

Measurement and Evaluation Protocols: Appendix D is the most recent impact evaluation study completed on this program.

Payment Plus (*formerly* Home Energy Assistance Plus)

From January 2002 through June 2006, the Residential Collaborative and Duke Energy Kentucky tested an innovative home energy assistance program called Payment Plus. The program was designed to impact participants' behavior (e.g., encourage meeting utility bill payments as well as eliminate arrearages) and to generate energy conservation impacts. That program was extended with the Commission's Order in Case No. 2004-00389 to include both the early participants and new participants each year.

The program has three parts:

1. Energy & Budget Counseling – to help customers understand how to control their energy usage and how to manage their household bills, a combined education/counseling approach is used.
2. Weatherization – participants in this program are required to have their homes weatherized as part of the normal Residential Conservation and Energy Education (low-income weatherization) program unless weatherized in past program years.
3. Bill Assistance – to provide an incentive for these customers to participate in the education and weatherization, and to help them get control of their bills, payment assistance credits are provided to each customer when they complete the other aspects of the program. The credits are: \$200 for participating in the energy efficiency counseling, \$150 for participating in the budgeting counseling, and \$150 to participate in the Residential Conservation and Energy Education program. If all

of the requirements are completed, a household could receive up to a total of \$500. This allows for approximately 125 homes to participate per year as some customers do not complete all three steps or have already had the weatherization completed prior to the program.

This program is offered over six winter months per year starting in October. Customers are tracked and the program evaluated after two years to see if customer energy consumption dropped and changes in bill paying habits occurred.

Over the last five years, participants have been monitored and compared to a control group of customers with similar arrearages and incomes. This evaluation has looked at not only energy savings, but arrearage and payment practices. It is the only long-term impact and process evaluation in the country looking at both energy savings and arrearages from a single program. As a result, there is long-term evidence that the program is effective at both saving natural gas and having a positive impact on arrearages. The evaluation firm recommended that the program continue.

Given the positive evaluation results, the Collaborative proposed and the Commission approved in May 2007 continuation of the program at a cost of \$150,000 per year, through 2009. By expanding the program Duke Energy Kentucky is adding an additional 80 participants beginning Fall of 2007. Follow up educational reinforcement will take place for all participants beginning Fall 2007.

Measurement and Evaluation Protocols: Appendix E is the most recent impact evaluation study completed on this program.

## **Power Manager**

The purpose of the Power Manager program is to reduce demand by controlling residential air conditioning usage during peak demand conditions in the summer months. The program is offered to residential customers with central air conditioning. Duke Energy Kentucky attaches a load control device to the customer's compressor to enable Duke Energy Kentucky to cycle the customer's air conditioner off and on when the load on Duke Energy Kentucky's system reaches peak levels. Customers receive financial incentives for participating in this program based upon the cycling option selected. If a customer selects Option A, their air conditioner is cycled to achieve a 1 kW reduction in load. If a customer selects Option B, the air conditioner is cycled to achieve a 1.5 kW load reduction. Incentives are provided at the time of installation: \$25 for Option A and \$35 for Option B. In addition, when a cycling event occurs, a Variable Daily Event Incentive based upon marginal costs is also provided.

The cycling of the customer's air-conditioning system has shown that there is minimal impact on the operation of the air-conditioning system or on the customer's comfort level. The load control device has built-in safe guards to prevent the "short cycling" of the air-conditioning system. The air-conditioning system will always run the minimum amount of time required by the manufacturer. The cycling simply causes the air-conditioning system to run less which is no different than what it does on milder days. Research from other programs, including previous Duke Energy Ohio and Duke Energy Kentucky programs, has shown that the indoor temperature should rise approximately one to two degrees for control Option A and approximately two to three degrees for

control Option B. Additionally, the indoor fan will continue to run and circulate air during the cycling event.

The initial design of Power Manager has been structured on the same basic principles as Duke Energy Kentucky's innovative PowerShare<sup>®</sup> program. Power Manager combines direct load control with a flavor of "real time pricing" through the Variable Daily Event Incentive structure as described above. By implementing the Variable Daily Event Incentive structure, Duke Energy Kentucky can educate customers on the real time cost of electricity. Duke Energy Kentucky continues to explore opportunities to cross-market the Power Manager program with Duke Energy Kentucky's other DSM programs thus tying both conservation and peak load management together as one package.

In 2006, Duke Energy Kentucky mailed 270,015 Power Manager marketing pieces and had 2,587 customers enrolled in the program with 1,958 switch installations completed from the enrollments. The cumulative installations as of the end of 2006 total 6,888 switches. The installation rate during 2007 was intentionally less than projected originally, due to a desire to ensure that existing switches, operations and systems were operating as efficiently and effectively as possible. Previous quality control assessments, measurements and verifications suggested that paging, installation, operations and signaling were not being effectively received within some areas. As such, significant effort during 2007 resulted in the successful increase in load reductions realized per household to an average of 1.04 kW per home, as reported within the Impact Evaluation Study provided in Appendix B. This quality management effort has provided increased assurance that the program operates as intended, and at a load reduction level that is



clearly cost effective and worthy of further pursuit and customer promotion. Termed the “Duke A Quality Control” (QC) program, the effort was implemented in January of 2007 to visit 3,400 switches in the field. The program consisted of a general inspection of the health of the air conditioner, the switch installation, and retrieval of the event performance data stored inside the switch. The switch interrogation equipment was enhanced during the first quarter of 2007, which enables Duke Energy Kentucky to receive information stored in the switch in an electronic format that enables faster data review versus transfer of data from a hard copy report onto a spreadsheet. As of June 2007, Duke Energy Kentucky completed 1,234 quality control inspections of the 3400 switches planned for review. Since resources were focused on the Quality Control efforts, Duke Energy Kentucky completed just 704 switch installations as of the end of June 2007, with 395 customer enrollments in 2007. Some of the 2006 customer enrollments were installed in 2007. It is expected that 1,500 or less of the projected 2,500 switch installations for 2007 will be completed due to the resources needed to complete the quality control program. The cost-effectiveness modeling results for Power Manager, as a result reflect the results of this successful effort.

Measurement and Evaluation Protocols: Appendix F is the most recent impact evaluation study completed on this program. The 2007 Duke Energy Kentucky Power Manager Impact Evaluation study reports that the program successfully achieves an average load reduction per home of 1.04 kW, with favorable cost-effectiveness results, given the program costs. To conduct the study as cheaply and efficiently as possible, existing Duke Energy Kentucky meters, staff and logger equipment were used to save costs. To insure objectivity, Duke Energy Kentucky contracted with Integral Analytics

(Dr. Michael Ozog) to review the study design, processes, results and statistics to insure that the study findings are reasonable, accurate and can be projected for integrated resource planning. This third party recommendation, review and comments can be found in the appendices.

### **Energy Star Products**

As approved in Order 2004-00389, the Energy Star Products program provides market incentives and market support through retailers to build market share and usage of Energy Star products. Special incentives to buyers and in-store support stimulate demand for the products and make it easier for store participation. The program targets Residential customers' purchase of specified technologies through retail stores and special sales events. The first year of the program focused on compact fluorescent lamps (bulbs) (CFL) and torchiere lamps. Technologies may change over the future years of program operation based on new technologies and market responses.

There are several market barriers addressed through the program. The first is price. Purchase rewards are provided for customers to lower first cost of the item and stimulate interest. The second barrier is retailer participation. Through retail education, in-field sales support (signs, ads, etc.), and stimulated market demand, retailers stock more product, provide special promotions and plan sales strategies around these Energy Star products. Additional support is provided through manufacturer relationships that often can reduce prices through special large-scale purchases. Coordination occurs with the national Energy Star initiatives such as "Change a Light, Change the World" promotion.

To stimulate the market and get customers to buy and install the efficient lighting, the program provides incentives or “customer rewards” through special in-store “Instant Reward” events that occur in stores at the time of purchase or at special promotional events in the community. Technology incentives start at \$2 per bulb and \$20 per torchiere. The program also provides training to sales staff of the retailers on the sales aids provided.

Duke Energy Kentucky has contracted with the Wisconsin Energy Conservation Corporation (WECC) to provide this service. Recognized as the national leader in this program and located in the region, Duke Energy Kentucky is taking advantage of WECC’s current activity to control costs and leverage other activity.

To reduce administrative costs and maintain cost-effectiveness of the program a revised approach to the market was implemented. Instead of year-round activities for the program, special campaigns are held at different times of the year and at different locations to promote these Energy Star Products. Three sales events took place in the 2005-06 filing period. The first event took place at Covington’s City Hall with the support of Covington’s Mayor Callery. Eight Do-It-Best retail stores participated in the sales promotion that lasted through February of 2006 and resulted in the sale of 24,616 CFL’s. Two events took place during April 2006 as part of Duke Energy Kentucky’s promotion of Earth Day. This sales promotion targeted Alexandria and Ludlow. Four True Value Hardware retailers in these areas participated in these sales promotions. The final results of these events resulted in the sale of 5,473 cfl’s.

Since then, a total of five promotional events took place. Three events in the fall 2006 were planned in coordination with the October national “Change the Light, Change

the World” campaign. They were held in Covington hosted by Mayor Callery’s office, Florence hosted by Mayor Diane Whalen’s office, and Newport hosted by Mayor Thomas Guidugli’s office. Thirteen local retailers participated in the program. In the spring of 2007 in coordination with Earth Day, two events took place. One was held in Alexandria hosted by Mayor Dan McGinley’s office and the other in Ludlow hosted by Mayor Ed Schroeder’s office. Four local retailers supported the sales events in Alexandria and Ludlow. Sales in this filing period totaled 48,823 CFL’s and 737 torchiere’s, exceeding the goals by 8,823 cfl’s and 237 torchieres. With such a successful response, marketing costs were reduced which enabled these additional bulb incentives to be paid within the existing budget.

Measurement and Evaluation Protocols: Appendix G is the most recent impact evaluation study completed on this program.

### **Energy Efficiency Website, On-line Energy Assessment and Free Energy Efficiency Starter kit**

As approved in Order 2004-00389, Duke Energy Kentucky’s residential website offers opportunities for customers to assess their energy usage and obtain recommendations for more efficient use of energy in their homes. This Kentucky program fits suitably into our new multi-state program design now referred to as our Residential Energy Assessment Program.

As an expansion to our previous energy efficiency website model, new website pages, new content and new on-line tools have been added. These on-line services help accomplish several things by providing energy efficiency information, tips, and bill analysis. However, Duke Energy Kentucky also intends to these tools to help identify

those customers who could benefit most by investing in new energy efficiency measures or practices. Those customers can then be targeted for participation in other Duke Energy Kentucky programs.

In November, 2006 our Quick-e-Audit tool was upgraded to the Home Energy Calculator provided by Apogee. In this new, easy to use energy analysis tool a customer provides information about their home, number of occupants, and other energy related home and family characteristics. This tool allows an unlimited number of potentially energy saving scenarios to be run and charts and tables compare the scenarios to show energy savings.

As an incentive to encourage customers to use the website, a free Energy Efficiency Starter Kit is offered. The kit is mailed directly to the customer's service address and provides the customer with the following measures:

- Showerhead, 1.5 GPM .
- Kitchen Swivel Aerator, 1.5 GPM
- Bathroom Aerator, 1.0 GPM
- 15 Watt CFL @
- 20 Watt CFL @
- Shrink Fit Window Kit
- Closed Cell Foam Weatherstrip, 17' Roll
- Switch and outlet draft stopper gaskets

The free kit offer was added to the Duke Energy Kentucky website in June, 2006. Through June 2007, 203 kits have been mailed. An identical program was initiated July 16, 2007 in the Duke Energy Ohio service area and this program announcement has since positively affected the Kentucky participation. We expect an increase in participation in the Kentucky website promotion as we increase our marketing in the greater Cincinnati area.

Measurement and Evaluation Protocols: Appendix G is the most recent impact evaluation study completed on this program.

### **Personal Energy Report (PER)**

The PER program provides Duke Energy Kentucky customers with a customized energy report aimed at helping them better manage their energy costs. With rising energy costs in all aspects of daily life, the customer is searching for information they can use and ideas they can implement which will impact their monthly energy bill. The PER program also includes the "*Energy Efficiency Starter Kit*" containing nine easily installed measures which demonstrate how easy it is to move towards improved home energy efficiency. For purposes of this pilot program, Duke Energy Kentucky has agreed to test the efficacy of the kit by sending it to 25% of the survey respondents. The program targets single family residential customers in the Duke Energy Kentucky market that have not received measures through the Home Energy House Call energy efficiency audit or Residential Conservation & Energy Education programs within the last three years.

The program gives information on the entire home from an energy usage standpoint providing energy tips and information regarding how they use energy and what simple, low cost/no cost measures can be undertaken to lower their energy bill. This program provides value because customers lack education on how they individually consume energy in their home and the steps which can be taken to lower their energy bills. This program is meant to educate the customer and put at their disposal, information, customized tips and simple to install measures which can all lower their energy costs.

To get this information, a customer completes an energy survey which generates the personalized energy report. Both are excellent educational tools. The survey stimulates the customer to think about how they use energy and then the PER provides them with tools and information to lower their energy costs. Additionally, the PER provides instructions on how to install the energy measures demonstrating how easy it is to improve their efficiency.

To gain customer participation, the PER program commences with a letter to the customer, offering the Personalized Energy Report if they would return a short, 14 question survey about their home. The survey asks very simple questions such as age of home, number of occupants, types of fuel used to cool, heat, and cook. Once the survey is returned, the information is used to generate a customized energy report. The report contains the following information:

- Month-to Month Comparisons of electric and/or gas usage including the amount of the bill

- Predictions of customer's usage based on 95<sup>th</sup> percentile weather conditions (extremely hot summer/extremely cold winter) and 5<sup>th</sup> percentile weather conditions (extremely mild summer/extremely mild winter). Also includes bill amounts based on 2006 tariffs.
- Trend chart showing usage of electric and/or gas by kWh/cf by month and amount of monthly bill
- Bill comparison of Duke Energy Kentucky vs. the average national electric and/or gas rate
- A disaggregation of how the customer uses electricity and/or gas
- Description of Budget Bill
- Customized energy tips

Customized tips are based upon the customer's specific answers to questions in the survey. As an example:

- If the age of the home is over 30 years, plastic window kits would be a *recommended measure*
- If over 50% of the ducts are in the attic, adding duct insulation would also be a *measure*.

As part of quality control and evaluation, Duke Energy Kentucky completes a follow-up survey with a sub-segment of the customers who received the offer and those who also responded to determine what drove their responses. An additional sub-segment of



customers who received the “*Energy Efficiency Starter Kit*” also receive the survey and include questions regarding installation of the measures found in the kit.

For the 25% of customers who received The “*Energy Efficiency Starter Kit*”, the kit contains the following items:

- 2 each 1.5 GPM showerheads
- 1 each Kitchen Swivel Aerator 2.2 GPM
- 1 each Bathroom Aerator 1.0 GPM
- 1 each Bath Aerator 1.5GPM
- 1 each Small Roll Teflon Tape
- 1 each 15 Watt CFL Mini Spiral
- 1 each 20 Watt CFL Mini Spiral
- 2 each 17’ Roll Door Weatherstrip
- 1 each Combination Pack Switch/Outlet Gasket Insulators
- Installation instructions for all measures

Duke Energy Kentucky is using a similar kit in the Home Energy House Call and NEED programs with significant success.

For the pilot, mailings went out in three (3) waves:

Wave 1 - May 22, 2006 to 6250 customers; 1417 responses = 22.7% (with kits)

Wave 2 – July 5, 2006 to 5489 customers; 1393 responded = 25.4% (with kits)

Wave 3 – August 18, 2006 to 35,336 customer; 6,249 responded = 17.7% (w/o kits)

Total mailed = 47,075; Response = 9059; Kits shipped = 2810; Overall response rate = 19%

Findings of the research from this pilot are described below. For the pilot, the budget totaled was \$109,246 however total expenditures were \$67,749. The primary reason for the difference of \$41,497 was that the number of customers fitting the criteria within the target was only 47,000 versus the 72,000 originally expected.

Measurement and Evaluation Protocols: Appendix H is the most recent impact evaluation study completed on this program.

### **C&I High Efficiency Incentive (Including Schools Initiative)**

The Commission's Order in Case No. 2004-00389 approved a new program for Duke Energy Kentucky to provide incentives to small commercial and industrial customers to install high efficiency equipment in applications involving new construction, retrofit, and replacement of failed equipment. In the original filing this program was to be jointly implemented with the Duke Energy Indiana territory to reduce administrative costs and leverage promotion. This joint program included expanded technologies beyond what was provided in Indiana. That expanded program in Indiana has not yet been approved. However, a new C&I expanded program is approved in the Duke Energy Ohio's territory for implementation in that state. Given that approval, the program can now economically expand technologies in Kentucky to those initially proposed in the Kentucky filing and include the following:

#### **High-Efficiency Incentive Lighting**

- T-8 with Electric Ballasts replacing T-12
- LED Exit Signs New/Electronic

- CFL Fixture
- CFL Screw in
- T-5 with Elec. Ballast replacing T-12
- T-5 High Output with Elec. Ballast replacing T-12
- T-5 High Output High Bay
- Tubular Skylight
- Hi Bay Fluorescent
- 320 Metal Halide Pulse Start
- LED Traffic Signals
- Controls/Occupancy Sensors

#### **High Efficiency Incentive HVAC**

- Packaged Terminal AC
- Unitary AC & Heat Pump
- Rooftop HP & AC
- Ground Source HP – Closed Loop
- Air Cooled Chillers
- Water Cooled Chillers
- Window AC
- HP Water Heater
- Thermostats/Controls

#### **High Efficiency Incentive Pumps, Motors & Drives**

- NEMA Premium Motors 1 to 250 HP with greater than 1500 hours per year
- High Efficiency Pumps 1-20 HP
- Variable Frequency Drives 1-50 HP

#### **Refrigeration**

- Energy Star Refrigerators & Freezers
- Energy efficiency Ice Machines
- Head Pressure Controls
- Night Covers for displays
- Efficient Refrigeration Condensers
- Anti-sweat Heater Controls
- Vending Machine Controls

#### **Other Misc. Technologies**

- Injection Molder Barrel Wraps
- Engineered Air Compressor Nozzles
- Pellet Dryer Duct Insulation
- Energy Star Clothes Washers for Commercial Applications

Timing of the expansion will be dependent on the budget availability and market response to the existing technologies within the program.

Incentives are provided through the market providers (contractors & retail stores) based on Duke Energy Kentucky's cost-effectiveness modeling but with a high-end limit of 50% of measure cost. Using the Duke Energy Kentucky cost-effectiveness model assures cost-effectiveness over the life of the measure. Primary delivery of the program is through the existing market channels, equipment providers and contractors. Duke Energy Kentucky is using its current DSM team to manage and support the program. Additional outside technical assistance is being provided by GoodCents to analyze technical applications and provide customer/market provider assistance as necessary. Duke Energy Kentucky also will provide education and training to its market providers to understand the program and the appropriate applications for the technologies. Full program operations began in the last quarter of 2005. Results to date were beyond expectation. In the first nine months of the program, 36 applications were processed totaling \$313,350 in incentives. Duke Energy Kentucky attributes this to high installation rates of T-8, T-5 High Output, and High Bay Lighting technologies as well as to a pent-up demand in the marketplace. To respond to the market, the following adjustments were made to the program in order to serve more customers and remain cost effective:

- Incentives for T-8, T-5 and High Bay fixtures are no longer eligible in a "new construction" application, only retrofit applications. The new construction market is utilizing these technologies as a normal practice so incentives are now not needed.
- The incentive levels for T-8 High Bay and T-5 High Output High Bay fixtures

were adjusted to align with price changes in the market.

- A cap of \$50,000 per facility per fiscal year (July 1 through June 30) was implemented in an effort to serve more customers.
- A reservation system was instituted during the proposal stage, to ensure that customers will receive their incentives once the project is complete.

Even given these changes, the program still ran out of funds in April of 2007. There were seven applications waiting to get paid in the amount totaling \$81,248 and Duke Energy Kentucky received four reservation applications totaling \$83,279 for projects scheduled to be completed in July – Sept.

In the fall of 2006, Duke Energy Kentucky filed with the Commission a request for a 100% increase in funding along with an additional \$451,885 for a Kentucky Schools program to respond to market demand and customer opportunities – providing schools funding for facility assessments, custom and prescriptive measures rebates and energy efficiency education from the NEED organization. On May 15, 2007, the Commission approved Duke Energy's application to expand the program.

During the last filing period, 12,742 light fixtures have been installed of which 30% were T8 High Bay 6 lamp and T5 High Output High Bay 4 lamp fixtures. Twenty HVAC units were installed, 4 motors and no pumps. In the first quarter of 2008, Duke Energy Kentucky will review the program's performance and adjust accordingly. Depending on the current market response and its impact on the current revised budget, Duke Energy Kentucky may incorporate the new measures by the end of the first quarter 2008. To-date, Kenton County Schools has been the only school in the Duke Energy

Kentucky service territory to take advantage of the Schools rebate, but there have been several inquiries. Given that the Commission's Order was issued May 15<sup>th</sup> and the filing period ended June 30<sup>th</sup>, it was unlikely to see significant impact for this filing period.

Letters to all eligible customers went out in April 2007 to promote the program. This mailing will go out again in the first quarter of 2008 so customers are aware that it is an ongoing program. Feedback from vendors has been very positive.

Measurement and Evaluation Protocols: Appendix I is the most recent impact evaluation study completed on this program.

The impact evaluation analysis was affected by several factors that could be improved in the future, as well:

1. **Uncertainty in lighting measure baseline.** The tracking system contained information on lighting fixtures installed, but no data were available on the type of lighting fixtures removed. AEC and TechMarket Works made assumptions on the type of fixture removed based on a review of the program engineering documentation. Recording the number and type of fixtures removed within the tracking system removes this uncertainty. This information is not always readily available or reliable, but applying some effort in this regard should improve the overall impact estimates in the future.
2. **Ambiguity in measure descriptions.** The lighting measure descriptions in the tracking system for T-8 fluorescent lamps were somewhat ambiguous. Although the lamp type, length and number of lamps per fixture were recorded, the lamp

watts were not. Several styles of T-8 lamps with varying input watts are available, and adding a lamp wattage description will better define the specific type of the installed measure.

3. **Lack of building type information.** Lighting and HVAC measure savings calculations rely on an understanding of the building type. It was possible to identify the building type from the customer name in most cases, but an additional field indicating the building type or customer SIC or NAICS code would be helpful in making this determination in the future.

The problems identified from the above impact evaluation comments and suggestions from the impact evaluation report are being addressed through revision of the application forms which ask for fixture removed, wattage clarification, and building type.

### **PowerShare**

The Commission's Order in Case No. 2006-00172 approved a revision to Duke Energy Kentucky's PowerShare program to allow customer premiums to be based on the avoided cost of new generation (a combustion turbine) instead of market values for capacity. This PowerShare update will first describe the program and then provide details on participation and curtailments for 2007 and the 2007 program evaluation.

**Brief Description:** PowerShare® is the brand name given to Duke Energy Kentucky's Peak Load Management Program (Rider PLM, Peak Load Management Program KY.P.S.C. Electric No. 4, Sheet No. 77). The PLM Program is voluntary and offers customers the opportunity to reduce their electric costs by managing their electric usage during the Company's peak load periods. Customers and the Company will enter into a

service agreement under this Rider, specifying the terms and conditions under which the customer agrees to reduce usage. There are two product options offered for PowerShare® called CallOption® and QuoteOption®:

- o CallOption® – A customer served under a CallOption® product agrees, upon notification by the Company, to reduce its demand or provide generation for purchase by the Company. Each time the Company exercises its option under the agreement, the Company will provide the customer a credit for the energy reduced or generation provided. If available, the customer may elect to buy through the reduction at a market-based price. In addition to the energy credit, customers on the CallOption® will receive an option premium credit. Only customers able to provide a minimum of 100 kW load response qualify for CallOption®.

- o QuoteOption® – Under the QuoteOption® products, the customer and the Company agree that when the average wholesale market price for energy during the notification period is greater than a pre-determined strike price, the Company may notify the customer of a QuoteOption® event and provide a Price Quote to the customer for each event hour. The customer will decide whether to reduce demand or provide generation during the event period. If they decide to do so, the customer will notify the Company and provide the Company an estimate of the customer's projected load reduction or generation. Each time the Company exercises the option, the Company will provide the customer an energy credit. There is no option premium for the QuoteOption® product since customer load reductions are voluntary. Only customers able to provide a minimum of 100 kW load response qualify for QuoteOption®.



Rider PLM was approved pursuant as part of the settlement agreement in Case No. 2006-00172. In the Commission's Order in Case No. 2006-00426, approval was given to include the PowerShare® program within the DSM programs.

**PowerShare 2007:** Our customer participation goal for 2007 was to retain all customers that currently participate and to get as many of these customers as possible to migrate to the CallOption® program. This would provide additional demand response that can reduce the need for new plant. The table below compares account participation levels for 2006 and 2007 as well as MW's enrolled in the program. The change in methodology for setting incentives has increased participation in the CallOption® program.

<b>Kentucky PowerShare Participation Update</b>					
<b>Enrolled Customers</b>					
CallOption			QuoteOption		
<u>2006</u>	<u>2007</u>	<u>Change</u>	<u>2006</u>	<u>2007</u>	<u>Change</u>
0	2	2	54	49	-5
<b>Enrolled Load Curtailment Potential (MW's)*</b>					
CallOption			QuoteOption		
<u>2006</u>	<u>2007</u>	<u>Change</u>	<u>2006</u>	<u>2007</u>	<u>Change</u>
0.0	1.8	1.8	9.6	9.0	-0.6
*Potential is 80% of enrolled load curtailment estimate					

During the summer of 2007, CallOption and QuoteOption events occurred on August 8 and August 9. The average hourly potential load curtailed, estimated in the 2007 program evaluation (see below), during these two events is 1,722 kW. Even though the

temperatures on these two event days were extreme, a special note should be made regarding the MISO market prices for energy. The wholesale market prices were relatively low and therefore did not encourage a large QuoteOption participation. This situation occurred due to the mild temperatures in the northern areas of MISO which allowed wholesale market prices for energy to remain relatively low even though the southern areas of MISO experienced extreme heat.

Measurement and Evaluation protocols: Appendix J is the most recent impact evaluation study completed on this program. Integral Analytics time series regression based impact evaluation analysis confirmed 1,144 KW of peak load impact, consistent with a peak normal 93.5 degree summer weekday. In addition, given the buy through option observed from one of the customers, averaging 578 KW, the sum total peak load capability for the PowerShare program overall is 1,722 KW. These results are consistent with a peak normal 93.5 degree summer weekday and with the incentive pricing offered to customers during the two events in 2007.

**WITNESS RESPONSIBLE:** Richard G. Stevie



Duke Energy Kentucky

Program Name	Applicable Rate Classification	Program Start Date	Participants from 07/2006 to 06/2007	Participants from Jun-07	Use of 3rd Party Vendors	Estimated kWh or kW, 07/2006 to 06/2007	Estimated kWh or kW, Cumulative Annual
Residential Conservation and Energy Education	RS Elec & Gas	January, 2003	166	2,403	Yes	13,706	1,497,069 kWh
Residential Home Energy House Call	RS Elec & Gas		44	243	Yes	47,916	251,019 kWh
Residential Comprehensive Energy Education Program (NEED)	RS Elec & Gas		697	5,877	Yes	440,992	3,914,082 kWh
Payment Plus (formerly Home Energy Assistance Plus) (1)	RS Elec & Gas	January, 2002	235	755	Yes	70,500	226,500 kWh
Power Manager	RS Elec only	November, 2003	1,926	7,883	Yes	3,291	7,678 kw
Energy Star Products	RS Elec & Gas	February, 2005	49,560	76,420	Yes	5,744,995	10,545,960 kWh
Energy Efficiency Website	RS Elec & Gas	February, 2006	203	165	No	45,691	54,615 kWh
Personal Energy Report (PER)	RS Elec & Gas	April, 2006	9,059	9,059	No	1,164,263	1,712,151 kWh
C&I High Efficiency Incentive (for Businesses and Schools)	DS, DP, DT, GS-FL, EH & SP	February, 2005	12,742	22,586	Yes	1,928,731	6,459,596 kWh
C&I Lighting	DS, DP, DT, GS-FL, EH & SP	February, 2005	4	4	Yes	3,318	4,740 kWh
C&I Motors	DS, DP, DT, GS-FL, EH & SP	February, 2005	20	96	Yes	12,215	83,712 kWh
C&I HVAC	DS, DP, DT, GS-FL, EH, SP & TT	May 2007 as part of DSM	2		Yes	1,722	
PowerShare	DS, DP, DT, GS-FL, EH, SP & TT	May 2007 as part of DSM			Yes		

(1) Energy savings included in Residential Conservation and Energy Education

Final Report  
**Estimates of the Energy Effects of the Payment  
Plus Pilot Program's Energy Education Workshop**

A Look at the Energy Consumption Of Pilot Participants  
and Kentucky & Ohio Weatherization Participants

APPENDIX A

**September 13, 2005**

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# Table of Contents

**EXECUTIVE SUMMARY ..... 2**  
    ABOUT THIS REPORT ..... 2  
    SUMMARY OF FINDINGS..... 2

**INTRODUCTION ..... 4**  
    EVALUATION METHODOLOGY ..... 5

**ENERGY USE ANALYSIS AND FINDINGS ..... 9**  
    *Sample Size*..... 9  
    *Statistical Precision*..... 9

**SECTION 1: CHANGES IN ENERGY CONSUMPTION..... 10**  
    *Changes in Electrical Consumption*..... 10  
    *Changes in Natural Gas Consumption*..... 15  
    *Changes in Natural Gas Consumption for those that Decreased their Consumption*..... 19

**SECTION 2: ESTIMATES OF ENERGY SAVINGS ATTRIBUTABLE TO THE EDUCATIONAL  
COMPONENTS OF THE PILOT PROGRAM ..... 23**  
    *Electrical Consumption Savings Estimates* ..... 24  
    *Therm Consumption Savings Estimates*..... 26

**CONCLUSIONS AND RECOMMENDATIONS ..... 28**

**APPENDIX A: MODIFICATIONS TO THE PREVIOUS REPORT ..... 29**

## Executive Summary

### About This Report

This report presents the results of an impact evaluation of Cinergy's Payment Plus Pilot Program and compares these results with the results from an impact evaluation of the Weatherization Program offered by Cinergy in Kentucky and Ohio. The Payment Plus Pilot program provides energy efficiency, conservation and financial management training to participants along with home weatherization services. The Ohio and Kentucky Weatherization program provides weatherization services. For comparison purposes the Kentucky and Ohio Weatherization Program participants are grouped together for this analysis in order to obtain a more reliable sample that more accurately estimates the impacts from the Weatherization programs. These two weatherization programs' participants are grouped into one assessment group because the program offerings and the participant weather is nearly identical allowing for a more rigorous assessment.

The analysis for the Pilot Program includes all participants that had enough reliable energy consumption data to conduct the analysis.

The Pilot program was first implemented in January 2002 and ran through May of the same year (Pilot Program I). The program was evaluated, modified and implemented again in June 2003 and ran through November 2003 (Pilot Program II). The Pilot Program serves high-arrears low-income customers who are also typically LIHEAP participants. The Kentucky and Ohio Weatherization programs serve LIHEAP customers, but does not provide a formal energy education. The homes examined in this study were weatherized between July 2002 and October of 2003.

The effect of the added education and training components of Cinergy's Payment Plus Pilot Program was evaluated by comparing the Pilot Participants (both Pilot I and Pilot II) to participants that only received only weatherization services. The difference in energy consumption between these two groups provides an estimate of the effects that can be attributable to the education that the participants received as a part of their participation in the Payment Plus Pilot Programs.

The first section of this report details the energy impacts of the Payment Plus Program as they compare to the energy savings realized by the participants of the Kentucky and Ohio Weatherization Programs. The second section dissects these results to estimate the level of energy savings that can be attributable to the educational component of the Payment Plus Program.

### Summary of Findings

TecMarket Works examined customer energy consumption records for a period of one to three years before the program and for one to two years following the program (depending on record availability). However, the analysis of the Payment Plus Program is based on a small population of participants (please see the discussion on sample size in "Energy Use Analysis and Findings"). The results of this analysis are presented in the

Energy Use and Analysis section of this report. The combined energy impact analysis results include:

1. Both kilowatt-hour and therm savings increase consistent with the level of Weatherization services provided. Weatherization program participants save on average 181 therms and 623 kilowatt-hours per year. When looking at the program components, Tier 1 participants save 142 therms and 229 kilowatt-hours, Tier 2 participants save 194 therms and 698 kilowatt-hours, and Tier 3 participants save 217 therms and 1104 kilowatt-hours per year. The more weatherization services received, the more savings are realized. However, this analysis does not look at the cost effectiveness of these investments, just savings.
2. The kilowatt-hour savings of the participants of the Kentucky and Ohio weatherization program are, on average, 623 kilowatt-hours per year. The savings of the Payment Plus program participants are significantly higher, with weatherized participants saving an average of 2,588 kWhs per year, and those that were not weatherized savings 2,813 kWhs per year.
3. The therm savings of the participants of the Kentucky and Ohio weatherization program are, on average, 181 therms per year for those that decreased their consumption. The savings of the Payment Plus program participants who decreased consumption, reduced their consumption significantly more, with weatherized Pilot II participants saving an average of 299 therms per year Pilot II participants that were not weatherized realized savings of only 106 therms per year, on average.

TecMarket Works estimated the energy consumption changes due to the increased educational component of the Payment Plus Program. The results of this analysis are presented in the *Estimates of Energy Savings Attributable to the Educational Components of the Pilot Program* section of this report. The results of the estimated energy impact of the educational component include:

1. The energy education component of the Payment Plus Programs results in a decrease in kWh consumption of about 19.8% - 22.0% kilowatt-hours per year. The results from the two methods used for estimating these savings (explained in section 2) are statistically similar and should be regarded as a strong indication of the effects of the educational workshops.
2. Estimates of therm savings from the educational components are not as similar across the two analysis approaches, indicating that from 49 - 217 therms per year can be attributed to the educational workshops of the Payment Plus Program.

The findings presented below indicate that the training and weatherization services received by the participants of both programs have resulted in decreased energy consumption.



## Introduction

This report presents the results of an impact evaluation of Cinergy's Payment Plus Pilot Program. This program provides energy efficiency, conservation and financial management training to participants along with home weatherization services. The program was first implemented from January through May of 2002 (Pilot Program I). The program was evaluated, modified and implemented again in June through November 2003 (Pilot Program II).

The Kentucky and Ohio Weatherization program participants are LIHEAP customers that have received weatherization services from Cinergy, but they have not received a formal energy education, similar to that provided in the Pilot Program. Comparing the Pilot Participants savings (both Pilot I and Pilot II) with those that are only weatherized provides a way to estimate the impacts that can be attributed to the Pilot Program education efforts. It should be noted that the Weatherization component of the program was modified from a three Tier system to a two Tier system during the period of this analysis. Findings for the Tier 2 and Tier 3 Weatherization participants include this change.

For a detailed description of the Payment Plus Pilot Programs, please refer to the August 2004 report by TecMarket Works titled "An Evaluation of the Payment Plus Pilot Program; Results of a Process, Energy Consumption and Arrearage Effects Evaluation".

## Evaluation Methodology

The study methodology consisted of a comparison group adjusted, weather-normalized energy use analysis to determine if participation in the Pilot Programs or the Weatherization Program resulted in energy savings.

Energy savings for the Pilot Program II participants and the Kentucky and Ohio weatherization recipients were identified by assessing the change in energy usage of the participants compared to the change in consumption of a comparison group of eligible customers who did not participate in the program or receive any weatherization services. The Princeton Scorekeeping Method (PRISM™) software was utilized in this analysis. PRISM™ is capable of providing weather-normalized data analysis of energy use.

An analysis was conducted on six groups of participants to identify changes in both kWh and therm consumption. The groups are:

1. Pilot II weatherized participants,
2. Pilot II participants who were not weatherized, and
3. All Kentucky and Ohio weatherization recipients that were not participants in the Payment Plus Program.
4. Tier 1 Kentucky and Ohio weatherization recipients.
5. Tier 2 Kentucky and Ohio weatherization recipients.
6. Tier 3 Kentucky and Ohio weatherization recipients.

Sample sizes for the Payment Plus groups are small, and should be considered as preliminary findings until there are enough pilot program participants to conduct a more rigorous assessment.

All analyses used a comparison group of 725 matched customers. These customers were LIHEAP recipients for three or four years out of the four years of data provided, and who had two or three years of billing data (depending on data availability).

After the comparison group was selected, further cleaning was conducted to eliminate those customers that did not have sufficient data for the study or included accounts in which there was a tenant change. These customers were analyzed with PRISM to obtain a comparison group that had clean and statistically reliable and similar consumption profiles. This “cleaning effort” left approximately 725 customers out of the original 1,317 customers that could be used for the matched comparison group for both the Payment Plus participants and the Weatherization participants. These customers were then randomly assigned false participation dates to establish the pre- and post-program analysis periods for the control group.

Participants’ data was also separated into pre and post periods. Participants who were weatherized after the educational workshops had their pre-participation data begin before the workshops, and their post-participation period beginning after the weatherization measures were installed at their home. Data between these two dates is not included in

the analysis. Participants who were not weatherized, or who were weatherized before the pre-participation period started, had their post-participation data begin one month after participating in the workshops.

The data that was used for this analysis was provided from Cinergy's monthly-metered account database. The data was provided in therms and kWh per month per customer for up to three years before the program and for up to twenty-four months after the program.

This report presents the savings in annual kilowatt-hours of electricity and therms of natural gas, and percent savings. Mean and median summaries are provided for each of the six groups of customers. A description of the PRSIM™ software is provided in the following section.

### PRISM™ Analysis

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 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, 1992 through December 31, 2002, recommended by PRISM™ support.

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, statistically described as the amount of variance in energy consumption explained by changes in degree-days. Energy consumption is assumed to be a linear function of degree-day.  $R^2$  varies from 0 to 1. If  $R^2$  is close to zero, it means that factors other than outdoor temperature are driving energy consumption. If the  $R^2$  is close to 1 it means that outdoor temperature is almost entirely responsible for energy consumption. Outdoor temperature is usually the overriding factor in both heating and air conditioning 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 and air conditioning systems 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 energy use is temperature dependant. If less than 70 percent of the energy used 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. For therm 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 percent or more of heating fuel use in this study is temperature driven. 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.

## Energy Use Analysis and Findings

One of the goals of the Payment Plus Program is for participants to learn ways to be more energy efficient. In this analysis, we examined and compared energy usage of Pilot Program II participants, and a comparison group of non-participants, over the years before and after the program. We also compared the usage of the Pilot participants who were weatherized, to the Cinergy's Kentucky and Ohio weatherization participants to identify an estimate of the effects of the energy efficiency education the Payment Plus participants received through the Pilot Program.

### Sample Size

Many of the customers in both the participant and the control group did not have a history of account information prior to program enrollment, or they had moved shortly after the program, making their consumption data unavailable or not relevant for the analysis. As a result, many participant accounts had to be eliminated from this study. The Pilot II results are based on thirty-one weatherized participants and eighteen non-weatherized participants (49 total). The group of Kentucky and Ohio weatherization program participants consists of 541 customers that had sufficient and valid account history to be included in the analysis. The comparison group consists of approximately 725 low-income customers with pre-participation payment and consumption histories that are similar to the participants.

Despite the small size of the Pilot groups, the precision levels are sufficient enough to draw conclusions of the overall effects of the program. However, as the program continues over the next few years, these findings will need to be confirmed. This report allows policy makers to have evidence of program effects early in the life of the program's efforts.

### Statistical Precision

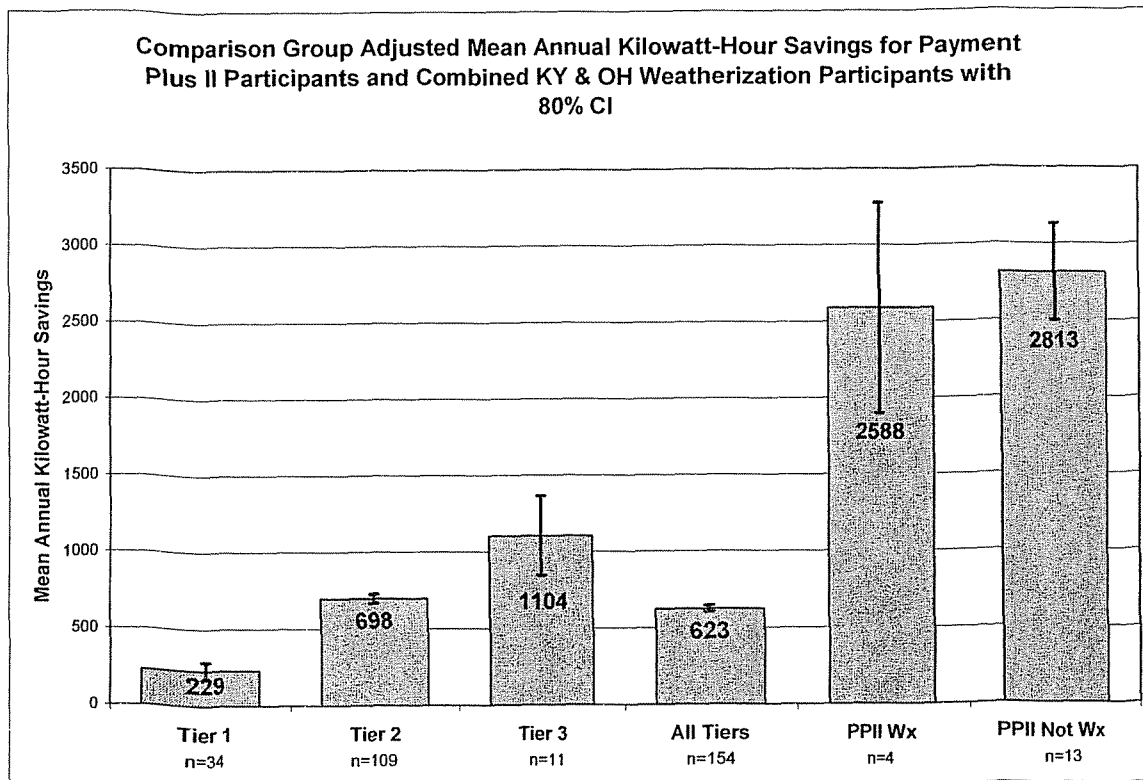
All of the analytical runs conducted in PRISM™ provide a  $R^2$  and CV(NAC) value that indicates the strength of the results provided. The higher the  $R^2$  value (maximum value is 1.0), and the lower the CV value, the more reliable the results are. All therm results presented in this report have a minimum  $R^2$  value of .70 and a maximum CV value of 7.0%, making the results presented highly reliable. The kilowatt-hour results have no minimum  $R^2$  value, but a maximum CV value of 7.0%. For more information on PRISM™ and these statistics, please see the section on methodology.

## Section 1: Changes in Energy Consumption

### Changes in Electrical Consumption

Kentucky/Ohio weatherization and Pilot II were successful at assisting customers with reducing their electrical consumption. Figure 1 shows the six groups analyzed in PRISM™ and their electrical savings per year. (There was not enough data to assess the group of Pilot I participants.)

Pilot II participants who were not weatherized reduced their consumption by 2,813 kWhs per year, after being adjusted for the comparison group, which increased their consumption. Pilot II participants that were weatherized decreased their consumption by an average of 2,588 kWhs per year. That is, both weatherized and non-weatherized Pilot II participants saved energy on their electric accounts. However, data variability in electric consumption is typically significant and we expect these values to be somewhat different each time this analysis is conducted.



**Figure 1. Comparison Group Adjusted Mean Annual Kilowatt-Hour Savings of Kentucky and Ohio Weatherization Recipients and Pilot II Participants**

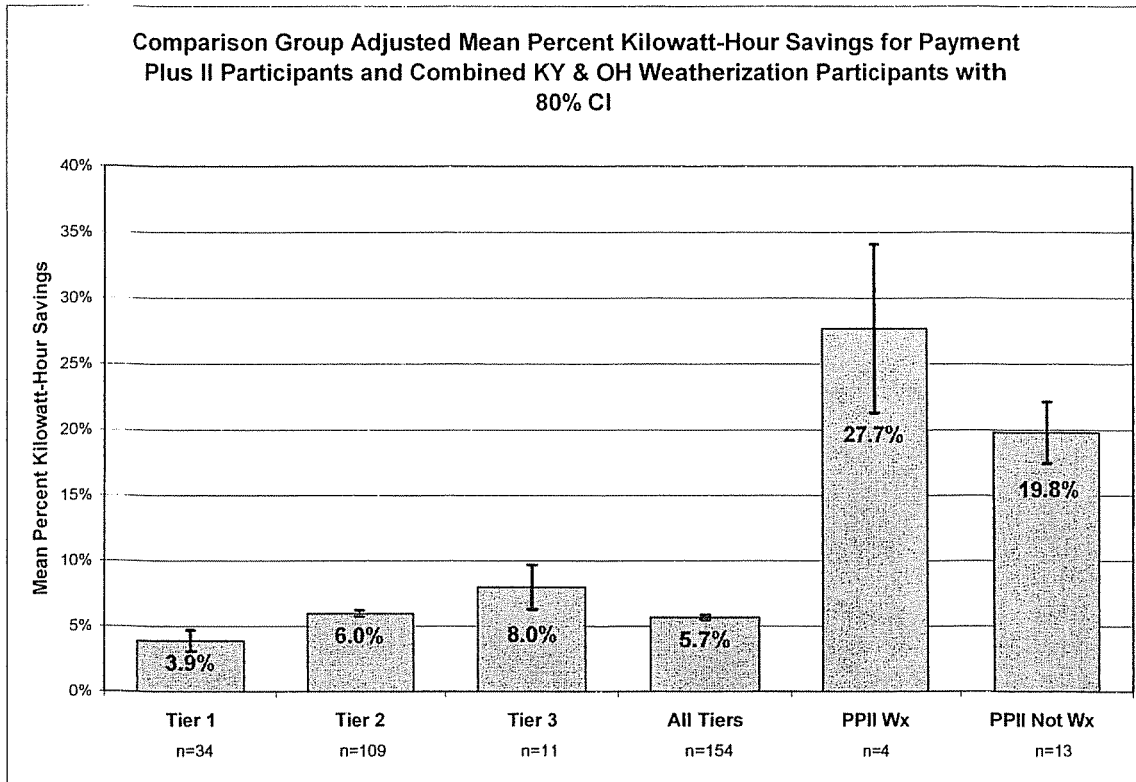
Kentucky and Ohio residents that received weatherization services from Cinergy reduced their consumption by an average of 623 kWhs per year. Those in Tier 1 saved only 229 kWhs/year, however, the customers placed in higher Tiers achieved higher savings. The

significance of these savings is that this group did not receive educational services. Their savings are due to weatherization services only.

The greatest electric savings were achieved by Pilot II participants who were not weatherized. These customers had the greatest mean annual kWh savings, with an adjusted net savings of 2,813 kWhs per year. However, again, these savings should be considered suggestive rather than confirmative (because of the small sample size) and we expect that while these savings relationships will continue in future studies, we also expect the amounts of savings to fluctuate.

