Customer Energy Efficiency Program
Measurement and Evaluation Program

# 1997 INDUSTRIAL ENERGY EFFICIENCY INCENTIVE PROGRAM IMPACT EVALUATION

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***PG&E Study ID numbers:***
***Process End Use: 334a***
***Indoor Lighting End Use: 334b***

***March 1, 1999***

Measurement and Evaluation
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# IMPACT EVALUATION OF PACIFIC GAS & ELECTRIC COMPANY'S 1997 INDUSTRIAL SECTOR ENERGY EFFICIENCY INCENTIVES PROGRAMS: PROCESS AND INDOOR LIGHTING END USES

***PG&E Study ID numbers: 334a and 334b***

## Purpose of Study

This study was conducted in compliance with the requirements specified in "Protocols and Procedures for the Verification of Costs, Benefits, and Shareholders Earnings from Demand-Side Management Programs", as adopted by California Public Utilities Commission Decision 93-05-063, revised 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 Process and Indoor Lighting end uses for which rebates were paid in 1997 by the following Pacific Gas & Electric Company industrial energy efficiency incentive programs: Advanced Performance Options, Customized, Retrofit Express, and Retrofit Efficiency Options.

## Methodology

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

Project-specific analyses were developed for projects that comprised at least 70% of the kWh, kW, and therm savings for each of the Process and Indoor Lighting end uses. Analyses were supported by on-site data collection for each project. A project-specific report was developed for each of the 23 Process analysis projects and for the 20 largest Indoor Lighting projects. A single report was prepared summarizing results for the remaining 184 smaller Indoor Lighting projects included in the sample. The project-specific analyses also quantified spillover impacts where identified. An additional 23 verification-only surveys were conducted for Process projects such that a census of Process projects was attempted for the evaluation.

A standardized net-to-gross (NTG) survey was administered for all Process and Indoor Lighting projects included in the sample, provided the customer was willing to cooperate with the survey and a customer representative who was reasonably familiar with the project decision was available. A total of 42 Process projects and 188 Indoor Lighting projects were included in the standardized NTG analysis. A scoring algorithm was applied to this survey to develop NTG ratios for each project.

In addition, large analysis projects (15 Process and 20 Indoor Lighting) received a customized NTG analysis. The customized analysis built upon the standardized NTG approach and included information from project files, additional customer interviews, vendor interviews, and PG&E Representative interviews. The goal of the customized NTG analysis was to provide the best possible NTG ratio for each large project by incorporating data from multiple sources, resolving inconsistencies among sources, and providing a narrative documenting the assigned project NTG ratio.

The project-specific evaluation results were expanded to program totals using appropriate techniques. Gross savings were expanded by end use using ratio estimators. NTG ratios were calculated for each end use as a savings-weighted average of project-specific NTG ratios.

## Study Results

The results of the industrial sector evaluation in the Process and Indoor Lighting end uses are summarized below:

**PG&E 1997 Industrial Energy Efficiency Incentives Programs**
**Summary of Evaluation Gross and Net Load Impacts**
**Process and Indoor Lighting End Uses**

| Process (Study: 334a) | Gross Savings | Gross Realization Rate | Net-To-Gross | | Net Savings | Net Realization Rate |
|---|---|---|---|---|---|---|
| | | | 1-FR* | SO* | | |
| **EX ANTE** | | | | | | |
| kW | 4,267 | | 0.75 | - | 3,200 | |
| kWh | 39,212,879 | | 0.75 | - | 29,409,659 | |
| Therms | 2,996,222 | | 0.75 | - | 2,247,167 | |
| **EX POST** | | | | | | |
| kW | 3,416 | 0.80 | 0.55 | 0.00 | 1,876 | 0.59 |
| kWh | 17,434,659 | 0.44 | 0.49 | 0.00 | 8,472,387 | 0.29 |
| Therms | 2,390,716 | 0.80 | 0.87 | 0.00 | 2,075,496 | 0.92 |

| Indoor Lighting (Study: 334b) | Gross Savings | Gross Realization Rate | Net-To-Gross | | Net Savings | Net Realization Rate |
|---|---|---|---|---|---|---|
| | | | 1-FR* | SO* | | |
| **EX ANTE** | | | | | | |
| kW | 3,769 | | 0.85 | - | 3,214 | |
| kWh | 20,465,386 | | 0.86 | - | 17,499,217 | |
| Therms | 0 | | - | - | 0 | |
| **EX POST** | | | | | | |
| kW | 4,315 | 1.14 | 0.69 | 0.0012 | 2,994 | 0.93 |
| kWh | 20,775,055 | 1.02 | 0.70 | 0.0013 | 14,495,908 | 0.83 |
| Therms | -4,579 | - | 0.70 | 0.0000 | -3,182 | - |

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

## Regulatory Waivers and Filing Variances

No regulatory waivers filed.

No E-Table variances.

# 1997 INDUSTRIAL ENERGY EFFICIENCY INCENTIVE PROGRAM IMPACT EVALUATION

## FINAL REPORT

**Process: PG&E Study ID #334a**
**Indoor Lighting: PG&E Study ID #334b**

**Prepared for**

**Pacific Gas and Electric Company**
**San Francisco, California**

**Prepared by**

**XENERGY Inc.**
**Oakland, California**

**March 1, 1999**

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# EXECUTIVE SUMMARY

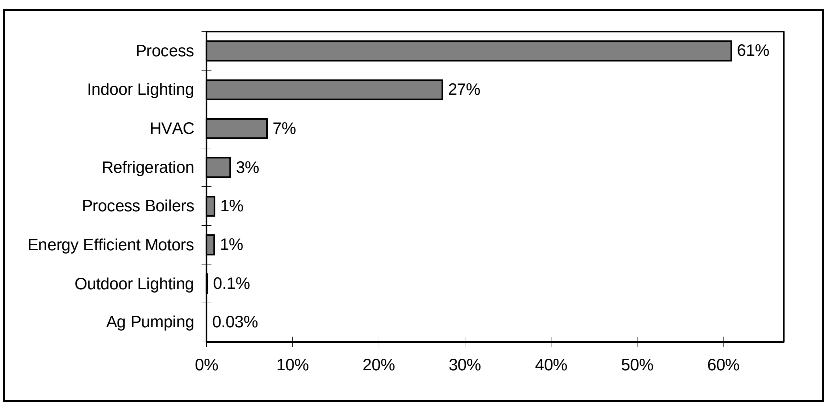
This report presents final impact evaluation results for the impact evaluation of Process and Indoor Lighting measures covered in Pacific Gas and Electric's (PG&E's) 1997 Industrial Energy Efficiency Incentives Programs. The programs include the Retrofit Express (RE) Program, the Retrofit Efficiency Options (REO) Program, the Advanced Performance Options (APO) Program, and the Customer Efficiency Options (CEO) Program.

Both gross and net Program impacts were developed for electric consumption (kWh), electric demand (kW), and natural gas consumption (therms). The evaluation approach was designed to meet the requirements of the Measurement and Evaluation Protocols (M&E Protocols). Site-specific engineering estimates of energy impacts for a sample of Program participants were utilized to determine gross impacts. Where applicable, short-term metering and monitoring were used to support the analyses. As required by the M&E Protocols, the analysis sample addressed over 70% of end-use kWh, kW, and therm impacts. Net-to-gross ratios were developed from customer self-report data and were applied to gross impacts to determine net Program impacts.

## E.1 BACKGROUND

PG&E offers rebates to industrial customers who adopt energy-efficiency measures to reduce energy consumption and demand in existing industrial facilities. In 1997, a total of 672 customer projects were paid rebates through the Retrofit Express, Retrofit Efficiency Options, Advanced Performance Options, and Customer Efficiency Options programs. The Process and Indoor Lighting end uses covered by this evaluation accounted for 379 of the projects and 88% of the industrial ex ante net avoided cost impacts. Figure E-1 shows a breakdown of Program impacts by end use. Since the Protocols require that end uses accounting for at least 85% of Program savings be evaluated, the current evaluation is restricted to these key end uses. The goal of the evaluation was to determine the load impacts associated with PG&E's investment in the Process and Indoor Lighting end-use components of the Industrial Programs.

**Figure E-1**
**Percent of Ex Ante Net Avoided Cost Impacts by End Use**



## E.2 METHODOLOGY

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

Project-specific analyses were developed for projects that comprised at least 70% of the kWh, kW, and therm savings for each of the Process and Indoor Lighting end uses. Analyses were supported by on-site data collection for each project. A project-specific report was developed for each of the 23 Process analysis projects and for the 20 largest Indoor Lighting projects. A single report was prepared summarizing results for the remaining 184 smaller Indoor Lighting projects included in the sample. The project-specific analyses also quantified spillover impacts where identified. An additional 23 verification-only surveys were conducted for Process projects such that a census of Process projects was attempted for the evaluation. A summary of the sample disposition is provided in Table E-1.

**Table E-1**
**Sample Disposition Summary**

| End Use | Process | Indoor Lighting |
|---|---|---|
| Total 1997 Projects | 50 | 329 |
| Analysis Sample | 23 | 204 |
| % of Total kWh | 82% | 79% |
| % of Total kW | 78% | 80% |
| % of Total Therms | 95% | - |
| Verification Sample | 24 | - |

A standardized net-to-gross (NTG) survey was administered for all Process and Indoor Lighting projects included in the sample, provided the customer was willing to cooperate with the survey and a customer representative who was reasonably familiar with the project decision was available. A total of 42 Process projects and 188 Indoor Lighting projects were included in the standardized NTG analysis. A scoring algorithm was applied to this survey to develop NTG ratios for each project.

In addition, large analysis projects (15 Process and 20 Indoor Lighting) received a customized NTG analysis. The customized analysis built upon the standardized NTG approach and included information from project files, additional customer interviews, vendor interviews, and PG&E Representative interviews. The goal of the customized NTG analysis was to provide the best possible NTG ratio for each large project by incorporating data from multiple sources, resolving inconsistencies among sources, and providing a narrative documenting the assigned project NTG ratio.

The project-specific evaluation results were expanded to program totals using appropriate techniques. Gross savings were expanded by end use using ratio estimators. NTG ratios were calculated for each end use as a savings-weighted average of project-specific NTG ratios.

## E.3 KEY FINDINGS

Evaluation ex post estimates of Program Impacts, relative to ex ante estimates, are summarized in Table E-2. Overall, net Program savings are estimated to be 4,870 kW, 22,968,295 kWh, and 2,072,314 therms on an annual basis. Approximately 76% of PG&E's ex ante net kW savings, 49% of the ex ante net kWh savings, and 92% of the ex ante net therm savings are being realized. Ninety percent confidence intervals are ±36% for net kW impacts, ±39% for net kWh impacts, and ±30% for net therm impacts.

**Table E-2**
**PG&E 1997 Industrial Energy Efficiency Incentives Programs**
**Summary of Evaluation Gross and Net Load Impacts**
**Process and Indoor Lighting End Uses**

| | Gross Savings | Gross Realization Rate | Net-To-Gross 1-FR* | Net-To-Gross SO* | Net Savings | Net Realization Rate |
|---|---|---|---|---|---|---|
| EX ANTE | | | | | | |
| kW | 8,035 | | 0.80 | - | 6,414 | |
| kWh | 59,678,265 | | 0.79 | - | 46,908,876 | |
| Therms | 2,996,222 | | 0.75 | - | 2,247,167 | |
| EX POST | | | | | | |
| kW | 7,730 | 0.96 | 0.63 | 0.0007 | 4,870 | 0.76 |
| kWh | 38,209,715 | 0.64 | 0.60 | 0.0007 | 22,968,295 | 0.49 |
| Therms | 2,386,137 | 0.80 | 0.87 | 0.0000 | 2,072,314 | 0.92 |

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

In order to gain a further understanding of Program performance, end-use level impacts are discussed next.

### *E.3.1 Process End Use*

Process ex post impacts are presented and compared to ex ante estimates in Table E-3. As the table indicates, ex post net impacts are 59% of the ex ante estimates for kW, 29% for kWh, and 92% for therms.

Relatively low Process realization rates are due, in large part, to three large projects where the ex ante analysis mischaracterized the basecase upon which savings are based. Two wine tank insulation projects showed zero impacts because the production of white wine in the climate zone where the wineries are located requires the use of insulated tanks, and therefore insulated tanks are the most appropriate basecase. For a third project, oil well pumps were converted from gas-driven pumps to electric motor pumps, and, as a result of the PG&E rebate, oil production was increased considerably. Application of the M&E Protocols required that the basecase be defined as the pre-retrofit equipment (the gas-driven pumps) and not the hypothetical, larger electric pumps utilized as a basecase in the ex ante analysis. The change in basecase led to large negative electric savings and positive gas savings for this project.

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

| | Gross Savings | Gross Realization Rate | Net-To-Gross 1-FR* | Net-To-Gross SO* | Net Savings | Net Realization Rate |
|---|---|---|---|---|---|---|
| EX ANTE | | | | | | |
| kW | 4,267 | | 0.75 | - | 3,200 | |
| kWh | 39,212,879 | | 0.75 | - | 29,409,659 | |
| Therms | 2,996,222 | | 0.75 | - | 2,247,167 | |
| EX POST | | | | | | |
| kW | 3,416 | 0.80 | 0.55 | 0.00 | 1,876 | 0.59 |
| kWh | 17,434,659 | 0.44 | 0.49 | 0.00 | 8,472,387 | 0.29 |
| Therms | 2,390,716 | 0.80 | 0.87 | 0.00 | 2,075,496 | 0.92 |

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

Exclusion of the three projects from the analysis causes net realization rates for kW and kWh to increase to 1.03 and 0.66, respectively. The net therm realization rate drops to 0.77 because the gas savings for the oil pump project are eliminated.

Table E-4 summarizes gross realization rates for the 23 Process projects that received site-specific analysis. As the table shows, about half of the projects have realization rates in the 0.75 to 1.25 range, which indicates that the ex post results are is general agreement with the ex ante estimates. However, the majority of projects that fell outside the 0.75 to 1.25 range tended to have low realization rates.

**Table E-4**
**Distribution of Process Realization Rates**

| Gross Realization Rate | Number of Projects kW | % Projects | kWh | % Projects | Therms | % Projects |
|---|---|---|---|---|---|---|
| > 1.25 | 3 | 16% | 2 | 9% | | |
| 0.75 - 1.25 | 7 | 37% | 13 | 57% | 1 | 50% |
| < 0.75 | 9 | 47% | 8 | 35% | 1 | 50% |
| Totals | 19 | 100% | 21 | 100% | 2 | |

Key reasons for gross impact discrepancies include:

- Measures not in place: For five oil well pump-off controller (POC) projects, a relatively large number of POCs had been removed or disconnected by the customer due to production problems; they had not yet been redeployed.
- Equipment/system performance that was different from projections: This factor involves equipment not performing as expected—such as when a motor's operational efficiency falls below its rated efficiency. The largest performance discrepancies involved POC projects that were not cycling the oil pumps off as much as expected.

- Different operating conditions: Equipment is often operated in a manner that is different from the ex ante predictions. For example, production hours or rates are constantly changing. At a number of sites, the evaluation revealed that equipment cycled or experienced a diversity factor that was not considered in the ex ante calculations.
- Basecase differences: Examples of basecase differences include the three problem projects discussed above. Aside from these projects, basecase discrepancies were minimal.

Table E-5 presents the distribution of NTG ratios for process projects. While the distribution seems reasonable, several of the largest kW and kWh impact projects returned NTG ratios below 0.50. This explains the relatively low NTG ratios shown above in Table E-3.

**Table E-5**
**Distribution of Process Net-to-Gross Ratios**

| NTGR Range | # Projects | % Projects |
|---|---|---|
| 1.00 | 7 | 17% |
| 0.70-0.99 | 16 | 38% |
| 0.30-0.69 | 15 | 36% |
| 0.01-0.29 | 1 | 2% |
| 0.00 | 3 | 7% |
| | 42 | 100% |

### *E.3.2 Indoor Lighting End Use*

Indoor Lighting ex post impacts are presented and compared to ex ante estimates in Table E-6. As the table indicates, ex post net impacts are 93% of the ex ante estimates for kW, and 83% for kWh. Negative therms impacts reflect interactive effects where reduced lighting wattage caused increase gas usage for space heating at some sites. Increased heating load was expressed in terms of kWh in the ex ante analysis, regardless of the type of heating the customer had.

**Table E-6**
**PG&E 1997 Industrial Energy Efficiency Incentives Programs**
**Summary of Evaluation Gross and Net Load Impacts**
**Indoor Lighting End Use**

| | Gross Savings | Gross Realization Rate | Net-To-Gross | | Net Savings | Net Realization Rate |
|---|---|---|---|---|---|---|
| | | | 1-FR* | SO* | | |
| EX ANTE | | | | | | |
| kW | 3,769 | | 0.85 | - | 3,214 | |
| kWh | 20,465,386 | | 0.86 | - | 17,499,217 | |
| Therms | 0 | | - | - | 0 | |
| EX POST | | | | | | |
| kW | 4,315 | 1.14 | 0.69 | 0.0012 | 2,994 | 0.93 |
| kWh | 20,775,055 | 1.02 | 0.70 | 0.0013 | 14,495,908 | 0.83 |
| Therms | -4,579 | - | 0.70 | 0.0000 | -3,182 | - |

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

Table E-7 summarizes gross realization rates for the 204 Indoor Lighting projects that were analyzed. As the table shows there is a rather wide variation in the realization rates. This can be expected because the ex ante estimates reflect broad industry averages for factors such as the change in connected load and annual operating hours, while the ex post results are site specific. Overall the project-specific discrepancies tended to even out as the ex ante and ex post impacts were in general agreement.

**Table E-7**
**Distribution of Indoor Lighting Realization Rates**

| Gross | Number of Projects | | | |
|---|---|---|---|---|
| Realization Rate | kW | % Projects | kWh | % Projects |
| > 1.25 | 64 | 33% | 76 | 37% |
| 0.76 - 1.25 | 46 | 24% | 68 | 33% |
| < 0.75 | 85 | 44% | 60 | 29% |
| Totals | 195 | 100% | 204 | 100% |

Key reasons for gross impact discrepancies are presented in Table E-8. The biggest contributors to gross realization rates exceeding 1.0 are the higher-than-expected noncoincident unit kW savings (connected load) and the higher coincident diversity factor. Connected load savings are larger ex post because many of the pre-retrofit lighting systems were found to be less efficient than assumed in the ex ante estimates. The higher coincident diversity factors reflect the fact that many industrial facilities are in full operation during summer weekday afternoons. Offsetting the effects of higher connected load savings were the impacts of HVAC interaction that were found to be lower in the ex post analysis.

**Table E-8**
**Indoor Lighting Savings Determinants**

| | Number of Units | Noncoincident Unit kW Savings | Annual Operating Hours | Coincident Diversity Factor | Net HVAC Interaction Effects: Peak kW Savings | Annual kWh Savings | Annual Therm Penalty |
|---|---|---|---|---|---|---|---|
| Ex Ante | 115,599 | 0.028 | 4,278 | 0.71 | 443.8 | 1,225,709 | 0 |
| Ex Post | 106,918 | 0.035 | 4,233 | 0.84 | 242.7 | 581,531 | -3,435 |
| Realization Rate | 0.92 | 1.26 | 0.99 | 1.18 | 0.55 | 0.47 | na |

Table E-9 shows the distribution of Indoor Lighting NTG ratios. Over half of the ratios fell in the 0.5 to 0.7 range, with most other projects showing NTG ratios that exceeded 0.7. This explains why Indoor Lighting NTG ratios average about 0.70 as shown in Table E-9.

**Table E-9**
**Distribution of Indoor Lighting Net-to-Gross Ratios**

| NTGR Range | # Projects | % Projects |
|---|---|---|
| 1.00 | 16 | 9% |
| 0.70-0.99 | 86 | 46% |
| 0.30-0.69 | 75 | 40% |
| 0.01-0.29 | 1 | 1% |
| 0.00 | 10 | 5% |
| | 188 | 100% |

# 1 INTRODUCTION

Pacific Gas and Electric Company (PG&E) offers rebates to industrial customers who adopt energy-efficiency measures to reduce energy consumption and demand in existing industrial facilities. In 1997, a total of 672 customer projects were paid rebates through the Retrofit Express (RE), Retrofit Efficiency Options (REO), Advanced Performance Options (APO), and Customer Efficiency Options (CEO) Programs. The Process and Indoor Lighting end uses covered by this evaluation accounted for 379 of the projects and 88% of the industrial ex ante net avoided cost impacts. Since the M&E Protocols require that end uses accounting for at least 85% of program savings be evaluated, the current evaluation is restricted to these key end uses. 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 REBATE PROGRAM DESCRIPTIONS

Each of the 1997 rebate programs covered by this evaluation is summarized below.

### *1.1.1 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 and 1997, 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.

### *1.1.2 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 1997, 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.

### *1.1.3 Advanced Performance Options (APO)*

This program 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.

### 1.1.4 Customer Efficiency Options (CEO)

This program offers technical, financial, and follow-up services to complement or create individual customer energy, environmental, and productivity improvement plans. The program was selectively marketed. Field marketing representatives screened customers using an objective and subjective screen that limited customer participation to those willing to act on high impact, cost-effective recommendations. All program components were tailored to the customer, based on identified needs. Although the program was closed to new participants in 1995, one large industrial lighting retrofit project received incentive payments in 1997 and is included in this evaluation.

## 1.2 PROJECT OVERVIEW

### 1.2.1 Evaluation Objectives

The primary objectives of the impact evaluation are to:

- Determine estimates of the gross and net impacts (kW, kWh, and therms) resulting from industrial process and indoor lighting measures installed through PG&E's incentive programs and rebated during 1997;
- Identify any discrepancies between estimated and measured impacts at the measure level and the end-use level;
- Suggest reasons for such discrepancies, such as differences between planning assumptions and what is found on-site for factors such as number of measures installed, connected load, and hours of operation;
- Conduct all analyses in a manner consistent with the California M&E Protocols; and
- Provide complete project documentation and databases required for regulatory replication of the study.

### 1.2.2 Evaluation Approach

The evaluation approach was designed to meet the requirements of the M&E Protocols. Site-specific engineering estimates of energy impacts for a sample of Program participants were utilized to determine gross impacts. Where applicable, short-term metering and monitoring were used to support the analyses. As required by the Protocols, the analysis sample addressed over 70% of end -use kWh, kW, and therm impacts.

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

## 1.3 REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 discusses the evaluation methodology. The study design, analysis methods, and data collection procedures are described.
- Section 3 presents evaluation results. Gross and net impacts for each analyzed end use – Process and Indoor Lighting – are presented and discussed.
- Appendices include A: site-specific evaluation results, B: sample data collection forms, C: site report templates, D: M&E Protocols Tables 6 and 7, and E: a description of the evaluation database.

# 2 METHODOLOGY

## 2.1 OVERVIEW

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

## 2.2 STUDY DESIGN

The impact evaluation focused on the Process and Indoor Lighting end-use components of PG&E's 1997 Industrial Programs. Together, these end uses comprise 88% of ex ante program net avoided cost savings. Project-specific analyses were utilized to estimate gross and net impacts for a sample of projects, with a concentration on the largest projects. Appropriate statistical techniques were used to expand sample results to the program population.

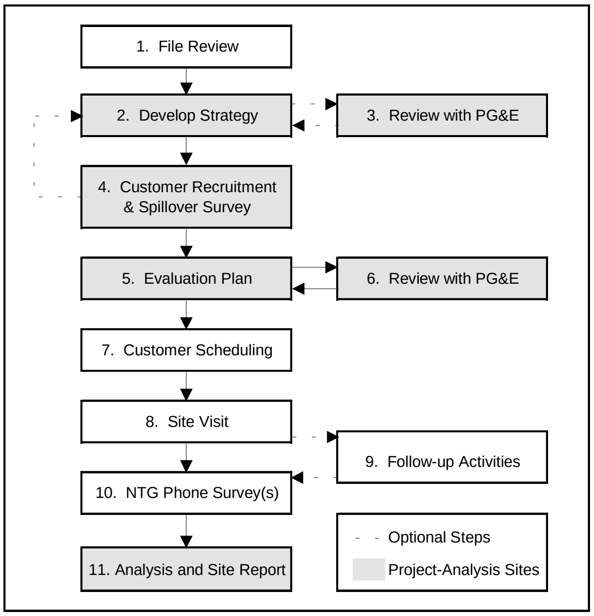
To develop gross savings estimates, a project-specific engineering analysis was conducted for most of the largest projects in each end use and a sample of smaller projects. The analyses were supported by on-site data collection activities. Verification-only on-site surveys were conducted for additional smaller projects in order to comply with the requirements of the Measurement and Evaluation Protocols (M&E Protocols).

Net impacts were estimated for each sampled project by combining gross savings results with net-to-gross ratios (NTGRs). The NTGRs were developed on a project-specific basis. A standard net-to-gross (NTG) survey was administered to customers for most sampled projects. (Projects for which a decision-maker was no longer with the company and an informed associate was not available did not receive NTG surveys.) A scoring algorithm was applied to this survey to develop NTGRs for each project. In addition, a customized NTG analysis was conducted for the largest projects in each end use. The customized analysis built upon the standardized NTG approach included information from project files and additional interviews with customers, vendors, and PG&E representatives.

### *2.2.1 Project Analysis Process*

The focus of the impact evaluation was on the project analysis. Each project designated for analysis was approached in a similar fashion. Figure 2-1 presents a schematic of the analysis process; this process is described more completely below. The verification-only studies and small lighting studies utilized some of the same steps as the larger analysis studies, as indicated by the unshaded boxes in Figure 2-1. Paths indicated with dotted lines in the figure show optional steps or steps that were not be required at for all projects.

**Figure 2-1**
**Project Analysis Process**




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

1. Review program files. Project technical files and support documentation provided useful information on the measure scope, equipment efficiency assumptions, operation conditions, and basecase assumptions. This information was usually sufficient to develop an initial measurement plan without a customer site visit. Key technical data and free-ridership information were extracted from the files.

2. Develop an initial evaluation strategy. The strategy included overall analytical approach, data collection activities (and instruments), and, where necessary, a proposed monitoring plan. The goal of the strategy was to leverage the initial analysis conducted for program approval by identifying and verifying key assumptions through surveys, modeling, and monitoring.

3. Contact PG&E representative(s), if necessary, to clarify issues of project scope and for background information. Based on discussions with the representative, the site strategy may have been revised.

4. Contact the customer to recruit participation, identify potential spillover, develop a preliminary understanding of data availability, and access for monitoring, as well as tentatively schedule site activities. Request that logs or other operating information be retained for use in the evaluation.

5. Prepare a site-specific evaluation plan based on strategy and level of resources available. Plans included lists of specific site information required and proposed monitoring instrumentation to be installed. Generic site-survey instruments were modified to apply

to the specific site. Customer limitations with respect to on-site personnel support, staff time, and scheduling were taken into account.

6. Submit plan to PG&E project manager for approval and modify, as necessary, per PG&E comments.
7. Schedule the site visit. Request that documentation be provided. Follow up with written confirmation/request as necessary.
8. Implement data collection activities. Conduct on-site surveys, perform measurements, and install monitoring equipment as needed.
9. If necessary, return to the site to remove monitoring equipment. Conduct other follow-up activities, as necessary. (If measures were not in place, PG&E representatives were contacted to investigate further.)
10. Conduct necessary NTG telephone interviews of the appropriate decision makers. Interviews may have included additional customer staff, vendors, and/or PG&E reps.
11. Carry out analyses and prepare a site report. A discrepancy analysis with tracking system estimates and assumptions is included in the site report.

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

### *2.2.2 Site Evaluation Plans and Reports*

The site evaluation plans were used to summarize the approaches to be utilized in the site analyses. A number of important factors were included as part of the plan, including (where applicable and available):

- Customer identification, including contacts
- Measure tabulation from PG&E records
- Description of business, products, and processes
- Pre-installation equipment and operations
- Technical discussion of the project
    - ◊ Measure-specific technical detail
- PG&E energy savings methodology
- Available site data
- Baseline identification

- Proposed evaluation methodology
  - ◊ Seasonality
  - ◊ Activity-level variable to be used for annualization
  - ◊ Interaction effects
  - ◊ Changes in production/operating levels
- Data requirements (site and secondary)
  - ◊ Data collection plan
  - ◊ Metering/Monitoring to be conducted
- Spillover identification and proposed analysis
- Net-to-gross considerations
  - ◊ Project economics (costs, required paybacks, etc.)
  - ◊ Discussion of project alternatives
  - ◊ Non-energy-savings benefits, if any

The site reports were developed as an extension of the site plans, with the inclusion of collected data, applied methodologies, and results. Attributes of the site reports include:

- Consistent format
- Summary of evaluation results vs. PG&E estimates
- Categorical explanation of discrepancies
- Full documentation of the analysis approach and calculations
- Findings of the net-to-gross analysis
- Appendices containing relevant data collected during the study

### *2.2.3 Measurement and Evaluation Protocols*

For industrial evaluations, the M&E Protocols (Table C-5) require that project-specific engineering analyses must be applied to projects representing a least 70% of the total kW, kWh, and therm savings for the targeted end-use element. Verification of installation must be conducted for all projects in the evaluation sample (a minimum of 150 projects for each end use or a census of projects if the end-use population is less than 150). The Process and Indoor Lighting sample designs (discussed next) were constructed to comply with the Protocols.

### *2.2.4 Process Sample Design*

The Process end use is by far the largest component of the 1997 Industrial Programs. It accounts for 61% of ex ante avoided-cost savings, 55% of ex ante kWh savings (39,212,879 kWh), 43% of ex ante kW savings (4,267 kW), and 95% of ex ante therm savings (2,996,222 therms).

### *Process Measures*

Based on a review of the Process project files, projects were allocated into six different measure-technology groups. A savings breakdown by these measure groups is presented graphically in Figure 2-2 and is also shown in Table 2-1. As the figure and the table show, thermal process modifications (four projects at three sites) account for all of the therm savings. Oil well pump modifications and controls account for about one-third of the kWh and kW savings. Variable frequency drive installations account for about 29% of the kWh savings but only 6% of the kW savings. Refrigeration/tank insulation measures account for 13% of kWh savings and 31% of kW savings (largely because the savings associated with these measures are associated with warm temperatures that correlate with the system peak demand).

**Figure 2-2**
**Ex Ante Process Savings by Measure Group**

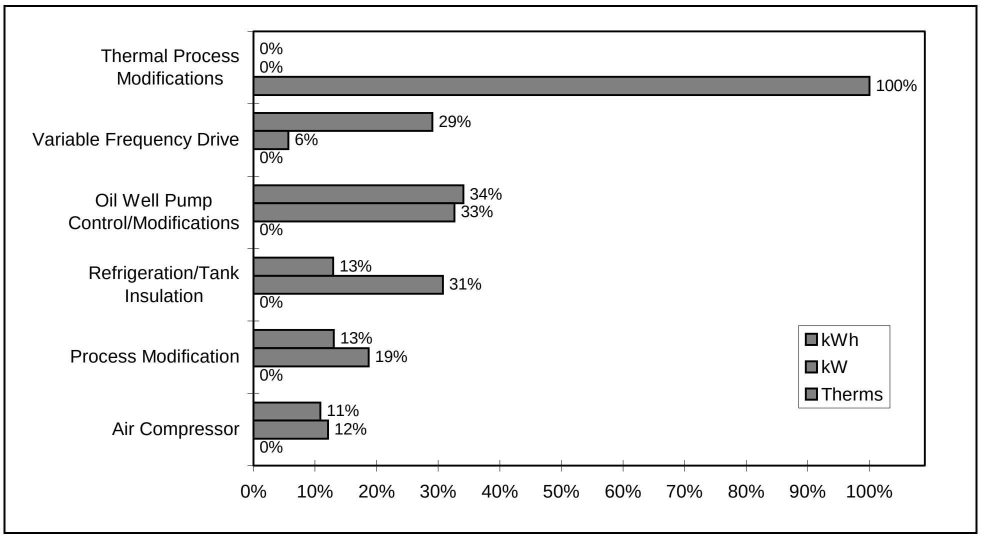


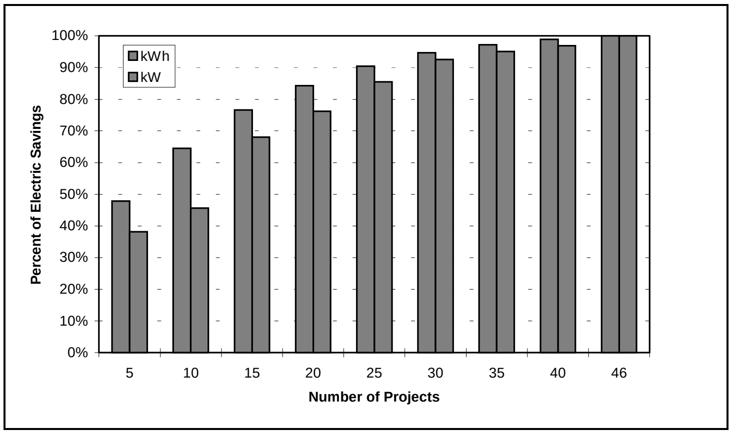

**Table 2-1**
**Ex Ante Process Savings by Measure Group**

| Measure Group | kWh | % kWh | kW | %kW | Therms | % Thm |
|---|---|---|---|---|---|---|
| Thermal Process Modifications | 0 | 0% | 0.0 | 0% | 2,996,222 | 100% |
| Variable Frequency Drive | 11,383,133 | 29% | 242.9 | 6% | 0 | 0% |
| Oil Well Pump Control/Modifications | 13,378,521 | 34% | 1,392.2 | 33% | 0 | 0% |
| Refrigeration/Tank Insulation | 5,080,752 | 13% | 1,313.8 | 31% | 0 | 0% |
| Process Modification | 5,113,633 | 13% | 799.9 | 19% | 0 | 0% |
| Air Compressor | 4,256,840 | 11% | 517.9 | 12% | 0 | 0% |
| Totals | 39,212,879 | 100% | 4,266.7 | 100% | 2,996,222 | 100% |

### *Process Projects*

A total of 50 industrial process projects were rebated in 1997. Figure 2-3 shows the distribution of ex ante electric savings for the 46 projects associated with electric savings. As the figure shows, the top 10 projects account for over 60% of the kWh savings and over 40% of the kW savings; the top 20 projects account for over 80% of the kWh savings and over 70% of the kW savings. Four process projects were associated with therm savings; the largest project accounted of 92% these savings.

**Figure 2-3**
**Cumulative Distribution of Ex Ante Electric Savings for the Process Projects**




### *Sample Design*

A census of all Process projects was attempted for the study. These projects received varying levels of analysis. For these 50 Process projects, 3 strata were identified as follows:

1. Large: These are the largest projects, ones that account for at least 70% of the ex ante kW, kWh, and therm impacts; these projects were targeted to receive a full engineering analysis and a customized NTG analysis.
2. Replacement: This is a group of replacement projects (with ex ante impacts greater than 500,000 kWh or 75 kW) that were to be included as analysis projects if any of the large projects could not be recruited; verification surveys and standard NTG analyses were to be conducted on these projects if they were not required as replacements.
3. Small: These are smaller projects that received verification surveys and standard NTG analyses. In addition, four of these sites received a less detailed site-specific analysis. This analysis consisted of an in-depth file review and a revision of PG&E ex ante calculations, based on post-retrofit operating data collected during the site surveys.

Table 2-2 presents the process sample design. There were 16 “Large” projects, accounting for 75% of the kWh impacts, 72% of the kW impacts, and 92% of the therm impacts. One site in this group accounts for all of the therm impacts. “Replacement” projects account for an additional 15% of kWh impacts and 14% of kW impacts. Together, the first two strata account for 89% of kWh impacts, 85% of kW impacts, and 92% of therm impacts.

**Table 2-2**
**Industrial Process Sample Design**

| Strata | # Projects | kWh | % kWh | kW | % kW | Therms | % Therms | Analysis Sample Size | DH w/ Neyman Allocation |
|---|---|---|---|---|---|---|---|---|---|
| Large | 16 | 29,238,582 | 74.6% | 3,060 | 71.7% | 2,750,000 | 91.8% | 16 | 14 |
| Replacement | 9 | 5,687,808 | 14.5% | 583 | 13.7% | 0 | 0% | As needed | |
| Small | 25 | 4,286,489 | 10.9% | 624 | 14.6% | 246,222 | 8.2% | 5 | 2 |
| Total | 50 | 39,212,879 | 100% | 4,267 | 100% | 2,996,222 | 100% | 21 | 16 |

The last column of Table 2-2 shows sample sizes developed using a Delanius-Hodges stratification technique with a Neyman allocation. This stratification and allocation of sample points provides a minimum ±5% precision at the 90% confidence level. The evaluation sample design deviates somewhat from the statistical sampling technique in order to ensure that 70% of the targeted savings are covered in the analysis. The adjusted sample design included additional sample points, was representative of the entire end-use population, and provided an adequate level of precision.

### *Projects Included in the Evaluation*

Table 2-3 summarizes the Process projects included in the evaluation. Overall 47 sites were verified or analyzed. These projects accounted for well over 70% of the ex ante gross impacts. Of these 46 projects, 42 were included in the net-to-gross analysis.

**Table 2-3**
**Process Projects Included in the Evaluation**

| Strata | Total Projects | Projects Verified | Projects Analyzed | Percent of Ex Ante Gross Impacts Analyzed | | | Sites in Net-to-Gross Analysis |
|---|---|---|---|---|---|---|---|
| | | | | kWh | kW | Therms | |
| Large/Replacement | 25 | 5 | 19 | 91% | 90% | 100% | 23 |
| Small | 25 | 19 | 4 | 13% | 7% | 40% | 19 |
| Total | 50 | 24 | 23 | 82% | 78% | 95% | 42 |

## *2.2.5 Indoor Lighting Sample Design*

Indoor Lighting measures comprised the second largest end -use savings in 1997. Indoor Lighting accounts for 27% of ex ante avoided-cost savings, 29% of ex ante kWh savings (20,465,386 kWh), and 38% of ex ante kW savings (3,769 kW).

### *Indoor Lighting Measures*

Figure 2-4 shows the percent of Indoor Lighting kWh savings by primary measure group, based on tracking system data. High-intensity discharge (HID) lighting was the largest savings component, followed by T-8 fixtures, and the addition of reflectors and delamping. These three measure groups accounted for 84% of ex ante lighting kW savings. Lighting kW savings followed a similar pattern to the kWh savings.

Table 2-4 presents Indoor Lighting program accomplishments by detailed measure category. The most prominent categories (accounting for over 70% of lighting impacts) were:

- HIDs greater than 250 watts;
- Four-foot T-8 fixtures; and
- Reflectors/delamping of 4-foot lamps.

