Customer Energy Efficiency Program
Measurement and Evaluation Program

IMPACT EVALUATION OF PACIFIC GAS & ELECTRIC COMPANY'S 1996 INDUSTRIAL SECTOR ENERGY EFFICIENCY INCENTIVES PROGRAMS: LIGHTING; HVAC; PROCESS

PG&E Study ID numbers:
350: Lighting
352: HVAC
353: Process

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IMPACT EVALUATION OF PACIFIC GAS & ELECTRIC COMPANY'S 1996 INDUSTRIAL SECTOR ENERGY EFFICIENCY INCENTIVES PROGRAMS: INDOOR LIGHTING, HVAC, AND PROCESS END USES

PG&E Study ID numbers: 350, 352, 353

Purpose of Study

This study was conducted in compliance with "Protocols and Procedures for the Verification of Costs, Benefits, and Shareholders Earnings from Demand-Side Management Programs," as adopted by California Public Utilities Commission Decision 93-05-063, revised January 1997, pursuant to Decisions 94-05-063, 94-10-059, 94-12-021, 95-12-054, and 96-12-079.

This study evaluated the ex post gross and net kW, kWh, and therm savings from the installation of energy efficiency measures in the indoor lighting, HVAC, and process end uses for which rebates were paid in 1996 by the following Pacific Gas & Electric Company industrial energy efficiency incentive programs: Advanced Performance Options, Customized, Retrofit Express, and Retrofit Efficiency Options.

Methodology

Evaluations were completed for two types of samples, the *project-specific* sample and the *verification* sample. The project-specific sample comprised over 70% of the total program database gross kW, kWh, and therm savings for each end use. The verification sample completed a census for the HVAC and process end uses, and brought the indoor lighting sample count up to 150 projects. Ex post gross savings in the project-specific sample were estimated using premise-specific data collection and engineering analysis techniques for projects in the HVAC and process end uses, and standardized data collection and engineering analysis techniques for projects in the indoor lighting end use. Each rebated item in the verification sample was located and inspected to determine what percentage was installed and operational.

Ex post net savings for the project-specific and verification samples were estimated using three levels of free-ridership analysis: *customized project-specific*, *standard project-specific*, and *verification*. Projects with the largest ex ante gross savings estimates (all HVAC and process projects in the project-specific sample, and indoor lighting projects in the project-specific sample with ex ante gross savings estimates greater than 35 kW) were given the customized project-specific free-ridership analysis, the most detailed analysis. Indoor lighting projects in the project-specific sample with ex ante gross savings estimates less than 35 kW were given the standard project-specific free-ridership analysis. Projects in the verification sample were given the verification free-ridership analysis, the least detailed analysis. The sources of free-ridership information were program files, interviews with customer contacts who either made the decision to install the rebated items or were most familiar with their operation, and interviews with vendors who recommended the rebated items.

The ex post gross kW, kWh, and therm savings at the end use level were estimated by first dividing the sum of the ex post gross savings for the project-specific sample by the sum of the corresponding ex ante gross savings. The resulting gross realization rates for the project-specific sample were then applied to ex ante gross savings estimates for remaining items in each end use. The ex post gross kW, kWh, and therm

savings estimates at the end use level were divided by the corresponding ex ante gross savings estimates to yield end use level kW, kWh, and therm gross realization rates.

The ex post kW, kWh, and therm net-to-gross-ratios (NTGR) at the end use level were estimated by first multiplying the ex post gross savings for each evaluated item by its NTGR. For each non-evaluated item, ex post gross savings were multiplied by the savings-weighted average NTGR for all evaluated items in the end use. This yielded ex post net kW, kWh, and therm savings for all items in each end use. The ratio of aggregate ex post net kW, kWh, and therm savings for each end use to the corresponding ex post gross savings estimates yielded end use-level kW, kWh, and therm NTGRs.

Study Results

The results of the industrial sector evaluation in the indoor lighting, HVAC, and process end uses are summarized below:

Indoor Lighting (Study #350)	Gross Savings	Gross Realization Rate	Net-To-Gross		Net Savings	Net Realization Rate
			1-FR	SO		
EX ANTE						
kW[1]	3,554	-	0.671	-	2,385	-
kWh	21,898,497	-	0.671	-	14,695,472	-
therms	-	-	-	-	-	-
EX POST						
kW[1]	3,040	0.855	0.593	0.007	1,802	0.755
kWh	23,007,545	1.051	0.661	0.006	15,199,622	1.034
therms	-121,057	-	0.809	0.000	-97,937	NA

HVAC (Study #352)	Gross Savings	Gross Realization Rate	Net-To-Gross		Net Savings	Net Realization Rate
			1-FR	SO		
EX ANTE						
kW[1]	714	-	0.607	-	434	-
kWh	7,868,568	-	0.628	-	4,944,384	-
therms	446,848	-	0.650	-	290,451	-
EX POST						
kW[1]	390	0.546	0.465	-	181	0.418
kWh	3,399,791	0.432	0.464	-	1,577,942	0.319
therms	3,597	0.008	0.200	-	718	0.002

Process (Study #353)	Gross Savings	Gross Realization Rate	Net-To-Gross		Net Savings	Net Realization Rate
			1-FR	SO		
EX ANTE						
kW[1]	3,009	-	0.650	-	1,956	-
kWh	31,894,817	-	0.650	-	20,731,631	-
therms	1,692,429	-	0.650	-	1,100,079	-
EX POST						
kW[1]	2,928	0.973	0.615	0.004	1,800	0.920
kWh	25,092,517	0.787	0.605	0.004	15,178,218	0.732
therms	1,458,710	0.862	0.603	-	879,618	0.800

[1] Defined as the average hourly kW savings coincident with the PG&E system maximum during the summer on-peak costing period (May 1 – October 31, weekdays at 3 P.M.)

Regulatory Waivers and Filing Variances

No regulatory waivers filed.

No E-Table variances.

FINAL REPORT

Impact Evaluation

of

1996 Industrial Sector Energy Efficiency Incentives Programs

PG&E Study ID Numbers:

350 (Lighting)
352 (HVAC)
353 (Process)

Submitted to

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APPENDICES

Executive Summary

This study evaluated the gross and net energy savings from efficiency measures for which rebates were paid in 1996 by Pacific Gas and Electric Company's (PG&E) Industrial Energy Efficiency Incentives (IEEI) 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:

- Ex post savings estimates for gross electric consumption, electric peak demand, and gas consumption.
- Net-to-gross ratios (NTGR) at both the program and end-use levels.
- Net-to-gross ratios (NTGR), adjusted for spillover effects, at both the program and end-use levels.

We developed savings estimates and NTGRs for the overall program as well as for three end uses: indoor lighting, HVAC, and process. 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-efficiency measures to reduce energy consumption and demand in existing industrial facilities. In 1996, 513 customer applications, containing 1,002 items, were paid rebates through the Advanced Performance Options, Customized, Retrofit Express, and Retrofit Efficiency Options Programs covered by this evaluation. The goal of this evaluation was to determine the load impacts associated with PG&E's investment in these programs.

Methodology

We completed evaluations for two types of samples, the *project-specific* sample and the *verification* sample. The project-specific sample provided a census of 70% of the program database savings for the lighting, process, and HVAC end uses. These projects received the most rigorous analysis. Since these projects 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 size of each project's savings. 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 end uses 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 item. 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: customized project-specific, standard project-specific, and verification. The most detailed level of analysis, customized project-specific analysis, was applied to all project-specific HVAC and process projects, as well as to all lighting projects with ex ante kW savings greater than 35 kW. 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, HVAC, and process end uses. There were four sources of free-ridership information in this study. These sources included program files, interviews with operations staff most familiar with measures, interviews with customer contacts who made the decision to install the rebated items, and surveys of vendors who recommended the efficiency equipment. Each level of free-ridership analysis relied on information from one or more of these four sources. Figure 1 provides an overview of the evaluation process for each site.

To create end-use-level estimates of gross savings, we extrapolated the gross realization rates from the completed project-specific evaluation group to the other items in each end use, then summed the savings for all items in the end use. To determine end-use-level NTGRs, we first extrapolated item-level NTGRs for evaluated items to non-evaluated items. Next, we calculated net savings for each item, and then summed the item net savings by end use. The ratio of end use net savings to end use gross savings yielded end-use-level NTGRs.

Results

The methods described above were used to estimate ex post gross and net savings for the 1996 paid items. The disposition of the analysis sample frame, along with the results of the analyses, are summarized below.

Sample Disposition

Of the 1,002 items paid in 1996, we excluded 256 small lighting items that collectively, accounted for about 1% of the total program lighting ex ante gross savings. During the course of recruiting customers to participate in the evaluation, 32 out of 306 customers refused to participate. These 32 customers accounted for 80 items (8% of the items paid in 1996). In addition, of the customers we set aside to replace those that refused to participate, we ultimately did not need to recruit eight of these (accounting for 23 items, which combined made up 1.5% of the total ex ante lighting savings). Our final sample consisted of 643 items that received onsite, decision-maker, and various other surveys. We installed short-term and one-time metering equipment to analyze 51 of these items during the onsite surveys. A more detailed summary of the sample disposition, by end use, can be found in Table 1.

Evaluation Load Impacts

Table 2 summarizes the results of our evaluation. It includes both PG&E program estimates (ex ante) and our evaluation estimates (ex post) of gross, net, and spillover savings, along with corresponding realization rates and net-to-gross ratios. Results are provided for each end use and for the program overall. These results are reported for kWh, kW, and therm savings, with the kW savings based upon the average coincident summer on-peak period kW savings.

Table 1: PG&E 1996 Industrial Energy Efficiency Initiatives Summary of Sample

End Use	Population (# of items)	Sample Frame	Final Analysis Sample	
			Onsite	Metering
HVAC	177	177	166	14
Lighting	776	520	429	28
Process	49	49	48	9
ALL	**1,002**	**746**	**643**	**51**

As Table 2 shows, we estimated overall kW, kWh, and therm gross realization rates of 0.87, 0.84, and 0.63, respectively. Process items had the highest kW and therm gross realization rates (0.97 and 0.86, respectively), while lighting items had the largest kWh gross realization rate (1.05). We also examined the effect of interactions between rebated items, as well as between lighting items and HVAC consumption. We found the effect of interaction between items to be negligible. The lighting-HVAC interaction decreased overall therm savings by about 8%. This occurred because more efficient lighting produces less heat in a building, thus increasing the amount of gas the heating systems must consume to warm the building.

Table 2 also presents ex ante and ex post net-to-gross ratios for each of the three end uses. The column titled "1-Freeridership (NTG)" shows ex post NTGRs that have been enhanced by the customized free-ridership analysis. The column titled "NTG w/spillover" lists the same NTGRs after incorporating spillover effects. Overall, the ex post NTGRs (without spillover) for kW, kWh, and therms are 0.60, 0.62, and 0.58, respectively. On an end-use level, process had the highest kW NTGR (0.62), while lighting had the highest kWh and therm NTGRs (0.66 and 0.81, respectively).

Figure 1: Summary of Site Evaluation Process

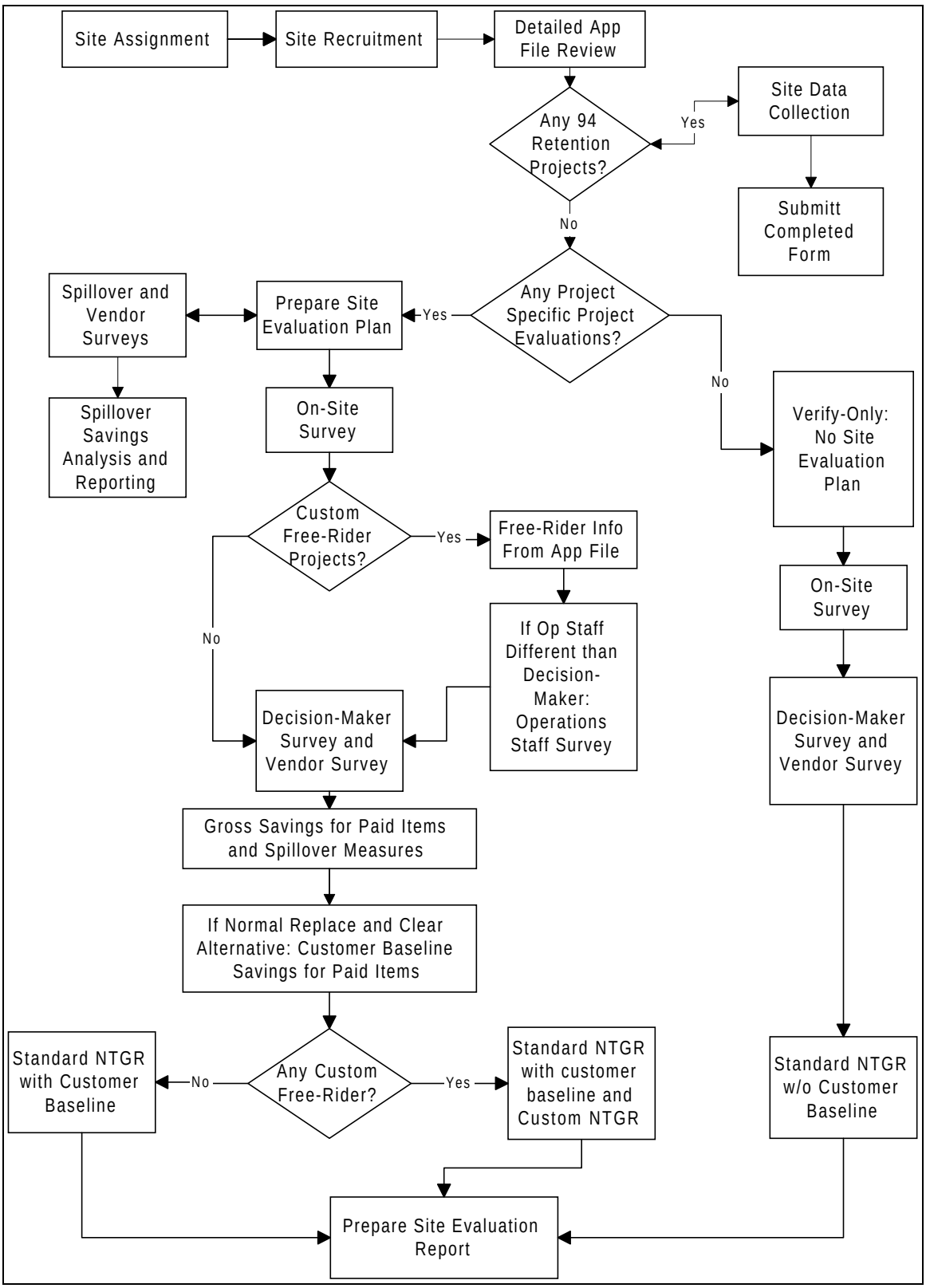

Table 2: PG&E 1996 Industrial Energy Efficiency Initiatives
Summary of Evaluation Gross and Net Load Impacts

~~HVAC~~	Gross		Ratios			Net		
	Savings	Realization Rate	1-Freeridership (NTG)	Spillover- to-Gross	NTG w/ spillover	Savings	Realization Rate	Spillover Savings
Ex Ante								
kW	714	-	0.607	-	0.607	434	-	-
kWh	7,868,568	-	0.628	-	0.628	4,944,384	-	-
Therms	446,848	-	0.650	-	0.650	290,451	-	-
kW[1]	390	0.546	0.465	-	0.465	181	0.418	-
kWh	3,399,791	0.432	0.464	-	0.464	1,577,942	0.319	-
Therms	3,597	0.008	0.200	-	0.200	718	0.002	-

~~Lighting~~	Gross		Ratios			Net		
	Savings	Realization Rate	1-Freeridership (NTG)	Spillover- to-Gross	NTG w/ spillover	Savings	Realization Rate	Spillover Savings
Ex Ante								
kW	3,554	-	0.671	-	0.671	2,385	-	-
kWh	21,898,497	-	0.671	-	0.671	14,695,472	-	-
Therms	-	-	-	-	-	-	-	-
kW[1]	3,040	0.855	0.593	0.007	0.600	1,802	0.755	22
kWh	23,007,545	1.051	0.661	0.006	0.667	15,199,622	1.034	142,711
Therms	-121,057	-	0.809	0.000	0.809	-97,937	N/A	-41

~~Process~~	Gross		Ratios			Net		
	Savings	Realization Rate	1-Freeridership (NTG)	Spillover- to-Gross	NTG w/ spillover	Savings	Realization Rate	Spillover Savings
Ex Ante								
kW	3,009	-	0.650	-	0.650	1,956	-	-
kWh	31,894,817	-	0.650	-	0.650	20,731,631	-	-
Therms	1,692,429	-	0.650	-	0.650	1,100,079	-	-
Ex Post								
kW[1]	2,928	0.973	0.615	0.004	0.619	1,800	0.920	13
kWh	25,092,517	0.787	0.605	0.004	0.609	15,178,218	0.732	112,197
Therms	1,458,710	0.862	0.603	-	0.603	879,618	0.800	-

~~All End Uses~~	Gross		Ratios			Net		
	Savings	Realization Rate	1-Freeridership (NTG)	Spillover- to-Gross	NTG w/ spillover	Savings	Realization Rate	Spillover Savings
kW	7,277	-	0.656	-	0.656	4,774	-	-
kWh	61,661,882	-	0.655	-	0.655	40,371,487	-	-
Therms	2,139,277	-	0.650	-	0.650	1,390,530	-	-
Ex Post								
kW[1]	6,357	0.874	0.595	0.005	0.600	3,783	0.792	35
kWh	51,499,853	0.835	0.621	0.005	0.625	31,955,781	0.792	254,908
Therms	1,341,250	0.627	0.583	-0.00003	0.583	782,399	0.563	-41

(1) Defined as the average hourly kW savings coincident with the PG&E system maximum during the summer on-peak costing period (May 1 - October 31, weekdays at 3 P.M.)

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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 1996 these rebates were paid for efficiency measures described in 513 program applications, processed under the Advanced Performance Options (APO), Customized, Retrofit Express (RE), and Retrofit Efficiency Options (REO). PG&E paid no applications in 1996 under either the Customized Efficiency Options (CEO) or the Off Peak Cooling (OPC) programs. The research documented in this report was undertaken to determine the ex post gross and net energy and demand impacts associated with PG&E's investment in these programs. This report presents the methodology and results of the program evaluation.

1.1 Overview of 1996 Rebate Programs

Each of the 1996 rebate programs covered by this evaluation are summarized below:

- **Customized:**. This program offered financial incentives to customers to undertake large or complex projects, not covered under the Express program, which saved gas or electricity. These customers submitted calculations for the projected first year energy savings, along with an application, prior to installation of high-efficiency equipment. The maximum total incentive amount for the Custom Program was $500,000 per account. The minimum qualifying incentive amount was $2,500 per project. This program ended in 1994 but some applications were paid in 1996.

- **Advanced Performance Options (APO)**. This program was instituted to replace the Customized Incentive Program. It offers financial incentives of $125/kW, $0.06/kWh and $0.20/therm of first-year energy savings to customers undertaking large or complex projects not covered under other PG&E programs. These customers work with their PG&E Customer Representative to identify potentially viable projects. PG&E is then responsible for calculating energy savings, which is often accomplished by using energy consultants. Maximum total incentive amount for the APO Program is $300,000 per account. The minimum qualifying incentive amount is $5,000 per project.

- **Retrofit Express (RE):** This program offers fixed rebates to PG&E's customers that install specific gas and electric energy-efficient equipment in their facilities. For 1996, the customer could also opt to receive assistance with equipment selection, the bidding process, economic analysis, and other services in exchange for a reduced rebate. The Program covers most common energy-savings measures: lighting, air conditioning, refrigeration/food service, and motors. The maximum total rebate amount is $300,000 per account. This includes participation in any combination of the lighting, air conditioning, refrigeration/food service, and motor program options.

- **Retrofit Efficiency Options (REO):** This program offers rebates for selected measures previously addressed by the Express and Customized programs. The REO Program targets commercial, industrial, and agricultural market segments most likely to benefit from these selected measures. Marketing efforts are coordinated among PG&E Divisions, emphasizing local planning areas with high marginal electric costs, to maximize program benefits. For 1996, the REO Program included two refrigeration measures, four building systems measures, seven industrial and municipal measures, and three agricultural measures. The minimum and maximum incentive amounts are $250 and $100,000 per project, respectively.

1.2 Research Goals and Objectives

The goal of this research was to perform an ex post impact evaluation of all efficiency measures funded under PG&E's 1996 industrial rebate programs. The impact evaluation was conducted in strict accord with the CPUC-adopted statewide "Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs" (M&E Protocols). The objectives of this evaluation were to:

- Determine the first-year gross kWh, kW and therm savings from each of three categories of efficiency measures (indoor lighting, HVAC, and process) for which rebates were paid during 1996.

- Conduct project-specific evaluations of measure savings for projects that account for 70 percent of PG&E's ex ante estimate of gross savings in the indoor lighting, HVAC, and process end uses.

- Conduct verification evaluations (that confirm equipment is present and operational) of projects such that the total number of both project-specific and verification evaluations equals 150 or a census for each of the indoor lighting, HVAC, and process end uses.

- Account for the effects of free-ridership on both project-specific and verification evaluations.

- Account for the effects of spillover.

- Estimate gross and net kWh and kW savings for each of the five standard electric energy costing periods.

- Explain any discrepancies that are found between the ex post results of this study and the ex ante PG&E Programs estimates of savings for the 1996 paid measures.

- Produce a database of measure-specific equipment characteristics that will meet the needs of future retention studies.

- Provide recommendations based on the study results that pertain to strengthening the Industrial Energy Efficiency Incentives (IEEI) programs, increasing customer value, improving the protocols and improving future program evaluations.

1.3 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:

- **Application**. PG&E's programs provide incentives after processing is complete for an application submitted by a customer. As each application is processed, an application file is created. PG&E's program database maintains information from these application files in electronic form. One or more application files 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 file is 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 the subject of this evaluation included applications received during 1993, 1994, 1995, and 1996.

- **Item**. Each of the application files describes energy efficiency measures that were paid rebates 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[1]". Each item is assigned a measure code in the database to indicate the type of equipment involved. Each item was assigned to a control number, indicating the PG&E meter that was affected by the equipment's 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 database allowed for only one.

- **End Use**. Each item was assigned a measure code and a description of the measure. For the purpose of its earnings claim, PG&E grouped measure codes by end use: indoor lighting (sometimes referred to in this report simply as "lighting"), process, and HVAC.

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

- **Corporation**. The MDSS application database contained the name of the organization that was paid the rebate. These names were matched to identify each unique corporation involved in the 1996 program.

- **Site**. A site is defined as one or more contiguous structures that are operated by the same corporation within a ZIP code area. 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. Multiple projects may have been associated with the same site, and multiple sites may be associated with the same corporation.

[1] In the MDSS database, multiple items with identical measure labels are sometimes entered for the same application, program year and control number. These were combined to create the "item" unit used in this evaluation.

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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 1,002 items associated with the 513 applications paid in 1996 by the APO, Customized, RE, and REO 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 three study domains for this evaluation: (1) indoor lighting, (2) process, and (3) HVAC.

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 (a list from which to draw the sample) consisting of 519 projects, associated with 453 control numbers (a unique identifier which PG&E assigns to each billing meter location). Of these projects, 137 were in the HVAC end use, 334 in lighting, and 48 in process.

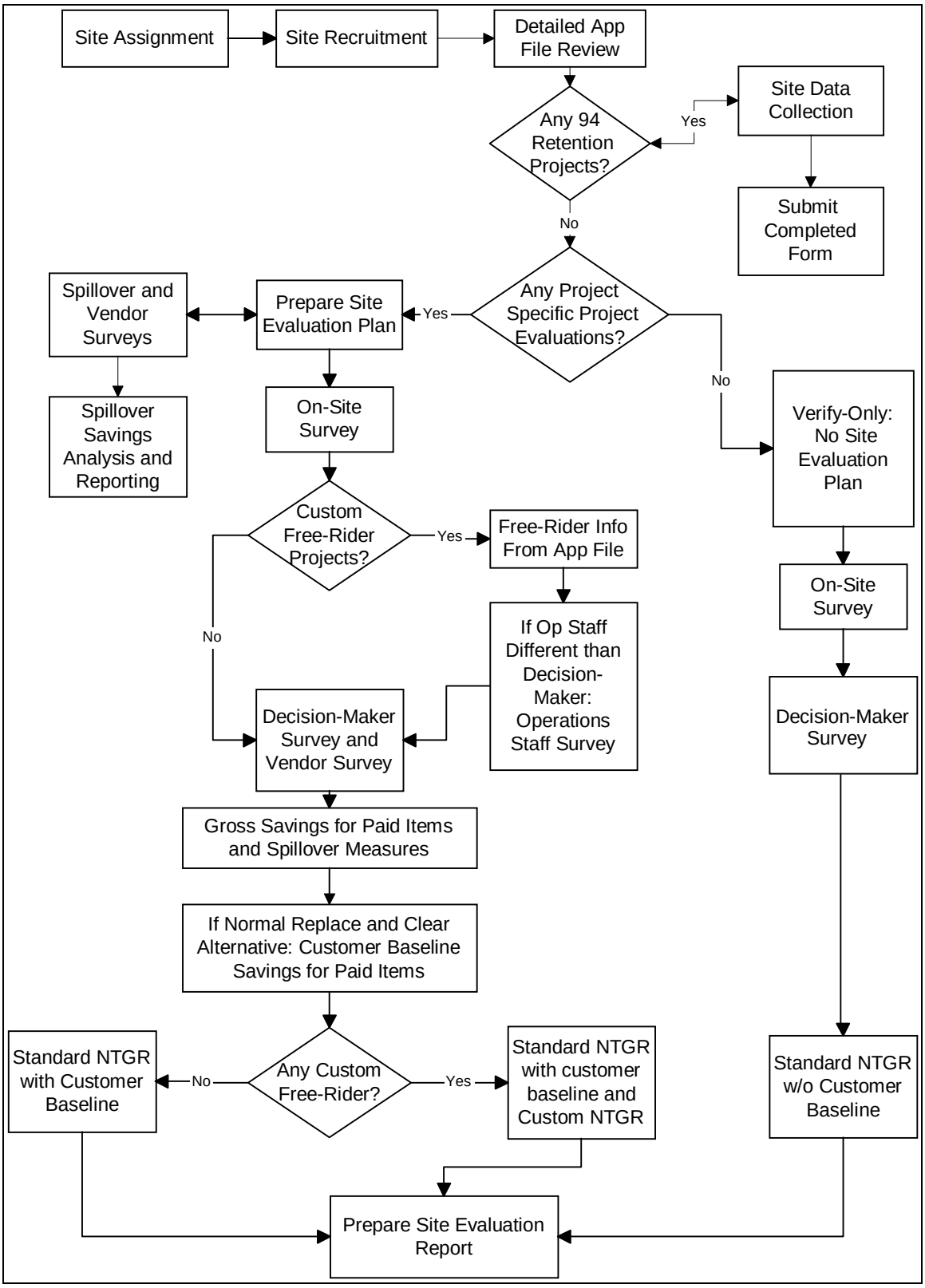
We completed evaluations for two samples. The first sample (referred to in this report as the project-specific sample) provided a census of 70% of the ex ante gross database kW, kWh, and therm savings for the indoor lighting, process, and HVAC domains. Data collection and evaluation techniques tailored 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. 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 containing a measure paid a rebate in 1996. 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 obtained permission for the data collection activities needed to evaluate all of the rebated projects and spillover measures located at the site. Once a site was recruited, the lead engineer conducted a detailed review of the relevant project files to thoroughly understand the projects present at the site.

Figure 1: Summary of Site Evaluation Process



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. We designated projects with the largest program savings--defined as all HVAC and process projects, and all lighting projects with demand savings greater than 35 kW—as custom projects that were given 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 of project (comprising those with program savings too small to be classified as custom, but large enough to fall within the top 70% of end use savings) was given project-specific estimates of gross savings and a standardized evaluation of free-ridership. A site containing at least one such project, but no projects given a customized free-ridership evaluation, was designated **standard project-specific (SPS)** site. The third type of project (those with the smallest program savings estimates), was given a verification evaluation and was referred to as a verify project. 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. Sites that only contained verify projects were designated **verify-only (VO) sites**.

The Site Recruitment Form (Appendix B contains an example) described each project at a site and classified the project type (project-specific or verify) and level of free-ridership analysis (Custom or Standard).

For each CPS site, 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 surveys[2] 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 plan included short-term metering and one-time measurements at some sites. We then submitted each plan to PG&E for approval, and when necessary, revised it. 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 contact[3] was different than the decision-maker[4], we completed an operations staff survey. We completed standardized decision-maker surveys for all projects, and a custom decision-maker survey for custom project-specific projects.

- **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 electric savings by PG&E-defined costing periods. In addition, the standard net-to-gross ratio (NTGR) was calculated. 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.

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[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 1996.

[4] Person who knows how and why the decision was made to install the items paid in 1996.

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.

For each VO site, we completed the following steps:

- Completed the data collection described in the verification forms and procedures (included in Appendix H). The standard decision-maker survey was administered for all projects.

- Computed the standard NTGR for all projects. These NTGR estimates were not adjusted to account for customer baseline savings (defined in Appendix A).

- Prepared a standardized verification spreadsheet report. If the verify project was part of a CPS or SPS site, we included the verification spreadsheet in the project-specific site evaluation report.

Finally, for all evaluated sites, we prepared a separate 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 ex post gross savings for at least 70 percent of the ex ante demand and consumption savings in each of the indoor lighting, HVAC, and process end uses. To create a program-level estimate of ex post gross savings, we extrapolated the findings from the project-specific evaluation 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. 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, we first applied the average NTGR for all project-specific and verify items within an end use to the gross savings for non-evaluated items, thus yielding net savings for all items. Next, these item-level net savings were summed for each end-use and the program overall. Net spillover savings were also identified. Calculating end-use and program NTGRs required dividing the end-use and total sums of the net savings by the corresponding gross savings sum. To adjust these NTGRs to account for spillover, we added the net spillover savings to the net program savings before dividing by the gross savings.

2.4 Compliance with M&E Protocols

Program year 1996 marks the third 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" (M&E Protocols), adopted by the California Public Utilities Commission in May of 1993 and most recently revised in January of 1997. The successful application by any utility for DSM earnings is contingent upon strict adherence 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, 7, and 11 of the Protocols.

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

Table	Pertaining To:
5	Protocols for the general approach to load impact measurement
6	Protocols for reporting of results of impact measurement studies used to support an earnings claim
7	Documentation protocols for data quality & processing
8A, 9A	Impact and persistence (retention) surveys
11	Reporting of load impact results for use in planning & forecasting
C-5	Measurement requirements for industrial incentive programs
C-13	Treatment of data perturbations

The methods, described in this report for estimating NTGRs, are in full compliance with the 1997 AEAP-adopted Appendix J of the Protocols, the *Quality Assurance Guidelines for Statistical, Engineering, and Self-Report Methods for Estimating DSM Program Impacts* (QAG) in Appendix J. More specifically, this evaluation is in full compliance with Chapter 4 of the QAG that concerns the self-report method. Note also that the 1997 AEAP-adopted language in Table 7 refers to Appendix J for those utilities that are relying on participant self report in estimating net-to-gross ratios.

This evaluation is also in full compliance with recent unanimous agreements made by the CADMAC Modeling and Base Efficiency Subcommittees regarding certain unresolved issues in Chapter 4 of the QAG. These agreements concern the proper handling of:

- accelerated installations (deferred free-ridership)
- unresolved inconsistencies
- third-party influence
- the use of qualitative information

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3. Sample Design

3.1 Sample Frame and Study Domains

The sample frame for this study has been developed from MDSS program database entries for the 1,002 items associated with the 513 applications paid in 1996 by the APO, Customized, RE, and REO industrial programs. A measure code, indicating a specific type of efficiency technology, was assigned to each item. An end use code was also assigned to group measures according to the three end uses which define the three domains of study for this evaluation: indoor lighting, process and HVAC.

The item-level entries from MDSS were aggregated to form the sample frame (list of projects). A project was defined as the set of items, listed on a single paid application, which 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 519 projects, associated with 453 control numbers (unique identifier which PG&E assigns to each billing meter location). As shown in Table 3-1, 137 of these projects are in the HVAC domain, 334 in light, and 48 in process. Note that some applications contained multiple projects, so that 513 applications yielded 519 projects.

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 ex ante program database gross savings for the indoor lighting, process, and HVAC domains. Project-specific data collection and evaluation techniques were 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. A simpler level of data collection and analysis was done for the second sample, which serves to verify the program data base. The first sample is referred to as the project-specific sample and the second as the verification 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 serves 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 that customer's sites.

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 is divided into three strata. The first stratum contains 13 projects, which collectively account for at least 70% of ex ante gross kWh, kW and therm savings for this domain. These 13 comprised the initial project-specific sample for HVAC. These 13 projects were identified by successively sorting the 137 HVAC projects in descending order, first by kWh, then kW and finally by therm 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, for cases when certain customers associated with the first stratum refuse to participate. Any project in this stratum not needed as a replacement became part of the verification sample. The first and second stratum accounted for 90% of kWh savings, 84% of kW savings and 100% of therm savings. The third stratum contained the next largest group in terms of average ex ante gross savings. These were all assigned to the verification sample. Data collection was completed for all of these projects to achieve a census for the domain. A census was required because there were less than 150 projects in the domain.

2. **INDOOR LIGHTING**. The first strata containing 74 projects was identified in the same fashion described for HVAC, except that none of these projects had therm savings, and thus the 334 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. The first and second stratum accounted for 84% of kWh savings and 83% of kW savings. The indoor lighting domain contained a number of projects with very small savings. A fourth strata was defined to contain the 67 projects with the smallest savings. Collectively, these projects accounted for 1% of savings, and were excluded from the sample, as they would provide information of little impact. This left 145 projects in the third strata, from which to select the balance of the verification sample. The balance of the 150 project sample for this domain were selected in order of descending savings from the third strata and were all designated verification projects.

3. **PROCESS**. This domain contained less than 150 projects, and so all had to be completed in either the project-specific or verification sample. The first stratum was defined as described for HVAC. The second stratum contained the project-specific replacements. The first and second stratum accounted for 86% of kWh savings, 88% of kW savings, and 82% of therm savings. Any projects in the second strata that were not needed in the project-specific sample were assigned to the verification sample. The third stratum contained the balance of the projects assigned to the verification sample.

3.4 Recruitment

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

Unfortunately, the program MDSS 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 reliable corporation and site codes for each of the 1,002 items. The 519 projects in the sample frame are associated with 419 unique sites and these sites are operated by 391 unique corporations.

Using the sample frame, coded by strata, corporation and site, we first released corporations containing only Strata 1 (Top 70% project-specific) and Strata 3 (verify a11/up to 150) projects for recruitment. As these corporations were either recruited or refused, we updated the status of Strata 2 (project-specific replacements or verify) projects. If a Strata 1 project was rejected, then we designated a sufficient number of Strata 2 projects as Project Specific to account for 70% of ex ante gross savings within the

Table 3-1: Program Database Ex Ante Gross Savings and Number of Projects by Domain and Strata

Domain	Strata	Number of Projects	MWh	% of End Use	kW	% of End Use	KTherms	% of End Use
HVAC	Top 70% Project Specific	13	6,114	78%	501	70%	446	100%
	Proj. Spec. Replacements or Verify	16	951	12%	98	14%	1	0%
	Verify All	108	803	10%	116	16%	0	0%
Total		137	7,869	100%	714	100%	447	100%
Lighting	Top 70% Project Specific	74	15,591	71%	2,499	70%		
	Proj. Spec. Replacements or Verify	48	2,774	13%	464	13%		
	Verify up to 150	145	3,325	15%	556	16%		
	Exclude	67	209	1%	35	1%		
Total		334	21,898	100%	3,554	100%		
Process	Top 70% Project Specific	15	23,216	73%	2,159	72%	1,220	72%
	Proj. Spec. Replacements or Verify	8	4,150	13%	469	16%	165	10%
	Verify All	25	4,529	14%	381	13%	307	18%
Total		48	31,895	100%	3,009	100%	1,692	100%
All Domains		519	61,662		7,277		2,139	

end use domain. If a Strata 1 project was recruited, then we could designate Strata 2 projects with small savings as verify. If a Strata 3 project in the Lighting end use was rejected, we replaced it with an additional Strata 3 project.

3.5 Sample Disposition

As shown in Table 3-2, the final program sample frame consists of 1,002 items in 519 projects at 419 sites. The table shows their disposition, both by end use and overall. In total, 256 items (33.0 % of the total number of items) comprise the excluded stratum of indoor 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 23 lighting items were reserved as replacements but never used. These replacement items also account for a very small portion of total savings.

Of the remaining items, 80 were lost due to customers refusing to participate in the study. Table 3-2 itemizes the number of refusals by type, with the most common reason being the customer lacked time for the study. All but 12 of these refusals affected lighting projects. In both the HVAC and process end uses, the recruitment rate was quite high (94 and 98% of the items, respectively). Overall, we performed evaluations for 643 items, comprising 64% of the total number of items.

Table 3-3 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. In addition, it demonstrates that we met the protocol requirement requiring us to complete project-specific evaluations for 70 percent of savings (kWh, kW and therms) for all end uses. The second 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.

Table 3-2: Final Sample Disposition

End Use / Disposition	Number of Sites	Number of Projects	Number of Items	% of Items in Population	% of Items in Sample	% of Population Program Savings kWh	% of Population Program Savings kW	% of Population Program Savings therms
HVAC								
Recruited	**109**	**129**	**166**	**93.8**	**93.8**	**98.5**	**98.6**	**100.0**
Business Gone	4	4	6	3.4	3.4	1.3	0.8	-
Lack of Time	2	2	3	1.7	1.7	0.2	0.4	-
Other	2	2	2	1.1	1.1	0.1	0.2	-
Total	117	137	177	100	100	100	100	100
Lighting								
Recruited	**133**	**150**	**429**	**55.3**	**86.3**	**80.9**	**80.0**	-
Excluded	121	154	256	33.0	n/a	7.0	7.3	-
Replacement	8	10	23	3.0	n/a	1.5	1.5	-
Business Gone	2	2	7	0.9	1.4	0.9	0.9	-
Lack of Time	8	11	37	4.8	7.4	7.1	7.6	-
Lack of Knowledge	3	3	11	1.4	2.2	0.7	0.7	-
Other	4	4	13	1.7	2.6	1.9	2.0	-
Total	279	334	776	100	100	100	100	-
Process								
Recruited	**40**	**47**	**48**	**98.0**	**98.0**	**98.3**	**98.6**	**100.0**
Business Gone	1	1	1	2.0	2.0	1.7	1.4	-
Total	41	48	49	100	100	100	100	100
ALL								
Recruited	**274**	**326**	**643**	**64.2**	**88.9**	**92.1**	**89.5**	**100.0**
Excluded	113	154	256	25.5	n/a	2.5	3.5	-
Replacement	8	10	23	2.3	n/a	0.5	0.7	-
Business Gone	6	7	14	1.4	1.9	1.4	1.1	-
Lack of Time	9	13	40	4.0	5.5	2.5	3.7	-
Lack of Knowledge	3	3	11	1.1	1.5	0.3	0.4	-
Other	6	6	15	1.5	2.1	0.7	1.0	-
Total	419	519	1002	100	100	100	100	100

* Summing the # of sites for each end use does not equal the total number of sites, since some sites had more than one end use.

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

Domain	End Use		
	HVAC	**Lighting**	**Process**
Project Specific			
Counts (N)			
Projects	12	95	15
Items	18	308	15
Program Savings			
kWh	5,579,340	15,602,681	23,215,672
kW	501	2,491	2,159
therms	445,812	-	1,220,013
% of Total End Use Savings			
kWh	70.9	71.3	72.8
kW	70.1	70.1	71.8
therms	99.8	N/A	72.1
Verify			
Counts (N)			
Projects	117	55	32
Items	148	121	33
Program Savings			
kWh	2,169,981	2,119,123	8,126,811
kW	204	352	807
therms	1,036	-	472,415
% of Total End Use Savings			
kWh	27.6	9.7	25.5
kW	28.5	9.9	26.8
therms	0.2	N/A	27.9
TOTALS			
Counts (N)			
Projects	129	150	47
Items	166	429	48
Program Savings			
kWh	7,749,321	17,721,804	31,342,483
kW	704	2,843	2,967
therms	446,848	-	1,692,429
% of Total End Use Savings			
kWh	98.5	80.9	98.3
kW	98.6	80.0	98.6
therms	100.0	N/A	100.0

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. Figure 4-1 at the end of this section graphically depicts the data sources and how the data fit into the evaluation work flow.

4.1 PG&E's Program Data Base

Extracts from the application, item, and other ancillary tables from PG&E's MDSS program data base provided basic information for each application paid in 1996 and the associated items. Key variables included the following:

1. Application number
2. Control number
3. Program year
4. End-use code
5. Measure description
6. Number of measure units rebated
7. PG&E division
8. Billing name
9. Service address
10. Date and amount of payment (PG&E rebate check)
11. Program code indicating which program processed the application
12. Estimates of gross kWh, kW, and therm savings developed by PG&E's program staff
13. Measure lifetime, realization rate, and net-to-gross ratio

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. We also obtained historical information on rebates paid during the years prior to 1996. We used this information during the recruitment process to help program participants identify measures for which they received a rebate in 1996.

4.2 PG&E's Program Files

We submitted a list of sampled participants to PG&E, so that PG&E could provide us with copies of the program participant files. 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), for custom project-specific projects, 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 custom 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. The information required varied, depending on whether the evaluated project was a project-specific or verify project (both types are defined in Section 5). 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 similar approach, so engineers used the survey forms shown in Appendix G to collect information about lighting fixture counts, "on" fractions, and schedules. 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 different 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

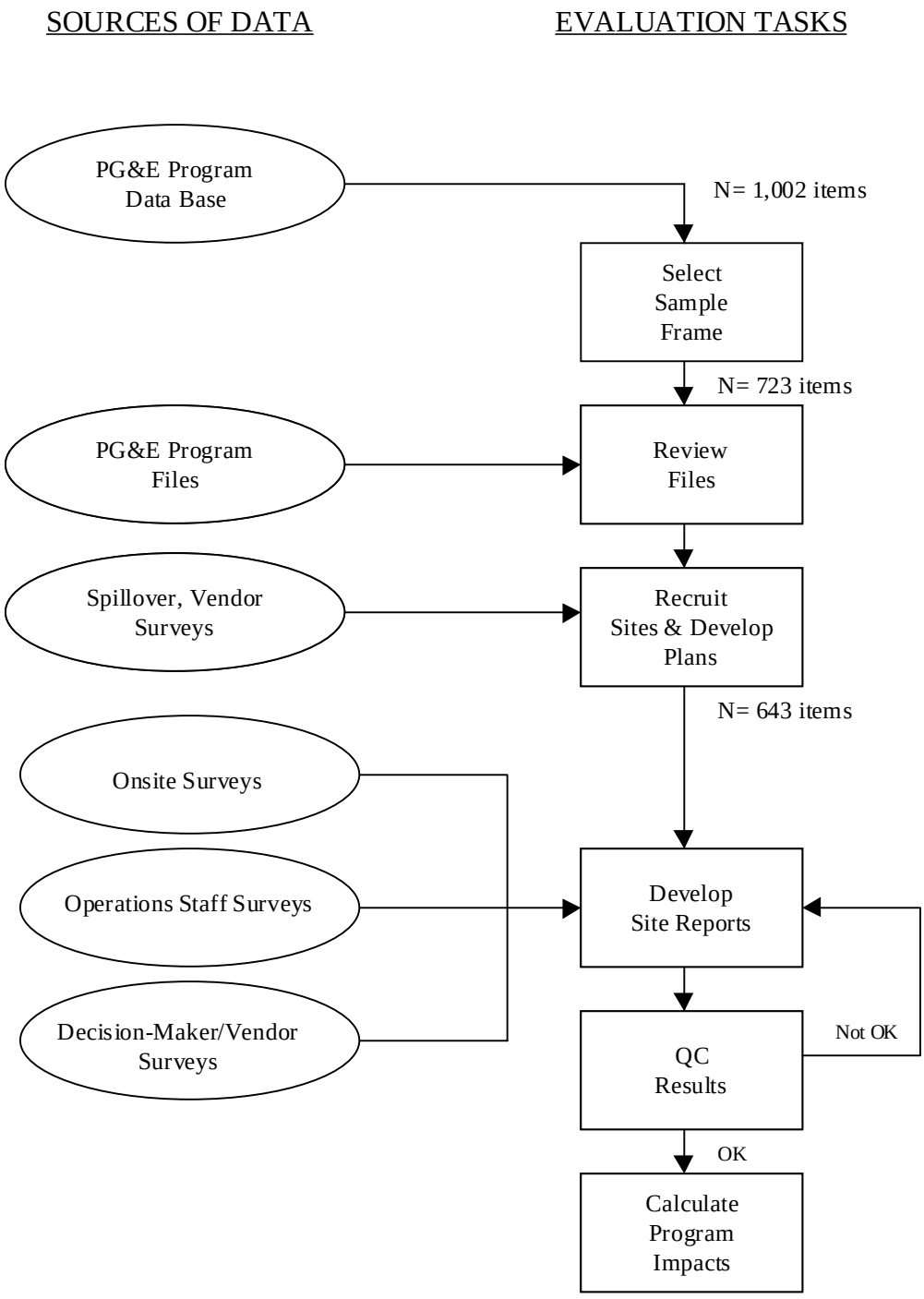
This survey collected information from the operations staff contact to be used in customizing the free-ridership analysis. Engineers administered this survey during the on-site survey when the site included a custom project-specific project and the customer contact most familiar with the measure(s) was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

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

4.7 Decision-Maker Survey

This survey collected information from the decision-maker, that is, the person who made the decision to install the rebated measure 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.

