Final Report

Measurement and Evaluation Study of the 2002 SCG Non-Residential Financial Incentives Program

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1. Executive Summary

This document is the final report for the Measurement and Evaluation Study of the 2002 SCG Local Non-Residential Financial Incentives Program (NRFIP). This report contains verification of the number of measures installed by delivery channel. Additionally, this report contains measures of program effectiveness resulting from a process evaluation.

The SCG Local Non-residential Financial Incentives Program (NRFIP) is a local program targeting small to medium commercial and industrial gas customers. The program includes technical support, education, training, outreach, contractor referral, bulk procurement, prescriptive rebates, and incentives.

The primary objectives of the study are to:

1. Verify achieved levels of energy (Therm) savings through a program savings study, and
2. Measure indicators of program effectiveness through a process evaluation.

The evaluation is based on telephone surveys with 83 program participants. We attempted to contact a total of 98 participants to complete 83 surveys, resulting in a conversion rate of 84.7%. Only one participant refused to complete the survey, which is a refusal rate of 1.2%. The survey responses have been statistically extrapolated to the program population.

Savings Verification Results

Table 1 presents the evaluated number of measures installed relative to the number of measures installed according to the program tracking system, both by delivery channel and overall. For all program measures, the total number of installations was evaluated to be 976 measures representing an installation rate of 94.6%. The NREC delivery channel is experiencing the lowest installation rate (53.6%) while the PARR channel has the highest installation rate (100%).

	Program Tracking # Measures Installed	Evaluated # Measures Installed	Installation Rate
NREC	112	60	53.6%
NRER	634	629	99.2%
PARR	300	300	100.0%
Total	**1,046**	**989**	**94.6%**

Table 1: Measure Installation Rates by Delivery Channel

Once the number of installed measures was estimated, we determined the program's annual Therm savings, using IPMVP option A, stipulated energy savings. The stipulated values for the relevant parameters were combined with the verified measure installations[1]. Table 2 shows the results. The first column shows the number of measure installations, and the second column

[1] The only measure category that was not represented in our sample was NREC Engine Rebuilds, which according to the program tracking system accounted for a total of 3 measures. We have assumed a 100% installation rate for these 3 measures.

shows the evaluated installation rate. Multiplying the first column by the second column yields the evaluated number of measure installations.

Overall, the program is achieving an annual gross Therms savings of 1,901,735 Therms and an annual net Therms savings of 1,593,624 Therms. There were no stipulated values for the EULs so we were not able to calculate gross and net life-cycle Therm savings.

	Program Tracking # Installed	Evaluated Installation Rate	Evaluated # Installed	Gross Therms Per Unit	Evaluated Gross Therms	Net to Gross Ratio	Evaluated Net Therms
NREC Engine Rebuilds	3	100%	3	1,065	3,196	80%	2,557
NREC Equip. Modernization	93	44%	41	17,122	701,988	80%	561,590
NREC Heat Recovery	16	100%	16	11,504	184,057	80%	147,245
NRER Furnace Replacement	5	100%	5	18,649	93,244	80%	74,596
NRER Kiln Replacement	3	100%	3	18,898	56,693	80%	45,354
NRER Misc. Process Equip. Replacement	623	99%	618	734	453,412	80%	362,730
NRER Oven Replacement	3	100%	3	32,656	97,968	80%	78,374
PARR Braising Pan	4	100%	4	565	2,259	100%	2,259
PARR Cabinet Steamer	7	100%	7	1,175	8,225	100%	8,225
PARR Cheese melter	6	100%	6	460	2,761	100%	2,761
PARR Combination Oven	10	100%	10	3,071	30,707	100%	30,707
PARR Convection Oven	92	100%	92	617	56,785	100%	56,785
PARR Deck Oven	2	100%	2	677	1,354	100%	1,354
PARR Fryer - High Effic. Unit	11	100%	11	449	4,939	100%	4,939
PARR Fryer - Unit with Electr. Ignition	10	100%	10	942	9,420	100%	9,420
PARR Griddle	42	100%	42	571	23,995	100%	23,995
PARR Over-fired [char] broiler	9	100%	9	706	6,357	100%	6,357
PARR Rotating Rack Oven	27	100%	27	3,109	83,932	100%	83,932
PARR Salamander	5	100%	5	269	1,343	100%	1,343
PARR Steam Kettle	8	100%	8	1,477	11,814	100%	11,814
PARR Under-fired broiler	67	100%	67	1,004	67,285	100%	67,285
Total	**1,046**	**95%**	**989**		**1,901,735**		**1,583,624**

Table 2: Program Gross and Net Therms Savings

Table 3 presents the gross and net realization rates for Therms savings by delivery channel as well as for the overall program. We have calculated the program tracking Therms by multiplying the program tracking number of installed measures by the stipulated Therms savings. Overall, the program is experiencing a gross realization rate of 68.0% and a net realization rate of 56.6% for Therm savings.

	Program Tracking Therms	Evaluated Gross Therms	Gross Realization Rate	Evaluated Net Therms	Net Realization Rate
NREC	1,779,567	889,240	50.0%	711,392	40.0%
NRER	704,986	701,318	99.5%	561,054	79.6%
PARR	311,177	311,177	100.0%	311,177	100.0%
Total	**2,795,730**	**1,901,735**	**68.0%**	**1,583,624**	**56.6%**

Table 3: Gross and Net Realization Rates by Delivery Channel

Table 4 compares the evaluated net Therms savings to those recorded in the program's AEAP filing. The verified net Therms savings fall short of those recorded in the program's AEAP filing

but is above the CPUC target. The difference between the savings filed by the program and the verified savings is predominantly due to inaccurate quantities of measure installations recorded in the program tracking system.

