Customer Energy Efficiency Program
Measurement and Evaluation Program

IMPACT EVALUATION OF PACIFIC GAS & ELECTRIC COMPANY'S 1996 RESIDENTIAL APPLIANCE EFFICIENCY INCENTIVES PROGRAMS

PG&E Study ID numbers:
372: Lighting; 373-1: Refrigerators

March 1, 1998

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

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

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IMPACT EVALUATION OF PACIFIC GAS & ELECTRIC COMPANY'S 1996 RESIDENTIAL APPLIANCE EFFICIENCY INCENTIVES PROGRAMS

PG&E Study ID Numbers:

372: High Efficiency Lighting

373-1: High Efficiency Refrigeration

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 measured the gross and net energy savings from high efficiency lighting and high efficiency refrigeration measures for which rebates were paid in 1996 by Pacific Gas and Electric Company's Residential Appliance Efficiency Incentives Programs. Rebates were provided through (1) the Efficient Refrigerator Rebate Program (Efficient Refrigerator Rebate and Salesperson /Dealer Incentive components); and, (2) the Multifamily Property Direct Incentive Program (for lighting measures).

Methodology

Gross refrigeration savings for each refrigerator in the PG&E Program tracking database were developed by subtracting the model's annual energy consumption from the annual energy consumption standard for a model of the same size and attributes. Both annual consumption and federal standards were corroborated through the model numbers by comparing the tracking system databases with the data contained in the California Energy Commission's (CEC's) Directory of Certified Refrigerators and Freezers.

Net savings for refrigerators were calculated by multiplying a California residential refrigeration net-to-gross ratio to the gross savings. The net-to-gross ratio was developed for PG&E under a separate study called the *Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Study Net-to-Gross Analysis (PG&E Study ID #373-2 and SDG&E Study ID #980).* This statewide report is included as Appendix B.

Gross savings for lighting measures were obtained by multiplying the number of observed fixtures times the kW savings per fixture times the annual hours each fixture is operated. Peak demand savings were determined by multiplying kW savings for all fixtures times the percent of fixtures that were reported to be on at the time on the system peak, a summer weekday afternoon. All operating and fixture confirmation data were collected via on-site surveys. Net-

to-gross ratios, developed using a customer self-report method, were applied to gross savings in order to develop net impact estimates.

Study Results

The results of the evaluation are summarized in the following tables.

Summary of First Year Load Impact Results
Appliance Efficiency Rebate Funded Refrigerators

	Gross Savings	Gross Realization Rate	Net-to-Gross Components[1] 1-FR	SO	Net-to-Gross Ratio[1]	Net Savings	Net Realization Rate
EX ANTE							
kW	521		1.00		1.00	521	
kWh	2,911,175		1.00		1.00	2,911,175	
EX POST							
kW	661	1.27	0.76	0.54	1.30	859	1.65
kWh	4,320,624	1.48	0.76	0.54	1.30	5,616,810	1.93

1 Evaluation source: Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Analysis (PG&E Study ID #373-2).

Summary of First Year Load Impact Results
High Efficiency Lighting

	Gross Savings	Gross Realization Rate	Net-to-Gross Ratio 1-FR	SO	Net Savings	Net Realization Rate
EX ANTE						
kW	151.1		0.94	-	142.1	
kWh	1,420,151		0.94	-	1,334,942	
EX POST						
kW	101.9	0.67	0.50	-	51.4	0.36
kWh	1,348,115	0.95	0.45	-	605,005	0.45

Regulatory Waivers and Filing Variances

No regulatory waivers filed.
There were no E-Table variances.

FIRST YEAR LOAD IMPACT EVALUATION OF PACIFIC GAS AND ELECTRIC COMPANY'S 1996 RESIDENTIAL APPLIANCE EFFICIENCY INCENTIVES PROGRAM

HIGH EFFICIENCY LIGHTING: PG&E STUDY ID #372
HIGH EFFICIENCY REFRIGERATION: PG&E STUDY ID #371-1

Prepared for

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San Francisco, California

Prepared by

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Oakland, California

March 1, 1998

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1 EXECUTIVE SUMMARY

This report presents results of the First Year Load Impact Evaluation of Pacific Gas & Electric Company's 1996 Residential Appliance Efficiency Incentives Programs, and addresses the refrigeration and lighting end uses. For the project, both gross and net impact estimates were developed for energy consumption (kWh) and electric demand (kW).

1.1 PROGRAM DESCRIPTION

The 1996 Appliance Efficiency Programs focused on two end uses, refrigeration and lighting.

Refrigeration

Two PG&E refrigerator programs were available in 1996:

- the Efficient Refrigerator Rebate Program, and
- the Refrigerator Salesperson/Dealer Incentive Program.

The costs for these programs were split between Residential Appliance Efficiency Incentives and Market Transformation funds, and benefits are divided proportionately between the two categories (51.2% Appliance Efficiency Incentives and 48.8 % Market Transformation). Information shown in this section is scaled to show accomplishments apportioned to the Residential Appliance Efficiency Incentives Program.

The PG&E programs were designed to encourage refrigerator purchasers to save energy by buying new, high efficiency refrigerators. The programs provided incentives for the purchase of refrigerators that consumed less energy than is allowable under 1993 Federal Appliance Standards. The amount of incentive offered depended on the rate of energy consumption of the refrigerator relative to the federal energy consumption standard for the refrigerator.

The 1996 Efficient Refrigerator Rebate Program offered residential customers rebates of $40, $60, or $80 when they purchased a new energy efficient refrigerator that was, respectively, 20, 25, or 30 percent or more efficient than the Federal Appliance Standard.

The Refrigerator Salesperson/Dealer Incentive Program incented appliance salespeople/dealers to stock and sell high-efficient refrigerators and encouraged salespeople to sell these refrigerators from October 1 through November 24, outside of the Efficient Refrigerator Rebate Program time period.

Lighting

In 1996, Multifamily Property Direct Incentive Program was the source of all lighting rebates evaluated in this study. The Multifamily Property Direct Incentive Program was not offered in

1996; net energy impacts during 1996 were from carry-over applications from 1995 which were paid in 1996.

1.2 EVALUATION APPROACH

1.2.1 Gross Impacts

Both refrigeration and lighting gross impacts were developed using an engineering approach.

Gross refrigeration savings for each refrigerator in the PG&E Program tracking database were developed by subtracting the model's annual energy consumption from the annual energy consumption standard for a model of the same size and attributes. Both annual consumption and federal standards were corroborated through the model numbers by comparing the tracking system databases with the data contained in the California Energy Commission's (CEC's) Directory of Certified Refrigerators and Freezers.

Gross savings for lighting measures were obtained by multiplying the number of observed fixtures times the kW savings per fixture times the annual hours each fixture is operated. Peak demand savings were determined by multiplying kW savings for all fixtures times the percent of fixtures that were reported to be on at the time on the system peak, a summer weekday afternoon. All operating and fixture confirmation data were collected via on-site surveys.

1.2.2 Net Impacts

Net savings for refrigerators were calculated by multiplying a California residential refrigeration net-to-gross ratio to the gross savings. The net-to-gross ratio was developed for PG&E under a separate study called the *Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Study Net-to-Gross Analysis (PG&E Study ID #373-2 and SDG&E Study ID #980).* This statewide report is included as Appendix B.

For lighting, net-to-gross ratios, developed using a customer self-report method, were applied to gross savings in order to develop net impact estimates.

1.3 RESULTS

1.3.1 Refrigeration

Table 1-1 summarizes impacts for the refrigerator rebate programs. Evaluation gross impacts exceed the initial PG&E assumptions. Differences can be accounted for by examining the planning assumptions in conjunction with evaluation findings and methodology:

- PG&E based the ex-ante calculations on an assumed average size refrigerator of 19 cubic feet. The actual program median size refrigerator was closer to 21 cubic feet. In addition, savings appears correlated with size, on a percentages as well as absolute basis, and the larger refrigerators had greatest savings.

- For planning purposes, PG&E discounted the assumed savings 13 percent below federal standards; yet, federal standards were used as the basis for this evaluation.
- PG&E based the ex-ante savings calculation on the lowest level in a savings category. The evaluation found program savings slightly higher than the minimum in each savings category. Most significant were the savings in the 30 percent and greater category where the average savings were found to be about 37 percent.
- The net realization rate for energy is almost 2 due to the combination of the gross realization rate and net-to-gross ratio that includes spillover estimates.

Table 1-1
Summary of First Year Load Impact Results
Appliance Efficiency Rebate Funded Refrigerators

	Gross Savings	Gross Realization Rate	Net-to-Gross Components[1]		Net-to-Gross[1] Ratio	Net Savings	Net Realization Rate
			1-FR	SO			
EX ANTE							
kW	521		1.00		1.00	521	
kWh	2,911,175		1.00		1.00	2,911,175	
EX POST							
kW	661	1.27	0.76	0.54	1.30	859	1.65
kWh	4,320,624	1.48	0.76	0.54	1.30	5,616,810	1.93

1 Evaluation source: Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Analysis (PG&E Study ID #373-2).

1.3.2 Lighting

Lighting impacts are summarized in Table 1-2. Gross energy impacts from the evaluation are similar to PG&E's ex ante estimates, but gross demand (kW) impacts are lower, reflecting the smaller fraction of multifamily common area lights that are estimated to be on during summer weekday afternoons. Many of the rebated lighting fixtures are located outside and are used primarily at night.

Evaluation net-to-gross ratios are also lower than PG&E's ex ante net-to-gross ratios, driving down the net realization rate. The rebated measures appear to be associated with a mature market in which customers' are willing to purchase high efficiency equipment on its own merit without a rebate. The result is that evaluation net savings estimates are less than half of the PG&E net savings estimates.

It is clear that the existence of PG&E lighting efficiency programs over the past decade could have had significantly impact on the transformation of the lighting efficiency markets. However, this evaluation did not address market transformation impacts, and the narrow focus of the net-to-gross analysis may contribute to the low estimates of net-to-gross ratios.

Table 1-2
Summary of First Year Load Impact Results
High Efficiency Lighting

	Gross Savings	Gross Realization Rate	Net-to-Gross Ratio		Net Savings	Net Realization Rate
			1-FR	SO		
EX ANTE						
kW	151.1		0.94	-	142.1	
kWh	1,420,151		0.94	-	1,334,942	
EX POST						
kW	101.9	0.67	0.50	-	51.4	0.36
kWh	1,348,115	0.95	0.45	-	605,005	0.45

2 RESIDENTIAL REFRIGERATION

2.1 OVERVIEW

This section presents results of the Pacific Gas & Electric's 1996 Efficient Refrigerator Programs. Results are shown for the following PG&E programs:

- Efficient Refrigerator Rebate Program (Rebate), and
- Refrigerator Salesperson/Dealer Incentive Program (SPIFF).

The costs for these programs were split between Residential Appliance Efficiency Incentives and Market Transformation funds, and benefits are divided proportionately between the two categories (51.2% Appliance Efficiency Incentives and 48.8 % Market Transformation). With the exception of Section 2.11, Table 2-1, and Table 2-12, discussion in this Chapter addresses the Program overall. Information shown in Tables 2-1 and 2-12 of this chapter and in the corresponding M&E Protocol Table 6, Appendix C, is scaled to show accomplishments apportioned to the Residential Appliance Efficiency Incentives Program.

2.2 PROGRAM DESCRIPTIONS

PG&E describes its residential refrigeration programs as follows:[1]

Residential Appliance Efficiency

EFFICIENT REFRIGERATOR REBATE PROGRAM

The 1996 program offered residential customers rebates of $40, $60, or $80 when they purchased a new energy efficient refrigerator that was 20, 25, or 30 percent or more efficient than the Federal Appliance Standard. In addition, all units were required to be CFC-free. The 1996 goal was 30,850 units. This program was funded between Residential Appliance Efficiency and Market Transformation programs. Benefits are divided proportionately between the two categories.

Salesperson/Dealer Incentive

This program also incented appliance salespeople/dealers to stock and sell high-efficient refrigerators and encouraged salespeople to sell these refrigerators from October 1 through November 24, outside of the efficient rebate program time period. Manufacturers informed PG&E that retailers often discontinue stocking efficient models during the non-rebate program months. Incentives to the salesperson and dealer for the 1996 program were as follows: 20 percent $10/$3, 25 percent $15/$5, and 30 percent $20/$8 where the incentives are paid to the salesperson and dealer, respectively.

Implementation Strategy

This program was implemented by working closely with the appliance manufacturers and retailers. Our efforts with the appliance industry maximized the number of qualifying models manufactured

[1] Pacific Gas and Electric Company: Annual Summary Report on Demand Side Management Programs in 1996 and 1997, April 1997, Section, Refrig: II/Res 3-4

and shipped to our service territory. Point-of-purchase materials, brochures, and applications were delivered directly to appliance retailers for promotion on the sales floor. Brochures, bill inserts, and an article in *Spotlight*, the PG&E bill insert newsletter, were used to promote the program directly to consumers.

Target Market

PG&E residential electric customers and appliance manufacturers and retailers.

1996 PROGRAM ACCOMPLISHMENTS

A total of 29,984 refrigerators were purchased in the Efficient Refrigerator Rebate program. This represents 12,458 units in the 20 percent category, 9,484 units in the 25 percent category, and 8,042 units in the 30 percent category.

In addition, the total participation in the 1996 salesperson/dealer incentive program was 7,228 units. This represents 2,801 units in the 20 percent category, 2,255 units in the 25 percent category, and 2,172 units in the 30 percent category as well as 200 kW and 1,115,300 kWh.

Net Energy Impacts (First Year)

	App. Eff.	Mkt. Trans.	Total
kW	521	497	1,018
kWh	2,911,420	2,774,469	5,685,889
therms	N/A	N/A	N/A

Expenditures

	Authorized	Budget	Actual
Appliance Efficiency-Rebate	$1,024,000	$1,024,000	$1,222,156
Market Transformation	$976,000	$976,000	$1,164,898
	$2,000,000	$2,000,000	$2,387,054

2.3 SUMMARY OF RESULTS

Table 2-1 summarizes the savings estimated by the evaluation for Appliance Efficiency Rebate funded refrigerators. The refrigerator programs save almost six million kilowatt hours per year and almost nine hundred kilowatts.

Table 2-1
Summary of Impact Estimates: Appliance Efficiency Rebate Funded Refrigerators[2]

	Gross Savings	Gross Realization Rate	Net-to-Gross Components[3]		Net-to-Gross Ratio	Net Savings	Net Realization Rate
			1-FR	SO			
EX ANTE[4]							
kW	521		1.00		1.00	521	
kWh	2,911,175		1.00		1.00	2,911,175	
EX POST							
kW	661	1.27	0.76	0.54	1.30	859	1.65
kWh	4,320,624	1.48	0.76	0.54	1.30	5,616,810	1.93

2.4 EVALUATION METHODOLOGY

This section discusses the methodology used to evaluate PG&E's 1996 residential high efficiency refrigerator programs. The method used to calculate savings is consistent with the CADMAC *Protocols and Procedures for the Verification of Costs, Benefits and Shareholder Earnings for Demand-Side Management Programs* (Protocols) for residential refrigeration. Net savings were calculated by applying a net-to-gross ratio to gross savings. The net-to-gross ratio calculation method is documented in the *Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Study Net-to-Gross Analysis*, which is included as Appendix B.

2.4.1 Gross Impacts

Gross impact estimates were calculated using an engineering approach. This approach was validated by the CPUC and is consistent the California Protocols Table C-3B for residential high efficiency refrigeration impact studies. Savings were based on data contained in PG&E's 1996

[2] The costs for this program were split between Residential Appliance Efficiency Incentives and Market Transformation funds, and benefits are divided proportionately between the two categories (51.2% Appliance Efficiency Incentives and 48.8% Market Transformation). Information shown in this table is scaled to represent accomplishments apportioned to the Residential Appliance Efficiency Incentives Program.

[3] See Appendix B for a copy of the net to gross report.

[4] Source: PG&E planning document.

Refrigerator Rebate Programs tracking system.[5] These PG&E databases contained the make and model number of refrigerators rebated in conjunction with the program. Participant records that did not contain the refrigerator make and model number were considered unconfirmed observations and were consequently dropped from the analysis. Unconfirmed refrigerators were not included in the gross savings estimate.

Gross Energy Savings

The energy savings were calculated for each refrigerator by subtracting the model's annual energy consumption from the annual energy consumption standard for a model of the same size and attributes. Both annual consumption and federal standards were confirmed through the model numbers by comparing the tracking system databases with the data contained in the California Energy Commission's (CEC) Directory of Certified Refrigerators and Freezers.[6] The American Home Appliance Manufacture's (AHAM) database was used as a backup source for consumption and standards information when program refrigerator model numbers were not listed in the CEC Directory. The total energy savings was calculated by summing the annual energy savings for all confirmed rebated refrigerators.

The equation used to calculate the gross energy is as follows:

$$GEI = \sum_{i}^{nr} \left(kWhStd_i - kWhRtd_i \right)$$

where:

GEI	= Gross Energy Impact
$kWh\ Std_i$	= the rated kWh per year consumption of units just meeting the Federal DOE standards, computed by using the attribute characteristics and adjusted volume of the rebated unit
$kWh\ Rtd_i$	= the rated kWh per year consumption of rebated unit
i	= for rebated unit I
nr	= the total number of rebated units

Gross Load Impacts

The gross load impact for each refrigerator was calculated by applying a normalized refrigerator load factor applicable to the peak load hour to the average refrigerator load. The average load was calculated by dividing the gross energy impacts by 8,760 hour per year.

The equation used to calculate the gross load impact is as follows:

[5] Database dated August 6,1997.

[6] Dated November 30,1997.

$$GLI = GEI * \frac{NRL}{8760 hr / yr}$$

where:

GLI = Gross Load Impact
NRL = Normalized Refrigerator Load, which is a factor relating the load at a given time to the average annual load = 1.34[7]

2.4.2 Net Impacts

Net impacts were calculated by multiplying a net-to-gross ratio to the gross savings. The net-to-gross ratio was developed under a separate study called *Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Study Net-to-Gross Analysis*, which is included as Appendix B.

The net-to-gross ratio incorporates the calculation of spillover effects and free ridership.

The equation used to calculate the net savings is as follows:

$$NS = GS * NTG$$

where:

NS = Net Savings (kW or kWh)
GS = Gross Savings (kW or kWh)
NTG = Net-To-Gross Ratio = 1.3

2.5 GROSS ENERGY SAVINGS

All energy savings are presented on a first year annual energy savings basis. In Table 2-2, total annual energy consumption data are presented for PG&E's efficient new refrigerator incentive programs.

Table 2-2
Annual Energy Consumption for the PG&E 1996 Efficient Refrigerator Programs

Program	Number of Refrigerators	Base Usage (from Standards) (kWh/year)	Program Refrigerator Usage (kWh/year)	Gross Energy Savings (kWh/year)
Rebate	29,988	24,457,778	17,728,149	6,729,629
SPIFF	7,236	6,076,760	4,367,671	1,709,089
Combined	37,224	30,534,538	22,095,820	8,438,718

[7] Source: Analysis of SCE and PG&E Refrigerator Load Data AAG & Associates, Inc, prepared for the California DSM Measurement Advisory Committee, April 5,1995.

The data show that over 37,000 high efficiency refrigerators were purchased as part of PG&E's programs. The combined gross savings from the two programs was approximately 8.4 million kilowatt-hours per year.

Table 2-3 provides average per-unit savings for three PG&E 1996 efficient refrigerator programs. These data show that the average high efficiency refrigerator purchased through one of the PG&E's programs saved 227 kilowatt-hours per year. The refrigerator consumes about 28 percent less energy than a comparable model that simply complies with federal appliance efficiency standards.

Table 2-3
Average Savings for the PG&E 1996 Efficient Refrigerator Programs

Program	Average per-unit Energy Consumption Standards for Program Refrigerators (kWh/year)	Average per-unit Energy Consumption for Program Refrigerators (kWh/year)	Average Annual per-unit Gross Energy Savings (kWh/year)	Average per-unit Percentage Savings
Rebate	816	591	224	27.5%
SPIFF	840	604	236	28.1%
Combined	820	594	227	27.7%

2.5.1 Distribution of Gross Savings by Energy Efficiency Level

Table 2-4 shows the distribution of energy savings by the percentage of energy that was saved. The results present results of the two programs combined. The table reveals a slight decrease in the number of units as efficiency increases with the range being about 15,000 program refrigerators that saved 20 percent decreasing to about 10,000 program refrigerators saved about 30 percent or better. This table also illustrates that the program refrigerators that saved more than 30 percent, were units for which the base case federal consumption standards were higher. Base case standards for units that saved more than 30 percent were, on average, about 200 kilowatts per year greater than standards for those units that saved 25 percent and 300 kilowatts per year greater than the standards for those units that saved 20 percent.

Table 2-4
Distribution of Combined Programs' Refrigerator Savings by the Percentage of Energy Savings

Refrigerator Category	Number of Units	Average per-unit Energy Consumption Standards for Program Refrigerators (kWh/year)	Average per-unit Energy Consumption for Program Refrigerator (kWh/year)	Average Annual per-unit Energy Savings (kWh/year)	Total Annual Energy Savings (kWh/year)
Units that save 20%	15,263	712	567	145	2,208,639
Units that save 25%	11,745	793	590	202	2,377,908
Units that save 30%	10,216	1014	636	377	3,852,171

Figure 2-1 illustrates that forty-one percent of the units purchased consumed 20 percent less than that allotted by federal appliance standards and thirty-two percent of the units sold saved 25 percent beyond standards. Twenty-seven percent of the program refrigerators saved at least 30 percent beyond the standards.