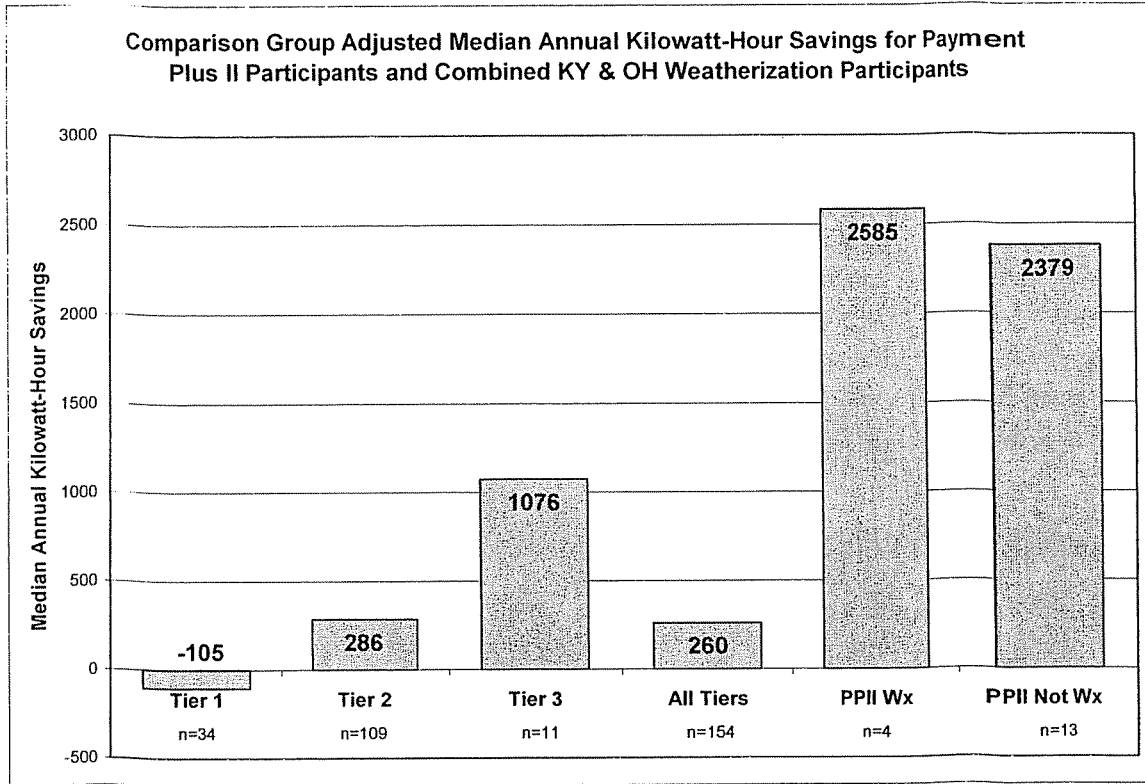
PRISM™ also calculates the net percent change in electrical consumption, which is presented in Figure 2. The comparison group increased their electrical consumption by 3.3%, while Pilot participants, on average, decreased their consumption. Weatherized Pilot II participants had the greatest decrease in consumption with an average 27.7% comparison group-adjusted net reduction. Pilot II participants that were not weatherized also achieved impressive net electric savings by decreasing their consumption 19.8% without weatherization services. Kentucky and Ohio weatherization recipients only slightly decreased their electric consumption by, on average, 5.7%. This lack of savings could be attributed to the fact that this group received only limited educational services, indicating that the energy education workshop component of Payment Plus is successful in decreasing the electrical consumption of the participants. Other estimates of the savings attributed to the educational component will be discussed in Section 2 of this report.





**Figure 2. Comparison Group Adjusted Mean Percent Kilowatt-Hour Savings of Kentucky and Ohio Weatherization Recipients and Pilot II Participants**

Figure 1 and Figure 2 examined the mean net program electric savings. However, an examination of the median savings is also informative. The median kWh savings provides an alternate perspective on the energy savings associated with participation in the Pilot programs and Kentucky and Ohio weatherization programs. Pilot II participants who were not weatherized had a net median savings of 2,585 kWh/year, compared to a mean savings of 2,588 kWh/year (see Figure 1). Pilot II participants who were weatherized have a similar result, with a median savings of 2,379 kWh/year compared to a mean increase of 2,813 kWh/year, indicating that some of the participants greatly increased their consumption, bringing the mean to a high average increase across the entire group. This indicates that the program was very effective at reducing gross savings for the weatherized participants. More than half of the Kentucky and Ohio weatherization recipients decreased their consumption, as the median savings of 260 kWh/yr is positive. Those in Tier 1 have a median that is negative, indicating that over half of those in that group increased their consumption; however, the mean savings is still positive, allowing the group, as a whole to decrease their consumption.



**Figure 3. Comparison Group Adjusted Median kWh Savings of Kentucky and Ohio Weatherization Recipients and Pilot II Participants**

Figure 4 shows the median percent change in electric consumption. All Pilot participant groups analyzed decreased their electrical use by a median comparison group-adjusted value of 18.6% to 31.2%, while the Kentucky and Ohio weatherization program participants only managed a comparison group-adjusted median savings of 4.0%.

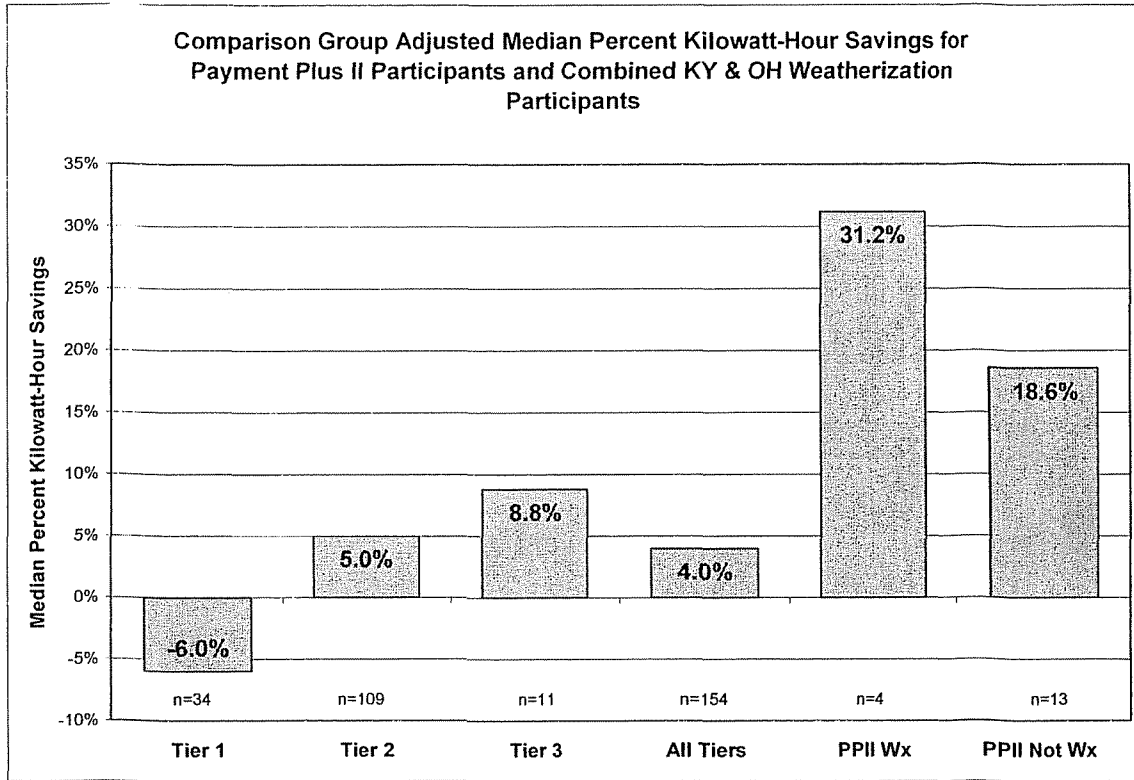
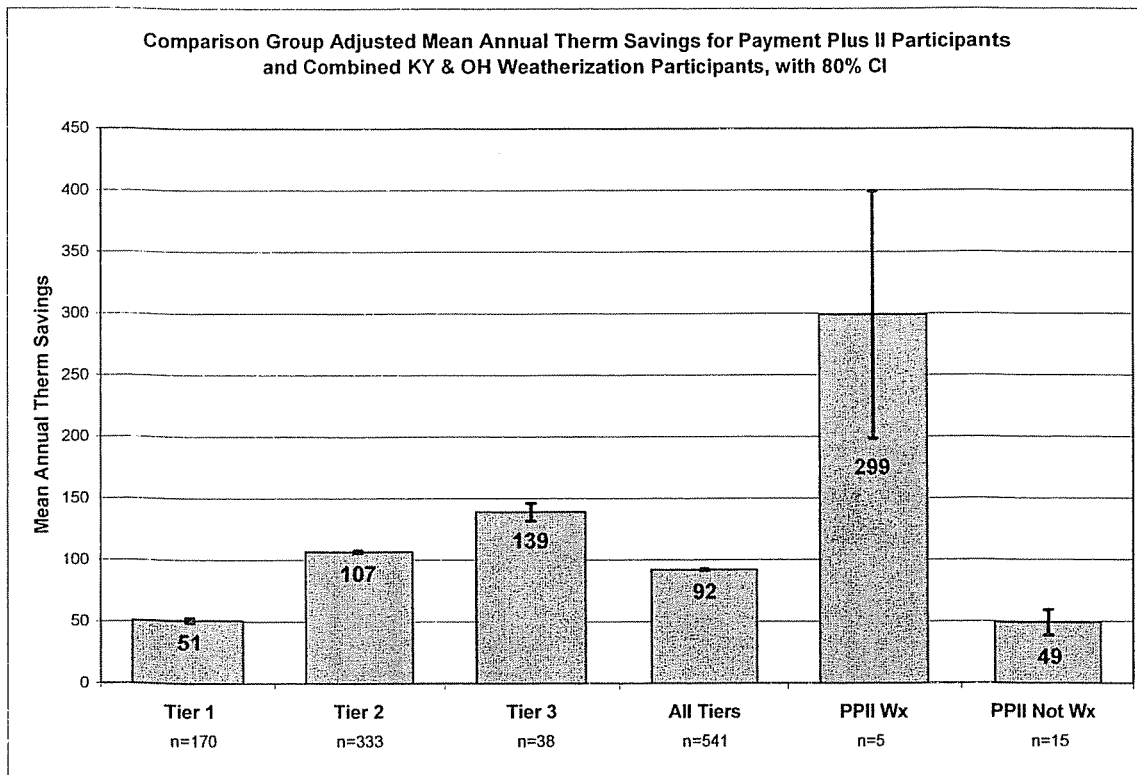


Figure 4. Comparison Group Adjusted Median Percent kWh Savings of Kentucky and Ohio Weatherization Recipients and Pilot II Participants

### Changes in Natural Gas Consumption

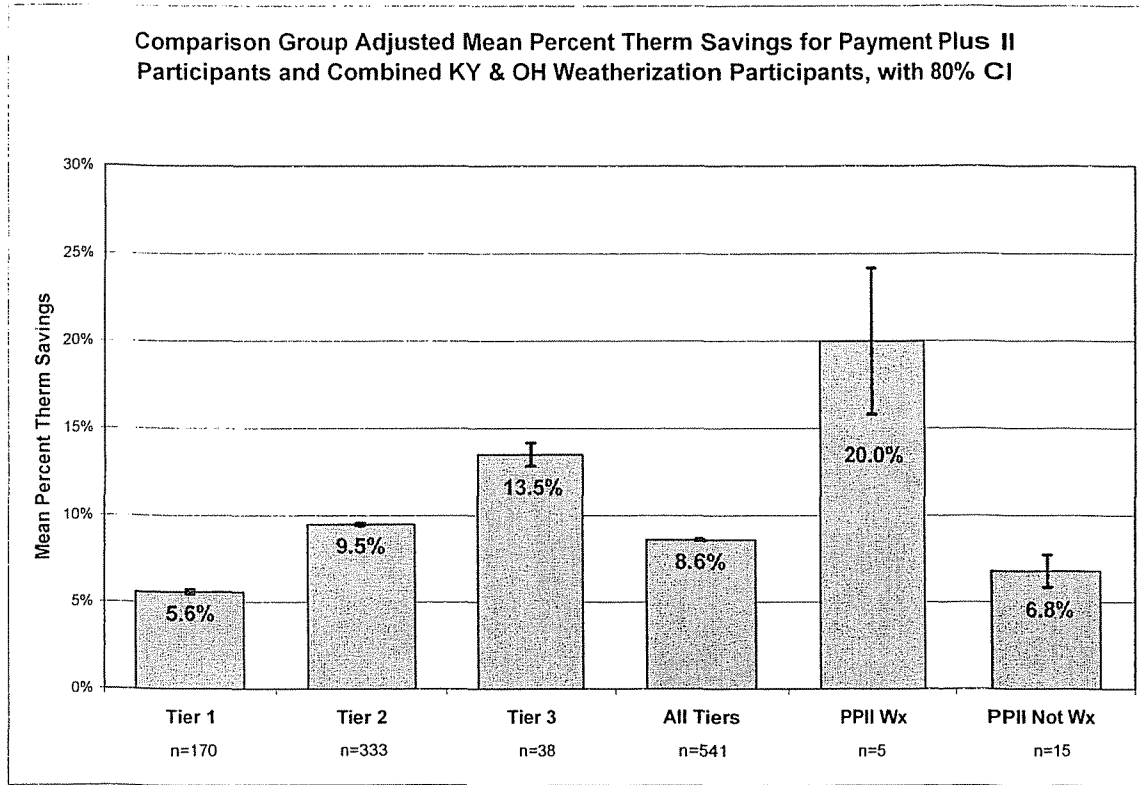
Participants also decreased the amount of natural gas they consumed after participating in the program. The comparison group used in this analysis is the same group that is used in the electrical analysis, however; in this case, the control group slightly decreased their consumption, by about 15 therms per year.

Figure 5 shows that weatherized participants have an advantage when it comes to reducing natural gas consumption. Weatherized Pilot II participants reduced their consumption by 299 therms per year. Kentucky and Ohio weatherization recipients reduced their consumption by 92 therms per year. Pilot II participants that were not weatherized were only able to save an average of 49 control-adjusted therms per year, slightly less than the Tier 1 weatherization participants.



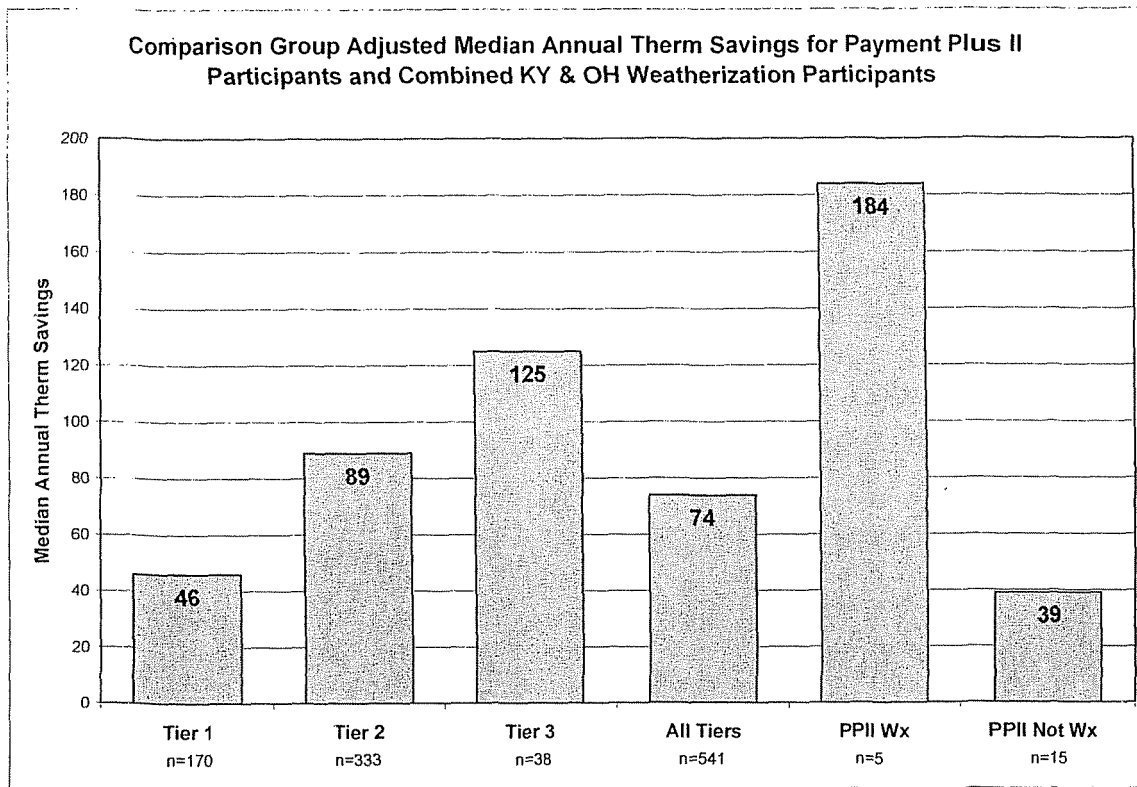
**Figure 5. Comparison Group Adjusted Mean Therm Savings of Kentucky and Ohio Weatherization Recipients and Pilot II Participants**

The average percent change in therm consumption shows a similar result, as seen in Figure 6. The participants who were not weatherized were able to decrease their consumption, by 6.8%, while weatherization allowed the Payment Plus participants to decrease their consumption by an average 20.0%. The Kentucky and Ohio weatherization recipients' consumption was reduced by an average 8.6%.



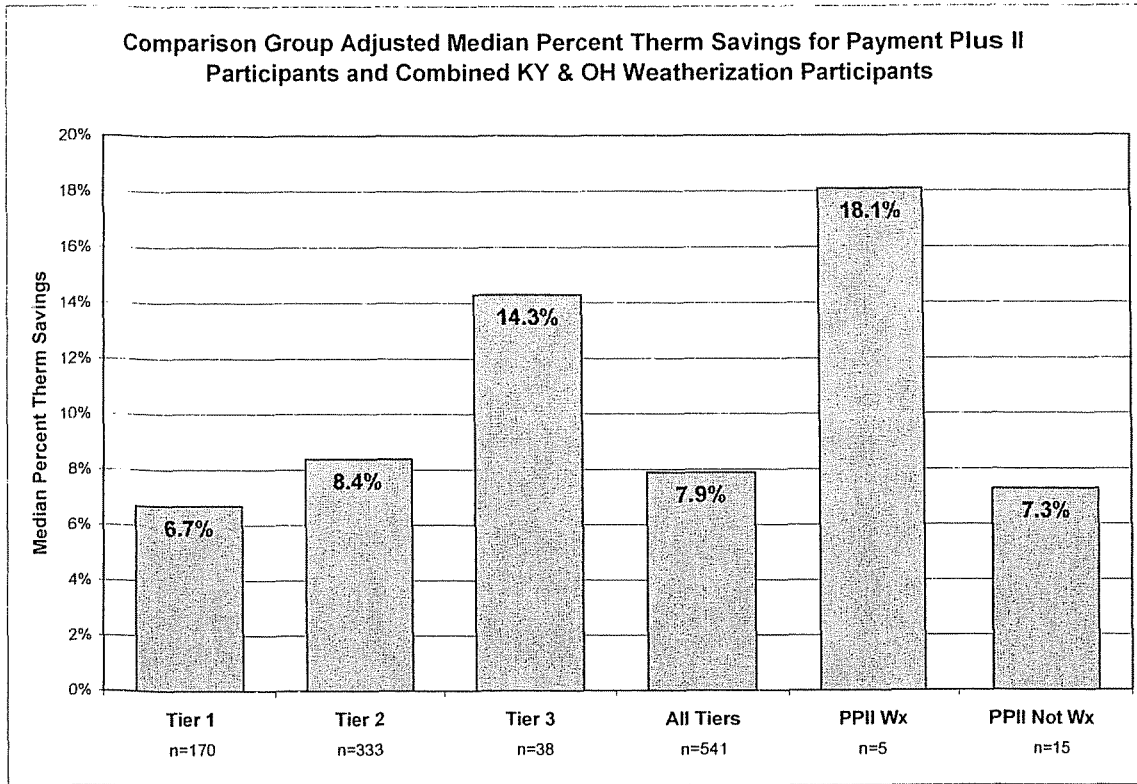
**Figure 6. Comparison Group Adjusted Mean Percent Therm Savings for Kentucky Weatherization Recipients and Pilot II Participants**

An assessment of the median savings aid the understanding of these results. The mean savings is high for the weatherized Payment Plus participants group, with a 20% reduction equal to 299 therms/year, however, the median savings, as shown in Figure 7 is 184 therms/year, indicating that there is a substantial sub-group that has experienced a high level of reduction in therm consumption. The other three groups have median scores that are similar to the mean therm consumption reductions, indicating that the average change is also the most expected change.



**Figure 7. Comparison Group Adjusted Median Therm Savings for Kentucky Weatherization Recipients and Pilot II Participants**

Figure 8 shows the median percent savings, and indicates that the Pilot II participants who were weatherized have the greatest amount of savings, with a median 18.1% reduction in natural gas consumption.

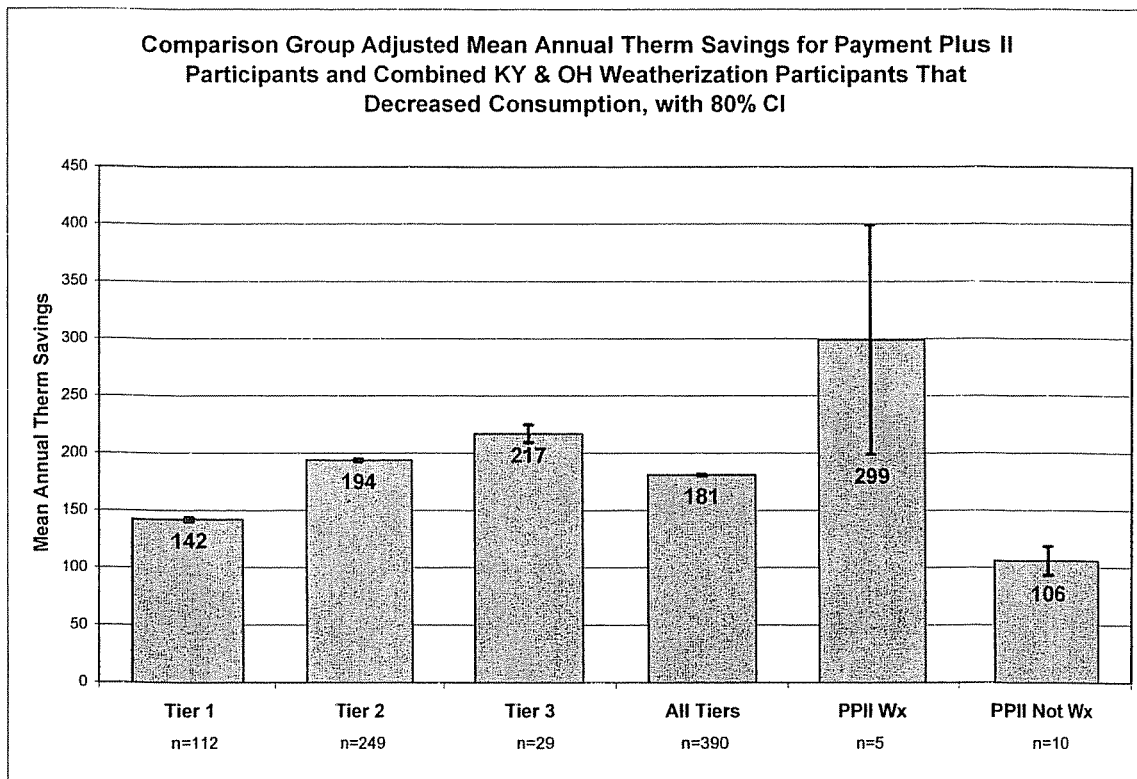


**Figure 8. Comparison Group Adjusted Median Percent Therm Savings of Pilot II Participants**

**Changes in Natural Gas Consumption for those that Decreased their Consumption**

We also looked at the changes in natural gas consumption for only those Kentucky and Ohio Weatherization customers who decreased their usage. Due to the fact that a house cannot consume more energy after weatherization takes place unless there are behavioral changes, we felt it was more representative of non-lifestyle changes (lifestyle changes include people added to the family, illness, etc.) by using the changes in consumption for those who decreased consumption.

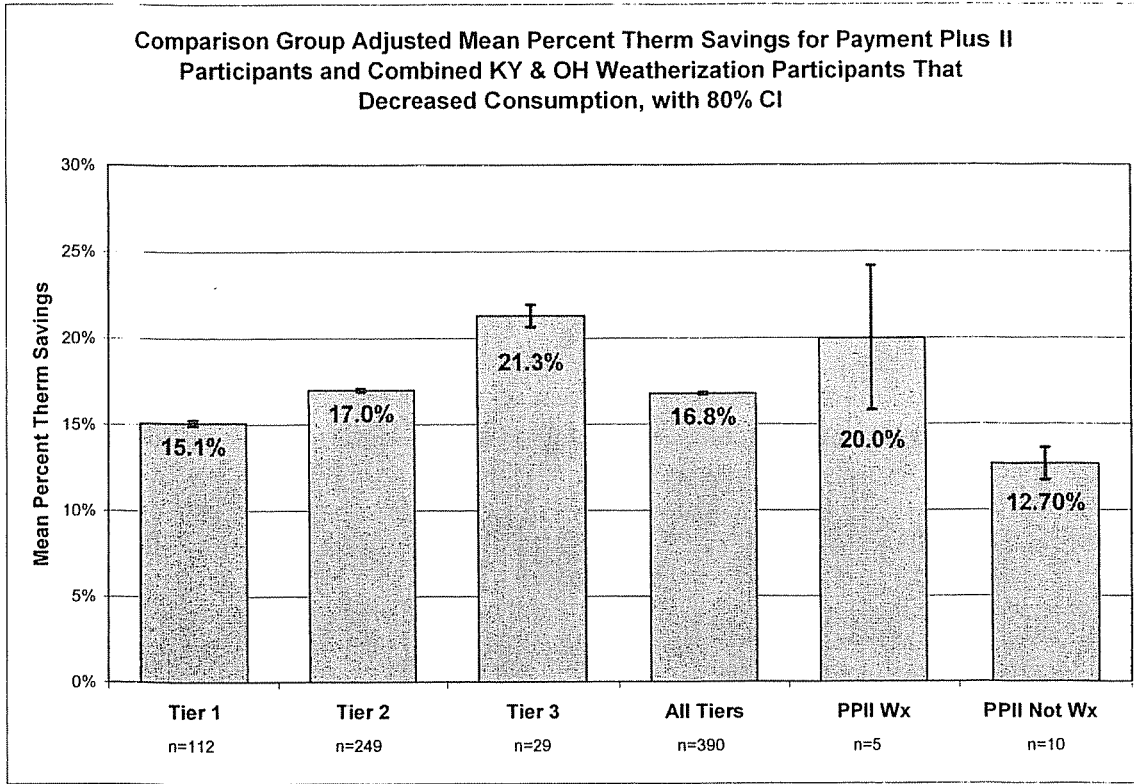
Removing the weatherized customers who increased their natural gas consumption from the analysis results in higher therm savings, as reported in Figure 9. With the customers who increased their consumption included in the analysis, Kentucky and Ohio Weatherization participants had an average savings of 92 therms/year, without these increasers, savings are 181 therms/year. Figure 10 below provides the mean percent changes in therm consumption.



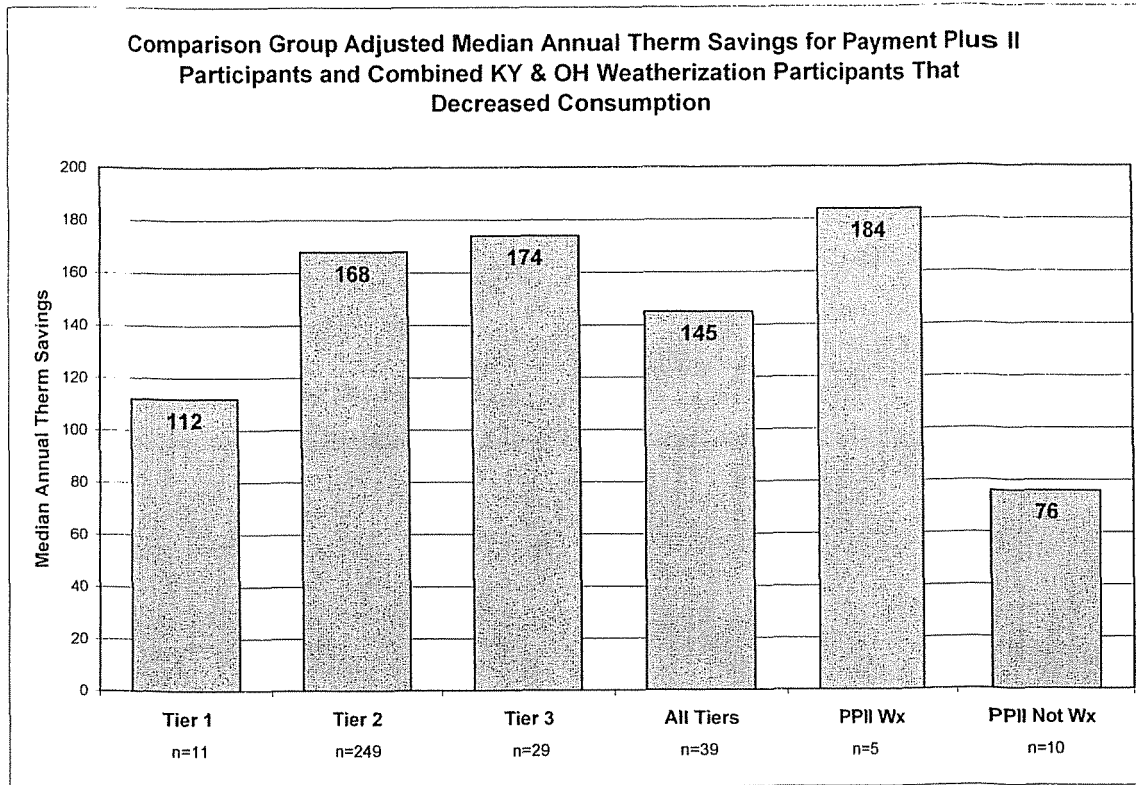
**Figure 9. Comparison Group Adjusted Mean Therm Savings of Kentucky and Ohio Weatherization Recipients and Pilot II Participants (Decreasing Consumption Only)**

Those in Tier 3 had the highest percent therm savings, with an average 21.3% decrease in therm consumption.



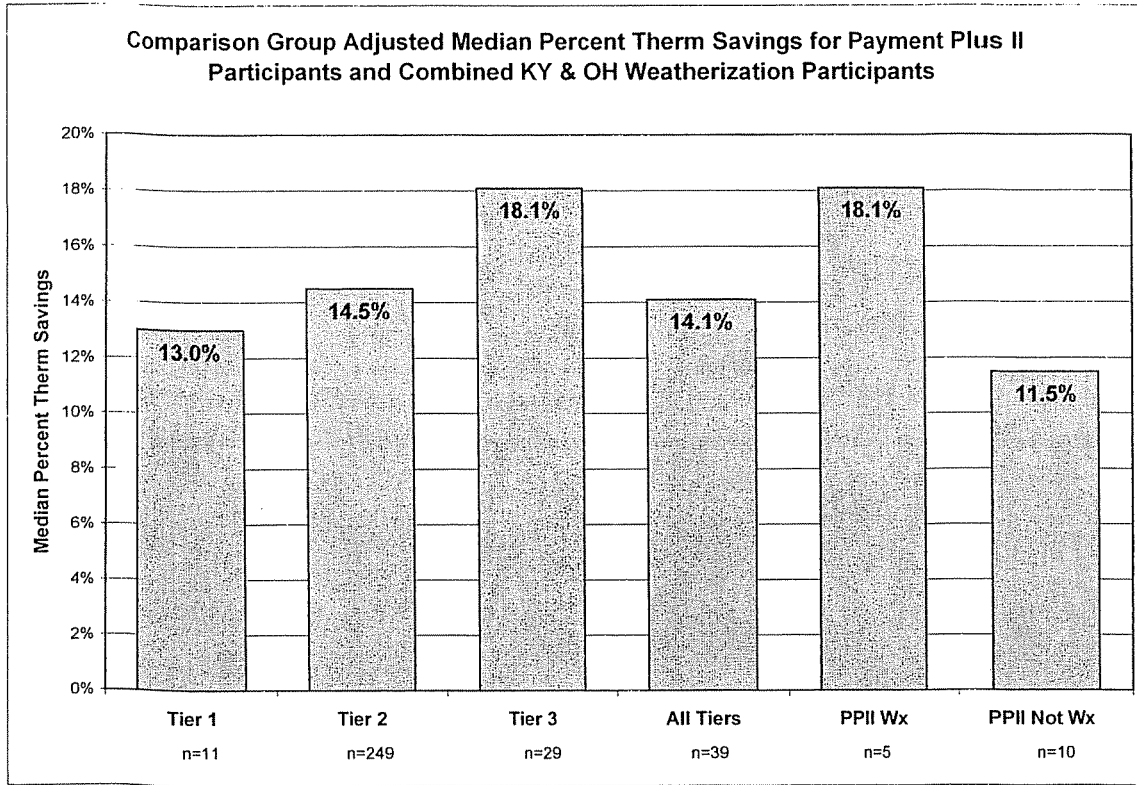


**Figure 10. Comparison Group Adjusted Mean Percent Therm Savings for Kentucky and Ohio Weatherization Recipients and Pilot II Participants (Decreasing Consumption Only)**



**Figure 11. Comparison Group Adjusted Median Percent Therm Savings for Kentucky and Ohio Weatherization Recipients and Pilot II Participants (Decreasing Consumption Only)**

In each of these groups, the mean (Figure 9) is larger than the median (Figure 11), meaning that for each of these groups, there are a number of customers with very high savings that are driving the higher means.



**Figure 12. Comparison Group Adjusted Median Percent Therm Savings of Kentucky and Ohio Weatherization Participants (Decreasing Consumption Only)**

**Section 2: Estimates of Energy Savings Attributable to the Educational Components of the Pilot Program**

This section will look at two different estimates for identifying energy savings that can be attributed to the energy education workshop component of the Payment Plus Pilot Program. Sample sizes for the Payment Plus groups are small, and should be considered as preliminary findings until there are enough pilot program participants to conduct a more rigorous assessment.

*Estimate 1:* This estimate takes the savings of Pilot II participants who were weatherized and who went through the energy education workshop. The values presented are the savings from the Pilot II participants (who received the education), less the savings of the Kentucky and Ohio weatherization participants (who did not receive the expanded education).

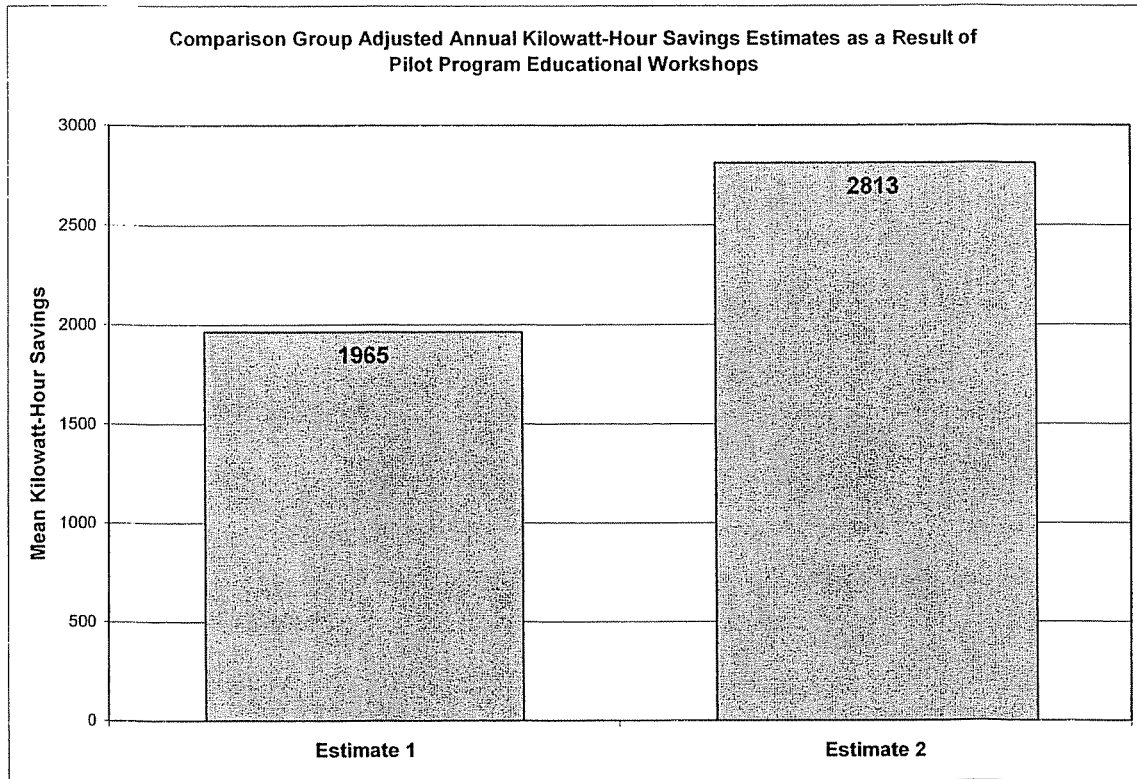
$$\begin{array}{rclcl}
 \text{Pilot II Participant Savings} & - & \text{Kentucky and Ohio Participant} & = & \text{Effect of} \\
 \hline
 & & \text{Savings} & & \text{Education} \\
 \hline
 \text{(weatherization + education)} & - & \text{(weatherization)} & = & \text{education}
 \end{array}$$

The values were previously adjusted by the same comparison group, so no further adjustment calculations are needed.

*Estimate 2:* Eighteen of the Pilot II workshop participants did not receive weatherization services from Cinergy (note there is an unknown potential for these participants to receive other assistance from other agencies); therefore, their savings are based solely on what they learned during the energy education workshops offered through the Pilot Program. In this group, all of the savings are therefore attributable to the effect of education, as that is the only service that they received from the program.

**Electrical Consumption Savings Estimates**

Annual electric savings that can be attributed to the educational component of the Pilot programs range from 1,965 kilowatt-hours per year to 2,813 kilowatt-hours per year (as seen in Figure 13), depending on the estimation approach used.



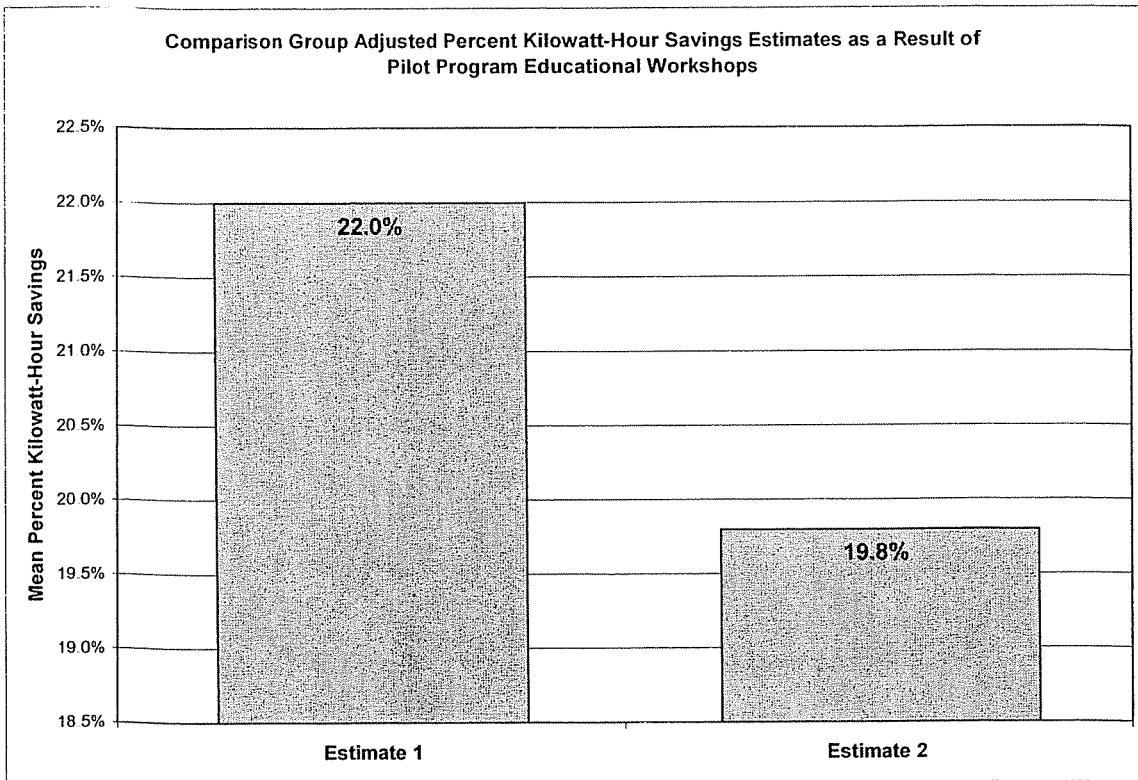
**Figure 13. Comparison Group Adjusted Annual Kilowatt-Hour Savings Estimates**

Estimate 1 used the savings from the Kentucky and Ohio weatherization participants less the savings from the Payment Plus participants who received weatherization services. Using this approach, the savings are estimated at 1,965 kilowatt-hours per year.

Estimate 2 uses the mean savings of the Payment Plus II participants that went through the educational workshop on energy efficiency, but did not receive weatherization measures. This approach results in an average 2,813 kilowatt-hours savings per year.

Giving both of these estimation approaches equivalent rating provides an average kilowatt-hour savings attributable to the educational component of the Payment Plus program of 2,389 kilowatt-hours per year.

Because of overall consumption levels of the different types of participants, the percent savings that can be attributed to the educational workshop tells a slightly different story. The savings estimates range from 19.8% to 22.0% attributed to the educational component of the Pilot programs. In these estimates, the lowest savings is from Pilot II participants that did not receive weatherization services and whose savings can be directly attributed to the workshop they attended as a Pilot program participant.



**Figure 14. Comparison Group Adjusted Kilowatt-Hour Percent Savings Estimates**

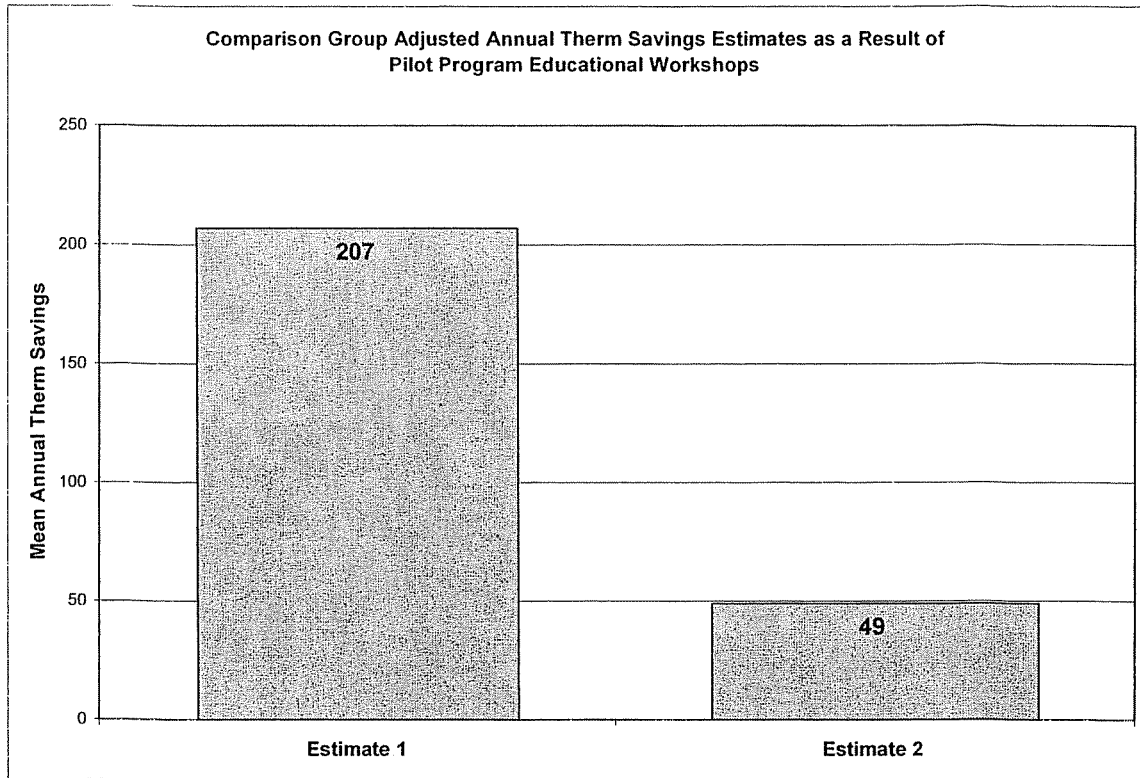
Estimate 1 used the savings from the Kentucky and Ohio weatherization participants less the savings from the Payment Plus participants who received weatherization services. Using this approach, the reduction in electrical consumption is estimated at 22.0%.

Estimate 2 uses the mean savings of the Payment Plus II participants who went through the energy efficiency educational workshop, but did not receive weatherization services. This approach results in a 19.8% reduction in electrical consumption.

The average percent kilowatt-hour savings attributable to the educational component of the Payment Plus program is 20.9%.

**Therm Consumption Savings Estimates**

Natural gas savings that can be attributable to the educational component of the Pilot programs range from a decrease of 49 therms per year to a decrease of 27 therms per year depending on the estimation approach (see Figure 15). The estimated savings using the Ohio and Kentucky weatherization service-only groups were able to reduce their therm consumption by more than four times what the Pilot II participants realized in reductions due to their participation in the educational workshops.



