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**Final  
Evaluation Report**

**Low-Income Residential Assistance Program**

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National Fuel Gas Distribution Corporation

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## EXECUTIVE SUMMARY

The National Fuel Gas Distribution Corporation (NFG) has been operating the Low-Income Residential Assistance program (LIRA) in its Pennsylvania service area to help its payment-troubled customers since early 1992.

Following approval by the Pennsylvania Public Utility Commission (PUC) in December 1991, the LIRA program began as a 36-month special tariff pilot offered to 1,000 customers in 14 counties serviced by NFG in Northwestern Pennsylvania. In May 1996, NFG petitioned the PUC for a continuation and expansion of the special tariff. In February 1997, the Commission approved the petition, and NFG was allowed to expand the services offered by the LIRA program to 5,000 customers.

The LIRA program uses a comprehensive approach, combining several features that together provide economic relief for payment-troubled customers and help reduce credit and collection costs. Many of these features are refinements based on the experiences learned in the Pennsylvania Pilot and the New York LIRA program. The program's incentives include:

- A three-tiered discounted rate structure;
- Payment budgeting;
- Arrearage forgiveness over a 12-month period when payments are made on time;
- A conservation credit for each unit of gas conserved;
- Energy audits and weatherization measures;
- Case management techniques to help participants better manage their bills; and
- Conservation education and assistance in maximizing household resources by linking customers to all available income support programs.

## EVALUATION GOALS AND METHODOLOGY

The evaluation involves a three-stage effort:

- **Stage 1:** Situation assessment, research design and sampling, a customer survey, and a process analysis that focuses on a qualitative assessment of the program's operation. A previous report summarized the results of the process analysis.<sup>1</sup>
- **Stage 2:** A preliminary payment and arrearage analysis, a gas use analysis, and a benefit-cost analysis. The main objectives of this phase are:
  1. Estimate the program impact on frequency and amount of participant payment;
  2. Estimate the program impact on gas use; and
  3. Conduct a benefit-cost analysis.
- **Stage 3:** The final stage of the analysis will revisit the findings reported here, as well as report findings of a follow-up analysis of the LIRA customer payment patterns, arrearage, gas use and the program's benefits and costs.

This report summarizes the results of Stage 2. The analysis focused on three groups of participants and a nonparticipant (comparison) group. Participants included:

- **Tier 1:** Customers whose income fell between 0% to 50% of the federal poverty level.
- **Tier 2:** Customers whose income fell between 51% to 110% of the federal poverty level.
- **Tier 3:** Customers whose income fell between 111% to 150% of the federal poverty level.

Nonparticipants included two groups:

- **Group A:** Former LIRA participants who were dropped from the program due to not having fulfilled certain requirements.
- **Group B:** NFG customers who had met the eligibility requirement, were invited to participate, but either declined or did not complete the necessary steps to become participants.

Data used in the analysis were compiled from five primary sources:

- LIRA Program Files;

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<sup>1</sup> See Haeri, H., Miller, E., and M. Perussi, "Process Evaluation of the Low-Income Residential Program." Barakat & Chamberlin. Final Report. March 23, 1999.

- Customer Files;
- Gas Consumption (Billing) Files;
- Customer Transaction Files; and
- Cost/Financial Data Files.

Information from all five sources was merged into a single database. Table 1 shows the disposition of participant and nonparticipant samples used in the analysis.

**Table 1**  
**Number of Customers Used in the Analysis**

Group	Number
Participants	537
Nonparticipants (A)	174
Nonparticipants (B)	1,388

Once the evaluation database was prepared, several indices were computed for the participant and nonparticipant groups. Comparisons between the proportional change in participant and nonparticipant indices were conducted using standard statistical tests. A billing analysis was performed to estimate the impact of the weatherization portion of the program on the participants' energy consumption. A net cash flow analysis was also conducted to estimate the cost-effectiveness of the program.

## FINDINGS

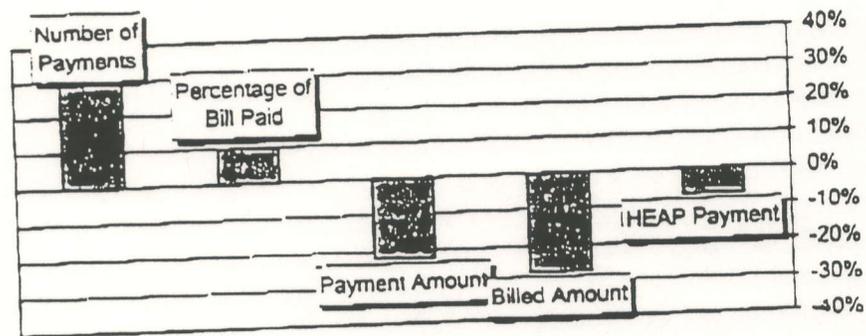
Overall, the program has been successful in moving most of the indices in the right direction. All estimated impacts are based on a comparison between the participant and both nonparticipant groups. As such, all calculations are estimates of *net* program impacts.

The evaluation findings are as follows:

- The number of payments made by the participants increased by 30% (an average of 2.2 payments per participant).
- The percentage of the bill paid per participant increased by 10%.

