RESIDENTIAL APPLIANCE EFFICIENCY INCENTIVES PROGRAM: FLUORESCENT LIGHTING (CFL) 1994 FIRST YEAR STATEWIDE LOAD IMPACT STUDY

Final Report

SDG&E STUDY ID #: 920
SCE STUDY ID #: 513
PROJECT ID #: 2063L

Prepared for
Southern California Edison
San Dimas, California
and
San Diego Gas & Electric
San Diego, California

Prepared by

XENERGY Inc.
Oakland, California

February 1996

oa:wsce14:report:cfl:title

TR48248.X2

LIST OF FIGURES

LIST OF TABLES

E EXECUTIVE SUMMARY

This report presents the results of the First Year Statewide Load Impact Evaluation of 1994 Residential Compact Fluorescent Lighting (CFL) Incentives Programs. This evaluation determined the gross and net impacts resulting from compact fluorescent lighting (CFL) rebate programs sponsored by Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E).

This Executive Summary presents the key findings of the analysis.

E.1 PROGRAM BACKGROUND

The programs analyzed in this evaluation were the Southern California Edison and San Diego Gas & Electric CFL rebate programs. Both SCE's and SDG&E's programs provided incentives for the purchase of CFLs to encourage the replacement of incandescent lamps and thereby save energy. Both utilities directed their rebates to manufacturers who, in turn, passed the savings on through their product distribution chains, thus providing substantial cost reduction to retail customers. SCE offered the rebated CFLs only through retail outlets. SDG&E offered their rebate bulbs both through retail outlets and through a variety of demand-side management programs, including direct install programs.

E.2 GROSS IMPACTS

Gross impacts were calculated using a triangulated engineering approach. Savings were based on the difference in the energy consumption between CFLs and the incandescent lamps that they replaced.

Table E-1 shows program energy and demand savings estimates. SCE's residential CFL program saved about 43.5 GWh per year and SDG&E's program saved about 19.0 GWh per year. Peak demand savings for SCE were about 4.9 MW and peak demand savings for SDG&E were about 2.1 MW.

Table E-1
Gross CFL Program Energy and Demand Savings Estimates

Utility	Number of Distributed CFLs	Total Gross Energy Savings (GWh/year)	Total Gross Peak Demand Savings (MW)
SCE	613,417	43.5	4.9
SDG&E	310,297	19.0	2.1
Combined	923,714	62.5	7.0

E.3 NET IMPACTS

The net-to-gross analysis was conducted by comparing the penetration of CFLs purchased in 1994 within and outside of California. Data were collected through a survey of Southern California residents and residents of five cities outside of California. None of the electric utilities serving the out-of-California areas had ever offered a residential CFL program.

The methodology incorporated both spillover and free-ridership impacts, with the CFL penetration outside of California serving as a proxy for in-state free ridership. The analysis was designed to make use of the surveying effort planned for the residential refrigerator evaluation that was conducted at the same time[1].

Table E-2 illustrates the CFL penetration differences between California and the out-of-state control areas. It shows that California households purchased CFLs at about twice the rate as households in the control areas: 10 percent in California as opposed to five percent in the control areas. For those households that did purchase CFLs in 1994, the average number of CFLs purchased was about the same.

Table E-2
Rate of CFL Penetration in California and Control Areas

	Percentage of Households that Purchased CFLs in 1994	CFLs Purchased per Household	Install & Retain Rate	CFLs Installed and Retained per Household	1994 Penetration Rate for CFLs per Household
CA	10.0%	3.76	85%	3.21	0.3227
Out-of-State	5.1%	3.70	83%	3.08	0.1585
Difference	4.9%	0.06	2%	0.13	0.1641

[1] *Statewide Impact Evaluation of 1994 Residential High Efficiency Refrigerators Rebate Programs*, XENERGY, January 1996.

This study estimated the net-to-gross ratio to be 0.90 for the residential application of CFLs from 1994 California CFL programs. A net-to-gross value of 0.75 was applied to the commercial application of CFLs distributed through the programs[2]. The program savings were calculated using these net-to-gross ratios and are presented in Table E-3.

Table E-3
Net Results

Utility	Total Net Energy Savings (GWh/year)	Total Net Peak Demand Savings (MW)
SCE	37.1	3.9
SDG&E	16.9	1.8
Combined	54.0	5.6

E.3.1 Data Collection

The net-to-gross analysis survey used random digit dialing to reach residential customers in both the California and out-of-state study areas. In the course of the study, 93,169 telephone calls were placed and 10,815 surveys were completed. Demographic data were collected for all respondents who purchased CFLs and 20 percent of the respondents who did not.

[2] The 0.75 net-to-gross value is based on the California protocol for default miscellaneous commercial applications.

1 INTRODUCTION

1.1 OVERVIEW

This report presents impact evaluation results for the Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E) residential compact fluorescent lighting (CFL) programs for 1994.

Gross savings were calculated using a triangulated engineering approach. Net savings were estimated using a survey-based net-to-gross analysis. The study was conducted in conjunction with the Statewide Impact Evaluation of 1994 Residential High Efficiency Refrigerator Rebate Programs. In particular, the net-to-gross methodology was designed to make use of the data collection effort planned for the refrigerator evaluation.

1.2 PROGRAM DESCRIPTIONS

SCE's and SDG&E's residential CFL programs were promoted energy savings by encouraging residential customers to replace incandescent lamps with CFLs. Both utilities were able to achieve substantial cost reductions for their residential customers by providing CFL rebates at the manufacturer level.

1.2.1 SCE's Program

SCE provided an average incentive of five dollars per CFL to 11 participating manufacturers who were willing to pass the full incentive amount on through their distribution systems. Many of the manufacturers provided additional incentives. The program ran from January 6 through December 31, 1994, and involved more than 700 retail outlets including most major retail chains in SCE's service territory. More than $3,000,000 in incentives were paid for 613,417 CFLs.

1.2.2 SDG&E's Program

SDG&E distributed 296,954 CFLs from Lights of America to residential customers. Five CFL wattages were offered through a combination of retail and internal programs. Of the total CFLs distributed by SDG&E, 213,750 were purchased by customers through retail outlets. The remaining 83,204 CFLs were distributed through a

variety of internal programs including direct install programs and give-away programs with corporate sponsorship.

1.3 EVALUATION APPROACH

Gross impacts were calculated using a triangulated engineering approach. Several sources of information were used to validate each factor that went into the analysis. Savings were based on the difference in the energy consumption between CFLs and the incandescent lamps that they replaced.

An important factor in the analysis was the annual hours of operation for CFLs. The estimates used in the analysis were based on metered data from PG&E and supported by metering studies from SCE and SDG&E.

Net savings were calculated by applying a net-to-gross ratio to the gross savings.

The net-to-gross analysis was conducted by comparing penetration of CFLs purchased in 1994 in California to those purchased out-of-state. Data were collected through a survey of California residents and residents of five cities outside California. Electric utilities serving the out-of-state respondents have never offered a residential CFL rebate program.

1.4 REPORT ORGANIZATION

The remainder of this report is organized as follows:

- Section 2 contains the key results of the evaluation.
- Section 3 contains a discussion of the analysis methodology and the data development.
- The survey questions used for the net-to-gross analysis are presented in Appendix A.
- Appendix B provides the CADMAC Protocol Tables 6 and Table 7.
- Appendix C contains a bibliography of reports.
- Appendix D contains the SDG&E and SCE Proposed Retroactive Waiver for 1994 Residential Appliance Efficiency Incentive Program High Efficiency Lighting.
- Appendix E contains the SDG&E *Residential Appliance Efficiency Incentives: Compact Fluorescents, Gross Impact*

Study, 1994 Residential CFL Program, Final Report. (Because Appendix A to the Gross Impact Study contains the same report that is included as Appendix F to this Statewide CFL Impact Study, we have included the report only once, in Appendix F.)

- Appendix F presents the SDG&E *1995 Residential Compact Fluorescent Lamp Peakday Survey.*

2 RESULTS

2.1 OVERVIEW

This section presents results of the 1994 Southern California Compact Fluorescent Program Impact Analysis. Results are shown for the Southern California Edison and San Diego Gas & Electric programs.

2.2 GROSS ENERGY SAVINGS

In Table 2-1, total annual energy consumption data are presented for the SCE and SDG&E 1994 CFL programs.

SCE's programs were responsible for distributing more than 500,000 CFLs in its service territory to residential customers for savings of about 29 GWh per year. At the same time, the residential program distributed almost 100,000 CFLs to commercial customers for an additional savings of about 15 GWh per year. The total gross savings from SCE's residential CFL program was about 43.5 GWh per year.

SDG&E's programs were responsible for distributing almost 300,000 CFLs to residential customers for savings of about 17 GWh per year. SDG&E also saved another 2 GWh per year from commercial customers purchasing CFLs offered through the SDG&E residential program. The total gross savings from SDG&E's residential CFL program were about 19.0 GWh per year.

On average, each CFL installed in a residential application saved about 56 kWh/year each. An average usage of 958 hours per year, 2.6 hours per day, was used to calculate energy savings in residential applications for both utilities.

The CFLs that were used in commercial applications saved an average of about 160 kWh per year. An average usage of 3,000 hours per year, 8.2 hours per day, was assumed for the commercial use of CFLs for both utilities.

Table 2-1
Components of the Gross CFL Energy Savings Estimates

Utility	Number of Distributed CFLs	Per-unit Gross Watt Savings	Average Hours/day of Use	Average per-unit Energy Savings (kWh/year)[1]	Total Gross Energy Savings (GWh/year)[2]
SCE Res	521,704	57.8	2.6	55.4	28.9
SCE Com	91,713	53.1	8.2	159.3	14.6
SCE All	613,417	57.1	3.5	70.9	43.5
SDG&E	310,297	58.9	2.9	61.3	19.0
Combined Res	818,658	58.2	2.6	55.8	45.7
Combined Com	105,055	53.5	8.2	160.4	16.8
Combined All	923,714	57.7	3.3	67.7	62.5

1 Equals watts x hours/day x 365 days/year ÷ 1000
2 Equals kWh/unit x units x percent installed ÷ 1,000,000

The data presented in Table 2-2 show that the average replaced incandescent lamp's wattage for residential application was about 77 watts and the average installed CFL wattage was between 18 and 20 watts.

