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FILE

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VIA OVERNIGHT MAIL

November 14, 2008

Docketing Division
Public Utilities Commission of Ohio
180 East Broad Street
Columbus, Ohio 43215-3793

Re: Case No. 08-1227-EL-UNC
Case No. 08-1228-EL-UNC

Dear Docketing:

Enclosed please find the original and seventeen copies of the Application of Duke Energy Ohio, Inc. to Establish Demand Side Management Programs for Residential and Non-Residential Consumers.

Please date-stamp the extra two copies of the application and return to me in the overnight envelope provided.

Should you have any questions, please contact me at (513) 419-1847.

Very truly yours,

Anita M. Schafer

Anita M. Schafer
Senior Paralegal

AMS
Enclosure

BEFORE

THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application for Recovery of Costs, Lost Margin, and Performance Incentive Associated with the Implementation of Electric Residential Demand Side Management Programs by Duke Energy Ohio	)))))))	Case No. 08-1227-EL-UNC
In the Matter of the Application for Recovery of Costs, Lost Margin, and Performance Incentive Associated with the Implementation of Electric Non-Residential Demand Side Management Programs by Duke Energy Ohio	)))))))	Case No. 08-1228-EL-UNC

DUKE ENERGY OHIO'S DSM STATUS REPORT AND APPLICATION TO RECONCILE AND UPDATE THE DSM RIDERS ASSOCIATED WITH DEMAND SIDE MANAGEMENT PROGRAMS FOR RESIDENTIAL AND NON-RESIDENTIAL CONSUMERS

Now comes Duke Energy Ohio (DE-Ohio) with the consensus of the Duke Energy Community Partnership (DECP) to file a status report on the existing demand side management (DSM) programs and an application to reconcile and update the DSM Riders for recovery of program costs, lost margins, and shared savings associated with the implementations of a set of demand side management programs for residential and small/medium size business consumers.

The Applicant is DE-Ohio of 139 East Fourth St., Cincinnati, Ohio 45202. The DECP collaborative members are: Working in Neighborhoods, People Working Cooperatively, the Kroger Company, Cincinnati/Hamilton County Community Action

Agency, Clermont County Community Services, Inc., Communities United for Action, Adams/Brown Counties Economic Opportunities, Inc, and Home Ownership Center of Greater Cincinnati. Ex Officio members include the Office of the Consumers' Counsel, the Ohio Energy Office, and the Public Utilities Commission of Ohio. The Cincinnati Public Schools (Schools) is a DECP Board Member.

This application is divided into three sections with eleven appendices. Section I provides background information, definitions, and acronyms. Section II provides the status report on the existing programs. Section III discusses the recovery mechanism and details on the calculation of the DSM riders.

Appendix A provides updated cost-effectiveness test results. Appendices B through I provide the results of the measurement and verification studies performed on the following programs as follows, Appendix B: Home Energy House Call, Appendix C: Smart $aver®, Appendix D: PowerManager, Appendix E1: Energy Star CFLs, Appendix E2: Energy Star Clothes Washers, Appendix F: Energy Efficiency Website, Appendix G, NEED Energy Education, Appendix H: Personalized Energy Report (PER), and Appendix I: C&I Prescriptive Program. Appendix J contains the DSM Riders. Appendix K provides the calculation of the DSM Riders.

I. INTRODUCTION

A. Background

DE-Ohio with the support and involvement of the DECP, has been active in the implementation of energy efficiency programs for many years. In 1992 the Commission ordered DE-Ohio (at that time The Cincinnati Gas & Electric Company) in Case No. 91-410-EL-AIR to form a Collaborative to provide energy efficiency programs to help reduce the electrical demand of consumers. Later that year, DE-Ohio formed its first Energy Collaborative made up of members of the community, companies, community groups, and community service agencies that deal with energy issues. This effort was for the benefit of all consumers, from residential to large industrial consumers. Many quality programs were developed and implemented during the period of 1992 through 1996, which helped consumers save energy.

On December 19, 1996, the Commission issued its order in Case No. 95-103-EL-FOR which recognized that the fundamental assumption that validates DSM, namely the inherent cost sharing linkage among all consumers of a utility, is broken in an open access, consumer choice environment. The key provisions of the order directed the Ohio Collaborative to "...focus on (residential) programs, such as weatherization, which benefit low-income consumers and reduce Percentage of Income Payment Program (PIPP) costs, thereby benefiting all consumers..." In January of 1997, the Collaborative dissolved and narrowed its focus and programs to better reflect the directive from the Commission.

In Case No. 03-93-EL-ATA, DE-Ohio recommended that DSM programs once again be implemented in its service area. DE-Ohio came to recognize that DSM programs can be considered cost-effective if the cost of implementation can be offset by savings relative to forward projected market prices. With that filing, DE-Ohio proposed to offer energy efficiency measures within DSM programs to all residential and small to medium-sized non-residential consumers, regardless of their generation supplier, through the year 2010. These smaller consumers also have the most market barriers hindering action including lack of information, expertise, training, and capital. DE-Ohio, working with interested stakeholders developed a wide-ranging set of DSM programs to address these market barriers for all consumers in its targeted consumer classes. With DE-Ohio's application in Case No. 06-91-EL-UNC and Case No. 06-92-EL-UNC, DE-Ohio, with the support of the interested stakeholders, proposed specific charges for residential electric consumers and non-residential electric consumers that would be recovered through DSM Riders. In its July 11, 2007 Order in Case No. 06-91-EL-UNC and Case No. 06-92-EL-UNC, the Commission subsequently approved the implementation of the proposed programs and the establishment of DSM Riders to recover program costs, lost margins, and shared savings.

B. Definitions

For the purposes of this Application, the following terms have been defined:

1) **"DSM Revenue Requirements"** shall mean the revenue requirements associated with all Program Costs, Administrative Costs, Lost Revenues (less fuel savings), and the Shared Savings Incentive.
2) **"Collaborative"** shall mean the DECP Collaborative.
3) **"Program Costs"** shall mean the costs incurred for planning, developing, implementing, monitoring and evaluating the DSM programs that have been approved by the Collaborative.
4) **"Administrative Costs"** shall mean the costs incurred by or on behalf of the collaborative process and that are approved by the Collaborative, including, but not limited to, incremental costs for consultants, employees and administrative expenses.
5) **"Lost Revenues"** shall mean the amount of net revenue due to lost sales due to installed DSM programs. Lost revenues will be calculated using estimates

approved by the Commission which may include engineering estimates[1] of the level of decreased sales for each program. The level of net revenue due to lost sales will be the product of the actual level or the level calculated by multiplying the average lost sales per unit of DSM by the number of installed units, multiplied by the incremental charge, less the fuel costs reflected in the applicable market price or rate. Following any retail rate case, lost revenue recovery would cease on any lost revenues subsequently reflected in rates.

6) **"Shareholder Incentive"** shall mean a percentage share of the net benefits attributable to DSM programs provided as an incentive to pursue such programs. The Shareholder Incentive or Shared Savings will be a percentage of the net resource savings generated by DSM measure installation during each twelve-month period. The percentage will be based upon the level of load savings achieved relative to the goal for the program at or below the projected level of spending for that level of load savings. Net resource savings is defined as program benefits less utility program costs. Benefits will be calculated on the basis of the present value of avoided costs over the expected life of the implemented DSM programs.

7) **"DSM Cost Recovery Mechanism"** shall mean the methodology used to reconcile differences between the amounts of revenue actually collected through the mechanism and the amount of revenues estimated to be collected. For program and administrative costs, a balance adjustment amount will be determined by calculating the amount collected and the actual costs during the

[1] Engineering estimates, estimates based on generally accepted engineering calculations, will be used when there are no data on savings available from impact studies.

same twelve-month period. For revenues attributable to lost sales, the balance adjustment will be determined by calculating the revenues from lost sales based upon the difference between the actual installed units of the DSM measures and the projected units. If engineering estimates or estimates taken from studies outside the DE-Ohio service area have been used as the basis for the calculation of lost revenues, during the first balancing period at which sufficient actual impact data is available, an adjustment for the difference between the original estimate and the actual impact data shall be made retroactive to the program start date, and shall be included in the balancing adjustment for the following year. After impact data from the first impact evaluation study has been employed in a reconciliation, differences between actual impact data collected in a given year and the actual impact data used in a prior year shall be used only to affect future cost recovery, and shall not be applied retroactively to the program start date. For the shareholder incentive, the balance adjustment amount will be calculated by determining the incentive amount based on actual installed DSM measures and the projected incentive amount. Adjustments to the cost-effectiveness calculations arising from completion of the first impact studies will be applied retroactively to the program start date. The results of future impact studies will be applied up to the timing of the prior impact study.

All of these adjustments will reflect any differences between actual and projected sales volumes. Any over- or under-recovery, with interest applied at the rate equal to the average of the three-month commercial paper rate for the immediately preceding twelve-month period, will be divided by kWh or MCF sales for a subsequent twelve-month period, as a portion of the DSM balance adjustment to the DSM Cost Recovery Mechanism. Any over- or under-recovery of a previous balance adjustment amount will also be included in the application of the DSM balance adjustment.

8) **"Voucher"** shall mean the credit receipt the consumer receives from a social service agency. The voucher can be used by the consumer as a partial payment toward the utility bill.

C. Acronyms

ACCA	**Air Conditioning Contractors of America**
AFUE	**Annual Fuel Utilization Efficiency**
ARI	**Air Conditioning and Refrigeration Institute**
DECP	**Duke Energy Community Partnership**
DE-Ohio	**Duke Energy Ohio**
DSM	**Demand Side Management**
ECM	**Electronically Commutated Motors**
HEHC	**Home Energy House Call**
HVAC	**Heating, Ventilation, and Air Conditioning**
IRP	**Integrated Resource Plan**
NATE	**North American Technician Excellence**
NEED	**National Energy Education Development**
PER	**Personalized Energy Report Pilot**
PIPP	**Percentage of Income Payment Program**

PV	**Photovoltaic**
RSES	**Refrigeration Service Engineers Society**
SEER	**Seasonal Energy Efficiency Ratio**

II. PROGRAM STATUS REPORT

DE-Ohio currently offers the following programs, the costs of which were recoverable through the DSM cost recovery riders approved by the Commission in Case No. 06-91-EL-UNC, Case No. 06-92-EL-UNC, and Case No. 06-93-GA-UNC.

Program 1: Home Energy House Call

Program 2: AC Check (Pilot)

Program 3: Smart $aver®

Program 4: PowerManager

Program 5: Energy Star Products

Program 6: Energy Efficiency Website

Program 7: Ohio Energy Project (NEED)

Program 8: Appliance Turn-In

Program 9: Personalized Energy Report (Pilot)

Program 10: Pre-Paid Billing Services

Program 11: Commercial and Industrial (C&I) Prescriptive Incentive Program

Program 12: Photovoltaic Schools Demonstration/Education Program

Program 13: House Call Plus Research Program (Pilot)

This section of the application provides a brief description of each current program, a review of the current status of each program, and information on any changes that may have been made to the programs. The following tables provide a brief summary of the load impacts achieved during this filing period.

Summary of Load Impacts: July 2007 Through June 2008			
	Incremental	Load Impacts Net of Free Riders	
Residential Programs	Participation	kWh	kW
Summer Saver (Air-conditioner)	140	35,871	18.3
Home Energy House Call	3,383	1,308,566	236.7
Ohio Energy Project (NEED)	1,000	181,300	20.0
Power Manager	10,019		8,516.2
Energy Star Products			
CFL's (Compact Fluorescent Lights)	401,833	24,511,813	4018.33
Torchieres (Floor lamps)			
Appliance Rebate	64	19,147	0.8
Energy Efficiency Web Site	2,613	383,223	39.2
Room AC Turn-In			
AC Check - Pilot			
Smart Saver Heat Pump with ECM	590	409,795	71.1
Personalized Energy Report Pilot	34,740	11,268,266	1,187.1
Pre-Paid Meter - Pilot			
Energy Star Products - Gas Furnace	3,067	NA	NA
Energy Star Products - Gas Furnace /ECM (Elec Impacts)	796	177,960	21.0
House Call Plus - Research (Elec Heated Homes)			
House Call Plus - Research (Gas Heated Homes)			
Total Residential	458,245	38,295,942	14,128.7

	Incremental	Load Impacts Net of Free Riders	
Non-Residential Programs	Participation	kWh	kW
C&I Lighting	34,286	21,702,102	3,302.7
C&I HVAC	246	4,410,013	2,137.6
C&I Motors	367	5,684,637	865.2
C&I Other	571	397,124	(6.5)
Total Non-Residential	35,470	32,193,877	6,299.1
Total	493,715	70,489,819	20,427.8

This demonstrates that DE-Ohio's overall efforts to implement programs that saved energy did not reach the goals for kWh impacts set out for the first year of the program as specified in DE-Ohio's application. Results fell short for the residential conservation programs, but exceeded the plan for the non-residential programs.

For residential programs, the filing included projected savings of 55,523,600 kWh and 17,128 kW for conservation programs and 2,500 kW savings for the demand response program. Comparison of the actual results reported above reveals that DE-Ohio's programs reached an achievement level of 69% (38,295,942 kWh/ 55,523,600 kWh implies 69%) for the residential conservation programs and over 100% (8,516 kW/ 2,500 kW implies 341%) for the demand response program (PowerManager).

For the non-residential programs, the original filing projected savings of 23,479,709 kWh and 6,356 kW for the first year of the programs. Comparison of the actual results reported above reveals that DE-Ohio's programs reached an achievement level of over 100% (32,193,877 kWh/ 23,479,709 kWh implies 137%) for the non-residential conservation programs.

Results of the latest cost-effectiveness tests for each of the programs are provided in Appendix A.

Program 1: Home Energy House Call

The Home Energy House Call program (HEHC) is an in-home energy analysis that helps consumers identify the most cost-effective steps they can take in their home to save energy. The HEHC analysis looks at shell measures, air sealing, lighting, heating and cooling equipment, and appliance use in the home. The energy specialist offers recommendations where potential efficiency improvements can be made, from insulation to equipment replacement, which will help customers save money on their utility bill.

Data taken from the analysis is run through a computer model to make recommendations and disaggregate the energy bill into usage categories. The results are mailed to the participant within 10 days of the audit. Recently, DE-Ohio made a change to the report delivery allowing customers to receive their report online in 24 hours. This change was implemented in August 2008. The HEHC analysis addresses the need for quality information on energy efficiency options within a home. Consumers can get information by measure from other sources, but no other source within the market provides a full analysis of all measures. This independent view adds credibility to the information and allows non-biased analysis. Another component of the program is the Energy Efficiency Kit. The kit contains the following measures that the auditor will install for the customer that will help customers begin seeing immediate savings:

- Showerhead – 1.5 GPM
- Kitchen Swivel Aerator – 1.5 GPM
- Bathroom Aerator – 1.0 GPM
- 15 Watt CFL bulb
- 20 Watt CFL bulb
- 17 foot roll of closed cell foam weather stripping
- Switch and outlet draft stopper gaskets
- Shrink Fit Window Kit (42" x 62")
- Small roll of Teflon tape (for plumbing installation)
- Duke Energy labeled DOE Energy Savers Tips booklet
- Product list/instructions

DE-Ohio targets qualifying customers located in specific zip codes, with direct mail brochures. To qualify, DE-Ohio customers must own and occupy their single-family home or condominium and have lived there a minimum of 4 months. Customers have 3 options to enroll in the program: business reply card (BRC); toll free number; and online. During the period July 1, 2007 through June 30, 2008, 3,383 audits have been completed which exceeds the fiscal year goal of 3,250 by 133 audits. DE-Ohio monitors the quality of the program by asking the participants to complete a written survey about their HEHC analysis experience and the information provided. Customers rate the overall program a 4.8 out of 5, where 5 is "most satisfied". DE-Ohio also does in-field review with the field auditors and phone interviews among participant samples.

The program is currently delivered through GoodCents, Inc., (GoodCents) a national energy services provider, who was chosen through a competitive bid process and is jointly implemented with the Duke Energy Indiana and Duke Energy Kentucky territories to reduce administrative costs and leverage promotion. Both the audit and the kit are offered at no cost to the customer. In the fall of 2007, DE-Ohio solicited RFPs for the implementation the program, and the contract was awarded to Wisconsin Energy Conservation Corporation located in Madison, Wisconsin. The Wisconsin Energy Conservation Corporation (WECC) has been administering and implementing programs for 25 years, including the Home Performance Program offered jointly by Duke Energy Indiana and Vectren Energy Delivery. WECC has contracted with Thermo-Scan Inspections (TSI) located in Carmel, Indiana to deliver this program. Thermo-Scan has been in the business of providing a wide array of inspection services for commercial and industrial businesses, municipalities, contractors and homeowners to identify, repair and protect homes, buildings, equipment and structures from moisture, leaks, corrosion and inefficient energy usage since 1979. They received the **Energy Star** for Homes **Outstanding Achievement Award** two years in a row recognizing the important contribution they make to energy efficient construction and environmental protection. Together, WECC and TSI can provide the administration, marketing, staff, tracking, systems, logistics, training, customer service, scheduling and technical support required to support Duke Energy's Home Energy House Call program. The transition to WECC and TSI will take place on November 1, 2008. Duke Energy has been working with WECC, TSI and GoodCents to ensure a seamless transition for the customers.

A process and impact evaluation for this program was conducted using both engineering estimation methods and statistical billing analysis evaluation methods. The more rigorous assessment of energy savings in this case derives from the statistical pre and post billing analysis, and as such, the energy savings estimated through the statistical methodology is used in this case for the cost effectiveness analysis. The program assessment, energy savings estimates are provided in Appendix B.

Program 2: AC Check Pilot Program

This program is designed to reduce residential air conditioning load by maximizing the operational efficiency of the central air conditioning units. A qualified technician will evaluate the operating condition of the central air conditioning unit through a series of documented tests. After the tests are completed, a tune up and refrigerant adjustment is completed to increase efficiency of the unit. Currently, program roll out has been delayed as DE-Ohio determines the most cost effective way to deliver this program. The program protocol is being redesigned to eliminate or minimize the administrative costs associated with using the Check Me program. Air conditioning testing is also weather dependent, so consistent testing in non-summer months is difficult to administer.

The target market for this program is consumers who have central air conditioning in owner-occupied single-family or mobile homes. Customers will be marketed through direct mail and selected contractors. The program looks at air flow and refrigerant charge to optimize unit operation. DE-Ohio tested this program previously on low-income homes and found 10% to 15% savings from these improvements.

DE-Ohio pays an incentive for the unit testing. HVAC contractors will provide the infield services for the pilot. Technicians will be provided training on the processes and procedures required for the program. In addition, quality control and monitoring occurs through a defined tracking system as well as through field monitoring.

The budget for this program is $32,500 for year 1 and $65,000 for year 2. Once the components of the pilot program described above have been finalized, the test will consist of 250 units for year 1 and 500 units for year 2. Depending on weather conditions, the program expects to start its first tests on or around April 15, 2009.

Program 3: Smart $aver®

Electric Measures: Heat Pumps and Air Conditioners

The electric portion of the Smart $aver® program provides market incentives and market support to consumers, heating contractors and new home builders to promote the use of high efficiency heat pumps with electronically commutated motors (ECM) and high efficiency Energy Star central air conditioners. Monetary incentives and technical support to trade ally sales personnel stimulate demand for the high efficient equipment options. This program is jointly implemented with the Duke Energy Indiana territory to reduce administrative costs and leverage promotional efficiencies. Technology categories included are heat pumps that are 14.0 SEER or higher with ECM fan motors and central air conditioners that are 14.0 SEER or higher with ECM fan motors. The program also supports incidental devices that increase efficiency on these two measures: thermal expansion valves, fan delay relay switches, new higher efficiency refrigerants and new compressor technologies. Efficiency requirements may change over time in response to changes in technology, market acceptance and upgrades to national or state efficiency codes.