- The payment amount per participant decreased by 22%<sup>2</sup> (approximately \$182).
- The billed amount per participant decreased by 27% (approximately \$348).
- The amount of Low Income Home Energy Assistance Program (LIHEAP) assistance received by the participants decreased by 7% (approximately \$7).
- Despite the rate discount offered by the program, the participants did not increase their energy consumption.
- Some participants also received weatherization services. These have witnessed a reduction of approximately 78 Ccf in energy consumption.
- Finally, overall, the program was slightly cost effective, with a net present value of improved cash flow of \$25,023.

Figure 1  
Changes in Major Indices



<sup>2</sup> Although the program has led to an increase in the percentage of the bill actually paid by 10%, due to the rate discounts offered to the participants, the amount actually paid per participant decreased by \$182 (a 22% net reduction).

## I. INTRODUCTION

The National Fuel Gas Distribution Corporation (NFG) has been operating the Low-Income Residential Assistance program (LIRA) in its Pennsylvania service area to help its payment-troubled customers since early 1992. The overall goal of the LIRA program has been to increase the number and the amounts of payments received from payment-troubled customers and to reduce the burden of arrearage and collection expenses.

Following approval by the Pennsylvania Public Utility Commission (PUC) in December 1991, the LIRA program began as a 36-month special tariff pilot offered to 1,000 customers in 14 counties serviced by NFG in Northwestern Pennsylvania. The program continued to operate beyond the expiration date to allow for further evaluation of its results and accomplishments. The favorable evaluation results of the pilot program prepared by researchers at Temple University prompted NFG to petition the PUC in May 1996 for a continuation and expansion of the special tariff. In February 1997, the Commission approved the petition, and NFG was allowed to expand the services offered by the LIRA program to 5,000 customers. Currently, LIRA has 2,959 participants.<sup>3</sup>

The LIRA program is operated by NFG's Outreach and Education Department. The program takes a comprehensive approach, combining several features that together provide economic relief for payment-troubled customers and help reduce credit and collection costs. Many of these features are refinements based on the experiences learned in the Pennsylvania Pilot and the New York LIRA program. They include:

- A three-tiered discounted rate structure;
- Payment budgeting;
- Arrearage forgiveness over a 12-month period when payments are made on time;
- A conservation credit for each unit of gas conserved;
- Energy audits and weatherization measures;
- Case management techniques to help participants better manage their bills;
- Conservation education; and
- Assistance in maximizing household resources by linking customers to all available income support programs.

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<sup>3</sup> This figure reflects enrollment as of 7/20/99.

These features work together to create a rich mix of benefits for customers and NFG. Lower, more affordable utility rates and arrearage forgiveness allow customers to catch up on their bills and assist them in developing better payment habits. This, in turn, lowers the cost of processing past-due accounts and the amount that NFG must write off as uncollectible debt.

## EVALUATION GOALS

To assess the performance of its Pennsylvania LIRA program, NFG has undertaken a comprehensive effort to evaluate the program's goals, processes, operations, and accomplishments. The evaluation is a three-stage effort.

- **Stage 1** consisted of a situation assessment, research design and sampling, a customer survey, and a process analysis that focused on a qualitative assessment of the program's operation. A previous report summarized the results of the process analysis.<sup>4</sup>
- **Stage 2** is the current phase of the analysis. This report summarizes the results of a preliminary payment and arrearage analysis, a gas use analysis, and a benefit-cost analysis.
- **Stage 3** will revisit the findings reported here, as well as report findings of a follow-up analysis of the LIRA customer payment patterns, arrearage, gas use and the program's benefits and costs.

Specifically, this report's (Stage 2) main objectives are to:

- Estimate the program impact on frequency and amount of payments made by participants;
- Estimate the program impact on gas use; and
- Conduct a benefit-cost analysis.

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<sup>4</sup> See Haeri, H., Miller, E., and M. Perussi, "Process Evaluation of the Low-Income Residential Program," Barakat & Chamberlin. Final Report. March 23, 1999.

## II. EVALUATION DESIGN

The impact analysis of the LIRA program primarily sought to provide reasonable and reliable estimates of the program's impacts and to assess its economic performance. The evaluation design was based on analyzing the change in LIRA participants' payment behavior and arrearages resulting from the program. To ensure that any observed differences could be justifiably attributed to the program, the change in participants' behavior was compared to changes in a group of comparable, nonparticipating customers. An identical evaluation design was employed in evaluating the impacts of the New York National Fuel LIRA program.

The analysis focused on three groups of participants and a nonparticipant (comparison) group:

### Participants

- Tier 1: Customers whose income fell between 0% to 50% of the federal poverty level.
- Tier 2: Customers whose income fell between 51% to 110% of the federal poverty level.
- Tier 3: Customers whose income fell between 111% to 150% of the federal poverty level.

### Nonparticipants

We defined two groups to act as nonparticipant/comparison groups:

- Group A: Former LIRA participants who were dropped from the program due to not having fulfilled certain requirements (see discussion below).
- Group B: NFG customers who had met the eligibility requirement, were invited to participate, but either declined or did not complete the necessary steps to become participants.

## EVALUATION CHALLENGES AND ISSUES

### Defining the Test Periods

Both the billing and transaction analyses require a definition of pre and post analysis periods. There are two possible approaches. One approach is to define two specific year-long periods and apply them to all customers in the study (i.e., all customers would have the same pre and post periods). Alternatively, the rolling time period approach defines a different analysis period for each participant based on the day the customer joins the program.

