	0.75
H-Factor	1.00	1.00	0.98	0.93	0.89
kW	1,832	1,840	1,802	1,711	1,629

8.7 Spillover Impacts

As part of the custom analysis, surveys were conducted at 130 sites with the aim of identifying installations of efficient equipment installed outside the program but to some extent induced by the program. This is referred to as spillover. Table 8-7 presents the spillover installations by end use. In all, only 14 spillover items at 11 sites were identified which accounted for about 2.2 million kWh. There is estimated to be a reduction of 266 kW based on average summer on-peak kW assumptions and a reduction of 310 kW based on connected load kW. There was no therm spillover identified. These impacts were later taken into account in determining the final program-level net savings and NTGR.

¹⁴ The net kW impact for each costing period equals the average summer on-peak kW net savings multiplied by the ratio of maximum kW savings during the costing period to the connected load kW savings.

Table 8-7: Spillover Impacts by End Use

End Use	No. of items	Connected Load kW	Avg. Summer Peak kW	kWh	Therms
Total	14	310	266	2,181,631	0
HVAC	1	225	210	1,742,219	0
Lighting	12	82	54	411,003	0
Process	1	3	3	28,409	0

8.8 Program-Level Net Impacts

Table 8-8 presents the results of weighting the net kWh and kW impacts by the marginal energy and capacity costs (by costing period). Therm impacts were weighted by the marginal cost for natural gas for each of two seasons. This was done so that all impacts could be translated into a common metric, dollars. Once translated, a single NTGR that represents the overall NTGR could be calculated. The table also presents the dollarized impacts by end use for kWh and therms as well as the dollarized impacts for kW under two different assumptions. The impacts for the maximum kW are, of course, larger. The final overall NTGR is calculated using the kWh, the average summer on-peak kW demand, and therm impacts.

The Custom NTGR and the Standard NTGR are provided, with the latter being a combination of the Self Report NTGR based on verification items and Standard NTGR based on project-specific items (both standard and custom). The rightmost column presents the program and end use total net dollarized impacts as a percent of the gross dollarized impacts. These can be viewed as NTGRs. Also, in this column, the additional percentage increase in the NTGR due to spillover is presented.

Table 8-9 presents the NTGR for the overall program and for each of the four end uses. Including those items for which a custom analysis was conducted raises the NTGR from .650 to .655, one half of a percentage point. Including spillover raises the NTGR further to .668, for an overall increase of 1.03%. As was mentioned earlier, of the 146 custom items, changes were made in Standard NTGR for 42 (30%) of the items. Even though 35 of these modifications were increases and 7 were decreases, the NTGR increased only 2 percentage points. Excluding one influential positive case, reduces the change to approximately one percentage point. As was explained in Section 6.3.1, no item NTGRs were calculated for miscellaneous items, so we applied average end-use NTGRs for all other evaluated items to them.

It is somewhat surprising that the custom analyses seem to have had little effect in modifying the Standard NTGR. This is primarily due to the fact that the additional information (e.g., customer motives and the extent of PG&E's influence) that was anticipated to be present in the PG&E program files was for the most part absent. In addition, very few interviews were conducted with the operations staff (because the operations staff was often the same person as the decision-maker) and little information was available from the open-ended questions on the decision-maker interviews. In Section 9, recommendations are made regarding how to increase both the quantity and quality of information available for the custom analysis.

In Table 8-9, confidence intervals are presented for both the 90% and 95% levels. Since the adjustment for spillover involved simply adding end-use and program-level net spillover impacts to direct end-use and program-level impacts, the original variation of the item-specific NTGRs, was unaffected. Thus, the confidence intervals for the Custom Item NTGR and the Custom & Spillover NTGR are identical. Also, note that a confidence interval could not be calculated for the Miscellaneous end use since the items in this end-use category were not evaluated. Instead, the average NTGR for all items observed for the sampled project-specific and verification projects was used.

As one can see, Lighting experienced the largest NTGRs, followed by HVAC, Miscellaneous, and Process. Note that, overall, the NTGR increased as a result of both custom analysis and incorporation of spillover. However, the HVAC NTGR actually decreased as a result of the custom analysis, but increased beyond the standard NTGR as a result of spillover. Lighting increased as a result of both the custom analysis and spillover. Finally, the Process NTGR increased as a result of the custom analysis but no spillover was identified.

Table 8-8: Program-Level Net Dollarized Impacts by End Use

End Use	Connected Load kW \$	Avg. Summer Peak kW \$	kWh \$	Therm \$	Total \$ (w/avg. kW \$)	Percent of Gross \$
Total						
Gross impacts	1,460,232	1,113,010	4,366,341	2,367,895	7,847,245	--
Net impacts (Standard NTGR)	951,760	745,689	2,835,488	1,520,603	5,101,780	65.0
Net impacts (Custom NTGR)	962,776	757,038	2,867,863	1,518,488	5,143,389	65.5
Spillover impacts	22,719	20,658	81,188	0	101,847	1.3
Overall Custom NTGR	0.659	0.680	0.657	0.641	0.655	--
Overall NTGR with spillover	0.675	0.699	0.675	0.641	0.668	--
HVAC						
Gross impacts	208,848	107,950	774,253	81,654	963,857	--
Net impacts (Standard NTGR)	142,034	81,646	523,136	38,107	642,889	66.7
Net impacts (Custom NTGR)	138,061	78,884	508,983	38,048	625,915	64.9
Spillover impacts	17,383	16,216	63,070	0	79,285	8.2
Overall Custom NTGR	0.661	0.731	0.657	0.466	0.649	--
Overall NTGR with spillover	0.744	0.881	0.739	0.466	0.732	--
Lighting						
Gross impacts	472,278	435,704	1,421,162	-12,627	1,844,239	--
Net impacts (Standard NTGR)	382,430	353,626	1,164,235	-10,579	1,507,283	81.7
Net impacts (Custom NTGR)	389,288	360,128	1,185,864	-10,643	1,535,349	83.3
Spillover impacts	5,061	4,167	17,086	0	21,252	1.2
Overall Custom NTGR	0.824	0.827	0.834	0.843	0.833	--
Overall NTGR with spillover	0.835	0.836	0.846	0.843	0.844	--
Miscellaneous						
Gross impacts	286,621	182,495	564,580	63,743	810,819	--
Net impacts (Standard NTGR)	175,177	111,545	345,437	38,952	495,934	61.2
Net impacts (Custom NTGR)	175,648	111,847	346,423	39,056	497,325	61.3
Spillover impacts	0	0	0	0	0	0.0
Overall Custom NTGR	0.613	0.613	0.614	0.613	0.613	--
Overall NTGR with spillover	0.613	0.613	0.614	0.613	0.613	--
Process						
Gross impacts	492,485	386,860	1,606,346	2,235,125	4,228,330	--
Net impacts (Standard NTGR)	252,120	198,871	802,680	1,454,123	2,455,674	58.1
Net impacts (Custom NTGR)	259,778	206,179	826,593	1,452,028	2,484,800	58.8
Spillover impacts	276	276	1,032	0	1,309	0.03
Overall Custom NTGR	0.527	0.533	0.515	0.650	0.588	--
Overall NTGR with spillover	0.528	0.534	0.515	0.650	0.588	--

Table 8-9: NTGR: Overall and by End Use

	Overall	HVAC	Lighting	Miscellaneous	Process
w/Standard Item NTGR	0.650	0.667	0.817	0.612	0.581
w/Custom Item NTGR	0.655	0.649	0.833	0.613	0.588
90% Confidence Interval	+/- .012	+/- .019	+/- .011	N/A	+/- .040
95% Confidence Interval	+/- .014	+/- .022	+/- .014	N/A	+/- .047
w/Custom NTGR & Spillover	0.668	0.732	0.844	0.613	0.588
90% Confidence Interval	+/- .012	+/- .019	+/- .011	N/A	+/- .040
95% Confidence Interval	+/- .014	+/- .022	+/- .014	N/A	+/- .047

9. Recommendations for Future Programs

This final section provides recommendations for designing future PG&E retrofit programs. The recommendations in this section are organized under two categories. The first group deals with a number of technical implementation issues, that if adopted, would improve the PG&E's ability to accurately estimate savings. The second group of recommendations suggests ways to improve future program evaluations. These recommendations would either reduce the cost of future evaluations, improve the accuracy of evaluation savings estimates, or aid in compliance with the M&E Protocols.

9.1 Technical Implementation Issues

Operating Hour Estimates: create a table for the Retrofit Express Program listing typical equivalent full load hour (EFLH) values for a variety of typical lighting scenarios in industrial situations (such as round the-clock operation, normal office hours, and occupancy-sensor-controlled, for example). Improved EFLH estimates would provide more accurate savings estimates than the current blanket assumption of 4,000 annual hours, particularly for the commercial portions of industrial facilities.

HID Fixtures Replacing Fluorescents: screen out cases where a customer is replacing fluorescent fixtures with HID fixtures. In nearly all cases where program participants made this change, we found negative savings.

HID Fixture Baseline: revise the baseline assumptions for HID fixture measures. The current baseline assumption of mercury vapor lamps and fixtures overestimates actual savings for the vast majority of cases.

kW Savings Calculation: establish a consistent basis for calculating electric demand (kW) savings, particularly for Custom program measures.

9.2 Program Evaluation Improvements

Data Entry Errors: set up stricter quality control to eliminate data entry errors when transferring program savings estimates from applications to the MDSS data base.

Measure-Affected Areas: record the affected floor area for each measure, as well as the measure location for Retrofit Express program measures.

Spillover and Free-Ridership: document spillover and free-ridership considerations in the program application. Record customer intentions as soon as possible after the initial contact with the PG&E program representative.

Standardized Cover Sheet: create a standardized cover sheet for Customized program measures to document key information, such as savings estimates for each measure, assumptions about baseline and efficient conditions used to estimate savings, and clear descriptions of the as-built conditions.

Decision-Maker Contact: record the name of the decision-maker if it is different from the site contact.

Payback Estimates: include any information about payback calculations for the measures in the file. In some cases, the customer calculated a payback in a different manner than the PG&E representative. In such cases, the customer included other information in the calculation such as increased operating maintenance or increased productivity associated with the new efficient equipment. Including such

information in the application file would provide a much better picture of the economics affecting the customer's decision and better insights into the effect of the PG&E program , both of which improve the quality of the custom analyses.

Program Files: When the program participant is willing to provide information about the reason for installing the measure, the criteria involved in the decision, other people at the site involved in the decision, and alternative equipment considered, such information should be included in the application file. Such information would allow evaluators to better estimate net-to-gross ratios.

Appendix A

Alphabetical Listing of Key Terms

Following is an alphabetical listing of key terms which are used throughout the evaluation report.

- **Application and APPLICATION NUMBER.** PG&E's programs provide incentives, after approval, for efficiency improvements described in applications submitted by a customer. One or more applications may be processed for the same customer at a single location. Some applications cover measures installed at more than one location controlled by the same customer. Each application is assigned an application number.
- **Application File.** For each paid application, PG&E's programs maintain a file containing all relevant documentation. This always includes the completed application showing the amount of the rebate paid for each item. The files can also contain invoices and documentation describing the estimation of savings, correspondence and other notes.
- **As-Built Consumption .** An estimate of consumption for the affected system as observed during the on-site survey.
- **Assigned Corporation.** One of the corporations that operates a sampled site, which has been assigned to a lead engineer. The same lead engineer was responsible for all of the sites associated with an assigned corporation.
- **Control Number.** When electrical service is established at a new location, a meter base is installed. PG&E assigns a permanent control number to this meter base. Each control number is associated with a service address.
- **Corporation and CORPORATE ID .** The name of the PG&E customer which appears on the first page of an application file, which is usually the name of the company which received the rebate. These names were matched to identify each unique corporation involved in the 1995 program, and each corporation was assigned a unique identification number (CORPORATE ID).
- **Costing Period Savings.** PG&E divides the year into five periods (Summer Peak, Summer Partial-Peak, Summer Off-Peak, Winter Partial-Peak and Winter Off-Peak), called costing periods. Costing period savings are the portions of the annual electrical savings which occur in each of these periods. These savings were computed for all project-specific evaluations.
- **Custom Free-Ridership Analysis.** This is an analysis of free-ridership which was conducted by the Net Impact Experts after data are available from the Spillover, Vendor, Operations Staff and Decision-Maker surveys, along with data from the program files, on-site survey and the engineering analysis of gross and net savings.

- **Custom Project-Specific (CPS) Evaluations.** A project-specific evaluation which uses a customized data collection and analysis procedure for evaluating NTGR.
- **Custom Project-Specific (CPS) Site.** A site where at least one custom project specific evaluation project was installed.
- **Customer Baseline Consumption .** An estimate of annual baseline consumption assuming the equipment which would have been installed by the customer if PG&E's program did not exist. This concept only applies to normal replacement and new equipment projects. The description of the customer baseline comes from the Standard Decision-Maker Survey.
- **Data Processing Sta .** Members of our team who were responsible for entry of data into the project database and for processing data received from time-of-use logger and C-180 installations.
- **Decision-Analysis Based Net-to-Gross Ratio (NTGR).** Ratio of decision-analysis net savings to gross savings. The data needed to compute the decision-analysis NTGR comes from the Standard Decision-Maker Survey.
- **Decision-Analysis Net Savings.** An estimate of net savings which is based on an assessment of the probability that the customer would have installed, without the rebate, exactly the same equipment which was installed with the rebate.
- **Decision-Maker.** A member of the customer's staff who is familiar with the process by which the customer decided to install the items (for which rebates were paid) at a sampled site.
- **Decision-Maker Survey (Standard and Custom).** The standard version of this survey can be found in Appendix K. It is administered by the Lead Engineer to the Decision-Maker, and provides information relevant to both the decision-analysis and engineering-analysis of net savings. A custom version of this survey was developed by the Net Impact Experts for each CPS site.
- **Early Replacement.** When the program causes a customer to replace a piece of equipment prior to the end of its useful life, this is called early replacement. There cannot be any free-ridership for items which are early replacements, because the customer did not have any plans for replacing the equipment.
- **End Use.** Each item is assigned a measure code by PG&E. For the purpose of its earnings claim, PG&E groups measure codes by end use: LIGHT, PROCESS and OTHER. For this evaluation, OTHER is further divided into HVAC and Miscellaneous (MISC). Exterior lighting items are classified as MISC and are not part of the LIGHT end use.

- **Engineering-Analysis Net Savings** . Difference between customer baseline consumption and as-built consumption. The description of the customer baseline comes from the Standard Decision-Maker Survey.
- **Engineering-Based Net-to-Gross Ratio (NTGR)**. Ratio of engineering-analysis net savings to gross savings.
- **Evaluation Algorithm**. The calculation procedure used by this study to estimate gross savings. It may or may not be the same as the PG&E Algorithm.
- **Free-ridership**. Free-ridership occurs when customers receive rebates even though they would have implemented an efficiency improvement without the rebate; hence, they are getting a “free ride” on the incentive program. The effect of free-ridership was estimated in the net savings analysis, which was performed on all projects in the HVAC, LIGHT and PROCESS end uses.
- **Free-Rider Type**. A classification which appears on the project recruitment form. Three types may appear: Custom, Standard, or None.
- **Gross Savings**. Difference between the gross savings baseline consumption and the as-built consumption for each item.
- **Gross Savings Baseline Consumption** . For early replacement the gross savings baseline is an estimate of the 1995 energy consumption for the customer system affected by an item assuming that the item had not been implemented. The definition for normal replacement is the same unless the equipment is subject to Title 24/20 standards, in which case the energy consumption estimate assumes that the standards are met by the affected equipment. For new equipment which increases capacity, Title 24/20 standards are imposed as appropriate and consumption is estimated based on the performance of similar equipment found at the same site. If the new equipment adds controls to existing equipment, the energy consumption estimate is based on the performance of the system prior to the installation of controls and Title 24/20 does not apply.
- **Gross Savings from Spillover** . The difference between customer energy consumption with and without the installation of spillover measures.
- **Instrumentation Specialist** . A technician who was responsible for the specification, installation and removal of multi-channel data recorders at selected sites. Also responsible for data acquisition and modification to the installation to correct any problems found in the data collected.
- **Item and ITEM NUMBER**. Each application describes energy efficiency measures for which rebates were paid by the program. Each type of equipment, e.g., energy management system or cooling tower, installed at a specific customer location, is referred to as an "item". Each item is assigned a standardized label by PG&E which indicates the type of equipment involved. Each item is assigned to a control number,

indicating the PG&E meter that was affected by the equipment's installation. More than one item may be assigned to the same control number. It is also possible that an item affects more than one control number, although the applications allow for only one to be assigned to each item. A unique ITEM NUMBER has been assigned to each item for every application included in this study. The combination of APPLICATION NUMBER, PROGRAM YEAR and ITEM NUMBER can be used to locate every item for which a rebate was paid in 1995.

- **Lead Engineer.** An engineer who was responsible for evaluation plans, data collection, analysis and reporting for all projects located at all sampled sites associated with an assigned corporation.
- **Measure.** Equipment installed in a customer's facilities for the purpose of reducing energy consumption or demand. Each item for which a rebate was paid by the program is a measure. However, a measure can also be installed by the customer without a rebate (these were identified through the Spillover Survey).
- **Measure Description.** A phrase which describes the equipment that comprises the measure. Standardized descriptions are provided by PG&E for each type of item included in the industrial efficiency programs.
- **Net Impact Experts.** Two staff from Ridge & Associates (Rick Ridge and Katherine Randazzo), were responsible for supporting the Lead Engineers in conducting the evaluation of free-ridership and spillover. They had the most extensive involvement with the evaluation of custom project-specific evaluations.
- **New Equipment.** The program may also motivate the customer to use more efficient new equipment when production capacity is increased or the addition of new controls, e.g., EMCS, for existing equipment. Like normal replacement, free ridership is possible, because PG&E's program did not cause the customer to install new equipment, it just affected the customer's selection of efficiency features.
- **Non-Energy Benefits.** Benefits other than reduced energy consumption and cost which are caused by the installation of an item. These might include benefits such as reduced maintenance costs, improved performance of the affected system, greater reliability, and improved safety.
- **Normal Replacement.** In some cases, the program motivates customers to select more efficient equipment when replacing equipment that has reached the end of its useful life (from the customer's perspective), this is called normal replacement. There can be free-ridership because the customer might choose to install equipment with higher efficiency even if the PG&E program did not exist.
- **On-Site Survey.** An inspection and measurement of systems affected by items installed at a sampled site.
- **Operations Staff Contact.** A member of the customer's staff who was familiar with the operation of the items (for which rebates were paid) installed at a sample site and

the operation of the systems that those items affect. This was the person who is identified as the Measure Information Contact on the Recruitment Form (See Appendix B).

- **Operations Staff Survey.** This survey can be found in Appendix J. This survey is administered to the Operations Staff Contact to obtain information relevant to the analysis of free-ridership at CPS sites.
- **Persistence.** The degree to which the energy savings initially achieved by the installation of an item last over time.
- **PG&E Algorithm.** The calculation procedure used by PG&E to estimate gross savings for each item.
- **PG&E Customer Representative.** A member of PG&E's division or corporate staff who services one of the customers who received rebates from the 1995 industrial program. In some cases this will be the person who assisted the customer in applying to the program in 1995 or a previous year. The name and telephone number for this person appeared on the Recruitment Form (Appendix B) when it was assigned to a Lead Engineer.
- **PG&E Project Manager.** Lisa Reid (415) 973-4747.
- **Process Technology Experts.** A group of experts who were available to the lead engineer to assist in the preparation of evaluation plans for project-specific evaluations in the PROCESS end use. Collectively, these experts cover a broad range of efficiency equipment and its applications to a variety of different types of industries.
- **Program Year.** Each application was assigned a program year. Program year refers to the year of the program's operation under which the application was received, not the year that the rebate was paid. Thus, the paid applications which were the subject of this evaluation include applications received during 1992, 1993, 1994 and 1995.
- **Project Tracking Supervisor.** Manager responsible for tracking percent-spent and percent-complete versus the budget and schedule assigned in the evaluation plan for each project-specific site evaluation.
- **Project and PROJECT ID.** A project is the set of items, listed on a single paid application which are assigned to the same end-use and control number. A unique identification number was assigned to each project (PROJECT ID).
- **Project Type.** A classification which appears on the project recruitment form. Two types may appear: Project-Specific and Verify.

- **Project-Specific Evaluation.** An evaluation which involves the estimation of gross and net savings for items which received rebates in 1995 and gross savings estimates for spillover measures. There are two sub-categories of these evaluations, which are distinguished by the type of free-ridership analysis: (a) custom and (b) standard.
- **Quality Control (QC) Engineer.** QC engineers were responsible for reviewing and approving draft and final site evaluation plans and reports. There were four QC engineers; one each for HVAC, LIGHT and PROCESS project-specific evaluations and one for verification evaluations.
- **Retention Study.** A study which will be performed in a future year to determine whether the installed items are still present and in use.
- **Sampled Project and Replacement Project.** A group of projects were selected to satisfy the objectives of this study, i.e., 70% of the HVAC, LIGHT and PROCESS savings and 150 projects for each of the four end uses. These are the sampled projects. Other sites were also selected which to be used as replacements if a customer refused to participate in the study or was eliminated due to other reasons (See the Recruitment Form in Appendix B).
- **Sampled Site.** A site where a sampled project was completed.
- **Site and SITE ID.** A site is defined as one or more contiguous structures which are operated by the same corporation within a ZIP code area. Sites have been identified by comparing the name of the organization paid the rebate and the service address associated with the control number found in the application file. Multiple projects may be associated with the same site and multiple sites may be associated with the same corporation. Each site was assigned a unique identification number (SITE ID).
- **Site Evaluation Plan Workbook.** An Excel workbook which contains portions of the project database and other sheets which were needed to prepare a Site Evaluation Plan.
- **Site Evaluation Report Workbook.** An Excel workbook which contains portions of the project database and other sheets which were needed to prepare a Site Evaluation Report.
- **Site Type.** A classification which appears on the project recruitment form. Three types appeared: CPS (Custom Project Specific), SPS (Standard Project Specific), or VO (Verify Only).
- **Spillover.** Spillover occurs when a customer installs efficiency improvements without receiving a rebate, but is influenced to take this action by any of PG&E's efficiency programs (rebate or informational). Spillover can be direct or indirect. An example of direct spillover is the customer installing efficient equipment after first learning about that equipment from a PG&E customer representative. An example of indirect spillover would be a vendor recommending a piece of equipment

promoted by PG&E's programs, because the program has caused the vendor to only stock that type of equipment. In the case of indirect spillover the customer may be completely unaware of the program's influence on the choice of equipment.

- **Spillover Contact** . A member of the customer's staff who was familiar with spillover measures installed in 1995. This might have been the same as the person most familiar with the items (for which rebates were paid) installed at a site, but could have been a different person.
- **Spillover Measure**. An energy efficiency improvement, installed during 1995 as a result of spillover, which would have qualified for a rebate under the 1995 Industrial Retrofit Programs. The improvement must have exceeded applicable Title 24/20 requirements.
- **Spillover Survey** . This survey can be found in Appendix D. This survey was administered to the Spillover Contact to identify any spillover measures.
- **Standard Project-Specific (SPS) Evaluations**. A project-specific evaluation which used a standardized data collection and analysis procedure for evaluating NTGR.
- **Standard Project-Specific (SPS) Site**. A site where at least one standard project specific evaluation project was installed but no CPS evaluations project were installed.
- **Vendor**. A distributor, installer or designer who assists the customer in selecting specific efficiency equipment.
- **Vendor Survey**. This survey can be found in Appendix D. It can be used as a follow-up to either a Spillover Survey or a Decision-Maker Survey. It determines whether PG&E's programs were influenced by the recommendations which the vendor made to the customer concerning the selection of efficiency equipment.
- **Verification Evaluations** . A project evaluation which involved verifying the number, type and operational status of the items for which rebates were paid in 1995. If the project was in the HVAC, LIGHT or PROCESS end uses, the evaluation also involved a standardized evaluation of NTGR.
- **Verification Only (VO) Site**. A site where only verification evaluation projects were installed.

Appendix B

Recruitment Survey and Form

Objective:

The primary objective of the recruitment effort is to obtain authorization from the customer for their participation in the evaluation. A secondary objective is to acquire additional names and telephone numbers that may be required for customer contact purposes during the course of the evaluation. It is important that the needed information be obtained while minimizing our contact with the customers.

There are two main types of evaluations to be conducted: project-specific and verification. The recruitment procedures are somewhat different for the two types of evaluations. Differences in the recruitment procedures are discussed below. This section of the appendix contains directions for completing the Recruitment Form and for conducting the Recruitment Survey for both project-specific and verification types of projects. A typical Recruitment Form and a copy of the Recruitment Survey are also included.

Recruitment Forms:

For each project to be evaluated, whether project-specific or verify, a Recruitment Form has been printed which contains specific customer information and project measure information. The second page of the form includes historical measure data which can be used to minimize any potential confusion over which measures are to be evaluated in this project.

Recruitment

To avoid multiple calls to the same customer contact person, the corporate ID will be the basis for making project assignments to each lead engineer (i.e. all projects with the same corporate ID will be assigned to one lead engineer). Many corporate IDs will have multiple projects and may have multiple sites with multiple projects. When a corporate ID has multiple projects, be sure to identify the primary measure at each site that must be evaluated when discussing the scope of the evaluation with the customer contact. If a customer contact authorizes participation in multiple projects, be sure to complete each of the appropriate Recruitment Forms.

Recruiters should make a reasonable effort to locate a customer contact that has the authority to authorize the company's participation in the evaluation. This effort may include multiple calls to reach the contact, calls to directory assistance for an alternative telephone number, and/or requesting to talk to a higher level manager, if the original contact person is no longer with the company and the replacement person is not familiar with the project. Also, you may call the PG&E customer representative to seek assistance in identifying and contacting the customer contact. Recruiters should spend approximately 20 minutes attempting to recruit each project before giving up, i.e. seeking a replacement project.

Although the contact person you speak with regarding recruitment may be the person to interview for spillover and/or free-ridership issues, those questions can not be asked as part of the recruitment call because the recruiter is not knowledgeable enough about the project. Those interviews will be conducted later.

Recruitment Survey:

A recruitment survey has been carefully prepared. Each recruiter should follow this script carefully and thoroughly complete the Recruitment Form.

Summary of Key Considerations During Recruitment

For all recruited projects, the on-site visit should be conducted within the next 6 weeks, unless requested otherwise by the customer. Make appropriate entries to the Contact Log to describe your communication with the customer (or PG&E rep).

Project Specific

- If no Decision Maker is available reject that project.

Verify Only

- No spillover (Measure) contact person is needed.
- If no Decision Maker is available reject that project, EXCEPT for projects which have “Miscellaneous” End Use. No Decision Maker is needed for those cases.
- If a project is recruited, attempt to schedule the on-site visit during that same telephone call if the authorizing person is also the contact for the on-site visit. Section 6.4 of the handbook provides information regarding Scheduling procedures. Appendix E contains a copy of the Scheduling Form.

Step-by-Step Instructions for Completing the Recruitment Form

1. Identify all Recruitment Forms with the same corporate ID number and review all the information on those forms.
2. Unless the project has already been recruited, write your initials and date in the upper right portion of page 1 of each recruitment form. If the project has been recruited, skip the recruitment procedure for that project. (Approximately 40 of the projects have been recruited.)
3. Check the recruitment form to identify whether there are any special contact instructions. If there are special contact instructions, those instructions should supersede instructions provided in this handbook.
4. Call the customer contact and using the **Recruitment Survey**, obtain the information to complete the middle section of the Recruitment Form: On-site Visit Authorization, Measure Information, On-site Visit Contact and Decision-Maker Interview Contact, as appropriate for the type of project.
5. Complete the Project Disposition section of the Recruitment Form based on the results of the recruitment.
6. If the customer agrees to participate in the evaluation, give Wendy the project and site ID and the name and address of the person to whom the PG&E letter should be sent. If the customer does not agree to participate in the evaluation, give Wendy the project and site ID and contact Ben to obtain a replacement site. (The lead engineer is responsible for obtaining the “Letter Sent” date from Wendy to record on the Recruitment Form.)

7. Make appropriate entries in the Contact Log.

RECRUITMENT SURVEY

PG&E INDUSTRIAL RETROFIT PROGRAM EVALUATION

SECTION

A.. HELLO. MY NAME IS _____ FROM SBW CONSULTING CALLING ON BEHALF OF THE PACIFIC GAS AND ELECTRIC COMPANY. MAY I PLEASE SPEAK TO _____ (say name of Contact Person)?