Incentives are available to three parties: new home builders, heating dealers and consumers. Heating dealers are usually the party that completes the application for incentives, as they are most aware of the technical information needed to certify the efficiency of the HVAC system. Current incentives are $300 for a Central AC, 14 SEER with ECM fan motor, and $300 for Heat Pumps, 14 SEER with ECM fan motors. Incentives are given to both the customer and heating dealer for existing home HVAC systems and to the builder for new home HVAC systems. For existing homes, incentives are $200 to the customer and $100 to the dealer, and for new homes incentives are $300 to the builder, unless the builder assigns payment to the customer. In July, 2007, DE-Ohio initiated the program with trade allies. Ongoing program delivery is accomplished with continued trade ally contacts by field representatives, daily communications on incentive application submittals and follow-up verification visits to homes that have been paid incentives.

In the residential new home market, builders and new homeowners are targeted. In the existing home market, DE-Ohio targets heating contractors and DE-Ohio consumers who purchase new heating systems or cooling systems for their homes. To be eligible, the application must be a single family home, condominium, or duplex. Dwellings not eligible are apartments, mobile homes, commercial or other non-residential buildings. New systems listed on the application must serve the entire home or if there is more than one system, all systems must meet the SEER minimum requirement.

The first year goal for participation was 100 Heat Pumps and 1000 Central Air Conditioners. First year actual participation is 590 heat pumps and 140 air conditioners. For the first year, 796 air conditioner sales were achieved in conjunction with a qualifying gas furnace sale, and are therefore accounted for under the combination sales in the Gas section which follows below.

Gas Measures: Gas Furnaces and Gas Furnaces with ECM Motors

The gas portion of the Smart $aver® program provides market incentives and market support to consumers, heating contractors and new home builders to promote the use of high efficiency, 90% + AFUE gas furnaces. The gas furnace does not require an ECM fan motor to qualify, but if an ECM fan is used and is combined with a matching Smart $aver® heat pump or air conditioner, incentives are doubled. When a qualifying gas furnace sale is made in conjunction with a new qualifying Smart $aver® heat pump or air conditioner including an ECM fan motor, this combination sale is tracked in its own category. Monetary incentives and technical support to trade ally sales personnel stimulate demand for the high efficient equipment options.

Incentives are available to three parties: builders, heating dealers and consumers. Heating dealers are usually the party that completes the application for incentives, as they are most aware of the technical information needed to certify the efficiency of the HVAC system. Current incentives are $300 for a gas furnace and $600 for a gas furnace with qualifying Smart $aver® heat pump or air conditioner and ECM fan motor. Incentives are given to both the customer and heating dealer for existing home HVAC systems and to the builder for new home HVAC systems. For existing homes, incentives are $200 to the customer and $100 to the dealer, and for new homes incentives are $300 to the builder, unless the builder assigns payment to the customer. The gas portion of the Residential Smart \$aver® program is run in conjunction with the electric measures and the education/training, marketing, market support, program delivery and quality control is all identical to the electric portion of the program.

In the residential new home market, builders and new homeowners are targeted. In the existing home market we target heating contractors and DE-Ohio consumers who purchase new heating systems for their homes. First year goal was 5,000 gas furnaces and 500 combination sales of a gas furnace and a qualifying Smart \$aver® heat pump or air conditioner with an ECM fan motor. First year actual participation is 3,863 gas furnaces and 796 combination sales. Total first year participation goal for all residential measures was 6,600 units, while the actual participation for all measures was 5,389. Residential construction in 2008 is currently down 40% from a year ago, so this is a reasonably good start, given existing and projected economic pressures. Participation in year 2 is expected to increase as more dealers are signed to the program and more customers consider investing in energy efficient HVAC systems. Program implementation is transitioning to WECC currently. They currently have a network of HVAC dealers and trade ally organizations in Duke's Midwest service territory that will provide support and encourage participation in the program.

An impact evaluation of the Smart \$aver® program was conducted for this filing and is provided in Appendix C. A combination of on-site sub-metering of HVAC units, coupled with detailed engineering estimation methods is used to project energy savings for the program's AC and Gas Furnace measures.

Program 4: PowerManager

The purpose of the PowerManager program is to reduce demand by cycling residential air conditioning usage during peak demand conditions in the summer months. The program is offered to residential customers with central air conditioning. DE-Ohio installs a load cycling device to the customer's compressor to enable DE-Ohio to cycle the customer's air conditioner off and on when the load on DE-Ohio'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 no adverse impact on the operation of the air-conditioning system or on the customer's comfort level. However, customers can opt out of the program if desired. 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 Indiana and Duke Energy Kentucky programs, has shown that the indoor temperature typically rises 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. DE-Ohio continues to explore opportunities to cross-market the PowerManager program with DE-Ohio's other energy efficiency programs thus tying both conservation and peak load management together as one package.

In 2007, DE-Ohio mailed 391,156 PowerManager marketing pieces and had 10,922 customers enrolled in the program with 3,011 switch installations completed from the enrollments. In 2008, DE-Ohio mailed 672,277 PowerManager marketing pieces and had 3,803 customers enrolled in the program with 7,032 switch installations completed from the enrollments. The cumulative installations as of the end of 2007/2008 year total 10,043 switches, which exceeds our goal by 8,116 switches. The installation rate during 2007 was intentionally higher than the projected 2,000 installations due to the fact that systems were implemented more quickly than originally anticipated and due to greater than expected customer responses to initial mailings. On average the marketing response rates have been approximately 5% to 6%. Customers can sign up for the program one of the following ways; phone, internet or reply card. Seventy-eight percent of customers have signed up via reply card, five percent by internet and seventeen percent by phone. As of June, 2008, DE-Ohio performed two control events, on 6/6/2008 and 6/9/2008. DE-Ohio is closely monitoring the performance of the new load control technology during summer 2008 within a randomly selected load research study group consisting of 40 customer sites with 44 cooling units and load control devices. Beginning May 2008, data loggers were installed on these cooling units to measure unit duty cycles, and load research meters were installed to measure 15-minute interval energy usage. In addition, these load control devices are being scanned at regular intervals throughout the summer with a Palm PC to record detailed information about the operation and reliability of the device. DE-Ohio will review this data to validate correct operation of the load control devices. An impact evaluation will be finalized and available for review by December 31, 2008. DE-Ohio has conducted evaluations and measurements of similar programs in nearby jurisdictions and expects that the Ohio measurements will likely reveal comparable load reduction results. As such, until the Ohio results are available, DE-Ohio will leverage the impact evaluation completed in 2007 for the Duke Energy PowerManager program in the Indiana and Kentucky service areas. Applying the results of these measurements to the Ohio participant group suggests an estimated reduction per switch of 0.85 kW for normal peak weather conditions. For reference, the 2007 impact evaluations completed for the PowerManager programs in the Indiana and Kentucky service areas is provided in Appendix D.

Program 5: Energy Star Products

The Energy Star Products program provides market incentives and market support through retailers to build market share and adoption of Energy Star products. Special incentives to buyers, coupled with educational materials, stimulate demand for the products and encourage retailers to participate in the programs. The program targets residential customers' retail purchases of specific technologies during designated promotional periods. During the first year of the programs, the focus is on Energy Star qualified Compact Fluorescent Light bulbs (CFLs). The technology focus may change over the next years of program operation based on new technologies and market responses.

There are several market barriers addressed by the program. The first is price.

Incentives provide customers a lower first cost of the item and stimulate interest. A second barrier is retailer participation. Through retail education, in-store sale support (signs, ads, mailers, 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 initiative such as "Change a Light, Change the World" promotion.

Original plans for the program featured an instant in-store rebate to DE-Ohio customers purchasing the specified Energy Star products. The program would have been administered by a third party company that specializes in retailer recruitment and training and rebate processing. While this model had been effective, DE-Ohio sought to reduce program costs while increasing customer awareness with direct-to-customer educational materials. The 2007-2008 program featured incentives or "customer rewards" in a variety of forms designed to provide market stimulation and encourage the customer to buy and install the efficient lighting. The form of the incentive and how it was delivered varied based on the retailer, however, the overall goal remained consistent: pair a compelling message on the advantages of CFLs with an attractive purchase price to spark adoption.

During the fall of 2007 promotions were executed through Wal-Mart (14 stores) retail outlets in the Cincinnati market. Around 530,000 DE-Ohio residential customers were sent a direct mailer containing 4 coupons for \$3 off select multi-packs of CFLs. The offer gave \$1 discount per bulb. The mailer contained information on the benefits of CFLs including energy savings and environmental benefits. Over 35,000 customers responded to the offer and 236,664 bulbs were sold.

Light bulbs are sold year round, however sales are seasonal with the highest volume during the months of October through December, uncovered via conversations with retailers, corresponding with shorter days and increased need for lighting. DE-Ohio used the second half of the fiscal year to work with a broader range of retailers and test other offer delivery methods. DE-Ohio partnered with The Home Depot and Lowe's Home Improvement to test the home improvement channels; with Ace Hardware (Ace) for the small independent retailer; and with Kroger for the grocery channel. A second Wal-Mart promotion was offered in conjunction with their Earth Day activities. Direct mail coupons were used for all of the promotions except for Lowe's and half of the Ace stores. For Lowe's, to test a lower cost delivery method, an online coupon was used. Customers received notification of a printable online coupon via a bill insert or on the DE-Ohio website. For Ace, the retailers were divided into two groups with half using a direct mail coupon and the other half using an in-store instant rebate. The offer was the same for both stores.

The total number of CFL bulbs sold in the 2007-2008 filing period was 398,180. Early results show that direct mail generates a higher response rate than the online or in-store coupons and that small retailers and grocery are not the most effective channels for price-based coupon offers. The Ace direct mail promotion targeted customers who lived near an Ace store, but these customers were not necessarily Ace customers. The Ace direct mail promotion did not result in as many bulbs sold as the Ace in-store coupon promotion. For the fall of 2008 three promotions are planned, targeting two effective channels for CFLs. Direct mail coupon promotions are scheduled for Wal-Mart and Lowe's in conjunction with the Energy Star Change a Light, Change the World campaign. The bulb sales targets are described in the table below.

Bulb Sales Targets for Fall 2008 Energy Star CFL Promotions

Retailer	Ohio	Kentucky	Total
Lowes	120,000	15,000	135,000
Walmart	228,000	17,500	245,500

Finally, to test the market acceptance of incentives on products other than lighting, DE-Ohio offered a $75 rebate on the purchase of a Whirlpool Energy Star qualified clothes washer purchased from HHGregg. In addition to the rebate, HHGregg offered special pricing. A total of 64 qualifying washers were sold during the 4 week promotion. This represents a 50% increase over the number typically sold during a promotion.

Two sets of evaluations were conducted for this program. First, the CFL evaluation is provided in Appendix E1, and includes program assessments from the perspective of customers, trade allies and program staff. In addition, on-site measurement of hourly customer lighting usage is obtained via random sampling of room-specific lighting logger installations. Second, a brief evaluation of the HHGregg clothes washer pilot is provided in Appendix E2. Energy savings estimates from these reports are used in the current cost effectiveness results reported in Appendix A.

Program 6: Energy Efficiency Website

DE-Ohio'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 Ohio program fits suitably into DE-Ohio's new multi-state program design now referred to as the Residential Energy Assessment Program. As an expansion to the previous energy efficiency website model, new website pages, new content and new online tools were added in 2006. These online services help provide energy efficiency information, tips, and bill analysis. The website features a multi-tiered design providing the consumer the opportunity to receive quick customized energy tips and, if they choose, the ability to complete an online audit and receive ten (10) self-install energy efficiency measures. The marketing of the Energy Efficiency Website is an initiative meant to diversify and increase the reach of DE-Ohio's DSM programs. With over 70% of DE-Ohio consumers having access to the Internet in either their homes or at work, the target market is comprised of those individuals who do not have the time or logistically cannot be available for the Home Energy House Call audit program. Marketing is conducted through direct mail and Call Center Representatives.

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 sent to every consumer who completes the first level of the online home energy audit. The kit is mailed directly to the customer's service address and provides the customer with the following measures:

- (1 each) 1.5 GPM low flow showerhead
- (1 each) 1.5 GPM Kitchen Aerator with Swivel and flip valve
- (1 each) 1.0 GPM bathroom faucet aerator
- (1 each) 15w ENERGY STAR® rated CFL Bulb

- (1 each) 20w ENERGY STAR® rated CFL Bulb
- (1 each) 17 foot roll of closed cell foam weather stripping
- (2 each) Switch Draft Stoppers (Gasket Insulators)
- (4 each) Outlet Draft Stoppers (Gasket Insulators)
- (1 each) Shrink fit window kit
- (1 each) roll of Teflon tape for showerhead or faucet aerator
- Duke Energy labeled DOE "Energy Savers" booklet
- Product information and installation instructions for all measures

The largest barrier to success of the program is making the consumer aware of the website. For those consumers interested in how they use energy and lowering their energy bill, the website contains the audit tool, an appliance calculator, efficient products e-catalog and a library of energy information. The challenge is to motivate them to visit the website, which we have pursued primarily through direct marketing to the end user and promotion through the Call Center Consumer Service Representatives.

In an effort to increase participation in this program, extensive changes are being made in both the online energy efficiency tools offered to customers and the process by which the free kit program is promoted. DE-Ohio now provides a full line of new interactive energy efficiency tools offered by Aclara. With this change, all customers who use DE-Ohio's online services to pay bills or view their accounts are directed through the Aclara menu page that highlights many energy efficiency opportunities, the most important of which is the Home Profile. The Home Profile is a short energy audit that will be promoted heavily and will be used to give the customer an immediate, personalized energy report on their energy usage. We anticipate the number of customers reached by this new process will be significantly larger than past energy efficiency tools. After the initial rollout of the new process, we will review the actual and projected participants and plan to add the energy efficiency kit offer to the process accordingly.

DE-Ohio also intends to use 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 DE-Ohio programs.

An impact evaluation for this program is provided in Appendix F using engineering analysis of the energy efficiency website program measures associated with the distributed kits.

Program 7: Ohio Energy Project (NEED)

The Ohio Energy Project (OEP) has been serving teachers and students since 1984. With the support of the National Energy Education Development (NEED) Project, OEP presents programs and materials that provide accurate, unbiased information on sources, forms, and transformation of energy, electricity, and energy efficiency, environmental and economic impacts of energy use.

The OEP's activities provide teachers and students in Ohio with the materials, skills and curriculum to promote energy education in the classroom. High School students are trained in leadership and presentation skills as well as hands-on energy activities that they use to teach energy concepts to younger students. Energy Workshops and Energy Fairs provide the opportunity for teachers to bring their students to learn the science of energy from high school student leaders. Teachers, in grades K-12, are offered a variety of Professional Development programs, from a three day Energy Sources Tour to half-day energy efficiency training. All of OEP's programs are aligned to the Ohio

Academic Content Standards.

The program provides 1,000 Home Energy Efficiency Kits that allows students and parents to directly install energy efficiency items in their homes as it relates to their curriculum. This facilitates learning and direct savings from the program. Since November 2007, the program has reached 469 teachers in the six counties served by DE-Ohio. These teachers have directly impacted at least 27,540 students.

- One Youth Energy Summit was conducted, training 91 high school student leaders and 10 high school teachers from 8 different school districts. 100% of teachers evaluated the program with highest rating.
- One Energy Fair was conducted, 420 students attended, and 26 schools were represented. Nine participating teachers attended a previous OEP program. 100% of teachers evaluated the program with the highest rating.
- Nineteen Energy Workshops were conducted, reaching approximately 950 students, in 19 different school buildings.
- Fifteen Professional Development programs were offered to teachers, covering topics of Nuclear Energy, Energy 101, Energy Sources Tour, Make and Take Electricity, Climate Status Investigation, teaching energy in the classroom, and fuel cell technology.
- 3,653 CFLs were distributed to Cincinnati residents.
- 1,000 Home Energy Efficiency Kits were distributed to students, impacting 1,000 homes.

A Teacher Advisory Board was developed to provide valuable insight to the needs of the classroom teacher and how DE-Ohio alongside OEP can deliver valuable programs and materials. In partnership with the Ohio Department of Development/Technology and West Clermont Local Schools, OEP will pilot a yearlong program with the 40 high school gifted and talented students. The purpose of the program will be to show students what Ohio is doing about the energy crisis and for students to understand their role in resolving the energy crisis. Upon completion and evaluation of the pilot program, ODOD/Technology will determine if they will fund a state wide gifted and talented program.

The OEP program was evaluated for this filing using an engineering analysis, coupled with projected installation of measures. This evaluation is provided in Appendix G, and highlights the need for improved energy savings attributable to these education activities. Generally, the achieved energy savings were lower than expected and future efforts should strive to promote more measures and/or increase the installation or adoption of the existing efficiency measures. For example, a CFL promotion in January 2008 of 543 students produced a 9.86 cost-effective utility test result. Adding more of these types of measures should improve program cost-effectiveness. Using the current energy savings estimates, the program is not cost effective, as shown in Appendix A.

Program 8: Appliance Turn – In

Older vintage room air conditioners (room ACs) can be one of the least efficient electrical appliances in the home. To encourage consumers to dispose of their old room air conditioners and purchase efficient Energy Star model, DE-Ohio will offer a room AC turn-in program. Located at retailer locations during special promotions, participants receive coupons towards more efficient units if they turn in an old unit. Units received will be recycled through a certified recycling agency.

Incentives will be provided on two levels, first an incentive to turn in the old unit and the second an additional incentive to upgrade to an Energy Star room AC unit. The logic for the two-level incentive approach is to get units recycled even if the participant is not replacing the old unit, as they may be going to a central AC system. Participants would receive a $15 coupon to drop off their old unit good towards anything in the store, and another $35 coupon towards a new Energy Star room AC unit, both good at the sponsoring retailers' facility.

The first year budget is $105,000 and $157,500 for year 2. The program expects to collect and recycle 1,000 room air conditioners in Year 1 and 1,500 in Year 2. In June of 2008, DE-Ohio offered its first promotional event in conjunction with Best Buy, the City of Cincinnati and Rumpke recycling. The single weekend event yielded 116 units recycled and 62 new Energy Star units were purchased.

Program 9: Personalized Energy Report (Pilot)

The Personalized Energy Report (PER) program provides DE-Ohio 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 consumer is searching for information they can use and ideas they can implement which will impact their monthly energy bill. The PER program also includes an Energy Efficiency Starter Kit, which contains nine easily installed measures that demonstrate how easy it is to move towards improved home energy efficiency. The program targets the entire home from an energy usage standpoint. The consumer is provided 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.

The PER program commences with a letter to the consumer, offering the Personalized Energy Report if they would return a short survey about their home and their energy related habits. The survey asks very simple questions such as age of home, number of occupants, and types of fuel used to heat, cool and cook. Once returned, the survey is used to generate a customized energy report. The report returned to the participating customers contained the following information:

- Month-to Month comparisons of a recent 12 month period for electric and/or gas usage including the amount of the bill
- Trend bar chart showing usage of electric and/or gas by kWh/ccf by month and amount of monthly bill
- A colorful pie chart with accompanying dollar estimates and percentages of the customer's disaggregated electricity and/or gas usage
- Sliding bar chart that estimates how the customer's annual energy use compares to the average, comparable home
- One or more promotions that encourages the customer to take advantage of other energy saving programs offered by DE-Ohio
- Energy tips that are personalized for each customer based on their answers to their survey questions

Customized tips will based upon the consumers 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

The Energy Efficiency Starter Kit will be sent to the consumer in conjunction with the Personalized Energy Report. The kit contains the following items:

- (1 each) 1.5 GPM low flow showerhead
- (1 each) 1.5 GPM Kitchen Swivel Aerator
- (1 each) 1.0 GPM Bathroom Aerator
- (1 each) 15 Watt CFL (Energy Star)
- (1 each) 20 Watt CFL (Energy Star)
- (1 each) 17 foot roll of closed cell foam weather stripping
- (1 each) Combination Pack (6) Switch/Outlet Draft Stoppers (Gasket Insulators)
- (1 each) Shrink fit window kit
- (1 each) small roll of Teflon tape for showerhead or faucet aerator
- Duke Energy labeled DOE "Energy Savers" booklet
- Product information and installation instructions for all measures

Our first Ohio PER campaign was a limited pilot program which ran in the fall of 2007. The pilot program targeted single family residential consumers in the DE-Ohio market that had not received measures through the Home Energy House Call energy efficiency audit or a weatherization program within the last three years. The program expected to reach 52,800 consumers. The results of the pilot program were 199,867 total solicitations sent, 34,580 total fulfilled customer reports including mailed and emailed reports, with a 17% response rate.