For this evaluation, we chose a rolling time period approach in defining the participants' pre and post time periods. Unlike participants, nonparticipants do not have a specific event that can be used to define a cutoff period. Therefore, the cut-off for the nonparticipants' pre period was defined as 2/1/98, the average participation start date. Consequently, 12 months from 2/1/97 to 1/31/98 were defined as the pre period, and the 12 months from 2/1/98 to 1/31/99 were defined as the post period. Customers were required to have at least 300 metered days (approximately ten months of data) to be included in the transaction/billing analysis. As we derived annual estimates for the transaction analysis, adjustments were made to the amounts paid, amounts billed, and the number of payments. These adjustments removed any possible biases caused by number of days (e.g., 300 vs. 365, or 400 vs. 365).

### Defining the Control Group

The primary challenge in this evaluation was choosing the appropriate comparison group. In traditional DSM evaluations, nonparticipants are defined as people who had the opportunity to participate but did not. This method can create problems with self-selection.<sup>5</sup>

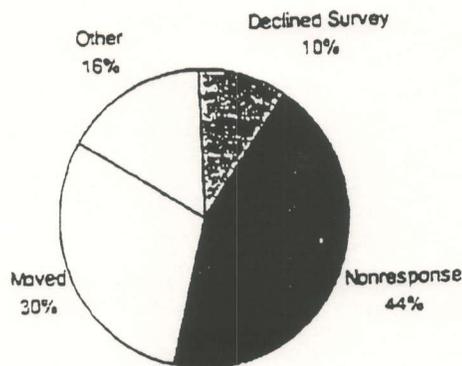
For this evaluation, we chose to use two customer segments to act as the comparison group:

**Group A:** LIRA customers who dropped out of the program before graduating. This group contains customers who are identical to the participants (in fact, they were themselves participants at one time). They differ from participants only in that they chose not to continue in the program. The fact that they chose not to finish the program may or may not be a cause of concern over self-selection. As Figure 2 demonstrates, nearly half (44%) of these customers simply failed to respond to information requests, and 30% had moved. Ten percent refused to complete an energy survey, and approximately 16% dropped out for other reasons. None of these reasons necessarily indicate a significant difference between the participating customers and this comparison group.

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<sup>5</sup> Self-selection is a statistical problem that occurs in programs with voluntary participation. It takes place when the participants are different in a systematic fashion from nonparticipants. The resulting bias is that estimated impact may be, at least partially, due to this difference rather than the treatment.

**Figure 2**  
**Reasons for Dropping Out of the Program**



Group B: LIRA-eligible customers who, for a variety of reasons, have not yet completed the steps necessary to become participants. If these customers have not gone through the necessary steps because they are fundamentally different, then self-selection is a problem. If they have not gone through the process because of inconvenience or having neglected to take the necessary steps, etc., then self-selection is not a problem. It is difficult, given the available data, to discern the reasons for not completing the enrollment process.

To minimize the effect of self-selection, if any, we chose to only use the *proportional change* in a key variable rather than the *absolute change* as a measure of "what would have happened in the absence of the program." This is because the size of the absolute change is more likely to be impacted by self-selection than that of the proportional change. The following model was used in assessing program impacts for most of the chosen indicators:

$$Net\ Impact = \frac{Post_{nonparticipat..x}}{Pre_{nonparticipat..x}} Pre_{participat..x} - Post_{participat..x}$$

Where x refers to the indicator (e.g., number of payments made) of interest.<sup>6</sup>

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<sup>6</sup> Traditionally, evaluators have used the difference of difference (absolute change) approach where the net impact is measured as:

$$Net\ Impact = (Post_{participat..x} - Pre_{participat..x}) - (Post_{nonparticipat..x} - Pre_{nonparticipat..x})$$

## DATA

Data used in this analysis were compiled from five primary sources:

- **LIRA Program Files:** Summary information on program participants, such as start date.
- **Customer Files:** The complete program data tracking database maintained by NFG containing basic information on eligible customers, such as unique ID numbers, account information, address, etc.
- **Gas Consumption (Billing) Files:** Pre and post program participation consumption records for all participants and the comparison group. These data included read date, Ccf used, and heating degree-days (HDD).
- **Customer Transaction Files:** Complete transaction records for participants and the comparison group, beginning one year before the program start date and continuing to present.
- **Cost/Financial Data Files:** Summary of program costs (administrative, operations, etc.), company cost of capital, inflation rate, amount of debt forgiven, collection costs, etc. All these data were used in conducting the cost-effectiveness analysis.

Information from all five sources was merged into a single database. Table 2 shows the disposition of participant and nonparticipant samples used in the analysis. After data were screened for quality, a total of 537 participants and 1,562 nonparticipants were available for analysis.<sup>7</sup>

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<sup>7</sup> Nonparticipants included 174 customers who dropped out (Group A) and 1,388 customers who were eligible but did not return program documentation (Group B) for a total of 1,562 nonparticipants.

**Table 2**  
**Composition of Study Samples**

	Participants	Non-Participants	
		Group A	Group B
Total in database	2,492	928	2,836
Missing income tier categorization	0	87	NA
Less than 10 months of transaction data	1,955	667	1,448
<i>Final Analysis Sample</i>	537	174	1,388

### III. PAYMENT BEHAVIOR AND ARREARS

The payment behavior analysis examined the effects that the LIRA program has had on the participants' payment amounts and frequency. Any change in participants' payment behavior was then compared to the nonparticipants' to establish the "net" effects of the program.