	CPUC Target	Program AEAP Filed	Verified
Net Therms Savings	1,256,000	2,307,288	1,583,624

Table 4: Net Therms Savings Compared to AEAP Filing

Process Evaluation Results

Approximately 60% of program participants state they have experienced a noticeable change in their gas bill. The program measures are resulting in noticeable gas savings, as evidenced by the fact that 60% of participants have seen a reduction in their utility costs.

Most participants found it somewhat easy to identify, specify, and install the equipment and to complete their program application. This finding reinforces the fact that participating in the program is not cumbersome or a burden to customers.

Participants need support in knowing more about energy efficient equipment and operations. Nearly 20% of participants report needing significant support in knowing more about these issues with another 20% stating they could use some support. Not one participant stated they didn't need any support in knowing more about energy efficient equipment and operation. This finding suggests that the program is reaching those customers that require support in understanding how to maximize their energy efficiency.

Observations and Recommendations

Several observations were made about the 2002 Non-Residential Financial Incentives Program through the course of conducting this evaluation. Some of these observations have resulted in recommendations for the program. Our major observations are[2]:\

1. Excellent Overall Measure Installation Rate,
2. Care Is Needed When Entering Program Tracking Data, and
3. Participants Are Experiencing Noticeable Gas Savings.

[2] Detailed specifics for each observation are articulated in the chapter entitled "Observations and Recommendations".

2. Introduction

This is the final report for the Measurement and Evaluation Study of the 2002 SCG Local Non-Residential Financial Incentives Program (NRFIP). In this chapter, we will describe the 2002 program as well as our general evaluation approach.

Program Overview

The SCG Local Non-residential Financial Incentives Program (NRFIP) is a local program targeting small to medium commercial and industrial gas customers. The program includes technical support, education, training, outreach, contractor referral, bulk procurement, prescriptive rebates, and incentives.

The SCG Local Non-residential Financial Incentives Program is comprised of three program elements:

1. The "Purchase-Apply-Receive Rebate" (PARR) provides streamlined rebates to non-residential customers who install one or more identified energy efficient measures from a prescribed list. This element focuses primarily on foodservice type equipment.
2. The "Non-Residential Equipment Replacement" (NRER) element is limited to "kind-for-kind" replacement of old, inefficient commercial or industrial end use gas fired technology for higher efficiency alternatives. Examples of measures incented under this element are gas engines and high temperature industrial process technologies.
3. The "Non-Residential Energy Conservation" incentive element provides qualified customers with a financial incentive to implement comprehensive energy savings commercial building envelope or industrial process changes on a unique, site-specific, case-by-case basis. Examples of measures incented under this element are commercial building envelope upgrades, engine rebuilds, energy management controls, and a variety of industrial process efficiency improvements.

In 2002, according to the program tracking data, the NRFIP program incented 112 measures to 52 participants under the NREC delivery channel and 634 measures to 66 participants under the NRER delivery channel. Under the PARR delivery channel, the 2002 NRFIP program rebated 300 measures to 174 participants.

Evaluation Overview

The primary objectives of the study are to:

1. Verify achieved levels Therm savings through a program savings study, and
2. Measure indicators of program effectiveness through a process evaluation.

To verify the achieved levels of Therm savings, the study will determine the number of measure installations achieved during the 2002 program year using telephone surveys. The same telephone survey will also be utilized to measure indicators of program effectiveness.

Using the SCG program tracking data as a sampling frame, we selected a statistically representative sample of 80 participants for the telephone survey. We ultimately completed a survey with 83 participants. All results were extrapolated to the program participant population.

We used a telephone survey to serve two purposes: verifying the measure installations and assessing the effectiveness of the program approach in delivering customer satisfaction. For each participant in the sample, the survey verified the measures listed in the SCG tracking

database. The survey also determined how participants heard of the program, reasons for participation, and customer perceptions on how the program has helped them manage their energy bills.

For the savings verification component of the evaluation, the statistical analysis of the data consisted of extrapolating the verified measure installations in the sample to the program population to estimate the total number of measure installations achieved by the program. We calculated measure installation rates by delivery channel and, the extent possible, by measure category, by comparing the tracking system data to the verified installations. The total number of measure installations achieved in the program year was then used to verify the energy savings achieved by the program using IPMVP option A, Stipulated Energy Savings, and the parameters assumed in the detailed cost-effectiveness workpapers. For the process evaluation component of the study, the statistical analysis of the data consisted of weighted frequency distributions, means, and cross-tabulations, where appropriate, to measure indicators of program effectiveness.

3. Results

Savings Verification Results

Verification of Number of Measures Installed

Table 5 presents the evaluated number of measures installed relative to the number of measures installed according to the program tracking system, both by delivery channel and overall. For all program measures, the total number of installations was evaluated to be 989 measures representing an installation rate of 94.6%. The NREC delivery channel is experiencing the lowest installation rate (53.6%) while the PARR channel has the highest installation rate (100%).