Table 2-2
Average Replaced Incandescent Wattage and Replacement CFL Wattage

Utility	Base Case Average Incandescent Bulb Wattage	Replacement Average CFL Wattage	Average Per-CFL Savings (Watts)
SCE Res	77.0	19.1	57.8
SCE Com	71.4	18.3	53.2
SDG&E	77.0	18.1	58.9

2.3 GROSS LOAD IMPACTS

Table 2-3 shows the gross peak demand impact of the SCE and SDG&E residential CFL programs. The SCE program saved more than 1 MW of peak demand from residential application and almost 4 MW of peak demand from commercial applications for a total of 4.9 MW of peak demand savings. The SDG&E programs saved about 2.1 MW of peak demand. SDG&E's Residential Retail component includes a small quantity of commercial sales, representing approximately four percent of the retail program's total activity.

Table 2-3
Gross Peak Demand Impacts

Utility	Number of Installed CFLs	Per-unit Gross Watt Savings	Diversity Factor[1]	Per-unit Gross Peak Watt Savings[2]	Total Gross Peak Demand Savings (MW)[3]
SCE Res	521,704	57.8	4.1%	2.4	1.25
SCE Com	91,713	53.1	75%	39.8	3.65
SCE All	613,417	57.1	15%	8.4	4.9
SDG&E	310,297	58.9	11%	6.7	2.1
Combined Res	818,658	58.2	5.7%	3.3	2.75
Combined Com	105,055	53.5	75%	40.1	4.21
Combined All	923,714	57.7	13.1%	7.5	6.96

1 Equals percentage of CFLs turned on at peak hour
2 Equals watt savings/unit x diversity
3 Equals peak watt savings/unit x installed units ÷ 1000

2.4 NET SAVINGS

The results of the net-to-gross analysis for the residential application of CFLs produced a net-to-gross ratio of 0.90. This ratio indicates that the programs achieved what they set out to accomplish, and maybe a little more. Applying this net-to-gross ratio to the gross savings produced the net savings shown in Table 2-4. The data show the programs' net energy savings were about 37.1 GWh/year for SCE and 16.9 GWh/year for SDG&E. The data also show that the net peak demand savings for SCE were about 3.9 MW and 1.8 MW for SDG&E.

Table 2-4
Net Savings

Utility	Total Net Energy Savings (GWh/year)	Total Net Peak Demand Savings (MW)
SCE Res	26.1	1.13
SCE Com	11.0	2.74
SCE All	37.1	3.9
SDG&E All	16.9	1.8
Combined Res	41.3	2.5
Combined Com	12.6	3.2
Combined All	54.0	5.6

2.4.1 Net-to-Gross Analysis Confidence Interval

Table 2-5 shows the net-to-gross ratio range based on 80 and 90 percent confidence intervals. The 90 percent confidence interval indicates that the true net-to-gross ratio falls between 0.73 and 1.08.

Table 2-5
Net-to-Gross Estimate Confidence Intervals

	Point Estimate	Low	High
@ 90% Confidence	90%	73%	108%
@ 80% Confidence	90%	77%	104%

2.4.2 Differences in CFL Penetration Rates Between California and the Control Areas

A major factor in determining the net-to-gross ratio was the difference between the penetration of CFLs in California relative to the control areas. Those differences are shown in Table 2-6. From these data it is evident that California households purchased CFLs at about twice the rate as households in the control areas. The survey data showed that about 10 percent of the households in California purchased CFLs in 1994 and as compared to five percent of the households in the control areas. For those households that did purchase CFLs in 1994, however, the average number of CFLs purchased was about the same in- and out-of-state, at about 3.7 bulbs per household. The penetration rate difference is 0.1641 CFLs per household.

Table 2-6
Rate of CFL Penetration in California and Control Areas

	Percentage of Households that Purchased CFLs in 1994	CFLs Purchased per Household	Install & Retain Rate	CFLs Installed and Retained per Household	1994 Penetration Rate for CFLs per Household
CA	10.0%	3.76	85%	3.21	0.3227
Out of State	5.1%	3.70	83%	3.08	0.1585
Difference	4.9%	0.06	2%	0.13	0.1641

Table 2-7 shows the difference in the number of CFLs purchased and installed for California and the control areas. Installed CFLs are net those CFLs that were installed but later removed. The percentage of CFLs installed, and still installed at the time of the survey, was 85% in California and 83% in the control areas.

Table 2-7
Components of the CFL Penetration Rate

	CFLs Purchased	CFLs Installed: Net Removals	Penetration Rate
California	1,752	1,497	85%
Out of State	877	731	83%

3 METHODOLOGY

3.1 OVERVIEW

This section discusses the methodology used to calculate the gross and net kWh and load impacts.

A critical issue affecting this analysis is the number of CFLs distributed through the residential programs to the commercial sector. These bulbs were all purchased through retail outlets and, for the most part, in small quantities. It is therefore assumed that most of these bulbs were installed in small business applications.

Although the percentage of CFLs installed in commercial application was small, 15 percent for SCE and five percent for SDG&E, the commercial application of CFLs is substantially different from residential use particularly with regard to the hours of use and load shape. To the extent possible, this analysis accounted for the distinctions and used separate assumptions to calculate commercial impacts.

The net-to-gross analysis that was conducted as part of this study was for the residential sector. A separate net-to-gross ratio of 0.75 was used for the CFLs installed in the commercial sector. This value was based on the default miscellaneous commercial net-to-gross ratio from the CPUC Measurement and Evaluation Protocols.

3.2 GROSS IMPACT ESTIMATES

In this study, gross savings were defined as the first year energy and peak demand savings potential from CFLs distributed through SCE's and SDG&E's residential CFL programs. The gross kWh impacts were estimated using Equation 2-1.

(Equation 2-1)

$$GKWH = \sum_{s} Bulbs_{s} \times \Delta Watts_{s} \times Hours_{s} / 1000$$

where:

GKWH	= gross kWh impacts
Bulbs	= the number of bulbs provided through each program
ΔWatts	= the average change in wattage from the base incandescent lamps to CFL

Hours = the average hours of operation for the changed lamps

s = market segment including utility service area and sector

Gross kW impacts were estimated using Equation 2-2, in which the installed bulbs were multiplied by the peak wattage savings. The peak wattage savings were defined as the change in wattage multiplied by the diversity factor.

(Equation 2-2)

$$GKW = \sum_{s} \Delta Watts_s \times Diversity_s \times Bulbs_s / 1000$$

where:

GKW = gross kW impact

Diversity = diversity factor, the percentage of lamps on at the system peak, represented by the percentage of time that the lamps are on during the peak planning hour

3.3 NET IMPACT ESTIMATES

Residential net impact estimates were based on a comparison of the penetration of residential CFLs in the treatment areas, which included SCE's and SDG&E's services territories, with the penetration of residential CFLs in the control areas, which included Boise, Idaho; Las Vegas, Nevada; Phoenix, Arizona; Tulsa, Oklahoma; and Shreveport, Louisiana.

A net-to-gross ratio was calculated from residential survey results using Equation 2-3.

$$NTG = \frac{TCP - TCB}{Bulbs} \qquad \text{(Equation 2-3)}$$

where:

NTG = net-to-gross ratio

TCP = total California penetration

TCB = total California baseline

Bulbs = the total number of bulbs provided through SDG&E and SCE programs

$$NTG = 0.90 = \frac{1{,}456{,}053 - 715{,}345}{818{,}658}$$

The TCP represents the full California residential penetration of CFLs including spillover effects. This value was calculated by multiplying the

California CFL retention rate for 1994 by the number of households in the SDG&E and SCE services territories.

The TCB represents the naturally-occurring and free-ridership level of California-purchased residential CFLs. This value was calculated by multiplying the control area CFL retention rate for 1994 by the number of households in the SDG&E and SCE services territories.

The California penetration and baseline levels were calculated using Equations 2-4 and 2-5.

$$TCP = TCPR \times HH \qquad \text{(Equation 2-4)}$$
$$TCP = 1{,}456{,}053 = 0.3227 * 4{,}512{,}500$$

$$TCB = OSPR \times HH \qquad \text{(Equation 2-5)}$$
$$TCB = 715{,}345 = 0.1585 * 4{,}512{,}500$$

where:

TCPR	= California penetration rate derived from the phone survey data
OSPR	= out-of-state penetration rate derived from the phone survey data
HH	= number of households (SDG&E and SCE) derived from billing records

The commercial net-to-gross ratio is assumed to be 0.75, which is the CPUC Protocol default miscellaneous value.

In Equations 2-6 and 2-7, the net-to-gross ratio is applied to the gross impacts to produce net impacts.

$$NKWH = \sum_{s} GKWH_s \times NTG_s \qquad \text{(Equation 2-6)}$$

$$NKW = \sum_{s} GKW_s \times NTG_s \qquad \text{(Equation 2-7)}$$

where:

NKWH	= net kWh impact
GKWH	= gross kWh impact
NKW	= net kW impact
GKW	= gross kW impact
NTG	= net-to-gross ratio
s	= segment

3.3.1 Net-to-Gross Precision Estimate

The net-to-gross precision was estimated using a two sample independent *t* test. The equation to calculate the sampling distribution around the difference between means is as follows:

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

where:

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

s^2_{pooled} = pooled variance estimate

N_n = number of observations

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

where:

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

3.4 Data Development for Gross Impact Analysis

The calculation of gross impacts began with the collection of data to estimate each component of the gross impact equation. This section discusses each of those components and how the data was developed.