The following four specific indicators (commonly accepted as robust measures of payment behavior) were used:

- The actual number of payments made during the pre and post periods;
- The total payment amount the participant made during the pre and post periods;
- The payment amount as a proportion of the amount billed during the pre and post program periods; and
- The number of reconnections (indicating collection actions resulting in service disconnection).

The choice of which control group to use in this case is a difficult one. While Group A offers the advantage of being able to compare the change in the chosen indicators of the various income tier levels, Group B is significantly larger and allows for more statistical robustness. Given these challenges, we decided on the following analytical approaches:

- A range estimate of program impact, as well as
- An overall estimate obtained by combining the two comparison groups.

T-tests were then calculated to assess the statistical significance of the estimated impacts.

Table 3 shows the assessment of the program impact on the actual number of payments made during the pre and post periods. Note that LIRA participants have increased the number of payments overall by 25% (from an average of 7.4 per participant in the pre period to 9.3 in the post). During the same period, the nonparticipant Group A witnessed an improvement of approximately 7%. Nonparticipant Group B's number of payments actually decreased by 6%. Using a proportional change approach, as described above, the program net impact is estimated to be between 19% and 31% (1.37 to 2.30 payments per participant). The t-tests show that these differences are statistically significant. Combining the two nonparticipant groups into one and

comparing it to the participants produced an overall estimate of 30% (2.2 payments) with a t-test of 14.63, indicating a highly significant increase.<sup>8</sup>

**Table 3**  
**Number of Payments**

Participants	N	Pre	Post	% Change
Tier 1	92	6.8	8.3	22%
Tier 2	296	7.3	9.3	27%
Tier 3	149	7.9	9.8	24%
Overall	537	7.4	9.3	25%
Nonparticipants (A)	N	Pre	Post	% Change
Tier 1	37	6.9	7.3	6%
Tier 2	86	6.8	7.2	6%
Tier 3	51	7.9	8.6	9%
Overall	174	7.1	7.6	7%
Nonparticipants (B)	N	Pre	Post	% Change
All	1,388	8.1	7.6	-6%
Net Program Impact				
Based on Group		# Payments	%	t-test
A		1.37	19%	4.76
B		2.30	31%	15.19
Overall		2.20	30%	14.63

As indicated in Table 4, the LIRA participants' payment amount, as a proportion of their bill, also increased. Before the program, participants paid approximately 67% of their total bills. After the program, this proportion increased to 86%, a 29% improvement. During the same period, nonparticipants also increased the proportion of their bills paid by 21% and 14% for Groups A and B, respectively. Using the same proportional change mentioned earlier, the program net impact is estimated to be between 6% and 11%. The t-test results indicate that these findings are statistically significant. Overall, the increase due to the program was estimated at 10% (t-test=6.08).

Despite the marked improvements in the payment frequency and proportion to billed amount paid, the actual amounts paid by participants dropped from \$849 to \$673 per participant in the first year of participation, a 21% reduction (Table 5). However, during the same time period, nonparticipants from Group A also witnessed a reduction in their payment amount (17%).

<sup>8</sup> The rule of thumb is that the t-test needs to be greater than 2 or less than -2 for the findings to be statistically significant at the 95% level.

Nonparticipants in Group B, however, showed a very modest increase in the total payment to NFG (3%). The t-test indicates that the change in the amount of payment among the participants and Group A nonparticipants was not statistically significant; there does not seem to be a significant difference between the two groups. The difference, however, between participants and the larger group of nonparticipants (Group B) is indeed statistically significant. Overall, the program was estimated to have induced a reduction in the average amount paid by LIRA participants of approximately \$182 (22%). This overall impact was statistically significant (t-test = 8.55).

**Table 4**  
**Percent of Billed Paid**

Participants	N	Pre	Post	% Change
Tier 1	92	0.58	0.85	46%
Tier 2	296	0.65	0.86	32%
Tier 3	149	0.75	0.87	16%
Overall	537	0.67	0.86	29%
Nonparticipants (A)	N	Pre	Post	% Change
Tier 1	37	0.57	0.70	23%
Tier 2	86	0.56	0.73	30%
Tier 3	51	0.77	0.82	6%
Overall	174	0.62	0.75	21%
Nonparticipants (B)	N	Pre	Post	% Change
All	1,388	0.87	0.98	14%
Net Program Impact				
Based on Group			%	t-test
A			6%	2.70
B			11%	6.14
<b>Overall</b>			<b>10%</b>	<b>6.08</b>

**Table 5**  
**Payment Amount**

<b>Participants</b>	<b>N</b>	<b>Pre</b>	<b>Post</b>	<b>% Change</b>
Tier 1	92	\$726	\$519	-29%
Tier 2	296	\$834	\$644	-23%
Tier 3	149	\$953	\$825	-13%
Overall	537	\$849	\$673	-21%
<b>Nonparticipants (A)</b>	<b>N</b>	<b>Pre</b>	<b>Post</b>	<b>% Change</b>
Tier 1	37	\$657	\$469	-28%
Tier 2	86	\$758	\$613	-19%
Tier 3	51	\$963	\$887	-8%
Overall	174	\$797	\$663	-17%
<b>Nonparticipants (B)</b>	<b>N</b>	<b>Pre</b>	<b>Post</b>	<b>% Change</b>
All	1,388	\$1,086	\$1,118	3%
<b>Net Program Impact</b>				
<b>Based on Group</b>	<b>Amount of Payment</b>	<b>%</b>	<b>t-test</b>	
A	(\$34)	-4%	1.20	
B	(\$201)	-24%	9.18	
<b>Overall</b>	<b>(\$182)</b>	<b>22%</b>	<b>8.55</b>	

