Exhibit No.:	
Issue:	Normal Billing Units; Weatherization Program
Witness:	Henry E. Warren
Sponsoring Party:	MoPSC Staff
Type of Exhibit:	Direct Testimony
Case No.:	GR-2001-292

MISSOURI PUBLIC SERVICE COMMISSION

UTILITY OPERATIONS DIVISION

DIRECT TESTIMONY

OF

HENRY E. WARREN, PhD

MISSOURI GAS ENERGY

A DIVISION OF SOUTHERN UNION COMPANY

CASE NO. GR-2001-292

Jefferson City, Missouri
April 2001

TABLE OF CONTENTS

SMALL GENERAL SERVICE BILLING DETERMINANTS 3

WEATHERIZATION PROGRAM 5

DIRECT TESTIMONY

OF

HENRY E. WARREN

MISSOURI GAS ENERGY

A DIVISION OF SOUTHERN UNION COMPANY

CASE NO. GR-2001-292

Q. Please state your name and business address.

A. My name is Henry E. Warren and my business address is P. O. Box 360, Jefferson City, Missouri, 65102.

Q. By whom are you employed and in what capacity?

A. I am employed by the Missouri Public Service Commission (PSC or Commission) as a Regulatory Economist in the Gas Department of the Utility Operations Division.

Q. How long have you been employed by the Commission?

A. I have worked at the Commission approximately eight years.

Q. What is your educational and professional background?

A. I received my Bachelor of Arts and my Master of Arts in Economics from the University of Missouri-Columbia, and a Doctor of Philosophy (PhD) in Economics from Texas A&M University. Prior to joining the PSC Staff (Staff), I was an Economist with the U.S. National Oceanic and Atmospheric Administration (NOAA).

At NOAA I conducted research on the economic impact of climate and weather. I began my employment at the Commission on October 1, 1992, as a Research

Economist in the Economic Analysis Department. My duties consisted of calculating adjustments to test year usage by gas and electric customers in rate cases to compensate for variations from normal weather, and I also assisted in the review of Electric Resource Plans for investor owned utilities in Missouri. Since December 1, 1997, I have been a Regulatory Economist II in the Tariffs/Rate Design Section of the Commission's Gas Department where my duties include reviewing tariff filings, applications and various other matters relating to state-regulated gas utilities in Missouri. I also compute weather normalization adjustments to test year volumes in gas rate cases.

Q. Are you a member of any professional organizations?

A. Yes, I am a member of the International Association for Energy Economics and the Western Economics Association.

Q. Have you previously filed testimony before the Commission?

A. Yes, I have submitted prepared written testimony in the cases listed in Schedule 1 attached to this testimony.

Q. What is the purpose of your direct testimony?

A. First, my direct testimony covers the billing unit allocation for volumes normalized for weather and read cycle days computed by Staff Witness James Gray in the test year for MGE's Small General Service (SGS) rate class. The test year volumes, the normal volumes, and computed adjustments are shown in Schedules 2-1 through 2-3.

Second, I will discuss the results of the MGE Experimental Weatherization Program (EWP) originally implemented in Case No. GR-93-240 and extended in Case Nos. GR-96-285 and GR-98-140. The results of an independent evaluation of the EWP conducted by TecMRKT Works, Oregon Wisconsin are in the attached reports, *Process and Impact Evaluation of Missouri Gas Energy's Pilot Weatherization Program,* March 1998, Attachment 1 and *An Impact Evaluation of the*

Missouri Gas Energy Low-Income Weatherization Pilot Program, May 1999, Attachment 2.

SMALL GENERAL SERVICE BILLING DETERMINANTS

Q. What billing determinants were established for the SGS class by the current rate design and how are Mr. Gray's normalized volumes allocated according to these billing determinants?

A. MGE's current SGS rates are differentiated into two blocks and two seasons for commercial and industrial customers. For both commercial and industrial SGS customers the *first block or initial block* contains the first 600 Ccf (hundred cubic feet) of natural gas used in the month and the *second block or tail block* contains all volumes over 600 Ccf per month. In order for Staff witness, Jim Russo, to compute the revenues associated with the normal volumes, the normal volumes must be properly allocated monthly to each block and season to determine the rate at which the volumes are to be computed.

Q. What data are used to compute these billing determinants?

A. The Company provided Staff with monthly bill frequency runs for the SGS rate code and customer classes served on the SGS tariff. I used the Company's bill frequency runs (January – December 2000) to determine the percentage of usage falling into each rate block for each month. Because the rates are the same for the three divisions of their service area – Joplin District, Kansas City District, and St. Joseph District the monthly data were aggregated over the service areas and the commercial and industrial SGS customers were combined.

Q. How did you use that data to determine normalized billing determinants for the test year?

A. For the SGS class, using the monthly bill frequency data for 2000, the monthly percent of use in the initial block has a high correlation with the monthly average use per customer per day. I used regressions to estimate an equation that quantified the relationship between the percentage of use in the first block in a month and the average use per customer per month. I used this relationship in order to estimate normal billing units in each month. Using the bill frequency analysis for the SGS class compiled by the Company, I used the bill frequency monthly Ccf per customer per day in the test year (2000) to estimate an equation that related it to the monthly percent use in the first block. Next, the normal monthly usage per customer was used in the regression equation to estimate the normal monthly percent in the first block.

In computing the adjustment to the observed test year volumes (Schedule 2-1) that will yield the estimated normal volumes (Schedule 2-2), the adjustment in the second block is set equal to the total minus initial block adjustment (Schedule 2-3). In each month the block adjustments are restricted so the blocks cannot go in a different direction than the total adjustment. If the block adjustments initially have opposite signs, a process is used to remove the inconsistency. The adjustment of the volumes in the first block is set to zero, and the second block is then equal to the total adjustment. For the MGE test year all of the SGS monthly block adjustments were in the same direction as the total adjustment so this consistency process was not used.

The difference between the predicted normal volumes and test year volumes gives an estimated monthly adjustment for the first block (Schedule 2-3). The

monthly adjustments to Test Year volumes in the blocks are in the center column of the Table in Schedule 2-3. The monthly adjustments are summed into seasonal and annual totals. The normal volumes in the November-March heating season in the first block are 42% of the total, the heating season second block has 31% of the total annual volumes, the April - October non-heating season has 19% of the normal annual volumes in the first block and 8% in the second block (Schedule 2-2).

Q. What is the Staff's recommendation for weather adjusted gas usage for the SGS commercial, and industrial customer classes?

A. Schedule 2-3 contains the adjustment volumes for each billing month during the test year. The total adjustment for the SGS customer classes is 11,745,363 Ccf. One-third (33%) of the total adjustment is in the heating season first block and half (51%) of the total adjustment is in the heating season second block. The volumes were allocated to the blocks for the SGS class as shown in Schedule 2-3. These adjustments were supplied to Staff witness Jim Russo for use in revenue normalization.

WEATHERIZATION PROGRAM

Q. What is MGE's Experimental Weatherization Program (EWP)?

A. This is a promotional practice described in MGE Tariff Sheets 96-101. Under the tariff, MGE has provided $250,000 annually for two years to the City of Kansas City Housing and Community Development (HCD) Department to weatherize the homes of low-income customers of MGE in the counties of Clay, Jackson, and Platte. The program commenced on June 6, 1997. Additional details of the program are contained in the tariff.

Q. What has been your role in MGE's EWP?

A. The tariff provides for MGE to pay for an independent consultant to evaluate the program. I participated in developing a Request for Proposal (RFP), and in the selection of a consultant to evaluate the previous weatherization program established in Case No. GR-93-240 and the current program established in Case No. GR-96-285. I worked on this RFP and selection of a consultant with other PSC Staff, Office of the Public Counsel (OPC), City of Kansas City, and MGE. The purpose of the independent consultant's evaluation is to aid the Staff in making a recommendation on the effectiveness of the program. The firm of TecMRKT Works, Oregon, Wisconsin was selected to do the evaluation.

Q. What is the status of the consultant's evaluation of the EWP and the subsequent Staff review of the EWP?

A. The initial phase of the evaluation, the *Process and Impact Evaluation Report* was presented to MGE, the PSC Staff and OPC on March 23, 1998. Mr. Nicholas Hall of TecMRKT Works presented the Impact Evaluation on the EWP in May 1999 to the Commission and Staff. Staff has reviewed the reports and concurs with the results of the evaluation.

Q. Were the results of the evaluation of the Cooperative Weatherization Program positive?

A. Yes, the independent evaluation found that the program was effective in increasing the efficiency of gas use by MGE customer participants and decreasing customer account problems by the participants.

Q. Do you recommend that the MGE weatherization program continue?

A. Yes, the experimental phase of the MGE weatherization program has concluded and the evaluation has shown the program has a positive effect, "The [weatherization] measures resulted in an average savings of 30 therms of baseload and 280 therms of space heating for a total of 310 therms annually" (TecMRKT Works, March 1998, p. vi). At the current average cost to residential customers of $.90 per Ccf this is a savings of about $279 annually. The May 1999 Report estimates that for 268 units weatherized between 1995 and 1998 the total cost to weatherize a unit was $2,096.08 (TecMRKT Works, May 1999, p. 15). The average customer that receives weatherization and experience savings of at least 100 Ccf per year will decrease the balance owed to MGE by about $20 per month (TecMRKT Works, March 1998, p. 43). If this leads to increased payments and decreased bad debt this will benefit MGE and the rest of the MGE customers.

The MGE program should be continued with Kansas City HDC Department and should be expanded proportionately to include all counties where MGE has sufficient customers to justify funding weatherization through the local weatherization assistance programs. Currently, all MGE customers are paying for the program in Kansas City, so it is equitable to extend the program to as many customers as is practical.

Q. Does this conclude your prepared Direct Testimony?

A. Yes, it does.

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the matter of Missouri Gas Energy's tariff sheets designed to increase rates for gas service in the company's Missouri service area.	))))	Case No. GR-2001-292

AFFIDAVIT OF HENRY E. WARREN

STATE OF MISSOURI)
) ss.
COUNTY OF COLE)

Henry E. Warren, is, of lawful age, on his oath states: that he has participated in the preparation of the foregoing Direct Testimony in question and answer form, consisting of 7 pages to be presented in the above case; that the answers in the foregoing Direct Testimony were given by him; that he has knowledge of the matters set forth in such answers; and that such matters are true and correct to the best of his knowledge and belief.

HENRY E. WARREN

Subscribed and sworn to before me this 16th day of April 2001.

Notary Public

My Commission Expires: _____

DAWN L. HAKE
Notary Public – State of Missouri
County of Cole
My Commission Expires Jan 9, 2005

MISSOURI GAS ENERGY

CASE NO. GR-2001-292

PREVIOUS CASES IN WHICH PREPARED TESTIMONY WAS PRESENTED BY:

HENRY E. WARREN

COMPANY NAME	CASE NUMBER
St. Joseph Light & Power Company	GR-93-042[1]
Laclede Gas Co.	GR-93-149[1]
Missouri Public Service	GR-93-172[1]
Western Resources	GR-93-240[1]
Laclede Gas Co.	GR-94-220[1]
United Cities Gas Co.	GR-95-160[1]
The Empire District Electric Co.	ER-95-279[1]
Laclede Gas Co.	GR-96-193[1]
Missouri Gas Energy	GR-96-285[1]
The Empire District Electric Co.	ER-97-081
Union Electric Co.	GR-97-393[1]
Missouri Gas Energy	GR-98-140[1]
Laclede Gas Co.	GR-98-374
St. Joseph Light & Power Company	GR-99-246[1]
Laclede Gas Co.	GR-99-315[1]
Union Electric Co. (d/b/a AmerenUE)	GR-2000-512[1]

1 Testimony includes computations to adjust test year volumes, therms, or kWh to normal weather.

MISSOURI GAS ENERGY
CASE NO. GR-2001-292

ALL REGIONS
TEST YEAR JANUARY 2000 - DECEMBER 2000

SMALL GENERAL GAS SERVICE (SGS)
ACTUAL VOLUMES

	SGS Commercial and Industrial Actual Ccf			
Month	Regular Bills to Customers	1st Block 0 - 600 Ccf	Tail Block Over 600 Ccf	Total Ccf
Jan	58,361	14,708,790	11,311,737	26,020,527
Feb	58,900	15,224,976	11,710,894	26,935,870
Mar	58,256	11,171,803	6,438,427	17,610,230
Apr	57,030	8,595,192	3,861,101	12,456,293
May	54,520	5,325,229	1,951,564	7,276,793
Jun	48,986	3,296,225	1,226,418	4,522,643
Jul	46,701	2,929,704	1,122,626	4,052,330
Aug	45,541	2,728,010	1,057,118	3,785,128
Sep	45,442	2,715,469	1,084,940	3,800,409
Oct	51,050	3,774,396	1,413,453	5,187,849
Nov	55,818	6,662,220	2,920,537	9,582,757
Dec	59,776	14,750,094	11,460,078	26,210,172
ANNUAL	640,381	91,882,108	55,558,893	147,441,001
%		62%	38%	
NOV-MAR	291,111	62,517,883	43,841,673	106,359,556
%	45%	42%	30%	72%
APR-OCT	349,270	29,364,225	11,717,220	41,081,445
%	55%	20%	8%	28%

MISSOURI GAS ENERGY
CASE NOS. GR-2001-292

ALL REGIONS
TEST YEAR JANUARY 2000 - DECEMBER 2000

SMALL GENERAL GAS SERVICE (SGS)
NORMAL VOLUMES

	SGS Commercial and Industrial Normal Ccf			
Month	Regular Bills to Customers	1st Block 0 - 600 Ccf	Tail Block Over 600 Ccf	Total Ccf
Jan	58,361	16,384,531	14,736,175	31,120,707
Feb	58,900	16,164,526	13,565,555	29,730,082
Mar	58,256	13,631,799	9,377,417	23,009,216
Apr	57,030	9,380,274	4,472,920	13,853,195
May	54,520	5,696,678	2,156,099	7,852,777
Jun	48,986	3,687,278	1,383,673	5,070,951
Jul	46,701	2,909,728	1,115,033	4,024,761
Aug	45,541	2,732,559	1,058,826	3,791,385
Sep	45,442	2,835,587	1,111,520	3,947,106
Oct	51,050	3,164,173	1,178,813	4,342,986
Nov	55,818	7,163,924	3,238,102	10,402,026
Dec	59,776	13,081,623	8,959,549	22,041,172
ANNUAL	640,381	96,832,680	62,353,684	159,186,364
%		61%	39%	
NOV-MAR	291,111	66,426,403	49,876,799	116,303,203
%	45%	42%	31%	73%
APR-OCT	349,270	30,406,277	12,476,885	42,883,162
%	55%	19%	8%	27%

MISSOURI GAS ENERGY
CASE NO. GR-2001-292

ALL REGIONS
TEST YEAR JANUARY 2000 - DECEMBER 2000

SMALL GENERAL GAS SERVICE (SGS)
ADJUSTMENTS TO VOLUMES

	SGS Commercial and Industrial Adjustment Ccf			
Month	Regular Bills to Customers	1st Block 0 - 600 Ccf	Tail Block Over 600 Ccf	Total Ccf
Jan	0	1,675,741	3,424,438	5,100,180
Feb	0	939,550	1,854,661	2,794,212
Mar	0	2,459,996	2,938,990	5,398,986
Apr	0	785,082	611,819	1,396,902
May	0	371,449	204,535	575,984
Jun	0	391,053	157,255	548,308
Jul	0	(19,976)	(7,593)	(27,569)
Aug	0	4,549	1,708	6,257
Sep	0	120,118	26,580	146,697
Oct	0	(610,223)	(234,640)	(844,863)
Nov	0	501,704	317,565	819,269
Dec	0	(1,668,471)	(2,500,529)	(4,169,000)
ANNUAL	0	4,950,572	6,794,791	11,745,363
%		42%	58%	
NOV-MAR	0	3,908,520	6,035,126	9,943,647
%		33%	51%	85%
APR-OCT	0	1,042,052	759,665	1,801,717
%		9%	6%	15%

MISSOURI GAS ENERGY

CASE NO. GR-2001-292

Attachment 1

Process and Impact Evaluation of Missouri Gas Energy's Pilot Weatherization Program,
TecMRKT Works, Oregon Wisconsin, March 1998

Final Report

Process And Impact Evaluation of Missouri Gas Energy's Pilot Weatherization Program

Prepared For:

Missouri Gas Energy's Evaluation Collaborative
3420 Broadway
Kansas City, MO 64111

March 30, 1998

Prepared By:

TecMRKT Works

827 Shady Oaks Lane
Oregon, Wisconsin, 53575
(608) 835 8855

2308 North Van Buren Ct
Arlington, VA 22205
(703) 241-3771

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY iv
   1.1. Process Evaluation Findings iv
   1.2. Impact Evaluation Findings vi

2. INTRODUCTION 1

3. PROGRAM DESCRIPTION 2

4. PROCESS EVALUATION DESIGN AND METHODOLOGY 4

5. PROCESS EVALUATION RESULTS 5
   5.1. Results of the Program Records Review 5
   5.2. Results of the Review of the Program Tracking System 5
   5.3. Results of the Customer Survey 6
      5.3.1. How Participants Heard About the Program 6
      5.3.2. Participant Satisfaction and Experience with the Program 8
   5.4. Educational Impacts 13
   5.5. Perceptions of Program Sponsorship and Attitudes Toward MGE 14
      5.5.1. Comments From the Participants 15
   5.6. Interview Results 16
      5.6.1. Program Management and Staff Interviews 17
      5.6.2. Contractor Interviews 21

6. THE IMPACT EVALUATION DESIGN AND METHODOLOGY 25
   6.1. Weatherization Program Data 25
   6.2. Gas Consumption Data 25
   6.3. Electric Consumption Data 26
   6.4. Fuel Use Data 26
   6.5. Weather Data 26
   6.6. PRISM 26
   6.7. Data Editing 28

7. IMPACT EVALUATION RESULTS 29
   7.1. The Units Being Analyzed 29
   7.2. Program Energy Savings for Natural Gas 30
   7.3. Program Savings from Electricity 31
   7.4. The Installed Measures 33
   7.5. Measure Specific Installation Costs 34
   7.6. Program Costs 35
   7.7. Program Cost Effectiveness 35
   7.8. The Cost-Effectiveness of Measures 36
   7.9. Impact Summary and Conclusions 40

8. IMPACTS ON PARTICIPANT'S ABILITY TO PAY ENERGY BILLS 42
8.1. Perceived Ability to Pay gas Bills 42
8.2. Impacts on Arrearages 42

9. ATTACHMENTS 47
9.1. APPENDIX A: LIST OF ITEMS THE CUSTOMERS WANT THAT WERE NOT INSTALLED 48
9.2. APPENDIX B: COMMENTS FROM PARTICIPANTS 46
9.2.1. Positive comments 46
9.2.2. Negative comments 48
9.3. ON-SITE INTERVIEW PROTOCOL 48
9.4. CUSTOMER SURVEY 48

ACKNOWLEDGMENTS

The principal researchers for this effort are Mr. Nicholas P. Hall and Dr. John Reed of TecMRKT Works. Program surveys were completed by Kim Leal and Brian Pearson of TecMRKT Works. PRISM analysis was conducted by Andrew Oh of TecMRKT Works.

This work could not have been completed without the cooperation of several individuals including, Karen Czaplewski of Southern Union Company, Charles Hernandez, Ted Austin, Janet Rethman-Huber, Craig Daniels, and Ron Crow of MGE; Ryan Kind, Henry Warren and R. Blair Hosford of the State of Missouri; Robert Jackson, John Quimby, Ken Robison, Tim Gappa, Bonny Jackson, Rocky Henry, and Bernita Cauthon from the Kansas City Housing and Community Development Office; and the individual contractors who agreed to be interviewed for this study.

1. EXECUTIVE SUMMARY

This report presents the results of a process and impact evaluation of the Missouri Gas Energy (MGE) Pilot Weatherization Program. The purpose of a process evaluation is to examine and document program operations and activities and to recommend changes that can be expected to improve program management or delivery. The purpose of an impact evaluation is to document the energy savings and the costs associated with achieving those savings.

The data collection and analysis activities conducted for this evaluation include on-site record reviews of 50 participant files, a review of the electronic Data Tracking System, interviews with program management and field staff, interviews with program contractors, a telephone survey with 151 program participants, analytical examinations of customer consumption, billing, and payment records and an analysis of program cost data.

1.1. Process Evaluation Findings

1. A majority of customers (65%) reported that the program improved their ability to pay their gas bill and about a third said they are saving an average of about $300 a year.

2. The program's records are very well maintained and available for management inspection and evaluation. The records contain enrollment information, audit results, information pertaining to the contractor(s) involved, most measures installed, the cost of the measures and the follow-up inspections. The records allow for process and measure tracking and service delivery documentation and evaluation. The hard-copy files are maintained at the Kansas City Housing and Community Development Department (KC-HCDD) in the office of the Home Weatherization Program.

3. The program tracking system is, in our opinion, an example of an exemplary system. All relevant participant information, including, client identification, contractor information, participation dates, measures installed, and relevant supporting events can be easily tracked through this system. In addition, the system is relational in that management documents can be produced to report information from the different data files maintained in the tracking system. The tracking system allows for automated report generation and participant and contractor correspondence. We have seen few systems that duplicate the extent of information available from this tracking system. One potential issue regarding the future use of the tracking system is that it is written in a program language that is seldom used and is not easily converted to standard off-the-shelf programs such as Microsoft Access.

4. Program information included in the tracking system is secured by access codes that restrict access to the system by unauthorized staff, minimizing potential data loss or corruption by non-authorized staff.

5. Contractors are satisfied with the program management and the improvements that have been made to the management of the program over the last few years. Contractors indicate program management has improved with the current manager and all are complementary of the current management.

6. Contractors are less complementary regarding the administration of the program and the speed with which program payments are made even though payments are typically made in a few days following inspection. Contractors report that the bid process is convenient, but the on-site requirement of picking up bids and the follow-up inspections and payment process is time consuming and, in some cases, unnecessarily unpleasant, even though the inspection typically takes less than two weeks and usually is completed within one week. Contractors also report some difficulty with the follow-up inspection process and in dealing with some program staff. Contractors report that automated systems are available for notifying of bid awards and follow-up inspections can be more timely.