Figure 2-1
Distribution of the Number of Combined Program Refrigerators by Savings Percentage

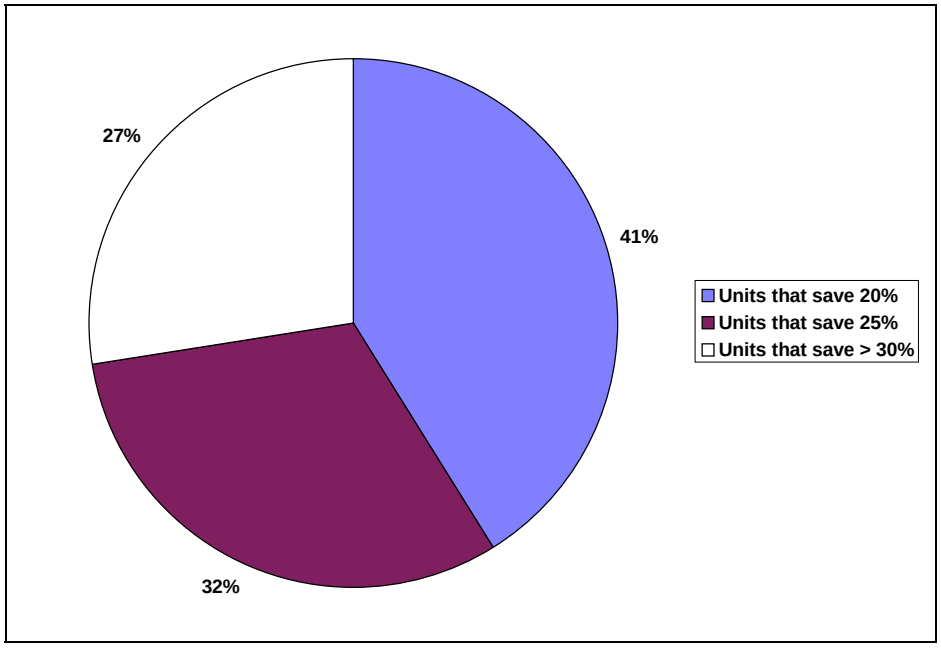
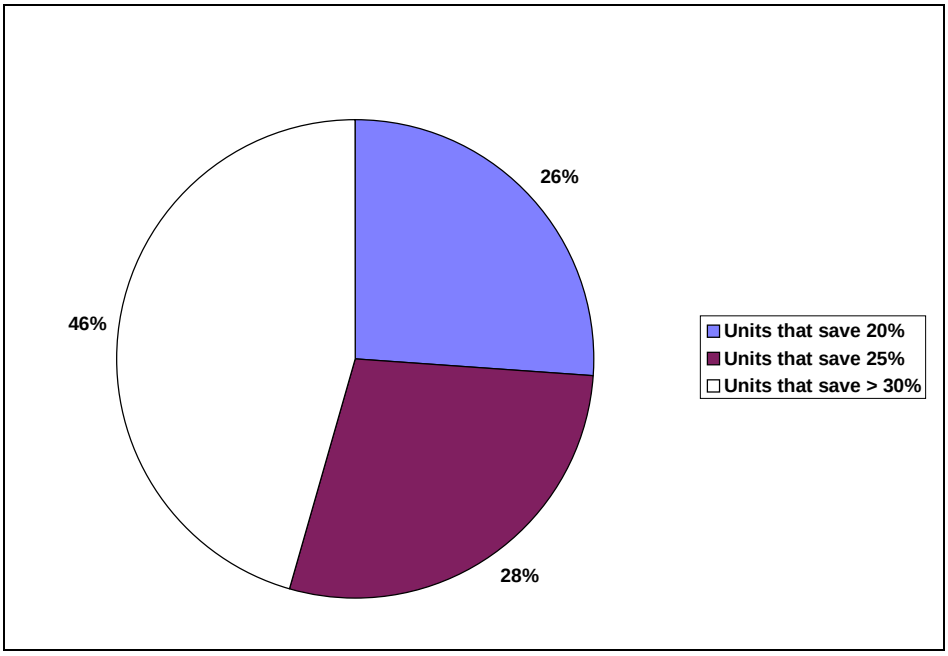


Figure 2-2 illustrates that forty-six percent of the energy savings were realized by units that saved 30 percent and that twenty-eight percent of the savings were realized by the units that saved 55 percent beyond federal standards. Twenty-six percent of energy savings were realized by the forty-one percent of the refrigerators that saved at least 20 percent beyond the federal standards.

Figure 2-2
Distribution of Energy Savings by Savings Percentage



2.5.2 Distribution of Gross Energy Savings by Refrigerator Size Category

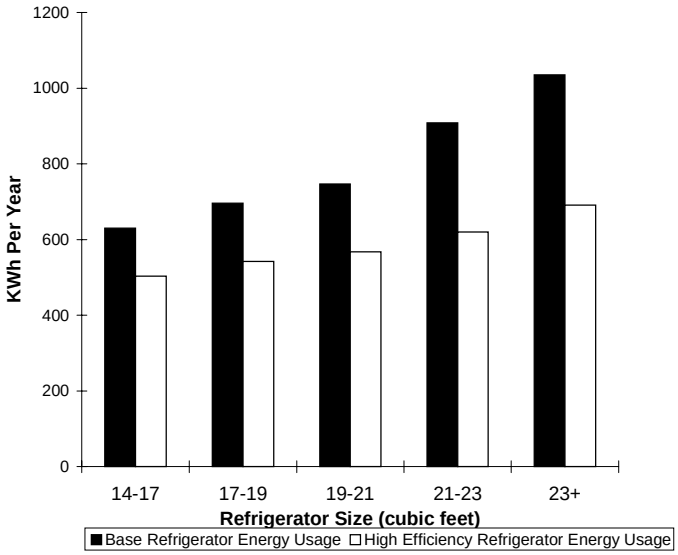
Table 2-5 provides a disaggregation of the combined programs' energy savings by refrigerator size. As would be expected, the average base case energy consumption increased as size increased, and correspondingly, the average energy savings generally increased as size increased. It is interesting to note that the greatest percent savings also occurs in the largest units and the smallest percent savings occurs in the smallest units.

Table 2-5
Distribution of Combined Programs' Refrigerator Savings by Refrigerator Size

Refrigerator Size (cubic feet)	Number of Units	Average per-unit Energy Consumption Standards for Program Refrigerators (kWh/year)	Average per-unit Energy Consumption for Program Refrigerators (kWh/year)	Average Annual per-unit Gross Energy Savings (kWh/year)	Percentage Energy Savings
14 - 17	5,906	630	503	127	20.2%
17 - 19	7,797	696	542	154	22.1%
19 - 21	7,899	747	568	179	24.0%
21 - 23	5,402	908	620	288	31.7%
23+	10,220	1,035	691	344	33.2%

Figure 2-3 graphically depicts an average energy consumption for program refrigerators relative to standard units of the same size.

Figure 2-3
Average Energy Use Comparison for Combined Programs' Refrigerators and Relevant Standards



2.6 GROSS LOAD IMPACTS

Table 2-6 presents total peak demand consumption data for PG&E's 1996 new energy efficient refrigerator programs.

Table 2-6
Total Peak Demand Consumption Data for PG&E's 1996 Efficient Refrigerator Programs

Program	Number of Refrigerators	Standards Base Peak Usage (kW)	Program Refrigerator Peak Usage (kW)	Gross Peak Demand Savings (kW)
Rebate	29,988	3,741	2,712	1,029
SPIFF	7,236	930	668	261
Combined	37,224	4,671	3,380	1,291

The data show that approximately 37,00 high efficiency refrigerators were purchased as part of PG&E's programs. The peak demand savings is an estimated 1,291 kilowatts.

Table 2-7 provides average per-unit demand savings for PG&E programs. These data show that the average high efficiency refrigerator purchased through the programs saved 35 peak watts.

Table 2-7
Peak Demand Savings for PG&E's 1996 Efficient Refrigerator Programs

Program	Average per-unit Standards Based Peak Usage (Watts)	Average per-unit Program Refrigerator Peak Usage (Watts)	Average per-unit Gross Peak Demand Savings (Watts)	Average per-unit Percentage Savings
Rebate	125	90	34	27.5%
SPIFF	128	92	36	28.1%
Combined	125	91	35	27.7%

2.7 NET SAVINGS

Net savings were calculated by applying a net-to-gross ratio of 1.3 to the gross savings[8].

Applying the 1.3 net-to-gross ratio to the gross savings estimates produces the results presented in Table 2-8. These data show that the net energy savings for PG&E's new energy efficient refrigerator programs was about 11 GWh/year and the peak demand savings was 1.7 MW.

Table 2-8
Net Savings for PG&E's 1996 New Refrigerator Programs

PG&E Programs	Number of Refrigerators	Net Energy Savings (kWh/year)	Average per-refrigerator Net Energy Savings (kWh/year)	Net Peak Demand Savings (kW)	Average per-refrigerator Net Peak Demand Savings (Watts)
Rebate	29,988	8,748,518	291	1,338	45
SPIFF	7,236	2,221,816	307	340	47
Combined	37,224	10,970,333	295	1,678	45

2.8 PROGRAM SPECIFIC RESULTS

This subsection provides program specific results disaggregated by refrigerator volume and efficiency level.

2.8.1 Distribution of Gross Energy Savings by Energy Efficiency Level by Program

Table 2-9 shows the distribution of energy saving by percentage of energy that was saved for each program. Most of the refrigerators sold through both programs were the models that saved 20% beyond standards. However, the higher efficiency models saving 25% and 30% beyond

[8] See Appendix B for a copy of the net-to-gross report.

standards also sold well. In both programs, the 25% beyond standards models outsold the 30% beyond standard models by small margins.

Table 2-9
Distribution of Program Refrigerator Savings by the Percentage of Energy Savings

Program	Refrigerator Category	Number of Units	Average per-unit Energy Consumption Standards for Program Refrigerators (kWh/year)	Average per-unit Energy Consumption for Program Refrigerator (kWh/year)	Average Annual per-unit Energy Savings (kWh/year)	Total Annual Energy Savings (kWh/year)
Rebate	Units that save 20%	12,459	708	565	144	8,825,454
Rebate	Units that save 25%	9,486	789	587	201	7,482,071
Rebate	Units that save 30%	8,043	1,013	637	376	8,150,253
SPIFF	Units that save 20%	2,804	728	580	148	2,041,886
SPIFF	Units that save 25%	2,259	811	604	207	1,831,121
SPIFF	Units that save 30%	2,173	1,014	634	380	2,203,753

2.8.2 Distribution of Gross Energy Savings by Refrigerator Size by Program

Table 2-10 shows the distribution of refrigerators as refrigerator volume by program. Again both programs were similar in that the greatest number of units were sold for the largest size. The number of units sold generally increased as size increased with the exception of the 21 - 23 cubic foot size.

For both programs, as size increased so did efficiency with the most efficient refrigerators being 23 cubic feet or greater, saving 33% beyond standards. The lowest efficiency models were the smallest, 14 - 17 cubic feet, which saved 20% beyond standards.

Table 2-10
Distribution of Program Refrigerator Savings by Refrigerator Size

Program	Refrigerator Size (cubic feet)	Number of Units	Average per-unit Energy Consumption Standards for Program Refrigerators (kWh/year)	Average per-unit Energy Consumption for Program Refrigerators (kWh/year)	Average Annual per-unit Gross Energy Savings (kWh/year)	Percentage Energy Savings
Rebate	14 - 17	5,273	630	503	127	20%
Rebate	17 - 19	6,172	696	541	155	22%
Rebate	19 - 21	6,233	745	567	179	24%
Rebate	21 - 23	4,282	908	620	287	32%
Rebate	23+	8,028	1,035	691	344	33%
SPIFF	14 - 17	633	630	504	127	20%
SPIFF	17 - 19	1,625	697	547	150	22%
SPIFF	19 - 21	1,666	751	573	179	24%
SPIFF	21 - 23	1,120	912	620	292	32%
SPIFF	23+	2,192	1,037	690	347	33%

2.9 CROSS PROGRAM ANALYSIS

Both PG&E refrigerator programs were very successful in encouraging refrigerator buyers to purchase higher efficiency units. This section looks at program impacts in an attempt to gain insight that can be applied to future program design.

One must keep in mind that the objective of SPIFF type programs are to ensure that manufactures and distributors continue to make high efficiency refrigerators available during the non “rebate” season. One goal toward meeting the objective would be for the savings from the SPIFF program to reflect the savings achieved in the rebate program. Figure 2-4 clearly illustrates that the goal was met. On a percentage basis, the SPIFF program tended to incent a slightly greater portion of the highest efficiency refrigerators, relative to the rebate program. This in contrast to the 1994 program year when the Rebate program refrigerators tended to be much more efficient than the SPIFF program refrigerators.

Figure 2-4
Percent of Refrigerators Purchased by Efficiency Level by Program

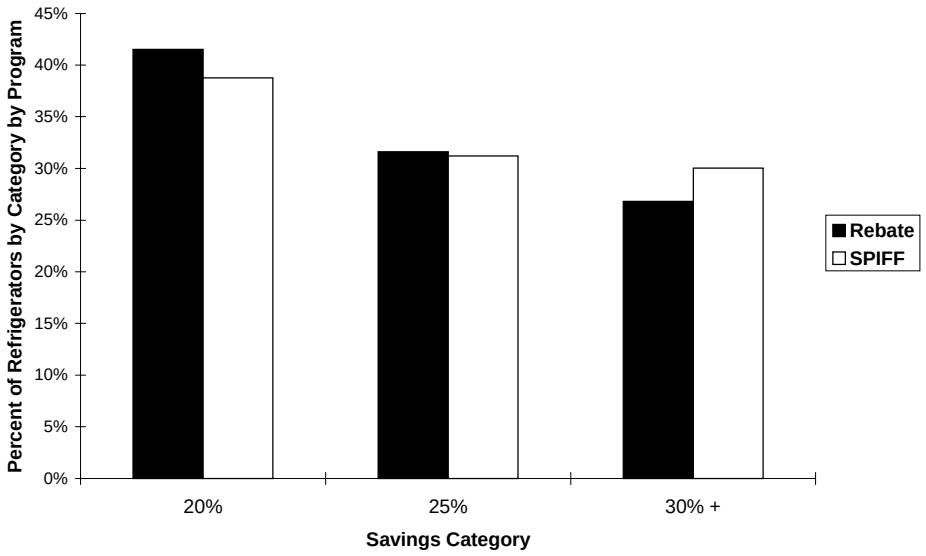
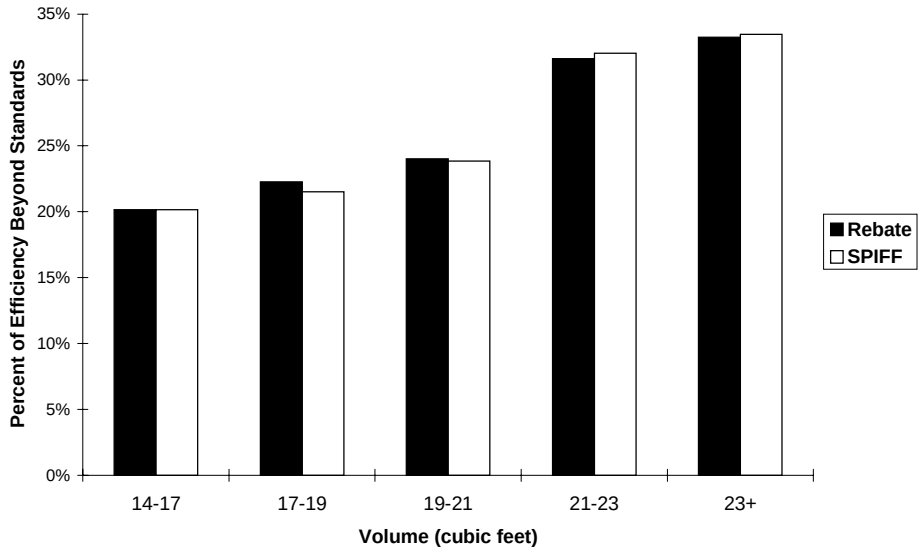


Figure 2-5, confirms the above finding and illustrates that, for each size category, the average energy savings was about the same for both the Rebate and SPIFF program refrigerators.

Figure 2-5
Refrigerator Energy Efficiency by Size by Program



Based on these results, one might conclude that it would be beneficial to shift the efficient refrigerator program emphasis more toward SPIFF type designs which are less expensive to implement. However, the question remains about whether the overall number of high efficiency refrigerators sold would be the same. In PG&E's 1996 program year, the SPIFF program clearly incented fewer refrigerators than the Rebate program, but it also ran for a shorter period of time and in a different season. The data presented here is insufficient to answer the broader programatic question.

2.10 REALIZATION RATE ANALYSIS

As shown in Table 2-11, the ex-post gross energy savings estimate is almost 50% higher than the ex-ante gross energy savings estimate.

Table 2-11
Summary of Impact Estimates (Not Adjusted for Funding Source)

	Gross Savings	Gross Realization Rate	Net-to-Gross Components[9]		Net-to-Gross Ratio	Net Savings	Net Realization Rate
			1-FR	SO			
EX ANTE[10]							
kW	1,018		1.00		1.00	1,018	
kWh	5,685,889		1.00		1.00	5,685,889	
EX POST							
kW	1,291	1.27	0.76	0.54	1.30	1,678	1.65
kWh	8,438,718	1.48	0.76	0.54	1.30	10,970,333	1.93

This difference can be accounted for by examining the planning assumptions in conjunction with evaluation findings and methodology.

- PG&E based the ex-ante calculations on an assumed average size refrigerator of 19 cubic feet. The actual program median size refrigerator was closer to 21 cubic feet. In addition, savings appears correlated with size, on a percentages as well as absolute basis, and the larger refrigerators had greatest savings.
- For planning purposes, PG&E discounted the assumed savings 13 percent below federal standards[11]; yet, federal standards were used as the basis for this evaluation.
- PG&E based the ex-ante savings calculation on the lowest level in a savings category. The evaluation found program savings slightly higher than the minimum in each savings

[9] See Appendix B for a copy of the net to gross report.

[10] Source: PG&E planning document.

[11] The 13 percent discount was based on the results of the study Pacific Gas & Electric Company Refrigerator Metering Part II: Costing Period Study. Prepared by Proctor Engineering Group and HBRS, Inc. September, 1994.

category. Most significant were the savings in the 30 percent and greater category where the average savings were found to be about 37 percent.

The net realization rate for energy is almost 2 due to the combination of the gross realization rate and net-to-gross ratio.

2.11 DIVISION OF SAVINGS BY FUNDING SOURCE

The costs for these programs were split between Residential Appliance Efficiency Incentives and Market Transformation funds, and benefits are divided proportionately between the two categories (51.2% Appliance Efficiency Incentives and 48.8 % Market Transformation).

Table 2-12
Summary of Impact Estimates: Appliance Efficiency Rebate Funded Refrigerators[12]

	Gross Savings	Gross Realization Rate	Net-to-Gross Components[13] 1-FR	Net-to-Gross Components[13] SO	Net-to-Gross Ratio	Net Savings	Net Realization Rate
EX ANTE[14]							
kW	521		1.00		1.00	521	
kWh	2,911,175		1.00		1.00	2,911,175	
EX POST							
kW	661	1.27	0.76	0.54	1.30	859	1.65
kWh	4,320,624	1.48	0.76	0.54	1.30	5,616,810	1.93

[12] The costs for this program were split between Residential Appliance Efficiency Incentives and Market Transformations funds, and benefits are divided proportionately between the two categories (51.2% Appliance Efficiency Incentives and 48.8% Market Transformation). Information shown in this table is scaled to represent accomplishments apportioned to Residential Appliance Efficiency Incentives Program.

[13] See Appendix B for a copy of the net to gross report.

[14] Source: PG&E planning document.

3 HIGH EFFICIENCY LIGHTING

3.1 PROGRAM BACKGROUND

In 1996, rebates for the installation of efficient lighting technologies evaluated in this study were disseminated via the Multifamily Property Direct Incentive Program. This program was authorized under the Residential Appliance Efficiency Program but was integrated into the Nonresidential Retrofit Express Program in 1995. As a result of a decrease in marginal costs and the incorporation of the results of the M&E studies, the Multifamily Property Direct Incentive Program did not pass the TRC test and was not offered in 1996. Net energy impacts during 1996 were from carry-over applications from 1995 which were paid in 1996.

For 1996, a total of 87 carry-over lighting applications were paid. PG&E estimated net energy first year impacts for these applications to be: 1,334,942 kWh and 142.1 kW.

3.2 SUMMARY OF EVALUATION RESULTS

Savings estimated by the evaluation for high efficiency lighting are summarized in Table 3-1.

Table 3-1
Summary of First Year Load Impact Results
High Efficiency Lighting

	Gross Savings	Gross Realization Rate	Net-to-Gross Ratio		Net Savings	Net Realization Rate
			1-FR	SO		
EX ANTE						
kW	151.1		0.94	-	142.1	
kWh	1,420,151		0.94	-	1,334,942	
EX POST						
kW	101.9	0.67	0.50	-	51.4	0.36
kWh	1,348,115	0.95	0.45	-	605,005	0.45

Overall, the Program is estimated to be saving 605,005 kWh and 51.4 kW per year. Gross impact realization rates were estimated to be 0.95 for energy and 0.67 for peak demand. However, low evaluation net-to-gross ratio estimates lowered net realization rates to 0.45 for energy (kWh) and 0.36 for peak demand (kW).

The low evaluation net-to-gross ratio estimates may to attributable to several factors, including:

- a mature, transformed market for Program lighting technologies in which customers are aware of and utilize energy efficiency measures to reduce their energy costs; and
- a net-to-gross approach that did not directly incorporate the impacts of spillover and the Program's effect on market efficiency.

3.3 EVALUATION METHODOLOGY

The lighting study methodology is discussed next. First, sampling issues are presented, followed by discussions of the gross saving analysis approach and the net-to-gross approach.

3.3.1 Sampling Issues

Table 3-2 shows estimated accomplishments by primary measure type, using tracking system estimates of gross savings. The key measure types addressed by the Program are: hardwired compact fluorescent lighting (CFLs), high intensity discharge lighting (HIDs), T-8 fluorescent fixtures (T8s), and miscellaneous other measures such as efficient exit signs and lighting controls.

Table 3-2
Accomplishments by Measure Type

Measure Type	Sites with Measure Type[1]	Units Installed	Ex Ante Gross Impacts[2]			
			kWh	%	kW	%
CFLs	53	2,050	463,980	33%	49.5	33%
HIDs	17	294	81,192	6%	8.6	6%
T8s	16	3,498	691,025	49%	72.8	48%
Other	36	663	187,141	13%	20.0	13%
Total Lighting	87	6,505	1,423,338	100%	150.9	100%

[1] Sites do not sum to total due to overlap of measures at some sites.
[2] Impacts in table are based on tracking system numbers with differ slightly from reported values.

Since there were only 87 lighting applications to be evaluated, on-site surveys were attempted on a census of participating sites. A total of 71 on-site surveys were completed (out of 84 sites where a service address could be identified). Sixty-one of these sites were willing to complete the net-to-gross portion of the survey. Site completion accomplishments are summarized in Table 3-3. A disposition report is included in Appendix A.

Table 3-3
Summary of Sample

Population	Sample Frame (Service Address Identified)	Gross Analysis Sample	Net Analysis Sample
87	84	71	61

The 71 sites surveyed for the gross analysis represent 49% of expected kWh savings. Table 3-4 compares completed surveys to total sites by measure type. The main factor affecting the coverage of program impacts was the inability to recruit one large site representing over 500,000 kWh and 50 kW of expected impacts. Table 3-5 shows survey completion rates by customer size groupings (in terms of expected savings). As the table shows, the completion rate was lower for the larger sites. These sites tended to be maintained by property management groups who: 1) changed-over since the rebate; 2) could not provide a person who was knowledgeable about the rebate; and 3) were otherwise less likely to participate in the study.

Table 3-4
Comparison of Total and Completed Sites

Measure Type	Population		Completed			
	Sites[1]	kWh	Sites[1]	% of Pop	kWh	% of Pop
CFL	53	463,980	40	75%	285,800	62%
HID	17	81,192	17	100%	81,192	100%
T8	16	691,025	28	175%	287,530	42%
OTHER	36	187,141	10	28%	39,419	21%
Total Lighting	87	1,423,338	71	82%	693,941	49%

[1] Sites do not sum to total due to overlap of measures at some sites.

Table 3-5
Completed Site by Customer Size

Site Size (Based on Expected Savings)	Sites with Known Address	Completed Surveys	Completion Rate
1. Over 11,900 kWh	21	14	67%
2. 4,000 - 11,900 kWh	21	19	90%
3. 1,500-4,000 kWh	21	19	90%
4. Under 1,500 kWh	21	19	90%
Total	84	71	85%

3.3.2 Data Collection

Data collection consisted of on-site surveys of participant sites. All surveys were conducted by an experienced surveyor with a strong understanding of lighting technologies. The survey instrument was used collect information on the following:

- measure verification and location;
- operating schedules;
- measure removal information; and
- net-to-gross decision analysis information.