Table 6 shows that billed amounts decreased, on average, by 39% for participants. This decrease is a direct result of the rate reduction offered by NFG to LIRA participants. The nonparticipants in Group A enjoyed the lower rates while they were in the program; the observed change in their billed amount is, therefore, also due to the LIRA rate discount. The observed drop in the billed amount for nonparticipants (Group B) is attributed primarily to a decrease in heating degree-days from the pre to post period. In this case, the appropriate comparison is between the participants and Group B. This comparison produces a net program decrease of \$381 in billed amount (t-test = 29.9, indicating highly statistically significant finding). However, in order to maintain consistency with the other indices, we estimated the program net impact based on the combined (A & B) comparison group. This resulted in an estimated decrease of \$348 in the average billed amount.

**Table 6**  
**Billed Amount**

Participants	N	Pre	Post	% Change
Tier 1	92	\$1,248	\$609	-51%
Tier 2	296	\$1,282	\$748	-42%
Tier 3	149	\$1,270	\$948	-25%
Overall	537	\$1,273	\$780	-39%
Nonparticipants (A)	N	Pre	Post	% Change
Tier 1	37	\$1,162	\$670	-42%
Tier 2	86	\$1,348	\$835	-38%
Tier 3	51	\$1,257	\$1,079	-14%
Overall	174	\$1,282	\$871	-32%
Nonparticipants (B)	N	Pre	Post	% Change
All	1,388	\$1,247	\$1,135	-9%
Net Program Impact				
Based on Group		\$	%	t-test
A		(\$82)	-6%	2.93
B		(\$381)	-30%	29.99
<i>Overall</i>		<i>(\$384)</i>	<i>-27%</i>	<i>24.50</i>

Participants also showed a significant reduction in the number of disconnection actions (see Table 7). Before the program, 15.8% of participant accounts experienced a service disconnection. This figure dropped dramatically to 5% – a 68.2% drop in disconnections in the first year of LIRA participation. During the same period, Group A’s disconnections dropped from 19% to 14.4% – a reduction of only 24.2%; Group B experienced nearly a 21% increase in disconnection (10.4% in the pre period increasing to 12.5% in the post period). The weighted average increase in disconnections among the two nonparticipant groups is approximately 12.4%. Applying the same proportional change approach used above, the net program impact is estimated at slightly over 80% reduction in disconnections.

**Table 7**  
**Average Number of Disconnections per Group**  
**before and after Participation**

Group	Before	After	% Change
Participants	85 (15.8%)	27 (5.0%)	-68.2%
Nonparticipant A	33 (19.0%)	25 (14.4%)	-24.2%
Nonparticipant B	144 (10.4%)	174 (12.5%)	20.8%

Table 8 displays the change in the amount of LIHEAP assistance received by the various groups. Overall, the program led to, approximately, a 7% reduction in the amount of LIHEAP payments received by participants. This reduction was barely statistically significant with a t-test of 2.3.

**Table 8**  
**LIHEAP Payments**

Participants	N	Pre	Post	% Change
Tier 1	92	\$152	\$145	-5%
Tier 2	296	\$101	\$77	-24%
Tier 3	149	\$22	\$14	-36%
Overall	537	\$88	\$71	-19%
Nonparticipants (A)	N	Pre	Post	% Change
Tier 1	37	\$143	\$96	-33%
Tier 2	86	\$122	\$109	-11%
Tier 3	51	\$42	\$21	-50%
Overall	174	\$103	\$80	-22%
Nonparticipants (B)	N	Pre	Post	% Change
Overall All	1,388	\$39	\$35	-10%
Nonparticipants All	N	Pre	Post	% Change
Overall All	1,562	\$46	\$40	-13%
Net Program Impact				
Based on Group		\$	%	t-test
A		\$3	-3%	2.8
B		\$10	10%	0.6
Overall		\$7	7%	2.3

Financial transactions recorded for participants are summarized in Table 9. Note that participants' consumption dropped slightly from 1,578 Ccf to 1,539 Ccf. Average heating degree-days declined significantly in the post period. It is important to note that, despite the rate reduction, energy consumption did not increase as would have been expected. In other words, there was *no abuse of the low rate* in the program.

The impact of the lower rate was significantly felt in the reduction in the amount billed. Program participants' average billed amount decreased by nearly 39%. During the same period, the decline experienced by the nonparticipants (probably due to milder weather) was only 11.5%.

Although participants are paying a significantly higher proportion of their bills, the absolute amount paid decreased by nearly 21%. During the same period, nonparticipants did not significantly change the amount paid.