	Program Tracking # Measures Installed	Evaluated # Measures Installed	Installation Rate
NREC	112	60	53.6%
NRER	634	629	99.2%
PARR	300	300	100.0%
Total	**1,046**	**989**	**94.6%**

Table 5: Measure Installation Rates by Delivery Channel

The discrepancy between the program tracking installations and the evaluated installations is primarily due to inaccurate program tracking data in terms of the quantity of measures installed. Only one participant reported that no equipment installation took place. There were several participants who reported installing measures of the type in question but of a different quantity. Some examples are:

- The program tracking data showed 20 boilers installed at one site. The participant reported that 2 boilers were installed, not 20. When asked about the discrepancy, the participant reported there never were any plans to install 20 boilers. Discussions with program staff and close inspection of the program tracking revealed that 20 small heaters were replaced with 2 boilers, and the SCG account representative misunderstood that even though the customer replaced 20 pieces of equipment SCG could only take credit for the 2 pieces that were actually installed.
- The program tracking data showed 10 dryers installed at one site. The participant reports that 8 dryers were installed. Discussions with SCG program staff and inspections of program records show that the program tracking data contained a typo regarding the quantity installed. In other words, 8 dryers were installed and rebated, not 10, even though the program tracking data shows a quantity of 10.
- The program tracking data shows 11 dryers total at a site. The participant reports installing 2 dryers. In this scenario, the site had 2 rows of program tracking data; one that showed 10 dryers and one that showed 1 dryer, indicating that the 10 is a typo and should have been a one.

Table 6 shows the evaluated number of measures installed and associated error bound by delivery channel as well as overall. The total number of measures installed was 989 measures, with an error bound of 13 measures, yielding a 90% confidence interval of (976, 1,002) measures. For NREC, the 90% confidence interval is (47, 73) measures, while for NRER, the 90% confidence interval is (627, 631) measures.

	Evaluated # Measures Installed	Error Bound	Relative Precision
NREC	60	13	21.7%
NRER	629	2	0.3%
PARR	300	0	0.0%
Total	**989**	**13**	**1.3%**

Table 6: Number of Measures Installed by Delivery Channel

All measures that were initially installed are reported to still be installed and in operation. When participants were asked why they decided not to install the measures that were present in the program tracking data, all but one participant reported there never were plans to install those measures. As described earlier in this section, there were some issues with the quantities recorded in the program tracking data. One participant did report planning to install a rebated measure that is not yet installed. This participant stated that preparation work was required before the measure could be installed and that they are currently installing the measure.

Verify Program Savings

Once the number of installed measures was estimated, we determined the program's annual Therm savings, using IPMVP option A, stipulated energy savings. The stipulated values for the relevant parameters were combined with the verified measure installations[3]. Table 7 shows the results. The first column shows the number of measure installations, and the second column shows the evaluated installation rate. Multiplying the first column by the second column yields the evaluated number of measure installations.

Overall, the program is achieving an annual gross Therms savings of 1,901,735 Therms and an annual net Therms savings of 1,583,624 Therms. There were no stipulated values for the EULs so we were not able to calculate gross and net life-cycle Therms savings.

	Program Tracking # Installed	Evaluated Installation Rate	Evaluated # Installed	Gross Therms Per Unit	Evaluated Gross Therms	Net to Gross Ratio	Evaluated Net Therms
NREC Engine Rebuilds	3	100%	3	1,065	3,196	80%	2,557
NREC Equip. Modernization	93	44%	41	17,122	701,988	80%	561,590
NREC Heat Recovery	16	100%	16	11,504	184,057	80%	147,245
NRER Furnace Replacement	5	100%	5	18,649	93,244	80%	74,596
NRER Kiln Replacement	3	100%	3	18,898	56,693	80%	45,354
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PARR Griddle	42	100%	42	571	23,995	100%	23,995
PARR Over-fired [char] broiler	9	100%	9	706	6,357	100%	6,357
PARR Rotating Rack Oven	27	100%	27	3,109	83,932	100%	83,932
PARR Salamander	5	100%	5	269	1,343	100%	1,343
PARR Steam Kettle	8	100%	8	1,477	11,814	100%	11,814
PARR Under-fired broiler	67	100%	67	1,004	67,285	100%	67,285
Total	**1,046**	**95%**	**989**		**1,901,735**		**1,583,624**

Table 7: Program Gross and Net Therms Savings

Table 8 presents the gross and net realization rates for Therms savings by delivery channel as well as for the overall program. We have calculated the program tracking Therms by multiplying the program tracking number of installed measures by the stipulated Therms savings. Note that for individual measure types the gross realization rate is the same as the measure installation rate and that the net realization rate is the installation rate times the net-to-gross ratio. Overall, the program is experiencing a gross realization rate of 68.0% and a net realization rate of 56.6% for Therms savings.

[3] The only measure category that was not represented in our sample was NREC Engine Rebuilds, which according to the program tracking system accounted for a total of 3 measures. We have assumed a 100% installation rate for these 3 measures.

	Program Tracking Therms	Evaluated Gross Therms	Gross Realization Rate	Evaluated Net Therms	Net Realization Rate
NREC	1,779,567	889,240	50.0%	711,392	40.0%
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PARR	311,177	311,177	100.0%	311,177	100.0%
Total	**2,795,730**	**1,901,735**	**68.0%**	**1,583,624**	**56.6%**

Table 8: Gross and Net Realization Rates by Delivery Channel

Table 9 compares the evaluated net Therms savings to those recorded in the program's AEAP filing. The verified net Therms savings fall short of those recorded in the program's AEAP filing but is above the CPUC target. The difference between the savings filed by the program and the verified savings is predominantly due to inaccurate quantities of measure installations recorded in the program tracking system.

	CPUC Target	Program AEAP Filed	Verified
Net Therms Savings	1,256,000	2,307,288	1,583,624

Table 9: Net Therms Savings Compared to AEAP Filing

Process Evaluation Results

Table 10 shows how participants first became aware of SCG's 2002 Non-Residential Financial Incentives Program by delivery channel. Overall, about 33% of participants learned of the program through their SCG account rep, while just fewer than 15% became aware of the program through an equipment vendor, manufacturer, or distributor. PARR participants were significantly more likely to learn of the program through a letter/mailing or a bill insert, while NREC participants were more likely to become aware of the program through their SCG account representative.