**Figure 2-4**
**Ex Ante Indoor Lighting kWh Savings by Measure Group**

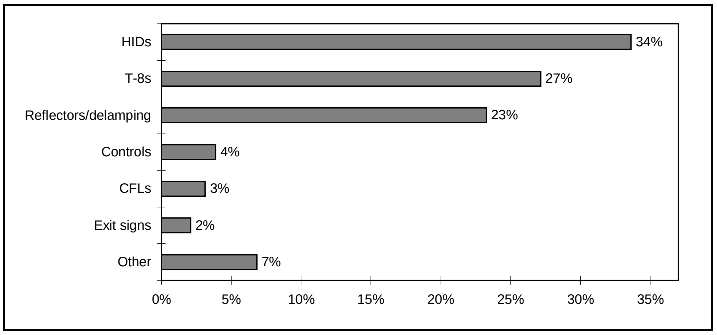


**Table 2-4**
**Ex Ante Indoor Lighting Impacts and Rebates by Measure Category**

| Measure Code | Measure Description | Measure Group | # Projects | kWh Savings | kW Savings | Rebate $ |
|---|---|---|---|---|---|---|
| L0 | LIGHTING: INDOOR (CUSTOMIZED) | Customized | 1 | 918,319 | 249.90 | 121,198 |
| L5 | EXIT SIGN: RETROFIT KIT | Exit signs | 23 | 137,669 | 17.40 | 2,296 |
| L8 | FIXTURE: INCAND TO FLUOR CONVERSION W/ELEC BLST | Other | 5 | 10,648 | 1.78 | 165 |
| L14 | BALLAST: ELECTRONIC, 2-LAMP BALLAST | Other | 1 | 176,448 | 33.08 | 15,164 |
| L17 | REFLECTORS WITH DELAMPING, 2 FT LAMP REMOVED | Reflectors/delamping | 6 | 130,131 | 23.59 | 2,467 |
| L18 | REFLECTORS WITH DELAMPING, 3 FT LAMP REMOVED | Reflectors/delamping | 1 | 2,350 | 0.42 | 21 |
| L19 | REFLECTORS WITH DELAMPING, 4 FT LAMP REMOVED | Reflectors/delamping | 63 | 4,348,229 | 786.88 | 138,389 |
| L20 | REFLECTORS WITH DELAMPING, 8 FT LAMP REMOVED | Reflectors/delamping | 12 | 345,064 | 59.04 | 6,366 |
| L21 | FIXTURE: T-8 LAMP & ELEC BLST, (FEM or NEW FIXTURE), 2 FT FIXT | T-8s | 17 | 235,937 | 43.98 | 8,602 |
| L22 | FIXTURE: T-8 LAMP & ELEC BLST, (FEM or NEW FIXTURE), 3 FT FIXT | T-8s | 14 | 22,157 | 3.82 | 910 |
| L23 | FIXTURE: T-8 LAMP & ELEC BLST, (FEM or NEW FIXTURE), 4 FT FIXT | T-8s | 194 | 5,190,671 | 961.85 | 424,096 |
| L24 | FIXTURE: T-8 LAMP & ELEC BLST, (FEM or NEW FIXTURE), 8 FT FIXT | T-8s | 28 | 184,828 | 32.07 | 17,608 |
| L26 | HID FIXTURE: INTERIOR, STANDARD, 101-175 WATT LAMP | HIDs | 5 | 94,080 | 15.78 | 4,410 |
| L27 | HID FIXTURE: INTERIOR, STANDARD, 176-250 WATT LAMP | HIDs | 4 | 661,056 | 110.80 | 19,719 |
| L31 | TIME CLOCK: LIGHTING | Controls | 2 | 3,318 | 0.00 | 63 |
| L36 | PHOTOCELL: LIGHTING | Controls | 22 | 8,268 | 0.00 | 273 |
| L60 | HALOGEN LAMP: < 50 WATTS | Other | 3 | 8,264 | 1.47 | 25 |
| L61 | HALOGEN LAMP: >= 50 WATTS | Other | 5 | 21,371 | 3.67 | 56 |
| L64 | COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, 5-13 WATTS | CFLs | 16 | 163,795 | 28.72 | 2,680 |
| L66 | COMPACT FLUORESCENT: HARDWIRED FIXTURE, 5-13 WATTS | CFLs | 8 | 86,320 | 15.43 | 3,577 |
| L80 | HID FIXTURE: INTERIOR, COMPACT, 71-100 WATT LAMP | HIDs | 2 | 4,340 | 0.73 | 315 |
| L81 | HID FIXTURE: INTERIOR, STANDARD, 251-400 WATT LAMP | HIDs | 29 | 2,162,560 | 361.88 | 62,784 |
| L82 | OCCUPANCY SENSOR: WALL MOUNTED | Controls | 26 | 185,049 | 43.96 | 5,529 |
| L83 | OCCUPANCY SENSOR: CEILING MOUNTED | Controls | 15 | 607,600 | 166.99 | 16,100 |
| L114 | BALLAST: ELECTRONIC | Other | 1 | 1,984 | 0.32 | 128 |
| L137 | EXIT SIGN: LED | Exit signs | 23 | 296,872 | 37.11 | 11,892 |
| L174 | COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, 14-26 WATTS | CFLs | 16 | 90,037 | 15.95 | 1,623 |
| L175 | COMPACT FLUORESCENT: SCREW-IN, MODULAR BLST, >= 27 WATTS | CFLs | 4 | 21,025 | 3.76 | 361 |
| L176 | COMPACT FLUORESCENT: HARDWIRED FIXTURE, 14-25 WATTS | CFLs | 12 | 79,230 | 13.78 | 2,243 |
| L177 | COMPACT FLUORESCENT: HARDWIRED FIXTURE, >= 26 WATTS | CFLs | 4 | 21,352 | 3.55 | 994 |
| L178 | COMPACT FLUORESCENT: HARDWIRED FIXTURE, 27-65 WATTS, INCANDESCENT | CFLs | 3 | 78,832 | 14.14 | 1,300 |
| L180 | COMPACT FLUORESCENT: HARDWIRED FIXTURE, 66-156 WATTS, INCANDESCENT | CFLs | 2 | 110,754 | 19.93 | 972 |
| L184 | FIXTURE: T-8 HIGH-OUTPUT LAMP & ELEC BLST, (FEM or NEW FIXTURE), 8 FT | T-8s | 2 | 2,354 | 0.42 | 220 |
| L187 | HID FIXTURE: INTERIOR, COMPACT, 36-70 WATTS LAMP, INCANDESCENT | HIDs | 1 | 9,408 | 1.70 | 512 |
| L189 | HID FIXTURE: INTERIOR, COMPACT, 71-100 WATTS LAMP, INCANDESCENT | HIDs | 1 | 7,304 | 1.31 | 320 |
| L191 | HID FIXTURE: INTERIOR, STANDARD, 101-175 WATTS LAMP, INCANDESCENT | HIDs | 2 | 17,039 | 3.06 | 440 |
| L192 | HID FIXTURE: INTERIOR, STANDARD, 101-175 WATTS LAMP, MERCURY VAPOR | HIDs | 1 | 866 | 0.14 | 76 |
| L193 | HID FIXTURE: INTERIOR, STANDARD, 176-250 WATTS LAMP, INCANDESCENT | HIDs | 10 | 427,892 | 75.97 | 9,975 |
| L194 | HID FIXTURE: INTERIOR, STANDARD, 176-250 WATTS LAMP, MERCURY VAPOR | HIDs | 4 | 29,243 | 4.82 | 1,870 |
| L195 | HID FIXTURE: INTERIOR, STANDARD, 251-400 WATTS LAMP, INCANDESCENT | HIDs | 32 | 1,366,349 | 235.70 | 29,901 |
| L196 | HID FIXTURE: INTERIOR, STANDARD, 251-400 WATTS LAMP, MERCURY VAPOR | HIDs | 21 | 2,196,373 | 373.86 | 55,503 |
|  | Totals |  |  | 20,465,386 | 3,768.74 | 971,141 |

### *Indoor Lighting Projects*

A total of 329 industrial Indoor Lighting projects were rebated in 1997. Figure 2-5 shows the distribution of ex ante savings for the largest 120 projects. As the figure shows, the top 20 projects accounted for over 40% of ex ante savings, the top 60 projects account for over 70% of savings, and the top 90 projects account for over 80% of savings.

**Figure 2-5**
**Cumulative Distribution of Ex Ante kWh Savings for Largest Indoor Lighting Projects**

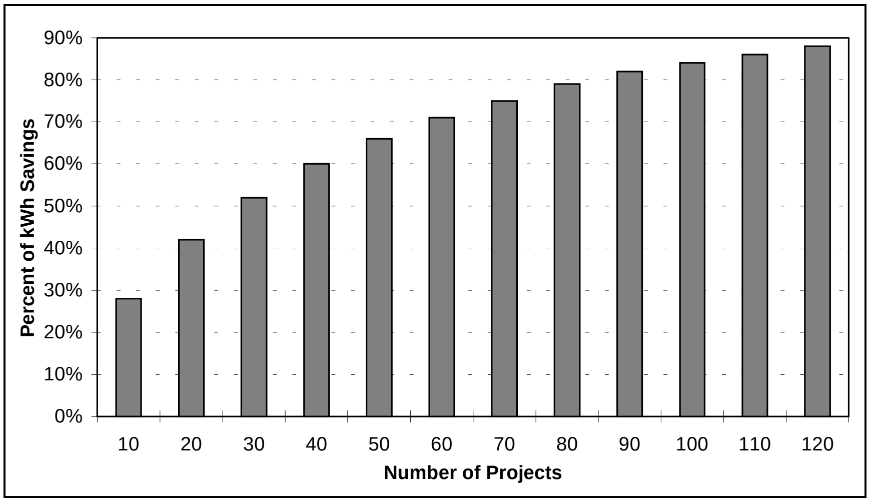



Table 2-5 shows the various combinations of measures installed for the 1997 Indoor Lighting projects. For this table, all of the smaller measure groups are aggregated into the Miscellaneous category. As the table indicates, 70 projects involved only HID installations, 86 projects involved only T-8 installations, 57 projects involved only installations of miscellaneous lighting measures (controls, CFLs, halogen lamps, exit signs, and incandescent to fluorescent conversions), and 122 projects involved a combination of measures. All projects that included reflectors/delamping measures also included T-8 measure installations.

**Table 2-5**
**Measure Installations for Indoor Lighting Projects**

| HIDs | Reflectors / delamping | T-8s | Misc. | Number of Projects | Percent of Projects |
|---|---|---|---|---|---|
| ✓ | ✓ | ✓ | ✓ | 6 | 2% |
| ✓ | | ✓ | ✓ | 5 | 2% |
| ✓ | | ✓ | | 11 | 3% |
| ✓ | | | ✓ | 4 | 1% |
| ✓ | | | | 70 | 21% |
| | ✓ | ✓ | ✓ | 28 | 9% |
| | ✓ | ✓ | | 31 | 9% |
| | | ✓ | ✓ | 31 | 9% |
| | | ✓ | | 86 | 26% |
| | | | ✓ | 57 | 17% |
| | | | | 329 | 100% |

### *Sample Design*

A total of 188 Indoor Lighting projects were included in the study. These projects also received varying levels of analysis. For the 329 Indoor Lighting projects, four strata were identified as follows:

1. Large-Custom: These were the 20 largest lighting projects that were targeted to receive site-specific engineering analyses and customized NTG analyses.
2. Large-Standard: These were also large lighting projects that, when combined with the first strata projects, accounted for at least 70% of the ex ante kWh and kW impacts for the lighting end use; these projects were targeted to receive site-specific engineering analyses and standard NTG analyses.
3. Replacement: This was a group of replacement projects (with ex ante impacts greater than 50,000 kWh or 9 kW) that were included as analysis projects if any of the larger projects could not be recruited.
4. Small: A random sample of these smaller projects received site-specific analyses and standard NTG analyses; the sample size was set, based on recruitment success of larger strata, to ensure that at least 150 lighting projects were included in the study.

Table 2-6 presents the Indoor Lighting sample design. The 20 largest projects accounted for 43% of the ex ante kWh impacts and 44% of the kW impacts. The next group of 36 large projects accounted for 28% of the kWh impacts and 27% of the kW impacts. Together, these "Large" strata comprised 70% of kW impacts and 71% of kW impacts. "Replacement" projects accounted for an additional 14% of kWh impacts and 13% of kW impacts. Together, the first 3 strata accounted for 84% of kWh and kW impacts.

**Table 2-6**
**Industrial Indoor Lighting Sample Design**

| Strata | # Projects | kWh | % kWh | kW | % kW | Analysis Sample Size | DH w/ Neyman Allocation |
|---|---|---|---|---|---|---|---|
| Large-Custom | 20 | 8,700,978 | 42.5% | 1,666 | 44.2% | 20 | 68 |
| Large-Standard | 36 | 5,678,822 | 27.7% | 1,021 | 27.1% | 36 | |
| Replacement | 39 | 2,770,318 | 13.5% | 490 | 13.0% | 12-14 | |
| Small | 234 | 3,315,268 | 16.2% | 591 | 15.7% | 80-82 | 12 |
| Total | 329 | 20,465,386 | 100% | 3,769 | 100% | 150 | 80 |

The last column of Table 2-6 shows the comparable sample, developed using Delanius-Hodges stratification with a Neyman allocation, that would provide ±9% precision at the 90% confidence level. As with the process sample, the statistical sampling approach was modified to ensure that 70% of the ex ante impacts were included in the evaluation analysis and that a minimum of 150 sites were visited.

### *Projects Included in the Evaluation*

Table 2-7 summarizes the Indoor Lighting projects included in the evaluation. Overall 204 sites were verified or analyzed. These projects accounted for about 80% of the ex ante gross impacts. Of these 204 projects, 188 were included in the net-to-gross analysis.

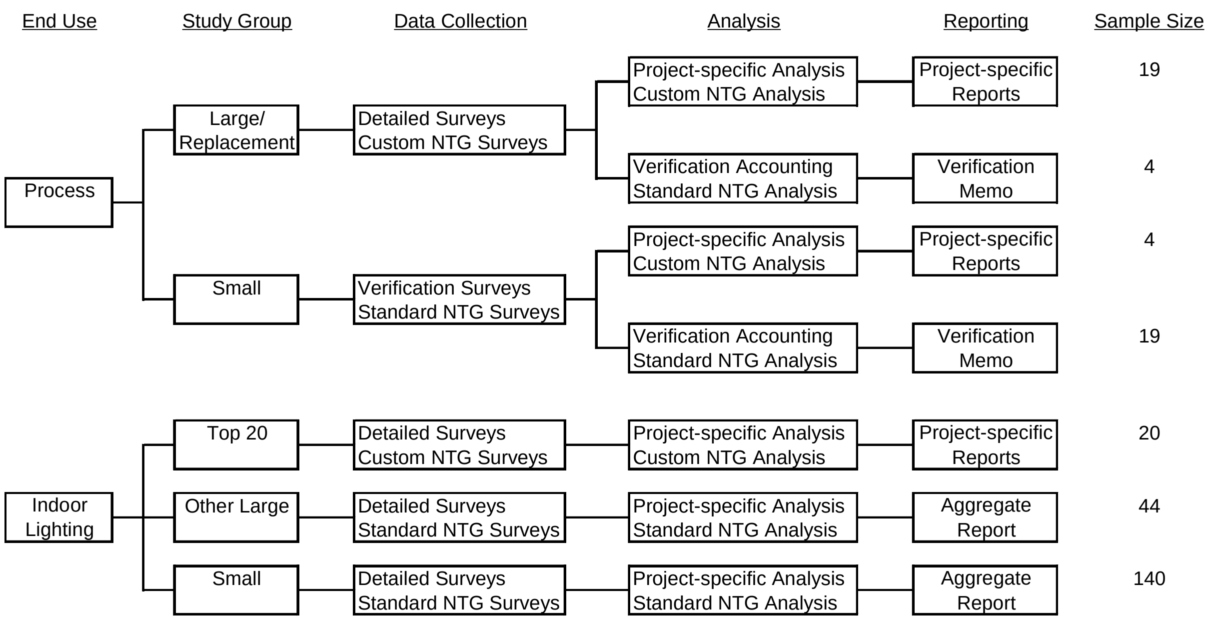
**Table 2-7**
**Indoor Lighting Projects Included in the Evaluation**

| Strata | Total Projects | Projects Analyzed | Percent of Ex Ante Gross Impacts Analyzed | | Sites in Net-to-Gross Analysis |
|---|---|---|---|---|---|
| | | | kWh | kW | |
| Large Custom | 20 | 20 | 100% | 100% | 20 |
| Large Std./Repl. | 75 | 44 | 65% | 65% | 39 |
| Small | 234 | 140 | 59% | 60% | 129 |
| Total | 329 | 204 | 79% | 80% | 188 |

### *2.2.6 Impact Evaluation Summary*

Figure 2-6 presents a summary of the impact evaluation activities. Primary data collection, analysis, and site reporting assignments are shown, and approximate sample sizes are indicated.

**Figure 2-6**
**Summary of Impact Evaluation Activities**




## 2.3 GROSS MEASURE SAVINGS METHODOLOGY

Gross measure savings were developed on a project-specific (and measure-specific) basis for each site in the analysis sample. Verification surveys were performed at additional smaller sites, and verified measures will be included in the analysis of program savings. All sampled sites were expanded to program totals using statistical techniques. The process analyses, lighting analyses, verification reviews, and sample expansion analyses used to derive gross savings are discussed next.

### *2.3.1 Process Analyses*

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

#### *Principles*

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

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

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

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

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

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

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

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

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

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

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

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

**Appropriate Measure Sampling:** The oil well pumping ("off-controller") measure projects involve 82 measure items with individually small savings. A methodology was developed for each customer location in which a sample group of wells was selected for performance measurements or power monitoring. The sample was selected from the population of all measure items at those sites in a manner that it is representative of all the project activity at that site. The project engineer consulted with the project statistician in developing the site plan to ensure that the sample was representative. The sampling plan is described in the project-specific analysis report. A sampling strategy was not required at other process sites.

### *General Analytical Technique*

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

**1. Measure Energy Input Profile for Evaluation Period:** The actual system energy use (or power) each hour comprises the unadjusted post-project power and energy use. An equipment submeter which records actual kW or parameters from which input power may be calculated, such as % full load, amps, etc., was used as documentation of the post-project energy use. For items where measurement of the rate of energy or fuel input was not appropriate or was impractical, measurements of parameters that provide a secondary indication of power and energy input were used. For instance, where a process line involving a large number of motors comprises the project, a representative group of motors was monitored as an indication of overall process use. The measurements are described in the site-specific evaluation report.

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

**3. Identify System Performance Profile for Evaluation Period:** The operating efficacy was calculated by dividing the input energy developed in Step 1 by the output identified in Step 2. (For example, for a chiller, the input power and supply and return chilled water temperatures would be measured at hourly intervals. Chiller tonnage would be calculated by multiplying the difference between the measured supply and return chilled water temperature and the flow rate by appropriate conversion factors. The power measured in Step 1 in turn would be divided by the calculated tons to determine the kW per ton at various loading levels.)

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

a. <u>Process Cooling</u>: Process cooling load profile and schedule, ambient dry bulb or wet bulb and sol-air temperature and cooling tower performance

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

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

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

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

f. Oil Well Pumps: None—Impacts are based on pre-and post installation pumping loading for the specific well characteristics.

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

### *Site-Specific Analyses*

Site-specific analysis approaches for the largest process analysis projects are outlined in Table 2-8 on the next page.

# Table 2-8
# Site-Specific Process Analysis Approaches

| Cntl # | Appl. Code | Ex Ante Impacts kWh | kW | Therms | Project Description | Evaluation Approach |
|---|---|---|---|---|---|---|
| 1028281 | AFB1012 | 8,356,551 | 213.0 | 0 | Installed high-efficiency motors and ASD's to serve 2-400hp dryer fans and 2-600 hp induced-draft fans on RTO unit.. | Monitored as-built fan motor input power; calculated flow rates from fan curves; estimated fan power with basecase technology; extrapolated to annual result using 8760 hour operating profile. |
| 0667001 | ATC0205 | 3,693,304 | 426.0 | 0 | Converted 9 gas-driven and 1 electric motor driven beam-type oil well pumps to submersible centrifugal pumps. | Spot-measured input power of as-built submersible pumps. Rejected PG&E basecase. Revised basecase to gas driven pumps at pre-retrofit pumping rates. |
| 5529355 | ATC0009 | 2,636,640 | 305.2 | 0 | 25 Oil Well Pump Right Sizing | Monitored a sample of pumps. Used results to calibrate ex ante estimates that were based on RodStar simulations |
| 1008376 | ATR6002 | 2,456,891 | 541.0 | 0 | Insulated 16 wine production/storage tanks. | Customer confirmed that insulation was required for production reasons. Determined 0 impacts. No additional analysis performed. |
| 5708822 | ETC0153 | 1,599,471 | 141.8 | 0 | 30 Oil Well Pump Off-Controls | A sample of pumps were monitored with POCs in effect and in the bypass mode. Impacts were calculated as the difference. |
| 1043410 | AJG0003 | 1,483,274 | 0.0 | 0 | Installed new motors and VFD's to serve 2-400 horsepower process exhaust fans. | Monitored as-built fan drive input power; Calculated percent full load power; estimated fan power for same flow with basecase inlet vane flow control; extrapolated to annual result using 8760 hour air flow profile. |
| 4387722 | ETC0135 | 1,428,335 | 136.0 | 0 | 39 Pump-Off Controllers | A sample of pumps were monitored with POCs in effect and in the bypass mode. Impacts were calculated as the difference. |
| 4730707 | ANR7700 | 1,247,261 | 10.7 | 0 | Replaced a multiple-conveyor ore stacking system with a single slewing-stacker conveyor system. | Monitored one conveyor motor for 3 wks to verify schedule and operating loads. Calculated postcase plant power and oper. hrs. and basecase plant power & adjusted basecase plant operating hours by production. Calc. Pre kW - Post kW for 8760 hours. |
| 0684590 | AFB1030 | 1,194,625 | 174.8 | 0 | Installed a new 200 ton water-cooled chiller in place of basecase air-cooled chiller serving a process cooling load. | Monitored chiller power, ambient temperatures for 1 week. Extrapolated load to annual period using enthalpy load model with "TMY-8760" weather data. Calc'd power using actual basecase air-cooled and postcase water cooled chillers. |
| 5266483 | AXR6034 | 1,182,000 | -1.9 | 0 | Installed 6 VFD's and 36 HE motors to serve 36 - 10 hp drying kiln circulating fans at a lumber mill. | Monitor 3 kilns fan input power for 1 month. Took difference between basecase fan power and observed power each hour; Extrapolated to annual period using direct extrapolation via 8760 file adjusted for seasonal weather and production. |
| 6123993 | AXR6001 | 1,108,799 | 278.5 | 0 | Revised a rock crushing, sorting and cleaning system eliminating several conveyors and sorters. | Monitored major process motors for 2 wks to verify schedule and operating loads. Spot measured power of other major loads. Requested production data. Adjust basecase plant operating hours for production. Calculate base & postcase power and energy. |
| 0920614 | AJT0015 | 1,073,363 | 89.0 | 0 | Replaced 3-450 horsepower air compressors with 2-250 horsepower compressors. | Monitored postcase compressor input power for 3 weeks. Confirmed flow rate from ex ante data. Used measured pre-retrofit power and measured as-built power for same flow/pressure as basecase. Extrapolated to annual using monitored load profile. |
| 4451422 | ETC0166 | 889,467 | 85.4 | 0 | Pump-Off Controllers | A sample of pumps were monitored with POCs in effect and in the bypass mode. Impacts were calculated as the difference. |
| 4451422 | ETC0136 | 870,269 | 76.5 | 0 | Pump-Off Controllers | A sample of pumps were monitored with POCs in effect and in the bypass mode. Impacts were calculated as the difference. |
| 0666353 | ATK1012 | 795,367 | 428.0 | 0 | Insulated 13 stainless steel wine production/storage tanks. | Customer confirmed that insulation was required for production reasons. Determined 0 impacts. No additional analysis performed. |
| 4451422 | ETC0202 | 652,296 | 62.0 | 0 | Pump Off-Controls | A sample of pumps were monitored with POCs in effect and in the bypass mode. Impacts were calculated as the difference. |
| 6123993 | AXR6037 | 507,594 | 169.2 | 0 | Replace and relocate a dust collector system with 225 horsepower of motors withtwa system of two motors totaling 150 horsepower. | Monitored power of 2 dust collectors hourly for 2 wks to verify post daily oper. hrs. and operating motor power. Calculate basecase motor power from ex ante pre-retrofit data. Calc kW difference for each operating hour. Extrapolate using "8760". |
| 0676955 | AJN1000 | 475,107 | 148.3 | 0 | Installed a new high-efficiency 600 horsepower pump vs. adding a new 125 hp pump and retaining the old 600 hp | Monitored 3-600 hp pumps for 2 weeks to identify load profile and op. sched. Calc'd flow from pump curve. Calculated base pumps power for same flow. Extrapolate to annual period with obs. flow and production. |
| 0914012 | ATK1003 | 278,094 | 27.0 | 0 | Air Compresser System Change/Modify | Verifed compressor operating hours, approx load profile and control strategy by 2 hour site observation and interviews. Adjusted ex ante estimates for observed load and operating hours and other changed conditions. |
| 0679820 | ANR6510 | 139,382 | 16.9 | 0 | Replace Standard Efficiency Motor With High Efficiency Motor | Verified installation and operating parameters. Reviewed and adjusted ex ante calculation to account for incorrect basecase efficiency and different operating hours. |
| 6351825 | AVV0013 | 125,531 | 0.0 | 0 | Compressed Air System | Verifed compressor operating hours, approx load profile and control strategy. Adjusted ex ante estimates for observed load and operating hours and other changed conditions. |
| 5851942 | AJG0005 | 0 | 0.0 | 99,000 | Furnace Modification Project, Install Automated Excess Air Damper | Verified installation and operating parameters. Verified ex ante calculations. Adjusted impacts to reflect operations using ex ante analysis approach. |
| 5851942 | AJG0009 | 0 | 0.0 | 2,750,000 | New Process Shell & Tube Heat Exchanger To Improve Crude Preheat Recovery | Verified heater charge and UCR rates and temperatures. Monitored UCR air-cooled heat exchanger fan motor to determine post-case consumption. Used OEM data sheets to calculate base case consumption to determine post case savings. |

### 2.3.2 Indoor Lighting Analyses

The Indoor Lighting analyses consisted of verifying the measure installation, determining the pre-retrofit equipment, determining the post-retrofit operating hours and operating profile, and calculating energy and demand savings for each PG&E costing period based on the type of energy-efficient equipment installed.

For efficient lamps and ballast, demand were calculated for each hour. The results were then aggregated into demand and energy savings for the five PG&E costing periods. The subscript '*i*' in the following equations denotes the *i*th hour and *f* denotes "fraction."[1]

$$\text{Direct kW Svgs}_\text{i} = \left[\left(\#\ \text{fix}_{base} \times \frac{\text{kW}}{\text{fix}_{\ base}}\right) - \left(\#\ \text{fix}_{post} \times \frac{\text{kW}}{\text{fix}_{\ post}}\right)\right] \times \text{UF} \times \text{DF}$$

$$\text{Cool kW Svgs}_\text{i} = \text{Direct kW Svgs}_\text{i} \times \left(\frac{1}{3}\right) \times \left(f\text{LtgToCool} \times \text{LtgCoolCoincid}_\text{i}\right)$$

$$\text{Heat kW Svgs}_\text{i} = \text{Direct kW Svgs}_\text{i} \times (0.4) \times \left(f\text{LtgToElecHeat} \times \text{LtgHeatCoincid}_\text{i}\right)$$

$$\text{Total kW Svgs}_\text{i} = \text{Direct kW Svgs}_\text{i} + \text{Cool kW Svgs}_\text{i} + \text{Heat kW Svgs}_\text{i}$$

where:

- UF in is the utilization factor - the fraction of lights working - it is used to net out impacts for burned-out lights; for most cases this factor was between 0.99 and 1.0.
- DF in is the diversity factor - the average fraction of lights turned on in a given hour.
- The factor of 1/3 is 1/COP. A typical coefficient of performance of 3.0 is assumed for existing cooling systems in all cases.
- The factor of 0.4 in is a typical fraction of the building area that is on the perimeter of a large building (assuming 100 ft x 200 ft building with a 15 ft wide perimeter zone).
- $\text{LtgCoolCoincid}_i$ and $\text{LtgHeatCoincid}_i$ are the fraction of the hour where lighting and cooling (heating) operate simultaneously.

For lighting control measures, a similar approach was utilized, but the change in diversity factor (DF) was utilized instead of the change in kW.

Once hourly kW impacts were developed, results were calculated for each of the five PG&E costing periods (*c*) and annually using the following formulas.

**Gross kWh Impacts:** $kWhimpact_c = \sum_{j \in c} Total\ kW\ Svgs_j$ where *j* is incremented hourly.

[1] This set of equations is based on the ASHRAE Journal paper by Robert Runquist, Karl Johnson, and Donald Aumann entitled "Calculating Lighting and HVAC Interactions."

**Annual Gross kWh Impact:** $$Annual\ kWh\ impact = \sum_{c=1}^{5} kWhimpact_c$$

**Average Gross kW Impacts:** $$\overline{kWimpact_c} = \frac{kWhimpact_c}{\sum_{j \in c} hours_j}$$ where $j$ is incremented hourly.

**Gross kW Impact Coincident with System Maximum (Hour):**

$$Coincident\ kW\ impact_c = \frac{\sum_{j \in h} Total\ kW\ Svgs_j}{\sum_{j \in h} hours_i}$$

where $h$ represents all potential coincident peak hours in the costing period. Note that the gross kW impacts reported in this report are the coincident kW impacts estimates associated with the summer on-peak costing period.

Finally the therm heating penalty is calculated using the annual kWh impacts as:

$$\text{Therm Penalty} = \text{Annual kWh Impact} \times f\text{LtgToHeat} \times (0.018)\left(\frac{\text{HeatCoincidHrs}}{\text{TotalLtgHrs}}\right)$$

where

$$0.018 = \left(\frac{\text{0.4 foot of perimeter length}}{\text{square foot of floor area}}\right)\left(\frac{\text{0.0341 Therm / kWh}}{\text{0.74 AFUE}}\right)$$

If the basecase fixture type was not known, a standard basecase was set consistent with the design estimates developed for each PG&E measure code as reported in the 1997 Program Advice Filing.[2] The design estimates were based on an assumed existing condition that represents a typical customer configuration prior to the retrofit. This backup approach was adopted because few PG&E records contain information about removed fixtures and because determining pre-retrofit fixture types based on customer interviews can be error-prone (especially when turnover of customer contacts is factored in). In cases where the base case information collected in the field appears incorrect, this backup approach was also used. Each project-specific report contains a justification for the base case used.

For lighting controls, changes in the operating schedule and post-retrofit wattage were used. Two methods were available for estimating the burn time reduction from occupancy sensors. The first was to compare the base and retrofit lighting schedules, and the second method was to default to the Title 24 standard savings rates.

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[2] Pacific Gas and Electric Company, 1997 Customer Energy Efficiency Programs, Advise Letter No. 1978-G / 1608-E, Workpapers, October 1, 1996.

In the first case, the two sets of schedules must be known sufficiently well that a savings calculation using the difference in schedules improves on the Title 24 assumption. This method is only useful in circumstances where the base case schedule was set by a time clock or was equal to the operating hours of the business. In other cases, the base case schedule is not known well enough to improve on the Title 24 assumption (10% reduction for spaces larger than 250 $ft^2$, 20% for spaces less than 250 $ft^2$, and 60% for spaces used only for storage). Where appropriate, the retrofit schedule was determined by using a lighting logger to measure at least two weeks of actual usage. In addition to the light loggers, surveyors interviewed staff who work under the particular lights as to their own schedules. This information was then used as a "reality check" on the logger data.

To simplify the HVAC impact calculation, it was assumed that heat from lights during periods when the space is unconditioned does not contribute to the heating and cooling loads. In fact this is not quite correct since some of this heat is stored in the mass of the building until the next conditioned period. However, this effect is usually *extremely* small (less than 2% of the HVAC impact and much less than 1% of the total impact), and its calculation would most likely require an hourly computer simulation. The simplified method yields sufficient results with much less analysis time.

Post-retrofit annual hours of operation were estimated for each of the affected lighting fixture groups. There were three sources of schedule data: (1) data logger records, (2) timeclock or EMS settings, and (3) facility manager, engineer, or other staff knowledge. From these three sources a full year of hourly lighting schedules was developed for each schedule group. The annual schedule included holidays and any other known downtime for the facility.

An hourly distribution of annual energy consumption was computed 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 was summed to produce a facility total. The hourly values were then aggregated into the five PG&E costing periods.

### *2.3.3 Program-Level Impacts*

The estimate of gross measure impacts for each end use was developed using the results of the site studies and verification visits. A method known as ratio estimation was used to extrapolate the sample results and derive the overall program impacts.

In ratio estimation, the tracking system estimates of savings are used to leverage the results from the various site studies and surveys. A separate ratio, or realization rate, was developed for each sampling stratum. The equation below demonstrates how the total program impacts were derived.

$$IMPACT = \sum_{i \in P} T_i * \frac{\sum_{j \in S} S_j}{\sum_{j \in S} T_j}$$

where:

*IMPACT* is the total gross impact for a given stratum (in kWh, kW, and/or therms);
$T_i$ is the tracking system estimate for site $i$;
$S_j$ is the estimated impacts from the site study for site $j$; and
$P$ and $S$ represent the collection of sites in the given strata of the population and site study sample, respectively.

Standard statistical formulas for the variance of ratio estimators were utilized to develop estimates of precision and associated confidence intervals for each end use.

## 2.4 NET PROGRAM SAVINGS METHODOLOGY

Net program savings were developed by applying NTGRs (net-to-gross ratios) to gross program impacts. The NTGRs were developed at the project level and then expanded to the program population using appropriate statistical techniques. Two levels of analysis were used to assign project-level NTGRs: a standard NTG analysis was applied to all project-specific analysis and verification projects, and a customized NTG analysis that built upon the standard NTG analysis for the largest projects (all Process analysis projects and the top 20 Indoor Lighting projects).

### *2.4.1 Project Analyses*

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

#### *Standard NTG Analysis*

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

**Initial Ratios**

The "stated intentions" question (Question C7 of the standard NTG survey included in Appendix B) was used to derive initial NTGRs for each surveyed facility and technology, based on what respondents state they would have done in the absence of the PG&E Program. Table 2-9 shows how the initial ratios were calculated. NTGR #1 is a simple zero/one determination depending on whether or not the customer was likely to install measures without the PG&E incentive. NTGR #2 allows for a variation in the NTG score depending upon how certain the customer was about their decision to install measures. NTGR #2 was used for the final calculations, and NTGR #1 was calculated as a cross-check on how the intermediate values in NTGR #2 affect the score.

**Table 2-9**
**Net-to-Gross Ratio Assignments Based on Participants' Stated Intentions**

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

### Consistency Checks

Next, consistency checks were used to limit the NTG probabilities when respondents' answers appeared to be inconsistent. Table 2-10 outlines the consistency checks used to adjust NTG probabilities. These checks were based on customers' responses to questions relating to sources of energy efficiency information, steps in the decision process, and significance of the PG&E Program in influencing customer decisions.

**Table 2-10**
**Consistency Checks**

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

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

Checks #3 - #6 limit the NTGRs based on the significance of the Program on the customer's decision to install measures (as determined in Question C6 of the standard survey). If the Program was "extremely significant," the NTGR *minimum* is set at 0.85, which is halfway between the "definitely would not install" and "probably would not install" probabilities shown in Table 2-9. A "very significant" rating equates to a *minimum* "probably would not install" NTGR of 0.7 in Table 2-9. A "somewhat significant" rating is equated to a *minimum* NTG probability of 0.5 which gives the PG&E Program partial credit for the measure installation. Finally, an "insignificant" rating limits the NTG probability to a *maximum* of 0.3, consistent with a "probably would install anyway" assignment in Table 2-9.

### Assessing Partial Free-ridership

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

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

Customers who were not likely to have installed measures anyway without the Program are asked if the equipment they otherwise would have installed would have been of standard efficiency or some intermediate level of efficiency (Question C9 of the survey). If the customer indicated the equipment would have been of intermediate efficiency, the initial NTGR was decreased by 0.2 to account for the fact that the gross savings estimate, which is based on standard efficiencies, overstates impacts that would have occurred without the Program. Table 2-11 summarizes the adjusted NTGR assignments after accounting for partial free-ridership.

**Table 2-11**
**Adjusted NTGRs Based on Efficiency of Nonprogram Equipment That Would Have Been Installed Without the Program**

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

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

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

### Accounting for Deferred Free-ridership

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

In addition to the assigned NTGR, the Program was given some credit for accelerating the installation of the energy efficient equipment. A *lifecycle* NTGR approach was used such that the first year net savings estimates incorporates the timing-effect of the program and the stream of savings does not need to be adjusted. The following equation was utilized:

$$NTGR' = NTGR + (1 - NTGR) \times \frac{Years\_Delayed\_Without\_Rebate}{Measure\_Life}$$

where *NTGR'* is the NTGR after accounting for deferred free-ridership, *NTGR* is the ratio assigned using values in Tables 2-9 through 2-11, *Years_Delayed* was established in the survey (Question C10 of the standard NTG survey), and *Measure_Life* is the ex ante measure life estimate.

### Additional Survey Questions

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

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

Some customers who agreed to be included in the gross impact analyses did not want to respond to the NTG survey. Alternately, the customer decision-maker for some projects was no longer available, and it was not possible to field the NTG survey. The general approach for these sites was to drop them from the NTG analysis and to calculate the end-use and Program NTGRs using savings-weighted averages of customers who do complete the surveys (see the subsection below on calculating Program NTGRs).

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

A number of NTG surveys were completed but contained “Don’t Know” responses to analysis questions. In general, NTGRs were calculated for each survey where there was a legitimate response to either the “Program significance” question (Question C6 of the standard NTG survey) or the “what would have happened without the Program” question (Question C7). Other survey questions were more auxiliary in nature and were not as central to the determination of free-ridership. In cases where either Question C6 or Question C7 is missing, all survey responses were reviewed to determine if the survey was legitimate. In cases where both C6 and C7 were missing, the survey was dropped from the NTG analysis. For Custom NTG projects, additional discussions with the customer, possibly with a different contact person, were used in an attempt to eliminate the “Don’t Know’s.”

### *Custom NTG Analysis*

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

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

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

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

- Where the customer got information on the technology (PG&E, vendor, other)
- Primary motivation for installation of the equipment (energy savings, production quality, retooling)
- Motivation for selection of the high-efficiency versus base equipment

- Perspectives of different players (engineer, CFO, plant manager)
- Influence from outside parties (ESCOs, contractors)
- Alternatives considered, past practices of the customer, project economics, non-energy benefits, project timing, project planning process, and project approval process

Vendor surveys were triggered in instances where the customer decision-maker (or in some cases the PG&E customer representative) indicated that a vendor was the primary proponent for the installation of more efficient equipment. Vendors were asked about the significance of the PG&E Program in their recommendation to install rebated measures and whether or not the rebated measures would have been installed in the absence of the Program.