A follow-up survey was conducted among a sub-segment of the consumers who received the offer, to better gauge reasons for participation and recommendations for future enhancements to the program. Additionally, a billing analysis was conducted using survey data to those consumers who did receive a customized energy report, including questions regarding installation of the measures found in the Energy Efficiency Starter Kit. These findings are provided in Appendix H and used in the current cost effectiveness results. Among other recommendations, it is suggested that the PER program consider additional cost effective marketing tools, such as newspaper ads and home and garden shows to further program reach to untapped markets.

Program 10: Pre-Paid Billing Services

Providing consumers with the option of paying for their electrical use prior to consumption not only allows consumers to control their bills, but promotes energy savings. Implemented by several utilities around the country, "Pre-Paid Billing Services" or pre-paid meters provides participants with the metering to understand their energy usage and has resulted in 10% to 20% energy savings. DE-Ohio plans to test this concept recruiting 100 consumers per year for the next four years and analyzing their energy savings compared to a control group.

Owner occupied single-family homes throughout the DE-Ohio territory are eligible for the program. The primary method of participant recruitment is through direct mail to DE-Ohio consumers by zip code areas. Other information is provided through bill stuffers, and call center referrals. Customers will have a pre-paid metering device installed in their home. Consumers cannot usually see the impacts from changing the operation of equipment or lifestyle habits with normal utility meters. A pre-paid meter system allows consumers to see those impacts on a real-time basis. This provides immediate feedback and enables consumers to realize that the steps they took to modify their behavior to be more efficient actually saved money. It also allows consumers to adjust their payments to the utility to better meet their personal schedules and cash flow. There are no direct incentives provided to the consumer. Incentives are provided through the consumer's ability to control their utility costs, payment and usage.

Participants will be supported by the DE-Ohio staff and call center. The equipment contractor will provide technical support. A competitive bid process will be used to chose a subcontractor to implement the program. Due to technical issues related to technology, the Pre-Paid Billing Services Program has not been implemented. The technical issues are being investigated to determine a resolution which will enable implementation of this program.

Once the program has been implemented, DE-Ohio will monitor the subcontractor through random inspections of sites and review of the billing systems. Consumer satisfaction surveys will be conducted. A full evaluation of the energy and bill paying impacts of this program will be conducted.

Program 11: Commercial & Industrial (C&I) Prescriptive Incentive Program

The Commercial & Industrial prescriptive incentive program provides incentives to commercial and industrial consumers to install high efficiency equipment in applications involving new construction, retrofit, and replacement of failed equipment. Incentives are provided based on DE-Ohio's cost effectiveness modeling but with a high-end limit of 50% of measure cost. This approach assures cost effectiveness over the life of the measure.

The small to medium sized commercial and industrial consumer can have significant energy consumption, yet is not frequently served by the Energy Services Market. These consumers lack knowledge and may not understand the benefits of high efficiency alternatives. They may feel that the payback period for energy efficient equipment is too long. DE-Ohio's program provides financial incentives to help reduce this cost differential and improve return. It also provides market demand where the dealers and distributors, or market providers, will stock and provide these high efficient alternatives as they can see increased demand for the products. DE-Ohio provides these market providers with additional information and support so that they better understand the best applications for these technologies.

This application also includes technologies like Process Equipment, Food Services Equipment, Energy Star Commercial Clothes Washers, Pumps/VFDs, covering more applications and end uses. This will allow more consumers to participate and avoid lost opportunities for high efficiency equipment in the marketplace.

All DE-Ohio commercial or industrial consumers except those receiving service under Rate TS, Service at Transmission Voltage are eligible. Upon approval of the company's application in July, 2007, DE-Ohio launched its marketing campaign that included direct mail letters to both eligible customers and vendors who provide services to customers in and around DE-Ohio's service territory. E-mails were sent to large business customers and a vendor training was scheduled to provide education and training to its market providers to help them understand the program and the appropriate applications for the technologies.

The program is promoted on DE-Ohio's business and large business websites where business customers could download and print all the applications containing all the necessary information necessary to participate and submit an application. In order to serve more business customers, DE-Ohio set an incentive CAP of $50,000 per facility.

Since program inception in July, 2007, through June 30, 2008, 192 customers have participated, 231 applications have been received, and 36,557 high efficiency measures have been installed. Although we did not meet the spending goal for this time period, considering the time it takes for programs of this type to get proposals out in the market and projects completed, we are very pleased with the response to the program. As part of DE-Ohio's Quality Assurance plan to assure appropriate installation of equipment, applications for incentives will be reviewed and checked for accuracy and whether measures meet appropriate standards. Random field inspections will occur to assure installation. DE-Ohio is currently conducting an impact evaluation of this program.

DE-Ohio has contracted with GoodCents through a bid process, to provide the back office support for implementation of this program. This program will be jointly implemented with the Duke Energy Indiana and Duke Energy Kentucky territories to reduce administrative costs and leverage promotion.

The program evaluation and energy impact estimates are provided in the evaluation contained in Appendix I. A combination of on-site sub-metering and engineering algorithms are used to derive the energy savings and load reduction estimates used the current cost effectiveness results.

School Incentive Program

Another component of the Commercial and Industrial Prescriptive Program is the

Schools programs. Due to the special needs of schools and recognizing that saving energy costs in schools helps all taxpayers, DE-Ohio and the DECP agreed to dedicate $500,000 of the Commercial and Industrial Prescriptive Incentive Program budget for school measures and support. The measures identified for the Commercial and Industrial Prescriptive Incentive Program can help schools reduce their energy consumption. There are three parts to the program:

Assessments: Schools can contract with their vendor of choice to conduct an assessment of their facility. DE-Ohio will pay 25% of the total cost of the assessment up to $500. If they install any of the recommended high efficiency measures as a result of the assessment, they can receive another 25% of the total cost of the audit up to $500.

Prescriptive Program: Schools will receive incentives for any of the Prescriptive measures installed as a result of the assessment.

Custom: Any additional measures identified in the assessment that provide energy savings opportunities and are not currently eligible for incentives in DE-Ohio's prescriptive program, can be submitted for evaluation to DE-Ohio's Marketing Analytics group for potential custom incentives.

Total combined incentives are capped at $100,000 per facility in the schools program. All school consumers of DE-Ohio are eligible except any school that may receive service under Rate TS, Service at Transmission Voltage. If all of the funds are not used by the schools within the year, they will be made available to other applicable commercial and industrial consumers. Likewise, if funds applicable to the Commercial and Industrial Prescriptive Incentive Program are not used by other commercial and industrial consumers, those funds will be made available to the schools above the earmarked amount.

To promote the program, DE-Ohio sent direct mail letters to school superintendents and building operators, set up face to face meetings with some, and developed a K-12 website where all the information and applications for the schools program resides. Because the filing approval came in July and school projects are typically completed during the summer months, we did not get significant participation. For this filing period of July 1, 2007 through June 30, 2008, 18 schools have submitted 20 applications totaling $60,216 in incentives for 1,015 high efficiency measures installed. Due to timing and through our marketing efforts we hope to see those numbers increase in this next filing period.

The School Incentive Program provides incentives to schools to install high efficiency equipment in applications involving new construction, retrofit, and replacement of failed equipment. This program will be jointly implemented with the proposed Commercial and Industrial Prescriptive Incentive Program.

School Custom Incentives

DE-Ohio currently offers Custom Incentives only to schools in Ohio. Custom Incentives are available to schools for energy efficiency measures which are not included in DE-Ohio's portfolio of Prescriptive Incentives. Custom Incentives were first made available on July 11, 2007. DE-Ohio has not yet received a Custom Incentive application from a school district in Ohio.

Upon receiving a Custom Incentive application, DE-Ohio reviews the application to ensure all the required information has been provided. After performing a technical evaluation as necessary to validate energy savings, measure submitted by the customer are modeled in DSMore to determine an acceptable incentive that ensures simple payback with the incentive is not less than two years. After notifying the customer of the acceptance of the proposed energy efficiency measure, and verifying measure installation, the incentive is provided to the customer.

DE-Ohio, in conjunction with a third-party measurement and verification provider, will evaluate the energy impacts of Custom Incentives. This process for each custom incentive may include: application review, site visits and/or onsite metering and verification of baseline energy consumption, customer interviews, and/or use of loggers/sub-meters. The impact evaluation will include post energy savings analysis, including freeridership and spillover, and cost effectiveness tests.

DE-Ohio's plan is to expand the availability of Custom Incentives beyond schools to all commercial and industrial customers. Awareness of Custom Incentives will be promoted through information on duke-energy.com, collateral and incentive applications provided to customers, and direct email communications. Custom Incentives will also be promoted through a new Non-residential Energy Assessment offered by DE-Ohio. Vendors will be provided information on Custom Incentives as well.

As use of Custom Incentives increase, DE-Ohio will evaluate applications and determine if certain measures can be included in the Prescriptive Incentives program. Including measures that reoccur in Custom Incentive applications in the Prescriptive Incentives, makes planning and applying for measure incentives easier for customers.

Program 12: Photovoltaic Schools Demonstration/Education Program

This program was designed to introduce PV into the mix of options under DE-

Ohio's DSM program. It seeks to create awareness of the technical achievements, environmental considerations, and public policy issues that have matured to make PV an option for meeting today's energy needs. The program also focuses on educating faculty and students in Ohio public schools about the benefits of PV as a source of renewable energy, through the installation and use of three PV demonstration units. This program has been successfully implemented in the Duke Energy Indiana territory.

This program advances the education of many parts of the market. It helps students, parents, teachers, and the school community, understand and work with PV as a potential resource. It also helps educate and build skills of contractors, electricians and other market providers for possible application in other locations. If the OEP program gets approval within this application, DE-Ohio would tie curriculum development and participation in the OEP program with the PV application to leverage both activities. DE-Ohio pays the expense of the PV purchase, installation, and basic monitoring. The first year budget request was $75,000. Expected participation in this program is three schools per year.

At this time, DE-Ohio has approved three Ohio schools for the 2008 Solar PV Program. The final selections were made after DE-Ohio and the installer visited each school, made formal presentations, and assessed each site for the 2.0 kW Solar PV system. Selections are as follows:

1. Cincinnati Public Schools will receive a Solar PV system at Pleasant Ridge Montessori Elementary School, Ohio's first Public Elementary School registered for LEED Certification. Reflecting the Program's values, Pleasant Ridge demonstrates leadership in the advancement of high performance public schools

and educates students and the community about the science and benefits of solar energy. The Solar PV system easily fits into the plan of the environmentally sensitive design. More importantly, it provides a much anticipated educational tool for the 579 students Pre K-8 to demonstrate first hand the benefits of clean energy.

2. St. Clement School, an urban school in the St. Bernard District, will receive a Solar PV system. The Solar PV system will serve the classroom and be an interactive part of the curriculum for the 195 students Pre K-8. With Smart Boards in classrooms, technology already plays an important role and students are eager to learn more from the Solar PV educational software. This program will inspire both students and teachers to learn and teach the benefits of Solar to the community.

3. William Henry Harrison High School is a leader in science and green education and will receive a Solar PV system to educate and demonstrate to its 1,300 students and the surrounding community. Set in a suburban Harrison, it is actively promoting Renewable Energy with events such as Family Science Night and learning tools such as the E3 Smart Program and the Energy Bike. The Solar Panels will be a strong educational component to the program and students will be able to monitor the data and learn about renewable energy.

DE-Ohio has met with representatives at all three schools, conducted a site visit with the installer, received approval for the 2.0 kW installations by the schools and is in the process of executing Interconnection Standards Agreements for the installations. All three installations should be completed by October 31st, 2008. Once installations are complete, a promotional launch will follow and the school staff will begin educational training of the monitoring software which will be used in the classrooms.

Program 13: House Call PLUS Research Program (Pilot)

With rising energy prices, there is an opportunity to increase savings in the residential market through more comprehensive building analysis and efficiency improvements. As shown through state programs in New York and California, a comprehensive audit program, utilizing diagnostic tools such as blower doors, infrared scanners and duct leakage tests, combined with a "one-stop" installation service can be effective at getting more measures installed cost effectively, thus increasing savings from 10% to 30%. This program is similar to the Home Performance with Energy Star and DE-Ohio is currently working to develop a program that utilizes proven practices outlined by Energy Star. The process has been slowed by the lack of existing infrastructure for this type of program offer.

The purpose of the program is to better understand the capabilities and skills of the contractors in the marketplace to provide a single source solution for energy efficiency. In addition, the program will help determine the value of offering a simplified process of identifying energy saving opportunities in the home coupled with a simplified whole house implementation solution.

There will be two aspects to the research project:

Assessment of the Market: This effort will include research to determine the skills and capabilities within the marketplace to provide services.

Applications Research: To help determine actual costs for services, DE-Ohio will test various delivery models to evaluate customer acceptance. The program will offer both a consultant and contractor model for service delivery. The results will help DE-Ohio understand the actual costs and feasibility of the services.

The outcome of this research would be used to help define and quantify the opportunity to impact the market for long term energy savings through this program. Training will be provided to selected market providers for program implementation. It is expected that 3 to 5 providers would receive the in-depth training. Where possible, training would be leveraged with the contractor training provided by the Ohio Office of Energy Efficiency.

The budget for year 1 is $132,500 and year 2 is $260,000.

III. CALCULATION OF THE 2008 DSM COST RECOVERY MECHANISM

A. Outline of DSM Activity

DE-Ohio is offering the following energy efficiency programs in its service territory in 2008/2009.

RESIDENTIAL PROGRAMS

- Home Energy House Call
- AC Check Pilot
- Smart $aver®
- PowerManager
- Energy Star Products
- Energy Efficiency Website
- Ohio Energy Project (NEED)
- Appliance Turn-In

- Personalized Energy Report (Pilot)
- Pre-Paid Billing Services

COMMERCIAL PROGRAMS

- C&I Prescriptive Incentive Program
    - School Incentive Program
- Photovoltaic Schools Demonstration/Education Program

RESEARCH

- House Call Plus Research Program (Pilot)

B. 2009 DSM Riders

DE-Ohio, in conjunction with the Interested Stakeholders, submits the proposed DSM Rider (Appendix J). This rider is intended to recover 2009 program costs and the associated lost revenues and shared savings and to true up any differences between actual and projected costs, lost revenues, and shared savings from the prior year. Pages 1 through 5 of Appendix K provide the background for the update calculation of the rider. The levels of shared savings are based upon the program achievement levels previously presented in Section II. The residential conservation programs at 69% of plan achieved a 3% level for shared savings, while the residential demand response program and the non-residential conservation programs achieved the 10% level of shared savings since both exceeded 100% of the plans. Appendix K, page 1 of 5, also provides the details on the current period reconciliation of the DSM Revenue Requirement. The true-up adjustment is based upon the difference between the actual DSM revenue requirement and the revenues collected during the most recent period.

Attachment K, page 5 of 5 contains the calculation of the 2009 Residential DSM

Rider rate. This calculation includes any reconciliation adjustments shown in Attachment K, page 1 of 5 and the DSM revenue requirement for 2009. The residential DSM revenue requirement for 2009 includes the costs associated with the next year spending on the Residential DSM programs and the associated net lost revenues and shared savings (Attachment K, pages 2 and 3 of 5). Total revenue requirements are incorporated along with the projected electric volumes (Attachment K, page 4 of 5) in the calculation of the Residential DSM Rider.

Attachment K, page 5 of 5 also contains the calculation of the 2009 C&I DSM Rider. The calculation includes any reconciliation adjustments calculated in Attachment K, page 1 of 5 and the DSM revenue requirement for 2009. The C&I DSM revenue requirement for 2009 includes the costs associated with the C&I DSM program (C&I High Efficiency Incentive) and the associated net lost revenues and shared savings (Attachment K, pages 2 and 3 of 5). Total revenue requirements are incorporated along with the projected electric volumes for the relevant rates (Attachment K, page 4 of 5) in the calculation of the C&I DSM Rider.

DE-Ohio's proposed 2009 DSM Riders, shown as Appendix J, are proposed to be effective with the first billing cycle in January 2009, is applicable to service provided under DE-Ohio 's electric service tariffs as follows:

Residential Electric Service provided under:

Rate RS, Residential Service, Sheet No. 30

Rate ORH, Optional Residential Service with Electric Space Heating, Sheet No. 31

Rate TD, Optional Time-of-Day Rate, Sheet No. 33

Rate CUR, Common Use Residential Services, Sheet No. 34

Rate RS3P, Residential Three Phase Service, Sheet No. 35

Non-Residential Electric Service provided under:

Rate DS, Service at Secondary Distribution Voltage, Sheet No. 40

Rate GS-FL, Optional Unmetered General Service Rate for Small Fixed Loads, Sheet No. 41-

Rate EH, Optional Rate for Electric Space Heating, Sheet No. 42

Rate DM, Secondary Distribution Service – Small, Sheet No. 43

Rate DP, Service at Primary Distribution Service, Sheet No. 44

Rate SFL-ADPL, Optional Unmetered Rate for Small Fixed Loads Attached Directly to Company's Power Lines, Sheet No. 46

Rate TS, Service at Transmission Voltage, Sheet No. 50

Rate RTP, Real Time Pricing Program, Sheet No. 90

Calculation of the Residential Charge

The proposed residential charge per kWh for 2009 was calculated by dividing the sum of: 1) the reconciliation amount calculated in Appendix K, page 1 of 5, and 2) the DSM Revenue Requirement associated with the DSM programs projected for calendar year 2009, by the projected sales for calendar year 2009. DSM Program Costs for 2009 include the total implementation costs plus program rebates, lost revenues, and shared savings. The calculations in support of the residential recovery mechanism are provided in Appendix K, page 5 of 5.

Calculation of the Non-Residential Charge

The proposed non-residential charge per kWh for 2009 was calculated by dividing the sum of: 1) the reconciliation amount calculated in Attachment K, page 1 of 5, and 2) the

DSM Revenue Requirement associated with the DSM program projected for calendar year 2009, by the projected sales for calendar year 2009. DSM Program Cost for 2009 includes the total implementation costs plus program rebates, lost revenues and shared savings.

Allocation of the DSM Revenue Requirement

The DSM Cost Recovery Mechanism attributes the costs to be recovered to the respective class that benefits from the programs. The amounts associated with the reconciliation of the Rider are similarly allocated as demonstrated in Appendix K, page 2 of 5. The costs for the PowerManager program are fully allocated to the residential electric class, since this is the class directly benefiting from the implementation of the program. As required, qualifying industrial consumers are permitted to "opt-out" of participation in, and payment for, the DSM programs.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I certify that a copy of the foregoing Application was sent by regular U.S. Mail or overnight mail to all Interested Stakeholders listed below this 14th day of November, 2008.