Figure 4-1: Sources of Data and Evaluation Tasks



5. Methodology for Engineering Estimates of Gross Savings

We estimated ex post gross savings for a group of projects in the HVAC, indoor lighting and process end uses which accounted for more than 70 percent of the savings in each end use. Procedures for evaluating these projects can be found in the site-specific evaluation plans. These 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. We collected data during an on-site survey, and re-estimated 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 1996 program savings in each of the lighting, HVAC and process end uses. A total of 122 projects received this, the most rigorous level of analysis. The sites included in this sample are a very diverse group of industrial facilities and custom applications of the program measures. As a result, the data collection and analysis methods for each project in this group were tailored to the complexity of the measure and the value of the savings. We developed custom data collection and analysis procedures for each process and HVAC project-specific evaluation, since PG&E had used significantly different approaches to estimate savings for similar measures. We used standardized procedures for lighting projects.

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 on the evaluation baseline, 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 ex ante program savings. It also described the proposed approach for estimating ex post 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 subjected each evaluation plan to a cursory review. Once they approved the plan, we scheduled the on-site survey. Appendix F contains a evaluation plan template with more detailed descriptions of the contents of a plan. Specific guidance for project-specific data collection and analysis are provided in the document titled: *1996 Industrial Retrofit Impact Evaluation: Data Collection and Energy Savings Calculation Handbook.* 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. This is not a comprehensive list of methods, but provides an indication of how we approached the work for a set of important efficiency technologies. The approach selected for each project depended upon the type of measure, the available information, and the evaluation budget. In all instances we considered alternative evaluation methodologies, weighed their reliability and accuracy advantages against their costs, selected the most appropriate evaluation method, and allocated the evaluation funds in the most cost-effective manner. In addition to the measure-specific algorithms, a standardized set of SAS jobs and DOE 2.1E models were used to create hourly savings estimates for each measure and to adjust for measure interaction effects. This provided information needed for estimating savings for each of PG&E's costing-periods.

5.1.1 Process

A total of seven program measure categories (measure codes) were included in the 15 project-specific process projects. Within certain broad categories, such as process controls and process other, there were a variety of different types of measures. All process project rebates were paid through either PG&E's

Customized Incentive or Retrofit Efficiency Options Programs. In all cases, a customized set of engineering analysis procedures was developed during program implementation by the program consultant. Below we discuss the approaches for several types of process measures. For all measures, we designed our evaluation methodology to account for changes in production volume, so that PG&E did not receive credit for savings associated with increased production that resulted from installing the rebated measure.

Compressed Air Systems. Compressed air system efficiency improvements involved installation of more efficient compressors properly sized to meet their loads, upgrading controls or complete system replacements. Nameplate data were obtained for the installed equipment during site visits, and pre-installation equipment information was obtained from the application file. Operator's logs were used when available to determine equipment performance. Performance curves were obtained from the respective manufacturers to corroborate information obtained from the logs.

Control measures for compressed air systems relied on short-term (several hours) logging of system performance both with the controls operating as designed (the as-built condition) and again without the effect of the controls. The control system provided the datalogging capability.

Complete system replacements were analyzed using short-term metered power data from the installed system. This information was extrapolated to a full year based on the monitored consumption for each unique type of day in a week. The resulting annual consumption was then compared to similar data from the application file to determine savings.

Combustion Systems. Combustion system measures included the replacement of old process/HVAC boilers with more efficient ones, burner and control improvements to increase combustion efficiency or heat recovery from stack gases or condensate.

For heat recovery and combustion efficiency measures, operator's logs were used to obtain flows, temperatures and pressures of steam, condensate return and makeup water, as well as results of combustion analysis for the determination of combustion efficiency. Data from before and after the installation were analyzed to determine the baseline and as-built energy consumption.

For boiler replacement, energy consumption for the as-built condition was based on a meter dedicated to the installed boilers. The same boiler load was assumed for the baseline, with a combustion efficiency based in Title 20 requirements.

Vacuum-Jacketed Cryogenic Fluid Piping. This measure involved the replacement of foam-insulated piping with vacuum-jacketed piping. Energy savings were based on monthly records of production quantities and energy consumed for the baseline and as-built conditions.

Glass-Melting Furnaces. Old glass-melters were replaced with more efficient units for this measure. Energy savings were based on operator's logs of concurrent power draw and production rates for both the less efficient and more efficient melters.

Oil Well Pumping Systems. Efficiency improvements to oil well pumping systems can involve modifications to make the pumping system more efficient or the addition of controls to improve the system's efficiency and reduce its operating time. The evaluation of both types of measures involved short-term (several hours) measurement of energy use for a random sample of project wells at each site. A combination of Telog current loggers and a Rustrak power logger were used.

For controls measures, energy use was measured with and without the controls to quantify energy savings. For system modifications, the as-built condition was measured and the pre-condition was based upon the results of the RodStar simulation program. This program has been validated and accepted for use in developing application savings estimates by PG&E.

5.1.2 HVAC

A total of 12 program measure categories (measure codes) were included in the 12 project-specific HVAC projects. This end use included measures covering a broad range of complexity with regard to evaluating gross savings. This category included, but was not limited to, the installation of high-efficiency packaged HVAC equipment and water-cooled chillers, over-sized cooling towers, adjustable speed drives on fans and pumps, energy management systems, and reflective window film. HVAC measures in the Customized program may have involved several of these measures under a single project application. Some of these projects were governed by Title 20 or 24 standards. High efficiency implies systems with efficiencies higher than those required by Title 24, and so the baseline condition for such projects was the minimum system efficiency required by Title 24.

During the on-site survey, nameplate information for the rebated as-built system was recorded. This information and manufacturers specification sheets were used to determine the system tonnage and efficiency (kW/ton). In one instance involving cooling tower pumping and fan controls, an energy management system provided the load and energy use information necessary for the as-built conditions. However, this required significant interaction and cooperation from the customer to obtain trend logs and install amp loggers to record data. We then matched the hourly pumping and fan measurements with hourly outdoor dry bulb temperature measurements and developed a correlation between $kWh_{as\text{-}built}$, outdoor temperature, and hour of the day. This correlation was then applied to a full year's worth of typical weather data for the appropriate California Climate Zone to obtain the annual energy use for the as-built system.

In most cases, the evaluation methodology called for the DOE-2 building energy simulation program. All models were developed to represent the specific PG&E project building. We calibrated the simulation model to bills whenever possible to provide confidence that our model was properly representing the as-built building. The model was then run with and without the rebated measure to quantify the measure energy savings. While the DOE2-based methodology was more expensive to implement, it allowed for seasonal adjustment of schedules, and accounted for kWh and therm savings that might result from measures such as energy management systems (EMS), that affected how an existing system operated. The DOE2-based approach was very building specific, providing confidence to the savings estimate.

5.1.3 Lighting

A total of 34 program measure categories (measure codes) were included in the 95 project-specific indoor lighting projects. These measures broke down into two categories: those that effectively reduced the lighting power density of the facility (capacity reduction), and those that 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. 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 indoor lighting capacity reduction and control measures, and to distribute the interactive effects between measures:

Capacity Reduction

Equation Set (1)

$$kW_{savings} = \#\ fixtures \times \left[\begin{pmatrix} Watts/\ fixture_{base} - \\ Watts/\ fixture_{as-built} \end{pmatrix} \div 1{,}000 \right] \times Utilization\_\ factor$$

$$kWh_{savings} = kW_{savings} \times hours_{as-built} \times HCIF_{kW}$$

$$therm_{takeback} = kW_{savings} \times 0.034 \times hours \times HCIF_{heat} \div heating\_efficiency$$

The utilization factor in the demand savings equations accounts for the fraction of the affected light fixtures that are "on". Savings should not be credited to lamps that are burned out or individually-controlled fixtures that are not on because the employee is not present. The appropriate value for the utilization factor was determined from a fixture count (operating and non-operating) taken during the on-site survey. When appropriate, different utilization factors were defined for occupied and unoccupied hours.

The HCIF terms in the equations represent heating/cooling system interaction factors. Reducing the lighting energy in a conditioned space reduces the space cooling load and increases the heating load. The interaction factors account for the fraction of the lighting energy savings that interacts with the space conditioning system. This fraction varied, depending upon the operating hours of the lighting system and whether the HVAC system included an economizer. A table of interaction factors was developed using DOE-2 prototype models.

When Title 24 LPD standards were used as the baseline condition, we used the following equations to quantify the first year gross savings for each capacity measure:

Hours of operation is the activity variable in these equations. This variable was adjusted to account for seasonal changes in work shifts and production schedules. Information on variations in operating hours throughout the year was obtained during the on-site interview.

Equation Set (2)

$$kW_{savings} = \left[\begin{pmatrix} Allowed\_LPD \times LPD\_Design\_Area \div 1{,}000 - Installed\_kW_{total} \end{pmatrix} \times Installed\_kW_{measure} \div Installed\_kW_{total} \right] \times Utilization\_\ factor$$

$$kWh_{savings} = kW_{savings} \times hours_{as-built} \times HCIF_{kW}$$

$$therm_{takeback} = kW_{savings} \times 0.034 \times hours \times HCIF_{heat} \div heating\_efficiency$$

Controls

Equation Set (3)

$$kW_{savings} = \#\ fixtures\_controlled \times Watts / fixture_{as-built} \times Utilization\_factor$$

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

$$therm_{takeback} = kW_{savings} \times (hours_{baseline} - hours_{as-built}) \times 0.034 \times HCIF_{heat} \div heating\_efficiency$$

Measure Interaction

When interaction occurs between lighting control and capacity measures, we used the following method to distribute the interactive effect across measures.

Equation Set (4)

$$kWh_{real} = kWh_{baseline} - kWh_{post}$$

$$= kWh\ (T12\ w/o\ controls) - kWh\ (T8\ with\ controls)$$

$$kWh_{additive} = kWh_{lights\text{-}indiv} + kWh_{controls\text{-}indiv}$$

$$kWh_{lights\text{-}indiv} = kWh\ lighting\ savings\ (T12>T8)\ with\ no\ controls$$

$$kWh_{controls\text{-}indiv} = kWh\ control\ savings\ with\ no\ lighting\ replacement\ (T12)$$

$$kWh_{lights\text{-}eval} = kWh_{lights\text{-}indiv} \times kWh_{real} / kWh_{additive}$$

$$kWh_{controls\text{-}eval} = kWh_{controls\text{-}indiv} \times kWh_{real} / kWh_{additive}$$

We used a variety of methods for collecting the kW and operating hours data required by the above equations. The most appropriate method depended on the lighting system/electrical panel configuration, accessibility, complexity of the load or schedule, and evaluation budget.

Often for sites with lighting control measures, we installed TOU light loggers to measure hours of operation. The number and type of lighting fixtures was confirmed during the on-site survey, and the lighting wattages obtained from a table of typical watt per fixture values for a variety of fixture types. This was a fairly inexpensive approach because no electricians were required for electrical panel work and it provided direct measurement data.

For sites without occupancy sensors, the lighting system operating hours were usually easy to obtain, either from an energy management system, timeclock, or conversations with facility staff. In such cases, measurements were not necessary. During the on-site survey, the control system could be interrogated for the system operating hours and a count of the rebated fixtures taken. The total system wattage could be determined using the watt/fixture table as in the previous approach. If the electrical panels were accessible and lighting circuits were isolated, one-time clamp-on measurements of the lighting load at the

circuit breaker could be taken to obtain kW more directly than counting fixtures and referencing the fixture table.

For lighting measures involving controls that reduce the number of operating hours, we selected from the same alternative approaches to measuring the as-built operating hours described previously. The baseline assumptions for operating hours, however, were based upon information presented in the PG&E project file and interviews with operations staff during the on-site survey.

For all of the above approaches, any necessary seasonal adjustments to the measured or observed operating hours were determined during the interview with facility staff. Appropriate adjustments were then made to the annual operating hours.

The as-built conditions (such as fixture count, fixture wattage, and operating hours) that were input to the equations above 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., the customer would have installed the same or similar equipment even without the program), then we used Title 20 or Title 24 requirements as the baseline conditions when applicable.

The data collection and analysis forms that we developed to support the evaluation of project-specific indoor lighting measures can be found 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 savings, PG&E also needs to know how the impact is distributed across five standard electric energy costing periods, defined as follows:

Costing Period	**Dates**	**Times of Day**
Summer Peak	May 1 to Oct. 31	12 pm - 6 pm weekdays
Summer Partial-Peak	May 1 to Oct. 31	8:30 am - noon, 6 pm - 9:30pm weekdays.
Summer Off-Peak	May 1 to Oct. 31	9:30 pm - 8:30 am weekdays, all day on weekends.
Winter Peak	Nov. 1 to Apr. 30	8:30 am - 9:30 pm weekdays.
Winter Off-Peak	Nov. 1 to Apr. 30	9:30 pm - 8:30 am weekdays, all day on weekends.

Our analysis of savings for each item was conducted at the hourly-level, to support the estimation of kWh savings 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 project-specific 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 204 projects (32 process, 117 HVAC, and

55 lighting 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 Savings

The project-specific evaluations estimated ex post gross savings for at least 70 percent of the demand and consumption ex ante savings in the indoor lighting, HVAC, and process end uses. To create a program-level estimate of ex post 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 gross 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. Once the extrapolation for all end uses was complete, we estimated program-level gross savings by summing the savings for all items.

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6. Methodology for Estimates of Net Impact

In addition to the gross savings analysis, described in the preceding section, we also performed analyses at three levels to assess the net kWh, kW, and therm impacts of the program. The first level of analysis examines each item, the second each end use, and the third the program overall. The approaches involved in all three levels are described in detail in the following sections.

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 motivated customers to replace equipment prior to the end of its useful life. This will be referred to as an "early replacement" action. Situations in which early replacement was potentially an issue with respect to free-ridership were carefully examined. In other cases, the program motivated the customer to select more efficient equipment when replacing equipment that had 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., an EMCS added to existing equipment. This will be referred to as a "new equipment" action.

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** occurs when the customer would have installed equipment that was more efficient than the equipment it replaced (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**.

6.1.1 Free-ridership Analysis for the Three Groups of Projects

All projects were placed into one of three evaluation groups, depending on the ex-ante gross savings associated with the items in the project. 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 35 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 project-specific lighting projects. This is referred to as the **standard project-specific** free-ridership analysis. The least detailed analysis was applied to lighting, HVAC, and process verification projects. This level of analysis is referred to as the **verification** free-ridership analysis.

6.1.2 Sources of information on Free-ridership

There are five 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. **PG&E 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 relevant to free-ridership analysis, such as letters written by PG&E customer representatives documenting 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 that led to the installation of measures under the 1996 program. Appendix K contains the survey we administered to 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. We used this description to define the customer baseline for the engineering calculation of net savings. If the decision-maker could not adequately describe 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.

4. **On-Site Survey**. During on-site surveys, 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 in Section 6.2 below). Some customers were not aware that they were implementing energy-saving measures that they otherwise would not have done in the absence of the program. This was most obviously the case when a participant was unaware that a vendors' recommendations were affected by a DSM program. In such a situation, the customer is not able to reliably self-report the influence of the program. More details about the use of the vendor survey can be found in Section 6.1.5.1 below.

   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 defines these three members, as well as other members of the distribution channel.

Table 6-1: Definitions of Distribution Channel Members

MEMBER	FUNCTION
Manufacturer	Companies that produce finished energy-efficient equipment
Distributors	The middlemen who purchase the equipment from the manufacturers, warehouse the inventory, and provide the products for sale within a given geographical area.
Installers	Agents who 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 who guide or influence end users' decisions to purchase electric equipment. Installers sometimes select the specific equipment for the end user.
Non-User Purchasers	Agents who 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 used 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 questions that we used to clarify the context and motivation for the decision. These questions were not used for the other two levels of analysis.

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" method, is fairly common in situations in which a comparison group is not available. The calculation of the self-report NTGR (SR_NTGR) is described in paragraph 6.1.4.1 of this report. The SR_NTGR was adjusted to produce what we call the Adjusted SR_NTGR or simply the ASR_NTGR, also described later in this report. This adjustment was only possible for project-specific sites and was based on an engineering

Table 6-2: Information Sources for Three Analysis Levels

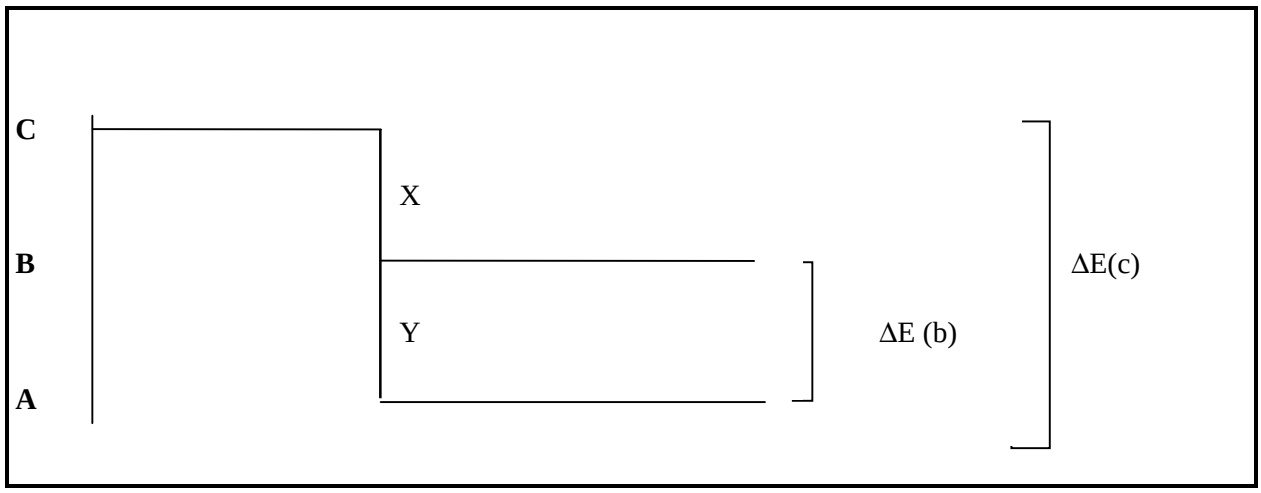
Information Sources	Verification	Standard Project-Specific	Customized Project-Specific
Decision Maker Interviews	**X**	**X**	**X**
Operations Staff Interviews			**X**
Vendor Interviews (NTGR)			**X**
Vendor Interviews (Spillover)		**X**	**X**
On-Sites		**X**	**X**
PG&E Program Files		**X**	**X**
Spillover Interviews		**X**	**X**

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 provided a unique opportunity to adjust the SR_NTGR for partial free ridership in order to produce a more accurate estimate of net kWh savings than would be possible in a regression framework.

hat 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. In the less complete evaluation, once the NTGR is estimated using the standard SR_NTGR approach, this NTGR is then multiplied by the estimate of gross savings (X + Y).

However, while this is appropriate in some situations, it is not appropriate in many others. For example, 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 "B" (equipment more efficient than the old equipment and 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 an intermediate level of efficiency. An adjustment must be made in the SR_NTGR that reflects the fact that equipment with an intermediate level of 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 (customer baseline)

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

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

ΔE(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.

ΔE(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.

ΔE(c) = E(c) - E(a). This represents the savings experienced by a customer who, in the absence of the program, would have kept its old equipment or would have replaced the old equipment with equipment equally efficient. 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, without the rebate, keeping pre-retrofit equipment or replacing the old equipment with equipment equally efficient.

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:

$$P(a) + P(b) + P(c) = 1 \quad (1)$$

The ASR_NTGR can then be calculated as:

$$ASR\_NTGR = P(a)\,[\Delta E(a)/\Delta E(c)] + P(b)[\Delta E(b)/\Delta E(c)] + P(c)[\Delta E(c)/\Delta E(c)] \quad (2)$$

This reduces to the following:

$$ASR\_NTGR = P(a)[0/\Delta E(c)] + P(b)[\Delta E(b)/\Delta E(c)] + P(c)[1] \quad (3)$$

or

$$ASR\_NTGR = P(b)[\Delta E(b)/\Delta E(c)] + P(c) \quad (4)$$

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, 13, 14 and 15 of the decision-maker survey (Appendix K), which 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.

An assumption of the self-report methodology is that the NTGR varies between zero and one. However, there are situations in which the NTGR falls outside the zero-to-one range because the engineering ratio falls outside the zero-to-one range. Because such a situation is highly unlikely, it is described along with our solutions in Appendix K.

6.1.3.3 Examples

Consider the following examples.[5] 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 0.8. This customer also indicates that in the absence of the rebate, they would have installed a central air conditioner with a SEER of 10, which we calculate would have consumed 60 kWh/yr. They also state that the old, pre-

[5] While these examples focus on kWh savings, the issue of partial free-ridership also applies to kW and therm savings as well.

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, or installing the intermediate air conditioner--they more likely would have installed the intermediate air conditioner. We now calculate the following:

P(a) = 0.2 [Note: P(a) = 1 - SR_NTGR]

P(b) = 0.8 [Note: P(b) = 1 - P(a). Therefore P(b) = SR_NTGR]

P(c) = 0

$\Delta E(b)/\Delta E(c)$ = (60-50 kWh)/(80-50 kWh) = 10 kWh/30 kWh = 0.33

ASR_NTGR = 0.8 * 0.33 = 0.267 [Note: ASR_NTGR = $P(b)[\Delta E(b)/\Delta E(c)]$

Net kWh Savings = 0.267 * 30 kWh = 8.0 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, they 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, or installing the intermediate air conditioner-they more likely would have installed the intermediate air conditioner. We now calculate the following:

P(a) = 0

P(b) = 1

P(c) = 0

$\Delta E(b)/\Delta E(c)$ = (60-50 kWh)/(80-50 kWh) = 10 kWh/30 kWh = 0.33

ASR_NTGR = 1 * 0.33 = 0.33

Net kWh Savings = 0.33 * 30 kWh = 9.9 kWh.

The 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 SR_NTGR of .25 and that this customer is a clear case of early or accelerated installation. The customer also states that the old, pre-retrofit central air conditioner had a SEER of 8, which we estimate consumed 80 kWh/yr. They also tell us in the decision-maker interview that of the two options--keeping their old air conditioner, or installing the intermediate air conditioner--they were more likely to have kept the old, pre-retrofit air conditioner, a statement consistent with the early replacement claim. We now calculate the following:

P(a) = .75 [Note: P(a) = 1 - SR_NTGR]

P(b) = 0

P(c) = .25 [Note: P(c) = 1 - P(a) Therefore P(c) = SR_NTGR]

$\Delta E(c)/\Delta E(c)$ = (80-50 kWh)/(80-50 kWh) = 30 kWh/30 kWh = 1

ASR_NTGR = .25 * 1 = .25 [Note: ASR_NTGR = P(c)[$\Delta E(c)/\Delta E(c)$

]Net kWh Savings = .25 * 30 kWh = 7.5 kWh.

The final example illustrates the case of 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 0.8. This customer also indicates that in the absence of the rebate, they would have retained the existing equipment, which has a SEER of 8 and consumes an estimated 80 kWh/yr. We now calculate the following:

P(a) = 0.2

P(b) = 0

P(c) = 0.8

$\Delta E(c)/\Delta E(c)$ = (80-50 kWh)/(80-50 kWh) = 30 kWh/30 kWh = 1

ASR_NTGR = 0.8 * 1 = 0.8 [Note: ASR_NTGR = P(c)[$\Delta E(c)/\Delta E(c)$]

Net kWh Savings = 0.8 * 30 kWh = 24 kWh.

6.1.4 Implementation of the NTGR Framework

Each of the three levels of free ridership analysis uses the standard NTGR framework described above. The amount of information each used for each analysis level corresponds to its complexity. Each level of analysis is described in detail below, beginning with the standard project-specific analysis (applied to the standard project-specific evaluation group). Subsequent sections discuss the custom project-specific analysis (applied to the custom project-specific evaluation group), and the verification level of analysis (applied to the verification evaluation group).

6.1.4.1 Standard Project-Specific Free-Ridership Analysis

The standard project-specific free-ridership analysis draws on information obtained from the decision-maker survey and the on-site survey. An analysis of closed-ended questions included in the decision-maker survey was carried out to derive a SR_NTGR, which was used to derive P(a) from which P(b) or P(c) can subsequently be derived. Using this information, the NTGR was calculated and then multiplied by the evaluation estimate of gross savings to estimate the net kWh savings.

The central inputs to the calculation of P(b) or P(c) come from decision-maker survey question numbers 5, 6, 7, 13, 14, and 15. First, the core questions 6, 7, 13, 14, and 15 were averaged, with the question 7 and 13 values transposed so that, like the other questions, a large value means a high P(b) or P(c). The answers to question 5 of the decision-maker interview were intended to act as consistency checks on the answers given to the core questions (6, 7, 13, 14, and 15). Specifically, if an answer to question 5 indicates that the customer learned of the program after installing the rebated equipment, the answers to the other questions should produce a NTGR of 0. In this case, a NTGR, based on the core questions, greater than 0 would represent an inconsistency. The decision-maker interviews for this program year yielded no cases where there was an inconsistency between answers given to the two types of questions

(core questions versus question 5). Thus, no modifications to the core NTGR were necessary from this cause.

Another potential conflict within the questionnaire occurs with question 7, which asks how likely it is that the customer would have installed the same thing without the rebate. Question 7 may be misunderstood because of the negative phrasing of the question. This question asks 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, resulting in answers that imply the opposite of what the respondent intended. We incorporated automatic checks into the survey form to detect clear contradictions between questions 6 and 7, since this is where such a misunderstanding would be most apparent. The survey instructs the interviewer to resolve contradictions between these two answers with additional queries. However, if the inconsistency was not or could not be resolved within the interview, the two questions, together with the other three core questions (13, 14 and 15), were averaged with equal weights.

For normal replacement situations governed by Title 20/24, we calculated a gross savings estimate using the Title 20/24 minimum requirements, rather than the pre-condition, as the baseline. 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), $\Delta E(c)$ is multiplied by the SR_NTGR (which may range from 0 to 1).

Using the information collected during the on-site survey for the as-built conditions, and the information obtained from the decision-maker on what the customer was planning to do in the absence of the program (customer baseline), we calculated $\Delta E(b)/\Delta E(c)$ or $\Delta E(c)/\Delta E(c)$ (which is by definition 1) and used one of these ratios as described in Section 6.1.1.3 to calculate the ASR_NTGR. We employed algorithms similar to those used to calculate the gross savings for the rebated measure.

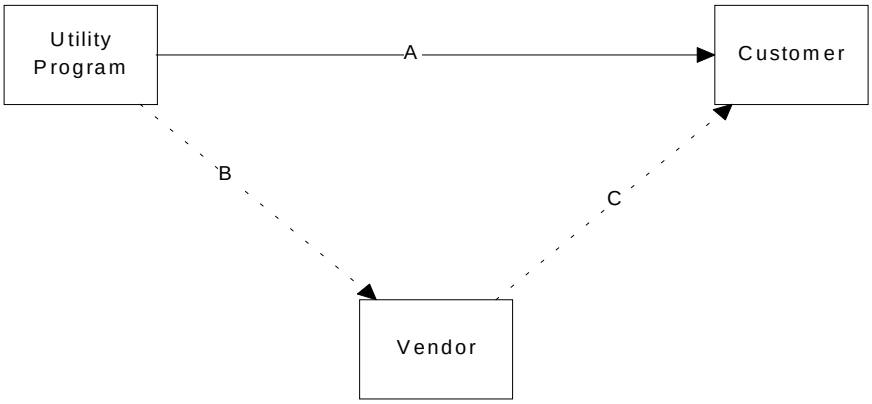
6.1.5 Custom Project-Specific Free-ridership Analysis

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 affect 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.

6.1.5.1 Vendor Interviews

The potential for the *indirect* effect of PG&E's program on customers through vendors was taken into account in the custom project-specific sites. This type of situation is represented by Figure 6-2, which shows two simple types of causal relationships.

Figure 6-2: Utility and Third-Party Influence



Self-report techniques have traditionally focused on the *direct* influence on the customer, "A." This direct effect is captured in the core NTGR. However, the *indirect* influence of the utility, represented by "B" and "C," is often ignored. The dotted lines represent the fact that the vendor may not, in every case, recommend what type of equipment to install. We used the survey in Appendix E to determine whether the program exerted influence through paths "B" and "C." If an SR_NTGR was estimated to be less than or equal to 0.3, then we contacted the vendor who provided the most assistance in designing or specifying the measure. The threshold of 0.3 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 three scenarios to illustrate how the customer's original SR_NTGR was modified using information from the vendor.

One example is a customer who, based on responses to the decision-maker interview, has an SR_NTGR of 0.25. Because this SR_NTGR is less than 0.3, 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 0.25, then we consider the *possibility* of setting 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. 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, influenced the decision.

Another example is a customer who, based on the decision-maker interview, has a SR_NTGR of 0.25. Because this SR_NTGR is less than 0.3, 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 0.3, 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. 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. We must recognize that PG&E could have influenced the customer both through the "A" path *and/or* the "B-C" path and that the utility can legitimately claim the stronger of the two paths as representing PG&E's influence on the customer's choice of efficient equipment.

Finally, consider a customer who, based on the decision-maker interview, has a SR_NTGR of 0.20. Because this SR_NTGR is less than 0.3 and the customer identifies the vendor as the most influential party, the vendor was contacted. If the vendor states that the probability that a PG&E program caused them to recommend the efficient equipment to the customer is greater than 0.3, we would first consider the possibility of adopting the SR_NTGR implied by the vendor interview. However, this interview also reveals that the customer's upper management has a long-standing commitment to energy efficiency because of its perceived cost-effectiveness. This means there is a high probability that the customer had already decided to purchase efficient equipment *before* they contacted the vendor. Thus, the vendor's recommendation had no effect on the customer's choice of equipment. In this example, we would use the customer's SR_NTGR of 0.20.

The use of 0.30 as a threshold for pursuing vendor influence was a conservative choice, since we only considered adjusting the SR_NTGR in instances where the customer reported very little direct PG&E influence. Theoretically, vendors could indirectly influence any customer. A second conservative choice was using vendor responses only if that vendor specifically remembered the customer and the rebated measure. A vendor might have indirectly influenced a customer, but subsequently forgotten dealing with the customer. Establishing these two criteria, though, meant that we only considered the strongest, most defensible cases of vendor influence. Under these conditions, the vendor's report of PG&E's influence on the recommendation made was taken into account in estimating the SR_NTGR. This vendor information was considered in the context of the larger qualitative analysis of all available information.

Originally, the plan for using the vendor information involved modifying the SR_NTGR by the vendor interview information via an algorithm. However, to conform with recent agreements by the CADMAC Modeling and Base Efficiency Subcommittees, we decided during the course of this evaluation to use the vendor information only in the context of all other information gathered for a project. In practice, this meant using vendor information only for custom projects. Since custom projects had much more quantitative and qualitative data available, the chances of correctly interpreting the vendor results were increased by placing these results in the context of this larger body of data. Vendor interviews completed for standard project-specific projects, on the other hand, were not used in the final NTGR analysis

6.1.5.2 Financial Information

In the majority of cases, the PG&E representative presented the customer with simple payback information for each item under consideration for installation. When that information was included in the PG&E file, or reported, along with other financial information, in the decision-maker interview, we took it into account in assessing P(b) or P(c). This was accomplished by building in a series of probes contingent on the answer to question 7 versus the financial information from two sources: payback information in the program file, and the self-reported financial information from the interview. For example, when financial figures met or exceeded the criteria set by the customer for investment, *without* the rebate, but the answer to question 7, by itself, implied a NTGR >0.5 (indicating high program influence)), the respondent was questioned about why the rebate was necessary given the favorable financial calculations. Conversely, when the company's financial criteria were not met without the rebate, but were met with it, and the influence of the rebate was rated low (implied NTGR < 0.5), the decision-maker was questioned about the low level of program influence. The information gathered by such questioning was considered in the context of the larger qualitative analysis of information for these custom projects.

6.1.5.3 File Information

When information contained in program files pertained to timing and motivational issues, the interviewing engineer consulted the NTGR team for suggestions on how to address the issues during the decision-maker interview. The results of these suggested special probes were considered as part of the qualitative analysis of the custom projects.

6.1.5.4 Operations Staff Pre-Quantified Interview Questions

Most often, the decision-maker and the operations staff person were the same person. When this was not the case, we conducted a separate interview with the operations staff. The information obtained from the operations staff was of two types: preset interview questions identical to the preset questions on the decision-maker survey (and that could serve as the inputs to a P(b) or P(c) algorithm), and open-ended questions similar to those asked of decision-makers. If the decision-maker was unable to answer a preset question and the operations staff was able to provide the answer, we used the operations staff's answer in place of the missing information from the decision-maker.

6.1.5.5 Decision-Maker Open-Ended Interview Questions

This type of question had two uses. The first was to help paint a complete picture of the decision process that led to installing the rebated equipment. The second was to detect misunderstandings embedded in the decision-maker's answers to the structured questions, and to pick up complexities in the process that could not fit into structured categories, thus producing unexpected combinations of answers, including contradictory ones. Answers to the open-ended questions could be compared to the answers to preset questions to spot contradictions.

6.1.5.6 Accelerated Installations

Question 11 on the decision-maker and the operations staff surveys asks the respondent whether the same equipment might have been installed without the rebate, but at a later date. When the respondent claimed the rebate accelerated the installation, the interviewer attempted to determine both the length of time and reasons why it was accelerated. We considered and weighed this information in the context of all of the information gathered for custom projects.

6.1.5.7 Engineering Ratio

The core inputs to the engineering ratio came from the decision-maker interviews. When appropriate, we asked questions in the operations staff interviews about the customer baseline to detect any contradictions. During the decision-maker interview, we asked the respondent if they had considered alternatives to the as-built equipment. If the answer was "yes," the respondent was asked to describe the alternative considered. Finally, the respondent was asked whether the company, in the absence of the program, would have been more likely to install this alternative or nothing at all. This last question allowed us to determine whether the customer's alternative equipment or the old equipment would be used to calculate E(b) or E(c), respectively. We also examined these questions together with all other open-ended questions on the decision-maker and the operations staff surveys for indications that the engineering ratio was based on an incorrect customer baseline.

6.1.5.8 Interviews with Lead Engineers

During the custom analysis for each site, the engineer could call the net-to-gross ratio team to discuss data collection ambiguities. In addition, the net-to-gross ratio team could 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 for each custom site.

6.1.6 Verification Free-ridership Analysis

We performed the simplest form of free-ridership analysis for HVAC, process, and lighting projects that had the smallest expected savings. For these projects, we completed the decision-maker survey and calculated a SR_NTGR.

6.1.7 Summary of NTGR Evaluation Groups

As described in previous sections, we calculated three types of NTGR using a different range of data for each evaluation group. Table 6-3 matches the three evaluation groups with their corresponding NTGR.

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

Evaluation Group	Type of NTGR
Custom Project Specific	Customized Adjusted Self-Report (CASR_NTGR)
Standard Project Specific	Adjusted Self-Report (ASR_NTGR)
Verification	Self-Report (SR_NTGR)

Table 6-4 indicates the number of implemented items that formed the basis for each level of NTGR calculation.

6.1.8 Reliability of the Customization Process

For the custom analysis, we integrated a combination of quantitative and qualitative data from a variety of sources to produce a final CASR_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, interpretations of the data may vary from one item to another, meaning, in effect, the measurement instrument may vary from one item to another. Thus, the central issue here is reliability, 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. Guidelines for the use of qualitative data are provided in Chapter 4 of the *Quality Assurance Guidelines* (QAG) contained in Appendix J of the Protocols, and these guidelines were followed for this study.

Another issue could be important in determining (and judging) both the reliability and validity of the customization process. While, for the most part, more information is better for making good NTGR decisions, certain kinds of information could bias the judgment of the customizers. Foremost among these types of information could be the knowledge of the size of savings for the project being judged.

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

	Verification **Self-Report** (SR_NTGR)	SPS **Standard** (ASR_NTGR)	CPS **Custom** (CASR_NTGR)	**Total**
Decision Maker Interviews	295	228	112	635
Operations Staff Interviews	N/C*	N/C*	37	37
Vendor Interviews	76**	36**	17	129
On-Sites	N/C*	228	113	341
PG&E Files	N/C*	228	113	341
Spillover Interviews	N/C*	225	112	337

* N/C indicates that the data collection procedure was not conducted for the type of free-ridership analysis.

** Data were collected, but not used, in calculating the NTGR. This is the result of a decision to use vendor interviews only in custom cases. See Section 6.1.5.1 for details.

Objectivity might have been threatened if the customizer knew that reducing the NTGR of a project would result in a large impact on the end-use level or program-level NTGR, as would be the case for very large projects. To avoid this problem, both customizers remained unaware of the size of the savings associated with projects under analysis.

6.1.8.1 The Data Integration Process

To ensure and measure reliability, several steps were taken by the two-person NTGR team. First, several principles were established to guide the integration of qualitative and quantitative data from the various sources associated with each site and project. Following is a list of the principles used together with an explanation of the principles. The principles themselves are shown in bold type, and the explanation of them, sometimes using examples based on retrospective experience with the customization process, is written in regular type.

A. **The standard NTGR should stand except when there is strong evidence that it should not. No one piece of information should be used to override the standard NTGR. Specifically, more than one piece or source of information should form a larger picture that contradicts the standard NTGR before an override is considered**. The core, standard NTGR is based on five pre-quantified questions in the decision-maker interview. The use of five items reduces greatly the possibility that the NTGR will be distorted in a large way by measurement error. Because of this multi-question approach, it was judged that this result should not be overridden easily. There were a number of instances where one comment in the interview could be interpreted to contradict the final standard NTGR. However, given the care with which the standard NTGR was measured, it would be a mistake to override it with one piece of information which could be misinterpreted by the interviewer or by the customizer. Only when there were multiple items that contradicted the standard NTGR were they seriously considered for forming the basis for changing the NTGR.

B. **The standard NTGR should not be changed unless the change is substantial**. This principle is based on several ideas. Although it was not possible to know the error band around any individual standard NTGR (certainly not while going through the customization process), conceptually there is some band of uncertainty around any estimate. It seemed unwise to tinker in relatively small ways with the quantified core NTGR the results of which could well fall within reasonable error bands. Such tinkering would be based on qualitative information which has to be translated to quantitative by the customizers. Unless the potential adjustment is fairly large, it seems less risky to stay with the direct, customer-based quantity than to rely on a qualitative judgement from a third party, such as the customizers, when that judgement is not based on any legitimate quantitative anchors such as payback or reports of timing accelerations. Even where there are quantitative anchors, if the difference between the standard NTGR and the potential customized NTGR was not great, it was judged better to use the standardized approach.

C. **In general, when information from the operations staff survey contradicts the decision-maker interview, the contradiction is best addressed during the decision-maker interview. When this does not occur the decision-maker information should take precedence. The exception to this is when the operations staff person offers either concrete evidence in opposition to the decision-maker, or the information is particularly compelling.** In general, the decision-maker is considered to have superior information about decisions made—this was the basis on which that person was identified for the "decision-maker" interview. By definition, the decision-maker is the preferred source. However, there are times when the operations staff person either has more specific information which should be taken into account, or that person offers a different perspective than the decision-maker. An example of the latter is the operations staff person who can report that installations of a series of items had begun before a rebate was offered.

D. **When there is no decision-maker interview, when there is no appropriate decision-maker interview[6], or when there is missing information on it, the operations staff interview is used to fill in missing information**. There were a few occasions where the decision-maker interviewed had only recently been employed by the rebated customer. They were interviewed because, initially, the person reported himself as the person most knowledgeable about the project. However, upon analyzing all interview answers from all parties, it can become evident that the initial 'decision-maker' was not actually knowledgeable about the decisions. In these situations, if there was another interview available from the operations staff , this was taken as the basis for the customized NTGR. In other situations, the decision-maker can defer to the operations staff person on such issues as the timing of installations that would have happened without the program. Thus, where the decision-maker may not have answered the question or where the answer is vague, we filled in the missing information using the answers of the operations staff if their answer was clearer.

E. **When information about the projected or forecasted timing of future installations was provided in the interview, it was not used in a routine manner. Rather, only when there is substantial evidence that accelerated installation was the *only* program influence was the specific degree of acceleration addressed**. For a variety of reasons, responses to the question asking when the customer would have installed the same equipment without the program were not used routinely to affect the standard or the custom NTGR. Among these reasons is the fact that hypothetical forecasts are error prone. Second, that question is only relevant when the customer indicates that *exactly* the same equipment would have been installed regardless of the program, but that it would have been installed *later*. This is an issue because it has become clear that many respondents give a projection of installation over time even when they have also said that the nature

[6] This phrase was actually added later as an elaboration of the basic principle. It is included here for clarity.

of the equipment would have been different in the absence of the program. It was decided to include the timing question only when the rest of the interview, including the open-ended questions, indicated that the *only* impact of the program was on timing. This judgement could only be made by examining the entire interview and other project documentation (program files, vendor information, or operations staff interviews). When that condition was met, then it became essential to base the NTGR solely on the timing forecast. The translation of the forecasted installations into NTGR terms was done based on a Forecast Conversion Table used in other studies.[7] Table 6-5 is the conversion table used in this project and others.

Table 6-5: Forecast Conversion

Forecasted Installation of Same Equipment	Implied NTGR
Less than 6 months	0
6 to 12 months	.125
1 to 2 years	.25
2 to 3 years	.5
3 to 4 years	.75
4 or more years	1.0
Never	1.0

Another basis for estimating a NTGR in the custom process was through the use of payback periods. A conversion of paybacks into NTGR terms was provided in the Protocols[8]. While this mapping of paybacks into NTGRs was designed for those measures and end uses that comprise the bottom 50 percent of a program's savings, it can be used to put a customer's payback into context so that it can be used, *along with all other available information*, to estimate the final custom NTGR. This table (Table 6-6) is repeated below for convenient reference.