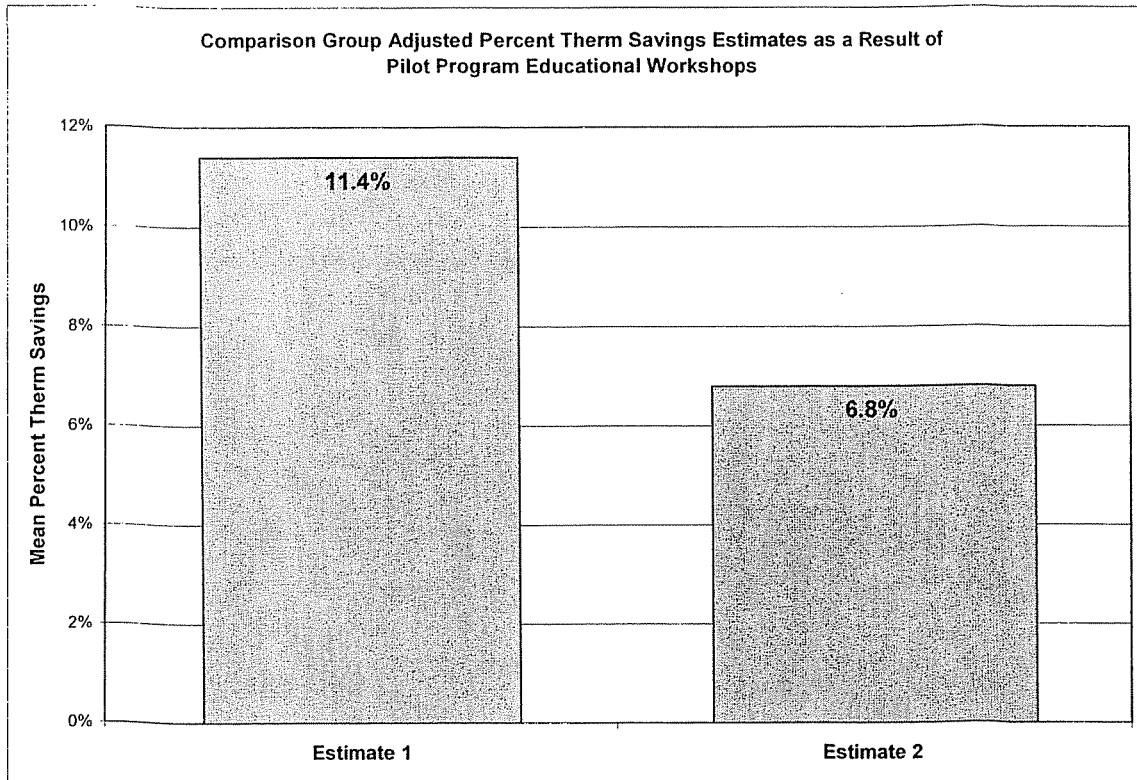
**Figure 15. Annual Therm Savings Estimates**

Estimate 1 used the savings from the Kentucky and Ohio weatherization participants less the savings from the Payment Plus participants who received weatherization services. Using this approach, the savings are estimated at 207 therms per year. (If only those customers who decreased their consumption after Kentucky and Ohio weatherization are examined, then this value decreases substantially to 118 therms per year.)

Estimate 2 uses the mean savings of the Payment Plus II participants who went through the energy efficiency educational workshop, but did not receive weatherization measures. This approach results in 49 therm savings per year.

The average therm savings attributable to the educational component of the Payment Plus program is 128 therms per year.

The percent reductions in natural gas usage range from a consumption decrease of 6.8% to a decrease of 11.4%. Again, the estimates using the methods described above result in more savings being attributable to the educational component of the program than the Pilot II participants who did not receive the weatherization.



**Figure 16. Therm Percent Savings Estimates**

Estimate 1 used the savings from the Kentucky and Ohio weatherization participants less the savings from the Payment Plus participants who received weatherization services. Using this approach, the reduction in natural gas consumption is estimated at 11.4%. (If only those customers who decreased their consumption after Kentucky and Ohio weatherization are assessed, then this value decreases substantially, to 3.2%.)

Estimate 2 uses the mean savings of the Payment Plus II participants who went through the energy efficiency educational workshop, but did not receive weatherization measures. This approach results in a 6.8% reduction in natural gas consumption.

The average percent natural gas savings attributable to the educational component of the Payment Plus program is 9.1%.



## Conclusions and Recommendations

The findings presented above indicate that weatherization program participants are consistently saving energy. The findings also show that there are additional savings if there is an expanded educational component to the program.

- Weatherization program participants save on average 181 therms and 623 kilowatt-hours per year. When looking at the program components, Tier 1 participants save 142 therms and 229 kilowatt-hours, Tier 2 participants save 194 therms and 698 kilowatt-hours, and Tier 3 participants save 217 therms and 1104 kilowatt-hours per year.
- While Weatherization program participants save an average of 623 kilowatt-hours per year, the Payment Plus participants were able to save from 2,588 to 2,813 kilowatt-hours annually, more than a 4-fold increase.
- For gas savings, Kentucky and Ohio weatherization recipients saved an average 181 therms annually while the Payment Plus participants who were weatherized saved 299 therms per year.
- Non-weatherized Payment Plus participants were also able to achieve savings of 49 therms per year as a result of the educational component.
- Half of the Payment Plus participants that were weatherized were able to save 184 therms or more annually, averaging a reduction of 18.1% in natural gas consumption.
- The educational component of the Payment Plus Pilot Program appears to be responsible for an annual savings of 1,965 – 2,813 kilowatt-hours and from 49 to 207 therms.

The results of this study indicate that the Payment Plus Program is highly successful at teaching participants energy conservation via the educational components of the program. Future Pilot Programs will need to be analyzed further to confirm this finding because of the small sample sizes used in these studies. TecMarket Works recommends that the educational component continue to be a requirement of the program and that follow up evaluations are conducted to increase the sample sizes available for these studies.

## Appendix A: Modifications to the Previous Report

In August of 2004 TecMarket Works conducted an evaluation of the Payment Plus Pilot Program<sup>1</sup>. This previous study used a limited control group for that assessment by identifying LIHEAP customers with a \$500 arrearage.

As a result of conducting an evaluation of the Ohio weatherization program (subsequent to the August 2004 report) we were able to obtain additional LIHEAP customers that could also be used to expand the more limited control group used in the August 2004 Payment Plus Pilot Program evaluation. The findings from the inclusion of the additional control group customers are incorporated into the findings in this report, therefore the energy consumption analysis results for the Payment Plus customers have slightly changed. We felt it necessary to use this expanded control group in order to gain a better understanding of the participants' energy usage.

This appendix provides a brief presentation of how the inclusion of the additional control group members influenced the previous findings presented in the August 2004 report. In the opinion of TecMarket Works, the expansion of the previous August 2004 control group increases the accuracy of the evaluation findings for the Payment Plus Pilot Program evaluation by providing a larger and more representative control group than the August 2004 control group.

The electric savings using the older August 2004 control group and the newer enhanced control group are presented in Table 1 below. The table below includes adjustments to the August 2004 control group energy savings by including the larger and more representative control group. These old values for the participants in the table are different than what was reported above in this report because there was different reliability criteria applied to the analysis. The reliability criteria used in this current study are based on non-weather correlated electric consumption rather than weather correlated consumption. The reliability criteria was changed because the electric consumption of both the participant and control group were found to not be strongly correlated to weather, and as a result the electric savings data is not weather normalized savings.

Table 1 below presents the difference between the August 2004 evaluation-reported electric savings and the current report (presented above) for Payment Plus Pilot Program Participants. The reader will note that the savings adjustments are not extensive, but do allow the evaluation to be more accurate.

---

<sup>1</sup> Evaluation of the Payment Plus Program: Results of a Process, Energy Consumption, and Arrearage Effects Evaluation, August 2004, Nick Hall and Johna Roth, TecMarket Works.

**Table 1. Changes to the August 2004 Reported Energy Savings Values as a Result of the Combined Control Group**

Energy Savings	Mean kWhs per Year	Mean Percent kWhs	Median kWhs per Year	Median Percent kWhs
<i>Old Values Reported in the August 2004 Report</i>				
Pilot I Weatherized	1868	11.4%	1874	11.2%
Pilot II Weatherized	-169	4.3%	1964	11.5%
Pilot II Not Weatherized	1375	5.0%	1256	6.3%
Old Control	571	8.1%	434	3.1%
<i>New Values in This Report Which Uses the Expanded Control Group</i>				
Combined Control	220	3.3%	143	2.5%
Difference	351	4.8	291	0.6



Morgan Marketing Partners

**APPENDIX B**

**Low Income Refrigeration Program  
Kentucky & Ohio  
2006 Savings Analysis**

**August 1, 2007**

**Submitted by Rick Morgan**



## Morgan Marketing Partners

### Refrigerator Analysis 2006

Duke Kentucky and its Energy Collaborative proposed in the September 27, 2002 filing in Case No. 2002-358 and subsequently received approval to expand the low income weatherization program to include refrigerators as a qualified measure in owner occupied homes. This program is also offered in the Duke Ohio territory. This memo is to report the data analysis to determine the average savings for the Low Income Refrigerator replacement program in Ohio & Kentucky territories during 2006.

#### Field Protocol

To understand the data results, it is important to understand the field protocol to determine the existing refrigerator's efficiency and whether it qualifies for replacement. The refrigerators are tested in homes that are being weatherized through either the Duke Energy Low Income Weatherization program and its delivery contractor, or the State Weatherization program delivery by the state weatherization agency in the area. When an delivery contractor auditor comes to the home to determine weatherization requirements, they install a digital power meter directly to the refrigerator. The refrigerator plugs into the power meter, manufactured by Brand Electronics, which then plugs into the wall. The auditor calibrates the unit and then lets it run for two hours at a minimum. Two hours is required so that the unit can stabilize and cycle. While more time would be optimal for increased accuracy, two hours has been shown to be able to determine poorly operating units that need replaced.<sup>1</sup>

The Protocol which follows specifies the steps that are taken by the auditor in the home and the applicable data entered.

#### Protocol Steps

1. *Clean refrigerator coils and Check seal on door gasket.*
2. *Check to see that the refrigerator closes tightly.*

---

<sup>1</sup> *SELECTION OF HIGH USAGE REFRIGERATORS AND FREEZERS* by Jim Mapp April 16, 1998. & *Low-Income Refrigerator Replacement – Selection Criteria for High Usage Refrigerator Replacement* by Jim Mapp Ph. D. Wisconsin Division of Energy, Kathy Schroder, Program Manager Cinergy Corp, and Rick Morgan, President Morgan Marketing Partners, 2001 IEPEC



## Morgan Marketing Partners

3. Open door and take data: Brand \_\_\_\_\_  
Model Number \_\_\_\_\_ Size \_\_\_\_\_  
Serial Number \_\_\_\_\_
4. Close Door when compressor comes on and note wattage. (remember to zero the watt meter before you start) Running Wattage: \_\_\_\_\_ watts
5. Let operate normally for two hours or more with door closed and take the total minutes and the kWhY reading (kWh per year estimate).  
Total Minutes: \_\_\_\_\_ kWhY reading: \_\_\_\_\_
6. Record peak running wattage at end of the test. Peak Watts \_\_\_\_\_
7. If Peak Wattage is less than 325 watts and the refrigerator has an estimated annual energy usage over 1315 kWhY – **Replace the unit.**
8. If Peak Wattage is more than 325 watts and the refrigerator has an estimated annual energy usage over 1565 kWhY – **Replace the unit.**

### Additional Information Collected

- Customer Name
- Address Where Unit Installed
- Customer Duke Energy Electric Account Number
- Number in Family
- Square Feet of dwelling
- Replacement Unit Size in ft<sup>3</sup>
- Special Conditions in the home
- Date New Unit Ordered
- Date New Unit Delivered
- Old Unit Removed by
- A second refrigerator used by the customer to be removed
- Auditor Name



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The meter calculates the annual kWh consumption based on the watts used over the period of the test. If the refrigerator is calculated by the meter to consume over 1315 kWh year (kWhY) it is replaced at no charge to the customer. However, defrost cycles sometimes initiate over the two hour test period which would skew consumption estimates. When a defrost cycle is occurs the meter measures a higher peak watt consumption during the test which is seen in the data. If the unit shows higher than 325 peak watts during the test, it is assumed that the unit has gone into defrost mode. The 325 was chosen as most compressors use 250 watts or less to operate and then with the lights included, would equal 300 peak watts or less. When the unit shows this high wattage demonstrating defrost mode, the kWh per year must equal 1565 kWh or more to be replaced. Units that have bad seals as determined by the auditor can be replaced in special cases even if the meter wattage is below the requirement.

If a unit is found to need replacement, the auditor orders a unit from the specified vendor providing the Energy Star unit. Three sizes are available, 21 cubic feet, 18 cubic feet and 15 cubic feet. The auditor determines the size for the replacement. The auditor is allowed to go to larger sizes under special circumstances. Of the total units replaced in both states, 40% were 21 ft<sup>3</sup>, 58% were 18 ft<sup>3</sup> and 2% were 15 ft<sup>3</sup>.

Old units are required to be removed by the refrigerator supplier at the time of the delivery of the new unit and the old unit is environmentally recycled. This assures that the old refrigerator does not continue to be used by the customer or get resold in the secondary market thus taking it permanently off the grid. If there is a second refrigerator on the premise that is working and the customer does not want it anymore, the program will remove and recycle the unit for free. The program has not been successful in getting second units removed as no second units were picked up during 2006. This may be an area that the program wants to work on in future years.

Field data is then entered into a database and was reviewed for this analysis. Savings is determined by taking the metered consumption estimate for the year (kWhY) minus the energy consumption rating for the specific Energy Star refrigerator replacing the original unit. These Energy Star consumption estimates are determined by the standardized manufacturer testing in accordance with Energy Star guidelines. Those consumption estimates are:

- 443 kWh/yr for 21 cubic foot
- 434 kWh/yr for 18 ft<sup>3</sup>
- 372 kWh/yr for 15 ft<sup>3</sup>



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## Results

The program data shows that there were 666 units tested in Ohio and Kentucky programs and 291 replaced. That is 43.7% replacement rate. By state information is listed below.

State	Tested	Replaced	Percent
Ohio	517	227	44%
KY	149	64	43%
Totals	666	291	43.7%

Based on the 2006 data from the field protocol outlined above, savings is on average 1089 kWh for all the units replaced. The highest savings was over 3300 kWh per year and the lowest 6 kWh. There were 43 units with less than the minimum savings (1315 kWhY minus 443 kWh of the 21 ft3 unit = 872 kWh). A majority had broken seals or other problems however these installations should be reviewed by Duke to assure that the protocols are being followed by all auditors.

State	Average Savings kWh/yr
Ohio	1105
KY	1033
Total	1089

The data used for analysis is within the attached spreadsheet. Due to privacy, customer names have been removed.

## DSMore Analysis

To complete the DSMore analysis of cost effectiveness, savings should be applied across all hours with an annual savings of 1089 kWh. By using the two hour meter test, natural diversity of load is automatically included, thus using Mode 3 standard testing will work. Life of the measure is related to how early the unit is being replaced. Effective useful life of the new unit is 8 years based on research completed in California on a long term





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recycling program.<sup>2</sup> This reflects the time the unit would be normally replaced with a new unit and the time that the replaced unit might be used as a secondary refrigerator before ultimate operations failure.

Duke should note additional non-energy environmental benefits in the consideration of the program. The refrigerator that is recycled gains non-energy environmental benefits by ensuring that the collected refrigerators are processed and recycled in a manner that meets and exceeds both federal and state environmental laws and regulations. Ozone-depleting chlorofluorocarbon refrigerants and foam insulation blowing agents (CFCs/HCFCs/HFCs), mercury, used oils, plastics, metals, and glass are recovered and recycled. Polychlorinated biphenyls (PCBs) are also recovered for disposal.

Cost for the program is approximately \$1000 per replaced refrigerator which includes the refrigerator delivered cost, recycling, testing and administration. These costs vary slightly by size, but for modeling the \$1000 average cost is appropriate.

---

<sup>2</sup> *Residential Refrigerator Recycling Ninth Year Retention Study* Study ID Nos. 546B, 563 prepared for Southern California Edison Company by KEMA July 22, 2004

Final Report  
**Estimates of the Energy Impacts of the Kentucky  
Home Energy House Call Program**

Energy Consumption Changes in Households that Received an  
Audit from Kentucky's Home Energy House Call Program

APPENDIX C

**September 9, 2005**

Prepared for

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# Table of Contents

<b>EXECUTIVE SUMMARY .....</b>	<b>2</b>
INTRODUCTION .....	2
SUMMARY OF FINDINGS.....	2
<b>EVALUATION METHODOLOGY .....</b>	<b>4</b>
<b>ENERGY USE ANALYSIS AND FINDINGS.....</b>	<b>11</b>
<i>Sample Size</i> .....	11
<i>Statistical Precision</i> .....	11
<b>SECTION 1: CHANGES IN KILOWATT-HOUR CONSUMPTION .....</b>	<b>12</b>
PROGRAM-WIDE EFFECTS ON ELECTRICAL CONSUMPTION .....	12
INCREASING OR DECREASING ELECTRICAL CONSUMPTION: A BREAKDOWN.....	14
<i>Participants That Decrease Their Electrical Consumption</i> .....	15
<i>Participants That Increase Their Electrical Consumption</i> .....	17
<b>SECTION 2: CHANGES IN THERM CONSUMPTION .....</b>	<b>20</b>
PROGRAM-WIDE EFFECTS ON THERM CONSUMPTION .....	20
INCREASING OR DECREASING THERM CONSUMPTION: A BREAKDOWN.....	21
<i>Participants That Decrease Their Therm Consumption</i> .....	22
<i>Participants That Increase Their Therm Consumption</i> .....	23
<b>STUDY CONCLUSIONS .....</b>	<b>26</b>
<b>APPENDIX A: OTHER FINDINGS .....</b>	<b>27</b>
<i>Square Footage of the Home</i> .....	27
<i>Vintage of Home</i> .....	28
<i>Type and Age of Water Heater</i> .....	30
<i>Number of People Living in the Home</i> .....	31
<i>Auditor</i> .....	31
<i>Days to Mail the Audit Report</i> .....	31

## Executive Summary

### Introduction

This report presents the results of an impact evaluation of the Home Energy House Call (HEHC) Program conducted by Cinergy Corp in the state of Kentucky. Customers in the Cinergy / ULH&P service area can request and receive an on-site energy audit of their homes. The HEHC program provides no-cost energy audits by energy specialists specifically trained in identifying ways to control energy costs in the customer's home. The specialists provide the following services during the audit:

- Analyze total home energy usage
- Checks home for air leaks
- Examines insulation levels
- Reviews appliances and heating/cooling systems

From the information collected during the audit, a detailed report identifying steps the customer can take to increase efficiency and reduce their energy bill is prepared and mailed to the customer for their review and record.

This evaluation of the energy impacts as a result of the HEHC program focuses on audits performed from August 2002 through June 2003.

Comparing the HEHC participants to a comparison group of those that did not receive the audit will provide estimates of changes in energy consumption that can be attributed to the information that the participants received as a part of their participation in the HEHC program. This report compares the energy savings by the fuel sources used for heating and cooling. Other factors, such as the square footage of the home, the year the home was built, type and year of water heater used, the number of people living in the home, and the energy service firm that performed the audit, were included in the data provided by Cinergy. This data was analyzed for savings trends. The result of this analysis is reported in Appendix A. However, because of the small sample size of the participant population once segregated into sub-groups, and the lack of strong correlation between key customer characteristics, the evaluation is unable to identify significant relationships between the amounts of energy saved beyond the program-wide savings levels for major fuel use groups. As a result, the reader is encouraged to focus on the savings in the main section of the report where the sample sizes are larger and provide for more statistical accuracy.

### Summary of Findings

TecMarket Works examined all participant energy usage records for a period of one to three years before the program and for one to two years following the program (depending on record availability). However, because of data reliability issues, the energy saving analysis of the HEHC program is based on a sub-sample of the 439

customer records provided for the analysis (please see the discussion on sample size in “Energy Use Analysis and Findings”).

The findings presented herein indicate that the home energy audit has resulted in decreased energy consumption in certain groups, while consumption has increased in other groups. Specifically, the HEHC program results in energy consumption reductions for heating fuels (electric or gas). Participants with electric heat reduce their electrical consumption, and those with natural gas heat reduce their therm consumption. This data indicates that the HEHC is a program that reduces heating costs.

Specific findings indicate that:

1. Program-wide kilowatt-hour savings were achieved only by those participants that heat their home electrically. This group saves a mean 399 kilowatt-hours per year, or 2.8% of their annual consumption.
2. Of the customers that decrease their kilowatt-hour consumption, those with electric heat and air conditioning units have the highest savings, with 2,026 kilowatt-hours per year reductions, or 10.3% of their annual consumption.
3. The HEHC program does result in a natural gas savings for homes that heat with natural gas. On average, the savings are just over 20 therms saved per year, comparison group adjusted. Those without central air reduce their consumption by 22 therms a year (3.4%), and those with central air reduce their consumption by 21 therms per year, or 2.7%.
4. Those with natural gas heat and central air conditioning remain the most stable between the pre- and post-program periods. Of this group that increased their electric consumption, they increased, on average, about 1,237 kilowatt-hours per year. This increase averaged 11.8% of their annual consumption. Those that decreased their consumption did so the least, averaging a 1,135 kilowatt-hours per year decrease, representing 11.7% of their annual consumption. About the same amount of participants increased and decreased consumption about the same amount after the program, making the average effect for this group an increase in consumption of 100 kilowatt-hours.

## Evaluation Methodology

The study methodology consisted of a weather-normalized energy usage analysis to determine if participation in the Home Energy House Call (HEHC) program resulted in energy consumption changes.

Energy savings of the HEHC participants were determined by looking at the change between pre- and post-program energy usage of the participants compared to the change in usage of a comparison group of eligible customers who did not participate in the program. The Princeton Scorekeeping Method (PRISM™) software was used to conduct this analysis. The primary purpose of the PRISM™ software is to provide weather-normalized data analysis of energy use between groups of participants and a comparison or control group. A PRISM analysis was conducted on six groups of participants, four for kWh consumption, and two for therm consumption. The groups analyzed for kWh consumption are:

1. Customers with natural gas heat.
2. Customers with electric heat.
3. Customer with central air and natural gas heat.
4. Customers with electric heat and an air conditioning unit.<sup>1</sup>

Therm consumption was divided into two groups:

1. Customers with natural gas heat.
2. Customers with central air and natural gas heat.

The HEHC participants were matched with customers in the same service area that had not participated in the program. The identification of the comparison group was made by selecting neighbors of the participants who have been offered participation in the program, but who elected not to participate. This matching was conducted so that the comparison group would match the enrollment criteria for the participant group (neighborhood targeting) and who had similar types of homes (neighbors).

There are four comparison groups utilized in this study, all of which are from the same larger core comparison group provided by Cinergy. These comparison groups are:

1. Therm data for all customers with natural gas heat.
2. Kilowatt-hour data for customers with electric heat.
3. Kilowatt-hour data for customers with natural gas heat.
4. Kilowatt-hour data for customers with electric heat and air conditioning.

After the comparison group was selected, further cleaning was conducted to eliminate those customers that did not have sufficient data for the study and to eliminate accounts

---

<sup>1</sup> These customers were determined by kWh consumption analysis using PRISM. PRISM has a "heating and cooling" model that analyzes kWh consumption as it would fit into the home's heating and cooling needs. This group is not based on data provided by Cinergy, but by the energy consumption model's fit.

in which there was a tenant change. This cleaning left 1,545 customers out of the approximately 3,500 customers that could be used for the matched comparison group for the Home Energy House Call participants' therm savings analysis. Kilowatt-hour analysis required the use of three different comparison groups. These groups and the number of customers that remained in the study following data cleaning include:

1. Kilowatt-hour data for customers with electric heat, n=314.
2. Kilowatt-hour data for customers with natural gas heat, n=806.
3. Kilowatt-hour data for customers with electric heat and air conditioning, n=286.

All comparison group customers were randomly assigned false audit dates to establish the pre- and post-program analysis periods for the comparison group.

Participants' data was also separated into pre and post periods. Participants who were audited had their pre data begin before the audit and their post data begin two months after the audit to ensure that the customer received the audit report and had at least some time to incorporate one or more of the recommended actions that were recommended in their audit report. Data between the end of the pre-program period and the start of the post-program period is not included in the analysis.

The comparison and participant groups were analyzed to be sure that the mix of customer's energy habits were similar. The following three graphs show that the comparison group and the participant groups (for the months before the HEHC audit) were nearly identical in their energy consumption patterns.



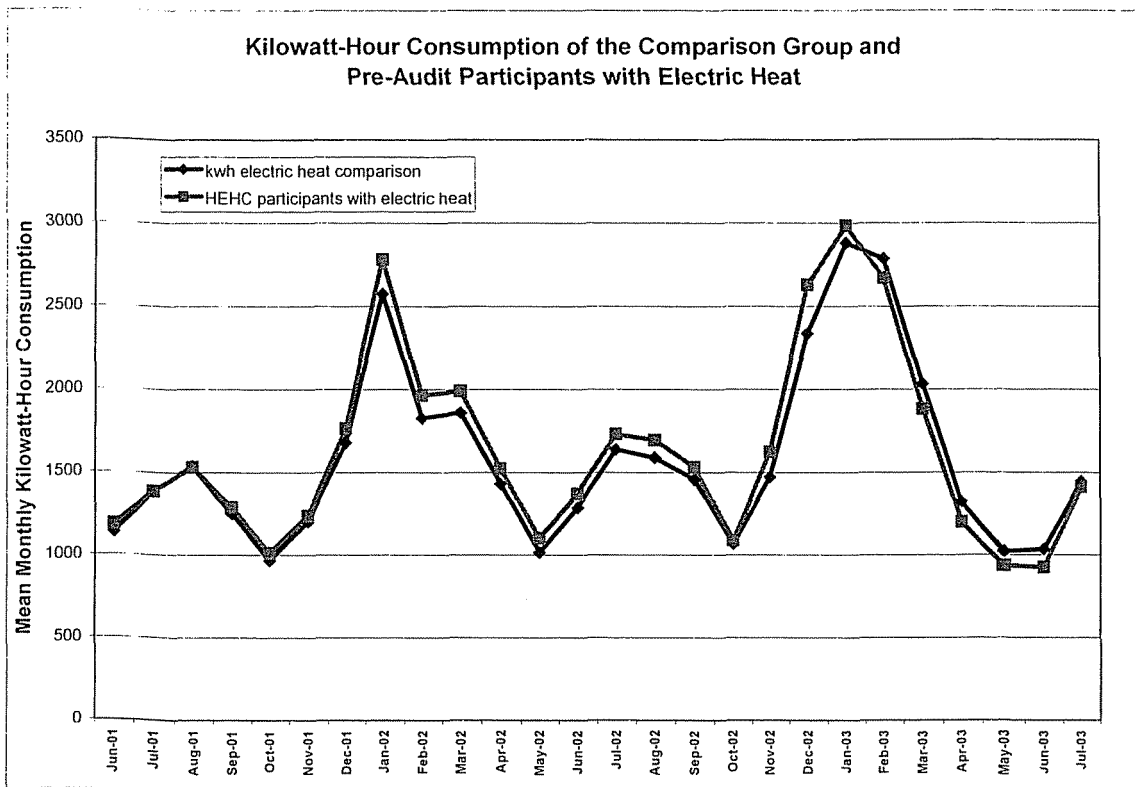


Figure 1. Kilowatt-Hour Consumption of the Comparison Group and Pre-Audit Participants with Electric Heat

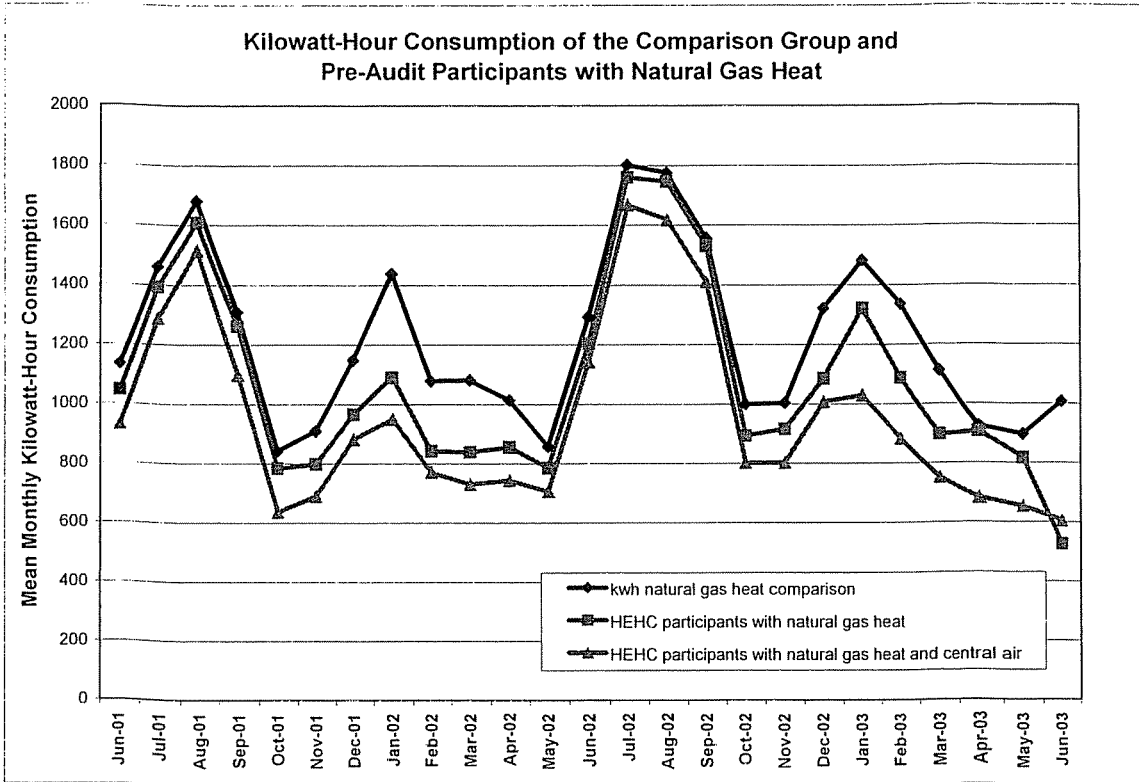
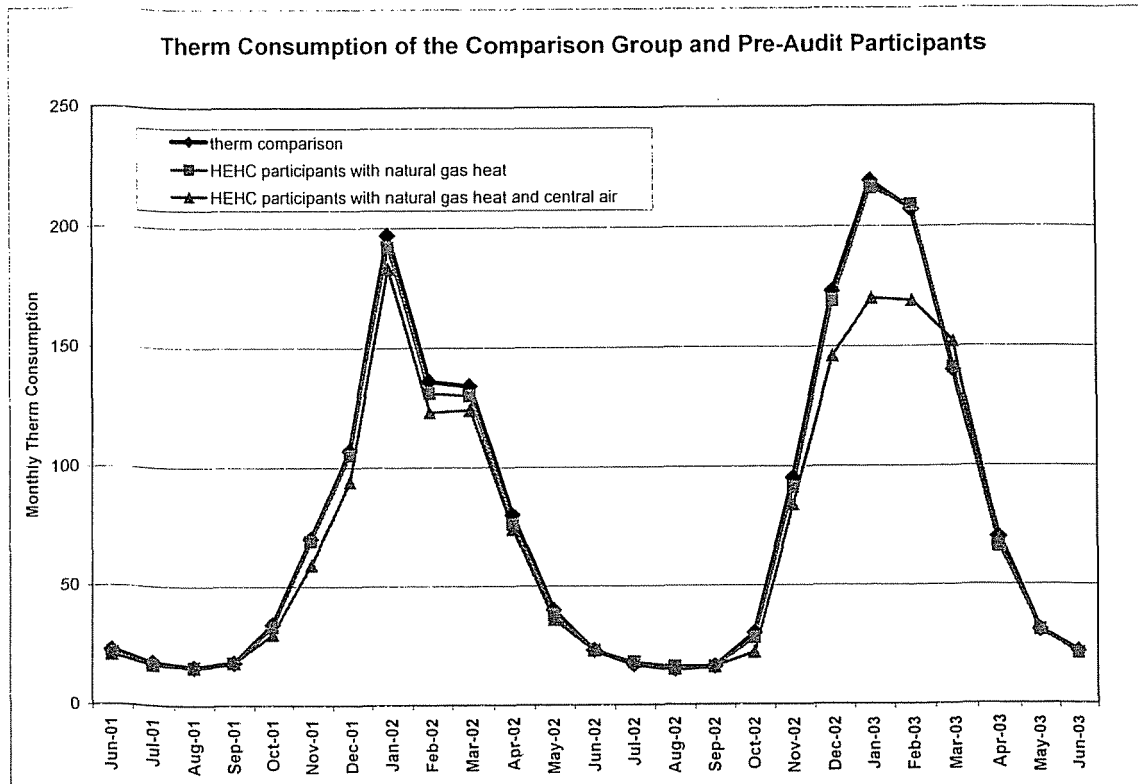


Figure 2. Kilowatt-Hour Consumption of the Comparison Group and Pre-Audit Participants with Natural Gas Heat



**Figure 3. Therm Consumption of the Comparison Group and Pre-Audit Participants**

The data that was used in this analysis was provided from Cinergy’s monthly-metered account database. The data was provided in therms and kilowatt-hours per month per customer for up to three years before the program and for up to twenty-four months after the program.

This report presents the savings in kilowatt-hours of electricity and therms of natural gas. Mean savings summaries are provided for each of the groups of customers. A description of the PRISM™ software is provided below.

**PRISM™ Analysis Software**

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 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, 1992 through December 31, 2002, recommended by PRISM™ support.

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, statistically described as the amount of variance in energy consumption explained by changes in degree-days. Energy consumption is assumed to be a linear function of degree-day.  $R^2$  varies from 0 to 1. If  $R^2$  is close to zero, it means that factors other than outdoor temperature are driving energy consumption. If the  $R^2$  is close to 1 it means that outdoor temperature is almost entirely responsible for energy consumption. Outdoor temperature is usually the overriding factor in both heating and air conditioning 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 and air conditioning systems 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 energy use is temperature dependant. If less than 70 percent of the energy used 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 percent or more of heating fuel use in this study is temperature driven. 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.

## Energy Use Analysis and Findings

The primary goal of the Home Energy House Call Program is to provide information customers need to help make their homes more energy efficient, and to provide it in a way that causes participants to take the recommended actions contained in their energy audit. By taking these actions the participant's home should be more energy efficient causing a decrease in their energy usage. In this analysis, we examined and compared energy usage of HEHC participants and a comparison group of non-participants over the years before and after the program.

### Sample Size

The Home Energy House Call results are based on a small sample of participants that is sufficient to provide an indication of the program's effects, however is not sufficient to provide an assessment of the impacts of the program beyond general fuel-type analysis levels. The sample size for all groups used in the analysis is displayed with the analyses results and the savings range for an 80% confidence interval around the reported impacts. The reader should view these results as an indication of what the savings may be for the analysis groups as a whole with the understanding that a larger (or different) sample pulled from the population may produce somewhat different results that would be expected to fall within the 80% confidence range.

### Statistical Precision

All of the analytical runs conducted in PRISM™ provide a  $R^2$  and CV(NAC) value that indicates the strength of the results provided. The higher the  $R^2$  value (maximum value is 1.0), and the lower the CV value, the more reliable the results are.

The customers' energy usage was processed through PRISM using pre-determined reliability criteria that needed to be met in order for the customer's usage to be included in the group being analyzed. The coefficient of variance for each customer had to be less than 7.0% in all cases. The  $R^2$  is set at 0.0 for the analyses that did not have to regress with weather data (such as kilowatt hour usage for those with gas heat). The  $R^2$  is set at 0.7 for analyses that is controlled by weather (such as kilowatt hour usage for those with electric heat, or therm usage for customers with natural gas heat). The number of participants whose data passed the statistical precision criteria is noted in each of the results discussions. For more information on PRISM™ and these statistics, please see the section on methodology.

## Section 1: Changes in Kilowatt-Hour Consumption

The Home Energy House Call program is, in some cases, successful at helping customers reduce their electrical consumption. To draw this conclusion we examined electrical savings for several groups of customers. First, we examined program-wide electrical savings, followed by an assessment of those that increased their consumption and those that decreased their consumption.

### Program-Wide Effects on Electrical Consumption

The electrical savings of the HEHC program varies depending on the group analyzed. Figure 4 shows the mean annual savings for each of the four groups examined in this analysis. Those with electric heat are the only electric energy savers. This group saved an average of almost 400 kilowatt-hours in their annual consumption, a 2.8% reduction. When the analysis is conducted to capture the electrical savings associated with those who cool their home with air conditioning, the savings drop into the negative levels, indicating an increase in electrical consumption despite the audit and report showing the customers ways in which they can achieve energy savings.

Those with natural gas heat do not achieve electric savings overall, with both groups (natural gas heat, and natural gas heating with central air) increasing electrical consumption. However, those with central air conditioning increase their consumption by substantially less (100 kwh/yr, or 0.6%) than those without central air (563 kwh/yr, or 4.5%). The following graphics report the average annual electric savings and the average percent savings for each of the groups analyzed, along with the 80% confidence range of the savings achieved.

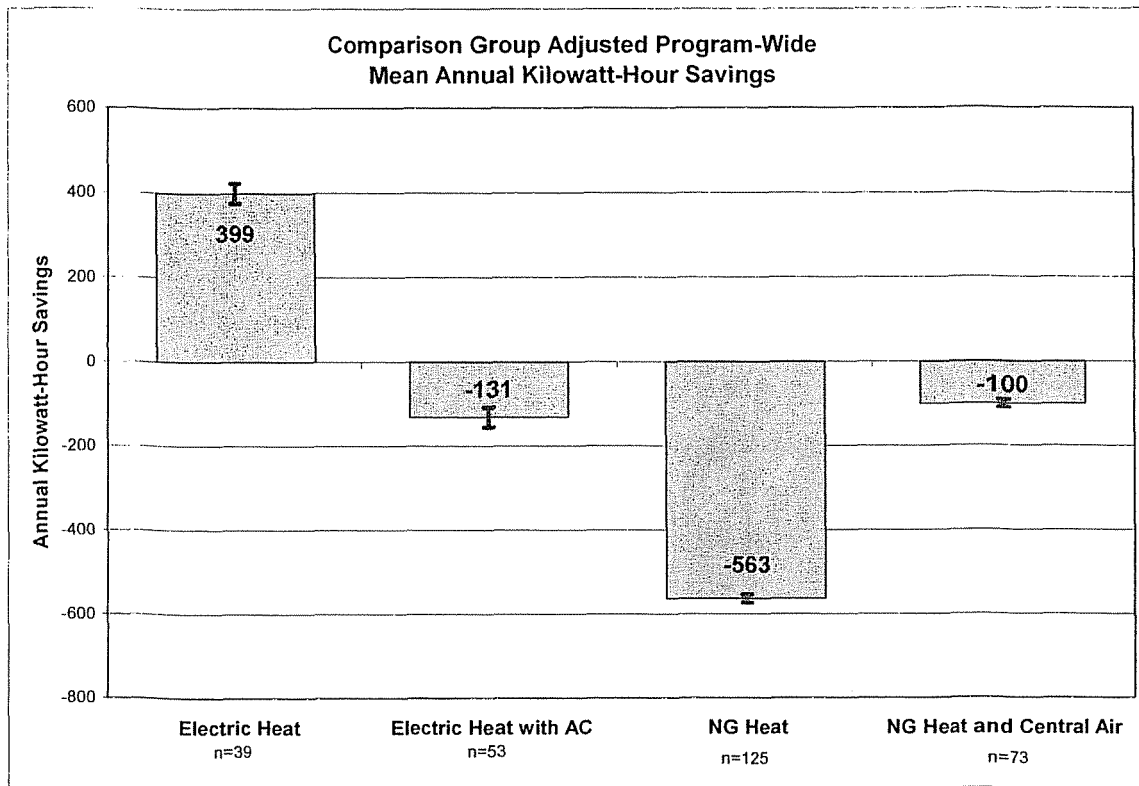
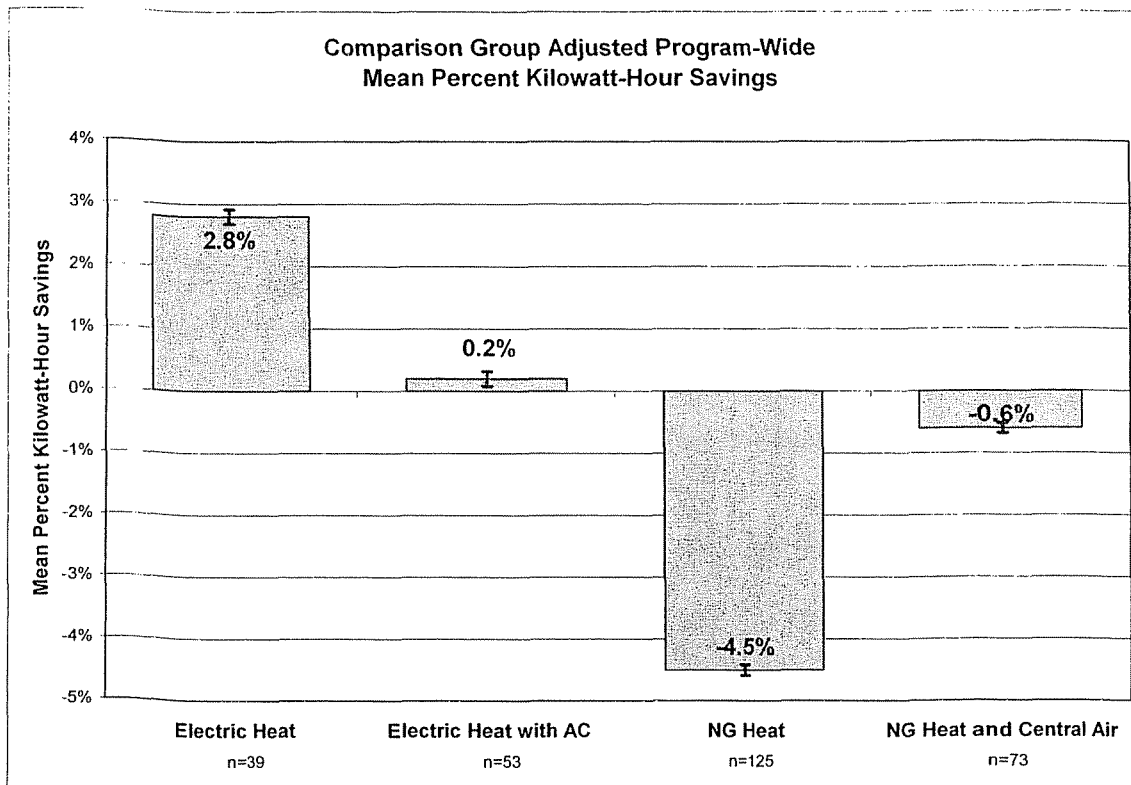


Figure 4. Comparison Group Adjusted Program-Wide Mean Annual Kilowatt-Hour Savings





**Figure 5. Comparison Group Adjusted Program-Wide Percent Kilowatt-Hour Savings**

To provide additional perspectives to these findings we segregated the groups into increasers and decreasers and examined the changes for those that decreased their consumption and those that increased consumption during the post-program period.

### Increasing or Decreasing Electrical Consumption: A Breakdown

Because this program relies on the customer to implement measures that would decrease their energy consumption, there is the realistic assumption that some of the homes will not heed the advice offered to them within the study period, despite the fact that they requested the audit be conducted. Many things can result in lack of savings during the study period: lack of time or money needed to take the actions, lack of interest at a level needed to rapidly take the recommended actions, lack of a belief that the actions will save enough energy, lack of a belief that taking the actions will result in a lower utility bill, among other reasons. Likewise, there are reasons for increased consumption, including adding more energy consuming equipment, more people living in the home, adoption of behaviors that use more energy, and/or changes in economic status of the occupants. In this analysis we do not have behavior or use condition information, and as a result we are not able to classify participants or comparison group members into action / behavior categories for additional analysis. However, in this section, we break apart the four categories of homes in the kilowatt-hour analysis findings section and report the number of homes increasing their electrical consumption and by how much they increase their consumption. Likewise, we report the same metrics for those that decreased their

consumption. Table 1 shows that in all groups, except for the group of customers with electric heat, more than half of the participants increased their electrical consumption following receipt of the audit report.

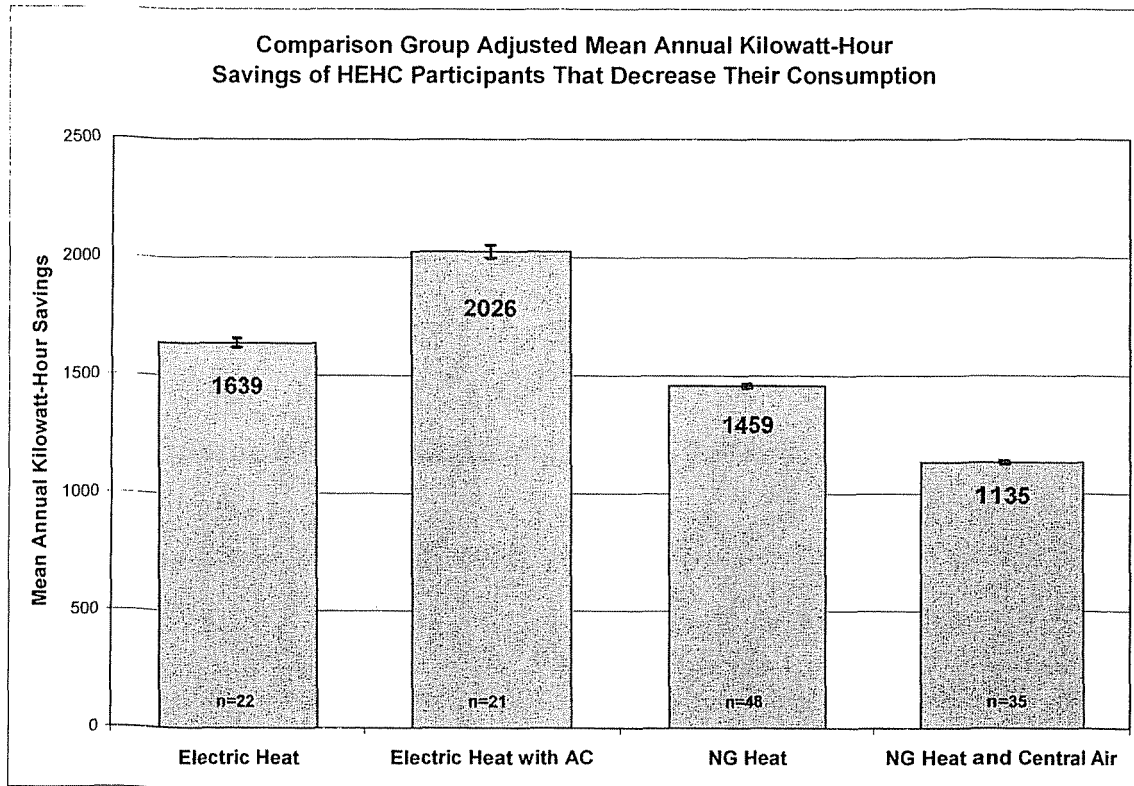
**Table 1. Percent of Customers Increasing or Decreasing Electrical Consumption After the HEHC Audit**

	Total	Percent Increasing	Percent Decreasing
Electric Heat	39	43.6%	56.4%
Electric Heat with AC	53	60.4%	39.6%
NG Heat	125	61.6%	38.4%
NG Heat and Central Air	73	52.1%	47.9%

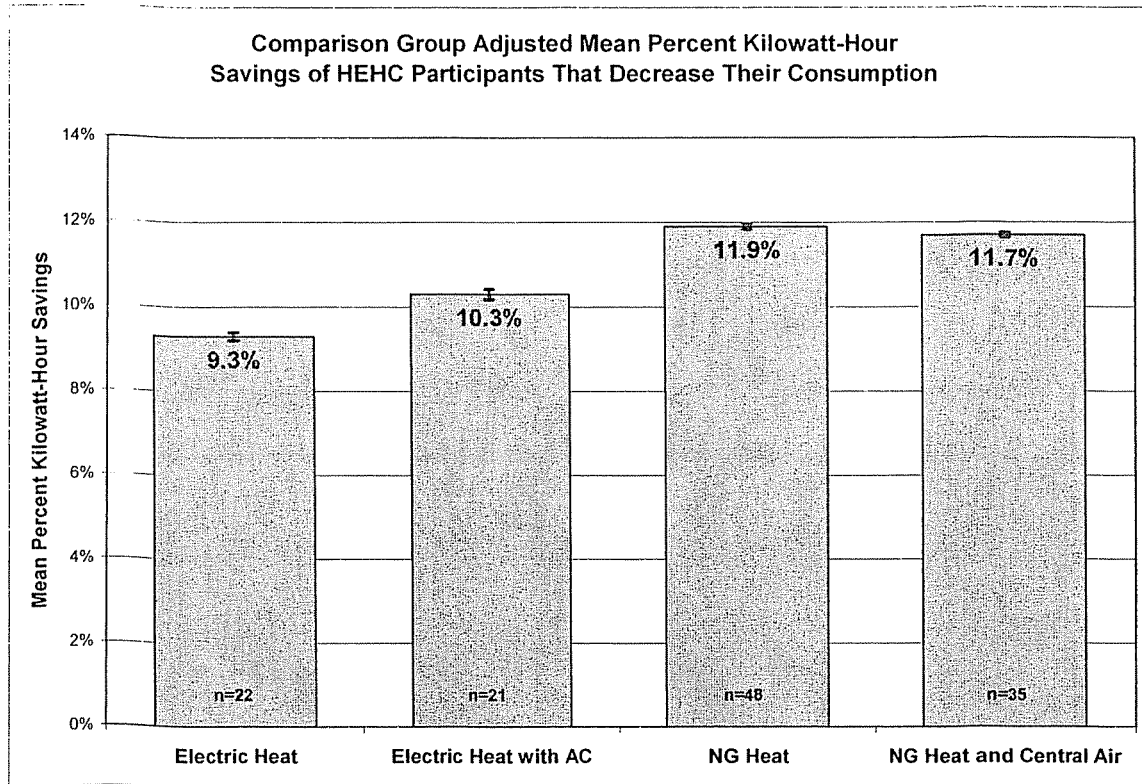
By dividing these groups into “increasers” and “decreasers,” we can assess the energy savings of those that made some changes in their homes or behavioral patterns that resulted in savings, presumably as a result of the audit and subsequent report. The findings also mean that the lack of overall savings shown in some of these groups is the result of a slight majority of participants that increase their consumption enough to hide the true energy savings of those that do make physical or behavioral changes to decrease their kilowatt-hour consumption. This is important to consider because it may mean that while the audit helps the customer save energy, in many cases the increase in consumption may offset the achieved savings. In this case, the HEHC program may be saving energy that results in a slower increase in consumption than what would have occurred without the program. Of course, without the behavioral information to know what is occurring in the participant’s homes, it remains just as likely that the participants in the non-electric heating groups are increasing their consumption after their participation in the HEHC program. Certainly the HEHC report may be more important to those customers who have electric heat and have the greatest need for the energy savings strategies included in the HEHC report.