- IF THE PERSON YOU ARE TALKING WITH IS THE CONTACT PERSON, CONTINUE WITH SECTION B

- IF THE CONTACT PERSON IS NOT AVAILABLE, BUT YOU CAN LEAVE A VOICE MESSAGE, LEAVE THE FOLLOWING MESSAGE:

HELLO. MY NAME IS ____ FROM SBW CONSULTING CALLING ON BEHALF OF THE PACIFIC GAS AND ELECTRIC COMPANY. SBW WAS SELECTED BY PG&E TO EVALUATE ITS 1995 INDUSTRIAL ENERGY EFFICIENCY PROGRAM. PG&E'S RECORDS INDICATE YOUR FIRM PARTICIPATED IN THE (IDENTIFY PROGRAM). PLEASE CALL ME AT TELEPHONE NUMBER ____ . THANK YOU.

- IF THE CONTACT PERSON IS NOT AVAILABLE AND DOES NOT HAVE VOICE MAIL, INQUIRE WHEN WOULD BE A GOOD TIME TO CALL BACK. LEAVE A MESSAGE OF YOUR NAME, THAT YOU ARE AN EMPLOYEE OF SBW CONSULTING, INC AND YOU WILL CALL AGAIN.

- IF YOU ARE TRANSFERRED TO THE CONTACT PERSON SAY:

HELLO . MY NAME IS _____ FROM SBW CONSULTING CALLING ON BEHALF OF PACIFIC GAS AND ELECTRIC. (THEN CONTINUE WITH SECTION B.)

- IF THE CONTACT PERSON IS NO LONGER THERE, SAY:

I'D LIKE TO TALK WITH A PERSON WHO IS FAMILIAR WITH THE (IDENTIFY PRIMARY MEASURE) PROJECT AT (IDENTIFY SITE ADDRESS) THAT WAS REBATED UNDER PACIFIC GAS & ELECTRIC'S REBATE PROGRAM LAST YEAR.

- IF THE ALTERNATE CONTACT PERSON IS AVAILABLE, SAY:

HELLO . MY NAME IS _____ FROM SBW CONSULTING CALLING ON BEHALF OF PACIFIC GAS AND ELECTRIC. (CONTINUE WITH SECTION B).

- IF THE ALTERNATE PERSON IS NOT AVAILABLE, FOLLOW THE GUIDELINES ABOVE FOR LEAVING A MESSAGE.

- IF NO ONE KNOWLEDGABLE ABOUT THE REBATE MEASURE IS EVER AVAILABLE SAY:

THANKS FOR YOUR ASSISTANCE . CIRCLE ITEM #6. "NO ONE KNOWLEDGEABLE" UNDER THE PROJECT DISPOSITION SECTION OF THE RECRUITMENT FORM.

B. IF YOU WERE IN CONTACT WITH THE CLIENT'S PG&E REP, SAY:

I HAVE SPOKEN WITH _____ PG&E'S REP FOR _____ (NAME OF THE COMPANY). HE MAY HAVE CONTACTED YOU TO DISCUSS THE REASON FOR MY CALL.

C. SBW WAS SELECTED BY PG&E TO EVALUATE ITS 1995 INDUSTRIAL ENERGY EFFICIENCY REBATE PROGRAM. PG&E'S RECORDS INDICATE THAT YOUR FIRM WAS RECENTLY INVOLVED IN A (IDENTIFY PRIMARY MEASURE) PROJECT AT (IDENTIFY SITE ADDRESS) THAT RECEIVED A REBATE OF (MENTION REBATE AMOUNT) AS A PARTICIPANT IN PACIFIC GAS & ELECTRIC'S (IDENTIFY PROGRAM, I.E. CUSTOMIZED, RETROFIT, REO) PROGRAM. IS THIS CORRECT?

- IF "YES": CONTINUE WITH SECTION D

-IF "NO" OR "DON'T KNOW", ASK TO SPEAK WITH A PERSON KNOWLEDGEABLE ABOUT THE (MEASURE INSTALLED) SYSTEM. RETURN TO SECTION A FOR DIALOGUE UNLESS YOU HAVE SPOKEN WITH SEVERAL PEOPLE AT THE COMPANY AND IT IS CLEAR THERE IS NO ONE KNOWLEDGEABLE ABOUT THE PROJECT AT THE COMPANY. IF THERE IS NO ONE KNOWLEDGEABLE, SAY: THANK YOU FOR YOUR TIME. CIRCLE ITEM #6 IN THE PROJECT DISPOSITION SECTION.

D. IF THE CUSTOMER HAS MULTIPLE PROJECTS, STATE AND CONFIRM THE PRIMARY MEASURE FOR EACH PROJECT AT EACH SITE.

E. IF CUSTOMER PARTICIPATED IN THE 1994 EVALUATION SAY:

OUR RECORDS INDICATE THAT YOU PARTICIPATED IN THE EVALUATION OF PG&E'S 1994 INDUSTRIAL PROGRAM EVALUATION. PG&E THANKS YOU FOR YOUR PAST COOPERATION.

OTHERWISE, CONTINUE WITH SECTION F.

F. I AM CALLING TO SEEK _____ (NAME OF CLIENT'S COMPANY) PARTICIPATION IN AN EVALUATION OF PG&E'S 1995 RETROFIT PROGRAM. PARTICIPATION IN THE EVALUATION WILL INVOLVE 3 ACTIVITIES: [IF PROJECT IS VERIFICATION THEN THE ENERGY EFFICIENCY MEASURES CONTACT PERSON IS NOT NEEDED. IF PROJECT IS VERIFICATION AND END USE TYPE IS "MISCELLANEOUS" THEN NEITHER TELEPHONE INTERVIEW IS NEEDED.]

- 1) A TELEPHONE INTERVIEW WITH THE PERSON(S) MOST FAMILIAR WITH ALL ENERGY EFFICIENCY MEASURES INSTALLED LAST YEAR
- 2) A VISIT TO THE PROJECT SITE BY ONE OF OUR FIELD ENGINEERS, AND

- 3) *A BRIEF TELEPHONE INTERVIEW WITH A PERSON WHO WAS INVOLVED IN THE DECISION TO PARTICIPATE IN PG&E'S 1995 PROGRAM.*

IF ASKED QUESTIONS CONCERNING THE SCOPE, STATE THAT TELEPHONE INTERVIEWS WILL NOT LAST MORE THAN 15 MINUTES AND THAT THE ON-SITE VISIT WILL TYPICALLY REQUIRE 4 HOURS FOR PROJECT SPECIFIC (2 HRS FOR VERIFY). WE WILL RECONTACT THEM IF WE DETERMINE UPON FURTHER REVIEW THAT WE WILL NEED SIGNIFICANTLY MORE TIME THAN THESE INITIAL ESTIMATES. ASSURE THEM THAT ANY INFORMATION THAT IS COLLECTED WILL BE KEPT STRICTLY CONFIDENTIAL.

G. *CAN YOU AUTHORIZE YOUR COMPANY'S PARTICIPATION IN THE EVALUATION?*

- IF **"YES"** THEN SAY: *ARE YOU WILLING TO PARTICIPATE IN THIS EVALUATION?*

- IF **"YES"**: **RECORD** NAME , TITLE AND MAILING ADDRESS FOR THANK-YOU LETTER FROM PG&E AND CONTINUE WITH SECTION H.

- IF **"NO"**: SAY: *THANK YOU FOR YOUR TIME. TERMINATE AND RECORD THE REASON FOR THE REFUSAL IN THE PROJECT DISPOSITION SECTION OF THE RECRUITMENT FORM.*

- IF **"NO"** THEN ASK: *CAN YOU PROVIDE ME WITH THE NAME AND TELEPHONE NUMBER OF THE PERSON WHO CAN APPROVE SUCH A REQUEST?*

- IF **"YES"** RECORD INFORMATION, CONTINUE WITH SECTION H ONLY, THEN RETURN TO SECTION A WHEN TALKING WITH THE ALTERNATE CONTACT.

- IF **"NO"** SAY: *THANK YOU FOR YOUR TIME. CIRCLE ITEM #6 UNDER PROJECT DISPOSITION.*

- IF **"DON'T KNOW"**: ARRANGE TO CALL BACK OR FOLLOW-UP WITH SPECIFIC INFORMATION NEEDED TO OBTAIN DECISION.. **RECORD** SPECIFIC INSTRUCTIONS ON THE RECRUITMENT FORM AND CONTACT LOG.

H. **IF CLIENT IS GOING TO BE CONTACTED BY DRA SAY:** *OUR RECORDS INDICATE THAT YOU MAY BE CONTACTED BY ANOTHER FIRM THAT MAY ALSO REQUEST PERMISSION FOR CONDUCTING AN ON-SITE SURVEY. THIS COULD BE AN INDEPENDENT ASSESSMENT BY CALIFORNIA'S STATE UTILITY REGULATORS AND IS NOT GOVERNED BY PG&E. WE APOLOGIZE FOR THIS INCONVENIENCE.*

I. **If the project is verification, skip to section J.** *FOR THE FIRST ELEMENT OF DATA COLLECTION, OUR ENGINEER WILL NEED TO SPEAK WITH THE PERSON OR PERSONS MOST FAMILIAR WITH THE FACILITY OPERATIONS AND THE OPERATION OF THE (STATE REBATED MEASURES TO BE EVALUATED AT EACH SITE AND/OR FOR EACH PROJECT) AND OTHER EFFICIENCY IMPROVEMENTS MADE LAST YEAR. THIS WILL ALLOW OUR ENGINEER TO BETTER UNDERSTAND THE FACILITY AND ITS OPERATIONS AND BE BETTER PREPARED FOR THE ON-SITE VISIT. ARE YOU THE APPROPRIATE PERSON TO CONTACT FOR THE INTERVIEW? THERE MAY BE ONE PERSON KNOWLEDGEABLE ABOUT THE REBATED PROJECT AND ANOTHER PERSON MOST KNOWLEDGEABLE ABOUT THE OVERALL*

ENERGY EFFICIENCY IMPROVEMENTS MADE DURING 1995. IN SUCH CASES, RECORD ON THE RECRUITMENT FORM BOTH NAMES AND RESPECTIVE CONTACT INFORMATION.

- IF “YES”: RECORD IN THE MEASURE INFORMATION AREA; THE CONTACT NAME , PHONE NUMBER, TITLE AND RELATIONSHIP ON THE RECRUITMENT FORM AND CONTINUE WITH SECTION K

-IF “NO”: *ASK: CAN YOU PROVIDE THE NAME(S) OF AND TELEPHONE NUMBERS OF THE MOST APPROPRIATE PERSON(S) TO CALL?*

- IF “YES”: RECORD IN THE MEASURE INFORMATION AREA; THE CONTACT NAME, TITLE, PHONE NUMBER, AND RELATIONSHIP TO THE CUSTOMER CONTACT ON THE RECRUITMENT FORM AND CONTINUE WITH SECTION K

IF “NO”: RECORD “INFORMATION NOT AVAILABLE” ON RECRUITMENT FORM AND CONTINUE

J. *TO PERFORM THE SECOND PIECE OF DATA COLLECTION, WE WILL NEED TO SCHEDULE AN ON-SITE SURVEY. TO DO THIS, WE NEED THE NAME OF THE PERSON WHO WOULD BE MEETING WITH OUR ENGINEER. WOULD THAT BE YOU?*

- IF “YES”: AND THE PROJECT IS VERIFICATION, SCHEDULE THE SITE VISIT. OTHERWISE, STATE THAT OUR ENGINEER WILL BE CONTACTING THEM, THANK THEM FOR THEIR COOPERATION, AND GO TO SECTION L. RECORD CONTACT’S NAME AS THE ON-SITE CONTACT ON THE RECRUITMENT FORM.

- IF “NO”:, *ASK: MAY I PLEASE HAVE THE NAME AND TELEPHONE NUMBER OF THE PERSON TO CONTACT FOR THE SITE VISIT? WHAT IS THEIR JOB TITLE AND RESPONSIBILITIES? WHAT WOULD BE THE APPROPRIATE WAY TO SET UP AN APPOINTMENT WITH THIS PERSON WHO WOULD MEET WITH OUR ENGINEER? CAN WE CONTACT THEM DIRECTLY? DO YOU KNOW WHAT IS A GOOD TIME TO GET IN TOUCH WITH THEM?* RECORD ON-SITE CONTACT INFORMATION ON THE RECRUITMENT FORM.

- IF “DON’T KNOW”: MAKE ARRANGEMENTS TO CALL THEM BACK TO IDENTIFY THE ON-SITE CONTACT PERSON AND SITE VISIT SCHEDULING ARRANGEMENTS. THEN CONTINUE.

K. **IF THE PROJECT IS VERIFICATION AND THE END USE IS “MISCELLANEOUS”, THEN THANK THEM FOR THEIR PARTICIPATION AND TERMINATE. OTHERWISE SAY: TO PERFORM OUR THIRD, AND LAST, ELEMENT OF DATA COLLECTION WE WILL NEED TO SPEAK WITH THE PERSON WHO WAS INVOLVED IN MAKING THE DECISION TO PARTICIPATE IN THE PG&E (STATE PROGRAM NAME) PROGRAM. ARE YOU THAT PERSON?**

-IF “YES”: SAY, THANK YOU FOR YOUR TIME . WE WILL BE CALLING YOU IN THE FUTURE TO ASK SOME QUESTIONS CONCERNING YOUR DECISION TO PARTICIPATE IN THE REBATE PROGRAM. RECORD DECISION-MAKER NAME AND PHONE NUMBER ON THE RECRUITMENT FORM.

- IF **“NO”**: ASK, CAN YOU PROVIDE THE NAME AND PHONE NUMBER OF THAT PERSON?

- IF **“YES”**: (**RECORD** DECISION-MAKER NAME, PHONE NUMBER, AND RELATIONSHIP TO THE CUSTOMER CONTACT ON THE RECRUITMENT FORM.) THANK THEM FOR THEIR COOPERATION AND TERMINATE.

IF **“NO/DON’T KNOW”**: THANK THEM FOR THEIR COOPERATION AND TERMINATE.

FOR ALL PROJECTS, WHETHER SUCCESSFULLY RECRUITED OR NOT, COMPLETE THE DISPOSITION CODING SECTION OF THE RECRUITMENT FORM AND COMPLETE THE CONTACT LOG.

Appendix C

Site Scheduling Form and Contact Log

1. Contact Log Procedures

1.1 Objective

The objective of the Contact Log is to document the history of telephone contacts to obtain various elements of information throughout the evaluation process. Contacts with customer as well as PG&E marketing representatives are to be included. This log will be attached to the Site Evaluation Report that is submitted to PG&E. This log will be kept for all sites including those only receiving verification level analysis.

1.2 Instructions

Site No. - Enter the appropriate site no. on each form.

Project No. - If there are multiple projects at the site and they end up going on different contact paths keep a separate log for each project and enter the appropriate project number at the top of the log.

Customer Name - Record the Company Name as found on the recruitment form.

Contact Name - Each time a successful contact is made with the PG&E marketing representative or directly with the customer, record the appropriate information on a line of the log form. Do not make an entry every time you leave a message. However, do make an entry if you have tried someone several times and are giving up to pursue another path.

PG&E/Cust. - Enter a P or C to identify whether the contact is a PG&E employee or a customer employee. There may be other types of contacts such as equipment vendors. Enter the appropriate descriptive word in these cases.

Purpose - In most cases, just record the appropriate code from the list at the bottom of the log. The note area is for additional explanation as needed.

Date - Enter the date the contact is made.

By - Enter the initials of the caller.

KEEP THE SITE LOG WITH THE SITE FILE AT ALL TIMES.

Site Visit Scheduling

Site ID	Scheduler Initials	Date scheduled:
---------	--------------------	-----------------

On-Site Visit Arrangements:	Lead Engineer: _____
	Field Engineer: _____
Site Name: _____	
Contact Name: _____	
Date and Time of Appointment: _____	
Location at Site to Meet	
Parking Availability: _____	
Directions to Site: _____	

Other Information for Site Visit:	
Does Site Contact know location of paid measure(s)? Y / N	
Access Problems to Physically Observe Equipment up Close: _____	

For project-specific lighting only:	
Was Title-24 lighting power density compliance required for this project? Yes ___ No ___ DK ___	
If Yes, are the Title-24 compliance forms available? Yes ___ No ___ DK	
Optional (depending on project):	
Are As-built Construction Plans Available? Yes ___ No ___ DK ___	
Is EMCS present? Yes ___ No ___ DK ___	
If Yes, is the Operator Available During Site Visit? Yes ___ No ___ DK	
Other:	

PG & E Representative should be notified Y / N	

Appendix D

Spillover Survey

1. Interview Instructions for Spillover Survey

1.1 Overview

The point of this interview is to identify potential spillover measures. The following definitions should be used for spillover and spillover measure.

- **Spillover.** Spillover occurs when a customer installs efficiency improvements without receiving a rebate, but is influenced to take this action by any of PG&E's efficiency programs (rebate or informational). Spillover can be direct or indirect. An example of direct spillover is the customer installing efficient equipment after first learning about that equipment from a PG&E customer representative. An example of indirect spillover would be a vendor recommending a piece of equipment promoted by PG&E's programs, because the program has caused the vendor to only stock that type of equipment. In the case of indirect spillover the customer may be completely unaware of the program's influence on the choice of equipment.
- **Spillover Measure .** An energy efficiency improvement, implemented during 1995 as a result of spillover, which would have qualified for a rebate under the 1995 Industrial Retrofit Programs. The improvement must exceed applicable Title 24/20 requirements.

After establishing a list of such potential spillover measures you will ask several questions about each one. Both your descriptions of the potential spillover measures and the answers to the questions about them will be entered into the response matrix on the last page of the survey.

1.2 Selection of the Respondent

The spillover contact should be the respondent to this survey.

- **Spillover Contact .** A member of the customer's staff who is familiar with spillover measures installed in 1995. This might be the same as the person most familiar with the items (for which rebates were paid in 1995) installed at a site, but it could be a different person.

The spillover contact may have been identified during the recruitment call. If not, you need to locate this person before you can complete an evaluation plan for a CPS or SPS site. If the person was previously identified, but is no longer available, you will have to find a substitute.

1.3 Eliminating Measures for which Rebates were Paid or are Pending

You have to make sure that no rebate has been paid or is pending for a spillover measure. To eliminate measures for which rebates were paid, you will review with the respondent the 1995 item list and the item history list (items paid before 1995) shown on the applicable project recruitment forms. The 1995 item list and item history list may not be complete. This can happen at sites served by more than one meter. It can also happen if a rebate was paid in 1996 for a item installed in 1995. You need to make it clear to the respondent that you do not want to list **any** measures for which a rebate was paid.

You also must eliminate measures for which a rebate is pending. The customer may have applied for a rebate but has not yet received the payment. Question 9 identifies these measures.

1.4 Creating a List of Potential Spillover Measures

You will ask the respondent Questions 1 through 5 to get them to describe potential spillover measures. These questions refer to different categories of changes that may have occurred at the site during 1995. Be prepared to explain each question to the respondent. The questions overlap, i.e., the same change could be cited in response to more than one question. Each unique change described by the customer in response to these questions is a potential spillover measure.

It is important that you establish and enter into the response matrix all of the potential spillover measures before you ask any further questions about these measures. Assign the next measure number (Meas. #) in the first column and then write a description of the measure in the second column of the matrix. Remember, after this interview is over you will have to determine whether this measure would have qualified for the program and whether it is likely to have substantial savings. Be very specific in describing each measure.

1.5 PG&E Influence Questions

Questions 6 through 9 are used to determine PG&E's influence on the installation of the potential spillover measures. Unless PG&E influenced the customer's decision to install a measure, the measure cannot be spillover. However, even if the customer believes there was little or no PG&E influence, the influence may have come through a vendor (see next section), so you must keep these measures on the list. Record the responses to the influence questions on the response matrix.

1.6 Information from Vendors

Question 10 and 11 are designed to get information on the vendors that were involved in the design, sale, or installation of the potential spillover measures. There are two reasons you may need information from vendors, following the Spillover Survey (You may also need vendor information following the Decision Maker Survey, but for a different reason).

1. **The respondent could not describe the measure in sufficient detail.** You need to determine whether the measure would have qualified for a rebate and whether it is likely to produce significant savings. Discuss the measure with vendors as necessary to obtain the information needed to determine whether the measure would have qualified for a rebate and has substantial savings. For example, the vendor might be able to provide the SEER rating for a package HVAC unit. **There is no pre-defined survey instrument for this purpose.**

2. **The respondent scored PG&E's influence less than 6 in Question 6.** You need to determine whether PG&E exerted its influence on the customer's decision through a vendor. For example, a designer might have received training from PG&E or a distributor may choose to carry only equipment which qualifies for PG&E's rebate programs. These influences could be invisible to the customer. The Vendor Survey (Appendix D) is designed to determine whether PG&E influenced the vendor's recommendations to the customer.

1.7 Identifying Spillover Measures

A measure listed in the response matrix is a spillover measure if it would have been eligible for a rebate under one of P&GE's industrial retrofit programs and any of the following criteria are satisfied:

1. Response to Question 6 on the Spillover Survey is greater than or equal to 6 (on a scale of 0 to 10).
2. Response to Question 6 on the Spillover Survey is less than 6, but the response to Question 5 or Question 6 on the Vendor Survey (See Appendix D) is greater than or equal to 6.

If you are uncertain whether a particular measure would have be eligible for a rebate, see the appropriate QC engineer for advice on how to make this determination.

The budget for evaluating spillover measures is limited. Therefore, you need to eliminate measures unless they are likely to provide significant savings. Consult the appropriate QC engineer for assistance in making this determination.

1.8 Completing Survey Forms

Complete one spillover survey for each CPS or SPS site. Make sure to record the SITE ID on the response matrix. If you do not identify any potential spillover measures write "**NONE**" on the response matrix.

2. Spillover Survey Instrument

Spillover Survey

PG&E Industrial Retrofit Program Evaluation

Before Beginning an Interview:

1. Obtain the Spillover Survey Contact name and telephone number.
 2. Review the 1995 item list and item history list on the recruitment form for all projects associated with this site.
 3. Write the SITE ID on a copy of the Response Matrix (last page of this survey).
 4. Thoroughly understand the instructions which precede this survey instrument.
- A. Hello. This is _____ from SBW Consulting calling on behalf of Pacific Gas & Electric. May I please speak with (name of Spillover Survey Contact)?

If the spillover contact is not available, but still reachable: schedule a callback

If spillover contact is no longer there, ask if you can have the name and phone number of another person who is familiar with energy efficiency improvements installed at this site in 1995.

___ YES, (**Record Name and Phone Number and start again with new contact**)

NAME: _____

TELEPHONE NUMBER: _____

___ NO (**Go to End**)

READ IF NECESSARY: If you would like the name and telephone number of a person at PG&E who can give you more information about this study, you may call Lisa Reid of PG&E at (415) 973-4747.

B. Exclude Rebate Items or Pending Rebate Items. Explain to the respondent that we are trying to identify energy efficiency measures which the company installed in 1995, but for which no PG&E rebate was paid or is pending. We need to identify these measures so that we can determine all of the savings from energy efficiency which the customer achieved in 1995. Go over the list of items for which rebates were paid in 1995 or previous years (see list on project recruitment forms). Tell them this list may not be complete and you need them to make sure they are not including any measure for which a rebate has been paid or for which they expect to receive a rebate in the future.

C: READ: I want to assure you that your answers will be kept strictly confidential and will not be shared with anyone outside of PG&E.

D: Description of Potential Spillover Measures: You need them to list all of the efficiency measures which the company installed at the site in 1995. You will ask them five questions to help the identify these measures. The questions may sound similar but they are different and should help them remember all of the changes which are efficiency measures.

Record a description of each unique efficiency measure in the first column of the response matrix.

1. Did you install or modify any equipment in 1995 that resulted in reduced energy use?
2. Did you change the configuration of any systems in 1995 that resulted in reduced energy use?
3. Did you install or modify any equipment in 1995 that resulted in less run time without reducing product output?
4. Did you install or modify any equipment in 1995 that resulted in higher product output without increasing energy consumption?
5. Did you install any new equipment (not replacements of existing equipment) in 1995 that exceeds California Energy Efficiency Standards?

E: PG&E's Influence on Measure Installation. After recording the potential spillover measures on the response matrix, ask Questions 6 through 9 for each measure. Use the codes as described in each question to record the responses on the response matrix.

6. Please rate on a scale from 0 to 10 how much influence PG&E had on your company's decision to install the efficiency measure. "0" means *no influence at all* and "10" means *PG&E was very influential*.

Record Response on Matrix

If response is "0" go to Q. 10

If response is greater than "0" continue

7. How did PG&E influence your decision to install this efficiency measure? (**Read list below and record all that apply on matrix**)

- ⇒1: Direct recommendation or information from PG&E representative
- ⇒2: Information from PG&E printed material
- ⇒3: Rebate for a similar measure before 1995
- ⇒4: Vendor Recommended by PG&E
- ⇒5: Other (**Specify. Record on back of response matrix labeled with Meas. #**)

8. When did PG&E's influence (even if small) occur?

- ⇒1: 1995
- ⇒2: Before 1995
- ⇒3: Don't Know
- ⇒4: Refused To Answer

9. Did you apply for a PG&E rebate for this efficiency measure?

- ⇒1: Yes, (**If rebate is still pending, eliminate this measure**)
- ⇒2: No
- ⇒3: Don't Know
- ⇒4: Refused To Answer

F: Vendor Information: You may need information from the vendor which had the greatest influence on the design and specifications for each efficiency measure. This could be an engineer who helped design or specify the measure, a company from which the equipment was purchased or a company who installed the measure. Ask the following questions for each spillover measure that has a response to Question 6 which is **less than 7**.

10. Which of the following provided the most assistance in the design or specification of (describe measure)? (**Read the list**)

- ⇒ 1: Designer or Consultant
- ⇒ 2: Equipment Distributor or Manufacturers Representative
- ⇒ 3: Installer
- ⇒ 4: Internal Staff (**go to end**)
- ⇒ 5: Don't Know (**go to end**)
- ⇒ 6: Refused to Answer (**go to end**)

11. **Ask for the name and telephone number for the person who assisted with design and specification. If they don't remember the specific person, ask for the firm name. I they don't have the phone number get the city where the firm is located.**

END: Those are all the questions I have. I greatly appreciate your time and cooperation. Thank you very much.

Response Matrix for Site ID:							
Meas. #	Q 1-5. Description of Potential Spillover Measure	Q6. Influence Rating (0-10)	Q7. How? 1: Direct 2: Info 3: Rebate 4: Vendor 5: Other	Q8. When? 1: 1995 2: Before 3: DK 4: Refuse	Q9. Applied for Rebate 1:Yes 2:No 3:DK 4:Refuse	Q10. Who Assisted? 1: Design 2: Dist 3: Install 4: Staff 5: DK 6: Refuse	Q11. Vendor who influenced specifications?(Company name, phone # or city , and contact person)
1							

Appendix E

Vendor Survey

1. Interview Instructions for Vendor Survey

1.1 Purpose

The point of this interview is to determine whether PG&E's efficiency programs have influenced vendor recommendations to their customers. We need this information under two circumstances:

1. **Spillover Survey Follow-Up.** You need to determine whether PG&E exerted its influence on the customer's decision to implement a spillover measure through a vendor. For example, a designer might have received training from PG&E or a distributor may have chosen to stock only equipment that qualifies for PG&E's rebate programs. These influences could be invisible to the customer. **You complete a vendor survey if the Spillover Survey Contact scored PG&E's influence less than 6 on a scale of 0 to 10. (Question 6 on the Spillover Survey).**
2. **Decision-Maker Survey Follow-Up.** You need to determine whether PG&E exerted its influence on the customer's decision to implement an item for which a rebate was paid in 1995 through a vendor. The methods of influence are the same as those for a spillover measure. **You complete this survey if the NTGR based on the Decision-Maker Survey responses is less than or equal to .3 (computed in the site evaluation workbook).**

1.2 Selection of the Respondent

The vendor contact is obtained in one of two ways.

1. **Spillover Survey Follow-Up.** Question 11 in the Spillover Survey identified the best available contact for following-up on a spillover measure.
2. **Decision-Maker Survey Follow-Up.** You will rely on invoices in the application file(s) to identify the best available contact for following-up on an item for which a rebate was paid in 1995.

1.3 Completing Survey Forms

When following up on a spillover survey, complete a vendor survey for each spillover measure which requires a vendor follow-up (see purpose section above). When following up on a decision-maker survey, complete one survey for each item which requires a vendor follow-up (see purpose section above).

2. Vendor Survey Instrument

Site Id: _____
(Meas # _____) or
(Proj ID _____ and Item Number _____)

Vendor Survey

PG&E Industrial Retrofit Program Evaluation

Before Beginning an Interview:

1. Obtain the Vendor Survey Contact name and telephone number.
2. Review the description of the spillover measure or item (rebate paid in 1995) which will be the subject of this interview. If free-rider type = Custom, determine if the item has an efficiency rating and whether it is subject to Title 20 requirements.
3. Write the SITE ID and Measure Number or SITE ID, Project ID and Item Number at the top of each page on a copy of this survey.
4. Thoroughly understand the instructions which precede this survey instrument.