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Appendix A

Cost Effectiveness Test Results

Program	UCT	TRC	RIM	Participant
Summer Saver (Air-conditioner)	1.09	5.02	0.68	NA
Home Energy House Call	2.84	2.84	1.49	NA
Residential Comprehensive Energy Education Program (NEED)	0.75	0.75	0.57	NA
Power Manager	2.18	2.36	2.18	NA
Energy Star Products	34.40	21.74	1.29	44.63
CFL's (Compact Fluorescent Lights)	6.42	4.06	1.11	8.61
Torchieres (Floor lamps)	NA	NA	NA	NA
Appliance Rebate	3.06	143.75	1.00	187.24
Energy Efficiency Web Site	9.41	9.41	1.87	NA
Room AC Turn-In	NA	NA	NA	NA
AC Check - Pilot	NA	NA	NA	NA
Smart Saver Heat Pump with ECM	2.18	1.98	1.02	2.76
Personalized Energy Report Pilot	13.99	14.59	2.33	NA
Pre-Paid Meter - Pilot	NA	NA	NA	NA
Energy Star Products - Gas Furnace /ECM (Elec Impacts)	3.56	0.98	2.02	1.17
House Call Plus - Research (Elec Heated Homes)	NA	NA	NA	NA
House Call Plus - Research (Gas Heated Homes)	NA	NA	NA	NA
Smart Saver - Energy Star Products - Gas Furnace	3.00	1.17	2.13	1.47
Smart Saver - Energy Star Products - Gas Furnace with ECM	1.76	0.96	1.28	1.44
C&I High Efficiency Incentive (for Businesses and Schools)				
Lighting	6.38	3.56	1.71	3.50
HVAC	10.47	2.80	2.02	2.11
Motors	13.58	7.63	1.98	6.98
Other	13.82	4.38	17.35	1.72

Appendix B

Process and Energy Impact Evaluation of the Home Energy House Call Program in Ohio

Final Report

Prepared for
Duke Energy
139 East Fourth Street
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September 15, 2008

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Summary of Findings

Energy Savings

The measures provided in the Energy Efficiency Starter Kits, when installed and used by program participants, provide significant energy savings to the participants and to Duke Energy. For the Ohio participants, the installation of the measures provided in the kit to the 1,680 participants provides an estimated net annual energy savings of 7,180 therms, 221,908 kWh and reduced peak load by 25.502 kilowatts.

	Gross Savings	**Net Savings**
Annual Savings for Kit Measure Installations		
kW	50.828	25.502
kWh	453,818.2	221,907.5
Therms	13,941.2	7,180.4
Annual Savings HEHC Recommendations Installs		
kW	102.9	20.783
kWh	249,863	50,222
Therms	9,771	1,964
Total Annual Savings for Kit Measures and Recommendations		
kW	153.728	46.285
kWh	703,681.2	272,129.5
Therms	23,712.2	9,144.4
Life Cycle Kit Measure Installs		
kWh		1,743,065
Therms		72,046
Life Cycle HEHC Recommendation Installs		
kWh		748,057
Therms		25,509
Total Life Cycle Kit and HEHC Recommendations Installs		
kWh		2,491,122
Therms		97,555

On a per-participant basis, this equals first year annual gross energy savings of 197 kWhs and .019 kW per person, with a net savings of 107 kWhs and .010 kWs for the energy efficiency kit. The home energy audit report provides gross first-year annual savings of 30 kWhs and .012 kW per person. The total first year net energy savings for the kit and the audit recommendations are 38 kWs, 230,184 kWhs and 6,980 therms.

The total net lifetime savings for the Home Energy House Call Program is 1,483 kWhs and 58 therms per participant.

The impact estimates are based on survey responses of what actions were taken and the use conditions associated with these actions for the weather zone in which the participants reside. The energy savings estimates are based on DOE-2 simulations of measure impact in residential buildings. This type of modeling and assessment approach is an industry standard and can be expected to provide accurate estimates of program impact that are consistent with the accuracy of the survey information provided by the program participants.

Energy Savings Distributions

The tables below present a summary of the total savings from the program participants. Table 1 presents the gross energy savings for each of the kit measures based on the randomly sampled participant survey responses extrapolated to the program population of 1,680. Table 2 presents the expected savings after the false-response and self-selection biases are factored into the calculations. These biases are described in Section 1, Savings Distributions. Table 3 presents the net savings, which factors in the estimated program freeridership.

Table 1. First Year Gross Energy Savings of Kit Measures, All Program Participants (n=1,680)

Kit Measures	kW	kWh	Therms
15-watt CFL	8.908	107,822	-160.4
20-watt CFL	7.564	87,330	-129.9
Weather stripping	0.156	532	10.5
Outlet gaskets	0.731	2,499	49.2
Window shrink kit	5.899	9,986	132.1
Showerhead	26.855	245,053	11,948.1
Bathroom aerator	0.343	286	1,004.0
Kitchen aerator	0.372	310	1,087.6

Table 2. First Year Energy Savings of Kit Measures, Net of False-Response and Self-Reporting Bias, All Program Participants (n=1,680)

Kit Measures	kW	kWh	Therms
15-watt CFL	5.354	64,801	-96.4
20-watt CFL	4.546	52,486	-78.1
Weather stripping	0.094	320	6.3
Outlet gaskets	0.439	1,502	29.6
Window shrink kit	3.545	6,001	79.4
Showerhead	13.454	122,772	5,986.0
Bathroom aerator	0.172	143	503.0
Kitchen aerator	0.186	155	544.9

Table 3. First Year Net Energy Savings of Kit Measures, Net of False-Response, Self-Reporting Bias and Freeridership, All Program Participants (n=1,680)

Kit Measures	kW	kWh	Therms
15-watt CFL	4.002	48,439	-72.1
20-watt CFL	3.398	39,233	-58.4
Weather stripping	0.082	278	5.5
Outlet gaskets	0.440	1,506	29.6
Window shrink kit	3.368	5,701	75.4
Showerhead	13.858	126,455	6,165.6

Bathroom aerator	0.170	142	496.7
Kitchen aerator	0.184	153	538.1

Program Operations

Third-party implementer changes have taken place since this program began operation, and the program is currently switching to a new implementation provider. With this change, program operations should improve with the use of program auditors who are expected to be better trained.

The program managers have obtained expert assistance to help improve the operations of the program, particularly in the areas of improved program design, marketing and quality control procedures. The program is currently meeting its objectives within budget.

Customer Satisfaction

Based on 100 surveys done of a random sample of the 1,680 participants in Ohio, the customer's satisfaction with the program is very high with an overall satisfaction score of 9.07 on a 10-point scale. They were satisfied with the audit (9.39 out of 10) and with the energy efficiency starter kit (8.98 out of 10).

Recommendations

1. The installation rate of the window shrink kit is very low (15%). This is expected because this measure is not one that everyone wants or needs and it requires installation expertise. Once installed, it renders the window non-functioning as a ventilation tool. The cost-effectiveness of this measure should be examined to determine the installation rate needed to reach the cost-effectiveness threshold. If this installation rate cannot be met, the item should be removed from the kit. In order to obtain the cost effectiveness threshold it may be necessary for the kit to be modified in a way that increases the installation rates. For example Duke should consider the following:
    a. Include clear customer-focused, easily accessible information on the effectiveness of installing the window shrink kit so that customers see the benefit information as soon as they open the kit and look at that measure.
    b. Make sure the kit includes clear, easy-to-follow instructions on how to install the kit.

    These messages need to be easy to find and easy to understand. The amount of time a customer will be exposed to this information might be only a few seconds. The message needs to be clear and be transmitted in a few seconds. If this does not increase installation rates above the cost effectiveness threshold, the measure should be discontinued as an item in the kit.

2. Duke should determine if the level of detail provided by the auditor can be cost-effectively enhanced. During the onsite visit, the auditors may be able to increase installation rates for needed changes by interacting with the customer about the

"areas of concern" in their home. We realize that this is not always possible because of the need to rapidly move in and out of the home for what is essentially a free service to the participant. However, the time interacting with the customer may well be the most valuable part of the audit in terms of getting customers to take needed actions. An increase in auditor training to include customer interaction and approaches should be considered. This effort must balance the cost of the service and the expected increase in savings.

3. The contract calls for the implementers to train their auditors. This requirement needs to be enforced. The auditors receive one week of classroom training before they accompany a fully trained and experienced auditor for 2-3 weeks. However, in some cases auditors have gone to the field before they were fully trained. The new contract with WECC may solve this issue by using only HERS certified raters to conduct the audits. However, this should be confirmed shortly after WECC assumes the role of implementer to ensure that the auditors are fully trained.

4. The incorporation of more testing technologies, such as the use of a blower door or infrared imaging would help some customers understand the energy saving opportunities better than a simple visual examination. However, this service is costly and could harm the participation rate and interest in the program if it's done by charging the customer. Within the current program, participants can request a blower door assessment for a cost of $125. To date, only one home has requested that test since the program started in 2003. However, as energy costs and environmental issues gain in importance; more customers may be interested in this service, so it is worth promoting this aspect of the program to identify the cost and benefits associated with increase testing promotion.

5. Having personal computers in the field with the auditors will allow them to upload and process the audit information in a more efficient manner, which will allow the reports to be delivered to the participant in a timelier manner. However, that approach should not distract from a well designed report. The report should be such that it is designed using state-of-the art behavior change theories that focus on presentation and education leading to an install decision. Duke should consider having color laser printers with the auditor so that the report can be delivered and reviewed with the customer while on site.

Introduction

This document presents the evaluation report for Duke Energy's Home Energy House Call (HEHC) Program as it was administered in Kentucky. An impact analysis was performed for each of the measures in the Energy Efficiency Starter Kit and for the measures that were installed as a result of the HEHC audit. The impacts are based on engineering analysis of the impacts associated with the self-reported measure installs identified through a participant survey. Additional analysis was performed using a billing analysis comparing the pre and post program energy consumption levels of program participants.

This report is structured to provide program energy savings impact estimations per measure via the engineering analysis, and program savings based on the billing analysis results. The impact tables reporting total savings are based on the savings identified from 100 surveyed participants extrapolated to the program's total participants. The study includes participants from January 2006 through September of 2007 (n=1,680). After each of the measures are discussed individually, the report presents the estimated energy savings achieved per distributed Energy Efficiency Starter Kit through the audit.

This impact evaluation of the measures with the kits is based on surveys conducted with customers who participated in the HEHC program and who have received the kits mailed by the program. The impact of the HEHC recommendations that were implemented is based on survey responses of the actions they have taken that were at least in part caused by the audit report. The study did not use on-site verification efforts to confirm if the survey information provided by the customer is accurate or if the measures taken were correctly installed or used. The impact analysis conducted for this study was systematically adjusted downward to account for self-selection bias and potential false response bias sometimes associated with survey research of socially acceptable behaviors documented via telephone surveys. As a result, the evaluation consultants consider this study a reasonable estimate of program-induced savings.

The evaluation was conducted by TecMarket Works and BuildingMetrics with assistance from Integral Analytics. The survey instruments were developed by TecMarket Works and BuildingMetrics. The survey was administered by TecMarket Works. Integral Analytics performed the billing analysis. BuildingMetrics developed the engineering algorithms to estimate energy impacts based on the survey responses.

Methodology

This section presents the approach for conducting this assessment.

Development of the Surveys

TecMarket Works and BuildingMetrics developed a customer survey for the Home Energy House Call (HEHC) Program participants to be implemented after they have had time to install at least some if not many of the actions in the kit and the recommendations offered during the home energy audit. The survey asked the customer for information specific to each of the measures included in the Energy Efficiency Starter Kit. In addition the participant was asked to report the actions that they had taken that were caused in whole or in part by the recommendations provided in the HEHC audit report. For each measure that was installed and for each recommendation taken, the participant was asked questions pertaining to their intentions to take that action without the intervention of the program. This information was used to estimate freeridership and to calculate net energy savings.

Because of evaluation budget limitations, the survey was restricted to 100 completed surveys with program participants, however the sample size obtained appears to be reasonable. These participants were surveyed by TecMarket Works. During the survey development process it was necessary to restrict questions so that the survey did not last longer than about 10 minutes. This approach helped control the evaluation cost, but also reduced the number of questions that could be asked in order to calculate energy savings. However, this procedure did not result in overly restrictive questions. To help focus the survey, the questions asked were based on key results of an earlier study employing an identical approach for similar measures. The experience from the previous study (PER Program) allowed this study to use those questions that were most informative to the energy impact estimation process and eliminate those questions that were found to have little impact on the results of the energy savings calculations. This allowed the HEHC survey to be shorter and more focused, yet still provide the information needed to estimate savings. The surveys can be found in Appendix C: Participant Survey Protocol.

Program Impact Estimation

Impact Estimates for Kit Measures

Using the measure-specific data collected from the customer surveys, we were able to extrapolate energy savings to the HEHC Program as a whole, and for each of the kit's eight measures individually. The energy savings for each of the measures was determined through a method in which TecMarket Works and BuildingMetrics assigned the estimates of energy savings for each of the measures included in the HEHC Energy Efficiency Starter Kit. The estimates were formed via engineering estimates of savings based on survey information and on modeling results in which the calculations for the actions taken follow DOE-II residential software modeling algorithms for the expected weather in which the actions are taken. Historical weather average daily conditions were used as the predictive weather. This approach allows for reliable energy savings estimates consistent with accepted modeling approaches based on customer-provided installation and use conditions.

The items distributed in the kit include the following measures.

1. 15-watt CFL
2. 20-watt CFL
3. Weather stripping
4. Outlet gaskets
5. Window shrink kit
6. Showerhead
7. Bathroom aerator
8. Kitchen aerator

The algorithms used to calculate the impact estimates can be found in Appendix A: Impact Algorithms Used.

Freeridership and Spillover

Freeridership and spillover were calculated for each measure in the Energy Efficiency Starter Kit. The level of freeridership was determined by using the responses to three questions in the survey (found in Appendix C). The three questions and the level of freeridership and/or spillover that was applied to the energy savings are presented in the table below, using the CFL as an example measure. All other possible combinations of answers to the series of questions resulted in 0% freeridership and 0% spillover.

Table 4. Freeridership and Spillover Factors for Energy Efficiency Kit Measures

6a: Did you have any CFLs installed before you got the kit?	6b: Were you planning on buying <additional> CFLs before you got the kit?	6c: Have you purchased any CFLs since you got the kit?	% Freeridership	% Spillover
yes	yes	yes	100	
yes	yes	no	100	
yes	no	yes		75
no	no	yes		100
no	yes	no	50	
no	yes	yes	50	50
Don't Know	yes	yes	75	25
Don't Know	yes	no	50	
Don't Know	no	yes		100
yes	already installed in every place	yes	100	
yes	already installed in every place	no	100	
Don't Know	maybe	yes	25	50
yes	maybe	yes		25
yes	maybe	no	25	
no	maybe	yes		50
yes	don't know	yes		75
no	don't know	yes		100
yes	yes	don't know	100	

yes	already installed in every place	don't know	100	
don't know	yes	don't know	50	
no	yes	don't know	50	

Freeridership was also calculated for the home energy audit as an independent analysis to determine the level of participants that would have had their homes audited if the HEHC were not made available. All other possible responses to these questions were counted as 0% freeridership.

Table 5. Questions to Estimate Freeridership for the Home Energy Audit

Considering an audit before the program?	If not available through the program, would you still have purchased an audit?	If yes, would you have purchased it within a year?	% Freeridership
yes	yes	yes	100
yes	yes	no	50
yes	yes	don't know	25

Three participants responded in a manner that labeled them as a freerider, and they had a mean freeridership level of 50.00%. Over the 100 participants, the overall freeridership level for the program's audit is very low at 0.5%.

Impact Estimates for HEHC Audit and Recommendations

The participants of the Home Energy House Call Program each received an audit of their home followed up by a customized audit report with specific recommendations for improvements to their home that would increase their home's energy efficiency. In this report, we present the recommendations as they were reported to us by the random sample of 100 participants contacted during the telephone survey. We first asked them what, if any, improvements they had made to their home. We then ask if this was a recommendation that was in the audit report. If they said that yes, (it was in the audit report) we ask how influential the recommendation in the audit report was to their decision to install the item on a scale of 1 to 10.

Savings were calculated using engineering algorithms that can be found in Appendix A: Impact Algorithms Used. The gross savings are adjusted for the influence factor. For example, if they said that the influence of the audit report was a 10 on the scale, full energy impacts are presented. If they reported that the audit report had an influence factor of 8, then 80% of the energy impacts are counted as program-induced and contribute to the program energy savings estimates. Self-selection bias and false response bias are then factored in to calculate the final estimated net impact.

Billing Analysis

This analysis presents the results of the billing analysis of the Ohio Home Energy House Call (HEHC) Program. This analysis relies upon a statistical analysis of actual customer billed energy (both electricity and natural gas) consumption before and after participation in the PER program to estimate the impact of the program. Table 1 presents the results of this billing analysis.

Table 1: Ohio HEHC Average Annual Savings: Billing Analysis versus Engineering Analysis

	Billing Analysis	Engineering Analysis
kWh	468	227
Therm	36	6

For this analysis, data are available both across households (i.e., cross-sectional) and over time (i.e., time-series). With this type of data, known as "panel" data, it becomes possible to control, simultaneously, for differences across households as well as differences across periods in time through the use of a "fixed-effects" panel model specification. The fixed-effect refers to the model specification aspect that differences across homes that do not vary over the estimation period (such as square footage, heating system, etc.) can be explained, in large part, by customer-specific intercept terms that capture the net change in consumption due to the program, controlling for other factors that do change with time (e.g., the weather).

Because the consumption data in the panel model includes months before and after the installation of measures through the program, the period of program participation (or the participation window) may be defined specifically for each customer. This feature of the panel model allows for the pre-installation months of consumption to effectively act as controls for post-participation months. In addition, this model specification, unlike annual pre/post-participation models such as annual change models, does not require a full year of post-participation data. Effectively, the participant becomes their own control group, thus eliminating the need for a non-participant group. We know the exact month of participation in the program for each participant, and are able to construct customer specific models that measure the change in usage consumption immediately before and after the date of program participation, controlling for weather and customer characteristics.

The fixed effects model can be viewed as a type of differencing model in which all characteristics of the home, which (1) are independent of time and (2) determine the level of energy consumption, are captured within the customer-specific constant terms. In other words, differences in customer characteristics that cause variation in the level of energy consumption, such as building size and structure, are captured by constant terms representing each unique household.

Algebraically, the fixed-effect panel data model is described as follows:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it},$$

where:

- y_{it} = energy consumption for home i during month t
- α_i = constant term for site i
- β = vector of coefficients
- x = vector of variables that represent factors causing changes in energy consumption for home i during month t (i.e., weather and participation)
- ε = error term for home i during month t.

With this specification, the only information necessary for estimation is those factors that vary month to month for each customer, and that will affect energy use, which effectively are weather conditions and program participation. Other non-measurable factors can be captured through the use of monthly indicator variables (e.g., to capture the effect of potentially seasonal energy loads).

The effect of the program, in this case the Personal Energy Report kit as well as recommended measures, is done by including a variable which is equal to one for all months after the customer received the kit and the report. The coefficient on this variable is the savings associated with the kit. In order to account for differences in billing days, the usage was normalized by days in the billing cycle. The estimated electric model is presented in Table 2.[1]

Table 2: Estimated Electricity Model – dependent variable is daily kWh usage, January 2005 through April 2008.

Independent Variable	Coefficient	t-value
Indicator variable for months after participation in program	-1.28	-2.3
Sample Size	6,345 obs (160 homes)	
R-Squared	75%	

This estimated model shows that the HEHC program (both kits and recommended measures) results in an annual savings of 468 kWh. This estimate is fairly well estimated, with the 90% confidence interval extending from savings of 140 kWh to 794 kWh per year.