7. Some contractors report that it is difficult to participate in the program because of the low per-job profit, the administrative and reporting burdens that add costs to the job, and the cost of carrying labor and materials until payments are received. Some contractors report that almost any other work is preferable to program jobs, and some contractors view the work as low-priority work in comparison to other jobs that provide less administrative overhead, more choice of materials and procedures, fewer follow-up activities, more rapid payments, and higher profits per job. However, these same contractors report they like the program and plan to continue bidding jobs and providing contractor services. Some of the contractors interviewed have been with the program for more than 10 years.

8. As with many other low-income programs, program participation is driven by social networking among customers and to a lesser extent, organizational referrals. Demand for service is higher than the budget allows and program promotion should be expanded only when the budget is expanded to match anticipated demand.

9. The program is managed and operated in a way that is similar to other publicly funded weatherization programs designed to install specified measures at the lowest cost, rather than a program offered by a private company that focuses on customer satisfaction and value. As a result, customer satisfaction mechanisms and customer communication systems do not play a strong roll in the delivery of program services. While customer satisfaction is high, the program can benefit from management systems that target increasing satisfaction with program measures and contractor performance if satisfaction is to be improved. This will require budgets that target improving customer satisfaction and communications.

10. Program publications and handouts are minimal and there is no customer training component associated with program delivery as recommended by the Missouri Public Service Commission. It is our understanding that the educational component is now being implemented with a modified version of the State of Washington's modular educational program that can be tailored to the individual customer's needs and

appliance mix. In our opinion, this system is one of the better educational programs available and is an attractive addition to a good program.

11. The primary drivers for program participation are improving the energy efficiency of the home and saving money on heating bills.

12. Customers report high or very high satisfaction with the program. Improvements in program satisfaction will require changes in the application and enrollment process, the timeliness of measure installations, and better communications from the program staff.

13. Customers report their homes are more comfortable, more efficient, safer, and are worth more as a result of participation.

14. Customers are satisfied with the measures but feel more measures are needed and the quality of the contractor performance needs attention.

15. Customers were able to identify the most efficient measures installed in their home but could not identify the least efficient measures.

16. Most customers do not know who sponsored the program and recognition of the program's sponsorship is low. Customer opinions of MGE are significantly improved when they understand that the program is provided by MGE. The program is an excellent customer relations tool but only when customers know it is provided by MGE.

17. Customers report that they would like additional measures installed. However, many of the additional measures requested do not pertain to energy use or energy efficiency. These requests indicate a lack of customer understanding about the purpose of the program and the program goal of reducing energy consumption rather than a general home improvement goal.

18. The current program is funded by charging all MGE customers. In the future, if other energy providers are allowed to market services to MGE's retail customers, a more equitable funding mechanism that allocates cost shares to all competitors would be appropriate. The national trend to deal with this problem is to require line and supply charges for all sales in the state in order to fund low-income services and to pay unrecovered debt, or to allow companies to transfer customer debt and service requirements to a supplier or system not subject to competitive market pressures.

1.2. Impact Evaluation Findings

1. The program produced strong energy savings, providing an average per customer savings of 8.7% of the household's baseline consumption and 20.2% of the space heating consumption for an average annual savings of 17.7%. The measures resulted in an average savings of 30 therms of baseload and 280 therms of space heating for a

total of 310 therms annually. The monitory savings average $170 a year per customer at $.55 a therm.

2. The savings of electricity is estimated about 1% of annual electrical consumption or about 75 to 85 kWhs a year. These savings are produced by reducing the need to run the furnace blower motor.

3. The program provides a positive benefit cost ratio for MGE customers. The benefit to cost ratio over the 20 year life expectancy of the installed measures is 1.37 to 1, or $1.37 in 1995 dollars returned to the customer for each 1995 dollar of program costs. The measures producing the highest benefit cost ratio are water heater blankets (13.8:1), wall insulation (3.23:1) infiltration reduction measures (1.4:1) and furnace replacements (1.2:1). Measures producing the lowest benefit to cost ratio are attic insulation (0.5:1) and heating system tune-ups and repairs (0.7:1).

4. The program improves the participant's ability to pay their bills and manage their financial affairs. In addition, for customers who achieved savings, the program helped reduce the amount they owed the utility.

In summary, we found the program provides positive benefit cost ratios, strong energy savings and is well organized and structured to provide valuable services to the participants. We found that the program is functioning well and is able to deliver valuable services to participants in a way that should be viewed as a credit to the Company, the City and many of the installation contractors. In addition, the program operations, records, and tracking systems we examined are exceptionally well designed and maintained and effectively support the program operations and implementation. These accomplishments do not include other program benefits that often accompany low-income weatherization programs that are not addressed in this study, such as gas leak repairs, reduced emergency calls to the company, and other health and safety benefits.

The major changes needed to the program are to improve the program for the operations of the contractors, better customer communications, provide a system for monitoring performance through customer feedback mechanisms that leads to more satisfied customers and contractors, and provide a way that customers recognize MGE as the sponsor of the program. In summary, we were positively impressed with what we saw and heard.

2. INTRODUCTION

This report presents the results of a process and impact evaluation of the Missouri Gas Energy (MGE) Pilot Weatherization Program. The MGE Pilot Weatherization Program is being implemented by the Kansas City Housing and Community Development Department (KC-HCDD) under contract to MGE. KC-HCDD uses private contractors to install measures.

The purpose of the evaluation is to:

- Describe the program and the roles of the key participants in the program
- Review the management and operation of the program and provide recommendations for improvement with particular emphasis on:
  - MGE's role in the program
  - the operation and effectiveness of MGE's implementation contractor (KC-HCDD) in managing the delivery of services
  - the delivery of weatherization services to customers by KC-HCDD's contractor
- Assess customers' knowledge of and satisfaction with the program
- Determine the energy savings per household for both gas and electricity
- Determine which measures may be producing the most savings
- Assess the benefits and costs associated with the program
- Assess the impact of the program on customer's ability to pay

The evaluation activities on which this report is based were conducted from June 1997 through February 1998. The activities included interviews with staff in the key participating organizations, a survey of 151 customers, a billing analysis using PRISM to determine energy savings, an analysis to determine which measures are the most effective, and an analysis of customer payment patterns.

3. PROGRAM DESCRIPTION

The MGE Pilot Weatherization Program is operated through a contractual agreement between MGE and the Kansas City Housing and Community Development Department. The program funding level is established through a 1993 rate case and is set at $250,000 a year less the cost of the evaluation. The City is fully responsible for implementing the program under an implementation contract with MGE.

The program, established in late 1994, parallels the weatherization services provided by the City on behalf of the USDOE, the Missouri and the Kansas City Weatherization Programs. Participants are MGE customers who own their own homes and who meet certain income eligibility criteria. They are served through this program if there are sufficient MGE programs funds. Otherwise, the customer participates in the City's weatherization program or is placed on a waiting list until funding is available. There is no significant difference between the City's weatherization program and the MGE Pilot Weatherization Program with respects to operational procedures or management and delivery systems. Essentially, the MGE program is a subset of the City's weatherization program.

Other than some limited outreach efforts there are no formal program marketing materials or activities to encourage participation in the MGE program. Eligible MGE customers contact the city or are referred to the City by MGE or other organizations or groups.

Once the customer is referred to the City, the customer is asked to come to the program office and bring income verification. If the customer demonstrates that their income is 150% or less of the area federal poverty level, the customer is placed on a waiting list for program services. After the initial screening the information for MGE customers is forwarded to MGE which verifies that the customer is eligible.

Prior to December 1995, eligible customers had to have a single monthly gas bill of at least $100 and have a "high" arrearage level in order to be included as an MGE program participant. Between 1995 and 1997 the criterion was changed to a threshold consumption of at least 20 MCF a year. In mid 1997 this threshold was eliminated. Now, MGE customers who own their home and pass the income requirements are placed on the waiting list. When a customer is approved by MGE, the Company forwards their energy consumption history to the City for use in the energy audit.

Because the program funding is limited, a customer typically may wait 2 months or more for service. The wait can be longer if no funds are available. Once funding is available, the weatherization program schedules an appointment with the customer and sends an energy auditor to the customer's home. "Cost-effective" measures are identified through the use of the National Energy Audit.

Following the audit, the approved measures are placed on bid with bidders that are approved suppliers for the identified measures. Some or all of the contractors submitting bids may contact the customer to inspect the home in order to prepare their bids. Because

bids for furnace repair or installations are handled separately, the homeowner may be contracted by these contractors as well.

Once the contractors prepare the bids they are submitted to the City for analysis and award. At an appointed time and place, the program staff open the bids and an award is made. The contractors are notified of the award, the measures to be installed and what they are permitted to charge the City for each measure. The contractors then contact the customers and arrange for installation.

All materials and labor must meet minimum program standards as described on specification sheets provided by the City. On completing the job, contractors turn in a job completion report. The City then schedules a follow-up inspection typically completed in about one week. If the inspector passes the job, the job is recorded as completed and payment is made to the contractor typically within one week. If the job fails the inspection, the contractor is informed and given a specific number of days to correct the problem. If the contractor does not complete the work in the required amount of time, a financial penalty is assessed and is deducted from the job payment. If the contractor completes the work within the required time the job is re-inspected and payment made. If the job does not pass the second inspection, the contractor is ordered to correct the problem or not be paid for the measures not meeting standards.

This entire process is monitored by a "real-time" automated tracking system maintained by the program. The system documents all phases of the service including program enrollment, approval, the audit, the approved measures, the bid process, the award, the work order, the price to be paid, the contractor, the follow-up inspection, and the payment(s).

4. PROCESS EVALUATION DESIGN AND METHODOLOGY

The process evaluation involved five tasks:

1. A review of program records and files
2. A review of the electronic program files and tracking database
3. Interviews with program management and implementation staff
4. Interviews with program contractors, and
5. A customer survey of 151 program participants.

Review of program records and files

Fifty participants were randomly selected from the program tracking system. The paperwork for these 50 cases was physically examined to test for the inclusion of enrollment and service delivery records. Records were examined for completeness of content and service delivery documentation.

Review of the electronic program files and tracking database

The contents and structure of the electronic data tracking system were reviewed during two visits to the program office. During the first visit, the Program Director demonstrated the system and its operation. During the second visit, the data tracking manager reviewed the content of the files and the methods used for maintaining the tracking system.

Interviews with program management and implementation staff

Interviews were conducted with key program managers and delivery staff at both the Kansas City program office and MGE. The content of these interviews covered program history, operations, procedures and potential changes to the program.

Interviews with program contractors

Interviews were conducted with 3 contractors who install measures. These interviews concentrated on the contractors' perspectives on program operations, procedures and desired changes to the program.

A Customer Survey of 150 program participants

A telephone survey with 151 program participants was conducted to discuss their opinions and experiences with the program and to obtain recommendations for program improvements and changes.

5. PROCESS EVALUATION RESULTS

5.1. Results of the Program Records Review

The review of the program hard-copy records was accomplished without problems. Program records were readily available and maintained in order of participation. All files were easily located and contained the necessary information to document enrollment, enrollment eligibility, the audit and the measures installed along with key enrollment and participation dates. It was possible to immediately locate the desired information within the files. We were impressed with the orderly way the hard-copy records are maintained and available to the program.

5.2. Results of the Review of the Program Tracking System

The program tracking system is one of the best tracking systems we have seen. Tracking starts with the enrollment and approval process and includes scheduling and delivery of the audit, the measures approved for bid, the bid and bid results, the contractor doing the installations, measure installation dates, problems with the project, the inspection results and payment dates. This system automatically sends bid awards and work orders and provides a complete real-time documentation of the program's activities and progress for each job.

During the demonstration of the tracking system we examined selected records. The Director was able to obtain the participation data within seconds and walked us through information pertaining to individual households. We were able to obtain downloads of participant records from the tracking system listing all participants, the measures installed in their homes, the dates of installation, the cost for each job for each of the categories of measures in the tracking system.

The tracking system is protected by access codes known only to specific individuals who need access to the tracking system. We were impressed with the accuracy and quality of the electronic data tracking system.

The single drawback to the system is that it is written in a rarely used language. This may make it more difficult to find people who can maintain the system and it may increase the difficulties of migrating to new generations of hardware or converting to an off-the-shelf tracking system should that be necessary or desirable in the future.

The system is designed for accounting purposes rather than evaluation. For instance, individual weatherization measures are tracked in general categories rather than by the specific measure. As an example, caulking around doors, windows, and sill plates, and weather-stripping installed on doors or windows, are tracked and identified as "infiltration" measures. The current system works admirably from an accounting standpoint but it does impose a burden of determining the exact measures and quantity of measures being installed during an evaluation. These data are available in the paper documentation. At a point when the system is being replaced, it would be useful to consider adding this additional information to the system. However, there are trade-offs

between the value of having this information available and the cost of entering and maintaining it.

We conclude that the system is working very well, that it is being used and that the staff are adequately trained to input and retrieve the data that they need.

5.3. Results of the Customer Survey

A customer survey was administered to 151 participants selected at random from the electronic program participation files. The survey was conducted by TecMRKT Works during afternoon and evening hours when people are most likely to be at home. The participant list was randomized across the participant period and customers were selected for contact from the participant lists.

We attempted to contact each customer in the sample to a maximum of 5 times on different days and at different times before replacing the customer. One hundred ninety eight contacts were attempted to obtain the 151 completed surveys. Only three customers refused to participate once contacted yielding a contact completion rate of 98%. Based on these completion rates, we believe that the final sample reflects the target participating population.

5.3.1. How Participants Heard About the Program

When asked how they heard about the program (Table 1), the largest group of participants (35%) reported they learned about the program through friends, relatives or neighbors. Thirteen percent said that they heard about the program through neighborhood or community organizations and another 13% said they heard about the program from local government. An additional 5% said they heard about the program through the federal or state government, 3% said they heard about it from MGE and 1% said they heard about it at work. Finally, 6% said that they heard about the program through a social group or activity.

When grouped, these responses indicate that neighborhood and social networking represent 41% of the ways in which customers learn about the program and that an additional 35% hear about the program through an organization. Together 76% of all participants hear about the program through their organizational or social networks. Only about 15% of participants reported hearing about the program through some form of mass media.

Table 1 How participants heard about the program

How participants heard about the program	Percent heard about the program n=151
Friend, relative or neighbor	35
Neighborhood or community organization	13
City or local government	13
TV (news or story)	8
Social group or social activity	6
Federal or state government	5
MGE	3
Received something in the mail	3
Newspaper advertisement or story	3
Flyer, poster, or printed material (non mailed)	1
From work	1
Don't know or don't remember	24

Source: Customer survey

The findings for how people hear about the program have implications for both the City and for MGE. First, the fact that the program is so strongly driven by social and organization networks means that participation rates, at their current level, are not dependent on the use of mass media. Second, because the program is more strongly driven by social networks than organizational networks, it means that program demand can be expected to grow in proportion to the rate of information exchange within the social networks. This is beyond the control of MGE or the KC-HCDD. Third, because program participation is often a function of the program environment in which the customer is placed, the network induced demand may be more a function of weatherization networks than MGE Pilot Program networks. (This opinion is supported by a later finding that the majority of participants do not know who sponsored the program.) This means that program demand is more for weatherization services than for characteristics associated with the MGE Pilot Program. Fourth, because a number of participants heard about the program through organizational referrals, changes to the program that impact the rate at which customers are referred by other organizations can be expected to have a rapid impact on program demand, but not a major impact until social networks catch up to the changes. However, because social networks are the primary method of hearing about the program, informing people about the MGE Pilot Program will continue to be more a function of social networks than organization referrals.

5.3.2. Participant Satisfaction and Experience with the Program

This section of the report presents information pertaining to the participants' levels of satisfaction. However, in order to interpret satisfaction data it is necessary to understand what satisfaction scores mean.

In the case of this evaluation, we measured satisfaction using a 1 to 5 scale, where 1 means very dissatisfied and 5 means very satisfied. It is generally the case that survey respondents tend to give high satisfaction scores. A score of 5 typically means the participant is very satisfied and has few, if any, problems with the aspect of the program being measured. A score of 4 typically means participants are generally satisfied, but there are usually issues that participants would like to see addressed. A score of 3 usually means there is dissatisfaction with one or more aspects of the program and scores below 3 indicate significant dissatisfaction.

5.3.2.1.Satisfaction with Program Operations

There were six survey questions that dealt with program management and administration. Table 2 presents both the average and the distribution of responses for these questions ordered from highest to lowest average satisfaction.

Table 2 Satisfaction with program operations

		Percent scoring satisfaction as				
Program Management and Administration Questions	Mean	1	2	3	4	5
Staff were knowledgeable and helpful	4.73	1	1	5	11	82
Staff were polite and professional	4.72	1	1	5	11	82
Home audit was made at a convenient time	4.63	2	0	4	21	73
Learning about the program and program requirements was convenient	4.25	1	3	20	25	52
Application was handled fast and effectively	4.23	3	5	13	26	54
Measure approvals took the right amount of time	4.16	3	2	17	34	45

Participants are satisfied with the staff knowledge, their social interaction with the staff and the audit scheduling process. Learning about program requirements, the application process, and the project approval times are rated in the 4.0 to 4.25 range and are areas that have satisfactory scores but should be monitored to see if improvement is needed.

Although the MGE Pilot Weatherization Program is managed and operated in ways similar to the Kansas City weatherization program, some of the administrative and operational procedures and steps that might be appropriate for a publicly funded program, may not be needed or can be expedited for a privately funded program where customer relations and customer service often take precedence over controls, procedures and processes. While we were impressed with the program's ability to enroll, audit and install measures compared to other public weatherization programs, we realize that when a corporate name is attached to a program, customer opinions of that company can suffer

as a result of lengthy waiting periods. We also realize that customer opinions of a company are difficult to repair once damaged. For the delivery of privately sponsored energy service programs, where customer satisfaction and corporate identification may be one of the key delivery goals, we recommend a 30 day target between program enrollment and the beginning of the installation of program measures. For publicly sponsored programs we realize delivery times are influenced by budget stream controls, program equity considerations and the need to publicly document processes leading to the expenditure of public funds and that these requirements may take precedence over customer satisfaction issues. If measure delivery times cannot be reduced to 30 days following enrollment, we recommend increased communications between the program enrollment staff and the customer regarding the length of the waiting period to minimize dissatisfaction with extended delivery periods.

5.3.2.2.Satisfaction with Contractors

There were four questions dealing with the customers opinions of the contractor's performance (see Table 3). In general, satisfaction with contractors is very good. Participants think that the contractors are courteous and helpful and they rate job clean-up in the good to very good range. In addition, participants feel that the contractors know what they are doing.

Program management may want to monitor customer satisfaction levels with respect to whether contractors are doing a complete and professional job. While the scores for doing a complete and professional job are acceptable, about 23% of all participants provided contractor scores that indicate some level of dissatisfaction. The comments section in the questionnaire reveals that 56% of survey participants indicated that additional work should have been done. The complete list of items is provided in Appendix A. The list indicates that the satisfaction level with job completeness may be related to the funding limits and perhaps to a lack of understanding about what work is to be performed. There were a number of comments that the crews did not complete repairs for items unrelated to weatherization activities.

Table 3 Satisfaction with contractors

		Percent scoring satisfaction as				
Contractor Questions	Mean	1	2	3	4	5
Contractor was courteous and helpful	4.53	4	2	7	12	75
Contractor cleaned up after themselves	4.39	5	3	7	17	68
Contractor knew what they were doing	4.37	3	1	12	25	59
Contractor did a complete and professional job	4.18	7	6	10	17	60

We recommend that the program staff (not contractors) make a special effort to educate participants about the work that can be done, the amount of work that can be done within

the funding levels, and the reasons why the program can accomplish only a subset of the work that may be needed.

5.3.2.3.General Program Satisfaction

Four survey questions were designed to gauge overall satisfaction with the program. One of these questions asked participants if they would recommend the program to their friends. Ninety percent of the participants scored this question with a "5" indicating they would overwhelmingly recommend the program.

When asked if the measures met their expectations, participants gave slightly lower scores. These scores demonstrate general satisfaction but can be higher if customers fully understand the limitations of the program.

When participants were asked if they learned a lot about how to save on their energy bills 54%, indicated they *strongly agreed* and 27% *agreed* that they had learned a lot. This is an important question because the program did not have an on-site educational component that specifically addressed how participants could save energy and reduce their bill. As a result, we conclude that the process of participation and observing measures being installed is an educational event. Participants feel that they learned how to reduce their bills by interacting with the program and contractor staff and by seeing the measures installed. Unfortunately, some contractors do not see this interaction as something for which they should be responsible because customer interaction and education is not included in the bid price.

At the time the evaluation began, the program was considering adding an educational component. By adding the question pertaining to what they learned, we now have a baseline from which to measure program improvements through the addition of an educational component. If the question is asked in the same way in the future, the 4.27 score can be used as a baseline from which to measure changes. Once other factors are taken into account, satisfaction scores greater than 4.27 may be attributable to the addition of an educational component.

Table 4 General program satisfaction

		Percent scoring satisfaction as				
General Program Questions	Mean	1	2	3	4	5
Would recommend the program to friends	4.80	3	0	2	5	90
Measures installed met expectations	4.30	4	4	10	23	60
Learned a lot about how to save energy and reduce bill	4.27	3	3	14	27	54

The final satisfaction question rates the program's overall performance. A 4.6 out of 5.0 (Table 5) indicates that program participants are satisfied to very satisfied with the program. Targeted program improvements can increase this score. Program improvements that might lead to higher satisfaction scores will require more interaction

time with the participants, additional funding levels that will enable more actions to be installed, a quicker enrollment and participation process, a better system to follow-up to address contractor problems, and better presentations that increase participant understandings about what the program can and cannot do. We realize that program improvements within the current program budget and implementation process will be difficult and that additional resources are likely to be required.

Table 5 Overall program satisfaction

		Percent scoring satisfaction as				
Overall Program Satisfaction Score	Mean	1	2	3	4	5
Rating of overall program satisfaction	4.6	1	1	5	22	71

5.3.2.4.Customer Perceptions of Impacts

Relative to their participation in the pilot program, customers were asked their perceptions about changes in household comfort, energy efficiency, safety, and value. A majority of participants (85%) agreed or strongly agreed that their home was more comfortable after the measures were installed. Only 4% disagreed or strongly disagreed and 12% percent neither agreed or disagreed with this statement.

Similarly, a total of 80% said they agreed or strongly agreed that their home is more energy efficient and that this change is a result of the program. When customers were asked about the safety of their home, 78% said they agreed or strongly agreed that their home was safer as a result of the program. Finally, when asked about changes in the value of their home, a strong majority (73%) agreed or strongly agreed that their home is worth more as a result of participation. Most of these customers strongly agreed with this statement. It is clear from these scores that a substantial majority of participants think that their homes are more comfortable, more energy efficient, safer and worth more as a result of their participation in the program..