	% of Participants			
	NREC	**NRER**	**PARR**	**Overall**
Letter / Mailing (Not Bill Insert)	3.9%	-	28.4%	17.8%
Bill Insert	-	1.5%	14.2%	8.9%
Friend / Colleague	-	1.5%	-	0.3%
SCG Website	-	1.5%	-	0.3%
Utility Account Representative	68.6%	33.8%	22.2%	32.9%
Other	-	4.6%	14.2%	9.6%
Vendor/Manufacturer/Distributor	19.6%	32.3%	6.8%	14.7%
Prior Program Experience	-	3.1%	2.3%	2.1%
SCG - Other	2.0%	-	3.4%	2.4%
Corporate Office / Franchise Meeting	-	6.2%	4.5%	4.1%
Don't Know	5.9%	15.4%	4.0%	6.8%

Table 10: Source of Awareness of Non-Residential Financial Incentives Program By Delivery Channel

Next, respondents were asked to provide the primary reason they participated in the program. Table 11 displays the responses by delivery channel. About 50% of participants chose to participate to upgrade to new equipment. Over 35% of participants state their primary reason for participating in the program was to achieve energy savings. NREC and NRER participants were significantly more likely than PARR participants to state that direct energy savings was their primary reason for participating. PARR participants were significantly more likely to participate in order to upgrade to new equipment.

	% of Participants			
	NREC	**NRER**	**PARR**	**Overall**
Direct Energy Savings	53.8%	53.8%	23.6%	35.7%
Upgrade to New Equipment	21.2%	36.9%	62.1%	49.1%
Improve Cost of Business Operations	9.6%	6.2%	-	3.1%
Other	-	3.1%	14.9%	9.6%
Regulation Changes	15.4%	-	-	2.7%

Table 11: Primary Reason for Participating in Non-Residential Financial Incentives Program By Delivery Channel

Table 12 presents the incidence of participants noticing a change in their gas bill since participating in the Non-Residential Financial Incentives Program by delivery channel. Overall, about 60% of participants have noticed a change in their bill. Approximately another 35% of

participants do not know if they have seen a change in their bill. Many of the participants that do not know if they are experiencing a change in their energy bill reported making additional equipment changes at or around the same time as installing the program measures, making it difficult to distinguish any changes.

	% of Participants			
	NREC	NRER	PARR	Overall
Yes	54.9%	32.8%	72.4%	60.6%
No	2.0%	10.9%	-	2.8%
Don't Know	43.1%	56.3%	27.6%	36.7%

Table 12: Incidence of Noticing a Change in Gas Bill

All participants who have noticed a change in their gas bill were asked to compare the change to their expectations. As shown in Table 13, only about 2% of all participants who have noticed a change are experiencing less energy savings than they expected, while nearly 75% of participants who have noticed a change are saving about as much as they expected. Just over 20% of participants who have noticed a change are saving even more than they expected. PARR participants are more likely to report saving more than expected, while NRER participants are the only respondents reporting savings less than expected.

	% of Participants With Change in Bill			
	NREC	NRER	PARR	Overall
Less Than I expected	-	14.3%	-	1.7%
About As Much As I Expected	86.2%	76.2%	69.8%	73.3%
More Than I Expected	13.8%	4.8%	25.4%	21.0%
Don't Know	-	4.8%	4.8%	4.0%

Table 13: Change in Gas Bill Compared to Participant Expectations Among Participants Who Noticed A Change in Bill

All respondents were read a list of items about the Non-Residential Financial Incentives Program and asked to rate the level of ease associated with each[4], using a scale of 1 to 5, where 1 means very difficult and 5 means very easy. Table 14 displays the mean rating of ease for each item by delivery channel. Overall, participants find it easy to participate, as the mean rating of each item is 4.02 or higher. On average, NRER participants found the various components of participating slightly more difficult than their NREC or PARR counterparts.

	Mean Rating			
	NREC	NRER	PARR	Overall
Identify & Specify Rebated (Incented) Equipment	4.62	3.88	4.13	4.16
Install the Rebated (Incented) Equipment	4.24	3.75	4.05	4.02
Complete Your Program Application	4.80	3.80	4.15	4.19

Table 14: Level of Ease Associated with Various Aspects of Participating

[4] The order in which the items were read was different for PARR participants than for NREC and NRER participants, in order to reflect the sequence of participation events for each unique delivery channel.

Participants were asked how long it took to receive their rebate/incentive once the equipment was installed and their application was complete. Table 15 summarizes the responses. Approximately 50% of participants received their check within 30 days of installing the equipment and completing their application. Another 20% of participants report receiving it within 30 – 59 days.

	% of Participants			
	NREC	**NRER**	**PARR**	**Overall**
Less Than 30 Days	53.8%	49.1%	49.7%	50.4%
30 - 59 Days	30.8%	22.8%	17.9%	21.3%
60 - 89 Days	7.7%	8.8%	1.2%	3.9%
90 Days or Greater	5.8%	15.8%	26.0%	20.2%
I Still Haven't Received It	-	-	-	-
Don't Know	1.9%	3.5%	5.2%	4.3%

Table 15: Length of Time to Receive Rebate/Incentive Once Application Was Complete By Delivery Channel

Participants were asked to describe their need to know more about energy efficient equipment and operations. As shown in Table 16, about 15% of participants state they could use significant support in having more information related to energy efficiency. Nearly 40% of participants could use some support only in certain areas, and about 30% could use a little support only in certain areas. Not one participant stated they didn't need any support in knowing more.