3.4.1 Bulbs

The total number of bulbs disseminated through the 1994 programs was provided to XENERGY by SDG&E and SCE.

SCE's CFL count included all CFLs for which they provided incentives. An analysis of the SCE bounce-back cards mailed in by customers indicates that 85 percent of the bulbs were installed in residences. The other 15 percent were installed in commercial applications[1].

SDG&E provided a separate count of CFLs used in residential and commercial applications.

[1] SCE provided incentives for 613,417 CFLs. The bounce-back cards indicated that 84 percent went to residential applications, 14 percent went to commercial applications, and the remainder went to both. For this analysis, XENERGY considered that half of the CFLs that were indicated for "both" applications were used in residences and half were used in commercial applications.

Bulbs That Left the Service Territory

SCE bounce-back cards indicate that some percentage of the bulbs for which SCE paid rebates left SCE's service territory. At first glance, this could be a cause for concern, but on further reflection, it is not an issue.

The numerator of the net-to-gross equations equals the total number of CFLs installed in the treatment area including all program CFLs and non-program CFLs. The numerator is estimated from the survey alone without consideration of program CFL counts. The denominator of the net-to-gross equation equals the number of program CFLs. The net-to-gross ratio compares the total number of installed CFLs to the number of program CFLs. Therefore, the net-to-gross ratio accounts for all CFLs that migrated in and out of the treatment area.

3.4.2 Change in Watts

Each utility provided data to support a change in wattage estimate. Differences in the data quality and format required slightly different approaches to estimating wattage changes for each utility. The average change in wattage was calculated by averaging the two utilities' values, weighted by the number of bulbs distributed by each utility.

Bounce-Back Cards

To a large extent, the change in wattage was based on an analysis of manufacturer's customer response cards, also called "bounce-back cards." Although there is a possibility that these data contain a self-selection bias, we believe that the bounce-back cards provide a reasonably representative sample of the population. Furthermore, by virtue of the magnitude of data, bounce-back cards provide the best available means of tracking most CFL distribution and estimates of replacement wattage.

The number of bounce-back card observations used to estimate the change in residential bulb wattage was 10,073 for SCE and 16,307 for SDG&E.

SDG&E

SDG&E provided two primary data sources to calculate the change in wattage for CFLs in residential applications, one for each of their programs:

- The Retail Program: Bounce-back cards were used to calculate the change in wattage from the SDG&E retail program. These data included the manufacturer's claimed wattage for the CFL replacement bulbs and the customer-provided wattage for the incandescent bulbs that were replaced.
- Internal Programs: Tracking system records of bulb replacements performed by SDG&E employees were used to calculate the change in wattage for the SDG&E internal programs. The tracking system contained the manufacturer's claimed wattage for the CFL replacement bulbs and installer-provided wattage for the incandescent bulbs that were replaced.

For both of these datasets, the change in wattage was calculated at a high level of disaggregation. Using bounce-back card responses and tracking system records, a separate change in wattage was calculated for each size of CFL for each program. The change in wattage was then weighted by the number of bulbs in each category of CFL wattage and program and summed to the average change in wattage for each program. Finally, the average change in wattage for each program was calculated by summing the change in wattage for each program, weighted by the number of bulbs installed through each program.

For both of these datasets, XENERGY considered the likelihood of incandescent bulb reporting errors. Typically, CFLs replace incandescent bulbs that are about four times the CFL's wattage. As a test, XENERGY recalculated the change in wattage with a dataset cleaned of outliers. Outliers were defined as any matched pairs (replaced incandescent and replacement CFL) with an incandescent wattage to CFL wattage ratio less than two or greater than eight. The "cleaned" dataset produced an average change in wattage that was less than one percent different from the change in wattage based on the data initially provide by SDG&E. This small difference was insignificant relative to other potential errors due to sampling, and consequently did not justify using "cleaned" data.

SDG&E Commercial Application

The change in wattage from the CFLs in commercial applications was calculated separately. This value was estimated by averaging the changes in wattage indicated for bounce-back cards identified as commercial applications. The change in wattage from the CFLs in commercial applications was based on 737 bounce-back card observations.

SCE

SCE provided bounce-back cards as the primary form of data with which to calculate the change in wattage. Customers reported both the CFL and replaced incandescent wattage. It was clear that some of the bounce-back card respondents were either confused about the differences between CFL wattage relative to the replaced incandescent wattage or made significant changes in the quality of lighting. Evidence of this included reports of unrealistic CFL wattage (e.g., 100 watt CFLs), negative savings where the incandescent wattage was lower than the CFL wattage, and savings that would indicate profound reductions in lighting quality (e.g., replacing a 100 watt incandescent with a two watt CFL). XENERGY cleaned this data using a similar strategy to the one described above. XENERGY included bounce-back card records in the analysis where CFL wattage was 30 watts or less and the incandescent wattage to CFL wattage ratio was greater than two and less than eight.

Separate calculations were made for residential and commercial CFL applications. The change in wattage from the CFLs in commercial applications was based on 1356 bounce-back card observations.

3.4.3 Hours of Use

A review of studies that analyze the hours of use for residential CFLs clearly shows that metered data is more accurate and consistent than self-reported data and that metered data are generally transferable across utilities in California[2]. Consequently, we relied on metered data for the hours of use estimates.

The residential hours of use estimate used for this evaluation was based on metering studies conducted by PG&E[3]. The PG&E study reported an average usage of 958 hours per year or 2.6 hours per day. This estimate is supported by an SCE[4] study that found that residential

---

[2] *Residential Statewide Lighting Study Task 2 and 3: Transferability of Baseline and Metered Data*, prepared for CADMAC, Barakat & Chamberlin, Inc., February 1994.

[3] *Pacific Gas and Electric Company 1992 Compact Fluorescent Lighting Program: Time-of-Use Study*, HBRS, December 1994. This study metered 167 residential CFL fixtures. The study found that the average usage for CFL fixtures was 958 hours per year, or 2.6 hours per day.

[4] *Residential Lighting Study: Time-of-Use Metering Results for Southern California Edison*, HBRS, November 1993. This study contains time-of-use light logger data from 477 residential customers. This study primarily metered fixtures with incandescent lamps and found that the average use was 2.6 hours per day.

lighting fixtures were on an average of 2.6 hour per day. The ongoing Lighting Logger Study presently being conducted by SDG&E was also considered in the analysis and was used to set an upper boundary on the average daily CFL usage estimate.[5]

It is assumed that the program CFLs used in commercial applications will have an average usage of 3,000 hours per year or 8.2 hours per day.

3.4.4 Diversity Factors

The residential diversity factor used in the peak demand analysis for SCE was derived from PG&E's CFL Time-of-Use Study[6]. This study found that the load reduction at the system peak was 2.3 watts. It also found that the average wattage reduction for a CFL was 55.5 watts. Dividing the 55.5 watts by the 2.3 watts produces a diversity factor of 4.1 percent.

A diversity factor derived for SCE's Time-of Use Metering Study produces a similar result[7]. This study indicates that about four percent of the residential lights are on at 3 p.m. on a summer weekday, SCE's peak load hour for planning purposes.

The SDG&E residential CFL diversity factor estimate was based on the SDG&E Residential Lighting (Compact Fluorescent) Peak-hour Study. This study estimated the peak diversity factor to be 8.55 percent.

Commercial Diversity Factors

The diversity factor used for the commercial application of CFLs distributed through both utilities' residential programs was 0.75. This

[5] The SDG&E metered data is useful in its capacity to provide a reasonable upper limit on average daily usage, but can not be used directly for this CADMAC study. The SDG&E study metered the highest use CFL in each home. By design, the hours of operation found in this study are higher than that of usage for the average CFL installed. Although the study was not completed at the time this was written, the preliminary results showed the value will be 2.7 or 2.8 hours per day.

[6] *Pacific Gas and Electric Company 1992 Compact Fluorescent Lighting Program: Time-of-Use Study*, HBRS, Inc. December 1994.

[7] *Residential Lighting Study: Time-of-Use Metering Results for Southern California Edison*, HBRS, November 1993.

value is based on Electric Power Research Institute commercial lighting load research.[8]

3.5 DATA DEVELOPMENT FOR NET-TO-GROSS ANALYSIS

3.5.1 Conducting Phone Surveys

Data for the net-to-gross analysis was collected using a telephone survey. The survey was conducted in conjunction with the CADMAC 1994 Statewide California Refrigerator Rebate Program survey that employed a random digit dialing methodology to call customers in California and out-of-state.

For those respondents who did claim to purchase CFLs in 1994, the surveyor did the following:

- confirmed that the lamp(s) is actually a CFL,
- asked how many CFLs they purchased,
- asked if the CFL(s) was installed, and
- asked if the CFL(s) remains installed.

The survey followed up with questions about CFL usage, satisfaction, and demographics. Demographic questions were also asked of a 20% of those respondents who did not purchase CFLs in 1994.

Sample Size and Design

The target population for both the treatment and control areas was defined as all households with electricity. It was assumed that all households with electricity had electric lighting in 1994. A telephone survey was conducted using random digit dialing to find a sample of customers from the total population.

Telephone surveys always include some coverage errors. By coverage error we mean error arising from the fact that sampling frame (i.e. the population of telephone numbers) does not completely overlap with the population if interest (in this case, the population of households that have electric lighting). We believe that the coverage error in this study was minimal because the high incidence rate for households with telephones and electric lighting in the general population.

[8] *Lighting Handbook for Utilities*, Enviro-Management & Research Inc., prepared for EPRI, Research Project 2285-6, April 1986.

The CADMAC protocol for the parallel refrigerator study required approximately 10,000 completed surveys. Making use of the survey calls that had to be placed for the refrigerator study provided 10,000 observation with a corresponding precision of ± one percent with 95 percent confidence. The final number of surveys completed is shown in Table 3-1.