**Table 9**  
**Summary of Financial Transactions**

Variable	Participants (n=537)		Nonparticipants (n=1562)	
	Pre	Post	Pre	Post
(All Participants)				
Average Ccf	1,578	1,539	1,709	1,671
Average Billed	\$1,273	\$780	\$1,251	\$1,106
Average Paid	\$849	\$673	\$1,054	\$1,067
Unpaid Amount:				
Total	\$424	\$107	\$197	\$39
Per Day	\$1.16	\$0.29	\$0.54	\$0.11
Total LIHEAP Amount	\$88	\$72	\$46	\$41
LIRA Rate Incentive (Conservation Credit)	NA	\$9	NA	NA
Net Balance:				
Total	\$336	\$26	\$151	(\$3)
Per Day	\$0.92	\$0.07	\$0.41	(\$0.01)

## IV. ENERGY USE ANALYSIS

The principal objective of the LIRA program is to increase the ability of low-income customers to pay their gas bills, thus reducing the company's credit and collection costs. Although the program offers several measures to help participants lower their gas consumption, LIRA was not, strictly speaking, designed to serve as a conservation program.

The program's measures do, however, provide an opportunity for modest gas conservation. This section analyzes the participants' consumption patterns to assess the extent to which the program measures are effective in reducing gas use. This analysis also generated the necessary information for the cost-effectiveness analysis (Section V).

Analysis of gas consumption focused on estimating gas usage before and after program participation under typical (long-run) heating degree-day conditions. Changes in consumption were estimated using a simple regression equation. This equation adjusted for changes in temperature in terms of heating degree-days (HDD) using the following formula:

$$Ccf_{it} = \alpha + \beta_1 POST + \beta_2 HDD_t$$

where  $Ccf_{it}$  is the monthly consumption for participant  $i$  at billing period  $t$ . The intercept,  $\alpha$ , represents the non-weather-sensitive component of consumption. POST is a binary variable (with the value of one (1) representing the post program period and zero (0) representing the pre program period),  $HDD_t$  represents heating degree-days in the billing period  $t$ .

Twelve separate equations (six for participants, and six for drop-outs),<sup>9</sup> differentiated by Low Income Usage Reduction Program (LIURP) participation (weatherization) and income tier, were estimated. In addition, two overall models distinguished only by LIURP were constructed, for a total of 14 models. Table 10 displays the results of the 14 estimated models. To normalize consumption figures for typical weather conditions, long-run heating degree-days and appropriate values for the pre-post binary variable were substituted in each equation. The results are presented in Table 10. Statistical details are presented in Appendix A.

As Table 10 shows, the LIURP customers saved more energy than their non-LIURP counterparts in all cases. In addition, the savings achieved by the majority of LIURP customers were significant either at the 90% or the 95% levels.

Overall, the LIURP customers saved approximately 98 Ccf annually. Non-LIURP customers saved only 15 Ccf. Both saving estimates are based on normal weather conditions.

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<sup>9</sup> Gas use analysis was limited due to unavailability of data for Group B. Since Stage 2 is only expected to produce preliminary results, we chose to wait and conduct a more comprehensive evaluation using both nonparticipant groups next year in Stage 3.

**Table 10**  
**Gas Savings Regression Models**

Group	Model	LIURP	N	Adj. Pre	Adj. Post	Delta	% Save
<b>Participants</b>							
Tier 1	1	No	124	1,437	1,435	2	0.11%
Tier 1	2	Yes	57	1,851	1,790	62*	3.33%
Tier 2	3	No	455	1,413	1,391	21**	1.50%
Tier 2	4	Yes	274	1,848	1,764	84**	4.57%
Tier 3	5	No	176	1,441	1,428	13	0.88%
Tier 3	6	Yes	117	1,946	1,827	119**	6.10%
<b>Dropped</b>							
Tier 1	7	No	45	1,354	1,402	-48	-3.90%
Tier 1	8	Yes	18	2,332	2,325	7	0.31%
Tier 2	9	No	97	1,522	1,499	24	1.55%
Tier 2	10	Yes	73	2,075	1,950	125**	6.04%
Tier 3	11	No	52	1,459	1,447	12	0.85%
Tier 3	12	Yes	34	2,046	1,923	123**	6.01%
<b>Overall</b>							
LIURP	13	No	949	1,433	1,419	15*	1.02%
LIURP	14	Yes	573	1,915	1,818	98**	5.10%

- \* Significant at the 90% level
- \*\* Significant at the 95% level

Table 11 displays a summary of the gas savings by income Tier and by program participation status. Overall, the LIURP portion of the program has led to a net reduction of 78 Ccf in gas consumption (approximately 4% of pre program total consumption).

**Table 11**  
**Summary of Program-Induced Gas Savings (Ccf)**

	Tier 1	Tier 2	Tier 3
Participant	58	55	101
Dropped	90	94	106
Overall		78	

## V. COST-EFFECTIVENESS ANALYSIS

The first step in developing the cost-effectiveness framework was to identify and define all of the potential benefits and costs attributable to the program. Table 12 provides a complete list of factors that could be considered in the analysis and indicates which were included in the present evaluation. The list of potential costs and benefits was compiled based on information available from studies of other low-income utility programs. Data obtained from the statistical analyses of customers' gas use and billing transactions were also used to support the analysis.

The cost-effectiveness model measured cash in-flows and out-flows with and without the LIRA program over time. The net present values (NPVs) of the cash flows discounted by NFG's pre-tax-weighted rate of return were then compared to see whether and to what extent the LIRA program created financial benefit for NFG and its ratepayers.

The analysis model incorporated cash flows for nonparticipants to account for non-program-related factors that might have affected payment behaviors.

Cash flows were computed using collected revenue, billed revenue, collection expenses, and carrying charges for both the participants and the nonparticipants. In the post period, the cash flow calculations for the participants also included debt forgiveness and program costs. The analysis also includes the impact of the change in LIHEAP (defined as basic and emergency) benefits paid to NFG.