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

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

### 2.4.2 Program Impacts

NTG results were summarized to the end-use and program levels as a weighted average of the site-specific NTG ratios. Separate kWh-, kW-, and therm-weighted NTG ratios were developed.

For each end use, the NTGR was weighted up to the strata level and end-use level using the following equations:

$$NTGR_{EU} = \sum_{s} \sum_{i \in s} w_s w_{s,i} NTGR_{s,i}$$

$$w_{s,i} = \frac{GrossImpacts_{s,i}}{\sum_{i \in s} GrossImpact_{s,i}}$$

$$w_s = \frac{GrossImpact_s}{\sum_{s} GrossImpact_s}$$

where:

| | | |
|---|---|---|
| $NTGR_{EU}$ | = | the end-use level NTGR |
| $NTGR_{s,i}$ | = | the NTGR for item *i* in stratum *s* |
| $w_{s,i}$ | = | the item-level weight within a given stratum |
| $w_s$ | = | the stratum-level weight |
| $GrossImpact_{s,i}$ | = | the gross impact (kWh, kW, or therms) for item *i* in stratum *s* |
| $GrossImpacts_s$ | = | the total gross impacts for stratum *s* |

Program-level NTGRs (for kWh, kW, and therms) can then be calculated as gross-impact-weighted averages of the end uses.

## 2.5 DATA COLLECTION

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

### *2.5.1 The Data Collection Process*

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

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

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

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

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

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

### *2.5.2 Data Collection Requirements*

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

#### *Project-Specific Analysis Sites*

**General Data Requirements:**

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

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

**On-Site Monitoring and Measurement**

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

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

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

### Data Sources and Data Collection Strategies

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

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

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

### Indoor Lighting Data Collection

Key data collection activities that supported the lighting calculations include:

- Field verification of fixture quantities;
- Confirmation that fixture modifications were as described in the application;
- Measurement of light levels or calculation of theoretical pre/post light levels to adjust level of service;
- Observation of operating schedules from customers' (automated) control systems;
- Measurement/monitoring of lighting operating time by time-of-use via light loggers at sites for which no good schedule data were available; and
- Interviews with customers and occupants to address technical and behavioral issues related to lighting system performance, and to confirm pre-retrofit fixture types.

For each measure, an attempt was made to compile a complete inventory of the program equipment. If a complete inventory could not be made, a representative sample was taken, and the results extrapolated to evaluate the rebated measure.

For occupant-controlled fixtures and whenever timeclock circuits could not be traced to a specific lighting group, time-of-use light loggers were installed during the site survey to collect data for a representative period up to two weeks. During the analysis, data from the light loggers was separated into weekday and weekend schedules before extrapolation to the full year schedule. Additionally, information on seasonal variations, if any, was collected in the operating schedule.

Ballast type was verified on at least one fixture of each rebated type. An attempt was also made to locate the lamp replacement storage closet to verify HID lamp wattage if it was difficult to verify the wattage from the floor.

Finally the general HVAC system type was recorded to select an appropriate whole system energy efficiency ratio (EER) for the HVAC interaction analysis.

### *Verification Sites*

Process Projects: Verification surveys were carried out for all measures included in Process end- use projects that did not receive a site analysis. Verification established:

- The quantity of each rebated measure item presently installed and operable at the site
- The quantity of measure items which are still in operating condition (defined as energy source being provided and equipment is capable of operation with minor adjustment or minor repair not involving capital expense)
- Removal dates if the equipment is no longer in place
- The reasons for any discrepancies

A standard NTG survey was administered to the appropriate decision maker associated with each verification site.

### *Net-to-Gross Surveys*

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

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

Experience indicates that biased answers are likely to be obtained if surveyors simply ask participants if they would have undertaken similar equipment installations in the program's absence. One reason for this bias is that respondents tend to answer as if the question were "if you had it to do over again, would you do the same project, even if you couldn't get financing or had not received information?" Customers who are happy with their projects will tend to reply in the affirmative. Another reason is that if this is the only question asked, respondents may recognize the purpose of the question, and give the answer they think will have the desired effect on the Program. An additional concern was that, while the main contact might have wanted to pursue the project even without PG&E incentives, the investment might not actually have been approved under these conditions. Thus, a part of the interview focused on identifying the key decision-maker who should address the net-to-gross issues.

### 2.5.3 Summary of Data Collection Instruments

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

#### File Review Form

The file review form provided a standardized way to extract pertinent information from the project hardcopy files. Key elements included:

- Customer contacts
- PG&E contacts
- Project timing (planning dates, construction dates, etc.)
- Measure identification (location, pre- and post-equipment specs, etc.)
- Measure operations information (production process, schedules, etc.)
- Savings methodology utilized for ex ante estimates
- Data availability (production logs, metering data, plans, related reports)
- Net-to-gross information
  - ◊ Project economics
  - ◊ Non-energy-saving benefits of the project
  - ◊ Existence of alternative projects
  - ◊ PG&E involvement in project planning

#### Recruitment and Spillover Survey

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

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

### *Indoor Lighting Surveys*

One survey instrument was developed for the lighting analysis and retention surveys (that we conducted of 1995 program participants at the same time as the impact evaluation surveys). Standardization of the survey instruments for the various evaluation components simplified database design and data entry development. First, the lighting surveys were used to collect key data components required for the impact analysis:

- Measure counts
- Pre-retrofit fixture types
- Percent of burned-out lights
- Operating hours
- Seasonality of operations
- Lighting controls associated with rebated fixture groups
- HVAC system data
- Identification of lighting logger installations

Second, the verification/retention component of the survey instrument was designed to provide data about whether or not a program measure was in place at the time of the survey. Key data elements included:

- Measure locations
- Measure counts
- Reasons for discrepancies between observed and expected measure counts
- Reasons for measure removals
- Install and removal dates

The forms provided the basic information which the surveyor needed to identify the specific measure(s), equipment, or system at the site. The surveyor was provided with basic information that was needed to identify the specific measure(s) at the site, including copies of key portions of the PG&E project file so that they can distinguish project equipment from related equipment. Ex ante impacts were also provided to indicate the extent of the retrofit.

### *Process Surveys*

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

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

#### Net-to-Gross Surveys

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

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

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

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

### 2.5.4 Surveyor Training and Safety Considerations

Prior to data collection activities, all staff involved in telephone and field data collection activities received training with the survey instruments. As part of the training requirement, all field staff were asked to view safety videotapes prior to visiting customer sites. Many of the surveys required no contact with equipment; however, a review of the potential hazards associated with industrial facilities ensured that all survey activities were carried out in accord with safe practices.

Training material included familiarization with OSHA workplace standards, PG&E safety guidelines and practices, and XENERGY safety protocols. The safety training first addressed personal safety, but also addressed issues that might affect equipment operation or performance. Key safety topics that were addressed as appropriate included:

- Working with and around electrical equipment,
- Placement of monitoring equipment
- Working around combustion,
- Hazardous, corrosive, and combustible materials
- Working with hot pipe and surfaces

- Working around rotating machinery
- Proper ladder use
- Oil field safety practices
- Site protection
- Hearing protection

Where measurements were taken, the site investigators were instructed to maintain safety practices as their highest priority. Safe practices began with the site-specific evaluation planning. Whenever alternative means were possible, the installation of equipment in live electrical circuits was avoided. In some cases, perceptive questioning and use of the customer's existing operating data systems was able to provide required operating data. In cases where direct monitoring was the only or preferred means of obtaining requisite operating data, the customer's technical staff (usually, an electrician) was requested to be present and to actually take spot measurements or install monitoring equipment whenever possible. In cases where customers declined to perform monitoring but verbally approved our staff to perform such monitoring, the monitoring was performed subject to specified monitoring safety guidelines.

# 3 RESULTS

## 3.1 OVERVIEW

This section presents results of the impact evaluation of PG&E's 1997 Industrial Energy Efficiency Incentives Programs. Overall net electric energy impacts for the Process and Indoor Lighting end uses covered by this evaluation are estimated to be 23 GWh; net summer on-peak demand savings are estimated to be 5 MW; and net natural gas savings are estimated to be 2 million therms per year.

The following impact results are presented below:

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

## 3.2 GROSS PROGRAM SAVINGS

Gross savings estimates were based on detailed site-specific engineering analyses for a sample of Program sites. Results from these studies were generalized to the Program level using a ratio approach. This section first presents Program-wide results, followed by a more detailed discussion of results for sites analyzed in the study, including a discussion of discrepancies. Finally, gross impacts by PG&E costing period are shown.

### *3.2.1 Program-Level Results*

Table 3-1 presents aggregate energy and demand impacts and realization rates. As these numbers indicate, Process end-use projects are realizing about 80% of ex ante kW savings, 44% of ex ante kWh savings, and 80% of ex ante therm savings. Indoor Lighting projects are realizing about 114% of ex ante kW savings and 102% of ex ante kWh savings. Combined Process and Indoor Lighting savings are about 96% of ex ante estimates for kW, 64% for kWh, and 80% for therms.

Relatively low Process realization rates are due, in large part, to three large projects where the basecase on which savings were based was mischaracterized in the ex ante analysis. One project involved oil well pump modifications. In this project, the PG&E rebate led to an increase in production. According to the M&E Protocols, this scenario requires impacts to be based on a comparison of the new technology versus the pre-retrofit technology at the pre-retrofit operating levels. Since the pre-retrofit equipment was gas-driven oil pumps and the post-retrofit equipment was electric-driven pumps, impacts for this project showed positive therm savings and negative electric savings. (The ex ante estimates assumed new, standard efficiency electric pumps as the basecase.)

**Table 3-1**
**Summary of Gross Impact Results**

| End Use | Ex Ante Estimates | Ex Post Results | Realization Rate | 90% Conf. Interval |
|---|---|---|---|---|
| Process | | | | |
| Summer On-peak kW | 4,267 | 3,416 | 0.80 | ±0.333 |
| Annual kWh | 39,212,879 | 17,434,659 | 0.44 | ±0.235 |
| Annual Therms | 2,996,222 | 2,390,716 | 0.80 | ±0.241 |
| Indoor Lighting | | | | |
| Summer On-peak kW | 3,769 | 4,315 | 1.14 | ±0.089 |
| Annual kWh | 20,465,386 | 20,775,055 | 1.02 | ±0.083 |
| Annual Therms | 0 | -4,579 | - | - |
| Total | | | | |
| Summer On-peak kW | 8,035 | 7,730 | 0.96 | ±0.345 |
| Annual kWh | 59,678,265 | 38,209,715 | 0.64 | ±0.249 |
| Annual Therms | 2,996,222 | 2,386,137 | 0.80 | ±0.241 |

The two other projects involved wine tank insulation measures. While uninsulated tanks are found at many wineries, the use of insulated tanks was necessary at the two evaluated facilities because the tanks were used to produce white wine in a warm climate zone. Based on customer staff interviews, it was determined that the only appropriate basecases for these specific facilities were insulated wine tanks. Therefore, the tank insulation measures provided zero impacts over that standard technology.

Table 3-2 shows adjusted gross impacts that would have been developed if the three problem projects had been excluded from the evaluation. Overall, kW and kWh realization rates increase substantially (from 0.80 to 1.48 for kW and from 0.44 to 0.75 for kWh). Therm impacts decline because the gas savings from the oil well project are eliminated.

**Table 3-2**
**Summary of Adjusted Gross Impact Results - Excluding 3 Process Projects**

| End Use | Ex Ante Estimates | Ex Post Results | Realization Rate | 90% Conf. Interval |
|---|---|---|---|---|
| Process | | | | |
| Summer On-peak kW | 4,267 | 6,328 | 1.48 | ±0.273 |
| Annual kWh | 39,212,879 | 29,477,635 | 0.75 | ±0.062 |
| Annual Therms | 2,996,222 | 1,922,200 | 0.64 | ±0.000 |
| Indoor Lighting | | | | |
| Summer On-peak kW | 3,769 | 4,315 | 1.14 | ±0.089 |
| Annual kWh | 20,465,386 | 20,775,055 | 1.02 | ±0.083 |
| Annual Therms | 0 | -4,579 | - | - |
| Total | | | | |
| Summer On-peak kW | 8,035 | 10,643 | 1.32 | ±0.287 |
| Annual kWh | 59,678,265 | 50,252,690 | 0.84 | ±0.103 |
| Annual Therms | 2,996,222 | 1,917,621 | 0.64 | ±0.000 |

### 3.2.2 Detailed Results for Studied Projects

This subsection focuses on results for projects that received site-specific analyses. Overall, 23 Process projects and 204 Indoor Lighting projects were included in the study. A more detailed review of evaluation findings for these projects provides additional insight as to why ex post results differed from ex ante predictions. Note that these results reflect unweighted impacts for the projects included in the evaluation. In this way, they differ from the summary results presented above. Process projects are discussed first, followed by Indoor Lighting projects.

#### Process Projects

The evaluated Process projects can be separated into six technology categories. Evaluation results by category are shown in Table 3-3. Similar results, excluding the three problem projects, are shown in Table 3-4.

**Table 3-3**
**Summary of Evaluated Process Project Results by Measure Group**

| | Total | Evaluated | kW | | | kWh | | | Therms | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Measure Category | Projects | Projects | Ex Ante | Ex Post | RR | Ex Ante | Ex Post | RR | Ex Ante | Ex Post | RR |
| Thermal Process Modifications | 4 | 2 | 0 | 0 | - | 0 | 0 | - | 2,849,000 | 1,773,150 | 0.62 |
| Variable Speed Drives | 6 | 3 | 211 | 978 | 4.63 | 11,021,825 | 8,684,359 | 0.79 | 0 | 0 | - |
| Oil Well Pump Control/Modifications | 11 | 7 | 1,233 | -237 | -0.19 | 11,769,782 | -2,090,021 | -0.18 | 0 | 468,516 | - |
| Refrigeration/Tank Insulation | 5 | 3 | 1,144 | 203 | 0.18 | 4,446,883 | 540,381 | 0.12 | 0 | 0 | - |
| Process Modification | 9 | 5 | 624 | 903 | 1.45 | 3,478,143 | 3,493,619 | 1.00 | 0 | 0 | - |
| Air Compressors | 15 | 3 | 116 | 181 | 1.56 | 1,476,988 | 1,422,902 | 0.96 | 0 | 0 | - |
| Totals | 50 | 23 | 3,328 | 2,028 | 0.61 | 32,193,621 | 12,051,240 | 0.37 | 2,849,000 | 2,241,666 | 0.79 |

RR = Realization Rate

**Table 3-4**
**Summary of Adjusted Evaluated Process Project Results by Measure Group - Excluding 3 Sites**

| | Total | Evaluated | kW | | | kWh | | | Therms | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Measure Category | Projects | Projects | Ex Ante | Ex Post | RR | Ex Ante | Ex Post | RR | Ex Ante | Ex Post | RR |
| Thermal Process Modifications | 4 | 2 | 0 | 0 | . | 0 | 0 | . | 2,849,000 | 1,773,150 | 0.62 |
| Variable Speed Drives | 6 | 3 | 211 | 978 | 4.63 | 11,021,825 | 8,684,359 | 0.79 | 0 | 0 | . |
| Oil Well Pump Control/Modifications | 11 | 6 | 807 | 449 | 0.56 | 8,076,478 | 3,917,617 | 0.49 | 0 | 0 | . |
| Refrigeration/Tank Insulation | 5 | 1 | 175 | 203 | 1.16 | 1,194,625 | 540,381 | 0.45 | 0 | 0 | . |
| Process Modification | 9 | 5 | 624 | 903 | 1.45 | 3,478,143 | 3,493,619 | 1.00 | 0 | 0 | . |
| Air Compressors | 15 | 3 | 116 | 181 | 1.56 | 1,476,988 | 1,422,902 | 0.96 | 0 | 0 | . |
| Totals | 50 | 20 | 1,932 | 2,714 | 1.40 | 25,248,059 | 18,058,878 | 0.72 | 2,849,000 | 1,773,150 | 0.62 |

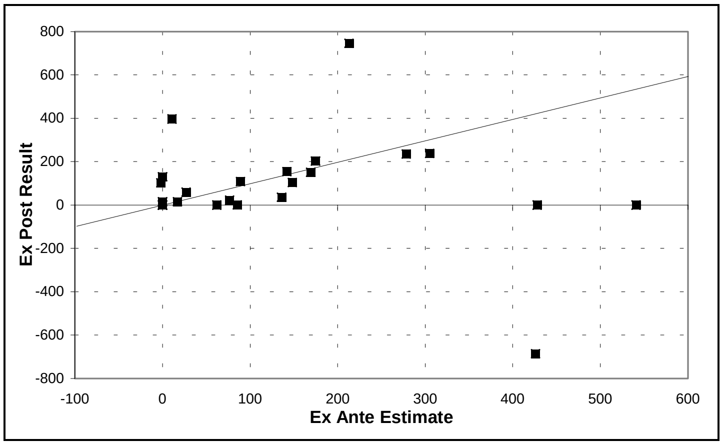
RR = Realization Rate

As the tables indicate, the variable speed drive (VSD), process modification, and air compressor projects returned the most favorable impact results. The large kW realization rate for the VSD projects is mainly due to conservative ex ante kW estimates that are based on the change in full load kW where VSD savings are low. The ex post estimates incorporate typical peak-hour loads that are typically below full-load conditions. VSD savings are much greater under these conditions.

The low realization rate for the thermal process modifications mainly reflects results of one very large project where post-retrofit equipment performance was determined to be different that predicted in the ex ante analysis. For oil well measures, the removal of the one problem project improves kW and kWh realization rates considerably. However, the oil pump realization rate remains relatively low (at 0.56 in Table 3-4) because of the effects of several pump-off controller (POC) projects. The evaluation found that a number of the POCs were either temporarily removed or disconnected because of their negative effect on oil production in specific oil fields.

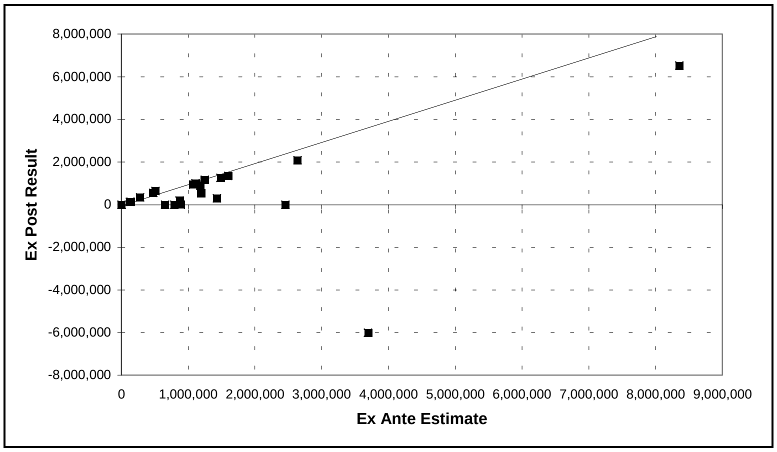
Figures 3-1 and 3-2 compare ex post evaluation results to ex ante savings estimates for kW and kWh. The diagonal lines represent points at which ex post results and ex ante estimates are equal (realization rates equal to 1.0). Therm impacts are compared in Table 3-5 because only three therm impact projects were analyzed (out of four total therm impact projects).

**Figure 3-1**
**Process Summer On-Peak kW Savings - Ex Ante vs. Ex Post**




As Figure 3-1 shows, ex post kW results are similar to ex ante estimates for a number of projects. The three largest ex ante kW projects are the three problem projects discussed above; they have zero or negative ex post kW impacts. Several other projects with zero kW impacts are POC projects where none of the rebated controls are in use. Most of the projects where the ex post result greatly exceeds the ex ante estimate (point well above the diagonal line) involve VSD projects. Another project, one with about 400 kW ex post impacts and nearly zero ex ante impacts, involves a facility that was able to eliminate its second shift as a result of the measure installation. Since the facility no longer operates after 3 p.m. on weekdays, almost all of the affected load is attributed to peak kW savings.

**Figure 3-2**
**Process Annual kWh Savings - Ex Ante vs. Ex Post**




As Figure 3-2 shows, over half of the projects show ex post kWh results that are similar to ex ante estimates (points on or near the diagonal line). The three problem projects are again shown with negative or zero ex post impacts. One very large VSD project shows ex post results somewhat lower than ex ante estimates because of lower-than-expected post-retrofit system performance, offset somewhat by higher-than-expected operating hours.

Table 3-5 presents gross therm impacts for: (1) the problem project with negative electric savings and positive therm savings; (2) a large oil refinery thermal process modification project where post-retrofit performance differed from ex ante estimates; and (3) a smaller thermal process project where ex ante savings were essentially verified by the ex post analysis.

**Table 3-5**
**Process Annual Therm Savings - Ex Ante vs. Ex Post**

| | Ex Ante | Ex Post | Realization Rate |
|---|---|---|---|
| 1 | 0 | 468,516 | - |
| 2 | 2,750,000 | 1,672,921 | 0.61 |
| 3 | 99,000 | 100,229 | 1.01 |

Table 3-6 presents the distribution of realization rates by Process projects. This table summarizes some of the relationships displayed graphically above.

**Table 3-6**
**Distribution of Process Realization Rates**

| Gross | Number of Projects | | | | | |
|---|---|---|---|---|---|---|
| Realization Rate | kW | % Projects | kWh | % Projects | Therms | % Projects |
| > 1.25 | 3 | 16% | 2 | 9% | | |
| 0.75 - 1.25 | 7 | 37% | 13 | 57% | 1 | 50% |
| < 0.75 | 9 | 47% | 8 | 35% | 1 | 50% |
| Totals | 19 | 100% | 21 | 100% | 2 | |

### Discussion of Discrepancies

As part of the project analyses, key factors leading to discrepancies between evaluation results and PG&E's estimated impacts were identified. Table 3-7 lists key factors causing discrepancies and the number of sites associated with each discrepancy. The approximate magnitude of each discrepancy is also indicated and is broken out for cases where the discrepancy led to higher impacts (where the ex post result was higher than the ex ante prediction) and lower impacts (where the ex post result was lower than the ex ante prediction). Following is a brief discussion of each discrepancy factor.

**Table 3-7**
**Process Projects: Summary of Discrepancies**

| Discrepancy Factor | Number of Projects | Energy Units | Magnitude of Discrepancies: Where Ex post > Ex Ante | Where Ex post < Ex Ante | Net |
|---|---|---|---|---|---|
| Measures not in place | 5 | kW | 33 | -242 | -209 |
| | 5 | kWh | 0 | -2,711,309 | -2,711,309 |
| | 0 | Therms | 0 | 0 | 0 |
| Equipment/system performance different from projections | 9 | kW | 19 | -1,094 | -1,074 |
| | 12 | kWh | 40,120 | -9,417,758 | -9,377,638 |
| | 1 | Therms | 0 | -807,809 | -807,809 |
| Different operating conditions | 2 | kW | 374 | -14 | 360 |
| | 11 | kWh | 426,800 | -2,245,750 | -1,818,950 |
| | 1 | Therms | 1,229 | 0 | 1,229 |
| Basecase differences | 7 | kW | 43 | -1,387 | -1,344 |
| | 7 | kWh | 196,273 | -6,486,815 | -6,290,541 |
| | 2 | Therms | 468,516 | -53,854 | 414,662 |
| Methodology differences | 12 | kW | 1,059 | -90 | 969 |
| | 3 | kWh | 0 | -182,373 | -182,373 |
| | 1 | Therms | 0 | -215,416 | -215,416 |

Measures Not in Place: This discrepancy is associated with five POC projects where controls were either removed from well pumps, disconnected, or installed on pumps that are not in operation. In each case, the customer has indicated that they plan to re-deploy the POCs, but they could not say when.

Equipment/System Performance Different From Projections: The ex ante energy savings estimates are assumptions based on how installed equipment will perform at specified operating conditions. Performance factors include such items as operating kW at certain load conditions (motors or pumps/fans), rated efficiency at certain loads (chillers), control system behavior in unloaded or at specified part-load conditions (compressors), and the effectiveness of pumping controls to optimize cycling or control strategies (oil well pump controls). At some sites, the evaluation was able to collect data on actual post-retrofit performance via metering/monitoring and review of customer data. The evaluation was able to improve on the initial estimates by using actual versus predicted performance in savings calculations/models. The largest performance discrepancies involved oil well projects (the large problem project and POC projects.)

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

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

At some sites, operating hours or schedules were different than initially predicted. At one site it was found that the facility does not need to operate during the summer on-peak coincident hour, resulting in little or no demand savings. At a number of sites, the evaluation revealed that equipment cycled or experienced a diversity factor that was not considered in the ex ante calculations. Changes in operating conditions contributed to both over- and under-predictions of program savings.

Basecase Differences: As part of the evaluation, an assessment was made of the appropriateness of the ex ante basecase. The ex ante basecase was accepted for most projects. Exceptions include: the three problem projects discussed earlier; and one VSD project where the pre-retrofit motor control strategy (a outlet damper) was deemed inappropriate and a somewhat more efficient control strategy (an inlet vane damper) was substituted.

Methodology Differences: This category includes projects that used an ex ante savings estimation methodology that was so different from the evaluation methodology that the reasons for impact differences were difficult to discern. These were sites where the initial savings analysis consisted of an engineering approach and the evaluation used a production/measurement method.

#### Verification Activities at Non-Analysis Sites

A total of 23 sites not included in the analysis sample received measure verification audits. All measures were found to be in place.

### *Indoor Lighting Projects*

A number of different measure types were installed as part of the evaluated Indoor Lighting projects. In many cases multiple measure types were included in the same project. Evaluation results by key measure category are shown in Table 3-8.

**Table 3-8**
**Summary of Evaluated Indoor Project Results by Measure Group**

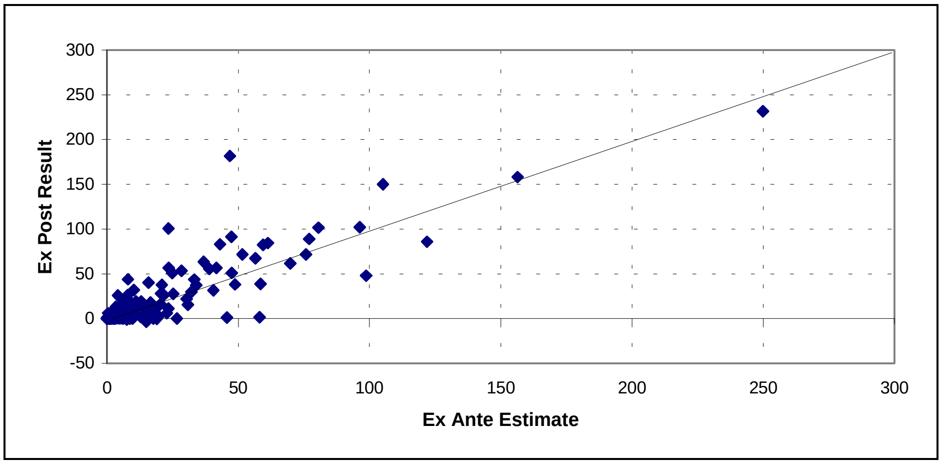
| Measure Category | Total Items | Evaluated Items | kW Ex Ante | kW Ex Post | kW RR | kWh Ex Ante | kWh Ex Post | kWh RR | Therms Ex Ante | Therms Ex Post | Therms RR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HIDs | 112 | 65 | 917 | 616 | 0.67 | 5,404,270 | 3,858,234 | 0.71 | 0 | 1 | - |
| T-8s with electronic ballast | 255 | 159 | 769 | 1,368 | 1.78 | 4,153,422 | 6,277,177 | 1.51 | 0 | -1,718 | - |
| Reflectors with delamping | 82 | 59 | 722 | 926 | 1.28 | 4,005,484 | 3,814,093 | 0.95 | 0 | -980 | - |
| CFLs | 65 | 47 | 82 | 51 | 0.62 | 466,337 | 229,989 | 0.49 | 0 | -56 | - |
| Exit Signs | 46 | 25 | 29 | 13 | 0.46 | 231,046 | 112,086 | 0.49 | 0 | -23 | - |
| Other/Customized | 16 | 10 | 286 | 264 | 0.92 | 1,110,378 | 1,238,364 | 1.12 | 0 | -428 | - |
| Controls | 65 | 47 | 197 | 96 | 0.49 | 737,220 | 688,576 | 0.93 | 0 | -231 | - |
| Totals | 576 | 412 | 3,001 | 3,334 | 1.11 | 16,108,157 | 16,218,519 | 1.01 | 0 | -3,435 | - |

RR = Realization Rate

As the table indicates, the T-8 fixture and delamping measures provided the highest realization rates. In addition the "Other/Customized" category, which is dominated by one large site, returned high realization rates. High-intensity discharge lighting (HIDs), compact fluorescent lighting (CFLs), and exit signs (and controls for kW) showed the lowest realization rates.

Figures 3-3 and 3-4 compare ex post evaluation results to ex ante savings estimates for kW and kWh. (Therm impacts are not included because all ex ante therm impacts are zero and ex post therm impacts are not very large.) The diagonal lines represent points at which evaluation results and PG&E estimates are equal (realization rates equal to 1.0).

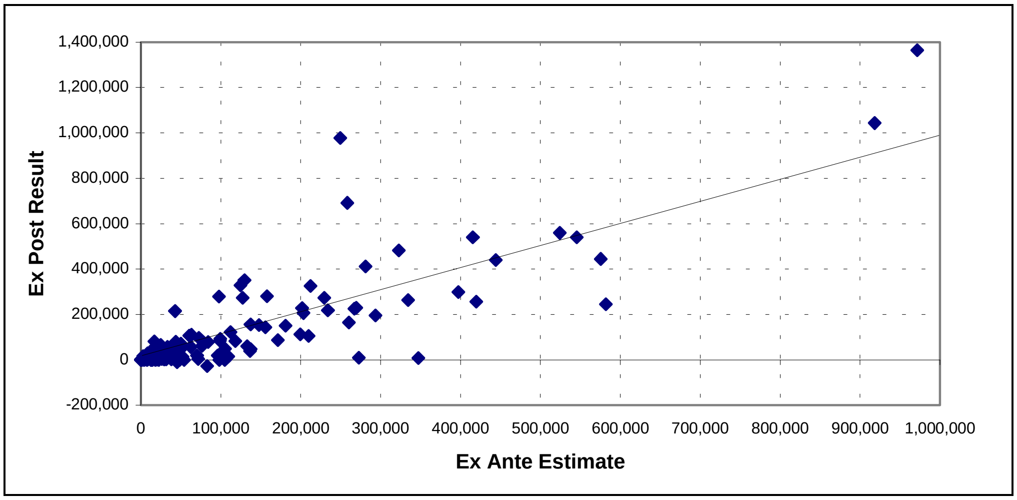
**Figure 3-3**
**Indoor Lighting Summer On-Peak kW Savings - Ex Ante vs. Ex Post**




As Figure 3-3 shows, there is considerable variation in ex post kW results and ex ante estimates. This can be expected because the ex ante estimates (for the Express Program that dominates the lighting measures) reflect broad industry averages for factors such as the change in connected load and the percent of lights on during the peak hour, while the ex post results are site specific.

The majority of points are above the diagonal line (indicating ex post results exceed ex ante estimates) because the reduction in connected load and the on-peak coincident diversity factors were often found to be higher that the ex ante estimates.

**Figure 3-4**
**Indoor Lighting Annual kWh Savings - Ex Ante vs. Ex Post**




As Figure 3-4 shows, ex post kWh results are also dispersed around the ex ante estimates. On average, the discrepancy between ex ante assumptions and ex post findings tended to even out, leading to a gross kWh realization rate close to 1.0.

Table 3-9 presents the distribution of realization rates by Indoor Lighting projects. This table summarizes some of the relationships displayed graphically above. Note that several projects showed zero ex ante kW impacts, so realization rates could not be calculated.

**Table 3-9**
**Distribution of Indoor Lighting Realization Rates by Project**

| Gross | Number of Projects | | | |
|---|---|---|---|---|
| Realization Rate | kW | % Projects | kWh | % Projects |
| > 1.25 | 64 | 33% | 76 | 37% |
| 0.76 - 1.25 | 46 | 24% | 68 | 33% |
| < 0.75 | 85 | 44% | 60 | 29% |
| Totals | 195 | 100% | 204 | 100% |

### Discussion of Discrepancies

To gain a better understanding of why ex post results differed from ex ante results, key components of the lighting impact calculations are presented in Table 3-10 (this table excludes one large custom project.) The number of units in this table refers to the number of lamps or control devices rebated.

**Table 3-10**
**Comparison of Indoor Lighting Impact Determinants - Express Program Projects**

| Measure Type | | Number of Units | Noncoincident Unit kW Svgs | Annual Operating Hours | Coincident Diversity Factor | Net HVAC Interaction Effects Peak kW Savings | Annual kWh Savings | Annual Therm Penalty |
|---|---|---|---|---|---|---|---|---|
| HIDs | Ex Ante | 2,209 | 0.410 | 5,064 | 0.79 | 143.2 | 412,266 | 0 |
| | Ex Post | 2,205 | 0.312 | 5,619 | 0.90 | 0.1 | -218 | 1 |
| | *Realization Rate* | *1.00* | *0.76* | *1.11* | *1.13* | *0.00* | *0.00* | *na* |
| T-8s w/ Electronic Ballast | Ex Ante | 86,186 | 0.009 | 4,916 | 0.80 | 154.2 | 348,286 | 0 |
| | Ex Post | 79,506 | 0.017 | 4,544 | 0.95 | 120.3 | 291,215 | -1,718 |
| | *Realization Rate* | *0.92* | *1.82* | *0.92* | *1.18* | *0.78* | *0.84* | *na* |
| Reflectors w/ Delamping | Ex Ante | 21,035 | 0.036 | 4,917 | 0.80 | 120.4 | 330,744 | 0 |
| | Ex Post | 19,648 | 0.046 | 4,058 | 0.94 | 76.8 | 164,772 | -980 |
| | *Realization Rate* | *0.93* | *1.29* | *0.83* | *1.18* | *0.64* | *0.50* | *na* |
| CFLs | Ex Ante | 1,344 | 0.066 | 4,906 | 0.80 | 14.1 | 39,076 | 0 |
| | Ex Post | 1,089 | 0.048 | 4,246 | 0.88 | 4.5 | 8,205 | -56 |
| | *Realization Rate* | *0.81* | *0.73* | *0.87* | *1.11* | *0.32* | *0.21* | *na* |
| Exit signs | Ex Ante | 718 | 0.034 | 8,760 | 1.00 | 4.8 | 19,077 | 0 |
| | Ex Post | 554 | 0.022 | 8,760 | 1.00 | 0.9 | 3,506 | -23 |
| | *Realization Rate* | *0.77* | *0.66* | *1.00* | *1.00* | *0.18* | *0.18* | *na* |
| Controls | Ex Ante | 1,307 | 0.457 | 1,134 | 0.33 | 0.0 | 60,561 | 0 |
| | Ex Post | 1,125 | 0.393 | 1,468 | 0.19 | 10.5 | 39,565 | -231 |
| | *Realization Rate* | *0.86* | *0.86* | *1.29* | *0.59* | *na* | *0.65* | *na* |
| Other | Ex Ante | 2,793 | 0.013 | 4,910 | 0.80 | 7.0 | 15,698 | 0 |
| | Ex Post | 2,784 | 0.010 | 6,409 | 1.00 | 3.6 | 11,752 | 68 |
| | *Realization Rate* | *1.00* | *0.81* | *1.31* | *1.25* | *0.52* | *0.75* | *na* |
| Total | Ex Ante | 115,599 | 0.028 | 4,278 | 0.71 | 443.8 | 1,225,709 | 0 |
| | Ex Post | 106,918 | 0.035 | 4,233 | 0.84 | 242.7 | 581,531 | -3,435 |
| | *Realization Rate* | *0.92* | *1.26* | *0.99* | *1.18* | *0.55* | *0.47* | *na* |

HID measures showed less savings than anticipated, mainly because pre-retrofit fixture efficiencies were higher than expected. Alternatively, T8 with electronic ballast measures showed higher savings as a results of lower-than-expected pre-retrofit efficiencies (many fixtures were still using 40-watt lamps). Lower CFL and exit sign savings were the result of lower numbers of installed units and lower per-unit savings. CFL operating hours were also lower than anticipated. Lower unit savings for exit signs result because many of these measures replaced a single 20-watt lamp while the ex ante estimate assumed that two 20-watt lamps would be replaced. Control-measure kW savings were low because it was determined that usage reductions during the peak hour were less than expected.

Ex post measure counts were lower than ex ante units for a variety of reasons, including: measure burnout (CFLs), measure dissatisfaction or the inability to locate enough suitable applications (controls), removals due to facility modifications (T8 lamps), and safety factors (exit signs not having a high enough contrast).

For the reflectors with delamping measure, some of the lower ex post unit counts are attributable to measure characterization. In the ex post evaluation, units were counts of modified fixtures because it was expected that a single lamp would be removed from each fixture. Later, it was found that sometimes two lamps were removed from a single fixture. So, if more than one lamp was removed from a fixture the effect was shown as a larger change in noncoincident unit savings (connected load). In contrast, each lamp removed was counted as a unit in the ex ante calculations.

In addition to the differences shown in Table 3-10, the ex post analysis found that tracking system results could not be replicated exactly from information provided in the Express Program forms and Advice filing. Table 3-11 compares the Express ex ante savings estimates from the tracking system with the savings estimates calculated using reported ex ante savings determinants. Results are generally within a few percentage points. Differences are largest for CFL and T8 measures (ignoring the small "Other" category). It is possible that tracking system impacts for some projects are based on assumptions from earlier program years that differ from current assumptions. This may explain some of the differences.

**Table 3-11**
**Comparison of Original Ex Ante (Tracking System) and Recalculated Ex Ante**

| | Annual kWh | | | Peak kW | | |
|---|---|---|---|---|---|---|
| Measure Type | Tracking System | Calculated | %Diff | Tracking System | Calculated | %Diff |
| HIDs | 5,404,270 | 4,993,195 | -7.6% | 916 | 859 | -6.2% |
| T-8s w/ electric ballast | 4,153,422 | 4,203,499 | 1.2% | 769 | 781 | 1.6% |
| Reflectors w/ delamping | 4,005,484 | 4,002,809 | -0.1% | 722 | 717 | -0.6% |
| CFLs | 466,337 | 472,910 | 1.4% | 82 | 85 | 3.2% |
| Exit signs | 231,046 | 231,039 | 0.0% | 29 | 29 | 0.2% |
| Controls | 737,220 | 737,442 | 0.0% | 197 | 197 | 0.2% |
| Other | 192,059 | 190,362 | -0.9% | 36 | 35 | -0.9% |
| Total | 15,189,838 | 14,831,256 | -2.4% | 2,750 | 2,704 | -1.7% |

### *3.2.3 Gross Impacts by PG&E Costing Period*

As part of the gross impact analysis, program savings were allocated to PG&E time-of-use periods. Results are presented in Table 3-12 on the following page.