Table 6 Customer opinion of household changes

Household impacts	Mean	% Strongly disagree	% Disagree	% Neither	% Agree	% Strongly agree
Home is more comfortable	4.38	3	1	12	25	60
Home is more efficient	4.32	2	3	15	21	59
Home is safer	4.25	3	1	19	24	54
Home is worth more	4.11	3	3	22	25	48

5.3.2.5.Most and Least Helpful Measures Installed Through the Program

Participants also were asked which measures they perceived to be the most and least helpful in reducing their heating bills. Participants were unable to identify measures that were least helpful but they were able to identify measures they consider to be most

helpful. While 88% of participants did not know which measures were least helpful, only 3% were unable to identify the most helpful measures.

According to customers, sealing doors and windows, installing wall insulation, replacing the furnace, caulking, and ceiling insulation are among the most effective measures. The two categories of sealing doors and windows and general caulking together make up 43% of the most effective measures cited by participants. The lowest numbers of participants cited new windows and doors and furnace tune-ups as effective.

These data indicate that participants are aware that sealing the doors, windows and walls, insulating the side-walls, and replacing the furnace are among the most effective measures and supports the idea that participants understand the linkage between installed measures and bill reductions. However, participants also reported that ceiling insulation is an effective efficiency measure. As we shall see later, this perception is not consistent with the impact evaluation which concludes that ceiling insulation is not near as effective other measures.

Table 7 Measures perceived to be most and least helpful program measures

Measures mentioned	% indicating measure as most helpful*	% indicating measure as least helpful
Sealing doors & windows	28	4
Wall insulation	25	1
Furnace replacement	16	
Caulking	15	3
Ceiling insulation	15	1
New windows	10	1
Other insulation	5	
New doors	5	1
Furnace tune-up	3	1
Don't know	3	88

* Total more than 100% because of multiple responses

5.3.2.6. Why Customers Participate

Participants gave numerous reasons for participating in the program (Table 8). The primary reason given was to improve the energy efficiency of their home. This response indicates that the customers who participated in MGE's Pilot Program are familiar with the concept of "energy-efficiency" and understand the relationship between energy efficiency and one or more of the customer benefits that can be obtained through improved efficiency.

The second most frequently mentioned reason for participation was to save money or reduce the heating bill and to obtain free equipment or home improvements. A distant fourth place reason is improving comfort. Together these responses indicate that

customers want the improved efficiency the program provides and customers understand that energy efficiency leads to personal benefits such as reduced bills and the installation of free measures.

What is surprising in this data are the percentage drops between improving the energy efficiency of the home (61%), saving money on heating bills (41%), obtaining free equipment (40%), and being more comfortable (16%). This suggests that the program is presented as an energy efficiency program rather than a program that is targeted at reducing heating bills or improving comfort. We suspect that because the program is implemented through the KC-HCDD in conjunction with their standard weatherization program, the focus on the interaction with the customer is energy efficiency, with bill reduction and comfort being second. However, if MGE wants to capitalize on the potential customer relations benefits of the program, MGE may want to develop program materials that stress the sponsorship of the program, the financial and comfort benefits of participation and energy efficiency as a way to reduced bills and increase comfort.

Table 8 Reasons for participation

Reasons for participation	Percent stating reason for participation n=151
Improve energy efficiency of home	61
Save money or reduce the heating bill	41
Obtain free equipment or home improvements	40
Be more comfortable or improve comfort	16
Reduce the amount owed the company	2
People in neighborhood said to do it	1
Improve the security of the home	1
Keep from having the gas turned off	1
MGE encouraged me to do it	1
Friends encouraged me to do it	1
Unsafe furnace	1
Furnace went out	1
I needed the help	1

Source: Customer Survey. Percent totals more than 100% because of multiple responses

5.4. Educational Impacts

The MGE Pilot Program did not have an educational program to support the weatherization measures during the evaluation period. However, an educational program based on a program designed by the Washington State Energy Office has been developed in the interim. This program appears to be well designed and is structured to provide a program tailored to individual customer needs. It is our understanding that the program allows the energy auditor to present behavioral recommendations and training to each

customer consistent with the needs that the auditor determines to be appropriate for the customer. We are encouraged by the development of this component and would suggest that the phase-two impact evaluation, scheduled to be completed in 1998, be modified to assess the impact of the educational component.

5.5. Perceptions of Program Sponsorship and Attitudes Toward MGE

As can be seen in Table 9, a majority of participants in the MGE Pilot Weatherization Program are unable to identify MGE as the program sponsor. Of the 151 participants surveyed, only 32 percent knew the program was provided by MGE. The remaining 68 percent were unable to identify MGE as the sponsor. MGE is providing a valuable service to low-income customers that, for the most part, is going unrecognized by the customers. Most of those who did not know who sponsored the program were unable to identify any sponsor while the remainder thought that Kansas City, a community group, the USDOE, or KCP&L sponsored the program.

Table 9 Customer's perception of who sponsored the program

Customer's response	Percent
Don't know	50
MGE	33
Kansas City	12
Community group, church, other organization	2
USDOE	1
KCP&L	1
Other	3

Customers who knew that MGE was the sponsor were asked if their attitude toward MGE was more positive, more negative or about the same following their participation. Of these customers, 63 percent said their attitude was more positive and 29 percent said it was about the same. Only 2 percent indicated there attitude was more negative. By a ratio of more than 2 to 1, customer attitudes toward MGE improved following participation. If the customer did not identify MGE as the sponsor, the customer was told that the program was sponsored by MGE and was then asked if having this knowledge changed their attitude toward MGE. For this group, 56% said their attitude was more positive, 37% said that it remained about the same, and 1% said that their attitude was more negative.

The MGE Pilot Weatherization Program can dramatically change customer attitudes toward MGE. However, for attitudes to change, the customer must know who is sponsoring the program.

Table 10 Attitudes changed as a result of program participation.

Change in attitude toward MGE after participation	Percent who already knew MGE sponsored the program	Percent who did not know MGE sponsored the program
More positive	63	56
About the same	29	37
More negative	2	1

We recommend that while the program is being provided in conjunction with the standard weatherization program, that it be clearly and repetitively presented to the customer as a service made possible by MGE. Because the program is valued by the customers, we see little reason why MGE should not obtain the customer relations benefit of the program. Based on our experiences we believe that at least 70% of participating customers should be able to identify MGE as the sponsoring organization.

5.5.1. Comments From the Participants

During the survey participants were given the opportunity to provide any comment(s) they wished about the program (See Appendix B). Some 72 participants provided positive comments and 55 provided negative comments. In general, the positive comments pertained to program operations, the staff, and the help the program provided. The negative comments were primarily focused on the contractors and the on-site activities. The number of negative comments is higher than what we typically see for a private utility program.

Because of the number of negative comments pertaining to the work performed and contractor relations, we recommend more attention be placed on recognizing and solving customer follow-up issues. The program currently has a drop-off mail-back survey that is given to each participant. In many cases this survey is returned to the program. These surveys can be supplemented with a call-back survey to customers who do not return their survey. The program staff can then identify all negative comments contained or expressed through the surveys and take the appropriate action to deal with the customer's issues. Because the program is sponsored by MGE, we would recommend that MGE monitor customer comments and the follow-up actions that are taken to solve legitimate customer issues. Under this system a job cannot be considered closed until the customer has signed-off as being satisfied with the job, or the program manger has determined the problem is beyond the scope of the program.

The number of negative comments may also be indicative of communications problems between program staff and the customer. Customers should have a clear understanding of the program, the available resources, the measures that can and cannot be installed, and what they can expect from the program and the contractors in terms of measures and contractor performance. The program staff should go over the program components with the customer so that the customer knows what to expect. The feed back system might be

designed to specifically ask about the recommended measures so that variations in what is recommended and expectations can be identified. We do not recommend that customer communications with regard to program delivery and customer expectations be placed in the hands of the installation contractors. This step should be a staff responsibility and should reside at MGE or the City.

We also recommend the establishment of a contractor reward system that is directly tied to the customer feedback system. This might take the form of a bonus tied to customer evaluations. Contractors that obtain an average quality score of 4.5 out of 5.0 (for example) or better on a four or five component rating system would receive a sliding scale bonus related to their total customer score. Contractors that receive a ranking of 4.0 or less could be terminated from the program while contractors receiving scores between 4.0 and 4.5 could be monitored. While we are sure that some contractors will not like their work being judged by the customer, contractors who take pride in customer relations and in the quality of their work should not object. As one contractor told us, *I must do my work in competition with contractors who do not care about the quality of their work. This places a burden on me as I will bid a high quality job, but I must compete against contractors that will not do good work.* A contractor reward system will help to level the playing field to compensate for quality differences according to the customer's expectations. In establishing such a system, it is also important to design the system in such a way that contractors cannot "game" the system.

Some contractors view the program as providing the least desirable work in their business and/or view the program as valley filling when business is slow. As one contractor told us, *this work is low profit work with high administrative overhead, with customers that we would normally not work with if we had a choice. We can make better money with less hassle with other customers.* The customer feedback incentive may serve to increase contractor profits if they do work that results in satisfied customers and it can help keep the best contractors in the system.

5.6. Interview Results

As part of the evaluation, TecMRKT Works planned 8 to 10 process interviews with individuals involved in the design and delivery of the weatherization program. A total of 13 interviews, consisting of 3 contractor interviews, 4 MGE staff interviews, and 6 Kansas City operations interviews, where actually completed.

The goal of the process interview was to:

1. discuss the program design and development process and the implementation of decisions pertaining to the operations of the program,
2. to discuss the program's ability to help low-income customers become better prepared to manage their energy consumption and pay for the services they receive, and
3. to obtain the opinions and recommendations of those interviewed regarding possible changes to the program.

5.6.1. Program Management and Staff Interviews

The program management and staff interviews focused on program development, design and operations.

5.6.1.1.MGE Interviews relating to history, structure and operations

1. The idea for the Pilot Weatherization Program first became an issue in a 1993 rate case before the Missouri Public Service Commission when the Company proposed the program to the PSC. After a number of hearings and discussions between the PSC and other interested organizations, the Company agreed to enter into an arrangement to collect $250,000 a year from their customers and to implement a weatherization program. From the Company's perspective, the primary purpose of the agreement was to provide money for weatherization rather than to provide weatherization services. Accordingly, they entered into a contract with Kansas City to provide the services on behalf of the Company at the rate of $250,000 a year. According to MGE there was no research to support the agreed upon funding levels or to identify the number of low-income customers who might need weatherization services. The funding level was set during the tariff agreement and the contracted services were limited to the levels set in the agreement.

2. The Company perceived that the City had a good program and that the MGE program could best be provided through an experienced provider like the City. The arrangement made between the City and the Company was that the Company provided the start-up information and support needed to develop and implement the program through the City's on-going weatherization program. The primary responsibility for fielding the program would rest with the City. The City actively pursued the arrangement with MGE. The arrangement appeared to be mutually beneficial for both parties.

3. The primary design of the program and the implementation options were not a significant concern for the Company. The City's program was already established and eliminated the need for an expensive or extensive program design and start-up effort. At the time the program was started, a participation threshold of at least $100 in a single monthly gas bill was required. This was changed in 1995 to 20 MCF or more per year as the minimum consumption level for participation. This was later relaxed and eventually eliminated after MGE received negative publicity for refusing service to customers because their bills were too low. The program currently has no consumption or arrearage requirements.

4. MGE is minimally involved in day-to-day operations. MGE allows the City to manage and implement the program as their expertise and experience dictates. The program is not hampered by multiple layers of management of the day-to-day operations. This is seen as a benefit to MGE because they do not believe they are structured or organized to provide weatherization services and weatherization services are not currently part of their corporate mission.

5. MGE sees the program as providing benefits to their customers and a certain amount of general public relations benefit to the Company. They also see the program as a method of improving or maintaining positive relationships with regulators and as a method of improving customer relations between the City and the customer. As we have previously shown, the program may not be providing the Company as many public relations benefits as they would like because customers are not aware of their sponsorship.

6. MGE's primary interest is in how much of this type of programming should be provided and whether the program is cost-effective. MGE is also interested in ensuring that the money is being well spent and in the impacts of the program on consumption and arrearages. MGE sees the program as a method for reducing the amount of bad debt from low-income customers, for providing the company with positive public relations benefits, and for demonstrating that MGE cares about it's low-income customers. MGE staff did not provide recommendations for program changes preferring to leave this to the program evaluation.

5.6.1.2.KC-HCDD Program Staff Interviews on Program Operations

The program staff interviews were focused on the operations and delivery of the program from the perspective of the staff providing the program services. *Interviewee comments illustrating the findings are in italics.*

1. Program staff believe the program is impacting the energy consumption of the customers but may not be impacting their ability to pay their bills. They indicated customers have several places to spend every dollar and are often caught in the struggle over which bills to pay. *If you reduce gas consumption, that may or may not equate to an increase in the ability to pay bills for the average low-income customer. However, it may mean that the arrearage levels may be less as a result of participation.*

2. Staff reported that in the early months MGE provided a lot of referrals but *as the MGE work force was reduced fewer and fewer referrals were made.*

3. Staff also report that *the program accounting and record keeping is second to none and is among the best in the country. We received a Missouri state award for technology development for this tracking system. Within 20 seconds I can see who did what work, when they did it, where it was done and what it costs.*

4. According to some staff, the per-home spending cap should be eliminated. They indicate that on average, the per-home spending level is a bit to low and that in some cases much more money is needed. In some cases the measures that are installed within the spending cap do not address the major energy problems of the home. *The program needs to be flexible to spend up to $3,000 or more per home if needed.*

5. Some staff also indicated that the program needs a dollar matching component so that the program can deal with additional measures via a shared expense system. In some cases they reported that homeowners would agree to extra measures and would be willing to share the cost of those measures.

6. Staff also thought that the MGE program should increase the income cap for participation. *Because the MGE program is not a federal funded program, there is no need to have such a low income cap.* They indicated that many people with incomes just above the cap have high arrearages and need this help as much or more than those below the cap. This person indicated that MGE could have two programs, a low-income program for the very low-income and a dollar matching program for families with higher incomes.

7. One program staff member indicated that the program measures reduce the amount of money needed for energy, but *the program should be supplemented with a program to get the arrearage level down. An arrearage reduction program that is linked to a weatherization program would be much more effective.*

8. Another staff member indicated that the promotion through the senior group produced applications from low-income seniors, who lived in $200,000 homes, who could pay their bills, and who consumed low levels of gas, but, who were eligible because of their incomes. This individual did not think that it was appropriate to weatherize these homes and then be unable to serve families in $40,000 homes with lower income levels. This individual wanted a method for prioritizing participants according to comparative need.

9. Several staff indicated that they cannot and should not promote the program because applications exceed program budgets. One individual indicated that he could spend two weeks on a promotional effort and produce thousands of applications that would sit for 10 years waiting for budget. Program staff are concerned that the program budget is too small relative to the need for the weatherization services. *We could use $2.5 million a year and still not reach all the low-income people in need of this service.* Another person said, *We need at least $500,000 to $1,000,000 a year to serve MGE customers alone.*

10. Some staff indicated that customers expect more from the program than it can deliver. *Some measures they want are out of scope or beyond program resources. We have to look at what we can do rather than what is needed in many homes. The need is far in excess of what we can do with the dollars we have. It is like handing out a single piece a bread to a starving man. It helps, but they need a meal.*

11. Staff report a need to supplement the weatherization program with an educational program. *We need a show-and-tell, sit-down, go over the material educational session with the head(s) of the household. Education will get more savings.*

12. Several staff talked of the need to require that all high energy users take part in an energy educational program provided in conjunction with the weatherization measures.

13. One manager advised us that there is a significant challenge in finding an educational trainer that knows the technical information and systems and at the same time can relate these things to the customers in ways that will result in change. *Education must be treated as a social system with skilled educational staff.*

14. One staff member indicated that the program needs to do a better job of making sure the contractors leave the homes in better shape. He reported that sometimes contractors do not clean up very well. *The contractors need to clean up after themselves and leave the home neat and clean. We should not ask the participant to clean up after the contractor.*

15. Some staff indicated that the program needs to increase its follow-up efforts including better inspections and seeing if the bills are actually reduced. And, if not, to identify why.

16. We also received comments pertaining to the value of furnace repair. Staff indicated that there are few savings to be achieved by fixing an inefficient furnace. One person indicated that if the furnace is more than 10 years old and needs repair, it should be replaced rather than repaired.

17. Some staff talked about the difficulty of finding and keeping good contractors. *If the contractors are good then they can make better money on their own with fewer hassles. We must be able to find and keep the good contractors, and low bid is not the best way to do this without strong contractor quality control. That means we need more money to attract the good contractors away from other jobs. The bottom line is that we are in competition for good contractors and we must realize this. This is a low-end job for the contractors. We must find a way to keep the good contractors interested. We need to streamline our processes and beef up our systems to meet the demands of the good contractors or we must learn to be satisfied with some bad contractors and some dissatisfied participants.*

18. It was reported that the participants can be grouped into the following categories. single non-working parents age 30 to 40, working single parents ages 30 to 40, single seniors ages 60 and up, and working families with 1 or 2 kids.

19. Some talked of ways to make the program easier for the participant and talked about how intrusive the program was for the customer. No suggestions were offered for how this could be done.

20. One person said that the quality of the measures and the installations should be improved but also indicated that this was impossible under the current budget. He said that with the current budget the quality was as good as can be expected.

Each program staff person interview was asked to give their recommendations for changes to the program. Their recommendations are as follows:

- Increase per-home spending cap.
- Provide a dollar match component for other measures and middle income homes.
- Increase the income requirement to allow low and middle income customers to participate.
- Classify and serve customers according to weatherization needs.
- Increase the budget from $250,000 to at least $2,500,000 a year.
- Link the program with an educational program.
- Make sure the contractors clean up after themselves.
- Increase follow-up inspections and see if bills are reduced.
- Don't fix bad furnaces, replace them with efficient ones.
- Require high energy users to have an educational program with measures.
- Learn to find and keep good contractors.
- Find a way to increase quality through an increase in the budget.

5.6.2. Contractor Interviews

The contractor interviews focused on operations from the perspective of the contractors. Contractors were open and expressive and appreciated the opportunity to provide their opinions and comments.

All contractors agreed that the program was an excellent service and indicated that the measures they install reduce energy bills and make homes more comfortable. One contractor said that in homes where he can do what is needed he expects that he can reduce peak winter bills from $400 to $150. None of the contractors indicated they knew of any efforts to educate customers on how to save energy other than through the informal process associated with participation.

The contractors interviews provided comments and recommendations pertaining to their involvement with the program.

1. Contractors said that the program has a lot of safeguards that protect the customer. They recommended the program inform customers as to how the process works, when contractors will show up, which contractors will show up, what they will be doing, what they are paid to do, and the experience of the contractors. *The customer should understand we are skilled private sector contractors and are not social service workers. Customers need to understand that the contractors are paid to install measures. We spend too much time educating and interacting with the customers.* This comment indicates that the letters sent from the program staff to the participants presenting the program and the measures that will be installed is not as effective as contractors would like. These comments also indicate that the contractors do not consider themselves to be program communication channels and therefore should not

be expected to effectively communicate program operations to the customer. These comments indicate the contractors consider themselves to be installation contractors only rather than client educators or program service staff.

2. *The time and money required from us to get in touch with the customer and schedule appointments and installations is excessive. It is often very difficult to get in touch with customers and sometimes we do not have good contact information. It is expensive to repetitively try to contact the customer to arrange for visits. We need help with this barrier.*

3. *The program jobs are low profit jobs for us. This places them at the bottom of the priority list. Most non-program jobs provide higher profit with fewer administrative hassles. When there are five jobs on our list, the jobs with the lowest profit (weatherization jobs) get the lowest position. This is the way the private sector works. The weatherization program provides a good second income, a kind of second priority work. But we cannot make a living or run a company on the profit from this work. So if we are to survive, we must put the weatherization jobs on our second priority list.*

4. *The paper work with this program is excessive and the program staff do not understand that each minute or our time is a minute of cost for us. We only make money when we are doing the work, the rest of this is administrative barriers. There is no reason why we must take 40 minutes to go and check our mail boxes only to learn there is nothing in them. We should get this information electronically by e-mail or by phone or fax. There needs to be a balance between contractor interests and the administrative operations of the program.*

5. *The paper work for the small jobs is identical to the large jobs. It makes it very hard to take small jobs when the administrative requirements can cost you money.*

6. *We often leave a home with a lot of needed work that can't be done because of the per-home cost limit. We see homes that can benefit from $1,000 more dollars, but we have to leave it half done. We need to have home efficiency goals so that we can do what is needed to reach an efficiency goal. In some homes we can reach the goal with $500, in others we will need $5,000. In some cases we put measures in the home knowing it will not make a difference because of everything that needs to be done. The MGE program does not need to have these limits. There is no federal requirement for these limits at MGE. Increase the limits for the MGE program in order to make the home energy efficient. The program goal (energy efficiency) and the funding limits (dollars per home) do not complement each other. The funding must support the energy goal or it makes no sense. Is the goal to spend a specific amount of money or to improve the energy efficiency of the home? What is our goal?*

7. *In some cases we need to do a lot of siding work to protect the insulation we have just put in the home, yet we are prohibited from doing the siding work so the insulation will not perform as intended and may actually hurt the home. We need a budget to*

correct these problems as we find them and the ability to correct the problem without more administrative delays that add non-funded costs.

8. *The Director has done an excellent job of turning this program around. It still has problems, but not near what they were years ago. The program is well managed and many of the bad contractors are gone thanks to the current management. It is a good system with checks and balance but it can be improved.*

9. *We sometimes have to go weeks or months before we get paid. This is money out of our pocket that we have to float for the program. The bank charges us interest on this money, yet we cannot tack interest charges on the bill if it is not paid in a timely way. We need to have inspections and payments within 7 days of when we say the work is completed, with the ability to charge interest to the program for payments not made in 7 to 14 days. The inspector can take weeks to get the job inspected and then the staff can sit on the payment for another 2 weeks. If we had a system where the staff would not get paid until the contractor was paid this problem would go away. We have also noticed that the bigger the job, the higher the probability of revisits and the higher the probability of payment delays. As a result, the jobs that cost us the most are the ones with the longest payment times. Just the opposite of what it should be. In many cases it seems that the administrative operations are the program goals rather than the work that should be done. With insurance, gas, vehicles, equipment, materials, employees, and program administrative time, we are often operating at a loss. The profit is very small on this work. Even one problem that requires revisits or delays can turn a job into a loss. Our average job is 2.5 days with a total profit of $39.00. One trip to the program office can eat the entire profit.*

10. *We need to get job contracts 5 or 10 at a time. We need to schedule this work as a batch rather than one at a time. This will allow us to spread the work across several jobs and when one is down we can be working on the other.*

11. Some contractors report that some program staff do not appreciate the fact that they are participating in the program and they feel that in some cases their participation is not respected or valued by specific staff. In some cases contractors avoid dealing with specific staff because they find the exchange unpleasant.