In a number of cases, where key participant personnel were not available on site, telephone follow-up interviews were conducted to gather operating information and Program participation decision making information used for the net-to-gross analysis.

A copy of the on-site survey instrument is provided in Appendix A.

3.3.3 Gross Impact Analysis

Gross impacts were determined using an engineering analysis supported by the on-site surveys. Given the limited number of participants (since this program is a 1995 carry-over) and the difficulty in performing billing analysis on this market segment (i.e., problems in collecting and

aggregating bills for multi-account sites, nonprogram impacts at the sites, increases in the level of lighting services during the retrofit, etc.), an engineering analysis was the most appropriate approach for developing accurate gross savings impacts.

Energy Impacts

Energy savings were estimated using the following basic equation:

$$kWh_{Saved} = [Watts_{SavedPerFixture}] \times [\text{Hours of Operation Per Day}] \times [1\ \text{kWh} / 1{,}000\ \text{Watts}] \times 365.$$

For the study, hours of operation were determined separately for each lighting control strategy. For photocells, average hours of darkness were calculated. For timers, schedules were ascertained by observation and interview. For switches, customer interviews were used. Prior experience has shown that most of the affected lights are controlled by timers and photocells. Table 3-6 presents the distribution of fixture groups for the surveyed sites. Times and photocells control the majority of lights, especially when looking at the percent of connected load affected by Program measures. The high concentration in device-controlled fixtures increases the reliability of observed and self-reported lighting hours.

Table 3-6
Distribution of Surveyed Lighting Control Types

Control Type	Percent of Fixture Groups	Percent of Connected Load Savings
Switches	26%	14%
Photocells	43%	53%
Timers	31%	33%

Table 3-7 presents estimates of annual operating hours by key measure group. The "other" category consists of exit sign lights that are on continuously.

Table 3-7
Evaluation Estimate of Average Annual Operating Hours

Measure Type	Annual Operating Hours
CFLs	4,921
HIDs	4,410
T8s	5,626
Other	8,760

Demand Impacts

A peak coincident factor was developed by calculating the fraction of impacts that occur during the PG&E peak period, using collected hours-of-operation data. This factor was used to estimate demand savings using the following equation:

$$kW_{Reduced} = [Watts_{SavedPerFixture}] x [\text{Peak Coincident Factor}] x [1\ \text{kW} / 1{,}000\ \text{Watts}].$$

Table 3-8 presents peak coincidence factors (the percent of lights on at the time of the system peak) developed from project data. As the table indicates almost all of the HID and CFL savings are off peak. These lights are mainly used at night.

Table 3-8
Peak Coincidence Factors

Measure Type	Coincidence Factor
CFLs	0.15385
HIDs	0.05556
T8s	0.41250
Other	1.00000

Control measures (photocells and timers) were not addressed in the evaluation. These measures accounted for under 50,000 kWh and 6.0 kW of impacts. Realization rates for the rest of the Program measures were applied to PG&E ex ante estimates to derive the evaluation result for the control measures.

Once savings were estimated on a per unit basis, they were generalized to the participant population using ratio estimators. A ratio estimator is developed by comparing the initial estimates of savings to the enhanced estimates obtained from the site analysis. The total gross impact is derived from the following equation.

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

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

where:

TOTSAV = the total gross energy or demand impact;

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

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

E_k = the enhanced engineering estimate for site k.

The sampling precision level can be calculated using the standard formula for a ratio estimator. The standard error of sampling is primarily a function of the correlation between T and E, the sample size, and the portion of expected savings in the sample.

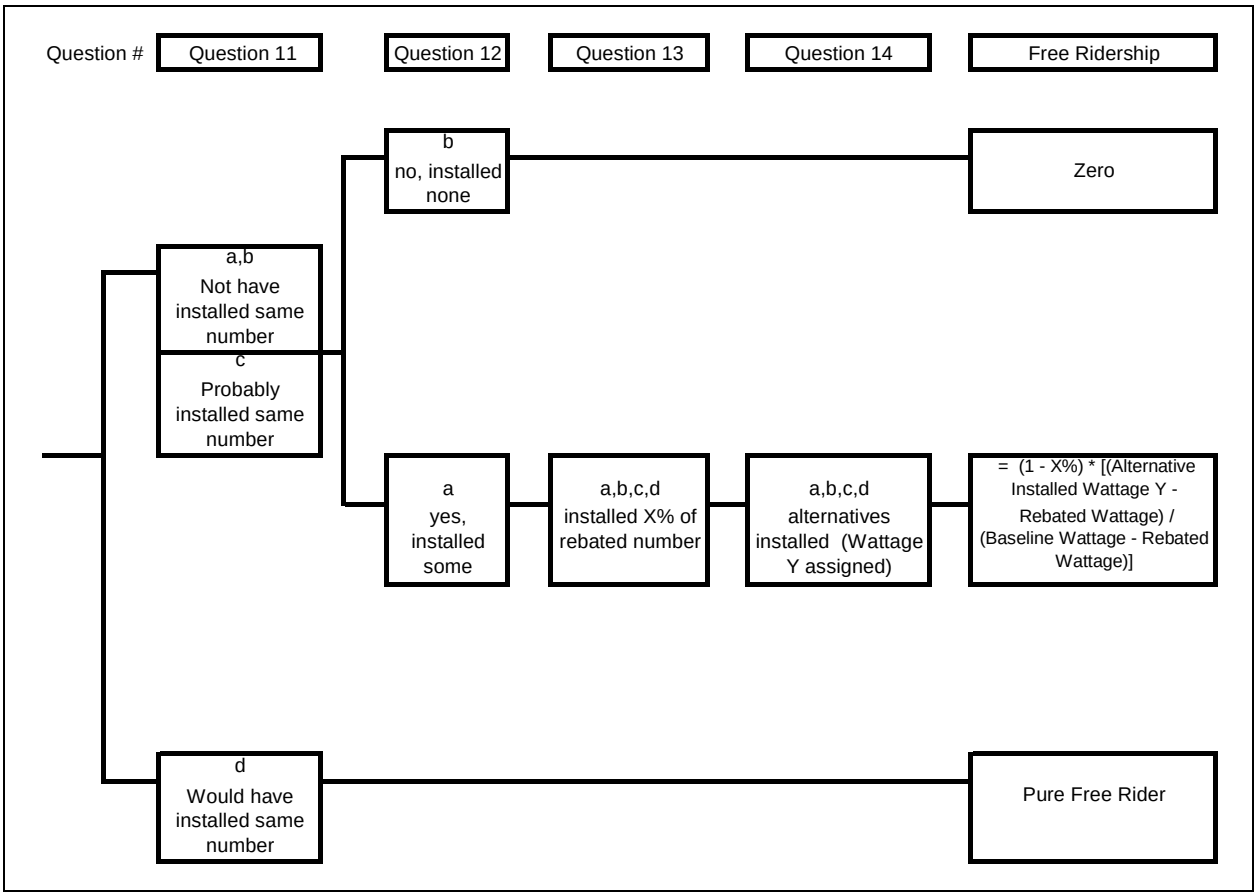
3.3.4 Net Savings

Net impacts were developed using a self-report free-ridership survey. Multi-family complex owners/managers were asked a series of questions to determine what they would have done in the absence of the program. Partial free ridership was also be determined. Consistency checks were

built into the questioning sequence to ensure that reasonable responses were ascertained. The primary decision analysis framework, based on the survey contained in Appendix A, is shown in Figure 3-1.

In this framework, customers were asked if they would have installed the same number of measures without the rebate. For those who did not reply that they "definitely would have" installed the same number, additional questions were asked regarding the number of measures they would have installed and the efficiency level of alternative measures. This information was combined to develop free-ridership rates. Minor adjustments were made to the free-ridership rates at several sites to address inconsistent responses. For example, a small "other" site reported that they definitely would have installed the same number of measures without the rebate but also said they were not sure if the ultimate decision maker would have approved the installation without the rebate.

Figure 3-1
Free-ridership Decision Analysis Framework



The key question in the decision sequence relates to whether or not participants would have installed the same number of measures without the PG&E rebate. As Figure 3-2 shows, a large percentage of participants, across all measures, indicate that they would likely have installed the

same number measures even without the rebate. In addition, for those who were not definite about installing the same number of measures, a large percent said they would still have installed some level of measures without the rebate (Figure 3-3). Review of these figures makes it clear that a large number of participants believe they would have installed efficient lighting technologies, even without the Program.

Figure 3-2
Likelihood of Installing the Same Number of Measures Without the Rebate

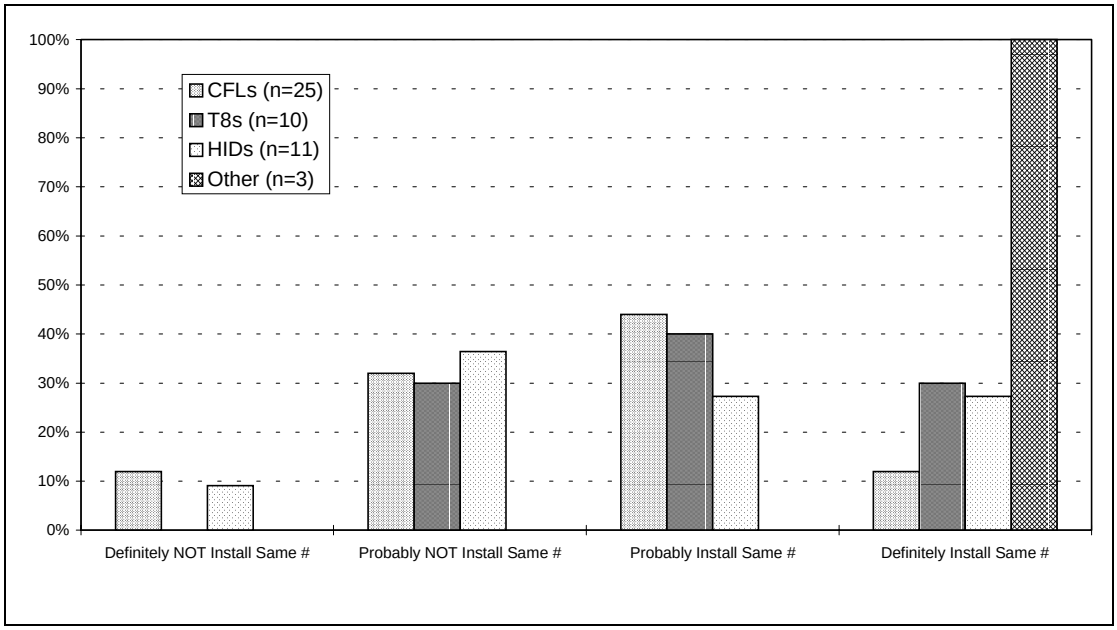
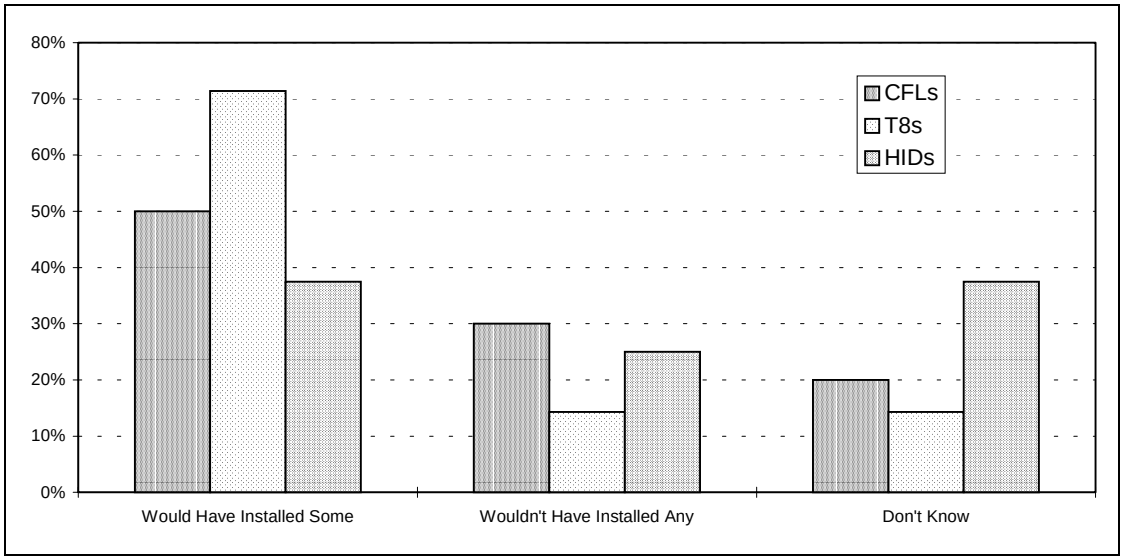


Figure 3-3
Likelihood of Installing Some Measures Without Rebate



Note: one of the "Other" measure participants responded to this question.

For control measures that were not directly addressed in the evaluation, evaluation program net-to-gross ratio averages were utilized.

3.4 IMPACT RESULTS

Results of the impact analysis are present below. First gross impacts are provided, followed by estimated net-to-gross ratios and net impacts.

3.4.1 Gross Impacts

Gross energy impacts are presented in Table 3-9. Overall, the realization rate of 0.95 shows that the PG&E ex ante estimates were quite close to realized levels. The CFL and HID measure groups had realization rates greater than one, while the T8s and "other" measures were somewhat below one. The higher level of HID savings appears related to the installation of larger-than-expected fixtures, resulting in a higher per unit savings estimate.

Table 3-9
First Gross Energy Impacts - kWh

Measure Type	PG&E Estimate	Evaluation Result	Realization Rate
CFLs	463,980	538,076	1.16
HIDs	81,192	171,506	2.11
T8s	691,025	504,181	0.73
Other Efficiency	138,808	88,581	0.64
Controls	48,333	45,771	0.95
Program Total	1,423,338	1,348,115	0.95

Gross peak demand (kW) estimates are presented in Table 3-10. Realization rates are lower than for the energy (kWh) savings. The primary factors lowering the kW realization rates are the lower coincidence factors associated with the summer afternoon system peak. Most multifamily lighting is outdoor night lighting and is not on during the day. HID lighting, used extensively in parking lots, has the lowest realization rate. The survey data indicated that only 6% of these lights were on during the time of the system peak.

Table 3-10
Gross First Year Peak Demand Impacts - kW

Measure Type	PG&E Estimate	Evaluation Result	Realization Rate
CFLs	49.5	33.1	0.67
HIDs	8.6	3.7	0.43
T8s	72.8	51.6	0.71
Other Efficiency	14.8	10.0	0.68
Controls	5.2	3.5	0.68
Program Total	150.9	101.9	0.68

Table 3-11 presents gross impact confidence intervals.

Table 3-11
Gross Impact Confidence Intervals

		90% Confidence Interval		80% Confidence Interval	
	Point Estimate	Lower bound	Upper bound	Lower bound	Upper bound
kWh Impacts	1,348,115	1,302,943	1,393,288	1,312,966	1,383,265
kW Impacts	101.9	91.6	112.2	93.8	109.9

3.4.2 Net Impacts

Free-ridership rates and associated net-to-gross ratios are presented in Table 3-12. CFLs and HIDs showed net-to-gross ratios in the 0.25 range. It appears that these measures are rapidly becoming the standard technology for outdoor lighting. T-8 fixtures returned a higher net-to-gross ratio. Many more customers would probably have not changed out there fluorescent lighting systems without the rebates. The "other" category consists mainly of exit signs. Because exit signs are on 24 hours per day, use of high efficiency technologies is very cost effective for customer installation without the Program rebate. This result drives down the net-to-gross ratio. It should also be noted that only 3 customers were included in the calculation of the "other" net-to-gross ratio.

Table 3-12
Estimated Free-ridership Rates and Net-to-Gross Ratios

Measure	Free-ridership Rate	Net-to-gross Ratio (1-FR)
CFLs	0.67	0.33
HIDs	0.78	0.22
T8s	0.27	0.73
Other Efficiency	0.96	0.04

Net savings estimates are obtained by applying the net-to-gross ratios in Table 3-12 to gross savings estimates (Tables 3-9 and 3-10). The average net-to-gross ratios of 0.45 (kWh) and 0.50 (kW) were applied to the gross "controls" impacts. Net impact results by measure type are shown in Table 3-13.

Table 3-13
First Year Net Savings Estimates by Measure

Measure	kWh	kW
CFLs	175,413	10.8
HIDs	37,217	0.8
T8s	368,556	37.7
Other Efficiency	3,277	0.4
Controls	20,541	1.8
Program Total	605,005	51.4

Table 3-14 presents net impact confidence intervals.

Table 3-14
Net Impact Confidence Intervals

		90% Confidence Interval		80% Confidence Interval	
	Point Estimate	Lower bound	Upper bound	Lower bound	Upper bound
kWh Impacts	605,005	466,292	743,717	497,071	712,939
kW Impacts	51.4	32.9	69.9	37.0	65.8

Finally, evaluation savings estimates are compared to PG&E ex ante estimates in Table 3-15. The evaluation gross kWh estimates are similar to PG&E estimates, while the gross kW estimates are about one-third lower – as a result of the estimated low number of fixtures that are in use during summer weekday afternoons.

Evaluation net-to-gross ratios are also lower than PG&E's assumed net-to-gross ratios. The rebated measures appear to be associated with a mature market in which customers' are willing to purchase high efficiency equipment on its own merit. The result is that evaluation net savings results are less than half of the PG&E net savings estimates.

It is clear that the existence of PG&E lighting efficiency programs over the past decade could have had significantly impact on the transformation of the lighting efficiency markets. However, this evaluation did not address market transformation impacts, and the narrow focus of the net-to-gross analysis contributes to the low estimates of net-to-gross ratios.

Table 3-15
First Year Impact Results for High Efficiency Lighting

	Gross Savings	Gross Realization Rate	Net-to-Gross Ratio		Net Savings	Net Realization Rate
			1-FR	SO		
EX ANTE						
kW	151.1		0.94	-	142.1	
kWh	1,420,151		0.94	-	1,334,942	
EX POST						
kW	101.9	0.67	0.50	-	51.4	0.36
kWh	1,348,115	0.95	0.45	-	605,005	0.45

A

LIGHTING SURVEY INSTRUMENT AND DISPOSITION REPORT

Tracking #_____

A. Identification of Decision Maker

We would like to ask a series of questions relating to your decision to participate in the PG&E multi-family energy efficiency program and in your decision to install *energy efficient lighting* at this complex.

A.1. Are you the person primarily responsible for the decision to participate in the PG&E program for purchases of *energy efficient lighting equipment*?

1. Yes. Continue with interview.
2. No. Ask for name, phone number, and time when person responsible is available to be contacted. End interview.
   Name:_____
   Phone:_____
   Time :_____

A.2. Were others at your company involved in authorizing that decision?

1. Yes.
2. No. (Skip to 4)
3. Don't know.

A.3. Who had ultimate responsibility for the decision?

1. (interviewee) Continue with interview.
2. (someone else) Ask for name, phone number, and time when person responsible is available to be contacted. End interview.
   Name:_____
   Phone:_____
   Time :_____

Tracking #_____

B. Compact Fluorescents

B.1. Are you satisfied with the performance of the Compact Fluorescents installed under the PG&E multi-family energy efficiency program?

1. Yes.
2. No.
3. Don't know.

B.2. Is there anything PG&E could or should have done that would have increased your satisfaction?

1. Yes. Describe:_____
2. No.
3. Don't know.

B.3. Will you consider installing similar Compact Fluorescents in the future in this or other complexes?

1. Yes.
2. No. (Skip to 6)
3. Don't know.

B.4. Will you consider installing similar Compact Fluorescents in the future without an incentive from PG&E?

1. Yes.
2. No.
3. Don't know.

B.5. If you had not installed the Compact Fluorescents with a rebate from PG&E, do you think you would be considering similar installations of *energy efficient lighting equipment* (without incentives from the utility company)?

1. Yes.
2. No.
3. Don't know.

B.6. Before this installation, had you installed similar Compact Fluorescents at this or any other complex without being provided an incentive by a local utility?

1. Yes.
2. No.
3. Don't know.

Tracking #_____

B.7. Had you been considering installing this type of Compact Fluorescents at this complex before exploring the possibility of receiving PG&E rebates?

1. Yes.
2. No. (Skip to 9)
3. Don't know.

B.8. Had you researched the price of Compact Fluorescents before deciding to install the equipment rebated by PG&E?

1. Yes.
2. No.
3. Don't know.

B.9. What made you start thinking about installing Compact Fluorescents at this complex?

1. Standard practice.
2. Reducing electric bills.
3. A PG&E audit.
4. Other. (describe:_____)
5. Don't know.

B.10. At the time you purchased the Compact Fluorescents, did you believe the additional cost associated with the more efficient equipment would have been justified if PG&E had not provided a rebate?

1. Yes.
2. No.
3. Don't know.

B.11. If the PG&E rebate had not been available, how likely is it you would have installed the number of Compact Fluorescents that you did?

1. Definitely would not have installed the same number.
2. Probably would not have installed the same number.
3. Probably would have installed the same number. (Skip to 15)
4. Definitely would have installed the same number. (Skip to 15)
5. Don't know.

B.12. If the PG&E rebate had not been available, would you have installed any *Compact Fluorescents*?

1. Yes.
2. No. (Skip to 15)
3. Don't know.

Tracking #_____

B.13. If the PG&E rebate had not been available, about how many *Compact Fluorescents* would you have installed compared to the number that were installed?

1. Would have installed 25% as many.
2. Would have installed 50% as many.
3. Would have installed 75% as many.
4. Would have installed other percentage. (enter percentage _____%)
5. Don't know.

B.14. For those *Compact Fluorescents* that you would not have installed if the PG&E rebate had not been available, what would you most likely have installed in their place?

1. ordinary incandescent light bulbs.
2. more efficient incandescent light bulbs, for example halogen bulbs.
3. screw-in compact fluorescents?
4. other. (describe _____)
5. Don't know.

B.15. Do you believe the person who was ultimately responsible for the decision would have approved purchase of the same number of installed *Compact Fluorescents* without the rebate?

1. Yes. (If answer to question 11 was probably *or* definitely would ***not have installed the same number***, probe why that is so given that purchase would have been approved. Then if answer to question 15 remains 'Yes,' ask questions 11 through 14 again and adjust answers to each.)
2. No. (If answer to question 11 was probably *or* definitely would ***have installed the same number***, probe how installation would have been possible without decision maker's approval. Then if answer to question 15 remains 'No,' ask questions 11 through 14.)
3. Don't know.

Tracking #_____

C. Fluorescents - Fixtures with Electronic Ballasts

C.1. Are you satisfied with the performance of the Fluorescents installed under the PG&E multi-family energy efficiency program?

1. Yes.
2. No.
3. Don't know.

C.2. Is there anything PG&E could or should have done that would have increased your satisfaction?

1. Yes. Describe:_____
2. No.
3. Don't know.

C.3. Will you consider installing similar Fluorescents in the future in this or other complexes?

1. Yes.
2. No. (Skip to 6)
3. Don't know.

C.4. Will you consider installing similar Fluorescents in the future without an incentive from PG&E?

1. Yes.
2. No.
3. Don't know.

C.5. If you had not installed the Fluorescents with a rebate from PG&E, do you think you would be considering similar installations of *energy efficient lighting equipment* (without incentives from the utility company)?

