1996 Industrial Energy Efficiency Incentive Program

Impact Study

Study 541

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Southern California Edison

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1.0 Executive Summary

Southern California Edison (SCE) retained Alternative Energy Systems Consulting, Incorporated (AESC), Ridge & Associates and KVDR, Inc. to evaluate the first year impacts of SCE's 1996 Industrial Energy Efficiency Incentive (IEEI) Program for industrial customers. The methods used and the data presented in this evaluation are consistent with the requirements contained in the *Protocols and Procedures for the Verification of Costs, Benefits and Shareholder Earnings from Demand-Side Management Programs* (Protocols) as adopted by D.93-05-063 and most recently revised in January 1997.

SCE provided AESC with a database describing the industrial sites and energy savings measures included in the 1996 IEEI program. The database included 143 coupons with a total of 186 measures. The small size of the program population permitted AESC to perform a complete census of the customers rather than evaluating a sample of the population. However, for the net-to-gross ratio (NTGR) evaluation, the population was stratified to identify coupons that, because of the size of their savings, should receive special attention. To achieve this stratification, SCE's estimated *ex ante* energy savings for each measure at a site were summed and the sites were ranked in descending order of savings.

SCE provided the actual coupons, which they used to document energy savings estimates for each measure. AESC used the coupons to verify measure characterizations and to obtain *ex ante* impact calculations.

AESC obtained information from the participants through on-site surveys, follow-up telephone calls and spot monitoring. During the on-site visit a survey was performed with a decision-maker that provided the information necessary to estimate the NTGR for each rebated measure. The on-site surveys also provided site and measure operating data, upon which AESC's *ex post* estimates of energy savings were based. AESC monitored the electrical usage of a number of different types of equipment to verify energy savings calculations for the measures.

The gross *ex post* impacts, NTGRs, and net *ex post* impacts were calculated for each measure in the industrial program and summed to provide the population impact. The estimation of the NTGRs is consistent with the guidelines on the use of the self-report method in Appendix J of the Protocols. The *standard*, self-report NTGRs were based on information gathered in interviews with the person most responsible for deciding to participate in the 1996 IEEI Program. The *standard*, self-report NTGR was calculated using the answers to a series of questions on the decision-maker questionnaire. For those coupons with larger expected impacts, additional quantitative and qualitative data were used to produce what is called a *custom*, self-report NTGR. Table 1-1 summarizes AESC's estimated annual gross energy and electric capacity impacts for the program and by end use. The net energy and electric capacity impacts, along with the average NTGR values that incorporate the effects of customization, are

presented in Table 1-2 for the program and by end use.

Table 1-1. 1996 IEEI Gross Impact Estimates

End Use	# Measures	Annual Energy Savings (kWh)	Electric Capacity (kW)
HVAC	16	10,836,255	234
Lighting	91	16,043,696	3,271
Process	79	48,394,913	4,329
Program Totals:	186	75,274,864	7,834

Table 1-2. 1996 IEEI Net Impact Estimates

	Annual Energy Savings (kWh)		Electric Capacity (kW)	
End Use	Impact	NTGR	Impact	NTGR
HVAC	7,616,819	0.703	52	0.221
Lighting	10,739,800	0.669	2,339	0.715
Process	34,104,409	0.705	2,843	0.657
Program Totals	52,461,028	0.697	5,234	0.668

2.0 Summary Tables

This document contains the results of the First Year Impact Study of Southern California Edison's (SCE) Industrial Energy Efficiency Incentive Program - 1996 (Study 541). The California Public Utilities Commission and California Energy Commission require Summary Tables and Study Documentation forms for each utility impact study. Tables 2-1 and 2-2 are provided in accordance with these requirements as described in Tables 6 and 7 of the *Protocols and Procedures for the Verification of Costs, Benefits and Shareholder Earnings from Demand-Side Management Programs* (Protocols) as adopted by D.93-05-063 and most recently revised in January 1997. Table 2-1 provides the impact study results in accordance with Table 6 while Table 2-2 responds to the requirements of Table 7 of the aforementioned Protocols.

Table 2-1. Completed Load Impact Study (Table 6 of Protocols)

1. Average Measure Usage:

1.A Base usage

	HVAC	Lighting	Process	Program
Energy (kWh)	2,641,257	417,181	2,563,085	1,519,932
Electric Capacity (kW)	297.56	80.73	373.10	223.56
Energy / DUM	26.63	2.39	2,563,085	1,088,626
Electric Capacity / DUM	0.0038	0.0005	373.10	158.47

1.B Impact year usage

	HVAC	Lighting	Process	Program
Energy (kWh)	1,963,991	240,878	1,951,929	1,115,840
Electric Capacity (kW)	282.91	44.81	317.96	181.31
Energy / DUM	18.01	1.16	1,951,929	829,047
Electric Capacity / DUM	0.0023	0.0002	317.96	135.05