**Table 3-12**
**Gross Impacts by PG&E Costing Period**

| Process and Indoor Lighting | | | | | | | |
|---|---|---|---|---|---|---|---|
| Costing Period | Avg kW Savings | Avg kW Savings Coincident with System Maximum | kW Adjustment Factor | kWh Savings | kWh Adjustment Factor | Annual kWh Savings | Connected Load kW Savings |
| Summer On Peak | 6,884 | 7,730 | 1.000 | 5,287,120 | 0.138 | 38,209,715 | 8,146 |
| Summer Part Peak | 5,658 | 6,691 | 0.866 | 5,069,188 | 0.133 | 38,209,715 | 8,146 |
| Summer Off Peak | 3,516 | 3,764 | 0.487 | 9,675,886 | 0.253 | 38,209,715 | 8,146 |
| Winter Part Peak | 5,716 | 6,050 | 0.783 | 9,362,460 | 0.245 | 38,209,715 | 8,146 |
| Winter Off Peak | 3,258 | 6,597 | 0.853 | 8,815,057 | 0.231 | 38,209,715 | 8,146 |
| **Process** | | | | | | | |
| Costing Period | Avg kW Savings | Avg kW Savings Coincident with System Maximum | kW Adjustment Factor | kWh Savings | kWh Adjustment Factor | Annual kWh Savings | Connected Load kW Savings |
| Summer On Peak | 2,514 | 3,416 | 1.000 | 1,930,958 | 0.111 | 17,434,659 | 3,409 |
| Summer Part Peak | 2,407 | 3,287 | 0.962 | 2,157,020 | 0.124 | 17,434,659 | 3,409 |
| Summer Off Peak | 1,838 | 2,171 | 0.636 | 5,057,979 | 0.290 | 17,434,659 | 3,409 |
| Winter Part Peak | 2,244 | 2,909 | 0.852 | 3,675,294 | 0.211 | 17,434,659 | 3,409 |
| Winter Off Peak | 1,705 | 2,562 | 0.750 | 4,613,407 | 0.265 | 17,434,659 | 3,409 |
| **Indoor Lighting** | | | | | | | |
| Costing Period | Avg kW Savings | Avg kW Savings Coincident with System Maximum | kW Adjustment Factor | kWh Savings | kWh Adjustment Factor | Annual kWh Savings | Connected Load kW Savings |
| Summer On Peak | 4,370 | 4,315 | 1.000 | 3,356,162 | 0.162 | 20,775,055 | 4,737 |
| Summer Part Peak | 3,250 | 3,404 | 0.789 | 2,912,168 | 0.140 | 20,775,055 | 4,737 |
| Summer Off Peak | 1,678 | 1,593 | 0.369 | 4,617,907 | 0.222 | 20,775,055 | 4,737 |
| Winter Part Peak | 3,472 | 3,142 | 0.728 | 5,687,167 | 0.274 | 20,775,055 | 4,737 |
| Winter Off Peak | 1,553 | 4,035 | 0.935 | 4,201,649 | 0.202 | 20,775,055 | 4,737 |

Summer On Peak: May 1 to Oct. 31 Noon-6 p.m. Weekdays; Coincident Hour 3 p.m.
Summer Part Peak: May 1 to Oct. 31 8:30 a.m. - Noon & 6-9:30 p.m. Weekdays; Coincident Hour 6 p.m.
Summer Off Peak: May 1 to Oct. 31 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday; Coincident Hour 10 p.m.
Winter Part Peak: Nov. 1 to Apr. 30 8:30 a.m. - 9:30 p.m.; Coincident Hour 6 p.m.
Winter Off Peak: Nov. 1 to Apr. 30 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday; Coincident Hour 8 a.m.

## 3.3 NET PROGRAM SAVINGS

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

### *3.3.1 Net-to-Gross Analysis*

The objective of the net-to-gross analysis is to determine what equipment purchase decisions would have occurred without the PG&E 1997 Industrial Programs. As discussed in Section 2 of this report, both free-ridership and spillover are taken into account, with a primary emphasis on free-ridership.

#### *Standard Net-to-Gross Survey*

All available evaluation projects received a standard NTG survey. Program participants were asked a series of survey questions to probe their decision process with respect to the installation of energy-efficient measures. The results of these questions were then used to constructNTGRs. Key survey results are presented below.

An important aspect of an energy efficiency program is its ability to inform customers of the availability of efficient technologies. To understand the information impact of the program, the participants were asked how they first learned about the energy-efficient technologies installed through the program. Table 3-13 presents the results. As shown, 10% of the surveyed Process participants and 28% of the Indoor Lighting participants first learned about relevant technologies from PG&E.

**Table 3-13**
**How Participants First Heard About Efficient Technologies**

| | Percentage of Respondents | |
|---|---|---|
| | Process | Indoor Lighting |
| From a contractor/architect/engineer | 14% | 32% |
| From a vendor | 24% | 13% |
| From PG&E | 10% | 28% |
| From other sources | 38% | 25% |
| Don't Know/Refused to Answer | 14% | 2% |
| Total | 100% | 100% |

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

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

Results are presented below in Table 3-14. As shown, only 2% of the Process participants and 13% of the Indoor Lighting participants stated they had learned about the Program after deciding on their specific energy efficiency purchases.

**Table 3-14**
**When Participants Learned About PG&E Rebate Program**

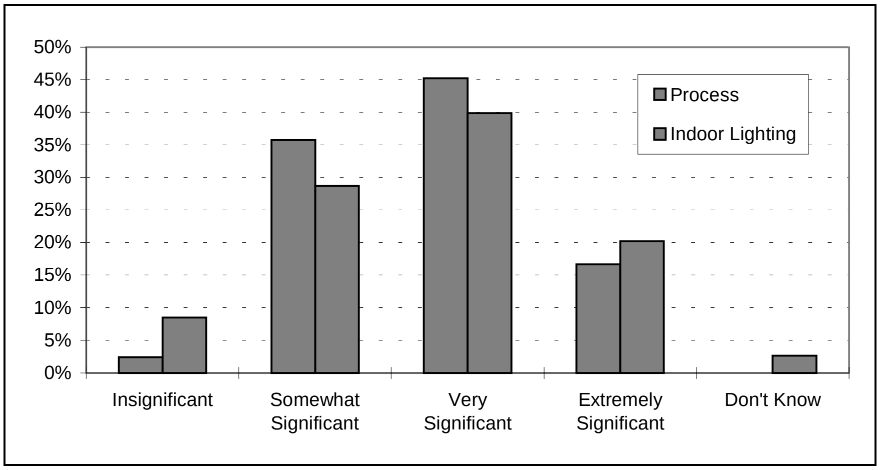
| | When Participants Learned About Program | | | |
|---|---|---|---|---|
| | Before | | After | |
| Decision Process | % of Process Respondents | % of Lighting Respondents | % of Process Respondents | % of Lighting Respondents |
| Thinking about installing energy efficient equipment | 76% | 63% | 21% | 34% |
| Decided to purchase specific equipment | 95% | 85% | 2% | 13% |

To test Program importance, the question was:

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

Responses are shown in Figure 3-5. About 60% of the respondents indicated the Program was very significant or extremely significant in influencing the energy efficiency installations. Less than 10% of the respondents indicated the Program was insignificant.

**Figure 3-5**
**Significance of Program on Decision to Install Measures**

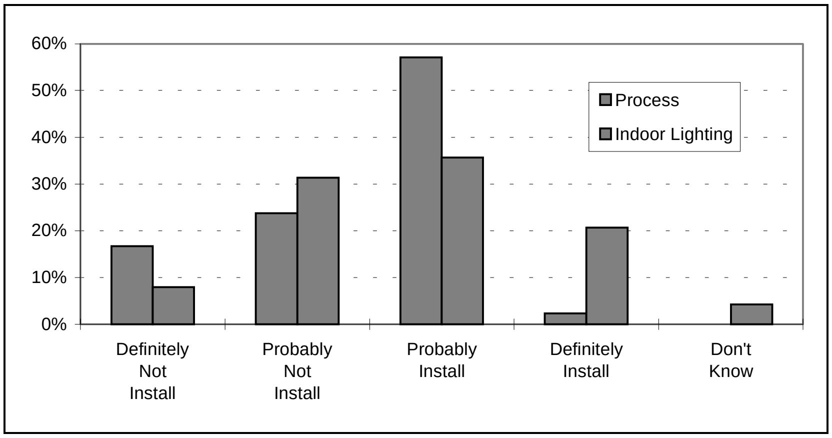



The stated intentions question was the key questions used to construct the standard self-report NTGRs. The primary stated intentions question was:

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

Responses are shown in Figure 3-6. About 40% of the respondents indicated they definitely or probably would not have installed the measures without the rebate. While a large number of participants indicated that they *probably* would have installed the measures anyway, it is generally believed that some of these customers interpret the question as: "*If you could do the project over again, would you?"* Customers who are happy with their project (now that performance uncertainty is no longer a threat) are likely to say they would do the project again. About half of the respondents who state they probably would have installed the measures anyway also indicate that the Program was very significant or extremely significant in their decision to install measures. The problems with respondents accurately responding to the hypothetical "what if" question is a major reason consistency checks are used in the standard NTG calculations (see Section 2).

**Figure 3-6**
**Likelihood Customer Would Have Installed Measure If Incentive Was Not Available**




Customers who were likely to have installed measures anyway without the rebate were asked if those measures would have been as efficient. Alternatively, customers who would not have installed measures without the rebate were asked if they would have installed equipment with above-standard efficiency. Results are tabulated in Table 3-15. This table indicates that most customers who first indicated that they would install measures anyway would probably have installed equipment of the same efficiency. About 11% of customers who would not have installed measures without the rebate may have selected equipment of intermediate efficiency.

**Table 3-15**
**Type of Equipment That Would Have Been Installed Without Rebate**

| | Percentage of Respondents | |
|---|---|---|
| | Process | Indoor Lighting |
| Efficiency of equipment that would have been installed for customers who would have installed measures anyway | | |
| Probably NOT as efficient | 12% | 10% |
| Probably as efficient | 68% | 84% |
| Don't Know | 20% | 6% |
| Type of equipment that would have been installed by customers who would not have installed measures with incentives | | |
| Standard Efficiency Equipment | 23% | 46% |
| Intermediate Efficiency Equipment | 12% | 11% |
| Would not have installed anything | 65% | 42% |
| Don’t Know | 0% | 1% |

### *Standard Net-to-Gross Results*

Using results of the standard NTG survey and the scoring method described in Section 2 of this report, standard NTGRs were calculated for each project. Table 3-16 shows the distribution of NTGRs for the Process and Indoor Lighting projects.

**Table 3-16**
**Distribution of Standard Net-to-Gross Ratios**

| NTGR Range | # Projects | % Projects |
|---|---|---|
| Process | | |
| 1.00 | 8 | 19% |
| 0.70-0.99 | 17 | 41% |
| 0.30-0.69 | 14 | 33% |
| 0.01-0.29 | 0 | 0% |
| 0.00 | 3 | 7% |
| Indoor Lighting | | |
| 1.00 | 14 | 7% |
| 0.70-0.99 | 92 | 49% |
| 0.30-0.69 | 71 | 38% |
| 0.01-0.29 | 1 | 1% |
| 0.00 | 10 | 5% |

Table 3-17 shows the average standard NTGRs calculated for kW, kWh, and therms. For process projects the NTGRs average about 0.5 for electric impacts and over 0.9 for the gas impacts. Indoor Lighting NTGRs average about 0.7.

**Table 3-17**
**Impact-Weighted Average Standard Net-to-Gross Ratios**

| | Process | Indoor Lighting |
|---|---|---|
| Summer On-peak kW | 0.59 | 0.68 |
| Annual kWh | 0.54 | 0.68 |
| Annual Therms | 0.93 | 0.69 |

### *Custom Net-to-Gross Ratios for Large Projects*

The custom NTGRs were designed to improve upon the standard NTGRs for the largest impact projects by incorporating additional information from project files, additional customer interviews, and other sources such as vendors and PG&E customer representatives. Table 3-18 shows how the distribution of NTGRs varied between the standard and custom analyses. Table 3-19 compares weighted-average NTGRs for the large projects that received a custom analysis.

For Process projects, the customization process tended to move projects out of the 0.70 to 0.99 range into the next lower or higher category. For Indoor Lighting, the distribution of NTGRs tended to shift down somewhat.

When combined with energy impact weights, the custom NTGRs were somewhat lower for the Process end use and somewhat higher for the Indoor Lighting end use. Results did not shift dramatically from the standard NTGRs.

**Table 3-18**
**Distribution of Standard and Custom Net-to-Gross Ratios for Large Impact Projects**

| NTGR Range | % of Projects | |
|---|---|---|
| | Standard | Custom |
| Process | | |
| 1.00 | 10% | 20% |
| 0.70-0.99 | 70% | 40% |
| 0.30-0.69 | 20% | 40% |
| 0.01-0.29 | 0% | 0% |
| 0.00 | 0% | 0% |
| Indoor Lighting | | |
| 1.00 | 13% | 7% |
| 0.70-0.99 | 40% | 33% |
| 0.30-0.69 | 37% | 33% |
| 0.01-0.29 | 0% | 7% |
| 0.00 | 20% | 20% |

**Table 3-19**
**Energy-Weighted Average Standard and Custom Net-to-Gross Ratios - Large Projects**

| | Process | | | Indoor Lighting | | |
|---|---|---|---|---|---|---|
| | Standard | Custom | Difference | Standard | Custom | Difference |
| Summer On-peak kW | 0.53 | 0.46 | -0.07 | 0.71 | 0.75 | 0.04 |
| Annual kWh | 0.48 | 0.40 | -0.08 | 0.70 | 0.74 | 0.04 |
| Annual Therms | 0.93 | 0.87 | -0.06 | 0.74 | 0.76 | 0.02 |

### *Spillover*

As part of the project-specific analyses, screening surveys were conducted to assess the effects of Program spillover—installations of energy-efficient equipment installed outside the Program but induced by the Program. Overall, three lighting sites reported installation of spillover measures. However, two of the spillover projects involved replacement of high-pressure sodium fixtures with metal halide fixtures, resulting in essentially zero savings. Therefore, impacts of only one spillover project are included in the ex post results. This project involved the replacement of incandescent fixtures with 12 HIDs. The spillover impacts were calculated and divided by gross impacts to determine spillover rates. Table 3-20 on the next page presents the results.

**Table 3-20**
**Spillover Results**

| End Use | Gross Impacts | Spillover | Spillover Rate |
|---|---|---|---|
| Process | | | |
| Summer On-peak kW | 3,416 | 0 | 0 |
| Annual kWh | 17,434,659 | 0 | 0 |
| Annual Therms | 2,390,716 | 0 | 0 |
| Indoor Lighting | | | |
| Summer On-peak kW | 4,315 | 5.3 | 0.0012 |
| Annual kWh | 20,775,055 | 27,629 | 0.0013 |
| Annual Therms | -4,579 | | 0 |
| Total | | | |
| Summer On-peak kW | 7,730 | 5.3 | 0.0007 |
| Annual kWh | 38,209,715 | 27,629 | 0.0007 |
| Annual Therms | 2,386,137 | 0 | 0 |

### *Final Net-to-Gross Ratios*

Final NTGRs were developed by incorporating results of the custom NTG analysis and the spillover analysis into the standard NTGRs reported in Table 3-17. These results are shown in Table 3-21.

**Table 3-21**
**Final Impact-Weighted Net-to-Gross Ratios**

| End Use | Standard NTGR | NTGR After Custom Adjustment | Spillover Rate | Final NTGRs Including Spillover |
|---|---|---|---|---|
| Process | | | | |
| Summer On-peak kW | 0.59 | 0.55 | 0 | 0.55 |
| Annual kWh | 0.54 | 0.49 | 0 | 0.49 |
| Annual Therms | 0.93 | 0.87 | 0 | 0.87 |
| Indoor Lighting | | | | |
| Summer On-peak kW | 0.68 | 0.69 | 0.0012 | 0.70 |
| Annual kWh | 0.68 | 0.70 | 0.0013 | 0.70 |
| Annual Therms | 0.69 | 0.70 | 0 | 0.70 |
| Total | | | | |
| Summer On-peak kW | 0.64 | 0.63 | 0.0007 | 0.63 |
| Annual kWh | 0.62 | 0.60 | 0.0007 | 0.60 |
| Annual Therms | 0.93 | 0.87 | 0 | 0.87 |

## *3.3.2 Net Impacts*

Net impacts were developed by applying the NTGRs from the previous table to ex post gross impacts. The net impact results are summarized in Table 3-22. For Process projects, the net kW, kWh, and therm realization rates are 0.59, 0.29, and 0.92, respectively. The low net kW and kWh realization rates are the combined effects of gross realization rates averaging below 1.0 and ex post NTGRs that are below ex ante NTGRs. For Indoor Lighting, the lower ex post NTGRs (0.70 versus 0.86 ex ante) cause net realization rates to fall below 1.0.

**Table 3-22**
**Summary of Net Impact Results**

| End Use | Ex Ante Estimates: Net Impacts | Ex Ante Estimates: Net-to-Gross Ratio | Ex Post Results: Net Impacts | Ex Post Results: Net-to-Gross Ratio | Ex Post Results: 90% Confidence Interval | Net Realization Rate |
|---|---|---|---|---|---|---|
| Process | | | | | | |
| Summer On-peak kW | 3,200 | 0.75 | 1,876 | 0.55 | ±0.019 | 0.59 |
| Annual kWh | 29,409,659 | 0.75 | 8,472,387 | 0.49 | ±0.020 | 0.29 |
| Annual Therms | 2,247,167 | 0.75 | 2,075,496 | 0.87 | ±0.006 | 0.92 |
| Indoor Lighting | | | | | | |
| Summer On-peak kW | 3,214 | 0.85 | 2,994 | 0.70 | ±0.020 | 0.93 |
| Annual kWh | 17,499,217 | 0.86 | 14,495,908 | 0.70 | ±0.017 | 0.83 |
| Annual Therms | 0 | - | -3,182 | 0.70 | ±0.020 | - |
| Total | | | | | | |
| Summer On-peak kW | 6,414 | 0.80 | 4,870 | 0.60 | ±0.023 | 0.76 |
| Annual kWh | 46,908,876 | 0.79 | 22,968,295 | 0.57 | ±0.022 | 0.49 |
| Annual Therms | 2,247,167 | 0.75 | 2,072,314 | 0.87 | ±0.021 | 0.92 |

As discussed at the beginning of this section, three problem Process projects contributed significantly to the low Process kW and kWh gross impacts. The same is true for net impacts. Table 3-23 recasts Table 3-22 under the assumption that the three projects are excluded from the ex post evaluation. As the table indicates, kW and kWh impacts and realization rates increase significantly. Net therm impacts decline because the oil pump gas impacts are not included.

**Table 3-23**
**Summary of Adjusted Net Impact Results - Excluding 3 Process Projects**

| End Use | Ex Ante Estimates: Net Impacts | Ex Ante Estimates: Net-to-Gross Ratio | Ex Post Results: Net Impacts | Ex Post Results: Net-to-Gross Ratio | Ex Post Results: 90% Confidence Interval | Net Realization Rate |
|---|---|---|---|---|---|---|
| Process | | | | | | |
| Summer On-peak kW | 3,200 | 0.75 | 3,595 | 0.57 | ±0.032 | 1.12 |
| Annual kWh | 29,409,659 | 0.75 | 16,563,513 | 0.56 | ±0.036 | 0.56 |
| Annual Therms | 2,247,167 | 0.75 | 1,724,109 | 0.90 | ±0.003 | 0.77 |
| Indoor Lighting | | | | | | |
| Summer On-peak kW | 3,214 | 0.85 | 2,994 | 0.70 | ±0.020 | 0.93 |
| Annual kWh | 17,499,217 | 0.86 | 14,495,908 | 0.70 | ±0.017 | 0.83 |
| Annual Therms | 0 | - | -3,182 | 0.70 | ±0.020 | - |
| Total | | | | | | |
| Summer On-peak kW | 6,414 | 0.80 | 6,589 | 0.57 | ±0.023 | 1.03 |
| Annual kWh | 46,908,876 | 0.79 | 31,059,421 | 0.58 | ±0.022 | 0.66 |
| Annual Therms | 2,247,167 | 0.75 | 1,720,927 | 0.90 | ±0.021 | 0.77 |

### *Net Impacts by PG&E Costing Period*

Net program impacts are shown by PG&E costing period in Table 3-24.

**Table 3-24**
**Net Impacts by PG&E Costing Period**

| Process and Indoor Lighting | | | | | | | |
|---|---|---|---|---|---|---|---|
| Costing Period | Avg kW Savings | Avg kW Savings Coincident with System Maximum | kW Adjustment Factor | kWh Savings | kWh Adjustment Factor | Annual kWh Savings | Connected Load kW Savings |
| Summer On Peak | 4,271 | 4,870 | 0.630 | 3,280,131 | 0.143 | 22,968,295 | 4,962 |
| Summer Part Peak | 3,438 | 4,168 | 0.539 | 3,080,187 | 0.134 | 22,968,295 | 4,962 |
| Summer Off Peak | 2,064 | 2,298 | 0.297 | 5,680,099 | 0.247 | 22,968,295 | 4,962 |
| Winter Part Peak | 3,513 | 3,778 | 0.489 | 5,754,264 | 0.251 | 22,968,295 | 4,962 |
| Winter Off Peak | 1,912 | 4,208 | 0.544 | 5,173,613 | 0.225 | 22,968,295 | 4,962 |
| **Process** | | | | | | | |
| Costing Period | Avg kW Savings | Avg kW Savings Coincident with System Maximum | kW Adjustment Factor | kWh Savings | kWh Adjustment Factor | Annual kWh Savings | Connected Load kW Savings |
| Summer On Peak | 1,222 | 1,876 | 0.549 | 938,351 | 0.111 | 8,472,387 | 1,656 |
| Summer Part Peak | 1,170 | 1,806 | 0.529 | 1,048,206 | 0.124 | 8,472,387 | 1,656 |
| Summer Off Peak | 893 | 1,192 | 0.349 | 2,457,929 | 0.290 | 8,472,387 | 1,656 |
| Winter Part Peak | 1,090 | 1,598 | 0.468 | 1,786,012 | 0.211 | 8,472,387 | 1,656 |
| Winter Off Peak | 828 | 1,407 | 0.412 | 2,241,889 | 0.265 | 8,472,387 | 1,656 |
| **Indoor Lighting** | | | | | | | |
| Costing Period | Avg kW Savings | Avg kW Savings Coincident with System Maximum | kW Adjustment Factor | kWh Savings | kWh Adjustment Factor | Annual kWh Savings | Connected Load kW Savings |
| Summer On Peak | 3,049 | 2,994 | 0.694 | 2,341,780 | 0.162 | 14,495,908 | 3,305 |
| Summer Part Peak | 2,268 | 2,362 | 0.547 | 2,031,981 | 0.140 | 14,495,908 | 3,305 |
| Summer Off Peak | 1,171 | 1,105 | 0.256 | 3,222,170 | 0.222 | 14,495,908 | 3,305 |
| Winter Part Peak | 2,423 | 2,180 | 0.505 | 3,968,252 | 0.274 | 14,495,908 | 3,305 |
| Winter Off Peak | 1,083 | 2,800 | 0.649 | 2,931,724 | 0.202 | 14,495,908 | 3,305 |

Summer On Peak: May 1 to Oct. 31 Noon-6 p.m. Weekdays; Coincident Hour 3 p.m.
Summer Part Peak: May 1 to Oct. 31 8:30 a.m. - Noon & 6-9:30 p.m. Weekdays; Coincident Hour 6 p.m.
Summer Off Peak: May 1 to Oct. 31 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday; Coincident Hour 10 p.m.
Winter Part Peak: Nov. 1 to Apr. 30 8:30 a.m. - 9:30 p.m.; Coincident Hour 6 p.m.
Winter Off Peak: Nov. 1 to Apr. 30 9:30 p.m.-8:30 a.m. Weekdays & All Saturday/Sunday; Coincident Hour 8 a.m.

## 3.4 OTHER FINDINGS AND RECOMMENDATIONS

During the course of the evaluation, a number of aspects regarding the Program and evaluation process were reviewed. A few recommendations developed from this review follow:

**1. File and tracking system calculations:** To develop an understanding of the ex ante impact estimates, both the hardcopy project files (for the Process projects) and the Express savings algorithms (for the Indoor Lighting projects) were carefully reviewed. In a number of cases, it was not possible to replicated the results stored in the tracking system that formed the basis for PG&E's earning claim. While some of the problems related to factors such as data entry errors, a number of discrepancies involved rounding or truncating analysis results during various stages of the ex ante calculations (especially for the Process projects). This rounding or truncating made it very difficult to work through the ex ante calculations and increased the effort required for the file review.

*Recommendation:* Calculations used to develop impact estimates should be clearly documented, without rounding of intermediate results.

**2. Pump-off controller impacts calculations:** Well-specific impacts for the POC measure are based on each pump's horsepower and volumetric efficiency. However, customers tend to move the POCs around, from well-to-well, based on analyses made subsequent to measure installations. The shuffling of POCs makes the well-specific impact calculations meaningless.

*Recommendation:* Standard per-unit POC impacts should be developed, based on an analysis that could make use of past evaluation results. Well-specific calculation should be eliminated. This approach will simplify the application process without loss of accuracy.

**3. Basecase assumptions:** As reported earlier in this section, inappropriate basecase assumptions lead to the overestimation of ex ante impacts. For one case in particular, the M&E Protocols required an adjustment to the ex ante basecase.

*Recommendation:* For large impact projects, the PG&E M&E staff should be consulted regarding the appropriateness of the basecase assumed in the ex ante estimates.

**4. Lighting project evaluation reports:** As part of the impact evaluation, project-specific reports were generated for the 20 largest Indoor Lighting projects. While these reports provide some insight into project savings, the writing and reviewing of these reports required considerable effort, one that could probably have been expended elsewhere. The nature of lighting impact calculations (the multiplication of units installed times hours operated times the reduction in connected load) lends itself to a batch process tied to a survey-results database. Site-specific lighting analyses and reporting are not necessary and add very little to the quality of the evaluation.

*Recommendation:* Eliminate project-specific Indoor Lighting reports in future evaluations. A summary site-analysis report can provide similar information with much less report writing and review time.

**5. Customer recruitment and spillover interview:** For large program projects, the evaluation study design called for an initial customer recruitment interview that included an assessment of whether or not program spillover was present. A second call was then required to schedule a site visit. The initial call and interview was designed to allow time for planning the analysis of spillover measures prior to the site visit. Unfortunately, the initial recruitment and spillover survey annoyed customers. They wanted to schedule the site visit and move on. Given the limited amount of spillover found during the past few evaluations, it seems more reasonable to conduct the spillover survey at the time of the site visit. Then an initial telephone call can be made to both recruit a customer and schedule the site visit, thereby increasing customer satisfaction.

*Recommendation:* Eliminate the initial telephone recruitment/spillover interview. Instead, use the telephone call to schedule a site visit and conduct the spillover interview and ensuing analysis on site.

# A PROJECT-SPECIFIC RESULTS

This appendix presents project-specific impact results for projects analyzed as part of the evaluation.  First, Process project results are shown, followed by Indoor Lighting project results.

# Table A-1
## Process Project Results

| Strat | CNTL# | Appl.# | Meas. | Description | Ex Ante - Gross kWh | Ex Ante - Gross kW | Ex Ante - Gross Thm | NTGR | Ex Ante - Net kWh | Ex Ante - Net kW | Ex Ante - Net Thm | Ex Post - Gross kWh | Ex Post - Gross kW | Ex Post - Gross Thm | NTGR | Ex Post - Net kWh | Ex Post - Net kW | Ex Post - Net Thm | Gross RR kWh | Gross RR kW | Gross RR Thm | Net RR kWh | Net RR kW | Net RR Thm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LRG | 0666353 | ATK1012 | 590 | INSULATE 13 WINE TANKS: 2 LOCATIONS | 795,367 | 428.0 | 0 | 0.75 | 596,525 | 321.0 | 0 | 0 | 0.0 | 0 | 0.00 | 0 | 0.0 | 0 | 0.00 | 0.00 | - | 0.00 | 0.00 | - |
| LRG | 0667001 | ATC0205 | 599 | 20 OIL WELL PUMPS: ROD TO SUBMERSIBLE | 3,693,304 | 426.0 | 0 | 0.75 | 2,769,978 | 319.5 | 0 | -6,007,638 | -685.8 | 468,516 | 0.75 | -4,505,729 | -514.4 | 351,387 | -1.63 | -1.61 | - | -1.63 | -1.61 | - |
| LRG | 0676955 | AJN1000 | 599 | REPLACE 600 HP PUMP vs. ADDED 125 HP PUMP | 475,107 | 148.3 | 0 | 0.75 | 356,330 | 111.2 | 0 | 553,207 | 104.2 | 0 | 0.70 | 387,245 | 72.9 | 0 | 1.16 | 0.70 | - | 1.09 | 0.66 | - |
| LRG | 0684590 | AFB1030 | 569 | NEW 200 TON PROCESS CHILLER | 1,194,625 | 174.8 | 0 | 0.75 | 895,969 | 131.1 | 0 | 540,381 | 203.3 | 0 | 0.50 | 270,191 | 101.7 | 0 | 0.45 | 1.16 | - | 0.30 | 0.78 | - |
| LRG | 0920614 | AJT0015 | 599 | REPLACE 3-450 HP COMPRESSOR WITH 2-250 HP | 1,073,363 | 89.0 | 0 | 0.75 | 805,022 | 66.8 | 0 | 947,394 | 108.1 | 0 | 0.50 | 473,697 | 54.1 | 0 | 0.88 | 1.21 | - | 0.59 | 0.81 | - |
| LRG | 1008376 | ATR6002 | 590 | INSULATE 16 WINE STORAGE TANKS | 2,456,891 | 541.0 | 0 | 0.75 | 1,842,668 | 405.8 | 0 | 0 | 0.0 | 0 | 0.00 | 0 | 0.0 | 0 | 0.00 | 0.00 | - | 0.00 | 0.00 | - |
| LRG | 1028281 | AFB1012 | 578 | MEAS#5 - NEW DRYER: ASD ON 2-400+2-600 hp FANS | 8,356,551 | 213.0 | 0 | 0.75 | 6,267,413 | 159.8 | 0 | 6,522,895 | 744.8 | 0 | 0.50 | 3,261,448 | 372.4 | 0 | 0.78 | 3.50 | - | 0.52 | 2.33 | - |
| LRG | 1043410 | AJG0003 | 578 | NEW MOTORS AND VSDS ON PROCESS COOL FANS | 1,483,274 | 0.0 | 0 | 0.75 | 1,112,456 | 0.0 | 0 | 1,263,607 | 130.2 | 0 | 1.00 | 1,263,607 | 130.2 | 0 | 0.85 | - | - | 1.14 | - | - |
| LRG | 4387722 | ETC0135 | P2 | 39 PUMP-OFF CONTROLLERS | 1,428,335 | 136.0 | 0 | 0.75 | 1,071,251 | 102.0 | 0 | 295,040 | 35.7 | 0 | 0.10 | 29,504 | 3.6 | 0 | 0.21 | 0.26 | - | 0.03 | 0.04 | - |
| LRG | 4451422 | ETC0136 | P2 | PUMP-OFF CONTROLLERS | 870,269 | 76.5 | 0 | 0.75 | 652,702 | 57.4 | 0 | 192,049 | 21.9 | 0 | 1.00 | 192,049 | 21.9 | 0 | 0.22 | 0.29 | - | 0.29 | 0.38 | - |
| LRG | 4451422 | ETC0166 | P2 | PUMP-OFF CONTROLLERS | 889,467 | 85.4 | 0 | 0.75 | 667,100 | 64.1 | 0 | 2,777 | 0.3 | 0 | 1.00 | 2,777 | 0.3 | 0 | 0.00 | 0.00 | - | 0.00 | 0.00 | - |
| LRG | 4451422 | ETC0202 | P2 | PUMP OFF-CONTROLS | 652,296 | 62.0 | 0 | 0.75 | 489,222 | 46.5 | 0 | 0 | 0.0 | 0 | 1.00 | 0 | 0.0 | 0 | 0.00 | 0.00 | - | 0.00 | 0.00 | - |
| LRG | 4730707 | ANR7700 | 574 | REPLACE PROCESS CONVEYOR SYSTEM | 1,247,261 | 10.7 | 0 | 0.75 | 935,446 | 8.0 | 0 | 1,165,166 | 396.9 | 0 | 0.35 | 407,808 | 138.9 | 0 | 0.93 | 37.09 | - | 0.44 | 17.31 | - |
| LRG | 5266483 | AXR6034 | 578 | 3 HIGH EFFICIENCY KILNS: ASD's ON 36-10 HP FANS | 1,182,000 | -1.9 | 0 | 0.75 | 886,500 | -1.4 | 0 | 897,857 | 102.5 | 0 | 0.30 | 269,357 | 30.8 | 0 | 0.76 | -53.95 | - | 0.30 | -21.58 | - |
| LRG | 5529355 | ATC0009 | 599 | 25 OIL WELL PUMP RIGHT SIZING PART OF ATC0001 | 2,636,640 | 305.2 | 0 | 0.75 | 1,977,480 | 228.9 | 0 | 2,078,562 | 237.3 | 0 | n/a | n/a | n/a | n/a | 0.79 | 0.78 | - | - | - | - |
| LRG | 5708822 | ETC0153 | P2 | 30 OIL WELL PUMP OFF-CONTROLS | 1,599,471 | 141.8 | 0 | 0.75 | 1,199,603 | 106.4 | 0 | 1,349,189 | 154.0 | 0 | 0.00 | 0 | 0.0 | 0 | 0.84 | 1.09 | - | 0.00 | 0.00 | - |
| LRG | 5851942 | AJG0009 | 560 | NEW PROCESS SHELL & TUBE HEAT EXCHANGER | 0 | 0.0 | 2,750,000 | 0.75 | 0 | 0.0 | 2,062,500 | 0 | 0.0 | 1,672,921 | 0.90 | 0 | 0.0 | 1,505,629 | - | - | 0.61 | - | - | 0.73 |
| LRG | 6123993 | AXR6001 | 580 | REPLACE ROCK CRUSHING EQUIPMENT | 1,108,799 | 278.5 | 0 | 0.75 | 831,599 | 208.9 | 0 | 998,459 | 234.8 | 0 | 0.90 | 898,613 | 211.3 | 0 | 0.90 | 0.84 | - | 1.08 | 1.01 | - |
| LRG | 6123993 | AXR6037 | 580 | REPLACE/RELOCATE - DUST COLLECTION SYSTEM | 507,594 | 169.2 | 0 | 0.75 | 380,696 | 126.9 | 0 | 643,187 | 151.2 | 0 | 0.95 | 611,028 | 143.6 | 0 | 1.27 | 0.89 | - | 1.61 | 1.13 | - |
| SML | 0679820 | ANR6510 | 599 | MOTORS | 139,382 | 16.9 | 0 | 0.75 | 104,537 | 12.7 | 0 | 133,600 | 15.6 | 0 | 0.70 | 93,520 | 10.9 | 0 | 0.96 | 0.92 | - | 0.89 | 0.86 | - |
| SML | 0914012 | ATK1003 | 589 | AIR COMPRESSER SYSTEM CHANGE/MODIFY | 278,094 | 27.0 | 0 | 0.75 | 208,571 | 20.3 | 0 | 349,831 | 59.0 | 0 | 1.00 | 349,831 | 59.0 | 0 | 1.26 | 2.19 | - | 1.68 | 2.91 | - |
| SML | 5851942 | AJG0005 | 550 | FURNACE MODIFICATION PROJECT | 0 | 0.0 | 99,000 | 0.75 | 0 | 0.0 | 74,250 | 0 | 0.0 | 100,229 | 1.00 | 0 | 0.0 | 100,229 | - | - | 1.01 | - | - | 1.35 |
| SML | 6351825 | AVV0013 | 589 | COMPRESSED AIR SYSTEM | 125,531 | 0.0 | 0 | 0.75 | 94,148 | 0.0 | 0 | 125,677 | 14.3 | 0 | 0.70 | 87,974 | 10.0 | 0 | 1.00 | - | - | 0.93 | - | - |