The natural gas model is presented in Table 3 below.

[1] The model includes weather terms and monthly indicator terms as well as the terms presented in the variables presented in Table 1. These terms were not included in order make interpretation clearer.

Table 3: Estimated Natural Gas Model – dependent variable is daily Therm usage, January 2005 through April 2008.

Independent Variable	Coefficient	t-value
Indicator variable for months after participation in program	-0.099	-2.04
Sample Size	4,370 obs (113 homes)	
R-Squared	73%	

This estimated model shows that the HEHC program results in an annual savings of 36 Therms. This estimate has a 90% confidence interval extending from a savings of 7 Therms to 65 Therms.

Section 1: Use of the Kit

This section presents the energy impact approach and calculations for installation and use of the measures in the Energy Savings Kit that was distributed to all HEHC participants. Findings are estimated using the 100 survey responses extrapolated to the 1,680 participants of the Home Energy House Call Program.

Use of the Kit's Measures and Their Impacts

CFLs

The CFLs included in the HEHC kit were installed by more recipients than any other measure in the Energy Efficiency Starter Kit. 93% of the recipients installed the 15-watt CFL, but only 78% of them installed the 20-watt CFL. Table 6 below shows a summary of the responses to the questions about the 15-watt CFL. The same information can be found in Table 7 for the 20-watt CFL. This information indicates that only 7% of the participants had not installed their bulbs, and only 1% will not install them in the future.

Table 6. Frequency of Installation: 15-watt CFL

Installed 15w bulb	**Surveyed participants** (n=100)
Yes	93%
No	7%
Don't Know	0%
Plan to Install 15w bulb	
Yes	4%
No	1%
Don't Know	1%

Table 7. Frequency of Installation: 20-watt CFL

Installed 20w bulb	**HEHC participants surveyed** (n=100)
Yes	78%
No	18%
Don't Know	3%
Plan to Install 20w bulb	
Yes	9%
No	4%
Don't Know	2%

Using the information above and the algorithm for lighting impacts (which can be found in Appendix A), the estimate of savings for these 1,680 customers totals 12.55 kW and 148,470 kilowatt hours per year. However, the reduction in heat output from switching the incandescent to the CFL results in an increase in therm consumption of 220.9 therms per year total. Savings can be found in Table 8.

The savings per customer (as extrapolated from the surveyed participants) for either of the CFLs can also be found Table 8 below. For instance, each customer that installed the 15-watt CFL will save 69 kWhs per year (107,822 / 1,562 = 69.03). This is the average per customer savings. The real savings will of course depend on the other factors involved (the wattage of the bulb removed and hours of use). These hours of use data have been measured as part of the overall CFL analysis, and are reasonable to use and apply in this analysis

Table 9 presents the impact estimates from the planned installations of the CFLs included in the kit. These savings may or not be realized, depending on whether the customers install the items.

Table 8. Impact Estimates from the Installation of the CFL Bulbs

	Estimated Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
15-watt CFL	1562	8.908	107,822.0	-160.4
20-watt CFL	1310	7.564	87,330.2	-129.9
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
15-watt CFL		0.006	69.03	-0.1
20-watt CFL		0.006	66.66	-0.1

Table 9. Potential Impact Estimates from the Planned Installation of the CFL Bulbs

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
15-watt CFL	67	0.431	5,217.2	-7.8
20-watt CFL	151	0.951	10,984.9	-16.3
Per Install (when done) →		**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
15-watt CFL		0.006	77.87	-0.12
20-watt CFL		0.006	72.75	-0.11

Weather Stripping

Just over half of the kit recipients (53%) installed the weather stripping. Given this level of installations, the savings for this measure are somewhat modest, Table 11 below shows the energy savings from these estimated 890 installations, with only 532 kilowatt hours and 10.5 therms saved per year.

Table 10. Frequency of Installation: Weather Stripping

Installed weather stripping	HEHC participants surveyed (n=100)
Yes	53%

No	36%
Don't Know	11%
Plan to install	
Yes	11%
No	37%
Don't Know	3%

Table 11. Impact Estimates from the Installation of the Weather Stripping

	Estimated Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Weather stripping	890	0.156	532.3	10.5
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
Weather stripping		0.0	0.6	0.01

Table 12. Potential Impact Estimates from the Planned Installation of the Weather Stripping

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
Weather stripping	185	0.047	160.3	3.2
Per Install (when done) →		**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
Weather stripping		0.0	0.87	0.02

Outlet Gaskets

About half of the recipients installed the outlet gaskets. The kilowatt hour savings from this measure are 2,500 kWh annually.

Table 13. Frequency of Installation: Outlet Gaskets

Installed the gaskets on outlets	HEHC participants surveyed (n=100)
Yes	45%
No	49%
Don't Know	6%
Plan to Install	
Yes	14%
No	25%
Don't Know	10%

Table 14. Impact Estimates from the Installation of the Outlet Gaskets

	Estimated Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Outlet gaskets	756	0.731	2,498.9	49.2
	Per Install →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
		0.001	3.31	0.07

Table 15. Potential Impact Estimates from the Planned Installation of the Outlet Gaskets

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
Outlet gaskets	235	0.289	989.1	19.5
	Per Install →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings
		0.001	4.21	0.08

Window Shrink Kit

Most of the kit recipients did not install the window film shrink kit. Only 15% of the population installed this measure.

Table 16. Frequency of Installation: Window Film Shrink Kit

Installed window shrink kit	HEHC participants surveyed (n=100)
Yes	15%
No	76%
Don't Know	9%
Plan to install	
Yes	5%
No	63%
Don't Know	5%

With the low numbers of installations combined with the fact that the PER study (conducted on the same set of measures) found that 38% of the kits were installed on double-pane windows, the savings for this measure are also quite low.

Table 17. Impact Estimates from the Installation of the Window Film Shrink Kit

	Estimated Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Window shrink kit	252	5.899	9,985.6	132.1
	Per Install →	Mean kW Savings	Mean kWh Savings	Mean Therm Savings

		0.023	39.63	0.52

Table 18. Potential Impact Estimates from the Planned Installation of the Window Shrink Kit

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
Window shrink kit	84	2.269	3,840.6	50.8
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
		0.027	45.72	0.6

Low-Flow Showerhead

A high percentage (41%) of the kit recipients installed the low-flow showerhead, with the resulting gross energy savings being high as well. Total energy savings are over 245,000 kilowatt-hours and almost 12,000 therms annually.

Table 19. Frequency of Installation: Low-Flow Showerhead

Installed the showerhead	HEHC participants surveyed (n=100)
Yes	41%
No	55%
Don't Know	4%
Plan to install	
Yes	12%
No	40%
Don't Know	4%

Table 20. Impact Estimates from the Installation of the Low-Flow Showerhead

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Showerhead	689	26.855	245,053.1	11,948.1
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
		0.039	355.66	17.34

Table 21. Potential Impact Estimates from the Planned Installation of the Low-Flow Showerhead

	Estimated Number Planning to	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings

	Install			
Showerhead	202	8.744	79,784.7	3,890.1
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
		0.043	394.97	19.26

Faucet Aerators

The customers were somewhat likely to install the faucet aerators included in the Energy Efficiency Starter Kit. Less than half of the kit recipients installed both of the aerators.

Table 22. Frequency of Installation: Bathroom Faucet Aerator

Installed the bathroom aerator	HEHC participants surveyed (n=100)
Yes	32%
No	60%
Don't Know	8%
Plan to install	
Yes	13%
No	41%
Don't Know	6%

Table 23. Frequency of Installation: Kitchen Faucet Aerator

Installed the kitchen aerator	HEHC participants surveyed (n=100)
Yes	35%
No	57%
Don't Know	8%
Plan to install	
Yes	10%
No	45%
Don't Know	2%

The energy impacts for this measure are in the table below, and indicate overall savings of almost 600 kilowatt hours per year and over 2,000 therms per year.

Table 24. Impact Estimates from the Installation of the Bathroom and Kitchen Faucet Aerators

	Number Installed	Total kW Savings	Total kWh Savings	Total Therm Savings
Bathroom aerator	537	0.343	286.1	1,004.0
Kitchen aerator	588	0.372	310.0	1,087.6
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
Bathroom aerator		0.001	0.53	1.87

Kitchen aerator		0.001	0.53	1.85

Table 25. Potential Impact Estimates from the Planned Installation of the Faucet Aerators

	Estimated Number Planning to Install	Total Potential kW Savings	Total Potential kWh Savings	Total Potential Therm Savings
Bathroom aerator	218	0.153	127.2	446.2
Kitchen aerator	168	0.105	87.4	306.8
	Per Install →	**Mean kW Savings**	**Mean kWh Savings**	**Mean Therm Savings**
Bathroom aerator		0.001	0.58	2.05
Kitchen aerator		0.001	0.52	1.83

All Kit Measures

The Energy Efficiency Starter Kit is a kit of 8 energy efficient measures. The tables below show the relative "popularity" of each of the items for the recipients of the kits and the total savings for each of the measures based on those surveyed customers that indicated they installed the measure or plan to install the measure.

The CFLs are the most likely measure to be installed, with the kitchen aerator and outlet gaskets coming in second. Given the past responses from the PER evaluation in 2007, the customer-indicated behaviors and changes (such as number of showers, wattage of bulb replaced, etc.) means that the showerhead provides a greater amount of savings than the CFLs.

Table 26 below presents the estimated savings when the percent installation is applied to the total program population of 1,680. The total savings from those that received the kits and were randomly selected for the survey is estimated to be 453,818 kilowatt-hours and 13,941 therms annually. The kilowatt impact of the kits is estimated to be 50.828.

Table 26. Summary of Total Savings for All Installed Measures

Ohio Kits	Installed	Plan to Install	Total kW savings	Total kWh savings	Therm savings
15-watt CFL	1562	67	8.908	107,822.0	-160.4
20-watt CFL	1310	151	7.564	87,330.2	-129.9
Weather stripping	890	185	0.156	532.3	10.5
Outlet gaskets	756	235	0.731	2,498.9	49.2
Window shrink kit	252	84	5.899	9,985.6	132.1
Showerhead	689	202	26.855	245,053.1	11,948.1
Bathroom aerator	537	218	0.343	286.1	1,004.0
Kitchen aerator	588	168	0.372	310.0	1,087.6
Total Savings			**50.828**	**453,818.2**	**13,941.2**

Table 27 below shows the mean savings per measure installed. To obtain these values, the total savings for each measure was divided by the total installations, resulting in a "per install" savings value. If a customer were to install each of the measures in the kit, the "Mean Total" amount at the bottom of each table would be the average energy savings based on the responses of that group.

Table 27. Summary of Mean Savings for All Measures

Kit Measures	Mean kW per install	Mean kWh per install	Mean Therms per install
15-watt CFL	0.006	69.03	-0.1
20-watt CFL	0.006	66.66	-0.1
Weather stripping	0	0.6	0.01
Outlet gaskets	0.001	3.31	0.07
Window shrink kit	0.023	39.63	0.52
Showerhead	0.039	355.66	17.34
Bathroom aerator	0.001	0.53	1.87
Kitchen aerator	0.001	0.53	1.85
Mean Total Savings, if all measures Installed	**0.077**	**535.95**	**21.46**

Savings Distributions

There are some risks associated with relying on self-reported behavioral changes, because the foundation of the savings estimates are based solely on the participant's responses, with no means to verify that the respondent has installed the kit's measures and is using them effectively. There are two main sources of bias with these types of surveys that directly impact the conclusions drawn from the responses. These sources of bias are Self-Selection Bias and False Response Bias. There is also an issue regarding the accuracy of the baseline energy use conditions used by the evaluation contractor to estimate savings in that many of these conditions need to be based on assumptions about the participant population, rather than on measurements. These three conditions impact the evaluation contractor's ability to provide accurate estimates of energy impact. These issues are discussed in more detail in the following paragraphs.

Self-Selection Bias

For this evaluation, we are using the self selection bias value of 29.9%. This value was estimated during the previous PER evaluation done in Kentucky and is likely applicable for the HEHC study as well. The self-selection bias applied in this study is described below and is taken from the text of the PER evaluation report.

PER Self-Selection Bias

The survey was sent to 5,401 PER Program participants – 3,562 customers that did not receive the kit, and 1,839 customers that did receive the Energy Efficiency Starter Kit. The data collection efforts resulted in 1,879 responses from PER participants who only received the PER (response rate = 52.8%), and 741 responses (response rate = 40.3%) from Kentucky PER participants who received the Energy Efficiency Kit. The people that filled out and returned the survey are the participants that are more likely to install measures from the Energy Efficiency Kit and consider taking actions based on the recommendations from the Personalized Energy Report. That is, they self-selected themselves to return the survey because they have a higher interest in the subject matter than the people who did not. These individuals also will often respond to a survey in order to let it be known that they did the right thing, and that they are taking steps to be more energy efficient. The customers that did not return the survey are more likely to have a lower interest in the subject matter, and are less likely to take actions. Thus, the people who returned the survey are not the typical participant, but rather are the participant that is more likely to take actions. With 47.2% of the PER group and 59.7% of the Kit group not responding, we are setting the self-selection bias used to estimate the potential range of impacts at half of the non-response rate. As a result, all estimated energy impact estimates will be discounted 29.9%[2] for customers that received the Energy Efficiency Kit and the Personalized Energy Report, and 23.6% for those that only received the Personalized Energy Report. All impact estimates will be discounted by this percentage in order to calculate the low end of the range of savings estimates for each measure and recommendation to adjust for self-selection bias. The adjustment approach is an estimate because there is no way to assign an adjustment factor for the survey without on-site verification efforts to establish a reliable bias factor. We set the factor at

[2] (59.7% response rate / 2 = 29.9% self-selection rate)

half of the non-response rate based on professional judgment from conducting surveys and metering studies of energy efficiency programs for over 28 years and interacting with the evaluation community regarding reasonable expectations and experience.

False Response Bias

False Response Bias is a problem with many self-reporting surveys. The participants respond not with the truth, but with the socially acceptable answer. In short, they lie about what measures they installed or what actions they have taken as a result of the Home Energy House Call program. False response bias is typically not a high number, but ranges from a low of two or three percent to a high of 15 percent in our experience depending on the topic and the population being tested. The False Response Bias is set at 10% for this survey, unless otherwise indicated. A 10% discount will be applied to all impact-related measure estimates to calculate the low end of the range of savings estimates for each measure and recommendation.

Baseline Energy Use Assumptions

When a mail survey is used to conduct an evaluation, the evaluation contractors are unsure of the actual conditions in the home that have experienced a change. For example, while a new showerhead may have been installed, it is impossible to estimate precise savings unless the flow rates and use conditions associated with the previous showerhead are well understood. For this study we established our baseline assumptions based on the survey results and our past research and experience with programs and program evaluations that have taken measurements of baseline conditions. We have also used housing-type computer models to estimate baseline conditions and behaviors. As a result, we are not adjusting the baseline conditions applied in this study based on on-site pre-program inspections, but rather we are using the survey results, the literature, our past research and field experience to set what we think are typical baseline conditions. However, because these are not program-participant measured baseline conditions, it is important to let the reader know that the baselines used in this study are estimated.

Level of Discounting for False Response Bias

The level of discounting used to determine the ranges for each of the measures and recommendations can be found in the table below. The self-selection bias discount factor for all measures for HEHC is 29.9%.

Measure	False Response Bias
CFLs	10%
Weatherstripping	10%
Outlet gaskets	10%
Window shrink kit	10%
Showerhead	20%
Aerators	20%

Section 2: Savings Estimates

Each of the Kit measures' savings are recalculated here in order to provide probable ranges of energy savings associated with each item. The tables below provide the gross energy savings (as extrapolated to the whole population and reported above), the savings after the self-selection bias and false reporting bias are factored in, and then the net savings which factors in freeridership and spillover using the estimates adjusted for the biases.

Table 28. Ohio Participants' Range of Kilowatt Savings – Installed Items

Measure	Total kW Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	5.354	8.908	4.002
20-watt CFL	4.546	7.564	3.398
Weatherstripping	0.094	0.156	0.082
Outlet gaskets	0.439	0.731	0.440
Window shrink kit	3.545	5.899	3.368
Showerhead	13.454	26.855	13.858
Bathroom aerator	0.172	0.343	0.170
Kitchen aerator	0.186	0.372	0.184

Table 29. Ohio Participants' Range of Kilowatt-Hour Savings – Installed Items

Measure	Total kWh Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	64,801.0	107,822.00	48,439.3
20-watt CFL	52,485.5	87,330.20	39,233.3
Weatherstripping	319.9	532.3	278.3
Outlet gaskets	1,501.8	2,498.90	1,505.6
Window shrink kit	6,001.3	9,985.60	5,701.3
Showerhead	122,771.6	245,053.10	126,454.8
Bathroom aerator	143.3	286.1	141.5
Kitchen aerator	155.3	310	153.4

Table 30. Ohio Participants' Range of Therm Savings – Installed Items

Measure	Total Therm Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	-96.4	-160.4	-72.1
20-watt CFL	-78.1	-129.9	-58.4
Weatherstripping	6.3	10.5	5.5
Outlet gaskets	29.6	49.2	29.6
Window shrink kit	79.4	132.1	75.4

Showerhead	5,986.0	11,948.10	6,165.6
Bathroom aerator	503.0	1,004.00	496.7
Kitchen aerator	544.9	1,087.60	538.1

Table 31, Table 32, and Table 33 below present the potential gross and net savings from the program if those that indicated they planned to install the item do indeed install the item.

Table 31. Ohio Participants' Range of Kilowatt Savings – Planned Items

Measure	Total kW Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	0.259	0.431	0.194
20-watt CFL	0.572	0.951	0.427
Weatherstripping	0.028	0.047	0.025
Outlet gaskets	0.174	0.289	0.174
Window shrink kit	1.364	2.269	1.295
Showerhead	4.381	8.744	4.512
Bathroom aerator	0.077	0.153	0.076
Kitchen aerator	0.053	0.105	0.052

Table 32. Ohio Participants' Range of Kilowatt-Hour Savings – Planned Items

Measure	Total kW Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	3,135.5	5,217.20	2,343.8
20-watt CFL	6,601.9	10,984.90	4,935.0
Weatherstripping	96.3	160.3	83.8
Outlet gaskets	594.4	989.1	595.9
Window shrink kit	2,308.2	3,840.60	2,192.8
Showerhead	39,972.1	79,784.70	41,171.3
Bathroom aerator	63.7	127.2	62.9
Kitchen aerator	43.8	87.4	43.2

Table 33. Ohio Participants' Range of Therm Savings – Planned Items

Measure	Total Therm Savings		
	Self-Selection and False Response	Unadjusted Gross Savings	Net Savings
15-watt CFL	-4.7	-7.8	-3.5
20-watt CFL	-9.8	-16.3	-7.3
Weatherstripping	1.9	3.2	1.7
Outlet gaskets	11.7	19.5	11.7
Window shrink kit	30.5	50.8	29.0
Showerhead	1,948.9	3,890.10	2,007.4
Bathroom aerator	223.5	446.2	220.8
Kitchen aerator	153.7	306.8	151.8

Effective Useful Lifetime Impact Estimates

In order to calculate the estimated energy impacts over the lifetime of the measures of the kit, we used the following life-spans for each of the measures.

Kit Measures	Effective Useful Life
15-watt CFL	5
20-watt CFL	5
Weather stripping	5
Outlet gaskets	20
Window shrink kit	1
Showerhead	10
Bathroom aerator	10
Kitchen aerator	10

The peak program kilowatt impact of the installed measures in the kit remains high for the first five years at 25.5 kW, then, in year 6 the savings drop to about 14 kW. Then in year 11, kW savings drop to less than 0.5 kW for the remainder of the 20 year period.