**Participants That Decrease Their Electrical Consumption**

As indicated above, those with electric heat reduced their kilowatt-hour consumption the most, however when only those that decrease consumption are considered, it is the group with both electric heat and air conditioning that save the most, just over 2,000 kwh/yr, or 10.3% of their annual consumption, when they make the effort to conserve. Those with natural gas heat that reduce their consumption also have substantial reductions of over 1,000 kilowatt-hours per year (which is a reduction of just under 12%). However, this savings is offset by the participants that increase their consumption.



**Figure 6. Comparison Group Adjusted Mean Annual Kilowatt-Hour Savings of HEHC Participants That Decrease Their Consumption**



**Figure 7. Comparison Group Adjusted Mean Percent Kilowatt-Hour Savings of HEHC Participants That Decrease Their Consumption**

**Participants That Increase Their Electrical Consumption**

Figure 8 below shows the mean annual kilowatt-hour increases in consumption for those participants that increased their energy. Those with natural gas heat have higher increases than those without central air, increasing by 1,823 kilowatt-hours per year (or 14.7%) without central air, while those with central air that increase their consumption only do so by 1,237 (or 11.8%).

Participants with electric heat that increase their consumption do not increase as much as those with natural gas heat. Electric heated home (that increase) increase by 1,248 mean kilowatt-hours per year, a 6.1% increase in consumption. Those with air conditioning units increase slightly more, by 1,582 kilowatt-hours per year, or 6.8%.

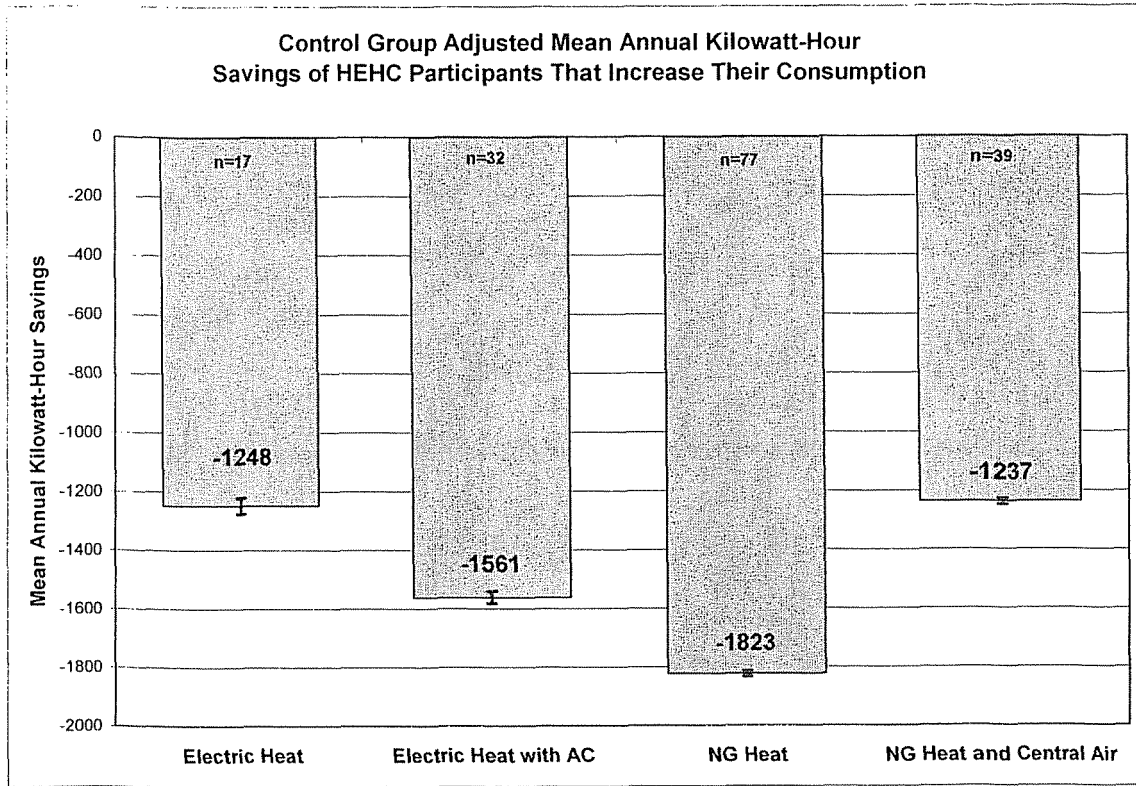


Figure 8. Comparison Group Adjusted Mean Annual Kilowatt-Hour Savings of HEHC Participants That Increase Their Consumption

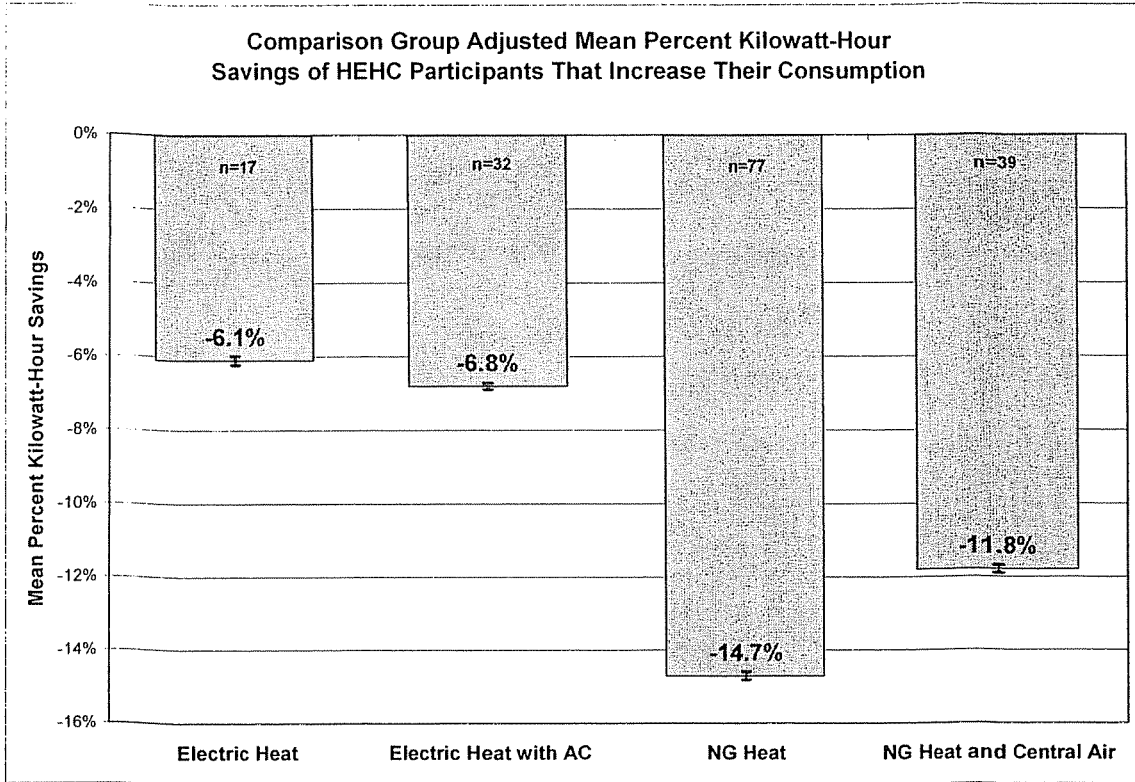


Figure 9. Comparison Group Adjusted Mean Percent Kilowatt-Hour Savings of HEHC Participants That Increase Their Consumption

## Section 2: Changes in Therm Consumption

In this section we report how those with natural gas heat changed their consumption after the HEHC audit and report. Customers with electric heat are not in this section, because they have little therm consumption to change, if any. (These would be customers with natural gas water heaters, of which there were too few to analyze.)

### Program-Wide Effects on Therm Consumption

As demonstrated in Figure 10 below, there is no statistical difference in natural gas savings between natural gas heating participants based on whether they have central air conditioning. Both groups reduce their therm consumption by just over 20 therms per year (after being adjusted for the comparison group.) This represents an overall reduction of 3.4% for those with natural gas heating, and 2.7% for those with natural gas heating and central air.

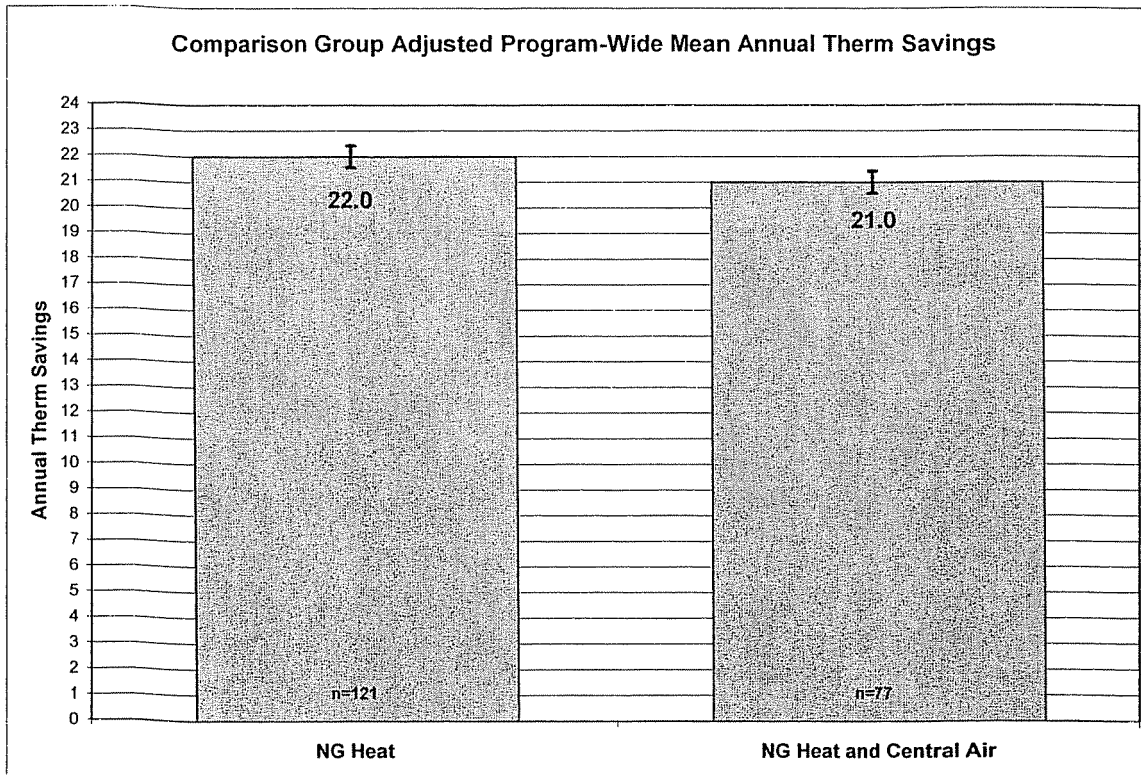
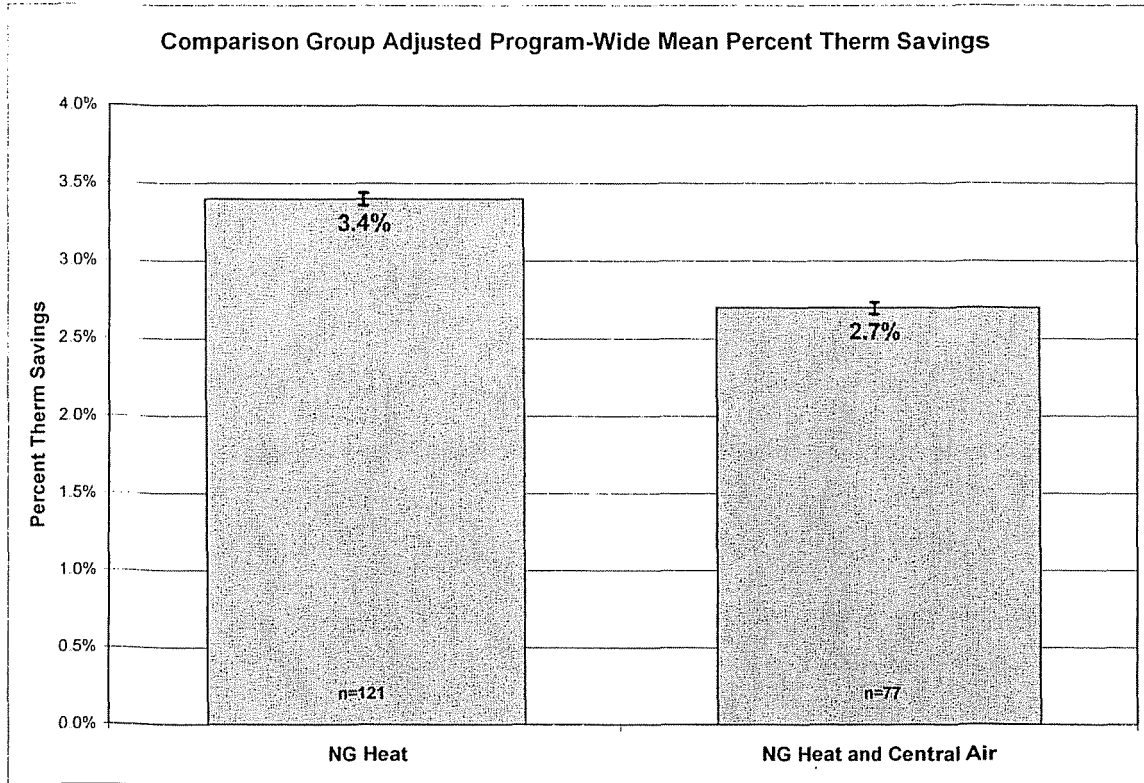


Figure 10. Comparison Group Adjusted Program-Wide Mean Annual Therm Savings



**Figure 11. Comparison Group Adjusted Program-Wide Mean Percent Therm Savings**

### Increasing or Decreasing Therm Consumption: A Breakdown

As reported in the kilowatt-hour analysis, the majority of those with natural gas heat increased their electrical consumption. However, more than 60% of the HEHC participants with natural gas heat decreased their therm consumption after receiving the audit report.

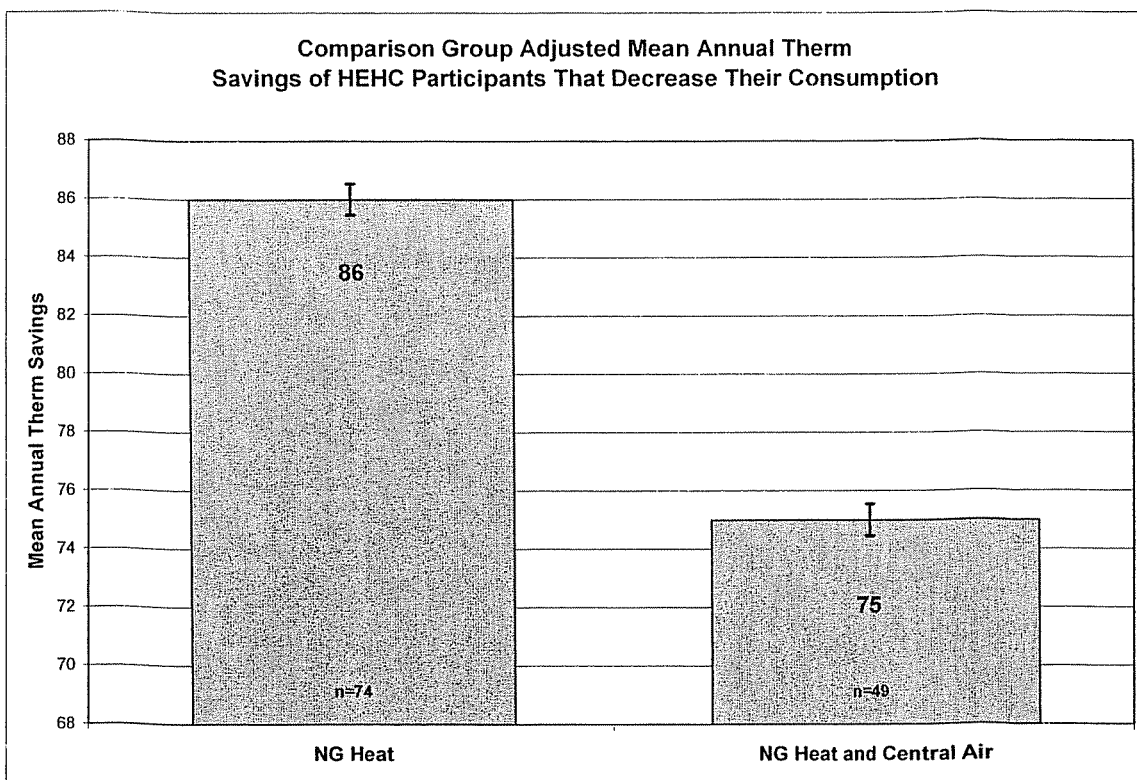


**Table 2. Percent of Customers Increasing or Decreasing Therm Consumption After the HEHC Audit**

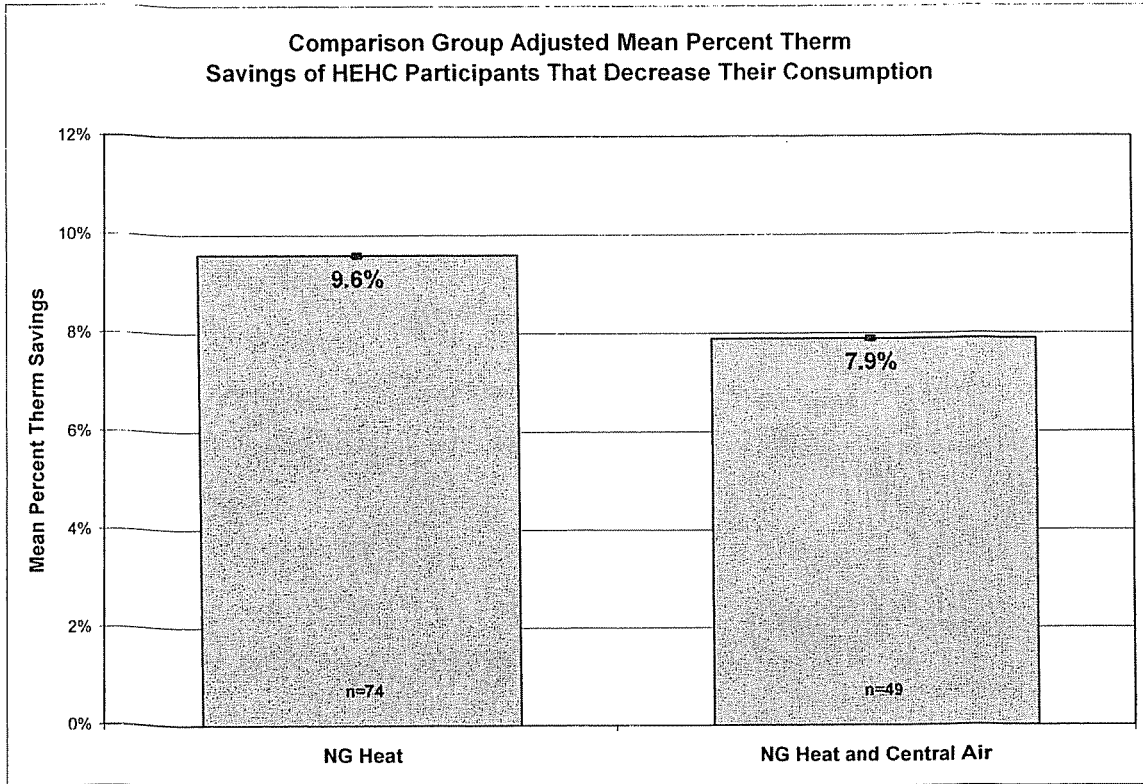
	Total	Percent Increasing	Percent Decreasing
NG Heat	125	38.8%	61.2%
NG Heat and Central Air	73	36.4%	63.6%

**Participants That Decrease Their Therm Consumption**

When we separate the increasers from the decreasers, we see a slight difference between those with central air and those without. Those without central air save a mean 86 therms per year after the audit (9.6%), while those with central air conditioning save a mean of 75 therms per year after the audit (7.9%).



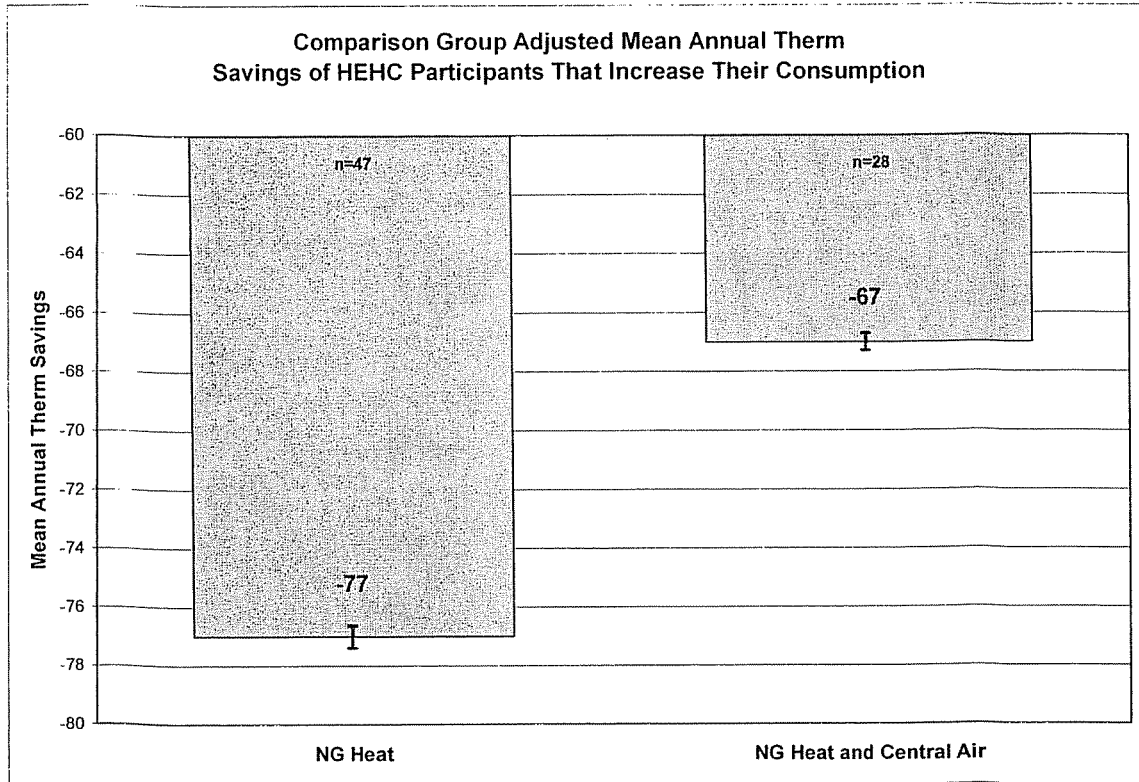
**Figure 12. Comparison Group Adjusted Mean Annual Therm Savings of HEHC Participants That Decrease Their Consumption**



**Figure 13. Comparison Group Adjusted Mean Percent Therm Savings of HEHC Participants That Decrease Their Consumption**

### Participants That Increase Their Therm Consumption

In the next analysis, we looked at only those customers that increased their therm consumption after the audit. Those without central air increase their therm consumption by a mean 77 therms per year (or 7.5%), and those with central air increase their consumption by a mean 67 therms per year (6.6%).



**Figure 14. Comparison Group Adjusted Mean Annual Therm Savings of HEHC Participants That Increase Their Consumption**

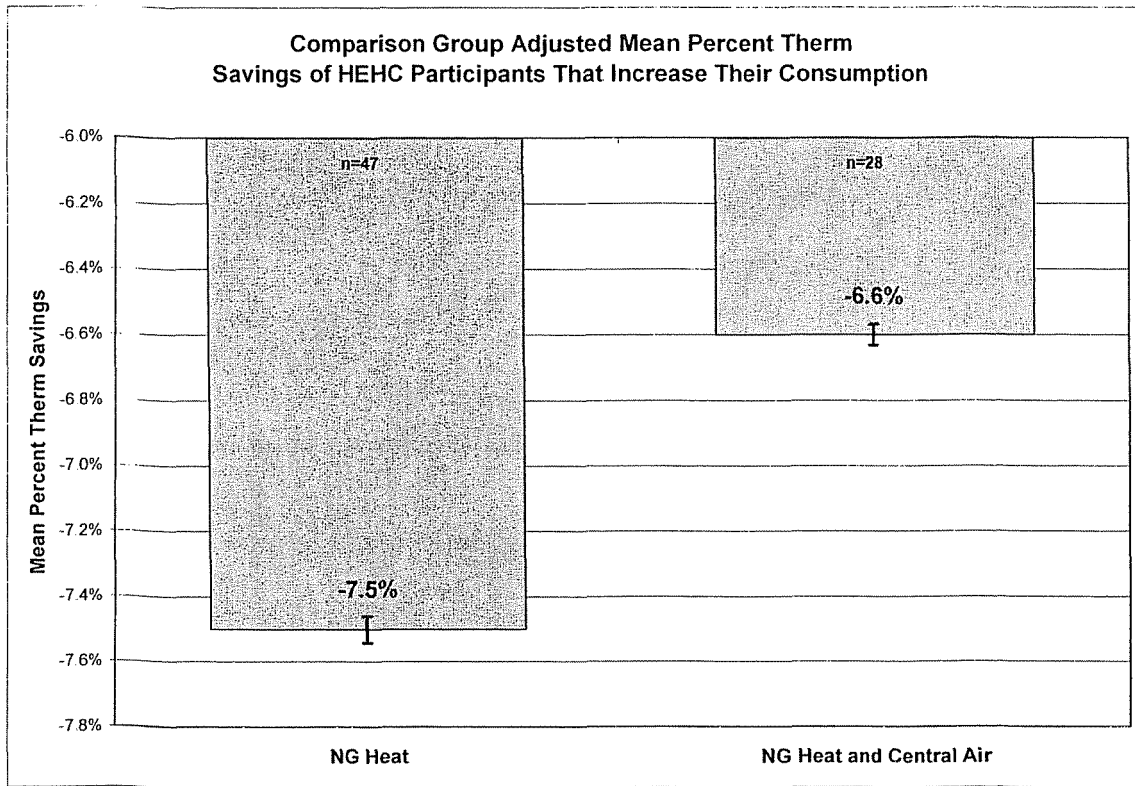


Figure 15. Comparison Group Adjusted Mean Percent Therm Savings of HEHC Participants That Increase Their Consumption

## Study Conclusions

The findings presented herein indicate that the home energy audit has resulted in decreased energy consumption in certain groups, while consumption has increased in other groups. Specifically, the HEHC program results in energy consumption reductions for heating fuels (electric or gas). Participants with electric heat reduce their electrical consumption, and those with natural gas heat reduce their therm consumption. This data indicates that the HEHC is a program that reduces heating costs.

Specific findings indicate that:

1. Program-wide kilowatt-hour savings were achieved only by those participants that heat their home electrically. This group saves a mean 399 kilowatt-hours per year, or 2.8% of their annual consumption.
2. Of the customers that decrease their kilowatt-hour consumption, those with electric heat and air conditioning units have the highest savings, with 2,026 kilowatt-hours per year reductions, or 10.3% of their annual consumption.
3. The HEHC program does result in a natural gas savings for homes that heat with natural gas. On average, the savings are just over 20 therms saved per year, comparison group adjusted. Those without central air reduce their consumption by 22 therms a year (3.4%), and those with central air reduce their consumption by 21 therms per year, or 2.7%.
4. Those with natural gas heat and central air conditioning remain the most stable between the pre- and post-program periods. Of this group that increased their electric consumption, they increased, on average, about 1,237 kilowatt-hours per year. This increase averaged 11.8% of their annual consumption. Those that decreased their consumption did so the least, averaging a 1,135 kilowatt-hours per year decrease, representing 11.7% of their annual consumption. About the same amount of participants increased and decreased consumption about the same amount after the program, making the average effect for this group an increase in consumption of 100 kilowatt-hours.

The results of this study indicate that the Home Energy House Call program is successful at helping save heating costs. In summary, participants that heat with natural gas save natural gas and those that heat with electricity save electricity. However, this study utilizes relatively small sample sizes for this analysis, and we cannot guarantee that the customers analyzed represent the population of the HEHC program. Further analysis should be done on more customers, with a sampling strategy that better reflects the population as a whole.

## Appendix A: Other Findings

In addition to the findings presented in the main body of this report, TecMarket Works also looked at the differences in savings by the square footage of the home, the year the home was built, type and age of water heater used, the number of people living in the home, and the energy service firms performing the audit. However, splitting the participant groups into these small categories reveals only speculative findings due to the low sample size. Therefore, only when trends were spotted are these findings presented in this report. The reader is cautioned about the sample size and reminded that the results presented are only possible indications of trends. Further analysis on a larger group of participants would need to be conducted to reach any conclusions, definitive or otherwise. These findings are reported below.

### Square Footage of the Home

Results for the kilowatt-hour analysis by area of conditioned spaced produced sporadic results that do not seem to follow any clear trend. However, the therm consumption seems to decrease as the home gets larger, with two anomalies in the larger homes analyzed.

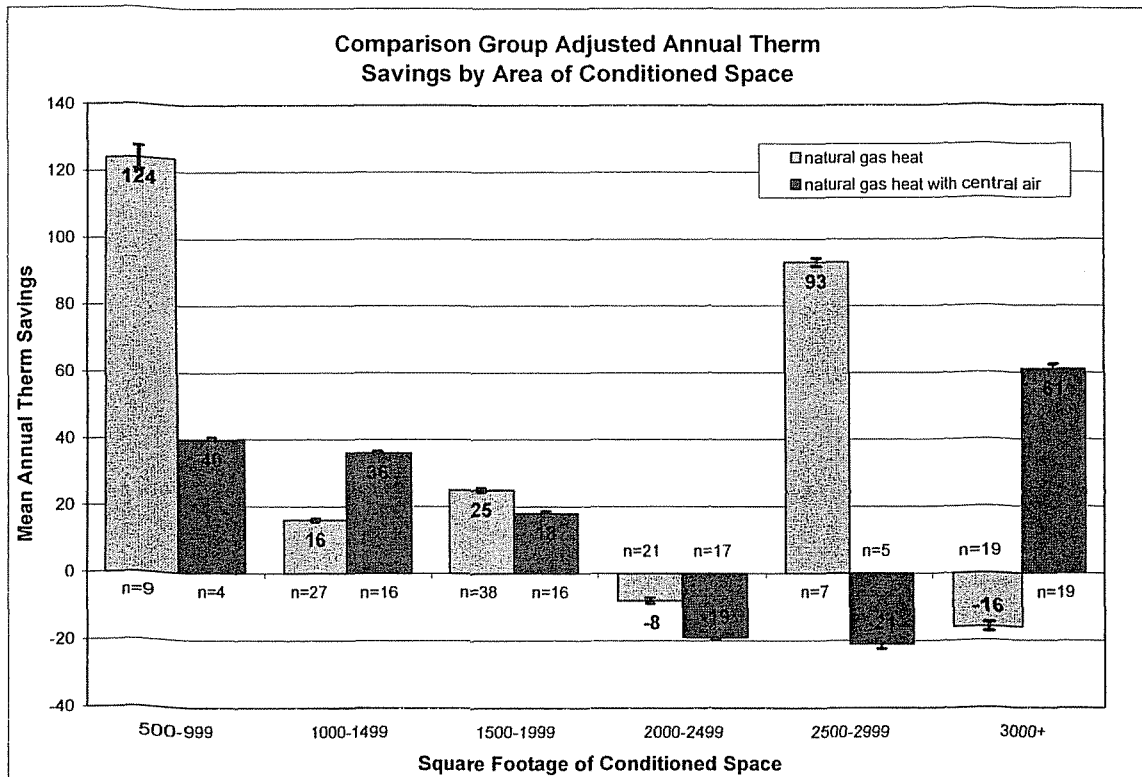
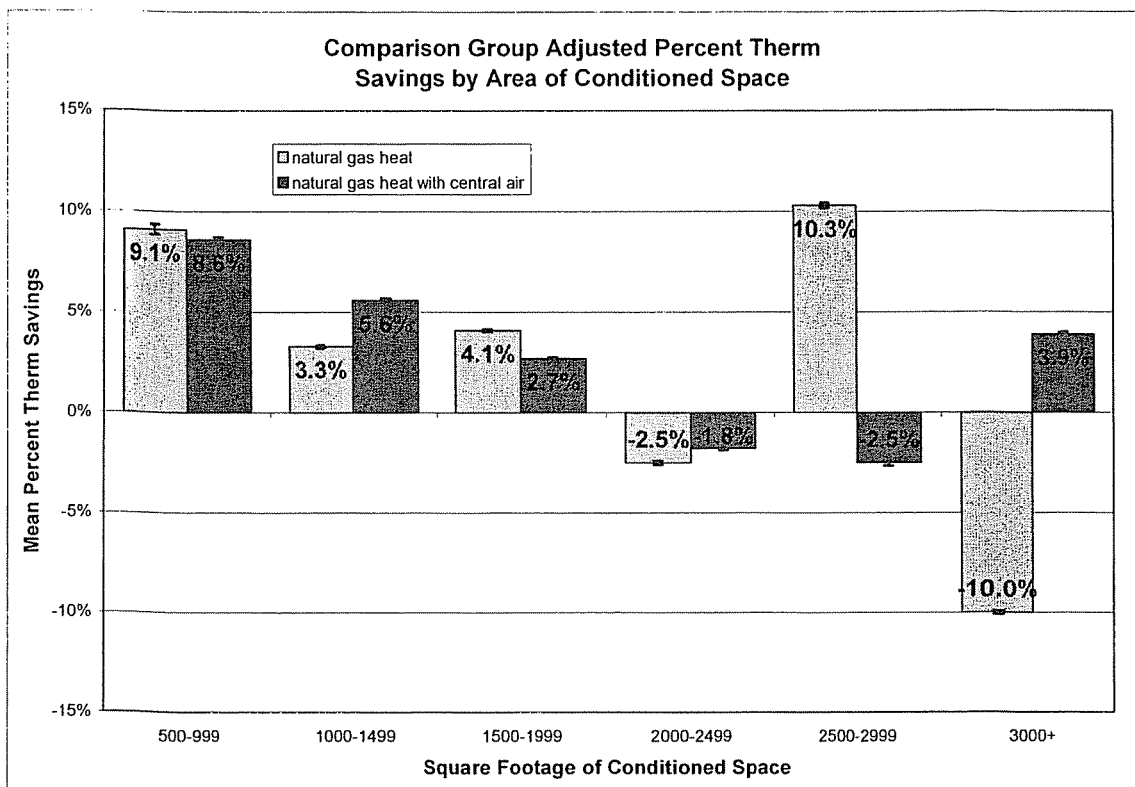


Figure 16. Comparison Group Adjusted Annual Therm Savings by Area of Conditioned Space



**Figure 17. Comparison Group Adjusted Percent Therm Savings by Area of Conditioned Space**

### Vintage of Home

When we looked at the energy savings by the age of the home, the therm consumption did not reveal any probable trends. However, it seems that the owners of the newer homes increased their consumption more than those living in older homes for those with electric heat and air conditioning, and those with natural gas heat. This may indicate that those that can afford newer homes do not view the savings of conserving electricity as significantly or important as others, and therefore are less likely to not make physical or behavioral changes to decrease their electrical consumption.

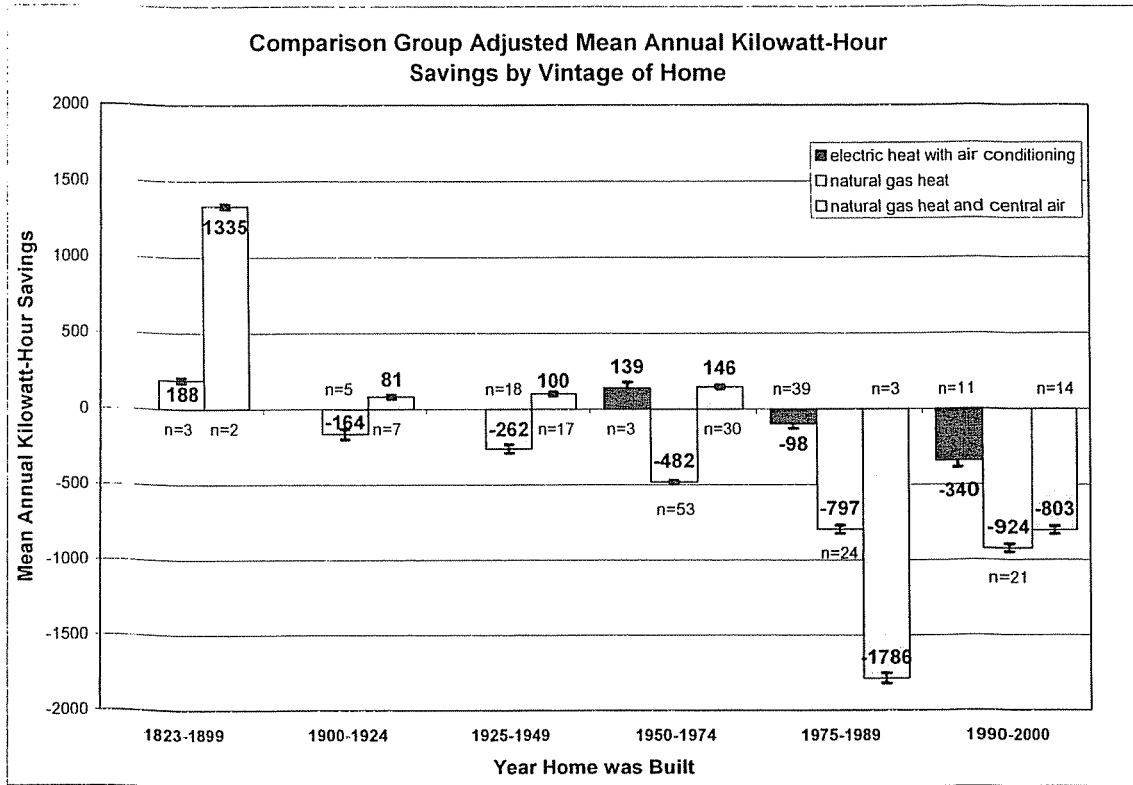


Figure 18. Comparison Group Adjusted Mean Annual Kilowatt-Hour Savings by Vintage of Home



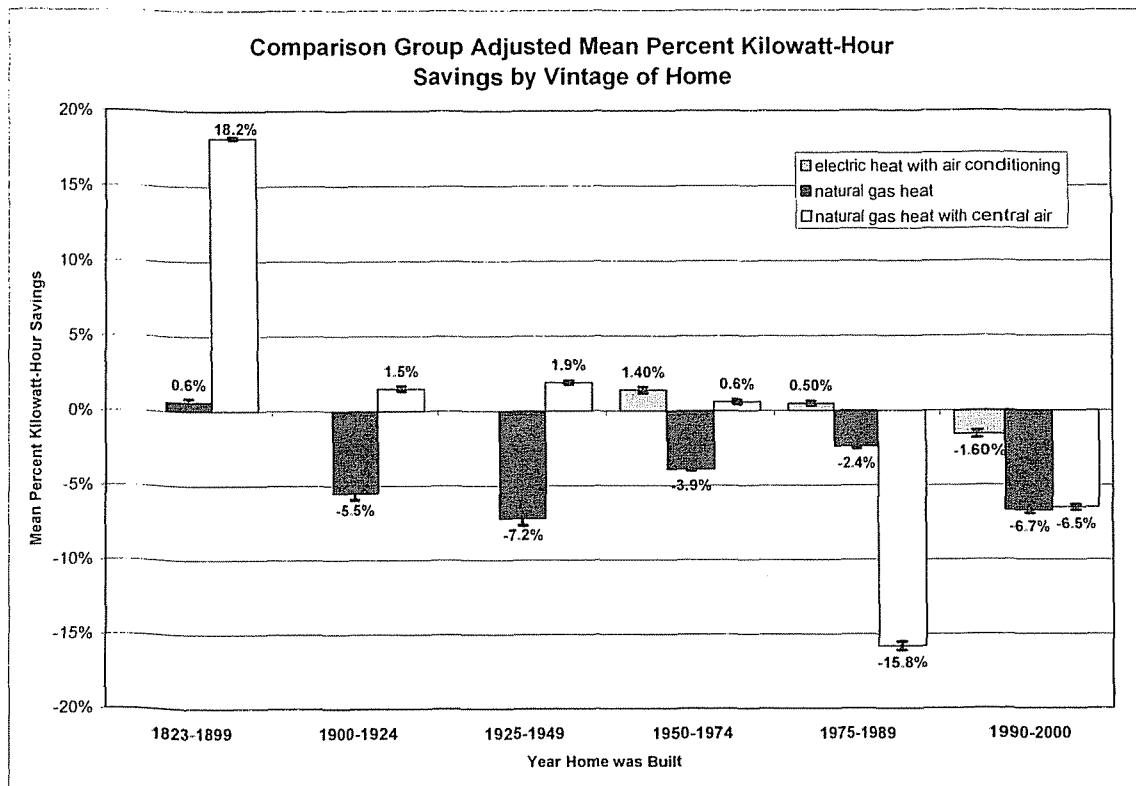


Figure 19. Comparison Group Adjusted Mean Percent Kilowatt-Hour Savings by Vintage of Home

### Type and Age of Water Heater

The type and age of a home’s water heater does not have an impact on energy savings. However, the water heater temperature setting was recorded during many of the audits. The water heater temperature settings are shown in Figure 20 below. An analysis of the water heater temperature data compared to the age of the installed water heater shows no relationship, suggesting factory water heater settings are almost always changed by the individual who installs or uses the heater. While not important to this study, this finding suggests that programs that focus on changing the manufacturer’s temperature setting to a lower temperature have little influence on the temperatures of the installed water heaters.

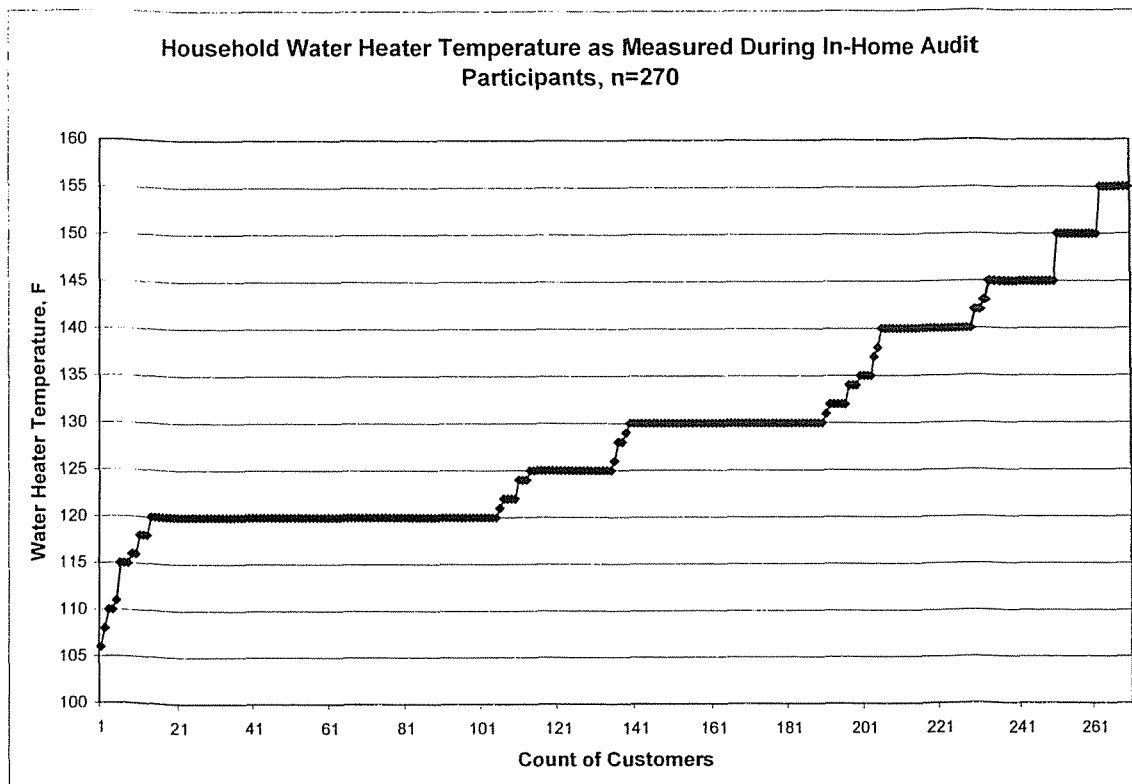


Figure 20. Water Heater Temperature at the Time of the HEHC Audit

### Number of People Living in the Home

There is no apparent connection between the number of people living in the home and the energy savings realized by the HEHC participants. Overall increases and decreases in consumption were scattered, with one exception: all the homes occupied by a single person (one individual) had an overall decrease in consumption. This finding indicates that people living alone are more likely to benefit from the HEHC than people living with others in the home.