Each contractor was asked to give recommendations for changes to the program. The following bullets present those recommendations:

- Speed up the inspection and payment process.
- Provide up-to-date communications to the contractor (*not just placed in our mail box at City Hall*) pertaining to the status of jobs.
- Use electronic and automated communications where possible.
- Have staff salaries and promotions tied to job performance.
- Allow contractors to fix related problems that are found on-site without more administrative procedures.

- Permit repairs to be done for the long-term operation of the equipment or savings. Don't allow temporary fixes that are designed to get in-and-out at least cost. Look at the longer term performance of the measures not just getting past the inspection.
- Don't fix furnaces that should be replaced. Error on the side that betters the customer and the energy savings rather than take a chance on repairing an old furnace.
- Reduce customer fear of the contractors so that customers do not fear the arrival of the contractor teams.
- Educate customers on the benefits of the smoke and CO^2 detectors and tell them of the risks of removing the batteries or allowing the batteries to go dead.
- Develop a better system for getting in touch with the customer to schedule appointments and for installations.
- Improve relationships between some staff members and some contractors.

6. THE IMPACT EVALUATION DESIGN AND METHODOLOGY

The basic design for the impact study is a comparison group design in which the pre- and post-retrofit weather adjusted energy consumption for buildings with a single heating source are compared for a retrofit and a comparison group. In this design, the weather normalized energy consumption of a retrofit and the comparison group is determined before and after weatherization measures are installed. For each group, the average change in energy consumption per unit between the before and after period is determined. The net savings are obtained by adding the per unit change in energy consumption for the two groups. Electricity consumption before and after the retrofit for non-space heating uses were compared in order to estimate savings from non-space heating related changes.

The participation and energy consumption data collected in this analysis were obtained from four sources: the State of Missouri, the KC-HCDD, MGE and Kansas City Power and Light. The specific data and the sources are described below.

6.1. Weatherization Program Data

TecMRKT Works requested program data from the Kansas City Weatherization Assistance Program for participants in the MGE program who had had measures installed and who were awaiting the installation of measures. The requested data included the program account number; account numbers for electric and gas service; personal identification information such as name, address, and telephone; a date when measures were inspected (a proxy for installation date); the installation costs associated with each of the nine measure categories such as infiltration, attic and wall insulation; and the total installation costs.

These data were contained in KC-HCDD program database management system. This system tracks dollars expended per category of measure installed rather than the number and amount of measures on a measure by measure. For instance, the category for "infiltration" contains the cost of installing an array of measures such as window and door caulk, sill box insulation, etc. The costs include labor and material. This means that the part of the evaluation aimed at analyzing measure specific savings focuses on savings from categories of measures rather than measure specific results.

The KC-HCDD program provided two files, one for homes in which measures had already been installed (282 locations) and one for homes awaiting installations (77 locations). Homes which were awaiting installations were assigned to the comparison group. The homes which had had installations were largely assigned to the retrofit group although those whose retrofits were too recent to have sufficient post-retrofit data to make a pre and post analysis possible were assigned to the comparison group.

6.2. Gas Consumption Data

Based on the program data provided by KC-HCDD, TecMRKT Works made a data request to MGE for four years of monthly energy consumption data, monthly bill reading dates, and data quality flags associated with each reading, as well as personal identification data for the 288 participants and the 77 homes awaiting installations.

TecMRKT Works provided files with account numbers to MGE. MGE provided 270 usable cases of data for participants and 75 for non participants.

6.3. Electric Consumption Data

TecMRKT Works made a similar request to KCP&L for monthly electric consumption data, monthly bill reading dates, and data quality flags associated with each reading and personal identification data for the same participant group and for those awaiting installations. KCP&L provided 258 usable cases of data for participants and 75 for non participants.

6.4. Fuel Use Data

After reviewing the relevant gas data provided by MGE, TecMRKT Works identified 270 building units with sufficient fuel data to warrant inclusion in the study. Of these, 183 had sufficient pre- and post-retrofit data for possible inclusion in the energy savings analysis. Of these 183 buildings, 130 buildings had data of sufficient quality to pass the reliability checks for the analysis (see below).

This reduction in the available records for impact analysis is not unusual. Records often contain a number of estimated billing records. The records with estimated data reduce the overall reliability of the data. This may especially be the case when estimates are made following a retrofit and the basis for estimating the data have not been updated to reflect the retrofit. Also, when there are a small number of post retrofit records, a small number of highly variable readings may reduce the reliability of the data. These variations in fuel use can be influenced by changes in family size, energy related behaviors, and the social and economic conditions of the household. Together, these conditions often make energy consumption data unusable for estimating weatherization program impacts.

6.5. Weather Data

In order to conduct an energy savings analysis using the PRISM software (see below), approximately twelve years of average daily temperature data are needed in addition to the weather data for the pre- and post-program years. These data were obtained from the offices of the Missouri Public Service Commission. The State of Missouri maintains weather data for weather stations throughout Missouri. These data were provided to TecMRKT Works. After reviewing data availability for the various weather stations in the Kansas City area, it was decided to use the temperature data from the Kansas City International Airport.

6.6. PRISM

Program impacts were examined using PRISM Advanced Version 1.0 software for Windows developed at Princeton University's Center for Energy and Environmental Studies.

PRISM is a commercially available analysis software package designed to estimate energy savings for heating and/or cooling loads in residential and small commercial

buildings. The current Advanced Version permits users to enter and edit data from a variety of sources, to carry out sophisticated reliability checks, to eliminate cases that do not meet standards, and to display results in graphical and textual forms.

PRISM allows the user to estimate the change in energy consumption per heating or cooling degree day for the periods before and after measures are installed in homes by combining energy consumption and weather data. By subtracting the estimate of energy use per degree day after the measures are installed from the value before the measures are installed and multiplying by an appropriate annual degree day value, total annual normalized energy savings can be estimated.

Degree days vary from year to year, which potentially presents a problem for deciding on a value for annual degree days. This is especially problematic if one is trying to determine paybacks. For example, one could normalize the savings to the period preceding the installation of measures or the period after. If one selects a warm period, then savings may be too low and paybacks too long. If one selects a cool period for normalization, then the estimate of paybacks may be too high.

PRISM mitigates this problem by effectively averaging temperatures over a twelve year period and providing an estimate of degree days that is typical for the region of the study, although not one that necessarily matches the specific weather conditions in any given year. The user can select a twelve year period or use the PRISM recommended period of January 1, 1980 to December 31, 1991. The advantage of normalizing to the PRISM recommended period is that the results will be consistent from study to study over a period of time. The same end can be achieved by consistently using the same user selected time frame. For this study we chose the period from June 1, 1982 through June 30, 1997.

A major feature of PRISM is the ability to evaluate cases against reliability criteria. The first criterion is the R^2 value (explained variance), a measure of the fit of the degree day and energy consumption data, or in statistical lingo, the amount of variance in energy consumption explained by changes in degree days. Energy consumption is assumed to be a linear function of degree days. R^2 varies from 0 to 1. If R^2 is close to zero, it means that factors other than outdoor temperature are driving heating fuel consumption. If the R^2 is close to 1 it means that outdoor temperature is almost entirely responsible for heating fuel consumption. Outdoor temperature is usually the overriding factor in heating fuel use and the goal of the weatherization program is to improve the thermal characteristics of the building shell and the fuel use rate of the heating system to reduce fuel use related to outdoor temperature. The PRISM default for R^2 is at .7. This means that at least seventy percent of heating fuel use is temperature related. If less than 70% of the fuel use in a building is temperature related, then it becomes difficult to understand the effects of the weatherization measures and the case is dropped from the analysis. We used .7 in this study although most of the R^2 values in this study were .85 or higher. In other words, 85% or more of heating fuel use in this study is temperature driven. Very few cases were dropped because of the R^2 criterion.

PRISM has a second measure of reliability which is the coefficient of variation for the normalized annual consumption (CV_{NAC}). Normalized annual consumption is the amount of fuel consumed by a unit for a typical weather year. When estimating normalized

annual consumption some estimates may have a very tight error band while others may have a band that is quite wide. In estimating the average consumption we want estimates of unit consumption that are very close to the actual and we want to eliminate values that may not be very close because they may cause the estimates of the average consumption for all units to vary significantly from the actual. Because the variation in the estimates of normalized annual consumption generally will be higher in homes with higher consumption, the estimate of the variation in normalized annual consumption is divided by the estimate of normalized consumption to obtain CVNAC. This provides a standardized measure of the variability of the normalized consumption that is comparable across homes. The PRISM default for CVNAC is 7% and that is the value used in this study. Housing units that failed the PRISM criteria most often failed this test.

6.7. Data Editing

We examined and cleaned data for natural gas as the predominant space heating fuel type. Because electricity consumption may decrease when the use of heating fuel is reduced, we examined household electricity consumption for all participants for whom we calculated savings for natural gas. Theoretically, improved efficiency would reduce furnace / boiler run times. In addition, increased electricity consumption (non-space heating) due to air conditioning use during summer months was also examined. However, for these households electricity consumption did not pass the PRISM reliability criteria because the R^2s were particularly low. We concluded that a temperature related component of electricity use could not be reliably extracted for the retrofitted buildings with non-electric primary space heating.

We examined the energy data for duplicates, estimated data, and out-of-range data, and for data comprehensiveness and established pre- and post-program participation dates for each home consistent with the Kansas City Weatherization Assistance Program inspection dates. We then formatted the data into files for import into the PRISM software. We subsequently ran the first PRISM analysis and examined raw data and PRISM results for each home.

We evaluated each home's R^2 and CVNAC values to identify "problem" homes to be singled out for more careful inspection. We also examined the pre- and post-retrofit energy consumption information and read dates. We confirmed that the retrofit dates used to assign energy consumption values to the pre- and post-program periods were correct. For homes where the dates were problematic, we examined the PRISM results by placing the values in question in both the pre- and post-program periods and identified in which period the best R^2 and CVNAC values were determined. If neither the pre- or post-program period provided an improved run, a reading which could not be clearly placed in either the pre or post retrofit periods was excluded from the analysis for the home. In some instances, PRISM runs were improved by merging consumption data from two or more periods into one period. This would improve the fit of a reading in which the meter might have been erroneously read or recorded such as reading the hundreds place high or low or reversing the numbers in the tens and ones places. Homes where data did not meet the reliability criteria were removed from the final PRISM analysis.

7. IMPACT EVALUATION RESULTS

The Missouri Gas Energy Low-Income Pilot Weatherization Pilot Program saved an average of 31.0 million BTUs of space heating energy per unit per year for the 130 housing units examined in the savings analysis. This represents an average 20.2% reduction in space heating fuel use per unit. During the program an estimated 282 housing units were weatherized, the program achieved a total annual energy savings of 8.7 billion BTUs or approximately 64,200 gallons of oil equivalent. Over the 20-year lifetime of the installed measures the energy savings are expected to equal 178 billion BTUs or about 1.28 million gallons of oil equivalent.

7.1. The Units Being Analyzed

According to the tracking information, the program served 288 single unit buildings between October 1994 and March 1996. The primary fuel examined in this analysis was natural gas. Table 11 presents the details of the inclusion of units in the PRISM savings analysis. As can be seen in this table, we started with 288 weatherized units contained in the program records at KC-HCDD, of these 270 were able to be matched to gas consumption data at MGE, of these 238 units had pre and post-program consumption records, of these units 183 had enough billing records to run an impact analysis using PRISM, of these 130 had consumption records that passed the reliability tests for impact analysis. For natural gas analysis about 45% of the participating units could be used in the impact analysis. This erosion of participants for impact analysis is normal and expected in weatherization programs. On average from 30% to 60% of participant's billing records are available and can be used for the impact analysis.

Table 11 Population of units in study

Fuel Type	Units originally identified by KC-HCDD	Units in gas or electric files received from the utilities	Units with Pre- and Post-Program Energy Records	Units with Sufficient Pre- and Post-records for weatherization savings analysis[1]	Units meeting reliability criteria to be included in savings analysis[2]
Natural gas (retrofit)	288	270	238	183	130
Natural gas (comparison)	77				50
Electric cooling (retrofit)	288	258	135	64	10
Electric cooling (comparison)	77	75	75	60	11
Totals			537	385	198

[1] Energy consumption analysis includes participants with data from January 1, 1992 through June 30, 1997.

[2] These units met the reliability criteria with PRISM R^2 levels of .7 or better and NAC of 7% or less.

In order to estimate the energy savings from program efforts, it is necessary to make assumptions pertaining to the measures installed and how these measures are used in the average home. For this evaluation it is assumed that the savings calculated for the average unit in the impact analysis reflect the savings in the average participant's unit and that the measures installed in homes last 20 years or more.

7.2. Program Energy Savings for Natural Gas

Table 12 presents the basic data from the energy savings analysis. The rows in This table represent the baseload consumption, the heating portion of total consumption, total consumption and the calculated reference temperature. Columns 2 and 3 are the pre- and post-average dwelling unit normalized energy consumption estimates for natural gas for the retrofit group as determined by the use of PRISM. Column 4 presents the gross estimate of savings for the retrofit group. The retrofit resulted in a total average gross savings of 320 therms of natural gas per year or approximately an 17.7% reduction in total usage (not space heating usage).

For the average dwelling, approximately 80% of the usage (1400 therms / 1740 therms * 100) is heating related and 20% is used for base loads such as water heating, pilot lights, etc. Retrofit measures are likely to affect the heating portion of the load more than the baseload. As we can see, the gross baseload reduction for the retrofit was about 50 therms or 14.7% of the estimated baseload (50 therms / 340 therms * 100) and the heating load reduction about 270 or about 19.3% of the heating load.

Columns 6 - 9 provide the same information for the comparison group. There was almost no gross change in consumption for this group. Total baseline consumption dropped about 20 therms but the heating portion of consumption increased by 10 therms for an average decline in usage of 10 therms per household. For the comparison group, the percentage gross changes in baseload, space heating and total consumption were 6%, -.9% and .7%. The negative sign indicates an increase in consumption. If we subtract the gross savings for the comparison group from those of the retrofit group, we find the net savings due to the program are 30 therms of base load (50 therms - 20 therms) and 280 therms of heating load (270 therms - (-10 therms)) for a combined net savings of 310 therms. The percentage net savings in baseload, space heating and total consumption are 8.7% (14.7%-8.8%), 20.2%, and 17.7% respectively. The 310 therms of net savings are quite in line with savings in other localities.

There are three additional points to be made in reference to this table. First, the net savings for the baseload of about 30 therms is almost exactly what one would expect given the installation of water heating blankets in homes. Second, there is absolutely no indication of take back effects. The reference temperatures for pre and post consumption retrofit groups (row 4) are almost identical and they are almost identical to the reference temperatures for the comparison group. If there were a take back affect, we would expect to see these temperatures increase. Finally, we should observe that the overall consumption of the comparison group is somewhat lower than that for the retrofit group. The comparison group used about 260 therms less energy in their hypothetical "before" period. This would suggest that those who had retrofits had slightly larger homes than those on the waiting list.

7.3. Program Savings from Electricity

A similar analysis was completed for electricity savings. The program was not designed to save electricity and therefore electric measures, such as compact fluorescent lamps, were not installed during the program. Electricity savings from the program would largely result from the reduced furnace run times due to weatherization measures and reduction in air conditioning energy savings. The proportion of homes with air conditioning which use the air conditioning for a significant number of hours during the summer does not appear to be very high.

For each home in the PRISM space heating analysis, we conducted a PRISM analysis of electricity consumption. As expected, we found no reliable weather related electricity savings for these homes. When we examined savings using a heating only model only 8 cases passed the reliability criteria. The result was an increase in consumption of about 508 kWh a year but the standard error was more than twice the savings indicating that the savings could not be distinguished from zero.

The cooling only model identified 7 cases that passed the reliability criteria. The mean savings for these households was about 45 kWh but the standard error was 20 times that indicating that the savings could not be distinguished from zero.

Finally, we let PRISM auto-select the best model. During this run ten cases passed the reliability checks but the savings were actually negative, meaning this group of households used more energy rather than less. However, the standard error, was three times the increase in consumption indicating that the consumption change did not differ from zero.

However, we do not believe that the program was without impact on the consumption of electricity. If the heating portion of natural gas use is reduced by 280 therms and the average heating system consumes 75,000 BTUs per hour, then we can multiply 280 therms by 100,000 BTUs and divide by 75,000 BTUs per household and determine that the average furnace actually ran about 373 fewer hours annually after weatherization. If we assume 838 watts per horsepower and a .25 horsepower blower motor, the reduction in consumption is about 78 kWh annually. The average annual consumption in these homes is about 7,100 kWh. Thus, the reduction in electric energy consumption is just slightly more than 1%. A small color television introduced into a home that was used 5 hours a day would consume twice the annual energy saved from the motor.

Thus, it is not surprising that we were unable to estimate electric savings from this program. Our findings indicate that factors other than the weatherization program such as the changing composition of the household, changes in patterns of appliance holding, and changes in behavior, are likely to have significantly larger impacts on electricity consumption than the weatherization measures.

Table 12 Energy use and savings calculations

	Retrofit Group				Comparison group					
	Pre-retrofit usage	Post retrofit usage	Gross change in usage	Gross percent change	Pre-retrofit usage	Post retrofit usage	Change in usage	Gross percent change	Net change	Net change percent
Base load portion (therms)	340	290	50	14.7	340	320	20	6.0	30	8.7
Heating portion (therms)	1400	1130	270	19.3	1140	1150	-10	-.9	280	20.2
Total (therms)	1740	1420	320	18.4	1480	1470	10	.7	310	17.7
Reference temperature (F)	62.7	62.2	.5		63.5	63.1	.4			

7.4. The Installed Measures

Figure 1 shows the percentages of measures installed as they were recorded in the KC-HCDD tracking system. Ninety-eight percent of all homes received infiltration measures. Examples of air infiltration measures are caulking around windows and doors and applying weather stripping. Ninety-two percent of the homes received repair and maintenance services sufficient to insure the effectiveness of weatherization measures. Examples include patching ceiling plaster or straightening door frames so that doors close tight.

Furnace repair and tune-up was done for health and safety reasons and for energy savings reasons. Eighty-seven percent of households were identified as having heating related measures for health and safety reasons and 70 percent for energy savings reasons. Many homes received heating related measures that were split between the two categories.

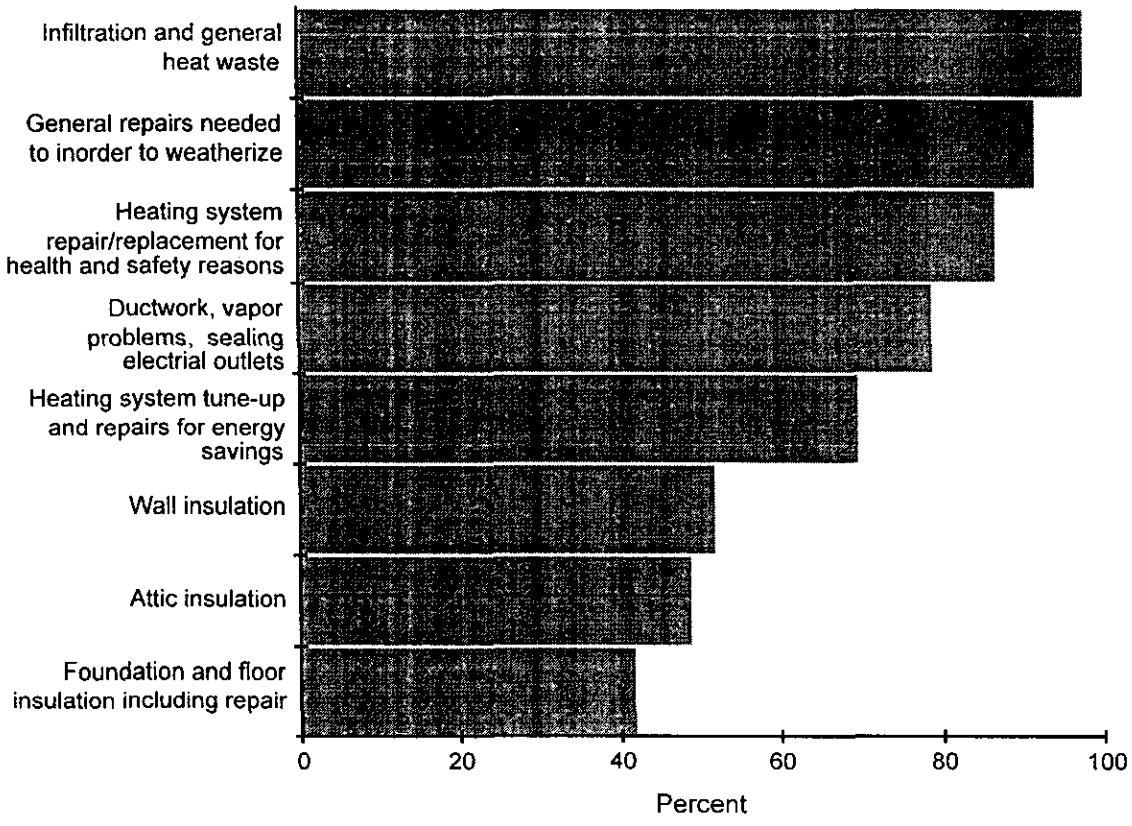

Figure 1 Percentages of measures installed

About 79 percent of the homes had measures related to ducts, vapor problems and sealing electrical outlets. Slightly more than half of the sites received wall insulation and 49 percent and 42 percent received attic or floor insulation respectively.