# Table A-2

## Indoor Lighting Project Results

| | | | Inst. Meas. | | | | Ex Ante - Gross | | | | Ex Ante - Net | | | Ex Post - Gross | | | | Ex Post - Net | | | Gross RR | | Net RR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strat | CNTL# | Appl.# | HID | T8 | Refl | Oth | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | kWh | kW |
| 1 | 0679820 | DNR5261 | 1 | 1 | 0 | 0 | 971,672 | 156.37 | 0 | 0.86 | 835,638 | 134.48 | 0 | 1,364,199 | 158.22 | -128 | 0.75 | 1,023,149 | 118.67 | -96 | 1.40 | 1.01 | 1.22 | 0.88 |
| 1 | 0885536 | DHT6147 | 1 | 0 | 0 | 0 | 272,800 | 45.65 | 0 | 0.86 | 234,608 | 39.26 | 0 | 9,636 | 1.10 | 0 | 1.00 | 9,636 | 1.10 | 0 | 0.04 | 0.02 | 0.04 | 0.03 |
| 1 | 0908474 | DJT9248 | 1 | 1 | 0 | 0 | 415,632 | 69.81 | 0 | 0.86 | 357,444 | 60.04 | 0 | 540,185 | 61.67 | 0 | 0.65 | 351,120 | 40.09 | 0 | 1.30 | 0.88 | 0.98 | 0.67 |
| 1 | 0997822 | DVV6000 | 0 | 1 | 1 | 0 | 267,140 | 48.79 | 0 | 0.86 | 229,740 | 41.96 | 0 | 225,479 | 38.28 | -78 | 1.00 | 225,479 | 38.28 | -78 | 0.84 | 0.78 | 0.98 | 0.91 |
| 1 | 1015112 | DJG3054 | 1 | 1 | 1 | 0 | 524,141 | 96.23 | 0 | 0.86 | 450,761 | 82.76 | 0 | 559,352 | 102.25 | -68 | 0.65 | 363,579 | 66.46 | -44 | 1.07 | 1.06 | 0.81 | 0.80 |
| 1 | 1100343 | DJN2305 | 1 | 1 | 1 | 0 | 582,138 | 98.73 | 0 | 0.86 | 500,639 | 84.91 | 0 | 245,242 | 47.84 | -8 | 0.95 | 232,980 | 45.45 | -8 | 0.42 | 0.48 | 0.47 | 0.54 |
| 1 | 3950021 | CEOVP005A | 0 | 0 | 0 | 0 | 918,319 | 249.90 | 0 | 0.75 | 688,739 | 187.43 | 0 | 1,042,935 | 231.61 | -361 | 0.95 | 990,788 | 220.03 | -343 | 1.14 | 0.93 | 1.44 | 1.17 |
| 1 | 4283690 | DVP7308 | 0 | 1 | 1 | 0 | 293,559 | 56.52 | 0 | 0.86 | 252,461 | 48.61 | 0 | 195,812 | 67.54 | -68 | 0.90 | 176,231 | 60.79 | -61 | 0.67 | 1.19 | 0.70 | 1.25 |
| 1 | 4312747 | DVV3196 | 0 | 1 | 1 | 0 | 444,089 | 80.57 | 0 | 0.86 | 381,917 | 69.29 | 0 | 439,452 | 101.73 | -71 | 0.50 | 219,726 | 50.87 | -36 | 0.99 | 1.26 | 0.58 | 0.73 |
| 1 | 4363530 | DVV3275 | 0 | 1 | 1 | 0 | 545,528 | 121.90 | 0 | 0.86 | 469,154 | 104.83 | 0 | 539,746 | 85.90 | -187 | 1.00 | 539,746 | 85.90 | -187 | 0.99 | 0.70 | 1.15 | 0.82 |
| 1 | 4494939 | DVP6311 | 0 | 1 | 1 | 0 | 334,474 | 61.26 | 0 | 0.86 | 287,648 | 52.68 | 0 | 263,353 | 84.47 | -91 | 1.00 | 263,353 | 84.47 | -91 | 0.79 | 1.38 | 0.92 | 1.60 |
| 1 | 4619188 | DVV3150 | 0 | 1 | 1 | 0 | 575,648 | 105.10 | 0 | 0.86 | 495,057 | 90.39 | 0 | 445,039 | 150.08 | -54 | 0.74 | 329,329 | 111.06 | -40 | 0.77 | 1.43 | 0.67 | 1.23 |
| 1 | 4619189 | DVV7100 | 0 | 1 | 1 | 0 | 280,962 | 51.57 | 0 | 0.86 | 241,627 | 44.35 | 0 | 412,347 | 71.69 | -31 | 0.75 | 309,260 | 53.77 | -23 | 1.47 | 1.39 | 1.28 | 1.21 |
| 1 | 4621707 | DNR7194 | 0 | 1 | 1 | 0 | 322,852 | 59.47 | 0 | 0.86 | 277,653 | 51.14 | 0 | 482,938 | 82.38 | -167 | 0.70 | 338,057 | 57.67 | -117 | 1.50 | 1.39 | 1.22 | 1.13 |
| 1 | 4699053 | DVV3183 | 0 | 1 | 1 | 0 | 397,162 | 75.82 | 0 | 0.86 | 341,559 | 65.21 | 0 | 298,609 | 71.69 | -103 | 0.50 | 149,305 | 35.85 | -52 | 0.75 | 0.95 | 0.44 | 0.55 |
| 1 | 5293541 | DVP6277 | 0 | 1 | 1 | 0 | 260,184 | 47.48 | 0 | 0.86 | 223,758 | 40.83 | 0 | 164,820 | 51.01 | -30 | 0.50 | 82,410 | 25.51 | -15 | 0.63 | 1.07 | 0.37 | 0.62 |
| 1 | 5736798 | DVP7027 | 0 | 1 | 1 | 0 | 258,122 | 47.39 | 0 | 0.86 | 221,985 | 40.76 | 0 | 691,971 | 91.23 | -239 | 0.50 | 345,986 | 45.62 | -120 | 2.68 | 1.92 | 1.56 | 1.12 |
| 1 | 5853747 | DVV7200 | 0 | 1 | 1 | 0 | 419,806 | 77.02 | 0 | 0.86 | 361,033 | 66.24 | 0 | 256,447 | 89.00 | -33 | 0.74 | 189,771 | 65.86 | -24 | 0.61 | 1.16 | 0.53 | 0.99 |
| 1 | 6284421 | DVV3015 | 0 | 1 | 0 | 0 | 269,550 | 58.50 | 0 | 0.86 | 231,813 | 50.31 | 0 | 228,975 | 38.68 | -79 | 0.30 | 68,693 | 11.60 | -24 | 0.85 | 0.66 | 0.30 | 0.23 |
| 1 | 6366790 | DVP6159 | 1 | 0 | 0 | 0 | 347,200 | 58.10 | 0 | 0.86 | 298,592 | 49.97 | 0 | 7,711 | 1.40 | 0 | 0.53 | 4,087 | 0.74 | 0 | 0.02 | 0.02 | 0.01 | 0.01 |
| 2 | 0109715 | DTK5294 | 1 | 0 | 0 | 0 | 99,200 | 16.60 | 0 | 0.86 | 85,312 | 14.28 | 0 | 92,050 | 18.12 | 0 | 0.87 | 80,084 | 15.76 | 0 | 0.93 | 1.09 | 0.94 | 1.10 |
| 2 | 0153371 | DXT6223 | 1 | 0 | 0 | 0 | 147,884 | 26.58 | 0 | 0.86 | 127,180 | 22.86 | 0 | 153,053 | 0.00 | 0 | 0.76 | 116,320 | 0.00 | 0 | 1.03 | 0.00 | 0.91 | 0.00 |
| 2 | 0172666 | DJQ9040 | 0 | 0 | 0 | 0 | 72,720 | 13.03 | 0 | 0.86 | 62,539 | 11.21 | 0 | 96,399 | 19.06 | -23 | 0.85 | 81,939 | 16.20 | -20 | 1.33 | 1.46 | 1.31 | 1.45 |
| 2 | 0274502 | DRN4829 | 1 | 0 | 0 | 0 | 203,360 | 34.03 | 0 | 0.86 | 174,890 | 29.27 | 0 | 206,086 | 37.15 | 0 | n/a | - | - | - | 1.01 | 1.09 | - | - |
| 2 | 0369670 | DJG2218 | 1 | 0 | 0 | 0 | 124,620 | 20.85 | 0 | 0.86 | 107,173 | 17.93 | 0 | 327,843 | 37.43 | 0 | 0.70 | 229,490 | 26.20 | 0 | 2.63 | 1.79 | 2.14 | 1.46 |

## Indoor Lighting Project Results

| | | | Inst. Meas. | | | | Ex Ante - Gross | | | | Ex Ante - Net | | | Ex Post - Gross | | | | Ex Post - Net | | | Gross RR | | Net RR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strat | CNTL# | Appl.# | HID | T8 | Refl | Oth | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | kWh | kW |
| 2 | 0369671 | DJG3278 | 1 | 0 | 0 | 0 | 157,938 | 28.38 | 0 | 0.86 | 135,827 | 24.41 | 0 | 280,591 | 53.39 | 0 | 0.70 | 196,414 | 37.37 | 0 | 1.78 | 1.88 | 1.45 | 1.53 |
| 2 | 0442464 | DNR6270 | 1 | 0 | 0 | 0 | 52,080 | 8.71 | 0 | 0.86 | 44,789 | 7.49 | 0 | 14,320 | 2.35 | 0 | 0.56 | 8,019 | 1.32 | 0 | 0.27 | 0.27 | 0.18 | 0.18 |
| 2 | 0574333 | DBG3099 | 0 | 1 | 0 | 0 | 48,628 | 9.05 | 0 | 0.86 | 41,820 | 7.78 | 0 | 46,541 | 9.08 | -7 | 0.50 | 23,271 | 4.54 | -4 | 0.96 | 1.00 | 0.56 | 0.58 |
| 2 | 0724678 | DJQ6059 | 1 | 0 | 0 | 0 | 54,282 | 9.75 | 0 | 0.86 | 46,683 | 8.39 | 0 | 14 | -0.05 | 0 | 0.70 | 10 | -0.04 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0868432 | DRG4516 | 1 | 0 | 0 | 0 | 136,400 | 22.82 | 0 | 0.86 | 117,304 | 19.63 | 0 | 39,562 | 5.87 | 0 | 0.50 | 19,781 | 2.94 | 0 | 0.29 | 0.26 | 0.17 | 0.15 |
| 2 | 0875329 | DRN5130 | 0 | 0 | 0 | 0 | 38,750 | 10.65 | 0 | 0.86 | 33,325 | 9.16 | 0 | 31,868 | 5.22 | -11 | 0.76 | 24,220 | 3.97 | -8 | 0.82 | 0.49 | 0.72 | 0.43 |
| 2 | 0875329 | DRN5241 | 0 | 1 | 1 | 0 | 201,844 | 36.86 | 0 | 0.86 | 173,586 | 31.70 | 0 | 228,182 | 63.43 | -79 | 0.76 | 173,418 | 48.21 | -60 | 1.13 | 1.72 | 0.99 | 1.51 |
| 2 | 0896126 | DNR7073 | 1 | 0 | 0 | 0 | 105,292 | 18.92 | 0 | 0.86 | 90,551 | 16.27 | 0 | -1,011 | -0.25 | 0 | 0.00 | 0 | 0.00 | 0 | -0.01 | -0.01 | 0.00 | 0.00 |
| 2 | 0984134 | DXT6241 | 1 | 0 | 0 | 0 | 97,876 | 15.84 | 0 | 0.86 | 84,173 | 13.62 | 0 | 279,425 | 40.29 | 0 | 0.70 | 195,598 | 28.20 | 0 | 2.85 | 2.54 | 2.32 | 2.07 |
| 2 | 0986913 | DFB7155 | 1 | 1 | 0 | 0 | 171,220 | 30.84 | 0 | 0.86 | 147,249 | 26.52 | 0 | 87,037 | 15.37 | -9 | 0.88 | 76,593 | 13.53 | -8 | 0.51 | 0.50 | 0.52 | 0.51 |
| 2 | 0997822 | DVV3327 | 0 | 0 | 0 | 0 | 70,176 | 8.77 | 0 | 0.86 | 60,351 | 7.54 | 0 | 19,011 | 2.30 | -7 | 1.00 | 19,011 | 2.30 | -7 | 0.27 | 0.26 | 0.32 | 0.30 |
| 2 | 1000630 | DHP7006 | 1 | 1 | 0 | 0 | 109,149 | 19.54 | 0 | 0.86 | 93,868 | 16.80 | 0 | 15,075 | 2.32 | -1 | 0.87 | 13,115 | 2.02 | -1 | 0.14 | 0.12 | 0.14 | 0.12 |
| 2 | 1001689 | DJN3298 | 1 | 1 | 1 | 0 | 137,205 | 24.83 | 0 | 0.86 | 117,996 | 21.35 | 0 | 156,096 | 50.66 | -3 | 0.85 | 132,682 | 43.06 | -3 | 1.14 | 2.04 | 1.12 | 2.02 |
| 2 | 1072803 | DXT6079 | 1 | 0 | 0 | 0 | 156,000 | 25.25 | 0 | 0.86 | 134,160 | 21.72 | 0 | 142,751 | 27.59 | 0 | 0.87 | 124,193 | 24.00 | 0 | 0.92 | 1.09 | 0.92 | 1.10 |
| 2 | 1075478 | DJQ9313 | 1 | 1 | 1 | 0 | 96,252 | 16.40 | 0 | 0.86 | 82,777 | 14.10 | 0 | 18,910 | 6.16 | -2 | 0.56 | 10,590 | 3.45 | -1 | 0.20 | 0.38 | 0.13 | 0.25 |
| 2 | 1087436 | DJN3151 | 0 | 1 | 1 | 0 | 63,540 | 11.64 | 0 | 0.86 | 54,644 | 10.01 | 0 | 110,835 | 13.04 | -20 | n/a | - | - | - | 1.74 | 1.12 | - | - |
| 2 | 1098358 | DHP6175 | 1 | 1 | 1 | 0 | 199,696 | 32.14 | 0 | 0.86 | 171,739 | 27.64 | 0 | 112,394 | 29.74 | -38 | 0.85 | 95,535 | 25.28 | -32 | 0.56 | 0.93 | 0.56 | 0.91 |
| 2 | 2885404 | DRN4881 | 1 | 1 | 0 | 0 | 60,688 | 10.23 | 0 | 0.86 | 52,192 | 8.80 | 0 | 106,386 | 31.74 | 0 | 0.00 | 0 | 0.00 | 0 | 1.75 | 3.10 | 0.00 | 0.00 |
| 2 | 3874976 | DVP7179 | 0 | 1 | 1 | 0 | 127,464 | 23.41 | 0 | 0.86 | 109,619 | 20.13 | 0 | 272,925 | 100.86 | -93 | 0.70 | 191,048 | 70.60 | -65 | 2.14 | 4.31 | 1.74 | 3.51 |
| 2 | 3923508 | DVP6274 | 0 | 1 | 0 | 0 | 249,600 | 46.80 | 0 | 0.86 | 214,656 | 40.25 | 0 | 977,621 | 181.62 | -338 | 0.50 | 488,811 | 90.81 | -169 | 3.92 | 3.88 | 2.28 | 2.26 |
| 2 | 4459616 | DNR7087 | 0 | 0 | 0 | 0 | 98,448 | 17.71 | 0 | 0.86 | 84,665 | 15.23 | 0 | 0 | 0.00 | 0 | n/a | - | - | - | 0.00 | 0.00 | - | - |
| 2 | 4621707 | DNR7032 | 0 | 1 | 1 | 0 | 212,262 | 38.92 | 0 | 0.86 | 182,545 | 33.47 | 0 | 326,031 | 55.61 | -113 | 0.70 | 228,222 | 38.93 | -79 | 1.54 | 1.43 | 1.25 | 1.16 |
| 2 | 4663550 | DRN4743 | 0 | 1 | 1 | 0 | 100,372 | 18.32 | 0 | 0.86 | 86,320 | 15.76 | 0 | 29,112 | 6.53 | -10 | n/a | - | - | - | 0.29 | 0.36 | - | - |
| 2 | 4838877 | DJN2304 | 0 | 1 | 1 | 0 | 84,130 | 14.23 | 0 | 0.86 | 72,352 | 12.24 | 0 | 78,220 | 10.98 | -27 | 0.89 | 69,616 | 9.77 | -24 | 0.93 | 0.77 | 0.96 | 0.80 |
| 2 | 4848172 | DXT6244 | 1 | 0 | 0 | 0 | 76,576 | 13.76 | 0 | 0.86 | 65,855 | 11.83 | 0 | 61,109 | 15.22 | 0 | 0.50 | 30,555 | 7.61 | 0 | 0.80 | 1.11 | 0.46 | 0.64 |
| 2 | 4895348 | DJN2273 | 1 | 1 | 0 | 0 | 137,680 | 23.46 | 0 | 0.86 | 118,405 | 20.18 | 0 | 46,573 | 11.07 | -3 | 0.70 | 32,601 | 7.75 | -2 | 0.34 | 0.47 | 0.28 | 0.38 |
| 2 | 4940551 | DVV3138 | 0 | 1 | 0 | 0 | 105,400 | 19.27 | 0 | 0.86 | 90,644 | 16.57 | 0 | 49,727 | 12.81 | -17 | 0.50 | 24,864 | 6.41 | -9 | 0.47 | 0.67 | 0.27 | 0.39 |

# Indoor Lighting Project Results

| | | | Inst. Meas. | | | | Ex Ante - Gross | | | | Ex Ante - Net | | | Ex Post - Gross | | | | Ex Post - Net | | | Gross RR | | Net RR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strat | CNTL# | Appl.# | HID | T8 | Refl | Oth | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | kWh | kW |
| 2 | 5091892 | DBG3071 | 1 | 0 | 0 | 0 | 71,790 | 12.90 | 0 | 0.86 | 61,739 | 11.09 | 0 | 4,480 | 1.60 | 0 | 0.70 | 3,136 | 1.12 | 0 | 0.06 | 0.12 | 0.05 | 0.10 |
| 2 | 5113237 | DJN3156 | 0 | 1 | 1 | 0 | 229,810 | 41.65 | 0 | 0.86 | 197,637 | 35.82 | 0 | 273,441 | 56.59 | -92 | 0.85 | 232,425 | 48.10 | -78 | 1.19 | 1.36 | 1.18 | 1.34 |
| 2 | 5173923 | DHS7031 | 0 | 1 | 1 | 0 | 129,792 | 23.49 | 0 | 0.86 | 111,621 | 20.20 | 0 | 350,814 | 56.62 | -121 | 1.00 | 350,814 | 56.62 | -121 | 2.70 | 2.41 | 3.14 | 2.80 |
| 2 | 5265413 | DTC9310 | 1 | 1 | 0 | 0 | 180,972 | 33.19 | 0 | 0.86 | 155,636 | 28.54 | 0 | 150,939 | 43.71 | -52 | 0.00 | 0 | 0.00 | 0 | 0.83 | 1.32 | 0.00 | 0.00 |
| 2 | 5649939 | DTC9030 | 0 | 1 | 1 | 0 | 62,536 | 11.11 | 0 | 0.86 | 53,781 | 9.55 | 0 | 56,336 | 19.13 | -19 | n/a | - | - | - | 0.90 | 1.72 | - | - |
| 2 | 5789023 | DVP7029 | 0 | 1 | 1 | 0 | 234,136 | 42.99 | 0 | 0.86 | 201,357 | 36.97 | 0 | 218,919 | 82.98 | -76 | 0.70 | 153,243 | 58.09 | -53 | 0.94 | 1.93 | 0.76 | 1.57 |
| 2 | 5845633 | DXT6250 | 0 | 1 | 1 | 0 | 118,370 | 21.63 | 0 | 0.86 | 101,798 | 18.60 | 0 | 81,904 | 26.27 | -28 | 0.90 | 73,714 | 23.64 | -25 | 0.69 | 1.21 | 0.72 | 1.27 |
| 2 | 5962657 | DVT3196 | 1 | 1 | 0 | 0 | 82,992 | 14.93 | 0 | 0.86 | 71,373 | 12.84 | 0 | -27,630 | -3.41 | 0 | 0.00 | 0 | 0.00 | 0 | -0.33 | -0.23 | 0.00 | 0.00 |
| 2 | 5984567 | DVV3211 | 0 | 1 | 1 | 0 | 112,108 | 20.64 | 0 | 0.86 | 96,413 | 17.75 | 0 | 122,067 | 28.16 | -42 | 0.70 | 85,447 | 19.71 | -29 | 1.09 | 1.36 | 0.89 | 1.11 |
| 2 | 6332106 | DVV3276 | 0 | 1 | 1 | 0 | 98,890 | 20.37 | 0 | 0.86 | 85,045 | 17.52 | 0 | 84,674 | 16.44 | -29 | 0.70 | 59,272 | 11.51 | -20 | 0.86 | 0.81 | 0.70 | 0.66 |
| 2 | 6446651 | DJN3291 | 0 | 1 | 1 | 0 | 209,910 | 40.54 | 0 | 0.86 | 180,523 | 34.86 | 0 | 105,823 | 31.45 | -14 | 0.70 | 74,076 | 22.02 | -10 | 0.50 | 0.78 | 0.41 | 0.63 |
| 2 | 6452771 | DVV3111 | 0 | 1 | 0 | 0 | 133,241 | 30.35 | 0 | 0.86 | 114,587 | 26.10 | 0 | 60,853 | 22.21 | -21 | 0.00 | 0 | 0.00 | 0 | 0.46 | 0.73 | 0.00 | 0.00 |
| 3 | 0033009 | DJN2308 | 0 | 1 | 0 | 0 | 9,984 | 1.87 | 0 | 0.86 | 8,586 | 1.61 | 0 | 11,442 | 3.24 | -2 | 1.00 | 11,442 | 3.24 | -2 | 1.15 | 1.73 | 1.33 | 2.01 |
| 3 | 0057235 | DNQ7007 | 1 | 0 | 0 | 0 | 2,393 | 0.43 | 0 | 0.86 | 2,058 | 0.37 | 0 | 3,075 | 1.35 | 0 | 0.00 | 0 | 0.00 | 0 | 1.29 | 3.13 | 0.00 | 0.00 |
| 3 | 0209855 | DJN3239 | 0 | 1 | 0 | 0 | 13,824 | 2.59 | 0 | 0.86 | 11,889 | 2.23 | 0 | 2,880 | 1.26 | 0 | 0.90 | 2,592 | 1.13 | 0 | 0.21 | 0.49 | 0.22 | 0.51 |
| 3 | 0231671 | DJN2393 | 1 | 0 | 0 | 0 | 24,800 | 4.15 | 0 | 0.86 | 21,328 | 3.57 | 0 | 65,644 | 25.84 | 0 | 0.50 | 32,822 | 12.92 | 0 | 2.65 | 6.23 | 1.54 | 3.62 |
| 3 | 0257243 | DRN5165 | 0 | 1 | 0 | 0 | 1,152 | 0.22 | 0 | 0.86 | 991 | 0.19 | 0 | 1,237 | 0.35 | 0 | 0.85 | 1,051 | 0.30 | 0 | 1.07 | 1.61 | 1.06 | 1.59 |
| 3 | 0269878 | DJN2309 | 0 | 1 | 0 | 0 | 6,536 | 1.21 | 0 | 0.86 | 5,621 | 1.04 | 0 | 2,093 | 0.17 | 0 | n/a | - | - | - | 0.32 | 0.14 | - | - |
| 3 | 0279061 | DJQ9288 | 0 | 0 | 0 | 0 | 212 | 0.00 | 0 | 0.86 | 182 | 0.00 | 0 | 309 | 0.00 | 0 | 0.50 | 155 | 0.00 | 0 | 1.46 | . | 0.85 | . |
| 3 | 0323019 | DJT9322 | 0 | 1 | 0 | 0 | 6,720 | 1.26 | 0 | 0.86 | 5,779 | 1.08 | 0 | 9,077 | 2.29 | -3 | 1.00 | 9,077 | 2.29 | -3 | 1.35 | 1.82 | 1.57 | 2.11 |
| 3 | 0504220 | DRN5252 | 1 | 0 | 0 | 0 | 48,600 | 8.74 | 0 | 0.86 | 41,796 | 7.52 | 0 | -505 | -0.16 | 0 | 0.30 | -152 | -0.05 | 0 | -0.01 | -0.02 | 0.00 | -0.01 |
| 3 | 0550812 | DRN4859 | 1 | 0 | 0 | 0 | 4,224 | 0.71 | 0 | 0.86 | 3,633 | 0.61 | 0 | 29 | 0.02 | 0 | 0.70 | 20 | 0.01 | 0 | 0.01 | 0.02 | 0.01 | 0.02 |
| 3 | 0582146 | DJN3094 | 0 | 1 | 1 | 0 | 1,400 | 0.26 | 0 | 0.86 | 1,204 | 0.22 | 0 | 1,126 | 0.25 | 0 | 0.50 | 563 | 0.13 | 0 | 0.80 | 0.97 | 0.47 | 0.57 |
| 3 | 0612464 | DVV2838 | 1 | 0 | 0 | 0 | 45,120 | 7.56 | 0 | 0.86 | 38,803 | 6.50 | 0 | -9,953 | -1.20 | 3 | 0.86 | -8,560 | -1.03 | 3 | -0.22 | -0.16 | -0.22 | -0.16 |
| 3 | 0698461 | DFB7046 | 0 | 1 | 0 | 0 | 3,200 | 0.56 | 0 | 0.86 | 2,752 | 0.48 | 0 | 3,717 | 1.23 | 0 | 1.00 | 3,717 | 1.23 | 0 | 1.16 | 2.19 | 1.35 | 2.55 |
| 3 | 0808591 | DRN4922 | 0 | 1 | 1 | 0 | 36,654 | 6.66 | 0 | 0.86 | 31,522 | 5.73 | 0 | 32,224 | 8.70 | -11 | 0.50 | 16,112 | 4.35 | -6 | 0.88 | 1.31 | 0.51 | 0.76 |
| 3 | 0846411 | DXT6245 | 0 | 1 | 0 | 0 | 2,256 | 0.38 | 0 | 0.86 | 1,940 | 0.33 | 0 | 1,239 | 0.40 | 0 | 0.50 | 620 | 0.20 | 0 | 0.55 | 1.03 | 0.32 | 0.60 |

# Indoor Lighting Project Results

| | | | Inst. Meas. | | | | Ex Ante - Gross | | | | Ex Ante - Net | | | Ex Post - Gross | | | | Ex Post - Net | | | Gross RR | | Net RR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strat | CNTL# | Appl.# | HID | T8 | Refl | Oth | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | kWh | kW |
| 3 | 0850228 | DNR6251 | 1 | 0 | 0 | 0 | 19,840 | 3.32 | 0 | 0.86 | 17,062 | 2.86 | 0 | 1,225 | 0.32 | 0 | 0.70 | 858 | 0.22 | 0 | 0.06 | 0.10 | 0.05 | 0.08 |
| 3 | 0895945 | DJQ6265 | 1 | 0 | 0 | 0 | 14,358 | 2.58 | 0 | 0.86 | 12,348 | 2.22 | 0 | -72 | -0.02 | 0 | 0.50 | -36 | -0.01 | 0 | -0.01 | -0.01 | 0.00 | 0.00 |
| 3 | 0920617 | DJT9196 | 1 | 0 | 0 | 0 | 15,240 | 2.56 | 0 | 0.86 | 13,106 | 2.20 | 0 | 9,461 | 1.08 | 0 | n/a | - | - | - | 0.62 | 0.42 | - | - |
| 3 | 0950188 | DJQ9192 | 0 | 1 | 0 | 0 | 12,032 | 2.05 | 0 | 0.86 | 10,348 | 1.76 | 0 | 17,893 | 5.19 | -6 | 0.70 | 12,525 | 3.63 | -4 | 1.49 | 2.54 | 1.21 | 2.06 |
| 3 | 1044808 | DJN3120 | 0 | 1 | 0 | 0 | 864 | 0.16 | 0 | 0.86 | 743 | 0.14 | 0 | 1,070 | 0.41 | 0 | 0.74 | 792 | 0.30 | 0 | 1.24 | 2.50 | 1.06 | 2.15 |
| 3 | 1061554 | DJN3168 | 0 | 1 | 0 | 0 | 3,072 | 0.58 | 0 | 0.86 | 2,642 | 0.50 | 0 | 1,349 | 0.43 | 0 | 0.50 | 675 | 0.22 | 0 | 0.44 | 0.75 | 0.26 | 0.44 |
| 3 | 1075012 | DJN3177 | 1 | 0 | 0 | 0 | 20,188 | 3.63 | 0 | 0.86 | 17,362 | 3.12 | 0 | 14,348 | 5.65 | 0 | 0.85 | 12,196 | 4.80 | 0 | 0.71 | 1.56 | 0.70 | 1.54 |
| 3 | 1075015 | DJN3186 | 0 | 1 | 0 | 0 | 4,992 | 0.94 | 0 | 0.86 | 4,293 | 0.81 | 0 | 5,466 | 0.62 | 0 | 0.50 | 2,733 | 0.31 | 0 | 1.09 | 0.67 | 0.64 | 0.39 |
| 3 | 1075015 | DJN3260 | 0 | 1 | 0 | 0 | 4,992 | 0.94 | 0 | 0.86 | 4,293 | 0.81 | 0 | 7,754 | 0.94 | -3 | 0.50 | 3,877 | 0.47 | -2 | 1.55 | 1.00 | 0.90 | 0.58 |
| 3 | 1075572 | DJQ9208 | 0 | 1 | 1 | 0 | 10,030 | 1.84 | 0 | 0.86 | 8,626 | 1.58 | 0 | 6,273 | 2.52 | 0 | 1.00 | 6,273 | 2.52 | 0 | 0.63 | 1.37 | 0.73 | 1.59 |
| 3 | 1088019 | DJQ9338 | 1 | 0 | 0 | 0 | 29,760 | 4.98 | 0 | 0.86 | 25,594 | 4.28 | 0 | 1,967 | 0.63 | -1 | 0.50 | 984 | 0.32 | -1 | 0.07 | 0.13 | 0.04 | 0.07 |
| 3 | 1088020 | DJQ9211 | 0 | 1 | 0 | 0 | 9,956 | 1.81 | 0 | 0.86 | 8,562 | 1.56 | 0 | 14,158 | 2.33 | -3 | 0.50 | 7,079 | 1.17 | -2 | 1.42 | 1.29 | 0.83 | 0.75 |
| 3 | 1100541 | DJN3266 | 0 | 1 | 0 | 0 | 5,376 | 1.01 | 0 | 0.86 | 4,623 | 0.87 | 0 | 15,755 | 2.27 | -5 | 0.50 | 7,878 | 1.14 | -3 | 2.93 | 2.25 | 1.70 | 1.31 |
| 3 | 1104355 | DNR7321 | 1 | 0 | 0 | 0 | 46,584 | 7.54 | 0 | 0.86 | 40,062 | 6.48 | 0 | 1,577 | 0.18 | 0 | 0.50 | 789 | 0.09 | 0 | 0.03 | 0.02 | 0.02 | 0.01 |
| 3 | 1124554 | DXT6107 | 1 | 0 | 0 | 0 | 8,652 | 1.55 | 0 | 0.86 | 7,441 | 1.33 | 0 | 12,987 | 4.64 | 0 | 0.70 | 9,091 | 3.25 | 0 | 1.50 | 2.98 | 1.22 | 2.43 |
| 3 | 1124554 | DXT6232 | 1 | 0 | 0 | 0 | 37,492 | 6.73 | 0 | 0.86 | 32,243 | 5.79 | 0 | 53,476 | 19.09 | 0 | 0.70 | 37,433 | 13.36 | 0 | 1.43 | 2.83 | 1.16 | 2.31 |
| 3 | 1135253 | DBT2152 | 0 | 1 | 0 | 0 | 2,238 | 0.51 | 0 | 0.86 | 1,925 | 0.44 | 0 | 3,486 | 0.88 | 0 | 0.50 | 1,743 | 0.44 | 0 | 1.56 | 1.72 | 0.91 | 1.00 |
| 3 | 1135258 | DBT2152 | 0 | 1 | 0 | 0 | 8,124 | 1.49 | 0 | 0.86 | 6,987 | 1.28 | 0 | 14,647 | 3.04 | 0 | 0.50 | 7,324 | 1.52 | 0 | 1.80 | 2.04 | 1.05 | 1.18 |
| 3 | 1159808 | DJN3184 | 0 | 1 | 0 | 0 | 2,256 | 0.38 | 0 | 0.86 | 1,940 | 0.33 | 0 | 1,816 | 0.63 | -1 | 0.85 | 1,544 | 0.54 | -1 | 0.80 | 1.64 | 0.80 | 1.62 |
| 3 | 1208816 | DRG4571 | 0 | 1 | 0 | 0 | 16,808 | 3.13 | 0 | 0.86 | 14,455 | 2.69 | 0 | 80,810 | 10.76 | 0 | 0.50 | 40,405 | 5.38 | 0 | 4.81 | 3.43 | 2.80 | 2.00 |
| 3 | 1284529 | DVV3410 | 0 | 0 | 0 | 0 | 17,775 | 3.19 | 0 | 0.86 | 15,287 | 2.74 | 0 | 0 | 0.00 | 0 | n/a | - | - | - | 0.00 | 0.00 | - | - |
| 3 | 1295710 | DRN4706 | 1 | 0 | 0 | 0 | 47,120 | 7.88 | 0 | 0.86 | 40,523 | 6.78 | 0 | 3,238 | 1.16 | 0 | 0.50 | 1,619 | 0.58 | 0 | 0.07 | 0.15 | 0.04 | 0.09 |
| 3 | 1442485 | DJR6013 | 0 | 1 | 0 | 0 | 4,136 | 0.70 | 0 | 0.86 | 3,557 | 0.60 | 0 | 4,631 | 1.78 | -2 | 0.70 | 3,242 | 1.25 | -1 | 1.12 | 2.53 | 0.91 | 2.06 |
| 3 | 1561933 | DJN3070 | 1 | 0 | 0 | 0 | 31,724 | 5.70 | 0 | 0.86 | 27,283 | 4.90 | 0 | 1,821 | 0.50 | 0 | 0.00 | 0 | 0.00 | 0 | 0.06 | 0.09 | 0.00 | 0.00 |
| 3 | 1783380 | DXT6198 | 1 | 1 | 0 | 0 | 18,951 | 3.10 | 0 | 0.86 | 16,298 | 2.67 | 0 | 5,957 | 0.70 | -1 | 0.50 | 2,979 | 0.35 | -1 | 0.31 | 0.23 | 0.18 | 0.13 |
| 3 | 1918592 | DJN3069 | 0 | 1 | 0 | 0 | 1,536 | 0.29 | 0 | 0.86 | 1,321 | 0.25 | 0 | 1,508 | 0.85 | 0 | 0.50 | 754 | 0.43 | 0 | 0.98 | 2.94 | 0.57 | 1.71 |
| 3 | 1918593 | DJN3069 | 0 | 1 | 0 | 0 | 5,760 | 1.08 | 0 | 0.86 | 4,954 | 0.93 | 0 | 10,117 | 2.64 | -3 | 0.50 | 5,059 | 1.32 | -2 | 1.76 | 2.44 | 1.02 | 1.42 |

## Indoor Lighting Project Results

| Strat | CNTL# | Appl.# | Inst. Meas. HID | T8 | Refl | Oth | Ex Ante - Gross kWh | kW | Thm | NTGR | Ex Ante - Net kWh | kW | Thm | Ex Post - Gross kWh | kW | Thm | NTGR | Ex Post - Net kWh | kW | Thm | Gross RR kWh | kW | Net RR kWh | kW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 1918594 | DJN3069 | 0 | 1 | 0 | 0 | 2,496 | 0.47 | 0 | 0.86 | 2,147 | 0.40 | 0 | 4,400 | 1.14 | -2 | 0.50 | 2,200 | 0.57 | -1 | 1.76 | 2.44 | 1.02 | 1.42 |
| 3 | 2254207 | DJN2349 | 0 | 1 | 0 | 0 | 5,211 | 1.01 | 0 | 0.86 | 4,481 | 0.87 | 0 | 2,391 | 0.77 | -1 | 1.00 | 2,391 | 0.77 | -1 | 0.46 | 0.76 | 0.53 | 0.88 |
| 3 | 2652374 | DNQ7290 | 0 | 1 | 0 | 0 | 2,303 | 0.39 | 0 | 0.86 | 1,981 | 0.34 | 0 | 1,821 | 0.69 | -1 | 0.50 | 911 | 0.35 | -1 | 0.79 | 1.76 | 0.46 | 1.02 |
| 3 | 2876134 | DJN2318 | 1 | 0 | 0 | 0 | 28,800 | 4.83 | 0 | 0.86 | 24,768 | 4.15 | 0 | 1,548 | 0.51 | 0 | 0.50 | 774 | 0.26 | 0 | 0.05 | 0.11 | 0.03 | 0.06 |
| 3 | 3342737 | DBV2129 | 0 | 1 | 0 | 0 | 5,654 | 1.05 | 0 | 0.86 | 4,862 | 0.90 | 0 | 5,823 | 1.91 | -2 | 1.00 | 5,823 | 1.91 | -2 | 1.03 | 1.81 | 1.20 | 2.11 |
| 3 | 3812341 | DJN3107 | 0 | 0 | 0 | 0 | 106 | 0.00 | 0 | 0.86 | 91 | 0.00 | 0 | 154 | 0.00 | 0 | 0.70 | 108 | 0.00 | 0 | 1.45 | . | 1.18 | . |
| 3 | 3838818 | DJN3293 | 0 | 1 | 0 | 0 | 24,000 | 4.50 | 0 | 0.86 | 20,640 | 3.87 | 0 | 16,886 | 6.65 | 0 | 0.70 | 11,820 | 4.66 | 0 | 0.70 | 1.48 | 0.57 | 1.20 |
| 3 | 3886502 | DVV3165 | 0 | 1 | 1 | 0 | 13,064 | 2.38 | 0 | 0.86 | 11,235 | 2.05 | 0 | 0 | 0.00 | 0 | n/a | - | - | - | 0.00 | 0.00 | - | - |
| 3 | 3890913 | DJN3107 | 0 | 0 | 0 | 0 | 106 | 0.00 | 0 | 0.86 | 91 | 0.00 | 0 | 154 | 0.00 | 0 | 0.70 | 108 | 0.00 | 0 | 1.45 | . | 1.18 | . |
| 3 | 3923508 | DVP7076 | 0 | 1 | 0 | 0 | 17,760 | 3.33 | 0 | 0.86 | 15,274 | 2.86 | 0 | 57,164 | 12.92 | -20 | 0.50 | 28,582 | 6.46 | -10 | 3.22 | 3.88 | 1.87 | 2.26 |
| 3 | 3964948 | DJN3272 | 0 | 1 | 1 | 0 | 39,640 | 6.21 | 0 | 0.86 | 34,090 | 5.34 | 0 | 41,771 | 9.16 | -2 | 0.70 | 29,240 | 6.41 | -1 | 1.05 | 1.48 | 0.86 | 1.20 |
| 3 | 3981362 | DJN3107 | 0 | 0 | 0 | 0 | 106 | 0.00 | 0 | 0.86 | 91 | 0.00 | 0 | 154 | 0.00 | 0 | 0.70 | 108 | 0.00 | 0 | 1.45 | . | 1.18 | . |
| 3 | 3983479 | DJN3107 | 1 | 0 | 0 | 0 | 5,581 | 1.51 | 0 | 0.86 | 4,800 | 1.30 | 0 | 1,535 | 0.00 | 0 | 0.70 | 1,075 | 0.00 | 0 | 0.28 | 0.00 | 0.22 | 0.00 |
| 3 | 4012534 | DJN3107 | 0 | 0 | 0 | 0 | 106 | 0.00 | 0 | 0.86 | 91 | 0.00 | 0 | 154 | 0.00 | 0 | 0.70 | 108 | 0.00 | 0 | 1.45 | . | 1.18 | . |
| 3 | 4115470 | DHM7171 | 0 | 1 | 0 | 0 | 10,560 | 1.98 | 0 | 0.86 | 9,082 | 1.70 | 0 | 10,428 | 3.16 | 0 | 0.79 | 8,238 | 2.50 | 0 | 0.99 | 1.60 | 0.91 | 1.47 |
| 3 | 4120544 | DJN3107 | 0 | 0 | 0 | 0 | 106 | 0.00 | 0 | 0.86 | 91 | 0.00 | 0 | 154 | 0.00 | 0 | 0.70 | 108 | 0.00 | 0 | 1.45 | . | 1.18 | . |
| 3 | 4134818 | DPS7026 | 0 | 1 | 1 | 0 | 27,366 | 4.41 | 0 | 0.86 | 23,535 | 3.79 | 0 | 17,533 | 4.80 | -2 | 1.00 | 17,533 | 4.80 | -2 | 0.64 | 1.09 | 0.74 | 1.26 |
| 3 | 4197905 | DJN3069 | 0 | 1 | 0 | 0 | 2,496 | 0.47 | 0 | 0.86 | 2,147 | 0.40 | 0 | 4,400 | 1.14 | -2 | 0.50 | 2,200 | 0.57 | -1 | 1.76 | 2.44 | 1.02 | 1.42 |
| 3 | 4200641 | DJN3215 | 0 | 0 | 0 | 0 | 659 | 0.11 | 0 | 0.86 | 567 | 0.09 | 0 | 14 | 0.01 | 0 | 0.85 | 12 | 0.01 | 0 | 0.02 | 0.05 | 0.02 | 0.05 |
| 3 | 4201248 | DRG6193 | 0 | 1 | 0 | 0 | 8,352 | 1.57 | 0 | 0.86 | 7,183 | 1.35 | 0 | 11,326 | 3.92 | -4 | 0.85 | 9,627 | 3.33 | -3 | 1.36 | 2.50 | 1.34 | 2.47 |
| 3 | 4316260 | DNL7105 | 0 | 0 | 0 | 0 | 12,306 | 2.21 | 0 | 0.86 | 10,583 | 1.90 | 0 | 0 | 0.00 | 0 | 0.70 | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 4368763 | DNR7304 | 0 | 1 | 0 | 0 | 11,232 | 2.11 | 0 | 0.86 | 9,660 | 1.81 | 0 | 13,099 | 4.97 | -5 | 0.56 | 7,335 | 2.78 | -3 | 1.17 | 2.36 | 0.76 | 1.54 |
| 3 | 4380051 | DJN3107 | 0 | 1 | 0 | 0 | 1,630 | 0.22 | 0 | 0.86 | 1,402 | 0.19 | 0 | 1,452 | 0.41 | 0 | 0.70 | 1,016 | 0.29 | 0 | 0.89 | 1.87 | 0.73 | 1.53 |
| 3 | 4423954 | DHM7021 | 0 | 1 | 0 | 0 | 2,688 | 0.50 | 0 | 0.86 | 2,312 | 0.43 | 0 | 1,587 | 0.60 | -1 | 0.65 | 1,032 | 0.39 | -1 | 0.59 | 1.19 | 0.45 | 0.90 |
| 3 | 4427005 | DNL7021 | 0 | 1 | 0 | 0 | 2,880 | 0.53 | 0 | 0.86 | 2,477 | 0.46 | 0 | 16,496 | 6.06 | -6 | n/a | - | - | - | 5.73 | 11.50 | - | - |
| 3 | 4464119 | DNL7199 | 0 | 1 | 0 | 0 | 2,400 | 0.45 | 0 | 0.86 | 2,064 | 0.39 | 0 | 3,810 | 1.01 | -1 | 0.00 | 0 | 0.00 | 0 | 1.59 | 2.25 | 0.00 | 0.00 |
| 3 | 4508582 | DPS7003 | 0 | 1 | 0 | 0 | 1,728 | 0.32 | 0 | 0.86 | 1,486 | 0.28 | 0 | 536 | 0.16 | 0 | 0.50 | 268 | 0.08 | 0 | 0.31 | 0.50 | 0.18 | 0.29 |