2. Average net and gross end use load impacts:

2. A. Load impacts

	HVAC	Lighting	Process	Program
Avg. Gross Impact (kWh)	677,266	176,304	612,594	404,704
Avg. Gross Impact (kW)	14.65	35.95	54.79	42.12
Avg. Net Impact (kWh)	476,051	118,020	431,701	282,049
Avg. Net Impact (kW)	3.23	25.70	35.99	28.14

Table 2-1. Completed Load Impact Study (Table 6 of Protocols) continued

2. B. Load impacts per designated unit of measure

	HVAC	Lighting	Process	Program
Avg. Gross Impact (kWh) / DUM	5.20	1.20	612,594	260,189
Avg. Gross Impact (kW) / DUM	0.00025	0.00026	54.79	23.27
Avg. Net Impact (kWh) / DUM	2.92	0.40	431,701	183,357
Avg. Net Impact (kW) / DUM	0.00009	0.00011	35.99	15.29

2. C. The percent change in usage (relative to base usage) of the participant group and comparison group. Comparison group not applicable to industrial sector.

	HVAC	Lighting	Process	Program
Percent Change in Usage - kWh	25.6%	42.3%	23.8%	26.6%
Percent Change in Usage - kW	4.9%	44.5%	14.8%	18.9%

2. D. Realization rates

	HVAC	Lighting	Process	Program
Realization Rate - Gr kWh	0.733	0.876	0.809	0.810
Realization Rate - Gr-kW	0.987	0.882	1.723	1.213
Realization Rate - Net-kWh	0.747	1.222	0.760	0.822
Realization Rate- Net-kW	0.321	1.313	1.509	1.368
Realization Rate - Gr-kWh/DUM	0.676	0.901	0.809	0.809
Realization Rate - Gr-kW/DUM	1.367	0.992	1.723	1.723
Realization Rate - Net-kWh/DUM	0.609	0.636	0.760	0.760
Realization Rate - Net-kW/DUM	0.821	0.901	1.509	1.509

3. Net -to Gross Ratios:

3. A. Average load impacts

	HVAC	Lighting	Process	Program
NTGR - Avg Impact kWh	0.703	0.669	0.705	0.697
NTGR - Avg Impact kW	0.221	0.715	0.657	0.668

3. B. Average load impacts per designated unit of measure

	HVAC	Lighting	Process	Program
NTGR - Avg Impact kWh/DUM	0.562	0.339	0.705	0.705
NTGR - Avg Impact kW/DUM	0.341	0.436	0.657	0.657

Table 2-1. Completed Load Impact Study (Table 6 of Protocols) continued

4. Designated Unit Intermediate data

4. A. Pre-installation average

	HVAC	Lighting	Process	Program
DUM Int. Data-Sqft PreInstall	117,500	84,036	n/a	n/a
DUM In. Data-Hrs PreInstall	n/a	6,150	n/a	n/a

4. B. Post-installation average

	HVAC	Lighting	Process	Program
DUM Int. Data-Sqft PostInstall	114,250	82,754	n/a	n/a
DUM Int. Data-Hrs PostInstall	n/a	5,773	n/a	n/a

5. Precision:

Listed below are the 80% and 90% Confidence Intervals for items 1 - 4 of this table.

T- 6 Ref.	Parameter	**Parameter**	**HVAC**	**Lighting**	**Process**	**Program**
1-A	Avg Base Usage -KWh	80% CL +/-	1,160,430	106,578	1,048,329	472,515
	Avg Base Usage -KWh	90% CL +/-	1,486,801	136,553	1,343,172	605,409
1-A	Avg Base Usage -KW	80% CL +/-	165.0	22.0	150.0	67.0
	Avg Base Usage -KW	90% CL +/-	211.0	29.0	192.0	86.0
1-A	Avg Base Use/DUM -KWh	80% CL +/-	8.71	1.32	1,048,329	4,569,368
	Avg Base Use/DUM -KWh	90% CL +/-	11.16	1.68	1,343,172	588,565
1-A	Avg Base Use/DUM -KW	80% CL +/-	0.0019	0.00016	150.0	66.0
	Avg Base Use/DUM -KW	90% CL +/-	0.0024	0.00021	192.0	84.0
1-B	Avg Impact Usage -KWh	80% CL +/-	642,267	66,161	953,418	415,259
	Avg Impact Usage -KWh	90% CL +/-	822,905	84,769	1,221,567	532,051
1-B	Avg Impact Usage -KW	80% CL +/-	156.0	13.0	145.0	64.0
	Avg Impact Usage -KW	90% CL +/-	200.0	16.6	185.0	82.0
1-B	Avg Impact Use/DUM -KWh	80% CL +/-	3.84	0.658	953418	413,552
	Avg Impact Use/DUM -KWh	90% CL +/-	4.92	0.843	1221567	529,863
1-B	Avg Impact Use/DUM -KW	80% CL +/-	0.007	0.000082	145.0	63.0
	Avg Impact Use/DUM -KW	90% CL +/-	0.009	0.0001	185.0	81.0
2-A	Avg Gr Impact - kWh	80% CL +/-	558,523	44,150	164,391	88,252
	Avg Gr Impact - kWh	90% CL +/-	715,607	56,567	210,626	113,072
2-A	Avg Gr Impact - kW	80% CL +/-	12.91	10.2	17.34	9.00
	Avg Gr Impact - kW	90% CL +/-	16.55	13.07	22.22	12.00
2-A	Avg Net Impact - kWh	80% CL +/-	496843	40509	155859	81,144
	Avg Net Impact - kWh	90% CL +/-	636580	51902	199694	103,965
2-A	Avg Net Impact - kW	80% CL +/-	2.32	9.8	16.0	8.3
	Avg Net Impact - kW	90% CL +/-	2.97	12.5	20.5	10.7