A. Hello. This is _____ from SBW Consulting calling on behalf of Pacific Gas & Electric.

If you have a specific contact name: May I please speak with (name of the contact)

If you do not have a specific contact name, describe how you got their company name . Say: Your company (designed/sold/installed) (describe measure) at (describe site). I am looking for the member of your staff who was involved with or would know about that project.

Read If Necessary: If you would like the name and telephone number of a person at PG&E who can give you more information about this study, you may call Lisa Reid of PG&E at (415) 973-4747.

B. Once you have the correct person ask the following questions.

1. On a scale of 0 to 10, how familiar are you with PG&E's energy conservation *programs* which encourage PG&E's customers to install energy efficiency measures? "0" means *not at all familiar* and "10" means *thoroughly familiar*.

Refused To Answer

2. On a scale of 0 to 10, how familiar are you with the *information* on energy conservation provided by PG&E, through training programs, printed literature, presentations at professional meetings or other promotional activities? "0" means *not at all familiar* and "10" means *thoroughly familiar*.

Refused To Answer

If sum of responses to 1 and 2 are less than 10 Go to End.

3. **Say:** (Contact Name) at (Contact's Company) said your company assisted them in implementing (describe the measure) at (describe the site). Do you recall this project?

Site Id: _____
(Meas # _____) or
(Proj ID _____ and Item Number _____)

- Yes
- No (**Go To Q. 6**)
- Don't Know (**Go To Q. 6**)
- Refused To Answer (**Go To Q. 6**)

4. Did you or your company *recommend* that they (purchase this specific equipment/make these specific changes)?

- Yes
- No (**Go To Q. 6**)
- Don't Know (**Go To Q. 6**)
- Refused To Answer(**Go To Q. 6**)

5. Please rate on a scale from 0 to 10 how likely it is that you would have recommended to (name of company) that they (purchase this specific piece of equipment/make these specific changes) if **PG&E's energy conservation programs and information did not exist**? "0" means *not at all likely* and "10" means *very likely*.

Response (0-10) **98** Don't Know **99** Refused to Answer

6. Please rate on a scale from 0 to 10 how likely it is that you would have recommended (specific piece of equipment/make these specific changes) to **any** customer in 1995 if **PG&E's energy conservation programs and information did not exist**. "0" means *not at all likely* and "10" means *very likely*.

Response (0-10) **98** Don't Know **99** Refused to Answer

7. **Use only if the response to 5 or 6 is less than 10** . How has PG&E influenced your recommendations? (**Read List and Check all that Apply**)

- Involvement in PG&E rebate programs
- Presentations such as those given by the Pacific Energy Center?
- Printed material
- Television or radio ads
- Visit by PG&E representative
- Other (Specify: _____)
- Don't Know
- Refused to Answer

Site Id: _____
(Meas # _____) or
(Proj ID _____ and Item Number _____)

C: **Custom Project Decision-Maker Follow-Up.** The remaining questions are only asked following a Decision-Maker survey for a Custom Project (Free Rider Type = "Custom" on the Recruitment Form). In addition, only ask these questions if the project involved a piece of equipment sold by this vendor and the equipment has an efficiency rating, e.g. SEER, COP, KW/TON.

8. **If equipment IS subject to Title 20 requirements.** What percentage of your stock of (describe equipment) exceeds California energy efficiency requirements?

- (Go To Q. 10)
- Don't Know (Go To End)
- Refused To Answer (Go To End)

9. **If equipment IS NOT subject to Title 20 requirements.** What percentage of your stock of (describe equipment) is more efficient than is typically sold in Northern California?

-
- Don't Know (Go to End)
- Refused To Answer (Go to End)

10. Please rate on a scale from 0 to 10 how much influence PG&E has had on this percentage. "0" means *no influence at all* and "10" means *very influential*.

-
- Don't Know (Go to End)
- Refused To Answer (Go to End)

11. *How* has PG&E influenced this percentage? (**Read List and Check all that Apply**)

- Through its rebate programs
- Presentations such as those given by Pacific Energy Center?
- Printed material
- Television or radio ads
- Visit by PG&E representative
- Other (Specify: _____)
- Don't Know
- Refused to Answer

END: Those are all the questions I have. I greatly appreciate your time and cooperation. Thank you very much.

Appendix F

Site Evaluation Plan Template

PROJECT-SPECIFIC EVALUATION PLAN SITE #XXX

SITE SUMMARY INFORMATION

Company Name:

Site Name: [Obtain from Recruitment Form]

Site Address:

Principal Site Contact Name: Telephone:

PG&E Representative Name: Telephone:

Assigned Lead Engineer:

SITEIDNO.	174
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PROJECTS PAID BY 1995 PROGRAMS

Project Application ID No. Number	Program Control Year Number	Account Number	End Use	PG&E Program	Project Type
--------------------------------------	--------------------------------	-------------------	---------	--------------	-----------------

ITEMS FOR EACH PROJECT

Project Item ID No. No. Efficiency Measure	Savings			Rebate (\$)
	(kWh)	(kW)	(Therms)	

Evaluation Plan for Spillover

If no evidence of spillover was found in the Spillover Survey, indicate so on the bottom of this page. If spillover was found, complete a spillover evaluation plan (described later in this template), and delete this section from the plan.

Evaluation Plan for Project ID:

End Use:

Measure Description

Efficiency Improvement: Description of the efficiency measure and how it results in kWh, kW or Therm savings. This will include a preliminary description of the systems directly affected by the measure and their location at the project site, e.g., overhead lighting in assembly building #3.

Preliminary Pre-installation Equipment and Operation: This data should be obtained from the application file and telephone discussion with the assigned PG&E customer Representative or customer staff. For early replacement measures, this section should describe the type and quantity of the replaced equipment, including relevant performance specifications, e.g., SEER or capacity. For normal replacement measures, the description in this section would depend upon the applicability of Title 20/24 to the measure. If Title 20/24 was not relevant, this section should describe the type and quantity of the replaced equipment (same as early replacement). If Title 20/24 was relevant, this section should describe any Title 20/24 requirements that apply to the measure.

Preliminary As-Built Equipment and Operation: This data should also be obtained from the application file and telephone discussion with MARs or customer staff. The type (make and model) and quantity of equipment subject to the rebate should be described along with the expected operating schedule. Be sure that the schedule includes daily and weekly variations in the operation of the affected equipment. Remember that savings estimates are based only on the post-period operating schedule, unless the paid measure affects the schedule of operation.

Primary Business and Product: Describe the type of business that is being conducted at the site and a general description of the product (if any) that is being produced. Make special note, if the measure is installed only in the office portion of a manufacturing facility.

Variability in Schedule and Production: Describe seasonal variations in the operation of the affected equipment, including variations with production output. This schedule information, combined with the daily and weekly schedule described above under as-built operation, should provide a complete annual schedule that accounts for all hours of the year.

Algorithms for Estimating Energy Savings for Paid Measure

PG&E Algorithm: An assessment of the equations or computer model used by PG&E to calculate savings, specifically indicating problems, if any, that cause the adoption of an alternative for this evaluation. For Retrofit Express measures the standard PG&E algorithm will be included. When applicable, both the as-built and baseline algorithms will be included. An indication should be made as to whether Title 20/24 requirements were assumed in PG&E's estimate of savings. Be sure all terms in the equations are adequately described.

- PG&E baseline: A summary restatement of the baseline conditions assumed by PG&E, for easy reference by the PG&E reviewer.

Evaluation Algorithm: The proposed approach for estimating first year gross savings in the evaluation that is consistent with the budget allocation assigned to the site. Includes equations that will be applied by the evaluation team or a description of the computer models to be used. When applicable, both the as-built and baseline algorithms will be included. If the selected

evaluation algorithm is different than the PG&E algorithm, discuss why the proposed algorithm is preferred. Be sure all terms in the equations are adequately described.

- **Baseline Comparison:** A summary comparison of the evaluation and PG&E baselines, for easy reference by the PG&E reviewer.

Annual Extrapolation: A summary restatement of the method that will be used to extrapolate the observations and measurements made during the on-site survey to annual values, for easy reference by the PG&E reviewer.

Costing Period Algorithm: A description of the method that will be used to disaggregate the evaluation estimate of annual savings into the five PG&E defined costing periods.

Data Collection

Site Specific Input Parameters: Description of parameters that will be obtained from site specific data sources. Each of these match one of the input variables shown in the evaluation algorithm or is required by the selected computer model. Be sure to include all parameters from the application file and from conversations with the site contact that will be confirmed during the site visit.

Data Collection Method: Description of the data source and measurement method for each input parameter. Possible data sources include (a) customer staff interviews, (b) production or operation logs, (c) EMCS records, (d) mechanical or electrical plans, (e) observations and spot measurements by the on-site survey engineer, (f) special metering previously installed by PG&E, (g) special metering installed for this evaluation, and (h) manufacturers' literature and other published equipment specifications. If new special metering is involved, this section will describe the data recorders and sensors to be installed, the measurements to be taken and the duration of the measurement period.

Customer Cost/Benefit Analysis (CPS projects only)

Cost and Payback: If PG&E performed a payback analysis during program implementation and it is documented in the application file, enter the values here. Give the payback values with and without the rebate, if available from the file. Also state the fuels (electric and/or gas) included in the analysis.

If the program documentation provides the cost of the measure, include this information. Be sure to note if the cost is total or incremental (as described in the file) and whether the cost includes labor and/or materials. In addition, include the lifetime of the measure, as documented in the file.

Non-Energy Costs and Benefits: Preliminary description of non-energy benefits to the extent that such information can be found in the application file.

Free-Ridership Issues (CPS projects only)

Equipment Alternatives: Indicate if alternative equipment was considered during program implementation, as documented in the application file.

Baseline: Provide a preliminary opinion of whether the baseline assumed by PG&E in their initial analysis was appropriate.

Motivation: Discuss any documents in the application that address the motivation for implementing the project.

Other Issues: Discuss any other information in the file that pertains to free-ridership considerations made in the initial analysis.

[The above descriptions are repeated for each project]

Evaluation Plan for Spillover ID:

Spillover Determination: Description of why this efficiency technology is considered to be a program spillover measure.

Efficiency Improvement: Description of the spillover measure and how it results in kWh, kW or Therm savings. This will include a preliminary description of the systems directly affected by the measure and their location at the project site.

Pre-installation Equipment and Operation: Description of the type and quantity of the equipment replaced by the spillover measure, including relevant performance specifications.

Evaluation Algorithm: The proposed approach for estimating the spillover measure energy savings in the evaluation. Includes equations that will be applied by the evaluation team or a description of the computer models to be used. Check with the QC engineer to be sure that the algorithm can be applied at an affordable cost.

Data Collection Methodology: Description of the algorithm input parameters that will be obtained from site-specific data sources. Also a description of the data sources and measurement methods that will be used for each input parameter.

[The above descriptions are repeated for each spillover measure]

Table 1: Site Staffing Plan, Schedule and Budget

SITE ID NO.		
PROPOSED STAFFING PLAN		
	Spillover ___	Project ___
On-site survey		Project ___
Decision-maker interview		Staff
Short-term measurements (if applicable)		Staff
Savings analysis (gross)		Staff
Savings analysis (free ridership)		Staff
Quality Control		Staff
Report		Staff
PROPOSED SCHEDULE		
On-site survey		9/9/99
Draft report		9/9/99
PROPOSED BUDGET		
	Staff	Labor/Misc
	Hours	Costs
Proposed Budget (Task 3: Project Specific)		
Evaluation Plan		
Revised Evaluation Plan		
Data Collection (on-site and interview)		
Short-term Measurements		
Analysis and Report		
Spillover Analysis		
Management	N/A	
Travel	N/A	
Equipment	N/A	
TASK 3 SUBTOTAL		
Proposed Budget (Task 4: Verify)		
HL/P (\$725/project)	No. of projects:	N/A
Misc. (\$645/project)	No. of projects:	N/A
Total Proposed Site Budget		
with Spillover analysis		
without Spillover analysis		
Allocated Budget (sum of project budgets)		
Difference (allocated - proposed w/o spillover)		

Note: If the proposed site budget is significantly greater than the allocated budget, provide an explanation for the difference as a note below the table.

Appendix G

On-Site Survey Forms - Project Specific Data

The following data collection procedures and forms will be applied to each project that receives a project specific evaluation. A set of forms will be completed for each project. All project items must be addressed by each type of form. The specific forms required are dependent upon the type of measure to be evaluated. The following forms are available:

Project Specific Persistence Summary - To be completed for **all** project measures.

Project Specific Retention Database Summary - To be completed for all projects except lighting capacity measures.

L1: Analysis Schedule - To be completed for all lighting capacity and controls measures.

L2: Project Specific Lighting Capacity Inventory - To be completed for all lighting capacity measures.

L3: Project Specific Lighting Controls Inventory - To be completed for all lighting controls measures.

L4: Project Specific Lighting Capacity Calculation Sheet - To be completed for all lighting capacity measures.

L5: Project Specific Lighting Capacity Summary - To be completed for all lighting capacity measures.

L6: Project Specific Lighting Controls Calculation Sheet - To be completed for all lighting controls measures.

1. Project Specific Persistence Summary Instructions

Every project receiving project specific evaluation treatment needs one of these forms. If the measure persistence is the same for several items you may list several items on one form. Each project item must be addressed on one of these forms. Comments on the persistence of the rebated measure are a required section in the Evaluation Report.

1.1 Before the on-site survey

Prefill the header box entries.

Item Number: Enter the item number(s) from the recruitment form.

Measure Description: Enter the database measure label as shown on the recruitment form for each item listed.

Program Value for Measure Lifetime: Enter the life in years assumed by PG&E. This may be obtained from the detailed file review or the Measure Lifetime reference table.

1.2 During the on-site survey

Ask site contact or other knowledgeable site personnel the open-ended questions shown on the form and record their responses. These responses will be the basis for the discussion of persistence in the Evaluation Report.

2. Project Specific Retention Database Summary Instructions

The Retention Database Summary form should be completed for all projects receiving project specific treatment. The forms developed for project specific lighting capacity projects include the necessary information for the retention database. One form should be completed for each project item.

2.1 Tasks before the On-Site Survey

Before the on-site survey, prefill the header box entries.

Item Number: Enter the item number from the recruitment form.

Measure Description: Enter the database measure label as shown on the recruitment form.

Units of Analysis: Enter the measure unit which you are using as the basis for identification. The units of analysis are the units that you intend to count or examine during the site visit. The units of analysis or the source of these units are specified in Table H-1. For many Custom measures the most appropriate units of analysis are determined in the detailed file review. For Retrofit Express measures, the units of analysis are the units used to compute the rebate, as indicated on the Application. For example, the units of analysis for an EMS system would be the specific features that were to be programmed according to the application file. In most instances, you will determine the most appropriate units as part of the detailed file review.

of Units from file: Enter the number of analysis units rebated, according to the application file. This is the expected count that you will be searching for during the site visit.

2.2 Tasks during the On-Site Survey

During the on-site survey, complete the entries appropriate for the specific measure. Use multiple lines as necessary to identify different descriptions, locations, or manufacturers. You will search for and inspect a census of units for each item, unless a specific sampling plan is developed and approved in advance by the QC engineer.

Description: For some measures the label on the recruitment form does not give an adequate description. If necessary, enter a more specific description of the various components comprising the item (e.g., the EMS feature or the pump function) in this column. When using abbreviations for lighting measures use the following:

For Fixture Type:

CF	Compact Flourescent
Flou	Flourescent
HAL	Halogen
HPS	High Pressure Sodium
INC	Incandescent
LPS	Lower Pressure Sodium
MH	Metal Halide
MV	Mercury Vapor

For Lamps per Fixture:

L #=number of lamps, L=lamps (example: for a 4 lamp fixture use 4L)

For Watts per Lamp:

W #=nomimal lamp wattage, W=watts (example: for a 40 watt lamp fixture use 40W)

For Lamp Length:

ft #=lamp length in feet (example: for a 4 foot lamp fixture use 4 ft)

For Ballast Type:

E	Electronic Ballast
M	Energy Efficient Magnetic Ballast
S	Standard Magnetic Ballast

For Control Type:

WOC	Wall Occupancy Sensor
COC	Ceiling Occupancy Sensor
TC	Time Clock or EMS system controls
PH	Photocell or daylighting controls

Schedule and watts per fixture are not needed as part of the lighting measure description.

Location: Enter a brief description of where the unit(s) is located (i.e., NE corner or Building H, scattered on roof, chip assembly area, etc.). The description must be complete enough for someone else to easily locate the measure.

Unit Quantity Installed: For each line, enter the number of installed units that you observed. If you can not gain access to some of the installed units for direct observation, enter the number given to you by the site contact. Make a note at the bottom of the form of counts that you did not directly observe and provide an explanation of why you could not observe them.

Unit Quantity Operational: For each line, enter the number of units that are operational. An operational measure is one that is working or is capable of working in some capacity. A measure that is broken or incapacitated during the site visit is not operational. A measure that is capable of working but is simply off or not being used during the site visit is considered to be operational. If you can not directly confirm the operational status, ask the site contact for this information. Make a note at the bottom of the form of operational status information that you did not directly observe.

Manufacturer, Model Number, and Other: Make entries for those data elements that are appropriate for the specific measure.

Before leaving the site, add the total installed count in column 3 and compare this value to the “# of units from file” value at the top of the form. If the values are different, provide an explanation at the bottom of the form as to why there was a difference (to the extent that it is known).

3. Project Specific Lighting Capacity Forms Instructions

Complete one set of forms for each lighting capacity project. Each project item must be addressed by each type of form. A set of forms includes:

- Project Persistence Retention Database Summary
- Project Specific Persistence Summary
- L1: Analysis Schedule
- L2: Project Specific Lighting Capacity Inventory
- L4: Project Specific Lighting Calculation Sheet
- L5: Project Specific Lighting Capacity Summary

3.1 Before the on-site survey

- a) prefill the header box entries
- b) determine during the measure information telephone contact whether Title-24 LPD compliance was required. Determining whether Title-24 LPD compliance was required is important to defining what information must be collected during the on-site survey. If Title-24 compliance was required, information must be collected on **all** fixtures to be able to calculate an LPD. Obtaining the Title-24 compliance documentation, if it is available, will be extremely helpful.
- c) determine the types of fixtures, as-built and as appropriate pre-condition, as well as the number of units you are expecting to find. Fill out the as-built and pre description sections as well as the “# of Units in File” column as best as you can from the file and the evaluation plan. This will help you determine the type and number of fixtures you are trying to find when you are on site. Sometimes you will need to fill out two separate lines on the form for one item (for example: when the fixture count for as-built versus pre-condition is different).

3.2 During the on-site survey

3.2.1 Complete Retention Database forms.

Complete the Retention Database Summary and Persistence Summary forms. There should be one completed for each item.

3.2.2 Initialize the Analysis Schedule form (L1).

Identify the measure-affected lighting and define the appropriate analysis schedules. Up to three analysis schedules are allowed for each item. For each schedule, enter a description of the schedule at the top of an Analysis Schedule form. (Example: M-F 8-5, 10% on during unoccupied hours). Also document any

seasonal variations and the number of holidays per year. If an LPD-based analysis is required, the analysis schedule should correspond to a specific floor area (i.e., you can not have two schedules corresponding to the same area) and the relevant floor area should be entered on the Analysis Schedule form.

3.2.3 Initialize the Lighting Capacity Inventory form (L2).

- Use however many lines necessary to define lighting groups by schedule, unit type, and location. Use numbers (i.e. 1, 2, and 3) to define the analysis schedule. Use letters (i.e. A, B, C ...) to define unit type.
- Enter a brief description of the lighting group location.
- For each unit type identified, enter a description of the fixture by completing each appropriate column in the description sections (fixture type - Fluor=fluorescent, MH=metal halide, MV=mercury vapor, CF=compact fluorescent, HPS=high pressure sodium, LPS=low pressure sodium, Inc=incandescent, HAL= halogen; lamps per fixture; lamp length in feet; ballast type - E=electronic, M=energy efficient magnetic, S=standard magnetic; watts per lamp).

- ◊ For normal replacement (non-LPD) and for early replacement analysis, both as-built and pre-condition must be completed for each rebated item.

Sometimes you will need to fill out two separate lines on the form for one item (for example: when the fixture count for as-built versus pre-condition is different).

For pre-condition descriptions of fluorescent lighting, you may need to note the age of the fixtures to figure out the type of magnetic ballast. Magnetic ballasts put in before 1988 may be the standard magnetic ballasts rather than the energy-efficient magnetic ballasts. These two types of ballasts use different amounts of energy. When in doubt about the age and/or type of magnetic ballasts in the pre-condition, assume energy efficient magnetic ballasts.

- ◊ For a LPD-based analysis you must describe all as-built fixtures (no pre-condition is required). Indicate yes or no in the “Rebated ?” column next to those fixture types that were rebated. If only a portion of a certain fixture type was rebated, define two different fixture types, one for rebated and another for non-rebated.
- For each unique fixture, schedule and location count the number of units installed, the number of units “off” and the number of units operational. An operational measure is one that is working or is capable of working in some capacity. A measure that is broken or incapacitated during the site visit is not operational. A measure that is capable of working but is simply off or not being used during the site visit is considered to be operational. Enter the data in the appropriate unit count columns.
- If sampling enter a sampling strategy in the comments section. Identify a sample number in the “Sample #” column for each sampling area. The most common sampling strategy is to count fixtures in a smaller area and extrapolate them to a larger area. For this type of sampling strategy obtain the square footage of the sampling area and total square footage this sampling area represents. Calculate the sample fraction for each sample number. This

sample fraction will be used to extrapolate the number of installed and operational units. For other sampling strategies, describe the strategy in the comments section. If sampling is done, a sampling scheme must be developed that is consistent with the budget. A census (sample fraction=1) should be done whenever feasible within the budget.

3.2.4 Initialize the Lighting Capacity Summary form (L5).

- In all cases, complete the HVAC related data requirements at the top of the form for the items identified in the header. This is necessary to select the appropriate DOE-2 prototype data for quantifying the heating/cooling interaction factors. The selection should be based upon the predominant characteristics associated with the item(s). The heating system efficiency may be obtained by interview. The system does not need to be examined.

3.3 After the on-site survey

3.3.1 Complete the Lighting Capacity Inventory form (L2).

- Use the sample counts and the sample fraction to calculate the Total Units Installed, “On” and Operational for each lighting group. (Total Units = Sample Count / Sample Fraction). List these in the comment section. (The operational count information is for the retention database only.)
- Look-up each of the as-built fixture types on the Lamp/Fixture Wattages Table and enter the values in the appropriate “Watts per Unit” column.
- Do the same for the pre-condition fixtures if appropriate.
- For normal replacement items, describe the appropriate Customer Baseline as completely as possible in the comments section (include a description of fixtures and watts per unit). This will be based on the information from the Decision Maker Survey. For normal replacement of ballasts, the pre-condition watts per unit values should be obtained from the energy efficient magnetic ballast column of the Lamp/Fixture Wattages Table since the ballasts need to comply with Title-20 requirements. (Consult the QC engineer for further explanation.)

3.3.2 Complete the Lighting Capacity Calculation Sheet (L4).

For each analysis schedule (3 maximum) the total kW, as-built and baseline if appropriate, and a utilization factor need to be calculated. The Calculation Sheet is designed to assist you in this process. You may put multiple items on one sheet but must indicate which calculation relates to which item. Baseline here is normally the pre-condition. However, if the customer baseline is different from the pre condition, complete an additional form for the customer baseline and check off the box at the top of the form to indicate which form is for the customer baseline and which is for the pre-condition.

- For each analysis schedule, copy the appropriate fixture type (unit type A,B,...), watts/fixture and total units installed from the Capacity Inventory forms for the as-built fixtures and

baseline fixtures, if necessary. The baseline may need to be on a separate line if the total units installed is different than in the as-built condition.

- Multiply the total watts/fixture values by the total units values and divide by 1000 to get total as-built and baseline kW installed.
- Calculate the “On” Fraction from the “Units Installed” and “Units Off” on the Lighting Capacity Inventory sheet. {On Fraction = (Units Installed - Units Off)/Units Installed }.
- Multiply the as-built kW values by the “on” fraction values to get total kW “on”.
- Sum the fixture type values to get totals for the analysis schedule.

3.3.3 Complete the Analysis Schedule form(L1).

- For each analysis schedule, enter the occupied hour utilization fraction based on the Total kW “on” and Total kW installed from the Calculation form. If no light logger have been used, the occupied utilization fraction is the Total kW “on” divided by the Total As-built kW. If light loggers have been used, use the logger data to derive utilization fractions. Consult the QC engineer on how best to do this if necessary.
- Enter unoccupied hour utilization fractions and seasonality information based upon interview information.
- Values need to be entered for all hours, days, and months. Use additional forms if necessary to document more than two seasonal schedules.

3.3.4 Complete the Lighting Capacity Summary form (L5).

- You must first determine what section (LPD or non-LPD) of the form to complete. This determination is based upon the results of the Decision Maker interview. There are 3 basic options:
 1. Normal Replacement/Title 24 Required: They were planning to change the lighting system without the PG&E program (normal replacement) and it was significant enough to require Title-24 LPD compliance. In this situation, our estimate of gross savings is based upon a comparison of the as-built LPD and the Title-24 LPD. Use the top portion of the form.
 2. Normal Replacement/No Title 24: They were planning to change the lighting system without the PG&E program (normal replacement) but it was not significant enough to require Title-24 LPD compliance. In this situation, our estimate of gross savings is based upon a comparison of the as-built rebated measure and the measure at levels compliant with Title 20 which basically states that energy efficient magnetic ballasts should be used. Use the bottom portion of the form.

3. Early Replacement: They were not planning to make any lighting changes in the absence of the PG&E program (early replacement). In this situation, our estimate of gross savings is based upon a comparison of the as-built rebated measure and the pre-condition. Since they were not planning to do anything, Title 20 and 24 are not an issue even if they said they went through the Title-24 compliance process. Use the bottom portion of the form.
 - If it is an LPD-based analysis, obtain the appropriate Baseline LPD from the Title-24 reference sheet or from the actual Title-24 documentation for the site. The floor area comes from the Analysis Schedule form.
 - Transfer the installed kW's from the Capacity Calculation form and calculate a kW savings for each analysis schedule.
 - If the customer baseline is different than the pre-condition, complete an additional form for the customer baseline and check off the box at the top of the form to indicate which form is for the customer baseline and which is for the pre-condition.

4. Project Specific Lighting Controls Forms Instructions

For lighting control measures, complete one set of forms for each project item. A set of forms includes:

- Project Specific Retention Database Summary
- Project Specific Persistence Summary
- L1: Analysis Schedule
- L3: Project Specific Lighting Controls Inventory
- L6: Project Specific Lighting Controls Calculation Sheet

4.1 Before the on-site survey

Prefill the header box entries. Based on your evaluation plan, at the top of the Control Inventory for (L3), indicate how many and what kind of control device(s) units you expect to find for each item. You may put one or multiple items on each Control Inventory form.

4.2 During the on-site survey

4.2.1 Complete Retention Database forms.

Complete the Retention Database Summary and Persistence Summary forms. There should be one completed for each item.

4.2.2 Initialize the Analysis Schedule form (L1).

Identify the controlled lighting fixtures and define the appropriate analysis schedules. Up to three analysis schedules are allowed for each item. For each schedule, enter descriptions of the pre-control and as-built schedules at the top of an Analysis Schedule form. Note the pre-control utilization factors based on interviews. Note unoccupied schedules and utilization factors schedules based upon the interview. Note the EMS/time clock schedules. Also describe the customer baseline schedule, if it is appropriate, based on the decision maker interview. (Example: Pre - M-F 8-5, 10% on during unoccupied hours, Post - M-F 7-6, 0% on during unoccupied hours). The final as-built occupied utilization factors will be based on the on-site inventory of the number of lights on or off.