# Indoor Lighting Project Results

| Strat | CNTL# | Appl.# | Inst. Meas. | | | | Ex Ante - Gross | | | NTGR | Ex Ante - Net | | | Ex Post - Gross | | | NTGR | Ex Post - Net | | | Gross RR | | Net RR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | HID | T8 | Refl | Oth | kWh | kW | Thm | | kWh | kW | Thm | kWh | kW | Thm | | kWh | kW | Thm | kWh | kW | kWh | kW |
| 3 | 4509839 | DVP6318 | 0 | 1 | 0 | 0 | 26,676 | 4.98 | 0 | 0.86 | 22,941 | 4.28 | 0 | 50,820 | 10.54 | 0 | 0.50 | 25,410 | 5.27 | 0 | 1.91 | 2.12 | 1.11 | 1.23 |
| 3 | 4509839 | DVP7251 | 0 | 1 | 0 | 0 | 12,672 | 2.38 | 0 | 0.86 | 10,898 | 2.05 | 0 | 10,165 | 2.23 | -4 | 0.50 | 5,083 | 1.12 | -2 | 0.80 | 0.94 | 0.47 | 0.55 |
| 3 | 4571665 | DNQ6321 | 1 | 1 | 0 | 0 | 16,880 | 3.11 | 0 | 0.86 | 14,517 | 2.67 | 0 | 16,213 | 4.23 | -6 | 0.85 | 13,781 | 3.60 | -5 | 0.96 | 1.36 | 0.95 | 1.34 |
| 3 | 4621707 | DNR7193 | 0 | 1 | 1 | 0 | 43,860 | 8.14 | 0 | 0.86 | 37,720 | 7.00 | 0 | 37,870 | 6.27 | -13 | 0.70 | 26,509 | 4.39 | -9 | 0.86 | 0.77 | 0.70 | 0.63 |
| 3 | 4624727 | DNR7216 | 0 | 1 | 0 | 0 | 5,472 | 1.03 | 0 | 0.86 | 4,706 | 0.89 | 0 | 3,344 | 1.55 | -1 | 0.30 | 1,003 | 0.47 | 0 | 0.61 | 1.51 | 0.21 | 0.53 |
| 3 | 4670922 | DJN3238 | 0 | 1 | 0 | 0 | 19,968 | 3.74 | 0 | 0.86 | 17,172 | 3.22 | 0 | 36,859 | 7.82 | -13 | 0.70 | 25,801 | 5.47 | -9 | 1.85 | 2.09 | 1.50 | 1.70 |
| 3 | 4694731 | DJN2251 | 0 | 0 | 0 | 0 | 24,080 | 3.01 | 0 | 0.86 | 20,709 | 2.59 | 0 | 8,481 | 1.03 | -3 | 0.70 | 5,937 | 0.72 | -2 | 0.35 | 0.34 | 0.29 | 0.28 |
| 3 | 4699053 | DVV3209 | 0 | 0 | 0 | 0 | 16,275 | 4.47 | 0 | 0.86 | 13,997 | 3.84 | 0 | 13,883 | 1.97 | -5 | 0.50 | 6,942 | 0.99 | -3 | 0.85 | 0.44 | 0.50 | 0.26 |
| 3 | 4718378 | DPS7005 | 0 | 1 | 0 | 0 | 1,152 | 0.22 | 0 | 0.86 | 991 | 0.19 | 0 | 4,568 | 1.38 | 0 | 0.50 | 2,284 | 0.69 | 0 | 3.97 | 6.39 | 2.31 | 3.71 |
| 3 | 4744820 | DJN2394 | 1 | 0 | 0 | 0 | 7,440 | 1.24 | 0 | 0.86 | 6,398 | 1.07 | 0 | 0 | 0.00 | 0 | n/a | - | - | - | 0.00 | 0.00 | - | - |
| 3 | 4824177 | DXT6268 | 0 | 1 | 0 | 0 | 24,488 | 4.42 | 0 | 0.86 | 21,060 | 3.80 | 0 | 28,460 | 7.62 | -5 | 1.00 | 28,460 | 7.62 | -5 | 1.16 | 1.72 | 1.35 | 2.00 |
| 3 | 4832026 | DVV3174 | 0 | 0 | 0 | 0 | 18,009 | 4.28 | 0 | 0.86 | 15,488 | 3.68 | 0 | 21,941 | 4.23 | -7 | 0.50 | 10,971 | 2.12 | -4 | 1.22 | 0.99 | 0.71 | 0.57 |
| 3 | 4861156 | DVV3174 | 0 | 0 | 0 | 0 | 9,657 | 2.29 | 0 | 0.86 | 8,305 | 1.97 | 0 | 11,766 | 2.27 | -4 | 0.50 | 5,883 | 1.14 | -2 | 1.22 | 0.99 | 0.71 | 0.57 |
| 3 | 4895295 | DJQ6172 | 0 | 1 | 0 | 0 | 8,732 | 1.40 | 0 | 0.86 | 7,510 | 1.20 | 0 | 12,270 | 3.00 | 0 | 0.85 | 10,430 | 2.55 | 0 | 1.41 | 2.15 | 1.39 | 2.12 |
| 3 | 4937090 | DNR7149 | 0 | 0 | 0 | 0 | 5,166 | 0.92 | 0 | 0.86 | 4,443 | 0.79 | 0 | 1,641 | 0.71 | -1 | 0.70 | 1,149 | 0.50 | -1 | 0.32 | 0.77 | 0.26 | 0.63 |
| 3 | 4939783 | DJN2280 | 1 | 0 | 0 | 0 | 14,880 | 2.49 | 0 | 0.86 | 12,797 | 2.14 | 0 | 17,857 | 2.72 | 0 | 0.50 | 8,929 | 1.36 | 0 | 1.20 | 1.09 | 0.70 | 0.63 |
| 3 | 4940551 | DVV3212 | 0 | 0 | 0 | 0 | 22,475 | 6.18 | 0 | 0.86 | 19,329 | 5.31 | 0 | 0 | 0.00 | 0 | 0.50 | 0 | 0.00 | 0 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 4941829 | DJN2303 | 0 | 1 | 0 | 0 | 44,013 | 7.21 | 0 | 0.86 | 37,851 | 6.20 | 0 | 24,795 | 8.38 | -4 | 0.89 | 22,068 | 7.46 | -4 | 0.56 | 1.16 | 0.58 | 1.20 |
| 3 | 4996634 | DRN5174 | 1 | 0 | 0 | 0 | 14,125 | 2.30 | 0 | 0.86 | 12,148 | 1.98 | 0 | 21,937 | 6.73 | 0 | 0.50 | 10,969 | 3.37 | 0 | 1.55 | 2.92 | 0.90 | 1.70 |
| 3 | 5003055 | DNL7069 | 0 | 0 | 0 | 0 | 20,976 | 3.79 | 0 | 0.86 | 18,039 | 3.26 | 0 | 11,243 | 5.21 | -4 | 0.70 | 7,870 | 3.65 | -3 | 0.54 | 1.37 | 0.44 | 1.12 |
| 3 | 5003481 | DJT6071 | 0 | 0 | 0 | 0 | 12,384 | 1.55 | 0 | 0.86 | 10,650 | 1.33 | 0 | 8,199 | 0.94 | 0 | 0.85 | 6,969 | 0.80 | 0 | 0.66 | 0.60 | 0.65 | 0.60 |
| 3 | 5020084 | DVP7001 | 0 | 0 | 0 | 0 | 29,205 | 7.98 | 0 | 0.86 | 25,116 | 6.86 | 0 | 42,336 | 5.03 | -12 | 0.70 | 29,635 | 3.52 | -8 | 1.45 | 0.63 | 1.18 | 0.51 |
| 3 | 5020084 | DVP7085 | 0 | 0 | 0 | 0 | 13,072 | 2.36 | 0 | 0.86 | 11,242 | 2.03 | 0 | 9,995 | 2.14 | -3 | 0.70 | 6,997 | 1.50 | -2 | 0.76 | 0.90 | 0.62 | 0.74 |
| 3 | 5022623 | DJN3259 | 0 | 1 | 0 | 0 | 3,776 | 0.68 | 0 | 0.86 | 3,247 | 0.58 | 0 | 3,686 | 1.48 | 0 | 0.56 | 2,064 | 0.83 | 0 | 0.98 | 2.17 | 0.64 | 1.42 |
| 3 | 5049982 | DTK6309 | 0 | 0 | 0 | 0 | 7,353 | 1.20 | 0 | 0.86 | 6,324 | 1.03 | 0 | 2,891 | 0.00 | 0 | 0.50 | 1,446 | 0.00 | 0 | 0.39 | 0.00 | 0.23 | 0.00 |
| 3 | 5049983 | DTK6310 | 0 | 0 | 0 | 0 | 4,644 | 0.76 | 0 | 0.86 | 3,994 | 0.65 | 0 | 2,891 | 0.00 | 0 | 0.50 | 1,446 | 0.00 | 0 | 0.62 | 0.00 | 0.36 | 0.00 |
| 3 | 5064292 | DNR7394 | 0 | 1 | 0 | 0 | 2,704 | 0.42 | 0 | 0.86 | 2,325 | 0.36 | 0 | 2,466 | 1.14 | -1 | 0.85 | 2,096 | 0.97 | -1 | 0.91 | 2.75 | 0.90 | 2.71 |

# Indoor Lighting Project Results

| | | | Inst. Meas. | | | | Ex Ante - Gross | | | | Ex Ante - Net | | | Ex Post - Gross | | | | Ex Post - Net | | | Gross RR | | Net RR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strat | CNTL# | Appl.# | HID | T8 | Refl | Oth | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | kWh | kW |
| 3 | 5068782 | DTK6312 | 0 | 0 | 0 | 0 | 5,418 | 0.88 | 0 | 0.86 | 4,659 | 0.76 | 0 | 3,373 | 0.00 | 0 | 0.50 | 1,687 | 0.00 | 0 | 0.62 | 0.00 | 0.36 | 0.00 |
| 3 | 5072100 | DVV3174 | 0 | 0 | 0 | 0 | 16,182 | 3.84 | 0 | 0.86 | 13,917 | 3.30 | 0 | 19,281 | 3.81 | -7 | 0.50 | 9,641 | 1.91 | -4 | 1.19 | 0.99 | 0.69 | 0.58 |
| 3 | 5084243 | DVP7296 | 0 | 1 | 1 | 0 | 15,825 | 2.64 | 0 | 0.86 | 13,610 | 2.27 | 0 | 27,485 | 8.97 | -9 | 0.50 | 13,743 | 4.49 | -5 | 1.74 | 3.39 | 1.01 | 1.97 |
| 3 | 5087705 | DJN3107 | 0 | 0 | 0 | 0 | 106 | 0.00 | 0 | 0.86 | 91 | 0.00 | 0 | 119 | 0.00 | 0 | 0.70 | 83 | 0.00 | 0 | 1.12 | . | 0.91 | . |
| 3 | 5115248 | DVP7066 | 0 | 1 | 0 | 0 | 2,688 | 0.50 | 0 | 0.86 | 2,312 | 0.43 | 0 | 1,790 | 0.37 | -1 | 0.70 | 1,253 | 0.26 | -1 | 0.67 | 0.74 | 0.54 | 0.60 |
| 3 | 5126781 | DVV3174 | 0 | 0 | 0 | 0 | 7,569 | 1.80 | 0 | 0.86 | 6,509 | 1.55 | 0 | 9,222 | 1.78 | -3 | 0.50 | 4,611 | 0.89 | -2 | 1.22 | 0.99 | 0.71 | 0.57 |
| 3 | 5134791 | DJN3107 | 0 | 0 | 0 | 0 | 212 | 0.00 | 0 | 0.86 | 182 | 0.00 | 0 | 238 | 0.00 | 0 | 0.70 | 167 | 0.00 | 0 | 1.12 | . | 0.91 | . |
| 3 | 5135674 | DTK6307 | 0 | 0 | 0 | 0 | 5,031 | 0.82 | 0 | 0.86 | 4,327 | 0.71 | 0 | 3,132 | 0.00 | 0 | 0.50 | 1,566 | 0.00 | 0 | 0.62 | 0.00 | 0.36 | 0.00 |
| 3 | 5146608 | DJN2300 | 0 | 1 | 1 | 0 | 18,786 | 3.03 | 0 | 0.86 | 16,156 | 2.61 | 0 | 4,811 | 1.41 | -2 | n/a | - | - | - | 0.26 | 0.46 | - | - |
| 3 | 5152281 | DTK6308 | 0 | 0 | 0 | 0 | 4,644 | 0.76 | 0 | 0.86 | 3,994 | 0.65 | 0 | 2,891 | 0.00 | 0 | 0.50 | 1,446 | 0.00 | 0 | 0.62 | 0.00 | 0.36 | 0.00 |
| 3 | 5189480 | DVP7023 | 0 | 1 | 0 | 0 | 42,624 | 7.99 | 0 | 0.86 | 36,657 | 6.87 | 0 | 215,082 | 44.02 | -74 | n/a | - | - | - | 5.05 | 5.51 | - | - |
| 3 | 5189674 | DJN2372 | 1 | 1 | 0 | 0 | 38,552 | 6.91 | 0 | 0.86 | 33,155 | 5.94 | 0 | 60,640 | 6.92 | 0 | 0.70 | 42,448 | 4.84 | 0 | 1.57 | 1.00 | 1.28 | 0.82 |
| 3 | 5210791 | DVP7094 | 0 | 1 | 1 | 0 | 49,950 | 8.96 | 0 | 0.86 | 42,957 | 7.71 | 0 | 48,199 | 11.23 | -16 | 0.56 | 26,991 | 6.29 | -9 | 0.96 | 1.25 | 0.63 | 0.82 |
| 3 | 5222973 | DJN3107 | 1 | 0 | 0 | 0 | 8,758 | 1.55 | 0 | 0.86 | 7,532 | 1.33 | 0 | 1,062 | 0.00 | 0 | 0.70 | 743 | 0.00 | 0 | 0.12 | 0.00 | 0.10 | 0.00 |
| 3 | 5222974 | DJN3107 | 0 | 0 | 0 | 0 | 106 | 0.00 | 0 | 0.86 | 91 | 0.00 | 0 | 0 | 0.00 | 0 | 0.70 | 0 | 0.00 | 0 | 0.00 | . | 0.00 | . |
| 3 | 5255069 | DRN5164 | 0 | 1 | 0 | 0 | 3,264 | 0.61 | 0 | 0.86 | 2,807 | 0.52 | 0 | 7,241 | 0.99 | 0 | 0.90 | 6,517 | 0.89 | 0 | 2.22 | 1.61 | 2.32 | 1.69 |
| 3 | 5255917 | DJN2302 | 0 | 1 | 1 | 0 | 29,805 | 4.83 | 0 | 0.86 | 25,632 | 4.15 | 0 | 41,822 | 9.22 | -6 | 0.89 | 37,222 | 8.21 | -5 | 1.40 | 1.91 | 1.45 | 1.97 |
| 3 | 5276048 | DXT6243 | 1 | 0 | 0 | 0 | 49,920 | 8.08 | 0 | 0.86 | 42,931 | 6.95 | 0 | 71,299 | 21.22 | 0 | 0.91 | 64,882 | 19.31 | 0 | 1.43 | 2.63 | 1.51 | 2.77 |
| 3 | 5310776 | DVP7107 | 1 | 0 | 0 | 0 | 38,288 | 6.88 | 0 | 0.86 | 32,928 | 5.92 | 0 | 2,523 | 0.91 | -1 | 0.00 | 0 | 0.00 | 0 | 0.07 | 0.13 | 0.00 | 0.00 |
| 3 | 5319305 | DXD6146 | 0 | 1 | 0 | 0 | 1,920 | 0.36 | 0 | 0.86 | 1,651 | 0.31 | 0 | 2,365 | 0.72 | 0 | 0.70 | 1,656 | 0.50 | 0 | 1.23 | 2.00 | 1.00 | 1.63 |
| 3 | 5359443 | DHP7107 | 0 | 1 | 0 | 0 | 2,186 | 0.32 | 0 | 0.86 | 1,880 | 0.28 | 0 | 2,164 | 0.83 | 0 | 0.50 | 1,082 | 0.42 | 0 | 0.99 | 2.59 | 0.58 | 1.51 |
| 3 | 5360597 | DNR7305 | 1 | 0 | 0 | 0 | 26,290 | 4.26 | 0 | 0.86 | 22,609 | 3.66 | 0 | 2,741 | 0.52 | 0 | 0.00 | 0 | 0.00 | 0 | 0.10 | 0.12 | 0.00 | 0.00 |
| 3 | 5368352 | DJN2301 | 0 | 1 | 1 | 0 | 33,581 | 5.33 | 0 | 0.86 | 28,880 | 4.58 | 0 | 56,825 | 12.47 | -14 | n/a | - | - | - | 1.69 | 2.34 | - | - |
| 3 | 5383058 | DHS6160 | 0 | 1 | 0 | 0 | 2,100 | 0.56 | 0 | 0.86 | 1,806 | 0.48 | 0 | 826 | 0.34 | 0 | n/a | - | - | - | 0.39 | 0.60 | - | - |
| 3 | 5397679 | DVV3174 | 0 | 0 | 0 | 0 | 10,179 | 2.42 | 0 | 0.86 | 8,754 | 2.08 | 0 | 12,128 | 2.40 | -4 | 0.50 | 6,064 | 1.20 | -2 | 1.19 | 0.99 | 0.69 | 0.58 |
| 3 | 5400898 | DHS6160 | 0 | 1 | 1 | 0 | 7,789 | 2.04 | 0 | 0.86 | 6,699 | 1.75 | 0 | 10,089 | 4.09 | -2 | n/a | - | - | - | 1.30 | 2.01 | - | - |
| 3 | 5440337 | DVV3174 | 0 | 0 | 0 | 0 | 6,786 | 1.61 | 0 | 0.86 | 5,836 | 1.38 | 0 | 8,085 | 1.60 | -3 | 0.50 | 4,043 | 0.80 | -2 | 1.19 | 0.99 | 0.69 | 0.58 |

# Indoor Lighting Project Results

| | | | Inst. Meas. | | | | Ex Ante - Gross | | | | Ex Ante - Net | | | Ex Post - Gross | | | | Ex Post - Net | | | Gross RR | | Net RR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strat | CNTL# | Appl.# | HID | T8 | Refl | Oth | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | Thm | NTGR | kWh | kW | Thm | kWh | kW | kWh | kW |
| 3 | 5534148 | DVV3174 | 0 | 0 | 0 | 0 | 6,003 | 1.43 | 0 | 0.86 | 5,163 | 1.23 | 0 | 7,165 | 1.41 | -2 | 0.50 | 3,583 | 0.71 | -1 | 1.19 | 0.99 | 0.69 | 0.58 |
| 3 | 5561721 | DVT2326 | 0 | 1 | 0 | 0 | 9,040 | 1.66 | 0 | 0.86 | 7,774 | 1.43 | 0 | 2,704 | 0.85 | 0 | 1.00 | 2,704 | 0.85 | 0 | 0.30 | 0.51 | 0.35 | 0.60 |
| 3 | 5639845 | DNR7104 | 1 | 0 | 0 | 0 | 40,681 | 7.31 | 0 | 0.86 | 34,986 | 6.29 | 0 | 5,999 | 0.87 | 0 | 0.91 | 5,459 | 0.79 | 0 | 0.15 | 0.12 | 0.16 | 0.13 |
| 3 | 5753923 | DPS7090 | 0 | 1 | 0 | 0 | 9,456 | 1.60 | 0 | 0.86 | 8,132 | 1.38 | 0 | 9,253 | 2.28 | -2 | 0.50 | 4,627 | 1.14 | -1 | 0.98 | 1.42 | 0.57 | 0.83 |
| 3 | 5781869 | DJQ6094 | 1 | 0 | 0 | 0 | 47,860 | 8.60 | 0 | 0.86 | 41,160 | 7.40 | 0 | -229 | -0.09 | 0 | 0.50 | -115 | -0.05 | 0 | 0.00 | -0.01 | 0.00 | -0.01 |
| 3 | 5788552 | DJN2307 | 0 | 1 | 0 | 0 | 3,744 | 0.70 | 0 | 0.86 | 3,220 | 0.60 | 0 | 8,236 | 1.85 | -3 | 0.50 | 4,118 | 0.93 | -2 | 2.20 | 2.64 | 1.28 | 1.54 |
| 3 | 5793204 | DVV3174 | 0 | 0 | 0 | 0 | 4,698 | 1.12 | 0 | 0.86 | 4,040 | 0.96 | 0 | 5,598 | 1.11 | -2 | 0.50 | 2,799 | 0.56 | -1 | 1.19 | 0.99 | 0.69 | 0.58 |
| 3 | 5919553 | DJN3028 | 0 | 1 | 0 | 0 | 12,048 | 2.26 | 0 | 0.86 | 10,361 | 1.94 | 0 | 10,464 | 1.54 | -2 | 1.00 | 10,464 | 1.54 | -2 | 0.87 | 0.68 | 1.01 | 0.80 |
| 3 | 5930941 | DVV3174 | 0 | 0 | 0 | 0 | 7,569 | 1.80 | 0 | 0.86 | 6,509 | 1.55 | 0 | 9,018 | 1.78 | -3 | 0.50 | 4,509 | 0.89 | -2 | 1.19 | 0.99 | 0.69 | 0.58 |
| 3 | 5970332 | DVV3174 | 0 | 0 | 0 | 0 | 7,308 | 1.74 | 0 | 0.86 | 6,285 | 1.50 | 0 | 8,595 | 1.72 | -3 | 0.50 | 4,298 | 0.86 | -2 | 1.18 | 0.99 | 0.68 | 0.58 |
| 3 | 5971889 | DRN5110 | 0 | 1 | 0 | 0 | 8,640 | 1.62 | 0 | 0.86 | 7,430 | 1.39 | 0 | 29,303 | 5.04 | 0 | 0.20 | 5,861 | 1.01 | 0 | 3.39 | 3.11 | 0.79 | 0.72 |
| 3 | 5980026 | DVP6347 | 0 | 1 | 0 | 0 | 2,362 | 0.38 | 0 | 0.86 | 2,031 | 0.33 | 0 | 1,499 | 0.49 | 0 | 0.87 | 1,304 | 0.43 | 0 | 0.63 | 1.29 | 0.64 | 1.30 |
| 3 | 5983857 | DJQ6046 | 1 | 1 | 0 | 0 | 43,932 | 7.90 | 0 | 0.86 | 37,782 | 6.79 | 0 | 79,678 | 26.14 | 0 | 0.92 | 73,304 | 24.05 | 0 | 1.81 | 3.31 | 1.94 | 3.54 |
| 3 | 6017624 | DVP6384 | 0 | 1 | 0 | 0 | 4,952 | 0.80 | 0 | 0.86 | 4,259 | 0.69 | 0 | 5,093 | 1.41 | 0 | 0.87 | 4,431 | 1.23 | 0 | 1.03 | 1.75 | 1.04 | 1.77 |
| 3 | 6133790 | DTC9070 | 1 | 0 | 0 | 0 | 25,425 | 4.14 | 0 | 0.86 | 21,866 | 3.56 | 0 | 43,045 | 12.11 | 0 | 0.50 | 21,523 | 6.06 | 0 | 1.69 | 2.92 | 0.98 | 1.70 |
| 3 | 6356059 | DXB6120 | 0 | 1 | 0 | 0 | 2,304 | 0.43 | 0 | 0.86 | 1,981 | 0.37 | 0 | 5,072 | 1.66 | 0 | 0.85 | 4,311 | 1.41 | 0 | 2.20 | 3.85 | 2.18 | 3.81 |
| 3 | 6444249 | DVP7010 | 0 | 1 | 0 | 0 | 22,936 | 4.19 | 0 | 0.86 | 19,725 | 3.60 | 0 | 33,270 | 4.02 | -12 | 0.70 | 23,289 | 2.81 | -8 | 1.45 | 0.96 | 1.18 | 0.78 |

# B DATA COLLECTION FORMS

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

- Customer notification letter
- File review form
- Telephone recruitment and spillover form
- On-site data collection forms
    - ◊ Equipment forms
    - ◊ Operations survey
    - ◊ Miscellaneous process instruments
- Net-to-gross forms
    - ◊ Standard net-to-gross questionnaire
    - ◊ Custom net-to-gross questionnaire
    - ◊ Vendor survey

# Customer Notification Letter

July 16, 1998

«CONNAME»
«PAYABLE»
«CHKSTRT»
«CHKCITY», «CHKST»  «CHKZIP»

Dear «F_NAME»:

As part of our ongoing effort to evaluate and improve our energy efficiency programs, PG&E has contracted with XENERGY, Inc., a nationally recognized energy research firm, to conduct surveys and analysis of industrial facilities that participated in our energy efficiency rebate programs during the past few years.  We would like to include your firm in our research project, and you may be contacted by XENERGY during the next few months to schedule a site visit.

Your input to this research effort is very important to us and will be used to gauge the impact of our program in the marketplace and improve the design of our energy efficiency programs for future years.  This survey will consist of a brief telephone interview and an on-site inspection of the program-related measures that were installed.  Depending upon the complexity of the measures that were installed, the site visit may last from one to several hours.

We understand that your time is valuable and thank you, in advance, for participating in this research effort.  If you have questions, please call me at (415) 973-2588.

Sincerely,

Amalia Klinger

Project Manager
Customer Energy Management

# File Review Form

# DATA EXTRACTION FORM

**Table 1. File Extract for Free Ridership: Financial Information**

| | Source 1 | Source 2 | Source 3 | Source 4 | Source 5 |
|---|---|---|---|---|---|
| | MDSS | PG&E File | PG&E Contact Name, Title | Customer Name, Title | Customer Name, Title |
| **FINANCIAL AMOUNTS ($)** | | | | | |
| Customer Engineering and Analysis Costs | | | | | |
| Analysis Incentive Support $ (from PG&E) | | | | | |
| Total Project Cost (Rebate Eligible)-Est. | | | | | |
| Total Project Cost (Rebate Eligible)-Final | | | | | |
| Total project Cost to Customer (Including All Costs)- Preliminary | | | | | |
| Total project Cost to Customer (Including All Costs)- Final | | | | | |
| Incremental Project Cost | | | | | |
| Incentive Amount - Preliminary Estimate | | | | | |
| Incentive Amount-Final | | | | | |
| PG&E/Vendor/Analyst Annual Savings Estimate | | | | | |
| Customer Annual Savings Estimate | | | | | |
| Customer Maintenance Savings estimate | | | | | |
| Customer Other Annual Avoided Costs | | | | | |
| Customer Simple Payback (including all savings or credits) without Incentive | | | | | |
| Customer Simple Payback (Including all savings or credits) with Incentive | | | | | |

**Table 2. File Extract for Free Ridership: Project Timing**

| | Source 1 | Source 2 | Source 3 | Source 4 | Source 5 |
|---|---|---|---|---|---|
| | **MDSS** | **PG&E File** | **PG&E Contact Name, Title** | **Customer Name, Title** | **Customer Name, Title** |
| **PROJECT TIMING** | | | | | |
| Date Project Planning Began | | | | | |
| Date Projet Budget Approved | | | | | |
| Date Final Planning Complete | | | | | |
| Date of PO or Construction Contract | | | | | |
| Date of Initial Contact with PG&E re efficiency Incentives | | | | | |
| Date of PG&E Prefield Inspection | | | | | |
| Date Customer Declaration of Intent | | | | | |
| Date of PG&E Commitment of Incentive Amount | | | | | |
| Date of First Invoice | | | | | |
| Date of Last Invoice | | | | | |
| Project Completion Date | | | | | |
| Project Start-up Date | | | | | |
| PG&E Post-field Date | | | | | |
| PG&E Check Authorization Date | | | | | |
| Date Incentive Check. | | | | | |
| NOTES | | | | | |

**Table 3. File Extract for Free Ridership: Contacts**

| | Name | Title | Telephone # | Fax #EMAIL | EMAIL/Notes |
|---|---|---|---|---|---|
| Customer Application Signer | | | | | |
| Customer MDSS File Contact | | | | | |
| Customer DOI Signer | | | | | |
| PG&E Representative Contact | | | | | |
| PG&E Prefield Contact | | | | | |
| PG&E postfield Contact | | | | | |
| PG&E HQ Program Technical Analyst Contact | | | | | |
| PG&E Technical Review Contractor Contact | | | | | |
| Vendor or Installing Contractor Contact | | | | | |
| Site Visit Technical Support Contact | | | | | |
| Site Visit Customer Senior Technical Contact | | | | | |
| Site Visit Recommended Decision Maker Contact | | | | | |
| Other Contact | | | | | |
| Other Contact | | | | | |
| | | | | | |
| | | | | | |

# Telephone Recruitment and Spillover Form

# Industrial Questionnaire

## XENERGY / Pacific Gas and Electric

## Industrial Retrofit Program Impact Evaluation

## Recruitment Guidelines and Spillover Questionnaire

### INTRODUCTION

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

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

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

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

New Contact:: ___________________________________________

Phone Number: ___________________________________________

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

[Indicate program measures from recruitment sheet if necessary.]

PS4a For **VERIFICATION** and **RETENTION** sites:

I would like to schedule a site visit to your facility to inspect the program measures and to ask you a few questions about their performance. This survey should take about **XXX** hour(s) and will involve an inventory of the installed measures to ensure that our records are accurate.

Scheduled visit: ___________________________________________

**End of Call**

PS4b For **LIGHTING ANALYSIS** sites:

I would like to ask you a few questions related to your participation in the PG&E program and set a date for a site visit. This survey should take about **XXX** hour(s) and will involve an inventory of the installed measures and a review of key operating parameters.

[Explain site activities]

Scheduled visit: ___________________________________________

PS4c For **PROCESS ANALYSIS** sites:

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

[Explain site activities]

Tentative visit: ______________________________________________________

PS5 Summarize recruitment activities

1 Successful recruitment

2 Could not reach customer (minimum 3 attempts)

3 Customer refused to participate — For analysis sites notify XENERGY project manager

4 Other, List: ________________________________________________________________

## IDENTIFICATION OF KEY CONTACT PERSONNEL

PS6 Determine who key contact personnel are:

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

## ANALYSIS DISCUSSION

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

Conduct survey with identified spillover contact.

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

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

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

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

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

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

S4 Describe measures installed and influenced by PG&E?

Measure 1: ____________________________________________________________

________________________________________________________________________

________________________________________________________________________

Measure 2: ____________________________________________________________

________________________________________________________________________

________________________________________________________________________

Measure 3: ____________________________________________________________

________________________________________________________________________

________________________________________________________________________

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

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

If rebate received or pending, eliminate measure from consideration

# On-Site Data Collection Forms

# PG&E INDUSTRIAL IMPACT & MEASURE RETENTION STUDY

| |
|---|
| *Control Number* |
| *PG&E Representative* |
| *Survey Types* |

| Measure Description | Study | Prog Year | Applic Code | Meas Code | kWh | kW | Thm | No. Install | No. Oper. | No. Paid | Check No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | | | | | | | | | | | |
| 2. | | | | | | | | | | | |
| 3. | | | | | | | | | | | |
| 4. | | | | | | | | | | | |
| 5. | | | | | | | | | | | |
| 6. | | | | | | | | | | | |
| 7. | | | | | | | | | | | |
| 8. | | | | | | | | | | | |
| 9. | | | | | | | | | | | |
| 10. | | | | | | | | | | | |
| 11. | | | | | | | | | | | |
| 12. | | | | | | | | | | | |

# PG&E INDUSTRIAL IMPACT & MEASURE RETENTION STUDY

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

Site Visit Notes:

Review Notes:

| Control Num | Application Num | Check Num | Check paid to |
|---|---|---|---|
| Complex | | | |

Location: ______________________________

| Measure Attribute | Measure Number → |
|---|---|
| Measure Code | |
| Install Date | |
| Area Affected ($ft^2$) | |
| Percent of Affected Area Conditioned | |
| Fixture Code | |
| Number Expected (lamps or sensors) | |
| Number Observed (lamps or sensors) | |
| Lamps Per Fixture | |
| Percent in Working Condition | |
| Fixture Control: Switch ☐ Occup ☐ Timer ☐ Photocell ☐ | |
| Discrepancy Code *see table below* | |
| Removal Code *see table below* | |
| Date of Removal *if applicable* | |

| | |
|---|---|
| Base Case Fixture Code *ask site contact* | |

*Ignore for Occupancy Sensors:*

Was Base Case Schedule Different? Y / N

—> If yes, please describe the differences on the back of this form

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

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

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

How many were installed? ____________

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

| Logger ID | Location |
|---|---|
| | |
| | |
| | |
| | |

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**Discrepancy Codes**

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

**Removal Codes**

| | | |
|---|---|---|
| R | 1 | Equipment failed, not replaced |
| | 2 | Remodeled |
| | 3 | Unable to locate equivalent replacement |
| | 4 | Change of tenancy or use of space |
| | 5 | Other (describe) |
| | | |

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

**Mfr:** **Model:**

Location:

Paid Savings: kWh kW therms

Rebate: $0.00

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

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

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

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

How many were installed? ____________

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

| **Logger ID** | **Location** |
|---|---|
| | |
| | |
| | |
| | |

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**Discrepancy Codes**

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

**Removal Codes**

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

# Hourly Schedules

| *Complex* | *Check Number* |
|---|---|
| | |

| Hour | S1 %on | S2 %on | S3 %on | S4 %on | S5 %on | S6 %on | S7 %on | S8 %on | S9 %on |
|---|---|---|---|---|---|---|---|---|---|
| Midnight | | | | | | | | | |
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |
| 21 | | | | | | | | | |
| 22 | | | | | | | | | |
| 23 | | | | | | | | | |
| Total Annual Hrs Hours | | | | | | | | | |

Notes:

# Operations Survey

## XENERGY / Pacific Gas and Electric Industrial Retrofit Program Impact Evaluation

Surveyor Name: ______________________________ PG&E Control Number: _______________

Interviewee Name: ____________________________ Check Number _______________

**ALTERNATIVE PROJECTS**

A1. Were alternative, less efficient, projects considered?

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

A2. Describe the alternatives

1 ________________________________________________________________________________

________________________________________________________________________________

2 ________________________________________________________________________________

________________________________________________________________________________

3 ________________________________________________________________________________

________________________________________________________________________________

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

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

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

________________________________________________________________________________

## PRODUCTION INCREASES

**[PROCESS ANALYSIS SITES ONLY]**

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

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

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

1 YES
2 NO
9 DON'T KNOW

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

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

Name:______________________________________

Phone:______________________________________

## EARLY REPLACEMENT

**[PROCESS ANALYSIS SITES ONLY]**

E1 Did the rebated equipment replace existing equipment?

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

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

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

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

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

## LIGHTING LEVEL INCREASES

**[LARGE LIGHTING ANALYSIS SITES ONLY]**

L1. Was there a significant increase in lighting levels associated with the installation of the rebated measures?

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

L2. Were there plans to increase lighting levels regardless of the efficiency of the new lights?

1 YES
2 NO
9 DON'T KNOW

L3. Would the lighting level increase have occurred anyway, without the installation of the specific rebated equipment (possibly utilizing a less efficient technology)?