Table 3-1
Number of Telephone Calls to Each Location

Location	Number of Calls Completed
Boise, Idaho	1,031
Las Vegas, Nevada	1,045
Phoenix Arizona	1,042
Tulsa, Oklahoma	1,123
Shreveport, Louisiana	1,168
SDG&E	2,269
Edison	3,137
Total	10,815

3.5.2 Data Interpretation and Cleaning

The following issues were subject to data interpretation and data cleaning.

Did the Respondent Buy a CFL?

Three questions were asked to determine whether a household purchased CFLs. The first was direct: "Did your household purchase any compact fluorescent lamps in 1994?" The second question required the respondent to describe the CFLs. If the respondent could not describe the CFL and instead described a tube fluorescent or an incandescent lamp, it was assumed that respondent did not purchase a CFL. The third question asked the respondent how much the CFL cost. If they responded that the CFL cost less than $3, it was assumed that they did not have a CFL. If the reported cost was between $3 and $5 the surveyor was to return to the second question and probe further. The response of at least $5 was considered reasonable for the purchase of a CFL.

The surveyors were provided with pictures of CFLs, examples, and descriptions of their size, shape, composition, and cost to help make the determination.

How Many CFLs Were Purchased?

A small percentage of surveys contained unrealistic claims about the number of CFLs purchased in 1994. Any survey claiming more than 12 CFLs purchased in 1994 was considered in error and excluded from the number of bulbs per household analysis. Also, the records indicating the purchase of CFLs yet having a purchase count of zero were considered in error and were excluded from the number of bulbs per household analysis.

3.5.3 Number of Households

Penetrations of CFLs both in California and in the control areas were multiplied by the number of households in the SCE and SDG&E service territories to develop the net-to-gross ratio. The numbers of households used in this analysis are presented in Table 3-2.

Table 3-2
Number of Households in the SCE and SDG&E Service Territories

	Number of Households
SCE	3,500,000
SDG&E	1,012,500
Total	4,512,500

3.5.4 Why Treatment Area Residents Purchased More CFLs Than Control Area Residents

This study shows that on average Edison's and SDG&E's service territories (treatment area) customers purchased more CFLs than residents in the control areas. This analysis concludes that the difference in CFL consumption is attributable to the 1994 Edison and SDG&E CFL programs. However, this study cannot conclude that the only influence on the CFL purchase rate difference was the treatment area programs. Another possible influence on the CFL penetration rate could be electric rate differences.

The average retail electric rate in the treatment area is about 12 cents per kWh. The average retail electric rate in the control areas is about six cents per kWh.

When choosing regions to serve as control areas, we were unable to locate one with that had no CFL program and had rates similar to that of the treatment area. Regions with higher electric rates are also the regions with CFL programs.

Electric rates were not included as part of the net-to-gross analysis because the data available would not support its inclusion. Data needed would include an estimate of electric price elasticity for the purchase of CFLs.

3.5.5 Issues Concerning the Measurement of Spillover in a Specific Time Period

The purpose of this evaluation was to measure one year of CFL program impacts. Consequently, the question arises whether the observed spillover effect was the result of the 1994 CFL programs.

At this time, spillover analysis is in its infancy. There are neither the data nor a methodology available that could adequately track the spillover effects from one year of a particular program as it is manifested in that year or others.

It is likely that the spillover effect observed in this study was the result of many years of previous CFL rebate programs. By the same token, the spillover effects from the 1994 programs will likely carry over into future years. By all rights, the historic program influences on CFL purchases during 1994 should be credited to the appropriate years' programs, and it would also be reasonable that future spillover resulting from the 1994 programs be back credited. Neither is likely, nor possible, at this time.

Considering that there is no way to isolate and measure the effects spillover from a particular year, the best we can do is note that trans-annual influences are an issue. Due to lack of data and methodology, we were forced to make the implicit assumption that the trans-annual spillover effects have a net impact that is negligible.

3.6 DEMOGRAPHIC COMPARISONS

The net-to-gross methodology is based on the assumption that the control group is similar to the treatment group except that the treatment group was offered discounted CFLs through utility programs. Tables 3-3 through 3-7 present a comparison of the demographic data collected during the survey and illustrate potential demographic differences between California and the control areas. A study of the tables reveals that the differences between California and control-area residents are negligible. These tables provide no clear reason to believe that demographic differences can explain the CFL penetration differences between California and control areas.

Table 3-3
What Type of Home Do You Live In?

	California	Out-of-state
Single-family house detached	68%	76%
Duplex, triplex, or fourplex	8%	5%
Apartment of more than four units	14%	11%
Mobile home	3%	3%
Other	4%	2%
Don't Know/Refused	4%	3%

Table 3-4
Do You Own or Rent Your Residence?

	California	Out-of-state
Own/buying	65%	71%
Rent/lease	30%	25%
Other	0%	0%
Don't Know/Refused	4%	4%

Table 3-5
What Was the Highest Level of Schooling that You Completed?

	California	Out-of-state
Grade school or less	2%	1%
Some high school	3%	6%
High school graduate	23%	28%
Some college	29%	26%
Business or technical school	3%	4%
College graduate	27%	25%
Some graduate school	3%	2%
Graduate degree	10%	8%

Table 3-6
Which of the Following Category Best Describes Your Total Household Income from All Sources During 1994 before Taxes?

	California	Out-of-state
Less than $10,000	5%	6%
$10,000 to $19,999	8%	11%
$20,000 to $29,999	11%	13%
$30,000 to $39,999	13%	14%
$40,000 to $49,999	11%	9%
$50,000 to $74,999	13%	12%
$75,000 to $99,999	7%	5%
$100,000 or more	6%	3%
Don't Know/Refused	26%	28%

Table 3-7
The Mean Response to Additional Demographic Questions

	California	Out-of-state
Number of years at address?	9.2	8.7
Number of people living in household?	3.1	2.9
Months per year of occupancy?	11.8	11.9
Number of people under age 12?	0.7	0.6

B

SUMMARY TABLES

B.1 TABLE 6: RESULTS OF IMPACT MEASUREMENT STUDIES USED TO SUPPORT EARNINGS CLAIMS

SAN DIEGO GAS & ELECTRIC AND SOUTHERN CALIFORNIA EDISON
M&E PROTOCOLS TABLE 6 - RESULTS USED TO SUPPORT PY94 STATEWIDE COMPACT FLUORESCENT LIGHTING INCENTIVE PROGRAMS
FIRST YEAR LOAD IMPACT EVALUATION, FEBRUARY 1996, CADMAC STUDY ID NO. 2063L

Designated Unit of Measurement: Compact Fluorescent Lamp (CFL)
END USE: RESIDENTIAL LIGHTING

				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	9,217		na	na	na	na
	Base kWh	82,794,946		na	na	na	na
	Base Therms	na		na	na	na	na
	Base kW/ designated unit of measurement	0.010		na	na	na	na
	Base kWh/ designated unit of measurement	76		na	na	na	na
	Base Therms/ designated unit of measurement	na		na	na	na	na
B. Impact year usage:	Impact Yr kW	2,254		na	na	na	na
	Impact Yr kWh	20,250,562		na	na	na	na
	Impact Yr Therms	na		na	na	na	na
	Impact Yr kW/designated unit	0.002		na	na	na	na
	Impact Yr kWh/designated unit	19		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	6,962	6,299	7,512	5,087	7,244	5,355
	A. ii. Load Impacts - kWh	62,544,387	56,589,062	67,478,914	45,699,210	65,075,864	48,102,259
	A. iii. Load Impacts - Therms		na	na	na	na	na
	B. i. Load Impacts/designated unit - kW	0.0075	0.0068	0.008	0.006	0.008	0.006
	B. ii. Load Impacts/designated unit - kWh	57.7	52.2	62	42	60	44
	B. iii. Load Impacts/designated unit - Therms	na	na	na	na	na	na
	C. i. a. % change in usage - Part Grp - kW	75.5%	75.5%	na	na	na	na
	C. i. b. % change in usage - Part Grp - kWh	75.5%	75.5%	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	na	na	na	na	na	na
	D.A. ii. Load Impacts - kWh, realization rate	na	na	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	na	na	na	na	na	na
	D.B. ii. Load Impacts/designated unit - kWh, real rate	na	na	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	0.90		1.08	0.73	1.04	0.77
	A. ii. Average Load Impacts - kWh	0.90		1.08	0.73	1.04	0.77
	A. iii. Average Load Impacts - Therms	na		na	na	na	na
	B. i. Avg Load Impacts/designated unit of measurement - kW	0.90		1.08	0.73	1.04	0.77
	B. ii. Avg Load Impacts/designated unit of measurement - kWh	0.90		1.08	0.73	1.04	0.77
	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 (hours/year, residential)	958		na	na	na	na
	B. Post-install average value (hours/year, commercial)	3000		na	na	na	na
6. Measure Count Data		NUMBER					
	A. Number of measures installed by participants in Part Group	789,269					
	B. Number of measures installed by all program participants in the 12 months of the program year	789,269					
	C. Number of measures installed by Comp Group	na					
7. Market Segment Data		CZone 7					
	Number of Participants -Gas	na					
	Number of Participants - Electric	na					

Note: By waiver, no comparison group was used for this analysis and therefore all protocol comparison group questions are not applicable.
Note: There is no precision estimate for the gross savings. The change in wattages was estimated from bounce-back cards which do not necessarily constitute a random sample of the population.