4.2.3 Initialize the Lighting Controls Inventory form(L3).

- Use however many lines necessary to define lighting groups by item, control device type, schedule, fixture type and location. Use numbers (i.e. 1, 2, and 3) to define the analysis schedule. Use letters (i.e. A, B, C ...) to define unit type. For Control Type use the following abbreviations (TC = time clock/EMS, WOC = wall occupancy sensor, COC = ceiling occupancy sensor and PH = photocell/daylighting).
- Enter a brief description of the lighting group location.
- Enter a full description of the fixtures controlled by each device by completing each appropriate column in the description section (fixture type - Fluor=fluorescent, MH=metal halide, MV=mercury vapor, CF=compact fluorescent, HPS=high pressure sodium, LPS=low pressure sodium, Inc=incandescent, HAL= halogen; lamps per fixture; lamp length in feet; ballast type - E=electronic, M=energy efficient magnetic, S=standard magnetic; watts per lamp).
- For each unique control type, fixture, schedule and location count the number of fixtures controlled and the number of control devices controlling those fixtures. Count the number of fixtures “off” and the number operational. Also count the number of control devices which are operational. An operational measure is one that is working or is capable of working in some capacity. A measure that is broken or incapacitated during the site visit is not operational. A measure that is capable of working but is simply off or not being used during the site visit is considered to be operational. Enter the data in the appropriate unit count columns.
- If sampling, enter a sampling strategy in the comments section. Identify a sample number in the “Sample #” column for each sampling area. The most common sampling strategy is to count fixtures/control devices in a smaller area and extrapolate them to a larger area. For this type of sampling strategy obtain the square footage of the sampling area and total square footage this sampling area represents. Calculate the sample fraction for each sample number. This sample fraction will be used to extrapolate the number of installed and operational units. For other sampling strategies, describe the strategy in the comments section. If sampling is done, a sampling scheme must be developed that is consistent with the budget. A census (sample fraction=1) should be done whenever feasible within the budget.
- If there is a customer baseline which is different than the pre-condition, enter a description of it in the comments section.

4.2.4 Initialize the Controls Calculation Sheet (L6).

- Complete the HVAC related data requirements at the top of the form. This is necessary to select the appropriate DOE-2 prototype data for quantifying the heating/cooling interaction factors. The selection should be based upon the predominant characteristics associated with this item. The heating system efficiency may be obtained by interview. The system does not need to be examined.

4.3 After the on-site survey

4.3.1 Complete the Lighting Controls Inventory form (L3).

- If sampling, use the sample counts and the sample fraction to calculate the Total Controlled Fixture and Control Device Counts. (Total Count = Sample Count / Sample Fraction)
- Look-up each of the lighting fixture types on the Lamp/Fixture Wattages, Table G-1 and enter the appropriate Watts per Fixture values.

4.3.2 Complete the Controls Calculation Sheet (L6).

For each analysis schedule (3 maximum) the total controlled kW needs to be calculated. The Controls Calculation Sheet is designed to assist you in this process.

- For each unique analysis schedule and item, copy the appropriate fixture type, watts/fixture and total fixture count from the Controls Inventory form. Clearly mark which schedule and which item is being addressed by each calculation.
- Multiply the total watts/fixture values by the total count values and divide by 1000 to get total kW controlled for each fixture type.
- Sum the fixture type values to get totals for each analysis schedule for each item.

4.3.3 Complete the Analysis Schedule form (L1).

- For each analysis schedule, enter the occupied hour utilization fraction based on observations and the interview. For controls, the final schedule used in the savings analysis is the difference between the usage with and without the controls. This allows savings to be calculated directly. The pre-condition schedule, as-built schedule and the final schedule (which is the difference between the other two schedules) should each be shown. For most schedules this will involve using two forms. Clearly identify which schedule is which.
- Values need to be entered for all hours, days, and months. Use additional forms if necessary to document more than two seasonal schedules.

- Enter unoccupied hour utilization fractions and seasonality information based upon interview information.
- If the customer baseline is different than the pre-condition, complete an additional set of forms for the customer baseline and indicate at top of the forms which set of forms is for the customer baseline and which is for the pre-condition.

Appendix H

On-Site Survey Forms - Verification Data

The following data collection procedures will be applied to each project that receives a verification evaluation. One form will be completed for each project item. The information on item counts will be used to confirm that energy savings predicted by the program were achieved. The remaining information will be input to a measure retention database for use by future studies.

1. Tasks Before the Onsite Survey

Before the on-site survey , prefill the header box entries.

Item Number: Enter the item number from the recruitment form.

Measure Description: Enter the database measure label as shown on the recruitment form.

Units of Analysis: Enter the measure unit which you are using as the basis for verification. The units of analysis are the units that you intend to count during the site visit. For example, the units of analysis for an EMS system would be the specific features that were to be programmed according to the application file. The units of analysis or the source of these units are specified in Table H-1. For many Custom measures the most appropriate units of analysis are determined in the detailed file review. For Retrofit Express measures, the units of analysis are the units used to compute the rebate, as indicated on the Application.

of Units from File: Enter the number of analysis units rebated, according to the application file. This is the expected count that you will be searching for during the site visit.

2. Tasks During the On-site Survey

During the on-site survey, complete the entries appropriate for the specific measure. Use multiple lines as necessary to identify different descriptions, locations, or manufacturers. You will search for and inspect a census of units for each item, unless a specific sampling plan is developed and approved in advance by the QC engineer.

Description: For some measures the label on the recruitment form does not give an adequate description. For example, the description of some lighting measures does not include the fixture type in terms of the number of lamps. If necessary, enter a more specific description of the various components comprising the item (e.g., the EMS feature or the pump function) in this column.

Location: Enter a brief description of where the unit(s) is located (i.e., NE corner or Building H, scattered on roof, chip assembly area, etc.)

Unit Quantity Installed: For each line, enter the number of installed units that you observed. If you can not gain access to some of the installed units for direct observation, enter the number given to you by the site contact. Make a note at the bottom of the form of counts that you did not directly observe and provide an explanation of why you could not observe them.

Unit Quantity Operational: For each line, enter the number of units that are operational. An operational measure is one that is working or is capable of working in some capacity. A measure that is broken or incapacitated during the site visit is not operational. A measure that is capable of working but is simply off or not being used during the site visit is considered to be operational. If you can not directly confirm the operational status, ask the site contact for this information. Make a note at the bottom of the form of operational status information that you did not directly observe.

Manufacturer, Model Number, and Efficiency: Make entries for those data elements that are appropriate for the specific measure. Table H-1 tells you what information is required for each measure. Enter N/A if you can not find the required data element. The QC engineer will assume that you forgot to get this information, if you leave a required data element blank.

Before leaving the site, add the total installed count in column 3 and compare this value to the “# of units from file” value at the top of the form. If the values are different, provide an explanation at the bottom of the form as to why there was a difference (to the extent that it is known).

Appendix I

Field Measurements

1. One-Time and Short-Term Measurements

At many project-specific sites it will be necessary for you to take one-time power measurements. At some sites it will also be necessary for you to take short term measurements using a Time-Of-Use (TOU) data recorder or a multichannel recorder. A description of each measurement type is provided below:

1.1 One-Time Power (F.W. Bell Power Meter)

The F.W. Bell Model UM-7900 Power Meter measures true RMS volts, true RMS amps, dc amps, frequency, phase angle, power factor, true power, reactive power and apparent power. For this study the majority of buildings will need only a true power measurement.

The meter is generally held inside electrical panels or switch gear where dangerous voltages are present. Do not use this meter unless you have thoroughly read these instructions and wear the necessary protective equipment. Use hot gloves and goggles or a face shield when working inside the panel. Inspect for signs of bare wires or faulty wiring before entering a panel. Wear rubber soled shoes and stay out of water while making measurements. Use insulated tools or wear gloves with uninsulated tools (e.g. ratchet set) whenever working on electrical panels. Also, open panels should never be left unattended.

The meter is capable of measuring true RMS power up to 999.9 KW at voltages up to 660 Vac for single or three phase configurations. Do not use this meter at voltages higher than 660 Vac. Panel voltage is usually indicated on the panel label.

There are several steps necessary to prepare for and to make a power measurement. First, it is necessary to gain access to each leg of the circuit, usually within an electrical panel or switch gear. If measurement can be made at the switch gear, it is a lot easier than at the individual panel. After deciding which circuits in a panel or panels in a switch gear you want to measure, carefully remove the panel cover(s) and place it on the floor. The meter jaw will need to fit around the wire whose power is being measured. Also the leads from the meter will need to be attached to the circuit lugs. Examine the lugs, other potential locations to attach the leads and conductors/circuits to be measured to determine where the measurement will be taken. The size of the panel opening and accessibility of wires and lugs may affect your ability to reach measurement locations and/or get the power meter jaw around wires. Removal of additional panels may or may not provide access. Also, wire ties can be removed to allow access to wires. Always use hot gloves when reaching into the panel.

For single phase power (single wire), the leads' alligator clips will need to be connected to ground and to the lug of the circuit being measured. The jaws will need to go around the conductor being measured.

For three phase power or single phase 3 wire power, readings are made twice because two of the three wires must be measured. For each reading, leads are attached to the conductor being measured and the ground. The same reference ground must be used for each reading. The ground is usually the fourth wire in a three phase circuit. Therefore, for three phase power and single phase 3 wire power, the lead alligator clips will need to be connected to all three circuit lugs or to two of the lugs and to another location in the box which would provide a reference ground (another possible ground is the screw attaching the box to the wall). Also, the jaws of the meter will need to go around two of the three conductors of the three phases, (one at a time). For further clarification on this, see the diagram on page 14 in the instruction booklet.

Once you determine where to measure, turn on the meter using the on/off switch on the handle. If the display does not light up or the low battery indicator is flashing, it needs a new battery. It uses one 9 volt battery. The meter can run for 8 hours of continuous operation. The meter will conserve energy by going into an idle mode (indicated by "IDLE" flashing on the display) if it is left on for more than 5 minutes. To use the meter after it has gone into idle, it will need to be turned off and on again. However, the meter should be turned off when not in use, to conserve batteries. When a battery is needed, load it through the access door located in the meter handle. Always support the battery snap when removing the battery, to avoid unnecessary stress on the battery leads. Once on, the meter performs some initial tests. These take about 2 seconds, after which the word "BELL" is displayed.

The next step is to zero the instrument (a zero indicator flashes to inform you whether you have zeroed the instrument yet). Depress the two white select button located below the on/off switch for at least 2 seconds. First "Poff" appears, then "0.0". When "0.0" is displayed, it has been zeroed. From then on zeroing can be done at anytime.

Next, install the voltage input leads into the jacks in the base of the handle, observing the polarity indicated by the colored arrows (Red=signal, Black=neutral). To measure attach the alligator clip for the black lead to ground (lug) and the alligator clip for the red lead to the lug associated with the conductor/circuit being measured. Now depress the trigger to open the jaws and carefully place the jaws around the conductor/circuit to be measured. Finally, repeatedly push the right hand white select button, located on the handle below the on/off switch, until you encounter the measurement needed. True power is being measured when the display reads "AC" and "KW". If it is hard to see the readings, there is a light for the panel. To turn the light on press both select buttons down for less than two seconds. For most other measurements the method is essentially the same except the select button is pushed until the desired measurement is displayed.

For three phase power or single phase 3 wire power, two of the three circuits must be measured using the same reference ground location. The total power equals the sum of the power of the two circuits measured.

When the measurement is completed, turn off the meter, disconnect the leads and store the meter. Replace all wire ties removed and remount all electrical panel covers.

1.2 One-Time Power (TIF Power Meter)

The TIF Model 2000A Power Meter measures the true RMS power flowing through a selected circuit. The meter is generally held inside electrical panels or switch gear where dangerous voltages are present.

Do not use this meter unless you have thoroughly read these instructions and are wearing the necessary protective equipment. Most of the measurement procedure is the same as the F.W. Bell Meter (see above).

The meter is capable of measuring true-RMS power up to 200 kW at voltages up to 580 for single phase and Wye and Delta three phase configurations. Do not use this meter at higher voltages.

To take a measurement it is necessary to gain access to each leg of the circuit, usually within an electrical panel or switch gear. Carefully remove the panel cover and place it on the floor. Determine if the circuit is likely to be higher or lower than 20 kW. If lower than 20, depress the top button on the left side of the meter and slide the bar (between the buttons) up to lock. If higher than 20, press the bottom button and slide the bar down to lock.

Put on the hot gloves and goggles. The meter is installed by depressing the tab beside the jaw to open them and carefully placing the jaws around the circuit to be measured. Then the alligator clips are attached to the lugs associated with the circuit being measured. The indicator will take approximately 10 seconds to stabilize so that the reading can be made. If the indicator shows only a 1 and a decimal point this means the power is in excess of the range of the meter. If you are at the low-range setting remove the meter and change the range to high. If you are at the high setting, indicate the kW to be in excess of 200 kW.

Depending upon the circuit configuration you will need to make measurements of one, two, or three conductors. Consult the owners manual or Bell Power Meter write up above for additional guidance.

1.3 Amp TOU Logger

The Telog LC2112 Current Recorder is used to measure the current level of selected circuits over time. The meter is generally installed inside electrical panels where dangerous voltages are present. Do not install this meter unless you have thoroughly read these instructions and are wearing the necessary protective equipment.

This meter is programmed to measure the intensity of the magnetic field surrounding a conductor every ten seconds. It calculates and stores the minimum, average, and maximum true root mean square (RMS) current for each 15 minute interval. The logger stores the most recent 6515 data points, or 21 days of data when configured as above. The meter is battery powered, with a 9-volt battery good for approximately 6 months.

The meter is installed by carefully placing the current transformer (CT) around one-leg of the circuit to be monitored. Two sizes of CTs are available, the small one for circuits of 100 amps or less, and the large one rated to 1000 amps. Each logger is configured to a CT size, so use the CT appropriate to the logger. Randy can reconfigure or determine present configuration. When installing the CT make sure you are wearing "hot gloves" and goggles. Identify the best location to place the CT, ensure you are well balanced, open the jaws of the CT and carefully close them around the selected circuit. Ensure that the CT is completely closed. Minimize the disturbance to the electrical wiring to the extent possible being sure to avoid contact with any metal parts. Place the LC2112 recorder in the bottom of the panel or

switch gear or otherwise secure it with wire ties or electrical tape. Check that the CT, recorder, and all other wiring is within the panel or switch gear before replacing the cover.

Make a notation on the Measurement Specification Form pertaining to the specific location of the meter so it can be easily found at the end of the monitoring period. Place a sticker on the panel or switch gear containing the logger. Return the recorder to SBW for data downloading before installing at another site. The meter can be moved to another circuit if desired before downloading; however, the unit must be downloaded within 21 days to avoid overwriting the earliest data.

1.4 Motor TOU Logger

The TOU Motor Logger produced by Pacific Science and Technology records the times that the magnetic field surrounding it crosses a pre-set threshold. The device can be used to measure the on-time of motors and other devices that develop a sufficient magnetic field when on to cross the pre-set threshold. Motor loggers have proved effective determining the on-time of some devices by placing them along the power supply circuit or near the motor windings.

The logger needs to be located so that it displays "on" when the device is on, and "off" when the device is off. Once an appropriate location is determined, it should be fixed by using the magnetic strip, a wire tie, or duct tape as appropriate.

DO NOT PRESS THE RESET BUTTON AT ANY TIME since this erases the memory register.

Loggers should be placed out of sight if possible to lessen the chances that someone might disturb or remove it. After placing the logger, make sure to note the meter number on the Measurement Specification Form and provide a description of specifically where it is placed to ensure it can be retrieved at the end of the metering period.

After removal, the logger should be returned to SBW for data downloading. **ALTERNATIVELY**, the logger can be reused at another site before data transfer.

IMPORTANT NOTE: Each logger must be sent back to SBW after its first measurement period so that we can confirm that it is working. Yellow highlighted meter number confirms that the logger has been tested.

The motor loggers require no maintenance. Do not expose the logger to water. Do not place the motor logger where excessive heat may harm it, such as adjacent to boilers. Do not drop the logger or attach it to rotating devices or in locations where it might fall into hazardous areas.

1.5 Lighting TOU Logger

The TOU Lighting Logger produced by Pacific Science and Technology records the times that the light level crosses a user set threshold. The device can be used to measure the on-time and time of on/off events of lighting fixtures.

The logger needs to be placed and set so that the display shows “on” when the light is on and “off” when the light is off. It must be placed so that it will never indicate “on” when the lamp being metered is off. This might happen where it is exposed to daylight, or light from other sources. Change the placement or sensitivity setting until the readings are correct.

To meter most fluorescent fixtures it is best to remove or open the fixture lens and place the logger so that it faces one of the tubes. While holding the logger in proximity to the lamp with the fixture on, use a small screwdriver to adjust the sensitivity downward until the display indicates “off”. Then turn the sensitivity up until the display indicates “on” and turn it approximately an additional one-quarter turn or less. Now turn the lamp off, and verify that the display indicates “off”. If not, repeat this process.

If the fixture being monitored has two or more levels, this will require a lighting logger to measure each level. Placement and adjustment will be more tricky in this case to isolate the on-time of individual tubes in the fixture.

DO NOT PRESS THE RESET BUTTON. This will erase the memory.

Loggers should be placed out of sight if possible to lessen the chances that someone might disturb or remove it. After placing the logger make sure to note the meter number on the Measurement Specification Form and provide a description of specifically where it is placed to ensure it can be retrieved at the end of the metering period.

After removal the logger should be returned to SBW for data downloading. ALTERNATIVELY, the logger can be reused at another site before data transfer.

IMPORTANT NOTE: Each logger must be sent back to SBW after its first measurement period so that we can confirm that it is working. Yellow highlighted meter number confirms that the logger has been tested.

The lighting loggers require no maintenance. Do not expose the logger to water. Do not place the lighting logger where excessive heat may harm it such as in close proximity to incandescent or halide lamps. Do not drop the logger or attach it to rotating devices.

1.6 C180-Multi-Channel Recorder.

Continuous hourly short term measurements are made with the Synergistics C-180 data recorder. This data recorder is capable of taking 16 single phase true power measurements, 16 analog temperature measurements and measurements from 48 digital sensors. They will be installed according to a measurement strategy developed during the site survey. The NHT instrumentation technician will be responsible for the installation and removal of these recorders. They will be left in place for at least 7 days and will record hourly average values for all measurements specified in the measurement plan.

2. Measurement Plan

At many project-specific sites, a series of short term measurements will be taken to support the calculation of gross energy savings. You will determine the type of measurements to be taken at each site during the development of the evaluation plan. The required measurements will be documented on the Measurement Specification Form (see Section 3. below). If only TOU loggers are specified on the form, you must install them during the on-site survey. If both TOU and multichannel loggers are specified, you can either install the TOU loggers during the on-site survey or have them installed by the NHT instrumentation technician, who will be installing the multichannel recorders. An additional trip to the sites with the TOU loggers will be required to retrieve the instruments. The loggers will be returned to the SBW office for downloading.

A measurement plan will be completed by the NHT instrumentation technician for each site where multichannel data recorders are specified. The measurement plan will consist of the Measurement Specification Form that you completed and a variety of other forms, completed by NHT, that fully document the recorder installation. The measurement plan for each building will address the following topics.

1. Sensors selected for each measurement to be taken.
2. Sensor configuration (number, size, placement).
3. Study period (period of time during which measurements are taken).
4. Duration of measurement (length of data collection period for a particular measurement).
5. Time interval of data records
6. Channel assignments (if a data logger is used).
7. End-use definitions (channel aggregations).
8. Sampling design (if only a portion of the total possible measurements were made).
9. Other requirements (e.g., cabling network and communications).

3. Measurement Specification Form

A Measurement Specification Form must be completed for all sites where short term measurements occur. At the top of the form you will record:

1. Site ID from the Recruitment form
2. Auditor Initials
3. Date
4. Page __ of __

Before the loggers or data recorders are installed, record the following information on the Measurement Specification Form:

1. **Project ID:** Enter the relevant project ID from the recruitment form.
2. **Item Number:** Enter the relevant item number from the recruitment form.

3. **Logger ID:** Enter the ID number for the specific logger or recorder being installed. This item is completed after the logger is installed.
4. **Description of Measurement:** A brief description of the measurement to be made.
5. **Time Interval (Multichannel Recorder Only):** The time increment that data is recorded for a particular measurement. The time increment for measurements that are recorded on a data logger can range from one minute to one hour.
6. **Location:** Area in building where the sensor was located. This information must be specific enough to find the device at the end of the measurement period.
7. **Date Installed and Removed:** Enter the date and time that the logger is initially installed and removed at the end of the measurement period. This information is particularly important for data downloading. The data is entered after the respective events occur.

Appendix J

Operations Staff Survey

1. Interview Instructions for Operations Staff Survey

1.1 Purpose

The purpose of this interview is to collect information from operation staff that will be used in the analysis of free ridership for CPS sites. Following is the definition of free ridership which you should keep in mind while conducting this interview:

- **Free-ridership.** Free ridership occurs when customers receive rebates even though they would have implemented an efficiency improvement without the rebate; hence, they are getting a “free ride” on the incentive program. The effect of free ridership is estimated in the net savings analysis, which is performed on all projects in the HVAC, LIGHT and PROCESS end uses.

For Custom Free ridership projects the analysis of net savings will include an analysis of the data collected from the Operations Staff Survey.

1.2 Selection of the Respondent

The operations staff contact should be the respondent to this survey.

- **Operations Staff Contact.** A member of the customer’s staff who is familiar with the operation of the items (for which rebates were paid) installed at a sample site and the operation of the systems that those items affect. This is the person who is identified as the **Measure Information Contact** on the Recruitment Form (See Appendix A).

However, this survey is only completed if the operations staff contact is different than the

- **Decision-Maker.** A member of the customer’s staff who is familiar with the process by which the customer decided to install the items (for which rebates were paid) at a sampled site.

1.3 How are these Data Used

Completed Operations Staff surveys are used in two ways:

1. **Customize Decision-Maker Survey.** The completed Operation Staff survey, along with the site evaluation plan, completed Spillover surveys and Vendor surveys (which were follow-up to Spillover) are sent to the Net Impact Experts (CPS sites only). They will use this information to create customized questions for the Decision-Maker survey for projects whose Free Rider Type = Custom (on the recruitment form).

2. **Custom Analysis of Free-Ridership.** The completed surveys will be attached to the draft site evaluation report. All of the site evaluation reports for CPS sites will be given to the Net Impact Experts who will perform the custom analysis of free ridership. Once the custom analysis of free ridership is complete, the results will be added to the site evaluation reports by the Net Impact Experts.

1.4 Completing Survey Forms

When the operation staff contact is a different person than the decision-maker, complete one Operations Staff survey for each item whose project has Free Rider Type = Custom (on the recruitment form).

Operations Staff Survey

PG&E Industrial Retrofit Program Evaluation

Before Beginning an Interview:

1. Determine whether the operation staff contact is a different person than the decision-maker.
 2. Review the exact description of each item whose project has Free Rider Type = Custom.
 3. Make copies of this form for each item whose project has Free Rider Type = Custom, write the SITE ID, PROJ ID, and Item Number on each copy.
 4. Thoroughly understand the instructions which precede this survey instrument.
1. Was the installation of the (describe item which received a PG&E rebate) part of a larger project? **If necessary read examples:** *Upgrading or retooling an assembly line, Increasing production capacity, Renovating a building or part of building.*

_____ Yes, (**Describe:** _____

- _____ No (**Go to 4**)
_____ Don't Know (**Go to 4**)
_____ Refused (**Go to 4**)

2. Where did the **idea** come from for (describe the larger project)? **If necessary read examples:** *Consultant, Internal staff, One of their competitors, PG&E.*

3. What were the main **reasons** for (describe the larger project)? **Ask them to describe up to three reasons. If necessary read examples:** *Reduce operating costs, Increase output, Reduce emissions, Increase safety.*

4. What were the main **reasons** for installing the (describe the item which received a PG&E rebate)? **Ask them to describe up to three reasons. If necessary read examples:** *Increase output, Reduced maintenance, Reduced energy costs, Favorable Payback.*

5. Where did the **idea** come from to install (describe the item which received a PG&E rebate)? **If necessary read examples:** *Consultant, Previous experience with energy efficiency projects, PG&E, Equipment supplier or installer, Internal staff.*

6. What role did PG&E's rebate play in the decision to install (describe the item which received a PG&E rebate)? **If necessary read examples:** *Made it financially feasible, Had no effect, Would not have considered the item except for the rebate.*

7. When did the people involved in the project learn about the possibility of a PG&E rebate? **If necessary read examples:** *Learned about rebate after installing the item, Learned about the rebate before installing the item. If more than one person was involved, record the earliest point that anyone in the organization new about the rebate.*

8. If the PG&E rebate had not been available, would you have installed the same equipment, with the same level of energy efficiency....

	Count	%	
1	_____	_____	...at the same time or within 6 months? (Go to End)
2	_____	_____	...within 6 months to 1 year? (Go to End)
3	_____	_____	...one to two years later? (Go to End)
4	_____	_____	...two to three years later? (Go to End)
5	_____	_____	...three to four years later? (Go to End)
6	_____	_____	...four or more years later? (Go to End)
7	_____	_____	...Never (Continue)
98	_____	_____	...Don't Know (Continue)
99	_____	_____	...Refused to Answer (Continue)

Time relative to the installation date. For items that consist of more than one piece of equipment, the Count and % columns allow you to record changes which would have occurred over time. Ultimately, **you must indicate the %** that would have occurred in each period. 100% will appear in one period for single piece items. The percentages must always sum to 100%. If the percentage for 7, 98 or 99 is greater than zero, continue, even if there are entries for 1 through 6.

Site ID _____ Project ID _____ Item Number _____

9. Did you consider alternatives to (describe item which received a PG&E rebate) that would have been less energy efficient?

- Yes
- No (**Go to End**)
- Don't Know (**Go to End**)
- Refused to Answer (**Go to End**)

10. Please describe these alternatives.

11. Who identified these alternatives? **If necessary read examples:** *Consultant, Internal staff, PG&E, Equipment supplier.*

END: Those are all the questions I have. I greatly appreciate your time and cooperation. Thank you very much.

Appendix K

Standard Decision-Maker Survey

1. Interview Instructions for Decision-Maker Survey

1.1 Purpose

Part of the purpose of this interview is to gather data needed to estimate the engineering-based and decision-analysis based Net-to-Gross Ratio (NTGR). The NTGR quantifies the free ridership effect for each item which makes up the LIGHT, HVAC or PROCESS end use projects (**This Survey is Not used for MISC end use projects**) installed at a sampled site. This survey also provides some of the information needed to conduct a custom analysis of free ridership for CPS sites. Following are the definitions of free-ridership and the associated concepts of net savings and NTGR.

- **Free-ridership.** Free ridership occurs when customers receive rebates even though they would have implemented an efficiency improvement without the rebate; hence, they are getting a “free ride” on the incentive program. The effect of free ridership is estimated in the net savings analysis, which is performed on all projects in the HVAC, LIGHT and PROCESS end uses.
- **Engineering-Analysis Net Savings.** Difference between customer baseline consumption and as-built consumption. The description of the customer baseline comes from the Standard Decision-Maker Survey.
- **Engineering-Based Net-to-Gross Ratio (NTGR).** Ratio of engineering-analysis net savings to gross savings.
- **Decision-Analysis Net Savings.** An estimate of net savings which is based on an assessment of the probability that the customer would have installed, without the rebate, exactly the same equipment which was installed with the rebate.
- **Decision-Analysis Based Net-to-Gross Ratio (NTGR).** Ratio of decision-analysis net savings to gross savings. The data needed to compute the decision-analysis NTGR comes from the Standard Decision-Maker Survey
- **Custom Free-Ridership Analysis.** This is an analysis of free ridership which will be conducted by the Net Impact Experts after data are available from the Spillover, Vendor, Operations Staff and Decision-Maker surveys, along with data from the program files, on-site survey and the engineering analysis of gross and net savings.

1.2 Selection of Respondent

The Decision-Maker, identified on the recruitment form, should be the respondent to this survey.

- **Decision-Maker.** A member of the customer's staff who is familiar with the process by which the customer decided to install the items (for which rebates were paid) at a sampled site.

If decision-maker is no longer there, explain the purpose of the survey and attempt to find another person who would know how and why the company decided to install the items for which rebates were paid in 1995.

1.3 Customizing the Standard Decision-Maker Survey

If a site contains any project for which Free Rider Type = Custom, i.e., Site Type = CPS, you must work with the Net Impact Experts to customize the standard decision-maker survey. With Wendy's assistance, you will provide the following information to Rick Ridge (telephone number 510-865-6011, fax number 510-865-1057), which will be used in customizing the standard survey:

- Revised evaluation plan showing the final description of the measures.
- Response matrix from the Spillover Survey.
- Completed Vendor Survey(s) (if any) associated with Spillover Survey.
- Completed Operations Staff survey (if any)

You will be sent one or more pages of additional questions to ask about selected items. Study these carefully before conducting the decision-maker survey

1.4 Vendor Follow-Up

In some cases, a follow-up Vendor Survey will be required to complete the collection of free ridership information. Vendor surveys are required when the decision-maker claims that PG&E's programs had little influence on the decision to install the paid items. Specifically, you need to complete a follow-up vendor survey for any item where the **NTGR based on the Decision-Maker Survey responses is less than or equal to .3 (computed in the Site Evaluation Workbook).**

1.5 How are these Data Used

Completed Decision-Maker surveys are used in four ways:

1. **Decision-Analysis Based Net-to-Gross Ratio (NTGR).** Responses to questions 5 through 7 and 11 are used in your Site Evaluation Workbook to calculate the standard decision-analysis based NTGR for all items, except those in the MISC end use. Response to question 10 is also used in the calculation of this ratio for items with project type = "Project Specific."
2. **Engineering -Based Net-to-Gross Ratio (NTGR).** The responses to 11 determines whether the item is Early Replacement. If it is, the engineering-base NTGR = 1. If it is Normal Replacement, you will use the response to questions 9 to model the customer baseline. The Workbook will use this information to enhance the estimate of NTGR for items with project type = "Project Specific."