[7] Spanner, G, and Riewer, S, 1990. "The Energy $avings Plan: Incentives for Efficiency Improvements in the Industrial Sector." Proceedings of the ACEEE Summer Study. Washington DC. Pp. 7.251 to 7.260.

[8] *Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand Side Management Programs*, adopted by the California Public Utilities Commission in May of 1993, and most recently revised in January of 1997. Table C-5:Impact Measurement Protocols for the Industrial Energy Efficiency Incentives Program

Table 6-6: Payback Conversion

Payback Period	Implied NTGR
6 months or less	.40
More than 6 months and less than 2 years	.75
2 years or more	1.00

With these principles in mind, the following steps were followed:

1. Each member of the team summarized information thought important to consider in customizing the NTGR. These summaries were not compared at this point.

2. Each member made independent judgments and categorized interviews and file information from 10 sites. Each site was put into three groups:

   - CSR_NTGR should be the same as the SR_NTGR
   - CSR_NTGR should be higher than the SR_NTGR
   - CSR_NTGR should be lower than the SR_NTGR

3. These judgements were compared and a preliminary inter-rater reliability calculation was made. There was an agreement rate of 80 percent on these ten cases.

4. The discrepancies in ratings for these cases were resolved, and in that process, an additional principle was developed on which to base further judgements. Following is the additional principle:

F. **When there was a contradiction between the decision-maker and the operations staff person regarding the timing of the installation, the decision-maker was assumed to have better knowledge of such a schedule. Therefore, in such situations, the decision-maker's answer was used.** This principle is, essentially, an elaboration of Principle D. The specific reason for this principle is that, in the case of decisions about future actions, the decision-maker was considered to have a more complete picture, including the financial aspects of future projects, than the operations staff person would not necessarily have. Thus, much greater weight was put on the decision-maker forecast.

1. The remaining cases were categorized in the same manner, using all principles established to date, and an inter-rater reliability calculation was made for these cases. The agreement rate on these cases was 85 percent.

2. Disagreements on these cases were resolved using the principles and further refinements of them. The disagreements fell into two categories.

   - One rater had missed a critical piece of information in the interview or program file, or

   - Disagreement about the weight to put on different pieces of conflicting information

Neither of these bases for disagreement can be systematically corrected by rules or principles; they are a matter of judgement.

3. We then independently estimated the magnitude of the adjustment for those NTGRs that required an adjustment.

4. Our recommended adjustments were compared and any differences resolved.

5. Finally, the rationales for the custom results were written.

6.2 Site-Level Spillover Assessment

Spillover is defined as the gross savings for non-rebated efficiency measures that were not included in the gross program savings, but would not have been installed had PG&E DSM programs not existed. What follows is a method for identifying and evaluating spillover measures installed in 1996 by participants in PG&E's 1996 Retrofit Industrial Program. We only evaluated spillover at sites where we performed a project-specific evaluation. During development of each site evaluation plan, we interviewed the customer to determine if spillover was present. The objective of this spillover interview was to determine if other efficiency measures were implemented in 1996 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, we had to contact more than one person to make this determination. Sometimes, as in the case the free-ridership analysis, a vendor interview was necessary to assess the level of influence of PG&E programs. Figure 6-3 displays the process for identifying spillover.

Estimating savings for a spillover item required an on-site survey. However, given time and budget constraints, before inspecting potential spillover equipment on-site, we had to be at least 60% certain that PG&E caused this installation to occur. The respondent's answer to question 5 of the spillover survey provided this probability. If this probability was less than 0.6, it might have meant that the respondent was unaware of PG&E's influence on the vendor who recommended the efficient equipment. For those participant respondents who indicated that there was less than a 0.6 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 vendor believed that the probability of PG&E's influence was greater than 0.6, the measure was classified as spillover.

Before collecting data during the on-site survey for spillover measures with probabilities greater than 0.6, we performed a preliminary engineering review. We only proceeded to evaluate a spillover measure if it would likely yield significant savings, or required little additional cost to evaluate. This was a conservative approach to estimating the impact of spillover measures because we did not include small-savings measures that were difficult to evaluate.

For spillover measures meeting the criteria discussed above, 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, 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 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 the detailed specification of alternative baselines was rarely possible even among the *rebated* items. We did not consider it cost-effective to invest in determining these baselines for spillover savings.

6.3 End-Use and Program-Level Net Savings

In this section, we describe the methods used to derive estimates of net savings and NTGRs within each end use and at the program level for kW, kWh, therms[9]. This process involves several steps and several components. First, we discuss the use of item-level savings and NTGR results to determine basic end use and program-level savings without spillover. This discussion considers the three evaluated groups, the methods used for each, and how their results were generalized to the unevaluated group of items. These issues are treated in a general, narrative way first, and then presented in algebraic form. We then discuss the inclusion of spillover savings and how they were integrated into the rebated savings. The final subsections describe the methods used to calculate confidence intervals for the program- and end use-level NTGRs and realization rates.

6.3.1 Net Impact Estimation

In this section, we describe the methods for producing end use- and program-level net impact estimates using the unique configuration of data available for each of the following four groups:

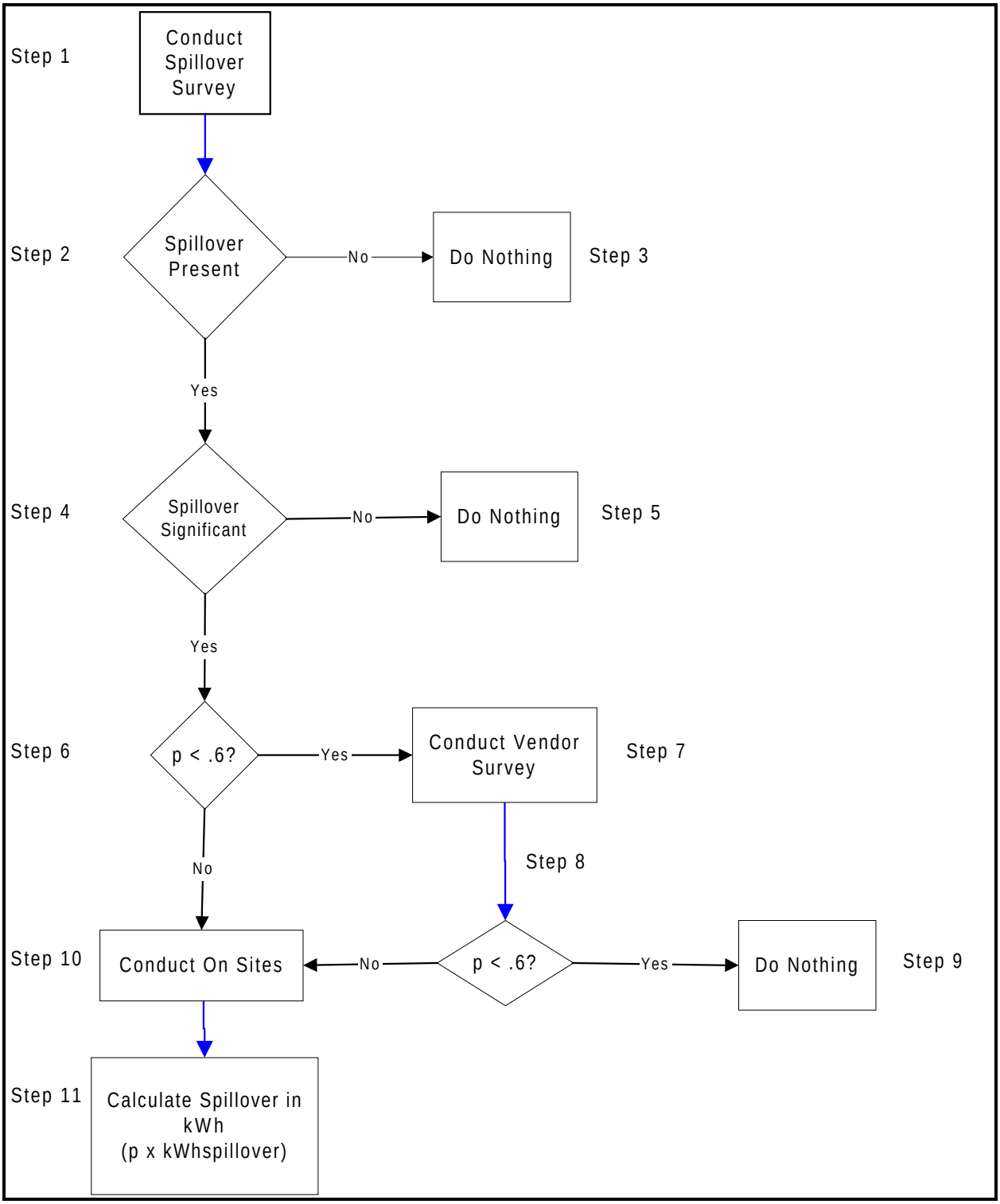
1. custom project-specific,
2. standard project-specific,
3. verification, and
4. excluded or refused projects.

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, vendor surveys, 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 used for custom project-specific items but *without* the custom decision information was used to produce savings estimates for the standard project-specific items.

[9] Although not technically required by the M&E Protocols, the calculation of an NTGR within each end use at the kW, kWh, and therm levels is required for use in the calculation of utility earnings.

Figure 6-3 Spillover Identification Process



The items contained in these two evaluation groups comprise 70 percent of program savings. All projects were listed in descending order by ex-ante savings. Beginning with the highest saver, each project was sampled with certainty until 70 percent of the savings were covered. 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 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 whenever a customer refused to participate. The result of each of these processes is a direct estimate of net savings per item.

Calculating the net kWh, kW, and therm savings for each end use involved three steps.

1. For each item within each end use, the (ex ante) gross kWh, kW, and therms obtained from the Program Database[10] were adjusted by the gross realization rate
2. for each item within each end use, this product is in turn multiplied by the final NTGR (the CASR_NTGR or the ASR_NTGR) for each item, and
3. item-level savings are then summed within each end use.

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

$$\text{NetkWh} = \sum_{e=1}^{N}\sum_{i=1}^{N} \left[\text{NTGR}_{e,i} * \left(\text{RR}_{e,i} * \text{PDKWH}_{e,i}\right)\right] \quad (5)$$

$$\text{NetkW} = \sum_{e=1}^{N}\sum_{i=1}^{N} \left[\text{NTGR}_{e,i} * \left(\text{RR}_{e,i} * \text{PDKW}_{e,i}\right)\right] \quad (6)$$

$$\text{NetTherms} = \sum_{e=1}^{N}\sum_{i=1}^{N} \left[\text{NTGR}_{e,i} * \left(\text{RR}_{e,i} * \text{PDTHERMS}_{e,i}\right)\right] \quad (7)$$

where[11]

$\text{NTGR}_{e,i}$ = the NTGR for the i^{th} project-specific item in the e^{th} end use (ex post)
$\text{RR}_{e,i}$ = the gross realization rate for the i^{th} project-specific item in the e^{th} end use
$\text{PDKWH}_{e,i}$ = the gross kWh savings for the i^{th} project-specific item in the e^{th} end use contained in PG&E's Program Database (ex ante)
$\text{PDKW}_{e,i}$ = the gross kW savings for the i^{th} project-specific item in the e^{th} end use contained in PG&E's Program Database (ex ante)
$\text{PDTHERMS}_{e,i}$ = the gross therm savings for the i^{th} project-specific item in the e^{th} end use contained in PG&E's Program Database (ex ante)

Group 3: Verification Items. The third (verification) group of evaluated projects is the group of projects sampled from those that account for the remaining 30 percent of savings in the Lighting,

[10] The Program Database includes those impacts obtained from the PG&E "E" Tables that are filed as a part of PG&E's earnings claim.

[11] Only terms that have not been previously defined will be defined in each of the remaining equations.

Process, and HVAC end uses. 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 to assess the accuracy of the gross savings estimates in the PG&E Program Database or to adjust them. For verification items, the net kWh, kW, and therms were calculated in three steps.

1. For each verification item within each end use, the gross kWh, kW, and therms obtained from the Program Database[12] were adjusted by the average gross realization rate for all items within each end use observed for the *project-specific* items,
2. for each verification item within each end use, this product is in turn multiplied by the final NTGR for each verification item, and
3. item-level savings are then summed within each end use.

For verification items, equations 8, 9, and 10 are provided as another way of looking at these calculations.

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

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

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

where

$\text{NTGR}_{e,i}$ = the NTGR for the i^{th} verification item in the e^{th} end use.

$\overline{\text{RR}}_{e,ps}$ = the average gross realization rate for the e^{th} end use for all project-specific items

PD = the prefix PD indicates that the source of the value is PG&E's Program Database.

Group 4: Excluded or Refused Items: The group of excluded or refused items lacks both realization rate estimates and NTGRs. Gross savings (ex post) were estimated by adjusting the program database estimates to reflect the gross realization rates observed for project-specific items within the same end use category. NTGRs were taken from the project-specific and verification items within each end use for which we were able to compute a NTGR. An average NTGR, weighted by ex-post gross savings, was calculated and applied to these non-evaluated items in the Program Database.

For excluded and refused items, the net kWh and kW were 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 observed in the project-specific items within a given end use,

[12] The Program Database includes those impacts obtained from the PG&E "E" Tables that are filed as a part of PG&E's earnings claim.

2. for each item, this product was then multiplied by the weighted-average NTGR for all items within a given end use in the observed project-specific and verification projects, and
3. item-level savings were then summed within each end use.

For excluded and rejected projects, equations 11, 12, and 13 are provided as another way of looking at these calculations.

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

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

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

where:

$\overline{NTGR}_{e,psv}$ = the weighted-average NTGR for project-specific (ps) and verification (v) measures

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

6.3.2 Net Impact Estimation by Costing Period

Net kWh and kW savings for each end use and the program overall were also calculated by costing period. To allocate the end use and program savings into these costing periods, we developed kWh and kW savings fractions for all items. For all evaluated project-specific items, the kWh savings fractions consist of the kWh savings in a given costing period divided by the annual kWh savings (this definition of kWh savings fractions is identical to the PG&E definition of the kWh H-factor). kW saving fractions represent a ratio between the average coincident peak kW savings and the peak kW connected load savings (this ratio must be less than or equal to one). Multiplying these fractions by the net savings for a given item yielded costing period net savings for each project-specific item.

We then determined the means of the kWh and kW savings fractions (weighted by ex post net savings) for project-specific items by end use. These mean values are shown in Tables 6-7 and 6-8. For verification, refused, and excluded items, we multiplied net savings by these mean fractions to determine their costing period net kW and kWh savings. For therm savings, we only calculated annual savings for each project-specific project, so costing period allocations and savings fractions did not apply.

Table 6-7: Mean kWh Savings Fractions

End Use	Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
HVAC	0.069	0.123	0.355	0.188	0.264
LIGHTING	0.112	0.103	0.304	0.202	0.279
PROCESS	0.092	0.107	0.306	0.194	0.302

Table 6-8: Mean kW Savings Fractions

End Use	Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
HVAC	0.351	0.511	0.487	0.501	0.378
LIGHTING	0.704	0.486	0.457	0.542	0.686
PROCESS	0.971	0.978	0.954	0.969	0.960

A simple example shows how these savings fractions were used for those cases for which savings fractions were not calculated (i.e., all non-project-specific items). Consider a hypothetical verification lighting item that had an estimated annual net savings of 2,000 kWh and a net peak demand reduction of 25 kW. First, the 2,000 kWh would be allocated to the costing periods using the mean kWh savings fractions for lighting in Table 6-7. The results for this example are presented in Table 6-9.

Table 6-9: Example of Costing Period Allocation of 2,000 kWh Lighting Savings for a Verify Item

End Use	Savings for 2,000 kWh by Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
Lighting	224	206	609	404	558

Next, the 25 kW net savings would be allocated to the costing periods using the savings fractions in Table 6-8. The results for this example are presented in Table 6-10.

Table 6-10: Example of Costing Period Allocation of 25 kW of Net Lighting Savings for a Verify Item

End Use	Coincident Demand Savings for 25 kW by Costing Period				
	Summer On Peak	Summer Partial Peak	Summer Off Peak	Winter Partial Peak	Winter Off Peak
Lighting	17.6	12.2	11.4	13.5	17.1

6.3.3 End-Use and Program-Level NTGRs

The end-use and program-level NTGRs were calculated by summing the gross and net kWh, kW, and therms savings for all items within end use and then across all end uses. Dividing each net savings sum by the corresponding gross savings sum produced NTGRs for kWh, kW, and therms within each end use and the program overall.

6.3.4 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 spillover savings were calculated based on the engineering estimates of gross savings, adjusted by the self-reported probability that the item was installed in 1996 because of a PG&E program. This adjustment leads to the net spillover savings for the item. Item savings from spillover installations were totaled for all project-specific evaluation sites to calculate total spillover savings for kWh, kW, and therms for each end use and for the 1996 program as a whole. These components of net savings were added to the net savings resulting directly from rebated equipment for kWh, kW, and therms for each end use and the program as a whole. Total program net savings for each end use and the program as a whole were then divided by the corresponding gross savings, to yield spillover-adjusted net-to-gross ratios. Note that, theoretically, the net-to-gross ratio could be higher than one 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, refused, or excluded items. While that type of generalization has a reasonable basis for the realization rates and NTGRs coming from rebated equipment, there is less of a basis for it for spillover impact. Recall that the generalization to verification and non-evaluated items was based on similarities in equipment type. It is difficult to make the argument that rebated equipment type is a good indicator 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.

6.3.5 Confidence Intervals

The 80% and 90% 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.

6.3.5.1 Realization Rate Confidence Intervals

For the realization rate, data were available for *all* the project-specific items representing the top 70% of program savings. Using these realization rates, a mean and standard error were calculated. The confidence interval were then calculated as follows:

$$\bar{y} \pm t s_{\bar{y}} \quad (17)$$

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 80% and 90% levels of confidence are 1.28 and 1.64, 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 that those for items for which realization rates are unavailable.

6.3.5.2 NTGR Confidence Intervals

For the NTGR, data were available for all project-specific items and a sample of non-project-specific items *within each of the three end uses*. One can think of this as a stratified random sample with two strata for each end use. With stratified random sampling, an unbiased estimate of the Variance of $\bar{y}_{st}$ is:

$$s^2(\bar{y}_{st}) = \sum_{h=1}^{L} \frac{W_h^2 s_h^2}{n_h} - \sum_{h=1}^{L} \frac{W_h s_h^2}{N} \qquad (18)$$

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 18 represents the finite population correction.

The confidence intervals are calculated as follows.

$$\bar{y}_{st} \pm ts(\bar{y}_{st}) \qquad (19)$$

where t = the critical value from the t distribution
s = the standard error of $\bar{y}$, the mean NTGR for the stratified sample (St) .

The critical values for the 80% and 90% levels of confidence are 1.28 and 1.64 respectively. Note that this calculation was performed for each end use and for the program as a whole.

7. Results of the Engineering Analysis of Gross Impact

7.1 Summary of Methodology

Gross savings were estimated for project-specific projects by implementing site-specific evaluation plans for a group of projects in the HVAC, indoor lighting, and process end uses that accounted for more than 70 percent of the ex ante gross savings in each end use. The site-specific evaluations plans provided a detailed description of the rebated items at each site and specified the data collection and engineering analysis procedures for evaluating gross impacts. We collected data during an on-site survey and re-estimated 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 rebated 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 1996 program savings in each of the lighting, HVAC, and process end uses. A total of 122 projects (12 HVAC, 95 lighting, and 15 process projects) received this level of analysis. The sites included in this sample are a very diverse group of industrial facilities and custom applications of the program measures. As a result, the data collection and analysis methods for each project in this group were tailored to the complexity of the measure and the value of the savings. We developed custom data collection and analysis procedures for each process and HVAC project-specific evaluation, since PG&E had used significantly different approaches to estimate savings for similar measures. We used standardized procedures for lighting projects.

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 204 projects (32 process, 117 HVAC, and 55 lighting 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 Savings: 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 file review ex ante estimates of gross 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. Once the extrapolation for all end uses was complete, we estimated program-level gross savings by summing the savings for all items.

Table 7-1: Breakdown of Baseline Assumptions

End Use	Baseline	No. of Measures	% of Total Measures
Total			
	Pre-condition	259	76
	Equal lumens	31	9
	Title 20	24	7
	Title 24	21	6
	Standard practice	6	2
HVAC			
	Pre-condition	14	78
	Title 24	4	22
Indoor Lighting			
	Pre-condition	231	75
	Equal lumens	31	10
	Title 20	23	7
	Title 24	17	6
	Standard practice	6	2
Process			
	Pre-condition	14	93
	Title 20	1	7

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. For non-Title-24 lighting projects with underlit spaces, missing pre-condition information, or newly-constructed areas, we estimated baseline energy consumption by assuming light fixtures that emit an number of lumens equal to the as-built condition. Table 7-1 below categorizes these baseline assumptions, both overall and by end use. Overall, a large majority of items (76%) used a pre-condition equipment baseline. We ultimately analyzed 78% of the HVAC items, 75% of the lighting items, and 93% 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, process items received the most short-term measurements (53% of all project-specific process items), even though the bulk of these measurements (27 of 37) were for lighting items. HVAC items were most frequently subject to one-time measurements (78% of all project-specific HVAC items) and in fact accounted for 14 of the 22 items that received such measurements.

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	**341**	**37**	**10.9**	**22**	**6.5**
HVAC	18	2	11.1	14	77.8
Indoor Lighting	308	27	8.8	1	0.3
Process	15	8	53.3	7	46.7

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 program applications and compares it against the actual number we found installed and operational during the on-site survey. Examples of measure units are fixtures for an indoor lighting item, tons for an HVAC item, or motors for process. 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 are slightly lower for the process and lighting items (about 94% and 97%, respectively).

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 process items (about 95%) and the highest for HVAC 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 process (about 94%) and the highest for HVAC (nearly 100%).

Table 7-3: Counts of Installed and Operational Units (Project-Specific Only)

End Use	Number of Evaluated Measures	No. of Measure Units			% of App. Units	
		From Applic.	Installed	Operational	Installed	Operational
Total	341	105,024	102,683	102,376	97.8	97.5
HVAC	18	8,984	8,979	8,979	99.9	99.9
Lighting	308	95,026	92,749	92,444	97.6	97.3
Process	15	1,014	955	953	94.2	94.0

Table 7-4: Counts of Installed and Operational Units (Verify Only)

End Use	Number of Evaluated Measures	No. of Measure Units			% of App. Units	
		From Applic.	Installed	Operational	Installed	Operational
Total	302	149,440	149,350	149,320	99.9	99.9
HVAC	148	133,084	133,073	133,073	99.99	99.99
Lighting	121	15,862	15,805	15,777	99.6	99.5
Process	33	494	472	470	95.5	95.1

Table 7-5: Counts of Installed and Operational Units (All Items)

End Use	Number of Evaluated Measures	No. of Measure Units			% of App. Units	
		From Applic.	Installed	Operational	Installed	Operational
Total	643	254,464	252,033	251,696	99.0	98.9
HVAC	166	142,068	142,052	142,052	99.99	99.99
Lighting	429	110,888	108,554	108,221	97.9	97.6
Process	48	1,508	1,427	1,423	94.6	94.4

7.5 Gross Realization Rates

Tables 7-6 and 7-7 show estimates of connected load kW savings, average summer on-peak kW savings coincident with the PG&E system maximum, annual kWh savings, and gas therm savings, 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 coincident summer on-peak demand savings realization rate provides a significantly more conservative estimate. The PG&E program was inconsistent in calculating kW savings, thus adding uncertainty to our kW realization rate estimates.

Subsequent references to kW savings in this report refer to average summer on-peak kW savings coincident with the PG&E system maximum.

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 coincident summer on-peak kW realization rate of 0.874 (with a 90% confidence interval of ± 0.072), a kWh realization rate of 0.835 (± 0.089), and a therm realization rate of 0.627 (± 0.305) for the 1996 Industrial Retrofit Program. Table 7-6 shows that on an end use basis, process measures had the highest kW realization rate (0.973), while lighting measures had the highest kWh realization rate (1.051). Therm realization rates were highest for process measures (0.862), but especially low for HVAC measures (0.008). HVAC realization rates across the board were much lower than average, not surprising since our evaluation found very low realization rates for the largest HVAC project.

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. This yielded negative evaluation therm savings, but because the program did not estimate savings or takebacks for lighting measure, lighting therm realization rate did not apply.

Table 7-7 provides realization rates for each of the four industrial retrofit programs present in the evaluation. The bulk of the items (94% of the total) and large shares of the electric savings (53% of kW savings, and 38% of the kWh savings) fell within the Retrofit Express program. The realization rates for this program were 0.824 and 1.001 for kW and kWh, respectively. The program estimated no therm savings, so the therm realization rate did not apply.

The Customized program accounted for only about 4% of the measures, but was responsible for 26%, 39%, and 61% of the total program kW, kWh, and therm savings, respectively. The average kW, kWh, and therm realization rates for this program were 0.793, 0.610, and 0.553. This kW realization rate is nearly the same as the Retrofit Express realization rate, but the kWh is significantly lower than the Retrofit Express rate.

The Advanced Performance Options (APO) program, with only seven measures, had higher-than-average realization rates for kW, kWh, and therms (1.430, 1.426, and 0.915, respectively). The Retrofit Efficiency Options (REO) program kW and therm realization rates were higher than average (0.984 and 0.771, respectively), but the kWh realization rate was slightly lower than average (0.785).

7.6 Gross Savings by Costing Period

The project-specific evaluations produced estimates of kW and kWh savings 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 costing period kWh and kW distributions for each measure. We subsequently applied the weighted averages of the distributions to all other measures to develop a program-level costing period summary, shown in Table 7-9.

Tables 7-10 and 7-11 show kWh H-factors and costing period savings, both by end use and for the program as a whole. KWh H-factors are defined as the kWh savings occurring in a given costing period divided by the kWh savings for an entire year. The first line of Table 7-10 shows the fraction of hours in

a year that fall within each costing period. For example, of the 8,784 hours in 1996 (a leap year), 792 hours occur during the summer on-peak period, yielding a fraction of 0.090. kWh H-factors higher than this fraction indicate that kWh savings are concentrated to some degree in that particular costing period.

Another way of viewing these results is in Figure 7-1, which shows the ratio of the H-factor to the costing period hour fraction. A ratio greater than one shows that kWh savings are higher than one would expect if the kWh savings occurred uniformly over the year. This occurs during the summer on-peak and both partial-peak costing periods. On an end-use level, more of the lighting kWh savings takes place during the summer on-peak period, while conversely, HVAC kWh savings are weighted heavily towards the summer partial- and off-peak periods.

The kW H-factor is the ratio of average coincident kW savings in the given costing period to those in the summer on-peak costing period. By definition, the summer on-peak H-factor is 1. Table 7-11depicts these H-factors, as well as the corresponding kW savings, by end use and overall. Figure 7-2 provides a graphic representation of the H-factors. These show that HVAC demand savings are greatest during the summer partial-peak, summer off-peak, and winter partial-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. Lighting kW savings show the opposite trend, with the highest H-factors during the summer on-peak and winter off-peak periods. The process demand savings are very nearly flat across the year, 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 five items where savings estimates from the two sources did not agree. Table 7-12 below shows the number of items where we identified differences in savings estimates, along with their effect on the total program savings. The three HVAC discrepancies had a minuscule effect on kWh savings. Of the two process discrepancies, one had a negligible effect on kW savings. The other, more significant difference apparently resulted from a keypunch error which reduced the total program therms savings by about 10% from the value shown on the PG&E application.

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 program savings. In addition, we also found other reasons for differences, such as additional savings resulting from lighting measures reducing cooling consumption. Tables 7-13, 7-14, and 7-15 below show, for each end use, 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 the Number of Units column. In the tables, this item would be tallied in the "-1 to -25 % difference" row. In addition, the bottom of the tables documents the number of items

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

	Connected Load kW	Avg. Summer Peak kW (1)	kWh	Therms
Total				
No. of Measures	1,002	1,002	1,002	1,002
MDSS Program Savings	7,277	7,277	61,661,882	2,139,277
Evaluation Savings	9,864	6,357	51,499,853	1,341,250
Realization Rate	**1.356**	**0.874**	**0.835**	**0.627**
90% Confidence Interval	+/-0.072	+/-0.072	+/-0.089	+/-0.305
HVAC				
No. of Measures	177	177	177	177
MDSS Program Savings	714	714	7,868,568	446,848
Evaluation Savings	1,458	390	3,399,791	3,597
Realization Rate	**2.042**	**0.546**	**0.432**	**0.008**
90% Confidence Interval	+/-0.261	+/-0.122	+/-0.144	+/-0.022
Indoor Lighting				
No. of Measures	776	776	776	776
MDSS Program Savings	3,554	3,554	21,898,497	-
Evaluation Savings	5,338	3,040	23,007,545	-121,057
Realization Rate	**1.502**	**0.855**	**1.051**	**N/A**
90% Confidence Interval	+/-0.077	+/-0.076	+/-0.096	-
Process				
No. of Measures	49	49	49	49
MDSS Program Savings	3,009	3,009	31,894,817	1,692,429
Evaluation Savings	3,068	2,928	25,092,517	1,458,710
Realization Rate	**1.020**	**0.973**	**0.787**	**0.862**
90% Confidence Interval	+/-0.356	+/-0.362	+/-0.366	+/-0.335

(1) Defined as the average hourly kW savings coincident with the PG&E system maximum during the summer on-peak costing period (May 1 - October 31, weekdays at 3 P.M.)

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

	Connected Load kW	Avg. Summer Peak kW (1)	kWh	Therms
Total				
No. of Measures	1,002	1,002	1,002	1,002
MDSS Program Savings	7,277	7,277	61,661,882	2,139,277
Evaluation Savings	9,864	6,357	51,499,853	1,341,250
Realization Rate	**1.356**	**0.874**	**0.835**	**0.627**
90% Confidence Interval	+/-0.072	+/-0.072	+/-0.089	+/-0.305
Advanced Performance Options (APO)				
No. of Measures	7	7	7	7
MDSS Program Savings	383	383	3,401,620	704,694
Evaluation Savings	651	548	4,849,299	644,732
Realization Rate	**1.698**	**1.430**	**1.426**	**0.915**
90% Confidence Interval	+/-1.052	+/-1.281	+/-1.354	-
Customized				
No. of Measures	38	38	38	38
MDSS Program Savings	1,869	1,869	23,884,553	1,315,353
Evaluation Savings	2,123	1,482	14,569,389	726,907
Realization Rate	**1.136**	**0.793**	**0.610**	**0.553**
90% Confidence Interval	+/-0.256	+/-0.197	+/-0.186	+/-0.304
Retrofit Express (RE)				
No. of Measures	940	940	940	940
MDSS Program Savings	3,864	3,864	23,615,793	-
Evaluation Savings	5,834	3,184	23,637,066	-122,292
Realization Rate	**1.510**	**0.824**	**1.001**	**N/A**
90% Confidence Interval	+/-0.075	+/-0.074	+/-0.094	-
Retrofit Efficiency Options (REO)				
No. of Measures	17	17	17	17
MDSS Program Savings	1,161	1,161	10,759,915	119,229
Evaluation Savings	1,257	1,143	8,444,099	91,903
Realization Rate	**1.082**	**0.984**	**0.785**	**0.771**
90% Confidence Interval	+/-0.391	+/-0.146	+/-0.146	-

(1) Defined as the average hourly kW savings coincident with the PG&E system maximum during the summer on-peak costing period (May 1 - October 31, weekdays at 3 P.M.)

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
Winter Off-Peak	Nov 1 - Apr 30	9:30 PM- 8:30 AM weekdays, all day weekends

Table 7-9: Gross Savings by Costing Period

PG&E Costing Period	Hour of PG&E System Maximum	**Average kW Savings**	Average kW Savings Coincident with System Maximum	KW Adjustment Factor	**MWh Savings**	MWh Adjustment Factor	Annual MWh Savings	Connected Load kW
Summer On-Peak	3:00 PM	6,007	6,357	1.00	5,108	0.10	51,500	9,864
Summer Partial Peak	6:00 PM	5,393	5,617	0.90	5,463	0.11	51,500	9,864
Summer Off-Peak	10:00 PM	5,196	5,390	0.86	15,875	0.31	51,500	9,864
Winter Partial Peak	6:00 PM	5,536	5,816	0.92	10,160	0.20	51,500	9,864
Winter Off-Peak	8:00 AM	5,920	6,274	0.99	14,894	0.29	51,500	9,864

Table 7-10: kWh H-Factors and Costing Period Savings (by End Use)

	Costing Period				
End Use	Summer On-Peak	Summer Partial Peak	Summer Off-Peak	Winter Partial Peak	Winter Off-Peak
Fraction of annual hours in costing period	**0.090**	**0.090**	**0.322**	**0.178**	**0.320**
H-Factor					
ALL	0.099	0.106	0.308	0.197	0.289
HVAC	0.069	0.123	0.355	0.188	0.264
Lighting	0.112	0.103	0.304	0.202	0.279
Process	0.092	0.107	0.306	0.194	0.302
Savings					
ALL	5,108,072	5,464,307	15,878,266	10,160,108	14,889,100
HVAC	236,184	419,083	1,207,541	639,781	897,201
Lighting	2,575,431	2,369,495	7,001,166	4,642,971	6,418,481
Process	2,296,456	2,675,729	7,669,559	4,877,355	7,573,417

Table 7-11: kW H-Factors and Costing Period Savings (by End Use)

	Costing Period				
End Use	Summer On-Peak	Summer Partial Peak	Summer Off-Peak	Winter Partial Peak	Winter Off-Peak
H-Factor					
ALL	1.000	0.898	0.865	0.922	0.985
HVAC	1.000	1.457	1.388	1.428	1.076
Lighting	1.000	0.691	0.649	0.769	0.974
Process	1.000	1.008	0.982	0.998	0.989
Savings					
ALL	6,357	5,617	5,390	5,816	6,274
HVAC	390	568	541	557	419
Lighting	3,040	2,099	1,973	2,338	2,960
Process	2,928	2,950	2,876	2,922	2,895

Figure 7-1: Ratio of kWh H-Factor to Fraction of Hours in Costing Period (by End Use)

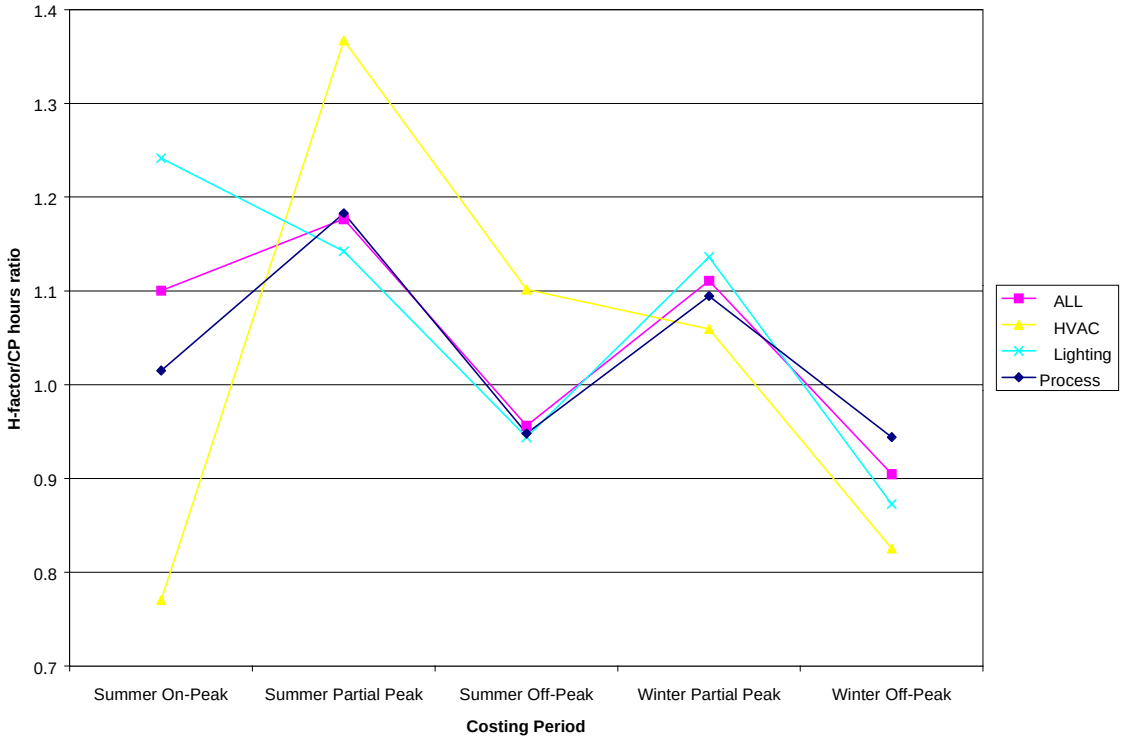
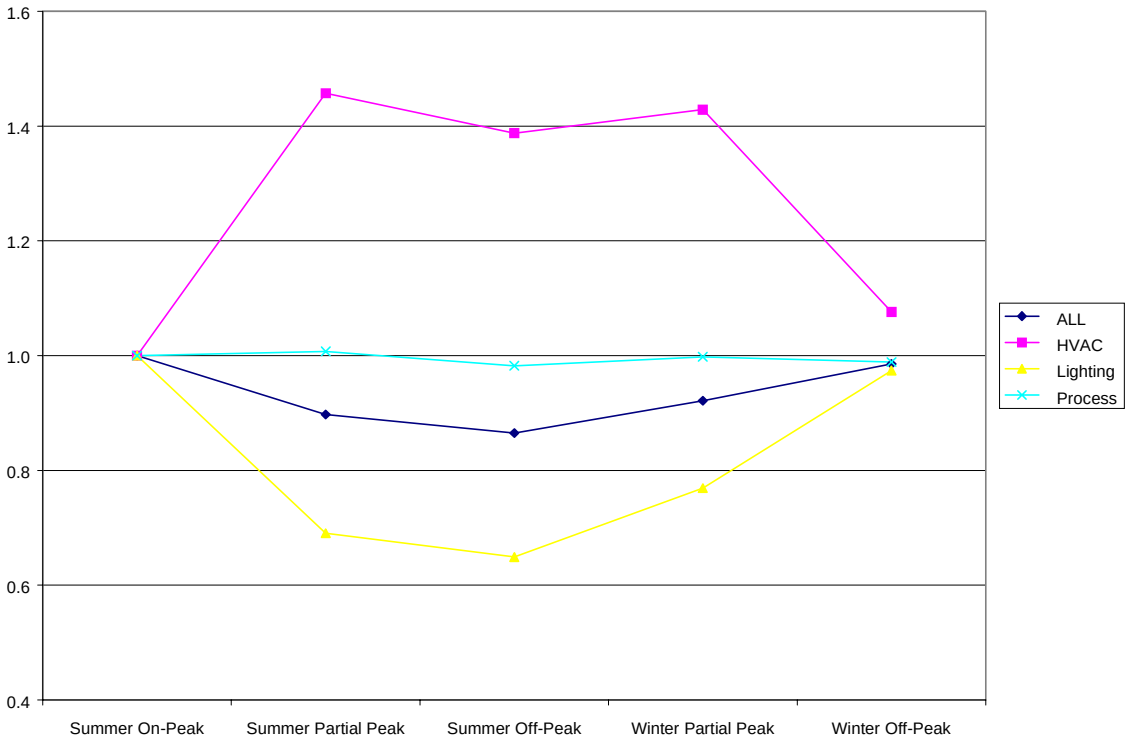


Figure 7-2: kW H-Factors (by End Use)



where the engineer indicated that there were additional reasons for differences between the savings estimates. Note that these tables tabulate the reasons for differences on an unweighted basis. Therefore, even though a measure may have large differences in assumptions, these differences may have a negligible impact on overall savings if the measure had small program savings.

Table 7-13 shows that for HVAC measures, differences in operating hours were the most significant of the three reason for savings differences. We found different operating hours than PG&E assumed for 75% of the HVAC measures. For process measures, differences in unit savings were the primary reason for savings differences: 93% of the measures showed a difference (see Table 7-14). Note that PG&E assumes average values for operating hours and per unit savings in their prescriptive programs. As a result, finding differences between these average values and the actual values from the evaluations is not surprising.

The number and magnitude of the differences were distributed much more widely for lighting, as Table 7-15 shows. Of the 308 evaluated lighting items, 22% had differences in capacity or number of units assumptions, 94% had differences in operating hour assumptions, and 98% had discrepancies in savings per unit assumptions. For 32% of the lighting items, engineers indicated there were other reasons for savings differences. Very often these were cases 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 7-16 below. We found heating and/or cooling interactions in nearly all of the lighting items that received project-specific analysis (267 out of 308 items, or 87%). The cooling interaction increased total evaluated lighting kWh savings by about 5.5%, and total program kWh savings by about 1.7%. The heating interaction decreased total therm savings by 8.3%.

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 17 lighting items and 2 HVAC items where such interactions occurred, as shown in Table 7-17. The table also lists the effects of the interactions on evaluation savings estimates. In general, the effect of these interactions was quite small. Lighting measure interactions reduced total lighting kW and kWh savings by 0.3% and 0.2%, respectively. In addition, lighting interaction reduced the lighting therm takeback (increased therm savings) by 0.1%. The HVAC measure interactions reduced HVAC kW and kWh savings by 5.8% and 0.2%, respectively. Overall, measure interactions across all end uses reduced kW savings by 1.0%, reduced kWh savings by 0.1%, and increased therm savings by 0.01%.

Table 7-12: Comparison of Program Data Base and Application Savings Estimates

End Use	MDSS Data Base Savings (1)	Program Application Savings	Percent Difference	No. of Items w/difference
Total				
kWh	56,767,657	56,768,763	0.002	3
kW	6,507	6,507	0.005	1
Therms	2,139,277	2,339,277	9.3	1
HVAC				
kWh	7,749,321	7,750,427	0.01	3
kW	704	704		
Therms	446,848	446,848		
Indoor Lighting				
kWh	17,675,853	17,675,853		
kW	2,836	2,836		
Therms	-	-		
Process				
kWh	31,342,483	31,342,483		
kW	2,967	2,967	0.01	1
Therms	1,692,429	1,892,429	11.8	1

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

Table 7-13: Differences in Key Assumptions Used in Program and Evaluation Savings Estimates (HVAC)

Percent Difference (1)	Number of Units		Operating Hours		Unit Savings		Other	
	# Meas.	% Meas.	# Meas.	% Meas.	# Meas.	% Meas.	# Meas.	% Meas.
Less than 100					21	**7**		
-76 to -100	10	**3**	15	**5**	19	**7**		
-51 to -75	7	**2**	10	**3**	20	**7**		
-26 to -50	6	**2**	70	**23**	51	**18**		
-1 to -25	47	**15**	57	**19**	65	**23**		
No difference	236	**77**	17	**6**	6	**2**		
1 to 25			51	**17**	52	**18**		
26 to 50			11	**4**	23	**8**		
51 to 75			29	**10**	13	**5**		
76 to 100			12	**4**	1	**0**		
Greater than 100	1	**0**	26	**9**	13	**5**		
Other reasons for differences?								
Yes							100	**32**
No							208	**68**
Totals	307	**100**	298	**100**	284	**100**	308	**100**

(1) A negative number indicates the evaluation finding is less than the program assumption.