7.5. Measure Specific Installation Costs

Table 13 reflects the different average costs for installing measures. The data have been presented in three ways. Column 2 is the cost to install a measure averaged over the 282 homes in the program. However, not all homes have each measure installed. Accordingly, column 3 is the average measure cost for just those homes that received the specific measure. Column 5 is the average measure cost of installing the specific measure in homes that were included in the savings analysis. These data suggest that the homes in our energy savings analysis had slightly more heating system work than did the average home.

Table 13 Average cost per weatherization measure

Measure	Average cost per unit for all housing units n= 282	Average cost per measure for units with measure and included in program records	Number of units	Average cost per measure for units with measure and included in impact analysis	Number of units
Heating system repair/replacement for health and safety reasons	$532.00	$612.34	245	$678.53	109
Wall insulation	$261.04	$497.38	148	$511.75	64
Infiltration and general heat waste	$430.90	$441.87	275	$448.38	125
Attic insulation	$208.39	$428.96	137	$443.80	65
General repairs needed in order to weatherize doors, windows, ceilings, etc.	$234.74	$255.59	259	$267.50	119
Heating system tune-up and repairs for savings reasons	$162.86	$233.13	197	$231.92	89
Foundation and floor insulation including repair	$49.98	$118.43	119	$120.12	51
Ductwork, vapor problems, electrical outlets and miscellaneous items	$68.19	$86.23	223	$75.29	103
Total	$1,948.10	-	282		

Considering the average measure cost per unit (Column 3), we see that the most costly measure was the heating system repair/replacement done for health and safety reasons at $612, followed by wall insulation ($497), infiltration measures ($442), and attic insulation ($429). Somewhat less costly were the general repairs ($256), heating system tune-ups ($233), foundation and floor insulation ($118) and the miscellaneous items ($86).

7.6. Program Costs

The preceding estimates for the cost of the work do not include program administration costs. Program costs include the costs associated with a site visit, conducting an audit, developing a set of specifications, placing the specifications for bid, awarding a contract, and providing technical assistance. Based on data supplied by the KC-HCDD, TecMRKT Works estimated program costs to be 12% of installation costs. Using the average installation costs per unit weatherized ($1948.10) and adding the 12% for program costs, the total cost to weatherize a unit is $2,181.87.

Table 14 summarizes the total program costs for the 282 units that were weatherized.

Table 14 Total program costs

Description	Units Weatherized October 1994 to March 1996 (282)[2]
Weatherization measure installation cost	$549,364.20
Kansas City Weatherization Assistance Program fixed and indirect costs	$65,923.70
Total costs	$615,287.90

[2] The totals are the number of units times the average cost per unit.

7.7. Program Cost Effectiveness

To determine the benefit-to-cost ratio for the program we compared the program delivery costs to the value of energy savings. The benefits were calculated based on an assumed life of the measures of 20 years. The annual savings in each of the 20 years were adjusted for the projected change in fuel prices and the change in the value of the dollar and then summed for the 20 years.

The changes in fuel prices are based on changes in the projected prices of natural gas using data from the Department of Energy's, Energy Information Administration (EIA). Periodically, the EIA makes 20 year projections of national fuel prices. However, regional prices of fuel can vary quite substantially from average national energy prices. Although EIA reports regional prices, it does not make similar regional projections of fuel prices. Thus, regional prices are available but not regional projections of price.

To overcome this problem, we assumed that regional energy prices follow national trends. By taking the regional price of energy and applying the national percentage change, we arrive at a reasonable projection of the regional price of fuels 20 years hence. Column 2 of Table 15 shows the EIA projected prices for natural gas in 1995 dollars. Column 3 is the percent change in constant 1995 dollars. Column 4 is the cost per million BTUs of natural gas in Missouri based on the EIA reported 1994 price of fuel. Column 5 is the annual savings in dollars to the customer in constant 1995 dollars. Over the 20 year lifetime of the measures, the customer can expect to save $2,993 in constant 1995 dollars.

If the $2,993 in benefits to customers are compared to the levelized cost of the program, $2,182, the benefit cost ratio the program is 1.37 to 1. In other words, the program returns a $1.37 in benefits to the customers for every dollar spent on the program.

Table 15 Changes in project fuel prices for 20 years

Year	National prices for natural gas 1995 dollars per mmBTU	Percent change in national natural gas prices	Missouri natural gas prices assuming national trend 1995 dollars per mmBTU	Annual cost savings in 1995 dollars	National prices for electricity	Percent change in national electricity prices	Price of electricity in Missouri assuming national trends
1994	$6.39		$5.40		$25.29		$21.37
1995	$6.01	-5.9468	$5.08		$24.67	-2.4516	$20.85
1996	$5.92	-1.4975	$5.00	$155.09	$23.95	-2.9185	$20.24
1997	$5.60	-5.4054	$4.73	$146.70	$23.82	-.5428	$20.13
1998	$5.65	.8929	$4.77	$148.01	$24.02	.8396	$20.30
1999	$5.65	.0000	$4.77	$148.01	$24.17	.6245	$20.42
2000	$5.63	-.3540	$4.76	$147.49	$24.09	-.3310	$20.36
2001	$5.60	-.5329	$4.73	$146.70	$24.14	.2076	$20.40
2002	$5.59	-.1786	$4.72	$146.44	$23.98	-.6628	$20.26
2003	$5.58	-.1789	$4.72	$146.18	$23.84	-.5838	$20.14
2004	$5.54	-.7168	$4.68	$145.13	$23.60	-1.0067	$19.94
2005	$5.49	-.9025	$4.64	$143.82	$23.49	-.4661	$19.85
2006	$5.45	-.7286	$4.61	$142.77	$23.41	-.3406	$19.78
2007	$5.41	-.7339	$4.57	$141.73	$23.25	-.6835	$19.65
2008	$5.36	-.9242	$4.53	$140.42	$23.12	-.5591	$19.54
2009	$5.33	-.5597	$4.50	$139.63	$23.02	-.4325	$19.45
2010	$5.27	-1.1257	$4.45	$138.06	$22.88	-.6082	$19.33
2011	$5.24	-.5693	$4.43	$137.27	$22.61	-1.1801	$19.11
2012	$5.21	-.5725	$4.40	$136.49	$22.34	-1.1942	$18.88
2013	$5.18	-.5758	$4.38	$135.70	$22.10	-1.0743	$18.67
2014	$5.19	.1931	$4.39	$135.96	$22.10	.0000	$18.67
2015	$5.18	-.1927	$4.38	$135.70	$22.28	.8145	$18.83
2016				$135.70			
				$2,993.03			

7.8. The Cost-Effectiveness of Measures

As part of the analysis, TecMRKT Works attempted to analyze the cost effectiveness of the various measures. A typical approach to this problem is to regress the presence or absence of the measures installed in homes on the savings for the homes. The resulting regression coefficients represent the average savings attributable to the measures. This approach works as long as there is sufficient variation in the measures installed between

homes. If nearly every home has a particular measure installed or almost none of the homes have a measure installed, then there is unlikely to be sufficient variation to accurately apportion the savings.

The application of this approach to the current problem was made difficult by a number of factors. The data available to us was not organized by discreet measures. For instance, several infiltration measures, such as caulking and weather stripping, were combined in a single category. There was no way to separate caulking from weather stripping. Secondly, the measures were presented in terms of their cost and it was not possible to effectively relate cost to activity. Using several tubes of caulk may have had greater effect than weather stripping doors but the cost of the two measures may have been relatively the same or quite different.

After a preliminary review and analysis of the measures we made several determinations. Infiltration measures were applied to nearly every house. Therefore, it did not make sense to identify infiltration as separate variable to be entered into the regression analysis. Secondly, the repair measures were necessary in order to complete other weatherization measures but do not contribute to savings directly. Plastering the ceiling in order to install ceiling insulation only marginally contributes to additional savings beyond the value of installing the ceiling insulation. Therefore, it was determined that the repair variable should be dropped from the analysis. This does not diminish the importance of repairs to the overall project, it merely indicates that we do not expect them to contribute to the overall savings.

We were also confronted with the problem of having two variables relating to heating systems. One variable included costs assigned to improving health and safety and the second assigned cost to improving energy efficiency. The fact that these variables were highly correlated caused severe problems with the analysis when they were entered at the same time. In order to deal with this problem, we combined the two variables to obtain a total cost for dealing with the heating system and then created two new variables. If the total cost of heating system repair was more than $800 or more we assumed that a new furnace was installed and we coded a variable that we called "furnace replacement." If the amount was less than $799 but more than zero we assume that there was a heating system tune-up or repair. By coding the variables in this way we were able to distinguish between new units and system repairs and tune-up.

Finally, we discovered that the category of miscellaneous caused a fair bit of disturbance in the analysis. We concluded after a bit of exploration that this variable included duct work which was related to heating systems and thus was correlated with the heating variables. We removed this variable from the analysis.

Table 16 shows the model with five variables, wall insulation, foundation and floor insulation, attic insulation, heating system repair and furnace replacement. Instead of using the dollar amounts, we recoded the variable so that if money was expended the variable recorded the presence of the measure and if money was not expended the absence of the measure was recorded. Because we used presence or absence and these are the unstandardized coefficients, they can be interpreted directly as the therms of savings resulting from the measure.

The largest savings are associated with furnace replacement and the next largest wall insulation. The constant can be interpreted as the average savings from all other sources including infiltration measures, repairs, and miscellaneous. In this model foundation and floor insulation, attic insulation and heating repair make relatively small contributions to the overall savings. Note that the standard errors for heating repairs and the constant are unacceptably large.

Table 16 Preliminary linear regression model based on the presence or absence of the energy saving measures

Measures	Unstandardized Coefficients		t	Statistical Significance
	B (tens of therms)	Standard Error		
Constant	104.64	99.04	1.057	.292
Wall insulation	171.81	50.30	3.416	.001
Foundation and floor	9.05	50.69	.179	.858
Attic insulation	21.45	50.63	.426	.671
Heating system tune-up and repair	42.32	97.85	.433	.666
Furnace replacement	227.33	101.77	2.234	.027

An alternative model in which heating repair is removed is shown in Table 17. In this model, heating repair is now represented in the constant. The coefficient of the constant now increases by about thirty therms but the standard error is significantly reduced and the constant is now significantly different than zero. Furnace replacement provides the largest amount of savings, wall insulation the next most savings, and the measures summarized in the constant, most particularly infiltration measures provide the next largest amount of savings.

Attic insulation and foundation and floor insulation provided the least savings. Some may be surprised that attic insulation provides so few savings but this finding is consistent with observations that we are making in other jurisdictions where we have found that infiltration and wall insulation provide significantly more savings than attic insulation.

These savings estimates are quite reasonable. For example, given the average pre retrofit heating energy consumption of 1400 therms, a furnace replacement represents about a 15 percent reduction in energy use which is about what one would expect if furnace efficiency is improved from 65 percent to 80 percent. According to program staff, the furnaces that are being installed have efficiency ratings of about 80%.

In Table 17 we distinguished between baseload and the heating portions of natural gas use. We estimated the reduction in baseload to be about 30 therms annually. Much of the reduction in baseload use is likely to result from the installation of water heater blankets on water heaters. If we attribute 30 therms of the saving to water heater blanket

installation, 30 therms to heating tune-ups and these are subtracted from the constant, the remaining 70 therms of savings are probably largely attributable to infiltration reduction.

Table 17 Final linear regression model based on the presence or absence of the energy saving measures

Measures	Unstandardized Coefficients		t	Signifi-cance
	B (tens of therms)	Standard Error		
Constant	133.73	49.56	2.698	.008
Wall insulation	175.48	49.79	3.524	.001
Foundation and floor	11.03	49.90	.221	.825
Attic insulation	23.55	50.22	.490	.625
Furnace replacement	213.50	53.06	4.023	.000

Based on these data, we can begin to make some assessments of the cost effectiveness of the different measures. Table 18 presents the costs of the measures, the dollar savings from the measures assuming that the cost of energy in constant dollars is about $0.46 per therm over a 20 year period and that the life of measures is about 20 years.

Table 18 Estimated benefit cost ratio of selected measures

Measure	Cost	Annual savings (therms)	20 year savings (dollars)	Benefit to cost ratio
Water heater blanket[1]	$20	30	$276	13.80
Infiltration measures	$442	70	$644	1.45
Wall insulation	$497	175	$1,610	3.23
Attic insulation	$429	24	$221	0.52
Heating tune-up and repair	$366[2]	30	$276	0.75
Heating system replacement	$1,621[3]	213	$1,960	1.21

1 Cost of a water heater blanket and installation estimated by TecMRKT Works

2 Cost of the heating repair is the average of the repairs in all homes that had heating repairs less than 800 dollars but greater than zero.

3 Cost of heating replacement is the average for all households with heating system costs identified as being greater than $800.

Based on the preceding it is clearly cost effective to install water heater blankets, wall insulation, infiltration measures, and heating system replacements. The value of heating system tune-ups and repair is questionable on the basis of energy savings along unless the efficiency of the system warrants it and attic insulation appears not to be cost effective in many instances. It is important to keep in mind that heating system replacements are usually installed for health and safety reasons. We have not estimated the health and safety benefits of replacing heating systems but they may be substantial in terms of

reducing illness and reducing the need for emergency and service visits to households. Likewise, there may be significant non energy benefits from heating system tune-ups including reduced services calls and health and safety related benefits.

7.9. Impact Summary and Conclusions

Between its inception and March 1997, the Missouri Gas Energy Low-Income Weatherization Assistance Pilot Program served 282 clients providing an estimated savings to Missouri citizens of $42,200 a year in current dollars or $844,026 over the 20 year life of the measures. On average, the consumption of space heating fuel for units heated with natural gas was reduced by 8.7 million BTUs annually, or 17.7% of total consumption, for a program-wide savings 174 billion BTUs over the 20 year life of the installed measures. These annual savings are sufficient to heat 50 low income homes at the pre-retrofit consumption rate for a year. The benefit-to-cost ratio for the program is 1.37 to 1. On the basis of this, we conclude that the Missouri Weatherization Program is cost effectively providing weatherization services to the residents of Missouri.

We also analyzed the benefit to cost ratios for the various types of measures installed. Water heater blankets pay for themselves in two years or less. Wall insulation, infiltration measures, and heating system replacement are also cost effective. Heating system replacement is usually done for health and safety reasons so the energy savings is a bonus benefit. Heating system tune-ups and repair do not appear to be cost effective until health and safety benefits are included. Attic insulation does not appear to be cost effective. From a policy standpoint, the program may want to consider the merits of replacing a furnace rather than tuning and repairing an existing system and insulating an attic, especially if the estimated combined cost of the two measures approach or exceed the cost of a furnace replacement.

It should be kept in mind that this evaluation has focused entirely on the benefits and costs of weatherization. There are other health and safety benefits and costs associated with this program that have not been fully evaluated here. In particular, the replacement and repair of furnaces may significantly reduce service calls and emergency calls and reduce the number and consequences of health problems associated with a poorly functioning furnace.

8. IMPACTS ON PARTICIPANT'S ABILITY TO PAY ENERGY BILLS

Among the potential benefits of the program is the possibility that participants may be better able to pay their utility bills, which will increase the possibility that they will be able to keep their accounts current which, in return, will reduce MGE's collection costs and the costs of carrying customers who are behind in paying their bills. We approached this analysis in two ways. The first was to ask customers about perceived changes in their ability to pay their utility bill and the second was to examine payment records before and after participation to see how patterns of payment may have changed.

8.1. Perceived Ability to Pay gas Bills

Customers were asked if they thought that their participation in the MGE Pilot Weatherization Program had improved their ability to pay their heating bills. A total of 65% of the participants indicated that they are now more able to pay their bills, 14% said they are not more able to pay and 21% said they were not sure.

The high percentage of participants who are unsure is typical for a program such as this one. For whatever reason, 14% of the customers actually had increases in their consumption following the installation of the measures. Another 12% had decreases in consumption smaller than 100 therms, which might not be readily detectable. These may be the customers who were unsure or who perceived they were less able to pay. Also, customers may be unable to link the effects of installed measures to bill reductions because the feedback, in the form of the bill, is divorced in time from consumption events and weatherization activities. In addition, weather fluctuations can mask the benefits of weatherization. When people are on level pay or budget plan, the actual reduction in bills may take place gradually over a period of several months rather than right away, diminishing their perception that things have changed. The recalculation of budget plan accounts may occur many months after weatherization takes place. Finally, low-income families have many places to spend their dollars and paying bills becomes a juggling act of paying one or another bill or partially paying several. In these circumstances, actual changes in the size of a utility bill may be lost.

Participants also were asked to estimate the amount of money they saved from the measures installed. About one-third of the survey respondents estimated savings, that ranged form zero dollars to a high of $1,000 dollars a year. The average estimate was $298 per year. This is about 75% higher than the average savings per customer which were about $170 per year assuming a cost of $.55 per therm. However, almost 18% of the participants in the analysis had savings that exceeded $298 per year. It is possible that the reported average is not out of line for customers who actually responded to the question.

8.2. Impacts on Arrearages

To determine the impact of the program on promptness of utility payments, we had planned to examine the difference in the number and dollar amounts of customers who were 30, 60, 90 and 120 days behind on their utility payments before and after the

retrofit. As it turned out this was not possible because MGE does not maintain the data in a way that allows compilation of arrearage level data for specific customers.

As an alternative, we developed an algorithm which allowed us to determine a running balance in customer accounts keyed to the billing date. Basically the algorithm and its variants permitted us to combine prior balances with current payments and credits to arrive at an on-going monthly balance for each account. Customers who were paid in full had running balances of zero, those who were paid ahead had a negative balance and those who were behind had positive balances.

There are several reasons why customers might have a negative balance, i.e., they were paid ahead, they may have a credit due as an adjustment to their budget billing plan, or because of payments made by LIHEAP or other assistance programs. These credits may exceed the average monthly billing for one to several months.

After we constructed the running balance for each customer, we coded an additional variable indicating whether the monthly balance was in the period before or after the retrofit. Also, we limited the analysis to households that had a minimum of nine months of payment data preceding the retrofit and nine months following it.

Finally we calculated a value that we called, the *change in balance*. For each household, we calculated the average of the running balance for the period before and after the retrofit. We then subtracted the average running balance from the post retrofit period from the average running balance in the pre retrofit period.

Households whose running balance did not change had a change in balance of zero. Households which were typically behind in paying their bills before the retrofit and whose payment record improved after the retrofit but who were still behind would had a positive change in balance. Customers who were behind before the retrofit and who reduced their running balance to zero or who had a credit would have a positive change in balance. All customers whose payment record deteriorated would show a negative change in balance.

There is an anomaly in this method. Customers who had a credit balance with the utility before the retrofit and who still had a credit balance after the retrofit, albeit a *smaller* credit balance, are coded as having a negative change in balance even though they are not in arrears. We found five such cases. We excluded these five cases from the analysis.

Based on this analysis, we found that the average participant had a small negative change in balance of about $5.00 a month during a period of time when average customer arrearage levels were climbing at unprecedented levels. This average change includes both customers who had savings as well as those customers who had no savings or experienced increases in consumption following the retrofit. We therefore divided the customers into savings quartiles. Customers with more than 480 terms of annual savings were placed in the first quartile of high savers, those with savings between 280 and 480 therms were placed in the second quartile or medium savers, those with savings between

100 therms and 280 therms were place into the third quartile of low savers, and those with savings less than 100 therms or whose consumption increased were placed in the fourth quartile of very low or no savings. Table 19 presents the results of this analysis

Table 19 Change in balance, balances and consumption before and after retrofit

Savings quartile (therms)	Change in balance (average dollars monthly)	Average monthly balance (dollars) owed to the utility before the retrofit	Average monthly balance (dollars) owed utility after the retrofit	Pre retrofit consumption (average therms)	Post retrofit consumption (average therms)
High savings	$13.63	$39.85	$26.22	2164	1399
Medium savings	$19.95	$3.48	$-16.47	1742	1390
Low savings	$-16.40	$32.00	$48.40	1562	1360
Very low or no savings	$-40.08	$11.39	$51.47	1538	1598
Total	$-5.02	19.79	24.81	1745	1436

When we account for the savings we see that the average change in balance for the two groups with strong savings is positive. Those with the most savings improved their change in balance by an average of about $13.63 per month and those in the second savings quartile improved their position by about $20 per month. On average the high savers reduced their average arrearages from about $40 (column 3) to about $26 (column 4) per month. Those in the medium savings quartile actually went from a position of a slight arrearage, about $3.50, to an average credit position of about $16.50 per month. This means that customers greatly improved their position with respect to owing the utility. Remember these are monthly figures. A $20 monthly improvement equals a $240 annual improvement.

Households with very low or increased consumption after the program, as expected, had not decreased their arrearages following the program. This is normal and expected. We would not expect to see improvements in bill payments from participants who had little or no savings.

What these data demonstrate is that for households where the retrofit produced medium or high energy savings, there was a substantial reduction in arrearages such that we can conclude that arrearage reductions are resulting from program participation when there are strong energy savings. In addition, houses which had low saving levels may have had their arrearage reduced somewhat from what it would have been without the program. This conclusion is reached because of the difference in balance reductions compared to the quartile with very low or no savings. For the group with very low or no savings the program had no impact on arrearage reductions and arrearage levels continued at a level that would be expected without the program.

The data we have reviewed provides evidence that the MGE program is successful at reducing customer debt for the participants who save energy and that the amount of arrearage reduction is proportional to the amount of savings. The implications from this analysis demonstrate the importance of achieving savings in most homes if arrearage reduction is to be expected. This is not always the case in weatherization programs for several reasons. First there are participants who already live in efficient homes and the program cannot significantly improve these homes to the extent that bill reductions are always possible. Second, there are participants who live in very inefficient homes that need several thousand dollars worth of work to make efficient. Because the program spending caps limit what can be done to these homes there is little impact on the monthly bills because of continued inefficiencies. Normally these two types of homes represent about 25% of homes served by weatherization programs. Then there is the great majority of homes in the middle, where the program produces measurable levels of savings. The efficiency of these homes are improved by the program and participants receive significant bill reductions as a result of participation. These are the homes where we are seeing arrearage reductions.

From the data we have reviewed it appears that on average, the program has a positive impact on debt reduction of somewhere between $14.00 and $20.00 a month for medium and high energy savers with an increase in debt of between $16.00 and $40.00 a month for medium-low to low energy savers. Because this analysis was conducted during a period that ended in mid 1997, when gas prices were at their highest and when arrearages were being reported at record highs across the country, we are impressed that this program demonstrated decreasing arrearages for two participant groups and reduced increases in arrearages for a third group when compared to the arrearages increases of customers who did not save energy through the program. This data strongly suggests that the program is effective at reducing arrearages and that arrearage reduction can be increased by increasing the savings for participating customers.