Continued on next page

5. Precision - Continued

T- 6 Ref.	Parameter	Parameter	HVAC	Lighting	Process	Program
2-B	Avg Gr Impact/DUM - kWh	80% CL +/-	2.3	0.664	165391	75,176
	Avg Gr Impact/DUM - kWh	90% CL +/-	2.95	0.85	210626	96,320
2-B	Avg Gr Impact/DUM - kW	80% CL +/-	0.0002	0.000096	17.34	7.80
	Avg Gr Impact/DUM - kW	90% CL +/-	0.0003	0.00012	22.22	10.00
2-B	Avg Net Impact/DUM - kWh	80% CL +/-	2.05	0.094	155,859	68,945
	Avg Net Impact/DUM - kWh	90% CL +/-	2.62	0.12	199,694	88,336
2-B	Avg Net Impact/DUM - kW	80% CL +/-	0.000059	0.000031	16	7.00
	Avg Net Impact/DUM - kW	90% CL +/-	0.000075	0.000093	21	9.00
2-D/A	Realization Rate- GR kWh	80% CL +/-	0.018	0.023	0.027	N/A
	Realization Rate- GR kWh	90% CL +/-	0.024	0.03	0.035	N/A
2-D/A	Realization Rate- GR-kW	80% CL +/-	0.03	0.026	0.065	N/A
	Realization Rate- GR-kW	90% CL +/-	0.038	0.034	0.083	N/A
2-D/A	Realization Rate- Net-kWh	80% CL +/-	0.028	0.028	0.033	N/A
	Realization Rate- Net-kWh	90% CL +/-	0.036	0.036	0.042	N/A
2-D/A	Realization Rate- Net-kW	80% CL +/-	0.103	0.021	0.088	N/A
	Realization Rate- Net-kW	90% CL +/-	0.132	0.028	0.112	N/A
2-D	Realization Rate- GR-kWh/DUM	80% CL +/-	0.065	0.017	0.027	N/A
	Realization Rate- GR-kWh/DUM	90% CL +/-	0.083	0.021	0.035	N/A
2-D	Realization Rate- GR-kW/DUM	80% CL +/-	0.078	0.019	0.065	N/A
	Realization Rate- GR-kW/DUM	90% CL +/-	0.1	0.024	0.083	N/A
2-D	Realization Rate- Net-kWh/DUM	80% CL +/-	0.081	0.093	0.033	N/A
	Realization Rate- Net-kWh/DUM	90% CL +/-	0.103	0.12	0.042	N/A
2-D	Realization Rate- Net-kW/DUM	80% CL +/-	0.059	0.061	0.088	N/A
	Realization Rate- Net-kW/DUM	90% CL +/-	0.075	0.079	0.112	N/A
3-A	NTGR - Avg Impact kWh	80% CL +/-	0.053	0.028	0.027	0.05
	NTGR - Avg Impact kWh	90% CL +/-	0.068	0.036	0.035	0.06
3-A	NTGR - Avg Impact kW	80% CL +/-	0.055	0.026	0.036	0.05
	NTGR - Avg Impact kW	90% CL +/-	0.071	0.034	0.045	0.07
3-B	NTGR - Avg Impact kWh/DUM	80% CL +/-	0.071	0.104	0.027	N/A
	NTGR - Avg Impact kWh/DUM	90% CL +/-	0.09	0.133	0.035	N/A
3-B	NTGR - Avg Impact kW/DUM	80% CL +/-	0.073	0.063	0.033	N/A
	NTGR - Avg Impact kW/DUM	90% CL +/-	0.094	0.08	0.042	N/A