1. Yes.
2. No.
3. Don't know.

C.6. Before this installation, had you installed similar Fluorescents at this or any other complex without being provided an incentive by a local utility?

1. Yes.
2. No.
3. Don't know.

Tracking #_____

C.7. Had you been considering installing this type of Fluorescents at this complex before exploring the possibility of receiving PG&E rebates?

1. Yes.
2. No. (Skip to 9)
3. Don't know.

C.8. Had you researched the price of Fluorescents before deciding to install the equipment rebated by PG&E?

1. Yes.
2. No.
3. Don't know.

C.9. What made you start thinking about installing Fluorescents at this complex?

1. Standard practice.
2. Reducing electric bills.
3. A PG&E audit.
4. Other. (describe:_____)
5. Don't know.

C.10. At the time you purchased the Fluorescents, did you believe the additional cost associated with the more efficient equipment would have been justified if PG&E had not provided a rebate?

1. Yes.
2. No.
3. Don't know.

C.11. If the PG&E rebate had not been available, how likely is it you would have installed the number of Fluorescents that you did?

1. Definitely would not have installed the same number.
2. Probably would not have installed the same number.
3. Probably would have installed the same number. (Skip to 15)
4. Definitely would have installed the same number. (Skip to 15)
5. Don't know.

C.12. If the PG&E rebate had not been available, would you have installed any Fluorescents?

1. Yes.
2. No. (Skip to 15)
3. Don't know.

Tracking #_____

C.13. If the PG&E rebate had not been available, about how many Fluorescents would you have installed compared to the number that were installed?

1. Would have installed 25% as many.
2. Would have installed 50% as many.
3. Would have installed 75% as many.
4. Would have installed other percentage. (enter percentage _____%)
5. Don't know.

C.14. For those Fluorescents that you would not have installed if the PG&E rebate had not been available, what would you most likely have installed in their place?

1. no new ballasts, only lamps exactly like the lamps in place before the rebate.
2. no new ballasts, only lamps like the lamps in place before the rebate but with lower wattage (e.g., 34 Watt T12 in place of 40 Watt T12 lamps).
3. hybrid or efficient magnetic ballasts with T12 lamps.
4. electronic ballasts with T12 lamps.
5. other.
6. Don't know. (describe _____)

C.15. Do you believe the person who was ultimately responsible for the decision would have approved purchase of the same number of installed Fluorescents without the rebate?

1. Yes. (If answer to question 11 was probably *or* definitely would ***not have installed the same number***, probe why that is so given that purchase would have been approved. Then if answer to question 15 remains 'Yes,' ask questions 11 through 14 again and adjust answers to each.)
2. No. (If answer to question 11 was probably *or* definitely would ***have installed the same number***, probe how installation would have been possible without decision maker's approval. Then if answer to question 15 remains 'No,' ask questions 11 through 14.)
3. Don't know.

Tracking #_____

D. HID Lights - High Intensity Discharge Exterior Lighting

D.1. Are you satisfied with the performance of the HID Lights installed under the PG&E multi-family energy efficiency program?

1. Yes.
2. No.
3. Don't know.

D.2. Is there anything PG&E could or should have done that would have increased your satisfaction?

1. Yes. Describe:_____
2. No.
3. Don't know.

D.3. Will you consider installing similar HID Lights in the future in this or other complexes?

1. Yes.
2. No. (Skip to 6)
3. Don't know.

D.4. Will you consider installing similar HID Lights in the future without an incentive from PG&E?

1. Yes.
2. No.
3. Don't know.

D.5. If you had not installed the HID Lights with a rebate from PG&E, do you think you would be considering similar installations of *energy efficient lighting equipment* (without incentives from the utility company)?

1. Yes.
2. No.
3. Don't know.

D.6. Before this installation, had you installed similar HID Lights at this or any other complex without being provided an incentive by a local utility?

1. Yes.
2. No.
3. Don't know.

Tracking #_____

D.7. Had you been considering installing this type of HID Lights at this complex before exploring the possibility of receiving PG&E rebates?

1. Yes.
2. No. (Skip to 9)
3. Don't know.

D.8. Had you researched the price of HID Lights before deciding to install the equipment rebated by PG&E?

1. Yes.
2. No.
3. Don't know.

D.9. What made you start thinking about installing HID Lights at this complex?

1. Standard practice.
2. Reducing electric bills.
3. A PG&E audit.
4. Other. (describe:_____)
5. Don't know.

D.10. At the time you purchased the HID Lights, did you believe the additional cost associated with the more efficient equipment would have been justified if PG&E had not provided a rebate?

1. Yes.
2. No.
3. Don't know.

D.11. If the PG&E rebate had not been available, how likely is it you would have installed the number of HID Lights that you did?

1. Definitely would not have installed the same number.
2. Probably would not have installed the same number.
3. Probably would have installed the same number. (Skip to 15)
4. Definitely would have installed the same number. (Skip to 15)
5. Don't know.

D.12. If the PG&E rebate had not been available, would you have installed any HID Lights?

1. Yes.
2. No. (Skip to 15)
3. Don't know.

Tracking #_____

D.13. If the PG&E rebate had not been available, about how many HID Lights would you have installed compared to the number that were installed?

1. Would have installed 25% as many.
2. Would have installed 50% as many.
3. Would have installed 75% as many.
4. Would have installed other percentage. (enter percentage _____%)
5. Don't know.

D.14. For those HID Lights that you would not have installed if the PG&E rebate had not been available, what would you most likely have installed in their place?

1. standard incandescent lamps.
2. halogen or tungsten incandescent lamps.
3. other. (describe _____)
4. Don't know.

D.15. Do you believe the person who was ultimately responsible for the decision would have approved purchase of the same number of installed HID Lights without the rebate?

1. Yes. (If answer to question 11 was probably *or* definitely would ***not have installed the same number***, probe why that is so given that purchase would have been approved. Then if answer to question 15 remains 'Yes,' ask questions 11 through 14 again and adjust answers to each.)
2. No. (If answer to question 11 was probably *or* definitely would ***have installed the same number***, probe how installation would have been possible without decision maker's approval. Then if answer to question 15 remains 'No,' ask questions 11 through 14.)
3. Don't know.

Tracking #_____

E. (use name of specific measures) Other Lighting Measures - Exit Sign Retrofit Kits, Timers, Photosensors, and Other Lights

E.1. Are you satisfied with the performance of the (use name of specific measures) installed under the PG&E multi-family energy efficiency program?

1. Yes.
2. No.
3. Don't know.

E.2. Is there anything PG&E could or should have done that would have increased your satisfaction?

1. Yes. Describe:_____
2. No.
3. Don't know.

E.3. Will you consider installing similar (use name of specific measures) in the future in this or other complexes?

1. Yes.
2. No. (Skip to 6)
3. Don't know.

E.4. Will you consider installing similar (use name of specific measures) in the future without an incentive from PG&E?

1. Yes.
2. No.
3. Don't know.

E.5. If you had not installed the (use name of specific measures) with a rebate from PG&E, do you think you would be considering similar installations of *energy efficient lighting equipment* (without incentives from the utility company)?

1. Yes.
2. No.
3. Don't know.

E.6. Before this installation, had you installed similar (use name of specific measures) at this or any other complex without being provided an incentive by a local utility?

1. Yes.
2. No.
3. Don't know.

Tracking #_____

E.7. Had you been considering installing this type of (use name of specific measures) at this complex before exploring the possibility of receiving PG&E rebates?

1. Yes.
2. No. (Skip to 9)
3. Don't know.

E.8. Had you researched the price of (use name of specific measures) before deciding to install the equipment rebated by PG&E?

1. Yes.
2. No.
3. Don't know.

E.9. What made you start thinking about installing (use name of specific measures) at this complex?

1. Standard practice.
2. Reducing electric bills.
3. A PG&E audit.
4. Other. (describe:_____)
5. Don't know.

E.10. At the time you purchased the (use name of specific measures) , did you believe the additional cost associated with the more efficient equipment would have been justified if PG&E had not provided a rebate?

1. Yes.
2. No.
3. Don't know.

(The remaining 15 questions are divided into 3 groups of 5 questions each. The groups are

Exit Sign Retrofit Kits (questions 11 to 15),
Lighting Controls (questions 16 to 20), and
Other Lighting Measures (questions 21 to 25).

Ask only those groups of questions appropriate to the measures for this multifamily complex.)

E.11. If the PG&E rebate had not been available, how likely is it you would have installed the number of any Exit Sign Retrofit Kits that you did?

1. Definitely would not have installed the same number.
2. Probably would not have installed the same number.
3. Probably would have installed the same number. (Skip to 15)
4. Definitely would have installed the same number. (Skip to 15)
5. Don't know.

Tracking #_____

E.12. If the PG&E rebate had not been available, would you have installed any Exit Sign Retrofit Kits?

1. Yes.
2. No. (Skip to 15)
3. Don't know.

E.13. If the PG&E rebate had not been available, about how many Exit Sign Retrofit Kits would you have installed compared to the number that were installed?

1. Would have installed 25% as many.
2. Would have installed 50% as many.
3. Would have installed 75% as many.
4. Would have installed other percentage. (enter percentage _____%)
5. Don't know.

E.14. For those Exit Sign Retrofit Kits that you would not have installed if the PG&E rebate had not been available, what would you most likely have installed in their place?

1. ordinary incandescent light bulbs.
2. more efficient incandescent light bulbs, for example halogen bulbs.
3. screw-in compact fluorescents?
4. other. (describe _____)
5. Don't know.

E.15. Do you believe the person who was ultimately responsible for the decision would have approved purchase of the same number of installed Exit Sign Retrofit Kits without the rebate?

1. Yes. (If answer to question 11 was probably *or* definitely would ***not have installed the same number***, probe why that is so given that purchase would have been approved. Then if answer to question 15 remains 'Yes,' ask questions 11 through 14 again and adjust answers to each.)
2. No. (If answer to question 11 was probably *or* definitely would ***have installed the same number***, probe how installation would have been possible without decision maker's approval. Then if answer to question 15 remains 'No,' ask questions 11 through 14.)
3. Don't know.

Tracking #_____

E.16. If the PG&E rebate had not been available, how likely is it you would have installed the number of Lighting Controls that you did?

1. Definitely would not have installed the same number.
2. Probably would not have installed the same number.
3. Probably would have installed the same number. (Skip to 20)
4. Definitely would have installed the same number. (Skip to 20)
5. Don't know.

E.17. If the PG&E rebate had not been available, would you have installed any Lighting Controls?

1. Yes.
2. No. (Skip to 20)
3. Don't know.

E.18. If the PG&E rebate had not been available, about how many Lighting Controls would you have installed compared to the number that were installed?

1. Would have installed 25% as many.
2. Would have installed 50% as many.
3. Would have installed 75% as many.
4. Would have installed other percentage. (enter percentage _____%)
5. Don't know.

E.19. For those Lighting Controls that you would not have installed if the PG&E rebate had not been available, what would you most likely have installed in their place?

1. nothing.
2. other. (describe _____)
3. Don't know.

E.20. Do you believe the person who was ultimately responsible for the decision would have approved purchase of the same number of installed Lighting Controls without the rebate?

1. Yes. (If answer to question 16 was probably *or* definitely would ***not have installed the same number***, probe why that is so given that purchase would have been approved. Then if answer to question 20 remains 'Yes,' ask questions 16 through 19 again and adjust answers to each.)
2. No. (If answer to question 16 was probably *or* definitely would ***have installed the same number***, probe how installation would have been possible without decision maker's approval. Then if answer to question 20 remains 'No,' ask questions 16 through 19.)
3. Don't know.

Tracking #_____

E.21. If the PG&E rebate had not been available, how likely is it you would have installed the number of Other Lighting Measures that you did?

1. Definitely would not have installed the same number.
2. Probably would not have installed the same number.
3. Probably would have installed the same number. (Skip to 24)
4. Definitely would have installed the same number. (Skip to 24)
5. Don't know.

E.22. If the PG&E rebate had not been available, would you have installed any Other Lighting Measures?

1. Yes.
2. No. (Skip to 24)
3. Don't know.

E.23. If the PG&E rebate had not been available, about how many Other Lighting Measures would you have installed compared to the number that were installed?

1. Would have installed 25% as many.
2. Would have installed 50% as many.
3. Would have installed 75% as many.
4. Would have installed other percentage. (enter percentage _____%)
5. Don't know.

E.24. For those Other Lighting Measures that you would not have installed if the PG&E rebate had not been available, what would you most likely have installed in their place?

1. nothing.
2. other. (describe _____)
3. Don't know.

E.25. Do you believe the person who was ultimately responsible for the decision would have approved purchase of the same number of installed Other Lighting Measures without the rebate?

1. Yes. (If answer to question 21 was probably *or* definitely would ***not have installed the same number***, probe why that is so given that purchase would have been approved. Then if answer to question 25 remains 'Yes,' ask questions 21 through 24 again and adjust answers to each.)
2. No. (If answer to question 21 was probably *or* definitely would ***have installed the same number***, probe how installation would have been possible without decision maker's approval. Then if answer to question 25 remains 'No,' ask questions 21 through 24.)
3. Don't know.

Final Sample Disposition Report

	Total Sample	
	Frequency	Percent of Sample Contacted
1996 Impact Particpants		
Could not accomodate in survey schedule - remote location	6	
Cancelled	1	1.28%
Refused	2	2.56%
Surveyed	71	91.03%
Contact person changed and new contact not aware of measures	1	1.28%
Unable to speak with appropriate contact person	3	3.85%
Total Contacted	78	100.00%
Average Number of Calls Per Site	2	
Minimum Number of Calls	1	
Maximum Number of Calls	7	

PG&E Residential Appliance Efficiency Incentive Lighting Program
Multifamily Impact/Measure Retention Study

PG&E Account Number	Name of Owner (as on PG&E bill)	**Tracking #**
		CNTL
Name of Contact Person	Contact Phone	
	(_____) _____ - _____ x(_____)	

Name of Complex

Address where Lighting items installed

City State Zip

	Area Code	Measure Code	Fixture Code	Num Obsrvd	Num Expctd	Control Code	Operating Schedule	Summer	Winter	Discrepancy Code	Removal Code	Years Since Remov.
1	AREACD1	MEASCD1	FIXTCD1	NUMOBS1	NUMEXP1	CTRLCD1	Wkday	OSWDS1	OSWDW1	DISCCD1	RMVLCD1	YRSREM1
							Wkend	OSWES1	OSWEW1			
2	AREACD2	MEASCD2	FIXTCD2	NUMOBS2	NUMEXP2	CTRLCD2	Wkday	OSWDS2	OSWDW2	DISCCD2	RMVLCD2	YRSREM2
							Wkend	OSWES2	OSWEW2			
3	ETC.						Wkday					
							Wkend					
4							Wkday					
							Wkend					
5							Wkday					
							Wkend					
6							Wkday					
							Wkend					
7							Wkday					
							Wkend					
8							Wkday					
							Wkend					

PG&E Residential Appliance Efficiency Incentive Lighting Program
Multifamily Measure Retention

Tracking # _____

Lighting Schedules

LS1_0-LS1_23 LS2_0-LS2_23 ETC.

S1		S2		S3		S4		S5		S6		S7		S8		S9	
Hr	%on	Hr	%on	Hr	%on	Hr	%on	Hr	%on	Hr	%on	Hr	%on	Hr	%on	Hr	%on
Mid-nigh		Mid-night		Mid-night		Mid-night		Mid-night		Mid-night		Mid-night		Mid-night		Mid-night	
1		1		1		1		1		1		1		1		1	
2		2		2		2		2		2		2		2		2	
3		3		3		3		3		3		3		3		3	
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11		11		11		11		11		11		11		11		11	
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16		16		16		16		16		16		16		16		16	
17		17		17		17		17		17		17		17		17	
18		18		18		18		18		18		18		18		18	
19		19		19		19		19		19		19		19		19	
20		20		20		20		20		20		20		20		20	
21		21		21		21		21		21		21		21		21	
22		22		22		22		22		22		22		22		22	
23		23		23		23		23		23		23		23		23	

Notes:

Table 1-Measure Codes for Lighting and Controls

Group	Code	Description
CFL	L87	Compact Fluorescent: Hardwire Fixture, 14-26 Watts (Res. Lighting)
CFL	L88	Compact Fluorescent: Hardwire Fixture, 27-50 Watts (Res. Lighting)
CFL	L86	Compact Fluorescent: Hardwire Fixture, 5-13 Watts (Res. Lighting)
HID	L89	Hid Fixture: 0-70 Watts
HID	L90	Hid Fixture: >= 71 Watts
T8	L93	Fixture: Replace Lamp & Blst, 2 Ft, T-8 & Elec Blst
T8	L94	Fixture: Replace Lamp & Blst, 3 Ft, T-8 & Elec Blst
T8	L95	Fixture: Replace Lamp & Blst, 4 Ft, T-8 & Elec Blst
T8	L96	Fixture: Replace Lamp & Blst, 8 Ft, T-8 & Elec Blst
T8	L97	Fixture: T-8 Fixture & Ballast, 2 Ft, 2-Lamp
T8	L98	Fixture: T-8 Fixture & Ballast, 2 Ft, 4-Lamp
T8	L100	Fixture: T-8 Fixture & Ballast, 4 Ft, 1-Lamp
T8	L101	Fixture: T-8 Fixture & Ballast, 4 Ft, 2-Lamp
T8	L103	Fixture: T-8 Fixture & Ballast, 8 Ft, 2-Lamp
OTHER	L53	Bypass/Delay Timer (Res. Lighting)
OTHER	L85	Exit Sign: Led Or Electroluminescent (Res. Lighting)
OTHER	L40	Exit Sign: Retrofit Kit (Res. Lighting)
OTHER	L92	Fixture: Incand To Fluor Conversion W/Elec Blst (Res. Lighting)
OTHER	L54	Photocell (Res. Lighting)
OTHER	L52	Time Clock (Res. Lighting)

Table 2-Observed/Expected Discrepancy Codes

Code		Description
		Removal
D	1	Removed, not replaced
	2	Removed, replaced with higher energy use (describe)
	3	Removed, replaced with lower energy use (describe)
	4	Removed, stockpiled
	5	Never installed, stockpiled
		Non-operational
	6	Temporarily taken out of operation
	7	Not operating due to failure/maintenance (estimate date of return to operation)
	8	Not being used to full capacity
		Not Identifiable
	9	Could not locate
	10	Could not assess
	11	Could not confirm wattage
	12	Never installed, not stockpiled
		Supplemental
	13	Installed measures exceed tracking system count
	14	Other (describe)

Table 3-Control Codes

Code		Description
C	1	Manual switch
	2	Photosensor
	3	Occupancy sensor
	4	Timer

Table 4-Area Codes

Code		Description
A	1	Hallway
	2	Storage/utility
	3	Office
	4	Recreation area
	5	Parking lot
	6	Laundry room
	7	Exterior walkway
	8	Exit
	9	Kitchen
	10	Other

Table 5-Removal Codes

Code		Description
		Equipment Failure/Maintenance
R	1	Equip failed
	2	Performance unsatisfactory/did not like it
	3	Maintenance issues
	4	Remodeling
	5	Remodeled/new purpose
		Standby/Backup Equipment
	6	Standby unit
	7	Installed. not used
	8	Comfort/Human Aspects
	9	Unable to locate equivalent replacement
	10	Relocated; in use
	11	Did not think it saved energy
		Equipment Use Redesigned
	12	No longer needed for intended purpose
	13	Reduced operations
	14	Increased operations
	15	Reduced space
	16	Increased space
	17	Change of tenancy/use
		Supplemental
	18	Increased number of measures
		Other
	19	Missing/stolen
	20	Don't know
	21	Other (describe)

LIGHTING FIXTURE CODES

Code	Lamp	Wattage
COMPACT FLUORESCENTS		
C005	CFL 5W	7
C007	CFL 7W	9
C009	CFL 9W	11
C011	CFL 11W	13
C013	CFL 13W	15
C015	CFL 15W	15
C018	CFL 18W	18
CO20	CFL 20W	22
C022	CFL 22W	24
C026	CFL 26W	28
C028	CFL 28W	30
CO32	CFL 32W	34
CO36	CFL 36W	38
CO40	CFL 40W	42
HALOGEN / TUNGSTEN LAMPS		
H020	Halogen 20W	30
H025	Halogen 25W	35
H035	Halogen 35W	45
H042	Halogen 42W	52
H050	Halogen 50W	60
H065	Halogen 65W	75
H075	Halogen 75W	85
T042	Tungsten 42W	42
T052	Tungsten 52W	52
T072	Tungsten 72W	72
T090	Tungsten 90W	90
INCANDESCENT LAMPS		
I020	Incandes. 20W	20
I025	Incandes. 25W	25
I034	Incandes. 34W	34
I036	Incandes. 36W	36
I040	Incandes. 40W	40
I042	Incandes. 42W	42
I050	Incandes. 50W	50
I052	Incandes. 52W	52
I055	Incandes. 55W	55
I060	Incandes. 60W	60
I065	Incandes. 65W	65
I067	Incandes. 67W	67
I072	Incandes. 72W	72
I075	Incandes. 75W	75
I090	Incandes. 90W	90
I100	Incandes. 100W	100
I120	Incandes. 120W	120
I135	Incandes. 135W	135
I150	Incandes. 150W	150
I200	Incandes. 200W	200
I300	Incandes. 300W	300
I500	Incandes. 500W	500
I750	Incandes. 750W	750
I10X	Incandes. 1000W	1000
I15X	Incandes. 1500W	1500

Code	Lamp	Wattage
METAL HALIDE FIXTURES		
M032	MH 32W	40
M070	MH 70W	95
M100	MH 100W	130
M150	MH 150W	195
M175	MH 175W	210
M250	MH 250W	300
M400	MH 400W	460
M750	MH 750W	825
M10X	MH 1000W	1080
M15X	MH 1500W	1620
MECURY VAPOR FIXTURES		
V040	MV 40W	50
V050	MV 50W	75
V075	MV 75W	95
V100	MV 100W	120
V175	MV 175W	205
V250	MV 250W	290
V400	MV 400W	455
V10X	MV 1000W	1075
SODIUM FIXTURES		
L035	LPS 35W	60
L055	LPS 55W	85
L090	LPS 90W	130
L135	LPS 135W	180
L180	LPS 180W	230
S035	HPS 35W	45
S050	HPS 50W	65
S070	HPS 70W	95
S100	HPS 100W	130
S150	HPS 150W	195
S200	HPS 200W	245
S250	HPS 250W	300
S310	HPS 310W	365
S400	HPS 400W	465
S10X	HPS 1000W	1100
QUARTZ LAMPS		
Q050	Quartz 50W	50
Q075	Quartz 75W	75
Q100	Quartz 100W	100
Q150	Quartz 150W	150
Q200	Quartz 200W	200
Q250	Quartz 250W	250
Q300	Quartz 300W	300
Q350	Quartz 350W	350
Q400	Quartz 400W	400
Q425	Quartz 425W	425
Q500	Quartz 500W	500
Q750	Quartz 750W	750
Q10X	Quartz 1000W	1000
Q15X	Quartz 1500W	1500