3. **Vendor Follow-Up.** Responses to questions 17 and 18 provide the name of the vendor involved in specifying each item, which will be used if you need to complete a vendor survey.
4. **Custom Free-Ridership Analysis.** All other questions, along with those which are added for CPS sites, will be used by the Net Impact Experts to perform a custom analysis of free ridership.

1.6 Completing the Decision-Maker Survey

The questions you ask will depend on the classification of the projects installed at each site. The required classification information is provided by the recruitment form. A label precedes each questions which tells you when to ask the question.

For all sites make a copy of the survey for each sampled item. Write the SITE ID, PROJ ID, and Item Number on each copy. Put a check mark next to questions which you will need to ask for each item.

Arrange copies of the survey by end use. Group similar measures within each end use. This is particularly important for the LIGHT end use.

You can shorten the survey time by asking the decision maker if the responses to questions 2 through 8 are the same for a group of similar measures. If the response is “yes” you can record the list of items on one copy of the survey and transfer the data to the copy which is devoted to each of those items after the you complete the interview.

1.7 If You Need Help

You may need assistance completing the survey in some cases. For example, you may be unable to resolve contradictory responses or unable to obtain responses to critical questions. If you have any substantial problem, call Rick Ridge (510-865-6011). If he is not available, leave a message. If you have not heard back from Rick within 2 hours, call Katherine Randazzo (707-874-3100). If she is not available, leave a message. If you have not heard back from Katherine within 2 hours, call Michael Baker.

Standard Decision-Maker Survey

PG&E Industrial Retrofit Program Evaluation

Before Beginning an Interview:

1. Obtain the Decision-Maker name and telephone number.
 2. Obtain customized questions from Net Impact Experts if site contains any projects for which Free Rider Type = Custom.
 3. Review the 1995 item list on the recruitment form for all HVAC, LIGHT and PROCESS projects associated with this site.
 4. Make one copy of the survey for each sampled item.
 5. Group similar items, e.g., all lighting capacity changes or all efficient motors.
 6. Put a check next to the questions you have to ask for each item.
 7. Thoroughly understand the instructions which precede this survey instrument.
- A. Hello. This is _____ from SBW Consulting calling on behalf of Pacific Gas & Electric. May I please speak with (name of Decision-Maker)?

If the decision-maker is not available, but still reachable: schedule a callback

- **Decision-Maker.** A member of the customer's staff who is familiar with the process by which the customer decided to install the items (for which rebates were paid) at a sampled site.

If decision-maker is no longer there, explain the purpose of the survey and attempt to find another person who would know how and why the company decided to install the items for which rebates were paid in 1995..

___ Yes, (**Record Name and Phone Number and start again with new contact**)

Name: _____

Telephone Number: _____

___ No (**Go to End**)

READ IF NECESSARY: If you would like the name and telephone number of a person at PG&E who can give you more information about this study, you may call Lisa Reid of PG&E at (415) 973-4747.

- B. Review the list of LIGHT, HVAC or PROCESS items for which rebates were paid in 1995. Confirm that the person you are speaking to is familiar with the decision to install these items and obtain the rebate. If not find the correct person. For sites with more than one item you may have to speak to more than one person.**
- C. Say:** I want to assure you that your answers will be kept strictly confidential and will not be shared with anyone outside of PG&E. **Then ask the following questions.**
1. **Use for all items.** When and how did you first learn about PG&E's Energy Efficiency Rebate Program?

2. **Use for all items.** Keeping that in mind, did you first hear about any of PG&E's Energy Efficiency Rebate Programs BEFORE you began to think about (describe item) or was it AFTER you began to think about it? (**Circle One**)

1 Before (**Go to Q.6**) 2 After
98 Don't Know 99 Refused to Answer

3. **Use for all items.** Was it BEFORE or AFTER you began to actually look at or collect information about the (describe item)? (**Circle One**)

1 Before (**Go to Q.6**) 2 After
98 Don't Know 99 Refused to Answer

4. **Use for all items.** Did you hear about the program BEFORE or AFTER you selected or decided on the exact specifications for (describe measure)? (**Circle One**)

1 Before (**Go to Q.6**) 2 After
98 Don't Know 99 Refused to Answer

5. **Use for all items.** Finally, did you hear about the program BEFORE or AFTER you installed (describe item)? (**Circle One**)

1 Before (**Go to Q.6**) 2 After
98 Don't Know 99 Refused to Answer

(If "Before" is circled for Q.2 or Q.3 or Q.4, the response to 5 must be "Before".)

6. **Use for all items.** On a scale from 0 to 10, with 0 being no influence at all and 10 being a lot of influence, how much influence did the PG&E rebate have on your decision to install (describe measure)? (**This only refers to PG&E's influence on the design or specification of the item, not on the timing of the item's installation.**)

___ Response (**0-10**) 98 Don't Know 99 Refused to Answer

7. **Use for all items.** If the PG&E rebate had not been available, how likely is it you would have installed exactly the *same* (describe item) (**if the installed equipment has specific efficiency ratings such as SEER, COP, KW/TON, Premium Motors add -- with the same efficiency rating**). Please use a scale from 0 to 10, with 0 being not at all likely and 10 being very likely.

___ Response (**0-10**) 98 Don't Know 99 Refused to Answer

Special Instruction for Contradictory Responses: If [Q.6 is 0,1,2 and Q7 is 0,1,2] or [Q.6 is 8,9,10 and Q.7 is 8,9,10]. Probe for the reason. However, it is important not to communicate a challenging attitude when posing the question. For example, say,

When you answered "8" for the question about the influence of the rebate, I would interpret that to mean that the rebate was quite important to your decision to install; then, when you answered "8" for how likely you would be to install the same equipment *without* the rebate, it sounds like the rebate was *not* very important in your installation decision. I want to check to see if I a misunderstanding your answers or if the questions may have been unclear.

If they volunteer a helpful answer at this point, respond by changing the appropriate answer. If not, follow up with something like:

Will you explain in your own words, the role the rebate played in your decision to install this efficient equipment?

If possible translate their answer into a question 7/8 response and check the response with the respondent for accuracy. If the answer doesn't allow you to decide what answer should be changed, write the answer down and continue the interview.

Answer: _____

8. **Only use for Project Type = Project Specific**. Did you consider any alternatives to the (describe item) installed with the PG&E rebate?

- Yes No (**Go to Q.11**)
 Don't Know (**Go to Q.11**) Refused to Answer (**Go to Q.11**)

9. **Only use for Project Type = Project Specific**. Please describe the alternative (**Not the Paid Item**) which you were most likely to have installed in the absence of the PG&E rebate. **Ask them to be as specific as possible. This will define the customer baseline condition and you will have to estimate savings using this baseline.**

10. **Only use for Project Type = Project Specific**. In the absence of the PG&E rebate, is it more likely that you would have done nothing or is it more likely that you would have installed the alternative you just described?

- 1** Nothing **2** The Alternative Described in Q.9
98 Don't Know **99** Refused to Answer

11. **Use for all items. This question asks about the paid item. Make sure the respondent is NOT THINKING about the alternative to the paid item, which they described in Q.9.** If the PG&E rebate had not been available, would you have installed the *same* (describe item) (if **efficiency rated add**, with the same efficiency rating) ...

	Count	%	
1	_____	_____	...at the same time or within 6 months?
2	_____	_____	...within 6 months to 1 year?
3	_____	_____	...one to two years later?
4	_____	_____	...two to three years later?
5	_____	_____	...three to four years later?
6	_____	_____	...four or more years later?
7	_____	_____	...Never
98	_____	_____	...Don't Know
99	_____	_____	...Refused to Answer

Time relative to the installation date. For items that consist of more than one piece of equipment, the Count and % columns allow you to record changes which would have occurred over time. Ultimately, **you must indicate the % that would have occurred in each period. 100% will appear in one period for single piece items. The percentages must always sum to 100%.**

12. **Only use for Free Rider Type = Custom.** Was the installation of the (describe item which received a PG&E rebate) part of a larger project? **If necessary read examples:** *Upgrading or retooling an assembly line, Increasing production capacity, Renovating a building or part of building.*

_____ Yes, (Describe: _____)

_____ No (Go to Q.15)

_____ Don't Know (Go to Q.15)

_____ Refused (Go to Q.15)

13. **Only use for Free Rider Type = Custom.** Where did the **idea** come from for (describe the larger project)? **If necessary read examples:** *Consultant, Internal staff, One of their competitors, PG&E.*

14. **Only use for Free Rider Type = Custom.** What were the main **reasons** for (describe the larger project)? **Ask them to describe up to three reasons. If necessary read examples:** *Reduce operating costs, Increase output, Reduce emissions, Increase safety.*

15. **Only use for Free Rider Type = Custom.** What were the main **reasons** for installing the (describe the item for which rebate was paid)? **Ask them to describe up to three reasons. If necessary read examples:** *Increase output, Reduced maintenance, Reduced energy costs, Favorable Payback.*

16. **Only use for Free Rider Type = Custom.** Where did the **idea** come from to install (describe the item for which rebate was paid)? **If necessary read examples:** *Consultant, Previous experience with energy efficiency projects, PG&E, Equipment supplier or installer, Internal staff.*

17. **Use for all Items.** Which of the following provided the most assistance in the design or specification of (describe measure)? (**Read the list**)

- Designer or Consultant
 Equipment Distributor or Manufacturers Representative
 Installer
 Internal Staff (**go to end**)
 Don't Know (**go to end**)
 Refused to Answer (**go to end**)

18. **Use for all items. Ask for the name and telephone number for the person who assisted with design and specification. If they don't remember the specific person, ask for the firm name. If they don't have the phone number get the city where the firm is located.**

Vendor Firm Name _____

Telephone Number _____

Contact at Vendor _____

Located in City _____

END: Those are all the questions I have. I greatly appreciate your time and cooperation. Thank you very much.

Appendix L

Site Evaluation Report Template

IMPACT EVALUATION REPORT SITE #XXX

SITE SUMMARY INFORMATION

Company Name:

Site Name: [Obtained from Evaluation Plan]

Site Address:

Principal Site Contact Name: Telephone:

PG&E Representative Name: Telephone:

Assigned Lead Engineer:

SITE ID NO.	174
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PROJECTS PAID BY 1995 PROGRAMS

Project Application ID No. Number	Program Year	Control Number	Account Number	End Use	PG&E Program	Project Type
--------------------------------------	-----------------	-------------------	-------------------	---------	--------------	-----------------

[Obtained from Evaluation Plan]

ITEMS FOR EACH PROJECT

Project Item ID No. No. Efficiency Measure	Savings			Rebate (\$)
	(kWh)	(kW)	(Therms)	

Spillover Analysis

If no spillover was found in the Spillover Survey, make a statement to that effect at the bottom of this page. If spillover was found, complete the spillover portion of this report (described later in this template), and delete this section from the report.

Project-Specific Impact Evaluation Report for Project ID: End Use:

Measure Description (*Modified Evaluation Plan per the results of the on-site survey*)

Efficiency Improvement: Description of the efficiency measure and how it results in kWh, kW or Therm savings. This will include a preliminary description of the systems directly affected by the measure and their location at the project site, e.g., overhead lighting in assembly building #3.

Preliminary Pre-installation Equipment and Operation: This data should be obtained from the application file and telephone discussion with the assigned PG&E Customer Representative or customer staff. For early replacement measures, this section should describe the type and quantity of the replaced equipment, including relevant performance specifications, e.g., SEER or capacity. For normal replacement measures, the description in this section would depend upon the applicability of Title 20/24 to the measure. If Title 20/24 was not relevant, this section should describe the type and quantity of the replaced equipment (same as early replacement). If Title 20/24 was relevant, this section should describe any Title 20/24 requirements that apply to the measure.

Preliminary As-Built Equipment and Operation: This data should also be obtained from the application file and telephone discussion with MARs or customer staff. The type (make and model) and quantity of equipment subject to the rebate should be described along with the expected operating schedule. Be sure that the schedule includes daily and weekly variations in the operation of the affected equipment. Remember that savings estimates are based only on the post-period operating schedule, unless the paid measure affects the schedule of operation.

Primary Business and Product: Describe the type of business that is being conducted at the site and a general description of the product (if any) that is being produced. Make special note, if the measure is installed only in the office portion of a manufacturing facility.

Variability in Schedule and Production: Describe seasonal variations in the operation of the affected equipment, including variations with production output. This schedule information, combined with the daily and weekly schedule described above under as-built operation, should provide a complete annual schedule that accounts for all hours of the year.

Algorithms for Estimating Energy Savings for Paid Measure

PG&E Algorithm: *Same as Evaluation Plan.*

Evaluation Algorithm: An edited version of the Evaluation Plan that describes the final approach used for estimating savings in the evaluation. Includes equations that were applied by the evaluation team or a description of the computer models that were used. Be sure it includes the final version of the annual extrapolation methodology.

Data Collection (*Modified Evaluation Plan per the results of the on-site survey*)

Site Specific Input Parameters: A final listing of input parameters that were obtained from site specific data sources.

Data Collection Method: Description of the data source and measurement method that was used for each input parameter. If new special metering was involved, this section will describe the data recorders and sensors that were installed, the measurements that were taken and the duration of the measurement period.

Customer Cost/Benefit Analysis (CPS projects only)

Cost and Payback: *Same as Evaluation Plan.*

Non-Energy Costs and Benefits: *Same as Evaluation Plan.*

Free-Ridership (Standard Project-Specific Projects)

Standard Decision-Maker Survey: Results of the telephone interview with the decision-maker who authorized installation of the paid 1995 measure.

Vendor Survey: Results of vendor telephone interview, made in cases when the customer would have implemented the measure without the program.

Customer Baseline: Results from the on-site survey and telephone follow-up which describe the equipment characteristics and operating practices which would have been adopted for the affected systems in the absence of the rebate (normal replacement measures only).

NTGR Estimates: Describe the decision-analysis and engineering based estimates of NTGR and the result of averaging these two estimates.

Free-Ridership (Custom Project-Specific Projects)

This section to be written by the Net Impact Experts after all CPS sites are complete.

Energy Savings

Comparison of PG&E and Evaluation Estimates: A description of the reasons why the evaluation estimate of savings is different than the estimate found in the program database.

Savings Persistence: Description of likely service life for the measure and factors which might tend to influence its performance over time based on interview with customer staff and data from published sources.

[The above descriptions are repeated for each project]

Impact Evaluation Report for Spillover ID: *(Modified Evaluation Plan per the results of the on-site survey)*

Spillover Determination: Description of why this efficiency technology is considered to be a program spillover measure. Also includes the results of the vendor survey in cases when the customer was not influenced by the program.

Efficiency Improvement: Description of the spillover measure and how it results in kWh, kW or Ther savings. This will include a final description of the systems directly affected by the measure and their location at the project site.

Pre-installation Equipment and Operation: Description of the type and quantity of the equipment replaced by the spillover measure, including relevant performance specifications.

Evaluation Algorithm: The approach used for estimating the spillover measure energy savings in the evaluation. Includes equations that were applied by the evaluation team or a description of the computer models that were used.

Data Collection Methodology: Description of the algorithm input parameters that were obtained from site-specific data sources. Also a description of the data sources and measurement methods that were used for each input parameter.

[The above descriptions are repeated for each spillover measure]

SITE ID

SAVINGS ESTIMATES FOR PROJECT-SPECIFIC EVALUATIONS

Project:	Item No.:	End Use:	First-Year Savings				Realization Rate		
			MWh	kW	Therms	NTGR	kWh	kW	Therms
Measure:									
Gross Savings									
	Program Database					—	—	—	—
	Application File					—			
	As-Built Evaluation					—			
Net to Gross Ratio (NTGR)									
	Program Database		—	—	—	—	—	—	—
	Standard Evaluation		—	—	—	—	—	—	—
	Custom Evaluation		—	—	—	—	—	—	—
Net Savings									
	Program Database					—	—	—	—
	Customer Baseline					—	—	—	—
	Standard Evaluation					—			
	Custom Evaluation					—			

Project:	Item No.:	End Use:	First-Year Savings				Realization Rate		
			MWh	kW	Therms	NTGR	kWh	kW	Therms
Measure:									
Gross Savings									
	Program Database					—	—	—	—
	Application File					—			
	As-Built Evaluation					—			
Net to Gross Ratio (NTGR)									
	Program Database		—	—	—	—	—	—	—
	Standard Evaluation		—	—	—	—	—	—	—
	Custom Evaluation		—	—	—	—	—	—	—
Net Savings									
	Program Database					—	—	—	—
	Customer Baseline					—	—	—	—
	Standard Evaluation					—			
	Custom Evaluation					—			

Project:	Item No.:	End Use:	First-Year Savings				Realization Rate		
			MWh	kW	Therms	NTGR	kWh	kW	Therms
Measure:									
Gross Savings									
	Program Database					—	—	—	—
	Application File					—			
	As-Built Evaluation					—			
Net to Gross Ratio (NTGR)									
	Program Database		—	—	—	—	—	—	—
	Standard Evaluation		—	—	—	—	—	—	—
	Custom Evaluation		—	—	—	—	—	—	—
Net Savings									
	Program Database					—	—	—	—
	Customer Baseline					—	—	—	—
	Standard Evaluation					—			
	Custom Evaluation					—			

SITE I

COMPARISON OF EVALUATION AND PROGRAM DATABASE ESTIMATES

Site ID	Proj ID	Item No.	Efficiency Measure	Reasons for Differences between Evaluation and Program Database Estimates of Gross Savings			Other Differences (Yes or No)
				% Change in...	Capacity or number of units	Operating Hours	
				kW or Btu/h Savings per unit			

SITE ID:

GROSS kW AND kWh SAVINGS BY COSTING PERIOD FOR PAID ITEMS

Project: Item No.:

Measure:

PG&E Costing Period	Hour of PG&E System Maximum	Average kW Savings	Average kW Savings		kWh Savings	kWh Adjustment Facto	Annual kWh Savings	Connected Load kW
			Coincident wit System Maximum	KW Adjustment Facto				
Summer On-Peak ¹	3:00 PM							
Summer Partial Peak ²	6:00 PM							
Summer Off-Peak ³	10:00 PM							
Winter Partial Peak ⁴	6:00 PM							
Winter Off-Peak ⁵	8:00 AM							

Project: Item No.:

Measure:

PG&E Costing Period	Hour of PG&E System Maximum	Average kW Savings	Average kW Savings		kWh Savings	kWh Adjustment Facto	Annual kWh Savings	Connected Load kW
			Coincident wit System Maximum	KW Adjustment Facto				
Summer On-Peak ¹	3:00 PM							
Summer Partial Peak ²	6:00 PM							
Summer Off-Peak ³	10:00 PM							
Winter Partial Peak ⁴	6:00 PM							
Winter Off-Peak ⁵	8:00 AM							

Project: Item No.:

Measure:

PG&E Costing Period	Hour of PG&E System Maximum	Average kW Savings	Average kW Savings		kWh Savings	kWh Adjustment Facto	Annual kWh Savings	Connected Load kW
			Coincident wit System Maximum	KW Adjustment Facto				
Summer On-Peak ¹	3:00 PM							
Summer Partial Peak ²	6:00 PM							
Summer Off-Peak ³	10:00 PM							
Winter Partial Peak ⁴	6:00 PM							
Winter Off-Peak ⁵	8:00 AM							

¹ May 1 to Oct 31, 12pm-6pm weekdays

² May 1 to Oct 31, 8:30am - noon, 6pm -9:30pm weekdays

³ May 1 to Oct 31, 9:30pm - 8:30am weekdays, all day weekends

⁴ Nov 1 to Apr 30, 8:30am-9:30pm, weekdays only

⁵ Nov 1 to Apr 30, 9:30pm-8:30am weekdays and all da on weekends

SITE ID

VERIFICATION RESULTS FOR VERIFY-PROJECT EVALUATIONS

Project: _____ **Item No.:** _____ **End Use:** _____
Measure: _____
 Location: _____

Type of Units Counted:

Number of Units			Percent of Application Count	
Application	Installed	Operational	Installed	Operational

Net-to-Gross Ratio (NTGR)
 Program Database
 Standard Evaluation

Project: _____ **Item No.:** _____ **End Use:** _____
Measure: _____
 Location: _____

Type of Units Counted:

Number of Units			Percent of Application Count	
Application	Installed	Operational	Installed	Operational

Net-to-Gross Ratio (NTGR)
 Program Database
 Standard Evaluation

Project: _____ **Item No.:** _____ **End Use:** _____
Measure: _____
 Location: _____

Type of Units Counted:

Number of Units			Percent of Application Count	
Application	Installed	Operational	Installed	Operational

Net-to-Gross Ratio (NTGR)
 Program Database
 Standard Evaluation

SITE ID:

SAVINGS ESTIMATES FOR EACH SPILLOVER ITE

Item Number	End Use	Measure	First-Year Savings		
			MWh	kW	Therms

SITE ID:

GROSS kW AND kWh SAVINGS BY COSTING PERIOD FOR SPILLOVER ITEM

Item No.:

Measure:

PG&E Costing Period	Hour of PG&E System Maximum	Average kW Savings	Average kW Savings	KW Adjustment	kWh Adjustment	Annual kWh Savings	Connected Load kW
			Coincident with System Maximum	Facto	Facto		
Summer On-Peak ¹	3:00 PM						
Summer Partial Peak ²	6:00 PM						
Summer Off-Peak ³	10:00 PM						
Winter Partial Peak ⁴	6:00 PM						
Winter Off-Peak ⁵	8:00 AM						

Item No.:

Measure:

PG&E Costing Period	Hour of PG&E System Maximum	Average kW Savings	Average kW Savings	KW Adjustment	kWh Adjustment	Annual kWh Savings	Connected Load kW
			Coincident with System Maximum	Facto	Facto		
Summer On-Peak ¹	3:00 PM						
Summer Partial Peak ²	6:00 PM						
Summer Off-Peak ³	10:00 PM						
Winter Partial Peak ⁴	6:00 PM						
Winter Off-Peak ⁵	8:00 AM						

Item No.:

Measure:

PG&E Costing Period	Hour of PG&E System Maximum	Average kW Savings	Average kW Savings	KW Adjustment	kWh Adjustment	Annual kWh Savings	Connected Load kW
			Coincident with System Maximum	Facto	Facto		
Summer On-Peak ¹	3:00 PM						
Summer Partial Peak ²	6:00 PM						
Summer Off-Peak ³	10:00 PM						
Winter Partial Peak ⁴	6:00 PM						
Winter Off-Peak ⁵	8:00 AM						

¹ May 1 to Oct 31, 12pm-6pm weekdays

² May 1 to Oct 31, 8:30am - noon, 6pm -9:30pm weekdays

³ May 1 to Oct 31, 9:30pm - 8:30am weekdays, all day weekends

⁴ Nov 1 to Apr 30, 8:30am-9:30pm, weekdays only

⁵ Nov 1 to Apr 30, 9:30pm-8:30am weekdays and all day on weekends

ATTACHMENTS

Recruitment Form: A copy of the completed recruitment form for the site. The form includes a complete listing of site contacts and a summary of program participation history.

Contact Log: Log sheet which records the name, date and topic for telephone and in-person contacts with the customer or PG&E staff.

Backup Data: Copy of important backup data used in the analysis of energy savings.

Appendix M

Site Evaluation Reports

As part of this evaluation, we prepared 379 site reports covering 493 project-specific and verify projects, which in turn accounted for 852 measure items. In lieu of providing the hard copy reports in this appendix, we sent electronic versions of these reports to PG&E, along with certain technical appendices which were supplied to PG&E as hardcopy attachment for each project-specific site report. In addition, the site zip files (a data product described in Appendix N) contain these reports as well.

To facilitate matching a given site with the corresponding site report, we have provided two tables, described below, in this appendix. Each table lists the site ID number we assigned, the company name, the site type (Project Specific or Verify), the end uses represented at the site, and the number of measures (items) at the site.

- **Table M-1 (pages M-2 to M-9):** breaks the sites according to site type, then lists them in ascending order by site ID number.
- **Table M-2 (pages M-10 to M-17):** Lists company names alphabetically.

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-1: List of Evaluated Sites
 (sorted by Site Type, then by Site No.)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use							
		Verify				Proj-Spec		Verify				Proj-Spec			
		H	L	M	P	H	L	P	H	L	M	P	H	L	P
2	Proj Spec			4				3				21			3
3	Proj Spec	1						1				1			2
5	Proj Spec						2								3
12	Proj Spec	1						1				2			1
13	Proj Spec				1			2					1		2
19	Proj Spec							1							9
20	Proj Spec							1							6
21	Proj Spec				1			1					1		1
35	Proj Spec	1						1				1			1
41	Proj Spec							1							1
51	Proj Spec							1							3
52	Proj Spec							1							2
57	Proj Spec							1							4
59	Proj Spec							2							9
61	Proj Spec							1							6
62	Proj Spec							1							10
64	Proj Spec							1							4
66	Proj Spec							1							5
67	Proj Spec	1						3				1			3
70	Proj Spec							1							5
71	Proj Spec							1							7
83	Proj Spec							1							5
87	Proj Spec							1							2
89	Proj Spec							1							7
90	Proj Spec							1							3
92	Proj Spec		1						2			1			2
93	Proj Spec							2							9
97	Proj Spec							1							3
103	Proj Spec							1							7
106	Proj Spec							1	1	1				1	5
108	Proj Spec	1						1				1			5
109	Proj Spec							1							5
113	Proj Spec				1				1				1		1
116	Proj Spec							1							4
117	Proj Spec							1							4
119	Proj Spec							1							3
127	Proj Spec							1							1
133	Proj Spec							1							5
135	Proj Spec			1				1				2		1	1
145	Proj Spec			1				1				1			2
149	Proj Spec							1							1
151	Proj Spec							1							2
157	Proj Spec							1							6
162	Proj Spec							1							3
163	Proj Spec							1							2
167	Proj Spec							1							5
168	Proj Spec							1							6
174	Proj Spec							1	1					1	2
177	Proj Spec							1							3
184	Proj Spec							2							3

PG&E 1995 Industrial Retrofit Program Evaluation

Table M-1: List of Evaluated Sites

(sorted by Site Type, then by Site No.)

Site No.	Site Type	No. of Projects by End Use				No. of Items by End Use							
		Verify				Proj-Spec							
		H	L	M	P	H	L	M	P	H	L	M	P
188	Proj Spec					1							6
189	Proj Spec					1							5
190	Proj Spec			1		1			1				3
191	Proj Spec					1							2
192	Proj Spec					1							2
196	Proj Spec	1				1			1				3
200	Proj Spec					1							6
202	Proj Spec					1							5
203	Proj Spec					1							6
204	Proj Spec	1				1			1				2
207	Proj Spec					1							3
210	Proj Spec						2						2
213	Proj Spec					1	1					1	2
214	Proj Spec	2				1			2			1	
222	Proj Spec			1		1			1				1
224	Proj Spec					1							2
229	Proj Spec			1		1			1				3
231	Proj Spec	1				1			2				2
237	Proj Spec	1	1			1			1	1			2
238	Proj Spec					1							2
242	Proj Spec		1			1			1				4
256	Proj Spec	1				1			2			1	
264	Proj Spec					1							5
265	Proj Spec			1		1			3				8
267	Proj Spec					1	1					2	1
268	Proj Spec			1		2			1				13
269	Proj Spec			1		1	1		1			1	2
280	Proj Spec			1		1			1				1
301	Proj Spec					2							4
303	Proj Spec					6							17
306	Proj Spec					1							3
307	Proj Spec					1	1	1				1	4
309	Proj Spec	1				1			1			1	
313	Proj Spec					2							5
316	Proj Spec			1		1			1				2
317	Proj Spec					1							3
322	Proj Spec					2							3
323	Proj Spec					2							7
325	Proj Spec					1							9
334	Proj Spec					1							1
336	Proj Spec					1							1
346	Proj Spec					1							2
366	Proj Spec					1							1
373	Proj Spec						2						2
385	Proj Spec					1							1
399	Proj Spec						1						1
402	Proj Spec					1							1
409	Proj Spec					1							1
466	Proj Spec						1						1
476	Proj Spec						1						1
487	Proj Spec					1							1

PG&E 1995 Industrial Retrofit Program Evaluation

Table M-1: List of Evaluated Sites

(sorted by Site Type, then by Site No.)