### Auditor

A look at the energy savings of homes by the auditor conducting the examination revealed no significant differences in energy savings. Six of the seven auditors had groups that increased their consumption overall, and groups that decreased their consumption overall. One auditor had overall decreases in consumption, but this is most likely a coincidence given the small sample sizes when each of the groups is divided into seven smaller groups.

### Days to Mail the Audit Report

Home Energy House Call managers claim that the reports are mailed within ten days of the audit. However, this is not consistent with the data examined in this study. Many audit reports were mailed three weeks or more after the audit. However, most of these delays occurred in the beginning of the program when the auditing firms were

experiencing start-up difficulties. According to Cinergy Program Managers, the more recent participants are receiving their audit reports within 10 days. The following graphic indicates the time between the audit and the mailing of the audit report for the population examined in this study. The delays in the receipt of the audit report may be expected to have an impact on the customer's ability to implement actions taken or maintain customer interest in taking actions.

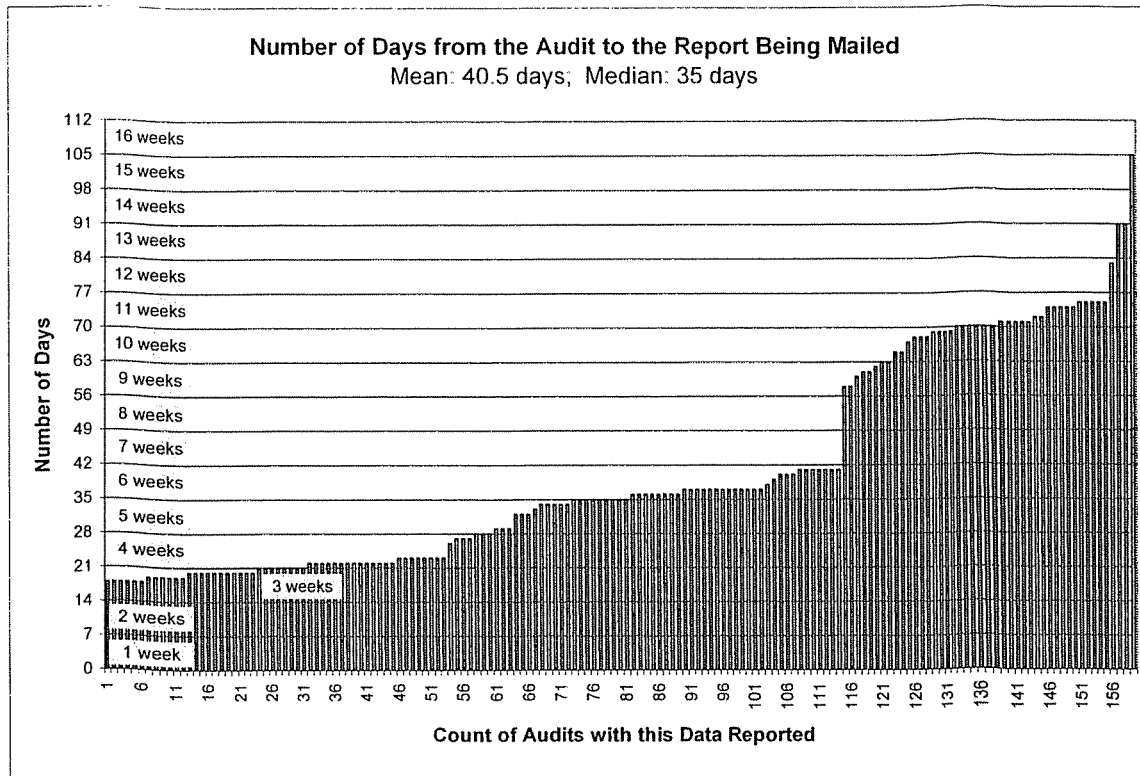


Figure 21. Number of Days from the Audit to the Report Being Mailed

Final Report

APPENDIX D

# **Kentucky NEED: Impact Evaluation**

*Prepared for:*  
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***September 12, 2005***

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## Introduction

National Energy Education Development (NEED) is a Washington, DC-based nonprofit association with the mission of promoting “an energy conscious and educated society by creating effective networks ... to design and deliver objective, multi-sided energy education programs.”<sup>1</sup> The NEED Program includes curriculum materials that teach the scientific concepts of energy and includes information to, “educate students about energy efficiency and conservation, and tools to help educators, energy managers and consumers use energy wisely.”

In December of 1994, Kentucky began a NEED Program. Shortly thereafter, Karen Reagor was hired to establish the KYNEED Program. It was her responsibility to secure funding and statewide Program delivery. In October 1997, Union Light Heat and Power (ULH&P) began funding the KYNEED-ULH&P Program. Since then, the Program has hosted teacher/student workshops, sponsored teachers’ attendance at summer training conferences, participated in Teacher In-Service and professional development opportunities, and sponsored award-winning teachers and students to attend NEED’s National Youth Awards Conference in Washington, DC.

Currently, the KYNEED project goal includes providing “non-biased energy education programs in schools in Boone, Campbell, Kenton, Gallatin, Grant and Pendleton counties, with a focus on energy conservation and efficiency”. The following table provides an update regarding goals, targets and current progress.

**Figure I.1: KYNEED Goals, Targets and Progress**

Goal	Target	Progress
Provide NEED Energy Education Materials to Teachers	100 teachers receive materials	94 Teachers registered in the KYNEED program
Conduct Teacher/Student Training Workshops	Three workshops	Three conducted
Plan, Coordinate and Facilitate Teacher In-Services	Three teacher in-services and a classroom presentation for university education majors	8 teacher in-service and one university presentation
Provide In-depth Training for Teachers via NEED curriculum	Encourage teachers from the collaborative service territory to attend NEED’s trainings	12 teachers attended from the territory
Develop, Coordinate and Facilitate a Parent/Student Energy Efficiency & Conservation Program	500 students and their families participate	To-date, 238 kits have been distributed and 9 participating teachers enrolled for fall 2005
Energy Efficiency and Conservation Practices in the Schools	Provide information to all school districts and work with those who request assistance	Working directly with 2 schools and co-hosted High Performance Schools Workshop in May
Promote participation in the NEED Youth Awards Program for Energy Achievement	Encourage schools in the six county area to participate	Six participating schools

<sup>1</sup> <http://www.need.org/info.htm>

A major Program enhancement was introduced in 2003. In addition to the current educational Program, a Conservation Action Kit was distributed to participating students. This kit contained energy-saving measures that were intended to facilitate hands-on learning and ultimately encourage energy awareness and behaviors that could ultimately lead to a lower energy bill. The kit contained several energy-efficient devices that required minimal installation time and effort, including:

- A compact fluorescent light bulb. This low-energy bulb was intended to replace the commonly-used higher energy incandescent light bulb.
- A high-efficiency showerhead that reduces water usage when used instead of an existing, higher-flow showerhead.
- Kitchen and bathroom aerators that reduce water flow when installed in bathroom and kitchen sinks.
- Thermometers that monitor temperature for rooms, hot water heaters and refrigerator/freezer components. These thermometers increase energy use awareness, which may in turn cause students to adjust their energy devices accordingly.
- A plastic bag that measures shower and faucet flow rates..

Along with the kit, students were asked to return an audit form that had three components:

1. ***House and Appliance Characteristics***, which asks students if they are ULH&P customers and basic information about their home, such as number of occupants, if they have certain appliances, and the fuel usage of heating and cooling equipment.
2. ***Behavioral Assessment***, which is presented in two separate forms—one to be filled out before the lessons and the other afterwards. The top portion asks questions about the number of incandescent and fluorescent bulbs in the home, use of the Energy Saver feature found on dishwashers, cold water laundry usage, the number of baths and showers in the home, and the temperature settings on cooling and heating equipment. The bottom portion of the form is more qualitative, and asks students to report the number of times per day that lights and electronics are left on, if water is run needlessly or if a window is left open.
3. ***Installation Survey***. This final component asks students about what occurs in their household with each measure. For example, if they installed the compact fluorescent lights (CFLs), what bulb Wattage was replaced, and how long is the bulb on each day? If they didn't use the CFL, why not, and do they plan to in the future?

## Evaluation Overview

This evaluation assessed energy savings attributable to Program efforts and provided feedback about the Program delivery in ULH&P's Kentucky service territory, particularly with regard to the kit. The evaluation consisted of the following:

- Program document review
- Program staff interviews (3)
- Program instructor interviews (2)
- An assessment of returned student surveys and the associated savings

## Conservation Lessons Delivery

Quantec's 2002 Program evaluation recommended improvements in five areas: 1) increase conservation emphasis of lessons, 2) develop targeted, measure-based lessons, 3) provide students with conservation measures, 4) provide measurable metrics, and 5) improve data collection instruments. The KYNEED Program has made significant progress on all of these recommendations.

Prior to 2002, the KYNEED Program had an implied conservation message throughout its curriculum. An Energy Conservation Contract was then used to increase awareness about saving energy at home. Since 2003, the Program developed curriculum that focuses on energy efficiency generally, but also emphasizes the kit. Each student receives an "Energy Efficiency Notebook" that contains nine lessons, each including a journal and homework assignment. Through this medium, each measure in the kit is introduced, and students are asked to take them home to install or implement some recommended behavioral changes. Teachers are provided with a Teacher's Guide containing additional information.

In addition to the notebook, audit forms are provided to students as a separate homework assignment. The *Energy Usage Before* survey is the homework assignment for Lesson 1, "What is Energy." Both the *Energy Usage After* and *Installation* surveys are part of the Lesson 9, "Landscaping Investigations,"<sup>2</sup> assignment.

Teachers and Program staff interviews indicated that teachers, parents and school administrators are excited about the new conservation focus. Several mentioned that the measures' "hands-on" nature is extremely beneficial in the classroom. Teachers are currently on waiting lists to receive additional kits of measures.

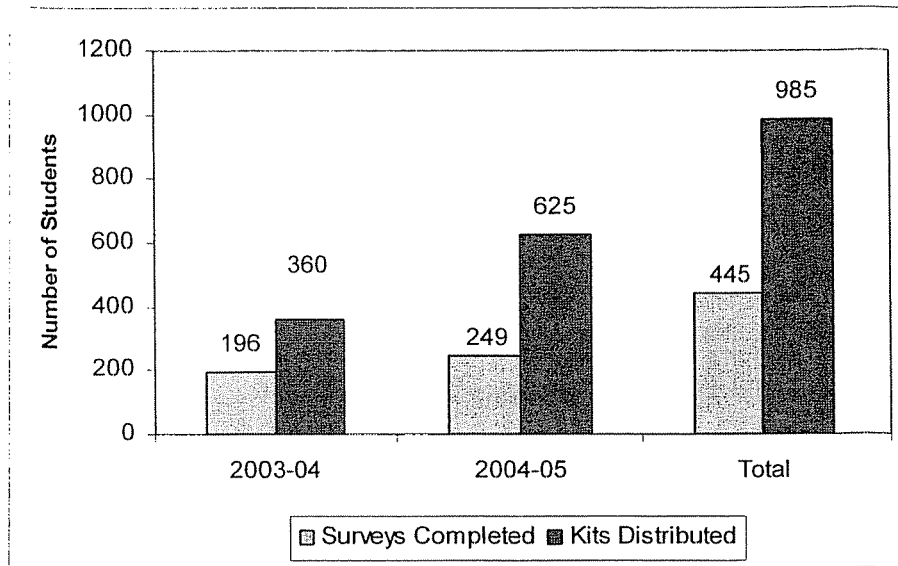
Teachers noted that their most significant concern was the confusion caused when only some of the students receive kits. UHL&P only provides measures to their customers even though many teachers have households served by Owen Electric, thus a portion of the class may not receive measures to take home.

From 2003 to 2005 (covering two Program years), UHL&P provided a total of 985 kits for an approximate cost of \$30,000. Overall, nearly half of the students returned some portion of the audit forms. In 2003 to 2004 the response rate was 54%, which dropped down to 40% in 2004 to 2005.

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<sup>2</sup> One teacher noted that this lesson was skipped because it was too difficult for 5<sup>th</sup> graders and beyond their control.

**Figure I.2: Surveys Returned and Kits Provided**



## Demographics

The *House and Appliance Characteristics* portion of the audit form was designed to describe students' home, energy-using equipment and baseline consumption characteristics.

The average home occupancy for respondents was 4.4, including 2.1 adults, 0.6 teens (12-18 years of age) and 1.8 children. The average home age is 21 years. Participants were also asked if they had certain appliances, as shown in Table I.2 below.

**Table I.2: Appliance Saturations, % of Respondents (N=445)**

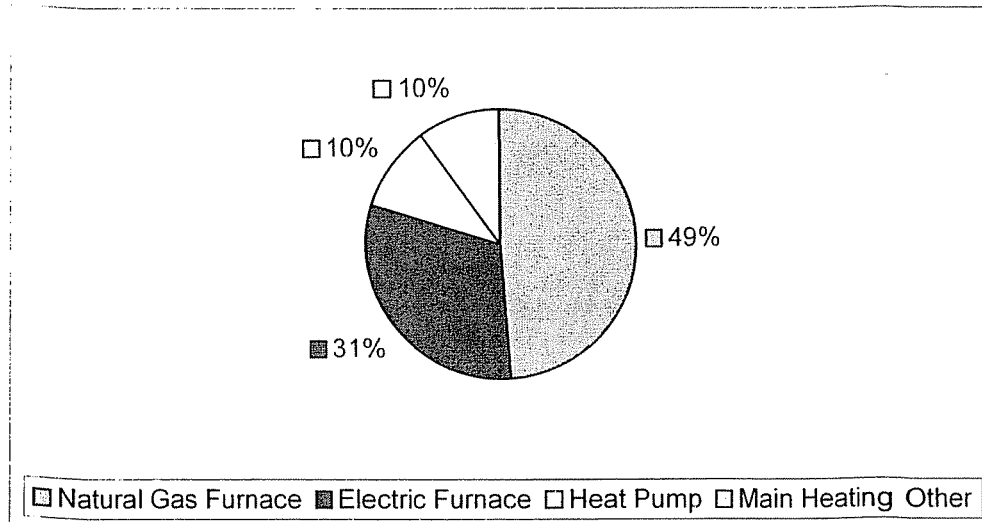
<b>Refrigerator</b>	<b>Television</b>	<b>Clothes Dryer</b>	<b>Clothes Washer</b>
98%	98%	96%	95%
<b>Computer</b>	<b>Dishwasher</b>	<b>Video Game System</b>	<b>Stand Alone Freezer</b>
93%	89%	86%	41%

For heating water, 51% of participants use electricity and 46% use natural gas.<sup>3</sup> Central air conditioning is used in 85% of the homes and 5% utilize room units. Most families heat their homes using natural gas (49%) and a smaller but significant amount use electric (31%), as shown by Figure I.2.

<sup>3</sup> Remainder "don't know."



Figure I.3: Primary Heating Source (N=445)



## Behavioral Assessment

The second audit form section was designed as a fundamental part of the curriculum as well as a way for Program staff to assess energy saving behaviors. Because the pre-2002 Energy Conservation Contract was the primary teaching tool, the behavioral assessment in the audit tool remained similar to the previous contract in order to provide a way to teach students new behaviors.

As described above, this behavioral assessment was handed out before the lessons and then again at the end of the lessons as a separate assignment. The objective was to see how students had improved on their energy behaviors, such as removing incandescent light bulbs, increasing air conditioners temperatures, leaving lights on and not allowing water to run needlessly.

Response rates for this section of the audit form were quite high, showing that most students responded to both the before and after questions. Ideally, the evaluation team would estimate the change in behavior for each indicator then estimate the resulting energy savings. Yet, a significant number of responses indicated that students were using *more* energy (an extremely unlikely result of the Program). Figure I.3 displays the percent of responses in each of three categories: using more energy, no change and using less energy.

**Figure I.4: Behavioral Responses (N=407<sup>4</sup>)**

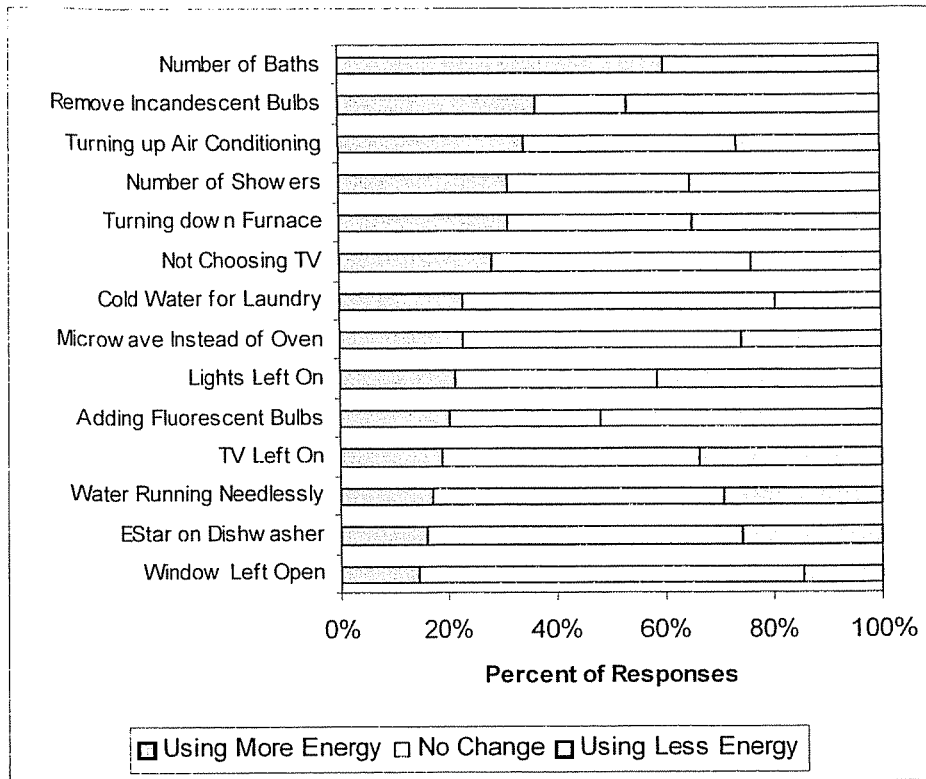


Table I.3 outlines the average change<sup>5</sup> in behaviors for answers that indicated less energy use, more energy use, and the average for all responses. In addition, the number of units are provided. Because of the high propensity for students to report an increase in energy-consuming behaviors, the overall averages indicate little overall change in energy consumption due to behaviors.

<sup>4</sup> Average number of responses across questions.

<sup>5</sup> Calculated as after lessons response minus before lessons

**Table I.3: Average Behavioral Changes**

Energy Saving Behavior	Average Change for Less Energy	Average Change For More Energy	Overall Average	Units
Window Left Open	-1.6	1.8	0.0	Times per day
EStar on Dishwasher	2.6	-2.8	0.2	Loads per Week
Water Running Needlessly	-2.3	2.4	-0.3	Times per day
TV Left On	-2.5	2.1	-0.4	Times per day
Adding Fluorescent Bulbs	3.8	-5.8	0.8	No. Bulbs
Lights Left On	-3.1	2.8	-0.7	Times per day
Microwave Instead of Oven	2.2	-2.0	0.1	Times per day
Cold Water for Laundry	2.6	-3.6	-0.3	Loads per Week
Not Choosing TV	2.7	-2.8	-0.1	Times per day
Turning down Furnace	-4.0	3.9	-0.4	Degrees
Number of Showers	-8.3	7.2	-0.7	Showers per week
Turning up Air Conditioning	4.9	-5.3	-0.3	Degrees
Remove Incandescent Bulbs	-17.3	15.4	-2.4	No. Bulbs
Number of Baths	-4.5	4.2	0.7	Baths per Week

\* Change calculated as Post-behavior minus Pre-behavior

Due to the magnitude and direction of many responses, we have concerns about the reliability of these data. Therefore, we did not estimate behavioral energy savings attributable to the Program, except in one case (turning down furnace). Some examples of the responses' inconsistencies are provided below.

One typical energy conservation lesson students learn is to reduce their number of baths and conversely, increase their number of showers. Taking a bath uses significantly more hot water, so showers can contribute to lower energy usage. On average, students reported an additional 0.73 baths taken in their home each week, driven by 60% of respondents who indicated *more* baths taken in their home each week. Complementing this result is that students reported 0.7 *fewer* showers each week.

Ideally, students would learn about energy efficient lighting through the Program, which would prompt their families to replace incandescent light bulbs with CFLs. Nearly half (47%) of students reported that they removed incandescent bulbs as a result of the Program, with an average of 17.3 removed bulbs. Yet, 40% of students stated that they *increased* the number of traditional bulbs after the Program at an average rate of 15.4 bulbs. Regardless of direction, the magnitude of these changes indicates a reporting issue. Specifically, one would expect that if large quantities of incandescent lights were removed from a home, a similar number of CFLs would be installed. This was not the case. CFLs were reported to be added at a rate of 3.8 per household (52% of respondents) and removed at a rate of 5.8 (20% of respondents).

In terms of appliance usage, a surprising number of students indicated an increased energy use, with 35% reporting that air conditioning temperature was turned *down*, 31% reporting that their furnace was turned *up*, 23% reporting that cold water was used for laundry *less* often after the lessons, and 16% stating that the energy saving feature on the dishwasher was used *less* often.

There are several possibilities why the results are so inconsistent with expectations:

- **Students have not learned energy saving behaviors.** It is possible that students do not know what to do to conserve energy as related to the topics on the behavioral assessment. This could be caused by incomplete lesson information. If the lessons are teaching this information, students could be forgetting it by the time they complete their “after” survey.
- **Students are not aware of their “pre” response.** Program staff rationally decided that it was best for the “before” and “after” surveys to be on separate pages, which would reveal the “true” results of their behavioral change. Yet, if families have forgotten their pre-responses, it may be difficult to indicate their changes in behavior.

We have noted survey improvement recommendations at the end of this report in the *Conclusions* section.

## Measure Installation

The third portion of the audit form asked students specifically about the Conservation Action Kit measures’ installation and use. Participants were asked if they had installed each measure, and if not, why.

Generally, this section had a much lower response rate than the first two sections, as only half of the *returned* surveys contained installation information.

### Lighting

Each kit included a 15-Watt compact fluorescent bulb. Of the 985 kits delivered, 24% responded to whether they had installed the CFL. Of those respondents, 73% affirmed that they installed the bulb; the average incandescent removed was 68 Watts. The CFLs were most often put in the bedroom and used just over four hours per day.

**Table I.4: Installation Characteristics of CFLs (N=233)**

% Response Rate	% Installed By Respondents	Average Wattage Replaced*	Average hours Used
24%	73%	67.9	4.2

\* Limited to less than 100 Watts

Of the 64 respondents who reported not installing the CFL, only six stated that the bulb didn’t fit, and 40 plan to install it in the future. Five respondents specified other reasons why they didn’t install the bulb, including “did not want to,” and “don’t like fluorescents.”

## Hot Water Savings Measures

Each kit contained three measures to reduce hot water usage in the home: high efficiency showerhead, bathroom aerator, and kitchen aerator. Like the CFL, the response rate was a consistent 24% of provided kits.

The high efficiency showerhead was most often installed; 40% of respondents utilized this measure in their homes. The kitchen aerator and bathroom aerators were installed by 34% and 31% of respondents, respectively. Program participants were also asked to measure the pre- and post-installation flow rates, which were used to determine the average flow reduction for each device, measured in gallons per minute (GPM), as shown on Table I.5.

**Table I.5: Installation Characteristics Hot Water Measures (N=233)**

Measure	Response Rate	% Installed by Respondents	Average Reduction in GPM*
Showerhead	24%	40%	0.89
Kitchen Aerator	24%	34%	0.96
Bathroom Aerator	24%	31%	0.90

\* Post GPM – Pre GPM, each limited between 1 and 7 GPM

Of the 139 students who reported not installing the showerhead, 25% indicated that it did not fit, 25% stated that they already had an efficient model, 15% said they plan to install at a later time, 10% are renters or struggled with installation, and 7% prefer their existing measure.

For the kitchen aerator, 31% (of 153) reported that the new model did not fit at their home, 12% indicated they already had the measure, and only 3% plan to install at a later time. For the bathroom aerator, a similar rate of respondents (32% of 162) stated that the measure did not fit in their home, 10% already have the measure in place, and 10% plan to install later.

## Educational Measures

The kit provided several devices to provide information for students to adjust various appliances, including hot water heaters, refrigerators, freezers, stand-alone freezers, furnaces, and air conditioners.<sup>6</sup>

Adjustment rates for these measures were below the installation rates above. This may be expected due to a student's lack of control over major appliances. Of the measures on the installation survey, the refrigerator was most often reported to be adjusted (17%), followed by the freezer (15%), the hot water heater (13%) and stand-alone freezer 5%.

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<sup>6</sup> Furnace and air conditioning changes were queried on the Behavioral Assessment; therefore the responses are not directly comparable.

**Table I.6: Appliance Adjustments**

Appliance Adjusted	Response Rate	% Adjusted by Respondents*	% Who Plan To Adjust	Average Change in Temperature*
Hot Water Heater	22%	13%	42%	-12.6
Refrigerator	22%	17%	40%	1.1
Freezer	22%	15%	45%	0.4
Stand Alone Freezer	18%	5%	27%	0.3
Furnace**	32%	61%	NA	-0.4
Air Conditioning**	29%	81%	NA	-0.3

\* Post-temperature minus Pre-temperature, each limited: hot water heater 100-200°F, refrigerator 30-44°F, freezer and stand-alone freezer -10-30°F, furnace and air conditioning 50-90°F

\*\* Responses provided on Section 2 of the audit form

Although adjustment rates were relatively low, the portion of students who plan to adjust was quite high. For all measures, except the stand-alone freezers, over 40% reported that they planned on adjusting the temperature but had not completed this yet (this question was not asked for furnaces and air-conditioning units).

For those families that did make adjustments, the average reported changes are relatively small. When the audit tool asked students why they did not make the recommended changes, the most frequently provided response was that they were already set at the correct temperature<sup>7</sup>. In addition, several comments were made by respondents that their current temperature settings were preferred or they were not sure how to make the recommended adjustments. For hot water heaters, several commented that they rent and therefore do not have control over that particular appliance.

Additionally, respondents were asked to report any other changes made in their energy consumption. Few responses were provided (7), including insulation, weatherization, new doors, and turning off lights.

## Energy Savings

We calculate a range of energy savings by measure for the average respondent. Additional details are provided in the Appendix. For the high-case, we assume that the non-respondents' installation rates are equal to that of the respondents. For the low-case, we assume that one-half as many non-respondents installed measures as compared to respondents. For example, if 50% of respondents indicated that they installed a particular measure, we assumed 25% of the non-respondents installed the measure. We feel this range of energy savings is relatively conservative since we are not crediting the Program with additional savings for those who "plan to install" and are not estimating energy savings from behavioral changes.

---

<sup>7</sup> Refrigerators: 24 of 65 responses, Freezers: 18 of 56, Stand Alone Freezers 19 of 41

We find that, based on the equipment saturations, baseline consumption patterns, and installation rates (reported in Appendix), the average participant saved between 240 and 360 kWh and between 10 and 16 therms per year. This translates to first year average cost savings of between \$25 and \$38, assuming rates of \$0.07/kWh and \$0.80/therm. The table below outlines estimated savings by measure.

**Table I.7: Estimates of Energy Savings**

Measure	High Savings Estimates		Low Savings Estimates	
	Electric (kWh/year)	Natural Gas (therms/year)	Electric (kWh/year)	Natural Gas (therms/year)
CFL-1	59		38	
Showerhead	214	9	147	7
Kitchen Aerator	32	1	22	1
Bathroom Aerator	25	1	18	1
Adjust Hot Water heater	10	1	7	0
Adjust Refrigerator	2		1	
Adjust Freezer	1		1	
Adjust Stand Alone Freezer	0		0	
Adjust Furnace	19	3	8	1
<b>Total Savings (energy units)</b>	<b>362</b>	<b>16</b>	<b>243</b>	<b>10</b>
<b>Total Cost Savings (Annually)</b>	<b>\$38</b>		<b>\$25</b>	

Using high and low savings results, the levelized cost of conserved energy was calculated for the kits only (\$30/kit) and kits plus admin (\$162,000)<sup>8</sup>. As shown below, when compared to the kit prices only, the energy savings are relatively inexpensive, \$0.02/kWh. Yet, when administrative costs are included, this cost per kWh increases ten-fold.

**Table I.8: Levelized Cost of Conserved Energy**

	Kits Only	Kits Plus Administrative
High Case	\$0.015	\$0.097
Low Case	\$0.022	\$0.143

<sup>8</sup> Admin costs were reported to be \$81,000 per year. Discount rate was assumed to be 7.5% and line losses were assumed to be 10%.

## Conclusions

Overall, the evaluation team is impressed with the progress made in the KYNEED-UHL&P Program, particularly with respect to conservation lessons. The combination of UHL&P's kit provision and the associated targeted curriculum has undoubtedly increased student conservation understanding. The Energy Efficiency Notebook has created a focused effort toward improving energy behaviors and installing kit measures.

The primary areas of Program improvement is related to the data collection instrument and encouraging installation of measures.

- ***Focus on collecting measure-based data.*** The primary goal of data collection for UHL&P should be verification of provided measures and related feedback. Therefore, it is possible for the audit form to be reduced to the final page and only a few demographic questions.
- ***Integrate verification into lessons.*** So far, the Program has done a sound job of integrating the conservation lessons and the measures taken home by students. Yet, the low response rates for the installation survey were below expectations. A reason for this could be that Lessons 4 through 8 cover the measure distribution but the *Installations* survey assignment is a requirement of Lesson 9, "Landscaping Investigations." We recommend integrating the questions about verifying installation into the lessons that distribute the measures.
- ***Set goals for increased response rates.*** The audit form response rates, particularly for the *Installation* survey, need to significantly improve. We expect that reduced data-collection requirements and integration into lessons will help. In addition, KYNEED should stress to teachers the importance of the data collection for their funding sources. Cinergy should set a reasonable response rate goal, possibly around 75%.
- ***Set goals for increased installation rates.*** Many of the installation rates, as reported by respondents, are lower than other school-based programs we have evaluated, as shown in Table I.9. Therefore, we recommend that the Program set the goal of increasing installation rates. One option is to provide a core set of measures (e.g., CFL, thermometers) and then provide hot-water measures, such as showerheads and aerators, only to those who do not already have an efficient unit at home. Another option may be for students to return the measures if they are not needed or don't fit in their homes. In addition, the program could provide incentives for students that install measures, such as additional lightbulbs.



**Table I.9: Installation Rate Comparison**

	Washington	Utah	Iowa	KYNEED
<b>% Respondents that Installed</b>				
CFL	87%	99%	92%	73%
Showerhead*	33%	63%	75%	40%
Bathroom Aerator	-	70%	73%	34%
Kitchen Aerator	-	-	-	31%
<b>% Participants that Adjusted</b>				
Water Heater	9%	62%	16%	13%
Refrigerator	10%	38%	6%	17%
Freezer	8%	64%	6%	15%
Stand-Alone Freezer	2%	-	-	5%
Furnace	65%	69%	28%	61%
AC	71%	65%	25%	81%
* Only given to those households using electric water heaters replacing an inefficient showerhead received showerheads				

- **Consider a way for students to follow up on installation.** When asked why they didn't install or adjust measure, many respondents said they "plan to," which was not counted toward energy savings for this evaluation. It would be ideal if students have an opportunity to follow up on these questions in the future and verify actual installation.
- **Consider optional behavioral assessment.** Although a primary Program goal is to teach students energy saving behaviors, the audit form's behavioral assessment did not provide useful information. If UHL&P would like to collect behavioral changes data, we recommend making significant changes to the current format. Otherwise, we recommend that the Program ensure that the behaviors on the audit tool are integrated into the lessons themselves, and this portion of the audit form is removed.
- **Develop reporting functionality.** We recommend that UHL&P develop a process to more regularly track statistics on returned survey results, which will enable more mid-stream process changes.
- **Consider measure changes.** If after one year, installation rates do not improve, it may be wise for UHL&P to consider removing those measures with the worst performance and adding others to replace them. For example, it may be possible to add weather-stripping, outlet covers or a room-temperature switch plate.

## Appendix: Energy Savings Calculation Details

### Installation Rate Assumptions

Installation	High	Low
CFL-1	73%	47%
Showerhead	40%	28%
Kitchen Aerator	34%	24%
Bathroom Aerator	31%	22%
Adjust Hot Water heater	13%	9%
Adjust Fridge	17%	12%
Adjust Freezer	15%	10%
Adjust Stand Alone Freezer	5%	3%
Adjust Furnace	61%	25%

### CFL Details

	Lifetime	Pre-Watt	Post-Watt	Hours per Day	Saturation*
Electric Savings	6	67.9	15.0	4.2	100%

### Showerhead Details

	Lifetime	Change in GPM	Shower Minutes per week*	Saturation	Conversion from GPM To kW or Therms
Electric Savings	8	0.9	183.7	51%	0.12
Gas Savings				46%	0.006

\*shower minutes per week = average occupants \* average post-lesson length of shower

### Kitchen Aerator Details

	Lifetime	Change in GPM	Water Flow In Minutes per Day*	Saturation	Conversion from GPM
Electric Savings	3	1.0	21.8	51%	0.073
Gas Savings				46%	0.004

\*Water Flow = % of HH Without Dishwasher \* (15' + Occupants \* 2') + (% of HH With Dishwasher) \* (3' + Occupant \* 0.5')

Assumptions :

- 1) Without Dishwasher-15 Minutes of Use Per Day Plus 2 Minutes for Each Occupant
- 2) With Dishwasher- 3 Minutes Per Day + 0.5 Minutes for Each Occupant)

### Bathroom Aerator Details

	Lifetime	Change in GPM	Water Flow In Minutes per Day*	Saturation	Conversion from GPM
Electric Savings	5	0.9	6.7	51%	0.073
Gas Savings				46%	0.004

\* Water Flow = Occupants \* 1.5 minutes

### Temperature of Hot Water Heater Details

	Lifetime	Change in Temp °F	% Savings / ° F*	Saturation	Savings (unit)/year	Average Savings (unit/year)
Electric Savings	2	12.6	0.40%	51%	154.9	7.1
Gas Savings				46%	11.6	0.5

\*% Savings / °F = 4%/10 – conversion for change in temperature found in DOE, Consumer Energy for Hot Water Heaters

### Temperature of Fridge Details

	Lifetime	Change in Temp °F	% Savings / ° F*	Saturation
Electric Savings	2	-1.1	-2.50%	98%

\* OPALCO estimate of 25% per 10 deg F.

Negative value used to convert negative change in temperature to positive energy savings

### Temperature of Freezer Details

	Lifetime	Change in Temp °F	% Savings / ° F	Saturation
Electric Savings	2	-0.4	-3.60%	98%

\*% savings / °F = -18% / 5 - conversion for change in temperature found Based on Home Energy Article for Freezer

Negative value used to convert negative change in temperature to positive energy savings

### Temperature of Stand Alone Freezer Details

	Lifetime	Change in Temp °F	% Savings / ° F	Saturation
Electric Savings	2	0.3	-3.60%	41%

\* % savings / °F = -18% / 5 - conversion for change in temperature found Based on Home Energy Article for Freezer

Negative value used to convert negative change in temperature to positive energy savings

**Temperature of Furnace Details**

	Lifetime	Change in Temp °F	% Savings /° F*	Saturation
Electric Savings	2	0.7	3.00%	41%
Gas Savings				49%

\* % savings / °F = 3% - conversion for change in temperature for a furnace found based on Kentucky Natural Resources and Environmental Protection Cabinet for "Make Your Home More Energy Efficient and Save Money" fact sheet

**Final Draft Report**  
**An Evaluation of the Payment Plus Pilot Program**

Results of a Process, Energy Consumption  
and Arrearage Effects Evaluation

**September 12, 2006**

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# Table of Contents

**EXECUTIVE SUMMARY ..... 4**

    ABOUT THIS REPORT ..... 4

    SUMMARY OF FINDINGS..... 5

    SIGNIFICANT PROCESS EVALUATION FINDINGS ..... 5

*Pilot IV*..... 5

    SIGNIFICANT PARTICIPANT INTERVIEW FINDINGS ..... 6

*Pilot IV*..... 6

    SIGNIFICANT ENERGY CONSUMPTION ANALYSIS FINDINGS ..... 7

*Pilots I, II and III Combined*..... 7

    SIGNIFICANT BILLING ANALYSIS EVALUATION FINDINGS ..... 7

*Pilot I*..... 7

*Pilot II*..... 8

*Pilot III*..... 8

**INTRODUCTION ..... 10**

    PROGRAM DESCRIPTION – PAYMENT PLUS PILOT PROGRAMS III AND IV ..... 10

    PROGRAM THEORY AND OPERATIONS ..... 11

    EVALUATION METHODOLOGY ..... 13

*Mini Process Evaluation*..... 13

*Energy Savings Analysis*..... 14

*Arrearage Analysis*..... 16

*Payment Effects Analysis*..... 16

*Customer Interviews*..... 17

**SECTION I: PILOT PROGRAM IV PROCESS INTERVIEW RESULTS..... 20**

*Outreach and Enrollment Process Has Improved*..... 20

*Changes to the Enrollment Outreach Effort*..... 20

*Reasons for Non Participation in the Pilot Program* ..... 22

*Reasons for Dropping Out after Enrolling*..... 22

*Reasons for Non Participation in Weatherization*..... 23

*Communication and Coordination Issues Between NKCAC and PWC Resolved*..... 23

*Increase Renter's Ability to Obtain Landlord's Approval*..... 23

*Program Changes Interviewees Would Like to See*..... 23

*Tracking System Adequate for Current Program Structure* ..... 24

*Overall Benefits to the Participants*..... 24

*What Ratepayers Are Receiving*..... 25

**SECTION II – PILOT IV PARTICIPANT INTERVIEW RESULTS..... 26**

*Recalling Participation or Enrollment in the Program*..... 27

*Issues with Credits Being Applied to the Participants' Bills* ..... 27

*Main Reasons for Participation or Enrollment* ..... 27

*Why Customers Aren't Getting Weatherization*..... 28

*Satisfaction with the Training Sessions* ..... 28

*Satisfaction with Weatherization Services*..... 32

*Views of the Overall Program* ..... 34

*Participant's Recommendations for Improvements*..... 35

*Actions Take as a Result of Participation*..... 35

**SECTION III: ENERGY USE ANALYSIS AND FINDINGS.....37**

ENERGY USE EVALUATION - PILOTS I, II AND III .....37

*Sample Size*..... 37

*Statistical Precision*..... 38

*Changes in Electricity Consumption Between Participants and Comparison Group*..... 40

*Changes in Natural Gas Consumption Between Participants and Comparison Group*..... 44

ENERGY SAVINGS OF PILOT I, II, AND III PARTICIPANTS COMBINED .....48

SUMMARY OF ENERGY SAVINGS ..... 50

**SECTION IV: ARREARAGE EVALUATION RESULTS .....51**

INTRODUCTION ..... 51

*Analysis Sample Size* ..... 51

ARREARAGE LEVELS ..... 51

*Pilot I*..... 51

*Pilot II*..... 53

*Pilot III*..... 55

*All Pilots*..... 56

**SECTION IV: PAYMENT EFFECTS .....59**

PERCENT OF THE BILL PAID - PILOT I ..... 59

DISCONNECTIONS ..... 60

DAYS TO PAY BILL ..... 62

PERCENT OF CUSTOMERS MAKING A PAYMENT ..... 63

**CONCLUSIONS .....66**

*Pilot IV*..... 66

SIGNIFICANT PARTICIPANT INTERVIEW FINDINGS ..... 67

*Pilot IV*..... 67

SIGNIFICANT ENERGY CONSUMPTION ANALYSIS FINDINGS ..... 68

*Pilots I, II and III Combined*..... 68

SIGNIFICANT BILLING ANALYSIS EVALUATION FINDINGS ..... 68

*Pilot I*..... 68

*Pilot II*..... 69

*Pilot III*..... 69

**APPENDIX A: PROCESS EVALUATION INTERVIEW PROTOCOL .....71**

**APPENDIX B: PARTICIPANT SURVEY INSTRUMENT .....75**



## Executive Summary

### About This Report

This report presents the results of a process and impact evaluation of Duke Energy's Payment Plus Pilot Program. This program provides energy efficiency, conservation and financial management training to participants along with home weatherization services. Participants receive financial incentives in the form of arrearage credits to their account in order to encourage participation. Together the training and weatherization services are expected to lower participant's utility bills and improve their payment performance. The program was first implemented from January through May of 2002 (Pilot Program I). The program was evaluated, modified and implemented again in June through November 2003 (Pilot Program II). Pilot III was implemented from December 2003 through March 2004 to test modifications to the program implemented after the completion of Pilot Program II. This report presents the evaluation results from a process evaluation of Pilot Program IV, implemented in August and September of 2004), and an effects evaluation (arrearage, payments and energy savings) of Pilot Programs I, II and III.

This report is presented in five sections as noted in the following table.

**Table 1 Evaluation Report Contents**

<b>Section One: Pilot Program IV</b>	<b>Section Two: Pilot Program IV</b>	<b>Sections Three - Five: Pilot Programs I, II, and III</b>
1. Interview results with program designers, managers and implementers	2. Interview results with participants	3. Assessment of weather-normalized energy savings, 4. Assessment of arrearage effects, 5. Assessment of payment effects

The first section provides the results from the Pilot Program IV process evaluation. The process evaluation employed in-depth interviews with program design, planning and implementation staff.

The evaluation efforts employed to develop the findings presented in section two included reviews of monthly-metered energy consumption records of Pilot Program I, II and III participants and a comparison group of matched non-participants. The analysis presented in section two is an assessment of the program's energy impacts and employs a weather-normalized assessment of pre- and post-program energy use adjusted to account for normal changes in consumption through the use of a comparison group. Section three presents the assessment of the programs' effects on arrearage levels, and section four includes the assessment of various payment effects such as the number of days needed to pay the bill and the percent of the billed amount paid. Sections three and four also employ the use of a matched comparison group to assess the net effects of the program on arrearage levels and payment effects. Finally, the findings presented in section five are the results of the customer interviews conducted in 2006 with Pilot IV participants and

those that enrolled but did not participate. These findings are compared to the sections of the participant survey completed in 2003 with Pilot II participants.

The findings presented in sections two through four are based on the reviews of the usage data for 2 to 17 Pilot I participants (depending on the analysis conducted) who had at least one year pre and two years of post-program account information. Because of the small size of the Pilot I population the findings associated with Pilot I participants should be assessed with caution. The findings for Pilot Program II are drawn from 36 participants, and Pilot III has 33 participants, each having at least one year of pre and one year of post-program energy usage and account information. These findings from Pilots II and III are more reliable than the findings from Pilot I.

## Summary of Findings

An overview of the key findings identified through this evaluation is presented in this section.

This program has been evaluated over a number of years in its “pilot” status. These evaluations show that the program has evolved to point where the implementation efforts are efficient and effective, and customer satisfaction is high. In addition, the evaluations show strong and long-term natural gas energy savings, short-term electric savings and to some degree, impacts on arrearage and payment levels. TecMarket Works recommends that the Payment Plus move beyond the pilot status into a standard program component of Duke’s low-income service portfolio.

## Significant Process Evaluation Findings

### Pilot IV

TecMarket Works interviewed seven individuals associated with the design, management and operations of the program and reviewed the energy and budgeting workshop materials. The significant findings from these activities are reported below:

1. The process used to enroll Crisis participants has improved to the level at which the Northern Kentucky Community Action Commission (NKCAC) has to turn down applicants. The latest Pilot Program was at full capacity. All potential enrollees should continue to be pre-screened before the program is offered to make sure that the program is only offered to eligible customers.
2. The communications and working relationships between People Working Cooperatively (PWC) and NKCAC have significantly improved. There is better and more consistent coordination of services, with times and dates of Pilot training sessions rapidly communicated between the organizations, PWC has been available to attend training sessions and answer questions about the weatherization. This has increased enrollments into the weatherization program.

In addition, Duke managers have been given advanced notice of meetings, allowing their participation.

3. PWC has made an effort to contact landlords to help Pilot participants obtain the needed permission for weatherization. While contact is difficult, when accomplished, the landlords have been positive about the program and allowed weatherization to go forward. However, this issue remains a participation barrier for renters.
4. The interviewed managers at NKCAC and PWC report that they would like to see the following program changes:
  - a. Continue to try and reach the more rural areas of the targeted counties. If these customers can be cost effectively served, recruit and provide training sessions throughout the counties into more rural areas of the service territory to allow more rural low-income customers an opportunity to participate without having to travel great distances.
  - b. Let the service providers know that they are free to piggy-back or coordinate the program with other social services provided by the implementation agencies to expand services and increase demand and enrollment success.

## Significant Participant Interview Findings

### Pilot IV

TecMarket Works was able interview twenty-five participants of the Pilot IV Program. The significant findings from these interviews are reported below:

1. The driving force for participation was to receive the bill credits. Eighty percent cited the credits as the primary reason they chose to enroll. Thirty-six percent said that they participated in order to learn how to save energy.
2. Program participants understood the program and the procedure for applying their credits better than in the past. This was an area of confusion for past participants that appears to have been eliminated.
3. Reported problems with getting the credits applied to their bills has dropped significantly. Very few of these issues are now being raised by participants. The process involved in applying credits was streamlined after the previous evaluation, with the intent of reducing or eliminating these types of complaints. This goal appears to have been achieved.
4. Participants are still very satisfied with the Training Sessions. On a scale of 1-10, average scores for all aspects of the training sessions were high across most response categories for both sessions (energy & budgeting). Satisfaction was

particularly high when rating the instructor's knowledge (9.4 & 9.6), comprehensiveness of subject matter (9.2 & 9.3), and presentation skills of instructor (9.2 & 9.4). The convenience of attending the session was the only response group that received satisfaction scores below 9 (8.6 & 8.8) indicating that there was less satisfaction with the convenience of attending the sessions, but these satisfaction scores are very good scores when using a 10-point scale.