	% of Participants			
	NREC	**NRER**	**PARR**	**Overall**
I Can Use Significant Support in Knowing More	11.5%	22.7%	14.5%	15.8%
I Can Use Some Support in Knowing More	46.2%	27.3%	5.2%	17.5%
I Can Use Some Support Only In Certain Areas	7.7%	34.8%	44.5%	35.7%
I Can Use A Little Support Only In Certain Areas	34.6%	15.2%	31.8%	28.5%
I Know Pretty Much What I Need to Know	-	-	-	-
Don't Know	-	-	4.0%	2.4%

Table 16: Participant Need to Know More About Energy Efficient Equipment & Operations by Delivery Channel

Demographics

Table 17 presents the participant firm's main line of business by delivery channel. Nearly 40% of participants report they are a restaurant or caterer. About 60% of NRER participants are laundry facilities.

	% of Participants			
	NREC	**NRER**	**PARR**	**Overall**
Restaurant / Catering	20.0%	-	56.6%	37.5%
Laundry	-	62.1%	-	14.1%
Bakery	18.0%	-	17.7%	13.7%
School / College	-	1.5%	14.9%	9.3%
Industrial	28.0%	19.7%	-	9.3%
Other	4.0%	10.6%	1.7%	4.1%
Food Manufacturing	16.0%	4.5%	-	3.8%
Grocery Store	-	-	5.7%	3.4%
Hotel	2.0%	-	3.4%	2.4%
Nursery	8.0%	1.5%	-	1.7%
Hospital	4.0%	-	-	0.7%

Table 17: Firm's Main Line of Business

4. Observations and Recommendations

This chapter presents observations made about the 2002 Non-Residential Financial Incentives Program through the course of conducting this evaluation. Recommendations to improve the program are also presented.

Excellent Overall Measure Installation Rate

Overall, the program is experiencing a high rate of measure installation. Overall, the measure installation rate was 94.6%. For PARR measures, the installation rate was 100%, and for NRER measures, the installation rate was 99.2%. For NREC measures, the installation rate was 53.6%. Nearly every uninstalled measure is due to incorrect quantities recorded in the program tracking system.

Care Is Needed When Entering Program Tracking Data

The discrepancy between the program tracking installations and the evaluated installations is primarily due to inaccurate quantities of the installed measure recorded in the program tracking data. Nearly all of the discrepancies in measure installations are due to inaccurate quantities in the program tracking data.

Some examples are:

- The program tracking data showed 20 boilers installed at one site. The participant reported that two boilers were installed, not 20. When asked about the discrepancy, the participant reported there never were any plans to install 20 boilers. Discussions with program staff and close inspection of the program tracking revealed that 20 small heaters were replaced with 2 boilers, and the SCG account representative misunderstood that even though the customer replaced 20 pieces of equipment SCG could only take credit for the 2 pieces that were actually installed.
- The program tracking data showed 10 dryers installed at one site. The participant reports that eight dryers were installed. Discussions with SCG program staff and inspections of program records show that the program tracking data contained a typo regarding the quantity installed. In other words, 8 dryers were installed and rebated, not 10, even though the program tracking data shows a quantity of 10.
- The program tracking data shows 11 dryers total at a site. The participant reports installing 2 dryers. In this scenario, the site had two rows of program tracking data; one that showed 10 dryers and one that showed one dryer, indicating that the 10 is a typo and should have been a one.

Therefore, in order to increase the measure installation rate, particularly for the NREC delivery channel, we recommend implementing a procedure that double-checks the measure data recorded in the program tracking system.

NRFIP program staff thoroughly investigated each discrepancy in measure installations identified in this evaluation. It was determined that in nearly each instance the proper incentive was in fact paid. In other words, the incentive was paid based on the actual measure installations, not the inaccurate quantities recorded in the program tracking system.

SCG has indicated that the following modifications will be implemented in the program tracking system (MAS) in Program Years 2004-2005 to resolve future discrepancies:

1. Account representatives will be required to add explanations when the number of installed measures differs from the number of replaced measures,
2. Detail Report #6 in MAS will include the number of incented measures, number of closed measures, and any comments detailing discrepancies,
3. An Exception Report will be developed in MAS detailing applications (projects) with discrepancies and explanation for discrepancies, and
4. All NREC and NRER projects will be thoroughly reviewed by Gas Company Tower (GCT) Staff when they receive the closed file. GCT Staff will follow up with the account representative if necessary to clarify any discrepancies and add a note to the file as appropriate.

Participants Are Experiencing Noticeable Gas Savings

About 60% of participants report they have noticed a change in their gas bill since installing the equipment rebated / incented through the program. Among participants that have noticed a change, approximately 95% report they are saving as much as they expected or more. Participants who have not noticed a change in their gas bill state this is because several equipment modifications took place at the same time so they cannot discern any changes related to the program measures.

5. EM&V Methodology

To evaluate the number of measures installed through the Non-Residential Financial Incentives Program, RLW utilized telephone surveys with a statistically representative sample of program participants. We used the program tracking data to design a sample statistically representative of the program. For each program participant in the sample, we verified the measures installed according to the program tracking data using a phone survey.

We also assessed the effectiveness of the program approach in delivering customer satisfaction using phone surveys. The process evaluation component was also designed to explore how participants first became aware of the program, reasons for participation, whether the participant has noticed a change in their gas usage since participating, and the level of ease associated with identifying and installing the rebated/incented equipment and completing the program application.