Site No.	Site Type	No. of Projects by End Use				No. of Items by End Use							
		Verify				Proj-Spec							
		H	L	M	P	H	L	M	P	H	L	M	P
490	Proj Spec				1								1
499	Proj Spec								1				1
531	Proj Spec							1					1
538	Proj Spec				1								1
546	Proj Spec							1					1
552	Proj Spec							1					1
553	Proj Spec				1								1
556	Proj Spec							1					1
567	Proj Spec							1					1
571	Proj Spec							1					1
572	Proj Spec							1					1
575	Proj Spec								1				1
580	Proj Spec							1					1
587	Proj Spec								1				1
590	Proj Spec							1					1
607	Proj Spec							1					1
611	Proj Spec				1								1
619	Proj Spec								1				1
621	Proj Spec								1				1
633	Proj Spec							1					1
643	Proj Spec							1					1
647	Proj Spec							1					1
651	Proj Spec							1					1
653	Proj Spec							1					1
655	Proj Spec							1					1
656	Proj Spec							1					1
659	Proj Spec							1					1
660	Proj Spec							1					1
666	Proj Spec							1					1
1	Verify				1							5	
4	Verify				1							3	
9	Verify	1							2				
11	Verify	1							2				
23	Verify	1							2				
24	Verify	1							2				
25	Verify				1							4	
26	Verify				1							1	
27	Verify		1	1					1	1			
28	Verify				2							2	
31	Verify	1							2				
32	Verify				1							3	
36	Verify		1	1					1	1			
37	Verify				1							3	
38	Verify	1							2				
39	Verify				1							2	
40	Verify	1		1					1	1			
42	Verify				1							2	
43	Verify	1							1				
45	Verify				2							5	
50	Verify				1							1	
53	Verify				1							1	

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-1: List of Evaluated Sites
 (sorted by Site Type, then by Site No.)

Site No.	Site Type	No. of Projects by End Use				No. of Items by End Use			
		Verify				Proj-Spec			
		H	L	M	P	H	L	M	P
58	Verify		1				1		
60	Verify	1					2		
65	Verify		1	1			4	3	
69	Verify		1				5		
74	Verify	1					1		
76	Verify	1					1		
77	Verify		1				6		
78	Verify		1				5		
80	Verify		1				2		
84	Verify	1		1			1	2	
85	Verify		1				3		
88	Verify			1				1	
94	Verify				3				3
95	Verify		1				2		
99	Verify	2					2		
105	Verify		1				2		
107	Verify	2					2		
112	Verify			2				3	
118	Verify				1				1
120	Verify	1	1				1	1	
121	Verify	1			2		1		2
124	Verify	2					2		
126	Verify	1					3		
131	Verify		1				8		
132	Verify	1					1		
150	Verify			1				2	
152	Verify			1				1	
155	Verify	1					2		
156	Verify	1					1		
166	Verify	2					3		
171	Verify	3					6		
176	Verify				2				2
183	Verify	2		1			4	1	
185	Verify			1				1	
195	Verify		1	1			4	1	
211	Verify	1					1		
216	Verify			1	1			9	1
217	Verify			2				3	
218	Verify	1					2		
221	Verify			3				3	
223	Verify			2				2	
230	Verify			1				1	
233	Verify			1				7	
234	Verify		1	1			1	1	
239	Verify				2				2
240	Verify			2				3	
243	Verify			1	1			1	1
244	Verify		1				2		
248	Verify		1				3		
251	Verify		2				3		
254	Verify			1				1	

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-1: List of Evaluated Sites
 (sorted by Site Type, then by Site No.)

Site No.	Site Type	No. of Projects by End Use				No. of Items by End Use															
		Verify		Proj-Spec		Verify		Proj-Spec													
		H	L	M	P	H	L	M	P												
260	Verify				2														2		
261	Verify				2															3	
270	Verify				2															2	
274	Verify				1															1	
276	Verify								1											3	
277	Verify	1																	2		
279	Verify	1																	1		
282	Verify	1																	2		
283	Verify				1															1	
285	Verify				1	1													1	1	
287	Verify		1	1															1	1	
288	Verify	1																	5		
289	Verify	1																	2		
292	Verify				2															2	
296	Verify					1														1	
310	Verify	1																	1		
314	Verify				1	1													2	1	
315	Verify		1																1		
327	Verify				2														2		
328	Verify				2															2	
329	Verify				2														2		
330	Verify				2														3		
331	Verify	1																	1		
335	Verify					1														1	
340	Verify				1															1	
341	Verify				1															1	
345	Verify		1																1		
348	Verify	1																	1		
350	Verify				1															1	
353	Verify	1																	1		
355	Verify	1																	1		
356	Verify	1																	1		
358	Verify	1																	1		
359	Verify					1														1	
360	Verify					1														1	
362	Verify					1														1	
363	Verify						1													1	
364	Verify	1																	1		
365	Verify	1																	1		
367	Verify				1															1	
368	Verify					1														1	
369	Verify					1														1	
370	Verify	1																	1		
372	Verify		1																	1	
374	Verify					1														1	
375	Verify					1														1	
378	Verify	1																	1		
379	Verify	1																	1		
380	Verify					1														1	
381	Verify	1																	1		
386	Verify						1													1	

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-1: List of Evaluated Sites
 (sorted by Site Type, then by Site No.)

Site No.	Site Type	No. of Projects by End Use				No. of Items by End Use			
		Verify		Proj-Spec		Verify		Proj-Spec	
		H	L	M	P	H	L	M	P
388	Verify		1					1	
390	Verify	1						1	
391	Verify	1						1	
392	Verify			1					1
393	Verify	1						1	
394	Verify	1						1	
397	Verify	1						1	
398	Verify			1					1
400	Verify	1						1	
401	Verify		1					1	
403	Verify	1						1	
404	Verify	1						1	
405	Verify			1					1
412	Verify	1						1	
414	Verify	1						1	
418	Verify		1					1	
423	Verify	1						1	
428	Verify		1					1	
431	Verify	1						1	
433	Verify	1						1	
435	Verify			1					1
437	Verify	1						1	
438	Verify	1						1	
441	Verify		1					1	
442	Verify		1					1	
443	Verify	1						1	
444	Verify		1					1	
445	Verify	1						1	
446	Verify		1					1	
450	Verify			1					1
452	Verify	1						1	
454	Verify		1					1	
456	Verify			1					1
463	Verify			1				1	
464	Verify	1						1	
467	Verify			1					1
468	Verify	1						1	
470	Verify	1						1	
471	Verify	1						1	
478	Verify	1						1	
480	Verify		1					1	
481	Verify	1						1	
482	Verify		1					1	
483	Verify	1						1	
484	Verify		1					1	
486	Verify		1					1	
489	Verify			1					1
491	Verify		1					1	
493	Verify	1						1	
494	Verify		1					1	
495	Verify			1					1

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-1: List of Evaluated Sites
 (sorted by Site Type, then by Site No.)

Site No.	Site Type	No. of Projects by End Use				No. of Items by End Use						
		Verify		Proj-Spec		Verify		Proj-Spec				
		H	L	M	P	H	L	M	P			
496	Verify			1					1			
498	Verify				1					1		
500	Verify	1							1			
502	Verify	1							1			
503	Verify				1						1	
507	Verify			1						1		
509	Verify				1						1	
510	Verify			1						1		
512	Verify				1						1	
513	Verify	1							1			
514	Verify			1						1		
517	Verify			1						1		
520	Verify			1						1		
521	Verify				1						1	
524	Verify	1							1			
525	Verify	1							1			
527	Verify			1						1		
530	Verify		1							1		
532	Verify				1						1	
534	Verify	1							1			
535	Verify	1							1			
536	Verify	1							1			
542	Verify	1							1			
543	Verify	1							1			
544	Verify				1						1	
545	Verify			1						1		
547	Verify			1						1		
549	Verify				1						1	
551	Verify	1							1			
554	Verify			1						1		
557	Verify			1						1		
558	Verify	1							1			
565	Verify			1						1		
568	Verify				2					2		
569	Verify	1							1			
570	Verify				1						1	
574	Verify	1							1			
578	Verify			1						1		
579	Verify			1						1		
584	Verify			1						1		
588	Verify				1						1	
591	Verify				1						1	
593	Verify	1								1		
598	Verify	1								1		
601	Verify	1								1		
602	Verify	1							1			
603	Verify			1							1	
604	Verify	1							1			
605	Verify			1						1		
606	Verify	1							1			
614	Verify	1							1			

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-1: List of Evaluated Sites
 (sorted by Site Type, then by Site No.)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use							
		Verify			Proj-Spec			Verify			Proj-Spec				
		H	L	M	P	H	L	P	H	L	M	P	H	L	P
620	Verify	1								1					
622	Verify	1								1					
625	Verify	1								1					
628	Verify				1								1		
635	Verify			1								1			
636	Verify		1									1			
638	Verify			1								1			
640	Verify			1								1			
641	Verify	1								1					
642	Verify			1								1			
645	Verify	1								1					
648	Verify	1								1					
650	Verify			1								1			
654	Verify			1								1			
657	Verify			1								1			
658	Verify				1								1		
662	Verify				1								1		
663	Verify			1								1			
665	Verify				1								1		
667	Verify	1								1					
668	Verify			1								1			
670	Verify	1								1					
671	Verify			1								1			

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-2: List of Evaluated Sites
 (sorted by Company Name)

Site No.	Site Type	No. of Projects by End Use				No. of Items by End Use			
		Verify		Proj-Spec		Verify		Proj-Spec	
		H	L	M	P	H	L	M	P
348	Proj Spec	1						1	
350	Verify		1						1
171	Verify	3						6	
353	Verify	1						1	
270	Verify		2						2
355	Verify	1						1	
356	Verify	1						1	
358	Verify	1						1	
359	Verify			1					1
360	Verify			1					1
218	Verify	1						2	
362	Verify		1						1
363	Verify			1					1
364	Verify	1						1	
365	Verify	1						1	
221	Verify		3						3
366	Proj Spec					1			1
367	Verify		1						1
368	Verify			1					1
369	Verify		1						1
92	Proj Spec	1					2	1	2
370	Verify	1						1	
317	Proj Spec					1			3
222	Proj Spec		1			1			1
177	Proj Spec					1			3
261	Verify		2						3
373	Proj Spec						2		2
374	Verify			1					1
303	Proj Spec					6			17
375	Verify			1					1
19	Proj Spec					1			9
378	Verify	1						1	
244	Verify		1						2
11	Verify	1						2	
379	Verify	1						1	
380	Verify		1						1
381	Verify	1						1	
188	Proj Spec					1			6
118	Verify			1					1
385	Proj Spec					1			1
386	Verify			1					1
38	Verify	1						2	
119	Proj Spec					1			3
157	Proj Spec					1			6
388	Verify		1						1
200	Proj Spec					1			6
57	Proj Spec					1			4
390	Verify	1						1	
391	Verify	1						1	
392	Verify			1					1
393	Verify	1						1	

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-2: List of Evaluated Sites
 (sorted by Company Name)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use						
		Verify			Proj-Spec			Verify			Proj-Spec			
		H	L	M	P	H	L	P	H	L	M	P	H	L
394	Verify	1								1				
397	Verify	1								1				
149	Proj Spec					1								1
398	Verify			1							1			
399	Proj Spec							1						1
400	Verify	1								1				
80	Verify		1							2				
401	Verify			1						1				
402	Proj Spec							1						1
403	Verify	1								1				
404	Verify	1								1				
32	Verify			1						3				
405	Verify				1						1			
189	Proj Spec							1						5
409	Proj Spec							1						1
229	Proj Spec				1			1			1			3
412	Verify	1								1				
414	Verify	1								1				
131	Verify		1							8				
251	Verify		2							3				
242	Proj Spec		1					1		1				4
103	Proj Spec							1						7
418	Verify			1						1				
4	Verify			1						3				
315	Verify		1							1				
309	Proj Spec	1						1		1				1
423	Verify	1								1				
184	Proj Spec							2						3
163	Proj Spec							1						2
39	Verify			1						2				
428	Verify			1						1				
150	Verify			1						2				
543	Verify	1								1				
116	Proj Spec							1						4
64	Proj Spec							1						4
190	Proj Spec			1				1			1			3
431	Verify	1								1				
433	Verify	1								1				
435	Verify				1							1		
185	Verify			1						1				
41	Proj Spec							1						1
331	Verify	1								1				
126	Verify	1								3				
231	Proj Spec		1					1		2				2
437	Verify	1								1				
325	Proj Spec							1						9
438	Verify	1								1				
441	Verify			1							1			
93	Proj Spec							2						9
442	Verify			1						1				
443	Verify	1								1				

PG&E 1995 Industrial Retrofit Program Evaluation

Table M-2: List of Evaluated Sites

(sorted by Company Name)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use						
		Verify				Proj-Spec		Verify				Proj-Spec		
		H	L	M	P	H	L	P	H	L	M	P	H	L
58	Verify			1							1			
248	Verify		1								3			
444	Verify			1							1			
327	Verify			2							2			
445	Verify	1								1				
40	Verify	1	1							1	1			
446	Verify			1							1			
450	Verify				1							1		
340	Verify			1							1			
341	Verify			1							1			
452	Verify	1								1				
454	Verify		1								1			
233	Verify			1							7			
120	Verify	1	1							1	1			
26	Verify			1							1			
99	Verify	2								2				
94	Verify				3						3			
456	Verify			1							1			
3	Proj Spec	1				1				1			2	
127	Proj Spec					1							1	
213	Proj Spec					1	1						1	2
202	Proj Spec						1						5	
268	Proj Spec			1			2				1		13	
117	Proj Spec						1						4	
463	Verify			1							1			
464	Verify	1									1			
466	Proj Spec							1						1
467	Verify				1						1			
468	Verify	1								1				
289	Verify	1								2				
470	Verify	1								1				
471	Verify	1								1				
27	Verify		1	1						1	1			
151	Proj Spec							1					2	
476	Proj Spec								1					1
478	Verify	1								1				
42	Verify		1								2			
480	Verify			1							1			
192	Proj Spec							1					2	
24	Verify	1								2				
481	Verify	1								1				
482	Verify			1							1			
483	Verify	1								1				
484	Verify			1							1			
486	Verify			1							1			
520	Verify			1							1			
487	Proj Spec							1					1	
330	Verify			2							3			
489	Verify				1							1		
490	Proj Spec							1					1	
59	Proj Spec								2					9

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-2: List of Evaluated Sites
 (sorted by Company Name)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use						
		Verify				Proj-Spec		Verify				Proj-Spec		
		H	L	M	P	H	L	P	H	L	M	P	H	L
9	Verify	1								2				
491	Verify		1							1				
493	Verify	1								1				
223	Verify			2						2				
167	Proj Spec						1							5
152	Verify		1							1				
494	Verify		1							1				
334	Proj Spec						1							1
335	Verify				1							1		
495	Verify				1							1		
496	Verify			1						1				
66	Proj Spec						1							5
498	Verify				1							1		
499	Proj Spec							1						1
74	Verify	1								1				
203	Proj Spec							1						6
500	Verify	1								1				
502	Verify	1								1				
503	Verify				1							1		
514	Verify			1								1		
507	Verify		1									1		
28	Verify			2								2		
509	Verify				1								1	
512	Verify				1								1	
513	Verify	1								1				
83	Proj Spec							1						5
88	Verify			1								1		
517	Verify			1								1		
23	Verify	1								2				
234	Verify		1	1						1	1			
240	Verify			2								3		
521	Verify				1								1	
313	Proj Spec							2						5
314	Verify			1	1							2	1	
84	Verify	1		1						1	2			
156	Verify	1								1				
524	Verify	1								1				
525	Verify	1								1				
97	Proj Spec							1						3
527	Verify			1								1		
328	Verify				2								2	
256	Proj Spec	1						1		2				1
105	Verify		1									2		
176	Verify				2								2	
243	Verify			1	1							1	1	
530	Verify		1									1		
531	Proj Spec							1						1
532	Verify				1								1	
210	Proj Spec									2				2
534	Verify	1										1		
535	Verify	1										1		

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-2: List of Evaluated Sites
 (sorted by Company Name)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use							
		Verify				Proj-Spec		Verify				Proj-Spec			
		H	L	M	P	H	L	P	H	L	M	P	H	L	P
67	Proj Spec	1				3			1				3		
536	Verify	1							1						
1	Verify			1							5				
538	Proj Spec					1							1		
204	Proj Spec	1					1		1					2	
282	Verify	1							2						
336	Proj Spec						1						1		
542	Verify	1							1						
121	Verify	1			2				1			2			
214	Proj Spec	2				1			2				1		
544	Verify				1						1				
545	Verify			1							1				
546	Proj Spec							1						1	
65	Verify		1	1					4	3					
87	Proj Spec						1							2	
76	Verify	1							1						
224	Proj Spec						1							2	
584	Verify			1							1				
50	Verify			1							1				
549	Verify				1							1			
52	Proj Spec						1							2	
77	Verify		1								6				
551	Verify	1							1						
552	Proj Spec						1							1	
553	Proj Spec						1							1	
5	Proj Spec						2							3	
554	Verify			1							1				
51	Proj Spec						1							3	
556	Proj Spec						1							1	
557	Verify			1							1				
558	Verify	1							1						
69	Verify		1								5				
207	Proj Spec						1							3	
565	Verify			1							1				
567	Proj Spec						1							1	
568	Verify			2							2				
106	Proj Spec						1	1	1				1	5	1
569	Verify	1							1						
216	Verify			1	1						9	1			
274	Verify			1							1				
195	Verify		1	1							4	1			
570	Verify				1							1			
265	Proj Spec			1				1			3			8	
571	Proj Spec							1						1	
572	Proj Spec							1						1	
237	Proj Spec	1		1				1		1				2	
155	Verify	1							2						
20	Proj Spec							1						6	
640	Verify			1							1				
574	Verify	1							1						
575	Proj Spec							1							1

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-2: List of Evaluated Sites
 (sorted by Company Name)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use								
		Verify			Proj-Spec			Verify			Proj-Spec					
		H	L	M	P	H	L	P	H	L	M	P	H	L	P	
168	Proj Spec						1								6	
578	Verify			1								1				
579	Verify			1								1				
580	Proj Spec						1								1	
316	Proj Spec			1			1					1			2	
254	Verify			1								1				
191	Proj Spec						1								2	
107	Verify	2									2					
306	Proj Spec						1								3	
62	Proj Spec						1								10	
587	Proj Spec								1						1	
279	Verify	1									1					
588	Verify				1								1			
162	Proj Spec						1								3	
601	Verify		1								1					
590	Proj Spec						1								1	
591	Verify				1								1			
593	Verify		1								1					
78	Verify		1								5					
598	Verify		1								1					
264	Proj Spec						1								5	
43	Verify	1									1					
602	Verify	1									1					
604	Verify	1									1					
269	Proj Spec				1		1	1				1		2	1	
12	Proj Spec	1					1			2					1	
605	Verify			1								1				
606	Verify	1									1					
607	Proj Spec						1								1	
90	Proj Spec						1								3	
603	Verify			1								1				
145	Proj Spec			1			1					1			2	
89	Proj Spec						1								7	
611	Proj Spec						1							1		
2	Proj Spec			4					3			21			3	
13	Proj Spec				1				2				1		2	
53	Verify			1								1				
614	Verify	1									1					
285	Verify			1	1							1	1			
35	Proj Spec	1					1				1				1	
112	Verify			2								3				
280	Proj Spec			1			1					1			1	
619	Proj Spec								1						1	
620	Verify	1									1					
217	Verify			2								3				
267	Proj Spec						1	1						2	1	
621	Proj Spec							1							1	
622	Verify	1									1					
307	Proj Spec						1	1	1					1	4	1
132	Verify	1									1					
239	Verify					2							2			

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-2: List of Evaluated Sites
 (sorted by Company Name)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use						
		Verify				Proj-Spec		Verify				Proj-Spec		
		H	L	M	P	H	L	P	H	L	M	P	H	L
183	Verify	2	1					4	1					
238	Proj Spec					1								2
260	Verify			2						2				
625	Verify	1						1						
166	Verify	2						3						
372	Verify		1						1					
133	Proj Spec					1							5	
21	Proj Spec				1		1			1				1
301	Proj Spec						2							4
628	Verify				1					1				
85	Verify		1						3					
60	Verify	1							2					
633	Proj Spec					1								1
635	Verify			1						1				
636	Verify		1							1				
196	Proj Spec	1					1		1					3
25	Verify			1						4				
288	Verify	1							5					
638	Verify			1						1				
174	Proj Spec					1	1						1	2
322	Proj Spec						2							3
323	Proj Spec						2							7
108	Proj Spec	1					1		1					5
641	Verify	1							1					
642	Verify			1						1				
643	Proj Spec					1								1
45	Verify			2						5				
124	Verify	2							2					
645	Verify	1							1					
346	Proj Spec						1							2
345	Verify		1							1				
510	Verify			1						1				
647	Proj Spec						1							1
648	Verify	1							1					
277	Verify	1							2					
31	Verify	1							2					
670	Verify	1							1					
650	Verify			1						1				
95	Verify		1							2				
211	Verify	1							1					
651	Proj Spec						1							1
653	Proj Spec						1							1
654	Verify			1						1				
655	Proj Spec						1							1
656	Proj Spec						1							1
657	Verify			1						1				
658	Verify			1							1			
659	Proj Spec						1							1
329	Verify			2						2				
660	Proj Spec						1							1
113	Proj Spec				1			1			1			1

PG&E 1995 Industrial Retrofit Program Evaluation
Table M-2: List of Evaluated Sites
 (sorted by Company Name)

Site No.	Site Type	No. of Projects by End Use						No. of Items by End Use						
		Verify				Proj-Spec		Verify				Proj-Spec		
		H	L	M	P	H	L	P	H	L	M	P	H	L
36	Verify		1	1						1	1			
662	Verify				1						1			
663	Verify			1						1				
135	Proj Spec			1		1				2		1		
230	Verify			1						1				
665	Verify				1						1			
61	Proj Spec						1						6	
292	Verify				2						2			
37	Verify			1						3				
666	Proj Spec					1							1	
70	Proj Spec						1						5	
667	Verify	1							1					
71	Proj Spec						1						7	
668	Verify			1						1				
283	Verify			1						1				
547	Verify			1						1				
276	Verify				1						3			
671	Verify			1						1				
287	Verify		1	1						1	1			
296	Verify				1						1			
109	Proj Spec						1						5	
310	Verify	1								1				

Appendix N

Program Evaluation and Measure Retention Databases

This appendix documents the final data products from this evaluation. These products consist of the final evaluation data base, measure retention data base, and site zip files. In addition, we document the raw data sets we received from PG&E, the intermediate data sets we developed during the evaluation, and the SAS jobs we wrote to analyze and manipulate the data.

All of these data products are loaded on two 100-megabyte Iomega® Zip™ disks, with the following directory structure:

<u>Subdirectory</u>	<u>Contents</u>
CODE	SAS jobs used to create intermediate data sets
DATA	Original MDSS data base extracts and intermediate data sets created during the evaluation
SITEZIPS	Site zip files containing site evaluation plans, data, code, and reports
FINDATA	Final program evaluation and measure retention data sets

These subdirectories and their contents are discussed in greater detail below. A list of the files in each of these subdirectories can found in Table N-1.

1.1 SAS Jobs

The CODE directory contains nine SAS jobs that manipulated the original PG&E MDSS data base extracts (the DB*.SAS and ET*.SAS series). It also contains two jobs that processed the hourly weather data we received from PG&E. CP.SAS, HSAVE.SAS, and their associated include files and macros were developed to support the item-level savings evaluations. The engineers in charge of each evaluation customized these jobs as appropriate for each item. The final customized versions of these jobs can be found in the site zip files. The QC*.SAS and PSAV*.SAS series of SAS jobs combined program and evaluation data to perform quality control checks and calculate net and program-level savings.

1.2 Data Sets

The DATA directory contains key raw and intermediate data for this evaluation. SAS data sets from the initial PG&E MDSS extracts can be found in the MDSS.ZIP zip file. Raw and processed hourly weather data are in the BING*, SBAYWEA, and WEATHER zip files. The data sets for necessary for reproducing our final savings estimates can be found in the PROGDB, QC, and PSAVE zip files. Of particular note is the BOTH.SD2 data set in PROGDB, which reconciles the original item-level progra data we received from PG&E with subsequent MDSS data extracts so that program data matched the

August 1996 revision of the E-tables. We made further adjustments to the program savings estimates in the PSAV1.SAS job (such as reducing miscellaneous and process terms by 10%, and reducing Shell Western therm savings by an additional 10%) to match the December 1996 version of the E-tables. These adjustments affected all of the PSAV*.SD2 data sets in the PSAVE zip file.

1.3 Site Zip Files

The SITEZIPS subdirectory contains 379 self-extracting site zip files. Each of these site zip files corresponds to an evaluated project-specific or verify site. The site zip files follow the naming convention S<site identification number>.ZIP. At a minimum, each site zip file contains the final site evaluation report (a Microsoft Word 5.0 document named FRPT<site identification number>.DOC) and the corresponding site report workbook (a Microsoft Excel 6.0 workbook named ERPT<site identification number>.XLS). These site report workbooks served as a central repository for key free ridership and engineering analysis data. We initialized these workbooks with program data base information, along with NTGR and savings calculation formulae. During the evaluation, lead engineers entered data to complete the analysis.

Site zip files for sites with project-specific projects also contain any DOE-2.1E models, SAS® programs, Excel 5.0 workbooks, and other supporting data that we used during the evaluation to develop savings estimates. In general, names for these supporting files contain the relevant project and item numbers (for example, the DOE-2 model for Project 123, Item 2 might be named P123_2G.INP, and the corresponding SAS® programs to process the data might be called HS123_2G.SAS and CP123_2G.SAS). Note that the site zip files do not contain information only available on hard copy, such as surveys, recruitment forms, contact logs, and some supporting data. We submitted all copies of all documents to PG&E during the course of the evaluation. Refer to Appendix M for tables listing site identification numbers and company names.

1.4 Program Evaluation Data Base

The FINDATA subdirectory contains the final evaluation data base. This data base holds information gathered via telephone surveys, on-site inspections, short-term end-use metering, and engineering calculations. Table N-2 lists and documents the variables included in this data base. We have supplied the data base in two formats, with the following file names:

- **IND95PDB.XPT** (SAS Version 6 transport file containing the data set IND95PDB)
- **IND95PDB.XLS** (Microsoft Excel 5.0 workbook)

The SAS Version 6 transport file can be read by any version of SAS on any currently supported platform, including SAS PC, SAS PC for Windows, and SAS under TSO. The transport file is partially self documenting, as it contains labels for each variable, along with information on each variable's data type and format. This information can be accessed via the SAS PROC CONTENTS procedure. In addition, a SAS PROC FORMAT job is provided to define value labels for each coded variable in the program evaluation data base.

The program evaluation data base contains original data from the PG&E MDSS data base, as well as information from the savings evaluation and free-ridership analysis. The key variables for the 1,668 observations in the data base are the project identification number (PROJID) and item number

(ITEMNUM). Information in this data base can be matched with the site zip files described below through the site identification number (SITEID). Evaluated items can be identified from the CATEGORY variable, which has the values “EVAL_PS” and “EVAL_VE” for items that received project-specific and verification analyses, respectively. Information in this data base can be linked to other PG&E data bases via the CONTROL variable.

The zip file also contains DBFORMTS.SAS, which is a SAS PROC FORMAT job. This file defines value labels for each of the coded variables that appear in the data base.

1.5 Measure Retention Data Base

The FINDATA subdirectory also contains the measure retention data base in two formats with the following filenames:

- **IND95RET.V6X** (SAS Version 6 transport file containing the data set IND95RET)
- **IND95RET.XLS** (Microsoft Excel 5.0 workbook)

This data base contains 2,434 observations, each with measure counts, descriptions, and equipment identifying information necessary for future retention studies. It is indexed by the same PROJID and ITEMNUM keys as the IND95PDB data base, as well as an additional location code (LOCNUM) key. The PROJID and ITEMNUM keys permit one to link into the detailed information in IND95PDB, such as customer name and address. Table N-3 lists and documents the variables included in this data base.