## Significant Energy Consumption Analysis Findings

### Pilots I, II and III Combined

TecMarket Works examined customer billing and payment records for three of the Pilot Programs' participants for a period of at least six months prior to the program and from one to four years following the program. The results of this analysis are presented below and in Sections Three and Four of this report. The combined energy impact analysis results include:

1. Over the longer period of this study the pilot participants have not been able to reduce their electrical consumption. This is different from the previous evaluation in which the participants experienced reduced electric consumption.
2. Pilot participants who were not weatherized are still able to decrease their consumption of natural gas in all Pilots except Pilot I. The weatherized participants over the successive pilots continue to save natural gas.
3. Weatherization is a key component of the Payment Plus Pilot Program for savings natural gas over the long-term. While kilowatt-hour savings are no longer present, participants have experienced electric savings for a significant period of time in past evaluations. These savings have eroded as the months and years have passed. It may be possible to recoup some of these savings by re-communicating tips on how to save electricity with past participants, or by allowing past participants to re-enroll in the energy training session (with or without program credits). However, these follow-up efforts may need to be cost effective, a difficult challenge when the extra savings may be additional short-term electric savings.

## Significant Billing Analysis Evaluation Findings

Each of the Pilots are discussed separately in this section.

### Pilot I

When reading the results of this assessment the reader is cautioned about using these findings as conclusive. There were not many participants that had enough pre- and post-program billing and payment data to include in the assessment. This means that the sample's precision level and the confidence interval are not rigorous enough to draw decisive conclusions, but instead should be considered indicators of results. Significant finding from the billing analysis include:

1. Arrearage levels for participants have substantially decreased in the years following participation (from \$719 to \$434), and non-participant arrearage levels increased slightly.
2. Likewise, there is also a trend suggesting that participants are beginning to pay a higher portion of their bill following participation. Participants paid, on average, about 47% of their utility bill during any given month before the program. Since participation, they have increased the percent of the bill paid to just over 56%. Participants appear to be increasing this amount while non-participants appear to be decreasing this amount.
3. Pilot I participants have been successful at decreasing their disconnection rates relative to the comparison group. In the post-program years, the comparison group has had a disconnection rate of 5.97%, while the participants have kept their disconnection rate quite low at 2.24%.

## Pilot II

TecMarket Works examined customer billing and payment records for a period of two years prior to the program and for three years following the Pilot II program (although some months are excluded due to poor sample size). The results of this analysis are presented below and in Sections Three and Four of this report. Significant findings include:

1. Pilot II participants have experienced a decrease in their arrearage levels in the months after participation. In the two years of post-program months, arrearages decreased by an average of 13%, whereas the comparison group arrearages increased by 7%.
2. Participants were able to limit the level of erosion of the amount of the payments they made each month relative to the total amount due on their bills. Participants were paying about 51% of the amount due before the program, after participation, they paid about 45% of the total bill. Likewise, the comparison group also decreased the amount they paid relative to what they owed during the same time, dropping from 45% to 30% of the bill paid.

## Pilot III

Pilot III has the strongest sample size for this analysis. There were typically data from at least 30 participants in each of the months analyzed, and a very strong comparison group of about 100-500 customers.

1. The mean arrearages of the Pilot III participants have increased slightly since participating in the program, at about the same level as the comparison group. There has been little change in this area.

2. Disconnections have decreased since participation. Before the program, the disconnection rate was 3.1%, and since then it has dropped to 2.4%. The comparison group's disconnection rate has increased from 3.8% to 4.4% in this same time period.
3. The percent of the bill paid by Pilot III participants has remained steady, while the comparison group has been paying less of their bill during the same time period.

## Introduction

This report presents the results of a mini process evaluation of the Payment Plus Pilot Program IV and an effects evaluation of Pilot Programs I, II and III. The process evaluation examined Pilot Program IV operations while the effects evaluation examined the effects of the program on the payment effects and energy consumption of Pilot Program I, II and III participants.

To conduct the process evaluation we interviewed program managers, designers and implementers employed the Northern Kentucky Community Action Commission (NKCAC), and People Working Cooperatively (PWC).

## Program Description – Payment Plus Pilot Programs III and IV

The Payment Plus Pilot Program is a small test program originally contracted to be implemented in six counties in northern Kentucky during the period from January to May of 2004. However, the program provider was unable to meet this obligation and the program was implemented in only two counties. Of those that participated, most participants came from Boone, Kenton or Campbell counties; however, one or two participants each came from Gallatin, Grant and Pendleton counties. In total 90 participants enrolled and participated in Pilot III, and 120 enrolled in Pilot IV. Each successive Pilot is designed or is operated somewhat differently than the others, allowing Duke Energy to obtain experience in different configurations of the program.

The primary purpose of the Pilot Program is to help low-income customers with significant arrearage and payment problems obtain the information and skills needed to control their consumption, reduce their utility bills and be capable of managing their energy accounts in a way that results in lower arrearage levels. The program provides each participant with significant credits (up to \$500.00) to their past-due arrearage levels in an effort to help move them out of debt and improve payment behaviors.

The program has three phases of service delivery. The first phase is participation in an energy education workshop designed to teach participants how to manage their energy use. The second phase is a workshop on financial management designed to teach participants how to manage their financial affairs so that they can live within their income levels and pay their bills on time. The third phase is a weatherization service in which their home is weatherized to make it more energy efficient. Participants were required to complete the energy workshop, but were not required to attend the budgeting workshop or have their home weatherized. However, to obtain the \$500 participation credit the participants need to complete all three phases of the program. For further details on how the credits are applied, see Item 4 in Program Theory and Operations on page 10.

The program is funded by Duke Energy and implemented by the Northern Kentucky Community Action Commission (NKCAC) in concert with People Working Cooperatively (PWC). NKCAC manages and administers the program and provides the participant training services. After the participants receive the program training and

during the weatherization services, the participants are referred to the state for additional weatherization services that are not provided under the Duke program.

Pilot Program IV was designed to build on the experience of Pilot Program I, II and III, and to continue the testing of the program. The Pilot Program IV effort was planned to serve 120 participants who had high levels of debt (arrearage) to Duke Energy.

The participants attended one or two training sessions (energy education and budgeting) and 45 of the 120 participants participated in the weatherization program. Attendance at the budgeting session and participation in the weatherization program were optional. Full participants took advantage of all three components of the program and received \$500 dollars in arrearage credits, free weatherization of their homes, and training that provides them with the skills they need to conserve energy and better manage their household budgets. These participants realized the greatest benefits from the program in terms of incentives and in reduced energy consumption. Other participants enrolled in the program, attended the first training session (energy) and did not attend the second session but went on to obtain weatherization services, or attended the second session but did not go on to obtain weatherization services. These “partial” participants received partial credits depending on which components of the program they completed.

## Program Theory and Operations

The program theory is simple and easily understood. The primary theory is founded on the belief that many low-income customers with high arrears can gain improved control over their bills and begin to pay down their utility debt if they are provided with the skills and support services needed to assist them through this effort. The program is grounded in the theory that providing participants with a significant reduction to their current arrears will place them in a better position to gain control over their utility bill. The credits provided by the program provide a financial helping-hand to the participants. However, the program is also designed from the theory that participants need more than financial assistance to be able to effectively manage their account. As a result, the program provides training on how to reduce consumption by implementing effective energy management strategies. In addition to the energy training, the program also weatherizes their home so that it is technically more energy efficient. Combined, the training and the weatherization measures provide a foundation for reducing consumption to be more consistent with participant’s ability to pay for that consumption. Finally, the program theory indicates that the participant’s ability to manage their energy bill is, to some degree, a function of their financial management skills. To improve participant’s financial management skills the program provides educational efforts aimed at helping participants establish household budgets and live within their budget. The program theory is based on the belief that these three program services, linked with substantial bill credits to start them on an improved payment path, provides a platform from which participants can begin to gain control over their accounts.

The Pilot Program IV services were implemented through a series of efforts that were coordinated across the contractor teams. The implementation tasks are described below:



1. NKCAC agreed to manage and administer the program for Duke Energy through a contractual agreement between the two organizations.
2. Duke Energy identified low-income customers who had high arrears and who might need help in gaining control over their bills. (High arrears are undefined by Duke Energy, but typically mean that the customer had an arrearage above the \$300 in total credits provided by the program, with a few exceptions as determined by Duke Energy.)
3. The individuals on the Duke Energy list were contacted by NKCAC via a program introduction letter explaining the program and requesting that interested customers contact NKCAC to enroll in the program. The goal of the outreach effort was to enroll 120 participants. NKCAC supplemented this effort with phone calls to improve the enrollment response from the letter.
4. Program participants were required to successfully complete one task. The other two tasks were optional. These were:
  - a. Required Task: Attend one of the Energy Efficiency Training Sessions held in August and September of 2004. These workshops discussed and demonstrated methods to reduce energy consumption and gain control over their energy bill. In return, participants received a credit of \$200 applied to their arrearage.
  - b. Optional Task 1: Attend a Financial Management Session held in August and September of 2004, which discussed and demonstrated household budgeting and management techniques to help participants understand their income levels and be able to live at or below their income level. In return for attending this second training session, the participants received a \$150 credit that was applied to their arrearage.
  - c. Optional Task 2: Receive an energy audit of their home to identify measures needed to lower energy costs, and receive weatherization services consistent with the audit results, program offerings, and approved measures. Both homeowners and renters could receive weatherization services. However, if the participant rented, they needed to obtain the permissions of the owner to conduct the audit and install the weatherization measures. After weatherization is complete, the customer received a credit of \$150 to their arrearage. This weatherization service is a separate but coordinated program that is offered in conjunction with the Payment Plus Program. The weatherization program is an ongoing program funded by Duke Energy and run by the NKCAC.

## Evaluation Methodology

The study methodology consisted of four parts. These are:

1. A process evaluation of Pilot Program IV in which TecMarket Works interviewed key program managers and staff in late June. The interviews were designed to review program operations and experiences and to identify and discuss implementation issues associated with the program's design or operations, particularly associated with problem areas identified in previous studies;
2. A weather-normalized energy usage analysis to determine if participation in the first three Pilot Programs resulted in energy-related consumption changes; and
3. An arrearage analysis in which TecMarket Works examined Pilot I, II and III participant's billing and payment streams to determine if the program had an effect on how bills are paid and how arrearages are managed.
4. A survey of Pilot IV enrollees was conducted to measure satisfaction levels, to identify implementation issues, and to identify barriers to program participation.

### Mini Process Evaluation

The mini process evaluation included onsite interviews with key Duke Energy, NKCAC, and PWC program delivery staff. These interviews focused on the design, planning, and implementation of the program and a review of the goals and objectives associated with the program. Interviews were conducted with the following individuals.

1. Kathy Schroder, Duke Program Manager
2. Florence Tandy, NKCAC Director
3. Pamela Whitehorn, NKCAC Program Implementation Manager
4. Lillian Caldwell, NKCAC Educational Director
5. Nina Creech, PWC Weatherization Program Manager
6. Stacy O'Leary, PWC Program Operations Staff
7. Diana Adams, PWC Program Operations Staff
8. Al Loving, PWC Weatherization Program Supervisor

The interviews were conducted in June 2006, and followed a formal evaluation interview protocol. This protocol is provided in Appendix A of this report and allows the reader to see the range and scope of the questions addressed during the mini process interviews.

## Energy Savings Analysis

Energy savings for Pilot Program I, II and III participants were determined by looking at the change in energy usage of the participants compared to the change in usage of a comparison group of eligible customers who did not participate in the program. The Princeton Scorekeeping Method (PRISM™)™ software was utilized in this analysis. PRISM™ is capable of providing weather-normalized data analysis of energy use. Analysis was done on eight groups of participants for both kWh and therm consumption. The groups are: weatherized participants from each of the three Pilots analyzed, non-weatherized participants from each of the Pilots, and then the three pilots were combined to get results from the Pilot Program over the three Pilots.

The analysis used two matched comparison groups of low-income customers who had not been weatherized, had two or three years of billing data, and had arrearage levels of \$500 or more at some point in the study period. The comparison group was analyzed to be sure that the mix of customer's energy needs were similar. The same comparison group used in a previous evaluation was used with the participants' data from Pilots I and II and contained reliable data from 49 customers for therm comparison and 20 for kWh comparison. A new comparison group was pulled for the Pilot III analysis that contained 95 customers for therm comparison and 36 customers for kWh comparison. These comparison groups were combined when the overall analysis of the combined three Pilots was performed, resulting in a comparison group of 157 customers for the therm comparison, and 56 for the kWh comparison.

After the comparison groups were selected by Duke Energy, data cleaning was conducted to eliminate those customers that did not have sufficient data for the study or included accounts in which there was a tenant change and resulted in the comparison population sizes reported above. These customers were randomly assigned false participation dates to establish the pre- and post-program analysis periods for the comparison group.

Participants' data was also separated into pre and post periods. Participants who were weatherized at some point after the program workshops had their pre data begin before the workshops and their post data begins two months after the weatherization measures were completed on their home. Data between these two dates was not included in the analysis. Participants who were not weatherized, or who were weatherized before the pre data started had their post data start two months after participating in the workshops.

The data that was used for this analysis was provided from Duke Energy's monthly-metered account database. The data was provided in therms and kWh per month per customer for up to three years before the program and for up to twenty-four months after the program.

This report presents the savings in kilowatt-hours of electricity and therms of natural gas. Mean and median summaries are provided for each of the groups of participants in order to allow comparisons between the mean and median, which can indicate when a group of participants have a household with unusually high or low savings. A description of the PRISM™ software is below.

### PRISM™ Analysis

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 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 (and previous evaluations of the Payment Plus Program) we chose the period from January 1, 1992 through December 31, 2002, recommended by PRISM™ support.

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-day.  $R^2$  varies from 0 to 1. If  $R^2$  is close to zero, it means that factors other than outdoor temperature are driving energy consumption. If the  $R^2$  is close to 1 it means that outdoor temperature is almost entirely responsible for energy consumption. Outdoor temperature is usually the overriding factor in both heating and air conditioning 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 and air conditioning systems 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 energy use is

temperature dependant. If less than 70 percent of the energy used 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 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. 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.

### Arrearage Analysis

The arrearage analysis was approached by analyzing changes in monthly arrearage levels for the Pilot I, II and III participants as compared to two comparison groups and comparing changes across these groups over time. Arrearage amounts were established by examining each customer's monthly past due debt. Each of the Pilots were evaluated separately, and then combined to assess the program's overall effects on arrearages and payment effects. Because each Pilot has different program participation dates, the Pilot participants that are included in this analysis varies from month to month throughout the analysis period. This analysis adjusts for changing sample size so that the results are automatically weighted appropriately.

### Payment Effects Analysis

Payment effects analysis assessments include the average percent of the bill paid each month for the participants and comparison groups over time, the average number of disconnect orders issued and filled for the participant and test group following program participation, the percent of customers in Pilots I, II and III and the comparison group that made a payment of any amount in each billing cycle, and the average number of days it took customers to pay their bill for the participants and comparison groups for Pilot I, II, and III.

*Percent of bill paid* was established by calculating the total payments made by the customer and the percent of bill the total payments covered for each customer for each month and calculating an overall average for each group across the pre- and post-program analysis months.

*The frequency of disconnects* was a simple averaging of the disconnect codes placed in the account record for the participant and comparison group over the pre- and post-program period for Pilot participants.

We also analyzed the *number of days between a billing and a payment* for Pilot participants before and after the program. The estimated number of days uses the bill issue date, (not the date the bill may have been received and/or opened) and the date that the first payment made in that month was recorded. Before analysis of the number of days between the billing and the customer payment, all payments or credits from sources other than the customer (NKCAC, corrections, etc.) were eliminated. As a result the number of days to make a payment toward a bill is based solely on the customer's payments.

### **Customer Interviews**

TecMarket Works' staff conducted interviews with twenty-five customers who enrolled in the Payment Plus Pilot IV Program. The program enrolled 120 participants in October and November of 2005. Of the 120 participants who were enrolled before the first workshop, forty-five finished the program and received all their credits. The remaining participants were Partial Participants, and fit into one of three groups depending on what aspects of the program they completed. The results of these interviews are compared to the results reported in the previous evaluation which included a participant survey of Pilot II participants. The questions were exactly the same, but the survey length was shortened to address satisfaction rates in this evaluation.

### **Table 2 and**

Table 3 present the number of participants and the levels to which they participated in Pilot II and IV.

**Table 2 Summary of Participation Status of Pilot II Enrollees**

	Dropouts	Participants n = 78			
		Full Participants	Partial Participants n = 45		
<b>Definition:</b>	Enrolled, but did not participate.	Attended both training sessions and received weatherization services	Attended energy training session only	Attended energy and financial management training sessions	Attended energy training session and received weatherization services
Enrollees	25	33	12	27	6
Percent	32%	42%	15%	35%	8%
Credits Provided	\$0	\$500	\$200	\$350	\$350

Table 3 Summary of Participation Status of Pilot IV Enrollees

	Dropouts	Participants n = 121			
		Full Participants	Partial Participants n = 79		
<b>Definition:</b>	Enrolled, but did not participate.	Attended both training sessions and received weatherization services	Attended energy training session only	Attended energy and financial management training sessions	Attended energy training session and received weatherization services
Enrollees	0	42 <sup>b</sup>	16	57 <sup>a</sup>	6
Percent	0%	35%	13%	47%	5%
Credits Provided	\$0	\$500	\$200	\$350	\$350

<sup>a</sup> A small portion of this group may still be eligible to receive weatherization services.

<sup>b</sup> Note: 17 of these 42 participants were weatherized before their participation in the Payment Plus Program.

There was only one participant interview protocol used for the survey of Pilot IV participants, and it can be found in Appendix B. The previous protocol was not included here as it contains questions that were not asked in this evaluation.



## Section I: Pilot Program IV Process Interview Results

This section of the report provides the results of the mini process evaluation. The results are presented for each of the primary researchable issues identified for investigation during the process evaluation planning efforts. These researchable issues were based on the results of the process evaluation of Pilot III done in 2004, in order to gauge the effectiveness of any changes implemented since then.

### Outreach and Enrollment Process Has Improved

The program participation goal for Pilot IV was set at 120 customers, and is the number of customers that could be enrolled in the program within the budget set and approved by the Commission. This amount was considered to be a reasonable number that could be handled by the program contractors during the fourth round of the test program and also was considered a reasonable number of participants to support the evaluation. The program enrolled 120 customers who participated in Pilot IV, allowing the program to reach 100% of their participation goal. The method of enrollment for this Pilot was a simple letter sent out to eligible customers, and the demand exceeded the supplied space for the program, with no follow-up phone calls necessary.

The letterhead mast used in the mailing to potential participants included the Duke Energy logos as well as those from NKCAC, but the envelope's return address indicated the mailing was from NKCAC. This approach may have helped improve the recruitment rate over previous programs because the low-income population may trust or be receptive to messages from NKCAC more than Duke Energy.

There is room for expansion of enrollment initiatives if the program is developed from a Pilot program into a full program, and NKCAC indicated that they can recruit more participants. NKCAC also indicates that that can coordinate with other programs and other low-income customers to let them know about the Payment Plus Program.

From the last process evaluation, there were two suggested improvements to the enrollment methods: *a) the enrollment process needs to be improved to increase the enrollment rate of targeted customers, and b) the process for enrolling Crisis participants into the Pilot Program needs to be changed so that the process does not cause damage to [Duke's] customer relationships.* These two issues have been resolved, as the enrollment process now focuses on a list of eligible customers supplied by Duke Energy. As a result, NKCAC indicated that there were no problems filling the classes to capacity, and NKCAC believes that there are many more customers that would enroll in the program if it is offered again.

### Changes to the Enrollment Outreach Effort

We previously recommended that the customer enrollment letter should not be relied upon as the primary method of motivating arrearaged customers to join the Program, due to the 5% to 16% enrollment rate from the letters two years ago. However, this is no longer

a concern, as the latest enrollment effort resulted in a demand for the program that exceeded the supply.

A comparison of the enrollment letters suggests there may be some key differences in the two letters that influenced participation decisions. In reviewing the previous 2003 letter and the more recent letter used in 2005, there is a great deal of similarity across the two letters however, there was also a significant amount of dissimilarity as noted below.

The letter used in 2003 was sent on Cinergy letterhead while the letter used in 2005 was sent on stationary that included both the Cinergy letterhead graphics and the letterhead graphics of NKCAC. This new letterhead helped convey the legitimacy of the program to the customer by including the graphics of both of the trusted organizations.

An analysis of the two letters suggest that the previous letter used in 2003 is easier to read and is written at a lower grade-level than the more successful 2005 letter used in the more recent enrollment effort. The previous letter was written at a Flesch Grade Point Level of 7.5 while the recent letter was written at the 8.4 grade level, almost a full grade point difference. The Flesch readability score for the previous letter is 65.2, making it 2 percent easier to read than the current letter with a readability score of 63.1 (note: the higher the score the easier it is to read and understand the letter). These numbers suggest the previous letter would have a higher enrollment rate because it is easier to read and understand. However, this is not the case.

The primary difference in the letters are that the more recent and more successful letter indicates that the customer is part of a “select group” of Duke customer who are being invited to participate in a Pilot Program. This was not indicated in the previous letter. The more recent letter also places Duke as the first mentioned organization to offer the program, listing Northern Kentucky Community Action Commission as the second organization, while in the previous letter the “community action agency” was placed first.

Both letters note that the customer can participate in “*three easy steps*.” However the previous letter says that each participant must attend three 1-hour budget management sessions, while the recent letter says that the participant must attend one 2-hour session on money saving and bill payment tips. This may be the most striking difference between the two letters. Attending a “*budget management*” session may not be the most attractive motivator for this target group, but to require them to attend three such sessions may be a very significant barrier. However, the most recent letter requires the participant to attend only one session on saving money and payment tips; something that is very likely to be a selling point rather than a participation barrier.

A second significant difference is that in the previous letter the customer is told they will receive \$50.00 for attending each of the three budget management sessions, while the newer letter indicates that the participant will receive \$150 for attending the single money saving and payment tips session. The more recent letter provides a less intrusive and more convenient way to get the education (one session instead of three) and pays them more money for their effort (\$150 a session instead of \$50 per session).

Finally, the weatherization step requires the customer to let the “community action agency” weatherize their home, while the more recent letter says that a Cinergy-approved weatherization provider will weatherize their home. The second letter provides a credibility guarantee for the weatherization services making them “Cinergy approved”. This may make it seem like it is a more trustworthy service provider whose work is seen by Cinergy as being trusted.

In summary, while the two letters are similar, there are striking differences in the way the program is offered and in the offerings provided. The key difference in the success of the second, more recent letter may not be associated with the letter at all, but is most likely the program change that provides more money for attending less sessions and the elimination of the use of the term *budget management* from the session description.

### Reasons for Non Participation in the Pilot Program

We asked all interviewees why they thought high arrearaged customers who have trouble paying their bills would not want to participate in the Pilot Program. We received a number of responses to this question. The primary responses include:

1. The customer is not sure if the offer is real, unsure about the real purpose of the program, don't believe it,
2. Their arrearage may not be that high anymore, so attending would not result in full credit or any credit.
3. A very small percent may have felt that the gas prices were too high for them to travel to the session (at the time there was a lot of news about rising gasoline prices).

### Reasons for Dropping Out after Enrolling

We also asked interviewees to speculate on why customers would enroll in the program and then not take part in the program. We received many of the same answers to the questions on why customers do not participate when offered the program. The reasons provided by interviewees include the following:

1. Some may not be able to plan well, they may forget about a 9am meeting.
2. The large incentive is provided first, then the incentive drops off so that participants get the main dollar benefit after the energy workshop, then get less incentives even though the budget workshop is longer. These customers suggested that Duke may want to restructure the incentive so that participants receive more as they move through the program, not less.
3. They thought that enrollment was required under LIHEAP and lost interest when they learned that participation was optional,
4. They had no child care during the workshop,
5. There was no convenient transportation to the workshops,
6. They could not take off work at the time of the workshops,
7. The timing of the workshops does not fit their personal schedule,

8. They are handicapped, or have trouble getting around,
9. Renters could not obtain landlord approval,
10. They were told that participation would not stop their disconnection, and
11. Reconsidered after seeing what they had to do.

### **Reasons for Non Participation in Weatherization**

We also asked interviewees about the reasons participants might have for not wanting the weatherization service provided with the Pilot Program. We received only a few answers to this question, however one interviewee indicated that all participants in Pilot III that were eligible for weatherization did receive or were receiving this service, indicating that participants who are eligible for weatherization and meet the documentation requirements will receive weatherization services. Reasons for not getting weatherization services that were provided by interviewees include:

1. Landlords do not want anyone seeing the condition of the home because of code or housing violations, unsafe or non-working equipment or structures, etc,
2. Tenants do not want to contact their landlord to request permission because they may be behind on rent.
3. They do not want people to see how they live or the condition of their home,

NKCAC has been working with PWC to get more participants to utilize the weatherization service. Applications were handed out at each of the sessions, and PWC has attended all of the energy education sessions.

### **Communication and Coordination Issues Between NKCAC and PWC Resolved**

In previous year, there was a strained relationship between NKCAC and PWC that influenced these two organization's ability to work cooperatively in a way that collectively benefited the program and Duke Energy's customers. These issues appear to have been resolved (due to staff changes at NKCAC), with both organizations now praising the other in their timeliness and response to communications.

### **Increase Renter's Ability to Obtain Landlord's Approval**

PWC managers indicated in both process evaluations that the program should consider helping renters obtain landlord permission for weatherization services by attempting to contact the landlord when the participant extends contact permission. PWC has made an effort to contact landlords, and when contact is made and the process, the work, and the liability issues are explained, the landlords have been open to the weatherization work being done.

### **Program Changes Interviewees Would Like to See**

We asked managers to report the changes that they would like to see if the program is continued. Only a few recommendations were expressed by the managers, indicating that managers are more satisfied with the program than in the previous pilots. However a few of the interviewed managers provided recommendations for improvements. The recommendations provided by the interviewees include:

1. Reduced class sizes: The classes may have been too large, as there were a few side conversations that may have been distracting.
2. The letter introducing the program to eligible customers may need to be further simplified, as there were some senior customers that did not respond that could really use the assistance that the program provides.
3. Have Al Loving at the Energy Education sessions to explain the weatherization component to the participants, and answer any questions they have about specific audit or installation issues.
4. Collapse the tier system for weatherization. All the customers are low-income and need assistance. Staff suggested that some customers are low consumers because of the condition of their home and they should not be penalized because they manage their consumption better than others.
5. Clearly communicate the timeline for weatherization to the customers, so that they understand that they need to fill out the paperwork and submit it in a prompt manner in order to receive the services and the credit in a timely manner.
6. Expand the geographical area that the program serves. There are 37 municipalities in the area, and some of the customers may be reluctant to travel to the city to attend classes.

### **Tracking System Adequate for Current Program Structure**

Managers indicated that the master tracking spreadsheet established for the program by Duke Energy works well for keeping track of program participants and for the administration of the program. They report that this system is updated frequently. However, in the past a manager noted that if the program was to move into a full-scale program with additional funds and higher participation goals, the program should consider moving to an internet based database design that serves the different stakeholders and can be used to feed information into other databases at the organizational level.

### **Overall Benefits to the Participants**

Interviewed managers were asked to describe what the primary program benefits are to participants. We received a number of responses to this question, including:

- **Quality Information:** Participants gain a great deal of knowledge that will help them manage their bills, control their energy and improve their lives. They learn to save energy, to reduce their bills, to finance and budget their lives.

- **Weatherization:** Participants are offered free energy audits and weatherization services that will help their homes be more energy efficient, and reducing their energy bills and improving comfort levels.
- **Arrearage Assistance:** The program provides a helping hand to give them a bit of a start down the road of improved financial management. It is not everything and will take some time, but it is a start.
- **Reduced Crisis Events:** Hopefully this program will help some people manage on their own and avoid the long-term hardships of crisis events.

### What Ratepayers Are Receiving

Managers were also asked what benefits ratepayers receive from programs like the Pilot Program. These responses are presented below:

- **Satisfaction:** Ratepayers can be satisfied that their utility and our society is providing help to their neighbors. The debt load that Duke carries affects all customers because it is a factor in rate increases.

## Section II – Pilot IV Participant Interview Results

A total of twenty-six interviews were conducted with participating low-income customers of the Payment Plus Pilot IV Program. All of the interviewees took part in one or more program events, including twenty participants who took part in both training sessions and had weatherization measures installed in their homes. This group of participants are called “full participants,” participating fully in all program components. We also interviewed five participants who completed one or two components, but who did not complete all three. These customers are called partial participants, having taken advantage of part of the program offerings.

This report presents a comparison of the results from the Pilot Program II evaluation completed in 2004 with the Pilot Program IV evaluation results. In reviewing these comparisons the reader should keep in mind that the Pilot II evaluation results are based on 51 interviews. The results from the Pilot Program IV evaluation are based on interviews with 26 participants across 121 participants.

**Recalling Participation or Enrollment in the Program**

Of the twenty-six interviews conducted with participants, only one person could not recall participating in the program. (This customer was a partial participant, attending the energy training session and receiving weatherization services.) All others contacted recalled enrolling in the program. It is not unusual for a very small percent of low-income program enrollees to not remember participation for a variety of reasons, including the health and mental state of the participant.

**Issues with Credits Being Applied to the Participants' Bills**

In the Pilot II evaluation, many customers reported that they had issues with getting the credits applied to their bills. In the Pilot II survey, 18 out of 49 customers (37%) reported problems with getting the credits applied to their bill. Only 3 out of 25 (12%) reported problems in the Pilot IV evaluation.

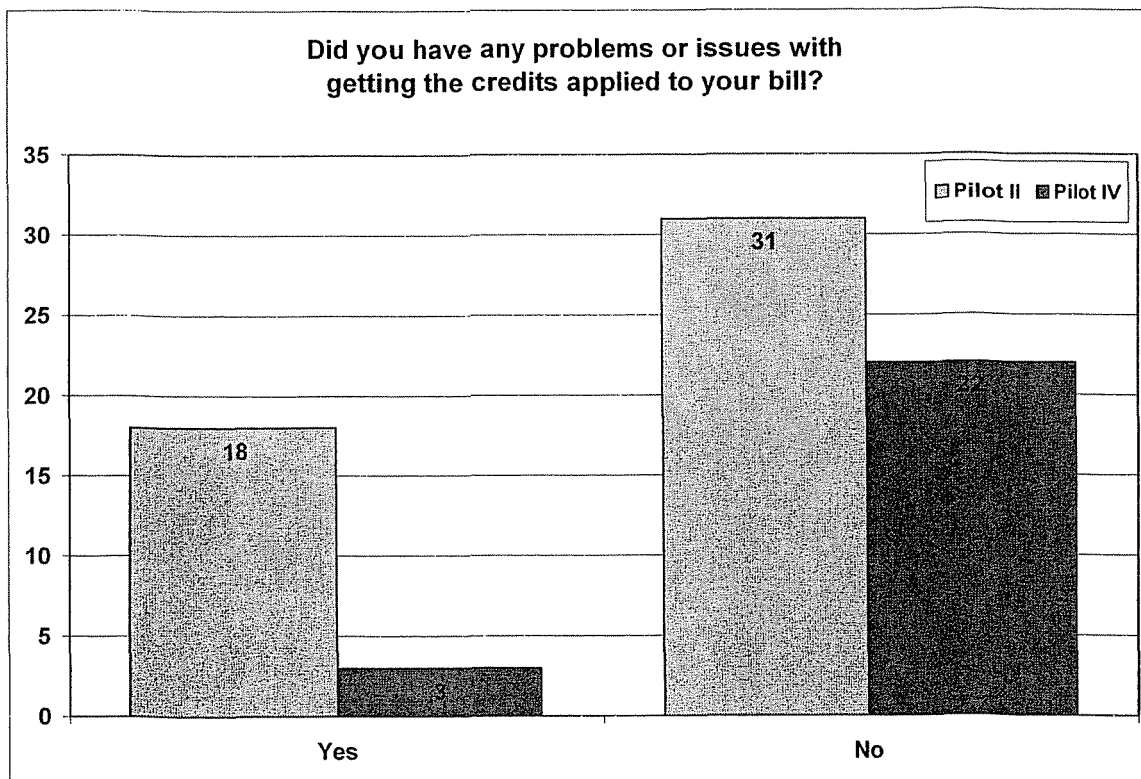


Figure 1 Pilot II and Pilot IV Participants reporting problems with credits being applied

**Main Reasons for Participation or Enrollment**

Twenty of the twenty-five respondents (80%) indicated that they enrolled in the program for one primary reason: to receive the bill credits. Fourteen (56%) of the participants indicated that they enrolled so that they could save energy in their home by learning conservation measures in the Energy Training Session, or by obtaining the weatherization services.



It is interesting to note that one of the customers reported that they enrolled in the program to attend the Financial Training session or to learn how to better manage their household income (in contrast to none reporting this for Pilot II). These results indicate that this aspect of the program is not viewed as much of a factor in the participation decision process.

**Table 4 Main Reasons Given for Enrolling in the Program**

	Pilot II (n=51)		Pilot IV (n=25)	
	Frequency	Percent	Frequency	Percent
To receive the bill credits	37	73%	20	80%
To save energy in my home	10	20%	9	36%
To obtain weatherization services	9	18%	6	24%
To find ways to reduce my utility bills	7	14%	5	20%
To avoid disconnect	3	6%	1	4%
For help paying current bill	2	4%	0	0%
To make my home more comfortable	2	4%	0	0%
Other	1	2%	1	4%

<sup>a</sup> Percent figures add up to over 100% as multiple answers were allowed.

**Why Customers Aren’t Getting Weatherization**

Only four participants interviewed were asked about why they did not receive weatherization services, as most of the interviewees received weatherization. One interviewee has been too busy with personal matters to fill out the application, another claims to have had communication issues with the program staff<sup>1</sup>. Another of the interviewees is a renter whose landlord will not allow the work to be done, and the fourth interviewee stated that the home he occupied was already energy efficient and that he did not need the service.

**Satisfaction with the Training Sessions**

During the interviews, participants were asked to rate their satisfaction with specific aspects of the program’s training sessions. Participants were asked to score their satisfaction using a 10-point scale where a 1 means very unsatisfied and a 10 means very satisfied. We asked participants to rate their satisfaction with the convenience of attending, comprehensiveness, materials, credits provided, the instructor’s knowledge and the instructor’s presentation skills. Selected results for both evaluated Pilot groups are presented in the following figures. We asked these questions for each of the two training sessions. A score of less than 7 (on a 10 point scale) typically means that there is at least some level of dissatisfaction with a program component. When participants provide a score of 7 or less in a response, they were asked how that aspect of the program could be improved.

<sup>1</sup> Duke Energy, NKCAC, and PWC have all indicated that the program staff and administration made many attempts at contacting customers to discuss issues and resolve complaints.

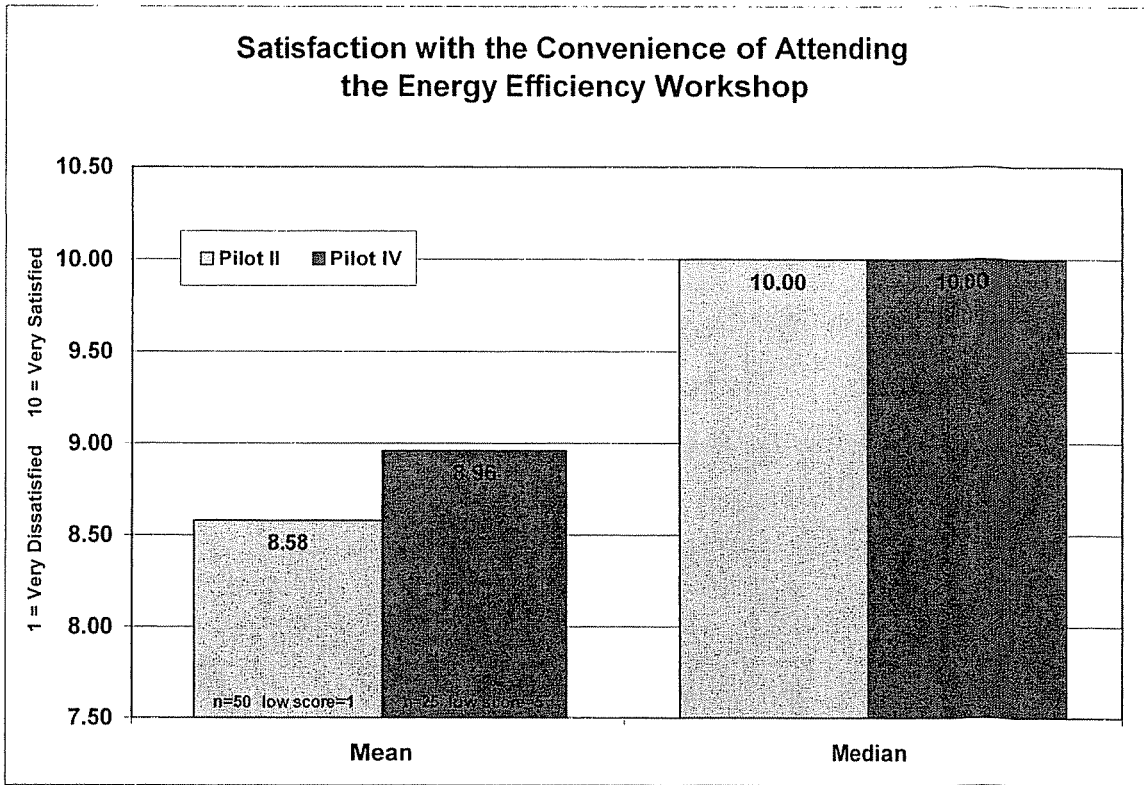


Figure 2 Satisfaction with the Convenience of Attending the Energy Efficiency Workshop

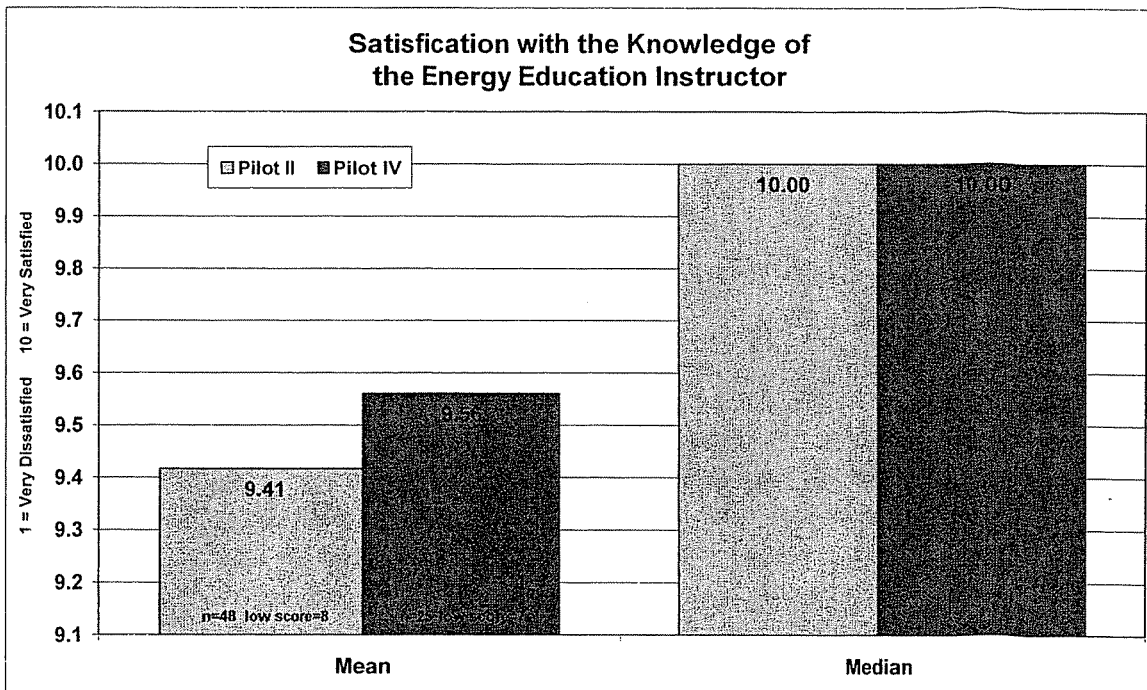


Figure 3 Satisfaction with the Knowledge of the Energy Education Instructor

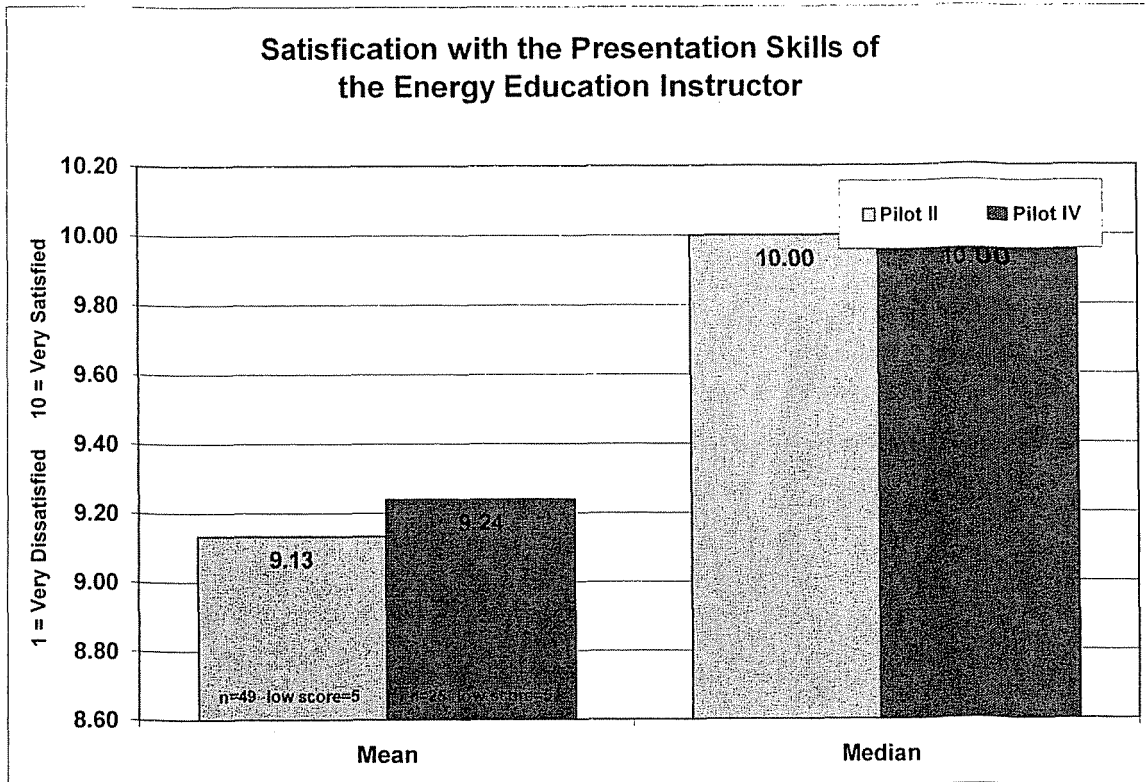


Figure 4 Satisfaction with the Presentation Skills of the Energy Education Instructor

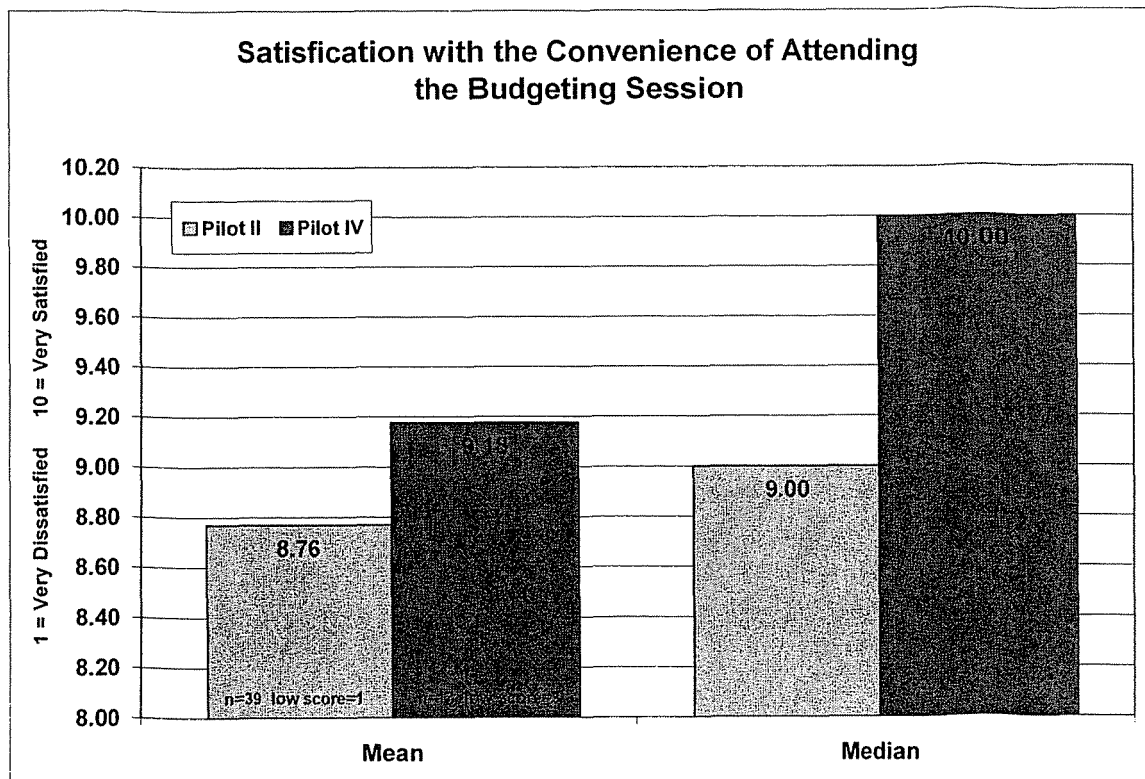


Figure 5 Satisfaction with the Convenience of Attending the Budgeting Session

Pilot IV participants report their highest levels of satisfaction with the instructor knowledge in the energy session. Satisfaction with the comprehensiveness of the subjects covered and the instructor’s presentation also score high with means over 9.0 for the energy session. The area of lowest satisfaction with the energy session was the materials handed out at this session. The explanations for this are: 1) At one of the energy sessions, there were not enough packets to distribute, and 2) At another session, two different packets were handed out, which led to some confusion, having to always check pages. All aspects of the budget training session scored a mean of over 9. Overall, convenience of attending the sessions has improved, and so has the rating of the instructor’s presentation skills. Table 5 presents the satisfaction scores for the program participants of both Pilot II and Pilot IV.

**Table 5 Mean Satisfaction Scores for Training Sessions**

1 = very dissatisfied, 10 = very satisfied. Customer Satisfaction with:	Pilot II		Pilot IV	
	Energy Session (n=50)	Financial Session (n=39)	Energy Session (n=25)	Financial Session (n=17)
Bill Credits Provided	9.47	9.77	Not Asked	
Instructor Knowledge	9.42	9.47	9.56	9.35
Comprehensiveness of Subjects	9.27	9.31	9.20	9.29
Materials Handed Out	9.16	9.49	8.36	9.41
Instructor Presentation Skills	9.13	9.23	9.24	9.35
Convenience of Attending	8.58	8.77	8.96	9.18

The comments of Pilot IV participants scoring satisfaction below a 7 are summarized below.