B.2 TABLE 7: DOCUMENTATION OF PROTOCOLS FOR DATA QUALITY AND PROCESSING

A. OVERVIEW INFORMATION

1. Study Title and Study ID: Residential Appliance Efficiency Incentives Program: Compact Fluorescent Lighting (CFL) 1994 First Year Statewide Load Impact Study. Study ID # 2063L
2. Program, Program Year or Years, and Program Description: 1994 Compact Fluorescent Lighting (CFL) incentive programs. These program provided rebates to CFL manufacturers under the condition that the incentive would be passed on through their distribution chain. SCE offered the rebated CFLs only through retail outlets. SDG&E offered their rebated CFLs through retail outlets and through a variety of demand side management programs including direct install programs.
3. End Uses and/or Measures Covered: The program covered compact fluorescent lamps.
4. Method(s) and Model(s) Used: Engineering
5. Program Participants: Program participants include all people who purchased high efficiency refrigerators and received rebates for Edison or SDG&E in 1994.
6. Analysis of Sample Size: See pages 3-9 and 3-10 of the report.

B. DATABASE MANAGEMENT

1. Flow Chart Illustrating Relationships between Data Elements: See Figure B-1, Flow of Data Elements Used in Analysis.
2. Specific Data Sources: See pages 3-4 through 3-11 of the report.
3. Data Attrition Process: See pages 3-4 through 3-11 of the report.
4. Internal/Organizational Data Quality Checks and Procedures: Not applicable.
5. Summary of the Data Collected but not Used: Not applicable.

C. SAMPLING

1. Sampling Procedures and Protocols: See pages 3-9 through 3-12 of the report.
2. Survey Information: Appendix A provides the survey instrument.
3. Statistical Descriptions: Not applicable.

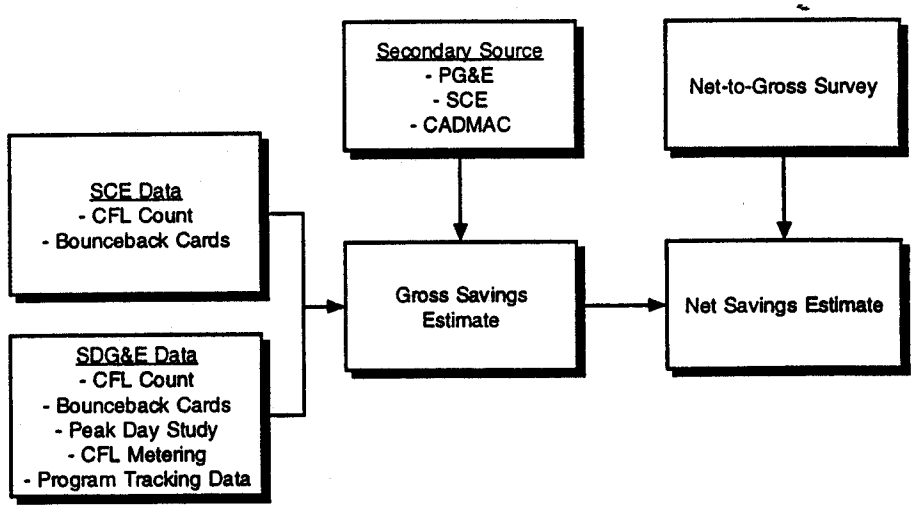
D. DATA SCREENING AND ANALYSIS

1. Procedures used for Treatment of Outliers, Missing Data Points, and Weather Adjustment: See pages 3-5 through 3-7 and 3-11 of the report.
2. Controlling for the Effects of Background Variables: See pages 3-11 through 3-14 of the report.
3. Procedures Used to Screen Data: See pages 3-11 through 3-14 and pages 3-9 through 3-11 of the report..
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: See page 3-5 of the report.
7. Autocorrelation: Not applicable.
8. Heteroskedasticity: Not applicable.
9. Collinearity: Not applicable.
10. Influential Data Points: Not applicable.
11. Missing Data: See page 3-11 through 3-12 of the report.
12. Precision: See page 3-4 of the report.

E. DATA INTERPRETATION AND APPLICATION

The method used was chosen because it was able to capture the effect of both freeridership and spillover in the form of free drivers. Detailed descriptions of the process and choices made are provided in Sections 3 of the report.

Figure B-1
Flow of Data Elements Used in Analysis



E

RESIDENTIAL APPLIANCE EFFICIENCY INCENTIVES

SDG&E *Residential Appliance Efficiency Incentives: Compact Fluorescents, Gross Impact Study, 1994 Residential CFL Program, Final Report.* (Because Appendix A to the Gross Impact Study contains the same report that is included as Appendix F to this Statewide CFL Impact Study, we have included the report only once, in Appendix F.)

RESIDENTIAL APPLIANCE EFFICIENCY INCENTIVES: COMPACT FLOURESCENTS
Gross Impact Study
1994 Residential CFL Program
Final Report

Prepared for

San Diego Gas & Electric
San Diego, California

Prepared by

XENERGY Inc.
San Diego, California

February 26, 1996

XENERGY Inc. • 4455 Murphy Canyon Road, Suite 220 • San Diego, CA 92123-4338 • (619) 573-1905 • FAX (619) 573-1884

XENERGY®

1 INTRODUCTION

To determine the value of its *1994 Residential Compact Fluorescent Lamp Program*, San Diego Gas & Electric (SDG&E) has commissioned XENERGY Inc. to conduct a study that allows a refined estimate of the load impacts of the program through improvements in assumptions to the impact estimation.

SDG&E's *Residential Compact Fluorescent Lamp Program* for 1994 was actually comprised of two channels of distribution: the retail and internal programs. The retail channel offered CFLs through selected retail outlets at reduced prices, while the internal channel delivered CFLs through SDG&E-sponsored residential energy efficiency programs, e.g., exhibit booths at fairs and shows and residential in-home programs. A total of 296,954 compact fluorescent lamps (CFL) were distributed through the Program: 213,750 through the retail and 83,204 through internal channels.

1.1 STUDY OBJECTIVE

The primary objective of this study was to improve the assumed hours of operation of CFLs purchased as part of SDG&E's *1994 Residential CFL Program* used in previous planning and evaluation activities through measurement *in situ*. The hours of operation were to be gathered over a short term, i.e., four to twelve weeks, and annualized.

Also, the study was to estimate the load impacts of SDG&E's 1994 Residential CFL Program.

1.2 SUMMARY OF THE APPROACH

The approach called for the monitoring of the hours of operation of CFLs installed in residences in SDG&E's service territory. These metered data were annualized and incorporated into an engineering analysis to estimate the load impacts of SDG&E's *1994 Residential Compact Fluorescent Lamp Program*. One hundred forty four residences were monitored during the period of August 1995 through December 1995.

The data were gathered and entered into a database which contained basic customer identification information, as well as logger information,

date and time installed, date and time removed, reading, and annualized values.

The refined estimates of hours of operation were used in an engineering analysis of the program load impacts. Gross and net energy savings and demand reductions were estimated.

1.3 ORGANIZATION OF THIS REPORT

The remainder of this report is organized as follows:

Section 2	results of the study
Section 3	discussion and recommendations for future research
Appendix A	methodology
Appendix B	1995 Residential CFL Peakday Survey

2 RESULTS

2.1 INTRODUCTION

This section presents the results of the *Gross Impact Study of SDG&E's 1994 Residential CFL Program.* The methodology is discussed in Section 3, Methodology.

The sample for the study was originally intended to be a two group comparison of Participants and Nonparticipants.

Participants were identified through SDG&E's program tracking system. Nonparticipant candidates went through the following screening steps in the effort to assure that they were, in fact, Nonparticipants. A service area wide stratified random sample was selected for in-depth appliance saturation surveys conducted by mail. A prime sample of 5,000 was implemeted. A sample of 400 was selected at random from the 5,000 sample primes for detailed onsite surveys. As the onsite survey were conducted by trained surveyors, a detailed lighting inventory was gathered in addition to other equipment and appliance holdings. For those residents that had a CFL, the surveyor asked the question "Do you recall receiving the compact fluorescent from SDG&E?" Of the 400 onsite surveys completed, a total of 121 had at least one CFL and answered "No" to the question. These customers comprised the sample frame of Nonparticipants for the *Gross Impact Study.* The screening process was specifically intended to identify Nonparticipants of the CFL program.

In spite of the exhaustive process to locate Nonparticipants, true Nonparticipants using CFLs were difficult to locate and identify. The exhaustive process implemented for this study resulted in three (3) true Nonparticipants of 44 customers that were identified as presumed Nonparticipants through the screening process.

The approach used for estimating the impact of the *1994 Residential Compact Fluorescent Lamp Program* pooled the data for the 144 sites monitored. This was due largely to the lack of a true Nonparticipant group.

Gross impacts are estimated using simplified engineering analyses. A net-to-gross ratio was applied to estimate net impacts. The net-to-

gross ratio was estimated using CFL saturation data collected through telephone surveys of California residents and a control group comprised of out-of-state residents. This survey was conducted as part of the *Statewide Impact Evaluation of 1994 Residential Compact Fluorescent Lighting (CFL) Programs.*

2.2 HOURS OF OPERATION

The estimation of the hours of operation was based on the metered data gathered during the study. The raw data were summarized to average daily hours of use by month for the period the monitoring took place.

The hours of operation were estimated by first reducing the monitored data to average daily hours for each month monitored. As shown in Table 2-1, our monitoring period covered only part of the year, August through December. To extrapolate these hours to an annual basis, the data were evaluated against similar data for Southern California Edison and Pacific Gas & Electric[1]. Table 2-1 shows the comparative data.

Table 2-2 shows the annualized metered hours. The metered average daily hours were extrapolated to each month of the year based on the following assumptions:

- Usage for the period January through June are essentially mirror images of usage for the period July through December; and
- Usage for June, July and August are comparable.

The monthly average daily hours per month were multiplied by the number of days in each month to estimate the total hours of use per month. The monthly totals were summed to estimate the annual hours of operation. The annual hours of operation were divided by 365 days per year to calculate the average daily hours of 2.7 hours per day.

[1] *Residential Lighting Study: Time-of-Use Metering Results*, 1993, and CADMAC's *Residential Statewide Lighting Study, Tasks 2 and 3: Transferability of Baseline and Metered Data*, Barakat and Chamberlin, Inc., February 1994.