Table 2-1. Completed Load Impact Study (Table 6 of Protocols) continued

6. Measure Count Data.

6. A. and B. Number of measures installed by participants

Item Code	Comp. Code	Measure Description	Number of Measures	Item Code	Comp. Code	Measure Description	Number of Measures
CU1	10A	Pump Sys Controls	2	HW12	1	Disconnect Lamps-Rewire	29
CU1	15A	Misc. (Process)	22	HW12	2	Disconnect Lamps-Fix Rpl	7
CU1	15C	Misc. (Space Cond)	1	HW12	3	Delamp - 8ft to 4 ft	7
CU1	16	Air Compressor	11	HW12	4	Delamp - FB40 to F17T8	3
CU1	19	Air Compressor System	7	LC	2	EMS (Lighting)	2
CU1	20	Cooling Tower	1	LD1	1	Daylighting System	1
CU1	23	Insul-Plastic Extrusion	2	LSM	9	LED Exit Signs	20
CU1	24	Insul-Process Equip	2	LSM	X	Indoor Lighting Sys Mod	10
CU1	25	Plastic Extrusion Equip	4	LSR	X	Indoor Lighting Sys Replace	12
CU1	27	Process Cooling	3	OM2	3A	Motors - 3 Phase	5
CU1	2C	EMS (Space Conditioning)	4	OS1	1	Adj Spd Drive (HVAC)	4
CU1	48	Chilled Water Controls	1	OS1	3	Adj Spd Drive (Process)	11
CU1	49	Economy Cycle	1	SAX	3	Air Cooled Pkg AC Units	4
CU1	59	Injection Molding Machine	6	SC1	3	Chiller 200 - <600 Tons	1
CU1	9A	Pump Systems (Controls)	2	SC1	4	Chiller 600 - <2000 Tons	1

7. Market segment data

Below are listed the industries (3 digit SIC Code) included in the program and the proportion of sites in each segment.

FAC_SIC-3	Proportion	# of Sites	SIC Description
101	0.0085	1	Iron Ores
102	0.0085	1	Copper Ores
131	0.0342	4	Crude Petroleum And Natural Gas
144	0.0085	1	Sand and Gravel
149	0.0085	1	Miscellaneous Nonmetallic Minerals
152	0.0085	1	Residential Building Construction
203	0.0342	4	Preserved Fruits and Vegetables
205	0.0085	1	Bakery Products
225	0.0085	1	Knitting Mills
227	0.0085	1	Carpets and Rugs
251	0.0171	2	Household Furniture
252	0.0256	3	Office Furniture
254	0.0085	1	Partitions and Fixtures
267	0.0342	4	Misc. Converted Paper Products
271	0.0598	7	Newspapers

Continued on next page

Table 2-1. Completed Load Impact Study (Table 6 of Protocols) continued

7. Market segment data - Continued

FAC_SIC-3	Proportion	# of Sites	SIC Description
272	0.0085	1	Periodicals
273	0.0085	1	Books
275	0.0513	6	Commercial Printing
282	0.0256	3	Plastics Materials and Synthetics
283	0.0171	2	Drugs
289	0.0085	1	Miscellaneous Chemical Products
295	0.0085	1	Asphalt Paving and Roofing Materials
306	0.0085	1	Fabricated Rubber Products, Nec
307	0.0171	2	Fabricated Rubber Products, Nec
308	0.1111	13	Miscellaneous Plastics Products, Nec
331	0.0171	2	Blast Furnace and Basic Steel Products
333	0.0085	1	Primary Nonferrous Metals
335	0.0085	1	Nonferrous Rolling and Drawing
339	0.0085	1	Miscellaneous Primary Metal Products
341	0.0085	1	Metal Cans and Shipping Containers
343	0.0256	3	Plumbing and Heating, except Electric
347	0.0171	2	Metal Services, Nec
349	0.0256	3	Misc. Fabricated Metal Products
354	0.0085	1	Metalworking Machinery
355	0.0171	2	Special Industry Machinery
356	0.0171	2	General Industrial Machinery
357	0.0256	3	Computer and Office Equipment
365	0.0085	1	Household Audio and Video Equipment
366	0.0085	1	Communications Equipment
367	0.0342	4	Electronic Components and Accessories
369	0.0171	2	Misc. Electrical Equipment & Supplies
371	0.0171	2	Motor Vehicles and Equipment
372	0.0769	9	Aircraft and Parts
376	0.0171	2	Guided Missiles, Space Vehicles, Parts
381	0.0085	1	Search and Navigation Equipment
382	0.0256	3	Measuring and Controlling Devices
394	0.0085	1	Toys and Sporting Goods
395	0.0085	1	Pens, Pencils, Office, & Art Supplies
506	0.0171	2	Electrical Goods
523	0.0085	1	Paint, Glass, and Wallpaper Stores
733	0.0085	1	Mailing, Reproduction, Stenographic

Table 2-2. Response to Protocol Table 7

The following information is provided in direct response to the corresponding items in Table 7 of the Protocols. Essential information regarding this evaluation is provided below. When necessary, the reader is directed to the appropriate report section where additional information can be found.

A. Overview Information

1. *Study Title:* Impact Evaluation of the Southern California Edison Company's 1996 Industrial Sector Energy Efficiency Incentives Programs: Lighting; HVAC; Process - Study ID: 541
2. *Program, program year, and program description:* 1996 Energy Efficiency Incentives were designed to target and deliver monetary incentives to Southern California Edison customers that installed energy efficiency equipment. This report addressed all rebate applications that were paid in 1996.
3. *End uses and/or measures covered*: This Evaluation covered HVAC, lighting, and process end uses.
4. *Methods and models used:*

   Gross Savings

   In general, if the coupon involved a simple measure such as a lighting or motor change, SCE and AESC used SCE's Measure Analysis and Recommendation System (MARS) to verify the calculations. This software is based on their Computerized Book of Standards (CBOS). If the coupon estimates were based on a custom engineering analysis by SCE, by a vendor or by a consulting engineer, then AESC performed manual engineering calculations to obtain its estimates. Please refer to Sector 6 for more details.