There were only three customers that had to rearrange their schedules to attend the training sessions. A few customers complained of the materials: one said the materials were too complicated and hard to follow, while two others thought that there was room for more information.

We also asked the participants if the sessions were too long, too short, or about right. Table 6 indicates that the majority of customers thought that the sessions were about the right length of time.

**Table 6 Customer Opinions on the Length of the Training Sessions**

Pilot II Score	Too Long		About Right		Too Short	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Energy Session (n=49)	5	8%	43	86%	1	2%
Financial Session (n=39)	4	10%	33	85%	2	5%
Pilot IV Score						
Energy Session	1	4%	23	92%	1	4%

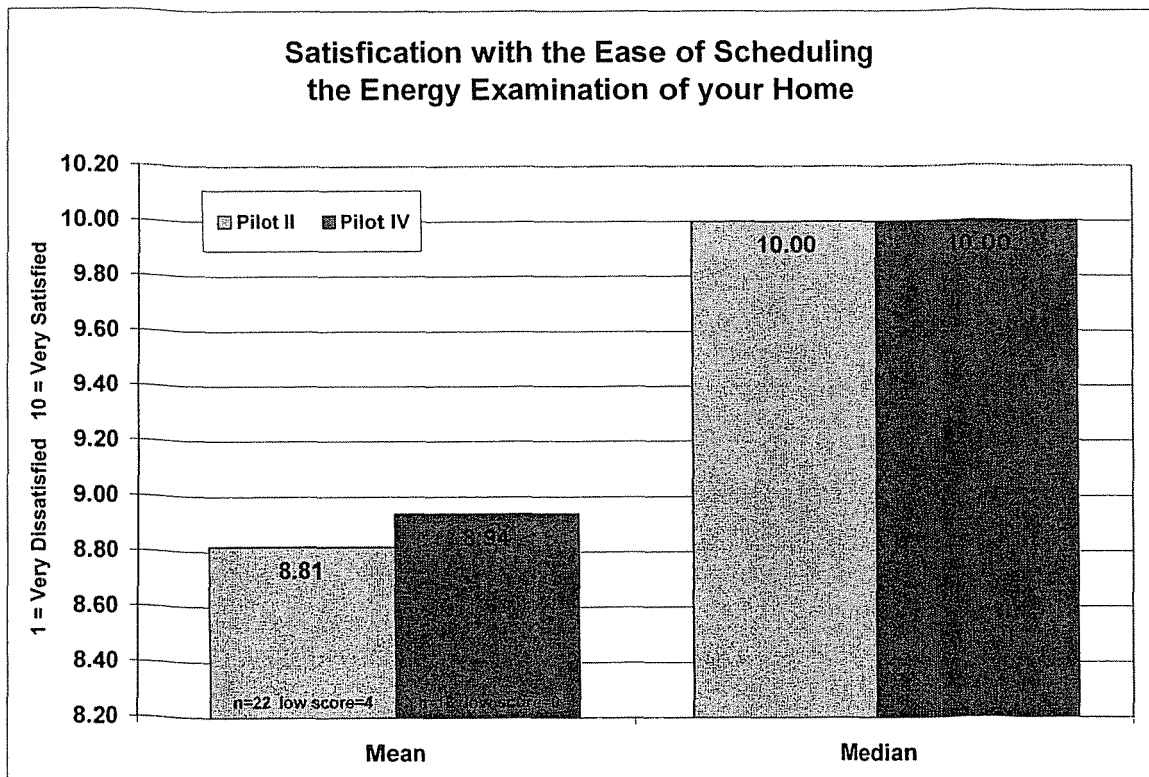
(n=25)						
Financial Session (n=17)	1	7%	14	82%	2	14%

**Satisfaction with Weatherization Services**

Program participants who had received their weatherization service before the evaluation interview were very satisfied with the quality of the measures installed and the information provided in past evaluations. Satisfaction scores for Pilot IV have increased in every measurement of satisfaction except for the scheduling of weatherization, which dropped slightly, but still remains high, see Table 7 and the figures below.

**Table 7 Customer Satisfaction with Weatherization Services**

Satisfaction with:	Pilot I (n=10)	Pilot II (n=22)	Pilot IV (n=20)
Information on the Installed Measures	10	9.30	9.50
Quality of the Measures Installed	10	9.25	9.64
Scheduling the Energy Audit	9.6	8.82	8.94
Weatherization Services Overall	8.7	8.71	9.00
Scheduling Weatherization	9.6	8.43	7.65



**Figure 6 Satisfaction with the Ease of Scheduling the Energy Examination of your Home**

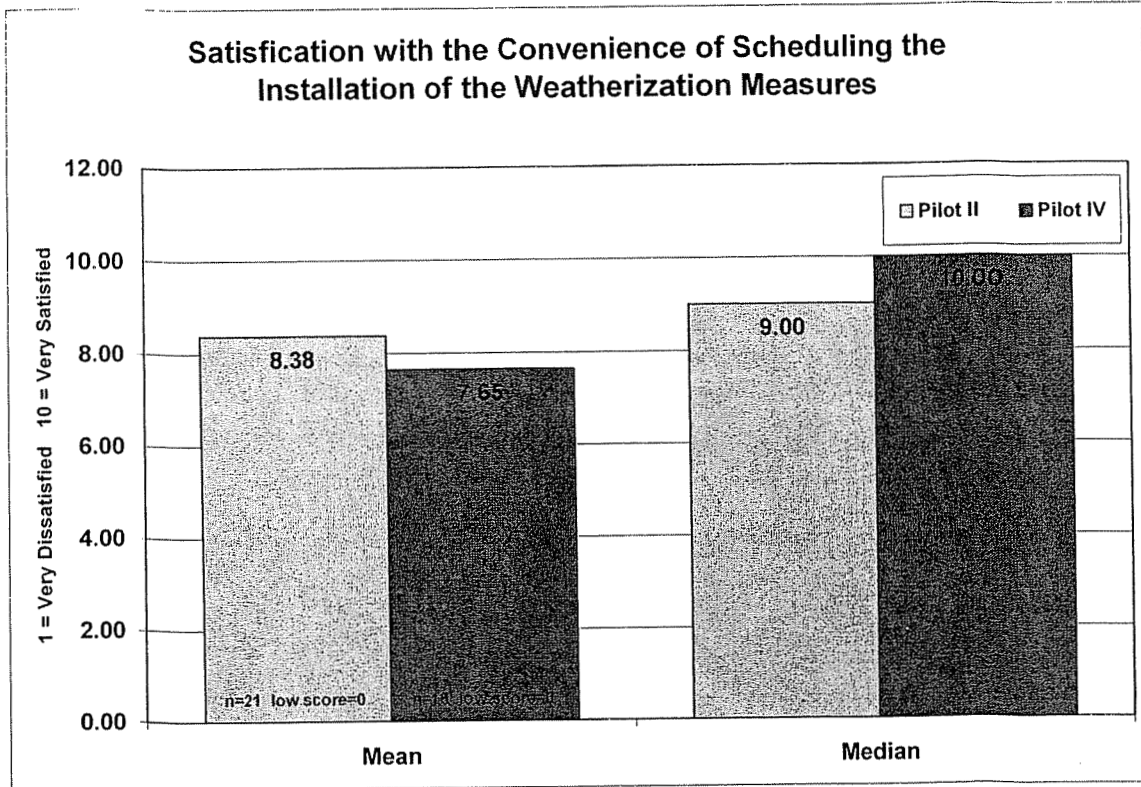


Figure 7 Satisfaction with the Convenience of Scheduling the Installation of the Weatherization Measures

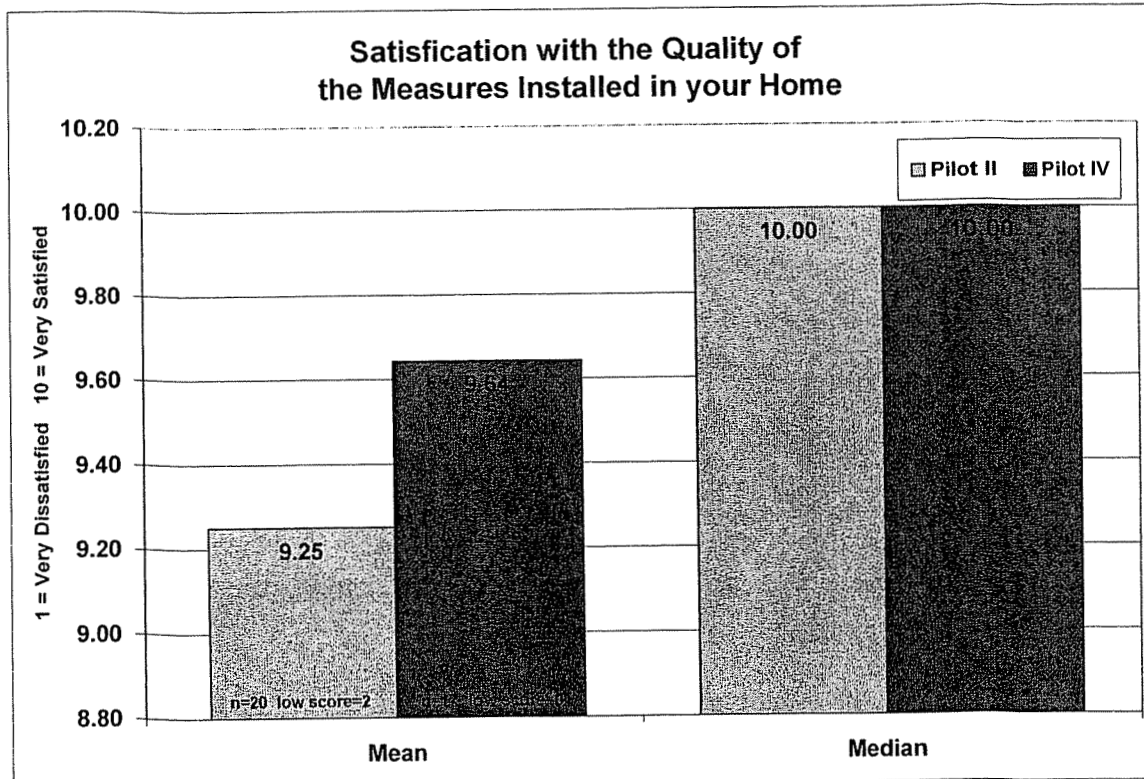


Figure 8 Satisfaction with the Quality of the Measures Installed in your Home

The drop in scores for Pilot IV is primarily due to a couple of customers providing lower scores and as a result, should not be interpreted as a systematic drop in customer satisfaction. With only 20 respondents, a couple of low-scoring participants can significantly affect the average score. The median score across all weatherization scores for all Pilots (I, II, and IV) is 10 on the 10 point scale used, with only one exception: the median satisfaction score with the scheduling of weatherization services received a median score of 9 in Pilot Program II.

When customers gave a score of 7 or lower, we asked them for suggestions to improve the service. The few comments received regarding the scheduling of the energy audit all mentioned issues such as the auditors not showing up when they said they were going to, or the process simply taking too long. Only one customer felt that she didn't get enough information from the weatherization installers who seemed to be in a hurry. One customer would like to receive additional weatherization services in addition to the refrigerator provided.

**Views of the Overall Program**

We also asked the customers how satisfied they were with specific aspects of the program. The results indicate very high satisfaction that has remained steady from Pilot II to Pilot IV.

Table 8 presents the satisfaction scores for the aspects of the program that were measured.

**Table 8 Mean Satisfaction Scores of Program**

Satisfaction with:	Pilot II Mean Score	Pilot IV Mean Score
Overall Program	9.58	9.39
Ease of Filling out Application Forms	9.09	9.52
Communication during the Application Process	8.91	8.83
Communication during Sessions and Weatherization	8.81	

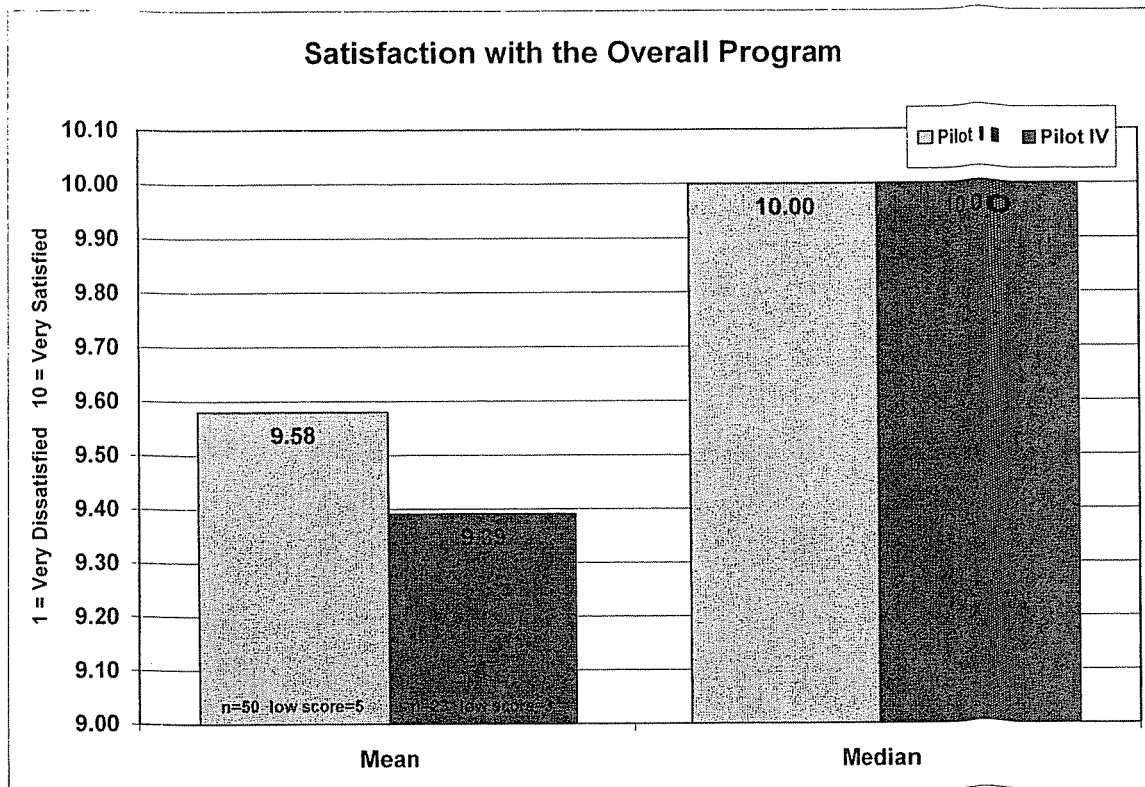


Figure 9 Satisfaction with the Overall Program

**Participant’s Recommendations for Improvements**

Participants were asked for suggestions for changes and what additional services the program could offer to improve the program. One man thought that special consideration should be given to those that have legitimate reasons for missing a training session, such as a hospital stay in which documentation can be provided. Other customers would like to have the credits applied to their bill regardless of their arrearage level (they would like to see their balance move into a credit situation if they participate according to the program requirements).

**Actions Take as a Result of Participation**

One of the goals of the interview is to determine if participants have used the skills they learned during the two workshops. To accomplish this goal we asked participants “*What actions, if any, have you taken in your home to save energy and reduce your utility bills as a result of what you learned in the this program?*” and “*What actions, if any, have you taken in your home to better manage your household budget as a result of what you learned in the this program?*” The responses to these questions demonstrate that participants are using the information and skills gained during the workshops to take actions that save energy, and that they have made adjustments to the way they handle their money. The actions that the participants report taking following the workshops are presented below:



Actions taken as a result of participation in the Energy Training Session:

1. Keeping the freezer full.
2. Replaced the refrigerator.
3. CFLs (four participants)
4. Sealed drafts.
5. Turning the lights off. (four participants)
6. Using cold water for clothes. (two participants)
7. Stripping over doors.
8. Keeping windows closed.
9. Using ceiling fans more often.
10. Sealed the windows. (three participants)
11. Using less hot water, taking cooler showers.
12. Weatherized the house - but other stuff was done already - he is pretty EE already.

Actions taken as a result of participation in the Financial Training Session:

1. Trying to get on even billing to get caught up.
2. More careful about where money is spent.
3. Quit smoking.
4. Thinking about using budget billing.
5. Cut down on some excess stuff we don't need.
6. Paying more attention - working on it, but money's tight.
7. Cooking two meals at once, using the microwave to reheat.

Overall, it seems that the participants were able to incorporate a significant amount of what they learned into their lives and the lives of their families.

### Section III: Energy Use Analysis and Findings

One of the goals of the Payment Plus Program is for the participants to learn ways to be more energy efficient. In this analysis, we examined and compared energy usage of Pilot Program I, II and III participants, and two comparison groups of non-participants (one for Pilots I and II, another for Pilot III), over the years before and after the program.

#### Energy Use Evaluation - Pilots I, II and III

##### Sample Size

Many of the customers in both the participant and the comparison group did not have a history of account information prior to program enrollment, or they had moved shortly after the program, making their consumption data unavailable or not relevant for the analysis. As a result, many accounts from both groups had to be eliminated from this study. Table 9 below indicates the number of customers that were analyzed in each of the groups studied.

**Table 9 Sample Sizes for Energy Analysis**

Group	kWh		Therm	
	Participants	Comparison <sup>a</sup>	Participants	Comparison <sup>a</sup>
Pilot I Weatherized	3	20	5	49
Pilot I Not Weatherized			2	
Pilot II Weatherized	7	20	11	49
Pilot II Not Weatherized			11	
Pilot III Weatherized	6	36	13	95
Pilot III Not Weatherized			4	
All Pilots Weatherized	16	56	29	144
All Pilots Not Weatherized			17	

<sup>a</sup> All customers known to have received weatherization services were removed from the comparison groups.

The comparison groups consists of about 300 low-income customers with payment and arrearage histories that are similar to the participants. There are two comparison groups used in this study, one to compare with Pilots I and II, which consists of the same customers used in the comparison group of the previous evaluation of Pilots I and II, and a third comparison group which was created for the analysis of Pilot III. These comparison groups are combined when all Pilot participants were combined in order to determine a full program effect on energy consumption.

Some of the groups are rather small, specifically those in the Pilot I study because the enrollment process did not consider available account history as instructed by Duke managers, and because four years have passed and several participants have moved. The

therm savings analysis of Pilot III non-weatherized customers also has a low sample size (6 customers). Due to these low numbers, the findings can only be viewed as anecdotal or representative of these groups as a whole, but not statistically accurate for these three groups.

### **Statistical Precision**

All of the analytical runs done in PRISM™ provide a  $R^2$  and CV(NAC) value that indicates the strength of the results provided. These values are provided in the table below. The higher the  $R^2$  value (maximum value is 1.000), and the lower the CV value, the better the data. For more information on PRISM™ and these statistics, please see the section on methodology.

Table 10 R<sup>2</sup> and CV (NAC) Associated with PRISM™ Energy Usage Analysis

Group	Statistic	Comparison	Participants
<b>Pilot I kWh Analysis</b>			
	R <sup>2</sup> – PRE	.955 (+/- .015)	.961 (+/- .073)
	R <sup>2</sup> – POST	.937 (+/- .025)	.982 (+/- .074)
	CV (NAC ) % – PRE	3.3 (+/- 0.6)	4.5 (+/- 1.7)
	CV (NAC ) % – POST	3.8 (+/- 0.7)	3.9 (+/- 0.9)
<b>Pilot I Therm Analysis – Weatherized</b>			
	R <sup>2</sup> – PRE	.997 (+/- .001)	.999 (+/- .003)
	R <sup>2</sup> – POST	.995 (+/- .003)	.980 (+/- .015)
	CV (NAC ) % – PRE	2.4 (+/- 0.3)	1.2 (+/- 1.2)
	CV (NAC ) % – POST	3.7 (+/- 0.3)	3.2 (+/- 0.2)
<b>Pilot I Therm Analysis – Not Weatherized</b>			
	R <sup>2</sup> – PRE	.997 (+/- .001)	.997 (+/- .002)
	R <sup>2</sup> – POST	.995 (+/- .003)	.998 (+/- .002)
	CV (NAC ) % – PRE	2.4 (+/- 0.3)	2.5 (+/- 0.1)
	CV (NAC ) % – POST	3.7 (+/- 0.3)	1.7 (+/- 0.6)
<b>Pilot II kWh Analysis</b>			
	R <sup>2</sup> – PRE	.955 (+/- .015)	.940 (+/- .033)
	R <sup>2</sup> – POST	.937 (+/- .025)	.855 (+/- .063)
	CV (NAC ) % – PRE	3.3 (+/- 0.6)	3.9 (+/- 0.8)
	CV (NAC ) % – POST	3.8 (+/- 0.7)	3.1 (+/- 0.6)
<b>Pilot II Therm Analysis – Weatherized</b>			
	R <sup>2</sup> – PRE	.997 (+/- .001)	.990 (+/- .011)
	R <sup>2</sup> – POST	.995 (+/- .003)	.966 (+/- .014)
	CV (NAC ) % – PRE	2.4 (+/- 0.4)	2.6 (+/- 0.9)
	CV (NAC ) % – POST	3.7 (+/- 0.4)	3.1 (+/- 0.7)
<b>Pilot II Therm Analysis – Not Weatherized</b>			
	R <sup>2</sup> – PRE	.997 (+/- .001)	.993 (+/- .018)
	R <sup>2</sup> – POST	.995 (+/- .003)	.983 (+/- .020)
	CV (NAC ) % – PRE	2.4 (+/- 0.3)	3.0 (+/- 0.4)
	CV (NAC ) % – POST	3.7 (+/- 0.3)	3.5 (+/- 0.6)
<b>Pilot III kWh Analysis</b>			
	R <sup>2</sup> – PRE	.945 (+/- .013)	.921 (+/- .029)
	R <sup>2</sup> – POST	.917 (+/- .021)	.868 (+/- .049)
	CV (NAC ) % – PRE	3.8 (+/- 0.4)	5.3 (+/- 0.5)
	CV (NAC ) % – POST	3.5 (+/- 0.3)	3.7 (+/- 0.7)
<b>Pilot III Therm Analysis – Weatherized</b>			
	R <sup>2</sup> – PRE	.989 (+/- .002)	.986 (+/- .009)
	R <sup>2</sup> – POST	.980 (+/- .003)	.988 (+/- .012)
	CV (NAC ) % – PRE	3.0 (+/- 0.2)	2.6 (+/- 1.4)
	CV (NAC ) % – POST	3.7 (+/- 0.3)	3.2 (+/- 1.4)
<b>Pilot III Therm Analysis – Not Weatherized</b>			
	R <sup>2</sup> – PRE	.990 (+/- .002)	.986 (+/- .004)
	R <sup>2</sup> – POST	.989 (+/- .003)	.988 (+/- .006)
	CV (NAC ) % – PRE	3.0 (+/- 0.2)	3.1 (+/- 0.5)
	CV (NAC ) % – POST	3.7 (+/- 0.3)	3.0 (+/- 0.5)

Case No. 2007-00477  
 Attach. STAFF-DR-01-004  
 Page 129 of 525

## Changes in Electricity Consumption Between Participants and Comparison Group

None of the Pilot participants were successful at reducing their electrical consumption over the long-term. Figure 10 shows the three groups analyzed separately and then combined in PRISM,<sup>TM</sup> and their annual electrical savings.

Figure 10 below shows that in each Pilot, annual comparison-adjusted kilowatt-hour consumption increases over the longer-term period. Pilot I participants increased their consumption by 339 kWh per year, while the comparison group decreased their consumption by 290 kWh per year, resulting in an adjusted increase for the Pilot I participants of 629 kWh per year. Pilot II I participants increased their consumption by 296 kWh per year, but with the application of the comparison group, their consumption increases to 585 kWh per year. Pilot III also increased their consumption. Their annual increase is estimated to be 530 kWh, and the comparison group increased their consumption as well, but not as much (319 kWh per year) – giving Pilot III participants a comparison-adjusted increase of 211 kWh per year. While in the short term there may be electric energy savings (see previous studies), but in the long term the electric savings appear to erode and approach their pre-participation levels.

This relative condition also holds when the different groups are combined and assessed as a single group, although the levels change as a function of the combining effect. When these three Pilot groups are combined (as a single unit) and the two comparison groups are combined, the increase in consumption is not as drastic. Combined, the Pilot participants increase their consumption by only 392 kWh per year. When the two comparison groups are combined, their consumption increases by 102 kWh per year. The end result of all the Pilot participants is a mean increase in annual consumption of 290 kWh per year, or about 24 kWh per month.

This does not mean that all participants increase their consumption, as we will see when these results are compared to the median savings (below). Also, the fact that four years have passed since the Pilot I participants attended the training session on how to decrease energy consumption needs to be considered, as well as the fact that this estimate is based on the analysis of only 3 participants that had reliable data. Many of the participants may have had changes in their kWh consumption due to factors beyond poor energy consumption behaviors. Changes such as more people living in the home, in-home illness, more medical equipment, larger televisions, or computer equipment all can have a profound effect on energy use. While these customers may still be turning off the lights when not in use and using CFLs, other factors may be hiding the savings that we would expect to see.

These increases in consumption are a new phenomenon, two years ago when Pilot I and II participants were analyzed, they were still at a decreased level of consumption when compared to their consumption before the program. This evaluation of kWh consumption tells a completely different story: the decreased consumption of kWh may not be for the long-term.

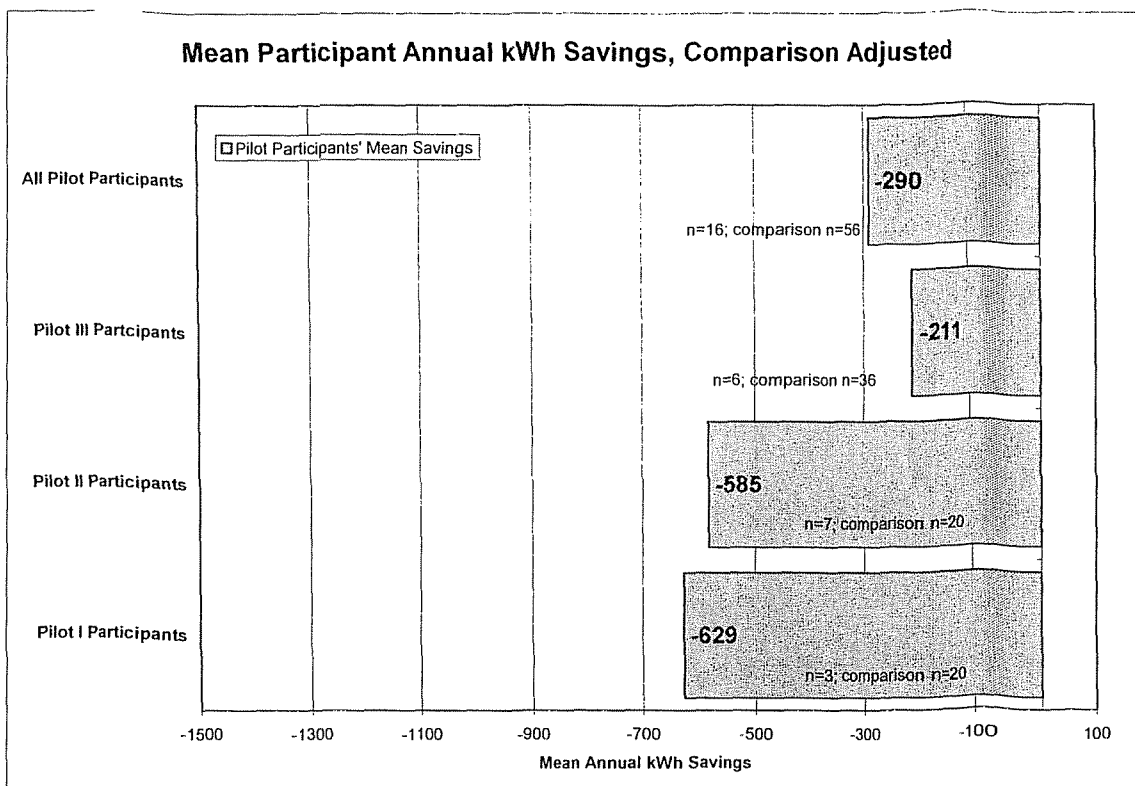
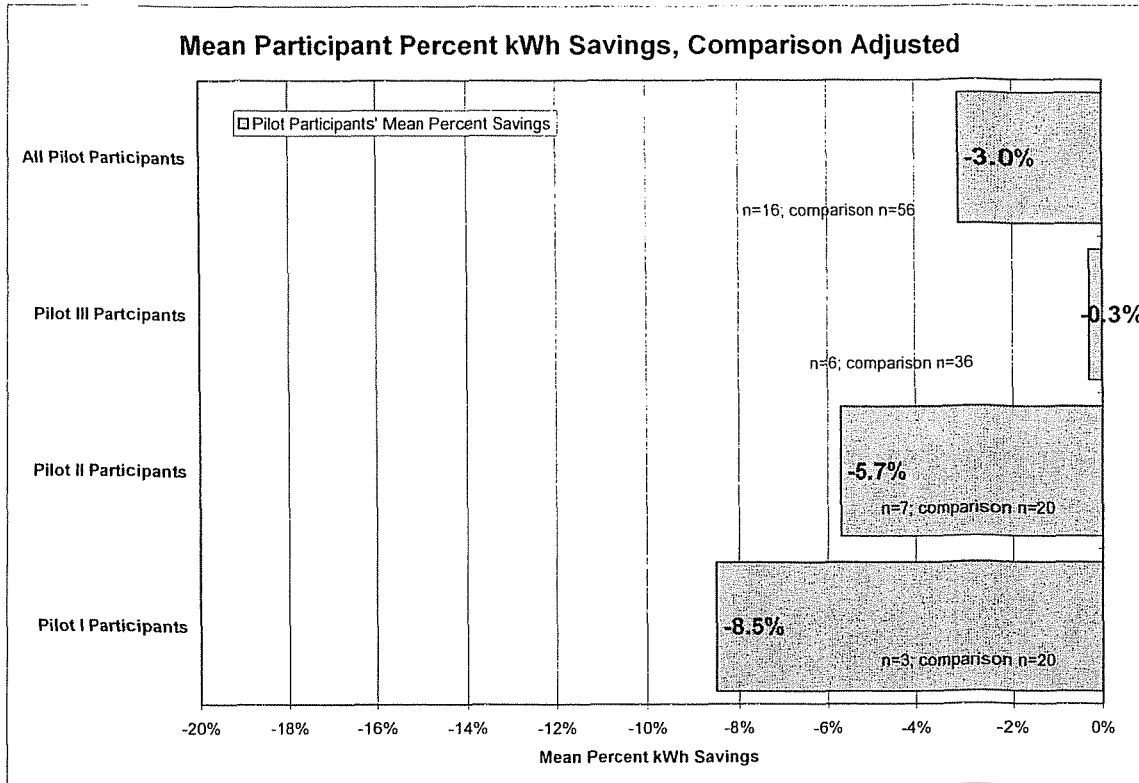


Figure 10 Mean Annual kWh Savings of Pilot Participants, Adjusted for Comparison Group Changes

PRISM™ also calculates the net percent change in electrical consumption, which is presented in Figure 11. The comparison group used for Pilots I and II decreased their electrical consumption by 1.5% (two years ago they increased their consumption by 8.1%). Pilot I participants comparison-adjusted increase of 629 kWhs per year is equal to 8.5%. Pilot II participants increased their consumption since participating in the program, by 5.7%. Pilot III participants, after one year, are saving only 0.3%.

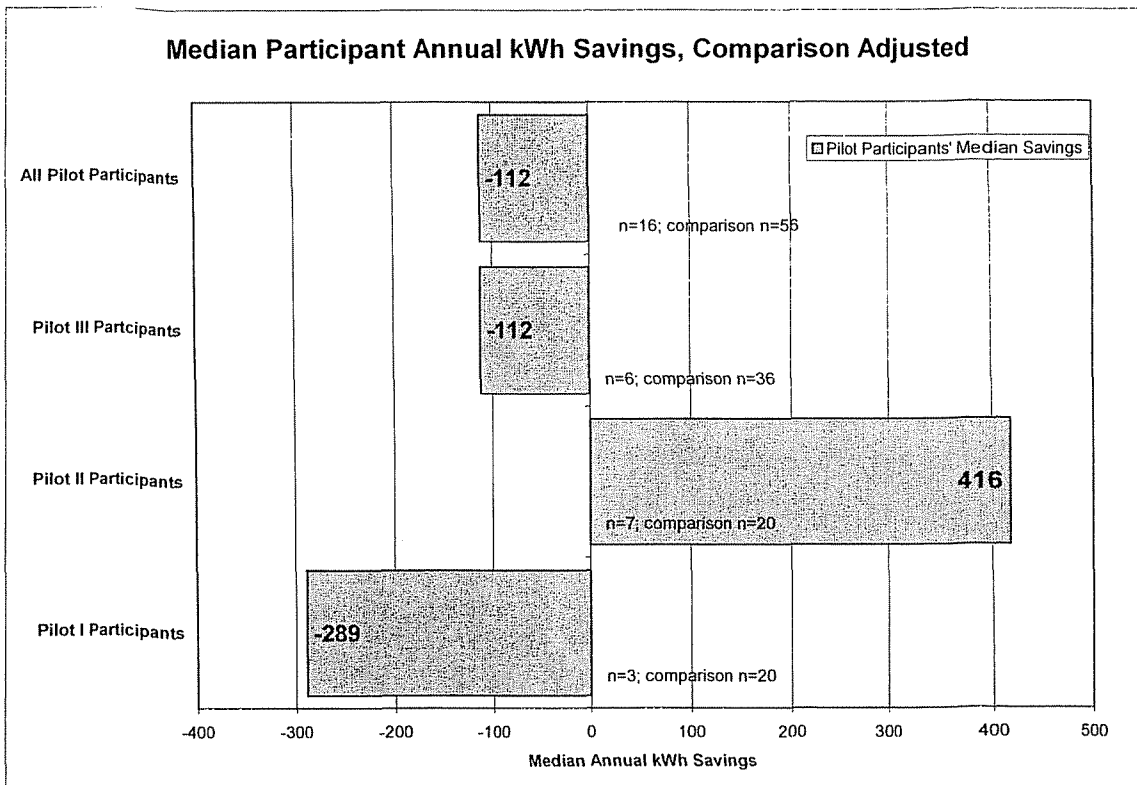
Overall, when the Pilot participants and the comparison groups are combined to analyzed all customer data, the Pilot participants' kWh comparison-adjusted consumption decreases by 3% - or, essentially, it doesn't change in the post-participation period when compared to the pre-participation period.



**Figure 11 Mean Percent kWh Savings of Pilot Participants, Adjusted for Comparison Group Changes**

Figure 10 and Figure 11 examined the mean net program savings. However, an examination of the median savings is also informative. The median kWh savings provides an alternate perspective on the energy savings associated with participation in the Pilot programs. Pilot I participants had a net median increase of 289 kWh/year (see Figure 12) compared to a mean increase of 629 kWh/year (see Figure 10), indicating that there is a number of participants who experienced very high increases in electrical consumption that acted to push the mean savings downward for the group as a whole.

Pilot II participants have a similar, but stronger, result, with a median savings of 416 kWh/year compared to a mean increase of 585 kWh/year, indicating that over half of them decreased their consumption by about 400 kWh/year or more, while some of them greatly increased their usage, bringing the mean to an average increase across the entire group. This indicates that the program was effective at reducing consumption for about half of the participants, there are some participants that increased their consumption so much that it drives the savings for the group as a whole down by a considerable amount. Pilot III participants have a mean increase of 211 kWh per year, while the median is an increase of 112 kWh per year, indicating that over half of the Pilot III participants have in fact increased their energy consumption more than customers decreased their consumption.



**Figure 12 Median Annual kWh Savings of Pilot Participants, Adjusted for Comparison Group Changes**

Figure 13 below shows the median percent changes in consumption for the three pilot groups. Overall, half of the Pilot participants have increased their kWh consumption by at least 2.1%.



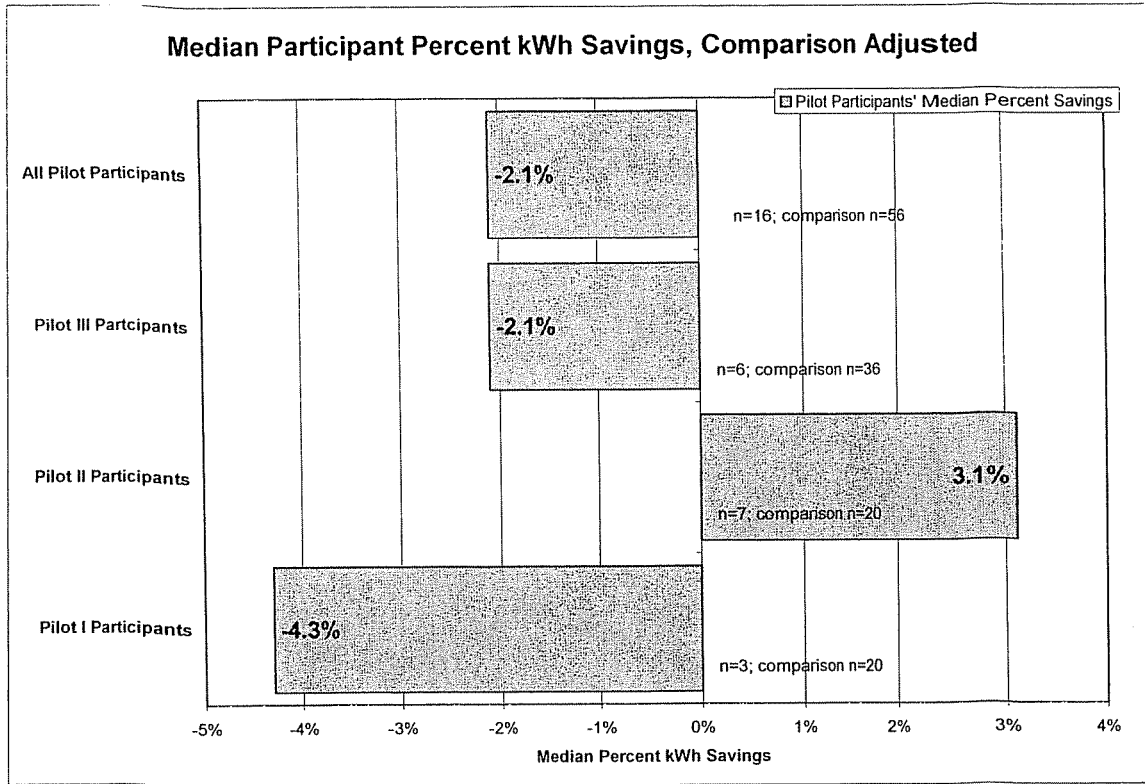
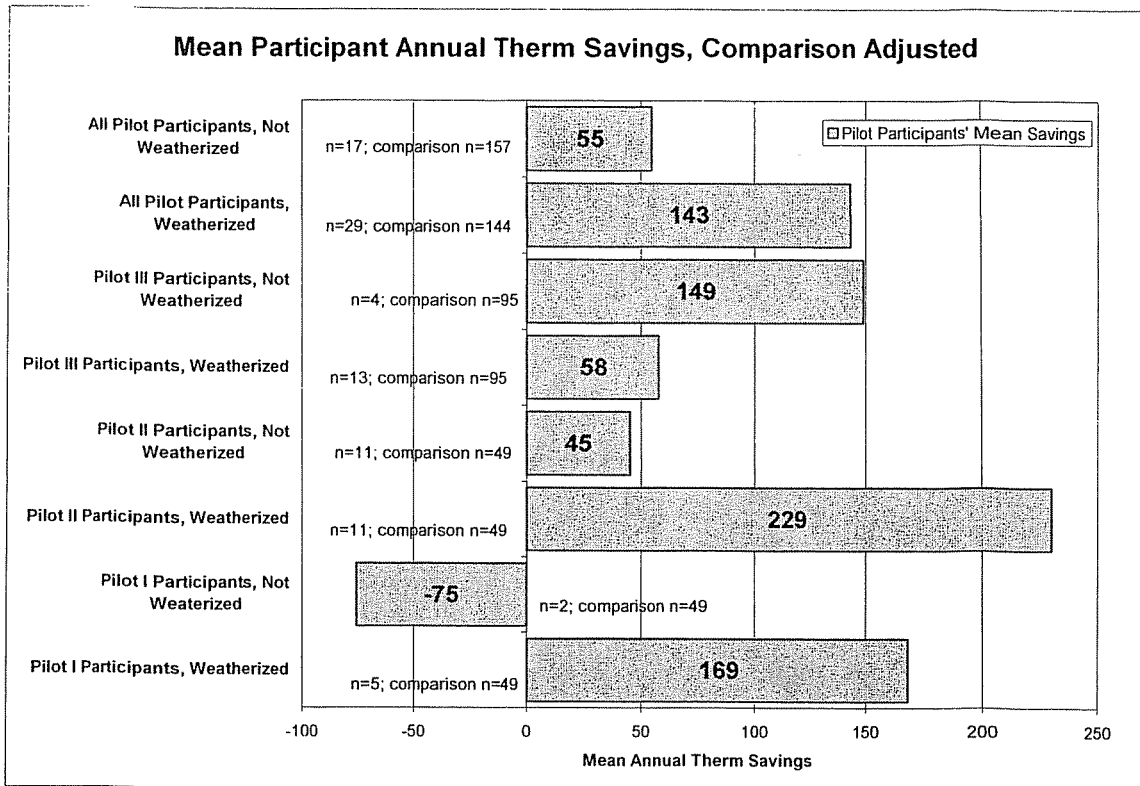


Figure 13 Median Percent kWh Savings of Pilot Participants, Adjusted for Comparison Group Changes

**Changes in Natural Gas Consumption Between Participants and Comparison Group**

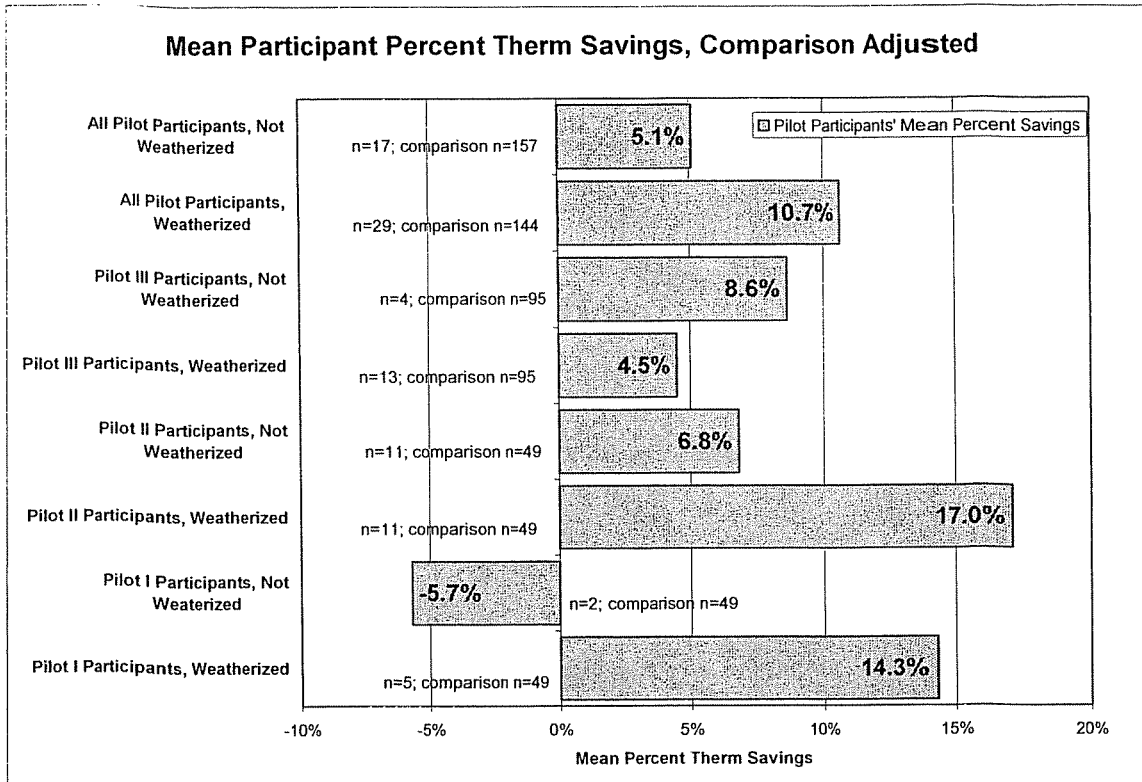
Pilot participants have positive results with the amount of natural gas they consumed after participating in the program. The comparison groups used in this analysis are the same groups that were used in the electrical analysis, and they also have realized reductions in their therm consumption. Pilot I and II comparison reduced their consumption by 9 therms per year, and the Pilot III comparison group reduced their consumption by 13 therm per year, so the Pilot participants' savings are decreased slightly due to this reduction by the comparison group.

Figure 14 shows that weatherized participants generally have an advantage when it comes to reducing natural gas consumption over all Pilot groups. Weatherized Pilot I participants reduced their consumption by 169 therms per year, while non-weatherized Pilot I participants increased their consumption by 75 therms per year. This figure shows that weatherization is the key component of this program in reducing therm consumption. All participants that were weatherized have a mean decrease in consumption. Over all Pilots, this difference is equivalent to about 143 therms per participant per year in savings.