However, a word of caution is in order concerning these findings. The standard deviations around the means are very high relative to the mean. This means that cases tended to group at the extremes of the distributions rather than the center. Thus, although the trends show arrearage reductions that are related to program savings, the dollar differences between the groups are not statistically reliable. It is quite possible that in a different study we will see a similar trend pertaining to the relationship between energy savings and arrearage reduction, however the dollar values may be different. The prudent policy position is to assume that the program succeeded in reducing arrearages for participants that have savings and that the level of arrearage reductions are related to the level of energy savings.

If MGE or the PSC wants to more completely understand the impact of the program on arrearage levels we would suggest a more comprehensive study of participant and non-participant payment patterns with a larger sample over a longer period of time. Participants could be identified as all Kansas City area weatherization program participants rather than just the MGE participants. In addition, the study should employ a matched control group of non-participants in order to account for the "naturally

occurring" changes in payment patterns. TecMRKT Works is ready to respond to this task if it should be requested by the PSC, MGE or the City.

9. ATTACHMENTS

9.1. APPENDIX A: LIST OF ITEMS THE CUSTOMERS WANT THAT WERE NOT INSTALLED

1. Replace screen door
2. Fix basement from leaking
3. Take care of furnace
4. Add more insulation
5. Fix hole in wall
6. Clean up insulation from circuit box
7. Replace windows
8. Insulate flat roof
9. Caulk windows
10. Fix the sidewalk
11. Do the basement
12. Do the garage doors
13. Roof cap was not put on
14. Do better insulation
15. Stop leak in the basement
16. Contractor broke window
17. Need better locks
18. Contractor scratched siding
19. Caulking discolored
20. Need storm windows
21. Need wall insulation
22. Stop the cold air leaks
23. Paint the home
24. New thermostat
25. New garage door
26. Insulate the walls
27. Cover large window
28. New front door
29. Insulation around storm door
30. More insulation on windows
31. Insulate walls
32. Paint door
33. Install hook
34. Caulk around the vents
35. Fix furnace
36. Fix window and door drafts
37. Need windows and gutters
38. Need storm windows
39. Need insulation and roof
40. Fix patio sliding doors
41. Need storm windows and ceiling vents
42. Window caulking caused a problem
43. Insulate the 3rd floor
44. Need exhaust fan
45. Install upstairs heat
46. Need the wires checked
47. Insulate porch floor
48. Caulk and fix the back door
49. Insulating loosened the attic window
50. Replace hot water heater
51. Fix door
52. Fix door facing
53. More insulation
54. Fix roof and gutters
55. Insulate crawl space
56. Need storm windows
57. Need another door
58. Need siding, paint and attic wires
59. Need insulation
60. Repair storm
61. Need furnace and weather-stripping
62. Need furnace and inside insulation
63. Need front door
64. Need window screen
65. Caulk windows
66. Seal doors and windows
67. Do a final inspection
68. Need outlet insulators
69. Need hot water heater
70. Need furnace
71. Need insulation
72. Need furnace
73. Need vents
74. Need storm door
75. Need roof
76. Fix storm door glass
77. Need storm windows and doors
78. Insulate crawl space
79. Seal windows
80. Garage door needs repair

9.2. APPENDIX B: COMMENTS FROM PARTICIPANTS

9.2.1. Positive comments

1. Very good program.
2. Very happy overall with the program.
3. Everyone was prompt and courteous.
4. Really appreciate the program.
5. Was glad to have the work done.
6. Very satisfied.
7. Good program.
8. Glad someone could help out.
9. Sold the home, but program was helpful.
10. No complaints.
11. Very good program for elderly.
12. It was okay.
13. Nice program.
14. I appreciate the program.
15. Nice program for low-income people.
16. Very satisfied.
17. Would recommend, very happy.
18. Very pleased, everyone very helpful.
19. Love the program, very satisfied.
20. Very happy start-to-finish.
21. Call me when I am eligible for more improvements.
22. Very satisfied.
23. Program did a good job.
24. Very happy, would recommend.
25. Good program for single women.
26. Program really helpful, learned to save energy.
27. Like it.
28. No problems (3 like this comment).
29. Everything was all right.
30. Good people.
31. Thank you for the program.
32. I recommend the program to others.
33. They were very nice people.
34. Pleased with the program.
35. Liked everything appreciated the program.
36. Enjoyed the program.
37. It is a wonderful program.
38. I love the program.
39. Pleased with program.
40. Did very good work.
41. Program is excellent, learned to save and feel safer now, no CO^2 now.
42. Good program, keep it up.
43. I liked everything.
44. I liked it all.
45. Old furnace leaked, bill went down, very pleased.
46. The process and workmanship was very good, very pleased.
47. Liked everything, no complaints.
48. Liked the program, the furnace was helpful.
49. Did a super job on caulking.
50. Did a wonderful job, would recommend to anyone.
51. Happy with what they did.
52. No dislikes, very pleased.
53. No complaints, did a good job.
54. Nice people, good work and grateful.
55. Program is an asset and I am thankful.
56. Glad to have program, consider age of home in dollar limitations.
57. Glad program exists.
58. Should advertise program more.
59. Appreciated the program.
60. Program was good.
61. Program is a blessing, advertise more.
62. Everyone was very nice, they were wonderful.
63. Appreciate the work they did.
64. Great program.
65. Pleased with program.
66. Did a very good job on what they were allowed to do.
67. Wish more people knew about it.
68. It is a good program.
69. Very nice and polite.
70. Like the program.
71. Liked everything, appreciated the program.
72. Program is a 5 (highest rating score) plus to me.

9.2.2. Negative comments

1. Some workers promised to be there and did not show up.
2. One contractor did not show up.
3. They could have gotten back to us sooner.
4. Contractors not professional, sloppy job.
5. Contractors unprofessional.
6. Somewhat satisfied with the program.
7. Wanted a new furnace.
8. Long waiting list.
9. Approved for $3,000 but only got $500 in work.
10. Don't own home anymore.
11. Was promised paint, but never received.
12. Could have cleaned up better
13. Still need things to be fixed.
14. Should have insulated better around doors.
15. Problem closing door now.
16. Had a gas leak they missed.
17. Contractor did very poor work, didn't complete work.
18. Need a new furnace.
19. Didn't help with drafts or reduce bills.
20. You need better advertising.
21. Have a leak in the floor would like fixed.
22. Heating & Cooling did a poor job, broke ceiling panels, cut phone wires, etc.
23. Insulation contractor had an attitude about coming back to fix holes in walls.
24. Took downspouts off and didn't put them back, left insulation all over.
25. Contractor's son stole tools, but then returned them.
26. Contractor did a poor job on back door and didn't keep appointments.
27. Still drafty on back porch.
28. Contractor never showed for appointments or was late, thermostat problem.
29. HVAC contractor did poor work and did $500 damage to ducts.
30. Door insulation doesn't look good.
31. Complained to city, contractor drinking on job, left beer cans.
32. Didn't replace the weather vain and caused a roof leak.
33. Program helpful but contractors could do better job.
34. Waiting for completion from 95, like what they did but took too long.
35. Could have used better materials to patch foundation, needs re-repair.
36. No evening appointments for inspection.
37. Do more measures.
38. Put furnace frame on wrong, should have caulked around windows.
39. Cracked 2 windows, inspectors should be more thorough, listen to homeowner.
40. Could have done a better job of caulking.
41. Still smell gas in kitchen, contractor was rude.
42. Still waiting for thermostat cap, had to have furnace rewired because of contractor.
43. Contractors did a sloppy job.
44. I need a hot water heater.
45. Furnace is loud and needs replaced.
46. Took two years on waiting list.
47. Contract was to come back and check the furnace.
48. A ceiling tile fell down.
49. Furnace is blowing cold air, did poor job on sealing attic windows.
50. Use sliding scale income requirements for program, like a 50/50.
51. Please fix the leak in bedroom roof.
52. Program employees should identify themselves.
53. People who do not pay their bill should not get special treatment.
54. Should have sealed windows, still drafty in home.
55. Contractor did not paint after insulation holes.
56. Better quality insulation
57. Made door draft worse
58. Poor repair of wall where insulated

9.3. ON-SITE INTERVIEW PROTOCOL

On-Site MGE Staff and Ally Process Evaluation Interview Protocol

Introduction

This protocol is provided for review prior to the process interviews for the MGE Pilot Weatherization Program Evaluation expected to be conducted during October of 1997. Interviews will be held with Missouri Gas Energy (MGE) and Kansas City (KC) staff including program design, management and implementation staff, as well as the contractor staff associated with program delivery including field auditors, installers and follow-up inspectors.

The protocol presents possible subject areas that will be discussed during each interview. However, not all subjects will be covered during each interview, as the knowledge and expertise of each individual being interviewed is different. As a result, some subjects will be covered in detail, others will be briefly covered, while others may not be covered at all. The protocol should be considered as a guide through the interview process rather than a road map of destinations.

The interviews will be semi-structured allowing participants to move across subject areas as needed to keep the discussions moving and productive. The atmosphere for the interview is professionally friendly, and structured to be an information exchange. We have adapted this structure because our clients typically ask us questions about how other programs operate or for ideas that they may consider. This is not as a rigidly structured investigative interview designed to support or contest pending litigation, rather it is a process interview to identify methods of operation that provide strength to the program and to identify areas that management can consider for future program efforts. The interviews will not identify personalities or program faults, but focus on strengths and areas where improvements to the program should be considered.

The interviews will take place during October 20-24, 1997. The interviews will be conducted by Mr. Nick Hall of TecMRKT Works 608 835-8855 voice, 608 835-9490 fax, e-mail: nphall@waun.tdsnet.com. This interview protocol should be copied and shared with all individuals taking part in the process interviews and across the different levels of program management and operations. We find the best interviews occur when people are informed about the interviews, are knowledgeable about their content prior to the interview and understand that the focus of the interview is on program strengths and improvements rather than on positions, personalities or individual performance.

Program staff and implementor interviews.

This step provides for the interviews with MGE, KC and contracted program design, management and delivery staff. It is anticipated that we will conduct up to 13 interviews. In most cases the interviews will be conducted during normal business hours when MGE and KC staff and contractors are typically on duty. However, interviews can also be scheduled at any time during the week of October 20-24, 1997 at the convenience of the interviewee. TecMRKT Works staff will be available for interviews 24 hours a day during this period and are receptive to after-hour or off-location requests for interviews.

The process interviews will be conducted via on-site interviews with key individuals identified by Missouri Gas Energy, (Charles Hernandez), the city of Kansas City Department of Housing and Community Development (Robert Jackson), Missouri Office of Public Council (Ryan Kind), and the Missouri Public Service Commission (Henry Warren). Each of these individuals will be asked to identify individuals to include in the interviews. In summary, we are looking to conduct interviews with key managers and staff involved in the design and development of the program as well as program implementation. Because there are a large number of topics that can be discussed during these interviews each interview will be tailored to the knowledge and involvement of the individual being interviewed and will be structured from the topics presented in this protocol. During the beginning of each interview we will identify the topics areas that apply to each individual. Then address those issues during the interview process.

Program staff and trade ally interview sample

The first step in scheduling interviews is to identify the individuals to be interviewed. To accomplish this we asked MGE, KC-HCDD, the Public Service Commission and the Office of Pubic Council to recommend names of individuals to be interviewed. This was accomplished during October 6-17, 1997. (Note: We realize the two organizations most familiar with the program and the individuals to be interviewed are MGE and KC-HCDD, however, as a routine course in the evaluation effort we extend the invitation to identify individuals to be interviewed to the regulatory offices as well.) This process has identified 13 individuals to be targeted for interviews. The individuals are identified in table 1 and, for ease of tracking the evaluation process, are also identified in an enlarged table on the last page of this protocol. This allows the contact table to be separated from the protocol for planning and scheduling purposes without impacting the comprehensiveness of the protocol.

The program staff and trade ally interview sample consists of following individuals:

No	Org.	Position	Name *	Phone	Fax
1	removeed	Removed for confidentially reasons	removed	removed	
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					

Table 1 Program Staff and Trade Ally Interview Sample

During the interviews the we will investigate topics and issues regarding program operations, delivery, and benefits. Specifically, the interviews will examine the following aspects:

- Assessment of the operational design and delivery of the program, including participant identification and enrollment, service timing and deliver, review of included measures, quality of program delivery and installed measures, involvement of the participant in the process, customer satisfaction with program and installed measures and program quality control.
- Assessment of MGE's involvement in the design and delivery of the program.
- An assessment of the methods and procedures used by KC-HCDD and contractors to deliver program services,
- Recommendations and the incorporation of changes to the program,

Task Support Needed

The on-site staff and trade ally interviews rely on the involvement and support of MGE, KC-HCDD and Evaluation Collaborative (EC) personal. This involvement includes:

- Identifying and targeting the appropriate individuals to include in the sample,
- Review and comment on survey protocols and field instruments,
- Confirming the study and interview process if contacted by targeted individuals,
- Assistance in informing targeted staff of the interview prior to a scheduling contact,
- Sharing of the interview protocol with target staff prior to the interview.

Subjects To Be Addressed During The MGE Staff and Trade Ally Interviews.

This section of the protocol presents the subjects to be discussed during the on-site interviews and provides the foundation for the interviews.

Introductions

The interviews will open with introductions and explanations of past and current roles and responsibilities pertaining to the program. Following introductions the interview will discuss the design, management and implementation of the program with each individual.

Program Associated Questions

Design goals and incorporation of options and recommendations into the program

1. What processes, organizations, expertise were used in designing the program?
2. What were/are the goals of the program?
3. How well did the program's history meet the program goals and objectives?
4. What design options were considered for the program (organizational options, delivery options, direct install vs indirect install vs self-install, grants and/or zero or low-interest loans, , measure options, participation or eligibility options, owner, renter, and multi-family options, targeting options (high-users, disabled, owners, single-parent families, etc.), income and eligibility options, etc.)?
5. What design recommendations and options did MGE choose or not choose to adopt and why?
6. What impact did adopted changes have on program operations or effectiveness?
7. What adopted changes were revised as a result of implementation tests?
8. What recommendations do managers and trade allies now have for changing the program?

The design and delivery of the program

1. Description of program delivery steps and activities, what were they, what are they?
2. Effectiveness of the design and delivery methods and procedures.
3. Appropriateness of the program's design to the characteristics of the population.
4. Ability of the program to deliver services and meet service needs.
5. Effectiveness of the contractors to deliver the program services.
6. Quality of the technology and measure installation, including training.
7. Recommendations for program improvements.
8. Effectiveness of the marketing efforts on the targeted population.
9. Funding levels and sources of funding, what is needed, where does/can it come from.

Benefits of the program and customer needs

1. Was the program able to build on or coordinate with other low-income programs or services, how? Who benefited from the coordination and how did they benefit?
2. How can coordination or services be improved to complement each other and what would this provide, cost, accomplish?
3. To what degree are customers needs met by the program and by the coordination?
4. What are the program and program delivery needs of the low-income customers?
5. What services (type and amount) are needed to help the low-income market?
6. How can services be funded, who can pay for these, through what mechanisms?

An assessment of the methods and procedures used by staff and allies to deliver program services

1. Were contractors familiar with and experienced in low-income program delivery?
2. Were there adequate procedures and management controls or systems in operation?
3. What was the length of time between sign-up and completion of service delivery?
4. How and when were home visits and installations scheduled, were these convenient?
5. Are you aware of any problems or issues that developed as a result of program delivery?

Satisfaction with program operations between MGE, KC-HCDD, and trade allies:

1. MGE, KC-HCDD and contractors as trade ally or service delivery partners.
2. MGE, KC-HCDD and contractors as a providers of low-income program services.
3. Program operational and delivery procedures and schedules.
4. Business benefits associated with the program, if any (arrearage and payment benefits, cut-offs reductions, customer, public or community relations, regulatory relations, etc.).
5. Contracts for service delivery and management.
6. Need for trade ally training or delivery coordination.
7. Financial benefits associated with the program.
8. Overall satisfaction of entering into contracts and delivering program services.

Recommendations for low-income program design characteristics

1. Marketing, enrollment or outreach.
2. Enrollment procedures and customer response activities.
3. Program delivery procedures and activities.
4. Potential program benefits or results.
5. Potential measures, service, or activities provided.
6. Levels or amounts of program benefits.
7. Training methods and procedures.
8. Follow-up activities.

Market Associated Questions

Low-income marketing materials and presentations

1. Customer understanding of visual and verbal descriptions and presentations.
2. Recommended changes to customer response activities following marketing contacts.
3. Effectiveness of materials and verbal descriptions and degree of customer understanding.
4. Recommendations for marketing materials and methods.
5. Other methods and routes to effectively reach customers.

Review of the program tracking system and program records

In addition to the process interviews, Mr. Hall will also examine the program tracking system to test the tracking system's ability to support program management and reporting. To accomplish this Mr. Hall will examine a sample of participant records and follow those records through the implementation process. The primary focus of this examination is to test the ability of the tracking system to support program management and operations, and to test the ability of the tracking system to accurately reflect program status.

Mr. Hall will also conduct a review of the hard-copy program records maintained by the program at MGE and KC-HCDD. The primary function of this examination will be to test the content of the records for completeness and accuracy of information and to compare the hard-copy records with the electronic records in the tracking system.

Mr. Hall can be contacted at his Wisconsin office.

9.4. CUSTOMER SURVEY

Lable Here

Missouri Gas Energy's
Low-Income Pilot Weatherization Program

Participant Survey

Survey Goal: 152 Completed Surveys From Program Participants.

SURVEY

Hello, my name is _____. I am calling on behalf of Missouri Gas Energy (MGE) and the Kansas City Weatherization Program, may I speak to _____ please.

Mr./Ms./Mrs. _____ I am calling to conduct a client satisfaction survey. I am not selling anything. We are seeking your opinions and perspectives about the weatherization services you received through the program. The survey will only take about 5 minutes and the information you provide be used to evaluate the program.

May I begin the survey?

1. ○ *Yes, begin* ——→ Go to question **1**.
2. ○ *No, rather not take interview* ——→ Thank them and terminate call.
3. ○ *No another time is better* ——→ Make appointment for return call.

We can call back at a different time. When would be the best time to call?

Record date, time, & thank them, and terminate call.

_____ _____ _____: _____ AM PM
Month Day Time

Participation Questions

Our records indicate that you participated in the Weatherization Program during *(year)*. **In this program an energy expert came to your home and inspected it for possible energy improvements. Then, following the inspection, contractors came to your home and arranged to have one or more energy efficiency measures installed in your home.**

1. Do you recall participating in the Weatherization Program?

1. If YES, Proceed with the interview,
2. If NO, Remind them about the program and ask again...

If Don't remember again, terminate interview and go to next location.

2. Do you recall how you <u>first</u> heard about the *"Weatherization Program"*?
(Do not read. Place the number "1" in front of the first answer.)

Number here ⇩

1. ___ Friend, relative or neighbor
2. ___ Federal, or state government agency or organization
3. ___ Kansas City or local government agency or organization
4. ___ Neighborhood or community organization
5. ___ Social group or activity
6. ___ Landlord
7. ___ Letter or program announcement in the mail
8. ___ Newspaper ad or story
9. ___ Radio,
10. ___ TV
11. ___ Someone came to my door
12. ___ Saw a poster or flyer
13. ___ Church bulletin or through the church
14. ___ Don't know or don't remember *(skip to question 4.)*
15. ___ Other: _____

3. What other ways did you hear about the *"Program"*?
(Number these above in order mentioned starting with number "2".)

4. Can you tell me the main reasons why you participated in the "*Weatherization Program*"?
(Do not read. Place the number "1" in front of first item mentioned, a "2" in the second item, etc.)

Number here ⇩

1. ___ Save money / reduce heating bill
2. ___ Improve energy efficiency
3. ___ Obtain free equipment or home improvements
4. ___ Be more comfortable, improve home comfort
5. ___ To reduce debt or amount owed
6. ___ Keep from having gas shut-off
7. ___ Learn about energy conservation / efficiency
8. ___ Help the environment
9. ___ Felt it was the right thing to do
10. ___ Friends encouraged you
11. ___ People in the neighborhood / community / etc. encouraged you
12. ___ Missouri Gas Energy encouraged you
13. ___ Other company encouraged you
14. ___ Improve the security of your home
15. ___ Other _____
16. ___ Don't know or don't remember *(skip to question* **6.**)

5. What are some of the other reasons why you participated ? *(Continue numbering in order mentioned.*

Program Operations Questions

Now I'm going to ask about the program.

The program was implemented in two steps. The first step was the enrollment, audit and project approvals. The second step was the actual installation of the measures. We will start with questions that pertain only to program enrollment, the audit and project approvals.

To do this I will read a series of statements. After each statement please indicate on a scale of 1 to 5 with 1 being Strongly Disagree and 5 being Strongly Agree, how strongly you disagree or agree with each statement.

	Strongly Disagree 1	Disagree 2	Neither D or A 3	Agree 4	Strongly Agree 5
6. The process of learning about the program and the program requirements was convenient	1	2	3	4	5
7. Your application for participation was handled in a fast and effective manner	1	2	3	4	5
8. Obtaining approvals on the measures to be installed took the right amount of time	1	2	3	4	5
9. The home energy audit *(inspection)* was made at a convenient time	1	2	3	4	5
10. The Kansas City program staff were polite and professional	1	2	3	4	5
11. The Kansas City program staff were knowledgeable and helpful	1	2	3	4	5

Now we will ask about the contractors who installed the weatherization measures in your home. Again we will use the same 1 to 5 scale.

	Strongly Disagree 1	Disagree 2	Neither D or A 3	Agree 4	Strongly Agree 5
12. The contractors who installed the weatherization measures were courteous and helpful	1	2	3	4	5
13. The contractors who installed the measures cleaned up after themselves	1	2	3	4	5
14.The contractors who installed the measures knew what they were doing	1	2	3	4	5
15. The contractors who installed the measures did a complete and professional job	1	2	3	4	5

Now we will ask about the program in general.

	Strongly Disagree 1	Disagree 2	Neither D or A 3	Agree 4	Strongly Agree 5
16. The measures installed in your home met your expectations	1	2	3	4	5
17. By participating in the program you learned a lot about how to save energy and reduce your heating bills	1	2	3	4	5
18. You would recommend this program to your friends or neighbors	1	2	3	4	5

Now I would like you to think about the total amount of time and effort you spent as a participant in the *"Weatherization Program"* and the benefits you are receiving from the program.