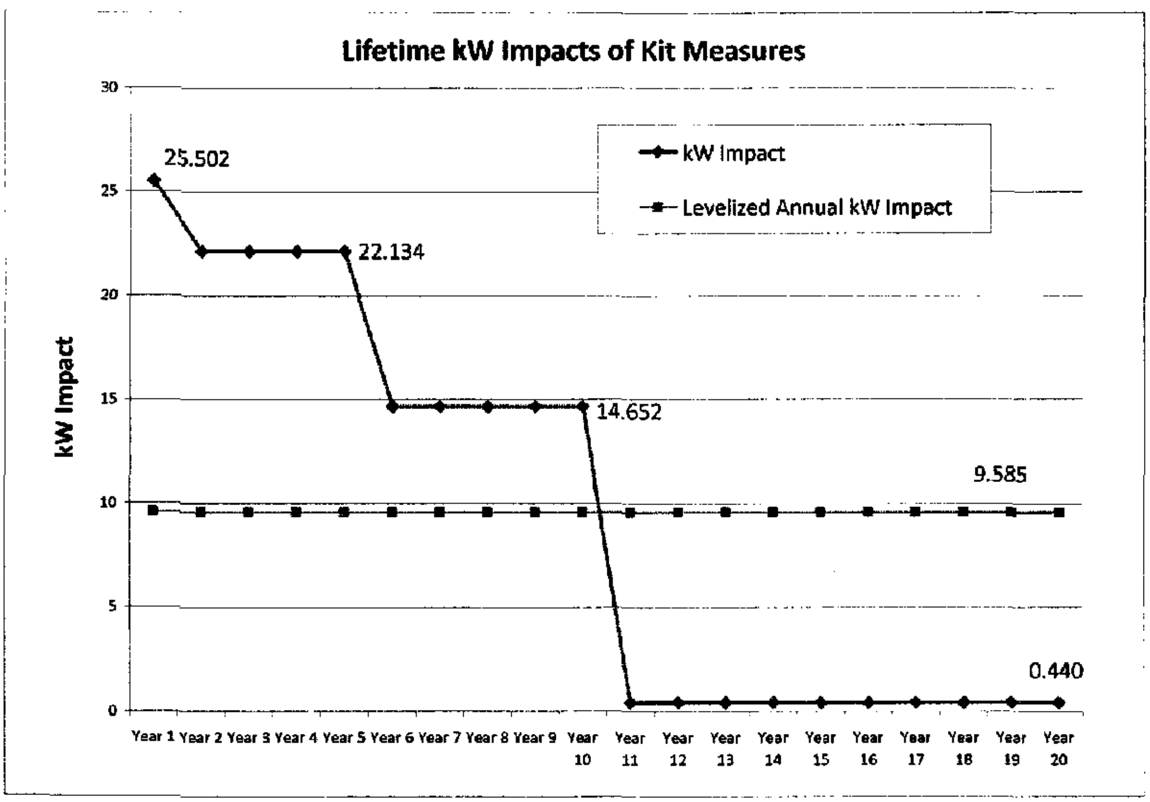

Figure 1. Lifetime kW Impacts of Kit Measures

The figure below presents the kilowatt hour savings that can be expected over the next 20 years based on the effective useful life of the installed measures. For the first five years, annual savings are close to 220,000 kilowatt hours for the 1,680 participants of the HEHC program. By year six, the savings drop to 128,000 kWhs, and in years eleven through twenty, annual kWh savings from the kit are just over 1,500 kWhs per year. The total kWh savings over the next twenty years for these 1,680 participants is 1,743,065 kWhs, a mean of 1,038 kWhs per participant.

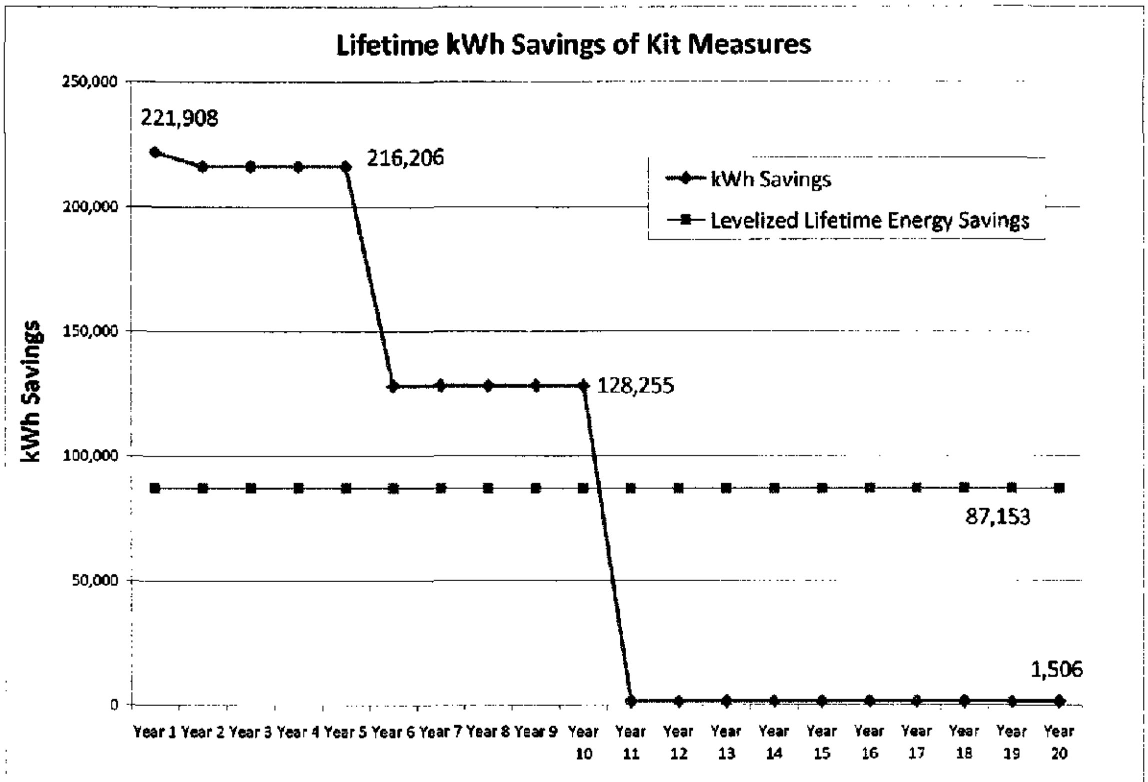

Figure 2. Lifetime kWh Savings of Kit Measures

The figure below presents the therm savings that can be expected over the next 20 years based on the effective useful life of the installed measures. For the first five years, annual savings are 7,180 therms for the 1,680 participants of the HEHC program. By year six, the savings increase slightly because the negative effect on natural gas usage caused as the gas impacts from CFLs use drops out of the equation (this assumes that the program is not the cause of continued CFL use), and in years eleven through twenty, annual therms drop drastically down to 30 therms per year. The total therm savings over the next twenty years for these 1,680 participants is 72,046 therms, a mean of 22 therms per participant. If the program causes the participant to permanently move to CFL use, the savings will continue. This savings would be market transformation savings and are not counted in this evaluation. As a result, these savings are less than what can actually be expected.

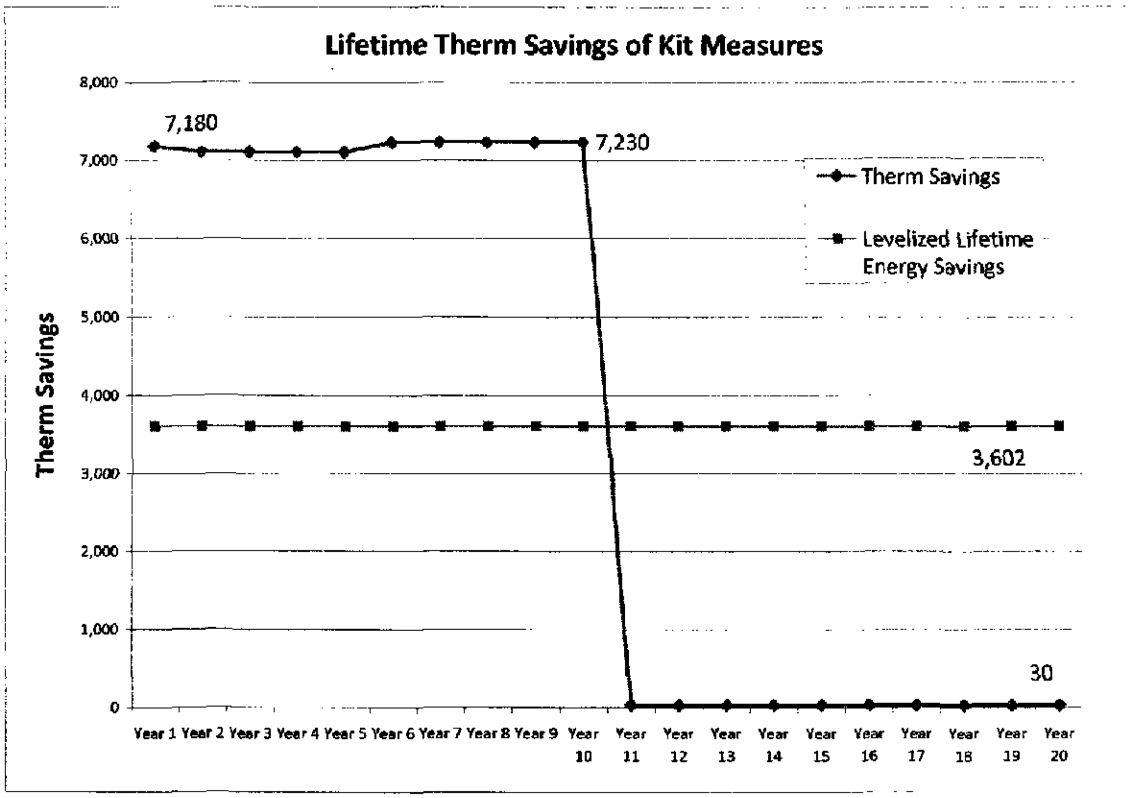

Figure 3. Lifetime Therm Savings of Kit Measures

Audit Freeridership

The Home Energy House Call audit had three (3%) participants as freeriders. To calculate freeridership, we used the following table:

Considering an audit before the program?	If not available through the program, would you still have purchased an audit?	If yes, would you have purchased it within a year?	% Freeridership
yes	yes	yes	100
yes	yes	no	50
yes	yes	don't know	25

These 3 participants had a mean freeridership level 50.00%. Over the 100 participants, the overall freeridership level for the program is 0.5%.

Savings from Audit Recommendations

The participants of the Home Energy House Call Program each received an audit of their home followed up by a customized audit report with specific recommendations for improvements to their home that would increase their home's energy efficiency. In this section, we present the recommendations as they were reported to us by the random sample of 100 participants contacted during the telephone survey. As noted in the

Methodology section above, we first asked them what, if any, improvements they made to their home. We then ask if this was a recommendation that was in the audit report. If they said that yes, it was in the audit report, we ask how influential the recommendation in the audit report was to their decision to install the item on a scale of 1 to 10.

Savings were calculated using engineering algorithms that can be found in Appendix A: Impact Algorithms Used. The gross savings are adjusted for the influence factor. For example, if they said that the influence of the audit report was a 10 on the scale, full energy impacts are presented. If they reported that the audit report had an influence factor of 8, then 80% of the energy impacts are presented and used to estimate energy savings resulting from the program. .

Table 34 below describes the actions taken by each of the respondents who indicated they took an action because of the recommendation in the audit report, the impact metrics used in calculated estimated savings, the influence factor as reported by the participant, and the program's adjusted net energy impacts without survey bias and false response adjustments.

Table 34. Actions Taken Because of the Audit Report and Net of Influence Energy Impacts

Respondent	Action Taken	Location	Algorithm Used	Influence	kW	kWh	Therms
1	Insulation	ducts	Duct insulation	9	0.152	359.3	4.6
2	UV film on windows	home	Window shrink kit	10	0.163	275.7	3.6
	Water heater blanket	basement	Insulated water heater	10	0.158	531.3	25.9
	New water heater	basement	Insulated water heater	10	0.158	531.3	25.9
	Seal duct work	home	Duct repair	10	0.219	454.7	5.4
3	New windows	home	High performance window	10	0.107	214.9	-7.3
	Insulation	home	Attic insulation	10	0.196	345.5	5.3
	Caulking	home	Window shrink kit	10	0.163	275.7	3.6
4	Water heater	basement	Insulated water heater	10	0.158	531.3	25.9
	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
5	Insulation	attic	Attic insulation	9	0.176	311.0	4.8
6	Refrigerator	home	New refrigerator	10	0.210	1508.5	-1.9
	Insulation	home	Attic insulation	10	0.196	345.5	5.3
7	Water heater blanket	basement	Insulated water heater	10	0.158	531.3	25.9
8	Taped ducts	home	Duct Repair	10	0.219	454.7	5.4
9	Tighten doors	home	Weather Stripping	9	0.005	16.5	0.3
10	Insulation	home	Attic insulation	7	0.137	241.9	3.7
	Caulking	home	Window shrink kit	7	0.114	193.0	2.6

	Water heater blanket	basement	Insulated water heater	7	0.111	371.9	18.1
11	Insulated pipes	home	Pipe Wrap	8	0.153	694.5	80.0
12	New AC	outside	New AC	1	0.091	137.5	0.0
13	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
14	Replaced door seal	home	Weather Stripping	10	0.005	18.3	0.4
15	Insulated water pipes	home	Pipe Wrap	10	0.191	868.1	100.0
17	Filled duct work	home	Duct Repair	10	0.219	454.7	5.4
18	Taped duct work	basement	Duct Repair	10	0.219	454.7	5.4
	Covered leaking coal chute	home	Fireplace closure	10	0.005	16.0	0.3
	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
19	Taped duct work	home	Duct Repair	10	0.219	454.7	5.4
	Caulking	home	Window shrink kit	10	0.163	275.7	3.6
20	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
22	Duct couples	home	Duct Repair	10	0.219	454.7	5.4
	Programmable thermostat	home	setback thermostat	10	-0.023	212.1	88.7
	Insulation	attic	Attic insulation	10	0.196	345.5	5.3
25	Sealed holes/leaks	home	Window shrink kit	10	0.163	275.7	3.6
26	Setback thermostat	home	setback thermostat	10	-0.023	212.1	88.7
	Taping duct work	home	Duct Repair	10	0.219	454.7	5.4
28	New furnace	basement	New furnace	10	0	0	16.3
	Replacement windows	home	High performance window	10	0.206	226.5	-6.9
30	Replacement windows	home	High performance window	10	0.206	226.5	-6.9
31	Caulking	home	Window shrink kit	5	0.082	137.9	1.8
34	Insulation	garage	Side wall insulation, $120ft^2$	8	0.031	76.9	1.4
Total for Sample of 100 Participants					6.125	14,872.8	581.6
Mean per Participant					0.061	148.7	5.8
Total if Extrapolated to Population of 1,680 Participants					102.9	249,863	9,771

The audit recommendations resulted in an estimated net of influence savings (adjusted for influence of the audit report) of 249,863 kWhs and almost 10,000 therms when the results are extrapolated to the HEHC population.

The following presents the effective useful life and false response bias that need to be applied to these estimates.

Table 35. Effective Useful Life and False Response Bias for Audit Recommendations

	Effective Useful Life (Years)	False Response Bias
Attic insulation	20	50%
basement wall insulation	20	50%
Dishwasher	9	50%
Dryer	11	50%
Duct insulation	20	50%
Duct repair	18	50%
Fireplace closure	5	50%
High performance window	20	50%
Insulated water heater	15	50%
New AC	15	50%
New furnace	20	50%
New heat pump	15	50%
New refrigerator	12	50%
Pipe Wrap	12	10%
setback thermostat	11	50%
Side wall insulation	20	50%
Washer (clothes)	12	50%
Weather Stripping	5	50%
Window shrink kit	1	50%

After the self-response bias (discussed in Self-Selection Bias section on page 23) and the above factors are applied, the total net energy impacts can be estimated.

The kilowatt impacts of the audit recommendations over their effective useful lives are presented in Figure 4 below. The impact of the installed audit recommendations remain strong over the 20 years due to a high number of long-term measures installed by the participants, such as attic and sidewall insulation.

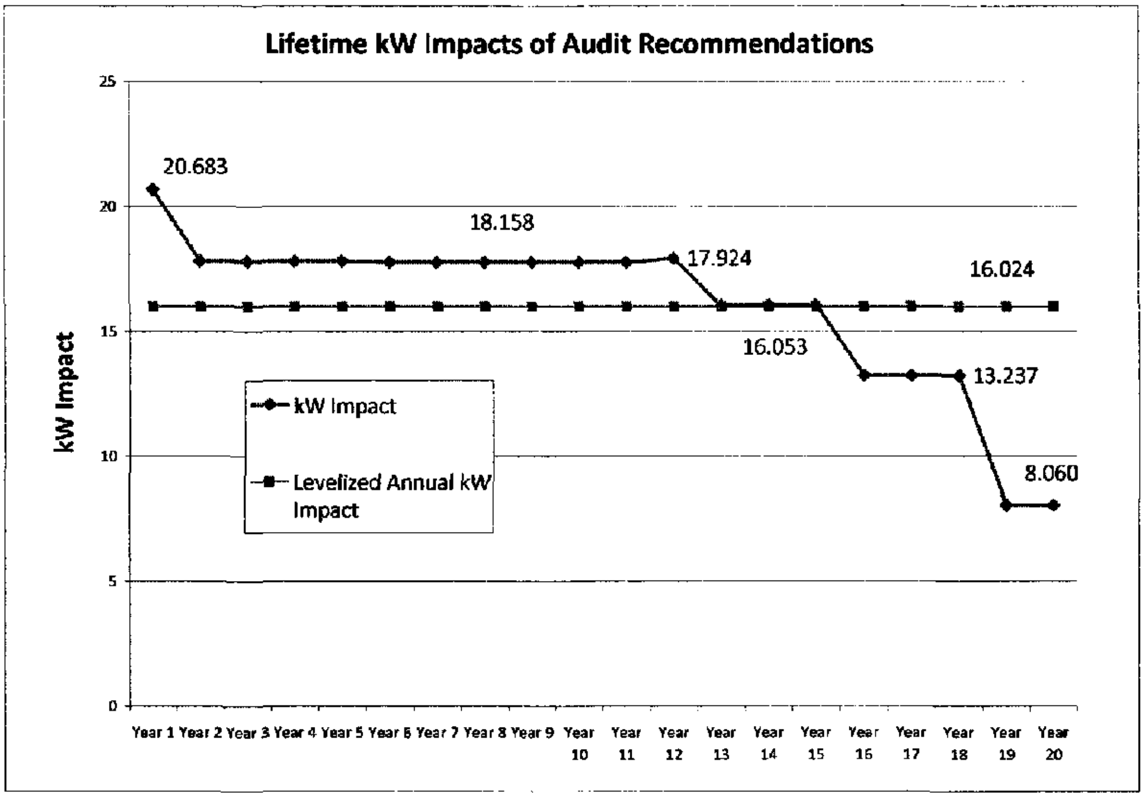

Figure 4. Lifetime kW Impacts of Audit Recommendations

The lifetime kilowatt-hour impacts are presented in Figure 5 below. The total and final net savings (net of influence, self-selection, and false-response) over the next 20 years for these installed audit recommendation is 748,057 kWhs.