Table 7-14: Differences in Key Assumptions Used in Program and Evaluation Savings Estimates (Process)

Percent Difference (1)	Number of Units		Operating Hours		Unit Savings		Other	
	# Meas.	% Meas.	# Meas.	% Meas.	# Meas.	% Meas.	# Meas.	% Meas.
Less than 100								
-76 to -100			7	**44**				
-51 to -75	1	**6**	2	**13**				
-26 to -50								
-1 to -25	3	**17**	1	**6**	2	**25**		
No difference	14	**78**	4	**25**	3	**38**		
1 to 25			1	**6**	1	**13**		
26 to 50			1	**6**	1	**13**		
51 to 75					1	**13**		
76 to 100								
Greater than 100								
Other reasons for differences?								
Yes							4	**22**
No							14	**78**
Totals	18	**100**	16	**100**	8	**100**	18	**100**

(1) A negative number indicates the evaluation finding is less than the program assumption.

Table 7-15: Differences in Key Assumptions Used in Program and Evaluation Savings Estimates (Indoor Lighting)

Percent	Number of Units		Operating Hours		Unit Savings		Other	
Difference (1)	# Meas.	% Meas.	# Meas.	% Meas.	# Meas.	% Meas.	# Meas.	% Meas.
Less than 100								
-76 to -100								
-51 to -75			1	**7**	1	**7**		
-26 to -50					3	**20**		
-1 to -25	6	**40**	6	**40**	5	**33**		
No difference	8	**53**	5	**33**	1	**7**		
1 to 25	1	**7**	3	**20**	3	**20**		
26 to 50					1	**7**		
51 to 75								
76 to 100								
Greater than 100					1	**7**		
Other reasons for differences?								
Yes							13	**87**
No							2	**13**
Totals	15	**100**	15	**100**	15	**100**	15	**100**

(1) A negative number indicates the evaluation finding is less than the program assumption.

Table 7-16: Effect of Heating-Cooling Interaction

	Proj-Spec Lighting	All End Uses
No. of measures	308	1002
No. of measures w/heat-cool interaction	267	267
% of total measures	**86.7**	**26.6**
Total evaluated kWh savings	16,392,878	51,499,853
Interaction kWh savings	894,204	894,204
% of total kWh savings	**5.5**	**1.7**
Total evaluated therm savings	-121,057	1,341,250
Interaction therm savings	-121,057	-121,057
% of total therm savings	**N/A**	**-8.3**

Table 7-17: Effect of Measure Interactions

End Use	No. of Items	No. of Measure Interactions	Evaluated Savings			Measure Interactions			% Interactive Effect		
			kW	kWh	Therms	kW	kWh	Therms	kW	kWh	Therms
Total	1002	19	9,864	51,499,853	1,341,250	101	51,742	-94	1.02	0.10	-0.01
HVAC	177	2	1,458	3,399,791	3,597	85	7,888	-	5.84	0.23	-
Indoor Lighting	776	17	5,338	23,007,545	-121,057	16	43,854	-94	0.29	0.19	0.08
Process	49	-	3,068	25,092,517	1,458,710	-	-	-	-	-	-

8. Results of Net Savings Analysis

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

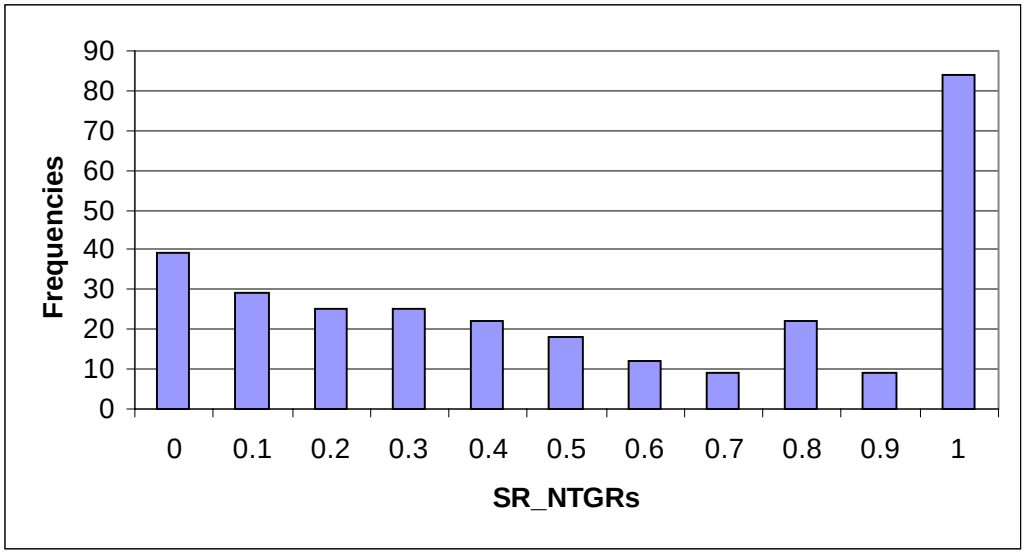
8.1 Reliability of Core NTGR (SR_NTGR) Items

Three new core questions were added to the decision-maker survey for the 1996 program evaluation (Questions 13, 14, and 15 on the survey in Appendix K) to form the basis for the SR_NTGR, or self-report NTGR. Surveys from previous evaluations had included only two core questions. The three new core questions were added to increase the reliability of the core measure of the NTGR. All other things being equal, reliability is increased by adding items to a scale. Before using the new items, an assessment of the internal consistency reliability was performed. The Cronbach's alpha for the five items is 0.96, well above an acceptable level of reliability. All items contribute to this high number, as the reliability would be slightly decreased by the elimination of any one of the five questionnaire items. Thus, we concluded that the five-item scale is the best measure of the core or Self-Report NTGR (SR_NTGR) in this study.

8.2 NTGR Results for Verification Items

For the 294 of the 302 verification items with decision-maker survey data, the SR_NTGR was calculated. The SR_NTGR was based on the responses to the five core questions in the decision-maker survey. The unweighted, overall SR_NTGR based on information for all 294 verification items is 0.53, with a standard deviation of 0.38. Figure 8-1 presents the distribution of the NTGRs for verification items.

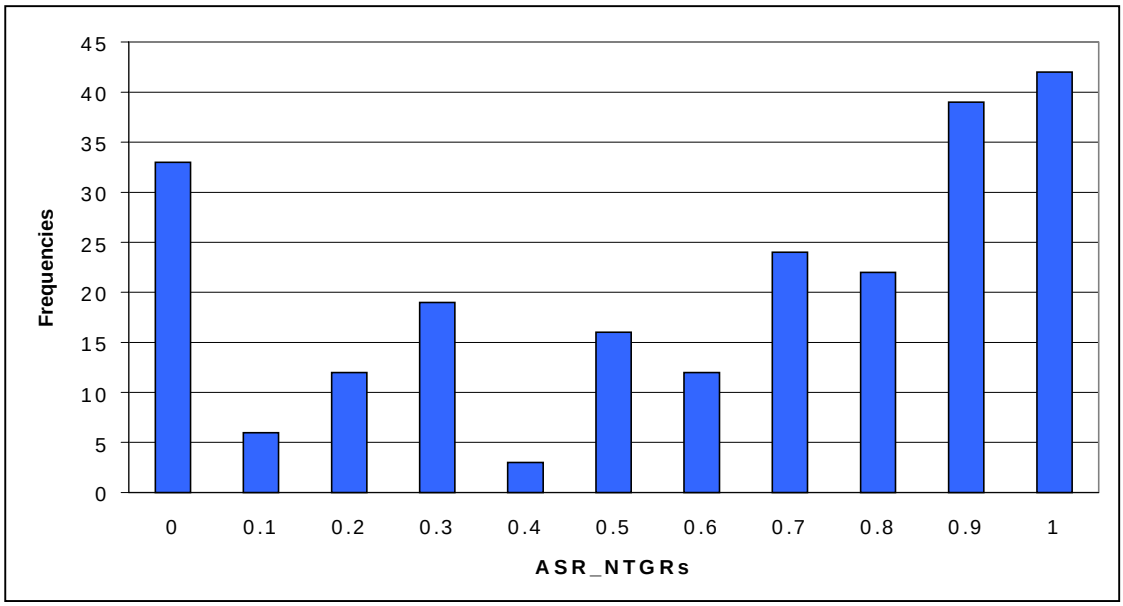
Figure 8-1: Distribution of SR_NTGRs for Verification Items



8.3 NTGR Results for Standard Project-Specific Items

For the 228 standard project-specific items, the SR_NTGR was first calculated and then adjusted for partial free-ridership to produce the ASR_NTGR. None of the items had missing data. The ASR_NTGR was based on the responses to the core questions on the decision-maker survey, as well as baseline information collected on site that was used to calculate the engineering ratio. We determined the appropriate baseline to account for partial free-ridership (i.e., situations where, in the absence of the PG&E program, the customer would have installed equipment with a rated efficiency somewhere between that of the gross baseline equipment and the as-built equipment). The unweighted, overall ASR_NTGR based on information for 228 items is 0.60, with a standard deviation of 0.35. Figure 8-2 presents the distribution of the NTGR for the 228 standard project-specific items.

Figure 8-2: Distribution of ASR_NTGRs for Standard Project-Specific Items

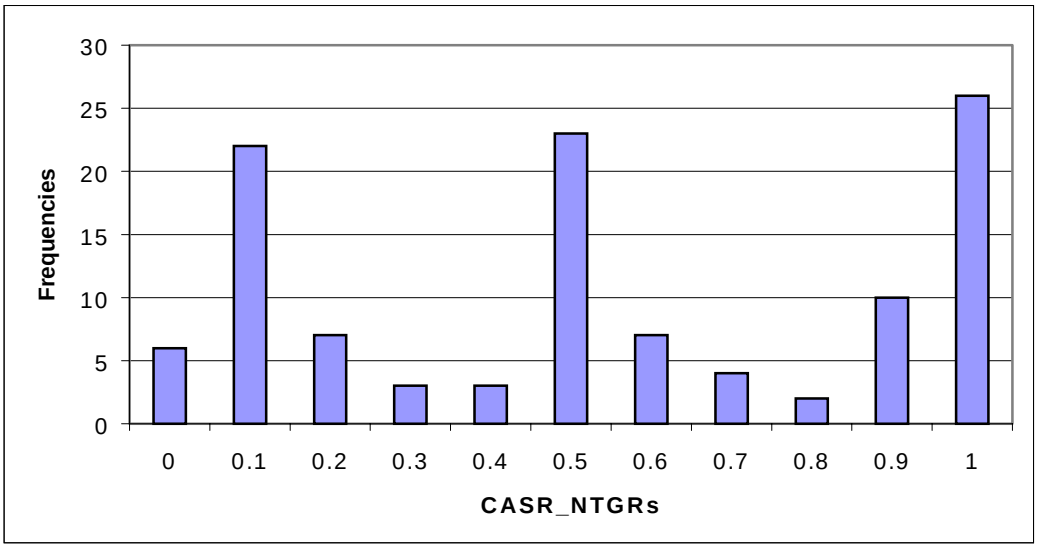


An important question is whether the adjustment for partial free-ridership was significant or not. For the group of standard project-specific items, the decision makers for 224 of the 228 items (98.2%) indicated that in the absence of the PG&E Program, they most likely would not have installed an alternative piece of equipment. The remaining 1.8% either did not know or did not respond to the question. Therefore, there was no partial free-ridership in this group.

8.4 NTGR Results for Custom Project-Specific Items

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 or confirm the ASR_NTGR. Figure 8-3 presents the distribution of the CASR_NTGRs for this group. Of the 113 custom items, none lacked decision-maker survey data. Among these items, the unweighted CASR_NTGR was 0.528 with a standard deviation of 0.351. Figure 8-3 presents the distribution of the CASR_NTGRs.

Figure 8-3: Distribution of CASR_NTGRs for Custom Project-Specific Items

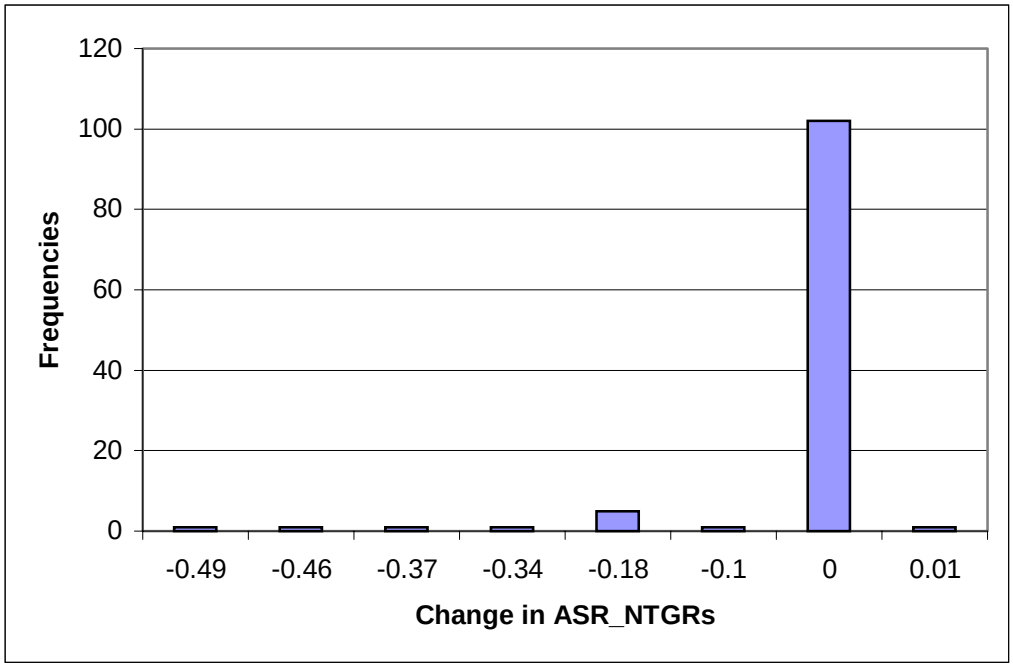


In the custom analysis of the 113 items examined, the ASR_NTGR was modified for 11 items. Of these modifications, 1 was an increase and 10 were decreases. Across all items, the changes produced a small *decrease* of 0.023 in the overall, raw, unweighted ASR_NTGR thus yielding a CASR_NTGR of 0.528. The effects were due to several factors, including information in the program files, and qualitative questions asked of the decision-makers and operations staff. An additional factor that was used was the participants' answers to the question on the timing of the installations, absent the program. When the respondent "forecasted" when they would have installed the same equipment without the program, this forecast was converted into an implied NTGR using the Forecast Conversion Table described in Section 6.1.8.1. This implied NTGR was used along with all other available information in estimating the custom NTGR. For the remaining 102 items, the ASR_NTGR did not change since any information identified provided insufficient grounds for *overriding* the ASR_NTGR or it served only to *confirm* it. Figure 8-4 presents the distribution of the changes resulting from the custom analysis for the 113 items.

For only one of the 113 custom project-specific items did the decision maker indicate that in the absence of the PG&E program, it was more likely that they would have installed an alternative piece of equipment. In this case, the usage of the alternate equipment could not be calculated reliably, and, therefore, could not be used. This resulted in an engineering ratio equal to one. Therefore, there was no partial free-ridership effect on this group.

Important in this discussion is the fact that nearly all respondents, in both the standard and custom project-specific groups, *could* remember whether or not they considered alternatives. Decision-makers for only four of the total of 341 items gave "don't know" as their answer. Of the remaining 337 items, 336 (99.7%) had decision-makers who specifically stated they did not consider any alternatives. If these program participants are typical of participants from other years, then partial free-ridership may be a relatively minor issue. It is interesting to note that similar results were found in the evaluation of PG&E's 1995 IEEI Program.

Figure 8-4: Distribution of NTGR Changes for Custom Project-Specific Items



8.5 Net Savings by End Use and Program

Table 8-1 presents the number of items, evaluated gross savings, evaluated net savings, and the NTGR based on the custom analysis, broken down by the three end uses, HVAC, indoor lighting, and process. The table also lists 90% confidence intervals. As one can see from Table 8-1, indoor lighting has the largest net savings for connected load kW, average summer on-peak kW, and kWh, while process has the greatest therm savings. The overall NTGRs are 0.640 (connected load kW), 0.595 (average kW), 0.621 (kWh), and 0.583 (therms). By end use, lighting had the highest NTGRs for connected load kW, kWh, and therms, while process had the highest NTGR for average summer peak kW. Note that the high NTGR for lighting therms applies to negative net savings. These negative savings reflect the increased heating load resulting from the cooler efficient lights. In this instance, the NTGR indicates the net increase in gas consumption that occurs because of PG&E's programs.

Table 8-2 presents each end use, each of which is first ranked from 1 to 3 with respect to connected load kW, average summer on-peak kW, kWh, and therm net savings and then ranked again in per-item terms. On a net impact per-item basis, process ranks first on connected load kW, average summer on-peak kW, kWh, and therm savings while, in general, HVAC ranks the lowest (except therms, where lighting, not surprisingly, has the smallest impact).

The effect of custom free-ridership analysis on end-use and overall NTGRs is shown in Table 8-3. This customization changed the item-level NTGRs for 11 items, as described in detail in Section 8.4 above. The table displays the NTGRs both before and after customization, as well as the difference between them. In terms of percentage points (where, for instance, a drop in the NTGR from 0.50 to 0.40 is defined as 10 percentage points), the overall connected load kW, average kW, and kWh NTGRs decreased by 2.9, 4.5, and 4.8 percentage points, respectively. The main causes of these decreases in the overall NTGRs for all but therms are the decreases in the process end use, where the decreases range

from 0.9 to 9.7 percentage points. Overall, the therm NTGR increased only slightly by one percentage point. The remaining changes in the HVAC and lighting end uses were less than one percentage point.

Table 8-4 presents the number of items, evaluated gross savings, evaluated net savings and the NTGR broken down by the four programs represented in the evaluation. Clearly, the Retrofit Express (RE) Program has the largest net savings for connected load kW, average summer peak kW, and kWh, but the lowest on therms. The Customized Program is consistently ranked second for all net savings. The Retrofit Efficiency Options (REO) is consistently ranked third for all net savings. Finally, the Advanced Performance Options (APO) is consistently ranked fourth except for therms.

From Table 8-5, one can see that, on a per-item basis, the impact rankings are clear. The APO program has the highest per-item savings, and the RE program has the smallest. The middle rankings are shared by REO and Customized.

8.6 Net Savings by Costing Period

Table 8-6 shows net kWh H-factors and costing period savings, both by end use and for the program as a whole. kWh H-factors are defined as the kWh savings occurring in a given costing period divided by the kWh savings for an entire year. The first line of Table 8-6 shows the fraction of hours in a year that fall within each costing period. For example, of the 8,784 hours in 1996 (a leap year), 792 hours occur during the summer on-peak period, yielding a fraction of 0.090. kWh H-factors higher than this fraction indicate that kWh savings are concentrated to some degree in that particular costing period.

The kW H-factor is the ratio of average coincident kW savings in the given costing period to those in the summer on-peak costing period. By definition, the summer on-peak H-factor is 1. Table 8-7 depicts these H-factors, as well as the corresponding net kW savings, by end use and overall.

8.7 Spillover Savings

As part of the project-specific analysis, screening surveys were conducted for 337 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 participant spillover. Table 8-8 presents net spillover savings, and their effect on end-use and program-level NTGRs. In all, we identified only three spillover items (one process, and two lighting). These items increased evaluation net kWh savings by 0.8% and average kW savings by 0.9%. The lighting items decreased total net therm savings by 0.01%. In general, spillover had little influence on the results of the evaluation: the overall average kW, kWh, and therm NTGRs changed by 0.005, 0.004, and 0.00003, respectively

Table 8-1: Net Savings by End Use

		No. of Items	Connected Load kW	Avg. Summer Peak kW[1]	kWh	Therms
Total		1,002				
Program	Net Savings		4,774	4,774	40,371,487	1,390,530
	Net-to-Gross Ratio		0.656	0.656	0.655	0.650
Evaluation[2]	Net Savings		6,315	3,783	31,955,781	782,399
	Net-to-Gross Ratio		**0.640**	**0.595**	**0.621**	**0.583**
	90% Confidence Interval		+ /-0.018	+ /-0.018	+ /-0.018	+ /-0.018
	Net Realization Rate		1.323	0.792	0.792	0.563
HVAC		177				
Program	Net Savings		434	434	4,944,384	290,451
	Net-to-Gross Ratio		0.607	0.607	0.628	0.650
Evaluation[2]	Net Savings		674	181	1,577,942	718
	Net-to-Gross Ratio		**0.462**	**0.465**	**0.464**	**0.200**
	90% Confidence Interval		+ /-0.01	+ /-0.01	+ /-0.01	+ /-0.01
	Net Realization Rate		1.555	0.418	0.319	0.002
Indoor Lighting		776				
Program	Net Savings		2,385	2,385	14,695,472	-
	Net-to-Gross Ratio		0.671	0.671	0.671	-
Evaluation[2]	Net Savings		3,725	1,802	15,199,622	-97,937
	Net-to-Gross Ratio		**0.698**	**0.593**	**0.661**	**0.809**
	90% Confidence Interval		+ /-0.025	+ /-0.025	+ /-0.025	+ /-0.025
	Net Realization Rate		1.562	0.755	1.034	-
Process		49				
Program	Net Savings		1,956	1,956	20,731,631	1,100,079
	Net-to-Gross Ratio		0.650	0.650	0.650	0.650
Evaluation[2]	Net Savings		1,915	1,800	15,178,218	879,618
	Net-to-Gross Ratio		**0.624**	**0.615**	**0.605**	**0.603**
	90% Confidence Interval		+ /-0.013	+ /-0.013	+ /-0.013	+ /-0.013
	Net Realization Rate		0.979	0.920	0.732	0.800

[1] Defined as the average hourly kW savings coincident with the PG&E system maximum during the summer on-peak costing period (May 1 - October 31, weekdays at 3 P.M.)

[2] This result incorporates item-level NTGRs enhancements from the custom free-ridership analysis.

Table 8-2: 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	3	3	3	2
Lighting				
Total	1	1	1	3
Per-Item	2	2	2	3
Process				
Total	2	1	2	1
Per-Item	1	1	1	1

Table 8-3: Effect of Customized Free-ridership Analysis on NTGRs

	Connected Load kW	Avg. Summer Peak kW	kWh	Therms
Total				
NTGR with **standard** freeridership analysis	0.669	0.640	0.669	0.574
NTGR enhanced w/**custom** freeridership analysis	0.640	0.595	0.621	0.583
Difference	-0.029	-0.045	-0.048	0.010
HVAC				
NTGR with **standard** freeridership analysis	0.466	0.473	0.467	0.200
NTGR enhanced w/**custom** freeridership analysis	0.462	0.465	0.464	0.200
Difference	-0.004	-0.008	-0.003	0.000
Lighting				
NTGR with **standard** freeridership analysis	0.699	0.594	0.662	0.810
NTGR enhanced w/**custom** freeridership analysis	0.698	0.593	0.661	0.809
Difference	-0.001	-0.002	-0.001	-0.001
Process				
NTGR with **standard** freeridership analysis	0.715	0.709	0.702	0.594
NTGR enhanced w/**custom** freeridership analysis	0.624	0.615	0.605	0.603
Difference	-0.090	-0.095	-0.097	0.009

Table 8-4: Net Savings by Program

		No. of Items	Connected Load kW	Avg. Summer Peak kW[1]	kWh	Therms
Total		1,002				
Program	Net Savings		4,774	4,774	40,371,487	1,390,530
	Net-to-Gross Ratio		0.656	0.656	0.655	0.650
Evaluation[2]	Net Savings		6,315	3,783	31,955,781	782,399
	Net-to-Gross Ratio		**0.640**	**0.595**	**0.621**	**0.583**
	Net Realization Rate		1.323	0.792	0.792	0.563
Advanced Performance Options (APO)		7				
Program	Net Savings		249	249	2,211,053	458,051
	Net-to-Gross Ratio		0.650	0.650	0.650	0.650
Evaluation[2]	Net Savings		458	368	3,281,116	644,732
	Net-to-Gross Ratio		**0.704**	**0.671**	**0.677**	**1.000**
	Net Realization Rate		1.839	1.476	1.484	1.408
Customized		38				
Program	Net Savings		1,215	1,215	15,524,960	854,979
	Net-to-Gross Ratio		0.650	0.650	0.650	0.650
Evaluation[2]	Net Savings		1,111	835	8,453,569	182,639
	Net-to-Gross Ratio		**0.523**	**0.563**	**0.580**	**0.251**
	Net Realization Rate		0.914	0.687	0.545	0.214
Retrofit Express (RE)		940				
Program	Net Savings		2,562	2,562	15,674,331	-
	Net-to-Gross Ratio		0.663	0.663	0.664	-
Evaluation[2]	Net Savings		3,935	1,871	15,526,757	-99,060
	Net-to-Gross Ratio		**0.675**	**0.587**	**0.657**	**0.810**
	Net Realization Rate		1.536	0.730	0.991	-
Retrofit Efficiency Options (REO)		17				
Program	Net Savings		749	749	6,961,143	77,499
	Net-to-Gross Ratio		0.645	0.645	0.647	0.650
Evaluation[2]	Net Savings		810	710	4,694,339	54,088
	Net-to-Gross Ratio		**0.645**	**0.621**	**0.556**	**0.589**
	Net Realization Rate		1.082	0.948	0.674	0.698

[1] Defined as the average hourly kW savings coincident with the PG&E system maximum during the summer on-peak costing period (May 1 - October 31, weekdays at 3 P.M.)

[2] This result incorporates item-level NTGRs enhancements from the custom free-ridership analysis.

Table 8-5: Program Rankings by Total Net and Per-Item Impact

Program	Max kW	Avg kW	kWh	Therms
APO				
Total	4	4	4	1
Per-Item	1	1	1	1
Customized				
Total	2	2	2	2
Per-Item	3	3	3	2
RE				
Total	1	1	1	4
Per-Item	4	4	4	4
REO				
Total	3	3	3	3
Per-Item	2	2	2	3

Table 8-6: Net kWh Savings by Costing Period

	Costing Period				
End Use	Summer On-Peak	Summer Partial Peak	Summer Off-Peak	Winter Partial Peak	Winter Off-Peak
Fraction of annual hours in costing period	**0.090**	**0.090**	**0.322**	**0.178**	**0.320**
H-Factor					
All End Uses	0.094	0.099	0.321	0.184	0.301
HVAC	0.082	0.133	0.348	0.202	0.234
Indoor Lighting	0.098	0.088	0.335	0.172	0.307
Process	0.092	0.107	0.305	0.195	0.302
Net kW Savings					
All End Uses	3,009,164	3,170,959	10,262,913	5,891,973	9,619,896
HVAC	129,669	209,854	549,845	319,370	368,926
Indoor Lighting	1,487,602	1,340,386	5,085,662	2,615,170	4,669,344
Process	1,391,893	1,620,719	4,627,405	2,957,433	4,581,626

Table 8-7: Net kW Savings by Costing Period

	Costing Period				
End Use	Summer On-Peak	Summer Partial Peak	Summer Off-Peak	Winter Partial Peak	Winter Off-Peak
H-Factor					
All End Uses	1.000	0.890	0.885	0.911	1.014
HVAC	1.000	1.557	1.481	1.568	1.149
Indoor Lighting	1.000	0.665	0.696	0.737	1.051
Process	1.000	1.012	0.986	0.999	0.985
Net kW Savings					
All End Uses	3,783	3,301	3,297	3,410	3,875
HVAC	181	282	269	284	208
Indoor Lighting	1,802	1,198	1,255	1,327	1,893
Process	1,800	1,820	1,774	1,799	1,773

Table 8-8: Net Spillover Savings by End Use

	Connected Load kW	Avg. Summer Peak kW[1]	kWh	Therms
Total				
Evaluated Net Savings[2]	6,315	3,783	31,955,781	782,399
Net-to-Gross Ratio[2]	0.640	0.595	0.621	0.583
Spillover Net Savings	**35**	**35**	**254,908**	**-41**
% of Evaluated Net Savings	0.6	0.9	0.8	-0.01
Spillover-Adjusted NTGR	**0.644**	**0.600**	**0.625**	**0.583**
HVAC				
Evaluated Net Savings[2]	674	181	1,577,942	718
Net-to-Gross Ratio[2]	0.462	0.465	0.464	0.200
Spillover Net Savings	**0**	**0**	**0**	**0**
% of Evaluated Net Savings	0	0	0	0
Spillover-Adjusted NTGR	**0.462**	**0.465**	**0.464**	**0.200**
Lighting				
Evaluated Net Savings[2]	3,725	1,802	15,199,622	-97,937
Net-to-Gross Ratio[2]	0.698	0.593	0.661	0.809
Spillover Net Savings	**23**	**22**	**142,711**	**-41**
% of Evaluated Net Savings	0.6	1.2	0.9	0.04
Spillover-Adjusted NTGR	**0.702**	**0.600**	**0.667**	**0.809**
Process				
Evaluated Net Savings[2]	1,915	1,800	15,178,218	879,618
Net-to-Gross Ratio[2]	0.624	0.615	0.605	0.603
Spillover Net Savings	**13**	**13**	**112,197**	**0**
% of Evaluated Net Savings	0.7	0.7	0.7	0
Spillover-Adjusted NTGR	**0.628**	**0.619**	**0.609**	**0.603**

[1] Defined as the average hourly kW savings coincident with the PG&E system maximum during the summer on-peak costing period (May 1 - October 31, weekdays at 3 P.M.)

[2] This result incorporates item-level NTGRs enhancements from the custom free-ridership analysis.

Appendix A

Alphabetical Listing of Key Terms

Following are definitions, listed alphabetically, for key terms used throughout the evaluation report.

- **Application and APPLICATION NUMBER**. PG&E's rebate 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 system affected by a measure, based on observations from the on-site survey.

- **Assigned Corporation**. One of the corporations, assigned to a lead engineer, that operates a sampled site. The same lead engineer is 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 that appears on the first page of an application file, usually the name of the company that received the rebate. These names were matched to identify each unique corporation involved in the 1996 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 that occur in each of these periods. These savings are computed for all project-specific evaluations.

- **Custom Free-Ridership Analysis**. This is an analysis of free-ridership 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 Net Savings.** Gross savings multiplied by the Custom NTGR.

- **Custom Net-to-Gross Ratio (NTGR).** An adjusted form of the standard NTGR prepared by the Net Impact Experts after complete analysis of the Decision-Maker, Operations Staff, Vendor, Spillover survey, and other information available through the draft site evaluation reports.

- **Custom Project-Specific (CPS) Evaluations**. A project-specific evaluation that 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 Savings**. An estimate of savings assuming the equipment that 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 Decision-Maker Survey.

- **Decision-Maker Survey**. This survey can be found in Appendix L. It is administered by the Lead Engineer to the Decision-Maker, and provides information used in calculating the Standard and Custom NTGR.

- **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.

- **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 that 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: lighting (interior), process, and HVAC.

- **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.

- **Evaluation Workbook**. An Excel workbook which contains portions of the project database and other sheets which are needed to prepare a Site Evaluation Plan and Report.

- **Free-Rider Type**. A classification which appears on the Site Recruitment Form, under the column headed FRT. Two types may appear: Custom (C) or Standard (S).

- **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.

- **Gross Savings Baseline Consumption**. For early replacement the gross savings baseline is an estimate of the 1996 energy consumption for the customer system affected by an item assuming that the item had not been implemented, i.e., the pre-installation equipment. 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.

- **Gross Savings**. Difference between the gross savings baseline consumption and the as-built consumption for each item.

- **Instrumentation Specialist**. A technician who is 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 1996.

- **Lead Engineer**. An engineer who is responsible for evaluation plans, data collection, analysis and reporting for all projects located at all sampled sites associated with an assigned corporation.

- **Measure Description**. A phrase describing the equipment that comprises the measure. Standardized descriptions are provided by PG&E for each type of item included in the industrial efficiency programs.

- **Measure Information Contact**. A member of the customer's staff who is familiar with the items for which a rebate was paid in 1996.

- **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 are identified through the Spillover Survey).

- **Net Impact Experts**. Katherine Randazzo and Rick Ridge 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 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.

- **Operations Staff Survey**. This survey can be found in Appendix K. 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 industrial program. In some cases this will be the person who assisted the customer in applying to the program

in 1996 or a previous year. The name and telephone number for this person will appear on the Recruitment Form (Appendix A) when it is assigned to a Lead Engineer.

- **PG&E Project Manager**. Amalia Klinger (415) 973-2588.

- **Program Year**. Each application is 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 are the subject of this evaluation, include applications received during 1994, 1995 and 1996.

- **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 has been assigned to each project (PROJECT ID).

- **Project Type**. A classification which appears on the Site Recruitment Form, under the "PT" column. Two types may appear: Project-Spec and Verify.

- **Project-Specific Evaluation**. An evaluation that involves the estimation of gross and net savings for items that received rebates in 1996 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 are responsible for reviewing and approving draft and final site evaluation plans and reports. There are four QC engineers; (1) Project-Specific Lighting Projects – Marc Schuldt, (2) Project-Specific HVAC Projects – Jeff Romberger, (3) Project-Specific Process Projects – Dianne Griffiths, and (4) Verify Projects – Ben Wildman.

- **Retention Study**. A study performed to determine what fraction of paid items are still in service after a specified period of time. This evaluation developed a database of location and quantity information for items paid in 1996, which will be used in a future retention study.

- **Sampled Project and Replacement Project**. A group of projects have been selected which satisfy the objectives of this study, i.e., 70% of the HVAC, light and process savings and 150 projects for each of these end uses. These are the sampled projects. Other sites have also been selected which will be used as replacements if a customer refuses to participate in the study or is 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 has been assigned a unique identification number (SITE ID).

- **Site Type**. A classification which appears on the Site Recruitment Form. Three types may appear: CPS (Custom Project Specific), SPS (Standard Project Specific), or VO (Verify Only).

- **Spillover Contact**. A member of the customer's staff who is familiar with spillover measures installed in 1996. This may or may not be the same person most familiar with the items at the site for which rebates were paid.

- **Spillover Measure**. An energy efficiency improvement installed during 1996 as a result of spillover that would have qualified for a rebate under the 1996 Industrial Retrofit Programs. The improvement must exceed applicable Title 24/20 requirements and must involve the purchase of labor or equipment by the customer.

- **Spillover Survey**. This survey can be found in Appendix D. This survey is administered to the Spillover Contact to identify any spillover measures.

- **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.

- **Standard Net Savings**. Gross savings multiplied by the Standard NTGR.

- **Standard Net-to-Gross Ratio (NTGR)**. An estimate of the free-ridership effect, based upon selected data from the Decision-Maker and Vendor surveys and the analysis of customer baseline savings, which are input to the Site Evaluation Workbook.

- **Standard Project-Specific (SPS) Evaluations**. A project-specific evaluation which uses 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 Survey**. This survey can be found in Appendix E. 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 influenced the recommendations that the vendor made to the customer concerning the selection of efficiency equipment.

- **Vendor**. A distributor, installer, or designer who assists the customer in selecting specific efficiency equipment.

- **Verification Evaluations**. A project evaluation that involves verifying the number, type and operational status of the items for which rebates were paid in 1996. The evaluation also involves a standardized evaluation of NTGR.

- **Verification Only (VO) Site**. A site where only verification evaluation projects were installed.

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Appendix B

Site Recruitment Survey and Form

1. Purpose

The primary purpose of the Site Recruitment Survey was to obtain the customer's agreement to participate in one or more elements of SBW's evaluation of PG&E's 1996 industrial energy efficiency programs. Depending on the types of program activity that have taken place at a customer's site, this evaluation may have required data for the:

1. 1996 rebate program gross and net impact analysis and measure retention database.

2. 1994 rebate program measure survival analysis.

3. 1996 EMS program gross and net impact analysis and measure retention.

Note that this report only addresses the first program. Evaluations for the latter two programs are addressed in separate reports.

The Site Recruitment Survey obtained contact information for customer staff involved in the evaluation work. For some sites, the recruitment survey also served to clarify the characteristics of certain rebate measures not completely documented in PG&E's rebate application files.

The sections below contain instructions and examples from the "Data Collection and Energy Savings Calculation Handbook," which provided each engineer with detailed directions for completing evaluation work.

2. Types of Evaluation Sites

1. **1996 Rebate Sites**. You will be recruiting sites where 1996 rebate projects were implemented. There are three classes of 1996 rebate sites:

   - *Custom Project-Specific* (CPS). These sites require project-specific evaluations of process, HVAC or large lighting rebate projects.

   - *Standard Project-Specific* (SPS). These sites require only project-specific evaluations of small lighting rebate projects.

   - *Verification-Only*. These sites require only verification analysis of small process, HVAC or lighting 1996 rebate projects.

2. **1994 Rebate Retention Sites**. You will also recruit sites where 1994 rebate projects were installed. The on-site surveys of these sites will determine what portion of the installed equipment is still operational.

3. **{1996 EMS Sites**. You will recruit sites where measures were implemented based on recommendations made in a 1996 Industrial EMS survey, but for which no rebate was paid.**}**

4. **Combination Sites**. Finally, you will recruit sites where a combination of program activities took place. For example, 1996 rebate and 1994 rebate, **{**or 1996 rebate and 1996 EMS**}**.

3. Site Recruitment Form

You will be given a partially pre-filled Site Recruitment Form for each site. This form is divided into the following parts:

1. **Site Information**. This section provides information such as the company name and the contact name provided by PG&E, along with the site type (CPS, SPS, and VO) for 1996 rebate sites. This section will also indicate: (a) if a letter has been sent to inform the customer about this study and to urge cooperation; (b) whether PG&E has provided special instructions for how to contact the customer; (c) whether you need to contact the PG&E customer representative prior to contacting the customer; and, (d) if the site is also being surveyed for other PG&E or CPUC studies.

2. **Site Contacts**. This section is where you record information about each contact at the site: (1) Site Authorization, (2) On-Site Visit, (3) Spillover, (4) Rebate Decision-Maker, **{**(5) EMS Decision-Maker,**}** (6) Operations Staff, and (7) Measure Information. Name, title and telephone number will be obtained for each of the contacts. Many of these contacts may be the same person. In some cases, separate contacts will be required for different types of efficiency technologies implemented at a site. For example, one person will be the On-Site Visit contact for a chiller improvement, but another person will be the On-Site Visit contact for the lighting improvement. The Notes section at the bottom of the page can be used to record this information. An address will also be needed for the "Thank You" contact, the person to receive a letter thanking them for agreeing to participate in this study.

3. **Recruitment Disposition**. In this section, you record the final status of recruitment for each project at a site by entering the date on which the disposition is determined in the appropriate space.

4. **1996 Rebate Projects and Items**. This section lists important information for all of the 1996 rebate projects and items. A project is a set of items which share the same Application Number, Program Year (year application submitted), Control Number (unique identifier of a PG&E billing meter) and End Use (Light, HVAC, or Process). The Project Type column indicates the level of analysis for each project (CPS, SPS or VO) and indicates the items which are to be included in the impact analysis.

5. **1994 Rebate Items**. This section lists important information for all of the 1994 rebate items. A column in this list identifies the items to be inspected for the 1994 rebate retention analysis.

6. **{1996 EMS Recommendations**. This section lists important information for all of the recommendations prepared for this site by PG&E's 1996 Industrial EMS program. A column in this list identifies recommendations, which were installed/implemented by the customer. Another column indicates whether the recommendation became a rebate measure. We will only inspect EMS measures which have been installed/implemented and for which no rebate was paid.**}**

7. **1993-1997 Rebate Item History**. This section lists important information for all other rebate items (1993-1997) installed at this site.

8. **Recruitment Form Supplement (for CPS and SPS sites)**. In some cases, the information contained in the rebate application files is not sufficient to develop a project-specific evaluation plan. This supplement contains a series of questions to obtain such information.

4. Preparing for a Recruitment Survey

1. Get a list of corporations to be recruited from Ben. This list will include the CORP and SITE IDs.

2. Get the site files. Pre-filled site recruitment forms will be in these files. In cases where multiple files are provided for a single SITE ID, the form should be in the top-most file. These files may contain:

   - Rebate Application Information (if site has 1996 rebates)
   - **{**Completed EMS Installation Surveys **}**
   - **{**EMS survey documentation**}**
   - Special instructions regarding customer contact
   - Listing of retention database information (if site has a 1994 rebate project in the retention database).

3. Review the pre-filled portions of the Site Recruitment Forms.

4. For sites with 1996 rebate projects, complete a detailed review of the program files for each site to obtain information needed for project-specific evaluation plans.

5. **{**For sites with 1996 EMS projects, complete a detailed review of the program files to determine what data will need to be collected in order to estimate savings.**}**

6. Determine the best way to contact multi-site corporations.

7. If required, contact the PG&E customer representative and discuss the best way to contact the customer.

5. Instructions for Completing the Site Recruitment Form

1. **{**For sites with both Rebate and EMS projects, use the Rebate Contact as your first contact.**}** If you have a contact name, call that person and say:

   My name is [your name] from SBW Consulting calling on behalf of the Pacific Gas and Electric Company. May I please speak to [name of contact person]?

2. If there is no contact name or the contact is no longer with the company, say:

   I am conducting an evaluation of the PG&E Industrial Energy Efficiency programs. Your firm [very brief highlight of program activity, like "received an rebate for energy efficiency measures"] from this program in [1996 and/or 1994 if 1994 Retention Analysis projects are involved]. I would like to speak with someone who is familiar with this [program activity].

3. If no one knows anything about the [program activity], contact the PG&E customer representative. If the customer representative can supply a contact name, restart the survey. If no contact name is available, complete the survey by entering the date in the appropriate column in the Site Recruitment Disposition section.

4. Once you find the correct person to talk with, explain what will be needed to complete the evaluation work for their site. What you say will depend on what PG&E program activities we have to evaluate at the site (1996 Rebate, 1994 Retention, {1996 EMS}). Assure the contact that data provided by their firm will be kept strictly confidential. This data will not be shared with anyone outside of PG&E. If they want to contact a person at PG&E who can give them more information about this study they can call Elsia Galawish at (415) 973-5347. Following this introductory conversation, obtain information on who to contact for the following evaluation purposes:

   4.1 For all sites, find the person who can authorize the on-site visit. Talk with that person and obtain authorization. Record the **Site Authorization** contact information.

   4.2 For all sites, identify the person who will be the on-site contact, i.e., the person our field engineer will meet at the site. This person will be the On-Site Visit contact. Record the **On-Site Visit** contact information.

   4.3 For sites where 1996 rebate measures **{**or 1996 EMS recommendations**}** are to be evaluated, find the person who is most knowledgeable concerning all energy efficiency measures undertaken by the company at this site in 1996. This person will be the Spillover contact. Record the **Spillover** contact information.

   4.4 For sites where 1996 rebate measures are to be evaluated, find the person who is familiar with the process by which the customer decided to install the items for which rebates were paid in 1996. This person will be the Rebate Decision-Maker contact. Record the **Rebate Decision-Maker** contact information.

   4.5 **{**For sites where a 1996 EMS recommendation was implemented for which no rebate was paid (based on the EMS Installation Survey), find the person who is familiar with the process by which the customer decided to install/implement the recommendation(s). This person will be the EMS Decision-Maker contact. Record the **EMS Decision-Maker** contact information.**}**

   4.6 For CPS sites, determine whether there is a member of the company's operations staff who is familiar with the operation of the rebated items and the affected systems (e.g., ASDs are the item and the affected system is a lumber drying kiln). This person will be the Operations Staff contact. Record the **Operations Staff** contact information.

   4.7 For all sites, find the person who is most knowledgeable concerning the equipment and operations of the efficiency measures for which a rebate was paid (1996 or 1994) **{**or which were recommended by the 1996 EMS audit**}**. This person will be the Measure Information contact. Record the **Measure Information** contact information.

   4.8 For all sites determine who should receive a letter thanking the company for agreeing to participate in this study. This is the Thank You contact. Confirm the correct mailing address for the Thank You Letter.

4.9 Determine which of the contacts is to be called to schedule the on-site visit and place a check in the "Schedule Contact?" column for that contact.

Note #1: In many cases, the same person will serve as the contact for more than one purpose. A number precedes each of the contacts on the Site Recruitment Form. You can enter one of these contact numbers in the name field to re-use your entries from one of the other contacts.