The analysis was performed for a five-year planning horizon. In our opinion, the five-year horizon was the most appropriate interval for assessing the program's effects. A shorter-than-five-year horizon's portrayal of program performance suffered from distortions caused by including forgiven amounts and tended to underestimate the program's net benefits. On the other hand, the ten-year horizon appeared overly optimistic in terms of net benefits and participants staying in the program. Given the attrition rates observed among participants to date, projection of current conditions for ten years appeared difficult to justify.

The model assumes that conditions from the first post year will persist for the five-year horizon. The model also includes the annual program costs for each of the five years.

**Table 12**  
**General Benefit-Cost Factors of a Low-Income Program**

Factor	Definition	NFG Model
Lost Revenue	Revenue Loss (Bill Reductions) from energy savings.	Yes
Lower Rates	Revenue Loss (Bill Reductions) from the utility offering a lower rate.	Yes
Avoided Supply Costs	Avoided supply cost from energy savings.	No
Added Supply Costs	Increased supply cost from increased energy use.	No
Program Cost	Program operation costs, including implementation and administration (not including program start-up costs or evaluation).	Yes
Participant Debt Write-Offs	Forgiven amounts owed by participants. <sup>10</sup>	Yes
Utility Collection Cost	Utility Collection Costs – utility costs for recovery of bill defaults, including carrying costs, bill collection costs, etc.	Yes
Participant Quality Gain	Indirect benefits the participant receives from energy efficiency improvements (or from a reduced rate), including a more comfortable home, reduced health, safety, and health care costs, increased ability to remain in own home, etc.	No
Public Dollar Loss	Participants receive (and need) fewer dollars from public programs, such as LIHEAP. From society's point of view, these dollars can be used elsewhere.	Yes
External Benefits	Benefits to society as a whole, including environmental benefits from energy efficiency, increased housing stock values, preservation of neighborhoods, etc.	No

Net Present Values of the various over/under-collection streams were then computed over the five-year period for both participants and nonparticipants. Table 13 shows the results of these calculations.

The NPV of the participant's pre program cash flow was computed at (\$3,805,936). This means that, had the program not existed (pre conditions remained the same), NFG would have been expected to under collect over \$3.8 million (present valued over the next five years). Based on the post program conditions, NFG is still expected to under collect, but only by approximately \$2.3 million. In other words, the program's gross impact is an improvement in collections of \$1.5 million (nearly a 40% improvement over the next five years). This indicates a cost-effective endeavor. However, during the same period, nonparticipants have also improved their associated cash flow by \$742,469 (38% improvement). Assuming the *proportional change* in the

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<sup>10</sup> One could argue that these debts would have never been paid and should not be considered true program costs. We chose a more conservative approach and included them as program costs.

nonparticipants' cash flow is indicative of what would have happened to the participants' cash flow in the absence of the program, the net program impact is computed at \$25,023. This demonstrates that the program slightly improved the cash flow at NFG and is somewhat cost-effective. This amount is small enough, though, to be within the error bands of the model.

If the forgiven debt is removed from the analysis (on the assumption that it would have been bad debt in any case), the net program impact increases to nearly \$600,000.

**Table 13**  
**Five-Year Net Present Values of Cash Flows**

	NPV
<b>Participants</b>	
Pre LIRA NPV	(\$3,805,936)
Post LIRA NPV	(\$2,299,223)
Difference	\$1,506,713
<b>Nonparticipants</b>	
Pre NPV	(\$1,907,140)
Post NPV	(\$1,164,671)
Difference	\$742,469
<b>Net Proportional Change</b>	<b>\$25,023</b>

It is interesting to note that, after the rate reduction, participants' consumption did not increase. In other words, there was not an abuse of the offering. However, the rate reduction did lead to a significant reduction in collected revenue (approximately \$1.3 million over the five-year period). A slightly different rate structure may have increased cost-effectiveness of the program.

## VI. CONCLUSIONS

This report focused on the quantitative assessment of the NFG's LIRA program. The evaluation's main goal was to conduct a payment and arrearage analysis, a gas use analysis, and a benefit-cost analysis. The evaluation relied on data compiled from five sources, including program files, customer files, gas consumption (billing) files, customer transaction files, and cost/financial data files.

The evaluation design was based on analyzing the change in LIRA participants' payment behavior and arrearages resulting from the program. To ensure that any observed differences could be justifiably attributed to the program, the change in participants' behavior was compared to changes in a group of comparable nonparticipating customers.

Several indices were selected as robust measures of the impact of the program. These included change in the number of payments made, change in the percentage of bill paid, change in the amount paid, change in the number of disconnections, and change in the amount of outside aid received by participants. All estimated impacts are based on comparison between the participant and both nonparticipant groups. As such, all calculations are estimates of *net* program impacts. The program has been successful in moving most of the indices in the *right* direction. The following is a list of changes in the right direction:

- The number of payments made by the participants increased by 30% (an average of 2.2 payments per participant);
- The percentage of the bill paid per participant increased by 10%;
- Slightly over 80% reduction in disconnections.

While these are all positive changes, the program also has led to the following impacts:

- The payment amount per participant decreased by 22% (approximately \$182);
- The billed amount per participant decreased by 27% (approximately \$348); and
- The amount of LIHEAP assistance received by the participants decreased by 7% (approximately \$7).