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

Name:______________________________________

Phone:______________________________________

# Miscellaneous Process Survey Instruments

# Industrial Adj Speed Drive Data

| | |
|---|---|
| Facility/Property | |
| Account/Application Number | |
| Date of Survey | |
| Auditor | |
| Contact(s) | |
| Equipment Location on Site | |
| Date/Time/Outside Temperature | |

| | **VSD # ___** | **VSD # ___** |
|---|---|---|
| Manufacturer | | |
| Model Number | | |
| Serial Number | | |
| Drive Rated Horsepower | | |
| Base Case Capacity Control Technology: (describe rationale) | | |
| Equipment End Use: (HVAC Pump/Fan; Exh Fan, Process pump/fan, line drive, other - describe) | | |
| Drive (Direct/Belt) | | |
| Motor Rated Horsepower/Phases | | |
| Motor Nominal Speed | | |
| Motor Rated Full Load Speed | | |
| Motor Rated Full Load Amps | | |
| Motor Rated Voltage | | |
| Is speed Constant or Variable? | | |
| How is speed controlled? | | |
| Control Parameter | | |
| Maximum Speed | | |
| Minimum Speed | | |
| Observed/ Measured Amps at visit | | |
| Observed/ Measured Volts at visit | | |
| Monitoring Performed? | | |
| **Post-Retrofit Use & Load Profile:** | Percent Load | Annual Hours |
| Describe observed annual load profile | 100 | |
| from Customer SCADA or EMS, | 90 | |
| monitoring or ___________________. | 80 | |
| | 70 | |
| | 60 | |
| | 50 | |
| | 40 | |
| | 30 | |
| | 20 | |
| | 10 | |
| | 0 | |

# PROCESS CHILLER DATA

| | |
|---|---|
| Facility/Property | |
| Control Number | |
| Date of Survey | |
| Auditor | |
| Contact(s) | |
| Equipment Location on Site | |
| Date/Time/Outside Temperature | |

| | **Chiller # C___** | **Chiller # C___** |
|---|---|---|
| End Use: (A/C, Process, comb) | | |
| Manufacturer | | |
| Model Number | | |
| Serial Number | | |
| Fuel | | |
| Nominal Tonnage | | |
| Input kW | | |
| Output at Max Rate (Btu/hr) | | |
| Min Output Rate (Btu/hr) | | |
| Output Temperature (max/min) | | |
| Type (Recip, Centrip, Absorb, Screw) | | |
| Compr. Rated Amps at Full Load | | |
| Number of Phases | | |
| **Circulating Pump** No./ HP | | |
| Hot Water GPM (Max, Min) | | |
| Design Pressure | | |
| Motor Volts/Phase/Amps Rated | | |
| Motor Volts/Phase/Amps Measured | | |
| **Circulating Pump** No./ HP | | |
| Chill Water GPM (Max, Min) | | |
| Design Pressure | | |
| Motor Volts/Phase/Amps Rated | | |
| Motor Volts/Phase/Amps Measured | | |
| **CONTROL STRATEGIES:** | | |
| Chill Water Reset (Max, Min Temp) | | |
| Reset Control Parameter (Max, Min temp) | | |
| Ambient Temp Lockout (Method, Setpoint) | | |
| | | |
| | | |
| **Tie-in to Other Systems:** | | |
| Air Handler Number(s) | | |
| Zone Number(s) | | |
| Operating Schedule No. | | |
| | | |

# Evap Condenser & Tower Data

| | |
|---|---|
| Facility/Property | |
| Control Number | |
| Date of Survey | |
| Auditor | |
| Contact(s) | |
| Equipment Location on Site | |
| Date/Time/Outside Temperature | |

| | **Condensor # C___** | **Condensor # C___** |
|---|---|---|
| Manufacturer | | |
| Model Number | | |
| Serial Number | | |
| Tower Type (Open, Cl, Upflo, Xflow, etc.) | | |
| Tower Rated Capacity (tons) | | |
| Inlet Temperature (Max, Min Temp) | | |
| Outlet Temperature (Max, Min Temp) | | |
| Outlet Reset Parameter ( Max, Min) | | |
| Number of Cells | | |
| **Fan(s)** No./Horsepower | | |
| Speeds (1,2,cfm range, etc.) (Max, Min) | | |
| Fan Type (Fixed prop, Var Prop,Cent.) | | |
| Volts/Phases/Amps (Rated) | | |
| Volts/Amps/Phases (Measured) | | |
| **Recirc/ Spray Pump** No./ HP | | |
| Volts/Phase/Amps | | |
| On Temp | | |
| Off Temp | | |
| **Condenser Pump** No./HP | | |
| Condenser Flow GPM (range) | | |
| Design Pressure | | |
| Volts/Phase/Amps | | |
| Design Condnsr Wtr Temp to Chlr | | |
| Observed Cdnsr Wtr temp to Chlr | | |
| Design Water Temp to Tower | | |
| Observed Wtr Temp to Tower | | |
| **CONTROL STRATEGIES:** | | |
| Outlet Setpoint (Max, Min) | | |
| Control Air Temperature (Max, Min) | | |
| Max Demand Control (Limit) kW | | |
| Demand Control | | |
| Variable Speed Operation | | |
| Floating Condensing Temp. | | |
| Two Speed Fan | | |
| Auxillary Pump On/Off Temps | | |
| Months in Operation | | |
| **Tie-in Information:** | | |
| Chiller No(s) & other Loads Served | | |
| Operating Schedule | | |
| Notes: | | |
| | | |
| | | |

# INDUSTRIAL FAN DATA

(Use only for air handlers with external heating and/or cooling sources)

| | |
|---|---|
| Facility/Property | |
| Account Number | |
| Contact | |
| Auditor | |
| Date of Survey | |
| Equipment Location | |
| Date/Time/Outside Temperature | |

| | UNIT #AHU ___ | UNIT #AHU___ |
|---|---|---|
| Manufacturer | | |
| Model Number | | |
| Serial Number | | |
| Unit Type | | |
| Number of Units of Type | | |
| Cooling Type (CHW, DX, evap) | | |
| Assoc Chiller/DX unit No._____ | | |
| Cooling Btu/hr | | |
| Heating Type (Elec Resist, hot water) | | |
| Heating Btu/hr or kW | | |
| Assoc. Heating Source Unit No.____ | | |
| **Indoor Supply Fan(s)** No./Horsepower | | |
| Air system Type (1 zone, mz, VAV, indu) | | |
| Fan Type (airfoil, back cur centrif, axial) | | |
| Rated Cfm (if VAV: Max / Min) | | |
| Design Static Pressure | | |
| Volts/Phases/Amps (Rated) | | |
| Motor Efficiency | | |
| Volts/Phases/Amps (Meas) | | |
| **Exhaust/Return Fan:** No., HP | | |
| Fan Type | | |
| Cfm (Max/Min) | | |
| Design Static Pressure | | |
| Rated Volts/Phase/Amps | | |
| Meas. Volts/Phase/Amps | | |
| **CONTROL:** | | |
| Economizer? | | |
| Supply Air Temp Setpoint | | |
| Hot Deck Setpoint (Max, Min) | | |
| Cold Deck Temp Setpoint (Max, Min) | | |
| Mixed Air Temp Setpoint | | |
| Occupied Fan: Constant / Cycles | | |
| **Tie-in Information:** | | |
| Zone(s)/ Area(s) Served | | |
| Operating Schedule Code | | |
| Associated Chiller/Cooler No. | | |
| Associated Heating Unit No. | | |
| | | |

## *MOTOR DATA*

| | | | |
|---|---|---|---|
| Facility/Property | | | |
| Control Number | | | |
| Date / Time of Survey | | | |
| Outside Temperature (°F) | | | |
| Auditor | | | |
| Contact(s) | | | |
| Equipment Location on Site | | | |

| | **Motor # M___** | **Motor # M___** | **Motor # M___** |
|---|---|---|---|
| Manufacturer | | | |
| Model Number | | | |
| Serial Number | | | |
| Horsepower | | | |
| Motor Type (ODP/TEFC,etc.) | | | |
| NEMA Efficiency | | | |
| Power Factor @ Full Load | | | |
| Frame Type | | | |
| RLA/FLA | | | |
| Volt | | | |
| Phase | | | |
| Quantity | | | |
| Driven Equipment | | | |
| End Use: (DHW, HVAC, Process,comb) | | | |
| Loading (Constant/Variable) | | | |
| Drive (Direct/Belt) | | | |
| Measured Amps | | | |
| Measured Volts | | | |
| Est. % Loaded when Measured | | | |
| Maximum Operating Load Factor | | | |
| Load / Operation Profiles | | | |

**Tie-in to Other Systems:**

**Notes:**

## BOILER or WATER HEATER DATA

| | | |
|---|---|---|
| Facility/Property | | |
| Control Number | | |
| Date of Survey | | |
| Auditor | | |
| Contact(s) | | |
| Equipment Location on Site | | |
| Date/Time/Outside Temperature | | |

| | **Water Heating Unit # H___** | **Water Heating Unit #H___** |
|---|---|---|
| End Use: (DHW, HVAC, Process,comb) | | |
| Manufacturer | | |
| Model Number | | |
| Serial Number | | |
| Fuel | | |
| Output Form (steam, hot water) | | |
| Max Input Rate (Btu/hr or____________) | | |
| Output at Max Rate Rate (Btu/hr) | | |
| Min Output Rate (Btu/hr) | | |
| Output Temperature/Pressure (max/min) | | |
| Type (boiler, storage heater, inst htr) | | |
| Compr. Rated Amps at Full Load | | |
| Number of Phases | | |
| **Circulating Pump** No./ HP | | |
| Hot Water GPM (Max, Min) | | |
| Design Pressure | | |
| Motor Volts/Phase/Amps Rated | | |
| Motor Volts/Phase/Amps Measured | | |
| **Circulating Pump** No./ HP | | |
| Hot Water GPM (Max, Min) | | |
| Design Pressure | | |
| Motor Volts/Phase/Amps Rated | | |
| Motor Volts/Phase/Amps Measured | | |
| **CONTROL STRATEGIES:** | | |
| Hot Water Reset (Max, Min Temp) | | |
| Reset Control Parameter (Max, Min temp) | | |
| Ambient Temp Lockout (Method, Setpoint) | | |
| | | |
| | | |
| **Tie-in to Other Systems:** | | |
| | | |
| Air Handler Number(s) | | |
| Zone Number(s) | | |
| Operating Schedule No. | | |

# Net-to-Gross Forms

# IDENTIFICATION OF DECISION MAKERS

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

Name:________________________________________ Title:________________________________________

Phone:________________________________________ Date:________________________________________

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

Name:________________________________________ Name:________________________________________

Role:________________________________________ Role:________________________________________

Phone:________________________________________ Phone:________________________________________

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

Equipment type:________________________________ Equipment type:________________________________

Name:________________________________________ Name:________________________________________

Phone:________________________________________ Phone:________________________________________

Equipment type:________________________________ Equipment type:________________________________

Name:________________________________________ Name:________________________________________

Phone:________________________________________ Phone:________________________________________

## MEASURE IDENTIFICATION

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

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

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

| **Lighting Measures** | |
|---|---|
| | HIDs - interior |
| | T-8s |
| | Reflectors with delamping |
| | Controls |
| | CFLs |
| | Exit signs |
| | Other |

| **Process Measures** (describe) | |
|---|---|
| | 1. |
| | 2. |

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

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

## MEASURE & PROGRAM PERFORMANCE SATISFACTION

**(CIRCLE ANSWER NUMBERS)**

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

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

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

[OPEN END] ________________________________________________________________

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

1 Yes
2 No
9 DON'T KNOW / REFUSED

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

[OPEN END] ________________________________________________________________

## ENERGY EFFICIENCY DECISION MAKING SECTION

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

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

1 Needed to replace older equipment.

2 Needed to add equipment because of a remodel , build-out, or expansion.

3 Wanted to reduce our energy costs

4 Wanted more control over how the equipment was used.

5 NONE OF THE ABOVE

9 DON'T KNOW / REFUSED

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

[SELECT SINGLE BEST RESPONSE]

1 Contractor

2 Architect / Engineer

3 Vendor

4 PG&E Information (Customer representative / literature / marketing materials)

5 Other non-PG&E literature

6 Friend / Business colleague / Professional association

7 Previous installation

8 OTHER **[SPECIFY]** ____________________________________________________________

9 DON'T KNOW / REFUSED

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

[SELECT SINGLE BEST RESPONSE]

1 Contractor

2 Architect / Engineer

3 Vendor

4 *PG&E* representative

5 Friend / Business colleague / Professional association

6 PG&E marketing materials / advertising

7 OTHER **[SPECIFY]** _______________________________________________________________

9 DON'T KNOW / REFUSED

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

1 BEFORE

2 AFTER

9 DON'T KNOW / REFUSED

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

1 BEFORE

2 AFTER

9 DON'T KNOW / REFUSED

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

1 Insignificant

2 Somewhat Significant

3 Very Significant

4 Extremely Significant

9 DON'T KNOW / REFUSED

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

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

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

3 Probably would have installed

4 Definitely would have installed

9 DON'T KNOW / REFUSED

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

1 Probably NOT as efficient

2 Probably as efficient

9 DON'T KNOW / REFUSED

**[SKIP TO C10]**

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

1 Standard efficiency equipment

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

3 Would not have installed anything

9 DON'T KNOW / REFUSED

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

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

1 Same Time To Less Than 1 Year

2 Over 1 Year LaterApproximately how many years later? _____________

9 DON'T KNOW / REFUSED

## CONCLUSION

Thank you for your cooperation.

## DECISION MAKER

**Interviewee Name:** _______________________________________________

**Title:** ___________________________________________________________ **Date:** ________/__________/_______

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

| **Lighting Measures** | |
|---|---|
| | HIDs - interior |
| | HIDs - exterior |
| | T-8s |
| | Reflectors with delamping |
| | Controls |
| | CFLs |
| | Exit signs |
| | Other |

| **Process Measures** (describe) | |
|---|---|
| | 1. |
| | 2. |

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

Name:___________________________________________ Name:___________________________________________

Dept:___________________________________________ Dept:___________________________________________

Role:___________________________________________ Role:___________________________________________

Phone:__________________________________________ Phone:__________________________________________

## MEASURE & PROGRAM PERFORMANCE SATISFACTION

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

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

_____________________________________________________________________________________________

_____________________________________________________________________________________________

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

_____________________________________________________________________________________________

_____________________________________________________________________________________________

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

_____________________________________________________________________________________________

_____________________________________________________________________________________________

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

_____________________________________________________________________________________________

_____________________________________________________________________________________________

## ENERGY EFFICIENCY DECISION MAKING SECTION

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

______________________________________________

______________________________________________

______________________________________________

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

______________________________________________

______________________________________________

______________________________________________

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

______________________________________________

______________________________________________

______________________________________________

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

______________________________________________

______________________________________________

______________________________________________

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

______________________________________________

______________________________________________

______________________________________________

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

______________________________________________

______________________________________________

______________________________________________

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

______________________________________________

______________________________________________

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

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

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

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

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

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

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

Investment Criteria: ______

Decision cut-off point: ______

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

With rebate: ______

Without rebate: ______________________________________________

______________________________________________

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

______________________________________________

______________________________________________

______________________________________________

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

______________________________________________

______________________________________________

______________________________________________

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

Inconsistency 1: ______________________________________________

______________________________________________

Response 1: ______________________________________________

______________________________________________

______________________________________________

Inconsistency 2: ______________________________________________

______________________________________________

Response 2: ______________________________________________

______________________________________________

______________________________________________

Inconsistency 3: ______________________________________________

______________________________________________

Response 3: ______________________________________________

______________________________________________

______________________________________________

**NOTES:**

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

## CONCLUSION

Thank you for your cooperation.

## INTRODUCTION

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

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

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

PS2 If **CONTACT** is no longer available ask to speak with someone who is familiar with equipment installed at the **PARTICIPANT SITE.**

New Contact:: ____________________________________________

Phone Number: ____________________________________________

PS3 Customer Contact indicated you were responsible for the installation of [describe equipment] at their site. I would like to ask you a few questions about that installation.

If vendor does not recall project and you can't find another contact, **end survey**

## PG&E INFLUENCE

**(CIRCLE ANSWER NUMBERS)**

V1 How familiar are you with PG&E's energy efficiency program? Would you say that you are:

1 Not very familiar
2 Somewhat familiar
3 Very familiar
9 DON'T KNOW / REFUSED

V2 How about the information PG&E provides to promote energy efficiency? Would you say that you are:

1 Not very familiar
2 Somewhat familiar
3 Very familiar
9 DON'T KNOW / REFUSED

V3 The CUSTOMER indicates that you recommend the installation of project equipment at their facility. Do you recall making this recommendation?

1 YES
2 NO **[GO TO V6]**
9 DON'T KNOW / REFUSED **[GO TO V6]**

V4 How significant was PG&E's energy efficiency program and information in influencing your decision to recommend the energy efficient equipment? Would you say . . .

1 Insignificant
2 Somewhat Significant
3 Very Significant
4 Extremely Significant
9 DON'T KNOW / REFUSED

V5 If the PG&E programs and information had not been available, how likely is it you would have recommended the energy efficient equipment? Would you say . . .

1 Definitely Would Not Have Recommended
2 Probably Would Not Have Recommended
3 Probably Would Have Recommended
4 Definitely Would Have Recommended
9 DON'T KNOW / REFUSED

**[GO TO CONCLUSION]**

V6 How significant was PG&E's energy efficiency program and information in influencing your decision to recommend the energy efficient equipment to any customer in 1997? Would you say . . .

1 Insignificant
2 Somewhat Significant
3 Very Significant
4 Extremely Significant
9 DON'T KNOW / REFUSED

## CONCLUSION

Thank you for your cooperation.

# C

# *SITE REPORT TEMPLATES*

This appendix contains templates used to develop the site plans and site reports. First the site plan template is shown, followed by the site report template. By design, the report template makes considerable use of the material developed during the site planning process.

# Draft Site Specific Project Impact Evaluation Plan
# Control #_______

*Check Address* *Site Address*

**File Principal Contact:**

**File Secondary Contact:**

**PG&E Recommended Contact:**

**PG&E Div. Mktg. Rep:**

**Summary of Program Activity:**

**Projects Paid By 1997 Programs**

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

**Measures Within Each Project**

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

## Program and Evaluation Savings Estimate Summary

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

## FACILITY DESCRIPTION

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

## OVERVIEW OF FACILITY SCHEDULE

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

## MEASURE DESCRIPTION

- *Describe the installed measure as shown in the project file.*

### *Pre-Retrofit Conditions*

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

### *Post-Retrofit Conditions*

- *Identify all post-retrofit conditions pertaining to the measure that are available in the file and from the customer interview.*
- *Specifically identify equipment when information is available*
    - *Equipment manufacturer, model number, capacity, rated input power, efficiency and other key descriptive and performance data*
    - *Number of units*
    - *Power and energy consumption (measured of rated)*
    - *Operating schedule: daily, weekly seasonal for full year*
    - *Production output, activity or level of service metric*
    - *Technical and economic aspects of project: (maintenance costs, quality improvements, etc.)*

## EX ANTE METHODOLOGY

### *Ex Ante Analysis Approach*

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

### *Ex Ante Algorithms*

*Present algorithms used in the ex ante analysis.*

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

### *Ex Ante Basecase*

*Summarize the basecase used in the ex ante analysis.*

### *Ex Ante Operating Schedule*

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

### *Ex Ante Key Assumptions*

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

### *Ex Ante Data Sources*

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

## PROPOSED EX POST EVALUATION METHODOLOGY

### *Analysis Approach*

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

### *Algorithms*

*Present specific algorithms to be used*

- *Preferred data, minimum data required to support calculations*

### *Basecase*

*Review ex ante basecase and determine if it seems appropriate.*

- *Identify alternative basecase or intermediate basecase and discuss of rationale for choosing*

### *Operating Schedule*

*Determine if the operating schedule has changed from the ex ante schedule.*

- *If so address how changes will affect impacts.*

### *Production Level Changes*

*Identify if production levels have changed.*

- *If so, address whether or not the rebate caused the production changes.*

### *Annualization of Results*

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

### *PG&E Costing Period Impact Calculations*

*Describe how each element of PG&E's costing period table will be calculated:*

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

## DATA REQUIREMENTS

- *Identify each data item required for methodology and source:*
- *Customer documentation to be requested, expected sources*
  - *Control or operating system records*

### *Monitoring Requirements*

*Submetering to be performed (proposed items to be measured and duration, frequency, interval, equipment to be used)*

- *Spot measurements to be taken*
- *Other data needs.*

## SPILLOVER

- *The spillover survey will be applied at the time of initial customer contact. The questionnaire will identify:*
    - *Preliminary (customer-reported) spillover measures*
    - *Brief description of spillover measure*
        - *Pre-installation equipment or system*
        - *Spillover measure description*

- *Criteria for acceptance of spillover impacts as program impact*
- *Description of proposed means of estimating savings including algorithms to be used*
- *Description of data requirements for spillover impact estimate*

## FREE RIDERSHIP ISSUES

### *Customer Cost/Benefit Analysis*

*Summarize cost/benefit analysis contained in the project file. Include payback with and without the incentive.*

### *Non-Energy Costs and Benefits*

*Identify any non energy cost/benefits such as maintenance savings, reliability improvements, compatibility with other process equipment will be identified.*

### *Equipment Alternatives/Alternative Baseline*

*Customer's basecase and alternatives considered. (Identify if different from the ex ante basecase and discuss reasons)*

### *Motivation*

- *Reasons for overall project implementation*
- *Reasons for selection of the specific equipment which was used (i.e. non-energy attributes that made the technology or efficient equipment the preferred option).*

### *Other Issues*

*Identify any other issues that may provide an indication of what the customer would have done if the incentive would not have been available.*

# Site Specific Project Impact Evaluation Report
# Control #_______

*Check Address* *Site Address*

**File Principal Contact:**

**File Secondary Contact:**

**PG&E Recommended Contact:**

**PG&E Div. Mktg. Rep:**

**Summary of Program Activity:**

**Projects Paid By 1997 Programs**

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

**Measures Within Each Project**

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

## Program and Evaluation Savings Estimate Summary

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

## SUMMARY OF FINDINGS

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

## FACILITY DESCRIPTION

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

## OVERVIEW OF FACILITY SCHEDULE

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

## MEASURE DESCRIPTION

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

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

### *Pre-Retrofit Conditions*

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

### *Post-Retrofit Conditions*

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

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

## EX ANTE METHODOLOGY

### *Ex Ante Analysis Approach*

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

### *Ex Ante Algorithms*

*Present algorithms used in the ex ante analysis.*

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

### *Ex Ante Basecase*

*Summarize the basecase used in the ex ante analysis.*

### *Ex Ante Operating Schedule*

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

### *Ex Ante Key Assumptions*

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

### *Ex Ante Data Sources*

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

## PROPOSED EX POST EVALUATION METHODOLOGY

### *Ex Post Analysis Approach*

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

### *Ex Post Basecase*

*Explain if ex ante basecase is deemed appropriate.*

- *If not, describe alternative basecase or intermediate basecase and discuss rationale for choosing*

### *Ex Post Operating Schedule*

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

#### *Production Level Changes*

*Identify if production levels have changed.*

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

### *Collected Data Ex Post*

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

#### *Monitoring Requirements*

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

### *Ex Post Algorithms*

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

### *Annualization of Results*

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

### *PG&E Costing Period Impact Calculations*

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

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

## SUMMARY OF GROSS IMPACTS

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

### *Ex Ante - Ex Post Discrepancies*

**Ex Ante vs. Ex Post Discrepancies**

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

### *Results by Costing Period*

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

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

## SPILLOVER

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

## NET-TO-GROSS RESULTS

Project net-to-gross ratio: ___

### *Standard Net-to-Gross Analysis*

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

### *Custom Net-to-Gross Analysis*

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

## ATTACHMENTS

### *Included in This Report*

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

### *Electronic*

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

D

# PROTOCOLS TABLES 6 AND 7

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

1. Table 6 - Process
2. Table 7 - Process
3. Table 6 - Indoor Lighting
4. Table 7 - Indoor Lighting

# Table 6 - Process

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

**ENDUSE: Process**
**Designated Unit of Measurement: Project**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Average Participant Group and Average Comaprison Group** | | **Participant** | **Comparison** | | | | | | | | |
| A. Pre-install usage: | Pre-install kW | na | na | | | | | | | | |
| | Pre-install kWh | na | na | | | | | | | | |
| | Pre-install Therms | na | na | | | | | | | | |
| | Base kW | na | na | | | | | | | | |
| | Base kWh | na | na | | | | | | | | |
| | Base Therms | na | na | | | | | | | | |
| | Base kW/ designated unit of measurement | na | na | | | | | | | | |
| | Base kWh/ designated unit of measurement | na | na | | | | | | | | |
| | Base Therms/ designated unit of measurement | na | na | | | | | | | | |
| B. Impact year usage: | Impact Yr kW | na | na | | | | | | | | |
| | Impact Yr kWh | na | na | | | | | | | | |
| | Impact Yr Therms | na | na | | | | | | | | |
| | Impact Yr kW/designated unit | na | na | | | | | | | | |
| | Impact Yr kWh/designated unit | na | na | **5. A. 90% CONFIDENCE LEVEL** | | | | **5. B. 80% CONFIDENCE LEVEL** | | | |
| | Impact Yr Therms/designated unit | na | na | **LOW BND** | **UP BND** | **LOW BND** | **UP BND** | **LOW BND** | **UP BND** | **LOW BND** | **UP BND** |
| **2. Average Net and Gross End Use Load Impacts** | | **AVG GROSS** | **AVG NET** | **AVG GROSS** | **AVG GROSS** | **AVG NET** | **AVG NET** | **AVG GROSS** | **AVG GROSS** | **AVG NET** | **AVG NET** |
| | A. i. Load Impacts - kW | 3,416 | 1,876 | 1,995 | 4,837 | 1,093 | 2,659 | 2,310 | 4,522 | 1,267 | 2,485 |
| | A. ii. Load Impacts - kWh | 17,434,659 | 8,472,387 | 8,212,989 | 26,656,329 | 3,949,807 | 12,994,967 | 10,259,135 | 24,610,183 | 4,953,297 | 11,991,477 |
| | A. iii. Load Impacts - Therms | 2,390,716 | 2,075,496 | 1,668,889 | 3,112,543 | 1,448,697 | 2,702,295 | 1,829,051 | 2,952,381 | 1,587,774 | 2,563,218 |
| | B. i. Load Impacts/designated unit - kW | 68 | 38 | 40 | 97 | 22 | 53 | 46 | 90 | 25 | 50 |
| | B. ii. Load Impacts/designated unit - kWh | 348,693 | 169,448 | 164,260 | 533,127 | 78,996 | 259,899 | 205,183 | 492,204 | 99,066 | 239,830 |
| | B. iii. Load Impacts/designated unit - Therms | 47,814 | 41,510 | 33,378 | 62,251 | 28,974 | 54,046 | 36,581 | 59,048 | 31,755 | 51,264 |
| | C. i. a. % change in usage - Part Grp - kW | na | na | na | na | na | na | na | na | na | na |
| | C. i. b. % change in usage - Part Grp - kWh | na | na | na | na | na | na | na | na | na | na |
| | C. i. c. % change in usage - Part Grp - Therms | na | na | na | na | na | na | na | na | na | na |
| | C. ii. a. % change in usage - Comp Grp - kW | na | na | na | na | na | na | na | na | na | na |
| | C. ii. b. % change in usage - Comp Grp - kWh | na | na | na | na | na | na | na | na | na | na |
| | C. ii. c. % change in usage - Comp Grp - Therms | na | na | na | na | na | na | na | na | na | na |
| D. Realization Rate: | D.A. i. Load Impacts - kW, realization rate | 0.80 | 0.51 | 0.47 | 1.13 | 0.30 | 0.72 | 0.54 | 1.06 | 0.34 | 0.68 |
| | D.A. ii. Load Impacts - kWh, realization rate | 0.44 | 0.25 | 0.21 | 0.67 | 0.12 | 0.38 | 0.26 | 0.62 | 0.15 | 0.35 |
| | D.A. iii. Load Impacts - Therms, realization rate | 0.80 | 0.92 | 0.56 | 1.04 | 0.64 | 1.20 | 0.61 | 0.99 | 0.70 | 1.14 |
| | D.B. i. Load Impacts/designated unit - kW, real rate | 0.80 | 0.51 | 0.47 | 1.13 | 0.30 | 0.72 | 0.54 | 1.06 | 0.34 | 0.68 |
| | D.B. ii. Load Impacts/designated unit - kWh, real rate | 0.44 | 0.25 | 0.21 | 0.67 | 0.12 | 0.38 | 0.26 | 0.62 | 0.15 | 0.35 |
| | D.B. iii. Load Impacts/designated unit - Therms, real rate | 0.80 | 0.92 | 0.56 | 1.04 | 0.64 | 1.20 | 0.61 | 0.99 | 0.70 | 1.14 |
| **3. Net-to-Gross Ratios** | | **RATIO** | | **RATIO** | **RATIO** | | | **RATIO** | **RATIO** | | |
| | A. i. Average Load Impacts - kW | 0.55 | | 0.53 | 0.57 | | | 0.53 | 0.56 | | |
| | A. ii. Average Load Impacts - kWh | 0.49 | | 0.47 | 0.51 | | | 0.47 | 0.50 | | |
| | A. iii. Average Load Impacts - Therms | 0.87 | | 0.86 | 0.87 | | | 0.86 | 0.87 | | |
| | B. i. Avg Load Impacts/designated unit of measurement - kW | 0.55 | | 0.53 | 0.57 | | | 0.53 | 0.56 | | |
| | B. ii. Avg Load Impacts/designated unit of measurement - kWh | 0.49 | | 0.47 | 0.51 | | | 0.47 | 0.50 | | |
| | B. iii. Avg Load Impacts/designated unit of measurement - | 0.87 | | 0.86 | 0.87 | | | 0.86 | 0.87 | | |
| | C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW | na | | na | na | | | na | na | | |
| | C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh | na | | na | na | | | na | na | | |
| | C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms | na | | na | na | | | na | na | | |
| **4. Designated Unit Intermediate Data** | | **PART GRP** | **NP GRP** | | | | | **PART GRP** | **PART GRP** | | |
| | A. Pre-install average value | 50 | na | | | | | na | na | | |
| | B. Post-install average value | 50 | na | | | | | na | na | | |
| **6. Measure Count Data** | | **NUMBER** | | | | | | | | | |
| | A. Number of measures installed by participants in Part Group | See next page | | | | | | | | | |
| | B. Number of measures installed by all program participants in the 12 months of the program year | See next page | | | | | | | | | |
| | C. Number of measures installed by Comp Group | na | | | | | | | | | |
| **7. Market Segment Data** | | | | | | | | | | | |
| | B. Distribution of participants by 3 digit SIC | See next page | | | | | | | | | |

## M&E PROTOCOLS TABLE 6 (CONTINUED)

### 6A/6B Measure Count Data

| Measure Code | Measure Description | Participant Group | Population |
|---|---|---|---|
| 550 | Process Controls | 1 | 2 |
| 560 | Process Heat Recovery | 1 | 2 |
| 569 | Process Change/Add Equipment | 1 | 2 |
| 578 | Process Adjustable Speed Drive | 0 | 3 |
| 580 | Process Change Physical | 1 | 3 |
| 589 | Air Compresser System Change/Modify | 3 | 12 |
| 590 | Process Insulate | 2 | 4 |
| 591 | Process Improved Maintenance | 2 | 3 |
| 599 | Process Other | 2 | 6 |
| P2 | Oil Well Pump-Off Controller | 5 | 32 |
| P9 | Variable Frequency Drive: Water Pumping: Throttling Valve To VFD | 176 | 178 |
| | Totals | 194 | 247 |

### 7B Distribution of 3 Digit SICs

| SIC3 | Percent |
|---|---|
| 17 | 2.0% |
| 104 | 2.0% |
| 131 | 22.0% |
| 142 | 4.0% |
| 144 | 6.0% |
| 202 | 2.0% |
| 203 | 2.0% |
| 204 | 2.0% |
| 206 | 2.0% |
| 208 | 6.0% |
| 242 | 10.0% |
| 244 | 2.0% |
| 249 | 6.0% |
| 262 | 2.0% |
| 263 | 2.0% |
| 267 | 2.0% |
| 275 | 2.0% |
| 291 | 6.0% |
| 311 | 2.0% |
| 327 | 4.0% |
| 331 | 4.0% |
| 341 | 2.0% |
| 344 | 2.0% |
| 357 | 2.0% |
| 367 | 2.0% |

# Table 7 - Process

# M&E PROTOCOLS TABLE 7
## PROCESS END USE

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

## A. OVERVIEW INFORMATION

### *1. Study Title and ID Number*

Evaluation of 1994 Industrial Process Energy-Efficiency Projects, ID # 334a

### *2. Program, Program Year, and Program Description*

PG&E’s Industrial Energy Efficiency Incentives Programs

Program year 1997

The Programs provide incentives to industrial customers to install energy-efficiency measures. The programs include the Retrofit Express Program (RE), the Retrofit Efficiency Options Program (REO), the Advanced Performance Options Program (APO), and the Customer Efficiency Options Program (CEO).

### *3. End Uses Covered*

Industrial Process

### *4. Methods Used*

Site-specific engineering approach

### *5. Participant and Comparison Group Definitions*

Participants: Industrial customers who received rebate checks in 1997 for installing Process measures

Comparison Group: None

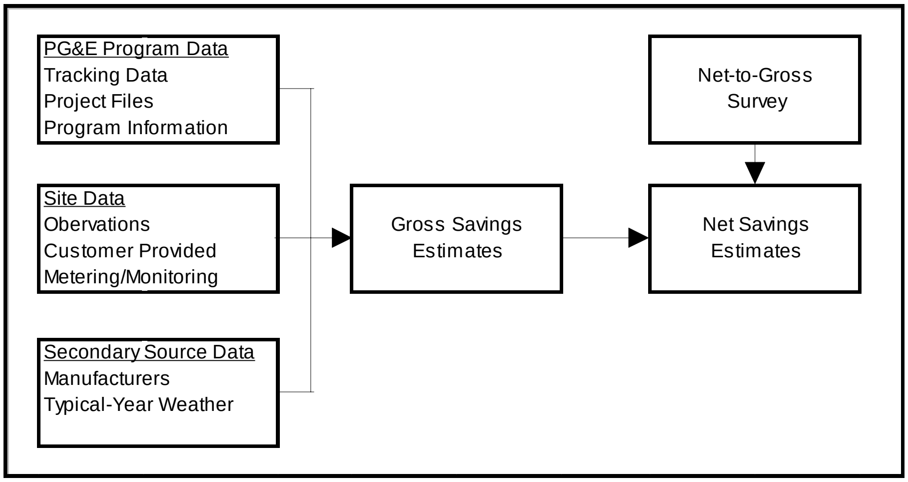
### *6. Analysis sample size*

19 customers, 23 installations, 194 measures installed, 23 observations (project installation level); these sites accounted for over 70% of the kW, kWh, and therm savings.

## B. DATABASE MANAGEMENT

### *1. Data Flow Chart*

Following is a flow chart describing the project data flow.




### *2. Data Sources*

See flowchart provided above for Item B.1.

### *3. Sample Attrition*

Twenty three projects were identified for possible site analyses; all 23 projects were analyzed.

The remaining 27 industrial process projects were targeted for verification surveys; 24 of these sites were verified. Of the 3 projects that were not surveyed, 2 incompletes were the result of customer refusals and one incomplete resulted because the customer was not available during the survey time frame.

Of the 46 projects that were analyzed or verified, there were 4 projects where customers did not complete the net-to-gross surveys.

### *4. Quality Checks*

Each site analysis was assigned to a senior engineer. This person was responsible for putting together a site analysis plan that made appropriate use of project data. The plan was reviewed by the lead evaluation engineer and the evaluation project manager. The site analysis was then conducted and a report was produced documenting all site-specific evaluation analyses and results. The site report was reviewed by the an evaluation engineer, an evaluation technical reviewer, the evaluation project manager, and PG&E staff for completeness.

### 5. Data Not Used

N/A

## C. SAMPLING

### 1. Sampling Procedures and Protocols

*Population/sampling frame*: 50 industrial process projects.

*Sampling strategy*: A census was attempted for the 16 largest projects, with 9 additional projects held out as backup projects to ensure that 70% of gross program impacts would be analyzed. For the remaining 25 smaller projects, a random sample of 4 projects selected. All projects were targeted for verification surveys. Ultimately, 16 large projects, 3 backup projects, and 4 small projects were analyzed.

*Sampling basis*: A project was defined as a unique combination of PG&E billing Control number and Application number.

*Stratification criteria*: Energy savings.

### 2. Survey Information

Instruments - see Appendix B of this report for survey instruments;

Response rates - see Item B.3 above for response rates.

Non-response bias - no attempts were made to account for non-response bias.

### 3. Statistical Descriptions

N/A

## D. DATA SCREENING AND ANALYSIS

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

7. *Autocorrelation*: N/A
8. *Heteroskedasticity*: N/A
9. *Collinerarity*: N/A
10. *Influential Data Points*: N/A
11. *Missing Data*: N/A
12. *Precision*: Gross savings - single ratio estimators were utilized; the standard approach for calculating the variance of a ratio estimator was utilized. Net-to-gross: the standard error of the mean net-to-gross ratio was utilized in the precision calculations.
13. *Engineering Analysis*: The engineering analyses used for this evaluation followed the general guidelines provided in Section 3 of Appendix J of the M&E Protocols. Several key aspects of the guidelines are addressed here:
    <u>Data collection</u>: On-site surveys conducted by senior engineering staff were used as the primary source of data collection. In most cases, the analysis was supported by metering/monitoring of post-retrofit equipment. Metering periods ranged from one week to four weeks. In addition, spot measurements or observation of customer's control-panel read-outs were used to ascertain equipment performance.
    <u>Basecase definition</u>: For each analyzed project, the ex ante basecase assumptions contained in PG&E project file were carefully reviewed for reasonableness. Discussions with customer staff were utilized to support the review. For all projects, pre-retrofit equipment/system specifications were available in the project file. In some necessary cases, pre-retrofit system measurements were also available. In most cases, the ex ante basecase assumptions were deemed appropriate and used for the ex post analysis. In several cases where pre-retrofit equipment was at the end of its useful life, the basecase equipment specifications were adjusted to conform with industry standards. For one project that involved production increments, the pre-retrofit equipment was utilized in the ex post analysis rather than a hypothetical basecase that was used for the ex ante calculations.
    <u>Interactive effects</u>: Engineering calculations were based on simple, equipment-specific models and did not included interactive effects. While the analyses did address impacts on the relevant process *systems* at each site, secondary effects on other end uses were not deemed significant and were not addressed.
    <u>Changes in production</u>: Changes in production occurred at a number of analysis sites. In each case, the influence of the PG&E incentive on the production increase was assessed. For all but one project, it was determined (through customer interview or technical assessment of the measure, i.e. for control measures) that the production increases would have occurred anyway. In these cases, the post-retrofit production levels was used as the basis of the impact calculation. For one project, it was determined that the increase in production was a direct result of the PG&E incentive. In this case, the pre-retrofit production level was used as the basis for the impact calculation.
14. *Net-to-Gross Analysis*: As self-report method was utilized for this study. All projects received a standard net-to-gross survey, and the largest 16 projects received an additional custom survey and analysis. Key aspects of the net-to-gross analysis are discussed next:

Identifying the correct respondent: The initial customer contact was asked to identify the appropriate net-to-gross respondent as part of the on-site survey.
Set-up questions: Set-up questions regarding customer satisfaction with the measures and the program and the customer's sources of measure and program information were used to get the customer thinking about the measure installation decision.
Use of multiple net-to-gross measures: Two primary questions were used to assess net-to-gross in the standard analysis. The questions addressed the significance of the program in the customer's decision to install measures and what the customer would have done in the absence of the incentive. The intended actions questions was the primary question is setting the net-to-gross ratio. The program significance question was used as a consistency check to adjust the net-to-gross ratio when the intended actions question appeared inconsistent with other responses. In addition, the timing of the program influence with respect to purchase decisions was used as an additional consistency check to identify free-riders. For the custom surveys, additional questions regarded financial assessment criteria and non-energy benefits were also factored into the net-to-gross analysis.
Use of multiple respondents: The custom net-to-gross analysis incorporated, when relevant, the input of multiple customer respondents. The most weight in the analysis was placed on the responses of the primary decision maker.
Partial and deferred free-ridership: Survey questions and analysis addressed both partial and deferred free-ridership.
Third party influence: For the custom net-to-gross analyses, if the customer respondent indicated a vendor was influential in the measure installation decision, an attempt was made to survey the vendor.
Non-responses and don't knows: customers who did not respond to the survey or did not respond to the 2 key survey questions (involving program significance and intended actions) were dropped from the net-to-gross analysis. They essentially received the average net-to-gross ratio.
Weighting: Impact weighted-average net-to-gross ratios were calculated separately for kW, kWh, and therm impacts.
Spillover: Spillover was calculated for a project if: (1) the customer indicated they installed additional measures that were not included in the PG&E tracking records; (2) the measures were installed as a result of the PG&E program; and (3) the customer did not plan to apply for a rebate for these additional measures.