Sample Design

The selection of the sample participants was guided by a model-based statistical sampling plan. Model-based sampling methods were also used to analyze the data, i.e., to extrapolate the findings from the sample participants to the target population of all program participants and to evaluate the statistical precision of the results. We stratified the participant population by delivery channel (i.e. NREC, NRER, and PARR) and Therms savings, as a way to maximize the Therms savings verified in our sample.

Theoretical Foundation

MBSS™ methodology was used to develop an efficient sample design and to assess the likely statistical precision associated the planned sample. The target variable of analysis, denoted *y*, is the verified number of measures installed through the program. The primary stratification variable, the program tracking number of measures installed, will be denoted *x*. A ratio model was formulated to describe the relationship between *y* and *x* for all units in the population, e.g., program participants.

The MBSS™ ratio model consists of two equations called the primary and secondary equations:

$$\begin{aligned} y_k &= \beta x_k + \varepsilon_k \\ \sigma_k &= sd(y_k) = \sigma_0 x_k^{\gamma} \end{aligned}$$

Here $x_k > 0$ is known throughout the population. *k* denotes the sampling unit, i.e., the participant. $\{\varepsilon_1, \ldots, \varepsilon_N\}$ are independent random variables with zero expected value, and β, σ_0, and γ (gamma) are parameters of the model. The primary equation can also be written as

$$\mu_k = \beta x_k$$

Under the MBSS ratio model, it is assumed that the expected value of *y* is a simple ratio or multiple of *x.*

Here, y_k is a random variable with expected value μ_k and standard deviation σ_k. Both the expected value and standard deviation generally vary from one unit to another depending on

x_k, following the primary and secondary equations of the model. In statistical jargon, the ratio model is a (usually) heteroscedastic regression model with zero intercept.

One of the key parameters of the ratio model is the error ratio, denoted *er*. The error ratio is a measure of the strength of the association between *y* and *x*. The error ratio is suitable for measuring the strength of a heteroscedastic relationship and for choosing sample sizes. It is *not* equal to the correlation coefficient. It *is* somewhat analogous to a coefficient of variation except that it describes the association between two or more variables rather than the variation in a single variable.

Using the model discussed above, the error ratio, *er*, is defined to be:

$$er = \frac{\sum_{k=1}^{N} \sigma_k}{\sum_{k=1}^{N} \mu_k} = \frac{\frac{1}{N}\sum_{k=1}^{N} \sigma_k}{\frac{1}{N}\sum_{k=1}^{N} \mu_k}$$

Figure 1 gives some typical examples of ratio models with different error ratios. An error ratio of 0.2 represents a very strong association between *y* and *x*, whereas an error ratio of 0.8 represents a weak association.

As Figure 1 indicates, the error ratio is the principle determinant of the sample size required to satisfy the 90/10 criteria for estimating *y*. If the error ratio is small, then the required sample is correspondingly small.

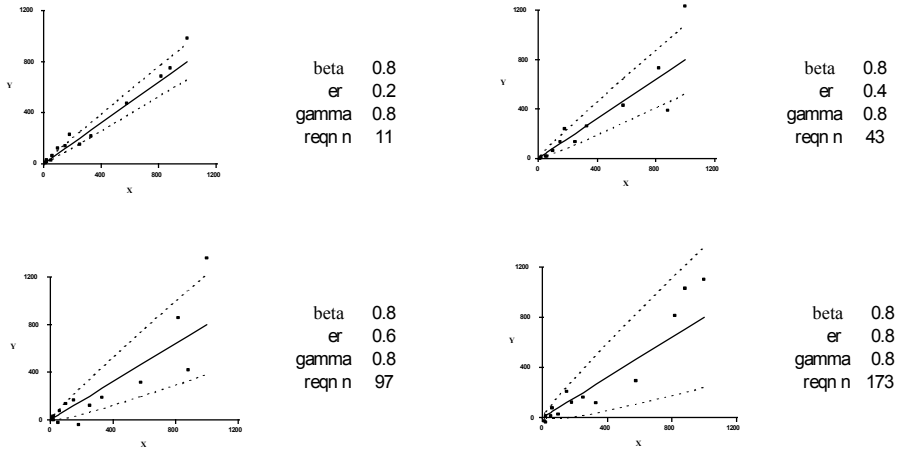

Figure 1: Examples of MBSS Ratio Models

Sampling Plan

At the planning stage of the M&V evaluation for the Non-Residential Financial Incentives Program, we proposed a sample of 80 participants for the telephone survey effort. Based on our past experience with programs of this nature, we conservatively assumed an error ratio of 0.3 for the telephone survey sample design. The expected relative precision associated with our sampling plan was $\pm 2.6\%$. By selecting a conservative value for the error ratio, the expected relative precision associated with the planned sample can be considered an upper bound. Therefore, we expected the relative precision achieved with our sample would be less than or equal $\pm 2.6\%$.

We stratified the program population by delivery channel (i.e. NREC, NRER, and PARR) and Therms savings, as a way to maximize the Therms savings verified in our sample. Table 18 shows our original sampling plan. Our sampling plan called for a sample of 80 participants for telephone survey data collection. This sample design was expected to yield a relative precision of ±2.6% at the 90% level of confidence for the overall number measures installed through the program.