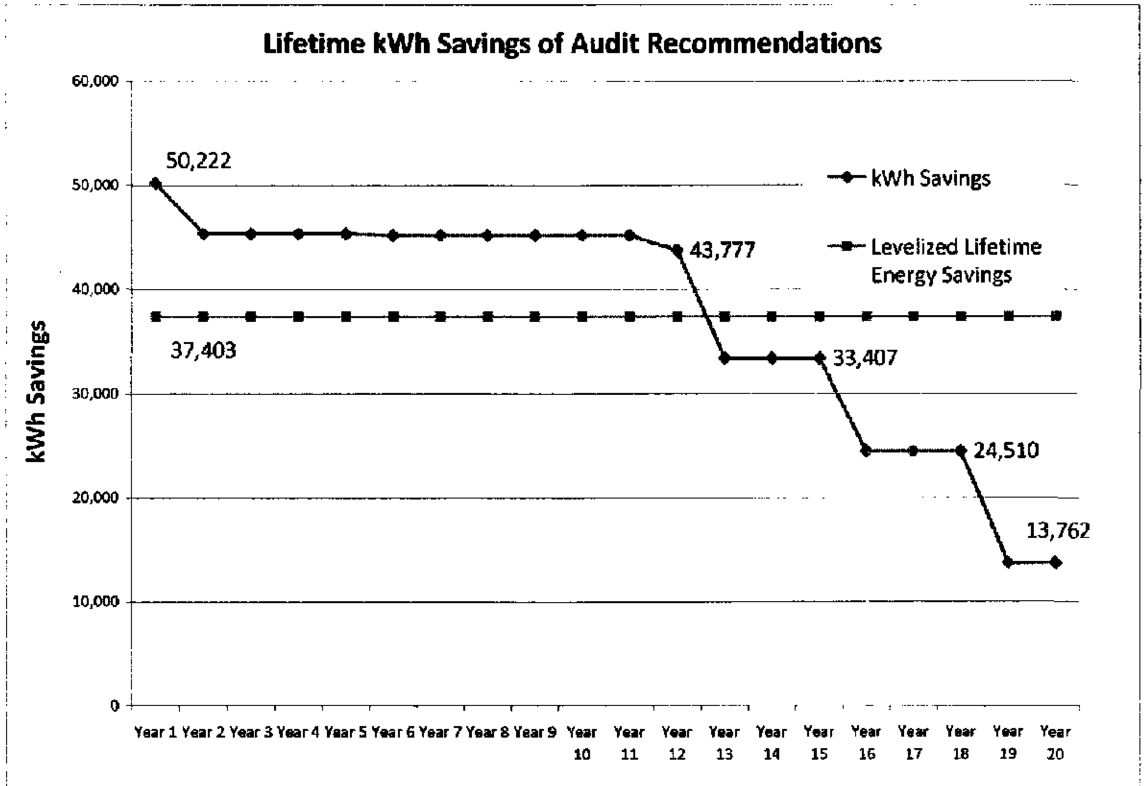

Figure 5. Lifetime kWh Savings of Audit Recommendations

Annual therm savings take a steep drop from 1,964 to 697 annual therms after twelve years, as presented below in Figure 6 below. However, the total net savings over the next twenty years for the installed measures recommended by the HEHC audit is 25,509 therms.

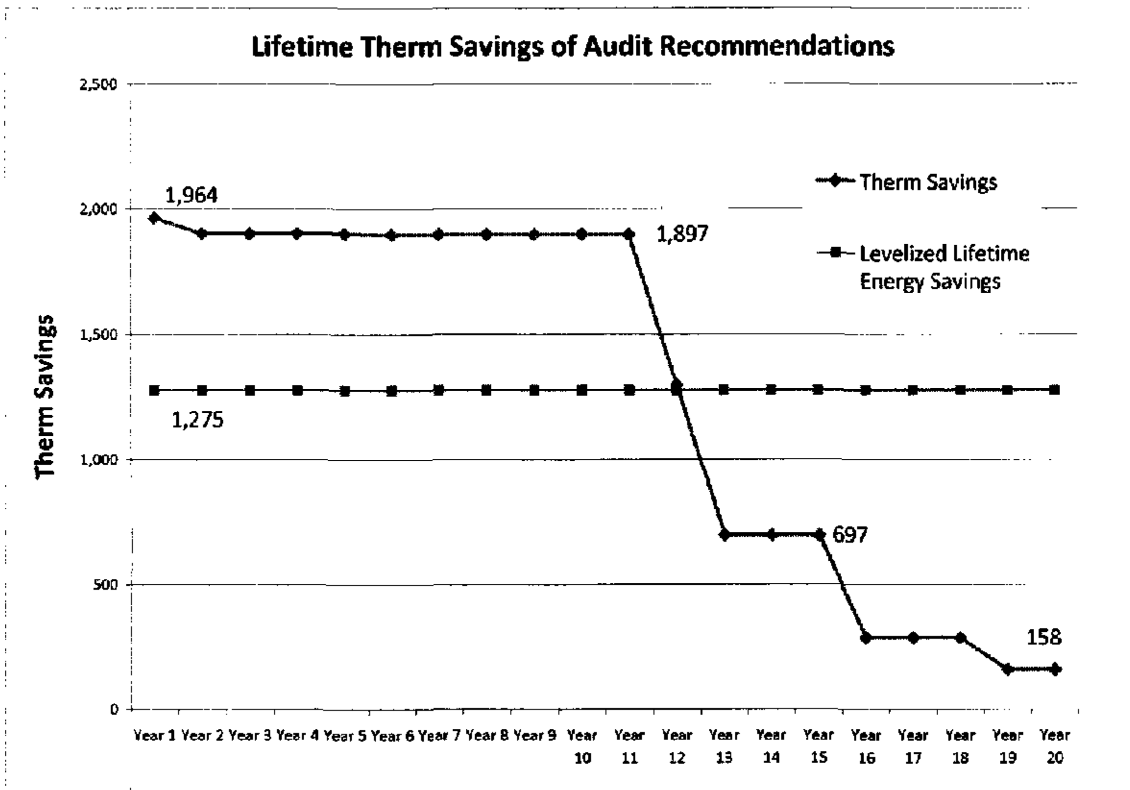

Figure 6. Lifetime Therm Savings of Audit Recommendations

Section 3: Program Operations and Customer Satisfaction

The program manager of Home Energy House Call was interviewed in July of 2008. The 100 customer surveys were performed in June-August of 2008. The interview protocol used during these interviews can be found in Appendices B and C. The results of the process interviews are report by the response categories presented below.

Program Objectives

One of the objectives of the HEHC Program is to raise customer awareness about how they use energy and to help them understand how they can affect their own bill with low cost or no cost actions, and that they can influence the environment with their activities.

This objective is being met, as customers are aware and they realize that taking the actions recommended by the audit and using the items in the kit do work to lower their energy consumption. However, according to a program manager, the level of detail provided by the auditors could be enhanced. Some auditors are better than others in the level of detail provided. In the interviews they are supposed to ask customers about "areas of concern" in their home, but sometimes they do not ask about it, or follow up on it because they forget, don't have time, or don't have the necessary knowledge to help address the issue.

A third-party contractor performs the audits. In order to minimize costs they allow 1 hour per audit and schedule 6 audits in a day. This schedule allows little time to move beyond a set of highly regimented activities, with little time for effectively communicating a complex message to customers. However, the program provides this service at no cost to the participant. As a result, the program does provide value to the participants and this value is recognized by a very high level of participant satisfaction with the program and the services provided.

From a cost effectiveness perspective, in which the program is to acquire energy savings below the avoided cost-of-supply option, the program is limited in the amount of service it can provide. Electricity (non-gas) customers have a small savings potential, providing little room for expanded services. As a result, the primary focus is on Duke's electric heat customers, or ones that use a significant amount of air conditioning (>12,000 kWh in the summer).

Program Operations

A third party contractor (GoodCents) implements the program currently. This includes operating the call center, hiring and training the auditors. The contractor has all the necessary software to collect and process the on-site audit information and translate the data into a custom report for the customers.

The program manager makes sure that the team is meeting expectations, conducts mock trainings, and sets up the on-sites visits for the auditors.

In conjunction with the contractor, the Duke program manager develops an annual marketing strategy. The marketing approach is organized by zip code targeting customers that have both electric and gas service from Duke or, in electric only territories, have high AC use in the summer.

The program enjoys a lot of media attention, especially in the fall and spring. The program manager assures that the information released about the program is accurate, coordinating messages with the contactors ability to serve.

The program has introduced the energy efficiency starter kits as a give-a-way item with the receipt of the audit. If requested, the auditor will install the items in the kit, but focuses on installing the CFL bulbs to make sure the savings are achieved.

Once the audit is completed, the report is developed and reviewed by the contractor and then mailed to the participant. The implementer reports program accomplishments and counts to Duke on a weekly basis.

Duke Energy performs periodic follow-ups and site verifications with the auditors, with assistance by Morgan Marketing Partners. There have been some adjustments to the program implementation approach as the program moved from the past contractor to a new provider (WECC).

Auditor Training

The contract calls for the implementers to train their auditors. The auditors receive one week of classroom training before they accompany a fully trained and experienced auditor for 2-3 weeks. The implementer wants to get their newly training auditing staff into the field as quickly as possible. However, in some cases auditors have gone to the field before they are fully trained. These auditors have needed additional training or coaching to develop the skills necessary to address the issues that will come up in any given house. The new contact with WECC may solve this issue by using only HERS certified raters to conduct the audits.

Implementation Changes

With the new implementation contactor moving to WECC, changes to the program are being planned. One of these changes is to make the HEHC report more user friendly and better able to convey the energy savings opportunity message to the participants. An additional change being planned is a shorter turn-around time between the audit and the delivery of the report.

Program Design

The current Home Energy House Call program was designed with input from Niagara Consulting (who helped design of the energy efficiency starter kit). Mr. Rick Morgan of Morgan Marketing Partners assists with quality review and auditor training planning. Internal Duke staff help with the development of the marketing information and manage the impact evaluation efforts.

Possible Program Improvements

The incorporation of more technologies like blower door testing or infrared imaging would help customers 'see' the energy saving opportunities; however this service is costly and could harm the participation rate and interest in the program by making it overly costly. Within the current program participants can request a blower door assessment for a cost of $125. To date, only one home has requested that test since the program started in 2003. However, as energy, energy costs and environmental issues gain in importance; more customers may be interested in this service.

Having PCs in the field with the auditors will allow them to upload and process the audit information in a more efficient manner, which will allow the reports to be delivered to the participant in a timelier manner. However, this may also be cost-prohibitive.

Participant Satisfaction Survey

One hundred of the 1,680 participants were selected at random for a telephone survey about the Home Energy House Call Program. The survey can be found in Appendix C: Participant Survey Protocol and the results of the survey are presented below.

Motivating Factors

The primary factor for participation is the customer's desire to reduce energy costs. Sixty-five percent provided this response as their primary motivating factor. The second most popular response (37% responding) was that they wanted to receive an energy audit of their home.

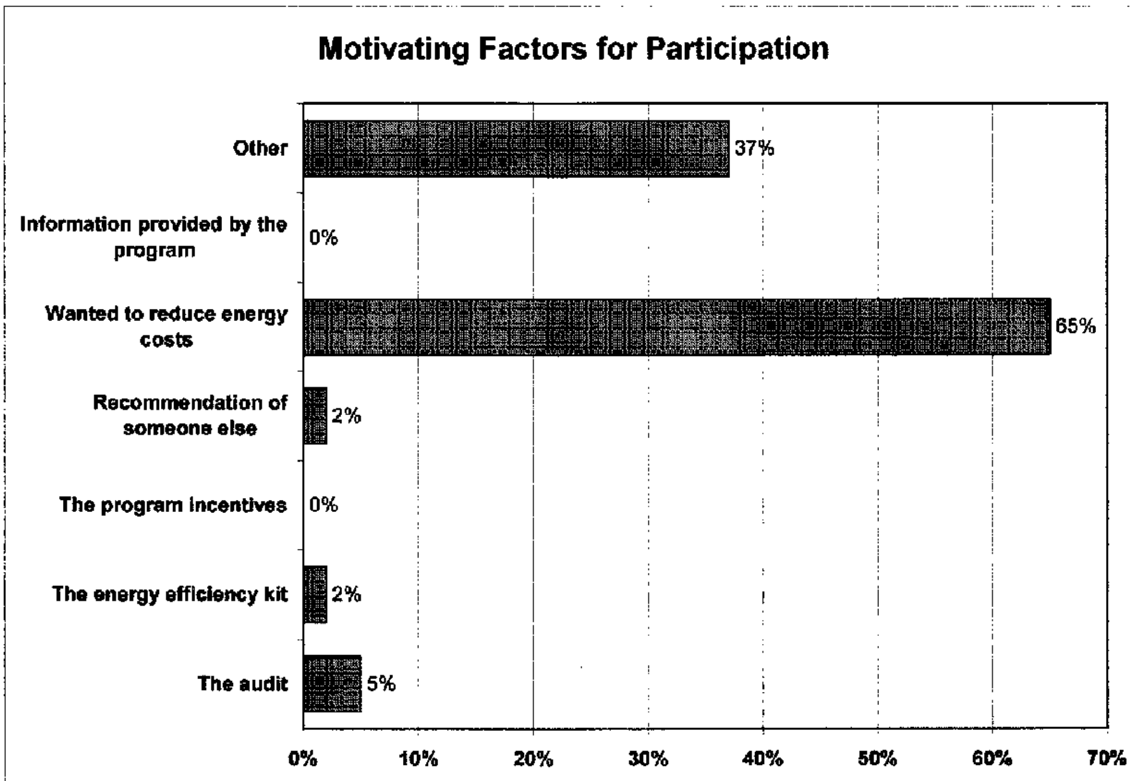

Figure 7. Motivating Factors for HEHC Participants

"Other" described:

- picked up a packet at the home show
- Big on recycling and energy saving
- conserve energy
- curious as how to save energy (n=4)
- duke asked her to
- duke shareholders
- easy
- economy
- flyer with the bill
- free and curious

- free item that was available, nothing to lose
- It was free
- look for possible improvements
- looking for something a little better
- make sure the house was efficient, get a professional opinion
- more environmental
- more responsible energy users
- *New home, wanted to check heating and insulation*
- new hot water heater and now water purifier
- not understanding delivery charges
- old house with leaks
- Received something in the mail
- reduce energy consumption
- Rising energy prices=primary, secondary=Audit several years from Cincinnati gas & electric. Registered professional engineer-wanted to see what level of information Duke was providing. Duke obtained a rate increase from public utility, therefore I was charged for it, consequently upset.
- save money
- see what improvements could be made
- Son is environmentalist, he told me about the program
- flyer in the bill
- Thought it might be a good deal
- To see what it was all about
- used to work for duke
- very concerned about the environment and carbon fuels

Audit Consideration

Almost a third (32%) of the surveyed participants were considering an audit of their home before enrolling in the program, but only 6% would have purchased one if they wouldn't have received one from through the program.

	Yes	No	DK/NS
Considered before HEHC	32	65	3
Purchased without HEHC	6	66	28
Purchased within a year without HEHC	2	0	4

However, as noted in Audit Consideration on page 40, only 3 of these responses resulted in the indication of any freeridership.

Energy Efficiency Purchases Since Enrollment in HEHC

Of the 100 participant surveyed, 36 indicated that they have made additional energy efficient upgrades since their enrollment in the HEHC program. These purchases are summarized in the table below.

The table shows that of the 60 improvements made by these 36 participants, 51 of them were suggested in the home audit report, and 9 were not suggested by the audit report. While the audit helps them make energy efficiency decisions, it is not the source of all of their energy efficiency actions. In order to gauge the influence of the audit in the actions taken by each home, we asked participants to rate the importance of the audit in their decision to take an action. The influence column presents the value associated with HEHC's influence on the decision to install the measure indicated. On a scale of 1 to 10, with 10 indicating that the decision was made with a very strong influence by their participation in the program, the mean response was 8.6, indicating that in most cases the program had an influence on the participant's decision to move forward and install energy efficient measures.

Respondent	Action Taken	Quantity	Location	Suggested In Audit?			How do you know it's efficient?	Influence
				Yes	*No*	*DK/NS*		
1	Insulation	1	ducts	X			Energy star rated	9
2	UV film on windows	1	home	X				10
	Water heater blanket	1	basement	X			Recommendation of auditor	10
	New water heater	1	basement	X			Energy star rated	10
	Seal duct work	1	home	X			Recommendation of auditor	10
3	New windows		home	X			Recommendation of auditor	10
	Insulation		home	X				10
	Caulking		home	X				10
4	Water heater	1	basement	X			Energy star rated	10
	Insulation	1	attic	X			Energy star rated	10
5	Insulation	1	attic	X			Recommendation of auditor	9
	Caulking	1	faucets	X			Recommendation of auditor	9
6	Refrigerator	1	home	X			Energy star rated	10
	Insulation	1	home	X			Energy star rated	10
7	Water heater blanket	1	basement	X			4 star rating	10
8	Taped ducts	1	home	X				10
	Sealed foundation	1	foundation	X				10
9	Tighten doors	1	home	X				9
	Check windows	1	home	X				9
10	Insulation	1	home	X			Energy star rated	7
	Caulking	1	home	X				7
	Water heater blanket	1	basement	X				7
11	Insulated pipes	1	home	X			Energy star rated	8
12	New AC	1	outside	X			Energy star rated	1
13	Insulation	1	attic	X			Energy star rated	10
14	Replaced door seal	1	home	X				10
15	Insulated water pipes	1	home	X			Recommendation of auditor	10
16	New furnace	1	basement	X			Energy star rated	
	New water heater	1	basement	X			Energy star rated	
17	Filled duct work	1	home	X				10

18	Taped duct work	1	basement	X				10
	Covered leaking coal chute	1	home	X				10
	Insulation	1	attic	X			Told us the height to go to	10
19	Taped duct work	1	home	X			Recommendation of auditor	10
	Caulking	1	home	X			Recommendation of auditor	10
20	Insulation	1	attic	X				
21	Air purifier w/ UV filter	1	home		X		Recommendation of Carrier	9
	Humidifier	1	home		X		Recommendation of Carrier	9
22	Duct couples	1	home	X				10
	Programmable thermostat	1	home	X				10
	Insulation	1	attic	X			Energy star rated	10
23	New furnace	1	basement	X			Recommendation of auditor	
	New heat pump	1	basement		X			
24	Removed drywall	1	basement	X				10
25	Sealed holes/leaks	1	home	X				10
26	Setback thermostat	1	home	X				10
	Taping duct work	1	home	X			Energy star rated	10
27	Storm door	1	home		X		Energy star rated	7
28	New furnace	1	basement	X			Energy star rated	10
	Replacement windows	1	home	X			Energy star rated	10
	New roof	1	roof	X			Energy star rated	10
29	Storm doors	2	home	X			Energy star rated	5
30	Replacement windows	3	home	X			Energy star rated	10
31	Insulation	1	home		X		Recommendation of auditor	5
	Caulking	1	home	X			Recommendation of auditor	5
32	Water heater	1	basement		X		Energy star rated	7
33	Front loading washer	1	laundry		X		Energy star rated	1
34	Insulation	1	garage	X			Energy star rated	8
35	Air conditioner	1	outside		X		Went from 8 to 13 SEER	1
36	Triple pane windows	8	home		X		Energy star rated	1

Program Satisfaction

The surveyed participants were very satisfied with the Home Energy House Call program. Figure 8 below shows the respondents' mean satisfaction scores with various aspects of the program.

Overall program satisfaction is very high at 9.07. Surveyed participants rated their satisfaction with the auditors who came to their homes and performed the audit. On a 1 to 10 scale, the auditors' friendliness, help and knowledge were rated a 9.35. The lowest satisfaction (7.51) was with the audit report providing new ideas for improving efficiency. These scores can be expected to improve with the new, more user friendly audit report currently being planned.