Code	Lamp	Wattage
2' FLUORESCENT		
T-12		
2S11	1L2'STD STD	32
2S12	2L2'STD STD	50
2S13	3L2'STD STD	74
T-8		
2M71	1L2'T8 EEMAG	23
2M72	2L2'T8 EEMAG	45
2M73	3L2'T8 EEMAG	68
4' T-8 FLUORESCENT		
4M71	1L4'T8 EEMAG	37
4M72	2L4'T8 EEMAG	71
4M73	3L4'T8 EEMAG	108
4M74	4L4'T8 EEMAG	142
4E71	1L4'T8 ELTRNC	39
4E72	2L4'T8 ELTRNC	62
4E73	3L4'T8 ELTRNC	89
4E74	4L4'T8 ELTRNC	114
4' T-10 FLUORESCENT		
4S82	2L4'T10 STD	98
4S83	3L4'T10 STD	157
4S84	4L4'T10 STD	196
4M81	1L4'T10 EEMAG	39
4M82	2L4'T10 EEMAG	72
4M83	3L4'T10 EEMAG	108
4M84	4L4'T10 EEMAG	142
4E81	1L4'T10 ELTRNC	39
4E82	2L4'T10 ELTRNC	62
4E83	3L4'T10 ELTRNC	89
4E84	4L4'T10 ELTRNC	114
4' T-12 FLUORESCENT		
4S11	1L4'STD STD	57
4S12	2L4'STD STD	96
4S13	3L4'STD STD	153
4S14	4L4'STD STD	192
4M11	1L4'STD EEMAG	50
4M12	2L4'STD EEMAG	86
4M13	3L4'STD EEMAG	136
4M14	4L4'STD EEMAG	172
4E11	1L4'STD ELTRNC	37
4E12	2L4'STD ELTRNC	69
4E13	3L4'STD ELTRNC	103
4E14	4L4'STD ELTRNC	138
4M21	1L4'EE EEMAG	43
4M22	2L4'EE EEMAG	72
4M23	3L4'EE EEMAG	115
4M24	4L4'EE EEMAG	144
4E21	1L4'EE ELTRNC	28
4E22	2L4'EE ELTRNC	59
4E23	3L4'EE ELTRNC	85
4E24	4L4'EE ELTRNC	118

Code	Lamp	Wattage
8' T-12 FLUORESCENT		
8S11	1L8'STD STD	100
8S12	2L8'STD STD	173
8S13	3L8'STD STD	273
8S14	4L8'STD STD	346
8M12	2L8'STD EEMAG	158
8M14	4L8'STD EEMAG	316
8E11	1L8'STD ELTRNC	87
8E12	2L8'STD ELTRNC	147
8E14	4L8'STD ELTRNC	282
8S21	1L8'EE STD	83
8S22	2L8'EE STD	138
8S23	3L8'EE STD	221
8S24	4L8'EE STD	276
8M22	2L8'EE EEMAG	123
8M24	4L8'EE EEMAG	246
8E21	1L8'EE ELTRNC	70
8E22	2L8'EE ELTRNC	113
8E24	4L8'EE ELTRNC	226
8' T-12 HO FLUORESCENT		
8S31	1L8'STD/HO STD	135
8S32	2L8'STD/HO STD	257
8S33	3L8'STD/HO STD	392
8S34	4L8'STD/HO STD	514
8M32	2L8'STD/HO EEMAG	237
8M34	4L8'STD/HO EEMAG	474
8E32	2L8'STD/HO ELTRNC	209
8E34	4L8'STD/HO ELTRNC	418
8S42	2L8'EE/HO STD	227
8S43	3L8'EE/HO STD	352
8S44	4L8'EE/HO STD	454
8M42	2L8'EE/HO EEMAG	207
8M44	4L8'EE/HO EEMAG	414
8E42	2L8'EE/HO ELTRNC	178
8E44	4L8'EE/HO ELTRNC	356
8' T-12 VHO FLUORESCENT		
8S51	1L8'STD/VHO STD	230
8S52	2L8'STD/VHO STD	450
8S53	3L8'STD/VHO STD	680
8S54	4L8'STD/VHO STD	900
8S61	1L8'EE/VHO STD	200
8S62	2L8'EE/VHO STD	390
8S63	3L8'EE/VHO STD	590
8S64	4L8'EE/VHO STD	780

Code	Lamp		Wattage
EXIT LIGHT FIXTURES			
EX07	1-7W lamp	CFL	8
EX09	1-9W lamp	CFL	10
EX10	2-5W lamps	CFL	12
EX14	2-7W lamps	CFL	16
EX30	2-15W lamps	INC	30
EX40	2-20W lamps	INC	40
EXLD	LED Sign		5

Fluorescent Fixture Legend	**ABCDE** *where:*	**A** = Length of Lamps	**B** = Ballast Type	**C** = Lamp Type	**D** = Number of Lamps	
	Ballast Type Codes			*Lamp Type Codes*		
	S= Standard	E= Electronic	D=Dimmable	1= T12STD	3= T12HO	5= T12VHO	7= T8STD
	M= EE Magnetic	H= Hybrid		2= T12EE	4= T12HOEE	6= T12VHOEE	8= T10STD

B

STATEWIDE REFRIGERATION NET-TO-GROSS ANALYSIS

Residential Appliance Efficiency Incentives Program:
High Efficiency Refrigeration
1996 First Year Statewide Load Impact Study
Net-To-Gross Analysis

Final Report

SDG&E Study ID #: 980
PG&E Study ID #: 373-2

Prepared for:

San Diego Gas & Electric and Pacific Gas & Electric

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CHAPTER 1
EXECUTIVE SUMMARY

This report presents the results of Hagler Bailly's net-to-gross analysis for the first year load impact study for the 1996 refrigerator rebate programs of San Diego Gas & Electric (SDG&E) and Pacific Gas & Electric (PG&E).

1.1 Summary of Method and Results

The methodology employed in this study was in compliance with the requirements specified in "Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs" ("Protocols"), 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.

There were seven principal analysis steps completed as part of this methodology:

1. Calculate the **total savings** from all refrigerators purchased in 1996 in the PG&E and SDG&E service territories. (Throughout the report, when we refer to "California" it should be understood that we are referring to the service territories of SDG&E and PG&E only.)

2. Determine the extent of **naturally occurring conservation** in 1996 in California.

3. Calculate **net savings** in 1996 in California by subtracting naturally occurring conservation (Step 2) from total California savings (Step 1).

4. Collect the **gross savings** from rebated refrigerators from PG&E and SDG&E (which were calculated from program tracking records according to rules in Table C-3B of the Protocols).

5. Calculate the **net-to-gross ratio** by comparing net savings (Step 3) with gross savings (Step 4).

6. Disaggregate total savings to quantify the levels of **"true program savings**," **"free rider savings"** and **"spillover savings."**

7. Estimate **precision** of the net-to-gross calculation.

Chapter 2 contains a detailed description of the methodological processes employed for each of these analysis steps, Chapter 3 presents the specific results from each of these steps, and Chapter 4 contains a discussion of issues raised in this analysis. Table 1-1 summarizes the results.

Table 1-1: Summary Results

Analysis Step	Description of Analysis	Result
1	Calculate total yearly savings in California	44,767,630 kWh
2	Determine extent of naturally occurring conservation in California	24,284,386 kWh
3	Calculate net yearly savings by subtracting results of Step 2 from results of Step 1	20,483,244 kWh
4	Calculate gross savings from rebated refrigerators	15,697,025 kWh
5	Calculate net-to-gross ratio by dividing results of Step 3 into results of Step 4	130.49%
6	Disaggregate net savings results from Step 3:	
6a	Determine free ridership rate	23.7%
6b	Apply free ridership rate to disaggregate savings	
	Free Rider Savings	3,720,195 kWh
	True Participant Savings	11,976,830 kWh
	Spillover Savings	8,506,414 kWh
7	Precision Results	(See Chapter 3)

1.2 Report Organization

This chapter has provided a brief summary of the methods and results of our net-to-gross analysis for energy efficient refrigerators. Chapter 2 provides an overview of the study objectives and a detailed description of the methodology, and Chapter 3 contains the detailed study results. Chapter 4 presents a discussion of issues related to the study methodology and results. There are four appendices attached to this report:

< Appendix A: M&E Protocols Table 6 for SDG&E[1]
< Appendix B: M&E Protocols Table 7
< Appendix C: SDG&E and PG&E Participant Free Rider Survey Instrument
< Appendix D: Refrigerator Model Number Matches

The reader is encouraged to refer to Hagler Bailly's *Residential Market Effects Study,*[2] prepared for PG&E and SDG&E in March 1998, for additional context and background related to the net savings results analysis presented in this report.

[1] PG&E's Table 6 is included in *Impact Evaluation of Pacific Gas and Electric Company's 1996 Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration.* PG&E Study ID #373-1. Prepared for PG&E by Xenergy, February 1998.

[2] *Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights.* Prepared by Hagler Bailly for SDG&E and PG&E. March 1998. SDG&E Study ID #3902. PG&E Study ID #3302.

CHAPTER 2
OBJECTIVES AND METHODOLOGY

2.1 PURPOSE OF STUDY

This study was designed to produce a net-to-gross ratio applicable to the 1996 refrigerator rebate programs of SDG&E and PG&E for their first year load impact study. The methodology employed and described in this chapter was in compliance with the requirements specified in "Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs" ("Protocols"), 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.

2.2 PROGRAMS EVALUATED

Both PG&E and SDG&E offered rebates for high efficiency refrigerators in 1996 under the umbrella of the Residential Appliance Efficiency Incentives (RAEI) program. A description of the utility programs included in this analysis is provided below:

2.2.1 PG&E

PG&E offered two distinct programs to encourage the sale of energy efficient refrigerators in 1996. The Efficient Refrigerator Rebate Program offered rebates to residential customers for the purchase of efficient refrigerators. The program was implemented in the summer months of 1996 through local retailers. The Refrigerator Salesperson/Dealer Incentive Program (SPIFF) offered incentives to salespeople and dealers between October 1 and November 24, 1996. Table 2-1 presents the relationship between the percentage of energy savings beyond the current federal efficiency standards (established in 1993) to the incentive offered through both of these programs.[1]

[1] *Annual Summary Report on Demand Side Management Programs in 1996 and 1997*, by PG&E, April 1997, page II\Res -3-4.

Table 2-1: 1996 PG&E Refrigerator Program Incentive Levels

	Percent Above 1993 Federal Efficiency Standards		
	20%	*25%*	*30%+*
Efficient Refrigerator Rebate Program	$40	$60	$80
Salesperson/Dealer Incentive Program	$10/$3	$15/$5	$20/$8

2.2.2 SDG&E

SDG&E's refrigerator rebate program was offered throughout 1996. Table 2-2 presents the relationship between the percentage of energy savings beyond standards to the rebate offered.

Table 2-2: 1996 SDG&E Refrigerator Program Incentive Levels ($)

	Percent Above 1993 Federal Efficiency Standards:				
Dates Offered:	*15-19.99%*	*20-24.99%*	*25-29.99%*	*30-34.99*	*35-39.99%*
9/26/93 - 2/14/96	$50	$75	$100	$125	$150
2/15/96 - 2/14/97	$25	$50	$75	$100	$125

2.3 METHODOLOGY

Our methodology was designed to yield a net-to-gross ratio and allow us to disaggregate total savings into savings attributable to true participants, free riders, and spillover. There were five steps associated with developing the net-to-gross ratio applicable to PG&E and SDG&E refrigerator rebate programs. A sixth step was necessary to disaggregate total savings into its component parts. The seventh and final step relates to estimating the level of precision for our net-to-gross ratio. These seven steps are:

1. Calculate the **total savings** from all refrigerators purchased in 1996 in California[2] (both rebated and non-rebated).

2. Determine the extent of **naturally occurring conservation** in 1996 in California.

[2] Throughout the report, when we refer to "California" it should be understood that we are referring to the service territories of SDG&E and PG&E only.

3. Calculate **net savings** in 1996 in California by subtracting naturally occurring conservation (Step 2) from total California savings (Step 1).

4. Collect the **gross savings** from rebated refrigerators from PG&E and SDG&E (which were calculated from program tracking records according to rules in Table C-3B of the Protocols).

5. Calculate the **net-to-gross ratio** by comparing net savings (Step 3) with gross savings (Step 4).

6. Disaggregate total savings to quantify the level of **"true program savings"**, **"free rider savings"** and **"spillover savings."**

7. Estimate the net-to-gross **precision.**

The following sections describe the methodological processes employed for each of these analysis steps.

Step 1: Total Savings from Refrigerators Purchased in 1996 in California

Hagler Bailly implemented a random-digit dial phone survey of residential households in SDG&E and PG&E territories to estimate refrigerator purchase rates and efficiencies.[3] The survey included extensive screening questions to locate people who had bought new refrigerators in 1996 (they may or may not have been program participants). When we found refrigerator purchasers we asked them to read us their refrigerator model numbers and manufacturer names. By matching that data with the 1996 *Directory of Certified Refrigerators & Freezers* from the Association of Home Appliance Manufacturers (AHAM), we identified the exact size, type, efficiency, and electricity use per year of each refrigerator. Using formulas established by the current federal standards that refer to size and type of refrigerator, we calculated for each refrigerator the electricity it would have consumed if it consumed as much electricity as allowed in the current federal standards (which were established in 1993 and are in effect throughout the country). Comparing numbers from these calculations gives an estimate of the amount of electricity a given refrigerator saves compared to the federal standard. (This method is in compliance with Table C-3B of the Protocols.)

To determine the total savings from refrigerators purchased in 1996 in California, we first estimated the total number of refrigerators purchased in California in 1996 (both rebated and non-rebated) by multiplying the 1996 refrigerator purchase rate (determined through our customer survey) by the total

[3] For a more extensive description of the methodology, see *Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights.* Prepared by Hagler Bailly for SDG&E and PG&E. March 1998. SDG&E Study ID #3902. PG&E Study ID #3302.

number of households in California in 1996. Then, we multiplied the total number of refrigerators purchased in 1996 in California by the average per-unit savings over the 1993 federal standards for refrigerators purchased in 1996 in California. This gave us the estimate of the total savings in California compared to the federal standards.

Step 2: Determine Extent of Naturally Occurring Conservation in 1996 in California

Hagler Bailly implemented a random-digit dial phone survey of residential households in the United States (excluding California) to estimate refrigerator purchase rates and efficiencies using the same method as discussed in Step 1. This data represented the comparison area and provides us with an estimate of the level of naturally occurring conservation in California. Since some of the people surveyed in this method would have been in regions with utility refrigerator programs, this method gives us a conservative estimate of the level of naturally occurring conservation.

We multiplied the average per-unit savings for refrigerators purchased in 1996 in the comparison area by the total number of refrigerators purchased in 1996 in California to get an estimate of the level of naturally occurring conservation (NOC) in California.

Step 3: Calculate Net Savings in 1996 in California

Subtracting naturally occurring conservation (Step 2 results) from total savings in California (Step 1 results) gives us the total net savings in 1996 realized in California.

Step 4: Collect 1996 Gross Program Savings

PG&E and SDG&E provided 1996 refrigerator rebate program gross savings estimates for use in this analysis. Both utilities employed an engineering approach to calculate gross savings in accordance to rules in Table C-3B of the Protocols.

Step 4A. PG&E Gross Impacts. PG&E's estimates were developed in a separate impact evaluation and are reported in PG&E Study ID #373-1.

Step 4B. SDG&E Gross Impacts.

SDG&E's gross impacts were calculated using an engineering approach. This approach was validated by the CPUC and is consistent with the California Protocols for high efficiency refrigerator impact studies. Savings were based on data in SDG&E's 1996 Refrigerator Rebate Program tracking system. This database contains both the annual energy consumption and the federal annual energy consumption standards for each rebated refrigerator. SDG&E confirmed the consumption values by comparing them with data in CEC's Directory of Certified Refrigerators and Freezers.

SDG&E calculated total gross energy savings for each refrigerator by subtracting the model's annual energy consumption from the energy each model would have consumed if it were only as efficient as the current federal standards, using formulas based on its size and attributes. SDG&E calculated its total energy savings by summing the annual energy savings for all rebate refrigerators.

SDG&E calculated total load impacts for each refrigerator by multiplying the average refrigerator load times a normalized refrigerator load factor applicable to the peak load hour of 1.34.[4] The average refrigerator load was calculated by dividing the gross energy impacts by 8,760 hours per year.

SDG&E calculated its gross energy and demand savings for their first earnings claim so no ex-post adjustment needed to be done for the current study.

Step 5: Calculate Net-to-Gross Ratio

The net-to-gross ratio is determined by dividing the net savings (Step 3 results) by gross savings (Step 4 results).

Step 6: Disaggregation of Total Savings to Estimate True Program Impacts and Spillover

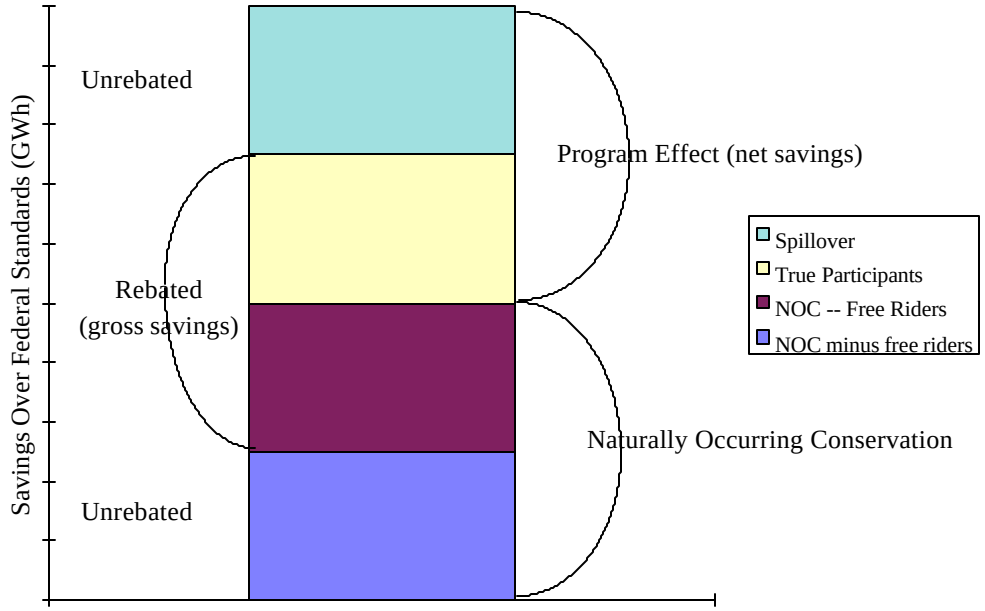
The total savings compared to federal standards of refrigerators in California is composed of four components:

1. Savings from true participants
2. Savings from free riders
3. Spillover
4. Un-rebated naturally occurring conservation (or total NOC minus free riders)

Figure 2-1 shows these components divided into equal parts. We will present another version of this graph in the next chapter with the actual results.

[4] *Analysis of SCE and PG&E Refrigerator Load Data*. (Project 2052R). AAG & Associates, Inc. Prepared for the California DSM Measurement Advisory Committee, April 5, 1995.

Figure 2-1: Components of Total Savings – Theory



(Components divided into equal parts for illustration only.)

The total savings compared to federal standards (the entire bar) is comprised of two main pieces: 1) total program effects and 2) naturally occurring conservation. Savings from true participants and spillover represent the total program effect (the "Program Effect" semicircle in the graph). As we discussed above (Step 3), total program effects (net savings) are calculated by subtracting NOC from total savings.

Naturally occurring conservation (the "Naturally Occurring Conservation" semicircle in the graph and calculated in Step 2) is composed of savings from free riders and un-rebated NOC (purchases of high efficiency refrigerators that were not affected by the program and did not receive rebates). Free riders are part of NOC because they would have purchased the refrigerator without the rebate.

To further disaggregate total savings and allow us to calculate spillover, additional calculations were applied to the program effect semicircle and the NOC semicircle. For this study, we estimated the free rider component using a self-report survey. The free ridership rate allows us to fix the lower bound of the rebated semicircle, which allows us to calculate the amount of spillover. The math for this calculation is as follows:

Total rebated savings - free riders = true participants
Total program effects - true participants = spillover

To measure the free-ridership rate, we implemented a separate survey of participants in the 1996 rebate programs (see Step 6a below). This free ridership rate was multiplied by the gross program savings to determine the level of "free rider savings".

Step 6a: Calculation of Free Ridership Rate

The free ridership rate for the 1996 programs was determined using a self-report survey of program participants, as follows:

- We completed a brief telephone survey with a total of 213 people who received refrigerator rebates for 1996 purchases ("participants") and asked a number of questions to determine the extent to which the program rebates influenced their purchase decisions.
- Based on participant responses to these questions, those who met at least one of the following criteria were not considered to be free riders (i.e., they were true participants):
  - Had not planned to buy a model of the same high efficiency level before hearing of the program rebate
  - Would not have paid the full price for the same high efficiency model of refrigerator if the rebate had not been available
  - Indicated that the rebate had at least some impact on their decision to purchase a high efficiency refrigerator (e.g., would not have purchased the same model without it, influenced the decision of when to buy new refrigerator, etc.)
- Of the remaining participants, respondents were classified as free riders if they reported that they:
  - Had planned to buy a model of the same high efficiency level before hearing of the program rebate
  - Would have paid the full price for the same high efficiency model of refrigerator regardless of the rebate
  - Indicated that the rebate had no impact on their decision to purchase a high efficiency refrigerator (e.g., would have purchased same model without it).
- There were a few participants who could not be classified as 100% free riders, but their responses indicated partial free ridership. We assigned them a free ridership rate of 50%.

It is commonly believed that self-report free ridership surveys overestimate actual free ridership levels. This survey was designed to minimize this problem but it should still be considered to produce a conservative net-to-gross ratio.

Table 2-3 presents the specific question wording and logic used to determine free ridership rates.

Table 2-3: Free Ridership Question Wording and Logic

Question Number	Question Wording	Skip Pattern and Free Ridership Determination Logic
F1	Had you planned to buy a model of same high efficiency level before you heard of the rebate?	NO – *not a free rider* YES/DK – ask F2
F2	Would you most likely have paid the full price for the same high efficiency model of refrigerator if the rebate had not been available?	NO – *not a free rider* YES – ask F4a DK – ask F3
F3	So, you are saying the rebate had no impact on your decision to purchase this high efficiency model of refrigerator?	NO/DK – ask F4a YES – *free rider*
F4a	Can you clarify for me in your own words what impact, if any, the rebate had on your decision to purchase that high efficiency model of refrigerator?	Open-ended question. *Verbatim responses used to determine free ridership.*

Step 7: Estimate the Precision of the Net-To-Gross Calculations

The precision estimate for the net-to-gross estimate was calculated using the same method used in the 1994 study with the following equation.[5]

$$s_{\bar{x}_1-\bar{x}_2} = \sqrt{s^2 pooled\left(\frac{1}{N_1}+\frac{1}{N_2}\right)}$$

where:

$s_{\bar{x}_1-\bar{x}_2}$ = standard error of the difference

S^2 pooled = pooled variance estimate

N_n = number of observations

The range of net savings = net savings estimate ± $s_{\bar{x}_1-\bar{x}_2}$ * t

where

t = critical value for t test at appropriate confidence interval.

The next chapter will present the results of the analyses completed in each of these seven steps. Chapter 4 includes a discussion of some of the issues that can help in interpreting the results.