Table 2-1
Average Daily Hours of Operation
Monthly

Month	SDG&E	SCE[1]	PG&E[1]
Jan.	-	3.5	3.2[2]
Feb.	-	3.5	-
Mar.	-	3.3	-
Apr.	-	2.7	-
May	-	2.3	-
Jun.	-	2.3	2.4[3]
Jul.	-	2.2	-
Aug.	2.45	2.2	-
Sep.	1.97	-	-
Oct.	3.21	-	-
Nov.	3.36	-	-
Dec.	2.69	2.9	-

(1) *Residential Statewide Lighting Study Tasks 2 and 3: Transferability of Baseline and Metered Data*, Barakat & Chamberlain, Inc., February 1994.

(2) Value was a 3 month average for the period Jan. 17 through March 17.

(3) Value was a 3 month average for the period June 1 through August 31.

Table 2-2
Annualized Hours of Operation

Month	Average Daily Hours Metered	Average Daily Hours Extrapolated	Number of Days per Month	Hours of Use Per Month
Jan.	-	2.7	31	83.4
Feb.	-	3.4	28	94.1
Mar.	-	3.2	31	99.5
Apr.	-	2.0	30	59.1
May	-	2.5	31	76.0
Jun.	-	2.5	30	76.0
Jul.	-	2.5	31	76.0
Aug.	2.45	2.5	31	76.0
Sep.	1.97	2.0	30	59.1
Oct.	3.47	3.2	31	99.5
Nov.	3.50	3.4	30	100.8
Dec.	4.00	2.7	31	83.4
Annual			365	982.9
Average Daily Hours				2.7

2.3 AVERAGE WATTS REDUCED PER CFL

The value for the average Watts reduced per lamp developed in the *Statewide Impact Evaluation of 1994 Residential Compact Fluorescent Lighting (CFL) Programs*, January 1996[2] was used in this analysis. In the aforementioned Statewide study, SDG&E's program database was used to estimate the average Watts reduced by lamp. The database contained the Wattage of the basecase lamp, usually an incandescent lamp, and the CFL. Information on the basecase lamp was obtained through customer "bounceback cards" if the CFL was purchased through retail outlets or from SDG&E personnel that installed CFLs in customer fixtures through an internal SDG&E program delivery mechanism. An average Wattage reduction for each CFL category was calculated. The total Watts reduced for each CFL category was calculated by multiplying the per lamp Watt reduction by the quantity of each type of CFL and the type of delivery mechanism.

Table 2-3 shows the total Watts reduced for each installed CFL Wattage category. Table 2-4 shows the average Watts reduced per CFL, which is based on the data from Table 2-3 was calculated by dividing the total Watts reduced for the Program by the total number of CFLs distributed in 1994.

Table 2-3
Total Watts Reduced
SDG&E's 1994 CFL Program

Installed CFL Watts	Average Removed Watts (Internal)	Average Removed Watts (Retail)	Average Watts Reduced (Internal)	Average Watts Reduced (Retail)	Bulb Distribution (Internal)	Bulb Distribution (Retail)	Watts Reduced (Internal)	Watts Reduced (Retail)
13	75.2	66.3	62.2	53.3	53,149	88,743	3,305,868	4,730,002
18	71.0	77.5	53.0	59.5	22,143	60,023	1,173,579	3,571,369
20	77.9	78.3	57.9	58.3	554	4,098	32,077	238,913
27	82.8	88.8	55.8	61.8	3,255	24,637	181,629	1,522,567
30	98.3	99.0	68.3	69.0	4,103	36,249	280,235	2,501,181
Total					83,204	213,750	4,973,387	12,564,031

[2] *Statewide Impact Evaluation of 1994 Residential Compact Fluorescent Lighting (CFL) Programs*, XENERGY Inc., January 1996.

Table 2-4
Average Watts Reduced Per CFL
SDG&E's 1994 CFL Program

Total Watts reduced	17,537,419
Total number CFL in 1994	296,954
Average Watts reduced per CFL	59.1

2.4 ADJUSTMENT FACTORS

This section describes factors used in estimating the load impacts of the Residential Compact Fluorescent Lamp Program.

2.4.1 Net-To-Gross

The net-to-gross estimate used to estimate the energy impacts was developed in the *Statewide Impact Evaluation of 1994 Residential Compact Fluorescent Lighting (CFL) Programs*. The net-to-gross ratio was developed by using data on CFL saturations gathered through telephone surveys of California residents and a control group comprised of out-of-state residents that have not been offered a CFL program by their local utility. The net-to-gross ratio developed for residential customers was 0.905.

2.4.2 Installation Rate

An installation rate of 0.82 was used based on SDG&E's Peak Day Survey conducted in October 1995. The Peak Day Survey is a telephone survey of program participants. Questions regarding the number of CFLs purchased and the number of CFLs installed were included in the survey. The survey responses are weighted by the number of CFLs distributed through the retail and internal channels.

2.5 PROGRAM LOAD IMPACTS

This presents the load impacts of SDG&E's 1994 Residential Compact Fluorescent Lamp Program developed in this study.

2.5.1 Energy Savings

The gross energy savings were estimated using the basic formula for daily energy savings shown in Equation 2-1. The gross savings are estimated for the individual CFL and extended to the Program level. The net Program savings are calculated by applying the net-to-gross ratio to the gross savings. Table 2-5 shows the gross and net energy savings and corresponding source data.

(Eq. 2-1)

$$kWh_{Saved} = [Watts_{ReducedPerLamp}]x[Hours\ of\ Operation\ Per\ Day]x[Installation\ Rate] \\ x[1\ kWh/1{,}000\ Watts].$$

Table 2-5
Energy Impacts of SDG&E's
1994 Residential Compact Fluorescent Lamp Program

Watts reduced per lamp	59.1
Hours of operation per day	2.7
Installation rate	0.82
Gross energy (kWh) savings per CFL installed	47.76
Number of CFLs in 1994 Program	296,954
Total Gross Program energy (kWh) savings	14,182,315
Net-to-gross factor	0.905
Total Net Program energy savings (kWh)	12,834,995

2.5.2 Demand Impacts

The gross demand reduction per CFL was estimated using the basic formula for demand reduction shown in Equation 2-2. The gross demand reduction was estimated for the individual CFL and extended to the Program level. The net Program demand reduction was calculated by applying the net-to-gross ratio to the gross demand reduction. Table 2-6 shows the gross and net demand reduction and supporting inputs.

(Eq. 2-2)

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

Table 2-6
Demand Impacts of SDG&E's
1994 Residential Compact Fluorescent Lamp Program

Watts reduced per lamp	59.1
Peak coincident factor	0.078
Gross demand (kW) reduction per CFL installed	0.00461
Installation rate	0.82
Number of CFLs in 1994 Program	296,954
Total Gross Program demand (kW) reduction	1,122
Net-to-gross ratio	0.905
Total Net Program demand reduction (kW)	1,015.4

3 METHODOLOGY

3.1 OVERVIEW

This section describes the methodology used to conduct the *1994 Residential Compact Fluorescent Monitoring Study* for San Diego Gas & Electric (SDG&E). The purpose of this study was to gather information on the measured usage of compact fluorescent lamps (CFLs) in the home and to estimate the impacts of the 1994 CFL programs at SDG&E.

3.1.1 Objective

The primary objective of this study was to measure *in situ* the hours of operation of CFLs purchased as part of SDG&E's 1994 Residential CFL program. The hours of operation were to be gathered over a short term, i.e., four to twelve weeks, and annualized.

Also, the study was to estimate the load impacts of SDG&E's 1994 Residential CFL Program.

3.1.2 Summary of the Approach

The original research design attempted to follow the guidelines established in the M&E Protocols. Under this design, as described in Tables C-3A and 5 of the M&E Protocols, net savings are estimated by subtracting the estimated Nonparticipant Load Impacts from Participant Load Impacts. Thus, Participant and Nonparticipant groups were recruited for the study.

The overall approach called for the short term monitoring of the hours of operation of CFLs installed in residences in SDG&E's service territory. These metered data were annualized and incorporated into an engineering analysis to estimate the load impacts of SDG&E's 1994 Residential Compact Fluorescent Lamp Program.

The project required the solicitation of Participants and Nonparticipants of SDG&E's 1994 Residential CFL Program to be subjects of the study. Light loggers were installed on one fixture in the home which had a CFL installed. The loggers were left in the home for a period of

four to twelve weeks. An inventory of CFLs in the home was also collected.

The data were gathered and entered into a database which contains basic customer identification information, as well as logger information, date and time installed, date and time removed, reading, and annualized values.

3.2 SAMPLING APPROACH

The sampling approach called for using a sample of Program Participants and Nonparticipants. The Participants were identified through the Program tracking database, and Nonparticipants were identified through SDG&E's residential appliance saturation survey (MIRACLE) on-site survey database as described below.

The 1994 CFL Program Participant sample was developed by using SDG&E's CFL Program tracking database to extract a preliminary mailing list for soliciting study participants. The Program tracking database was based on "bounceback cards" that were attached to CFLs sold through the CFL Program. These "bounceback cards" were completed by the participant and returned to SDG&E. Letters soliciting participation in the monitoring study were sent to a random sample drawn from the tracking system. A "return card" confirmed the willingness to participate in the study, as well as confirming the customer's telephone number and address. Site visits were scheduled via telephone for logger installation.

Nonparticipant candidates went through the following screening steps in the effort to assure that they were, in fact, Nonparticipants. A service area wide stratified random sample was selected for in-depth appliance saturation surveys conducted by mail. A prime sample of 5,000 was implemented. A sample of 400 was selected at random from the 5,000 sample primes for detailed onsite surveys. As the onsite survey were conducted by trained surveyors, a detailed lighting inventory was gathered in addition to other equipment and appliance holdings. For those residents that had a CFL, the surveyor asked the question "Do you recall receiving the compact fluorescent from SDG&E?" Of the 400 onsite surveys completed, a total of 121 had at least one CFL and answered "No" to the question. These customers comprised the sample frame of Nonparticipants for the *Residential Compact Fluorescent Monitoring Study.* The screening process was specifically intended to identify Nonparticipants of the CFL program.