5. For 1996 rebate sites (CPS and SPS), where you do not have sufficient information to prepare an evaluation plan from the application files, ask the questions on the Recruitment Form Supplement of the appropriate contact person(s).

6. Complete the survey by entering the date under the appropriate response in the Site Recruitment Disposition section for each project.

6. What to do After Recruitment is Complete for a Site

1. Make sure that a response has been recorded from each question.

2. Staple the Recruitment Form Supplement pages (if any) to the Site Recruitment Form and submit to Ben.

3. Record the recruitment contact on your contact log.

Site Recruitment Form

PG&E 1996 INDUSTRIAL RECRUITMENT FORM Page ____ of

Corp ID: 371 Site ID: 2 Site Type: SPS Recruiter: _____ Date: _____

PG&E Control#: 2 Letter Sent? _____ Other Surveys? _____ Net Impact Expert: KR

Company Name: MOBIL CHEMICAL CO. FOAM PROD DIV. Business Type: PLASTICS FOAM PRODUCTS

Company Address: 2024 NORRIS ROAD Contact Name: SHARLETT SEARS

BAKERSFIELD 93308 Contact Phone: 805/392-4028

PG&E Rep Name: Cunningham, Mark A Rep Phone: 805/321-4405 Call Rep 1st? ____

Comments: _____

SITE CONTACTS

	Schedule Contact?	Project #'s	Name	Title or Relationship to Project	Phone
1. Site Authorization:					
2. On-Site Visit:					
3. Spillover:					
4. Rebate Dec-Maker:					
5. EMS Dec-Maker:					
6. Operations Staff:					
7. Measure Information:					

	Name	Title	Address	Phone
"Thank You" Recipient:				

RECRUITMENT DISPOSITION (Enter the Date Disposition is Determined)

Project #'s	Recruited	No Contact	Business Gone	Lack of Time	Language Barrier	Lack of Knowledge	Other (Specify)	Thank you Sent

NOTES

Page _____ of

PG&E 1996 INDUSTRIAL RECRUITMENT FORM

Corp ID: 371 Site ID: 2 Site Type: SPS

Recruiter: _____ Date: _____

1996 REBATE PROJECTS AND ITEMS

PID	I#	PT	FRT	Measure Description	End-Use	kW	kWh	Therms	Rebate
3	1	PS	C	INSTALL HVAC EMS	HVAC	0.0	386,065	0	15,443
4	1	PS	S	INSTALL HVAC EMS	HVAC	0.0	159,938	0	9,596
5	1	V	S	INSTALL HVAC EMS	HVAC	0.0	263,345	0	15,801

1994 Rebate Items

Measure Description	End-Use	PG&E Count	To Be Inspected
A/C: CENTRAL, < 65 KBTU/H	HVAC	1	Y
THERMOSTAT: SETBACK PROGR	HVAC	3	Y

1996 EMS Recommendations

Survey Code	Rec No.	Measure Description	End-Use	kW	kWh	Therms	Disposition
8888888	1	INSTALL HVAC EMS	HVAC	0.0	386,065	0	REB
8888888	1	INSTALL HVAC EMS	HVAC	0.0	159,938	0	INST

1993 - 1997 Rebate Item History

Prg Yr	Item No.	Measure Label	End-Use	kW	kWh	Therms	Rebate $
95	1	PROCESS ENERGY EFFICIENT MOTOR	PROCESS	3.0	25,027	0	1,502
94	2	PROCESS ENERGY EFFICIENT MOTOR	PROCESS	11.4	95,760	0	5,746
93	3	PROCESS OTHER	PROCESS	0.0	197,790	0	3,598
94	4	FIXTURE: 4 FT T-8 W/ELEC BLST, 2 32-WATT T-8 LAMPS	LIGHT	0.8	4,664	0	1,590
95	5	ADJUSTABLE SPEED DRIVE: HVAC FAN, 50 HP MAX	PROCESS	0.0	26,355	0	1,575
94	6	ADJUSTABLE SPEED DRIVE: HVAC FAN, 50 HP MAX	PROCESS	0.0	11,295	0	675
94	7	PROCESS CHANGE/ADD EQUIPMENT	PROCESS	24.5	358,972	0	22,519

NOTES

Recruitment Form Supplement
1996 Industrial Rebate and EMS Program Evaluation

1. Business Type: _____

2. **For Lighting or HVAC Measures**: Affected Floor Area and Functional Space Use [specify by Item #]:

3. **For Lighting Measures**: [Normal/Early Replacement. Ask this question only if Title-24 is applicable. See Marvin if you need help with the rules for determining applicability.] Would the affected equipment have been changed within one year of the actual installation if there had been no PG&E rebate? [A **Yes** indicates the item is a "Normal Replacement", **No** indicates "Early Replacement"]

   Item #'s for which answer is **NO:**

   If YES: Which equipment [specify by Item #] and was a Title 24 application prepared [if so, request Title 24 documentation]?

   3a. Was this a **modification** of existing fixtures or a complete **replacement** [specify by Item #]?

4. Pre-conditions /As-built Information:

		Pre-Condition (if Early Replacement)	As-Built
Items:	Equip. Desc.		
	Location		
	Oper. Sched.		
Items:	Equip. Desc.		
	Location		
	Oper. Sched.		

5. Feasibility of obtaining measurements, if they are being considered [specify by Item #]:

6. Cost/Complexity adders, e.g., security/safety issues, access procedures, equipment access, ladder availability:

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 made to obtain various elements of information throughout the evaluation process. Contacts with the customer as well as the PG&E marketing representatives are to be included. This log will be attached to the Site Evaluation Report that is submitted to PG&E. A log will be kept for each site, including those receiving only a 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 successful telephone contact with the PG&E marketing representative or the customer is recorded on 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" column 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.

2. Site Visit Scheduling Form

2.1 Objective

The objective of the Site Visit Scheduling Form is to assist in gathering sufficient information during the site scheduling process to allow adequate preparation for the on-site work. Depending on the project, this form may have more information than needed. On the other hand, some topics may not be covered. Take a moment before calling the site contact to determine if sections can be omitted or if additional information will be needed. Site visits should not be scheduled before the site evaluation plan is approved by PG&E.

2.2 Instructions

Site ID - Enter the appropriate site ID.

Scheduler Initials - Enter your initials.

Date Scheduled - Enter the date the schedule was set.

On-Site Visit Arrangements - Self explanatory.

Other Information for Site Visit - Obtain the information for each of these items as they pertain to your project. The site contact may not know all the information you are seeking. Other potential sources of information are the detailed file review, the recruitment process, one of the other contacts (e.g., the measure information contact) identified during recruitment, and the PG&E customer representative.

Safety issues beyond normal caution will not apply at many sites, while at others they will be important. Make sure you understand all the safety requirements that will apply before showing up at the site.

Information on the site recruitment form will indicate whether the PG&E customer representative is to be contacted regarding the on-site work schedule. Transfer this information from the recruitment form to the bottom of the scheduling form.

Appendix D
Spillover Survey

1996 Industrial Rebate Program Evaluation

1. Interview Instructions for Spillover Survey

1.1. Overview

The point of this survey is to identify potential spillover measures. This survey is only used for CPS and SPS sites. 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 does not include improvements specifically recommended by an EMS survey completed in 1996. Savings from these improvements will credited to the 1996 EMS program**. 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 1996 as a result of spillover, which would have qualified for a rebate under the 1996 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 most knowledgeable concerning all energy efficiency measures undertaken by the company at a rebate site in 1996. This person was identified in the Site Recruitment Survey. This might be the same as the person most familiar with the items (for which rebates were paid in 1996) installed at a site, but it could be a different person.

If the spillover contact identified in the Site Recruitment Survey 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 rebate item(s) listed on the Site Recruitment Form. These rebate item lists 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 1997 for an item installed in 1996. 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 4 identifies these measures.

1.4. Creating a List of Potential Spillover Measures

You will ask the respondent to describe potential spillover measures. 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

Question 2 is 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 5 and 6 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 2**. 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 that qualifies for PG&E's rebate programs. These influences could be invisible to the customer. The Vendor Survey is designed to determine whether PG&E influenced the vendor's recommendations to the customer.

1.7. Identifying Spillover Measures

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

1. Response to Question 2 on the Spillover Survey is greater than or equal to 6 (on a scale of 0 to 10).

2. Response to Question 2 on the Spillover Survey is less than 6, and the response to Question 5 or Question 6 on the Vendor Survey is less than 6.

If you are uncertain whether a particular measure would have been 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, along with the survey disposition code and completion date. If you do not identify any potential spillover measures write "**NONE**" on the response matrix. The completed survey form must be attached to the draft site evaluation report.

2. Spillover Survey Instrument

Spillover Survey
1996 Industrial Rebate Program Evaluation

Before Beginning an Interview:

1. Obtain the Spillover Contact name and telephone number from the Site Recruitment Form
2. Review the rebate item lists on the Site Recruitment Form.
3. Write the SITE ID on a copy of the Response Matrix (last page of this survey).
4. Thoroughly understand the instructions that precede this survey instrument.

A. Hello. This is [your name] from SBW Consulting calling on behalf of Pacific Gas & Electric. May I please speak with [name of Spillover 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 1996.

___ 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 Elsia Galawish at (415) 973-5347.

B. Exclude Rebate Items or Pending Rebate Items. Explain to the respondent that we are trying to identify energy efficiency measures that the company installed in 1996, but for which no PG&E rebates were paid or are pending. We need to identify these measures so that we can determine all of the savings from energy efficiency that the customer achieved in 1996. Go over the list of items for which rebates have been paid. Tell the Spillover Contact that this list may not be complete and you need 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 the contact to list all of the efficiency measures which the company installed at the site in 1996. Prompt for possible spillover measures by asking:

1. In 1996 did you add or modify any equipment that resulted in a decrease in energy consumption or an increase in productivity?

You can prompt the contact by explaining that your are looking for modification to existing equipment or new equipment, which does any of the following:

- Exceeds California Efficiency Standards, if applicable
- Produces higher output
- Reduces energy use

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

E: PG&E's Influence on Measure Installation. After recording the potential spillover measures on the response matrix, ask Questions 2 through 6 for each measure. Use the codes as described in each question to record the responses on the response matrix.

2. 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*.

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

If response is "0" go to Q. 4

If response is greater than "0" continue

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

1 Direct recommendation or information provide by a PG&E representative

2 Information from PG&E printed material

3 Rebate for a similar measure paid before 1996

4 Vendor Recommended by PG&E

5 Other (**Specify. Record on back of response matrix labeled with Meas. #**)

4. 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 2 which is **less than 6**.

5. 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**)

6. Ask for the name and telephone number for the person who most assisted with the design and specification of the measure. 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.

END: **If more measures continue to the next measure. If last measure, say**: Those are all the questions I have. I greatly appreciate your time and cooperation. Thank you very much.

7. **Survey Disposition. Record final status of the survey and date complete at the top of the response matrix.**

   1 Survey completed successfully

   2 Never able to reach contact (three tries failed)

   3 Contact refused to complete the survey

   4 Survey not completed for other reasons (Specify on response matrix)

Spillover Response Matrix for Site ID: | **Disposition Code (1-4):** | **Survey Completion Date:**

Meas. #	Q1. Description of Potential Spillover Measure	Q2. Influence Rating (0-10)	Q3. How? 1: Direct 2: Info 3: Rebate 4: Vendor 5: Other	Q4. Applied for Rebate 1:Yes 2:No 3:DK 4:Refuse	Q5. Who Assisted? 1: Design 2: Dist 3: Install 4: Staff 5: DK 6: Refuse	Q6. Vendor who influenced specifications? (Company name, phone # or city , and contact person)
1						

Notes: (Respondent name, telephone number and other comments)

.

Appendix E

Vendor Survey

1996 Industrial Rebate Program Evaluation

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 Contact scored PG&E's influence less than 6 on a scale of 0 to 10. (Question 2 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 1996 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 Workbook).**

1.2 Selection of the Respondent

The vendor contact is obtained in one of two ways.

1. **Spillover Survey Follow-Up**. Question 6 in the Spillover Survey identified the best available contact for following-up on a spillover measure.

2. **Decision-Maker Survey Follow-Up**. Question 30 in the Decision-Maker Survey identified the best available contact for following-up on an item for which a rebate was paid in 1996.

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. When following up on a Decision-Maker Survey, complete one survey for each **rebate item** which requires a vendor follow-up. Attach the completed survey to the site evaluation report.

2. Vendor Survey Instrument

Vendor Survey
1996 Industrial Rebate Program Evaluation

Before Beginning an Interview:

1. Obtain the Vendor Survey Contact name and telephone number (from Spillover Survey or Decision-Maker Survey).
2. Review the description of the spillover measure or rebate item which will be the subject of this interview.
3. Write the SITE ID and Measure Number (for spillover measures) or SITE ID, Project ID and Item Number (for rebate items) at the top of each page on a copy of this survey.
4. Thoroughly understand the instructions which precede this survey instrument.

Notes: (Respondent name, telephone number and other notes)

A. Hello. This is [your name] 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/item] 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 Elsia Galawish at (415) 973-5347.

B. Once you have the correct person and you have explained the purpose of this survey, 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 *very familiar*.

   _____ Response (**0 to 10**) **98** Don't Know **99** 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 *very familiar*.

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

   If sum of responses to 1 and 2 are less than 7, Go to End.

Site ID:_____ (Measure # _____ or Project ID _____ and Item Number _____)

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

   1 Yes
   2 No (**Go To Q. 6**)
   3 Don't Know (**Go To Q. 6**)
   4 Refused To Answer (**Go To Q. 6**)

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

   1 Yes
   2 No (**Go To Q. 6**)
   3 Don't Know (**Go To Q. 6**)
   4 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**) (**Go To END**) **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 1996 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

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

7. **Survey Disposition. Indicate below the final status of this survey.**

   1 Survey completed successfully
   2 Never able to reach contact (three tries failed)
   3 Contact refused to complete the survey
   4 Survey not completed for other reasons (Specify: _____)

   Date Completed: / /9_

.

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:

SITE ID NO.

PROJECTS PAID BY 1996 PROGRAMS

Project ID No.	Application Number	Progra Year	Control Number	Account Number	End	PG&E	Project Type

ITEMS FOR EACH PROJECT

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

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. If the measure affects equipment schedules, then get pre-installation schedule information, including daily and weekly variations.

Preliminary As-Built Equipment and Operation: This data should also be obtained from the application file and telephone discussions with the PG&E customer Representative 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. Include process production information such as batch vs. continuous production modes, scheduling interruptions that are part of the normal process, normal variations in daily production, etc.

Square Footage of Affected Area: Provide the square footage of the conditioned measure-affected area for HVAC measures. No value is required for Process measures.

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 (*For projects that adhere to a master plan, reference that plan*): 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. Also, when applicable, include an indicate that interactions between measures will occur. 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. When it will be useful for analysis, describe an "activity variable" (e.g., tons of product) that can be used to annualize energy consumption and a method for quantifying it.

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.

Include both the cost of the measure and, if the program documentation provides it, marginal cost data. 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 (*Repeat for each spillover measure*):

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. When applicable, assume Title 24 conditions for the pre-installation period.

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.

Table 1: Site Staffing Plan, Schedule and Budget

SITE ID NO. XXX			
PROPOSED STAFFING PLAN			
		Spillover __ Project __	Project __
On-site survey			Staff
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 Hours	Labor/Misc Costs
Proposed Budget (Task 4: 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 4 SUBTOTAL			
Proposed Budget (Task 5: Verify)			
H/L/P ($XXX/project)	No. of projects:	N/A	
94 Retention ($YYY/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; no 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.

Template for Lighting Evaluation Plans

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:

SITE ID NO.

PROJECTS PAID BY 1996 PROGRAMS

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

ITEMS FOR EACH PROJECT

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

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:** **Lighting**

Measure Description

Efficiency Improvement: Description of the efficiency measures, as documented in the rebate application. This will include the location of each measure, as described by the application file or the customer staff.

Measure	Description	Qty & Units	Location
1			
2			
3			

Preliminary Pre-Installation and As-Built Conditions: These 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, the pre-installation portion should describe the type and quantity of the replaced equipment. For control measures, the pre-installation portion will include the pre-installation operating schedule for the affected fixtures. For normal replacement measures, the pre-installation 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. In all cases, this section will also describe and quantify the installed (as-built) rebated equipment. Also included here is a description of the as-built operating schedule for each measure. This schedule should account for all hours of the year.

Pre-Installation				
Measure	**Qty/ Units**	**Description**	**Schedule (Controls measures only)**	**Comments**
1				
2				
3				

As-Built				
Measure	**Qty/ Units**	**Description**	**Schedule**	**Comments**
1				
2				
3				

Baseline Condition: Discuss what baseline conditions will be used in the evaluation algorithms (Pre-installation condition, Title 24 baseline, Title 20 baseline, equal lumens, etc.) and why. (e.g., the pre-installation lighting will be used as the baseline in the evaluation algorithms because the measures were fixture modifications and therefore not subject to Title 24 LPD requirements).

Additional Information: Include here any additional pertinent information, such as interaction between control and capacity measures.

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, for instance, 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

Make reference to the master lighting evaluation plan for a description of the PG&E Retrofit Express and Evaluation algorithms used for estimating energy savings.

For Custom applications, include here 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. 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.

Data Collection

Make reference to the master lighting evaluation plan for a description of the data collection method.

If special metering is involved (i.e. light loggers), 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.

Item No.	Efficiency Measure	Material Cost	Payback (yrs) w/out Rebate	Payback (yrs) w/Rebate
1				
2				
3				
4				
5				
6				
	TOTAL	**$ -**	**0.00**	**0.00**

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 (*Repeat for each spillover measure*):

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. When applicable, assume Title 24 conditions for the pre-installation period.

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.

Table 2: Site Staffing Plan, Schedule and Budget

SITE ID NO.			
PROPOSED STAFFING PLAN			
		Spillover__ Project__	Project__
On-site survey			Staff
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 Hours	Labor/Misc Costs
Proposed Budget (Task 4: 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 4 SUBTOTAL			
Proposed Budget (Task 5: Verify)			
H/L/P ($ /project)	No. of projects:	N/A	
Retention ($ /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.

Master Lighting Evaluation Plan

Algorithms for Estimating Energy Savings for Paid Measure

PG&E Algorithm: For each Retrofit Express capacity measure, PG&E used the following standard equations to compute energy savings:

$$kW_{savings} = \Delta kW / unit \times \#\_units \times demand\_diversity\_factor$$
$$kWh_{savings} = \Delta kW / unit \times \#\_units \times operating\_hours$$

For each Retrofit Express control measure, PG&E used the following standard equations to compute energy savings:

$$kW_{savings} = kW / unit \times \#\_units \times demand\_diversity\_factor$$
$$kWh_{savings} = kW / unit \times \#\_units \times hours\_reduced$$

PG&E obtained fixture wattage from a standard table developed by the program. The following table lists the demand diversity factors (ratio of non-coincident to coincident demand) and annual full load operating hours used as standard program assumptions for each type of lighting measure:

Measure Description	Demand Diversity Factor	Annual Operating Hours
Halogen lamps < 50 watts	0.67	2,000
Halogen lamps > 50 watts	0.67	3,000
Compact fluorescents	0.67	4,000
Exit signs	1.00	8,760
Fluorescent fixtures and fixture modifications	0.67	4,000
Interior HID fixtures	0.67	4,000
Wall Mounted Occupancy Sensors	0.235	1,050 hours reduced
Ceiling Mounted Occupancy Sensors	0.301	1,170 hours reduced

•PG&E baseline**:** As specified in the Retrofit Express policies and procedures notebook.

Evaluation Algorithm:

For non-LPD based analyses, we will use the following equations to quantify first year gross savings for each capacity measure:

Equation Set (1)

$$kW_{savings} = \#\ fixtures \times \left[\begin{pmatrix} Watts/\ fixture_{base} - \\ Watts/\ fixture_{as-built} \end{pmatrix} \div 1{,}000 \right] \times Utilization\_\ factor$$

$$kWh_{savings} = kW_{savings} \times hours_{as-built} \times HCIF_{kW}$$

$$therm_{takeback} = kW_{savings} \times 0.034 \times hours \times HCIF_{heat} \div heating\_efficiency$$

When Title 24 LPD standards are used as the baseline condition, we will use the following equations to quantify the first year gross savings for each capacity measure:

Equation Set (2)

$$kW_{savings} = \left[\begin{pmatrix} Allowed\_LPD \times LPD\_Design\_Area \div 1{,}000 - Installed\_kW_{total} \end{pmatrix} \times Installed\_kW_{measure} \div Installed\_kW_{total} \right] \times Utilization\_\ factor$$

$$kWh_{savings} = kW_{savings} \times hours_{as-built} \times HCIF_{kW}$$

$$therm_{takeback} = kW_{savings} \times 0.034 \times hours \times HCIF_{heat} \div heating\_efficiency$$

We will use the following equations to quantify first year gross savings for each control measure:

Equation Set (3)

$$kW_{savings} = \#\ fixtures\_controlled \times Watts/\ fixture_{as-built} \times Utilization\_\ factor$$

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

$$therm_{takeback} = kW_{savings} \times (hours_{baseline} - hours_{as-built}) \times 0.034 \times HCIF_{heat} \div heating\_efficiency$$

$HCIF_{kw}$ and $HCIF_{heat}$ are the heat/cool interaction factors which account for reduced electric air conditioning loads and increased gas heating loads, respectively, due to the decreased lighting energy. These factors will be based upon a series of DOE-2 building simulation runs. If the area affected by the measure is unconditioned, $HCIF_{kw} = 1$ and $HCIF_{heat} = 0$.

Utilization_factor is the ratio of "on" fixtures to the total installed fixtures. This factor accounts for fixtures or lamps that are not operational due to: burned out lamps, failed ballasts, or not turned on.

When interaction occurs between lighting control and capacity measures, we will use the following method to distribute the interactive effect across measures. Example: Lighting replacement (T12>T8) and installed controls.

Equation Set (4)

$$kWh_{real} = kWh_{baseline} - kWh_{post}$$

$= kWh\ (T12\ w/o\ controls) - kWh\ (T8\ with\ controls)$

$kWh_{additive} = kWh_{lights\text{-}indiv} + kWh_{controls\text{-}indiv}$

$kWh_{lights\text{-}indiv} = kWh\ lighting\ savings\ (T12>T8)\ with\ no\ controls$

$kWh_{controls\text{-}indiv} = kWh\ control\ savings\ with\ no\ lighting\ replacement\ (T12)$

$kWh_{lights\text{-}eval} = kWh_{lights\text{-}indiv} \times kWh_{real} / kWh_{additive}$

$kWh_{controls\text{-}eval} = kWh_{controls\text{-}indiv} \times kWh_{real} / kWh_{additive}$

The Evaluation Algorithm will use data collected on-site representing as-built conditions whereas the PG&E Algorithm used standard operating conditions for the rebated measures.

- Annual extrapolation: For the affected lighting fixtures in each schedule zone, we will estimate the as-built annual hours of operation. The annual hours will be determined by extrapolating the operating hours data gathered during the on-site survey. Annual use will include modifications for holidays and any other shut-down periods. For most lighting, the data will come from information obtained by observation and interviews with the on-site personnel. When possible, lighting schedule data will be obtained from energy management systems or other lighting controllers.

Where short term lighting metering is done, the normal time-of-use schedule will be determined from the metering data.

Costing Period Algorithm: For each schedule zone, we will compute an hourly distribution (8,760 values) of annual energy consumption by applying the annual profile of operating hours to the average kW demand and diversity factor computed from the lighting inventory. The distribution for each zone will be summed to produce a facility total. The hourly values will then be aggregated into the five PG&E defined costing periods.

Data Collection

During the on-site survey, we will collect data necessary to quantify the capacity, utilization factor ("on" fixtures and total fixtures), schedule, and heat/cool interaction factor for the program measures.

For early replacement or non-LPD baseline evaluations, we will confirm the pre-installation lighting configuration while on-site. For Title 24 LPD baseline evaluations, we will determine the square footage of the measure-affected areas.

For each measure, we will attempt to compile a complete inventory of the program equipment. For Title 24 LPD baseline evaluations, the inventory will include all installed non-rebated fixtures to determine the as-built LPD. If a complete inventory cannot be completed, a known size area will be inventoried and this data will be extrapolated to evaluate the rebated measure. The count of fixtures will include indication of "on" status by fixture type.

For manual or time-clock controlled fixtures, we will establish up to three operating schedules for each retrofit based upon observation and on-site interview information.

For occupancy controlled fixtures, we will attempt to install PST time-of-use light loggers during the site survey to collect lighting system schedule data for a period of about two weeks. If it is not possible to install light loggers, we will estimate an as-built schedule based upon observation and on-site interview information.

During the on-site survey, we will collect information on seasonal variations in the operating schedule to support the annual extrapolation. Schedule data will include holidays, weekends, and extended periods of shutdown such as Christmas or other seasonal variations.

We will verify ballast type on at least one of each fixture and/or rebated ballast, as shown by the rebated measures on the application.

To support the selection of the most appropriate heat/cool interaction factor, we will also collect characteristic data including building type, HVAC system type and heating system efficiency.

Appendix G

On-Site Survey Forms – Project-Specific Data

This appendix documents the forms and procedures we used to conduct project-specific evaluations. It contains sections originally included in the "Data Collection and Energy Savings Calculation Handbook" that address the following topics:

1. General Project-Specific Evaluation Procedures
2. Costing Period Savings Distribution
3. Interactions Between Measures
4. 1996 Retention Database Summary
5. Persistence Summary
6. General Project-Specific Lighting Evaluation Procedures
7. Project Specific Lighting Capacity Forms Instructions
8. Project Specific Lighting Controls Forms Instructions
9. Lighting Savings Analysis
10. Miscellaneous Lighting Issues

The forms that these sections refer to can be found at the end of this appendix.

1. General Project-Specific Evaluation Procedures

First-year energy savings determined by this evaluation are to be disaggregated into the savings realized in each of PG&E's seasonally defined time-of-day costing periods. Procedures have been established to accumulate calculated hourly savings in the proper periods. These values are automatically loaded into preformatted report tables in the site workbook for cutting and pasting into the site evaluation reports. This appendix describes the analysis procedures to be followed for both normal cases and cases in which negative savings occur. In addition, a method is provided for distributing energy savings among interactive measures.

This appendix also includes field data collection forms for the 1996 Project-Specific Retention Database and Persistence Summaries.

2. Costing Period Savings Distribution

First-year energy savings are calculated according to methods in the site evaluation plan, unless extenuating circumstances prevent this from occurring. Talk to the QC Engineer to determine whether it is necessary to notify the PG&E Project Manager of any departures from the approved method. In most cases, the analysis will be straightforward; however, procedures have also been instituted to cover situations such as negative savings. The following sections explain the costing period distribution procedures for several situations. Talk to the QC Engineer if you come across a situation that is not covered. Basic analysis procedures for lighting measures are provided later in this appendix.

2.1 Normal Data Analysis Procedures

2.1.1 Generating Hourly Savings for a Full Year Using DOE-2

There are two ways DOE-2 can be used to generate annual savings on an hourly basis. If the measure saves energy simply by reducing the connected load, use the load reduction as the load in the DOE-2 input. The reported "consumption" is then equivalent to the savings. A full year's hourly reports can be used directly in accumulating costing period data. A DOE-2 input file template (ELECTOU.INP) is available in X:\CODE for this purpose. Copy the template to your local drive, edit it to reflect conditions for the site being analyzed and run it as you would any DOE-2 model.

If measure savings are dependent on weather or other variables, it will be necessary to model energy consumption for baseline and as-built conditions. The difference between them yields savings. Because hourly values must be obtained, it is necessary to generate hourly reports for both cases, then perform the subtraction on an hour-by-hour basis. HSAVDOE.SAS is used to perform the hourly calculations. Copy the template of this SAS job from X:\CODE to your local drive and edit it to reflect accurate site information.

2.1.2 Generating Hourly Savings for a Full Year Using SAS

If you determine first-year annual savings by some means other than DOE-2, it will be necessary to run an HSAVE.SAS to create hourly savings values. A template for this SAS job is available in X:\CODE. Copy it to your local drive and edit it to reflect information for the site. You will also need to define a procedure describing the schedule of savings for the entire year. It is necessary to take into consideration seasonal, weekly and daily variations when describing this schedule. Compare the results of this run to the values obtained from the analysis to make sure it did what was expected. If not, troubleshoot the program and try it again. The output from this run will be a listing of 8,760 values of hourly savings.

2.1.3 Incorporate Hourly Savings into the Site Workbook

When hourly savings values have been generated, copy CP.SAS from the X:\CODE directory onto your local drive. Edit this file to reflect information for the site and save it locally according to the naming convention specified in Appendix N. This job will accumulate hourly savings in the appropriate costing periods and place the results in the corresponding site workbook. Based on survey information, further calculations are performed within the workbook and results are placed in preformatted tables for pasting into the site evaluation reports and for use in the project final report.

2.2 Negative Savings

In some cases, energy consumption will increase following measure installation. This can be due to interactions (e.g., therm takeback) or improper application of the technology. The normal DOE-2 input file (ELECTOU.INP) cannot handle negative savings, so a separate input file, NEGSAVE.INP, has been made available in X:\CODE. This input file requires saving to be entered under the SOURCE-BTU/HR (S-B) keyword rather than the LIGHTING-KW (L-KW) keyword. Note the S-B keyword requires input in BTU/hour. Multiply your kW savings by 3,413 to convert to BTU/hour. The DOE-2 output will be in kW.

When you have obtained your hourly values, copy the CPNEG.SAS template from X:\CODE to your local drive. Use it as you would CP.SAS (as described above) to incorporate the hourly data into the site workbook. Note that the workbook assumes the first-year kW savings to be the maximum hourly change in non-coincident connected load. Negative savings are reported as zero. If the magnitude of the negative hourly savings is small, this presents no problem. If the magnitude is large, you should discuss the situation with the QC Engineer.

3. Interactions Between Measures

This situation is most likely to occur when two measures (items) are applied to the same system, one reducing the connected load while the other increases system efficiency via controls. This may not be the only situation in which measures interact to affect savings. Be alert to the possibility and if you are not sure about it, ask the QC Engineer.

When measures do interact, it is necessary to generate hourly savings files for each measure as if interacting measures were not installed. An additional hourly savings file should then be generated incorporating the effects of all the interacting measures (i.e., the as-built condition). Each of these files should then be subjected to CP.SAS and the resulting files zipped into site zip files as specified in Appendix N of the "Data Collection and Savings Evaluation Handbook".

CPG.SAS is a SAS job created to distribute the savings from the as-built hourly savings among the individual measures in proportion to their individual savings. It should be copied from X:\CODE to your local drive, edited according to the directions within CPG.SAS and saved according to specified naming conventions. The outputs from this job are Excel files that are to be incorporated into the site workbook. Appendix N of the "Data Collection and Savings Evaluation Handbook" indicates where these files will be located.

Note that individual measures cannot be split. As an example, assume lamps and ballasts are replaced throughout an entire building as one measure, ceiling occupancy lighting controls are installed on one floor as a second measure, and wall-mounted sensors are installed to control lighting in specific rooms on a different floor as a third measure. Both control measures would affect the single lighting measure. Perform three individual measure runs and a composite run incorporating all three measures, and proceed as described above.

4. 1996 Retention Database Summary

The 1996 Retention Database Summary form should be completed for all rebate 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.

4.1 Tasks before the On-Site Survey

Before the on-site survey, pre-fill 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 to be used 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 to be used for each measure are specified in Table H-1. For some 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.

File Quantity: Enter the number of analysis units rebated, according to the application file. You will be searching during the site visit for this expected count.

For Lamp Removal, this is the number of lamps removed. For Phantom lamp removal this value is zero.

4.2 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 may 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. Use the following abbreviations for lighting measures:

For Fixture Type:

CF	Compact Fluorescent
FL	Fluorescent
HAL	Halogen
HPS	High Pressure Sodium
INC	Incandescent
LPS	Low Pressure Sodium
MH	Metal Halide
MV	Mercury Vapor
RMV	Removed Lamp
PRMV	Phantom Lamp Removal

For Lamps per Fixture:

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

For Watts per Lamp:

# W	#=nominal 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:

EB	Electronic Ballast
MB	Energy Efficient Magnetic Ballast
SB	Standard Magnetic Ballast

Examples: HPS 400W = 400 Watt High Pressure Sodium fixture (Single lamp is assumed)

FL 4L 40W 4ft MB = Fluorescent fixture: four 4-foot, 40-watt lamps & mag. 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. This value should never be greater than the file quantity, even if more were installed than rebated.

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 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.

NOTE: If you can only sample certain locations of a total installation, extrapolate the installed and operational values to the total installation as provided in the Application. For example, assume the file quantity indicates 1,000 items were installed in five different locations. Further assume you could only sample locations that were supposed to have 100 items installed and you found 95 items, 85 of which were operational. For the entire project, you would then report 950 items installed and 850 operational. Make a note of the sample fraction (i.e., the sample size divided by the file quantity). For items occurring in large enough quantities to require sampling, you will probably base your sample on locations. The sample size is the number of items that are *expected* at that location. As indicated in the example, missing items are extrapolated to the entire population.

Manufacturer and Model Number: Make entries for those data elements that are appropriate for the specific measure (see Table H-1).

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, explain the difference at the bottom of the form. If less than 90 percent of the expected units are found for any item, contact the PG&E representative and explain the situation. If the rep believes the units have been installed, talk to the QC Engineer, who will discuss with the PG&E Project Manager whether a second site visit to locate the missing units is warranted.

5. Persistence Summary

Every project receiving project specific evaluation treatment needs one of these forms. 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.

5.1 Before the on-site survey

Pre-fill the header box entries and, for each item, the first three columns of the form.

Site ID: Enter the site identification number from the recruitment form.

Project ID: Enter the project identification number from the recruitment form.

Item Numbers: 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 in Appendix R of the "Data Collection and Savings Evaluation Handbook".

5.2 During the on-site survey

Obtain data for the last four columns on the form for use in preparing the report section that addresses savings persistence.

Customer's Estimate of Measure Lifetime: Enter the customer's estimate of the item's life.

Factors That Would Influence Measure Life: Enter one of the coded responses from the bottom of the form. If the appropriate code is "OT" (Other Reason), provide an explanation in the "Comments" section of the form, referring to the Item # being addressed.

Replacement: These first of these two columns provides space to enter a code value from the bottom of the form corresponding to the customer's stated plans for replacement of the item. If the appropriate code is "OT" (Other Reason), provide an explanation in the "Comments" section of the form, referring to the Item # being addressed. The second column provides space to enter the number of months until a planned replacement. If there are no replacement plans, enter "NA". If the item has already been replaced, enter as a negative number the number of months since replacement.

6. General Project-Specific Lighting Evaluation Procedures

The following data collection procedures and forms will be applied to each lighting 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:

6.1 Lighting Forms

L1: Lighting General Information – To be completed for all lighting capacity and control measures.

L2: Analysis Schedule - To be completed for all lighting capacity and controls measures.

L3: Project Specific Lighting Capacity Inventory - To be completed for all lighting capacity measures.

L4: Project Specific Lighting Controls Inventory - To be completed for all lighting controls measures.

L5: Project Specific Lighting Capacity Calculation Sheet (Early Replacement or Non-LPD Baseline) - To be completed for all lighting capacity measures that are evaluated with an early replacement or non-LPD baseline.

L6: Project Specific Lighting Capacity Calculation Sheet (Title 24 LPD Baseline) – To be completed for all lighting capacity measures that are evaluated with a Title 24 LPD baseline.

L7: Project Specific Lighting Capacity Summary - To be completed for all lighting capacity measures.

L8: Project Specific Lighting Controls Calculation Sheet - To be completed for all lighting controls measures.

6.2 Miscellaneous Lighting Issues

There are several miscellaneous issues regarding lighting measures that affect the savings calculations and need to be addressed in a specific manner. The final section of this appendix discusses the most common specialty items, as listed below:

1. **Lamp Removal.** Lamp removal measures offer three main challenges for savings calculations:
    - Lamp removal & lamp replacement within the same fixtures
    - Lamp removal without reflectors
    - Phantom delamping
2. **Equal Lumens Baseline.** If Title 24 is not applicable, we will use a baseline of equal lumens (rather than pre-condition) in three cases: under-lit space, missing pre-condition data, and new construction.
3. **Title 24 Relevance.** This section applies when a Title 24-baseline is required by our analysis.
4. **Lighting Interaction** between control and capacity measures

7. 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:

- L1: Lighting General Information
- L2: Analysis Schedule
- L3: Project Specific Lighting Capacity Inventory

- L5: Project Specific Lighting Calculation Sheet (Early Replacement or Non-LPD Baseline) and / or L6: Project Specific Lighting Calculation Sheet (Title 24 LPD Baseline)

- L7: Project Specific Lighting Capacity Summary

7.1 Before the on-site survey

a) Pre-fill the header box entries

- Determine during the measure information telephone contact if 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. Indicate on the Lighting General Information form if a Title 24 baseline is required, and if so, list the affected Item numbers. **Refer to the "Title 24 Relevance" section of this appendix to determine if Title 24 LPD standards are required and how best to assign area designation numbers.**

b) Pre-fill the "Measure Data (from application file)" section on the Lighting General Information sheet, including Item No., Item Description, and Quantity Rebated. Pre-fill in the Climate Zone entry on this same form. As best you can, determine the types of fixtures, as-built and (as appropriate) pre-condition, as well as the number of units you are expecting to find. This information may be found in the application file or in the evaluation plan. This will help you conduct your on-site inspection efficiently.

7.2 During the on-site survey

7.2.1 Complete Retention Database forms.

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

7.2.2 Complete the Lighting General Information form (L1).

- Document the total project floor area (ft^2) affected by all items in the project.

- Complete the Heat/Cool Interaction Data section for each item. This is necessary to select the appropriate DOE-2 prototype data for quantifying the heating/cooling interaction factors. Each selection should be based upon the predominant heat/cool characteristics associated with each item. (Example: If 40% of item 1 is installed in an unconditioned warehouse, and 60% is installed in a conditioned office area, use the conditioned office area heat/cool data to define the interaction characteristics for all of item 1.) *Complete one line only for each item.*

The following descriptions will be helpful in selecting the most appropriate building type to describe the space in which your measure interacts with the HVAC system:

- Office: Typical office building occupied 8am to 5pm weekdays
- Computer/Lab: Very internal gain intense building that operates 24 hours per day. There is no heat interaction with this building, however cooling interactions are large.
- Warehouse/Manufacturing: Moderate internal loads (less than an office), and operates 24 hours per day. The building type has large cooling and heating interactions.

- Document the general operating schedules for all rebated lighting. Include here any information that will help you identify the appropriate schedule(s) for each item, including location, emergency lighting, seasonal variations, lighting controls, use of light loggers, etc. This will be your basis for defining analysis schedules (form L2). Document the number of holidays, and the holiday operating schedule. If lighting control measures operate lighting capacity measures, include the pre-control lighting capacity schedule. If you prefer, you may bypass this section and document the schedules directly on the Analysis Schedule form(s).

- For LPD based analyses only, assign an Area Designation number to each identified floor area that contains one or more rebated measures. Document the square footage of the space, and provide a description of the space (including the primary usage of the space. This will aid in determining the LPD required by Title 24. Remember that the space may be as large as the entire building, and may be much larger than the specific area where the measure is installed. **Refer to the "Title 24 Relevance" section of this appendix to determine if Title 24 LPD standards are required and how best to assign area designation numbers.**

7.2.3 Initialize the Analysis Schedule form (L2).

An analysis schedule documents the year-round operating schedule for a lighting measure, with "on" fractions (utilization fractions) for all 8,760 hours of the year. Only one item may be assigned to a specific analysis schedule number, although one item may have up to three analysis schedules. (While two items may share the same general operating schedule, it is likely that they will have different utilization fractions, thus different analysis schedules are required.) The information you document here must be sufficient to accurately describe the year-round operating schedule. Utilization fractions will be calculated based on data collected on the Project Specific Lighting Capacity Inventory form (L3), and the lower half of the Analysis Schedule form will be completed after the site visit.

Identify the measure-affected lighting and define the appropriate analysis schedules. Some or all of this information may come from the Lighting General Information form (L1). 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. List specific dates of variations in the operating schedule.

7.2.4 Initialize the Project Specific Lighting Capacity Inventory form (L3).

- 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.

Fixture Description

- 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; watts per lamp; lamp length in feet; ballast type - E=electronic, M=energy efficient magnetic, S=standard magnetic; watts per lamp). The watts per fixture column will be completed after the site visit.

  ◊ For non-LPD based analyses, both as-built and baseline descriptions must be completed for each rebated item. **Refer to the "Title 24 Relevance" section of this appendix to determine if Title 24 LPD standards are required by this evaluation.**

  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 normal replacement analyses, use Title 20 energy efficient magnetic ballasts in the baseline description, even if the actual pre-condition was standard magnetic ballasts.

  When in doubt about the wattage of pre-condition T-12 fluorescent lamps, use the larger value shown on the Lamp Wattage Table (Example: for 4-foot T-12 lamps, use 40-watt lamps as the baseline, not 34-watt.)

  ◊ For an LPD-based analysis, you must describe all as-built fixtures within the designated area (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.

Fixture Count

- For each unique fixture, schedule, and location, count the number of units installed, the number of baseline units, 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. A lamp that is burnt out, but is still attached to a working ballast is considered "off", but 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.

- If the pre-condition was underlit, or if there was no pre-condition (as in new construction) and was not relevant, define a baseline of equal lumens and document this in the Equal Lumens Baseline Description portion of the Comments section. **Refer to the "Equal Lumens Baseline" section of this appendix for further instructions and discussion of this topic.** If you have any questions on the applicability of an equal lumens baseline, consult the QC Engineer.

7.3 After the on-site survey

7.3.1 Complete the Lighting Capacity Inventory form (L3).

- 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.)

- For Equal Lumens baselines, calculate the quantity of baseline fixtures required to provide equal luminance to the as-built rebated fixtures. Complete the baseline description and count

based on this calculation. **Refer to the "Equal Lumens Baseline" section of this appendix for further instructions and discussion of this topic.**

7.3.2 Complete the Lighting Capacity Calculation Sheet (L5 and/or L6).

For each analysis schedule (3 maximum per item) the total kW, as-built and baseline if appropriate, and utilization factor need to be calculated. The Calculation Sheets are designed to assist you in this process. You may put multiple items on one sheet but must indicate which calculation relates to which item.

You must first determine which form (L5 or L6) 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 form L6. Refer to the section 4.3 (Title 24 Relevance) of this appendix for further discussion of Title 24 applicability.

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 form L5.

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 form L5.

L5 (non-LPD) Instructions

For Early replacement or Non-LPD baseline analyses use Form L5 and the instructions below:

- 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,...), as-built watts/fixture, as-built units counted, sampling fraction (sampling fraction=1 if a complete inventory was taken), baseline watts/fixture, and baseline units counted from the Capacity Inventory forms. Identify the item number for the section.

- Multiply the total watts/fixture values by the total units values, divide by the sampling fraction, and divide by 1,000 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 as-built kW "on".

- Sum the as-built total kW, total as-built kW "on, and baseline kW installed columns for each analysis schedule.

- Calculate the total "on" fraction {Total "On" Fraction =(Sum of Total As-built kW "On")/(Sum of As-built Total kW)} for use in the analysis schedule description.

L6 (LPD baseline) Instructions

For Title 24 LPD baseline analyses use Form L6 and the instructions below:

- Complete one form for each area designation. A designated area may contain rebated measures from more than one project and/or more than one schedule. This form will aid you in calculating the total energy savings and distributing them among all rebated measures within the area.