These changes occurred due to the rate discount that NFG offered to the LIRA participants. While these are positive changes from the participants' perspective, they are damaging to NFG's cash flow. However, it is interesting to note that the participants did not increase their energy consumption despite the rate discount. In other words, there was no abuse of the offering by the LIRA participants. In any case, while the program remained marginally cost-effective, the amount of rate discount and its impact on NFG receipts is worthy of further consideration.

## APPENDIX A

### BENEFIT-COST MODEL DOCUMENTATION

1. **Billed Revenue:** Bills generated from monthly gas use and service charges.

$$\begin{aligned} \text{Total annual billed revenue} = \\ & (\text{Total annual customer charge} + \text{Total annual gas use charge} + \\ & - \text{Total annual Reconnect charge} - \text{Total LIRA conservation credit}) * \\ & \text{Number of customers} \end{aligned}$$

2. **Bill Collection Expenses:** Average collection costs.

$$\begin{aligned} \text{Total annual collection costs} = \\ \text{Average annual expense for collection per customer} * \text{Number of customers} \end{aligned}$$

3. **Carrying Charges:** Interest accruing on unpaid billed revenue.

$$\begin{aligned} \text{Carrying charges per participant} = \\ \text{Total annual amount owed per participant} * \text{NFG's short-term debt rate} \end{aligned}$$

4. **Total of Billed Revenue, Expenses, and Carrying Charges:** Sum of bills, collection expenses, and carrying charges.

$$\begin{aligned} \text{Total charges associated with customers in arrears} = \\ \text{Total annual billed revenue} + \text{Total annual collection expenses} + \\ \text{Total annual carrying charges accruing} \end{aligned}$$

5. **Collected Revenue:** Actual dollar amounts of customer payments.

$$\begin{aligned} \text{Total Collected Revenue} = \\ \text{Average annual customer payment per customer} * \text{Number of customers} \end{aligned}$$

6. **Over-/Under-Collections:** The difference between charges assigned to customers in arrears and payments received.

$$\begin{aligned} \text{Annual over- or under-collections} = \\ \text{Total of all charges associated with customers in arrears} - \\ \text{Total collected revenue} \end{aligned}$$

7. **LIHEAP Contributions:** Monies received through social agencies to help customers offset bills (LIHEAP, etc.).

*Total third-party contributions received for energy bill assistance =  
Average third-party contribution per customer \* Number of customers*

8. **Over-/Under-Collections and LIHEAP eligible:** Over-/Under-Collections, including the effect of third-party contributions.

*Annual over- or under-collections =  
Annual over- or under-collections +  
Total third-party contributions received for energy bill assistance*

9. **LIRA program expenses:** Actual annual expenses attributable to the LIRA program.
10. **Overall Net Present Value:** Present value (over-/under-collection with LIHEAP -LIRA expenses).

### DATA SOURCES AND ASSUMPTIONS

The three tables that follow delineate assumptions currently used in the Benefit-Cost model.

**Table A-1  
General Assumptions for LIRA Benefit-Cost Model**

Item	Value	Comment/Source
Number of participants	2,492	Actual (prior to 3/1/99)
LIRA rate per Ccf	\$0.4861	Actual (weighted average across all three income tiers)
LIRA customer charge	\$5.0600	Actual
LIRA conservation credit	\$0.0991	Actual
Regular customer charge	\$11.6800	Actual
Regular customer (<50 Ccf)	\$0.7112	Actual
Regular customer (>50 Ccf)	\$0.6616	Actual
LIRA start-up costs	\$91,278	Excluded from analysis
Annual program costs:	\$357,844	Project data file
Total debt forgiven	\$651,061	LIRA database
Inflation rate	1.79%	National Fuel
Collection expenses (nonparticipant)	\$36.29	National Fuel
Collection expenses (participant)	\$6.96	National Fuel
Pre tax rate of return	13.24%	National Fuel

**Table A-2**  
**General Assumptions – Participants**

Item	Value		Comments/Source
	Pre	Post	
Sample size (n) used:	537	537	Impact Analysis
Number of bills issued	6,444	6,444	Impact Analysis
Normalized gas use (ccf)	1,578	1,539	Impact Analysis
LIHEAP: basic, emergency	\$88.00	\$72.00	Impact Analysis
Rate-payer payment	\$850.88	\$699.95	Impact Analysis
Billed amount	\$1,276.06	\$811.30	Impact Analysis
Annual conservation credit	---	\$9.00	Derived from pre-post Ccf
Reconnect charge	\$7.00	\$2.22	Impact Analysis
Normal degree days	6,279	6,279	National Fuel
Actual degree days	6,214	5,238	Estimated from data

**Table A-3**  
**General Assumptions – Nonparticipants**

Item	Value		Comments/Source
	Pre	Post	
Sample size (n) used:	1,562	1,562	Impact Analysis (A and B)
Number of bills issued	18,744	18,744	Impact Analysis
Normalized gas use (ccf)	1,709	1,671	Impact Analysis
LIHEAP: basic, emergency	\$46.30	\$40.70	Impact Analysis
Rate-payer payment	\$1,052.67	\$1,105.23	Impact Analysis
Billed amount	1,250.36	\$1,222.18*	Impact Analysis (*using pre rate and normalized use)
Reconnect charge	\$5.01	\$5.63	Impact Analysis
Normal degree days	6,279	6,279	National Fuel
Actual degree days	6,313	5,333	Estimated from data