Table N-1: Detailed List of Data Products

Subdirectory	Filename	Type of file(s)	Description	
\CODE	DBLOAD.SAS	SAS job	Loads initial PG&E MDSS data extracts	
	DBSAMP1-5.SAS	SAS jobs	Develops initial sample frames	
	DBFRAME1.SAS	SAS job	Develops initial sample frames	
	ET.SAS	SAS job	Reconciles MDSS with E-tables, creates final program data base	
	ET2.SAS	SAS job	Reconciles MDSS with E-tables	
	DECWEA.SAS	SAS job	Processes PG&E hourly weather data	
	WEATHER.SAS	SAS job	Processes PG&E hourly weather data	
	CP.SAS	SAS job	Summarizes savings analysis (customized for each item)	
	CPGMAIN.INC	SAS include file	Supports CP.SAS	
	CPMAIN.INC	SAS include file	Supports CP.SAS	
	CPMAINNG.IN	SAS include file	Supports CP.SAS	
	CPSUM.MAC	SAS macro	Supports CP.SAS	
	CPTABLE.MAC	SAS macro	Supports CP.SAS	
	DELFILES.MAC	SAS macro	Supports CP.SAS	
	DOE2NEG.MAC	SAS macro	Supports CP.SAS	
	DOE2SAS.MAC	SAS macro	Supports CP.SAS	
	GCMERGE.MAC	SAS macro	Supports CP.SAS	
	GETFILES.MAC	SAS macro	Supports CP.SAS	
	GETXLS.MAC	SAS macro	Supports CP.SAS	
	HCI.MAC	SAS macro	Supports CP.SAS	
	PUTXLS.MAC	SAS macro	Supports CP.SAS	
	HSAVE.SAS	SAS job	Summarizes savings analysis (customized for each item)	
	HSAVE1.INC	SAS include file	Supports HSAVE.SAS	
	HSAVE2.INC	SAS include file	Supports HSAVE.SAS	
	QC1-5F.SAS	SAS jobs	Combines all site evaluations, checks data	
	LABFIX.SAS	SAS job	Adjusts measure units	
	QCINFO.SAS	SAS job	Additional quality checks	
	PSAV1-4.SAS	SAS jobs	Calculates program gross and net savings/impacts	
	FINALDB.SAS	SAS job	Generates final data sets	
	\DATA	MDSS.ZIP	Zipped SAS data sets	Original PG&E MDSS extracts
		BING95.ZIP	Zipped ASCII	PG&E hourly weather data
		BING96.ZIP	Zipped ASCII	PG&E hourly weather data
		BING96A.ZIP	Zipped ASCII	PG&E hourly weather data
BING96B.XLS		Excel 5.0	PG&E hourly weather data	
SBAYWEA.ZIP		Zipped SAS data sets	Hourly weather data	
WEATHER.ZIP		Zipped SAS data sets	Hourly weather data	
PROGDB.ZIP		Zipped SAS data sets	Initial & revised MDSS data base reconciled with E-tables	
QCDATA0-7.*DB		Access 2.0 data bases	Data bases with macros to aggregate site evaluation data	
QC.ZIP		Zipped SAS data sets	Combined PG&E and eval data for from QC*.SAS jobstream	
PSAVE.ZIP		Zipped SAS data sets	Program savings from PSAV*.SAS jobstream	
\SITEZIPS		S< site id> .ZIP	Zipped various files	Site evaluation plan, workbook, report, DOE-2 models etc.
\FINDATA		IND95PDB.XLS	Excel 5.0	Final evaluation data base
	IND95PDB.XPT	SAS ver. 6 transport	Final evaluation data base	
	DMFORMTS	SAS job	Formats for IND95PDB survey variables	
	IND95RET.XLS	Excel 5.0	Final retention data base	
	IND95RET.XPT	SAS ver. 6 transport	Final retention data base	

Table N-2: Evaluation Data Set Variable List

Data Set	Variable	Type	Label	Data Source
IND95PDB	PROJID	Num	KEY 1: Project ID number (SBW-assigned)	KEY
IND95PDB	ITEMNUM	Num	KEY 2: Item number (SBW-assigned)	KEY
IND95PDB	CUSTNTGR	Num	Eval customized NTGR	Eval Survey
IND95PDB	M5_1	Num	Dec-maker survey Q.5 response	Eval Survey
IND95PDB	M6_1	Num	Dec-maker survey Q.6 response	Eval Survey
IND95PDB	M7_1	Num	Dec-maker survey Q.7 response	Eval Survey
IND95PDB	NTGR	Num	Eval standard NTGR	Eval Survey
IND95PDB	Q10	Num	Dec-maker survey Q. 10 response	Eval Survey
IND95PDB	Q11_3PCT	Num	Dec-maker survey Q. 11 response (item 3)	Eval Survey
IND95PDB	Q11_4PCT	Num	Dec-maker survey Q. 11 response (item 4)	Eval Survey
IND95PDB	Q11_5PCT	Num	Dec-maker survey Q. 11 response (item 5)	Eval Survey
IND95PDB	Q11_6PCT	Num	Dec-maker survey Q. 11 response (item 6)	Eval Survey
IND95PDB	SURVDVEN	Char	Dec-maker vendor survey performed (Y/N)	Eval Survey
IND95PDB	SURVOPER	Char	Operations staff survey performed (Y/N)	Eval Survey
IND95PDB	SURVSPIL	Char	Spillover measure identified @ site (Y/N)	Eval Survey
IND95PDB	SURVSVEN	Char	Dec-maker vendor survey performed (Y/N)	Eval Survey
IND95PDB	VQ5	Num	Vendor survey Q.5 response	Eval Survey
IND95PDB	VQ6	Num	Vendor survey Q.6 response	Eval Survey
IND95PDB	AGKW	Num	Eval gross max kW savings	Evaluation
IND95PDB	AGKW2	Num	Eval gross summer onpeak avg kW savings	Evaluation
IND95PDB	AGKWH	Num	Eval gross kWh savings	Evaluation
IND95PDB	AGTHERM	Num	Eval gross therm savings	Evaluation
IND95PDB	APPUNIT	Num	Number of units in application	Evaluation
IND95PDB	BASELINE	Char	Gross baseline used in evaluation	Evaluation
IND95PDB	CATEGORY	Char	Evaluation category	Evaluation
IND95PDB	CDIF	Num	App/eval pct diff in unit capacity	Evaluation
IND95PDB	CKWC	Num	Customer baseline kW savings	Evaluation
IND95PDB	CKWHC	Num	Customer baseline kWh savings	Evaluation
IND95PDB	CNTKW	Num	Eval net max kW savings w/custom NTGR	Evaluation
IND95PDB	CNTKW2	Num	Eval net avg kW savings w/custom NTGR	Evaluation
IND95PDB	CNTKWH	Num	Eval net kWh savings w/custom NTGR	Evaluation
IND95PDB	CNTTHERM	Num	Eval net therm savings w/custom NTGR	Evaluation
IND95PDB	CTHMC	Num	Customer baseline therm savings	Evaluation
IND95PDB	EU	Char	End use	Evaluation
IND95PDB	HCIKWH	Num	Lighting heat-cool interaction (in kWh)	Evaluation
IND95PDB	INSUNIT	Num	No. of installed units	Evaluation
IND95PDB	ITEMNTGR	Num	Eval weighted item NTGR	Evaluation
IND95PDB	KW2RR	Num	Eval max kW realization rate	Evaluation
IND95PDB	KWHRR	Num	Eval kWh realization rate	Evaluation
IND95PDB	KWRR	Num	Eval avg kW realization rate	Evaluation
IND95PDB	LITEEFLH	Num	Lighting equiv full-load hours	Evaluation

Data Set	Variable	Type	Label	Data Source
IND95PDB	MAAREA	Num	Eval measure-affected area (sq ft)	Evaluation
IND95PDB	MEASLBL2	Char	Measure label	Evaluation
IND95PDB	NETKW	Num	Eval net max kW savings	Evaluation
IND95PDB	NETKW2	Num	Eval net summer onpeak avg kW savings	Evaluation
IND95PDB	NETKWH	Num	Eval net kWh savings	Evaluation
IND95PDB	NETTHERM	Num	Eval net therm savings	Evaluation
IND95PDB	ODIF	Num	App/eval pct diff in operatinghours	Evaluation
IND95PDB	ONETIME	Char	Eval one-time measurement flag (Y/N)	Evaluation
IND95PDB	OPUNIT	Num	Number of operational units	Evaluation
IND95PDB	SDIF	Num	App/eval pct diff in operatinghours	Evaluation
IND95PDB	SHORTTRM	Char	Eval one-time measurement flag (Y/N)	Evaluation
IND95PDB	SITEID	Num	Site ID number (SBW-assigned)	Evaluation
IND95PDB	SOFPKWF	Num	Eval summer off-peak kW fraction	Evaluation
IND95PDB	SOFPKWHF	Num	Eval summer off-peak kWh fraction	Evaluation
IND95PDB	SONPKWF	Num	Eval summer on-peak kW fraction	Evaluation
IND95PDB	SONPKWHF	Num	Eval summer on-peak kWh fraction	Evaluation
IND95PDB	SPTPKWF	Num	Eval summer part-peak kW fraction	Evaluation
IND95PDB	SPTPKWHF	Num	Eval summer part-peak kWh fraction	Evaluation
IND95PDB	TFREETYP	Char	Free-ridership analysis type (Std/Cust)	Evaluation
IND95PDB	THMRR	Num	Eval therm realization rate	Evaluation
IND95PDB	TPROJTYP	Char	Project type (Proj Spec/Verify)	Evaluation
IND95PDB	TSITETYP	Char	Site type (VO/CPS/SPS)	Evaluation
IND95PDB	UNITS_N	Char	Measure unit type	Evaluation
IND95PDB	WOFPKWF	Num	Eval winter off-peak kW fraction	Evaluation
IND95PDB	WOFPKWHF	Num	Eval winter off-peak kWh fraction	Evaluation
IND95PDB	WPTPKWF	Num	Eval winter part-peak kW fraction	Evaluation
IND95PDB	WPTPKWHF	Num	Eval winter part-peak kWh fraction	Evaluation
IND95PDB	XDIF	Char	App/eval other reasons for svgs diff	Evaluation
IND95PDB	FKW	Num	kWh savings from PG&E program file	PG&E application
IND95PDB	FKWH	Num	kWh savings from PG&E program file	PG&E application
IND95PDB	FTHM	Num	therm savings from PG&E program file	PG&E application
IND95PDB	ACCOUNT	Char	PG&E account number	PG&E data base
IND95PDB	APPCD	Char	PG&E application number	PG&E data base
IND95PDB	CONTROL	Num	PG&E control number	PG&E data base
IND95PDB	DIV_CODE	Char	PG&E division	PG&E data base
IND95PDB	EU_DESC	Char	PG&E end use description	PG&E data base
IND95PDB	FCOMPANY	Char	Company name	PG&E data base
IND95PDB	MEAS_COD	Char	PG&E measure code	PG&E data base
IND95PDB	MEAS_DES	Char	PG&E measure description	PG&E data base
IND95PDB	METERNUM	Char	PG&E meter number	PG&E data base
IND95PDB	NPDKW	Num	PG&E data base net kW savings	PG&E data base
IND95PDB	NPDKWH	Num	PG&E data base net kWh savings	PG&E data base
IND95PDB	NPD THERM	Num	PG&E data base net therm savings	PG&E data base
IND95PDB	P_KW_RR	Num	PG&E kW realization rate	PG&E data base

Data Set	Variable	Type	Label	Data Source
IND95PDB	P_KWH_RR	Num	PG&E kWh realization rate	PG&E data base
IND95PDB	PDKW	Num	PG&E data base gross kW savings	PG&E data base
IND95PDB	PDKWH	Num	PG&E data base gross kWh savings	PG&E data base
IND95PDB	PDTHERM	Num	PG&E data base gross therm savings	PG&E data base
IND95PDB	PINCCST1	Num	PG&E paid incremental item cost	PG&E data base
IND95PDB	PNTG	Num	PG&E net-to-gross ratio	PG&E data base
IND95PDB	PPJ_LIF1	Num	PG&E project life for item	PG&E data base
IND95PDB	PREBATE1	Num	Rebate amount	PG&E data base
IND95PDB	PREMID	Char	PG&E premise ID number	PG&E data base
IND95PDB	PROGRAM	Char	PG&E program code	PG&E data base
IND95PDB	PROGYR	Num	Year application submitted (program year)	PG&E data base
IND95PDB	PROJTCST	Num	PG&E project cost	PG&E data base
IND95PDB	PSHRHLD1	Num	PG&E shareholder savings (\$)	PG&E data base
IND95PDB	SERVADDR	Char	Service address	PG&E data base
IND95PDB	SERV CITY	Char	Service city	PG&E data base
IND95PDB	SIC_CODE	Num	SIC code	PG&E data base
IND95PDB	SIC_DESC	Char	SIC description	PG&E data base
IND95PDB	SQ_FOOT	Num	Square footage from application	PG&E data base

Table N-3 Retention Data Base Variable List

Data Set	Variable	Type	Label	Data Source
IND95RET	PROJID	Num	Key 1: Project ID number (SBW-assigned)	KEY
IND95RET	ITEMNUM	Num	Key 2: Item number (SBW-assigned)	KEY
IND95RET	LOCNUM	Num	Key 3: Location number (SBW-assigned)	KEY
IND95RET	DESCRIP	Char	Detailed descrip. of measure components	Evaluation
IND95RET	LOCATION	Char	tion of measure component	Evaluation
IND95RET	MANUF	Char	Manufacturer	Evaluation
IND95RET	MODEL	Char	Make and model number	Evaluation
IND95RET	NUMINST	Num	Number of measure units installed	Evaluation
IND95RET	NUMOP	Num	Number of measure units operational	Evaluation
IND95RET	OTHER	Char	Other descriptive information	Evaluation

Appendix O

M&E Protocol Information

This appendix provides a consolidated tabulation of results from this evaluation which meet the reporting requirements defined by the California Public Utility Commission's Measurement and Evaluation (M&E) Protocols. The tables and descriptions within provide the information requested in Tables 6 and 7 of the M&E Protocols.

The first part of this appendix contains the information required in Table 6 of the Protocols for each of the evaluated end uses (HVAC, lighting, miscellaneous, and process). The designated unit of measurement for each of these end uses is as follows:

- HVAC: measure-affected floor area, expressed in square feet.
- Lightin : the product of measure-affected floor area (expressed in square feet) and hours of operation (in thousands).
- Miscellaneous: project
- Process: project

Certain items in Table 6 of the protocols address unit energy consumption (UEC). The protocols deem these items optional in instances where the models employed in the evaluation cannot yield appropriate UECs. These optional items are not included in the tables below. The engineering portion of the evaluation generally yielded energy savings, rather than consumption, estimates for the evaluated items. Because of this, program-wide engineering estimates of gross energy consumption and UEC could not be determined.

The second part of this appendix provides data quality and processing documentation as discussed in Table 7 of the Protocols. The numbering scheme for this portion corresponds to that in Table 7.

A. Response to Table 6 Requirements

Refer to Pages O-2 through O-10.

B. Response to Table 7 Requirements

Refer to Pages O-11 through O-13.

C. Response to Table 11 Requirements

Refer to Page O-14.

RESPONSE TO M&E PROTOCOL TABLE 6

Protocols for Reporting of Results of Impact Measurement Studies Used to Support and Earnings Claim

Table 6

END USE: **INDUSTRIAL LIGHTING**
 DESIGNATED UNIT OF MEASUREMENT: **1000 HRS*SQUARE FEET**

		5. 90% Confidence Level				5. 80% Confidence Level					
		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound		
1. Average Participant Group and Average Comparison Group Usage											
A. Pre-Installation Usage	kWh	Note: Gray areas indicate category is not applicable.									
	kW										
	therms										
Base Usage	kWh										
	kW										
	therms										
Base Usage per Designated Unit of Meas.	kWh										
	kW										
	therms										
B. Impact Year Usag	kWh										
	kW										
	therms										
Impact Year Usage per Designated Unit of Meas.	kWh										
	kW										
	therms										
2. Avg. Net & Gross End Use Load Impacts											
A. Load Impacts	kWh	<u>Gross</u>	<u>Net</u>	<u>Gross</u>	<u>Gross</u>	<u>Net</u>	<u>Net</u>	<u>Gross</u>	<u>Gross</u>	<u>Net</u>	<u>Net</u>
	kW	29,848	24,966	12,183	47,514	14,656	35,275	16,061	43,636	16,919	33,012
	therms	4.600	3.783	2.213	6.987	2.307	5.260	2.737	6.463	2.631	4.936
		-82.4	-69.4								
B. Load Impacts per Designated Unit of Meas.	kWh	0.3705	0.4058	0.1512	0.5898	0.2382	0.5734	0.1994	0.5417	0.2750	0.5367
	watts	0.0571	0.0604	0.0275	0.0867	0.0368	0.0840	0.0340	0.0802	0.0420	0.0788
	ktherms	-1.0226	-0.8619								
C. Participant Group Percent Change in Usage	kWh										
	kW										
	therms										
Comparison Group Percent Change in Usag	kWh										
	kW										
	therms										
D. Realization Rates	kWh	<u>Gross</u>	<u>Net</u>	<u>Gross</u>	<u>Gross</u>	<u>Net</u>	<u>Net</u>	<u>Gross</u>	<u>Gross</u>	<u>Net</u>	<u>Net</u>
	kW	0.99	1.10	0.41	1.58	0.64	1.55	0.53	1.45	0.74	1.45
	therms	0.96	1.06	0.46	1.46	0.65	1.47	0.57	1.35	0.74	1.38
3. Net-to-Gross Ratio											
A. Average Load Impacts	kWh	<u>Ratio</u>		<u>Ratio</u>	<u>Ratio</u>			<u>Ratio</u>	<u>Ratio</u>		
	kW	0.84		0.833	0.855			0.835	0.853		
	therms	0.84		0.833	0.855			0.835	0.853		
B. Avg. Load Impacts per Designated Unit of Meas.	kWh	0.84		0.833	0.855			0.835	0.853		
	kW	0.84		0.833	0.855			0.835	0.853		
	therms	0.84		0.833	0.855			0.835	0.853		
C. Avg. Load Impacts (as % Change in Usage)	kWh										
	kW										
	therms										
4. Designated Unit Intermediate Data											
A. Pre-Installation Avg. (Mean) Value for Participant Grou	DUM										
Pre-Installation Avg. (Mean) Value for Comparison Group	80,554										
B. Post-Installation Avg. (Mean) Value for Participant Grou	80,554										
Post-Installation Avg. (Mean) Value for Comparison Group											
5. Precision (see columns at far right)											
6. Measure Count Data											
A. No. of Measures Installed by Participants in Part. Group	Count										
B. No. of Meas. Installed by All Prog. Part. During Prog. Yr.	425										
C. No. of Measures Installed by the Comparison Group	1,010										

END USE:

INDUSTRIAL LIGHTING

7. Market Segment Data

Percent

Distribution of Participants by SIC Label

ADHESIVES AND SEALANTS	0.2
AGRICULTURAL CHEMICALS, NEC	0.3
AIR AND GAS COMPRESSORS	0.1
AIRCRAFT PARTS AND EQUIPMENT, NEC	0.1
ALUMINUM EXTRUDED PRODUCTS	0.3
ALUMINUM SHEET, PLATE, AND FOIL	0.2
ANALYTICAL INSTRUMENTS	1.5
ANIMAL AND MARINE FATS AND OILS	0.1
ARCHITECTURAL METAL WORK	0.1
ASPHALT FELTS AND COATINGS	0.6
AUTOMOTIVE AND APPAREL TRIMMINGS	0.2
BIOLOGICAL PRODUCTS, EXCEPT DIAGNOSTIC	0.3
BLAST FURNACES AND STEEL MILLS	0.1
BOAT BUILDING AND REPAIRING	0.1
BOOKBINDING AND RELATED WORK	0.5
BOTTLED AND CANNED SOFT DRINKS	0.3
BREAD, CAKE, AND RELATED PRODUCTS	0.9
CANDY AND OTHER CONFECTIONERY PRODUCTS	0.3
CANNED FRUITS AND VEGETABLES	0.6
CANNED SPECIALTIES	0.1
CARPENTRY WORK	0.1
CHEMICAL PREPARATIONS, NEC	0.1
CHILD DAY CARE SERVICES	0.1
CHOCOLATE AND COCOA PRODUCTS	0.1
COMMERCIAL LIGHTING FIXTURES	0.1
COMMERCIAL PRINTING	0.3
COMMERCIAL PRINTING, LITHOGRAPHIC	2.8
COMMERCIAL PRINTING, NEC	1.0
COMMUNICATIONS EQUIP., NEC	0.3
COMPUTER AND OFFICE EQUIPMENT	2.3
COMPUTER PERIPHERAL EQUIPMENT, NEC	0.4
COMPUTER STORAGE DEVICES	0.8
COMPUTER TERMINALS	0.6
CONCRETE PRODUCTS, NEC	0.4
CONCRETE, GYPSUM, AND PLASTER PRODUCTS	0.1
CONSTRUCTION SAND AND GRAVEL	0.4
COPPER FOUNDRIES	0.1
CORRUGATED AND SOLID FIBRE BOXES	2.0
COSTUME JEWELRY	0.1
CUSTOM COMPOUNDING OF PURCHASED RESINS	0.2
DEHYDRATED FRUITS, VEGETABLES, SOUPS	0.1
DENTAL EQUIPMENT AND SUPPLIES	0.5
DOG AND CAT FOOD	0.1
ELECTRICAL EQUIPMENT & SUPPLIES, NEC	0.2
ELECTRICAL WORK	3.2
ELECTRON TUBES	0.6
ELECTRONIC COMPONENTS, NEC	1.6
ELECTRONIC COMPUTERS	2.0
ENVELOPES	0.2
FABRICATED METAL PRODUCTS, NEC	0.3
FABRICATED PIPE AND FITTINGS	0.1
FABRICATED PLATE WORK (BOILER SHOPS)	0.2
FABRICATED RUBBER PRODUCTS, NEC	0.1
FABRICATED STRUCTURAL METAL	0.8
FABRICATED STRUCTURAL METAL PRODUCTS	0.3
FARM MACHINERY AND EQUIPMENT	0.4
FIBER CANS, DRUMS & SIMILAR PRODUCTS	0.6
FLAT GLASS	0.1
FLAVORING EXTRACTS AND SYRUPS, NEC	0.1
FLUID MILK	0.2
FLUID POWER VALVES & HOSE FITTINGS	0.3
FOOD PREPARATIONS, NEC	0.3
FRESH OR FROZEN FISH PREPARED FISH	0.2
FROZEN FRUITS AND VEGETABLES	0.7
FROZEN SPECIALTIES	0.2
GAMES, TOYS, AND CHILDREN'S VEHICLES	0.1
GASKETS, PACKING & SEALING DEVICES	0.1
GENERAL INDUSTRIAL MACHINERY, NEC	0.2
GLASS CONTAINERS	0.1
GREETING CARDS	0.2
GUIDED MISSILES AND SPACE VEHICLES	0.1
GYPSUM PRODUCTS	0.9
HARDWOOD VENEER AND PLYWOOD	0.1
HEAVY CONSTRUCTION, NEC	0.3
HIGHWAY AND STREET CONSTRUCTION	1.7
HOISTS, CRANES, AND MONORAILS	0.1
INDUSTRIAL BUILDINGS AND WAREHOUSES	0.3
INDUSTRIAL GASES	0.1
INDUSTRIAL INORGANIC CHEMICALS, NEC	0.1
INDUSTRIAL MACHINERY, NEC	3.2
INDUSTRIAL ORGANIC CHEMICALS, NEC	0.1
INORGANIC PIGMENTS	0.1
INSTRUMENTS TO MEASURE ELECTRICITY	0.1
LABORATORY APPARATUS & FURNITURE	0.1
LEATHER TANNING AND FINISHING	0.4
LUGGAGE	0.1
MACHINE TOOLS AND METAL FORMING TYPES	0.3
MALT BEVERAGES	0.1
MANUFACTURED ICE	0.3
MANUFACTURING INDUSTRIES, NEC	0.6
MARKING DEVICES	0.2
MATTRESSES AND BEDSPRINGS	0.5
MEASURING AND CONTROLLING DEVICES	0.2

Appendix O - M&E Protocol Information

MEAT PACKING PLANTS	0.2
METAL CANS	0.3
METAL COATING AND ALLIED SERVICES	0.5
METAL DOORS, SASH, AND TRIM	0.2
METAL STAMPINGS, NEC	0.5
MILLWORK	0.3
MINERALS, GROUND OR TREATED	0.8
MISCELLANEOUS METAL WORK	0.1
MISCELLANEOUS PLASTICS PRODUCTS	0.4
MISCELLANEOUS PUBLISHING	0.2
MOTOR VEHICLE PARTS AND ACCESSORIES	1.4
MOTOR VEHICLES AND CAR BODIES	0.5
MULTI TENANT OFFICES (4)	0.1
NATURAL, PROCESSED, AND IMITATION CHEESE	0.2
NEWSPAPERS	1.7
NONCURRENT-CARRYING WIRING DEVICES	0.1
NONFERROUS ROLLING AND DRAWING	1.0
NONFERROUS WIRE DRAWING & INSULATING	0.7
NONRESIDENTIAL CONSTRUCTION, NEC	0.1
NONWOVEN FABRICS	0.1
OIL AND GAS FIELD MACHINERY	0.3
OPERATIVE BUILDERS	2.7
OPHTHALMIC GOODS	0.1
OPTICAL INSTRUMENTS AND LENSES	0.4
PACKAGING MACHINERY	0.1
PAINTS AND ALLIED PRODUCTS	0.1
PAPER MILLS	0.2
PAPER: COATED AND LAMINATED, NEC	1.5
PAPERBOARD MILLS	0.1
PARTITIONS AND FIXTURES	0.7
PARTITIONS AND FIXTURES EXCEPT WOOD	0.1
PERIODICALS	0.1
PERSONAL LEATHER GOODS, NEC	0.1
PETROLEUM REFINING	1.6
PHARMACEUTICAL PREPARATIONS	1.3
PHOTOGRAPHIC EQUIPMENT AND SUPPLIES	0.3
PLASTICS FOAM PRODUCTS	0.2
PLASTICS MATERIALS AND RESINS	0.3
PLASTICS PRODUCTS, NEC	0.8
PLATEMAKING SERVICES	0.2
PLATING AND POLISHING	0.3
PLUMBING, HEATING, AIR CONDITIONING	1.3
POLISHES AND SANITATION GOODS	0.2
PORCELAIN ELECTRIC SUPPLIES	0.1
PREPARED FEEDS, NEC	0.2
PRIMARY METAL PRODUCTS, NEC	0.2
PRINTED CIRCUIT BOARDS	1.3
PROCESS CONTROL INSTRUMENTS	0.2
PUMPS AND PUMPING EQUIPMENT	0.1
RADIO AND TV COMMUNICATIONS EQUIPMENT	0.4
RECONSTITUTED WOOD PRODUCTS	0.1
REFRIGERATION AND HEATING EQUIPMENT	0.4
RELAYS AND INDUSTRIAL CONTROLS	1.0
RESIDENTIAL LIGHTING FIXTURES	0.2
SALTED AND ROASTED NUTS AND SEEDS	0.4
SAUSAGES AND OTHER PREPARED MEATS	0.2
SAW BLADES AND HANDSAWS	0.5
SAWMILLS AND PLANING MILLS, GENERAL	1.9
SCALES AND BALANCES EXCEPT LABORATORY	0.2
SEARCH & NAVIGATION EQUIPMENT	2.1
SEMICONDUCTORS AND RELATED DEVICES	6.6
SHEET METAL WORK	2.1
SIGNS AND ADVERTISING DISPLAYS	0.4
SILVERWARE AND PLATED WARE	0.1
SINGLE TENANT OFFICE (4)	0.1
SINGLE-FAMILY HOUSING CONSTRUCTION	0.1
SPECIAL INDUSTRY MACHINERY, NEC	0.4
SPEED CHANGERS, DRIVERS AND GEARS	1.0
SPORTING AND ATHLETIC GOODS, NEC	0.3
STATIONERY PRODUCTS	0.1
STEEL FOUNDRIES, NEC	0.3
STEEL SPRINGS, EXCEPT WIRE	0.2
STRUCTURAL WOOD MEMBERS, NEC	0.1
SURGICAL AND MEDICAL INSTRUMENTS	0.6
SURGICAL APPLIANCES AND SUPPLIES	0.5
SWITCHGEAR AND SWITCHBOARD APPARATUS	0.5
TANKS AND TANK COMPONENTS	0.3
TELEPHONE AND TELEGRAPH APPARATUS	0.2
TEMPORARY SERVICES FOR CONSTRUCTION (2)	1.7
TRANSFORMERS, EXCEPT ELECTRONIC	0.3
TURBINES AND TURBINE GENERATOR SETS	0.7
UNSUPPORTED PLASTICS FILM & SHEET	0.1
VEGETABLE OIL MILLS, NEC	0.2
WATER WELL DRILLING	0.1
WINES, BRANDY, AND BRANDY SPIRITS	4.6
WOMEN'S HANDBAGS AND PURSES	0.1
WOMEN'S, JUNIORS' & MISSES' DRESSES	0.5
WOOD CONTAINERS, NEC	0.3
WOOD KITCHEN CABINETS	0.8
WOOD OFFICE FURNITURE	0.1
WOOD PALLETS AND SKIDS	0.6
WOOD PARTITIONS AND FIXTURES	0.4
WOODWORKING MACHINERY	0.3