[5] *Residential Appliance Efficiency Incentives Program High Efficiency Refrigeration: 1994 First Year Statewide Load Impact Study*. SDG&E Study ID #914. Xenergy, Inc., prepared for Southern California Edison and SDG&E, February 1996.

CHAPTER 3
RESULTS

This chapter presents the results of Hagler Bailly's net-to-gross analysis for PG&E and SDG&E 1996 refrigerator rebate programs. These results were derived using the methodology and the associated analytic steps described in Chapter 2. Results are presented below in Table 3-1 and discussed in more detail in the sections that follow.

Table 3-1: Net Savings Analysis Results

Analysis Step	Description of Analysis	Result
1	Calculate total yearly savings in California	44,767,630 kWh
2	Determine extent of naturally occurring conservation in California	24,284,386 kWh
3	Calculate net yearly savings by subtracting results of Step 2 from results of Step 1	20,483,244 kWh
4	Calculate gross savings from rebated refrigerators	15,697,025 kWh
5	Calculate net-to-gross ratio by dividing results of Step 3 into results of Step 4	130.49%
6	Disaggregate net savings results from Step 3:	
	6a Determine free ridership rate	23.7%
	6b Apply free ridership rate to disaggregate savings	
	Free Rider Savings	3,720,195 kWh
	True Participant Savings	11,976,830 kWh
	Spillover Savings	8,506,414 kWh

Step 1: Total Savings from Refrigerators Purchased in 1996 in California

As discussed in Chapter 2, the total yearly savings from refrigerators purchased in 1996 in California (again meaning just SDG&E and PG&E territories) were estimated by matching model and manufacturer data provided by survey respondents with data from AHAM. On average, the typical refrigerator purchased in 1996 in California saved 108.5 kWh per year compared to the current federal standard.

The survey results produced an annual refrigerator purchase rate of 7.5% – that is, 7.5% of the households in California purchased a new refrigerator in 1996. Multiplying this number by the number of

households in SDG&E and PG&E territories (5,502,918) yields an estimate of the number of refrigerators purchased in California in 1996 (412,719). Finally, multiplying the per-unit savings by the number of refrigerators purchased gives us the estimate of the yearly savings in California when compared to the federal standards (44.8 GWh, or 108.5 * 412,719).

Step 2: Determine Extent of Naturally Occurring Conservation in 1996 in California

The comparison area (which was the entire country minus the entire state of California) provides us with an estimate of the level of naturally occurring conservation in California. Using the same method employed for Step 1, we calculated the average per-unit yearly savings for refrigerators purchased in 1996 in the comparison area compared to the current federal standards (58.8 kWh). Multiplying this by the number of refrigerators purchased in California in 1996 gives us an estimate of the level of naturally conservation in California (24.3 GWh).

Step 3: Calculate Net Savings in 1996 in California

Subtracting naturally occurring conservation (Step 2 result) from total savings in California (Step 1 result) gives us the total net savings attributable to the program (20.5 GWh).

Step 4: Determine 1996 Gross Program Savings

Both PG&E and SDG&E 1996 refrigerator rebate program gross savings estimates were provided to us for use in this analysis.[1] Together, the utilities report a total of 15,697,025 kWh in gross program savings for 1996.

Step 5: Calculate Net-to-Gross Ratio

The net-to-gross ratio is determined by comparing the net savings (Step 3 results) to gross savings (Step 4 results). The resulting ratio is 130.49%

Step 6: Disaggregation of Total Savings

Step 6a: Calculation of Free Ridership Rate

Using the methodology described in Chapter 2, the free ridership rate for the 1996 programs was determined to be 23.7%. Table 3-2 presents the results of this determination. We assigned a free ridership rate of 0.5 to partial free riders (adding 0.7% to the free-ridership rate).

[1] PG&E's estimates were developed in a separate impact evaluation and are reported in PG&E Study ID #373-1.

Table 3-2: Free Ridership Rate Determination

Category	Response	Number of Responses	Percent of Responses
Non-Free Rider	Did not plan on purchasing same model of refrigerator before hearing about rebate	107	50.2%
	Would not have paid full price for same model of refrigerator if rebate was not available	16	7.5%
	Rebate confirmed decision of which model to purchase	13	6.1%
	Would not have purchased same model without rebate	8	3.8%
	Rebate influenced decision of when to buy	4	1.9%
	Don't know if rebate would have influenced purchase decision	13	6.1%
		161	**75.6%**
Free Riders	Rebate did not influence purchase decision	34	16.0%
	Had not heard of rebate until survey	2	0.9%
	Would have purchased anyway, rebate was a "nice bonus"	13	6.1%
		49	**23.0%**
Partial Free Rider	Rebate allowed purchase of larger unit with same efficiency level	2	0.9%
	Rebate was like a "reimbursement" to validate purchase	1	0.5%
		3	**1.4%**

Step 6b: Disaggregate Net Impacts

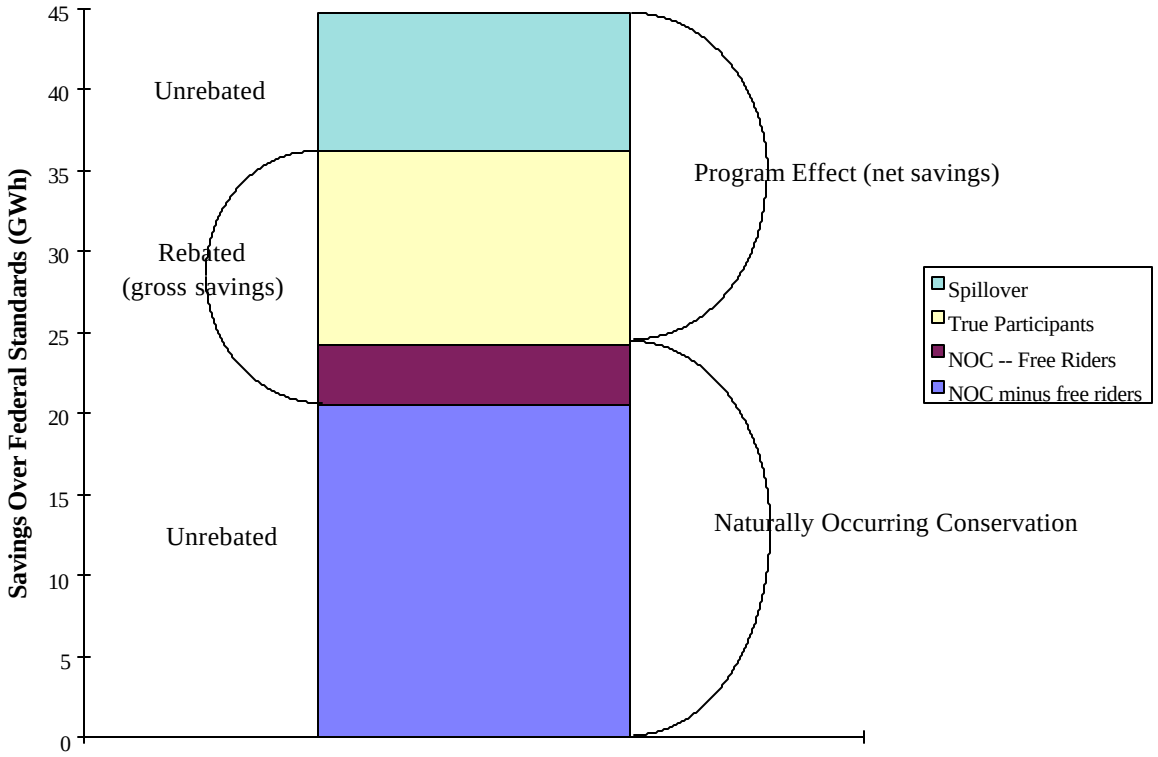
As described in Chapter 2, the total savings compared to federal standards of refrigerators in California is composed of four components (Figure 3-1):

1. Savings from true participants
2. Savings from free riders
3. Spillover
4. Un-rebated naturally occurring conservation (or total NOC minus free riders)

The free ridership rate derived from the analysis completed in Step 6a was found to be 23.7%. Multiplying this free ridership rate by the gross program savings produces about 3.7 GWh of "free rider savings." Subtracting these free rider energy savings from gross savings yields about 12.0 GWh of "true program savings" (or savings that were the result of the program's direct influence – the rebate). Subtracting the true participant savings from the net savings realized in California (Step 3 result) results in about 8.5 GWh in "spillover savings" (20.5 GWh - 12.0 GWh). Spillover savings represent the amount of savings realized in California (a) outside of the direct influence of the utility rebate programs

(i.e., unrebated purchases), and (b) over and above what would have naturally occurred in the market without the programs.

Figure 3-1: Components of Total Savings



Step 7: Precision Estimate

The analysis discussed above produced a net-to-gross ratio of 130.5%. Using the method described in Chapter 2, we calculated confidence intervals around the net-to-gross ratio. The 90% confidence interval around this number ranges from 191.6% to 69.3% (see Table 3-3). The 80% confidence interval around this number ranges from 178.2% to 82.8%.

Table 3-3: Precision Estimate

Description of Analysis	Per-Unit kWh	Number of Units	Total kWh	Net-To-Gross Ratio
Gross savings from rebated refrigerators			15,697,025	
Net savings	49.6	412,719	20,483,244	130.5%
90% Upper Bound	72.9	412,719	30,083,017	191.6%
90% Lower Bound	26.4	412,719	10,883,471	69.3%
80% Upper Bound	67.8	412,719	27,964,647	178.2%
80% Lower Bound	31.5	412,719	13,001,840	82.8%

(Note: The data used in the calculations have more decimals than shown in this table, as a result, multiplying per-unit kWh shown by the number of units shown will not result in the exact total kWh shown.)

CHAPTER 4
DISCUSSION

This chapter presents a discussion of the methodology used in and the results of Hagler Bailly's net-to-gross analysis for the PG&E and SDG&E 1996 refrigerator rebate programs. This discussion is organized around two principal issues: (1) spillover results, and (2) free ridership results.

4.1 SPILLOVER RESULTS

As reported in Chapter 3, we estimate approximately 45 GWh in energy savings were realized in California in 1996. Just over half of this amount "would have occurred anyway" due to naturally occurring conservation (54%). About 27% was a direct result of the utilities' rebate programs in 1996, and the remaining 19% represents spillover savings.

Another way of interpreting the spillover results is to think of gains in refrigerator efficiency over time in terms of "percent above federal efficiency standards". Our market effects research[1] found that although the number of rebates given in utility programs has declined over the years, the average efficiency of refrigerators sold through these programs relative to federal standards has steadily increased.

- In 1986, the efficiencies of refrigerators bought in California were not significantly different from those bought in the rest of the country.

- In 1991, the average refrigerator purchased in California was 10.2% more efficient than the 1990 federal standards, which was significantly higher than the 5.7% found in the rest of the country. We estimate that virtually 100% of the difference in average efficiency between the refrigerators sold in California and the rest of the country is accounted for by refrigerators sold through utility programs. Therefore, it appears that had the utilities not offered rebate programs in 1991, refrigerators purchased in California would have been similar to those purchased in the rest of the country.

- An assessment of the refrigerator rebate programs offered by Southern California Edison and SDG&E in 1994 concluded that the average efficiency of refrigerators purchased in Southern

[1] *Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights.* Prepared by Hagler Bailly for PG&E and SDG&E. SDG&E Study ID # 3902. PG&E Study ID #3302. March 1998.

California was also higher than the comparison area, and 100% of the difference in refrigerator efficiencies was attributable to the utilities' rebate programs.[2]

Factors Contributing to Spillover

We speculate that a combination of factors have contributed to the magnitude of spillover savings observed in the 1996 refrigerator market, as discussed below.

Refrigerator Efficiency Standards

Refrigerator efficiency standards have been central to much of the changes in the industry over the past 10 years. California led much of the country by developing statewide refrigerator standards in 1987 and revising them for 1990. On November 17, 1989, the first federal refrigerator efficiency standards were set forth and they became effective on January 1, 1990. At that time, the federal standards were not as stringent as the statewide standards adopted in California for 1990. On January 1, 1993, the federal standards were revised and became consistent with the California statewide standards. These 1993 standards are still in force today.

Utility Program Incentive Design

California utilities have been working for many years to influence the production of refrigerators that are even more efficient than required by the relevant standards. Consistently each year, utilities have altered their incentive structure as the more efficient models became available on the market (as evidenced by increased participation levels for these higher efficiency models). In reaction to increased equipment availability and improved market demand, utilities would scale back the incentive amount for the earlier models, or eliminate the incentive altogether, and offer increased incentives for even higher efficiency models.

Market Reactions and Interactions

The changes in efficiency standards and utility incentive structures have led to several reactive and interactive effects within the distribution channel for refrigerators:

< "Market Push" – manufacturers have produced high efficiency refrigerators both to (a) comply with changing statewide/federal standards, and (b) capture the market demand created by utility rebate programs designed to encourage the adoption of even higher efficiency models.

[2] *Residential Appliance Efficiency Incentives Program, High Efficiency Refrigerators, 1994 First Year Statewide Load Impact Report*. SDG&E Study ID #914. Xenergy, Inc., prepared for Southern California Edison and SDG&E, February 1996, page 4-2.

< "Market Pull" – increased consumer awareness and demand for higher efficiency refrigerators has served to influence both manufacturer production and retailer sales of these models.

Overall, these factors combined have contributed to the magnitude of spillover savings observed in the 1996 California refrigerator market.

4.2 FREE RIDERSHIP RESULTS

The methodology used by in the 1994 study[3] incorporated the effects of spillover and free ridership and did not produce estimates of these factors separately. Hence, from that research it was not possible to determine whether spillover and free ridership effects were small or large and were canceling each other out. Our study produced results using a methodology that was similar to Xenergy's, but also calculated a separate free ridership rate which allowed us to determine the magnitude of spillover effects observed in the market. We were thus able to calculate the free ridership and spillover components of the net-to-gross ratio.

Our approach to determining the rate of free ridership was based on participants' self-reported responses and was consistent with the Protocols and with the California DSM Measurement Advisory Committee (CADMAC) *Quality Assurance Guidelines* regarding procedures for using self-report methods. For example, we included "set-up" questions which were used to guide respondents through a process of establishing benchmarks against which to remember the decision making process. In addition, our survey instrument also made use of multiple questionnaire items to measure free-ridership and address inconsistencies.

Earlier studies of free ridership also included participant responses regarding whether or not they had compared energy efficiency levels and prices of refrigerators prior to learning of the rebate. While these questions were included in our survey, the responses were not used in the free rider calculation for the following reasons.

Based on discussions with both PG&E and SDG&E prior to implementing the survey, it was agreed that in some parts of the market for refrigerators, rebates may have created situations where customers have no choice but to purchase an energy efficient refrigerator for certain types and sizes of refrigerator. In such areas, we expect free rider rates will be higher. For example, in those areas, customers shopping for refrigerators with no interest in or knowledge of efficiency or rebates are likely to come across one model that fits their needs (e.g., size, features, color, etc.) – they decide to buy it (literally have no choice) and only then learn that there is a rebate for the model they have chosen. To be

[3] *Residential Appliance Efficiency Incentives Program, High Efficiency Refrigerators, 1994 First Year Statewide Load Impact Report*. SDG&E Study ID #914. Xenergy, Inc., prepared for Southern California Edison and SDG&E, February 1996.

conservative, in this analysis we have counted these people as free riders although earlier methods would have classified them as non-free riders since they did not compare efficiency levels or price differentials. (The definition of these purchasers as free riders is complicated by the fact that even though they would have bought the energy efficient refrigerator without the rebate, without the effects of the utility program they would not have been forced to purchase the energy efficient refrigerator, and so are in this sense affected by the program and are not free riders.) Thus, we agreed that we would ask questions about comparing efficiency levels and price differentials as part of the "set-up questions", but would not use participant responses to these questions in the free rider calculations.

APPENDIX A
M&E PROTOCOLS TABLE 6 FOR SDG&E*

Appliance Efficiency Incentives Program: High Efficiency Refrigeration. PG&E Study ID #373-1. Prepared for PG&E by Xenergy, February 1998.

M&E PROTOCOLS TABLE 6 -- SDG&E
Residential Appliance Efficiency Incentive Programs
Designated Unit of Measurement: Refrigerator
ENDUSE: Residential Refrigeration

				5. A. 90% CONFIDENCE LEVEL				5. B. 80% CONFIDENCE LEVEL			
				LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND
1. Average Participant Group and Average Comparison Group		**PART GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**	**PART GRP**	**PART GRP**	**COMP GRP**	**COMP GRP**
A. Pre-Install Usage:	Pre-Install kW	na	na	na	na	na	na	na	na	na	na
	Pre-Install kWh	na	na	na	na	na	na	na	na	na	na
	Pre-Install Therms	na	na	na	na	na	na	na	na	na	na
	Base kW	na	na	na	na	na	na	na	na	na	na
	Base kWh	na	na	na	na	na	na	na	na	na	na
	Base Therms	na	na	na	na	na	na	na	na	na	na
	Base kW/ designated unit of measurement	na	na	na	na	na	na	na	na	na	na
	Base kWh/ designated unit of measurement	na	na	na	na	na	na	na	na	na	na
	Base Therms/ designated unit of measurement	na	na	na	na	na	na	na	na	na	na
B. Impact year usage:	Impact Yr kW	na	na	na	na	na	na	na	na	na	na
	Impact Yr kWh	na	na	na	na	na	na	na	na	na	na
	Impact Yr Therms	na	na	na	na	na	na	na	na	na	na
	Impact Yr kW/ designated unit	na	na	na	na	na	na	na	na	na	na
	Impact Yr kWh/ designated unit	na	na	na	na	na	na	na	na	na	na
	Impact Yr Therms/ designated unit	na	na	na	na	na	na	na	na	na	na
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	0.0959	0.1251	na	na	na	na	na	na	na	na
	A. ii. Load Impacts - kWh	176	230	na	na	na	na	na	na	na	na
	A. iii. Load Impacts - Therms	na	na	na	na	na	na	na	na	na	na
	B. i. Load Impacts/designated unit - kW	0.0959	0.1251	na	na	na	na	na	na	na	na
	B. ii. Load Impacts/designated unit - kWh	176	230	na	na	na	na	na	na	na	na
	B. iii. Load Impacts/designated unit - Therms	na	na	na	na	na	na	na	na	na	na
	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. iii. a. % 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	1.0	1.0	na	na	na	na	na	na	na	na
	D.A. ii. Load Impacts - kWh, realization rate	1.0	1.0	na	na	na	na	na	na	na	na
	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	1.0	1.0	na	na	na	na	na	na	na	na
	D.B. ii. Load Impacts/designated unit - kWh, real rate	1.0	1.0	na	na	na	na	na	na	na	na
	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	1.3049		69.3	191.6			82.8	178.2		
	A. ii. Average Load Impacts - kWh	1.3049		69.3	191.6			82.8	178.2		
	A. iii. Average Load Impacts - Therms	na		na	na			na	na		
	B. i. Avg Load Impacts/designated unit - kW	1.3049		69.3	191.6			82.8	178.2		
	B. ii. Avg Load Impacts/designated unit - kWh	1.3049		69.3	191.6			82.8	178.2		
	B. iii. Avg Load Impacts/designated unit - Therms	na		na	na			na	na		
	C. i. Avg Load Impact 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 Impact 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 Impact based on % chg in usage in impact year relative to base usage in impact year - Therms	na		na	na			na	na		
4. Designated Unit Intermediate Data				**PART GRP**	**PART GRP**			**PART GRP**	**PART GRP**		
	A. Pre-Install average value	na		na	na			na	na		
	B. Post-Install average value	na		na	na			na	na		
6. Measure Count Data		**NUMBER**									
	A. Number of measures installed by participants in Part Grp	41,218									
	B. Number of measure installed by all program participants in the 12 months of the program year	na									
	C. Number of measures installed by Comp Grp	na									
7. Market Segment Data		na									

APPENDIX B
M&E PROTOCOLS TABLE 7

A. OVERVIEW INFORMATION

1. **Study Title and Study ID Numbers:** Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration: 1996 First Year Statewide Load Impact Study: Net-To-Gross Analysis. SDG&E Study ID #980. PG&E Study ID #373-2

2. **Program, Program year (or years) and program description:** 1996 Residential Refrigerator Rebate Program. This program provided rebates for the purchase of refrigerators that consumed less energy than is allowable under federal appliance standards. The amount of the rebate offered depended on the rated energy consumption of the refrigerator relative to the current federal energy consumption standard for the refrigerator. See Chapter 2, Section 2.2 for details.

3. **End uses and/or measures covered:** The program covered new, high efficiency refrigerators for the residential sector.

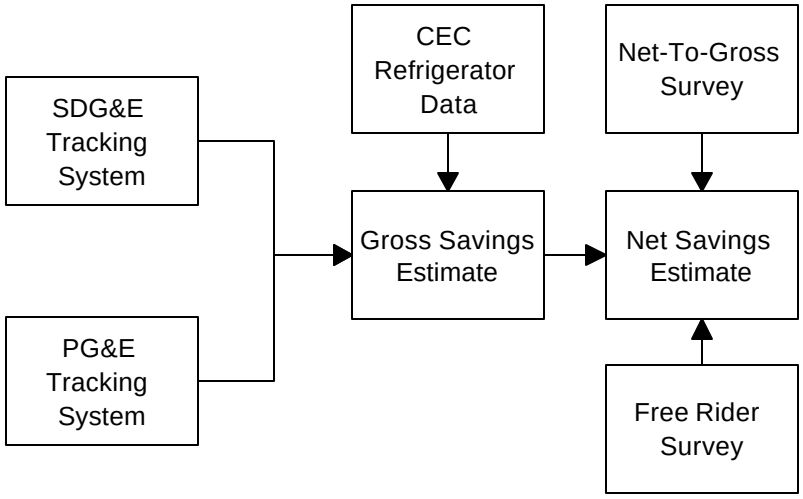
4. **Methods and models used:** The methodology employed in this study is explained in Chapter 2.

5. **Participant and comparison group definition:** Program participants include all people who purchased high efficiency refrigerators and received rebates from SDG&E or PG&E in 1996. The comparison group was individuals who purchased refrigerators for their own, residential use in 1996 in the United States, excluding the entire state of California. Because the comparison group includes individuals who might have gotten a rebate, it leads to a conservative net-to-gross estimate.

6. **Analysis Sample Size:** The population of all participants rather than a sample was used for the gross savings calculations. The population included 78,442 high efficiency rebated refrigerators. The sample used for the self-report portion of the net-to-gross analysis was comprised of 213 participants in SDG&E and PG&E territories who purchased refrigerators in 1996. The survey that was used to measure spillover included 897 screening surveys in SDG&E territory, 1,022 in PG&E territory, and 2,011 in the rest of the country (minus all of California). The screening survey yielded energy efficiency data on 42 refrigerators purchased in SDG&E territory in 1996, 60 in PG&E territory, and 117 in the rest of the country.

B. DATABASE MANAGEMENT

1. **Flow chart illustrating relationship between data elements:**



2. **Specific data sources:** See Chapter 2, Section 2.3 of the report.

3. **Data attrition process:** See Chapter 2, Section 2.3 of the report.

4. **Internal/Organizational data quality checks and procedures:** Not applicable.

5. **Summary of data collected but not used:** Not applicable.

C. SAMPLING

1. **Sampling procedures and protocols:** See Chapter 2, Section 2.3, Steps 1 and 2.