	Stratum	Max Therms	Population Size	Population # Measures	Sample Size
NREC	1	10,188	21	24	3
	2	20,163	9	11	3
	3	31,368	6	6	3
	4	50,110	4	24	3
	5	1,000,000	12	47	12
	Total		**52**	**112**	**24**
NRER	1	14,596	21	63	4
	2	20,970	10	73	4
	3	30,806	7	38	4
	4	45,291	6	46	4
	5	600,000	22	414	22
	Total		**66**	**634**	**38**
PARR	1	1,624	124	145	4
	2	5,604	29	63	4
	3	14,361	12	30	4
	4	27,327	7	30	4
	5	300,000	2	32	2
	Total		**174**	**300**	**18**

Table 18: Original Non-Residential Financial Incentives Program Sample Design

Final Sample Design

The case weights were calculated using the strata cutpoints from our original sample design. We considered using balanced post-stratification as an alternative. However, the achieved relative precision was better, or lower, using our original strata cutpoints. Table 19 shows the final sample design that was used to calculate the case weights. For example, the case weight for the 3 units in the first stratum of the NREC delivery channel is 21 / 3 = 7.

	Stratum	Max Therms	Population Size	Population # Measures	Sample Size	Case Weight
NREC	1	10,188	21	24	3	7.000
	2	20,163	9	11	3	3.000
	3	31,368	6	6	3	2.000
	4	50,110	4	24	3	1.333
	5	1,000,000	12	47	11	1.091
	Total		**52**	**112**	**23**	
NRER	1	14,596	21	63	3	7.000
	2	20,970	10	73	8	1.250
	3	30,806	7	38	5	1.400
	4	45,291	6	46	5	1.200
	5	600,000	22	414	18	1.222
	Total		**66**	**634**	**39**	
PARR	1	1,624	124	145	5	24.800
	2	5,604	29	63	5	5.800
	3	14,361	12	30	5	2.400
	4	27,327	7	30	4	1.750
	5	300,000	2	32	2	1.000
	Total		**174**	**300**	**21**	

Table 19: Final Non-Residential Financial Incentives Program Sample Design

Telephone Survey Instrument Design

We developed a questionnaire for the evaluation with separate sections dedicated to the verification of measure installations and the process evaluation. The first section of the survey instrument is dedicated to verifying the installation of measures recorded in the SCG program tracking database including:

- Verification that the measure was installed,
- If not installed, reason why not,
- Verification that the measure is still installed,
- If not still installed, why not,

The next section of the participant survey instrument was designed to obtain a variety of information for the process evaluation including:

- How participants heard of the program,
- The reasons for program participation,
- Customer perceptions on how the program has helped them manage their energy bills,
- Participant satisfaction and recommended program improvements, and
- Market barriers to participation and installation.

The survey also contained a series of demographic questions. The following demographics were captured with the survey:

- Business Type,
- Title & Position, and
- Number of Years at Organization and Position.

RLW submitted the survey instrument to the SCG project manager and other interested parties for a final review and ultimately approval.

Telephone Survey Data Collection

Using the survey instrument described above, telephone surveys were conducted from RLW's CA office. All telephone surveyors were provided instruction on program operation, proper etiquette for contacting participants, and how to interpret participant responses.

All survey calls were tracked and any refusals or incomplete responses were recorded. Upon completing each interview, the telephone survey manager reviewed the survey for accuracy and completeness and then entered the data into an electronic database designed specifically for this survey by the project analyst.

Data were validated automatically using imbedded database functionality. The entered data were also continuously reviewed by the telephone survey manager. Prior to analysis, the project analyst thoroughly performed a quality control check on the data, identifying and correcting any illogical or unreasonable responses.

Table 20 presents the dispositions of the telephone survey data collection effort. We attempted to contact a total of 98 participants. Of these 98 participants, 83 completed a telephone survey, corresponding to conversion rate of 84.7%[5]. Only 1 participant refused to complete the survey, which is a refusal rate of only 1.2%.

	# of Participants
Completed	83
Program Contact No Longer With Company.	4
Disconnected	1
Left Message	4
No Answer	2
Refusal	1
Wrong Number	3
Total	**98**
Conversion Rate	**84.7%**

Table 20: Telephone Survey Dispositions

Measure Verification Analysis

Model-Based Statistical Sampling or MBSS™ was used to extrapolate the sample results to the target population. The general idea behind model-based statistics is that there is a relationship

[5] The conversion rate is defined as the ratio of successfully completed surveys to all attempted contacts.

between the variable of interest – in this case, the verified number of measures installed – and a variable that is known for the entire population – in this case, the program tracking number of measures installed. Using this prior information allows for greater precision with a given sample size because the prior information eliminates some of the statistical uncertainty.

The estimate of the number of measures installed in the population is expressed as the ratio of the sample average evaluated number of measures installed to the sample average program tracking number of measures installed times the population total program tracking number of measures installed.

$$Y = y/x\ X$$

Where:

Y is the population total number of measures installed

y is the average number of measures installed in the sample

X is the population total program tracking number of measures installed

x is the average program tracking number of measures installed in the sample.

Measure installation rates for the overall program are calculated in the next chapter. Results are also disaggregated for by delivery channel (i.e. NREC, NRER, and PARR).

Theoretical Background

The sample design discussion in the methodology section of this report described the sample designs used in this study. Therefore this section will describe in more detail the methods used to extrapolate the results to the target population. Two topics will be described:

- Case weights, and
- Stratified ratio estimation using case weights.

Case Weights

Background

Given observations of a variable *y* in a stratified sample, estimate the population total *Y*.