   Measure Level Net Impacts and Net-to-Gross Ratios (NTGRs)

   Table C-5 of the Protocols does not require a comparison group. Since, in this study, there was no comparison group, the self-report method was used to estimate all NTGRs. Guidelines for the use of this method are contained in Chapter 4 of Appendix J of the Protocols. The measure-level NTGRs were estimated using information gathered from the person at each site most responsible for deciding to participate in the SCE IEEI Program. These NTGRs are referred to as the *standard* NTGRs (SSR_NTGR).

   However, for those customers with the largest expected savings, additional steps were taken to estimate their NTGRs. For these customers, additional quantitative and qualitative data were collected and analyzed to produce what is called a *custom* NTGR (CSC_NTGR). All of the information gathered for each custom measure was integrated into a coherent narrative that either supported the standard NTGR or argued for changing it. The narrative for each custom measure is presented in Appendix C of this report.

Table 2-2. Response to Protocol Table 7 continued

Net Savings

The measure-level NTGR (for custom measures the *custom* NTGR was used and the *standard* NTGR was used for all others) was multiplied by the measure-level gross impacts to derive net impacts for both kWh and kW. Within each end use, the net kWh and kW were summed to produce end-use net kWh and kW impacts. Within each end use, the gross kWh and kW impacts were then summed to produce end-use gross kWh and kW impacts. Within each end use, the ratio of the net kWh and kW impacts to the gross kWh and kW impacts produced kWh and kW NTGRs for each end use.

The overall NTGRs across both kWh and kW impacts were estimated by first converting both net and gross kWh and kW impacts into a common unit, dollars, using marginal energy and capacity costs. The end-use net impacts for kWh *and* kW were then summed. Next, the end-use gross impacts for kWh and kW were summed. Within each end use, the *combined* kWh and kW net impacts were divided by the *combined* kWh and kW gross impacts to derive the overall NTGR for each end use.

The NTGR for the overall Program was derived by summing the combined net kWh and kW impacts across the three end uses. Next, the combined gross kWh and kW impacts were summed across all three end uses. Finally, calculating the ratio of the net impacts to the gross impacts yielded the overall program NTGR.

As was mentioned above, there were two levels of decision-maker NTGR analysis, the standard and the custom. The standard measure-specific free-ridership analysis draws on information obtained from the Standard Decision-Maker survey. An analysis of closed-ended questions included in the decision-maker survey was carried out in order to derive a standard, self-report NTGR.

Inputs

The central inputs to the calculation came from decision-maker survey questions 5, 6, 7, 22, 23 and 24. First the core questions 6, 7, 22, 23 and 24 were averaged. Note that the values for questions 7 and 22 must first be transposed so that their large values have the same meaning as the large values of the other questions. The validity of the NTGR based on the five core questions could be challenged, if in response to question 5, the decision-maker said that he had not learned about the SCE program until *after* the installation was complete. However, there was no need to develop a method of resolving such conflicts because no decision-maker indicated that he learned about the program after the installation.

Another potential conflict within the survey occurs with question 7 which asks how likely it is that the customer would have installed the same thing without the rebate. It is known that question 7 is subject to misunderstanding because of the necessarily negative phrasing of the question. It was necessary to ask if the customer would have made the same installation if

the program had *not* been in effect. This negative in the

Table 2-2. Response to Protocol Table 7 continued

question sometimes causes misunderstandings and, therefore, answers that imply the opposite of what the respondent wanted to communicate. This potential for error was handled by incorporating automatic checks into the survey form that detected clear contradictions between questions 6 and 7 since this is where such a misunderstanding would become visible. Where there was a contradiction between these two answers, the interviewer was instructed in how to resolve the contradiction with suggested phrasing for presenting the apparent conflict to the respondent and requesting resolution. However, if the inconsistency was not or could not be resolved within the interview, questions 6 and 7, together with the other three core questions (22, 23 and 24) were averaged with equal weights.

Deferred free riders are customers who, in the absence of the program, would have eventually installed exactly the same equipment that was installed through the program. That is, the utility *accelerated* the installation of the equipment. Question 11 on both the standard decision-maker survey asks the respondent whether the same equipment might have been installed without the rebate, but later than was the case under the influence of the program. However, determining the extent of free ridership is a complex problem that requires examination of all available data rather than depending on a single survey question. Thus, question 11 was not used in estimating the SSR_NTGR. This decision is consistent with recent agreements by the CADMAC Modeling and Base Efficiency Subcommittees.

The custom analysis involved the collection of additional quantitative and qualitative data. The custom measure-specific free-ridership analysis includes all of the features described above in the standard project-specific analysis, plus additional data collection and analysis. The largest projects are usually the most complex and this fact raises the concern that the questions used to estimate the SSR_NTGR could miss some critical pieces of the decision process. It is important to understand the entire story of the process of thinking about the change, considering alternatives, balancing costs and benefits, making decisions, etc. Because of these complexities and potential differences across customers, a more complete and detailed approach was taken for this group. The thrust of the method was to construct a case study involving a comprehensive, internally consistent description of the decision process. This means gathering information from more sources than were employed in the standard measure-specific analysis, as well as more detailed and narrative descriptions of the processes.