- For each area designation, enter the floor area (ft^2) and the LPD allowed by Title 24. Obtain the appropriate Allowed LPD from the Title 24 reference sheet or from actual Title 24 documentation for the site. The floor area comes from the Lighting General Information form (L1).

For Rebated Fixtures:

- For each Project ID/Item No./Schedule No., copy the appropriate fixture type (unit type A,B,...), as-built watts/fixture, as-built units counted, and sampling fraction (sampling fraction=1 if a complete inventory was taken) from the Capacity Inventory forms.

- Multiply the total watts/fixture values by the total units values, divide by the sampling fraction, and divide by 1,000 to get total as-built 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 as-built kW "on".

- Sum the as-built total kW, total as-built kW "on", and baseline kW installed columns for each analysis schedule.

- Calculate the total "On" fraction {Total "On" Fraction =(Sum of Total As-built kW "On")/(Sum of As-built Total kW)} for use in the analysis schedule description.

- Calculate the Total Installed Rebated kW (= the sum of all as-built total kW within the rebated fixtures within the designated area).

For Non-Rebated Fixtures:

- For the non-rebated fixtures within the designated area, copy the appropriate fixture type (unit type A,B,...), as-built watts/fixture, as-built units counted, and sampling fraction (sampling fraction=1 if a complete inventory was taken) from the Capacity Inventory forms.

- Multiply the total watts/fixture values by the total units values, divide by the sampling fraction, and divide by 1,000 to get as-built total kW installed.

- Sum the as-built total kW column to get the total installed non-rebated kW.

Total Installed kW:

- Add the Total Installed Rebated kW and the Total Non-Rebated kW together to find the Total Installed kW value.

Savings Fraction:

- For each Project/Item/Schedule combination, calculate the Savings Fraction {Savings Fraction = (Project/Item/Schedule level As-built Total kW) divided by (Total Installed kW)}.

7.3.3 Complete the Analysis Schedule form (L2).

- Identify if the analysis schedule is an As-built Capacity Measure Schedule or a Pre-Condition Capacity Measure Schedule (necessary only if capacity measure interacts with a rebated control measure), and check the appropriate box.

- 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 loggers have been used, the occupied utilization fraction can be found on form L6, as the Total "On" Fraction (*Total As-built 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 seasonal variation 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.

7.3.4 Complete the Project Specific Lighting Capacity Summary Sheet (L7).

For LPD based analyses, use the top of the form (Option 1), and the following instructions:

- Complete one form for each area designation. A designated area may contain rebated measures from more than one project and/or more than one schedule. This form will aid you in calculating the total energy savings and distributing them among all rebated measures within the area. The calculation is handled by the form in two steps.

- Copy the Allowed LPD, floor area (ft^2), and total Installed kW from the Calculation form (L6) to the appropriate space in Step 1.

- Calculate the total kW saved in the designated area (Total kW saved = Allowed LPD x Floor Area (ft^2) / 1,000 – Total Installed kW). If this results in a negative value, the building (or area) is considered non-compliant by Title 24 standards, and negative savings will be calculated by this evaluation.

- Copy the Project ID, Item No., Schedule No., and Savings Fraction from the Calculation form (L6) to the appropriate space in Step 2. Also copy the Total kW Savings from Step 1.

- For each Project/Item/Schedule line, multiply the Savings Fraction by the kW Saved. This results in the kW savings associated with the specific Project/Item/Schedule combination.

For non-LPD analyses, use the bottom of the form (Option 2), and the following instructions:

- For each Project/Item/Schedule combination, transfer the installed kWs (baseline and as-built) from the Capacity Calculation Sheet (L5) and calculate a kW savings for each analysis schedule. kW savings = baseline total kW installed – As-built total kW installed.

- 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.

8. Project Specific Lighting Controls Forms Instructions

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

- L1: Lighting General Information
- L2: Analysis Schedule
- L4: Project Specific Lighting Controls Inventory
- L8: Project Specific Lighting Controls Calculation Sheet

8.1 Before the on-site survey

a) Pre-fill the header box entries.

b) Pre-fill the "Measure Data (from application file)" section on the Lighting General Information sheet, including Item No., Item Description, and Quantity Rebated. Pre-fill in the Climate Zone entry on this same form. Based on your evaluation plan, at the top of the Control Inventory form (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.

8.2 During the on-site survey

8.2.1 Complete Retention Database forms.

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

8.2.2 Complete the Lighting General Information form (L1).

- Document the total project floor area (ft^2).
- Complete the Heat/Cool Interaction Data section for each item. This is necessary to select the appropriate DOE-2 prototype data for quantifying the heating/cooling interaction factors. Each selection should be based upon the predominant heat/cool characteristics associated with each item. (Example: If 40% of item 1 is installed in an unconditioned warehouse, and 60% is installed in a conditioned office area, use the conditioned office area heat/cool data to define the interaction characteristics for all of item 1.) *Complete one line only for each item.*
- Document the general operating schedules for all rebated lighting. For each control measure, indicate what the pre-installation operating schedule was, and what the as-built schedule is. Document the number of holidays, and the holiday operating schedule. Specify if you are installing light loggers to determine the as-built schedule. This will be your basis for defining analysis schedules (form L2). If you prefer, you may bypass this section and document the schedules directly on the Analysis Schedule form(s).

8.2.3 Initialize the Analysis Schedule form (L1).

An analysis schedule for a control measure documents the *difference* in the year-round operating schedule of controlled fixtures that results from the installation of the control measure, with delta-"on" fractions (utilization fractions) for all 8,760 hours of the year. Only one item may be assigned to a specific analysis schedule number, although one item may have up to three analysis schedules. (While two items may share the same general operating schedule, it is likely that they will have different delta-utilization fractions, thus different analysis schedules are required.) The information you document here must be sufficient to accurately describe the year-round operating schedule. Delta-utilization fractions will be calculated based on customer interview, observation, and light logger data. The lower half of the Analysis Schedule form will be completed after the site visit.

Identify the controlled lighting fixtures and define the appropriate analysis schedules. Some or all of this information may come from the Lighting General Information form (L1). 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 7-9, 10% on during unoccupied hours, As-built - 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, customer interview, or light logger data.

8.2.4 Initialize the Project Specific Lighting Controls Inventory form (L4).

- 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).

- If interaction occurs between the rebated control measure and rebated capacity measures, specify which Project ID and Item number(s) correspond to the capacity measure.

- 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; watts per lamp; lamp length in feet; ballast type - E=electronic, M=energy efficient magnetic, S=standard magnetic; watts per lamp). The watts per fixture column will be completed after the site visit.

- For each unique item number, 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". 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 lighting interaction occurs, provide a full description and count of the baseline fixtures in the same manner as the as-built controlled fixtures. **Refer to the Lighting Interaction section of this appendix for an explanation of lighting interaction.**

- 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.

8.3 After the on-site survey

8.3.1 Complete the Lighting Controls Inventory form (L4).

- If there is a customer baseline that is different than the pre-condition, enter a description of it in the Comments section. The customer baseline will be defined by the Decision Maker survey.

- Look-up each of the lighting fixture types on the Lamp/Fixture Wattages, Table G-1 and enter the appropriate Watts per Fixture values.

8.3.2 Complete the Controls Calculation Sheet (L8).

For each analysis schedule (3 maximum per item) 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 to the As-built Affected Lighting section of this form. Clearly mark which schedule and which item is being addressed by each calculation.

- If interaction occurs between this control measure and rebated capacity measures, you must also complete the Pre-condition Lighting section. For each rebated capacity measure fixture that is listed in the As-built section, you must list the pre-condition lighting configuration. For each case, copy the appropriate Project ID, Item No(s)., watts/fixture and units installed from the Controls inventory form to the Pre-condition Lighting section.

IMPORTANT: If interaction occurs, you must list any non-rebated controlled lighting in both the As-built and Pre-condition sections. The point of this exercise is to determine the installed as-built capacity that is controlled by the rebated control measure, AND the total capacity that would have been controlled had no capacity measures been installed.

- For both As-built and pre-conditions, multiply the total watts/fixture values by the units count values, divide by the sampling fraction, and divide by 1,000 to get total kW controlled for each fixture type.

- Sum the fixture type total kW values to get totals for each analysis schedule for each item.

8.3.3 Complete the Analysis Schedule form (L2).

- 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. {Example: Pre-controls schedule of 8:00am to 9:00pm M-F, 95% "on", 0% "on" during all other hours; As-built controlled schedule of 8:00am to 5:00pm M-F, 80% "on", 0% "on" during all other hours. The delta-schedule used by this evaluation would be defined as: 8:00am to 5:00pm M-F, 15% (.15) utilization fraction; 5:00pm-9:00pm, 95% (.95) utilization fraction; 0% during all other hours.}

- Identify if the analysis schedule is a Control Measure Schedule or a Customer Baseline Schedule, and check the appropriate box.

- 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 seasonal variation information based upon interview information.

9. Lighting Savings Analysis

Use the schedules defined for each item (from form L2) and the kW savings for each schedule/item (from forms L7 and L8) as inputs to the ELECTOU.INP DOE-2 program in the savings analysis procedure.

10. Miscellaneous Lighting Issues

10.1 Lamp Removal

10.1.1 Lamp Removal & Lamp Replacement Measures

In many instances these two measures occur in the same fixture. For our evaluation, we need to isolate savings due to each measure, and will use a baseline and as-built condition that does not double-count the savings.

Example: Pre-condition of 4-lamp 4-foot fixtures with 40-watt lamps and magnetic ballasts; As-built condition of 2-lamp 4-foot fixtures with 32-watt lamps and electronic ballasts and new reflectors.

Measure 1. Lamp removal (Credit allowed since reflectors were installed.)

Evaluation Baseline: 4-lamp fixture with 40-watt lamps and magnetic ballast

Evaluation As-built: 2-lamp fixture with 40-watt lamps and magnetic ballast

Measure 2. Lamp Replacement

Evaluation Baseline: 2-lamp fixture with 40-watt lamps and magnetic ballast

Evaluation As-built: 2-lamp fixture with 32-watt lamps and electronic ballast

10.1.2 Lamp Removal without Reflectors

In cases where the program measure reduces the lighting intensity in a space through delamping or fixture removal and a new reflector is not installed to maintain the lighting level, you should create a modified pre-installation baseline which assumes the reduced light intensity condition. In this way the decrease in energy consumption associated with the reduction in intensity will not be included in the estimate of gross savings. This baseline change will be limited to situations where a Title 24 baseline is not appropriate.

Example: Pre-condition of 4-lamp 4-foot fixtures with 40-watt lamps and magnetic ballasts; As-built condition of 2-lamp 4-foot fixtures with 32-watt lamps and electronic ballasts but no new reflectors installed.

Measure 1. Lamp removal

Evaluation: No credit given, since new reflectors were not installed

Measure 2. Lamp Replacement

Evaluation Baseline: 2-lamp fixture with 40-watt lamps and magnetic ballast

Evaluation As-built: 2-lamp fixture with 32-watt lamps and electronic ballast

10.1.3 Phantom De-lamping

PG&E often credited savings for lamp removal when no lamp removal actually occurred. This happened when lamp replacement also occurred in the same fixture, and the pre-installation lighting had a much greater Watts/fixture value than what the PG&E program assumed. PG&E typically credited one lamp removed for each fixture affected by lamp replacement (or one for every reflector purchased). For our evaluation, we will not credit phantom de-lamping, and will use the actual pre-condition in our algorithms to give proper credit for lamp replacement. Note that the application file may not mention "phantom delamping" or the actual pre-condition at all. You will need to determine this based on customer interview and intuitive reasoning.

Example: Rebate given for one 8-foot lamp removal and four 4-foot lamp replacements. Actual pre-condition of a single 8-foot fixture with two 8-foot 110-watt High Output lamps and magnetic ballast; As-built consists of a single 8-foot fixture with four 4-foot 32-watt lamps and electronic ballasts.

Measure 1. 8-foot lamp removal

Evaluation: No credit given since no lamps were actually removed.

Measure 2. 4-foot lamp replacement

Evaluation Baseline: 2-lamp fixture with 110-watt lamps and magnetic ballast

Evaluation As-built: 4-lamp fixture with 32-watt lamps and electronic ballast

10.2 Equal Lumens Baseline

In some cases, we will need to calculate savings on an "equal lumens" baseline, rather than the pre-installation condition. This may occur with the following three scenarios: under-lit space; missing pre-condition data; and new construction. Note that if Title 24 is required by our evaluation, we will *not* use an equal lumens baseline.

An equal lumens baseline is a baseline condition that provides the same level of luminance as the as-built lighting. You will use the following equation to calculate the quantity of baseline fixtures required to provide this level:

$$\textit{Quantity of baseline fixtures} = \textit{(Quantity of As-built fixtures)} \times \frac{\textit{(Lumens per As-built Fixture)}}{\textit{(Lumens per Baseline Fixture)}}$$

The lumens per fixture values can be found in the reference section of this document.

10.2.1 Under-lit Space

For some sites, the HID rebate measure replaced an existing fluorescent lighting system that did not provide adequate light. In these cases, the new HID system was sized to provide the additional lighting required to solve the under-lit problem. If savings are computed in the evaluation with respect to the pre-installation fluorescent system, the higher lighting levels penalize the evaluation savings. We have agreed with PG&E that in these cases they should not be penalized for solving the under-lit problem. For this case, we will create a modified pre-condition that artificially increases the number of fluorescent fixture to achieve equivalent lumens as the as-built conditions. Savings are then defined as the difference between the pre and post consumption under constant lumens. This will often result in a small amount of negative savings. Note that if the customer does *not* believe that the pre-condition was under-lit, you will not calculate an equal lumens baseline, and instead will simply use the pre-condition configuration.

10.2.2 Missing Pre-condition Data

In the circumstance when the customer can tell you what type of pre-condition lighting was installed, but does not know the quantity of fixtures, you will need to calculate the quantity of pre-condition fixtures that would provide equal lumens to the as-built equipment. If the customer does not know the type of pre-condition lighting, you will use a default lighting type and a quantity of fixtures based on equal lumens. Consult the QC Engineer to determine a default lighting type.

10.2.3 New construction

When the rebated measure occurs in an addition or new construction, you will need to use a baseline with a default lighting type and a quantity of fixtures based on equal lumens. If the customer would have installed something else without the rebate, you will use this information for your customer baseline analysis. Consult the QC Engineer to determine a default lighting type.

10.3 Title 24 Relevance

The question you need to answer is this: Are Title 24 standards required *by our evaluation* for this measure?

Title 24 is NOT required if any of the following are true:

- The measure is fixture modifications (lamp replacement or lamp removal)

- The measure in installed in an unconditioned space. Conditioned space means that the space is either directly OR indirectly mechanically heated OR cooled. Swamp coolers do not count as cooling equipment. It depends, though, on how much heating or cooling is provided. In the case of a large warehouse that has a few units heaters by loading docks or doorways, it may not make the entire structure a heated space. The total quantity of heating provided to the space has to exceed 10 Btu/(hr-ft^2). Similar logic applies to a mechanical cooling system; if it provides more than 5 Btu/(hr-ft^2), the space is directly conditioned.

- The project(s) (could be multiple measures) replaces less than or equal to 50% of the fixtures in the space.

- The measure is Early Replacement (even if the customer had to meet Title 24, we will use a pre-condition baseline in our evaluation.)

If ALL of the above are false, we will use a Title 24 baseline in our evaluation.

10.3.1 Capacity Measures

If you can obtain Title 24 documentation from the customer, you will follow the same methodology to calculate savings. If not, you may select either the Complete Building Method, or Area Category Method.

Complete Building Method:

The entire building is allowed a certain LPD based on the predominant type of use of the building (see table below). Calculate the installed LPD by inventorying ALL installed fixtures (rebated and non-rebated) in the building. Use this method when all of the lighting in the building was changed at the time of the measures, or if you cannot isolate specific areas for an Area Category Method. With this method, you will assign only one Area Designation number and description that encompasses the entire building. You will need to calculate the square footage of the building and document this on the Lighting General Information form L1.

Allowed LPD by Complete Building Method

Type of Use	Allowed Watts/ft²
General Commercial and Industrial Work Buildings	1.2
Grocery Store	1.8
Industrial and Commercial Storage Buildings	0.8
Medical Buildings and Clinics	1.5
Office Building	1.5
Religious Worship, Auditorium, and Convention Centers	2.0
Restaurants	1.5
Retail and Wholesale Store	2.0
Schools	1.8
Theaters	1.5
All Others	0.8

Area Category Method:

Each area (surrounded by boundaries) is allowed a certain LPD based on the primary function of the area (see table below). Calculate the installed LPD by inventorying ALL installed fixtures (rebated and non-rebated) in the area. Use this method when only some of the lighting in the building was changed at the time of the rebated measures, or if it is easy to separate different areas of the building with different functions by boundaries. With this method, you will assign multiple Area Designation numbers, each corresponding to a separate area of the building. You will need to calculate the square footage of each area, and document it on the Lighting General Information Form (L1). You may NOT have multiple designated areas that overlap the same floor space.

Allowed LPD by Area Category Method

Primary Function	Allowed Watts/ft²
Auditorium	2.0[1]
Bank (Financial Institution)	1.8
Classrooms	2.0
Commercial and Industrial Storage[2]	0.6
Conventions Conference or Meeting Centers	1.6
Corridors, Restroom and Support Space	0.8
Dining	1.2
Exhibit	2.3
General Commercial and Industrial Work Area	1.3
Grocery Store	2.0
Hotel Function Area	2.3[1]
Kitchen	2.2
Lobbies:	
-Hotel Lobby	2.3[1]
-Main Entry Lobby	1.6[1]
Malls, Arcades[3], Atria, Recreation Function[4]	1.2[1]
Medical and Clinical Care	1.8
Office	1.6
Precision Commercial and/or Industrial Work	2.0
Religious Worship	2.2[1]
Retail and Sales Wholesale Showrooms	2.2
Theaters:	
-Motion Pictures	1.0
-Performance	1.5[1]

1 The smallest of the following values may be added to he allowed lighting power, listed above, for ornamental chandeliers and sconces that are switched or dimmed on circuits different from the circuits for general lighting:

a. 20 watts per cubic foot times the volume of the chandelier or sconce; or

b. 1 watt per square foot times the area of the task space that the chandelier or sconce is in; or

c. The actual design wattage of the chandelier or sconce.

2 Includes packing, shipping and receiving areas.

3 Includes amusement arcades.

4 Includes gymnasiums and exercise rooms. For professional gymnasiums requiring greater lighting levels, use the Tailored Approach.

10.3.2 Control Measures

For separately metered areas larger than 5,000 ft², automatic lighting control devices are REQUIRED by Title 24. Thus, if Title 24 is applicable to the analysis, any rebated control measures within the space result in zero savings by our analysis. However, having control measures installed may increase the maximum LPD allowed in the form of an "automatic control credit". See the table for lighting adjustment factors.

Power Savings Adjustments for Lighting Controls

Type of Control	Type of Spaces	Lighting Adjustment Factor
Occupant Sensor With separate sensor for each space	Any space < or = 250 ft² enclosed by an opaque ceiling to floor partition; any size classroom, corridor, conference or waiting room	0.20
	Rooms of any size that are used exclusively for storage	0.60
	Rooms > 250 ft²	0.10
Dimming System		
Manual	Hotels/motels, Restaurants, Auditoriums, Theaters	0.10
Multi-scene Programmable	Hotels/motels, Restaurants, Auditoriums, Theaters	0.20
Lumen Maintenance Controls	Any Space	0.10
Tuning	Any Space	0.10
Automatic Time Switch Control Device	Room < 250 ft² and with timed manual override at each switch location required by §131(a), and controlling only the lights in the area enclosed by ceiling-height partitions	0.05
Combined Controls		
Occupant sensor with a separate sensor for each space used in conjunction with lumen maintenance controls	Any space < or = 250 ft² and enclosed by opaque ceiling to floor partitions	0.37
Occupant sensor with programmable multi-scene dimming system	Hotels/motels, Restaurants, Auditoriums, Theaters	0.35

Occupant sensor with a separate sensor for each space used in conjunction with daylighting controls, and separate sensor for each space	Any space < or = 250 ft² within a daylit area and enclosed by opaque ceiling to floor partitions	0.10*
*May be added to daylighting control credits		

10.4 Lighting Interaction

When rebated control measures control rebated capacity measures, the energy savings that occur are the result of both measures. Your task is to properly distribute the savings between these two measures.

You may find the following occurrences within the lighting interaction:

- The capacity measure and control measure were rebated under different applications (hence become different projects)
- A single capacity measure interacts with more than one control measure
- A single control measure interacts with more than one capacity measure
- More than one control measures interact with more than one capacity measures
- Only a portion of a capacity measure interacts with the control measure(s) – the rest are not controlled by rebated equipment
- Any combination of the above

Evaluating savings in a multi-step process, and requires collecting more data than for non-interacting measures. During your site visit, you must determine the following:

- For control measures, you must determine the as-built affected capacity, the pre-condition capacity, the as-built schedule, and the pre-controls schedule.
- For capacity measures you must determine the as-built capacity, the pre-condition capacity, the as-built schedule, and the pre-condition schedule.

For each of the rebated items there will be a DOE2 & CP.SAS run where the only change reflected in the inputs is that due to the measure itself. Additionally, there is a group run which accounts for all the as-built savings due to controls and capacity measures.

10.4.1 Measure Runs

Capacity Measure

For a capacity measure, the savings is due to the change in capacity (L-kW = pre-capacity – as-built capacity). The schedule used for the capacity savings is the schedule that was in effect before the controls went in.

Normally we have been evaluating capacity measures using the as-built schedule. In this case we are using the pre-condition schedule to isolate savings due to the capacity change.

Control Measure

For a controls measure, the savings is due to the change in operating schedule from the controls (Delta schedule = Pre-control schedule – As-built schedule). To isolate the savings for the control measure, the controls schedule (delta schedule) is applied to the pre-existing capacity (L-kW = pre-condition capacity).

10.4.2 Group Run

The group run will fully reflect as-built energy savings. Everything that was in the measure runs will also appear in the group run.

Items affected by controls will have changed values in the group run

Non-controlled capacity will appear in the group run exactly as it appeared in the item run

Controls measures will use the same schedule (delta schedule) as in the measure run, but the capacity controlled (l-kW) is changed to reflect the actual as-built capacity

It is the savings from this group run that is the total for savings for all the measures. The item runs serve to determine how the savings are proportioned from the group. The sum of the savings for all the items in the group run should be less than the sum of the savings for the individual item runs.

10.4.3 Summary

To evaluate control measures:

Item Runs - control schedule savings (delta schedule) @ old capacity controlled

Group Run - control schedule savings (delta schedule) @ new capacity controlled

To evaluate capacity measures:

Item Runs – capacity savings @ old schedule

Group Run – capacity savings @ new schedule

Each of the above runs includes running the ELECTOU.INP DOE-2 program, and the CP.SAS program. Once all of these have been completed, you will need to run the CPG.SAS program to distribute the actual savings between items. Refer to the Costing Period Distribution section of Appendix G for more discussion on this procedure.

10.4.4 Other Considerations

Only measures affected by the controls need to follow these procedures. If there is a capacity measure that is not affected by the controls, evaluate that capacity change as has been done for other non-interacting projects.

You cannot split a measure (item). That is, if any portion of a capacity change is affected by controls then the complete capacity change must appear in the item and group runs. Some of the capacity will have schedules that change due to controls and some of the capacity will be under the same schedule in both item and group runs.

Any portion of a capacity measure which is not affected by controls appear in both the item runs and group runs without being changed from one run to the other.

Any portion of the control measure which affects non-rebated capacity appears in both the item and group runs without a change from one run to the other.

Remember that for Title 24 based analyses, control measures result in zero savings. No lighting interaction occurs, and no special analysis is required. The capacity analyses will be run with as-built operating schedules.

Appendix H
On-Site Survey Forms – Verification Data

The following procedures apply to each verification project. Each of these projects is to:

- Quantify the number of units installed under the program
- Quantify the number of units that are operational
- Provide locations of installed units
- Indicate the manufacturer and model number of installed equipment
- Provide reasons for equipment that could not be found

Note that completed verification field data collection forms provide all the information required for the 96 Retention Summary, so a separate form is not required for the retention work. A blank verification data collection form is included at the end of this appendix.

1. Tasks Before the On-Site Survey

Prior to recruiting a verification project, perform a detailed review of the application file. When all Verification and Project-Specific application files associated with a single Corporate ID have been reviewed, recruit the site according to the instructions in Appendix A. Site visit scheduling and coordination can then take place.

Prior to the site visit, pre-fill the header box entries on the Verification Data Collection form. There will be one form for each item in the Project. The item # and measure description should be obtained from the corresponding recruitment form. The units of analysis come from Table H-1. They are what you will use to quantify the measure while in the field. All measures in the database are included in the table and it is important to use the designated units. The file quantity is the number of units specified in the application file as having been rebated. Convert the quantity to the units specified in Table H-1 if they do not agree with the units from the file.

2. Tasks During the On-Site Survey

Complete entries on the form as appropriate.

Description: This is an optional entry allowing clarification if the item being counted is a component of a larger system or is poorly described: it is not the same as the Measure Description from the top of the page.

Location: requires a balance of specificity and brevity. Consider that the item you are describing may have to be located two years later by someone who has never been to the site – further consider that *you* may be the one trying to locate the item. Entries such as “Various Rooms” or “Building X” are not specific enough. Note that when several locations are entered, the

Verification Report will indicate "Various" as the location. The database, however, will retain the individual locations, so it is important to gather this information.

Unit Quantity Installed: is the number of units found installed in the field. Remember that the basis for the count is the Units of Analysis from Table H-1. Make a note at the bottom of the form of installation status information that you did not directly observe.

Unit Quantity Operational: is the number of units found that are operational. This does not mean they have to be operating at the moment you observe them. They do have to be capable of operating. Units that are broken or incapacitated are not operational. Ask the site contact about the operational status if you cannot directly confirm it. Make a note in the Comments section regarding operational status information you do not directly observe.

Manufacturer, Model Number and Efficiency: Make entries for those data elements that are appropriate for the specific measure. Table H-1 indicates 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 obtain this information if the space is left blank. When multiple manufacturers or model numbers are encountered, they will be handled in a manner similar to that for Location. That is, the Verification Report will indicate "Various" as the response, however, the database will retain the more-specific information.

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 Unit Quantity Installed is less, enter the code from the "Reasons for Short Counts" table at the bottom of the page; if the reason is "OT" (i.e., other reason), provide an explanation in the Comments section. Never enter a value in this space greater than the file quantity. When you are confident of your count, note the totals of Unit Quantities Installed and Operational on the last page.

3. Tasks Following the On-Site Survey

If you found less than 90% of the units specified in the file for any measure, contact the PG&E representative and discuss the situation. If the location of additional units or reasons for missing units is known, make note of this information. If the Rep is sure that additional units exist, inform the QC Engineer and the Project Manager will be contacted to determine whether a second site visit is warranted.

When your counts are finalized, enter the data from the field data sheets in the Site Workbook on the Verification Data worksheet. Entries will be automatically transferred to the Report worksheet for pasting into the site evaluation report.

Table H-1. Units of Analysis to be Used and Information to be Obtained for Verification and Retention Purposes in 1996 PG&E Industrial Evaluation

Measure Label	Units	Mfr	Model
A/C: CENTRAL, < 65 KBTU/HR, AIR-COOLED, SINGLE PACKAGE (yr< 96)	TONS	X	X
A/C: CENTRAL, < 65 KBTU/HR, AIR-COOLED, SPLIT-SYS/SNGL PKG	TONS	X	X
A/C: CENTRAL, < 65 KBTU/HR, AIR-COOLED, SPLIT-SYSTEM (yr< 96)	TONS	X	X
A/C: CENTRAL, > = 135 & < 240 KBTU/HR, AIR-COOLED, SPLIT-SYS/SNGL PKG	TONS	X	X
A/C: CENTRAL, > = 135 & < 760 KBTU/HR, AIR-COOLED, SINGLE PKG	TONS	X	X
A/C: CENTRAL, > = 240 & < 760 KBTU/HR, AIR-COOLED, SPLIT-SYS/SNGL PKG	TONS	X	X
A/C: CENTRAL, > = 65 & < 135 KBTU/HR, AIR-COOLED, SPLIT-SYS/SNGL PKG	TONS	X	X
ADJUSTABLE SPEED DRIVE: HVAC FAN, 50 HP MAX	HP	X	X
AIR COMPRESSER SYSTEM CHANGE/MODIFY	FILE	X	X
BALLAST: ELECTRONIC, 2-LAMP BALLAST	FIXTURES		
BALLAST: ELECTRONIC, 3-LAMP BALLAST	FIXTURES		
BALLAST: ELECTRONIC, 4-LAMP BALLAST	FIXTURES		
CHANGE/ADD OTHER EQUIPMENT	FILE	X	X
COMPACT FLUORESCENT: HARDWIRED FIXTURE, > = 26 WATTS	FIXTURES		
COMPACT FLUORESCENT: HARDWIRED FIXTURE, 14-25 WATTS	FIXTURES		
COMPACT FLUORESCENT: HARDWIRED FIXTURE, 5-13 WATTS	FIXTURES		
COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, > = 26 WATTS	LAMPS		
COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, 14-25 WATTS	LAMPS		
COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, 5-13 W	LAMPS		
COMPRESSED AIR LEAKAGE REDUCTION: RECIP OR MULTIPLE COMPRESS	FILE		
CONSTANT AIR VOLUME TO VARIABLE AIR VOLUME CONVERSION, TRANSITIO	SUP FAN ASDs	X	X
COOLING TOWER: OVERSIZED, VALLEY	TONS	X	X
EXIT SIGN: LED OR ELECTROLUMINESCENT	FIXTURES		
EXIT SIGN: RETROFIT KIT	FIXTURES		
FIXTURE: 2 FT T-8 W/EL BLST, 1 31-W T-8 U OR 2 17-W T-8	FIXTURES		
FIXTURE: 2 FT T-8 W/EL BLST, 2 31-W T-8 U OR 4 17-W T-8	FIXTURES		
FIXTURE: 2 FT T-8 W/EL BLST, 3 31-W T-8 U OR 6 17-W T-8	FIXTURES		
FIXTURE: 4 FT T-8 W/ELEC BLST, 1 32-WATT T-8 LAMP	FIXTURES		
FIXTURE: 4 FT T-8 W/ELEC BLST, 2 32-WATT T-8 LAMPS	FIXTURES		
FIXTURE: 4 FT T-8 W/ELEC BLST, 3 32-WATT T-8 LAMPS	FIXTURES		
FIXTURE: 8-FT T-8 W/EL BLST, 1 8-FT T-8 OR 2 32-W, 4-FT T-8	FIXTURES		
FIXTURE: 8-FT T-8 W/EL BLST, 2 8-FT T-8 OR 4 32-W, 4-FT T-8	FIXTURES		
FIXTURE: INCAND TO FLUOR CONVERSION W/ELEC BLST	FIXTURES		

Table H-1. Units of Analysis to be Used and Information to be Obtained for Verification and Retention Purposes in 1996 PG&E Industrial Evaluation

Measure Label	Units	Mfr	Model
FIXTURE: T-8 LAMP & ELEC BLST, (FEM or NEW FIXTURE), 2 FT FI	LAMPS		
FIXTURE: T-8 LAMP & ELEC BLST, (FEM or NEW FIXTURE), 3 FT FI	LAMPS		
FIXTURE: T-8 LAMP & ELEC BLST, (FEM or NEW FIXTURE), 4 FT FI	LAMPS		
FIXTURE: T-8 LAMP & ELEC BLST, (FEM or NEW FIXTURE), 8 FT FI	LAMPS		
HALOGEN LAMP: < 50 WATTS	LAMPS		
HALOGEN LAMP: > = 50 WATTS	LAMPS		
HID FIXTURE: INTERIOR, COMPACT, 36-70 WATT LAMP	FIXTURES		
HID FIXTURE: INTERIOR, COMPACT, 71-100 WATT LAMP	FIXTURES		
HID FIXTURE: INTERIOR, STANDARD, 101-175 WATT LAMP	FIXTURES		
HID FIXTURE: INTERIOR, STANDARD, 176-250 WATT LAMP	FIXTURES		
HID FIXTURE: INTERIOR, STANDARD, 251-400 WATT LAMP	FIXTURES		
HIGH EFFICIENCY GAS BOILER: MANUFACTURING PROCESSES	FILE	X	X
HVAC ADJUSTABLE SPEED DRIVE	FILE	X	X
HVAC CONTROLS	CONTROLS BOX	X	X
INSTALL HVAC EMS	FEATURES	X	X
INSULATE BUILDING SHELL (CEILING, WALLS)	SQUARE FEET		
OCCUPANCY SENSOR: CEILING MOUNTED	SENSORS		
OCCUPANCY SENSOR: WALL MOUNTED	SENSORS		
OIL WELL PUMP-OFF CONTROLLER	POC's or TIMERS	X	X
PHOTOCELL: LIGHTING	PHOTOCELLS		
PROCESS ADJUSTABLE SPEED DRIVE	FILE	X	X
PROCESS BOILER CHANGE/ADD	BOILERS	X	X
PROCESS BOILER HEAT RECOVERY	BOILERS		
PROCESS BOILER OTHER	FILE	X	X
PROCESS CHANGE PHYSICAL	FILE		
PROCESS CHANGE/ADD EQUIPMENT	FILE	X	X
PROCESS CONTROLS	CONTROLS BOX	X	X
PROCESS NON-AG PUMP REPAIR	PUMPS		
PROCESS OTHER	FILE	X	X
REFLECTIVE ROOF COATING	SQUARE FEET		
REFLECTIVE WINDOW FILM	SQUARE FEET		
REFLECTORS WITH DELAMPING, 2 FT LAMP REMOVED	LAMPS		
REFLECTORS WITH DELAMPING, 3 FT LAMP REMOVED	LAMPS		
REFLECTORS WITH DELAMPING, 4 FT LAMP REMOVED	LAMPS		
REFLECTORS WITH DELAMPING, 8 FT LAMP REMOVED	LAMPS		
THERMOSTAT: SETBACK PROGRAMMABLE	THERMOSTATS	X	X
TIME CLOCK: HVAC	TIME CLOCKS	X	X
TIME CLOCK: LIGHTING	TIME CLOCKS	X	X
VARIABLE FREQUENCY DRIVE: WATER PUMPING: THROTTLING VALVE TO	HP	X	X
WATER CHILLER: WATER-COOLED, VALLEY	TONS	X	X

Appendix I

Field Measurements

1. One-Time and Short-Term Measurements

At many project-specific sites it was necessary to take one-time power measurements. At some sites it was necessary 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 and understand the safety section of the handbook.

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). Clarification is provided in 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 a 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 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.

1.7 Dranetz 808 Demand Analyzer

The Dranetz 808 meter provides readings of true rms kW, kVA, and power factor as instantaneous or averaged readings for user-specified time periods on single or polyphase electrical systems. This instrument is very versatile with respect to obtaining desired readings. It is designed for use on a 110-volt, 60 Hz power source. An on-board battery will automatically provide power if the supply is interrupted. Data are recorded on a paper tape and must be entered by hand into any computerized analysis tools. Manuals are provided with the Dranetz meter. Make sure you are familiar with its operation before taking it in the field.

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 particularily important for data downloading. The data is entered after the respective events occur.

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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 person is identified during the Site Recruitment Survey.

However, this Operations Staff 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

The completed surveys will be given to the Net Impact Experts who will use the responses in performing the custom analysis of free-ridership.

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 Site Recruitment Form). The completed surveys must be attached to the site evaluation report.

Site ID _____ Project ID _____ Item Number _____

Operations Staff Survey

1996 Industrial Rebate Program Evaluation

Before Beginning an Interview:

1. Determine whether the operations 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.

Notes: (Respondent name, telephone number and other notes)

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 Elsia Galawish at (415) 973-5347.

1. Was the [installation/removal] 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*.

   1 Yes, (**Describe**:_____

   _____

   2 No (**Go to 4)**

   98 Don't Know (**Go to 4**)

   99 Refused to Answer (**Go to 4**)

2. Where did the **idea** come from for [describe the larger project]? **If necessary read examples:** *Consultant, Internal staff, One of your 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, Comply with an Environmental or Health regulation, Increase safety*.

   _____

4. What were the main **reasons** for [installing/removing] 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, Comply with an Environmental or Health regulation, Reduced energy costs, Favorable Payback.*

   _____

Site ID _____ Project ID _____ Item Number _____

5. Where did the **idea** come from to [install/remove] [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.* **If the response is internal staff**, **probe for the source of this idea, for example**: *a class offered by PG&E, visit from PG&E customer representative, past participation in PG&E programs, standard industry practice, common knowledge*.

_____

6. What role did PG&E's rebate play in the decision to [install/remove] [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/removed] the same equipment, with the same level of energy efficiency....

	Count	%	
1	_____	____	...within 6 months?
2	_____	____	...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 -**Try for a less precise response, if still "don't know" use 98**

	Count	%	
8	_____	____	...less than one year?
9	_____	____	...one year or more?

99 _____ ____ ...Refused to Answer

<u>Time relative to the installation/removal date</u>. 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, <u>you must indicate the %</u> that would have occurred in each period. 100% will appear in one period for single piece items. The percentages must always sum to 100%.

Site ID _____ Project ID _____ Item Number _____

9. If the response to Q. 8, for all or a portion of the item was more than one year, probe for the reason why the installation would have occurred then.

_____

10. Did you consider alternatives to [describe item which received a PG&E rebate] that would have been less energy efficient?

1 Yes

2 No (**Go to End**)

98 Don't Know (**Go to End**)

99 Refused to Answer (**Go to End**)

11. Please describe these alternatives.

_____

_____

_____

12. Who identified these alternatives? **If necessary read examples:** C*onsultant, Internal staff, PG&E, Equipment supplier*.

_____

END: **If more items continue to the copy of this survey set up for the next item. If last item, say**: Those are all the questions I have. I greatly appreciate your time and cooperation. Thank you very much.

13. **Survey Disposition. Indicate the final status of the survey. Record this information only once on the copy of the survey used for the first item.**

1 Survey completed successfully

2 Never able to reach contact (three tries failed)

3 Contact refused to complete the survey

4 Survey not completed for other reasons

Date Complete: / /9_

Appendix K

Standard Decision-Maker Survey

This appendix contains three parts. The first contains the detailed instructions for completing the decision-maker survey, as appeared in the *1996 Industrial Retrofit Impact Evaluation Data Collection and Energy Savings Calculation Handbook.* The second discusses special cases that might arise while calculating the NTGR. Finally, the decision-maker survey itself is at the end of the appendix.

1. Interview Instructions for Decision-Maker Survey

1.1 Purpose

The purpose of this interview is to gather data needed to estimate the 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 implemented at a sampled site. Following are the definitions of free-ridership 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.

- **Standard Net-to-Gross Ratio (NTGR)**. Ratio of net savings to gross savings. The data needed to estimate the decision-maker version of the NTGR (you prepare this estimate in the Site Evaluation Workbook) comes from this survey, your evaluation of the "customer baseline" version of gross savings, and the vendor survey.

- **Custom Free-Ridership Analysis**. This is an analysis of free-ridership conducted by the Net Impact Experts (Katherine Randazzo and Rick Ridge) after data were 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. This ultimately resulted in the Custom NTGR estimate.

1.2 Selection of Respondent

The Decision-Maker, identified on the Site 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/remove the items (for which rebates were paid) at a sampled site.

If the 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 1996.

1.3 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 0.3 (computed in the Site Evaluation Workbook).**

1.4 How are these Data Used

Completed Decision-Maker surveys are used in three ways:

1. **Standard Net-to-Gross Ratio (NTGR)**. Responses to questions 5-11, and 13-15 are used in your Site Evaluation Workbook to calculate the standard decision-maker NTGR.

2. **Vendor Follow-Up**. Response to question 30 provides the name of the vendor involved in specifying each item, which will be used if you need to complete a vendor survey.

3. **Custom Free-Ridership Analysis**. All other questions will be used by the Net Impact Experts to perform a custom analysis of free-ridership.

1.5 Additional Question(s) for Custom Free-Ridership Analysis

For some CPS sites, the application files may contain information that can be used to create one or more additional questions which will aid the Net Impact Experts in the custom free-ridership analysis. When you review these files you should look for documents that provide any of the following types of information:

1. Whether program guidelines have been met, e.g., memos for special permission.
2. Issues related to the timing of the item installation , e.g., equipment purchased before the date that the rebate was offered.
3. Motivations for the item's installation or motivation for when to install equipment.
4. Deviations from standard decision processes, either by PG&E or the customer.
5. Financial calculations done by the customer (not by PG&E for the customer).

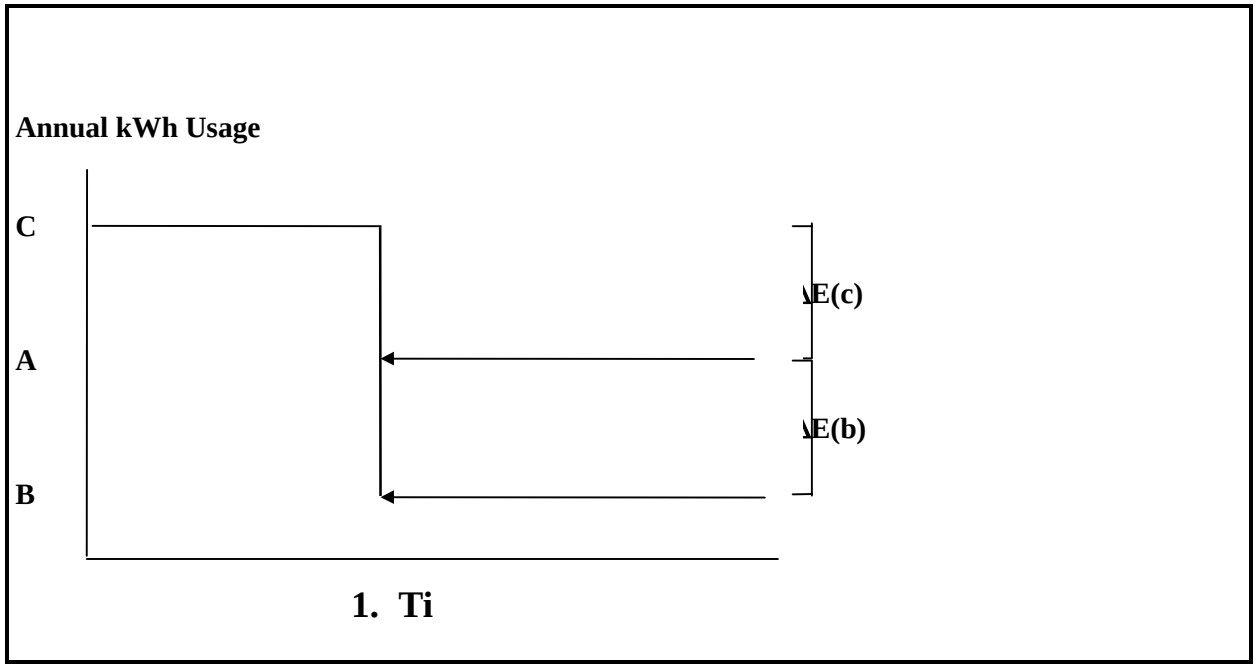
Information of these types might lead to a additional questions concerning the rebate and its impact on the customer's decision to implement an item. If you find information of these types, you should contact the assigned Net Impact Expert (see section 1.7) to work out specific wording of additional question(s). Space is provided in Q. 28 of the decision-maker survey to record the question(s) to be asked.

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 Site Recruitment Form. A label precedes each question 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 the survey questions 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 you complete the interview. Remind the decision maker about the types of questions that were asked, e.g., their motivation for installing the item, alternatives considered, and financial factors, to avoid making it too easy for them to say "yes, all my answers would be the same."