19. On a scale of 1 to 5 with 1 being Very Dissatisfied and 5 being Very Satisfied, how would you rate your overall satisfaction with the program?
(Circle number)

Very Dissatisfied				Very Satisfied
1	2	3	4	5

Program Measure and Results Questions

20. Now I would like you to think about all of the measures you received from the program. Which measure installed in your home do you think is the most helpful in reducing your heating bills? *(Do not read responses.)*

1. ❑ Ceiling insulation
2. ❑ Wall insulation
3. ❑ Other insulation
4. ❑ Furnace tune-up
5. ❑ Furnace replacement
6. ❑ Repairs made to home or part of home
7. ❑ New doors
8. ❑ New windows
9. ❑ Sealing doors or windows
10. ❑ Caulking the home
11. ❑ Other
12. ❑ Don't know

21. Now which measure do you think is the least helpful in reducing your heating bills.

1. ❑ Ceiling insulation
2. ❑ Wall insulation
3. ❑ Other insulation
4. ❑ Furnace tune-up
5. ❑ Furnace replacement
6. ❑ Repairs made to home or part of home
7. ❑ New doors
8. ❑ New windows
9. ❑ Sealing doors or windows
10. ❑ Caulking the home
11. ❑ Other
12. ❑ Don't know

22. What measures do you think the program should have installed?

Should have installed or completed _____

23. Since participating in the Weatherization Program do you think you are better able to pay your heating bill?

1. ❑ Yes
2. ❑ No
3. ❑ Not sure Don't know

24. On average about how much money do you think you are savings each year as a result of your participation in the Weatherization Program?

$ _____ a year

25. To the best of your knowledge what company or organization sponsored the Weatherization Program? *(Do not read answers, check the box(es) as appropriate)*

1. ❑ Missouri Gas Energy (MGE)
2. ❑ Kansas City
3. ❑ The State of Missouri
4. ❑ The US Department of Energy
5. ❑ Kansas City Power & Light (KCP&L)
6. ❑ The county or other political jurisdiction
7. ❑ Church, community group, or other not-for-profit organization
8. ❑ Don't know
9. ❑ Other

If 2 through 9 above:
26. The program was sponsored by MGE. Now that you know this would you say your attitude toward MGE is more positive, more negative or about the same?

1. ❑ More positive
2. ❑ More negative
3. ❑ About the same

4. ❑ Don't know not sure
5. ❑ Other

If 1 from above:
27. Since your participation in the program would you say your attitude toward MGE is more positive, more negative or about the same?

6. ❑ More positive

7. ❑ More negative
8. ❑ About the same
9. ❑ Don't know not sure
10. ❑ Other

I am now going to read a series of statements about changes in your home since participating in the program. On a scale of 1 to 5 with 1 being Strongly Disagree and 5 being Strongly Agree, please tell me how strongly you agree or disagree with each of the following statements.

	Strongly Disagree 1	Disagree 2	Neither D or A 3	Agree 4	Strongly Agree 5
28. **My home is a safer place to live**	1	2	3	4	5
29. **My home is more energy efficient**	1	2	3	4	5
30. **My home is more comfortable**	1	2	3	4	5
31. **My home worth more now**	1	2	3	4	5

32. Finally we would like to hear your recommendations or comments about the program. Are there any particular things you liked or disliked about the program or do you have any recommendations for changes?

_____

_____

_____

END

Thank you very much for your help in this survey. We appreciate the time you have given us and the answers you have shared. End survey.

MISSOURI GAS ENERGY

CASE NO. GR-2001-292

Attachment 2

An Impact Evaluation of the Missouri Gas Energy Low-Income Weatherization Pilot Program,
TecMRKT Works, Oregon Wisconsin, March 1998

An Impact Evaluation of the Missouri Gas Energy Low-Income Weatherization Pilot Program

A Final Report Prepared for
Missouri Gas Energy Company

May 1999

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Table of Contents

TABLE OF CONTENTS I

EXECUTIVE SUMMARY 1

CHAPTER 1. INTRODUCTION 2

Program Background 2

CHAPTER 2. THE IMPACT EVALUATION DESIGN AND METHODOLOGY 3

Data Collection Techniques 3
Gas Consumption Data 4
Electric Consumption Data 4

Fuel Use Data 4

Weather Data 5

PRISM™ 5

Data Editing 6

CHAPTER 3. ENERGY IMPACTS 8

Introduction 8

The Units Being Analyzed 8

Program Energy Savings for Natural Gas 9

Program Savings from Electricity 10

CHAPTER 4. PROGRAM COSTS 13

The Installed Measures 13

Measure Specific Installation Costs 14

CHAPTER 5. PROGRAM COST EFFECTIVENESS 17

The cost-effectiveness of measures 17

CHAPTER 6. SUMMARY AND CONCLUSIONS 23

Executive Summary

This report presents the result of an impact evaluation of Missouri Gas Energy's Low-Income Weatherization Assistance Pilot Program. The evaluation is the second phase of a multi-year process and impact evaluation. In 1998 a process and early feed-back impact evaluation was conducted. The 1998 study documented program processes and operational effectiveness. In addition, the early feedback impact documented energy savings in less than a year following program participation. In 1999 the impact evaluation was repeated. This allowed the program to experience a longer post-program consumption history and increased the reliability of the energy savings estimates.

The 1999 impact evaluation documents increased savings and an improved benefit cost ratio for the program. Between its inception and March of 1999, the Missouri Gas Energy Low-Income Weatherization Assistance Pilot Program served 343 clients providing an estimated savings to Missouri citizens of $61,720 a year in 1997 dollars or $1,167,540 over the 20 year life of the installed measures.

On average, the consumption of space heating fuel for units heated with natural gas was reduced by 34.4 million BTUs annually, or 20.9 percent of total gas consumption, for a program-wide savings 296 billion BTUs over the 20 year life of the installed measures. This gas savings is provided through a 28.2 percent reduction in heating related gas consumption and an 8.5 percent increase in baseload consumption and provides each customer with an annual savings of $155 dollars.

In addition, the program is providing an electric savings of 500 kWh per year per customer, or about $35.00 a year off the average bill. The benefit-to-cost ratio for the program is 1.62 to 1. On the basis of this, we conclude that the Missouri Weatherization Program is cost effectively providing weatherization services to the residents of Missouri.

Chapter 1. Introduction

TecMRKT Works is pleased to present this report describing the impacts of the Missouri Gas Energy (MGE) Low-Income Weatherization Pilot Program. The evaluation examines program impacts and the benefits associated with those impacts, including those provided to the customer and to the State of Missouri. This study repeats an earlier short-term impact analysis performed at the end of 1997. The short-term analysis provided an early indicator of program impacts using less than a year of customer consumption records for of the participants. The short-term analysis indicated that the program was producing cost-effective energy savings, but because of the short-term nature of the data used in the analysis a more rigorous impact analysis was needed to confirm the estimated savings. This report presents the results from the longer-term analysis and is based on between 1.5 and 2 years of consumption data following participation.

This report is based on an analysis of information provided by Missouri Gas Energy, the Kansas City Weatherization Assistance Program, Kansas City Power and Light the State of Missouri and the University of Dayton. Gas consumption data was provided by Missouri Gas Energy. The Kansas City Weatherization Assistance Program identified program participants, a comparison group and cost data. Kansas City Power and Light provided electric consumption data. Daily weather data was obtained from the State of Missouri and by the national weather tracking data base maintained by the University of Dayton.

Program Background

The Low-Income Weatherization Pilot Program is sponsored by Missouri Gas Energy Company which contracts the delivery of service to the Kansas City Weatherization Assistance Program. The primary objective of the program is to improve the energy efficiency of eligible low-income households. In addition to providing energy efficiency and health and safety benefits, the program also provides financial benefits to participants by reducing the amount of money needed to pay energy bills and by increasing participant's ability to control their consumption.

The Kansas City Weatherization Assistance Program has program implementation staff responsible for identifying and enrolling participants, conducting energy audits, installing measures, inspecting completed work and for educating participants about how to control energy costs.

Chapter 2. The Impact Evaluation Design and Methodology

The basic design for this impact study is a comparison group design in which the pre- and post-retrofit weather adjusted energy consumption for buildings with a single heating source are compared for a retrofit and a comparison group using time-series weather and participant consumption data. In this design, the weather normalized energy consumption of a retrofit and the comparison group is determined before and after weatherization measures are installed. For each group, the average change in energy consumption per unit between the before and after period is determined. The net savings are obtained by adding the per unit change in energy consumption for the two groups. In addition, electricity consumption before and after the retrofit for non-space heating uses was compared in order to estimate savings from non-space heating related changes.

Data Collection Techniques

The participation and energy consumption data collected in this analysis were obtained from five sources: the State of Missouri, the KCWAP, MGE, Kansas City Power and Light and the University of Dayton's national weather data archives. The specific data and the sources are described below.

Weatherization Program Data

TecMRKT Works requested program data from the Kansas City Weatherization Assistance Program for participants in the MGE program who have had measures installed and who were awaiting the installation of measures. The requested data included the Weatherization Program tracking number; account numbers for electric and gas service; personal identification information such as name, address, and telephone; a date when measures were inspected (a proxy for installation date); the installation costs associated with each of the nine measure categories such as infiltration, attic and wall insulation; and the total installation costs.

These data were contained in the KCWAP program database management system. This system tracks dollars expended per category of measure installed rather than the number and amount of measures on a measure by measure basis. For instance, the category for "infiltration" contains the cost of installing an array of measures such as window and door caulk, sill box insulation, etc. The costs include labor and material. This means that the part of the evaluation aimed at analyzing measure specific savings focuses on savings from categories of measures rather than measure specific results.

The KCWAP program provided two files, one for homes in which measures had already been installed (411 locations, 282 of which were in the previous analysis) and one for homes awaiting installations (63 locations) Many of the homes awaiting in the previous study are now among the 411 for which we have participation data. Homes which were

awaiting installations were assigned to the comparison group. The homes which had had installations were largely assigned to the retrofit group although those whose retrofits were too recent to have sufficient post-retrofit data to make a pre and post analysis possible were assigned to the comparison group.

Gas Consumption Data

Based on the program data provided by KCWAP, TecMRKT Works made a data request to MGE for six years of monthly energy consumption data (four years of data were requested for the previous study), monthly bill reading dates, and data flags associated with each reading, as well as personal identification data for the 411 participants and the 63 homes awaiting installations. TecMRKT Works provided files with account numbers to MGE. MGE provided 399 participant cases, (346 of which were usable cases of data for participants), and 94 for non-participants, (93 of which were usable cases).

Electric Consumption Data

TecMRKT Works made a similar request to KCPL for monthly electric consumption data, monthly bill reading dates, and data quality flags associated with each reading and personal identification data for the same participant group and for those awaiting installations. KCPL provided 390 usable cases of data for participants and 124 for non participants. In the previous study, KCPL provided 258 cases of data for participants and 75 for non-participants.

Fuel Use Data

After reviewing the relevant gas data provided by MGE, TecMRKT Works identified 399 building units with sufficient fuel data to warrant inclusion in the study. Of these, 346 had sufficient pre- and post-retrofit data for possible inclusion in the energy savings analysis (Table 1). Of these 346 buildings, 255 had data of sufficient quality to pass the reliability checks for the analysis (see below).

In impact evaluations records with estimated data reduce the overall reliability of the analysis. This is especially the case when estimates are made following a retrofit and the formulas for estimating consumption have not been updated to reflect the retrofit. Also, when there are a small number of post retrofit records, a small number of highly variable readings may reduce the reliability of the data. These variations in fuel use can be influenced by changes in family size, energy related behaviors, and the social and economic conditions of the household. Together, these conditions often make energy consumption data unusable for estimating weatherization program impacts. Typically, in low-income programs as many as 50% of the units do not pass the reliability checks. MGE's rate of 74% passing this test indicates that most reads are actual meter reads and the number of estimated meter reads is low.

Weather Data

In order to conduct an energy savings analysis using the PRISM™ software (see below), approximately twelve years of average daily temperature data are needed in addition to the weather data for the pre- and post-program years. These data were obtained from the University of Dayton Department of Engineering Web site (http://www.engr.udayton.edu/weather/source.htm) which maintains a national weather data base for weather stations throughout the U.S. In addition, weather data from the Kansas City International Airport was obtained from the State of Missouri. These data were provided to TecMRKT Works. After reviewing data for the various weather stations in the Kansas City area, TecMRKT Works decided that the temperature data from the Kansas City International Airport most represented the program implementation area. This was the weather data used for comparing participant and non-participant energy consumption in this evaluation.

PRISM™

Program impacts were examined using PRISM™ Advanced Version 1.0 software for Windows developed at Princeton University's Center for Energy and Environmental Studies.

PRISM™ is a commercially available analysis software package designed to estimate energy savings for heating and/or cooling loads in residential and small commercial buildings. The current Advanced Version permits users to enter and edit data from a variety of sources, to carry out sophisticated reliability checks, to eliminate cases that do not meet standards, and to display results in graphical and textual forms.

PRISM™ allows the user to estimate the change in energy consumption per heating or cooling degree day for the periods before and after measures are installed in homes by combining energy consumption and weather data. By subtracting the estimate of energy use per degree day after the measures are installed from the value before the measures are installed and multiplying by an appropriate annual degree day value, total annual normalized energy savings can be estimated.

Degree days vary from year to year, which potentially presents a problem for deciding on a value for annual degree days. This is especially problematic if one is trying to determine paybacks. For example, one could normalize the savings to the period preceding the installation of measures or the period after. If one selects a warm period, then savings may be too low and paybacks too long. If one selects a cool period for normalization, then the estimate of paybacks may be too high.

PRISM™ mitigates this problem by effectively averaging temperatures over a twelve year period and providing an estimate of degree days that is typical for the region of the study, although not one that necessarily matches the specific weather conditions in any given year. The user can select a twelve year period or use the PRISM™ recommended period of January 1, 1980 to December 31, 1991. The advantage of normalizing to the PRISM™ recommended period is that the results will be consistent from study to study

over a period of time. The same end can be achieved by consistently using the same user selected time frame. For this study we chose the period from January 1, 1982 through December 31, 1998. In the previous study we selected the period from July 1, 1982 through June 30, 1997.

A major feature of PRISM™ is the ability to evaluate cases against reliability criteria. The first criterion is the R^2 value (explained variance), a measure of the fit of the degree day and energy consumption data, or in statistical lingo, the amount of variance in energy consumption explained by changes in degree days. Energy consumption is assumed to be a linear function of degree days. R^2 varies from 0 to 1. If R^2 is close to zero, it means that factors other than outdoor temperature are driving heating fuel consumption. If the R^2 is close to 1 it means that outdoor temperature is almost entirely responsible for heating fuel consumption. Outdoor temperature is usually the overriding factor in heating fuel use and the goal of the weatherization program is to improve the thermal characteristics of the building shell and the fuel use rate of the heating system to reduce fuel use related to outdoor temperature. The PRISM™ default for R^2 is at .7. This means that at least seventy percent of heating fuel use is temperature related. If less than 70 percent of the fuel use in a building is temperature related, then it becomes difficult to understand the effects of the weatherization measures and the case is dropped from the analysis. We used .7 in this study although most all of the R^2 values in this study were .85 or higher. In other words, 85 percent or more of heating fuel use in this study is temperature driven. Very few cases were dropped because of the R^2 criterion.

PRISM™ has a second measure of reliability which is the coefficient of variation for the normalized annual consumption (CV_{NAC}). Normalized annual consumption is the amount of fuel consumed by a unit for a typical weather year. When estimating normalized annual consumption some estimates may have a very tight error band while others may have a band that is quite wide. In estimating the average consumption we want estimates of unit consumption that are very close to the actual and we want to eliminate values that may not be very close because they may cause the estimates of the average consumption for all units to vary significantly from the actual. Because the variation in the estimates of normalized annual consumption generally will be higher in homes with higher consumption, the estimate of the variation in normalized annual consumption is divided by the estimate of normalized consumption to obtain CV_{NAC}. This provides a standardized measure of the variability of the normalized consumption that is comparable across homes. The PRISM default for CV_{NAC} is 7 percent and that is the value used in this study. Housing units that failed the PRISM™ criteria most often failed this test.

Data Editing

We examined and cleaned data for natural gas as the predominant space heating fuel type. Because electricity consumption may decrease when the use of heating fuel is reduced, we examined household electricity consumption for all participants for whom we calculated savings for natural gas. Theoretically, improved efficiency would reduce furnace / boiler run times. In addition, increased electricity consumption (non-space heating) due to air conditioning use during summer months was also examined. However, for these households electricity consumption did not pass the PRISM™

reliability criteria because the R^2s were particularly low. We concluded that a temperature related component of electricity use could not be reliably extracted for the retrofitted buildings with non-electric primary space heating.

We examined the energy data for duplicates, estimated data, and out-of-range data, and for data comprehensiveness and established pre- and post-program participation dates for each home consistent with the Kansas City Weatherization Assistance Program inspection dates. We then formatted the data into files for import into the PRISM™ software. We subsequently ran the first PRISM™ analysis and examined raw data and PRISM™ results for each home.

We evaluated each home's R^2 and CV_{NAC} values to identify "problem" homes to be singled out for more careful inspection. We also examined the pre- and post-retrofit energy consumption information and read dates. We confirmed that the retrofit dates used to assign energy consumption values to the pre- and post-program periods were correct. For homes where the dates were problematic, we examined the PRISM™ results by placing the values in question in both the pre- and post-program periods and identified in which period the best R^2 and CV_{NAC} values were determined. If neither the pre- or post-program period provided an improved run, a reading which could not be clearly placed in either the pre or post retrofit periods was excluded from the analysis for the home. In some instances, PRISM™ runs were improved by merging consumption data from two or more periods into one period.

Chapter 3. Energy Impacts

Introduction

The Missouri Gas Energy Low-Income Weatherization Pilot Program saved an average of 34.4 million BTUs of natural gas and 500 kWh of electricity per home per year for the housing units examined in the savings analysis. This is an 11% increase in natural gas savings over the estimated savings identified in the short-term analysis conducted earlier and supports the need to conduct longer-term evaluations of these programs. This saving is provided by an average 28.2 percent savings in space heating fuel per unit, an 8.5 percent increase in household baseload consumption and a 1.3 percent net reduction in electric consumption. During the program an estimated 411 housing units were weatherized, achieving a total annual energy savings of 14.1 billion BTUs or approximately 104,000 gallons of oil equivalent or 141,000 therms and 205,500 kWh of electricity. Over the 20-year lifetime of the installed measures the energy savings are expected to equal 296 billion BTUs or about 2.2 million gallons of oil equivalent or 2,960,000 therms.

The Units Being Analyzed

According to the tracking information, the program served 411 single unit buildings between January 1995 and January 1998. The primary fuel examined in this analysis was natural gas. Table 1 presents the details of the inclusion of units in the PRISM™ savings analysis.

Table 1. Population of Units In Study

Fuel Type	Units originally identified by KCWAP	Units in gas or electric files received from the utilities	Units with Pre- and Post- Program Energy Records	Units with Pre- and Post- records for weatherization savings analysis[1]	Units meeting reliability criteria to be included in savings analysis[2]
Natural gas 1999 study (retrofit)	411	399	379	346	255
Natural gas 1999 study (comparison)	96	94	94	93	84
Electric cooling 1999 study (retrofit)	411	408	390	232	174
Electric cooling 1999 study (comparison)	126	126	126	124	100
Totals 1999 study			989	795	613

[1] Energy consumption analysis includes participants with data from January 1, 1992 through December 31, 1998.
[2] These units met the reliability criteria with PRISM R^2 levels of .7 or better and NAC of seven percent or less.

In order to estimate the energy savings from program efforts, it is necessary to make assumptions pertaining to the measures installed and how these measures are used in the average home. For this evaluation it is assumed that the savings calculated for the average unit in the impact analysis reflect the savings in the average participant's unit and that the measures installed in homes last 20 years or more.

Program Energy Savings for Natural Gas

Table 2 presents the basic data from the energy savings analysis. The rows in Table 2 represent the base load consumption, the heating portion of total consumption, total consumption and the calculated reference temperature. Columns 2 and 3 are the pre- and post-average dwelling unit normalized energy consumption estimates for natural gas for the retrofit group as determined by the use of PRISM™. Column 4 presents the gross estimate of savings for the retrofit group.

The retrofits resulted in a total average gross savings of 303 therms of natural gas per year or approximately an 18.4 percent gross reduction in total usage (not just space heating usage). When we take the energy consumption of the control group into account the net savings from the retrofits increases to 20.9 percent for all consumption and 28.2 percent savings (374 therms) in space heating related natural gas consumption.

For the average dwelling, approximately 81 percent of the usage (1338 of 1644 therms) is heating related and 19 percent is used for base loads such as water heating, pilot lights, etc. This is almost exactly the same ratio as the 1998 study where approximately 80 percent of the usage was heating related and 20 percent was used for base loads. Retrofit measures affect the heating portion of the load more than the base load. As we can see, the gross base load reduction for the retrofit was about 44 therms or 14.4 percent of the estimated base load and the heating load reduction was 259 or about 19.4 percent of the heating load. In the previous study, the gross base load reduction for the retrofit was about 50 therms or 14.7 percent of the estimated base load and the heating load reduction about 270 or about 19.3 percent of the heating load.

Columns 6 - 9 provide the same information for the comparison group. There was a slight increase in gross consumption for this group. Total base load consumption increased 115 therms but the heating portion of consumption decreased by 75 therms for an average increase in usage of 40 therms per household. For the comparison group, the percentage gross changes in base load, space heating and total consumption were 22.9 percent, -9 percent and –2.5 percent, respectively. The negative sign indicates an increase in consumption. If we subtract the gross savings for the comparison group from those of the retrofit group, we find the net savings due to the program are -31 therms of base load (44 therms – 75 therms) and 374 therms of heating load (259 therms - (-115 therms)) for a combined net savings of 344 therms. The percentage net savings in base load, space heating and total consumption are –8.5 percent, 28.2 percent, and 20.9

percent respectively. The 344 therms of net savings in this study is quite in line with savings in other localities with significant heating loads.