2. **Survey information:** Appendix C provides the free rider survey instrument. The market effects survey also collected information used in this analysis, as well as information used for a separate study. [1] Random digit dialing screening calls were completed in 3,930 households (1,919 in California and 2,011 nationally). Respondents were asked if they purchased a refrigerator in 1986, 1991, or 1996. If they did, they were asked to read the model number and provide the manufacturer name. Valid refrigerator model numbers were collected for 102 refrigerators

[1] See the following report for a complete discussion of the survey method and purpose: *Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights.* Prepared by Hagler Bailly for SDG&E and PG&E. March 1998. SDG&E Study ID #3902. PG&E Study ID #3302.

purchased in California in 1996 and for 117 purchased nationally. The difference between the 3,930 screening surveys and the 219 valid model numbers is composed of the following:

- Respondents who did not purchase a refrigerator in 1996.
- 1996 refrigerator purchasers who were unwilling or unable to find their refrigerator model number.
- 1996 refrigerator purchasers who provided refrigerator model numbers that could not be found in the 1996 *Directory of Certified Refrigerators & Freezers* published by the Association of Home Appliance Manufacturers (AHAM).

Spillover Survey Attrition Table

		SDG&E	PG&E	National	Total
Total Screening Surveys		897	1,022	2,011	3,930
Completed Refrigerator Surveys†					
	1996	49	77	147	273
	1991	59	59	122	240
	1986	55	54	95	204
	Total	163	190	364	717
Valid Refrigerator Model Numbers ‡					
	1996	42	60	117	219
	1991	49	40	77	166
	1986	21	28	42	91
	Total	112	128	236	476

† Purchased refrigerators in either 1996, 1991, or 1986. Fully completed surveys used in the market effects analysis, some additional partially-completed surveys were included in the market share analysis. The market effects analysis is reported in *Residential Market Effects Study: Refrigerators and Compact Fluorescent Lights*. Prepared for San Diego Gas & Electric and Pacific Gas & Electric by Hagler Bailly. March 1998. SDG&E Study ID #: 3902. PG&E Study ID #: 3302.

‡ Purchased refrigerators in either 1996, 1991, or 1986 and provided refrigerator make and model numbers that could be matched to AHAM data to obtain refrigerator characteristics and energy usage. These surveys were used in the market share analysis.

Free Rider Survey Attrition Table

	SDG&E	PG&E	Total
Starting Sample	215	190	405
No phone number	23	19	42
Ineligible †	13	2	15
Adjusted sample	179	169	348
Language Barrier	1	2	3
Refused	21	16	37
Unable to contact after 6 attempts	25	34	59
Completed surveys	103	110	213
Response rate ‡	57.5%	65.1%	61.2%

† Ineligible includes business numbers

‡ Computed as (completed surveys/adjusted sample)

3. **Statistical descriptions:** Not applicable.

D. DATA SCREENING AND ANALYSIS

1. **Procedures used for treatment of outliers, missing data points, and weather adjustments:** Respondents who did not provide refrigerator model numbers or who provided ones that could not be found in the AHAM database were re-called to attempt to collect valid model numbers. Collected model numbers were matched one-by-one with the 1996 AHAM refrigerator database. When exact matches could not be found the numbers were compared to other similar numbers of the same brand and manufacturer within the database. The first round of analysis considered clear character errors, omissions, or additions. The next round of analysis considered similar model numbers to identify characters, or strings of characters, that provided a clue to the energy use characteristics. In the final round of analysis, numbers that were not found in the booklet for the appropriate year were compared to numbers in the previous and succeeding years. Hand matching was required because small variations are often made to model numbers to indicate cosmetic differences between refrigerators and each variation of model number may not be represented in the AHAM data. For example, two refrigerators in the same brand and model may be different colors which would slightly change the overall model number. Because of all of the slight variations the model numbers were matched by hand to ensure proper identification. The matched model numbers are shown in Appendix D.

2. **Controlling for the effects of background variables:** See Chapter 4.

3. **Procedures used to screen data:** See Chapter 2, Section 2.3.

4. **Regression Statistics:** No regression models were used. Not applicable.

5. **Specification:**
   a. No regression models were used. Not applicable.
   b. No regression models were used. Not applicable.
   c. No regression models were used. Not applicable.
   d. No regression models were used. Not applicable.
   e. No regression models were used. Not applicable.

6. **Error in measuring variables:** Not applicable.

7. **Autocorrelation:** Not applicable

8. **Heteroskedasticity:** Not applicable.

9. **Collinearity:** Not applicable.

10. **Influential data points:** Not applicable.

11. **Missing data:** See discussion under point one above.

12. **Precision:** See Chapter 3, Step 7.

E. DATA INTERPRETATION AND APPLICATION

The rationale for choosing this method is presented in Chapter 2, section 2.3.

APPENDIX C
SDG&E AND PG&E PARTICIPANT FREE RIDER SURVEY INSTRUMENT

CASEID Unique Identification Number

REFRIGERATOR PARTICIPANTS

IDENTIFYING CORRECT RESPONDENT—REFRIGERATOR PARTICIPANTS

I2a Who in your household was involved in the decision of what type of refrigerator to purchase?

1 Respondent
2 Respondent and someone else
3 Someone else in household [ASK TO SPEAK WITH THAT PERSON]
4 Other [SPECIFY WHO; ASK TO SPEAK WITH THAT PERSON]
-8 Don't know
-9 Refused

ESTABLISHING BENCHMARK FOR DECISION PROCESS—REFRIGERATOR PARTICIPANTS

B1 What were your main reasons for purchasing a new refrigerator? (DO NOT READ; INDICATE ALL THAT APPLY)

For B1a to B1d:

1 Didn't have a refrigerator and needed on
2 Wanted a second refrigerator
3 Old refrigerator quit working
4 Old refrigerator still worked, but was not working properly
5 Old refrigerator cost too much too run; wanted energy-efficient refrigerator
6 Remodeled kitchen and wanted new refrigerator
7 Moved to a new residence
9 Need one for a rental unit
10 Need a bigger one
11 Wanted different type of refrigerator (one with more options)
-8 Don't know/recall
-9 Refused

B1a 1st Response
B1b 2nd Response
B1c 3rd Response

B1d 4th Response

B2 Did you hear about [SDG&E's/PG&E's] refrigerator rebate program BEFORE you started to shop for a new refrigerator?

1 Yes, heard about the program BEFORE started shopping
3 No, became aware while shopping
-8 Don't know/recall
-9 Refused

B3a When and how did you first learn about [SDG&E's/PG&E's] rebates for refrigerators?

1 Few years ago when replacing refrigerators for apartments
2 Through a flyer sent with bill
3 Ad in newspaper
4 Ad in newspaper and flyer in bill
5 After purchased refrigerator
6 At the store/displays in store (Sears)
7 From park manager
8 From salesman/employee of store
9 Word of mouth (friends, colleagues, etc.)
10 Ad on TV
11 Not sure when heard of it
-8 Don't know
-9 Refused

B4 How many stores did you visit while looking for a new refrigerator?

_____ stores
0 None [SPECIFY HOW SHOPPED FOR REFRIGERATOR]
-8 Don't know/recall
-9 Refused

B5 On a scale of 1 to 5 with 1 being "very easy" and 5 "very difficult", how easy was it to find the type of refrigerator you wanted in a high-efficiency model?

1	2	3	4	5	-8	-9
Very easy				Very difficult	Don't know	Refused

B6 Did the salesperson encourage you to buy a high efficiency model of refrigerator?

1 Yes
3 No
-8 Don't know/recall

-9 Refused

B7 When you were looking at new refrigerators, did you compare the energy efficiency level or efficiency ratings of different refrigerators?

1 Yes
3 No [SKIP TO F1]
-8 Don't know/recall [SKIP TO F1]
-9 Refused

B8 Did you compare efficiency levels of refrigerators BEFORE you heard about the rebate?

1 Yes
3 No [SKIP TO F1]
-8 Don't know/recall [SKIP TO F1]
-9 Refused
! NA

B9 Did you compare the prices of alternative refrigerators BEFORE you heard about the rebate?

1 Yes
3 No
-8 Don't know/recall
-9 Refused
! NA

FREE RIDER QUESTIONS—REFRIGERATOR PARTICIPANTS

F1 Had you planned to buy a model of the same high efficiency level BEFORE you heard of the rebate?

1 Yes
3 No [SKIP TO DEMOGRAPHICS]
-8 Don't know/recall
-9 Refused

F2 Would you most likely have paid the full price for the same high efficiency model of refrigerator if the rebate had <u>not</u> been available?

1 Yes [SKIP TO F4a]
3 No [SKIP TO DEMOGRAPHICS]
-8 Don't know/recall
-9 Refused

! NA

F3 So you are saying the rebate had no impact on your decision to purchase this high efficiency model of refrigerator?

1 Yes [SKIP TO DEMOGRAPHICS]
3 No
-8 Don't know/recall
! NA

(CATI CONSISTENCY CHECK: If the respondent answers "don't recall" to F2, or "no" or "don't

F4a Can you clarify for me in your own words what impact, if any, the rebate had on your decision to purchase that high efficiency model of refrigerator?

1 Would not have purchased without the rebate
2 Confirmed decision of which model to purchase
3 The rebate had not impact
4 Rebate allowed me to get a little bigger model of the same efficiency level
5 Rebate influenced decision on when to buy
6 Would have purchased refrigerator anyway, the rebate was a nice bonus
7 It was like a reimbursement to validate the purchase
8 Had not heard about rebate until the survey
9 Impacted by a combination of rebates from the utility and the store
10 Rebate had a little impact
11 Rebate allowed us to purchase a higher efficiency model
-8 Don't know
-9 Refused
! NA

[SKIP TO DEMOGRAPHICS]

DEMOGRAPHICS—ALL PARTICIPANTS

Finally, I need to ask you a few questions about your household. I want to assure you that all your answers are confidential. This information is only used for classification purposes.

D1a In what type of residence do you live?

1 Single family detached house
2 Mobile home or house trailer
3 2-4 unit multi-family building
4 5+ unit multi-family building
6 Condominium
7 Apartment
-8 Don't know
-9 Refused

D2a Do you own or rent this residence?

1 Own or buying
2 Rent or lease
4 Government owns building
-8 Don't know
-9 Refused

D3 What is the highest grade of schooling you have completed?

1 Grade school or less
2 Some high school
3 High school graduate
4 Some business or technical school
5 Business or technical school graduate
6 Some college
7 College graduate (4-year degree)
8 Some graduate work
9 Graduate degree
-8 Don't know
-9 Refused

D4 Which of the following age categories best describes your age? Are you . . . ?

1 Less than 25 years old
2 25 to 34 years old
3 35 to 44 years old
4 45 to 54 years old
5 55 to 59 years old
6 60 to 64 years old
7 65 years old or older
-8 Don't know
-9 Refused

D5 Finally, which of the following broad categories best describes your total household income in 1996 before taxes? Was it . . . ?

1 Less than $10,000
2 $10,000 to $14,999
3 $15,000 to $19,999
4 $20,000 to $29,999
5 $30,000 to $39,999
6 $40,000 to $49,999
7 $50,000 to $74,999
8 $75,000 to $99,999
9 $100,000 or more
-8 Don't know
-9 Refused

GEND
1 Male
3 Female

APPENDIX D
REFRIGERATOR MODEL NUMBER MATCHES

During the customer survey, respondents were asked to read the brand and model number of their refrigerator. Collected model numbers were matched one-by-one with the 1996 *Directory of Certified Refrigerators & Freezers* from the Association of Home Appliance Manufacturers (AHAM). When exact matches could not be found the numbers were compared to other similar numbers of the same brand and manufacturer within the database. The first round of analysis considered clear character errors, omissions, or additions. The next round of analysis considered similar model numbers to identify characters, or strings of characters, that provided a clue to the energy use characteristics. In the final round of analysis, numbers that were not found in the booklet for the appropriate year were compared to numbers in the previous and succeeding years. Hand matching was required because small variations are often made to model numbers to indicate cosmetic differences between refrigerators and each variation of model number may not be represented in the AHAM data. This appendix presents all of the matched model numbers for the 1996 data.

Brand	Model Given	Model Found
Admiral	RSWA228A	RSWA228AA*
Amana	5SXD2252W/20C	SXD22S2
Amana	BB120TE	BB120T
Amana	BR2256L	BR22S6
Amana	BX2055L	BX20S5
Amana	BX2055W	BX20S5
Amana	BX2255L	BX22S5
Amana	BX22A2W	BX22A
Amana	BX22RL	BX22R5
Amana	BX22S5E	BX22S5
Amana	BX22S5L	BX22S5
Amana	FRD27S4W	SRD27S4
Amana	SCD25TL	SCD25T
Amana	SCD25TL	SCD25T
Amana	SMD 22TBW	SXD22N
Amana	SRD2553W	SRD25S5
Amana	SRD25S5	SRD25S5
Amana	SRD25S5E	SRD25S5
Amana	SRD25S5W	SRD25S5
Amana	SSD25NBW	SSD25NB
Amana	SX25NW	SX25S
Amana	SXD22S2L	SXD22S2
Amana	SZI20NL	SZI20N
Amana	TA18TW	TA18T
Amana	TH21S3W	TH21S3

Brand	Model Given	Model Found
Amana	THI1863	THI18T
Amana	TXI21A3W	TXI21A3
Amana	TY2154W	TY21S4
Frigidaire	FRS22WNCW	FRS22WNC*1
Frigidaire	FRS22XGCWI	FRS22XGC*1
Frigidaire	FRS22XGWI	FRS22XGC*1
Frigidaire	FRS24XGZW	FRS24XHA*2
Frigidaire	FRS24ZGEW	FRS246ZGE*0
Frigidaire	FRS26ZSEB	FRS26ZSE*0
Frigidaire	FRT18KRE	FRT18TRC*1
GE	PFX20JAXA WW	TFX20JAX
GE	TBH18DATFROH	TBH18DAX
GE	TBX 18DA	TBX18DAX
GE	TBX 21 JAX FRAA	TBX21JAX
GE	TBX14DAX	TBX14DAX
GE	TBX16SIXGRAD	TBX16SIX
GE	TBX18DA	TBX18DAX
GE	TBX18JAXKRAA	TBX18JAX
GE	TBX18K	TBX18KAY
GE	TBX18SA	TBX18SAX
GE	TBX21JI	TBX21JIX
GE	TBX21MAXBRAA	TBX21MAX
GE	TBX21NI	TBX21NIX
GE	TBX22PASSRAA	TBX22PAX
GE	TBX22QA	TBX22PAX
GE	TBX22QAYARWW	TBX22PAX
GE	TBX22TASMRBB	TBH22PAS
GE	TCX22ZA	TCX22ZA
GE	TFHW24R	TFHW24RR
GE	TFX 20 JA	TFX20JAS
GE	TFX20JR	TFX20JRX
GE	TFX20JRX; TFX20NWX	TFX20JRX
GE	TFX222RXDWW	TFX22JRX
GE	TFX24JR	TFX24JRX
GE	TFX24PRXB	TFX24PFX
GE	TFX24R	TFX24RR
GE	TFX24S	TFX24SR
Gibson	MRT18FNBWI	MRT18FNB*1
Gibson	RT19PNAWO	MRT19PNB*2
Hotpoint	CKX18CAXCRWH	CTX18CAX
Hotpoint	CSH2GRT	CSH22GRT
Hotpoint	CSHX20KAXA	CSX20KAX
Hotpoint	CSX22GAY	CSX22GAS
Hotpoint	CSX22GR	CSX22GRS
Hotpoint	CSX22GRXA	CSX22GRX
Hotpoint	CTH18EATFRW	CTH18EAT
Hotpoint	CTX14CAPBRWH	CTX14CAT
Hotpoint	CTX14CYTBRWH	CTX14CYT
Hotpoint	CTX18BXKRWH	CTX18BAX

Brand	Model Given	Model Found
Hotpoint	CTX18EA	CTX18EAX
Hotpoint	CTX18GA	CTX18GAX
Hotpoint	CTX18GIXGRWW	CTX18GIX
Hotpoint	CTX18LYYBRWH	CTX18LYY
Hotpoint	CTX18LYYZRWH	CTX18LYY
Hotpoint	CX18G1SERWH	CTX18GIX
Kelvinator	MRT 18 BRAWO	MRT18BRC*0
Kenmore	106.95324	95324**
Kenmore	106.954551	95455**
Kenmore	106.9552881	95528
Kenmore	106.9552921	95529**
Kenmore	106.9555711	95557**
Kenmore	106.9555953	95559**
Kenmore	106.955712	95579**
Kenmore	106.965181	96518**
Kenmore	106.9658215	96582**
Kenmore	106.973831	97383**
Kenmore	106.975061	97506**
Kenmore	106.9759713	97597**
Kenmore	1069430010	94300**
Kenmore	1069552610	95526
Kenmore	1069555781	95557**
Kenmore	1069555781	95557**
Kenmore	1069638610	96386
Kenmore	1069659780	96597**
Kenmore	1069730681	97306**
Kenmore	1069738312	97383**
Kenmore	1069758613	97586**
Kenmore	253 936 1012	2539363010
Kenmore	2539668480	25396684*0
Kenmore	2539768411	2539768310
Kenmore	363-9759681	97596*
Kenmore	363.9731783	97317*
Kenmore	363.9759611	97596*
Kenmore	363.9764711	97647
Kenmore	3639550417	95504*
Kenmore	3639554710	95547*
Kenmore	3639711580	97515*
Kenmore	3639742884	97428*
Kenmore	3639752713	97527*
Kenmore	3639761514	97615**
Kenmore	3639762881	97628*
Kenmore	564.9933611	564.9935611
Kenmore	5649630410	564.96304*0
Kenmore	5649931741	564.9931741
Kenmore	596.953561	596.95356*
Kenmore	9550580	95505**
Kenmore	9552611	95526**
Kenmore	9555712	95557*

Brand	Model Given	Model Found
Kenmore	9557913	95579**
Kenmore	9658280	96582**
Kenmore	9750311	97503**
Kenmore	9751713	97517**
Kitchenaid	KBRS21 KDWH01	KBRS21KD**0*
Kitchenaid	KBRS21KDWH01	KBRS21KD**0*
Kitchenaid	KBRS22K	KTRS22KA**0*
Kitchenaid	KFRS27SDA	KSRS27QA**1*
Kitchenaid	KSR25QALIO	KSR*25QA**0*
Kitchenaid	KSRC22DA	KSRC22DA**0*
Kitchenaid	KSRP27QDALOO	KSRP27QD**0*
Kitchenaid	KSRS25FDWH01	KSRS25FD**0*
Kitchenaid	KSRS25QAWH10	KSRS25QA**1*
Kitchenaid	KSUS27QDWH00	KSUS27QD**0*
Kitchenaid	KTHC18KBWH00	KTHC18KB**0*
Kitchenaid	KTRS19KDAL01	KTRS19KD**0*
Kitchenaid	KTRS21KDAL02	KTRS21KD**0*
Kitchenaid	KTRS21KDWH04	KTRS21KD**0*
Kitchenaid	KTRS21MDWH	KTRS21MD**0*
Magic Chef	RB193A	RB193A*
Magic Chef	RC223A	RC223T*
Magic Chef	RV150T	RB150T*
Maytag	RCW2000D	RCW2000DA*
Maytag	RSD2000D	RSD2000DA*
Maytag	RSD2000D	RSD2000DA*
Maytag	RSD2400C	RSD2400DA*
Maytag	RST2200F	RSD2200DA*
Maytag	RSW24EODAE	RSW24EODA
Maytag	RSW2700E	RSW2700DA*
Maytag	RTD1800C	RTD1700CA*
Maytag	RTD21EOC	RTD21EODA*
Maytag	RWS22A00	RSW2200EA
Montgomery Ward	HMG19136	HMG19136
Montgomery Ward	HMG19155	HMG19155
Montgomery Ward	HMG211447	HMG21144*
Montgomery Ward	HMG21146	HMG21144*
Montgomery Ward	HMG21153	HMG21154*
Montgomery Ward	HMG231740	HMG23174*
Montgomery Ward	HMG62164	HMG62164*
Montgomery Ward	HMG67184	HMG67184*
Roper	RT12BKXDW00	RT12DK*D*0*
Roper	RT18HDXDW*5	RT18HD*D*0*
Roper	RT8HDXDW05	RT18HD*B*0*
Tappan	TRT18NREWO	MRT18JRB*1
Westinghouse	MRT18CSCW	MRT18CSC*0
Westinghouse	MRT18GREWO	MRT18GRC*0
Westinghouse	RT173L	MRT17HZB*1
Whirlpool	ED 22PW	ED22PW*D*0*
Whirlpool	ED20TKXDWOO	ET20TK*D*0*

Brand	Model Given	Model Found
Whirlpool	ED22DQXBB01	ED22DQ*B*0*
Whirlpool	ED22PW	ED22PW*A*0*
Whirlpool	ED25DQ	ED25DQ*A*0*
Whirlpool	ED25DQ	ED25DQ*A*0*
Whirlpool	ED25DQ	ED25DQ*D*0*
Whirlpool	ED25DS	ED25DS*D*0*
Whirlpool	ED25DSXDB03	ED25DS*D*0*
Whirlpool	ED25DSXDW01	ED25DS*D*0*
Whirlpool	ED25PWXAWO1	ED25PW*D*0*
Whirlpool	ED25TW	ED25TW*D*0*
Whirlpool	ED27DQ	ED27DQ*A*0*
Whirlpool	ET 20BK	ET20PK*D*0*
Whirlpool	ET18GKXDNO5	ET18GK*D*0*
Whirlpool	ET18NK	ET18NK*A*0*
Whirlpool	ET18NKXAN03	ET18NK*A*0*
Whirlpool	ET18PKXAW00	ET18PK*A*0*
Whirlpool	ET18ZK	ET18DK*A*0*
Whirlpool	ET1AGK	ET18GK*D*0*
Whirlpool	ET20NMXAW01	ET20NM*D*0*
Whirlpool	ET20PM	ET20PM*D*0*
Whirlpool	ET21DK	ET21DK*D*0*
Whirlpool	ET21DK OR DM	ET21DK*D*0*
Whirlpool	ET21DK/ET21DK/ET21 DM	ET21DK*D*0*
Whirlpool	ET21DKXZWO4	ET21DK*D*0*
Whirlpool	ET25DK	ET25DK*D*0*
Whirlpool	ETI8DKXBWOI	ET18DK*B*0*
Whirlpool	TT18CK	ET18ZK*D*0*
Whirlpool	TT18DKXEW03	ET18DK*A*0*
White Westinghouse	15CSCW	MRT15CSC*2
White Westinghouse	FRS26WRC	MRS24WRC*0
White Westinghouse	MRS20HRAW4	MRS20HRA*4
White Westinghouse	WRT 21NR CD	WRT21NRC*0*

C

PROTOCOLS TABLES 6 AND 7

This appendix presents the CPUC Protocols: Table 6 and Table 7. The following tables are presented in order:

- Table 6 - Refrigeration
- Table 6 - Lighting
- Table 7 - Refrigeration
- Table 7 - Lighting

Table 6 - Refrigeration

PACIFIC GAS & ELECTRIC
M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY96 HIGH EFFICIENCY REFRIGERATOR APPLIANCE INCENTIVE PROGRAMS
FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1998, PG&E STUDY ID NO. 373