The presumed Nonparticipants were sent a letter soliciting participation in the monitoring study. A "return card" confirmed the willingness to participate in the study, as well as confirming the customer's telephone number and address. Site visits were scheduled via telephone for logger installation.

An analysis of the responses indicates that most of the Nonparticipants are in fact, Program Participants. Over 93 percent of the Nonparticipants had Program CFLs. The saturation of Program CFLs for Participants and Nonparticipants were virtually identical. Due to these findings the two groups were pooled in the analysis.

3.3 MONITORING COMPACT FLUORESCENT LAMP USAGE

The monitoring process was comprised of several steps: solicitation of study participants, installation and removal of light loggers, completion of an inventory of CFLs, and data management.

3.3.1 On-Site Visit

Potential study participants who responded to the solicitation letters were contacted via phone to schedule an appointment to install the light loggers and conduct an inventory of CFLs in the home.

An inventory of CFLs installed in fixtures in the home was developed through observation and interviews. For each CFL the manufacturer, model number and Wattage was recorded.

One fixture with a CFL installed was selected for the usage monitoring within each home. The fixture selected for monitoring was the fixture that the customer deemed the most frequently used fixture with a CFL installed. Loggers were mounted to the fixture using a non-damaging method. The loggers used were Pacific Science & Technology, Co.'s Model TOU-L logger.

3.3.2 Data Management

The CFL inventory data entered into a data management system and subjected to a series of quality control steps. Light logger data were downloaded from the loggers using Pacific Science & Technology's Smart Logger software. The data were then converted to a time series format and exported to an ASCII file. The data were then imported into SAS for analysis.

3.4 ESTIMATION OF HOURS OF OPERATION

Due to the time available and the nature of the study, we were able to monitor fixtures over a five month period from August through December 1995. The study started in August, thus it was a ramp-up period. The loggers were removed in January 1996. In a more optimal study, a full twelve months of monitored data would have been collected to avoid the potential problems associated with extrapolating partial year data to an annual basis. Some of the problems that affect such an extrapolation include the effects of:

- Varying amount of daylight;
- Daylight savings time;
- Vacations and/or other periods of seasonal low occupancy; and
- Other factors that are affected by seasonal or annual cycles.

In order to properly extrapolate the metered data to an annual basis, we evaluated similar data from lighting studies conducted for Southern California Edison and Pacific Gas and Electric. This evaluation showed that there was a trend of uniform usage for the first half of the year that was comparable to the second half of the year. It also showed that June, July and August are essentially the same. Given this information, the metered data for this study were annualized by using the following assumptions:

- Usage for the period January through June are essentially mirror images of usage for the period July through December.
- Usage for June, July and August are comparable.

3.5 ESTIMATION OF LOAD IMPACTS USING NET-TO-GROSS RATIO

This approach calls for the estimation of the impacts of SDG&E's 1994 CFL Program using a simplified engineering approach, coupled with the application of a net-to-gross ratio to estimate net impacts. The delta Watts, i.e., difference between the base case incandescent lamp and the CFL, are multiplied by the hours of operation and other factors (retention rate and installation rates) to estimate the energy savings per year per bulb. This value is extended to the program level based on the number of program CFLs for 1994.

3.5.1 Energy Impacts

This section describes the estimation of the energy impacts of SDG&E's 1994 Residential CFL Program.

Gross Energy Savings

Gross energy savings will be estimated using the basic equation shown in Equation 3-1.

(Eq. 3-1)

$$kWh_{Saved} = [Watts_{ReducedPerLamp}]x[Hours\ of\ Operation\ Per\ Day]x[Installation\ Rate] \\ x[1\ kWh/1{,}000\ Watts].$$

The value for the average Watts reduced per lamp developed in the "Statewide Impact Evaluation of 1994 Residential Compact Fluorescent Lighting (CFL) Programs," January 1996[1] was used in this analysis. In the aforementioned Statewide study, program databases were used to estimate the average Watts reduced by lamp. The databases contain the Wattage of the base case, usually an incandescent lamp, and the CFL. An average Wattage reduction for each Program CFL was calculated. A final weighted average for the Program was calculated by applying weights based on the quantity of each type of CFL moved through the Program.

Net-to-Gross Ratio

The net-to-gross estimate used to estimate the energy impacts was developed in the *Statewide Impact Evaluation of 1994 Residential Compact Fluorescent Lighting (CFL) Programs*. The net-to-gross ratio was developed by using data on CFL saturations gathered through telephone surveys of California residents and a control group comprised of out-of-state residents that have not been offered a CFL program by their local utility. The net-to-gross ratio developed for residential customers was 0.905.

Installation Factor

The installation rate used in the estimation of load impacts was based on SDG&E's Peak Day Survey conducted in October 1995. The Peak Day Survey is a telephone survey of program participants. Questions

[1] "Statewide Impact Evaluation of 1994 Residential Compact Fluorescent Lighting (CFL) Programs," XENERGY Inc., February 1996.

regarding the number of CFLs purchased and the number of CFLs installed were included in the survey. The survey responses are weighted by the number of CFLs distributed through the retail and internal channels.

3.5.2 Peak Coincident Demand Impacts

A peak coincident factor was developed using the hours of operation data at the time of SDG&E's system peak. This factor was used to estimate demand savings using Equation 3-2.

(Eq. 3-2)

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

The *peak coincident factor* was estimated by assessing the fraction of CFLs that were on during the time hour of SDG&E's system peak day. The actual system peak for 1995 was August 30 at 3:30 p.m. There were relatively few loggers installed at that time, due to project start-up. The next proxy date for the system peak was September 5th at 3:30 p.m. This date, since it was close to August 30th, had few loggers installed. The next proxy date was October 3rd at 3:00 p.m. This date was chosen for estimating peak coincidence since it had the broadest number of installed loggers. The data indicated that 7.8% of the CFLs monitored were turned on at the system peak date and time.

These data were corroborated through SDG&E's 1995 Residential Compact Fluorescent Lamp Peakday Survey . A copy of the analysis of the survey data is included in Appendix A. In this study, a telephone survey of CFL program participants, it was estimated that 8.6% of the CFLs obtained through the Program in 1994 and installed were on at the time the Peakday survey was administered. Similar results were obtained from SDG&E Peakday surveys conducted from 1992 through 1994, as well.

4 DISCUSSION

This section presents a discussion of the use and implications for future research regarding the estimation of the peak coincidence factor for residential CFL's.

4.1 PEAKDAY SURVEYS AND PEAK COINCIDENT FACTOR ESTIMATION

SDG&E has conducted a stream of Peakday Surveys to estimate the peak coincidence factor. Such surveys have been conducted in 1992[1], 1993[2], 1994 (data not previously published) and the most recent in 1995. A summary of the results is shown in Table 4-1.

Table 4-1
Summary of Peakday Survey Results

Survey	n	Peak Coincidence Factor
1992 Peak Day Survey	314	0.103
1993 Peak Day Survey	375	0.12
1994 Peak Day Survey	527	0.087 to 0.127(1)
1995 Peak Day Survey	817	0.086

Note 1: Results for 1994 Peakday Survey were stratified based on delivery mechanism. Weights were not available at time of this report.

The results of the surveys have estimated coincidence factors that have been consistently above 0.080 through the four studies. This pattern indicates a relatively stable trend line for the Peak coincidence factor estimation using Peakday telephone surveys of participants. In addition, these results are consistent with a recently completed monitoring study conducted on CFL usage for SDG&E. In this study, light loggers indicated a Peak coincidence factor of 0.078.

---

[1] 1992 Lighting Process & Impact Study, San Diego Gas & Electric, Rpt # MIAP-92-P09-S01-R305, pp 18-21.

[2] Residential Appliance Efficiency Incentives: Compact Fluorescents, Net Impact Results of the 1993 Retail Sales Program, Rpt # MIAP-93-P50-906-416 (CEC Rpt # 906), June 1994, p 3.

The consistency among the studies, both Peakday survey and the hours of operation monitored data, lends support to the use of Peakday surveys for estimating the Peak coincidence. The methodology and results were reviewed favorably by the DRA's Evaluation Consultant in a review memo dated September 15, 1995, and were considered to be "as trustworthy as they could get, short of large scale metering of the hours of operation." While this review is favorable, the methodology may be improved by considering research alternatives that would strengthen the study. Several recommendations are described briefly in Section 4.2.

4.2 IMPLICATIONS FOR FUTURE RESEARCH

There are several concerns that should be addressed in future research efforts.

The Peakday surveys have been consistent in both the sampling and implementation that lends it well for tracking and trending purposes. There is difficulty, however, in identifying the specific system Peakday. It is a matter of timing and little bit of luck that the selected day will be a good proxy for the actual Peak day. It is suggested, therefore, that more than one survey be administered in a given year. For example, a survey should be implemented before end of August, and another targeted at a likely Peakday in September or October. This will do two things. First, it provides more than one opportunity to "hit" the Peakday. Second, it allows the assessment of differences of usage during the summer period and late summer or early fall, when school is back in session.

Tracking of survey completions has apparently been performed with a great deal of rigor at CIC Research, the telephone survey firm that has conducted the surveys. The data are collected and written on the questionnaire forms, but are not entered in the analysis dataset. It is recommended that the final survey dataset include the dates and times surveys are completed. This would help address questions regarding bias that may be introduced into the results due to the timing of survey completion.