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. One of the Net Impact Experts, either Katherine Randazzo (KR) or Rick Ridge (RR) will be assigned to help you resolve any issues pertaining to this survey (the person assigned appears on the Site Recruitment Form). Katherine can be reached at (707-874-3100) and Rick at (510-865-6011). If either is not available, leave a message. If you have not heard back within 2 hours, call the other. If you have not heard back on your second call within 2 hours, call Michael Baker.

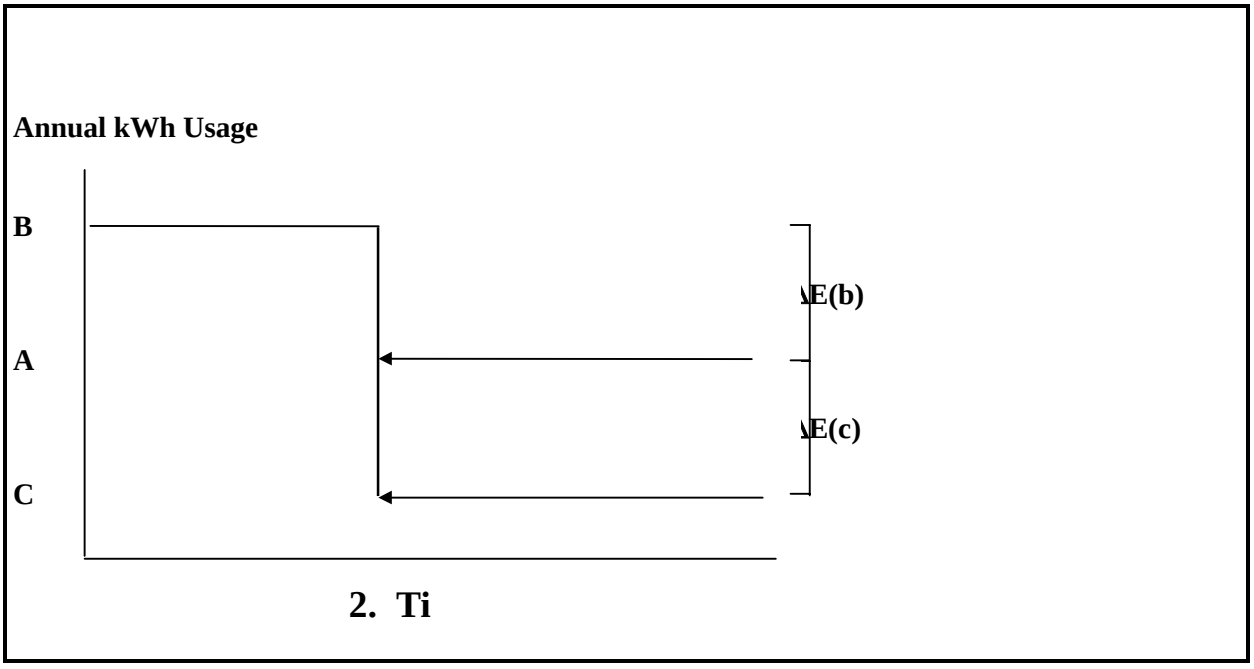
2. NTGR Special Cases

An assumption of the self-report methodology is that the NTGR varies between zero and one. However, there are situations in which the NTGR falls outside the zero-to-one range because the engineering ratio falls outside the zero-to-one range. This can happen for several reasons. First, recall that C is the annual usage of the pre-retrofit equipment, B is the annual usage of the alternative equipment, and A is the annual usage of the as-built equipment (as described in Section 6.1.3 of the body of the report). Also,

note that C – A equals the full gross impacts. Furthermore, in cases where there is an alternative piece of equipment specified, B – A is the partial gross, i.e., gross adjusted for partial free-ridership.

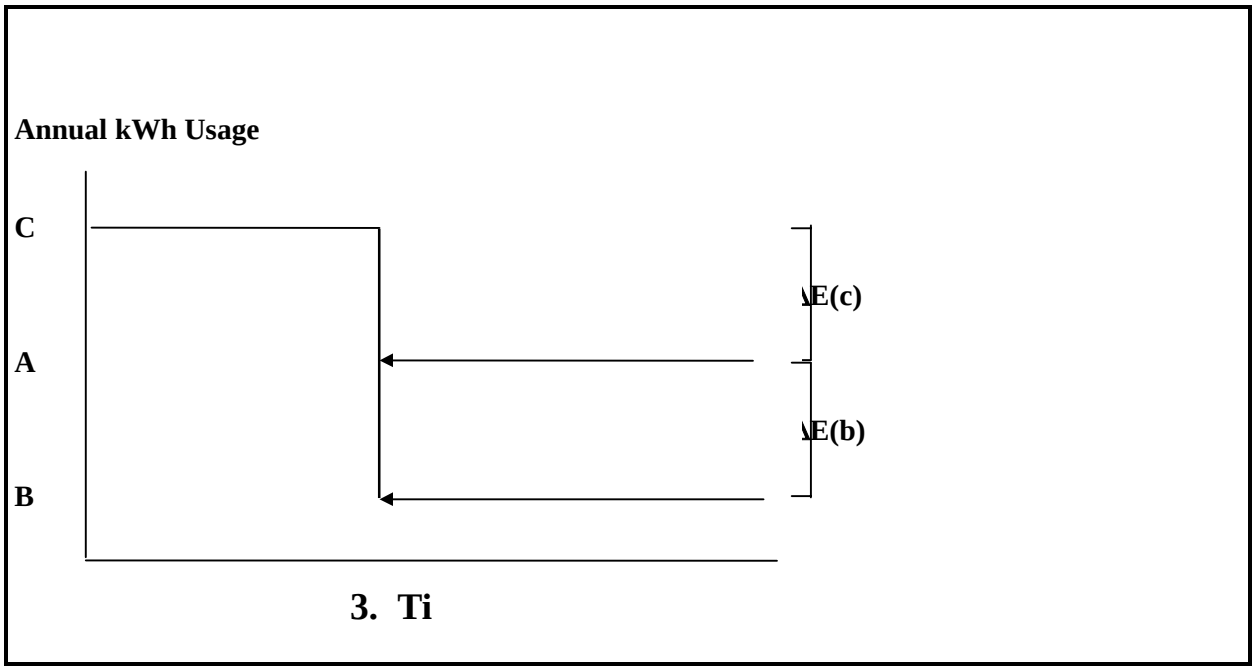
When C or B is more efficient than A, the engineering ratio will be negative, i.e., a NTGR less than one. When both C and B are more efficient than A, the ratio will be positive and could potentially be much larger than one. While there are, of course, six possible combinations, three are presented below in Figures K-1, K-2 and K-3 for illustrative purposes.

Figure K-1



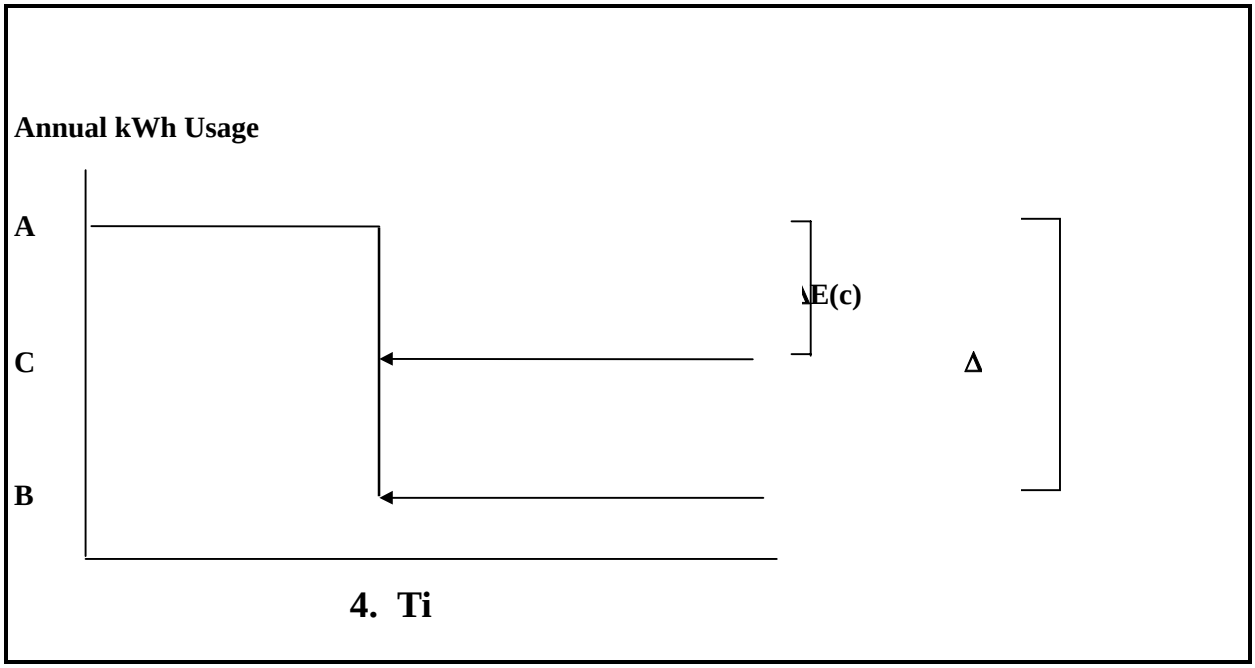
Given the annual usage of A, B, and C displayed in Figure K-1, ΔE(c) will be negative and ΔE(b) will be positive, making the engineering ratio, ΔE(b)/ΔE(c), negative.

Figure K-2



Given the annual usage of A, B, and C displayed in Figure K-2, ΔE(c) will be positive and ΔE(b) will be negative, making the engineering ratio, ΔE(b)/ΔE(c), negative.

Figure K-3



Given the annual usage of A, B, and C displayed in Figure K-3, ΔE(c) will be negative and ΔE(b) will be negative, making the engineering ratio, ΔE(b)/ΔE(c), positive and potentially much larger than 1.

All six possible combinations of A, B, and C and the resulting engineering ratio are presented in Table K-1.

Table K-1

Annual Usage Relationship	**Situation**	**Resulting Engineering Ratio (ΔE(b)/ΔE(c))**	ASR_NTGR
1. C > B > A	Typical	Positive	Within range
2. C > A > B	Anomalous	Negative	Negative
3. B > A > C	Anomalous	Negative	Negative
4. B > C > A	Anomalous	Positive	Potentially larger than 1
5. A > C > B	Anomalous	Positive	Potentially larger than 1
6. A > B > C	Anomalous	Positive	Within range

Below are described the rules for handling each of the anomalous situations. Note these rules constrain the NTGR to fall in the range of zero to one and take the customer's description of the alternative equipment, B, as a valid point of comparison in calculating the net impacts, regardless of whether these partial impacts are negative or positive.

2.1 Situation #2: C > A > B

1. The engineering ratio is less than 0, thus making ASR_NTGR (the product of P(b) or P(c) and the engineering ratio, ΔE(b)/ΔE(c)), less than 0.
2. Since the ASR_NTGR cannot, by definition, be less than 1, set the ASR_NTGR equal to SR_NTGR.
3. The partial gross impacts are, in this situation, negative and the full gross impacts are positive.
4. The now positive ASR_NTGR should be multiplied by the negative partial gross impacts to yield negative net impacts.

2.2 Situation #3: B > A > C

1. The engineering ratio is less than 0 thus making ASR_NTGR (the product of P(b) or P(c) and the engineering ratio, ΔE(b)/ΔE(c)) less than 0.
2. Since the ASR_NTGR cannot, by definition, be less than 1, set the ASR_NTGR equal to SR_NTGR.
3. The partial gross impacts are, in this situation, positive and the full gross impacts are negative.
4. The now positive ASR_NTGR should be multiplied by the positive partial gross impacts to yield positive net impacts.

2.3 Situation #4: B > C> A

1. Although the engineering ratio will be positive, it is possible that the ratio may actually be much larger than 1. It may be so much larger than 1 that the ASR_NTGR itself may be larger than 1 which, by definition, is not possible [at least without taking spillover into consideration].
2. If the ASR_NTGR is greater than 1, set the ASR_NTGR equal to SR_NTGR.
3. Both the partial and full gross impacts are, in this situation, positive.

4. The ASR_NTGR should be multiplied by the positive partial gross impacts to yield positive net impacts.

2.4 Situation #5: A > C > B

1. Although the engineering ratio will be positive, it is possible that the ratio may actually be much larger than 1. It may be so much larger than 1 that the ASR_NTGR itself may be larger than 1 which, by definition, is not possible [at least without taking spillover into consideration].
2. If the ASR_NTGR is greater than 1, set the ASR_NTGR to the value of the SR_NTGR.
3. The product of the ASR_NTGR and the negative full gross load impacts will yield negative net load impacts.

2.5 Situation #6: A > B > C

1. The engineering ratio will be positive and less than 1 thus eliminating the chance that the ASR_NTGR will be greater than 1.
2. Both the full and partial gross impacts are *negative*.
3. The product of the ASR_NTGR and the negative partial gross load impacts will yield negative net load impacts.

Site ID _____ Project ID _____ Item Number _____

Decision-Maker Survey

1996 Industrial Rebate Program Evaluation

Before Beginning an Interview:

1. Obtain the Decision-Maker name and telephone number.
2. Review the 1996 item list on the recruitment form for all HVAC, Light and Process projects associated with this site.
3. Make one copy of the survey for each sampled item.
4. Group similar items, e.g., all lighting capacity changes.
5. Put a check next to the questions you have to ask for each item.
6. Record payback information from the application file on Question 26.
7. If appropriate, prepare additional questions, with the help of the Net Impact Expert, see Question 28, for further explanation of this requirement. Only applies to Free-Rider Type = Custom.
8. Thoroughly understand the instructions which precede this survey instrument.

Notes: (Respondent name, telephone number and other notes)

_____

A. Hello. This is [your name] 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 1996..

___ 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 Elsia Galawish at (415) 973-5347.

B. Review the list of Light, HVAC or Process items for which rebates were paid in 1996. 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.

Site ID _____ Project ID _____ Item Number _____

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 learn that a rebate was available from PG&E for [describe item] 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**. Was it BEFORE or AFTER you selected or decided on the exact specifications for [describe item]? (**Circle One**)

   1 Before (**Go to Q.6**) **2** After **98** Don't Know **99** Refused to Answer

5. **Use for all items**. Finally, was it BEFORE or AFTER you [installed/removed] [describe item]? (**Circle One**)

   1 Before (**Go to Q.6**) **2** After **98** Don't Know **99** Refused to Answer

6. **Use for all items**. On a scale from 0 to 10, with 0 being no influence at all and 10 being very influential, how much influence did the PG&E rebate have on your decision to [install/remove] [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/removed] exactly the *same* [describe item] [**if the installed equipment has specific efficiency ratings such as SEER, COP, KW/TON 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. (**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

   For Free-Rider Type = Custom, copy Response (0-10) to Question 25.

   Notes: _____

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,

Site ID _____ Project ID _____ Item Number _____

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 am 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 responses for questions 6 and 7 and check these responses 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/removed] with the PG&E rebate, which you would have implemented in the same time frame if the rebate had not been available?

___ 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 [make sure they are not thinking about 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

Site ID _____ Project ID _____ Item Number _____

11. **Use for all items**. **This question asks about the paid item. Make sure the respondent is <u>NOT THINKING</u> 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/removed] the *same* [describe item] [**if efficiency, rated add:** with the same efficiency rating] ...

	Count	%	
1	_____	____	..within 6 months?
2	_____	____	..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 - **Try for less precise response, if still "don't know" use 98**

	Count	%	
8	_____	____	...less than one year?
9	_____	____	...one year or more?

99 _____ ____ ...Refused to Answer

<u>Time relative to the installation date</u>. 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, <u>you must indicate the %</u> 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**. If the response to **Q. 11**, for all or a portion of the item, was **more than one year**, probe for the reason why the installation would have occurred then.

_____

Say: Here are some statements that may be more or less true for your company about [**describe item**]. Please assign a number between 0 and 10 to register how true it is. 10 indicates that it is completely true, and 0 indicates that it is completely untrue.

13. **For All Items**. The rebate was nice but it was unnecessary to cause the [**describe item**] to be implemented.

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

14. **For All Items**. The rebate was a critical factor in implementing the [**describe item**].

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

Site ID _____ Project ID _____ Item Number _____

15. **For All Items**. We would not have implemented the [**describe item, including its efficiency rating if applicable**] without the rebate.

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

16. **Only use for Free Rider Type = Custom**. Was the installation of the [describe item] 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*.

    1 Yes, (**Describe**: _____

    2 No (**Go to Q.19**) **98** Don't Know (**Go to Q.19**) **99** Refused (**Go to Q.19**)

17. **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 your competitors, PG&E*.

    _____

18. **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, Comply with an Environmental or Health regulation, Increase safety*.

    _____

    _____

19. **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, Comply with an Environmental or Health regulation Reduced maintenance, Reduced energy costs, Favorable Payback.*

    _____

    _____

20. **Only use for Free Rider Type = Custom**. Where did the **idea** come from to [install/remove] [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.* **If the response is internal staff**, probe for the source of this idea, for example: *a class offered by PG&E, visit from PG&E customer representative, past participation in PG&E programs, standard industry practice, common knowledge*.

    _____

Site ID _____ Project ID _____ Item Number _____

21. **Only use for Free Rider Type = Custom**. What financial calculations does your company make before proceeding with a investment like deciding to [install/remove] [describe item]? [Prompt by reading list if necessary]

1 None **(Go to Q. 26)** **2** Payback

3 Return on Investment (ROI) **4** Break-even Analysis

5 Other, specify: _____

98 Don't Know **(Go to Q. 26)** **99** Refused **(Go to Q. 26)**

22. **Only use for Free Rider Type = Custom**. What is the cut-off point that your company uses for deciding to proceed with the investment?

_____ Response with appropriate units

98 Don't Know **99** Refused to Answer **(98, 99 skip to Q. 24, then Q. 26)**

23. **Only use for Free Rider Type = Custom**. What was the result of the calculation for [describe item]?

A. **With** the PG&E rebate

_____ Response with appropriate units

97 No Calc **(skip to Q. 26)**

98 Don't Know **99** Refused to Answer (**98, 99 skip to Q. 24, then Q. 26**)

B. **Without** the PG&E rebate

_____ Response with appropriate units

97 No Calc (**go to Q 24, then Q. 25 C**)

98 Don't Know (**go to Q 24, then Q. 25 C**)

99 Refused to Answer (**go to Q 24, then Q. 25 C**)

24. **Only use for Free Rider Type = Custom**. Using a scale from 0 to 10, 10 being extremely important, and 0 being not at all important, how important was this financial calculation in your decision to proceed with [describe item]?

___ Response (**0-10**)

97 No calc **(go to Q. 26)**

98 Don't Know

99 Refused to Answer

Site ID _____ Project ID _____ Item Number _____

25. **Only use for Free Rider Type = Custom**. When respondent provides both **with and without** rebate results, ask one of the three following questions, if any of the bulleted conditions are met. If the **without** rebate result was not provided, Question C is the only possible question to ask.

Record Response to Question 7 here ➔ _____

A. If

- Item **did** meet customer's cut-off criteria **without** the rebate, and
- Response to Q.7 is **less than 5**

Even without the rebate this [describe item] met your company's financial criteria. Why wouldn't you have gone ahead with it even without the rebate?

_____

B. If

- Item **didn't** meet company's cut-off criteria **without** rebate, and
- Item **did** meet **with** rebate, and
- Response to Q.7 is **greater than 5**

The rebate seemed to make the difference between meeting your financial criteria and not meeting them, but you are saying that the rebate didn't have much effect on your decision, why is that?

_____

C. If

- Item **didn't** meet cut-off criteria **with** rebate, and
- Response to Q.7 is **less than 5**

The rebate didn't cause this [describe item] to meet your company's financial criteria, but you said that the rebate had an impact on the decision to [install/remove] the [describe item]. Why did it have an impact?

_____

Site ID _____ Project ID _____ Item Number _____

26. **Only use for Free Rider Type = Custom**. If the company **did not** make its own financial calculations, but payback **with and without** the PG&E rebate is available from the application file, ask one of the following questions. If the **without** rebate result was not in the file, Question D is the only possible question to ask. If both are missing **go to Q.27.**

Record payback from Application File: **With** Rebate _____ **Without** Rebate _____

A. **Ask**: According to PG&E records you were informed that the payback with the rebate was [from above] and without the rebate was [from above]. Do you remember being told about the payback.

1 Definite No (**go to Q.27**) **2** Yes or Maybe (**go to B, C or D as appropriate**)

B. If

- Item payback is **less than or equal to 2 years without** the rebate, and
- Response to Q.7 is **less than 5**

This [describe item] had quite a short payback even without the rebate. Why you wouldn't have [installed/removed] the [describe item] regardless of the rebate?

_____

C. If

- Item payback is **more than 3 years without** the rebate, and
- Item payback is **less than or equal to 2 years with** the rebate, and
- Response to Q.7 is **greater than 5**

The rebate seemed to make a big difference in the payback period, but you are saying that the rebate didn't have much effect on your decision, why is that?

_____

D. If

- Item payback is **more than 3 years with** the rebate, and
- Response to Q.7 is **less than 5**

The rebate didn't bring this [describe item] to a very attractive payback period, but you said that the rebate had an impact on the decision to [install/remove] the [describe item]. Why did it have an impact?

_____

27. **Only use for Free Rider Type = Custom**. Were there any competing investments under consideration at the same time that [describe item] was being considered?

1 Yes, specify _____

2 No **98** Don't Know **99** Refused to Answer

Site ID _____ Project ID _____ Item Number _____

28. **Only use for Free Rider Type = Custom**. Additional custom free-ridership question(s):

Response:

29. **Use for all Items.** Which of the following provided the most assistance in the design or specification of [describe item]? [**Read the list**]

    1 Designer or Consultant

    2 Equipment Distributor or Manufacturers Representative

    3 Installer

    4 PG&E Customer Representative (**go to end**)

    5 Internal Staff (**go to end)**

    98 Don't Know (**go to end**)

    99 Refused to Answer (**go to end**)

30. **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: **If more items continue to the copy of this survey set up for the next item. If last item, say**: Those are all the questions I have. I greatly appreciate your time and cooperation. Thank you very much.

31. **Survey Disposition. Indicate the final status of the survey. Record this information only once on the copy of the survey used for the first item.**

    1 Survey completed successfully

    2 Never able to reach contact

    3 Contact refused to complete the survey

    4 Survey not completed for other reasons (Specify: _____)

    Date Complete: / /9_

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.

PROJECTS PAID BY 1996 PROGRAMS

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

[Obtained from Evaluation Plan]

ITEMS FOR EACH PROJECT

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

PROJECT-SPECIFIC EVALUATION RESULTS

	Energy Savings						Net to Gross	Realization Rate	
	Gross			Net					
	kW	kWh	Therms	kW	kWh	Therms	Ratio	Gross	Net
PG&E									
Evaluation									

Spillover Analysis

If no spillover was found in the Spillover Survey, make a statement to that effect at the bottom of the first 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.

Pre-installation Equipment and Operation: This data should be obtained from the Evaluation Plan and updated to reflect any new or revised information obtained in the field.

As-Built Equipment and Operation: This data should also be obtained from the Evaluation Plan and updated according to actual conditions observed in the field. Include the measure-affected area (square feet) for the HVAC end-use or, if applicable, values for activity level for Process end-use.

Note whether rebated equipment was found and whether it was operating as specified in the Project File. Provide a summary description of reason(s) for equipment that was either not found or was found operating outside its specified performance during the site visit.

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.

Annual Extrapolation: The method that 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 used to disaggregate the evaluation estimate of annual savings into the five PG&E defined costing periods.

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: *Based on Evaluation Plan.*

Non-Energy Costs and Benefits: *Same as Evaluation Plan.*

Free-Ridership (Standard Project-Specific Projects)

Standard Decision-Maker Survey: Results of the interview with the decision-maker who authorized installation of the paid 1996 measure.

Vendor Survey: Results of vendor telephone interview, made in cases when the customer would have implemented the measure without the program. If not performed, explain why.

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). If not required, explain why (e.g. early replacement).

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 summary description of the data and discussion of 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 infleuenced by the program.

Efficiency Improvement: Description of the spillover measure and how it results in kWh, kW or Therm 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]

ENERGY SAVINGS SUMMARY
FOR 1996 SPILLOVER MEASURES

SITE ID:

SAVINGS ESTIMATES FOR EACH SPILLOVER ITEM

Item Number	End Use	Measure	First-Year Savings MWh	kW	Therms

ENERGY SAVINGS BY COSTING PERIOD FOR 1996 SPILLOVER MEASURES

SITE ID:

GROSS kW AND kWh SAVINGS BY COSTING PERIOD FOR SPILLOVER MEASURES

Project: **Item No.:**
Measure:

PG&E Costing Period	Hour of PG&E System Maximum	Average kW Savings	Average kW Savings Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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

VERIFICATION RESULTS SUMMARY

SITE ID

VERIFICATION RESULTS FOR VERIFY-PROJECT EVALUATIONS

Project: **Item No.:** **End Use:**

Measure:

Location:

Type of Units Counted:	
Manufacturer	
Model	

Survival Rate Summary

Number of Units			Percent of Application Count	
Application	Installed	Operational	Installed	Operational

Net-to-Gross Ratios

Program Database
Standard Evaluation

Missing Units Summary

Quantity Missing	Reason
0	Total

SUMMARY OF SITE- LEVEL ENERGY SAVINGS FOR 1996 PAID MEASURES

SITE ID

SAVINGS ESTIMATES FOR PROJECT-SPECIFIC EVALUATIONS

Project: **Item No.:** **End Use:**
Measure:

	First-Year Savings				Realization Rate		
	MWh	kW	Therms	NTGR	kWh	kW	Therms
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:**
Measure:

	First-Year Savings				Realization Rate		
	MWh	kW	Therms	NTGR	kWh	kW	Therms
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:**
Measure:

	First-Year Savings				Realization Rate		
	MWh	kW	Therms	NTGR	kWh	kW	Therms
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				—			

ENERGY SAVINGS BY COSTING PERIOD FOR 1996 PAID MEASURES

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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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

SITE ID

COMPARISION OF EVALUATION AND PROGRAM DATABASE ESTIMATES

				Reasons for Differences between Evaluation and Program Database Estimates of Gross Savings			
				% Change in...			
Site ID	Proj ID	Item No.	Efficiency Measure	Capacity or number of units	kW or Btu/h Savings per unit	Operating Hours	Other Difference (Yes or No)

The table above shows reasons for differeneces between the Program Database estimates of savings and the estimates prepared for this site evaluation report. The "% Change in …" columns indicate the percent difference in values assumed for three key parameters. For example, under the "Capacity or Number of Units" column, if the program assumed that 100 fixtures were replaced and this evaluation determined that 80 had been replaced, the % change would = -20%.

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.

Decision-Maker Survey: Completed Decision-Maker Survey showing customer's responses. This information is subsequently used in the determination of Net-to-Gross Ratios.

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. This may include, but is not limited to:

- Manufacturer's performance curves
- Application file information
- Copies of production logs
- Data recordings & charts
- Spot measurements
- Field information used in Free-Ridership Assessment
- Spillover Analysis
- Survey Responses

Template for Lighting Evaluation Reports

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.

PROJECTS PAID BY 1996 PROGRAMS

Project ID No.	Application Number	Program Year	Control Number	Account Number	End Use	PG&E Program	Project Type
[Obtained from Evaluation Plan]							

ITEMS FOR EACH PROJECT

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

EVALUATION PROJECT SPECIFIC RESULTS SUMMARY

	Energy Savings						Net to Gross Ratio	Realization Rate	
	Gross			Net					
	kW	kWh	Therms	kW	kWh	Therms		Gross	Net
PG&E									
Evaluation									

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 temoplate), and delete this section from the report.

Project-Specific Impact Evaluation Report for Project ID: End Use: Lighting

Measure Description *(Modified Evaluation Plan per the results of the on-site survey)*

Efficiency Improvement: Description of the efficiency measures, as shown in the rebate application. This will include the location of each measure, as described by the application file or the customer staff.

Measure	Description	Qty & Units	Location
1			
2			
3			

Pre-installation and As-Built Conditions: These data should be obtained from the application file, telephone discussion with the assigned PG&E customer representative, and customer interview and observation data from the on-site inspection. For early replacement measures, the pre-installation portion should describe the type and quantity of the replaced equipment. For normal replacement measures, the pre-installation 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. In all cases, this section will also describe and quantify the installed rebated equipment. Also included here is a description of the as-built operating schedule for each measure.

Pre-Installation				
Measure	**Qty/ Units**	**Description**	**Schedule (Controls measures only)**	**Comments**
1				
2				
3				

As-Built				
Measure	**Qty/ Units**	**Description**	**Schedule**	**Comments**
1				
2				
3				

Baseline Condition: Discuss what baseline conditions were used in the evaluation algorithms (pre-installation condition, Title 24 baseline, Title 20 baseline, equal lumens, etc.) and why.

Include here whether the project is normal or early replacement. (i.e., The pre-installation lighting was used as the baseline in the evaluation algorithms because the measures were fixture modifications and therefore not subject to Title 24 LPD requirements).

Additional Information: Include here any additional pertinent information, such as interaction between control and capacity measures.

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, for instance, 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 *(Modified Evaluation Plan per the results of the on-site survey)*

Make reference to the master lighting evaluation plan for a description of the PG&E Retrofit Express and Evaluation algorithms used for estimating energy savings.

For Custom applications, include here as 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. 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.

Data Collection *(Modified Evaluation Plan per the results of the on-site survey)*

Make reference to the master lighting evaluation plan for a description of the data collection method.

This section will identify whether a sampling strategy or complete inventory was used to determine the installed measure count.

If special metering was involved (i.e. light loggers), this section will describe the data recorders and sensors installed, the measurements taken, and the duration of the measurement period.

This section will discuss the quantity of schedules established for each measure, and will address issues that may have affected the equipment inventory during the on-site inspection (such as customer time constraints or security issues).

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 Decision-Maker Survey: Results of the interview with the decision-maker who authorized installation of the paid 1996 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.

Customized Analysis (Custom Project-Specific Projects only): 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 infleuenced by the program.

Efficiency Improvement: Description of the spillover measure and how it results in kWh, kW or Therm 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]

ENERGY SAVINGS SUMMARY
FOR 1996 SPILLOVER MEASURES

SITE ID:

SAVINGS ESTIMATES FOR EACH SPILLOVER ITEM

Item Number	End Use	Measure	First-Year Savings MWh	kW	Therms

ENERGY SAVINGS BY COSTING PERIOD FOR 1996 SPILLOVER MEASURES

SITE ID:

GROSS kW AND kWh SAVINGS BY COSTING PERIOD FOR SPILLOVER MEASURES

Project: **Item No.:**
Measure:

PG&E Costing Period	Hour of PG&E System Maximum	Average kW Savings	Average kW Savings Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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

VERIFICATION RESULTS SUMMARY

SITE ID

VERIFICATION RESULTS FOR VERIFY-PROJECT EVALUATIONS

Project: **Item No.:** **End Use:**

Measure:

Location:

Type of Units Counted:	
Manufacturer	
Model	

Survival Rate Summary

Number of Units			Percent of Application Count	
Application	Installed	Operational	Installed	Operational

Net-to-Gross Ratios

Program Database
Standard Evaluation

Missing Units Summary

Quantity Missing	Reason
0	Total

SUMMARY OF SITE- LEVEL ENERGY SAVINGS FOR 1996 PAID MEASURES

SITE ID

SAVINGS ESTIMATES FOR PROJECT-SPECIFIC EVALUATIONS

Project: **Item No.:** **End Use:**

Measure:	First-Year Savings MWh	First-Year Savings kW	First-Year Savings Therms	NTGR	Realization Rate kWh	Realization Rate kW	Realization Rate Therms
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:**

Measure:	First-Year Savings MWh	First-Year Savings kW	First-Year Savings Therms	NTGR	Realization Rate kWh	Realization Rate kW	Realization Rate Therms
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:**

Measure:	First-Year Savings MWh	First-Year Savings kW	First-Year Savings Therms	NTGR	Realization Rate kWh	Realization Rate kW	Realization Rate Therms
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				—			

ENERGY SAVINGS BY COSTING PERIOD FOR 1996 PAID MEASURES

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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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 Coincident with System Maximum	KW Adjustment Factor	kWh Savings	kWh Adjustment Factor	Annual kWh Savings	Connected Load kW
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

SITE ID								
COMPARISON OF EVALUATION AND PROGRAM DATABASE ESTIMATES								
				Reasons for Differences between Evaluation and Program Database Estimates of Gross Savings				
				% Change in...				
Site ID	Proj ID	Item No.	Efficiency Measure	Capacity or number of units	kW or Btu/h Savings per unit	Operating Hours	Other Difference (Yes or No)	

The table above shows reasons for differences between the Program Database estimates of savings and the estimates prepared for this site evaluation report. The "% Change in" columns indicate the percent difference in values assumed for three key parameters. For example, under the "Capacity or Number of Units" column: if the program assumed that 100 fixtures were replaced and this evaluation determined that 80 were replaced, the capacity % change column would show -20%.

Attachments

This section will list the attachments that have been sent to PG&E, including but not limited to, the following:

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.

Decision Maker Survey: A copy of the completed decision maker survey for each item at this site.

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 274 site reports. These reports covered 122 project-specific projects which accounted for 341 measure items, as well as 204 verify projects which accounted for 302 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 that 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-7):** breaks the sites according to site type, then lists them in ascending order by site ID number.

- **Table M-2 (pages M-8 to M-13)**: Lists company names alphabetically.

Table M-1: List of Evaluated Sites (sorted by site type, then by site number)

Site Number	Site Type	No. of Projects by End Use						No. of Items by End Use					
		Verify			Proj-Spec			Verify			Proj-Spec		
		H	L	P	H	L	P	H	L	P	H	L	P
1009	CP						1						1
1011	CP			1			2			1			2
1012	CP						1						1
1017	CP						1						1
1018	CP			1			1			1			1
1049	CP						1						1
1083	CP					1						1	
1091	CP					1						4	
1093	CP					1						3	
1095	CP					1						3	
1100	CP					1						1	
1123	CP					1						5	
1132	CP				1	1					4	7	
1169	CP		1			1			3			1	
1177	CP						1						1
1184	CP				1						1		
1190	CP				1						1		
1203	CP					2						6	
1205	CP					1						7	
1214	CP					1						2	
1223	CP						1						1
1228	CP	1			2			1			4		
1235	CP				1						1		
1250	CP						1						1
1251	CP				3	2					3	17	
1258	CP					1						3	
1273	CP					2						6	
1284	CP		1			1			2			6	
1326	CP					1						6	
1330	CP					1						5	
1340	CP				1						1		
1359	CP				1						2		
1360	CP						1						1
1368	CP					2						4	
1375	CP					1						5	
1379	CP				1						1		
1385	CP					1						1	
1386	CP					2						5	
1387	CP					1						1	
1425	CP			2			2			2			2
1432	CP						1						1
1434	CP						1						1
1003	SP	1				1		3				3	
1065	SP					1						1	
1067	SP					1						6	
1070	SP					1						1	
1074	SP					1						5	
1082	SP					1						5	
1094	SP					1						4	
1097	SP					1						4	

Site Types: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
End Uses: H=HVAC; L=Lighting; P=Process

Table M-1: List of Evaluated Sites (sorted by site type, then by site number)

Site Number		Site Type	~~No. of Projects by End Use~~ Verify H	L	P	Proj-Spec H	L	P	~~No. of Items by End Use~~ Verify H	L	P	Proj-Spec H	L	P
1102		SP					1						2	
1107		SP					1						2	
1115		SP					1						3	
1118		SP					1						6	
1120		SP					1						5	
1129		SP					1						4	
1130		SP					1						2	
1133		SP					1						4	
1136		SP					1						4	
1137		SP					1						4	
1139		SP					1						3	
1149		SP					1						1	
1162		SP					1						7	
1166		SP					1						5	
1170		SP					1						4	
1176		SP					1						2	
1181		SP					1						3	
1182		SP					1						2	
1185		SP					1						2	
1193		SP					1						2	
1221		SP					1						3	
1222		SP					1						6	
1227		SP					2						13	
1231		SP					1						1	
1236		SP					1						1	
1252		SP					1						3	
1253		SP					1						1	
1262		SP					1						6	
1268		SP					1						3	
1283		SP					1						7	
1288		SP					1						2	
1290		SP					1						3	
1297		SP					1						1	
1299		SP					1						4	
1303		SP					1						1	
1305		SP					1						5	
1312		SP					1						1	
1314		SP					1						5	
1318		SP					1						1	
1322		SP					1						3	
1329		SP					1						5	
1338		SP					1						3	
1341		SP					1						4	
1344		SP					4						7	
1348		SP					1						1	
1349		SP					1						1	
1355		SP					1						1	
1384		SP					1						1	
1388		SP					1						5	
1393		SP					1						1	

~~Site Types~~: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
~~End Uses:~~ H=HVAC; L=Lighting; P=Process

Table M-1: List of Evaluated Sites (sorted by site type, then by site number)

Site Number		Site Type	No. of Projects by End Use						No. of Items by End Use					
			Verify			Proj-Spec			Verify			Proj-Spec		
			H	L	P	H	L	P	H	L	P	H	L	P
1395		SP					1						1	
1407		SP					1						4	
1410		SP					2						2	
1411		SP					1						1	
1564		SP					1						6	
1002		VE		1						3				
1005		VE			1						1			
1008		VE	1						1					
1010		VE			1						1			
1013		VE			1						1			
1014		VE			1						1			
1015		VE		1						1				
1016		VE	1						1					
1019		VE	1						1					
1020		VE	1						1					
1021		VE	1						2					
1022		VE	1						1					
1024		VE	1						2					
1025		VE		1						5				
1026		VE	3						4					
1027		VE	1						1					
1028		VE	1						1					
1029		VE	1						2					
1030		VE	1						2					
1031		VE	1						1					
1032		VE	1						1					
1035		VE			1						1			
1037		VE			1						1			
1040		VE		1						4				
1041		VE			1						1			
1044		VE			1						1			
1047		VE			1						1			
1050		VE	1						2					
1051		VE		1						1				
1052		VE			1						1			
1053		VE	1						1					
1054		VE	1						3					
1055		VE	1						2					
1056		VE		2						2				
1059		VE		1						3				
1060		VE	1						1					
1061		VE	1						1					
1064		VE		1						7				
1066		VE	1						2					
1068		VE	1						2					
1069		VE	1						1					
1072		VE	1						2					
1073		VE			1						1			
1076		VE		1						4				
1081		VE			1						1			

Site Types: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
End Uses: H=HVAC; L=Lighting; P=Process

Table M-1: List of Evaluated Sites (sorted by site type, then by site number)

Site Number	Site Type	No. of Projects by End Use						No. of Items by End Use					
		Verify			Proj-Spec			Verify			Proj-Spec		
		H	L	P	H	L	P	H	L	P	H	L	P
1029	VE	1	1					1	3				
1032	VE	1	1					1	1				
1038	VE	1		1				1		1			
1096	VE	1						1					
1008	VE	1	2					1	4				
1009	VE	1		1				1		1			
1267	VE	1		2				1		2			
1269	VE	1	1					1	1				
1264	VE	1	1					2	1				
1260	VE	1						1					
1270	VE	1						1					
1271	VE	1						1					
1272	VE	1	3					1	5				
1273	VE	1	1					1	2				
1280	VE	1	1					2	3				
1287	VE	4	1					4	5				
1289	VE	1	1					1	2				
1291	VE	1						1					
1298	VE		1						3				
1297	VE	1		1				1		1			
1290	VE	1	1					1	4				
1296	VE	1	2					1	4				
1298	VE	2						2					
1360	VE	1	1					2	3				
1367	VE	1	1					1	2				
1360	VE	3						3					
1363	VE	2	1	1				2	2	1			
1308	VE	2						2					
1379	VE	1						1					
1370	VE	1						1					
1374	VE	1						1					
1379	VE	2						2					
1380	VE	2	1					2	3				
1383	VE	1		1				1		1			
1388	VE	1						1					
1389	VE		1	1					2	1			
1398	VE	1						1					
1398	VE	2		1				2		1			
1397	VE	1	1					1	4				
1300	VE	1	1					1	5				
1309	VE	1	1					2	1				
1302	VE	1	1					1	3				
1305	VE		1						3				
1309	VE		1	1					1	1			
1353	VE	1	1					3	2				
1356	VE		1						1				
1358	VE		1	1					1	1			
1368	VE	1		1				2		1			
1369	VE	2		1				2		2			
1308	VE	1		1				1		1			

Site Types: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
End Uses: H=HVAC; L=Lighting; P=Process

Table M-1: List of Evaluated Sites (sorted by site type, then by site number)

Site Number		Site Type	No. of Projects by End Use						No. of Items by End Use					
			Verify			Proj-Spec			Verify			Proj-Spec		
			H	L	P	H	L	P	H	L	P	H	L	P
1364		VE		1						1				
1365		VE	1						2					
1367		VE	1	1					1	2				
1370		VE		1						2				
1372		VE			1						1			
1381		VE		1						1				
1389		VE		1						1				
1392		VE		1						2				
1398		VE	1						2					
1399		VE	1						2					
1401		VE		1						1				
1402		VE	1						1					
1403		VE	1						2					
1406		VE	1						1					
1409		VE		1						1				
1413		VE			1						1			
1414		VE	1						2					
1418		VE	1						2					
1419		VE	1						1					
1420		VE		1						1				
1423		VE	1						1					
1426		VE	3						5					
1429		VE	1						2					
1433		VE	1						2					

Site Types: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
End Uses: H=HVAC; L=Lighting; P=Process

Table M-2: List of Evaluated Sites (sorted by company name)

Site Number		Site Type	No. of Projects by End Use						No. of Items by End Use					
			Verify			Proj-Spec			Verify			Proj-Spec		
			H	L	P	H	L	P	H	L	P	H	L	P
1200		VE		1						5				
1202		VE	1						1					
1329		SP					1						5	
1091		CP					1						4	
1387		CP					1						1	
1125		VE	1						1					
1119		VE	4						4					
1223		CP						1						1
1184		CP				1						1		
1064		VE		1						7				
1168		VE	1						1					
1185		SP					1						2	
1364		VE		1						1				
1564		SP					1						6	
1177		CP						1						1
1232		VE		1						1				
1348		SP					1						1	
1272		VE	1	3					1	5				
1354		VE	1						3					
1111		VE	1						1					
1411		SP					1						1	
1109		VE	1						1					
1047		VE			1						1			
1031		VE	1						1					
1019		VE	1						1					
1068		VE	1						2					
1318		SP					1						1	
1081		VE			1						1			
1323		VE	1						1					
1136		SP					1						4	
1250		CP						1						1
1217		VE		1						1				
1113		VE		1						2				
1205		CP					1						7	
1249		VE			1						1			
1259		VE	1						1					
1100		CP					1						1	
1133		SP					1						4	
1322		SP					1						3	
1389		VE		1						1				
1021		VE	1						2					
1264		VE	1						2					
1309		VE	1						1					
1014		VE			1						1			
1037		VE			1						1			
1219		VE	2						2					
1054		VE	1						3					
1344		SP					4						7	
1118		SP					1						6	
1410		SP					2						2	

Site Types: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
End Uses: H=HVAC; L=Lighting; P=Process

Table M-2: List of Evaluated Sites (sorted by company name)