Note that the population total of *y* is the sum across the *H* strata of the subtotals of y in each stratum. Moreover each subtotal can be written as the number of cases in the stratum times the mean of *y* in the stratum. This gives the equation:

$$Y = \sum_{h=1}^{H} N_h \mu_h$$

Motivated by the preceding equation, we estimate the population mean in each stratum using the corresponding sample mean. This gives the conventional form of the stratified-sampling estimator, denoted $\hat{Y}$, of the population total *Y:*

$$\hat{Y} = \sum_{h=1}^{H} N_h \bar{y}_h$$

With a little algebra, the right-hand side of this equation can be rewritten in a different form:

$$\begin{aligned}\hat{Y} &= \sum_{h=1}^{H} N_h \bar{y}_h \\ &= \sum_{h=1}^{H} N_h \left(\frac{1}{n_h} \sum_{k \in s_h} y_k \right) \\ &= \sum_{k=1}^{n} \left(\frac{N_h}{n_h} \right) y_k\end{aligned}$$

Motivated by the last expression, we define the ***case weight*** of each unit in the sample to be $w_k = \frac{N_h}{n_h}$. Then the conventional estimate of the population total can be written as a simple weighted sum of the sample observations:

$$\hat{Y} = \sum_{k=1}^{n} w_k y_k$$

The case weight w_k can be thought of as the number of units in the population represented by unit *k* in the sample. The conventional sample estimate of the population total can be obtained by calculating the weighted sum of the values observed in the sample.

Stratified Ratio Estimation

Ratio estimation is used to estimate the population total *Y* of the target variable *y* taking advantage of the known population total *X* of a suitable explanatory variable *x*. The ratio estimate of the population total is denoted $\hat{Y}_{ra}$ to distinguish it from the ordinary stratified sampling estimate of the population total, which is denoted as $\hat{Y}$.

Motivated by the identity $Y = BX$, we estimate the population total *Y* by first estimating the population ratio *B* using the sample ratio $b = \bar{y}/\bar{x}$, and then estimating the population total as the product of the sample ratio and the known population total *X*. Here the sample means are calculated using the appropriate case weights. This procedure can be summarized as follows:

$$\begin{aligned}\hat{Y}_{ra} &= b X \quad \text{where} \\ b &= \frac{\bar{y}}{\bar{x}} \\ \bar{y} &= \frac{1}{\hat{N}} \sum_{k=1}^{n} w_k y_k \\ \bar{x} &= \frac{1}{\hat{N}} \sum_{k=1}^{n} w_k x_k \\ \hat{N} &= \sum_{k=1}^{n} w_k\end{aligned}$$

The conventional 90 percent confidence interval for the ratio estimate of the population total is usually written as

$$\begin{aligned}
\hat{Y}_{ra} &\pm 1.645\sqrt{V\left(\hat{Y}_{ra}\right)} \quad \text{where} \\
V\left(\hat{Y}_{ra}\right) &= \sum_{h=1}^{H} N_h^2 \left(1-\frac{n_h}{N_h}\right)\frac{s_h^2(e)}{n_h} \\
s_h^2(e) &= \frac{1}{n_h-1}\sum_{k\in s_h}\left(e_k-\bar{e}_h\right)^2 \\
e_k &= y_k - b\,x_k
\end{aligned}$$

We can calculate the relative precision of the estimate $\hat{Y}_{ra}$ using the equation

$$rp = \frac{1.645\sqrt{V\left(\hat{Y}_{ra}\right)}}{\hat{Y}_{ra}}$$

MBSS theory has led to an alternative procedure to calculate confidence intervals for ratio estimation, called model-based domains estimation. This method yields the same estimate as the conventional approach described above, but gives slightly different error bounds. This approach has many advantages, especially for small samples, and has been used throughout this study.

Under model-based domains estimation, the ratio estimator of the population total is calculated as usual. However, the variance of the ratio estimator is estimated from the case weights using the equation

$$V\left(\hat{Y}_{ra}\right) = \sum_{k=1}^{n} w_k\left(w_k-1\right)e_k^2$$

Here w_k is the case weight discussed above and e_k is the sample residual $e_k = y_k - b\,x_k$. Then, as usual, the confidence interval is calculated as

$$\hat{Y}_{ra} \pm 1.645\sqrt{V\left(\hat{Y}_{ra}\right)}$$

and the achieved relative precision is calculated as

$$rp = \frac{1.645\sqrt{V\left(\hat{Y}_{ra}\right)}}{\hat{Y}_{ra}}$$

The model-based domains estimation approach is often much easier to calculate than the conventional approach since it is not necessary to group the sample into strata. In large samples, there is generally not much difference between the case-weight approach and the conventional approach. In small samples the case-weight approach seems to perform better. For consistency, we have come to use model-based domains estimation in most work.

This methodology generally gives error bounds similar to the conventional approach. Equally, the model-based domains estimation approach can be derived from the conventional approach by making the substitutions:

$$\begin{aligned}
\bar{e}_h &\approx 0 \\
s_h^2(e) &\approx \frac{1}{n_h}\sum_{k\in s_h} e_k^2
\end{aligned}$$

In the first of these substitutions, we are assuming that the within-stratum mean of the residuals is close to zero in each stratum. In the second substitution, we have replaced the within-stratum variance of the sample residual *e,* calculated with $n_h - 1$ degrees of freedom, with the mean of the squared residuals, calculated with n_h degrees of freedom.

Model-based domains estimation is appropriate as long as the expected value of the residuals can be assumed to be close to zero. This assumption is checked by examining the scatter plot of *y* versus *x*. It is important to note that the assumption affects only the error bound, not the estimate itself. $\hat{Y}_{ra}$ will be essentially unbiased as long as the case weights are accurate.

Process Analysis

The project analyst analyzed the results of the telephone survey. The quantitative process survey analysis was carried out using SPSS, a commonly used statistical software package. RLW calculated weighted frequencies, means, and cross tabulations of data, where appropriate, to provide unbiased estimates of population characteristics. All statistical significance tests were conducted at the 90% level of confidence, and statistically significant differences are discussed in the report where appropriate. These tests have been used to make comparisons among the three delivery channels of the program (i.e. NREC, NRER, and PARR).