There are a couple additional points to be made in reference to the baseload data in this table. First, the net savings for the base load was –30 therms indicating a net increase in baseload consumption for the average participant home. However if we look at the data we see that the increase in baseload consumption is a net increase and not a gross increase. That is, both the participant group and the comparison group decreased their baseload consumption over the study period, however, the comparison group decreased their consumption at a rate faster than the participant group and that difference is 31 therms or 8.5 percent. What is interesting is that while the baseload consumption for the participant group decreased by 14.4 percent the comparison group's baseload consumption decreased by 22.9 percent. The participant group decreased consumption at a rate that was about 60 percent less than the decrease for the comparison group.

Second, we conclude that there is absolutely no indication of take-back effects with this program. The reference temperatures for pre and post consumption retrofit groups (row 4) are almost identical and they are almost identical to the reference temperatures for the comparison group. If there were a take back affect, we would expect to see these temperatures increase.

Finally, we should observe that the overall consumption of the comparison group is very similar to the retrofit group. The comparison group used about 44 therms less energy in their hypothetical "before" period. This suggests that the average size of homes were about the same in both the retrofit and comparison groups.

Program Savings from Electricity

A similar analysis was completed for electricity savings. The program was not designed to save electricity and therefore electric measures, such as compact fluorescent lamps, were not installed during the program. Electricity savings from the program would largely result from the reduced furnace run times due to weatherization measures and reduction in air conditioning energy savings. Consumption records indicate that the proportion of homes with air conditioning and which use the air conditioning for a significant number of hours during the summer does not appear to be very high.

For each home in the PRISM™ space heating analysis, we conducted a PRISM™ analysis of electricity consumption. We let PRISM auto-select the best model. During this run, 174 participant cases passed the reliability checks but the savings were actually negative, meaning this group of households used more energy rather than less. The mean savings for these 174 cases was –456 kWh or about a $3.00 per month increase. For the comparison group, 100 cases passed the reliability checks. However, the mean savings for these cases was –950 kWh or about a $6.00 a month increase, providing an almost 500 kWh or $3.00 dollars per month net decrease in electric consumption for program participants. This net reduction in electric savings is about 5 times what we would expect to see if we only consider the furnace run-time savings and provides an indication that there are electric savings from this program beyond the savings from increased heating

efficiencies. These savings are most likely as a result of the educational training provided by the program or through air conditioning savings.

Table 2. Energy use and savings calculations

	Retrofit Group				Comparison group					
	Pre-retrofit usage	Post retrofit usage	Gross change in usage	Gross percent change	Pre-retrofit usage	Post retrofit usage	Gross Change in usage	Gross percent change	Net change	Net change percent
1999 Study										
Base load portion 1999 study (therms)	306	262	44	14.4	328	253	75	22.9	-31	-8.5
Heating portion 1999 study (therms)	1338	1079	259	19.4	1272	1387	-115	-9.0	374	28.2
Total 1999 study (therms)	1644	1341	303	18.4	1600	1640	-40	-2.5	343	20.9
Reference temperature (°F)	63.4	61.2	2.3		63.1	63.5	-.4			

Chapter 4. Program Costs

The Installed Measures

Figure 1 shows the percentages of eight measures installed as they were recorded in the KCWAP tracking system. Ninety-nine percent of all homes received infiltration and general heat waste installation measures and 95 percent received door, window, and / or plaster repairs. Examples of air infiltration measures are caulking around windows and doors and applying weather stripping.

Furnace repair and tune-up was done for health and safety reasons and for energy savings reasons. Eighty-eight percent of households were identified as having heating related measures installed for health and safety reasons and 71 percent for energy savings reasons. Many homes received heating related measures that were split between the two categories. Eighty-three percent of the homes had measures related to ducts, vapor problems and sealing electrical outlets. Almost half of the sites received attic insulation (52 percent) and wall insulation (51 percent). Forty-five percent installed foundation and / or floor insulation.

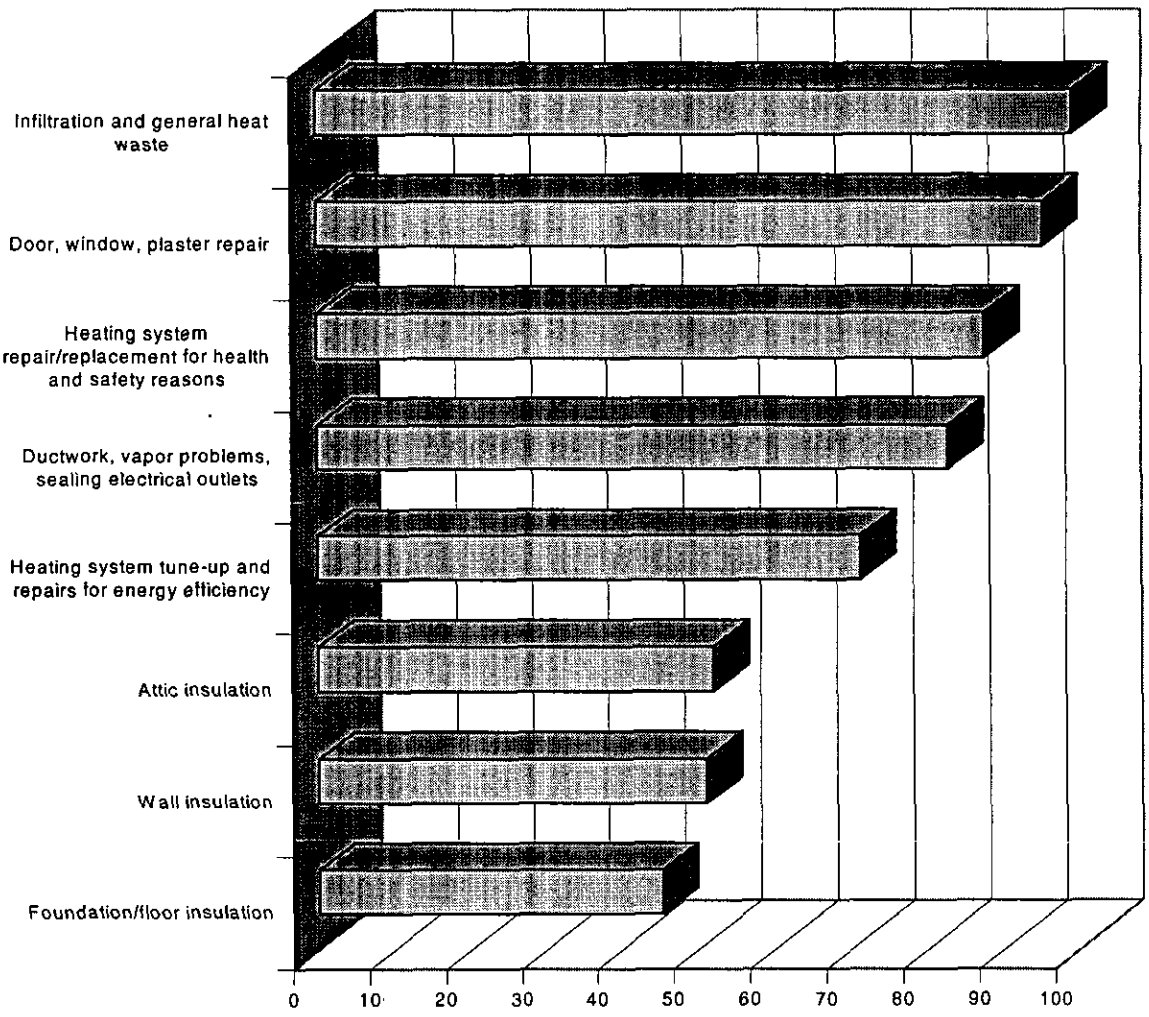

Figure 1. Percentages of measures installed

Measure Specific Installation Costs

Table 3 reflects the different average costs for installing measures. The data have been presented in three ways. Column 2 is the cost to install a measure averaged over the 343 homes (excluding mobile homes) in the program. However, not all homes had each measure installed. Accordingly, column 3 is the average measure cost for just those homes that received the specific measure. Column 5 is the average measure cost of installing the specific measure in homes that were included in the savings analysis.

These data suggest that the homes in our energy savings analysis had slightly more heating system work than did the average home.

Table 3. Average Cost Per Weatherization Measure

Measure	Average cost per unit for all housing units	Average measure cost per unit for units with measure	Number of units	Average measure cost per unit for units with measure included in savings analysis	Number of units
1999 Study (n = 343)					
Infiltration and general heat waste	$416.49	$428.99	333	$443.14	265
General repair needed to weatherize doors, windows, ceilings, etc.	$224.03	$245.50	313	$256.46	251
Foundation and floor insulation including repair	$56.12	$121.06	159	$114.63	121
Heating system repair/replacement for health and safety reasons	$503.03	$565.70	305	$583.34	234
Wall insulation	$236.34	$479.68	169	$501.63	139
Attic insulation	$197.81	$411.21	165	$418.59	135
Heating system tune-up and repair for savings reasons	$169.92	$237.88	245	$241.89	187
Ductwork, vapor problems, electrical outlets and miscellaneous items	$67.76	$84.82	274	$87.40	217
Total	$1871.50	$2574.84	343		268

Considering the average measure cost per unit (Column 3), we see that the most costly measure was the heating system replacement done for health and safety reasons at $566, followed by wall insulation ($480), infiltration and general heat waste ($429), attic insulation ($411),general repair needed to weatherize doors, windows, ceilings, etc. ($246), heating system tune-ups ($238), foundation / flooring insulation ($121), and miscellaneous items ($85).

The preceding estimates for the cost of the work do not include program administration costs. Program costs include the costs associated with a site visit, conducting an audit, developing a set of specifications, placing the specifications for bid, awarding a contract, and providing technical assistance. Based on data supplied by the KCWAP, TecMRKT Works estimated program costs to be 12 percent of installation costs. Using the average installation costs per unit weatherized ($1,871.50) and adding the 12 percent for program costs, the total cost to weatherize a unit is $2,096.08.

Table 4 summarizes the total program costs for the units that were weatherized.

Table 4. Total Program Costs

Description	Units Weatherized January 1995 to December 1998 [2]
1999 Study (n = 343)	
Weatherization measure installation cost	$641,965.66
Kansas City Weatherization Assistance Program fixed and indirect costs	$77,034.37
Total costs	$719,000.03

[2] The totals are the number of units times the average cost per unit.

Chapter 5. Program Cost Effectiveness

To determine the benefit-to-cost ratio for the program we compared the program delivery costs to the value of energy savings. The benefits were calculated based on an assumed life of the measures of 20 years. The annual savings in each of the 20 years were adjusted for the projected change in fuel prices and the change in the value of the dollar and then summed for the 20 years.

The changes in fuel prices are based on changes in the projected prices of natural gas and electricity using data from the Department of Energy's, Energy Information Administration (EIA). Each year the EIA makes 20 year discounted fuel price projections and reports these projections in the Annual Energy Outlook. The discounted price projections used in this report are contained in the 1999 Annual Energy Outlook. This report is available on the world wide web and can be accessed via an Acrobat reader at http://www.eia.doe.gov/oiaf/aeo99/pdf/0383(99).pdf. However, regional prices of fuel can vary quite substantially from average national energy prices. Although EIA reports regional prices, it does not make similar regional projections of prices. Thus, regional price trend projections are available but not Kansas City area prices.

To overcome this problem, we assumed that Kansas City energy prices will follow national trends. By taking the local price of energy from MGE and from KCP&L and applying the national projections of price we arrived at a reasonable projection of fuel prices in Kansas City over the next 20 years. Column 1 of Table 5 shows the number of the year from 0 to 20. Column 2 provides the year from 1998 to 2018. Column 3 shows the EIA projected prices for natural gas in 1997 dollars using current MGE residential prices. Column 4 is the projected prices for electricity using current residential prices from KCP&L. Fixed customer charges are not included in these rates. Column 5 is the number of therms saved per participant. Column 6 is the present value, discounted price of the projected gas savings. Column 7 is the electric savings per participant in kWh. Column 8 is the present value, discounted price of the projected electric savings. Over the 20 year lifetime of the measures, the customer can expect to save $2,789 in natural gas costs and $614 in electric cost in 1997 dollars for a total savings of $3,403.

If the $3,403 in benefits to customers are compared to the levelized cost of the program, of $2,096, the benefit cost ratio the program is 1.62 to 1. In other words, the program returns a $1.62 in benefits to the customers for every dollar spent on the program.

The cost-effectiveness of measures

As part of the analysis, TecMRKT Works attempted to analyze the cost effectiveness of the various measures. A typical approach to this problem is to regress the presence or absence of the measures installed in homes on the savings for the homes. The resulting regression coefficients represent the average savings attributable to the measures. This approach works as long as there is sufficient variation in the measures installed between

homes. If nearly every home has a particularly measure installed or almost none of the homes have a measure installed, then there is unlikely to be sufficient variation to accurately apportion the savings.

Table 5. Changes in projected fuel prices for 20 years

	Year	Gas price	Electric price	Therms saved / home	Gas dollars saved / home	kWh saved / home	Electric Dollars saved / home
0	1998	$0.450	$0.068	0	0	0	0
1	1999	$0.428	$0.066	344	$147.06	500	$32.88
2	2000	$0.432	$0.065	344	$148.65	500	$32.39
3	2001	$0.432	$0.064	344	$148.65	500	$31.88
4	2002	$0.428	$0.063	344	$147.06	500	$31.43
5	2003	$0.422	$0.062	344	$145.24	500	$30.89
6	2004	$0.418	$0.062	344	$143.87	500	$31.13
7	2005	$0.413	$0.063	344	$142.05	500	$31.28
8	2006	$0.413	$0.062	344	$142.05	500	$31.14
9	2007	$0.412	$0.062	344	$141.60	500	$31.11
10	2008	$0.408	$0.062	344	$140.46	500	$31.00
11	2009	$0.404	$0.062	344	$138.86	500	$30.87
12	2010	$0.400	$0.062	344	$137.73	500	$30.80
13	2011	$0.397	$0.061	344	$136.59	500	$30.72
14	2012	$0.394	$0.061	344	$135.45	500	$30.29
15	2013	$0.389	$0.060	344	$133.86	500	$29.96
16	2014	$0.386	$0.059	344	$132.72	500	$29.73
17	2015	$0.384	$0.059	344	$132.04	500	$29.62
18	2016	$0.383	$0.059	344	$131.58	500	$29.42
19	2017	$0.383	$0.058	344	$131.81	500	$29.22
20	2018	$0.383	$0.058	344	$131.81	500	$29.02
	Totals				$2,789.13		$614.78

Source of price trend projections: USDOE 1999 Annual Energy Outlook
Source of current fuel price: Natural gas: MGE Electricity: KCP&L

The application of this approach to the current problem was made difficult by a number of factors. The data available to us was not organized by discreet measures. For instance, several infiltration measures, such as caulking and weather stripping, were combined in a single category. There was no way to separate caulking from weather stripping. Secondly, the measures were presented in terms of their cost and it was not possible to effectively relate cost to activity. Using several tubes of caulk may have had greater effect than weather stripping doors but the cost of the two measures may have been relatively the same or quite different.

After a preliminary review and analysis of the measures we made several determinations. Infiltration measures were applied to nearly every house. Therefore, it did not make sense to identify infiltration as separate variable to be entered into the regression analysis. Secondly, the repair measures were necessary in order to complete other weatherization

measures but do not contribute to savings directly. Plastering the ceiling in order to install ceiling insulation only marginally contributes to additional savings beyond the value of installing the ceiling insulation. Therefore, it was determined that the repair variable should be dropped from the analysis. This does not diminish the importance of repairs to the overall project, it merely indicates that we do not expect them to contribute to the overall savings.

We were also confronted with the problem of having two variables relating to heating systems. One variable included costs assigned to improving health and safety and the second assigned cost to improving energy efficiency. The fact that these variables were highly correlated caused severe problems with the analysis when they were entered at the same time. In order to deal with this problem, we combined the two variables to obtain a total cost for dealing with the heating system and then created two new variables. If the total cost of heating system repair was $800 or more we assumed that a new furnace was installed and we coded a variable that we called "furnace replacement." If the amount was less than $799 but more than zero we assume that there was a heating system tune-up or repair. By coding the variables in this way we were able to distinguish between new units and system repairs and tune-up.

Finally, we discovered that the category of miscellaneous caused a fair bit of disturbance in the analysis. We concluded after a bit of exploration that this variable included duct work which was related to heating systems and thus was correlated with the heating variables. We removed this variable from the analysis.

Table 6 shows the model with five variables, wall insulation, foundation and floor insulation, attic insulation, heating system repair and furnace replacement. Instead of using the dollar amounts, we recoded the variable so that if money was expended the variable recorded the presence of the measure and if money was not expended the absence of the measure was recorded. Because we used presence or absence and these are the unstandardized coefficients, they can be interpreted directly as the therms of savings resulting from the measure.

The largest savings are associated with furnace replacement and the next largest wall insulation. The constant can be interpreted as the average savings from all other sources including infiltration measures, repairs, and miscellaneous. In this model foundation and floor insulation, attic insulation and heating repair make relatively small contributions to the overall savings. Note that the standard errors for heating repairs and the constant are unacceptably large.

Table 6. Preliminary linear regression model based on the presence or absence of the energy saving measures

Measures	Unstandardized Coefficients		t	Signifi-cance
	B (tens of therms)	Standard Error		
Constant	104.64	99.04	1.057	.292
Wall insulation	171.81	50.30	3.416	.001
Foundation and floor	9.05	50.69	.179	.858
Attic insulation	21.45	50.63	.426	.671
Heating system tune-up and repair	42.32	97.85	.433	.666
Furnace replacement	227.33	101.77	2.234	.027

An alternative model in which heating repair is removed is shown in Table 7. In this model, heating repair is now represented in the constant. The coefficient of the constant now increases by about 49 therms but the standard error is significantly reduced and the constant is now significantly different than zero. Furnace replacement provides the largest amount of savings, wall insulation the next most savings, and the measures summarized in the constant, most particularly infiltration measures provide the next largest amount of savings.

Attic insulation and foundation and floor insulation provided the least savings. Some may be surprised that attic insulation provides so few savings but this finding is consistent with observations that we are making in other jurisdictions where we have found that infiltration and wall insulation provide significantly more savings than attic insulation in leaky homes.

These savings estimates are quite reasonable. For example, given the average pre retrofit heating energy consumption of 1400 therms, a furnace replacement represents about a 15 percent reduction in energy use which is about what one would expect if furnace efficiency is improved from 65 percent to 80 percent. According to program staff, the furnaces that are being installed have efficiency ratings of about 80 percent.

Table 7. Final linear regression model based on the presence or absence of the energy saving measures for 1999 Study

Measures	Unstandardized Coefficients		t	Signifi-cance
	B (tens of therms)	Standard Error		
Constant	153.41	39.03	3.930	.008
Wall insulation	141.51	39.24	3.606	.815
Foundation and floor	85.43	39.23	2.178	.031
Attic insulation	23.55	39.46	1.777	.077
Furnace replacement	70.12	61.37	.234	.000

Table 8. Final linear regression model based on the presence or absence of the energy saving measures for 1998 Study

Measures	Unstandardized Coefficients		t	Signifi-cance
	B (tens of therms)	Standard Error		
Constant	133.73	49.56	2.698	.008
Wall insulation	175.48	49.79	3.524	.001
Foundation and floor	11.03	49.90	.221	.825
Attic insulation	23.55	50.22	.490	.625
Furnace replacement	213.50	53.06	4.023	.000

Based on these data, we can begin to make some assessments of the cost effectiveness of the different measures. Table 9 presents the costs of the measures, the dollar savings from the measures assuming that the cost of energy in constant dollars is about $0.41 per therm over a 20 year period and that the life of measures is about 20 years. Forty-one cents per therm is used because it is the present value of fuel savings at the half-way point in the measure's useful life.

Table 9. Estimated benefit cost ratio of selected measures

Measure	Cost	Annual savings (therms)	20 year savings (dollars)	Benefit to cost ratio
Water heater blanket[1]	$20	30	$246	12.30
Infiltration measures	$442	70	$574	1.30
Wall insulation	$497	175	$1,435	2.89
Attic insulation	$429	24	$197	0.46
Heating tune-up and repair	$366[2]	30	$246	0.67
Heating system replacement	$1,621[3]	213	$1,747	1.08

1 Cost of a water heater blanket and installation estimated by TecMRKT Works

2 Cost of the heating repair is the average of the repairs in all homes that had heating repairs less than 800 dollars but greater than zero.

3 Cost of heating replacement is the average for all households with heating system costs identified as being greater than $800.

Based on the preceding it is clearly cost effective to install water heater blankets, wall insulation, infiltration measures, and heating system replacements. The value of heating system tune-ups and repair is questionable on the basis of energy savings along and attic insulation appears not to be cost effective. It is important to keep in mind that heating system replacements are usually installed for health and safety reasons. We have not estimated the health and safety benefits of replacing heating systems but they may be substantial in terms of reducing illness and reducing the need for emergency and service visits to households. Likewise, there may be significant non energy benefits from heating system tune-ups including reduced services calls and health and safety related benefits.

Chapter 6. Summary and Conclusions

Between its inception and December 1998, the Missouri Gas Energy Low-Income Weatherization Assistance Pilot Program served 343 clients providing an estimated savings to Missouri citizens of $61,720 a year in current 1997 dollars or $1,167,540 over the 20 year life of the measures. On average, the consumption of space heating fuel for units heated with natural gas was reduced by 34.4 million BTUs annually, or 20.9 percent of total gas consumption, for a program-wide savings 296 billion BTUs over the 20 year life of the installed measures. This gas savings is provided through a 28.2 percent reduction in heating related fuel consumption and an 8.5 percent increase in baseload consumption. The benefit-to-cost ratio for the program is 1.62 to 1.

We also analyzed the benefit to cost ratios for the various types of measures installed. Water heater blankets pay for themselves in two years or less. Wall insulation, infiltration measures, and heating system replacement are also cost effective. Heating system replacement is usually done for health and safety reasons so the energy savings is a bonus benefit. Heating system tune-ups and repair do not appear to be cost effective until health and safety benefits are included. Attic insulation does not appear to be cost effective. From a policy standpoint, the program may want to consider the merits of replacing a furnace rather than tuning and repairing an existing system and insulating an attic, especially if the estimated combined cost of the last two measures exceeds the cost of a furnace replacement.

It should be kept in mind that this evaluation has focused entirely on the benefits and costs of weatherization. There are other health and safety benefits and costs associated with this program that have not been fully evaluated here. In particular, the replacement and repair of furnaces may significantly reduce service calls and emergency service calls, and reduce the number and consequences of health problems associated with a poorly functioning furnace.