To help address issues of bias from time of survey completion, it is recommended that more intensive telephone surveying over a shorter period may be considered. For example, setting the goal of filling the sample cells before 5 or 6 p.m. on the Peakday. The current follow-up process helps to reduce the potential bias from non-response, but, SDG&E may want to consider developing a research design where the

non-respondents would be factored into the peak coincidence factor estimation.

If an hours of operation metering project is conducted, a joint effort of conducting a Peakday survey on metered customers, thereby allowing the validation of the survey results. This is similar to conducting an on-site survey of mail survey respondents of an appliance saturation study to validate the mail responses.

F

1995 RESIDENTIAL CFL PEAKDAY SURVEY

SDG&E *1995 Residential Compact Fluorescent Lamp Peakday Survey*

1995 RESIDENTIAL COMPACT FLUORESCENT LAMP PEAKDAY SURVEY

Prepared for

San Diego Gas & Electric
San Diego, California

Prepared by

XENERGY Inc.
San Diego, California

February 26, 1996

XENERGY Inc. • 4455 Murphy Canyon Road, Suite 220 • San Diego, CA 92123-4338 • (619) 573-1905 • FAX (619) 573-1884

XENERGY

1 INTRODUCTION

Each year San Diego Gas & Electric conducts a survey to estimate the degree to which compact fluorescent lamps (CFL) are used at the time of SDG&E's electric system peak. During the month of October, 1995, a telephone survey of residential customers who had purchaed CFL's in 1994 was conducted. This report presents the results of the telephone survey and discusses the application of the results for evaluating the 1994 Residential CFL Program.

Section 2 describes the methodology used for the telephone survey. Section 3 presents the results, while Section 4 presents a discussion of the results and implications for future research. The Appendix contains copies of the telephone questionnaire used for the study.

2 METHODOLOGY

2.1 OVERVIEW

This section describes the methodology used to conduct the 1995 Residential Peakday Compact Fluorecent Lamp Survey. The methodology employed has been used in similar Peakday surveys conducted in 1992, 1993, and 1994.

2.2 TELEPHONE SURVEY

2.2.1 Survey Day Selection

The day the Peakday Survey is adminstered is based on the likelihood of SDG&E's electric system reaching its summer peak hour load. SDG&E's system operations staff are contacted daily in the attempt to project whether a peakday is reasonably likely to occur. Under this approach, the survey usually doesn't take place on an actual system peak day, but on a close proxy day for the true system peak.

2.2.2 Sample

SDG&E's *1994 Residential Compact Fluorescent Lamp Program* was comprised of three subprograms as shown in Table 2-1. Sample sizes were 270 per subprogram. The sample was estimated at the 90% confidence level with a 10% error within each strata, assuming a 35% response rate.

A sample frame was drawn from the CFL program tracking databases for each subprogram. The frame selection was random and then randomly ordered in a defined sequence. This ordered sequence was used to control the implementation.

Table 2-1
1995 CFL Peakday Survey Sample

Subprogram	No. of CFLs	Sample Size
Retail	213,750	270
Special events	63,831	270
Energy service center	6,497	270
Total	284,078	810

2.2.3 Questionnaire

The questionnaire used for this survey has been refined from previous Peakday surveys. Two versions were used, depending on what subprogram the respondent participated in. Copies of the questionnaires are included in Appendix A.

2.2.4 Survey Implementation

The survey is implemented under a set of instructions that strives tomaintain the integrity of the sample design. The following instructions were followed by the telephone survey firm, CIC Research:

1. Begin conducting the surveys within 30 minutes of being notified by SDG&E that a peak demand period was iminent.
2. The sample quota were to be contacted from each sample cell in the listed order.
3. At least three attempts were to be made to each listed contact name, after that, the next name after 270 was contacted, and so forth.
4. Complete records for each contact attempt were to be kept.
5. During the three days following the start of the Peakday Survey, repeated attempts to contact each member of the intial 270 contacts in each list.
6. The interviewer requests to speak to the person most familiar with the term "compact fluorescent lamp."

2.2.5 Analysis

The analysis was conducted using the survey responses. First, the total number of CFL's installed per subprogram was estimated from the

survey responses. Second, the number of CFL's turned on at the time of system peak per subprogram was estimated. The coincidence factor for each subprogram was estimated by dividing the number of CFL's turned on by the total number of CFL's installed. Weights were applied to estimate the coincidence factor at the program level.

3 RESULTS

This section presents the results of the 1995 Residential CFL Peakday Survey. The survey was implemented on October 1995. A total of 817 surveys were completed. Table 3-1 shows the sample quotas and responses each subprogram.

Table 3-1
Sample Size and Responses

Subprogram	Sample Size	No. Responses	Sample Weight
Energy Service Center	270	272	0.023
Special Events/Other	270	274	0.225
Retail	270	271	0.752
Total	810	817	1.000

Table 3-2 shows that the survey respondents had a weighted installation rate of 0.82, indicating that 82 percent of the CFL's procured through SDG&E's 1994 Residential CFL Program was installed.

Table 3-2
Installation Rates For 1994 Residential CFL Program

Subprogram	Weight	No. CFL's From SDG&E	No. Installed	Unweighted Installation Rate	Weighted Installation Rate
Energy Service Center	0.023	524	401	0.765	0.02
Special Events/Other	0.225	452	307	0.679	0.15
Retail	0.752	1,309	1,127	0.861	0.65
Total	1.000	2,285	1,835		0.82

Table 3-3 shows that the survey respondents had an overall weighted peak coincidence factor of 0.86. This means that 86 percent of the CFL's installed were turned on at the time of the Peakday survey.

Table 3-3
Peak Coincidence Factor
1994 Residential CFL Program

Subprogram	Weight	No. Installed	No. On At 2 P.M.	%-On During Peak	Weighted Peak Coin. Factor
Energy Service Center	0.023	401	49	0.122	0.003
Special Events/Other	0.225	307	20	0.065	0.015
Retail	0.752	1,127	102	0.091	0.068
Total	1.000	1,835	171		0.086

The 90 percent and 80 percent confidence intervals associated with the weighted peak coincidence factor.

Table 3-4
80% and 90% Confidence Intervals

Weighted Peak Coincidence Factor	0.086
Std error of the mean	0.004882
90% Confidence Interval	0.077 to 0.094
80% Confidence Interval	0.079 to 0.092

4 DISCUSSION

This section presents a discussion of the use and implications for future research regarding the estimation of the peak coincidence factor for residential CFL's.

4.1 PEAKDAY SURVEYS AND PEAK COINCIDENT FACTOR ESTIMATION

SDG&E has conducted a stream of Peakday Surveys to estimate the peak coincidence factor. Such surveys have been conducted in 1992[1], 1993[2], 1994 (data not previously published) and the most recent in 1995. A summary of the results is shown in Table 4-1.

Table 4-1
Summary of Peakday Survey Results

Survey	n	Peak Coincidence Factor
1992 Peak Day Survey	314	0.103
1993 Peak Day Survey	375	0.12
1994 Peak Day Survey	527	0.087 to 0.127(1)
1995 Peak Day Survey	817	0.086

Note 1: Results for 1994 Peakday Survey were stratified based on delivery mechanism. Weights were not available at time of this report.

The results of the surveys have estimated coincidence factors that have been consistently above 0.080 through the four studies. This pattern indicates a relatively stable trend line for the Peak coincidence factor estimation using Peakday telephone surveys of participants. In addition, these results are consistent with a recently completed monitoring study conducted on CFL usage for SDG&E. In this study, light loggers indicated a Peak coincidence factor of 0.078.

---

[1] 1992 Lighting Process & Impact Study, San Diego Gas & Electric, Rpt # MIAP-92-P09-S01-R305, pp 18-21.

[2] Residential Appliance Efficiency Incentives: Compact Fluorescents, Net Impact Results of the 1993 Retail Sales Program, Rpt # MIAP-93-P50-906-416 (CEC Rpt # 906), June 1994, p 3.

The consistency among the studies, both Peakday survey and the hours of operation monitored data, lends support to the use of Peakday surveys for estimating the Peak coincidence. The methodology and results were reviewed favorably by the DRA's Evaluation Consultant in a review memo dated September 15, 1995, and were considered to be "as trustworthy as they could get, short of large scale metering of the hours of operation." While this review is favorable, the methodology may be improved by considering research alternatives that would strengthen the study. Several recommendations are described briefly in Section 4.2.

4.2 IMPLICATIONS FOR FUTURE RESEARCH

There are several concerns that should be addressed in future research efforts.

The Peakday surveys have been consistent in both the sampling and implementation that lends it well for tracking and trending purposes. There is difficulty, however, in identifying the specific system Peakday. It is a matter of timing and little bit of luck that the selected day will be a good proxy for the actual Peak day. It is suggested, therefore, that more than one survey be administered in a given year. For example, a survey should be implemented before end of August, and another targeted at a likely Peakday in September or October. This will do two things. First, it provides more than one opportunity to "hit" the Peakday. Second, it allows the assessment of differences of usage during the summer period and late summer or early fall, when school is back in session.

Tracking of survey completions has apparently been performed with a great deal of rigor at CIC Research, the telephone survey firm that has conducted the surveys. The data are collected and written on the questionnaire forms, but are not entered in the analysis dataset. It is recommended that the final survey dataset include the dates and times surveys are completed. This would help address questions regarding bias that may be introduced into the results due to the timing of survey completion.

To help address issues of bias from time of survey completion, it is recommended that more intensive telephone surveying over a shorter period may be considered. For example, setting the goal of filling the sample cells before 5 or 6 p.m. on the Peakday. The current follow-up process helps to reduce the potential bias from non-response, but, SDG&E may want to consider developing a research design where the

non-respondents would be factored into the peak coincidence factor estimation.

If an hours of operation metering project is conducted, a joint effort of conducting a Peakday survey on metered customers, thereby allowing the validation of the survey results. This is similar to conducting an on-site survey of mail survey respondents of an appliance saturation study to validate the mail responses.