The sources of information potentially available for estimating the CSR_NTGR are described below. First, additional information was collected from the decision-maker on the economics of the decision to purchase the efficient equipment, including the financial calculations usually done for capital investments, the company's cutoff point

Table 2-2. Response to Protocol Table 7 continued

for such calculations, and the results of any calculations for this specific rebated equipment, both *with* and *without* the rebate. In addition, the decision-maker was asked a series of open-ended questions as a check on the answers to closed-ended questions and to place the equipment choice in a broader context.

Also included was a question regarding accelerated installation. Survey question 11 on the decision-maker survey asks the respondent whether the same equipment might have been installed without the rebate, but later than was the case under the influence of the program. When accelerated installations were claimed, the respondent was asked why the equipment installation was accelerated by the time period mentioned. Determining the extent of free ridership is a complex problem that requires examination of all available data rather than depending on a single survey question. Thus, the answer to question 11 was considered and weighed in the context of *all of the information gathered for each custom project*.

Under certain conditions, interviews were also attempted with the customer's operations staff, vendors associated with the installation of the efficient equipment, and the Edison energy services representative in order to obtain a more comprehensive picture of Program's influence on the customer's equipment choice.

Finally, information from the Program paper files were examined for any other information related to the equipment purchase. Such information as the payback both with and without the rebate were frequently present.

A more detailed description of the method and the aggregation from measure-level net and gross kWh and kW impacts and NTGRs to end-use net and gross kWh and kW impacts and NTGRs, to the overall end-use NTGRs, and finally to the overall Program-level NTGR is provided in Section 7 of this report.

5. *Participants and comparison group definition:* Participants are defined as all industrial customers who received a rebate during 1996. No comparison groups were used.
6. *Analysis sample size:* A census was attempted and achieved with respect to on-site engineering estimates of gross impacts. This covered 117 decision-makers associated with 143 coupons and 186 measures. With respect to self-report interviews used to estimate the NTGR, a census of 117 decision-makers was attempted and a 98.2 percent (115 completed interviews) response rate was achieved. More details regarding sample sizes are presented in Section 4. Table A6-1 presents the breakdown of the 186 measures by end use.

Table 2-2. Response to Protocol Table 7 continued

Table A6-1. Breakdown of Measures by End Use

Stratum	Population of Coupons	Percent
1	66	46%
2	54	38%
3	15	10%
4	8	6%
Total	143	100%

B. Database Management

1. *Describe and provide flow chart illustrating the relationships between data elements*

   The flowchart below illustrates the construction of the final analysis database used in estimating the NTGRs and the net kWh and kW impacts