Protocols for Reporting of Results of Impact Measurement Studies Used to Support and Earnings Claim

Table 6

END USE: **INDUSTRIAL HVAC**
 DESIGNATED UNIT OF MEASUREMENT: **SQUARE FEET**

		5. 90% Confidence Level				5. 80% Confidence Level													
		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound										
1. Average Participant Group and Average Comparison Group Usage																			
A. Pre-Installation Usage	kWh	Note: Gray areas indicate category is not applicable.																	
	kW																		
	therms																		
Base Usage	kWh																		
	kW																		
	therms																		
Base Usage per Designated Unit of Meas.	kWh	Note: Gray areas indicate category is not applicable.																	
	kW																		
	therms																		
B. Impact Year Usag	kWh																		
	kW																		
	therms																		
Impact Year Usage per Designated Unit of Meas.	kWh	Note: Gray areas indicate category is not applicable.																	
	kW																		
	therms																		
2. Avg. Net & Gross End Use Load Impacts																			
A. Load Impacts	kWh									Gross	Net	Gross	Gross	Net	Net	Gross	Gross	Net	Net
	kW									76,856	50,383	14,510	139,20	20,273	80,492	28,196	125,51	26,883	73,883
	therms	2,391	1,114	608	4,174	1	2,227	1,000	3,782	245	1,983								
B. Load Impacts per Designated Unit of Meas.	kWh	6.423	4.210	1.213	11.633	1.694	6.726	2.356	10.489	2.246	6.174								
	W	0.626	0.421	-0.417	1.670	0.035	0.806	-0.188	1.441	0.120	0.721								
	therm	0.200	0.093	0.051	0.349	0.000	0.186	0.084	0.316	0.020	0.166								
C. Participant Group Percent Change in Usage	kWh	Note: Gray areas indicate category is not applicable.																	
	kW																		
	therms																		
Comparison Group Percent Change in Usag	kWh	Note: Gray areas indicate category is not applicable.																	
	kW																		
	therms																		
D. Realization Rates	kWh	Gross	Net	Gross	Gross	Net	Net	Gross	Gross	Net	Net								
	kWh	0.97	0.96	0.18	1.75	0.39	1.54	0.36	1.58	0.51	1.41								
	kW	0.83	0.86	-0.55	2.22	0.07	1.66	-0.25	1.92	0.25	1.48								
	therms	0.98	0.95	0.25	1.70	0.00	1.90	0.41	1.54	0.21	1.69								
3. Net-to-Gross Ratio																			
A. Average Load Impacts	kWh	Ratio		Ratio	Ratio			Ratio	Ratio										
	kW	0.73		0.713	0.750			0.717	0.746										
	therms	0.73		0.713	0.750			0.717	0.746										
B. Avg. Load Impacts per Designated Unit of Meas.	kWh	0.73		0.713	0.750			0.717	0.746										
	kW	0.73		0.713	0.750			0.717	0.746										
	therms	0.73		0.713	0.750			0.717	0.746										
C. Avg. Load Impacts (as % Change in Usage)	kWh	Note: Gray areas indicate category is not applicable.																	
	kW	Note: Gray areas indicate category is not applicable.																	
	therms	Note: Gray areas indicate category is not applicable.																	
4. Designated Unit Intermediate Data																			
A. Pre-Installation Avg. (Mean) Value for Participant Grou		DUM	Note: Gray areas indicate category is not applicable.																
Pre-Installation Avg. (Mean) Value for Comparison Group		11,967	Note: Gray areas indicate category is not applicable.																
B. Post-Installation Avg. (Mean) Value for Participant Grou		11,967	Note: Gray areas indicate category is not applicable.																
Post-Installation Avg. (Mean) Value for Comparison Group			Note: Gray areas indicate category is not applicable.																
5. Precision (see columns at far right)																			
6. Measure Count Data																			
A. No. of Measures Installed by Participants in Part. Group		Count	Note: Gray areas indicate category is not applicable.																
B. No. of Meas. Installed by All Prog. Part. During Prog. Yr.		163	Note: Gray areas indicate category is not applicable.																
C. No. of Measures Installed by the Comparison Group		225	Note: Gray areas indicate category is not applicable.																

END USE:	INDUSTRIAL HVAC
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7. Market Segment Data	<u>Percent</u>
Distribution of Participants by SIC Label	
AGRICULTURAL CHEMICALS, NEC	0.9
ANALYTICAL INSTRUMENTS	1.8
ASPHALT FELTS AND COATINGS	0.4
ASPHALT PAVING MIXTURES AND BLOCKS	0.9
BEEET SUGAR	0.4
BLAST FURNACES AND STEEL MILLS	0.4
BOOK PUBLISHING	0.4
BURIAL CASKETS	0.9
CANNED SPECIALTIES	0.4
COMMERCIAL PRINTING, LITHOGRAPHIC	2.7
COMMERCIAL PRINTING, NEC	1.3
COMMUNICATIONS EQUIP., NEC	0.4
COMPUTER AND OFFICE EQUIPMENT	1.3
COMPUTER PERIPHERAL EQUIPMENT, NEC	0.9
COMPUTER STORAGE DEVICES	0.4
COMPUTER TERMINALS	1.3
CRUDE PETROLEUM AND NATURAL GAS	0.9
CUSTOM COMPOUNDING OF PURCHASED RESINS	0.4
DEHYDRATED FRUITS, VEGETABLES, SOUPS	3.1
DENTAL EQUIPMENT AND SUPPLIES	0.9
ELECTRICAL EQUIPMENT & SUPPLIES, NEC	1.8
ELECTRICAL WORK	1.3
ELECTROMEDICAL EQUIPMENT	1.3
ELECTRONIC COMPONENTS AND ACCESSORIES	0.4
ELECTRONIC COMPONENTS, NEC	0.9
ELECTRONIC COMPUTERS	0.9
EXPLOSIVES	0.9
FABRICATED METAL PRODUCTS, NEC	0.4
FABRICATED PIPE AND FITTINGS	0.4
FABRICATED RUBBER PRODUCTS, NEC	0.4
FARM MACHINERY AND EQUIPMENT	0.9
FLAT GLASS	0.9
FLUID MILK	0.4
FOOD PREPARATIONS, NEC	1.3
FROZEN BAKERY PRODUCTS, EXCEPT BREAD	0.4
GUIDED MISSILES AND SPACE VEHICLES	1.8
HIGHWAY AND STREET CONSTRUCTION	0.4
INDUSTRIAL GASES	0.4
INDUSTRIAL INORGANIC CHEMICALS, NEC	0.4
INDUSTRIAL MACHINERY, NEC	1.8
INDUSTRIAL TRUCKS AND TRACTORS	0.4
INSTALLING BUILDING EQUIPMENT, NEC	0.4
LEATHER GOODS, NEC	0.4
LIGHTING EQUIPMENT, NEC	0.9
MAGNETIC & OPTICAL RECORDING MEDIA	0.9
MANIFOLD BUSINESS FORMS	0.4
MANUFACTURED ICE	0.9
MANUFACTURING INDUSTRIES, NEC	0.9
MEASURING & CONTROLLING DEVICES, NEC	0.4
MEASURING AND CONTROLLING DEVICES	0.9
METAL STAMPINGS, NEC	0.9
MISCELLANEOUS PUBLISHING	0.4
MOTOR VEHICLES AND CAR BODIES	0.4
MOTORS AND GENERATORS	0.4
NEWSPAPERS	0.4
NONFERROUS WIRE DRAWING & INSULATING	0.4
NONWOVEN FABRICS	0.4
OIL AND GAS FIELD MACHINERY	0.4
OPERATIVE BUILDERS	1.8
OPHTHALMIC GOODS	2.2
OPTICAL INSTRUMENTS AND LENSES	0.4
PAPER MILLS	0.9
PAPERBOARD MILLS	0.9
PARTITIONS AND FIXTURES	0.4
PETROLEUM REFINING	0.9
PHARMACEUTICAL PREPARATIONS	1.8
PLASTICS FOAM PRODUCTS	1.8
PLASTICS PRODUCTS, NEC	1.3
PLATEMAKING SERVICES	0.9
PLUMBING, HEATING, AIR CONDITIONING	2.2
POLISHES AND SANITATION GOODS	0.9
POWER DRIVEN HAND TOOLS	0.4
PREPARED FEEDS, NEC	0.4
PRINTED CIRCUIT BOARDS	1.3
RADIO AND TV COMMUNICATIONS EQUIPMENT	1.3
READY-MIXED CONCRETE	0.4
REFRIGERATION AND HEATING EQUIPMENT	0.4
ROOFING, SIDING AND SHEET METAL WORK	0.4
RUBBER AND PLASTICS FOOTWEAR	0.4
SAWMILLS AND PLANING MILLS, GENERAL	0.4
SEMICONDUCTORS AND RELATED DEVICES	6.7
SERVICE INDUSTRY MACHINERY, NEC	0.9
SHEET METAL WORK	1.3
SINGLE TENANT OFFICE (4)	0.9
SPECIAL INDUSTRY MACHINERY, NEC	0.4
SPECIAL TRADE CONTRACTORS, NEC	0.4
STATIONERY PRODUCTS	0.4
STRUCTURAL WOOD MEMBERS, NEC	0.9
TELEPHONE AND TELEGRAPH APPARATUS	0.4
TEMPORARY SERVICES FOR CONSTRUCTION (2)	3.6
TRANSFORMERS, EXCEPT ELECTRONIC	0.4
WINES, BRANDY, AND BRANDY SPIRITS	11.2
WOOD KITCHEN CABINETS	0.4
WOOD PRODUCTS, NEC	0.4

Protocols for Reporting of Results of Impact Measurement Studies Used to Support and Earnings Claim

Table 6

END USE: **INDUSTRIAL MISCELLANEOUS**
 DESIGNATED UNIT OF MEASUREMENT: **PROJECTS (per measure)**

		5. 90% Confidence Level				5. 80% Confidence Level					
		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound		
1. Average Participant Group and Average Comparison Group Usage											
A. Pre-Installation Usage	kWh kW therms	Note: Gray areas indicate category is not applicable.									
Base Usage	kWh kW therms										
Base Usage per Designated Unit of Meas.	kWh kW therms										
B. Impact Year Usag	kWh kW therms										
Impact Year Usage per Designated Unit of Meas.	kWh kW therms										
										<u>Gross</u>	<u>Net</u>
A. Load Impacts	kWh kW therms	36,509 6,382 1,246	22,402 3,911 764								
B. Load Impacts per Designated Unit of Meas.	kWh kW therms	55,224 9,654 1,885	33,885 5,916 1,155								
C. Participant Group Percent Change in Usage	kWh kW therms										
Comparison Group Percent Change in Usag	kWh kW therms										
		<u>Gross</u>	<u>Net</u>	<u>Gross</u>	<u>Gross</u>	<u>Net</u>	<u>Net</u>	<u>Gross</u>	<u>Gross</u>	<u>Net</u>	<u>Net</u>
D. Realization Rates	kWh kW therms	0.82 0.88 1.16	0.67 0.72 0.95								
3. Net-to-Gross Ratio											
A. Average Load Impacts	kWh kW therms	<u>Ratio</u> 0.61 0.61 0.61		<u>Ratio</u>	<u>Ratio</u>			<u>Ratio</u>	<u>Ratio</u>		
B. Avg. Load Impacts per Designated Unit of Meas.	kWh kW therms	0.61 0.61 0.61									
C. Avg. Load Impacts (as % Change in Usage)	kWh kW therms										
4. Designated Unit Intermediate Data											
A. Pre-Installation Avg. (Mean) Value for Participant Grou		<u>DUM</u> 0.661									
Pre-Installation Avg. (Mean) Value for Comparison Group		0.661									
B. Post-Installation Avg. (Mean) Value for Participant Grou											
Post-Installation Avg. (Mean) Value for Comparison Group											
5. Precision (see columns at far right)											
6. Measure Count Data											
A. No. of Measures Installed by Participants in Part. Group		<u>Count</u> 180									
B. No. of Meas. Installed by All Prog. Part. During Prog. Yr.		337									
C. No. of Measures Installed by the Comparison Group											

END USE:	INDUSTRIAL MISCELLANEOUS
7. Market Segment Data	<u>Percent</u>
Distribution of Participants by SIC Label	
ADHESIVES AND SEALANTS	0.3
AGRICULTURAL CHEMICALS, NEC	3.1
AIRCRAFT PARTS AND EQUIPMENT, NEC	0.3
ANIMAL AND MARINE FATS AND OILS	0.3
ARCHITECTURAL METAL WORK	0.3
BAGS:PLASTIC, FOIL AND COATED	0.3
BEEET SUGAR	0.3
BLAST FURNACES AND STEEL MILLS	1.5
BOTTLED AND CANNED SOFT DRINKS	0.3
BREAD, CAKE, AND RELATED PRODUCTS	1.5
CANNED FRUITS AND VEGETABLES	14.1
CANNED SPECIALTIES	0.3
CHOCOLATE AND COCOA PRODUCTS	1.5
COMMERCIAL PRINTING, LITHOGRAPHIC	0.3
CONSTRUCTION SAND AND GRAVEL	0.6
CORRUGATED AND SOLID FIBRE BOXES	0.6
CRUDE PETROLEUM AND NATURAL GAS	7.1
DEHYDRATED FRUITS, VEGETABLES, SOUPS	1.2
DIMENSION STONE	0.3
ELECTRICAL WORK	1.2
ELECTROMEDICAL EQUIPMENT	0.3
FABRICATED PLATE WORK (BOILER SHOPS)	0.6
FARM MACHINERY AND EQUIPMENT	1.2
FIBER CANS, DRUMS & SIMILAR PRODUCTS	0.6
FLOUR AND OTHER GRAIN MILL PRODUCTS	0.3
FLUID METERS AND COUNTING DEVICES	0.3
FLUID MILK	0.3
FOLDING PAPERBOARD BOXES	0.6
FOOD PREPARATIONS, NEC	0.9
FRESH OR FROZEN FISH PREPARED FISH	0.3
FROZEN BAKERY PRODUCTS, EXCEPT BREAD	1.2
FROZEN FRUITS AND VEGETABLES	0.9
GLASS AND GLAZING WORK	0.3
GYPSUM PRODUCTS	0.6
HIGHWAY AND STREET CONSTRUCTION	0.3
ICE CREAM AND FROZEN DESSERT PRODUCTS	0.9
INDUSTRIAL BUILDINGS AND WAREHOUSES	0.3
INDUSTRIAL INORGANIC CHEMICALS, NEC	0.3
INDUSTRIAL MACHINERY, NEC	0.6
LEATHER TANNING AND FINISHING	0.3
MALT BEVERAGES	0.3
MANUFACTURED ICE	0.6
MANUFACTURING INDUSTRIES, NEC	0.3
MARKING DEVICES	0.3
MATTRESSES AND BEDSPRINGS	0.6
MEAT PACKING PLANTS	1.5
METAL CANS	0.6
MILLWORK	1.8
MINERAL WOOL	0.3
MINERALS, GROUND OR TREATED	0.9
NATURAL, PROCESSED, AND IMITATION CHEESE	0.6
NONFERROUS WIRE DRAWING & INSULATING	0.6
NONMETALLIC MINERAL PRODUCTS, NEC	0.3
OIL AND GAS FIELD MACHINERY	0.9
PAINTS AND ALLIED PRODUCTS	0.6
PAPER:COATED AND LAMINATED, NEC	0.3
PAPERBOARD MILLS	2.8
PERIODICALS	0.3
PETROLEUM REFINING	10.4
PICKLES, SAUCES, AND SALAD DRESSINGS	0.3
POTTERY PRODUCTS, NEC	0.3
POULTRY SLAUGHTERING AND PROCESSING	0.6
PREPARED FEEDS, NEC	1.8
PRIMARY METAL PRODUCTS, NEC	0.3
PRINTING TRADES MACHINERY	0.3
READY-MIXED CONCRETE	1.2
RECONSTITUTED WOOD PRODUCTS	1.5
REFRIGERATION AND HEATING EQUIPMENT	0.3
SALTED AND ROASTED NUTS AND SEEDS	0.3
SAWMILLS AND PLANING MILLS, GENERAL	6.7
SEARCH & NAVIGATION EQUIPMENT	0.3
SEMICONDUCTORS AND RELATED DEVICES	1.2
SHEET METAL WORK	0.3
SPECIAL TRADE CONTRACTORS, NEC	0.3
SPEED CHANGERS, DRIVERS AND GEARS	0.3
STATIONERY PRODUCTS	0.6
STEEL FOUNDRIES, NEC	0.3
TEMPORARY SERVICES FOR CONSTRUCTION (2)	0.3
WATER WELL DRILLING	0.3
WINES, BRANDY, AND BRANDY SPIRITS	5.8
WOOD KITCHEN CABINETS	0.3
WOOD OFFICE FURNITURE	0.3
WOOD PALLETS AND SKIDS	0.6
WOOD PRODUCTS, NEC	4.0

Protocols for Reporting of Results of Impact Measurement Studies Used to Support and Earnings Claim

Table 6

END USE: **INDUSTRIAL PROCESS**
 DESIGNATED UNIT OF MEASUREMENT: **PROJECTS (per measure)**

		5. 90% Confidence Level				5. 80% Confidence Level					
		Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound		
1. Average Participant Group and Average Comparison Group Usage											
A. Pre-Installation Usage	kWh kW therms	Note: Gray areas indicate category is not applicable.									
Base Usage	kWh kW therms										
Base Usage per Designated Unit of Meas.	kWh kW therms										
B. Impact Year Usag	kWh kW therms										
Impact Year Usage per Designated Unit of Meas.	kWh kW therms										
2. Avg. Net & Gross End Use Load Impacts											
A. Load Impacts	kWh kW therms	Gross 369,01	Net 189,58	Gross 82,640	Gross 655,38	Net 16,979	Net 362,19	Gross 145,50	Gross 592,51	Net 54,869	Net 324,30
		44.01	22.59	7.42	80.59	-14.01	59.19	15.45	72.56	-5.97	51.15
		153,40	99,655	22,174	284,62	-426,791	626,10	50,980	255,82	-311,230	510,54
B. Load Impacts per Designated Unit of Meas.	kWh kW therms	378,01	194,21	84,656	671,36	17,394	371,03	149,05	606,97	56,208	332,21
		45.08	23.14	7.61	82.56	-14.35	60.63	15.83	74.33	-6.12	52.40
		157,14	102,08	22,715	291,56	-437,201	641,37	52,223	262,06	-318,821	522,99
C. Participant Group Percent Change in Usage	kWh kW therms										
Comparison Group Percent Change in Usag	kWh kW therms										
D. Realization Rates	kWh kW therms	Gross 0.66	Net 0.52	Gross 0.15	Gross 1.17	Net 0.05	Net 0.99	Gross 0.26	Gross 1.06	Net 0.15	Net 0.88
		0.82	0.64	0.14	1.49	-0.40	1.68	0.29	1.35	-0.17	1.45
		1.18	0.93	0.17	2.20	-3.98	5.83	0.39	1.98	-2.90	4.76
3. Net-to-Gross Ratio											
A. Average Load Impacts	kWh kW therms	Ratio 0.59		Ratio 0.548	Ratio 0.627			Ratio 0.557	Ratio 0.619		
		0.59		0.548	0.627			0.557	0.619		
		0.59		0.548	0.627			0.557	0.619		
B. Avg. Load Impacts per Designated Unit of Meas.	kWh kW therms	0.59		0.548	0.627			0.557	0.619		
		0.59		0.548	0.627			0.557	0.619		
		0.59		0.548	0.627			0.557	0.619		
C. Avg. Load Impacts (as % Change in Usage)	kWh kW therms										
4. Designated Unit Intermediate Data											
A. Pre-Installation Avg. (Mean) Value for Participant Grou		DUM									
Pre-Installation Avg. (Mean) Value for Comparison Group		0.98									
B. Post-Installation Avg. (Mean) Value for Participant Grou											
Post-Installation Avg. (Mean) Value for Comparison Group											
5. Precision (see columns at far right)											
6. Measure Count Data											
A. No. of Measures Installed by Participants in Part. Group		Count									
B. No. of Meas. Installed by All Prog. Part. During Prog. Yr.		84									
C. No. of Measures Installed by the Comparison Group		96									

END USE:	INDUSTRIAL PROCESS
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7. Market Segment Data	<u>Percen</u>
Distribution of Participants by SIC Label	
ALUMINUM SHEET, PLATE, AND FOIL	2.1
BREAD, CAKE, AND RELATED PRODUCTS	1.0
BROADWOVEN FABRIC MILLS, WOOL	1.0
CANNED FRUITS AND VEGETABLES	2.1
CANNED SPECIALTIES	1.0
CHEMICAL PREPARATIONS, NEC	1.0
CONCRETE PRODUCTS, NEC	1.0
CONSTRUCTION SAND AND GRAVEL	1.0
CRUDE PETROLEUM AND NATURAL GAS	18.8
CRUSHED AND BROKEN LIMESTONE	1.0
DEHYDRATED FRUITS, VEGETABLES, SOUPS	1.0
ELECTRONIC COMPONENTS, NEC	1.0
FIBER CANS, DRUMS & SIMILAR PRODUCTS	2.1
FLOUR AND OTHER GRAIN MILL PRODUCTS	1.0
FOOD PREPARATIONS, NEC	3.1
GENERAL INDUSTRIAL MACHINERY, NEC	1.0
GLASS CONTAINERS	2.1
INDUSTRIAL GASES	2.1
INDUSTRIAL INORGANIC CHEMICALS, NEC	1.0
INDUSTRIAL MACHINERY, NEC	1.0
INDUSTRIAL SAND	1.0
METAL CANS	5.2
METAL COATING AND ALLIED SERVICES	1.0
MINERAL WOOL	1.0
MOTOR VEHICLES AND CAR BODIES	1.0
NATURAL, PROCESSED, AND IMITATION CHEESE	2.1
NEWSPAPERS	1.0
NONFERROUS WIRE DRAWING & INSULATING	1.0
OFFICE FURNITURE, EXCEPT WOOD	1.0
OPTICAL INSTRUMENTS AND LENSES	2.1
PAPER MILLS	2.1
PAPERBOARD MILLS	1.0
PETROLEUM REFINING	6.3
PLASTICS FOAM PRODUCTS	2.1
PLASTICS PIPE	1.0
PLASTICS PRODUCTS, NEC	8.3
PREPARED FEEDS, NEC	1.0
RECONSTITUTED WOOD PRODUCTS	2.1
RICE MILLING	1.0
SAWMILLS AND PLANING MILLS, GENERAL	6.3
SEMICONDUCTORS AND RELATED DEVICES	1.0
SERVICE INDUSTRY MACHINERY, NEC	1.0
SOAP AND OTHER DETERGENTS	1.0
STRUCTURAL AND CLAY PRODUCTS, NEC	1.0
TEMPORARY SERVICES FOR CONSTRUCTION (2)	1.0
WOOD PRODUCTS, NEC	1.0

RESPONSE TO M&E PROTOCOL TABLE 7

A. Overview Information

1. Study Title: **Impact Evaluation of Pacific Gas & Electric Company's 1995 Industrial Sector Energy Efficiency Incentives Programs: Lighting; HVAC; Process**

Study ID: **325** (IEEI Lighting), **327** (IEEI HVAC), **328** (IEEI Process)

2. Customized , Retrofit Express, REO, and Thermal Storage Programs. All applications paid in 1995.
3. Evaluations covered HVAC, Lighting, Process, and Miscellaneous end uses.
4. Gross savings estimated by engineering methods via DOE 2.1E simulations and other engineering models, see Section 5. Net-to-gross ratios estimated through self-reports in interviews. Further adjustment to NTGR comes from vendor surveys and from estimation of alternative baseline consumption based on customer reports of alternatives considered to as built installations. See Section 6.
5. No comparison groups were used.
6. Reports of sample sizes are in Section 3.

B. Database Management

1. Tables and flow charts that show all data sources and their interrelations can be found in Section 6, Tables 6-2, 6-4, and 6-5, Figures 6-2, 6-3, and 6-4.
2. The sources of all data elements are described in Sections 4 and 6.
3. Sample selection processes, recruitment, response rates, and attrition are described in Section 3.
4. Gross savings data quality checks: each evaluation was reviewed by a senior-level engineer who verified the reasonableness of the technical approach, collected data, and evaluation results. Gross savings results were further subjected to data checks which identified items with negative savings, with large discrepancies compared to the program estimates, and with unusually high or low normalized savings. Any outliers were further scrutinized to confirm their correctness.

Net savings data quality checks: internal consistency checks built into decision-maker interviews--interviewers alerted to internal contradictions. For custom sites, consistency checks routinized between file information, operations staff surveys, and decision-maker interviews. Also, consistency reviewed systematically between pre-quantified question responses and narrative question responses, both for decision makers and operations staff.

5. All data collected were used.

C. Sampling

1. A complete description of the sample design and implementation can be found in Section 3.
2. Data collection instruments are provided in Appendices D through K. Sample disposition reports are in Section 3.

D. Data Screening and Analysis

1. Once recruitment was completed, very few data points were missing. The few that were missing, and their handling, is discussed in Section 6.
2. Background variables were not an issue since comparison groups were not used.
3. No screening of cases was done beyond the initial sampling. Since analysis did not depend on billing data, many of the usual reasons for screening did not exist.
4. N/A
5. N/A
6. Potential errors in measuring customers' level of free ridership are dealt with by multiple measures of the same concept, increasing reliability of measures. Also, internal consistency checks are provided to detect contradictions and misunderstandings during the interview so that they can be addressed on the spot with the respondent. For projects in the custo evaluation group, additional checks were provided by asking open-ended questions, whose answers could be compared to the pre-quantified questions to check for contradictions. Also in this group were interviews with operations staff, where different from decision makers, and those answers were used to check for contradictions as well. Finally, in the custo evaluation group, file information, including payback calculations were used to detect contradictions in reported motivations for installations, especially pertaining to the role of the rebate.
7. N/A
8. N/A
9. N/A
10. N/A
11. Once recruitment was completed, very few data points were missing. The few that were missing, and their handling, is discussed in Section 6.
12. The formulas for standard errors are shown in Section 6.

E. Data Interpretation and Application

1. Gross savings were calculated by engineering methods. Net savings were calculated by application of self-report-based NTGRs. Separate estimates of net savings were calculated for each evaluation group and each end use. Realization rates based on ratios between engineering

estimates and program tracking system estimates, plus NTGRs, both based on sampled and evaluated sites, were applied to excluded site program tracking system savings to produce net savings estimates for all groups. These net savings were summed across evaluation groups and end uses to produce a program-level net savings. Savings were also calculated for spillover installations and added to the total net savings based on rebated measures.

2. A full description of the aggregation from item-level net savings and NTGRs to program-level net savings, program-level NTGRs, and end-use-level savings and NTGRs is reported in Section 6.

RESPONSE TO M&E PROTOCOL TABLE 11

Base Energy Usage

The engineering models for this study produced estimates of the change in kWh, kW, and therm usage resulting from the installed measures. The evaluation does not provide any estimates of base energy usage.

Determination of Net Program Impacts

The overall net-to-gross ratios (NTGR) for each end use are listed in the Response to M&E Protocol Table 6 above. These ratios are highly dependent on the features of the programs offered by PG&E during the study years and, as such, would not be generally applicable to other program years. Furthermore, there is no reason to expect that the program participants, paid rebates in 1995, are typical of the PG&E industrial class or of participants that will receive rebates in future years. Large portions of the program savings can be attributed to a small number of participants who operate large industrial facilities. As these facilities each have unique energy use characteristics, we do not believe that these results would be applicable to future forecasting applications.

Load Impacts

The first-year gross impacts per designated unit of measurement for each end use are as follows:

End Use	Designated Unit of Measurement (DUM)	Electric Usage Impact (kWh/DUM)	Electric Peak Demand Impact (W/DUM)	Gas Usage Impact (therm/DUM)
HVAC	Square footage	6.47	0.651	0.200
Lighting	Square footage × annual hours of operation ÷ 1000	0.381	0.059	-0.001
Miscellaneous	Projects	64,891	9,655	1,885
Process	Projects	378,010	45,080	157,142

As noted for the net impacts, there is no reason to expect that the program participants who were paid rebates in 1995 are typical of the PG&E industrial customer class or of participants that will receive rebates in future years. Large portions of the program savings can be attributed to a small number of participants who operate large industrial facilities. As these facilities each have unique energy use characteristics, we do not believe that these results would be applicable to future forecasting applications.