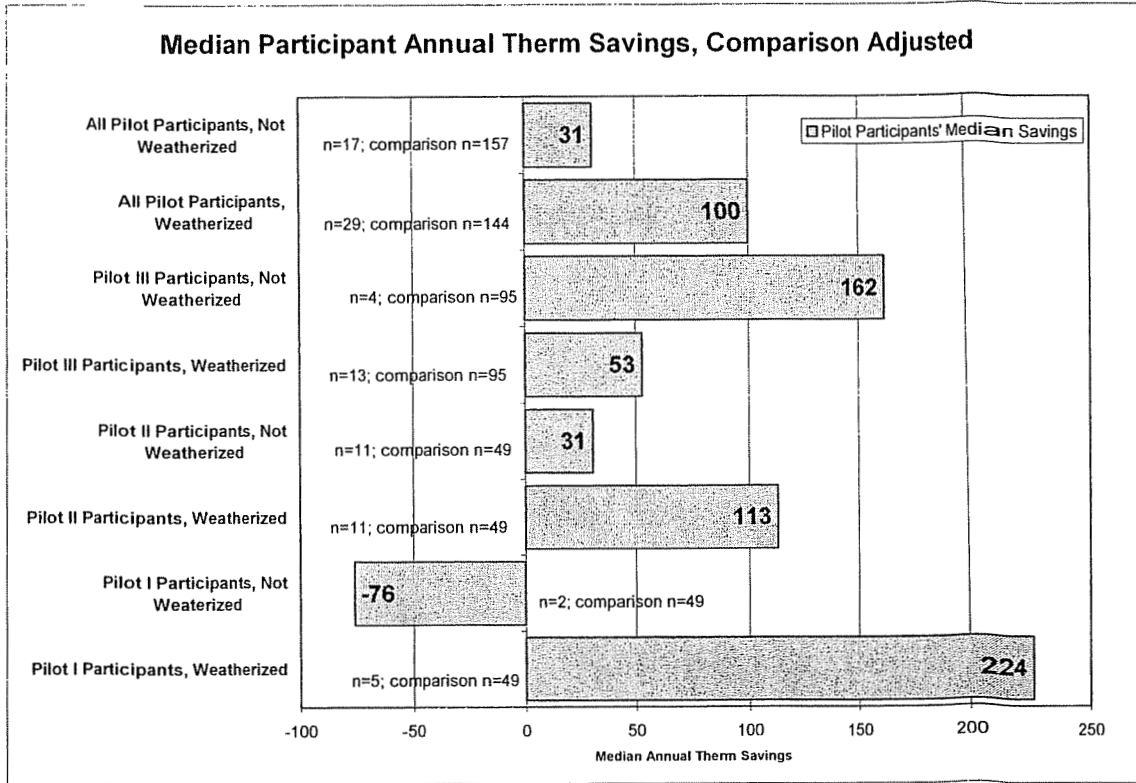
**Figure 14 Mean Annual Therm Savings for Pilot Participants, Adjusted for Comparison Group Changes**

The average percent change in therm consumption shows a similar result, as seen in Figure 15 below. The Pilot II and III participants who were not weatherized were able to decrease their consumption somewhat, but non-weatherized participants in Pilot I increased their consumption by 5.7%. Weatherization allowed the participants to decrease their consumption by 10.7% over all Pilots.



**Figure 15 Mean Percent Therm Savings for Pilot Participants, Adjusted for Comparison Group Changes**

Median savings again aid the understanding of the results. In Figure 16, the median savings are positive for all groups except Pilot I non-weatherized, indicating that for all but this group, over half of the participants decreased their consumption, regardless of weatherization. This finding, in combination with the mean results presented above, indicate that the Payment Plus Program is helping participants decrease their therm consumption. However, savings are substantially increased when weatherization services are provided.



**Figure 16 Median Annual Therm Savings for Pilot Participants, Adjusted for Comparison Group Changes**

Figure 17 shows the median percent savings, which also indicates that the Pilot I participants that were not weatherized have the greatest amount of increases, with a median 7.8% increase in therm consumption. However, all other participants have median savings. Overall, the Pilot Program is most effective when the weatherization component is included. Over half of the weatherized participants have comparison-adjusted annual savings of 100 therms, or a decrease in therm consumption of 10.4%.

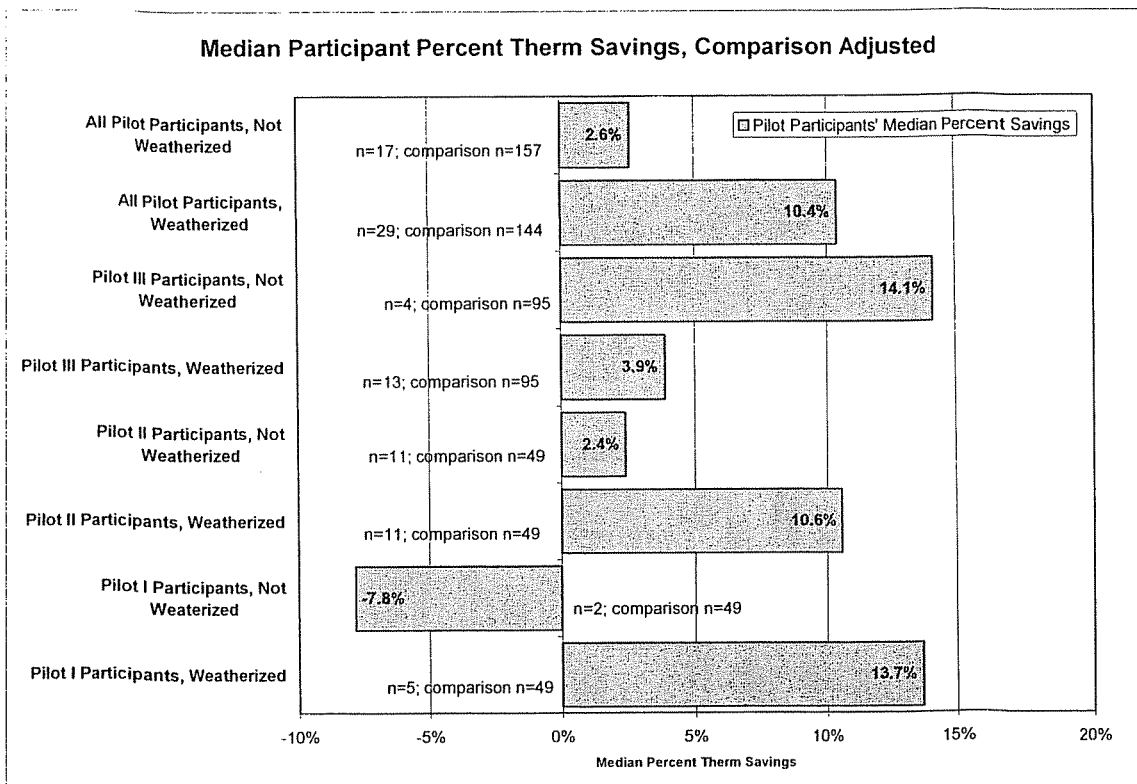
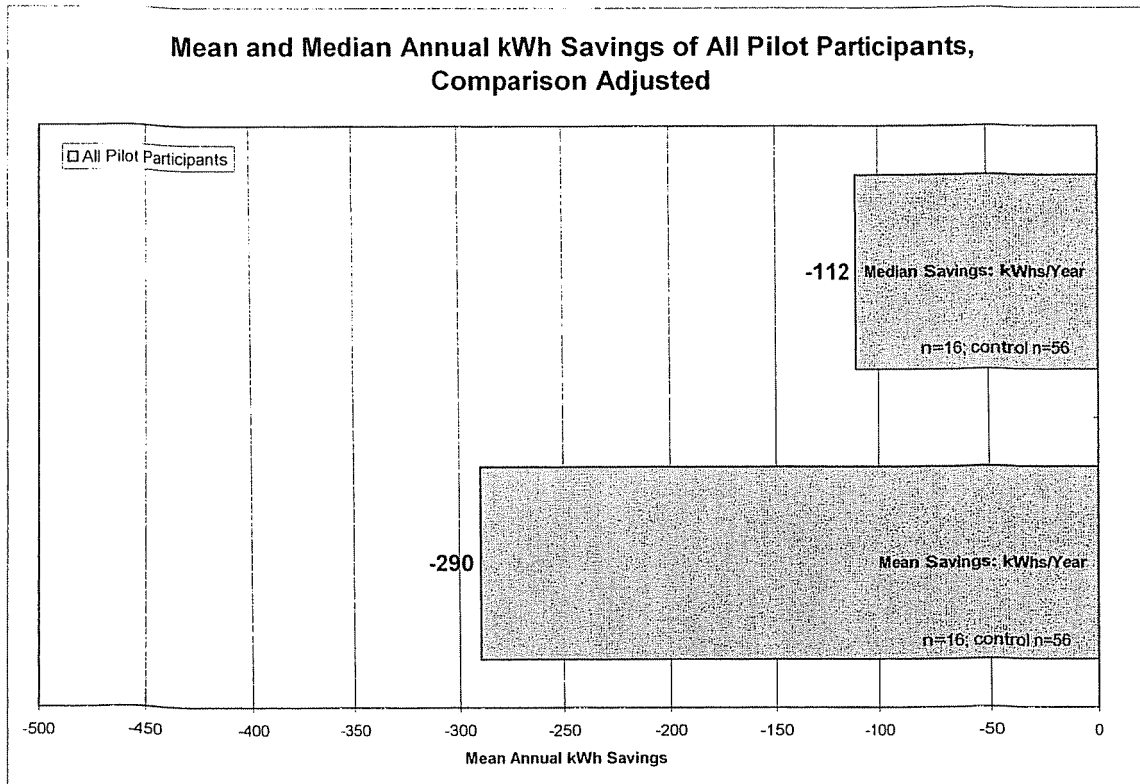


Figure 17 Median Percent Therm Savings for Pilot Participants, Adjusted for Comparison Group Changes

### Energy Savings of Pilot I, II, and III Participants Combined

With the weather-normalized results provided by PRISM™ it is possible to combine the Pilot participants together as a single group and assess the energy impacts across both groups. This assessment provides the most reliable indication of program energy impacts because it treats participants from all three Pilots as a single group. While this was done above, here we will look only at overall Pilot Program effects on energy consumption, and compare mean and median results directly to better show the changes in consumption after participating in the program.



**Figure 18 Mean and Median Savings per Year of All Pilot Participants Combined, Adjusted for Comparison Group Changes**

Figure 18 above shows that the median kWh savings per year is lower than the mean negative savings. This indicates that over half of the participants are increasing their consumption by 112 kWh per year or more, and some participants increase their consumption by an amount large enough to drive the overall mean to an increase in consumption.

Figure 19 below shows the mean and median annual therm savings, revealing that half of the Pilot participants that are not weatherized do have decreases in therm consumption, those that decrease their consumption do so at a large enough amount to keep the mean savings in the positive. Weatherized Pilot participants do well overall, saving a mean 143 therms a year, with half of the participants saving over 100 therms annually.

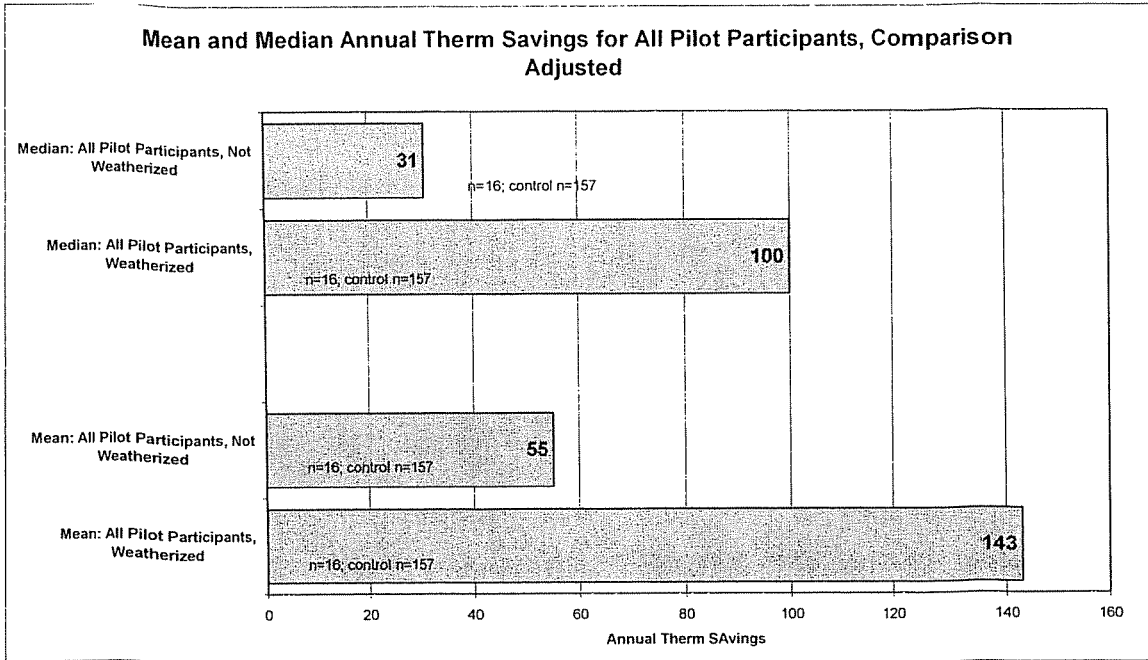


Figure 19 Mean and Median Therm Savings per Year for Pilot I & II Participants Combined, Adjusted for Comparison Group Changes

### Summary of Energy Savings

While the kilowatt hour savings are discouraging, the therm savings for the Pilot participants are both strong and positive. The findings in this analysis point to weatherization as a key component of the Payment Pilot Program in reducing energy consumption in the low-income population. The program may want to consider making weatherization mandatory.

In addition, the kilowatt-hour consumption results for Pilots I and II have significantly changed over the past two years, indicating that the lessons learned in the energy class have either been forgotten or there have been changes in some of the households beyond behavioral changes.

## Section IV: Arrearage Evaluation Results

### Introduction

A key goal of the Payment Plus Program is the reduction of arrearages carried by the area's low-income population. As a result, a detailed analysis of the payment effects of the program were conducted to determine if there were changes as a result of participation in the Program.

Four years have passed since the Pilot Program I participants attended their training session(s) and (possibly) received weatherization. This is enough time to permit a long-term assessment of the effects of the program on arrearage levels. In a previous evaluation report we analyzed the arrearage patterns before, during, and for the short-term post period of Pilot I. In this study we will examine the post-program arrearage data for close to four years following the end of the program and test for changes in arrearage patterns due to participation in the Payment Plus Pilot Program I. Pilots II and III are also studied for medium- and long-term effects of the program.

### Analysis Sample Size

The sample size for this analysis varies over each of the 60 months in this analysis (June 2001 through May 2006). The primary weakness of this arrearage and payment patterns analysis is that at times the sample size for the participants for which payment data was available can drop to a very low level, and for some months in the Pilot II analysis there is no data. At most, there are 52 customers in the Pilot III participant group. The overall analysis of the combined participants provide a range of 10 to 113 participants, so this overall analysis is the most rigorous and statistically sound.

Many of the customers in both the participant and comparison groups have moved or dropped their service, causing accounts to be eliminated from this analysis. The results presented in this section are based on participants that have enough data to examine trends in usage. The comparison group also changes over the 60 months, and two different groups are used through the analysis. One comparison group is compared to Pilot I and II participants, and another is compared to the Pilot III participants. The overall analysis combines the two comparison groups. In retrospect, we realize it would have been better to forecast the need for longer-term analysis for the Pilot program four years ago and select a comparison group at that time that was large enough to carry the analysis forward for at least four years. Future comparison groups should be informed by the potential need to reevaluate participants over extended periods of time.

### Arrearage Levels

#### Pilot I

Arrearage levels for the Pilot I participants who had enough data to analyze have decreased from a mean monthly arrearage of \$719 in the six months before participation to \$438 in the last six months of the analysis, 43 to 48 months after participation. The



comparison group’s monthly average arrearage for these same periods of time increased from \$338 to \$449.

The arrearage levels presented in Figure 20 represent the average monthly arrearage for the participant group and the comparison group over the six months before the program compared to the six months after the program (1-6 months), after which the analysis block is months (7-12 months), and so on until the latest billing month pulled for this analysis (May 2006). The 6-month block before the program ends immediately before the classes, and runs back 6 months (August 2001 through January 2002). The period after the program starts immediately following the program, and runs for 6 months (June 2002 through November 2002), and the last period reflects mean monthly arrearage data for the period December 2005 through May 2006. This analysis allows us to examine the data for four full years after the program compared to six months prior to the program, taking into account the effects of high winter and summer energy costs across all three periods of time.

Essentially this graphic shows that Pilot I arrearages have decreased by 39% in the four years since and the Payment Plus Program. The comparison group’s arrearage has increased 33%, indicating that the Pilot I participants are doing well in managing their arrearages, keeping them down while the comparison group’s arrearages have increased.

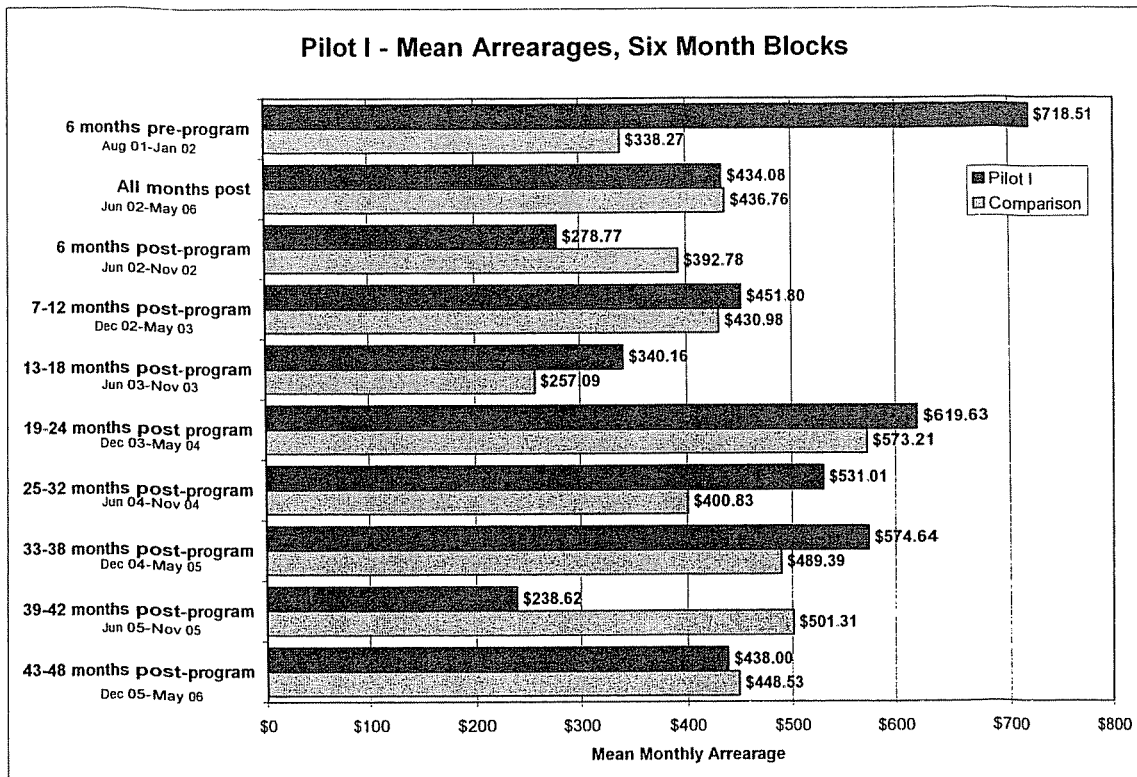


Figure 20 Mean Monthly Arrearage Levels for Pilot I Participants

Figure 21 below show the mean arrearages of Pilot I participants for each month of the study. Before the program period, it is easy to see the right participants were chosen by

the fast accumulation of arrearages that averaged over \$1,000 before they participated in the program. The program, through credits and encouraging behavioral changes, reduced that average arrearage to just over \$200.

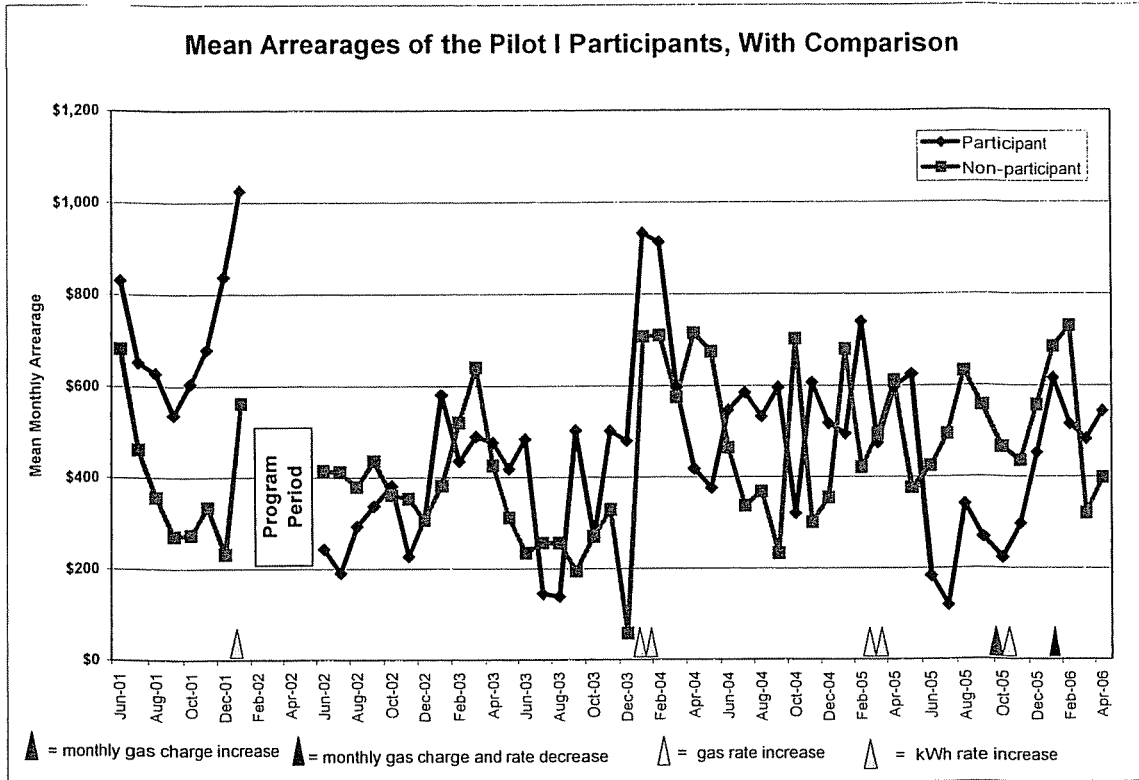


Figure 21 Mean Arrearages of the Pilot I Participants by Month, With Comparison

**Pilot II**

The analysis of the Pilot II participants is based on the billing and arrearage data of 55 customers that had data to analyze and who did not move during the study period.

Pilot II participants increased their arrearage over the study period by only 5%. The comparison group increased their arrearage by 51%. The rate of increase is much lower for the participants, and the arrearage for the participant group is still lower (in dollars) than the mean arrearage of the comparison group.

For Pilot II, six months of pre-program data was used (December 2002 through May 2003), and thirty-five months of post data (July 2003 through May 2006).

Figure 22 below shows that Pilot II participants maintained a fairly steady level of arrearage throughout the post-program period. The comparison group’s arrearage was more erratic, and also increased over the time period studied.

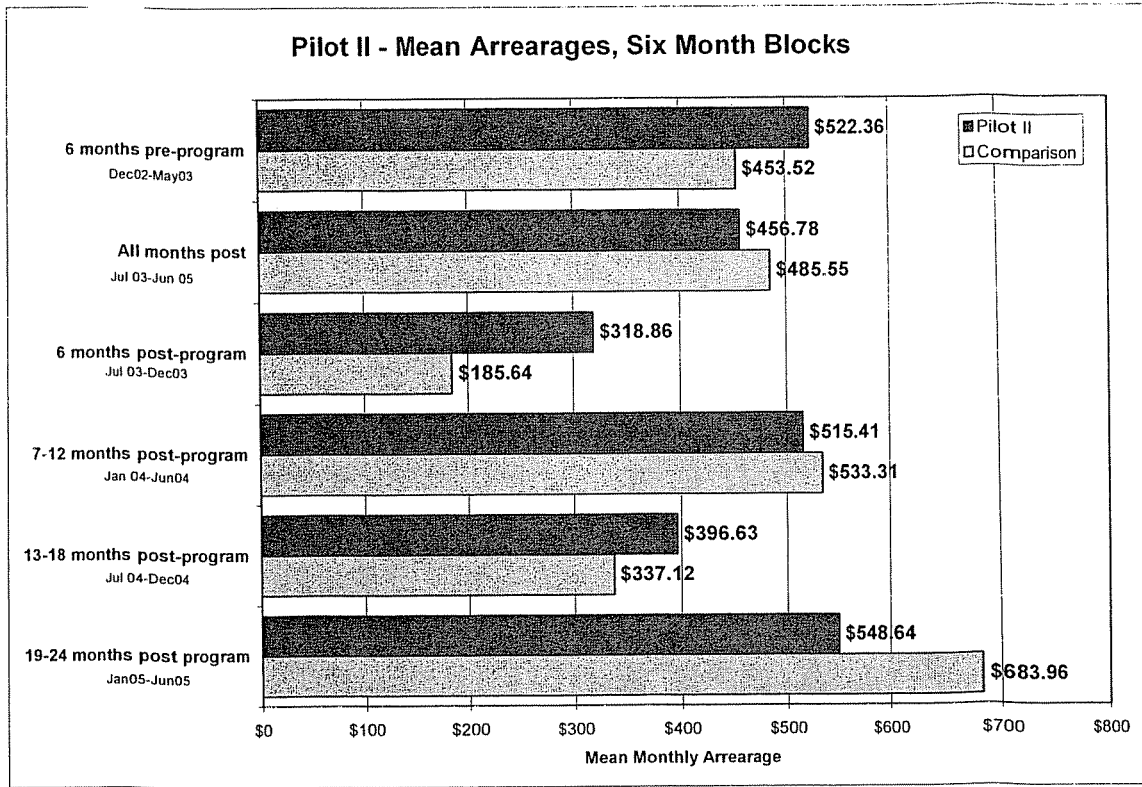


Figure 22 Mean Monthly Arrearage for Pilot II Participants

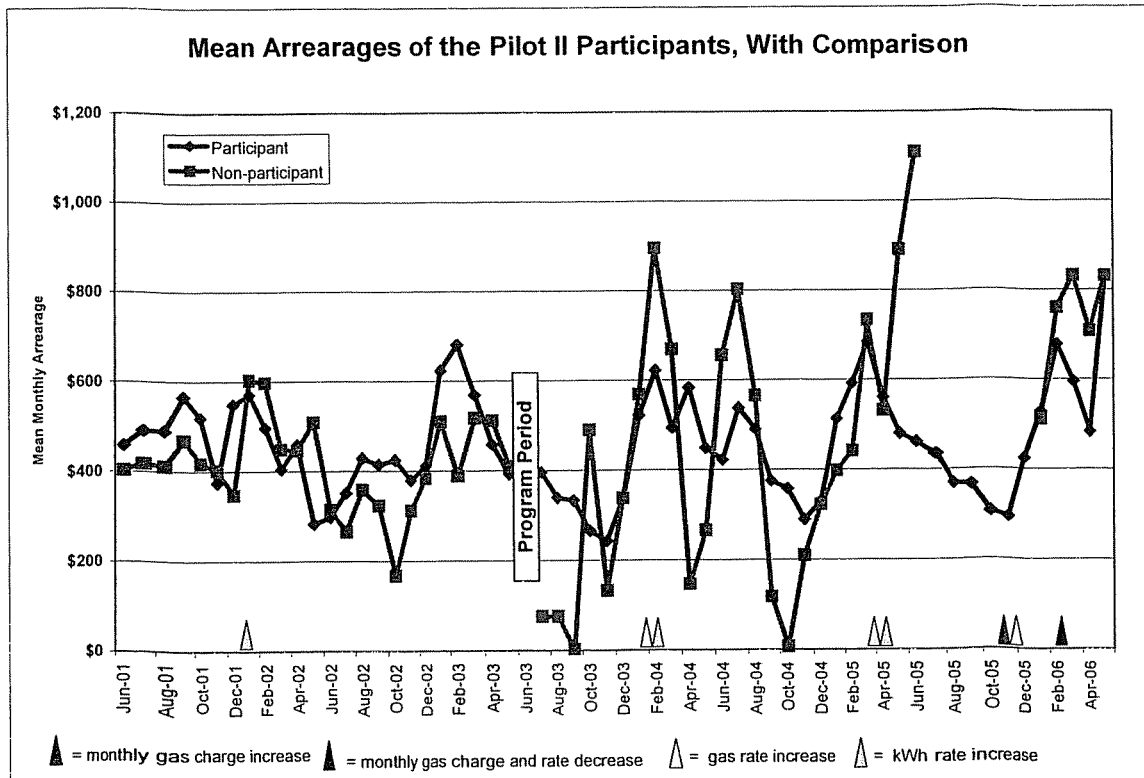
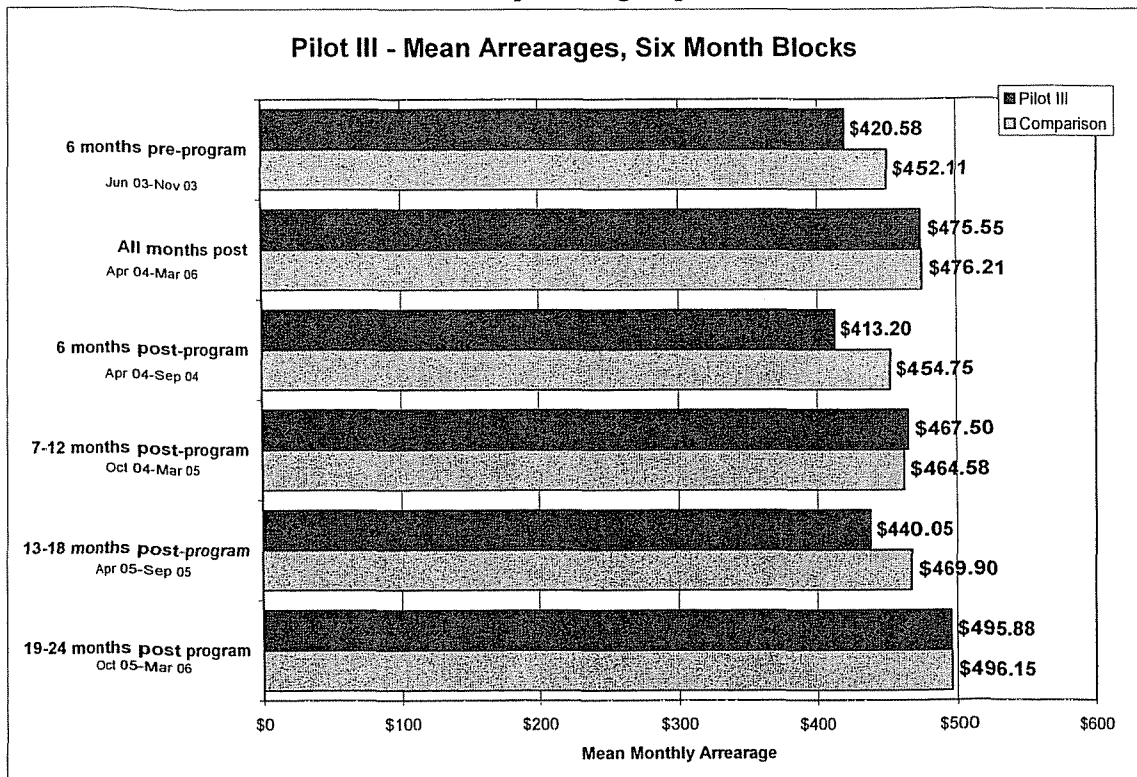


Figure 23 Mean Arrearages of the Pilot II Participants by Month, With Comparison

**Pilot III**

Pilot III participants, like the Pilot II participants, have slightly increased their arrearage in the months since the Pilot III program. In the six months before the program (June 2003 through November 2003), the participants carried an average arrearage of \$421, while the comparison group's arrearage was \$452. Both the participant's and comparison group's arrearage hold steadily in the six-month blocks following the program months. The Participant's average arrearage increased by 18% to \$496, while the comparison group average arrearage increased by 10% to \$496. While the participants are carrying the same level of arrearage, those arrearages are growing at a slightly faster rate than those of the comparison group.

Figure 25 below shows the Pilot III participants and comparison group mean monthly arrearages for the time period studied. Arrearages for the participants actually increased the month after participation in the program, but then in later months their arrearages were about the same as those in the comparison group.



**Figure 24 Mean Monthly Arrearage for Pilot III Participants**

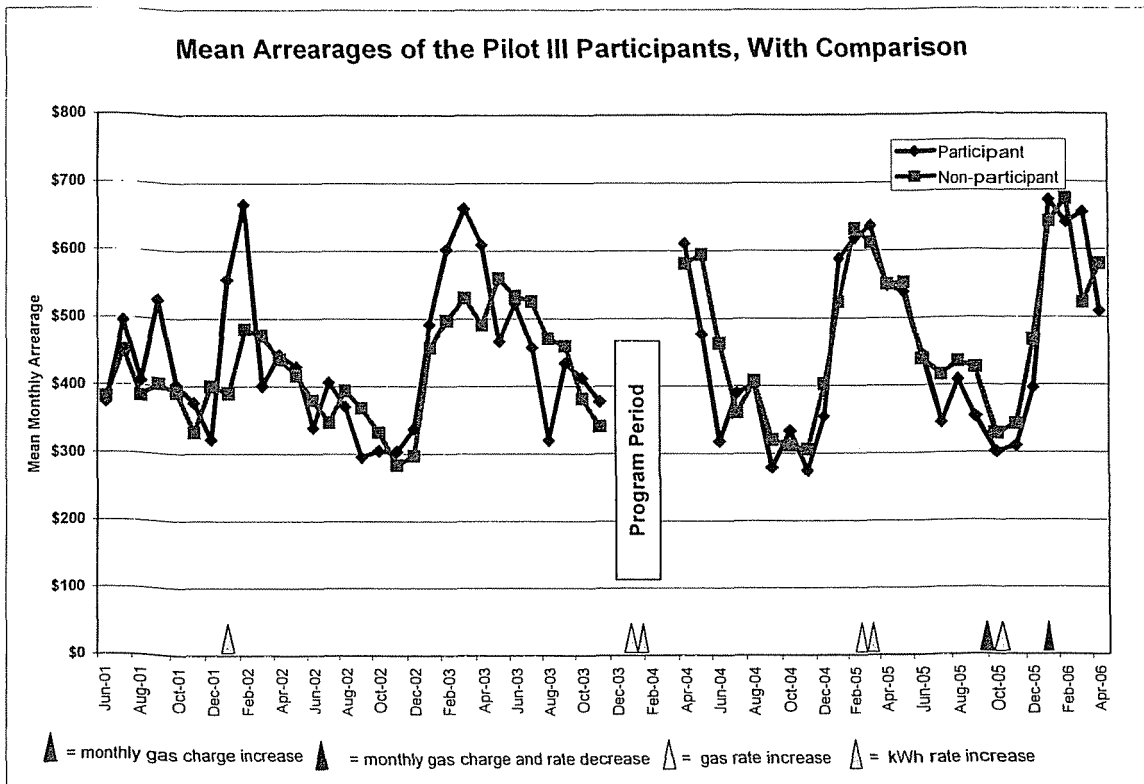


Figure 25 Mean Arrearages of the Pilot III Participants by Month, With Comparison

**All Pilots**

The three Pilot participant groups were combined to gauge the overall effect on arrearage of the Payment Plus Program. Figure 26 below shows the mean monthly arrearage in the six months before the pilot programs for the participants and the comparison group, and the mean monthly arrearage for all months since program participation for all participants and comparison group customers.

Pilot I participants carried the highest mean arrearage before entering the program, which is a result of the enrollment efforts for that Pilot, which focused on customers in crisis-mode. Their arrearages were significantly reduced since program participation, and they, as a group, have maintained much lower mean arrearages since the program which was four years ago. The comparison group used for Pilot I has had the opposite condition, their arrearage has increased from \$397 to \$437.

Pilot III is the only participant group that has increased their mean arrearage since participation, but the increase is slight (\$437 to \$476). However, the comparison group also slightly increased their arrearage from \$420 to \$476.

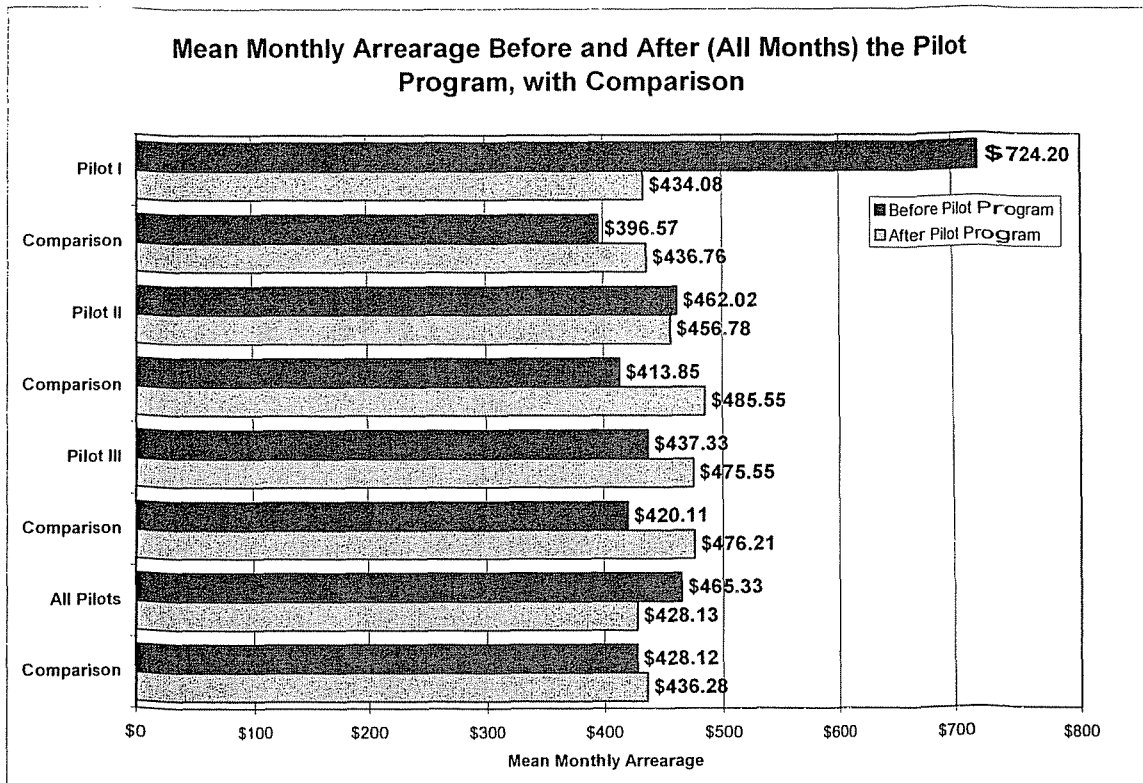


Figure 26 Mean Monthly Arrearage for All Pilot Participants

When the data from all three Pilots are combined, it's clear that the Payment Plus Program has a positive effect on the arrearages of the participants. The average monthly arrearage in the six months before participation is \$465.33, and this drops to an average arrearage of \$428.12, a decrease of 8%, while the arrearage of the comparison groups all increase.

The median arrearage over the same periods of time mimic the mean, but the overall drop in arrearage is much larger for the Pilot Program participants, with the median arrearage being \$377 after the program, where the mean above was \$428. This indicates that over half of the Pilot Participants were able to reduce their arrearage but there are some customers whose arrearage is high enough to bring the mean up to \$428.

The low-income customers that participate in the Payment Plus Pilot Program lower their arrearage when compared to the comparison group. Overall, Pilot participants reduce their arrearage by 8%, while the comparison group increased their arrearage by 2%, resulting in a 10% decrease in arrearages for the Pilot participants over the long-term.

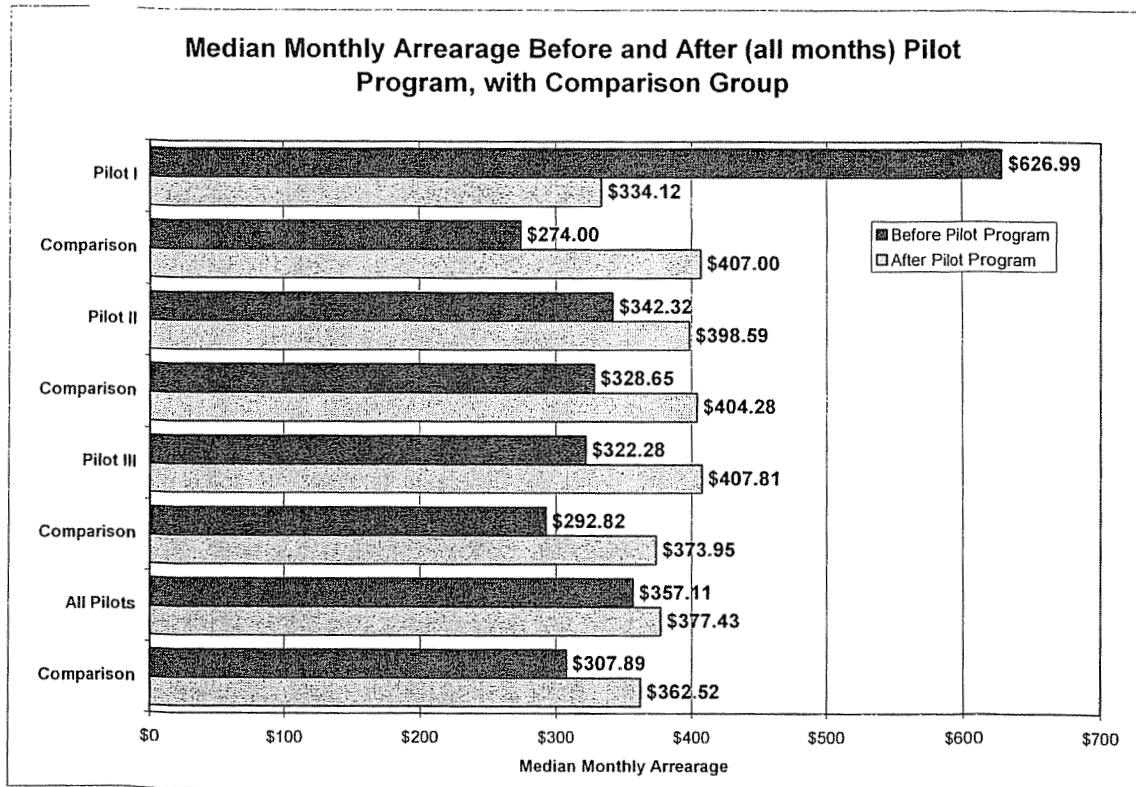


Figure 27 Median Monthly Arrearage for All Pilot Participants

## Section IV: Payment Effects

### Percent of the Bill Paid - Pilot I

This section looks at the payments made each month by the Pilot participants and the comparison group in comparison to the amount due on their bill. (Please see the introduction of the previous section on Pilot I arrearage for information on sample sizes of both the participant and comparison groups.)

During the examination of the payment data we noticed that in many cases multiple payments were made during a single month as people struggled to make weekly or bi-monthly payments. When these instances occurred we summed the payments made by the customer and then compared the sum to the amount due on the bill for that month. If there was no payment made in a month, they were excluded from the analysis for that month (no data to evaluate). Therefore, Figure 28 shows the percent of the bill paid of those that made a payment on their bill.

Figure 28 below shows how the percent of the total bill paid (by those making a payment) has changed. Pilot I has the highest increase – paying an average of 56% of the amount due since they participated four years ago, compared to only an average of 47% of the bill in the six months before participation. More of an improvement has been made when the comparison group is factored in, as they have decreased the percent of the bill paid during the same time period, from 54% of the bill to only 30%.

Pilot II has decreased the amount paid on their bills, but is doing better than the comparison group. Pilot III has maintained their level of payment, which is an improvement over their comparison group, which has decreased their percent of the bill paid from 54% to 47% during the same time period.

Over all the Pilot groups, the percent of the bill paid has stayed the same. Before participation, they paid 49.5% of their bill, and since participation, they pay 49.8% of the bill. However, the comparison groups have decreased the percent of the bill paid from 52% to 45% of the bill. Together, the program has improved the payment ability of the participants relative to the comparison group.



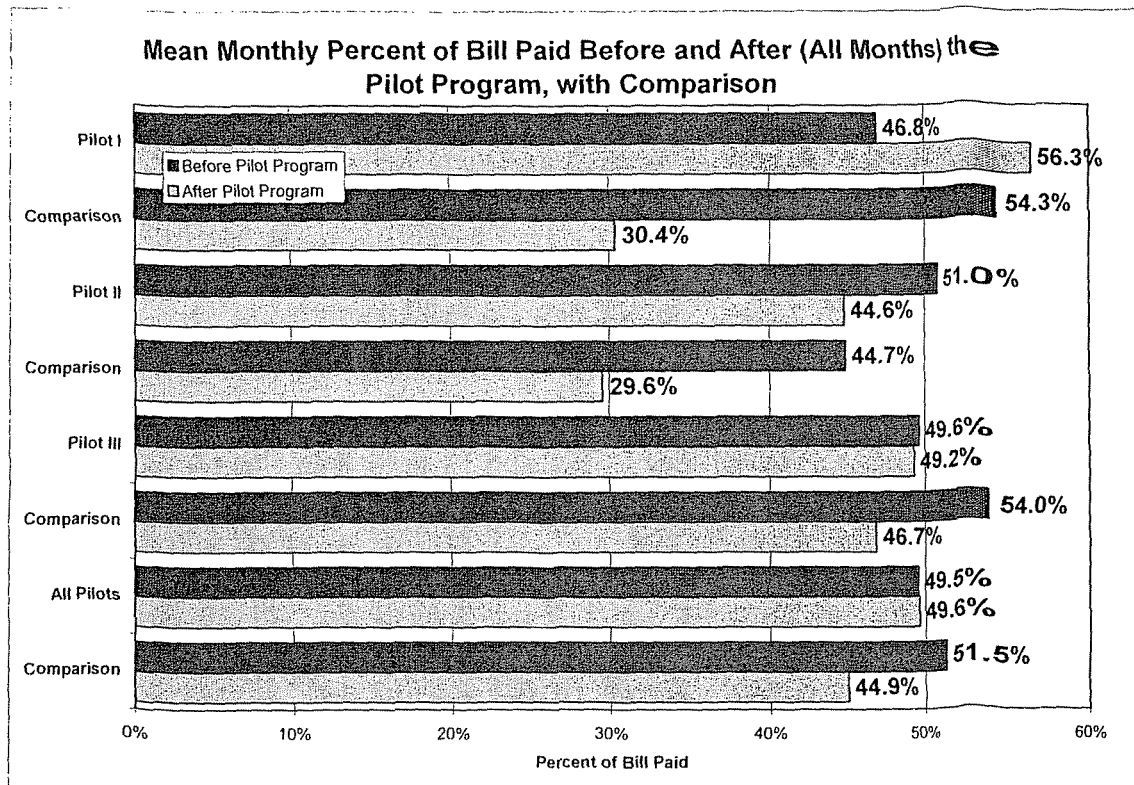


Figure 28 Mean Percent of the Bill Paid by Pilot Participants

When the Pilot groups and comparison groups are combined, the participants have not changed their payment behavior very much (from 41% paid to 42% paid). However, the comparison group has dropped their percentage of the bill paid drastically, from 89% to 51%. That is, while non-participants are becoming less able to pay their bills, participants have been able to maintain their payment patterns.

### Disconnections

Another indication of changes in payment behavior is the frequency of disconnected service in the studied groups. Figure 29 below shows the percent of customers that were disconnected in each of the studied groups. The graph covers all months studied (June 2001 through May 2006). Pilot I participants were disconnected at a rate of 1.54% for each month in the months leading up to their participation in the Pilot Program. In the months since their participation, an average of 2.23% of the customers in any given month will be disconnected, an increase of 45%. However, the comparison group studied in conjunction with Pilot I participants have fared worse. In the months before the program was offered, disconnection was a reality for 2.29% of the customers in any given month, whereas since the program, it occurs to 5.97% of the customers in the comparison group, and increase of 260% - a rate of increase almost 6 times that of the Pilot I participants.