Site Number		Site Type	No. of Projects by End Use						No. of Items by End Use					
			Verify			Proj-Spec			Verify			Proj-Spec		
			H	L	P	H	L	P	H	L	P	H	L	P
1131		VE	1						1					
1283		SP					1						7	
1251		CP				3	2					3	17	
1020		VE	1						1					
1011		CP			1			2			1			2
1241		VE		2						4				
1170		SP					1						4	
1262		SP					1						6	
1226		VE	1						1					
1022		VE	1						1					
1303		SP					1						1	
1101		VE			2						2			
1155		VE	1						1					
1174		VE	1						1					
1010		VE			1						1			
1294		VE		1						4				
1236		SP					1						1	
1349		SP					1						1	
1098		VE	1						1					
1072		VE	1						2					
1357		VE		1						1				
1393		SP					1						1	
1395		SP					1						1	
1292		VE		1						3				
1253		SP					1						1	
1162		SP					1						7	
1314		SP					1						5	
1231		SP					1						1	
1379		CP				1						1		
1339		VE	1	1					1	1				
1233		VE			1						1			
1016		VE	1						1					
1214		CP					1						2	
1149		SP					1						1	
1227		SP					2						13	
1375		CP					1						5	
1024		VE	1						2					
1191		VE	1						1					
1398		VE	1						2					
1032		VE	1						1					
1258		CP					1						3	
1056		VE		2						2				
1370		VE		1						2				
1193		SP					1						2	
1274		VE	1						1					
1368		CP					2						4	
1367		VE	1	1					1	2				
1093		CP					1						3	
1183		VE			1						1			
1137		SP					1						4	

~~Site Types~~: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
~~End Uses:~~ H=HVAC; L=Lighting; P=Process

Table M-2: List of Evaluated Sites (sorted by company name)

Site Number		Site Type	No. of Projects by End Use						No. of Items by End Use					
			Verify			Proj-Spec			Verify			Proj-Spec		
			H	L	P	H	L	P	H	L	P	H	L	P
1150		VE	1						1					
1340		CP				1						1		
1107		SP					1						2	
1176		SP					1						2	
1102		SP					1						2	
1359		CP				1						2		
1338		SP					1						3	
1112		VE	1						1					
1182		SP					1						2	
1341		SP					1						4	
1288		SP					1						2	
1270		VE	1						1					
1070		SP					1						1	
1013		VE			1						1			
1352		VE			1						1			
1305		SP					1						5	
1203		CP					2						6	
1201		VE	1						2					
1026		VE	3						4					
1299		SP					1						4	
1083		CP					1						1	
1308		VE	2						2					
1082		SP					1						5	
1015		VE		1						1				
1030		VE	1						2					
1153		VE		2						4				
1409		VE		1						1				
1008		VE	1						1					
1363		VE			1						1			
1284		CP		1			1			2			6	
1332		VE	1						1					
1269		VE	1						1					
1106		VE	1						1					
1180		VE		1						3				
1025		VE		1						5				
1087		VE	1						1					
1385		CP					1						1	
1173		VE	1						1					
1208		VE		1						3				
1328		VE	1						1					
1156		VE	1						2					
1002		VE		1						3				
1188		VE	1						1					
1287		VE		1						5				
1147		VE	1						1					
1386		CP					2						5	
1190		CP				1						1		
1074		SP					1						5	
1310		VE	1						1					
1040		VE		1						4				

~~Site Types~~: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
~~End Uses:~~ H=HVAC; L=Lighting; P=Process

Table M-2: List of Evaluated Sites (sorted by company name)

Site Number		Site Type	No. of Projects by End Use						No. of Items by End Use					
			Verify			Proj-Spec			Verify			Proj-Spec		
			H	L	P	H	L	P	H	L	P	H	L	P
1009		VE						1						1
1011		CP			1			2			1			2
1012		CP						1						1
1017		CP						1						1
1018		CP			1			1			1			1
1049		CP						1						1
1083		CP					1						1	
1091		CP					1						4	
1093		CP					1						3	
1095		CP					1						3	
1100		CP					1						1	
1123		CP					1						5	
1132		CP				1	1					4	7	
1169		CP		1			1			3			1	
1177		CP						1						1
1184		CP				1						1		
1190		CP				1						1		
1203		CP					2						6	
1205		CP					1						7	
1214		CP					1						2	
1223		CP						1						1
1228		CP	1			2			1			4		
1235		CP				1						1		
1250		CP						1						1
1251		CP				3	2					3	17	
1258		CP					1						3	
1273		CP					2						6	
1284		CP		1			1			2			6	
1326		CP					1						6	
1330		CP					1						5	
1340		CP				1						1		
1359		CP				1						2		
1360		CP						1						1
1368		CP					2						4	
1375		CP					1						5	
1379		CP				1						1		
1385		CP					1						1	
1386		CP					2						5	
1387		CP					1						1	
1425		CP			2			2			2			2
1432		CP						1						1
1434		CP						1						1
1003		SP	1				1		3				3	
1065		SP					1						1	
1067		SP					1						6	
1070		SP					1						1	
1074		SP					1						5	
1082		SP					1						5	
1094		SP					1						4	
1097		SP					1						4	

~~Site Types~~: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
~~End Uses:~~ H=HVAC; L=Lighting; P=Process

Table M-2: List of Evaluated Sites (sorted by company name)

Site Number		Site Type	No. of Projects by End Use						No. of Items by End Use					
			Verify			Proj-Spec			Verify			Proj-Spec		
			H	L	P	H	L	P	H	L	P	H	L	P
1017		CP						1						1
1035		VE			1						1			
1312		SP					1						1	
1138		VE		1						1				
1197		VE		1						4				
1425		CP			2			2			2			2
1418		VE	1						2					
1289		VE		1						2				
1384		SP					1						1	
1171		VE	1						1					
1423		VE	1						1					
1221		SP					1						3	
1189		VE			1						1			
1298		VE	2						2					
1432		CP						1						1
1434		CP						1						1
1362		VE			1						2			
1095		CP					1						3	
1094		SP					1						4	
1326		CP					1						6	
1330		CP					1						5	
1407		SP					1						4	
1420		VE		1						1				
1209		VE		1						1				
1365		VE	1						2					
1399		VE	1						2					
1044		VE			1						1			
1301		VE	1						1					
1360		CP						1						1
1345		VE		1						1				
1097		SP					1						4	
1321		VE	1						1					
1051		VE		1						1				
1130		SP					1						2	
1099		VE	1						1					
1237		VE	1						1					
1273		CP					2						6	
1120		SP					1						5	
1041		VE			1						1			
1218		VE			1						1			
1342		VE		1						3				
1073		VE			1						1			
1304		VE			1						1			
1358		VE			1						1			
1325		VE		1						2				
1028		VE	1						1					
1388		SP					1						5	
1061		VE	1						1					
1049		CP						1						1
1403		VE	1						2					

Site Types: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
End Uses: H=HVAC; L=Lighting; P=Process

Table M-2: List of Evaluated Sites (sorted by company name)

Site Number		Site Type	No. of Projects by End Use						No. of Items by End Use					
			Verify			Proj-Spec			Verify			Proj-Spec		
			H	L	P	H	L	P	H	L	P	H	L	P
1052		VE		1					1					
1401		VE	1											
1065		SP				1					1			
1290		SP				1					3			
1271		VE						1						
1196		VE		1				2	1					
1381		VE	1											
1076		VE	1											
1414		VE						2						
1228		CP			2			1		4				
1115		SP				1					3			
1337		VE						1						
1257		VE						1						
1163		VE	1					2						
1050		VE						2						
1139		SP				1					3			
1300		VE	1											
1157		VE	1											
1413		VE		1					1					
1088		VE						1						
1104		VE	1											
1335		VE						1						
1315		VE						2						
1027		VE						1						

Site Types: CP=Project-Specific with Custom Free-Ridership; SP=Project-Specific with Standard Free-Ridership; VE=Verify Only
End Uses: H=HVAC; L=Lighting; P=Process

Appendix N

Program Evaluation and 1996 Retention Panel Data Bases

This appendix documents the final data products from this evaluation. These products consist of the final evaluation and 1996 retention panel data base, as well as the site zip files and corresponding paper 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.

With the exception of the paper files, all of these data products are loaded on two 100-megabyte Iomega® Zip™ disks, with the following directory structure:

DISK	SUBDIRECTORY	CONTENTS
1	CODE	SAS jobs used to create intermediate data sets.
1	DATA	Original MDSS data base extracts and intermediate data sets created during the evaluation.
1	FINDATA	Final program evaluation and retention panel data sets.
1 & 2	SITEZIPS	Site zip files containing site evaluation plans, data, code, and reports.
1	CONFREP	Site reports containing confidential information necessary for future retention studies.

These subdirectories and their contents are discussed in greater detail below. A list of the files in each of these subdirectories can be found in Table N-1.

1.1 SAS Jobs and Visual Basic Code

The CODE directory contains the SAS jobs that manipulated the original PG&E MDSS data base extracts and created the evaluation sample frame. The CP and HSAVE zip files contain the SAS jobs, as well as their associated include files and macros, that 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, in conjunction with the QC.EXE Visual Basic program, 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 data base extract can be found in the SAMPLE.ZIP zip file. The data sets necessary for reproducing our final savings estimates can be found in the QC and PSAVE zip files.

1.3 Site Zip Files and Supporting Documentation

The SITEZIPS subdirectory contains 274 self-extracting site zip files. Each of these site zip files corresponds to an evaluated project-specific or verify-only 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 97 document named RPT<site identification number>.DOC) and the corresponding site report workbook (a Microsoft Excel 97 workbook named SITE<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. Refer to Appendix M for tables listing site identification numbers and company names.

Site zip files for sites with project-specific projects also contain any DOE-2.1E models, SAS programs, Excel workbooks, and other supporting data that we used during the evaluation to develop savings estimates. The names for these supporting files contain the relevant site, project, and item numbers in a standardized format (for example, the DOE-2 model to calculate gross savings for Project 1234, Item 2 would be named P1234G2.INP, and the corresponding SAS programs to process the data might be called H1234_2.SAS or C1234_2.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 types of supporting data. This hard copy supplemental information was shipped to PG&E separately. Both the electronic files in the SITEZIPS directory and the supporing documentation has been purged of any information that might reveal the identity, phone number, or location of a customer.

1.4 Program Evaluation and 1996 Retention Panel Data Base

The FINDATA subdirectory contains the final evaluation/retention data base. This data base holds information gathered from the PG&E program data base and files, as well as via telephone surveys, on-site inspections, short-term end-use metering, and engineering calculations. In general, the data fall into the following six categories:

1. PG&E data base
2. File review
3. Savings evaluation
4. Decision-maker survey
5. Vendor survey

6. Retention panel

Note that the data base contains confidential information about customer names, addresses, and phone number.

Table N-2 lists and documents the variables in these categories in more detail. We have supplied the data base in two formats, with the following file names:

- **IND96PDB.XPT** (SAS Version 6 transport file containing the data set IND96PDB)
- **IND96PDB.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 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 key variables for the 1,002 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 APPCD, PROGYR, and CONTROL variables.

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 Confidential Site Reports for the Retention Panel

In several instances, the 1996 retention panel data base does not contain detailed enough information to perform future survival analyses. For example, some customers installed rebated pump-off controllers at hundreds of oil wells scattered throughout a wide area. The retention panel contains data summarizing the controllers' general location and number, but only by referring to the site report, which contains detailed listings of each well and lease number, can future evaluators identify which controllers were inspected as part of this evaluation. Very often this critical information is also confidential, and thus has been deleted from the site zip files in the SITEZIPS subdirectory. To ensure this information remains available, we have included certain site reports with confidential customer information still contained within. These reports can be found in the CONFREP subdirectory.

Table N-1: Detailed List of Electronic Data Products

Disk No.	Subdirectory	FILE NAME*	TYPE OF FILE(S)	DESCRIPTIONS
1	\CODE	DBLOAD2.SAS	SAS 6.12 job	Converts raw MDSS data base to SAS data sets
		DBSAMP1, -3.SAS	SAS 6.12 jobs	Create project- and item-level sample frame
		CP.ZIP	SAS & DOE-2 files (zipped)	Summarizes lighting savings analysis (customized for each item)
		HSAVE.ZIP	SAS jobs/files (zipped)	Summarizes HVAC, process savings analysis (customized for each item)
		QC1-3.SAS	SAS 6.12 jobs	Combines all site evaluation data, checks results
		QC.EXE/-.BAS	Visual Basic 5.0 executable/project	Extracts data from site workbooks (used by QC1.SAS)
		PSAV1-4.SAS	SAS 6.12 jobs	Calculates program gross and net savings/impacts
		FINALDB.SAS	SAS 6.12 job	Generates final data sets
1	\DATA	**MJOB1.ZIP** mjob1.mdb* mjob1.ldb	Access 97 data base (zipped)	Original PG&E MDSS extract
		SAMPLE.ZIP frame1.sd2* frame2.sd2* appeu1.sd2* appeu2.sd2* item1.sd2 item2.sd2	SAS 6.12 data sets (zipped)	Raw PG&E program data, sample frames
		QC.ZIP allqc.sd2* allspill.sd2	SAS 6.12 data sets (zipped)	Combined PG&E and eval. data from the QC*.SAS jobstream
		PSAVE.ZIP psav1 to -4.sd2 psavsum3.sd2 psavsum4.sd2	SAS 6.12 data sets (zipped)	Program and spillover savings from PSAV*.SAS jobstream
1	\FINDATA	IND96PDB.XLS*	Excel 5.0	Final program evaluation and 1996 retention panel data base
		IND96PDB.XPT*	SAS Version 6 transport	Final program evaluation and 1996 retention panel data base
		DBFORMTS.SAS	SAS code	Formats for IND96PDB variables
1	\CONFREP	RPT<site id>.DOC*	Word 97 files	Site reports containing confidential info necessary for future retention studies.
1 & 2	\SITEZIPS	S<site id>.ZIP	Various files (in 274 zip files)	Site eval. Plan, workbook, report, DOE-2 models, data, etc.

* Files marked with asterisks contain confidential customer information

Table N-2: Evaluation Data Set Variable List for IND96PDB

DATA SOURCE	VARIABLE	TYPE	LABEL
1. PG&E Data Base	ACCOUNT	Char	PG&E account number
	APPCD	Char	PG&E application number
	CNAME	Char	PG&E original customer contact name
	CONTROL	Num	PG&E control number
	CORPCD	Num	PG&E corporation code
	CPHONE	Char	PG&E original customer contact phone
	DIV	Char	PG&E division
	MEASCD	Char	PG&E measure code
	MEASLBL	Char	Measure label
	NPDKW	Num	PG&E data base net kW savings
	NPDKWH	Num	PG&E data base net kWh savings
	NPDTHERM	Num	PG&E data base net therm savings
	PAYTO	Char	PG&E data base customer name
	PCTKW	Num	% of program end use kW savings
	PCTKWH	Num	% of program end use kWh savings
	PCTTHM	Num	% of program end use therm savings
	PDKW	Num	PG&E data base gross kW savings
	PDKWH	Num	PG&E data base gross kWh savings
	PDTHERM	Num	PG&E data base gross therm savings
	PKWHRR	Num	PG&E kWh realization rate
	PKWRR	Num	PG&E kW realization rate
	PNTG	Num	PG&E net-to-gross ratio
	PNUMPUR	Num	PG&E data base # of items purchased
	PREBATE	Num	Rebate amount
	PROGRAM	Char	PG&E program code
	PROGYR	Num	Year application submitted (program yr)
	PROJICST	Num	PG&E paid incremental item cost
	PROJLIF	Num	PG&E project life for item
	PROJTCST	Num	PG&E project cost
	PSHRHLD	Num	PG&E shareholder savings ($)
	SCITY	Char	Service city
	SICLBL	Char	SIC label
	SSTREET	Char	Service street
	SZIP	Num	Service ZIP code
2. File Review	FCITY	Char	PG&E file customer city
	FCOMPANY	Char	PG&E file company name
	FKW	Num	PG&E file kW savings
	FKWH	Num	PG&E file kWh savings
	FNUMPUR	Num	PG&E file # of items purchased
	FSTREET	Char	PG&E file customer address
	FTHM	Num	PG&E file therm savings
	FUNITS	Char	PG&E file measure units
	FZIP	Num	PG&E file customer ZIP code
	REPDEPT	Char	PG&E representative department
	REPEMAIL	Char	PG&E representative e-mail address
	REPNAME	Char	PG&E representative
	REPPHONE	Char	PG&E representative phone number

DATA SOURCE	VARIABLE	TYPE	LABEL
3. Savings eval. (KEY)	ITEMNUM	Num	KEY 2: Item number (SBW-assigned)
3. Savings eval. (KEY)	PROJID	Num	KEY 1: Project ID number (SBW-assigned)
3. Savings evaluation	AGKW	Num	Eval gross max kW svgs (connected load)
	AGKW2	Num	Eval gross coinc sum onpeak avg kW svgs
	AGKWH	Num	Eval gross kWh savings
	AGTHERM	Num	Eval gross therm savings
	BASELINE	Char	Gross baseline used in evaluation
	CANNKWH	Num	Customer baseline kWh savings
	CANNTHM	Num	Customer baseline therm svgs (w/HCI)
	CATEGORY	Char	Evaluation disposition category
	CDIF	Num	App/eval pct diff in unit capacity
	CMAXKW	Num	Customer baseline kW savings
	CNTKW	Num	Eval net max kW savings w/custom NTGR
	CNTKW2	Num	Eval net avg kW savings w/custom NTGR
	CNTKWH	Num	Eval net kWh savings w/custom NTGR
	CNTTHERM	Num	Eval net therm savings w/custom NTGR
	CONTADDR	Char	Eval customer contact address
	CONTCITY	Char	Eval customer contact city
	CONTCOMP	Char	Eval customer contact company name
	CONTNAME	Char	Eval customer contact name
	CONTPHON	Char	Eval customer contact phone number
	CONTSTAT	Char	Site contact state
	CONTZIP	Num	Site contact ZIP code
	CORPID	Num	Corporate ID number (SBW-assigned)
	CTHMDE	Num	Customer baseline therm svgs (no HCI)
	CUSTNTGR	Num	Eval customized NTGR
	EU	Char	End use
	FREETYPE	Char	Type of free-ridership analysis
	HCIKWH	Num	Lighting heat-cool interaction (in kWh)
	KW1	Num	Summer on-peak avg kW savings
	KW2	Num	Summer part-peak avg kW savings
	KW2RR	Num	Eval coinc avg sum on-pk kW real. rate
	KW3	Num	Summer off-peak avg kW savings
	KW4	Num	Winter part-peak avg kW savings
	KW5	Num	Winter off-peak avg kW savings
	KWH1	Num	Summer on-peak kWh savings
	KWH2	Num	Summer part-peak kWh savings
	KWH3	Num	Summer off-peak kWh savings
	KWH4	Num	Winter part-peak kWh savings
	KWH5	Num	Winter off-peak kWh savings
	KWHRR	Num	Eval kWh realization rate
	KWRR	Num	Eval connected load kW realization rate
	KWSYSPH1	Num	Summer on-peak coincident avg kW svgs
	KWSYSPH2	Num	Summer part-peak coincident avg kW svgs
	KWSYSPH3	Num	Summer off-peak coincident avg kW svgs
	KWSYSPH4	Num	Winter part-peak coincident avg kW svgs

DATA SOURCE	VARIABLE	TYPE	LABEL
	KWSYSPH5	Num	Winter off-peak coincident avg kW svgs
	LITEEFLH	Num	Lighting equiv full-load hours
	MEASAREA	Num	Eval measure-affected area (sq ft)
	NETKW	Num	Eval net max kW savings
	NETKW2	Num	Eval net summer onpeak avg kW savings
	NETKWH	Num	Eval net kWh savings
	NETTHERM	Num	Eval net therm savings
	NTGR	Num	Eval standard NTGR
	ODIF	Num	App/eval % diff in operating hours
	OS_DISP	Num	Operation staff survey disposition
	OTMEAS	Char	Eval one-time measurement flag (Y/N)
	PROJTYPE	Char	Project type (SBW-assigned)
	SDIF	Num	App/eval % diff in operating hours
	SITEID	Num	Site ID number (SBW-assigned)
	SOFPKWF	Num	Eval summer off-peak kW fraction
	SOFPKWHF	Num	Eval summer off-peak kWh fraction
	SONPKWF	Num	Eval summer on-peak kW fraction
	SONPKWHF	Num	Eval summer on-peak kWh fraction
	SP_DISP	Num	Spillover survey disposition
	SPTPKWF	Num	Eval summer part-peak kW fraction
	SPTPKWHF	Num	Eval summer part-peak kWh fraction
	STATUS	Char	Evaluation status
	STMEAS	Char	Eval short-term measurement flag (Y/N)
	THMRR	Num	Eval therm realization rate
	WOFPKWF	Num	Eval winter off-peak kW fraction
	WOFPKWHF	Num	Eval winter off-peak kWh fraction
	WPTPKWF	Num	Eval winter part-peak kW fraction
	WPTPKWHF	Num	Eval winter part-peak kWh fraction
	XDIF	Char	App/eval other reasons for svgs diff %
4. Dec-Maker Survey	DMP_DISP	Num	Dec-maker survey disposition (proj spec)
	DMV_DISP	Num	Dec-maker survey disposition (verify)
	Q10	Num	Dec-maker survey Q.10 response
	Q11_1	Num	Dec-mkr survey Q11 response #1 (final)
	Q11_2	Num	Dec-mkr survey Q11 response #2 (final)
	Q11_3	Num	Dec-mkr survey Q11 response #3 (final)
	Q11_4	Num	Dec-mkr survey Q11 response #4 (final)
	Q11_5	Num	Dec-mkr survey Q11 response #5 (final)
	Q11_6	Num	Dec-mkr survey Q11 response #6 (final)
	Q11_7	Num	Dec-mkr survey Q11 response #7 (final)
	Q11_8	Num	Dec-mkr survey Q11 response #8 (final)
	Q11_9	Num	Dec-mkr survey Q11 response #9 (final)
	Q11_98	Num	Dec-mkr survey Q11 response #98 (final)
	Q11_99	Num	Dec-mkr survey Q11 response #99 (final)
	Q11_1X	Num	Dec-mkr survey Q11 response #1 (orig)
	Q11_2X	Num	Dec-mkr survey Q11 response #2 (orig)
	Q11_3X	Num	Dec-mkr survey Q11 response #3 (orig)
	Q11_4X	Num	Dec-mkr survey Q11 response #4 (orig)

DATA SOURCE	VARIABLE	TYPE	LABEL
	Q11_5X	Num	Dec-mkr survey Q11 response #5 (orig)
	Q11_6X	Num	Dec-mkr survey Q11 response #6 (orig)
	Q11_7X	Num	Dec-mkr survey Q11 response #7 (orig)
	Q11_8X	Num	Dec-mkr survey Q11 response #8 (orig)
	Q11_9X	Num	Dec-mkr survey Q11 response #9 (orig)
	Q11_98X	Num	Dec-mkr survey Q11 response #98 (orig)
	Q11_99X	Num	Dec-mkr survey Q11 response #99 (orig)
	Q13	Num	Dec-maker survey Q.13 response
	Q14	Num	Dec-maker survey Q.14 response
	Q15	Num	Dec-maker survey Q.15 response
	Q5	Num	Dec-maker survey Q. 5 response
	Q6	Num	Dec-maker survey Q. 6 response
	Q7	Num	Dec-maker survey Q. 7 response
5. Vendor Survey	VDM_DISP	Num	Vendor survey disposition (proj-spec)
	VDMVDISP	Num	Vendor survey disposition (verify)
	VQ5	Num	Vendor survey Q.5 response (final)
	VQ6	Num	Vendor survey Q.6 response (final)
	VQ5X	Num	Vendor survey Q.5 response (orig)
	VQ6X	Num	Vendor survey Q.6 response (orig)
	VSP_DISP	Num	Vendor survey disposition (spillover)
6. Retention Study	INSTALL1	Num	Location 1: Number of installed units
	INSTALL2	Num	Location 2: Number of installed units
	INSTALL3	Num	Location 3: Number of installed units
	INSTALL4	Num	Location 4: Number of installed units
	INSTALL5	Num	Location 5: Number of installed units
	INSTALL6	Num	Location 6: Number of installed units
	ITEMDSC1	Char	Location 1: Item description(s)
	ITEMDSC2	Char	Location 2: Item description(s)
	ITEMDSC3	Char	Location 3: Item description(s)
	ITEMDSC4	Char	Location 4: Item description(s)
	ITEMDSC5	Char	Location 5: Item description(s)
	ITEMDSC6	Char	Location 6: Item description(s)
	LOCDSC1	Char	Location 1 description
	LOCDSC2	Char	Location 2 description
	LOCDSC3	Char	Location 3 description
	LOCDSC4	Char	Location 4 description
	LOCDSC5	Char	Location 5 description
	LOCDSC6	Char	Location 6 description
	MANUF1	Char	Location 1 equipment manufacturer
	MANUF2	Char	Location 2 equipment manufacturer
	MANUF3	Char	Location 3 equipment manufacturer
	MANUF4	Char	Location 4 equipment manufacturer
	MANUF5	Char	Location 5 equipment manufacturer
	MANUF6	Char	Location 6 equipment manufacturer
	MODEL1	Char	Location 1 equipment model
	MODEL2	Char	Location 2 equipment model
	MODEL3	Char	Location 3 equipment model

DATA SOURCE	VARIABLE	TYPE	LABEL
	MODEL4	Char	Location 4 equipment model
	MODEL5	Char	Location 5 equipment model
	MODEL6	Char	Location 6 equipment model
	OPERAT1	Num	Location 1: Number of operating units
	OPERAT2	Num	Location 2: Number of operating units
	OPERAT3	Num	Location 3: Number of operating units
	OPERAT4	Num	Location 4: Number of operating units
	OPERAT5	Num	Location 5: Number of operating units
	OPERAT6	Num	Location 6: Number of operating units
	OTHER1	Char	Location 1 : Other comments
	OTHER2	Char	Location 2 : Other comments
	OTHER3	Char	Location 3 : Other comments
	OTHER4	Char	Location 4 : Other comments
	OTHER5	Char	Location 5 : Other comments
	OTHER6	Char	Location 6 : Other comments
	QUANT1	Num	Reason 1: # of units missing
	QUANT2	Num	Reason 2: # of units missing
	QUANT3	Num	Reason 3: # of units missing
	REASON1	Char	Reason 1 for missing units
	REASON2	Char	Reason 2 for missing units
	REASON3	Char	Reason 3 for missing units

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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, 7, and 11 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, 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.
- Lighting: the product of measure-affected floor area (expressed in square feet) and hours of operation (in thousands).
- 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 parts 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. The third portion of the appendix addresses Protocol Table 11 requirements.

A. Response to Table 6 Requirements

Refer to Pages O-2 through O-7.

B. Response to Table 7 Requirements

Refer to Pages O-8 through O-10.

C. Response to Table 11 Requirements

Refer to Page O-11.

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 HVAC**
DESIGNATED UNIT OF MEASUREMENT: **SQUARE FEET**

			5. 90% Confidence Level				5. 80% Confidence Level			
			Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
1. Average Participant Group and Average Comparison Group Usage										
A. Pre-Installation Usage	kWh									
	kW									
	therms									
Base Usage	kWh									
	kW									
	therms									
Base Usage per Designated Unit of Meas.	kWh									
	kW									
	therms									
B. Impact Year Usage	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	Gross	19,208	Net	8,915	Gross	25,626	Gross	12,790	Net	20,399	Net	-2,570	Gross	24,217	Gross	14,199	Net	17,878	Net	-49
(= total impact / total no. of installed measures)	kW		2.202		1.024		2.696		1.708		1.961		0.087		2.588		1.816		1.756		0.293
	therms		20		4		77		-36		2,161		-2,153		65		-24		1,687		-1,679
B. Load Impacts per Designated Unit of Meas.	kWh		0.305		0.142		0.407		0.203		0.324		-0.041		0.385		0.225		0.284		-0.001
(= total impact / total no. of installed measures	W		0.035		0.016		0.043		0.027		0.031		0.001		0.041		0.029		0.028		0.005
/average no. of DUM per measure)	therm		0.00032		0.00006		0.001		-0.001		0.034		-0.034		0.001		0.000		0.027		-0.027
C. Participant Group Percent Change in Usage	kWh																				
	kW																				
	therms																				
Comparison Group Percent Change in Usage	kWh																				
	kW																				
	therms																				
D. Realization Rates		Gross		Net		Gross		Gross		Net		Net		Gross		Gross		Net		Net	
	kWh		0.43		0.32		0.58		0.29		0.73		-0.09		0.54		0.32		0.64		0.00
	kW		0.55		0.42		0.67		0.42		0.80		0.04		0.64		0.45		0.72		0.12
	therms		0.01		0.002		0.03		-0.01		1.32		-1.31		0.03		-0.01		1.03		-1.02
3. Net-to-Gross Ratios																					
A. Average Load Impacts	kWh	Ratio	0.46			Ratio	0.45	Ratio	0.47					Ratio	0.46	Ratio	0.47				
	kW		0.47				0.45		0.48						0.46		0.47				
	therms		0.20				0.19		0.21						0.19		0.21				
B. Avg. Load Impacts per Designated Unit of Meas.	kWh		0.46				0.45		0.47						0.46		0.47				
	kW		0.47				0.45		0.48						0.46		0.47				
	therms		0.20				0.19		0.21						0.19		0.21				
C. Avg. Load Impacts (as % Change in Usage)	kWh																				
	kW																				
	therms																				
4. Designated Unit Intermediate Data		DUM																			
A. Pre-Installation Avg. (Mean) Value for Participant Group		62,975																			
Pre-Installation Avg. (Mean) Value for Comparison Group																					
B. Post-Installation Avg. (Mean) Value for Participant Group		62,975																			
Post-Installation Avg. (Mean) Value for Comparison Group																					
5. Precision (see columns at far right)																					
6. Measure Count Data		Count																			
A. No. of Measures Installed by Participants in Part. Group		166																			
B. No. of Meas. Installed by All Prog. Part. During Prog. Yr.		177																			
C. No. of Measures Installed by the Comparison Group																					

Note: Gray areas indicate category is not applicable.

END USE: **INDUSTRIAL HVAC**

7. Market Segment Data

Distribution of Participants by SIC Label

	Percent
DRUGS	5.6
FOOD PREPARATIONS, NEC	5.6
HIGHWAY AND STREET CONSTRUCTION	5.6
PETROLEUM REFINING	16.7
RADIO AND TV COMMUNICATIONS EQUIPMENT	22.2
SEMICONDUCTORS AND RELATED DEVICES	16.7
SURGICAL AND MEDICAL INSTRUMENTS	22.2
WINES, BRANDY, AND BRANDY SPIRITS	5.6

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			
				Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower 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 Usage	kWh										
	kW										
	therms										
Impact Year Usage per Designated Unit of Meas.	kWh										
	kW										
	therms										
2. Avg. Net & Gross End Use Load Impacts		~~Gross~~	~~Net~~	~~Gross~~	~~Gross~~	~~Net~~	~~Net~~	~~Gross~~	~~Gross~~	~~Net~~	~~Net~~
A. ~~Load Impacts~~	kWh	29,649	19,587	32,354	26,944	21,906	17,268	31,760	27,538	21,397	17,777
(= total impact / total no. of installed measures)	kW	3.917	2.322	4.264	3.570	2.630	2.013	4.187	3.646	2.563	2.081
	therms	-156	-126								
B. ~~Load Impacts per Designated Unit of Meas.~~	kWh	0.311	0.206	0.340	0.283	0.230	0.181	0.333	0.289	0.225	0.187
(= total impact / total no. of installed measures	watts	0.041	0.024	0.045	0.037	0.028	0.021	0.044	0.038	0.027	0.022
/average no. of DUM per measure)	therms	-0.002	-0.001								
C. Participant Group Percent Change in Usage	kWh										
	kW										
	therms										
Comparison Group Percent Change in Usage	kWh										
	kW										
	therms										
D. ~~Realization Rates~~		~~Gross~~	~~Net~~	~~Gross~~	~~Gross~~	~~Net~~	~~Net~~	~~Gross~~	~~Gross~~	~~Net~~	~~Net~~
	kWh	1.05	1.03	1.15	0.95	1.16	0.91	1.13	0.98	1.13	0.94
	kW	0.86	0.76	0.93	0.78	0.86	0.66	0.91	0.80	0.83	0.68
	therms										
3. Net-to-Gross Ratios		~~Ratio~~		~~Ratio~~	~~Ratio~~			~~Ratio~~	~~Ratio~~		
A. ~~Average Load Impacts~~	kWh	0.66		0.64	0.69			0.64	0.68		
	kW	0.59		0.57	0.62			0.57	0.61		
	therms	0.81		0.78	0.83			0.79	0.83		
B. ~~Avg. Load Impacts per Designated Unit of Meas.~~	kWh	0.66		0.64	0.69			0.64	0.68		
	kW	0.59		0.57	0.62			0.57	0.61		
	therms	0.81		0.78	0.83			0.79	0.83		
C. Avg. Load Impacts (as % Change in Usage)	kWh										
	kW										
	therms										
4. Designated Unit Intermediate Data		~~DUM~~									
A. ~~Pre-Installation Avg. (Mean) Value for Participant Group~~		95,275									
Pre-Installation Avg. (Mean) Value for Comparison Group											
B. ~~Post-Installation Avg. (Mean) Value for Participant Group~~		95,275									
Post-Installation Avg. (Mean) Value for Comparison Group											
5. Precision (see columns at far right)											
6. Measure Count Data		~~Count~~									
A. No. of Measures Installed by Participants in Part. Group		429									
B. No. of Meas. Installed by All Prog. Part. During Prog. Yr.		776									
C. No. of Measures Installed by the Comparison Group											

END USE: **INDUSTRIAL LIGHTING**

7. Market Segment Data

Distribution of Participants by SIC Label

	Percent
ALUMINUM EXTRUDED PRODUCTS	0.3
BOOK PUBLISHING	1.3
BOOKBINDING AND RELATED WORK	0.3
BOTTLED AND CANNED SOFT DRINKS	1.9
CANNED FRUITS AND VEGETABLES	0.3
CHOCOLATE AND COCOA PRODUCTS	1.0
COMMERCIAL PRINTING, LITHOGRAPHIC	0.6
COMMERCIAL PRINTING, NEC	1.3
COMPUTER AND OFFICE EQUIPMENT	5.5
COMPUTER PERIPHERAL EQUIPMENT, NEC	1.3
ELECTROMEDICAL EQUIPMENT	2.9
ELECTRONIC COMPONENTS, NEC	2.3
ELECTRONIC COMPUTERS	2.6
FABRICATED METAL PRODUCTS, NEC	0.6
FABRICATED PLATE WORK (BOILER SHOPS)	0.6
FLOUR AND OTHER GRAIN MILL PRODUCTS	4.2
FOOD PREPARATIONS, NEC	1.6
GASKETS, PACKING & SEALING DEVICES	0.3
GYPSUM PRODUCTS	1.0
INDUSTRIAL FURNACES AND OVENS	1.9
INDUSTRIAL MACHINERY, NEC	3.9
INDUSTRIAL VALVES	1.9
MANUFACTURING INDUSTRIES, NEC	2.3
MEASURING & CONTROLLING DEVICES, NEC	1.6
MEAT PACKING PLANTS	0.6
METAL DOORS, SASH, AND TRIM	0.6
METALWORKING MACHINERY, NEC	1.0
MOBILE HOMES	1.3
MOTOR VEHICLES AND CAR BODIES	0.3
NEWSPAPERS	3.6
NONFERROUS ROLLING AND DRAWING	1.9
OPHTHALMIC GOODS	1.0
PACKAGING MACHINERY	1.6
PAPER MILLS	0.3
PETROLEUM REFINING	5.5
PLASTICS PRODUCTS, NEC	1.6
PLATING AND POLISHING	0.6
PORCELAIN ELECTRIC SUPPLIES	1.0
PRINTED CIRCUIT BOARDS	1.3
PROCESS CONTROL INSTRUMENTS	2.9
RESIDENTIAL LIGHTING FIXTURES	0.6
SAWMILLS AND PLANING MILLS, GENERAL	1.0
SEMICONDUCTORS AND RELATED DEVICES	6.8
SHEET METAL WORK	1.6
SOAP AND OTHER DETERGENTS	1.9
SOFTWOOD VENEER AND PLYWOOD	0.3
SPECIAL INDUSTRY MACHINERY, NEC	1.6
SPECIAL PRODUCT SAWMILLS, NEC	2.3
SURGICAL AND MEDICAL INSTRUMENTS	4.9
SWITCHGEAR AND SWITCHBOARD APPARATUS	0.6
TELEPHONE AND TELEGRAPH APPARATUS	1.3
WINES, BRANDY, AND BRANDY SPIRITS	5.2
WOMEN'S HANDBAGS AND PURSES	1.0
WOOD OFFICE FURNITURE	0.3
WOOD PRODUCTS, NEC	1.9
X-RAY APPARATUS AND TUBES	1.3

Protocols for Reporting of Results of Impact Measurement Studies Used to Support and Earnings Claim **Table 6**

END USE: **INDUSTRIAL PROCESS**
DESIGNATED UNIT OF MEASUREME**PROJECTS (per measure)**

		5 90% Confidence Level				5 80% Confidence Level			
		Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound	Upper Bound	Lower Bound
1. Average Participant Group and Average Comparison Group Usage									
A. Pre-Installation Usage	kWh								
	kW								
	therms								
Base Usage	kWh								
	kW								
	therms								
Base Usage per Designated Unit of Meas.	kWh								
	kW								
	therms								
B. Impact Year Usage	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	512,092	309,760	750,557	273,627	460,289	159,230	698,211	325,973	427,246	192,273
(= total impact / total no. of installed measures)	kW	59.758	36.728	81.961	37.556	47.846	25.609	77.087	42.429	45.406	28.050
	therms	29,770	17,951	41,357	18,182	42,684	-6,781	38,814	20,726	37,255	-1,352
B. ~~Load Impacts per Designated Unit of Meas.~~	kWh	522,988	316,350	766,526	279,449	470,083	162,618	713,067	332,909	436,337	196,364
(= total impact / total no. of installed measures	kW	61.030	37.509	83.704	38.355	48.864	26.154	78.727	43.332	46.372	28.647
/average no. of DUM per measure)	therms	30,403	18,333	42,237	18,569	43,592	-6,926	39,639	21,167	38,048	-1,381
C. Participant Group Percent Change in Usage	kWh								
	kW								
	therms								
Comparison Group Percent Change in Usage	kWh								
	kW								
	therms								
D. ~~Realization Rates~~									
	kWh	0.79	0.73	1.15	0.42	1.09	0.38	1.07	0.50	1.01	0.45
	kW	0.97	0.92	1.33	0.61	1.20	0.64	1.26	0.69	1.14	0.70
	therms	0.86	0.80	1.20	0.53	1.90	-0.30	1.12	0.60	1.66	-0.06
3. Net-to-Gross Ratios									
A. ~~Average Load Impacts~~	kWh	0.60		0.59	0.62			0.59	0.62		
	kW	0.61		0.60	0.63			0.60	0.63		
	therms	0.60		0.59	0.62			0.59	0.61		
B. ~~Avg. Load Impacts per Designated Unit of Meas.~~	kWh	0.60		0.59	0.62			0.59	0.62		
	kW	0.61		0.60	0.63			0.60	0.63		
	therms	0.60		0.59	0.62			0.59	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 Group~~		0.98							
Pre-Installation Avg. (Mean) Value for Comparison Group									
B. ~~Post-Installation Avg. (Mean) Value for Participant Group~~		0.98							
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		48							
B. No. of Meas. Installed by All Prog. Part. During Prog. Yr.		49							
C. No. of Measures Installed by the Comparison Group									

Note: Gray areas indicate category is not applicable.

END USE: **INDUSTRIAL PROCESS**

7. Market Segment Data

Distribution of Participants by SIC Label

	Percent
CANNED FRUITS AND VEGETABLES	13.3
CRUDE PETROLEUM AND NATURAL GAS	40.0
GLASS CONTAINERS	6.7
INDUSTRIAL GASES	6.7
MINERAL WOOL	13.3
PHARMACEUTICAL PREPARATIONS	6.7
SAWMILLS AND PLANING MILLS, GENERAL	13.3

RESPONSE TO M&E PROTOCOL TABLE 7

A. Overview Information

1. Study Title: Impact Evaluation of Pacific Gas & Electric Company's 1996 Industrial Sector Energy Efficiency Incentives Programs: Lighting; HVAC; Process.

   Study IDs: 350 (IEEI Lighting), 352 (IEEI HVAC), 353 (IEEI Process)

2. Advanced Performance Options (APO), Customized, Retrofit Express (RE), and Retrofit Efficiency Options (REO) programs. All applications were paid rebates in 1996.

3. Evaluations covered HVAC, lighting, and process end uses.

4. Gross savings estimated by engineering methods via DOE 2.1E simulations and other engineering models, as described in Section 5. Net-to-gross ratios were estimated through self-reports in interviews. Further adjustment to NTGRs came from vendor surveys and from estimating alternate baseline consumption, based on customer reports of alternatives considered to as-built installations. Refer to Section 6 for details.

5. No comparison groups were used.

6. The table below outlines the evaluation population, sample frame, and final analysis sample. Additional details can be found in Section 3.

End Use	Population (# of items)	Sample Frame	Final Analysis Sample	
			Onsite	Metering
HVAC	177	177	166	14
Lighting	776	520	429	28
Process	49	49	48	9
ALL	**1,002**	**746**	**643**	**51**

B. Database Management

1. Tables and flow charts that show all data sources and their interrelations can be found in Section 2 (Figure 2-1), Section 4 (Figure 4-1), and Section 6 (Tables 6-2 and 6-4; Figures 6-1, 6-2, and 6-3).

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, data collected, 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 other anomalies. Any outliers were further scrutinized to confirm their correctness.

Net savings data quality checks: internal consistency checks were built into decision-maker interviews, so that interviewers were alerted to internal contradictions. For custom sites, consistency checks were applied to compare information from file information, operations staff surveys, and decision-maker interviews. Also, consistency between pre-quantified question responses and narrative question responses were reviewed systematically, both for decision makers and operations staff.

5. For the most part, all data collected were used. There were two exceptions. First, Question 11 on the Decision-Maker Survey, available for all items, was not used in estimating the NTGRs for non-custom items. This decision is consistent with recent agreements by the CADMAC Modeling and Base Efficiency Subcommittees. It was agreed that questions such as Q. 11 that have to do with the *timing* of the installation should not be routinely used to determine early replacement/deferred free-ridership. Thus, the use of Question 11 was restricted to custom items and, even here, it was never used routinely but rather it was taken into consideration along with all the other information for a given item in order to estimate the NTGR for custom projects. Note that, for all project-specific items, Question 11 was used to determine the appropriate baseline (pre-condition, Title 20, etc.) for the gross savings estimate.

   Second, vendor interviews conducted for project-specific items to assist in estimating the NTGRs were only used for custom sites, since these sites had much more quantitative and qualitative data available. The chances of correctly interpreting the vendor results were increased by placing these results in the context of this larger body of data.

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, E, and G through K. Sample disposition reports are in Section 3.

3. N/A

D. Data Screening and Analysis

1. Once recruitment was completed, very few data points were missing. The few that were missing, and how they were handled, 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 custom 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 custom 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 how they were handled, is discussed in Section 6.

12. The formulas for calculating standard errors and corresponding confidence intervals are listed in Section 6.

E. Data Interpretation and Application

1. Ex post gross savings were calculated by engineering methods. Ex post net savings were calculated by applying self-report-based NTGRs. Separate estimates of net savings were calculated for each program and end use. Average end use realization rates (based on ratios between ex post and ex ante estimates of gross savings) and NTGRs were applied to non-sampled ex ante gross savings estimates to produce net savings estimates for all items. These net savings were summed across end uses to calculate overall net savings. Net savings were also calculated for spillover installations and added to the total net savings for 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 1996, 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	0.305	0.035	0.00032
Lighting	Square footage × annual hours of operation ÷ 1000	0.311	0.041	-0.002
Process	Projects	522,988	61,030	30,403

As noted for the net impacts, there is no reason to expect that the program participants who were paid rebates in 1996 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.