## E. DATA INTERPRETATION AND APPLICATION

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

# Table 6 - Indoor Lighting

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

**ENDUSE: Indoor Lighting Process**
**Designated Unit of Measurement: 1000 hours × Square feet**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Average Participant Group and Average Comaprison Group** | | **Participant** | **Comparison** | | | | | | | | |
| A. Pre-install usage: | Pre-install kW | na | na | | | | | | | | |
| | Pre-install kWh | na | na | | | | | | | | |
| | Pre-install Therms | na | na | | | | | | | | |
| | Base kW | na | na | | | | | | | | |
| | Base kWh | na | na | | | | | | | | |
| | Base Therms | na | na | | | | | | | | |
| | Base kW/ designated unit of measurement | na | na | | | | | | | | |
| | Base kWh/ designated unit of measurement | na | na | | | | | | | | |
| | Base Therms/ designated unit of measurement | na | na | | | | | | | | |
| B. Impact year usage: | Impact Yr kW | na | na | | | | | | | | |
| | Impact Yr kWh | na | na | | | | | | | | |
| | Impact Yr Therms | na | na | | | | | | | | |
| | Impact Yr kW/designated unit | na | na | | | | | | | | |
| | Impact Yr kWh/designated unit | na | na | **5. A. 90% CONFIDENCE LEVEL** | | | | **5. B. 80% CONFIDENCE LEVEL** | | | |
| | Impact Yr Therms/designated unit | na | na | **LOW BND** | **UP BND** | **LOW BND** | **UP BND** | **LOW BND** | **UP BND** | **LOW BND** | **UP BND** |
| **2. Average Net and Gross End Use Load Impacts** | | **AVG GROSS** | **AVG NET** | **AVG GROSS** | **AVG GROSS** | **AVG NET** | **AVG NET** | **AVG GROSS** | **AVG GROSS** | **AVG NET** | **AVG NET** |
| | A. i. Load Impacts - kW | 4,315 | 2,994 | 3,981 | 4,649 | 2,712 | 3,276 | 4,055 | 4,575 | 2,774 | 3,214 |
| | A. ii. Load Impacts - kWh | 20,775,055 | 14,495,908 | 19,076,126 | 22,473,984 | 13,237,706 | 15,754,110 | 19,453,092 | 22,097,018 | 13,516,882 | 15,474,934 |
| | A. iii. Load Impacts - Therms | -4,579 | -3,182 | -6,170 | -2,987 | -3,954 | -2,411 | -5,817 | -3,340 | -3,783 | -2,582 |
| | B. i. Load Impacts/designated unit - kW | 0.00011 | 0.00007 | 0.00010 | 0.00011 | 0.00007 | 0.00008 | 0.00010 | 0.00011 | 0.00007 | 0 |
| | B. ii. Load Impacts/designated unit - kWh | 0.50554 | 0.35274 | 0.46420 | 0.54688 | 0.32213 | 0.38336 | 0.47337 | 0.53771 | 0.32892 | 0 |
| | B. iii. Load Impacts/designated unit - Therms | -0.00011 | -0.00008 | -0.00015 | -0.00007 | -0.00010 | -0.00006 | -0.00014 | -0.00008 | -0.00009 | 0 |
| | C. i. a. % change in usage - Part Grp - kW | na | na | na | na | na | na | na | na | na | na |
| | C. i. b. % change in usage - Part Grp - kWh | na | na | na | na | na | na | na | na | na | na |
| | C. i. c. % change in usage - Part Grp - Therms | na | na | na | na | na | na | na | na | na | na |
| | C. ii. a. % change in usage - Comp Grp - kW | na | na | na | na | na | na | na | na | na | na |
| | C. ii. b. % change in usage - Comp Grp - kWh | na | na | na | na | na | na | na | na | na | na |
| | C. ii. c. % change in usage - Comp Grp - Therms | na | na | na | na | na | na | na | na | na | na |
| D. Realization Rate: | D.A. i. Load Impacts - kW, realization rate | 1.14 | 0.93 | 1.05 | 1.23 | 0.84 | 1.02 | 1.07 | 1.21 | 0.86 | 1.00 |
| | D.A. ii. Load Impacts - kWh, realization rate | 1.02 | 0.83 | 0.94 | 1.10 | 0.76 | 0.90 | 0.96 | 1.08 | 0.77 | 0.89 |
| | D.A. iii. Load Impacts - Therms, realization rate | na | na | na | na | na | na | na | na | na | na |
| | D.B. i. Load Impacts/designated unit - kW, real rate | 1.14 | 0.93 | 1.05 | 1.23 | 0.84 | 1.02 | 1.07 | 1.21 | 0.86 | 1.00 |
| | D.B. ii. Load Impacts/designated unit - kWh, real rate | 1.02 | 0.83 | 0.94 | 1.10 | 0.76 | 0.90 | 0.96 | 1.08 | 0.77 | 0.89 |
| | D.B. iii. Load Impacts/designated unit - Therms, real rate | na | na | na | na | na | na | na | na | na | na |
| **3. Net-to-Gross Ratios** | | **RATIO** | | **RATIO** | **RATIO** | | | **RATIO** | **RATIO** | | |
| | A. i. Average Load Impacts - kW | 0.69 | | 0.68 | 0.71 | | | 0.68 | 0.70 | | |
| | A. ii. Average Load Impacts - kWh | 0.70 | | 0.68 | 0.71 | | | 0.69 | 0.71 | | |
| | A. iii. Average Load Impacts - Therms | 0.70 | | 0.69 | 0.70 | | | 0.69 | 0.70 | | |
| | B. i. Avg Load Impacts/designated unit of measurement - kW | 0.69 | | 0.68 | 0.71 | | | 0.68 | 0.70 | | |
| | B. ii. Avg Load Impacts/designated unit of measurement - kWh | 0.70 | | 0.68 | 0.71 | | | 0.69 | 0.71 | | |
| | B. iii. Avg Load Impacts/designated unit of measurement - | 0.70 | | 0.69 | 0.70 | | | 0.69 | 0.70 | | |
| | C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW | na | | na | na | | | na | na | | |
| | C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh | na | | na | na | | | na | na | | |
| | C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms | na | | na | na | | | na | na | | |
| **4. Designated Unit Intermediate Data** | | **PART GRP** | **NP GRP** | | | | | **PART GRP** | **PART GRP** | | |
| | A. Pre-install average value | 109,586 | na | | | | | na | na | | |
| | B. Post-install average value | 109,586 | na | | | | | na | na | | |
| **6. Measure Count Data** | | **NUMBER** | | | | | | | | | |
| | A. Number of measures installed by participants in Part Group | See next page | | | | | | | | | |
| | B. Number of measures installed by all program participants in the 12 months of the program year | See next page | | | | | | | | | |
| | C. Number of measures installed by Comp Group | na | | | | | | | | | |
| **7. Market Segment Data** | | | | | | | | | | | |
| | B. Distribution of participants by 3 digit SIC | See next page | | | | | | | | | |

## M&E PROTOCOLS TABLE 6 (CONTINUED)

### 6A/6B Measure Count Data

| Measure Code | Measure Description | Participant Group | Population |
|---|---|---|---|
| 199 | Lighting - Other | 1 | 1 |
| L114 | Ballast: Electronic | 0 | 64 |
| L137 | Exit Sign: Led | 480 | 863 |
| L14 | Ballast: Electronic, 2-Lamp Ballast | 2,757 | 2,757 |
| L17 | Reflectors With Delamping, 2 Ft Lamp Removed | 761 | 761 |
| L174 | Compact Fluorescent: Screw-In, Modular Blst, 14-26 Watts | 168 | 292 |
| L175 | Compact Fluorescent: Screw-In, Modular Blst, >= 27 Watts | 51 | 57 |
| L176 | Compact Fluorescent: Hardwired Fixture, 14-25 Watts | 154 | 202 |
| L177 | Compact Fluorescent: Hardwired Fixture, >= 26 Watts | 71 | 71 |
| L178 | Compact Fluorescent: Hardwired Fixture, 27-65 Watts, Incandescent | 3 | 104 |
| L18 | Reflectors With Delamping, 3 Ft Lamp Removed | 10 | 10 |
| L180 | Compact Fluorescent: Hardwired Fixture, 66-156 Watts, Incandescent | 54 | 54 |
| L184 | Fixture: T-8 High-Output Lamp & Elec Blst, (Fem Or New Fixture), 8 Ft | 22 | 22 |
| L187 | HID Fixture: Interior, Compact, 36-70 Watts Lamp, Incandescent | 0 | 16 |
| L189 | HID Fixture: Interior, Compact, 71-100 Watts Lamp, Incandescent | 0 | 8 |
| L19 | Reflectors With Delamping, 4 Ft Lamp Removed | 19,596 | 23,892 |
| L191 | HID Fixture: Interior, Standard, 101-175 Watts Lamp, Incandescent | 0 | 11 |
| L192 | HID Fixture: Interior, Standard, 101-175 Watts Lamp, Mercury Vapor | 0 | 2 |
| L193 | HID Fixture: Interior, Standard, 176-250 Watts Lamp, Incandescent | 138 | 175 |
| L194 | HID Fixture: Interior, Standard, 176-250 Watts Lamp, Mercury Vapor | 0 | 34 |
| L195 | HID Fixture: Interior, Standard, 251-400 Watts Lamp, Incandescent | 284 | 461 |
| L196 | HID Fixture: Interior, Standard, 251-400 Watts Lamp, Mercury Vapor | 637 | 881 |
| L20 | Reflectors With Delamping, 8 Ft Lamp Removed | 668 | 757 |
| L21 | Fixture: T-8 Lamp & Elec Blst, (Fem Or New Fixture), 2 Ft Fixt | 3,392 | 3,999 |
| L22 | Fixture: T-8 Lamp & Elec Blst, (Fem Or New Fixture), 3 Ft Fixt | 210 | 321 |
| L23 | Fixture: T-8 Lamp & Elec Blst, (Fem Or New Fixture), 4 Ft Fixt | 80,625 | 107,905 |
| L24 | Fixture: T-8 Lamp & Elec Blst, (Fem Or New Fixture), 8 Ft Fixt | 768 | 2,296 |
| L26 | HID Fixture: Interior, Standard, 101-175 Watt Lamp | 58 | 98 |
| L27 | HID Fixture: Interior, Standard, 176-250 Watt Lamp | 312 | 313 |
| L31 | Time Clock: Lighting | 3 | 7 |
| L36 | Photocell: Lighting | 22 | 78 |
| L5 | Exit Sign: Retrofit Kit | 240 | 497 |
| L60 | Halogen Lamp: < 50 Watts | 16 | 51 |
| L61 | Halogen Lamp: >= 50 Watts | 9 | 80 |
| L64 | Compact Fluorescent: Screw-In, Modular Blst, 5-13 Watts | 547 | 685 |
| L66 | Compact Fluorescent: Hardwired Fixture, 5-13 Watts | 294 | 359 |
| L8 | Fixture: Incand To Fluor Conversion W/Elec Blst | 11 | 11 |
| L80 | HID Fixture: Interior, Compact, 71-100 Watt Lamp | 7 | 7 |
| L81 | HID Fixture: Interior, Standard, 251-400 Watt Lamp | 775 | 872 |
| L82 | Occupancy Sensor: Wall Mounted | 506 | 709 |
| L83 | Occupancy Sensor: Ceiling Mounted | 776 | 784 |

### 7B Distribution of 3 Digit SICs

| SIC3 | Percent | SIC3 | Percent |
|---|---|---|---|
| 138 | 0.6% | 284 | 0.3% |
| 140 | 0.3% | 285 | 0.3% |
| 152 | 0.3% | 287 | 0.6% |
| 154 | 2.4% | 289 | 0.9% |
| 171 | 1.5% | 291 | 0.9% |
| 172 | 0.3% | 306 | 0.3% |
| 173 | 1.8% | 308 | 3.6% |
| 174 | 0.3% | 322 | 0.3% |
| 175 | 0.3% | 327 | 1.2% |
| 176 | 1.2% | 328 | 0.3% |
| 178 | 0.3% | 329 | 0.3% |
| 179 | 1.5% | 331 | 0.3% |
| 201 | 0.9% | 332 | 0.6% |
| 202 | 0.6% | 333 | 0.3% |
| 203 | 0.6% | 335 | 1.2% |
| 205 | 3.0% | 336 | 0.3% |
| 206 | 0.3% | 341 | 1.2% |
| 208 | 4.6% | 342 | 0.3% |
| 209 | 0.6% | 344 | 4.6% |
| 242 | 4.6% | 347 | 3.3% |
| 243 | 2.4% | 349 | 0.6% |
| 244 | 0.6% | 354 | 1.2% |
| 249 | 1.2% | 355 | 0.6% |
| 251 | 0.3% | 356 | 0.3% |
| 252 | 0.3% | 357 | 10.0% |
| 254 | 0.6% | 359 | 4.3% |
| 262 | 0.9% | 362 | 0.6% |
| 263 | 0.3% | 364 | 0.3% |
| 265 | 0.9% | 366 | 4.0% |
| 267 | 0.3% | 367 | 7.6% |
| 270 | 2.1% | 369 | 0.6% |
| 271 | 0.9% | 372 | 1.2% |
| 273 | 0.3% | 373 | 0.6% |
| 275 | 2.7% | 381 | 0.6% |
| 278 | 0.3% | 382 | 2.4% |
| 279 | 0.3% | 384 | 0.6% |
| 281 | 0.3% | 386 | 0.3% |
| 283 | 1.2% | 399 | 0.6% |

# Table 7 - Indoor Lighting

# M&E PROTOCOLS TABLE 7
## INDOOR LIGHTING END USE

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

## A. OVERVIEW INFORMATION

### *1. Study Title and ID Number*

Evaluation of 1994 Industrial Indoor Lighting Energy-Efficiency Projects, ID # 334b

### *2. Program, Program Year, and Program Description*

PG&E's Industrial Energy Efficiency Incentives Programs

Program year 1997

The Programs provide incentives to industrial customers to install energy-efficiency measures. The programs include the Retrofit Express Program (RE), the Retrofit Efficiency Options Program (REO), the Advanced Performance Options Program (APO), and the Customer Efficiency Options Program (CEO).

### *3. End Uses Covered*

Industrial Indoor Lighting

### *4. Methods Used*

Site-specific engineering approach

### *5. Participant and Comparison Group Definitions*

Participants: Industrial customers who received rebate checks in 1997 for installing Indoor Lighting measures

Comparison Group: None

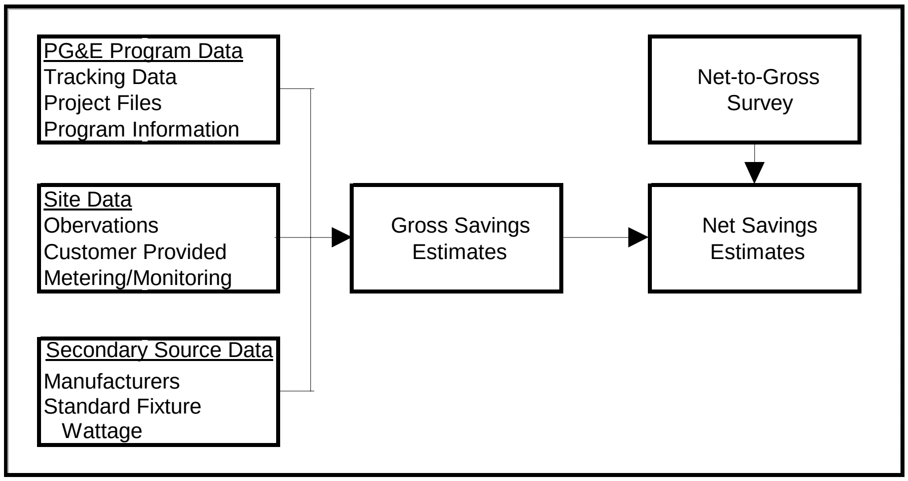
### *6. Analysis sample size*

19 customers, 23 installations, 194 measures installed, 23 observations (project installation level); these sites accounted for over 70% of the kW, kWh, and therm savings.

## B. DATABASE MANAGEMENT

### *1. Data Flow Chart*

Following is a flow chart describing the project data flow.




### *2. Data Sources*

See flowchart provided above for Item B.1.

### *3. Sample Attrition*

| | |
|---|---|
| Population/sample frame: | 329 projects |
| Recruitment attempted: | 235 projects |
| Completed surveys: | 204 projects |
| Incompletes: | 31 projects |
| Unable to contact: | 10 projects |
| Customer refusal: | 21 projects |

Of the 204 projects that were analyzed, there were 16 projects where customers did not complete the net-to-gross surveys.

### *4. Quality Checks*

All surveys where conducted by experienced surveyors. Each survey was QC'd by a senior engineer. Additional electronic data QC was implemented once the surveys were data entered. Analysis for each project was conducted by a senior engineer. Results were QC'd by a second engineer. Final site reports were reviewed by a senior engineer, the evaluation project manager, and by PG&E staff.

### *5. Data Not Used*

N/A

## C. SAMPLING

### 1. *Sampling Procedures and Protocols*

*Population/sampling frame*: 329 industrial indoor lighting projects.

*Sampling strategy*: A census was attempted for the 56 largest projects, with 39 additional projects held out as backup projects to ensure that 70% of gross program impacts would be analyzed. For the remaining 234 smaller projects, a random sample of 82 projects were targeted. Ultimately, 48 large projects, 16 backup projects, and 140 small projects were analyzed. Additional smaller projects were included in the analysis because there was some concern that the 70% gross impact threshold might not be attained and as a results of schedulers trying to keep surveyors busy throughout the data collection period.

*Sampling basis*: A project was defined as a unique combination of PG&E billing Control number and Application number.

*Stratification criteria*: Energy savings.

### 2. *Survey Information*

Instruments - see Appendix B of this report for survey instruments;

Response rates - see Item B.3 above for response rates.

Non-response bias - no attempts were made to account for non-response bias.

### 3. *Statistical Descriptions*

N/A

## D. DATA SCREENING AND ANALYSIS

1. *Outliers*: N/A
2. *Background Variables*: N/A
3. *Data Screening*: N/A, all visited sites were included.
4. *Regression Statistics*: N/A; analysis method was site-specific engineering calculation supported by metering/monitoring.
5. *Specification*: N/A; regression model was not used.
6. *Error in Measuring Variables*: Senior surveyors were used to minimize measurement error. Anomalies in the analysis results were carefully reviewed and follow-up analysis was conducted where necessary. In limited cases where initial basecase assumptions seemed

implausible (very high or very low lighting densities) a standardized basecase was substituted for the basecase developed during the on-site survey.

7. *Autocorrelation*: N/A
8. *Heteroskedasticity*: N/A
9. *Collinerarity*: N/A
10. *Influential Data Points*: N/A
11. *Missing Data*: N/A
12. *Precision*: Gross savings - single ratio estimators were utilized; the standard approach for calculating the variance of a ratio estimator was utilized. Net-to-gross: the standard error of the mean net-to-gross ratio was utilized in the precision calculations.
13. *Engineering Analysis*: The engineering analyses used for this evaluation followed the general guidelines provided in Section 3 of Appendix J of the M&E Protocols. Several key aspects of the guidelines are addressed here:
    <u>Data collection</u>: On-site surveys conducted by senior surveyors were used as the primary source of data collection. A rigorous attempt was made to collect accurate hours of operation. Where lighting hours could not be ascertained with a high degree of certainty (through customer interview, review of facility logs, review of time clock settings, etc.) lighting loggers were installed.
    <u>Basecase definition</u>: For most projects and measures, the pre-retrofit lighting equipment was utilized as the basecase. Under certain conditions -- when the customer could not identify the pre-retrofit equipment or when there was a significant change in the use of the lighted space -- a standardized basecase was utilized. The standardized basecase utilized assumptions similar to the ex ante analysis, based on standard efficiency design conditions.
    <u>Interactive effects</u>: HVAC interactive effects were calculated in instances where space cooling and/or space heating were present. The approach is outlined in Section 2 of the report.
14. *Net-to-Gross Analysis*: As self-report method was utilized for this study. All projects received a standard net-to-gross survey, and the largest 20 projects received an additional custom survey and analysis. Key aspects of the net-to-gross analysis are discussed next:
    <u>Identifying the correct respondent</u>: The initial customer contact was asked to identify the appropriate net-to-gross respondent as part of the on-site survey.
    <u>Set-up questions</u>: Set-up questions regarding customer satisfaction with the measures and the program and the customer's sources of measure and program information were used to get the customer thinking about the measure installation decision.
    <u>Use of multiple net-to-gross measures</u>: Two primary questions were used to assess net-to-gross in the standard analysis. The questions addressed the significance of the program in the customer's decision to install measures and what the customer would have done in the absence of the incentive. The intended actions questions was the primary question is setting the net-to-gross ratio. The program significance question was used as a consistency check to adjust the net-to-gross ratio when the intended actions question appeared inconsistent with other responses. In addition, the timing of the program influence with respect to purchase

decisions was used as an additional consistency check to identify free-riders. For the custom surveys, additional questions regarded financial assessment criteria and non-energy benefits were also factored into the net-to-gross analysis.

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

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

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

Non-responses and don't knows: customers who did not respond to the survey or did not respond to the 2 key survey questions (involving program significance and intended actions) were dropped from the net-to-gross analysis. They essentially received the average net-to-gross ratio.

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

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

## E. DATA INTERPRETATION AND APPLICATION

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

# E EVALUATION DATABASE

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

## E.1 DIRECTORY STRUCTURE

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

**Table E-1**
**Electronic Data Directory Structure**

| Subdirectory | Description |
|---|---|
| DBF | dBase files used to transfer data to/from SAS to Excel/Access |
| \SURVEY | Survey data |
| \TRACKING | Program tracking data |
| \OTHER | Other data |
| EXCEL - ACCESS | Excel and Access data, programs, and variable descriptions |
| FINAL DATA | Final evaluation dataset in SAS and Excel format |
| LITSITES | Indoor lighting project reports (analysis in EXCEL - ACCESS directory) |
| PROCSITES | Process project reports and analysis spreadsheets |
| \REPORTS | Reports |
| \SPREADSHEETS | Analysis spreadsheets |
| SASDATA | SAS datasets |
| SASPGM | SAS programs |

## E.2 DESCRIPTION OF ELECTRONIC FILES

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

**Table E-2**
**Electronic Files**

| DATASET | DESCRIPTION |
|---|---|
| DBF\OTHER | Subdirectory of "other" DBF files |
| BYPERIODSML.DBF | Costing period data for Small Indoor Lighting Report (from SAS) |
| COMPAREBYMEASALL.DBF | Comparison of lighting savings determinants data - all projects (from SAS) |
| COMPAREBYMEASSML.DBF | Comparison of lighting savings determinants data - small projects (from SAS) |
| CUSTNTGR.DBF | Custom net-to-gross results (for loading into SAS) |
| EXPOSTBCSML.DBF | Project Ex post basecase descriptions for Small Indoor Lighting Report (from SAS) |
| IMPRESULTSML.DBF | Project impact results for Small Indoor Lighting Report (from SAS) |
| LITLOOK.DBF | Fixture type lookup table for Small Indoor Lighting Report (for loading into SAS) |
| LTG_ALL.DBF | Lighting analysis results for all project from 8760.XLS (for loading into SAS) |
| NTGRCALC.DBF | Standard NTGR calculations for Custom NTGR projects (for loading into SAS) |
| PROCRES.DBF | Process impact results extracted from project spreadsheets (for loading into SAS) |
| PROCTYPE.DBF | Process project technology classifications (for loading into SAS) |
| SAVDETSML.DBF | Project-specific savings determinants for the Small Indoor Lighting Report (from SAS) |
| VERREPE.DBF | Data for verification reports (from SAS) |
| DBF\SURVEY | Subdirectory of DBF survey files |
| TMAIN.DBF | Site-level survey data (see INDUSTRIAL_VARIABLES.XLS for descriptions |
| TMEAS.DBF | Measure-level survey data (see INDUSTRIAL_VARIABLES.XLS for descriptions |
| TNTG.DBF | Net-to-gross survey data (see INDUSTRIAL_VARIABLES.XLS for descriptions |
| TPROJ.DBF | Project-level survey data (see INDUSTRIAL_VARIABLES.XLS for descriptions |
| TSPILL.DBF | Spillover survey data (see INDUSTRIAL_VARIABLES.XLS for descriptions |
| DBF\TRACKING | Subdirectory of DBF tracking files - from PG&E ACCESS database |
| ACTION.DBF | Action code descriptions |
| APP97.DBF | Application-level data |
| CONTACT.DBF | Customer contact information |
| EMPLOYEE.DBF | PG&E customer rep information |
| END_USE.DBF | End use code descriptions |
| ITEM97.DBF | Item-level data |
| MEASURE.DBF | Measure-code descriptions |
| SEGMENT.DBF | Customer segment descriptions |
| SIC.DBF | SIC code descriptions |
| EXCEL - ACCESS | Subdirectory of Excel and ACESS files |
| 8760.XLS | Lighting analysis workbook |
| INDUSTRIAL_VARIABLES.XLS | Description of survey and lighting analysis variables |
| INDUSTRL.MDB | Survey database |
| RESULTS.XLS | Results workbook for Final Report |
| SMALL LIGHTING.XLS | Results workbook for Small Indoor Lighting Report |
| LITSITES | Subdirectory of Indoor Lighting site reports |
| R*******.DOC | 20 large project reports, ******* identifies the PG&E Control Number for the analyzed site |
| SMALL LIGHTING REPORT.DOC | Report summarizing project-specific analysis for smaller indoor lighting projects |
| PROCSITES\REPORTS | Subdirectory of Process site reports |
| R*******.DOC | 21 project reports; ******* identifies the PG&E Control Number for the analyzed site |
| PROCSITES\SPREADSHEETS | Subdirectory of Process site spreadsheets |
| *******.XLS | 21 project spreadsheets; ******* identifies the PG&E Control Number for the analyzed site |
| SASDATA | Subdirectory of SAS datasets |
| EVALSURV.SD2 | Evaluation survey data from Survey DBF files |
| INDBILLS.SD2 | Industrial billing data |
| LETTER.SD2 | Data used to develop the customer recruitment letter |
| LITEVAL.SD2 | Lighting analysis results from LTG_ALL.DBF, at the project and measure level |
| LITITEM.SD2 | Lighting analysis results from LTG_ALL.DBF, at the project, measure, and location level |
| LITSAMP.SD2 | Indoor Lighting sample data |

**Table E-2**
**Electronic Files**

| DATASET | DESCRIPTION |
|---|---|
| MULTCON.SD2 | Listing of projects with common custome contacts - for recruiting and scheduling |
| NTGR.SD2 | Net-to-gross results |
| PROCSAMP.SD2 | Process sample data |
| RETENT95.SD2 | Data for the 1995 Retention surveys, conducted at the same time as the eval surveys |
| TRACK97.SD2 | Evaluation tracking dataset from TRACKING DBF files |
| T_APP1.SD2 | Data for survey setup - application level - large projects and oil projects |
| T_APP2.SD2 | Data for survey setup - application level - smaller projects |
| T_ITEM1.SD2 | Data for survey setup - item/measure level - large projects and oil projects |
| T_ITEM2.SD2 | Data for survey setup - item/measure level - smaller projects |
| T_SITE1.SD2 | Data for survey setup - site level - large projects and oil projects |
| T_SITE2.SD2 | Data for survey setup - site level - smaller projects |
| VERREPE.SD2 | Data for verification reports |
| SASPGM | Subdirectory of SAS datasets |
| LIT4REPS.SAS | Summarizes lighting analysis data for Final Report and Small Indoor Lighting Report |
| LITSUM.SAS | Summarizes and analyzes lighting results data for Final Report |
| NTGR.SAS | Calculates net-to-gross ratios from survey data |
| PROCSUM.SAS | Summarizes and analyzes process results data for Final Report |
| RDLIT.SAS | Reads lighting analysis data (LTG_ALL.DBF) into SAS |
| RDSURV.SAS | Reads survey data (Survey DBFs) into SAS |
| RDTRAK.SAS | Reads tracking data (Tracking DBFs) into SAS |
| SAMPLE.SAS | Analyzes tracking data to create sample ensuring 70% impacts are addressed |
| TOEXCEL.SAS | Combines 97 tracking and 95 retention data and sets up output for survey data (T_***.SD2's) |
| VERREPE.SAS | Reads survey and tracking data and writes out verification report data |
| FINAL DATA | Subdirectory containing the final evaluation datasets |
| FNLDATA.SD2 | SAS dataset |
| FNLDATA.XLS | Excel dataset |

## E.3 DESCRIPTION OF EVALUATION DATASET VARIABLES

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

**Table E-3**
**Final Evaluation Dataset Variables**

| DATA TYPE | VARIABLE NAME | DESCRIPTION |
|---|---|---|
| IDENTIFICATION | CNTL | PG&E CONTROL NUMBER |
| | CODE | REBATE APPLICATION NUMBER |
| | EU | END USE TYPE |
| | EVALSTAT | EVALUATION STATUS - EVAL, VERIFY, NOT STUDIED |
| | ORDER | STUDY ORDER ASSIGMENT |
| | P_MEASUR | MEASURE CODE |
| | STRATA | EVAL97 EU STRATA |
| | STUDY | STUDY GROUP |
| TRACKING | ACCT | PG&E ACCOUNT NUMBER |
| | CHECKNO | REBATE CHECK NUMBER |
| | CHKCITY | REBATE CHECK CITY |
| | CHKIS_DT | REBATE CHECK ISSUE DATE |
| | CHKST | REBATE CHECK STATE |
| | CHKSTRT | REBATE CHECK STREET |
| | CHKZIP | REBATE CHECK ZIP CODE |
| | CONNAME | CUSTOMER CONTACT |
| | CONPHONE | CUST CONTACT PHONE |
| | CORPID | CORPORATE ID CODE |
| | CUSTNAME | CUSTOMER NAME - BILL SYS |
| | DIVISION | PG&E DIVISION CODE |
| | FEDTAXID | FEDERAL TAX ID |
| | KWH | ANNUAL KWH USAGE |
| | MEASDESC | MEASURE DESCRIPTION |
| | MGROUP | LIGHTING MEASURE GROUP |
| | NETKW | EX ANTE NET KW IMPACTS |
| | NETKWH | EX ANTE NET KWH IMPACTS |
| | NETTHM | EX ANTE NET THERM IMPACTS |
| | P_AVOID | AVOIDED COST |
| | P_EUCODE | END USE CODE |
| | P_ICOST | INCREMENTAL COST |
| | P_KW | EX ANTE GROSS KW SAVINGS |
| | P_KWH | EX ANTE GROSS KWH SAVINGS |
| | P_NTG | NET-TO-GROSS RATIO |
| | P_NUMPUR | NUMBER PURCHASED |
| | P_PCOST | PROJECT COST |
| | P_PLIFE | PROJECT LIFE (YEARS) |
| | P_REBATE | REBATE AMOUNT |
| | P_SHARE | SHAREHOLDER INCENTIVE |
| | P_THM | EX ANTE GROSS THM SAVINGS |
| | P_TRC | TRC RATIO |
| | PAYABLE | REBATE CHECK PAYABLE TO |
| | PCOMP_DT | PROJECT_COMPLETION_DATE |
| | POSTF_DT | POSTFIELD DATE |
| | PREF_DT | PREFIELD DATE |
| | PREMID | PREMISE ID CODE |
| | PRJDESC | PROJECT DESCRIPTION |
| | PRJDESC2 | PROJECT DESCRIPTION 2 |
| | PROGCODE | PROGRAM CODE |
| | PROGYR | PROGRAM YEAR |

**Table E-3**
**Final Evaluation Dataset Variables**

| DATA TYPE | VARIABLE NAME | DESCRIPTION |
|---|---|---|
| **TRACKING (cont.)** | REPLANID | PG&E REP EMAIL ID |
| | REPNAME | PG&E REP NAME |
| | REPPHONE | PG&E REP PHONE |
| | SERADD | SERVICE ADDRESS - BILL SYS |
| | SERCITY | SERVICE CITY |
| | SERZIP | SERVICE ADDR ZIP CODE |
| | SIC2 | SIC2 |
| | SQFT | SQUARE FOOTAGE |
| | THM | ANNUAL THM USAGE |
| **SURVEY** | AREAAF | AREA SQFT AFFECTED BY LIGHTING |
| | BASECS | BASECASE FIXTURE CODE |
| | C1 | STD NTG SURVEY QUESTION 1 |
| | C10 | STD NTG SURVEY QUESTION 10 |
| | C10YRLAT | STD NTG SURVEY QUESTION 11 |
| | C2 | STD NTG SURVEY QUESTION 2 |
| | C3 | STD NTG SURVEY QUESTION 3 |
| | C4 | STD NTG SURVEY QUESTION 4 |
| | C5 | STD NTG SURVEY QUESTION 5 |
| | C6 | STD NTG SURVEY QUESTION 6 |
| | C7 | STD NTG SURVEY QUESTION 7 |
| | C8 | STD NTG SURVEY QUESTION 8 |
| | C9 | STD NTG SURVEY QUESTION 9 |
| | CONDIT | PERCENT OF AREAAF WITH HVAC |
| | COOLTYPE | COOLING SYSTEM TYPE |
| | CUSTEQP | CUSTOMER EQUIPMENT DESCRIPTOR |
| | DISCREP | DISCREP |
| | DIVISION | DIVISION |
| | EQPDUTY | EQUIPMENT USAGE DUTY |
| | EQPMFR | EQUIPMENT MANUFACTURER |
| | EQPPOWER | EQUIPMENT NAMPLATE POWER |
| | EQPSIZE | SIZE OF PROCESS EQUIPMENT |
| | EXPECT | NUMBER EXPECTED |
| | FIXCD | LIGHTING FIXTURE CODE |
| | FIXCNTL | LIGHTING CONTROL CODE |
| | HEATTYPE | HEATING SYSTEM TYPE |
| | INST_DT | MEASURE INSTALL DATE (PER CUSTOMER) |
| | LAMPFIXT | LAMPS PER FIXTURE |
| | MODELNUM | EQUIPMENT MODEL NUMBER |
| | OBSERV | NUMBER OBSERVED |
| | OPERATE | NUMBER OPERATING |
| | PRJNOTES | PROJECT NOTES |
| | REM_DT | MEASURE REMOVE DATE |
| | REMOVE | REMOVAL CODE |
| | SURVDATE | SURVEY DATE |
| | SURVEYOR | SURVEYOR |
| | WORKING | PERCENT OF LAMPS WORKING |
| **ANALYSIS** | CNTGR | CUSTOM NET-TO-GROSS RATIO |
| | NEGTHMP | LIGHTING/HVAC INTERACTION - THM |
| | NPSTKW | NET KW SAVINGS - EX POST |
| | NPSTKWH | NET KWH SAVINGS - EX POST |

**Table E-3**
**Final Evaluation Dataset Variables**

| DATA TYPE | VARIABLE NAME | DESCRIPTION |
|---|---|---|
| **ANALYSIS (cont.)** | NPSTTHM | NET THM SAVINGS - EX POST |
| | NTGR | COMBINED NET-TO-GROSS RATIO' |
| | PKWHSAV | LIGHTING/HVAC INTERACTION - KWH |
| | PKWSAV | LIGHTING/HVAC INTERACTION - KW |
| | PSTANKWH | GROSS ANNUAL KWH SAVINGS - EX POST |
| | PSTANTHM | GROSS ANNUAL THM SAVINGS - EX POST |
| | PSTDIVER | COINCIDENT DIVERSITY FACTOR |
| | PSTNOCKW | CHANGE IN CONNECTED LOAD PER UNIT |
| | PSTOPHRS | OPERATING HOURS |
| | PSTPKKW | GROSS PEAK KW SAVINGS - EX POST |
| | PSTUNITS | NUMBER OF LIGHTING UNITS IN PLACE |
| | RRGKW | GROSS REALIZ RATE KWH |
| | RRGKWH | GROSS REALIZ RATE KWH |
| | RRGTHM | GROSS REALIZ RATE KWH |
| | RRNKW | NET REALIZ RATE KWH |
| | RRNKWH | NET REALIZ RATE KWH |
| | RRNTHM | NET REALIZ RATE KWH |
| | SNTGR | STANDARD NET-TO-GROSS RATIO |
| | SOFF_HV1 | SUMMER OFF-PEAK AVG KW SAVINGS |
| | SOFF_HV2 | SUMMER OFF-PEAK PEAK KW SAVINGS |
| | SOFF_HV4 | SUMMER OFF-PEAK KWH SAVINGS |
| | SOP_HV1 | SUMMER ON-PEAK AVG KW SAVINGS |
| | SOP_HV2 | SUMMER ON-PEAK PEAK KW SAVINGS |
| | SOP_HV4 | SUMMER ON-PEAK KWH SAVINGS |
| | SPP_HV1 | SUMMER PARTIAL-PEAK AVG KW SAVINGS |
| | SPP_HV2 | SUMMER PARTIAL-PEAK PEAK KW SAVINGS |
| | SPP_HV4 | SUMMER PARTIAL-PEAK KWH SAVINGS |
| | WOFF_HV1 | WINTER OFF-PEAK AVG KW SAVINGS |
| | WOFF_HV2 | WINTER OFF-PEAK PEAK KW SAVINGS |
| | WOFF_HV4 | WINTER OFF-PEAK KWH SAVINGS |
| | WPP_HV1 | WINTER PARTIAL-PEAK AVG KW SAVINGS |
| | WPP_HV2 | WINTER PARTIAL-PEAK PEAK KW SAVINGS |
| | WPP_HV4 | WINTER PARTIAL-PEAK KWH SAVINGS |