Designated Unit of Measurement: REFRIGERATOR
END USE: RESIDENTIAL REFRIGERATION

				5. A. 90% CONFIDENCE LEVEL		5. B. 80% CONFIDENCE LEVEL	
				LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND
1. Average Participant Group and Average Comparison Group		**PART GRP**		**PART GRP**	**PART GRP**	**PART GRP**	**PART GRP**
A. Pre-install usage:	Pre-install kW	na		na	na	na	na
	Pre-install kWh	na		na	na	na	na
	Pre-install Therms	na		na	na	na	na
	Base kW	2,392		na	na	na	na
	Base kWh	15,633,683		na	na	na	na
	Base Therms	na		na	na	na	na
	Base kW/ designated unit of measurement	0.125		na	na	na	na
	Base kWh/ designated unit of measurement	820		na	na	na	na
	Base Therms/ designated unit of measurement	na		na	na	na	na
B. Impact year usage:	Impact Yr kW	1,731		na	na	na	na
	Impact Yr kWh	11,313,060		na	na	na	na
	Impact Yr Therms	na		na	na	na	na
	Impact Yr kW/designated unit	0.091		na	na	na	na
	Impact Yr kWh/designated unit	594		na	na	na	na
	Impact Yr Therms/designated unit	na		na	na	na	na
2. Average Net and Gross End Use Load Impacts		**AVG GROSS**	**AVG NET**	**AVG NET**	**AVG NET**	**AVG NET**	**AVG NET**
	A. i. Load Impacts - kW	661	859	458	1,266	547	1,178
	A. ii. Load Impacts - kWh	4,320,624	5,616,811	2,994,192	8,278,315	3,577,476	7,699,351
	A. iii. Load Impacts - Therms	na	na	na	na	na	na
	B. i. Load Impacts/designated unit - kW	0.035	0.046	0.024	0.067	0.029	0.062
	B. ii. Load Impacts/designated unit - kWh	227	295	157	435	188	405
	B. iii. Load Impacts/designated unit - Therms	na	na	na	na	na	na
	C. i. a. % change in usage - Part Grp - kW	27.6%	na	na	na	na	na
	C. i. b. % change in usage - Part Grp - kWh	27.6%	na	na	na	na	na
	C. i. c. % change in usage - Part Grp - Therms	na	na	na	na	na	na
	C. ii. a. % change in usage - Comp Grp - kW	na	na	na	na	na	na
	C. ii. b. % change in usage - Comp Grp - kWh	na	na	na	na	na	na
	C. ii. c. % change in usage - Comp Grp - Therms	na	na	na	na	na	na
D. Realization Rate:	D.A. i. Load Impacts - kW, realization rate	1.27	1.65	na	na	na	na
	D.A. ii. Load Impacts - kWh, realization rate	1.48	1.93	na	na	na	na
	D.A. iii. Load Impacts - Therms, realization rate	na	na	na	na	na	na
	D.B. i. Load Impacts/designated unit - kW, real rate	1.27	1.65	na	na	na	na
	D.B. ii. Load Impacts/designated unit - kWh, real rate	1.48	1.93	na	na	na	na
	D.B. iii. Load Impacts/designated unit - Therms, real rate	na	na	na	na	na	na
3. Net-to-Gross Ratios		**RATIO**		**RATIO**	**RATIO**	**RATIO**	**RATIO**
	A. i. Average Load Impacts - kW	1.3		69%	192%	83%	178%
	A. ii. Average Load Impacts - kWh	1.3		69%	192%	83%	178%
	A. iii. Average Load Impacts - Therms	na		na	na	na	na
	B. i. Avg Load Impacts/designated unit of measurement - kW	1.3		69%	192%	83%	178%
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	1.3		69%	192%	83%	178%
	B. iii. Avg Load Impacts/designated unit of measurement - Therms	na		na	na	na	na
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	na		na	na	na	na
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	na		na	na	na	na
	C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms	na		na	na	na	na
4. Designated Unit Intermediate Data		**PART GRP**		**PART GRP**	**PART GRP**	**PART GRP**	**PART GRP**
	A. Pre-install average value	na		na	na	na	na
	B. Post-install average value	na		na	na	na	na
6. Measure Count Data		**NUMBER**					
	A. Number of measures installed by participants in Part Group	19,059					
	B. Number of measures installed by all program participants in the 12 months of the program year	19,059					
	C. Number of measures installed by Comp Group	na					
7. Market Segment Data		**NUMBER**					
	Number of Participants -Gas	na					
	Number of Participants - Electric	19,059					

Note: The costs for this program were split between Residential Appliance Efficiency Incentives and Market Transformation funds, and benefits are divided proportionately between the two categories (51.2 % Appliance Efficiency Incentives and 48.8 % Market Transformation). Information shown in this table is scaled to represent accomplishments apportioned to the Residential Appliance Efficiency Incentives Program.

Note: No comparison group was used for this analysis and therefore all protocol comparison group questions are not applicable.

Note: All net savings values are based on the "Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Study Net-to-Gross Analysis "

Note: There is no precision estimate for the gross savings because the whole population was used instead of a sample.

Table 6 - Lighting

M&E PROTOCOLS TABLE 6 **Residential Appliance Efficiency Program**

Designated Unit of Measurement: Lamp
ENDUSE: Lighting

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	**LOWER BOUND**	**UPPER BOUND**	**LOWER BOUND**	**UPPER BOUND**	**LOWER BOUND**	**UPPER BOUND**	**LOWER BOUND**	**UPPER BOUND**
2. Average Net and Gross End Use Load Impacts		**AVG GROSS**	**AVG NET**	**AVG GROSS**	**AVG GROSS**	**AVG NET**	**AVG NET**	**AVG GROSS**	**AVG GROSS**	**AVG NET**	**AVG NET**
	A. i. Load Impacts - kW	101.9	51.4	91.6	112.2	32.9	69.9	93.8	109.9	37.0	65.8
	A. ii. Load Impacts - kWh	1,348,115	605,005	1,302,943	1,393,288	466,292	743,717	1,312,966	1,383,265	497,071	712,939
	A. iii. Load Impacts - Therms	na	na	na	na	na	na	na	na	na	na
	B. i. Load Impacts/designated unit - kW	0.016	0.008	0.014	0.017	0.005	0.011	0.014	0.017	0.006	0.010
	B. ii. Load Impacts/designated unit - kWh	207	93	200	214	72	114	202	213	76	110
	B. iii. Load Impacts/designated unit - Therms	na	na	na	na	na	na	na	na	na	na
	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	0.67	0.36	0.61	0.74	0.23	0.49	0.62	0.73	0.26	0.46
	D.A. ii. Load Impacts - kWh, realization rate	0.95	0.45	0.92	0.98	0.35	0.56	0.92	0.97	0.37	0.53
	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	0.67	0.36	0.61	0.74	0.23	0.49	0.62	0.73	0.26	0.46
	D.B. ii. Load Impacts/designated unit - kWh, real rate	0.95	0.45	0.92	0.98	0.35	0.56	0.92	0.97	0.37	0.53
	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	0.50		na	na			na	na		
	A. ii. Average Load Impacts - kWh	0.45		na	na			na	na		
	A. iii. Average Load Impacts - Therms	na		na	na			na	na		
	B. i. Avg Load Impacts/designated unit of measurement - kW	0.50		na	na			na	na		
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	0.45		na	na			na	na		
	B. iii. Avg Load Impacts/designated unit of measurement - Therms	na		na	na			na	na		
	C. i. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kW	na		na	na			na	na		
	C. ii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - kWh	na		na	na			na	na		
	C. iii. Avg Load Impacts based on % chg in usage in Impact year relative to Base usage in Impact year - Thms	na		na	na			na	na		
4. Designated Unit Intermediate Data				**PART GRP**	**PART GRP**			**PART GRP**	**PART GRP**		
	A. Pre-install average value	na		na	na			na	na		
	B. Post-install average value	na		na	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											
	A. Distribution by CEC climate zone	na									

Table 7 - Refrigeration

A. OVERVIEW INFORMATION

A.1. Study Title and Study ID Number

Study Title: *Impact Evaluation of Pacific Gas and Electric Company's 1996 Residential Appliance Efficiency Incentives Programs*

Study ID No: 373-1: Residential Appliance Efficiency: Refrigerators

A.2. Program Year and Program Description

Program year: 1996

The PG&E energy efficient refrigerator programs were designed to encourage refrigerator purchasers to save energy by buying new, high efficiency refrigerators. The programs provided incentives for the purchase of refrigerators that consumed less energy than is allowable under federal appliance standards. All units were required to be CFC free. The amount of incentive offered depended on the rate of energy consumption of the refrigerator relative to the federal energy consumption standard for the refrigerator.

A.2.a) Efficient Refrigerator Rebate Program (Rebate)

The 1996 program offered residential customers rebates of $40, $60, or $ 80 when they purchased a new energy efficient refrigerator that was 20, 25, or 30 percent or more efficient than the Federal Appliance Standard. In addition, all units were required to be CFC-free. The 1996 goal was 30,850 units. This program was funded between Residential Appliance Efficiency and Market Transformation programs. Benefits are divided proportionately between the two categories.

Refrigerator Incentives Offered by Rebate Program

Percentage Energy Savings Beyond Federal Standards	Rebate Amount
20%	$40
25%	$60
30% or more	$80

A.2.b) Refrigerator Salesperson/Dealer Incentive Program (SPIFF)

This program incented appliance salespeople/dealers to stock and sell high-efficient refrigerators and encouraged salespeople to sell these refrigerators from October 1 through November 24, outside of the efficient rebate program time period. Manufacturers informed PG&E that retailers often discontinued stocking efficient models during the non-rebate program months. Incentives to the salesperson and dealer for the 1996 program were as follows: 20 percent $10/$3, 25 percent $15/$5, and 30 percent $20/$8 where the incentives are paid to the salesperson and dealer, respectively.

Refrigerator Incentives Offered by SPIFF Program

Percentage Energy Savings Beyond Federal Standards	Salesperson/ Dealer Incentive
20%	$10/$3
25%	$15/$5
30% or more	$20/$8

A.3. End Uses Covered

The program covered new, high efficiency refrigerators.

A.4. Methods and Models Used

This section discusses the methodology used to evaluate PG&E's 1996 new energy efficient refrigerator programs. The method used to calculate gross savings is consistent with the CADMAC *Protocols and Procedures for the Verification of Costs, Benefits and Shareholder Earnings for Demand-Side Management Programs* (Protocols) for residential refrigeration. Net savings were calculated by applying a net-to-gross ratio to gross savings. The net-to-gross ratio calculation method is documented in the *Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Study Net-to-Gross Analysis* which is included as Appendix B.

A.4.a) Gross Impacts

Gross impacts were calculated using an engineering approach. This approach was validated by the CPUC and is consistent the California Protocols for high efficiency refrigerator impact studies. Savings were based on data contained in PG&E 1996 Refrigerator Rebate Programs tracking system.

(1) Gross Energy Savings

The energy savings were calculated for each refrigerator by subtracting the model's annual energy consumption from the annual energy consumption standard for a model of the same size and attributes. Both annual consumption and federal standards were based on the data contained in the CEC's Directory of Certified Refrigerators and Freezers. The American Home Appliance Manufacture's (AHAM) database was used as a backup source for consumption and standards information when program refrigerator model numbers were not listed in the CEC Directory. The total energy savings was calculated by summing the annual energy savings for all confirmed rebated refrigerators.

The equation used to calculate the gross energy is as follows:

$$GEI = \sum_{i}^{nr} \left(kWhStd_i - kWhRtd_i \right)$$

where:

GEI	= Gross Energy Impact
$kWh\ Std_i$	= the rated kWh per year consumption of units just meeting the Federal DOE standards, computed by using the attribute characteristics and adjusted volume of the rebated unit
$kWh\ Rtd_i$	= the rated kWh per year consumption of rebated unit
i	= for rebated unit I
nr	= the total number of rebated units

(2) Gross Load Impacts

The gross load impact for each refrigerator was calculated by applying a normalized refrigerator load factor applicable to the peak load hour to the average refrigerator load. The average load was calculated by dividing the gross energy impacts by 8,760 hour per year.

The equation used to calculate the gross load impact is as follows:

$$GLI = GEI * \frac{NRL}{8760 hr / yr}$$

where:

GLI	= Gross Load Impact
NRL	= Normalized Refrigerator Load, which is a factor relating the load at a given time to the average annual load = 1.34[1]

[1] Source: *Analysis of SCE and PG&E Refrigerator Load Data, AAG & Associates, Inc*., prepared for the California DSM Measurement Advisory Committee, April 5, 1995.

A.4.b) Net Impacts

Net impacts were calculated by multiplying a net-to-gross ratio to the gross savings. The net-to-gross ratio was developed under a separate study *Residential Appliance Efficiency Incentives Program: High Efficiency Refrigeration 1996 First Year Statewide Load Impact Study Net-to-Gross Analysis* which is included as Appendix B. The method incorporates the calculation of gross spillover effects and free ridership.

The equation used to calculate the net savings is as follows:

$$NS = GS * NTG$$

where:

NS	= Net Savings (kW or kWh)
GS	= Gross Savings (kW or kWh)
NTG	= Net-To-Gross Ratio = 1.30

A.5. Participant and Comparison Group Definition

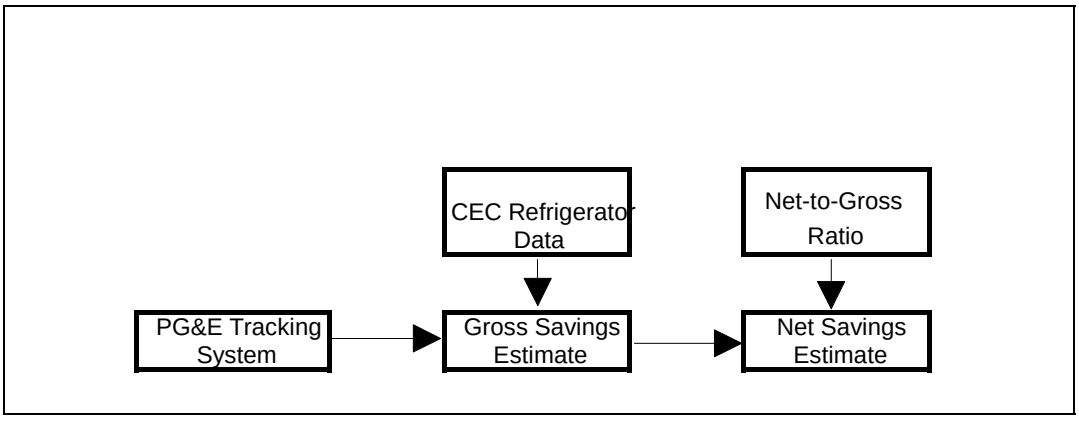
Program participants include all people who purchased high efficiency refrigerators and received rebates PG&E in 1996. There was no comparison group used in this analysis.

A.6. Analysis Sample Size

No sample was used for gross savings calculations. The population included 37,224 high efficiency rebated refrigerators.

B. DATABASE MANAGEMENT

B.1. Flow Chart



B.2. Specific Data Sources

PG&E Tracking System and CEC Refrigerator Database. See methodology discussed above.

B.3. Data Attrition

There are 37,282 refrigerator observations in the PG&E database. Of that total, 37,036 refrigerator observations have model numbers found in the CEC database, and 246 observation do not match. Using 9 model numbers from the AHAM database, account for another 188 observations. The total number of usable observations is 37,224. All units are qualifying high efficiency refrigerators. The total count is 12 more units than the 37,212 units that were reported in *the PG&E Annual Summary of DSM Programs - April 1997*.

Of the 58 observations with model numbers that do not match either database, all but 4 units have model numbers that say "QUALIFIYING", making them unusable. The remaining 4 units' model numbers also unusable due to assumed data entry errors.

B.4. Data Quality

Not applicable. Data not linked to customers. Model numbers in tracking system matched model numbers in CEC or AHAM databases.

B.5. Data Collected Specifically for the Analysis but not Used

None.

C. SAMPLING

Not applicable.

C.1. Sampling Procedures and Protocols

Not applicable.

C.2. Survey Information

Not applicable.

C.3. Statistical Descriptions

Not applicable.

D. DATA SCREENING AND ANALYSIS

D.1. Outliers, Missing Data Points and Weather Adjustment

Not applicable.

D.2. Control for the Effects of Background Variables

Not applicable.

D.3. Screening Data

Not applicable.

D.4. Regression Statistics

Not applicable.

D.5. Specification

Not applicable.

D.5.a) Heterogeneity

Not applicable.

D.5.b) Changes

Not applicable.

D.5.c) Self-Selection

Not applicable.

D.5.d) Omitted Factors

Not applicable.

D.5.e) Interpretation as Net Impacts

Not applicable.

D.6. Error in Measuring Variables

Not applicable.

D.7. Autocorrelation

Not applicable.

D.8. Heteroskedasticity

Not applicable.

D.9. Collinearity

Not applicable.

D.10. Influential Data Points

Not applicable.

D.11. Missing Data

Not applicable.

D.12. Precision

Not applicable.

E. DATA INTERPRETATION AND APPLICATION

E.1. Net Impacts

Net impacts were calculated using methods falling under category 1d of Section E of Protocols Table 7 and other application methods agreed upon by CADMAC

E.2. Rationale

The method conforms to ProtocolsC-3B.

The costs for these programs were split between Residential Appliance Efficiency Incentives and Market Transformation funds, and benefits and accomplishments are divided proportionately between the two categories (51.2% Appliance Efficiency Incentives and 48.8 % Market Transformation).

Table 7 - Lighting

A. OVERVIEW INFORMATION

A.1. Study Title and Study ID Number

Study Title: *Impact Evaluation of Pacific Gas and Electric Company's 1996 Residential Appliance Efficiency Incentives Programs*

Study ID No: 372: High Efficiency Lighting

A.2. Program Year and Program Description

Program year: 1996

In 1996, rebates for the installation of efficient lighting technologies evaluated in this study were disseminated via the Multifamily Property Direct Incentive Program. This program was authorized under the Residential Appliance Efficiency Program but was integrated into the Nonresidential Retrofit Express Program in 1995. As a result of a decrease in marginal costs and the incorporation of the results of the M&E studies, the Multifamily Property Direct Incentive Program did not pass the TRC test and was not offered in 1996. Net energy impacts during 1996 were from carry-over applications from 1995 which were paid in 1996.

For 1996, a total of 87 carry-over lighting applications were paid.

A.3. End Uses Covered

Lighting.

A.4. Methods and Models Used

Gross impacts were determined using an engineering analysis supported by the on-site surveys. Energy (kWh) and demand (kW) impacts were developed using the following basic equations:

Energy:

$$kWh_{Saved} = [Watts_{SavedPerFixture}] \times [\text{Hours of Operation Per Day}] \times [1\ \text{kWh} / 1{,}000\ \text{Watts}] \times 365.$$

Demand:

$$kW_{Reduced} = [Watts_{SavedPerFixture}] x [\text{Peak Coincident Factor}] x [1\ \text{kW} / 1{,}000\ \text{Watts}].$$

Net impacts were developed using a self-report free-ridership survey. Multi-family complex owners/managers were asked a series of questions to determine what they would have done in the absence of the program.

A.5. Participant and Comparison Group Definition

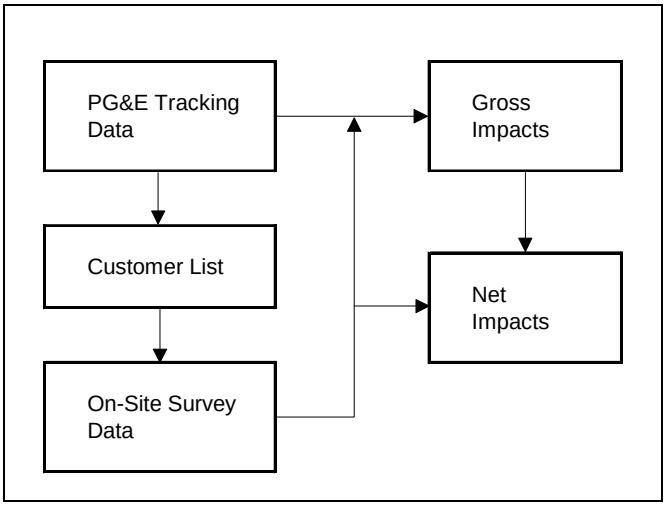
Program participants were defined as multifamily common area customers who purchased high efficiency lighting and received rebates from PG&E in 1996. There was no comparison group used in this analysis.

A.6. Analysis Sample Size

Number of customers: 71 complexes
Number of measures: 3,224 units

B. DATABASE MANAGEMENT

B.1. Flow Chart



B.2. Specific Data Sources

Tracking Data:

MFAPP96.SD2	SAS dataset - application-level data
MFITEM96.SD2	SAS dataset - item (measure) level data

On-site survey data:

LIGHT1.SD2	SAS dataset - light fixture types, counts and operating hours
LIGHT2.SD2	SAS dataset - participation decision questions

Program files:

LIGHT.SAS	SAS program to determine gross impacts and output net-to-gross frequencies for net-to-gross analysis
LIGHTNTG.XLS	Net-to-gross analysis spreadsheet

B.3. Data Attrition

Total program sites:	87
Sites with identified service address:	84
Sites surveyed for gross impacts:	71
Sites surveyed for net impacts:	61

B.4. Data Quality

The PG&E control number was used to link tracking data and survey data.

B.5. Data Collected Specifically for the Analysis but not Used

Not applicable.

C. SAMPLING

Not applicable.

C.1. Sampling Procedures and Protocols

Not applicable.

C.2. Survey Information

Survey instrument and sample disposition are provided in Appendix A of the Report.

C.3. Statistical Descriptions

Not applicable.

D. DATA SCREENING AND ANALYSIS

D.1. Outliers, Missing Data Points and Weather Adjustment

Not applicable.

D.2. Control for the Effects of Background Variables

Not applicable.

D.3. Screening Data

Not applicable.

D.4. Regression Statistics

Not applicable.

D.5. Specification

Not applicable.

D.5.a) Heterogeneity

Not applicable.

D.5.b) Changes

Not applicable.

D.5.c) Self-Selection

Not applicable.

D.5.d) Omitted Factors

Not applicable.

D.5.e) Interpretation as Net Impacts

Not applicable.

D.6. Error in Measuring Variables

Not applicable.

D.7. Autocorrelation

Not applicable.

D.8. Heteroskedasticity

Not applicable.

D.9. Collinearity

Not applicable.

D.10. Influential Data Points

Not applicable.

D.11. Missing Data

Not applicable.

D.12. Precision

Not applicable.

E. DATA INTERPRETATION AND APPLICATION

E.1. Net Impacts

Net impacts were calculated using methods falling under category 1c of Section E of Protocols Table 7 and other application methods agreed upon by CADMAC

E.2. Rationale

Given the limited number of participants (since this program is a 1995 carry-over) and the difficulty in performing billing analysis on this market segment (i.e., problems in collecting and aggregating bills for multi-account sites, nonprogram impacts at the site, increases in levels of lighting services during the retrofit, etc.), an engineering analysis was the most appropriate approach for developing accurate gross savings impacts. To accompany this gross savings approach, a self-report net-to-gross method was deemed most appropriate. Other net-to-gross methods based on statistical comparisons were not suitable for this study, given the limited number of participants, the large variation in types of multifamily complexes, and subsequent difficulty in identifying an appropriate control group.