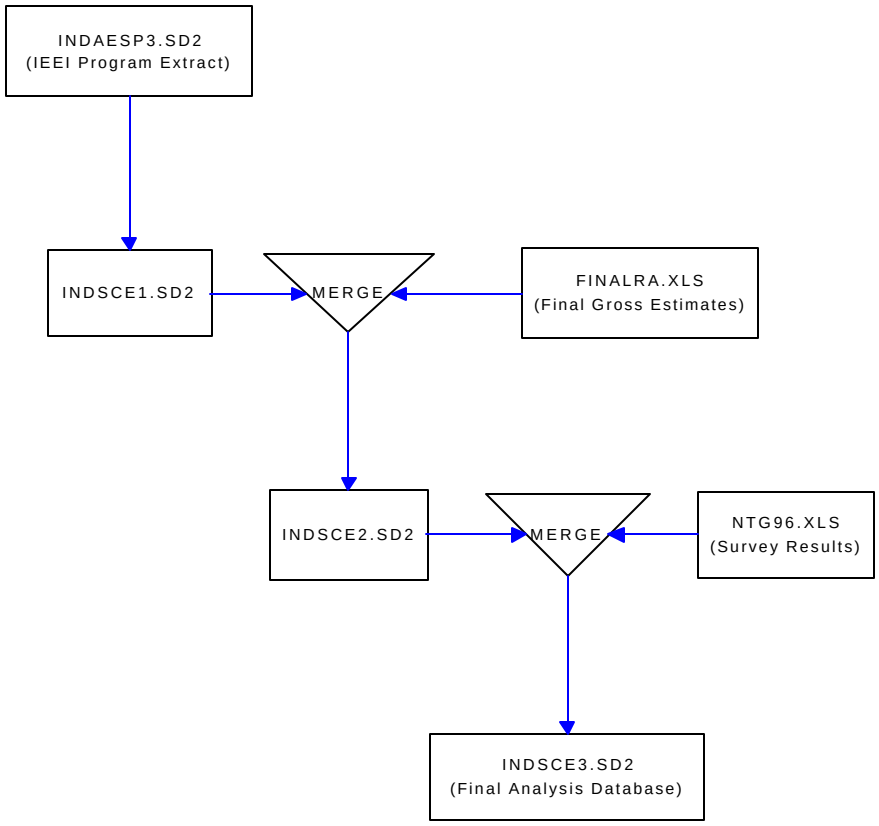

Table 2-2. Response to Protocol Table 7 continued

The construction of the final analysis SAS dataset required three steps. First, an extract from the IEEI Program tracking system was taken and stored in INDAESP3.SD2. Next, only those variables essential to the analysis were kept in INDSCE1.SD2 and merged with the final gross impact estimates, FINALRA.XLS, based on engineering analyses to produce INDSCE2.SD2. Finally, INDSCE2.SD2 was merged with NTG96.XLS to produce the final analysis dataset INDSCE3.SD2. Please see Table F-1 in Appendix F for more details about this process, including the number of observations in each file and the function of each SAS job.

2. *Identify the specific data sources for each data element:* The sources of all data elements are described below:
   - Engineering data for use in estimating gross impacts for all measures was obtained from on-site surveys,
   - Data used in estimating the standard NTGRs were obtained via interviews with the key decision-maker .

   Additional data for estimating custom NTGRs were collected from:
   - interviews with operations staff at each site,
   - interviews with Edison energy services representatives,
   - interviews with vendors associated with the installation of the efficient equipment, and
   - information was available from Program files.

3. *Diagram and describe data attrition process:* There is no significant data attrition. Only two decision-maker interviews could not be completed. Their missing values were filled and included in the end use and program level analyses. Sample selection processes, recruitment, response rates, and attrition are described in Sections 4 and 5.

4. *Describe the internal organizational data quality checks:* Gross savings data quality checks: Each evaluation was reviewed by a senior-level engineer who verified the reasonableness of the technical approach, data collected, and evaluation results. Gross savings results were further subjected to data checks which identified measures with negative savings, with large discrepancies compared to the program estimates, and other anomalies. Any outliers were further scrutinized to confirm their correctness. Net savings data quality checks: internal consistency checks were built into decision-maker interviews, so that interviewers were alerted to internal contradictions. For custom sites, consistency checks were made also between file information, and the decision-maker interviews. Also, consistency between pre-quantified question responses and narrative question responses were reviewed systematically, both for decision-makers and operations staff. Finally, all data entry was 100 percent verified and cleaned prior to analysis.

Table 2-2. Response to Protocol Table 7 continued

5. *Provide a summary of the data collected specifically for the analysis but not used:* For the most part, all data collected were used. There were two exceptions. First, Q. 11 on the Decision-Maker Survey, available for *all* measures, was not used in estimating the NTGRs for non-custom measures in strata one and two. This decision is consistent with recent agreements by the CADMAC Modeling and Base Efficiency Subcommittees. It was agreed that questions like Q. 11 that have to do with the *timing* of the installation should not be *routinely* or *mechanically* used to determine early replacement/deferred free-ridership. Thus, the use of Q. 11 was restricted to custom measures and, even here, it was never used routinely but rather it was taken into consideration along with all the other information for a given measure in order to estimate the NTGR.

   Second, vendor interviews to assist in estimating the NTGRs were only used for custom measures since these measures have much more quantitative and qualitative data available to provide a more comprehensive picture of the decision process. The chances of correctly interpreting the vendor results were increased by placing these results in the context of this larger body of data.

C. Sampling

1. *Sampling procedures and protocols:* A census was attempted both with respect to on-site engineering analysis of gross impacts and interviews with the 117 decision-makers associated with the 143 coupons and the associated 186 measures. A complete description of the sample design and implementation can be found in Section 4.
2. *Survey Information and survey instruments:* Data collection instruments are provided in Appendix D. A census was achieved with respect to on-site engineering analysis of gross impacts. A census was attempted with the 117 decision-makers associated with the 143 coupons and 186 measures, resulting in a response rate of 98.3 percent. Sample disposition reports are in Section 5.7.
3. *Statistical Descriptions:* Not Applicable

D. Data Screening and Analysis

1. *Describe treatment for outliers, missing data points and weather adjustments:* Once data collection was completed, very few data points were missing. There were only two measures (both process) for which a decision-maker interview could not be completed. For these two measures (both non-custom), the observed average NTGR for the process end use was applied.
2. *Describe control of background effects:* Background variables were not an issue since the analytical methods used to estimate both gross and net impacts were based on an analysis of each individual coupon and its related measure(s). These approaches do

Table 2-2. Response to Protocol Table 7 continued

not allow for the statistical control of such background effects as changes in economic conditions.

3. *Describe data screening procedures:* No screening of coupons and measures was done prior to data collection. That is, a census was attempted. Also, since analysis did not depend on billing data, many of the usual reasons for screening data did not exist.
4. *Regression statistics*: Not Applicable
5. *Specification:* Not Applicable
6. *Error in measuring variables:* Potential errors in measuring customers' level of free ridership are dealt with by multiple measures of the same concept, increasing reliability of measures. Also, internal consistency checks were provided to detect contradictions and misunderstandings on closed-ended questions during the interview so that they can be addressed on the spot with the respondent. For projects in the custom evaluation group additional checks were provided by asking open-ended questions, whose answers could be compared to the closed-ended questions to check for contradictions. Also in this group were interviews with decision-makers. Whenever possible, input from the operations staff were incorporated during the interview. Any contradictions between the decision-maker and the operations staff were resolved during the interview. Finally, in the custom evaluation group, file information, including payback calculations, was used to detect contradictions in reported motivations for installations, especially pertaining to the role of the rebate.
7. *Autocorrelation:* Not Applicable
8. *Heteroskedasticity*: Not Applicable
9. *Collinearity:* Not Applicable
10. *Influential data points:* Not Applicable
11. *Missing data:* Once data collection was completed, very few data points were missing. Only two decision-maker interviews were not completed for two measures in the process end use. For these, the missing NTGRs were filled using the observed mean NTGR for the process end use. More details are provided in Section 7.
12. *Precision*: Both the 80 percent and 90 percent confidence intervals for the final, custom NTGRs were calculated for both kWh and kW within each end use, for the end use as a whole, and for the program. The 80 percent and 90 percent confidence intervals were also calculated for realization rates. Since these are the critical ratios, these confidence intervals were calculated in two steps. First, the variance of the ratio (either realization rate or NTGR) was estimated using the following equation:

$$v(\hat{R}) = \frac{(1-f)}{n\bar{x}^2}(s_y^2 + \hat{R}^2 s_x^2 - 2\hat{R}s_{yx})$$

Table 2-2. Response to Protocol Table 7 continued

Where:

$v(\hat{R})$ = Variance of the NTGR

$\hat{R} = \frac{\bar{y}}{\bar{x}}$,the NTGR

f = Sampling fraction

n = Size of sample

$\bar{x}$ = Mean of gross impacts

$\bar{y}$ = Mean of net impacts

s_x^2 = Variance of the gross impacts

s_y^2 = Variance of the net impacts

s_{yx} = Covariance of the gross and net impacts

Once the variance of $\hat{R}$ was estimated, then the following equation is used to estimate the 80 percent and 90 percent confidence intervals:

$$\hat{R} = \pm z\sqrt{v(\hat{R})}$$

where z = The critical values for the 80% and 90% levels of confidence. i.e., 1.28 and 1.64.

Confidence intervals for other reported variables were calculated using the following formula:

$$\bar{y} \pm ts_{\bar{y}}$$

where t = the critical value from the t distribution
s = the standard error of $\bar{y}$, the NTGR.

The critical values of t for the 80% and 90% levels of confidence are 1.28 and 1.64 respectively. These confidence intervals were calculated for both lighting and process and placed around the end-use and program-level NTGRs calculated above.

E. Data Interpretation and Application

1. *Net impact calculations*: The methods used to estimate the measure-level net impacts was a combination of the ones listed in E.1.c and E.1.d in Table 7 of the Protocols.

Table 2-2. Response to Protocol Table 7 continued

2. *Describe process, choices made, and rationale for choices made in Section E.1, above:* Per Table 5 of the Protocols, engineering models were used to estimate gross impacts. The self-report method was chosen since Table C-5 does not require a comparison group. Note that there were only two measures (both process) for which a decision-maker interview could not be completed.

The challenges of data interpretation and application occurred primarily in the custom analysis of those coupons with the largest savings. The interpretation and analysis of the quantitative and qualitative data for the *custom* measures was a complex task. Without an explicit set of rules that are applied consistently and systematically, any such analysis can become unreliable. To guard against unreliable results, two steps were taken. First, the self-report method was developed so that it is consistent with the guidelines in Chapter 4 of Appendix J of the Protocols. Second, additional rules were developed and applied independently by two analysts. The results were then compared to detect any serious discrepancies in interpretation and analysis. The agreement rate, indicating the reliability of the custom analysis, between the two analysts was 85 percent.

The principles that were developed and applied are summarized below:

- The standard NTGR should stand except when there is strong evidence that it should not. No one piece of information should be used to override the standard NTGR. Specifically, more than one piece or source of information should form a larger picture that contradicts the standard NTGR before an override is considered.
- The standard NTGR should not be changed unless the change is substantial.
- In general, when information from the operations staff survey contradicts the decision-maker interview, the contradiction is best addressed during the decision-maker interview. When this does not occur, the decision-maker information should take precedence. The exception to this is when the operations staff person offers either concrete evidence in opposition to the decision-maker, or the information is particularly compelling.
- When there is no decision-maker interview, when there is no appropriate decision-maker interview or when there is missing information on it, the operations staff interview is used to fill in missing information.

Table 2-2. Response to Protocol Table 7 continued

- When information about the projected or forecasted timing of future installations was provided in the interview, it was not used in a routine manner. Rather, only when there was substantial evidence that accelerated installation was the *only* program influence was the specific degree of acceleration addressed.
- When there was a contradiction between the decision-maker and the ESR regarding the installation acceleration schedule, the midpoint between the two was used.

More details about the development of the rules and their application can be found in Section 7.1.6 of this report.