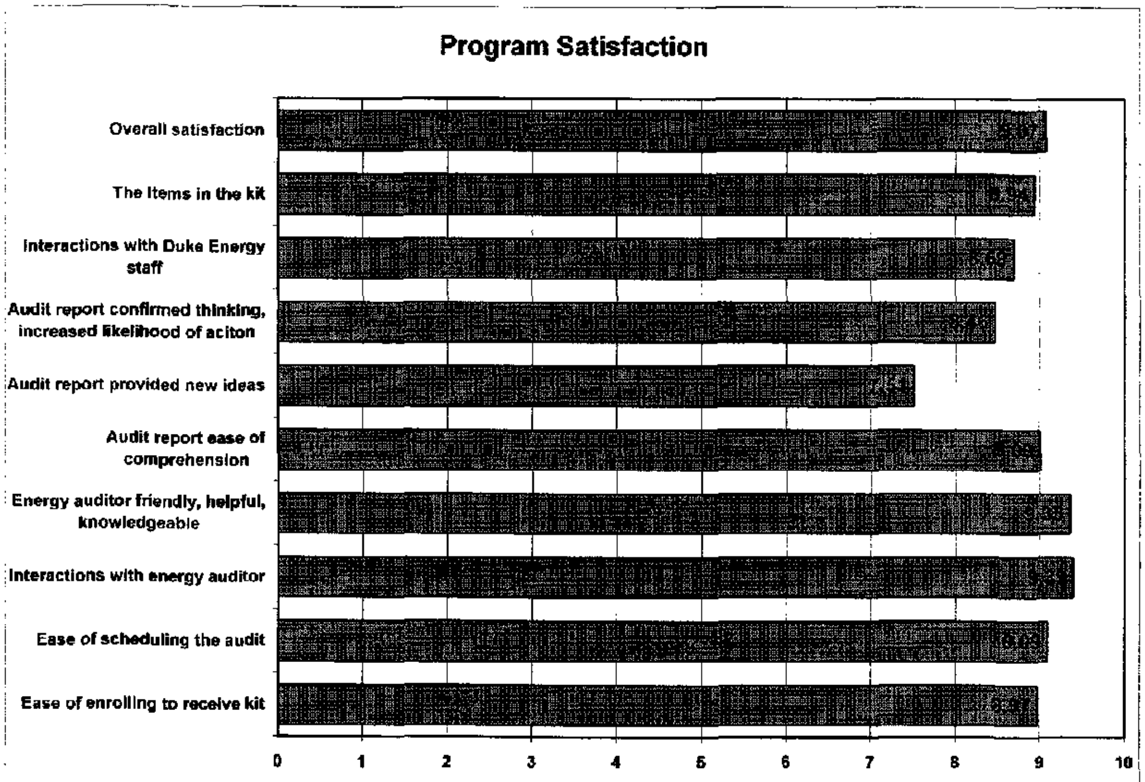

Figure 8. Program Satisfaction

Services and Program Changes Participants Would Like

We asked the 100 surveyed participants what other services they would see be a part of the HEHC program. Their responses are bulleted below:

- more information about alternative energy sources (n=5)
- cheaper electricity (n=3)
- Include a blower door test (n=2)
- have someone install the items for you (n=2)
- looking for something that would give an explanation as to why usage is so high

- windows insulation, handicap/elderly assistance
- more free perks
- more specific solutions
- provide names of places where items can be purchased or where people can be hired to do some of the work
- help with my bills
- A means of actually saving energy and money.
- If they'd provided a number for the Better Business Bureau or contractors for some of the work needed.
- Infrared camera to indicate missing insulation in walls
- New windows
- Give people information on how much it costs if they leave their computer or TV on.
- They need something for the handicapped and elderly. They should do this before winter and summer, extreme temperatures.
- A demonstration on things that are harder to visualize (techniques, products, etc)
- I'd like it to tell me in a larger way how to cut costs. Analyze my bill and see what might be wrong at certain times of the year
- more information on different programs offered through Duke
- Ability to download an electronic copy of my bill (PDF format for download)
- Research into how to reduce energy bills.
- It should be more widely promoted/advertised.
- information available for future questions or contact information in case new questions arise
- It would be helpful if they had a list of companies more friendly to people with fixed incomes.
- They could include some recommendations about behaviors or procedures to improve efficiency. Lifestyle changes.
- A follow up program to see what else can be done, make sure things were done correctly
- A follow-up audit because my bills continue to increase despite the measures I've taken
- At least provide the services they claim to provide. For example, when filling out with the auditor, there are options for additional services. One such is a blower door test, auditor was unaware of what this procedure was. Contacted Duke after the audit was received to inquire about blower test. Air infiltration is critical, and without this an energy audit is useless.
- Blower door test and infrared camera to show exactly where heat/cool air was lost
- Insulate garage underneath the house-no feedback.
- using an air infiltration test, hook up a fan to the front door and see how much air you can pull through
- Free labor to implement recommended changes
- thermal imaging camera to see where you're losing energy
- recommend someone to install the things in the kit or just do it for them, especially "dumb women" and elderly people

- IR imaging or whole house air infiltration test
- house pressure check, fan in the door test
- point out how you can get someone to take pictures and show where heat loss is
- have a fee or something to agree to an infrared house scan to see where losses are
- somebody showed you how to do some of the things in the kit

We also asked them if there were any changes they would like to see made to the program. Their responses are below:

- give averages to compare with similar homes. "Comparables."
- Bring a sheet showing how much energy different appliances use and if there is any drain when turned off.
- I'd like them to add a bill explanation specialist to explain delivery charges and explain the bill.
- perhaps some type of energy use comparison
- If they could have more auditors so people didn't have to wait as long, and they should confirm your request/approval and a time frame as to how long one must wait
- Overall thoroughness, or infrared cameras to check temperature
- ensure a reduction in my bill because the program hasn't helped me
- Funded by Duke rather than by the customers.
- decrease the time it took to get back to her about the appointment
- Information for customers on more energy efficient products and more options
- don't hire overweight auditors, get physically capable people
- letting people know about energy tax savings

We asked the surveyed participants what could be done to increase interest and participation in the program. Their suggestions are below:

- more advertisement (n=41)
- continue sending information with the bill (n=3)
- Emphasize the savings on utility bills
- watch the energy prices go up
- make them more aware of the savings
- Lower people's rates if they adopt the program
- Showing the savings
- Give discounts to those who participate
- semiannual newsletter with progress reports, promoting awareness
- Make phone calls - brochures with bills get thrown away
- If they keep raising their rates, many people will be interested
- get statements from satisfied customers
- Quit cutting down trees in Green Township
- Cost of electricity and gas doubling this winter will do it.
- a rebate for those who participate

- The rising energy costs should do that for you
- make them aware that it's a free audit
- emphasize the cost savings and the environmental impact
- show examples of before and after bills so they know how much they can save
- good PR and interaction with people
- show people where exactly they're losing their heat, would be a big selling point
- make a commercial telling people to call if they need help
- tell them how much money they can save
- Use examples to show savings from peoples' homes
- Testimonials

What Participants Liked Most

We asked the participants what they liked most about the program. Their responses are bulleted below.

- The program was free (n=15)
- The information it provided (n=12)
- The energy efficiency kit (n=10)
    - shower head
    - light bulbs
    - aerators and light bulbs
- suggestions previously not considered
- Willingness to actually come out, not just send a list of things to do
- The auditor was willing to talk and take his time and answer all questions and offered to help wherever necessary.
- savings of the light bulbs
- Duke is trying to lower energy usage free of charge.
- pretty thorough and friendly
- It was thorough and not very time consuming.
- the availability
- It was nice to get a second opinion and some new ideas
- Personal contact and personal service, and it was free
- energy audit, finding out things that I didn't know already, how to better insulate the house
- Finding out how the house rated in terms of efficiency
- The auditor was very professional and explained things very clearly and easily.
- relatively easy to set up and save some money
- It helps people save money, friendly people.
- auditor was nice, told what was needed and what wasn't
- That they made me more aware of things I can do to save money.
- The auditor.
- It shows Duke is interested in consumer consumption. It is helpful.
- I didn't expect them to come with a kit for me to implement right away

- Opportunity to have someone in my home to say specifically what to do and where.
- custom report
- Recommendations that are reasonable, it also helps new home owners take a look at what they can do to conserve energy.
- It was nice to have someone come to your home not trying to sell anything
- They supplied the items for free and helped implement them
- auditor was informative and agreeable
- Really liked the auditor. He was professional, helpful, and very polite.
- The ease of the whole thing. The report, the implementation.
- the representative was informative and nice to talk to
- It provided more energy saving ideas and methods.
- The auditor was thorough and polite and professional
- a person came out and individually looked at the house on a unique basis
- It gave a lot of people ideas they would not have thought of on their own.
- It was very efficient, they did it quickly and it was not very intrusive, it was effective.
- Nothing - it's an intentional effort to mislead the public.
- It came with some things (kit) to increase efficiency.
- Someone came and evaluated the house without trying to sell a product. Free help.
- Convenience of scheduling and availability, representative was very prompt. I also liked the distribution of efficient items.
- Pointed out things I wasn't aware of as well as insulation that could be added to improve efficiency.
- It was very educational, I learned a lot, it was pretty nice.
- Scheduled around my time and made good recommendations.
- Very helpful
- auditor gave information to save energy that they weren't familiar with
- Duke's getting out there to help people reduce their energy costs.
- It gave me some of the recommended items rather than just suggestions
- more knowledge about saving energy, ways to cut down on use
- It educates people and gives them some directions
- They were prompt
- more information on what you could do, think it will help some people
- the courtesy
- guy came out and walked through and talked about things
- concrete suggestions you could really go out and do and see immediate benefits that were quick and easy fixes
- knowing there is something you can do to improve your lifestyle and help everyone else at the same time
- the kit was nice and unexpected
- seemed very thorough
- very friendly and knowledgeable and helped save money

- got to get in pretty quickly

What Participants Liked Least

We also asked the surveyed participants what they liked least about the program. Their responses are below.

- How long it took to get the information (audit report)
- plastic over the windows
- Nothing other than still using the same amount of energy.
- When it came to reconsideration of the bill, I could not get any help from anyone for improvements needed.
- more knowledgeable staff would be desirable
- would have liked more energy savings
- The kit - most of it didn't get used.
- the report wasn't true. They wrote up the report to look good even though everything was already done.
- Getting the audit scheduled was difficult
- Followed all suggestions by the report/auditor and bills have not decreased.
- That I followed the program and my rates still increased!
- the light bulbs and the aerator-they are not aesthetically pleasing
- The fact that the changes were implemented but the rates went up which led to nothing in savings.
- All the repairs necessary.
- Limited availability.
- The duration it took to get the report and to get someone here.
- Time it took to get it done
- The time frame and not knowing if I was eligible. And they should let you know how often you can have an audit done.
- Timing. It was difficult to schedule around peoples' jobs.
- Not a significant change in the results.
- It wasn't as high tech as I expected (thorough)
- I haven't benefited from it at all yet.
- I was surprised by the follow-up letter's timing (almost a year after the audit)
- the light bulbs
- There was a lack of communication initially and we weren't sure how long the auditor would be here. They should describe the audit in more detail prior to coming out.
- That the personnel were so grossly lacking knowledge in regards to actual energy savings.
- Some of the technical jargon wasn't clear.
- It didn't provide me with any new information
- Not very well-known, it could have been advertised more widely.
- response time to the initial submission asking for an audit, took 3 months

- The auditor didn't demonstrate or explain everything.
- It's not advertised enough.
- Didn't realize the depth of the program
- The auditor
- wasn't anything they could do that wasn't thought of already
- could've gone further but don't know how
- mix-up with the mail in, didn't get a call from duke, had to call back
- got all the ideas and can't do them herself, needs some help installing them
- pretty cursory
- was hoping it would be more comprehensive, not much value added
- having to leave messages instead of getting to talk to the people
- wish they auditor was more personable; he just did his job, wasn't friendly

Appendix A: Impact Algorithms Used

The impact algorithms contained in this appendix are from the evaluation of the Personalized Energy Report done in 2007. This study included a mail-in survey with over 1,000 returned surveys. This evaluation of the Home Energy House Call Program included phone surveys of 100 participants and did not ask questions about heating and cooling fuels and systems in the home, size of windows, etc. Therefore, the values for these items are taken from the mean of the results of the PER results from 2007. These values are highlighted in these appendices whenever they were used.

CFLs

General Algorithm

Gross Summer Coincident Demand Savings

$$\Delta kW_S = \text{units} \times \left[\frac{(Watts \times DF_s)_{base} - (Watts \times DF_s)_{ee}}{1000}\right] \times CF_S \times (1 + HVAC_{d,\,s})$$

Gross Annual Energy Savings

$$\Delta kWh = \text{units} \times \left[\frac{(Watts \times DF)_{base} - (Watts \times DF)_{ee}}{1000}\right] \times FLH \times (1 + HVAC_c)$$

$$\Delta therm = \Delta kWh \times HVAC_g$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
Δtherm	= gross annual therm interaction
units	= number of units installed under the program
$Watts_{ee}$	= connected (nameplate) load of energy-efficient unit
$Watts_{base}$	= connected (nameplate) load of baseline unit(s) displaced
FLH	= full-load operating hours (based on connected load)
DF	= demand diversity factor
CF	= coincidence factor
$HVAC_c$	= HVAC system interaction factor for annual electricity consumption = 0.005443995
$HVAC_d$	= HVAC system interaction factor for demand =0.167018
$HVAC_g$	= HVAC system interaction factor for annual gas consumption = -0.00149

15 W CFL Measure

$Watts_{ee}$ = 15, which is the input power of program supplied CFL

$Watts_{base}$ - calculated from survey responses as shown below = 63.85514

Wattage of bulb removed	$Watts_{base}$	Notes
<= 44	40	Most popular size < 44 W
45 – 70	60	Lumen equivalent of 15 W CFL
71 – 99	75	Most popular size in range
> = 100	100	Most popular size in range

FLH - calculated from survey responses as shown below: = 1404.905 for 15-watt, 1340.106 For the 20-watt bulb.

Hours of use per day	FLH	Notes
<1	183	Average value over range
1-2	548	Average value over range
3-4	1278	Average value over range
5-10	2738	Average value over range
11-12	4198	Average value over range
13-24	6753	Average value over range

DF = 1.0 and CF = 0.10

The coincidence factor for this analysis was taken as the average of the coincidence factors estimated by PG&E and SCE for residential CFL program peak demand savings. The PG&E and SCE coincidence factors are combined factors that consider both coincidence and diversity, thus the diversity factor for this analysis was set to 1.0

$HVAC_c$ - the HVAC interaction factor for annual energy consumption depends on the HVAC system, heating fuel type, and location. The HVAC interaction factors for annual energy consumption were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Covington, KY

Heating Fuel	Heating System	Cooling System	HVACc	HVACg
Other	Any except Heat Pump	Any except Heat Pump	0	0
Any	Heat Pump	Heat Pump	-0.16	0
Gas Propane Oil	Central Furnace	None	0	-0.0021
		Room/Window	0.079	-0.0021
		Central AC	0.079	-0.0021
	Other	None	0	-0.0021
		Room/Window	0.079	-0.0021

		Central AC	0.079	-0.0021
Electricity	Central furnace	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0
	Electric baseboard	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0
	Other	None	-0.45	0
		Room/Window	-0.36	0
		Central AC	-0.36	0

$HVAC_d$ - the HVAC interaction factor for demand depends on the cooling system type. The HVAC interaction factors for summer peak demand were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix.

Covington, KY

Cooling System	HVACd
None	0
Room/Window	.17
Central AC	.17
Heat Pump	.17

20W CFL Measure

$Watts_{ee}$ = 20, which is the input power of program supplied CFL
$Watts_{base}$ - calculated from survey responses as shown below: = 68.52787

Wattage of bulb removed	$Watts_{base}$	Notes
<= 44	40	Most popular size < 44 W
45 – 70	60	Most popular size in range
71 – 99	75	Lumen equivalent of 20 W CFL
> = 100	100	Most popular size in range

Weatherstripping, Outlet Gaskets, and Fireplace Closure

Gross Summer Coincident Demand Savings

$\Delta kW_S = \text{units} \times (\Delta cfm/unit) \times (kW / cfm) \times DF_S \times CF_S$

Gross Annual Energy Savings

$\Delta kWh = \text{units} \times (\Delta cfm/unit) \times (kWh / cfm)$

$\Delta therm = units \times (\Delta cfm / unit) \times (therm / cfm)$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of buildings sealed under the program
Δcfm/unit	= unit infiltration airflow rate (ft^3/min) reduction for each measure
DF	= demand diversity factor = 0.8
CF	= coincidence factor = 1.0
kW/cfm	= demand savings per unit cfm reduction = 0.00164264
kWh/cfm	= electricity savings per unit cfm reduction = 4.490984952
therm/cfm	= gas savings per unit cfm reduction = 0.088377565

Unit cfm savings per measure

The cfm reductions for each measure were estimated from equivalent leakage area (ELA) change data taken from the ASHRAE Handbook of Fundamentals (ASHRAE, 2001). The equivalent leakage area changes were converted to infiltration rate changes using the Sherman-Grimsrud equation:

$$Q = ELA \times \sqrt{A \times \Delta T + B \times v^2}$$

where:

A	= stack coefficient (ft^3/min-in^4-°F) = 0.015 for one-story house
ΔT	= average indoor/outdoor temperature difference over the time interval of interest (°F)
B	= wind coefficient (ft^3/min-in^4-mph^2) = 0.0065 (moderate shielding)
v	= average wind speed over the time interval of interest measured at a local weather station at a height of 20 ft (mph)

The location specific data are shown below:

Location	Average outdoor temp	Average indoor/outdoor temp difference	Average wind speed (mph)	Specific infiltration rate (cfm/in^2)

Covington	33	35	22	1.92

Measure ELA impact and cfm reductions are as follows:

Measure	Unit	ELA change (in^2/unit)	ΔCfm/unit (KY)
Outlet gaskets	Each	0.357	0.69
Weather strip	Foot	0.089	0.17
Fireplace	Each	1.86	3.57

Unit energy and demand savings

The energy and peak demand impacts of reducing infiltration rates were calculated from infiltration rate parametric studies conducted using the DOE-2 residential building prototype models, as described at the end of this Appendix. The savings per cfm reduction by heating and cooling system type are shown below:

Heating Fuel	Heating System	Cooling System	kWh/cfm	kW/cfm	therm/cfm
Other	Any except Heat Pump	Any except Heat Pump	1.14	0.00000	0.000
Any	Heat Pump	Heat Pump	12.85	0.00248	0.000
Gas Propane Oil	Central Furnace	None	0	0	0.124
		Room/Window	1.14	0.00000	0.124
		Central AC	1.14	0.00000	0.124
	Other	None	0	0	0.124
		Room/Window	1.14	0.00000	0.124
		Central AC	1.14	0.00000	0.124
Electricity	Central furnace	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000
	Electric baseboard	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000
	Other	None	23.27	0.01238	0.000
		Room/Window	23.84	0.01485	0.000
		Central AC	23.84	0.01485	0.000

Window Shrink Kit

Gross Summer Coincident Demand Savings

ΔkW_S = no. windows ×SF/window × (ΔkW/SF) × DF_S × CF_S

Gross Annual Energy Savings
ΔkWh = no. windows ×SF/window × (ΔkWh/SF)

Δtherm = no. windows ×SF/window × (Δtherm/SF)

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
No windows	= quantity of windows treated with window film from survey
SF/window	= window square feet based on window size = 19.90221
DF	= demand diversity factor
CF	= coincidence factor
ΔkW/SF	`= electricity demand savings per square foot of window treated =0.001131
ΔkWh/SF	`= electricity consumption savings per square foot of window treated = 1.531539
Δtherm/SF	`= gas consumption savings per square foot of window treated=0.020262

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Window area assumptions (per window):

Window Type	Size (SF)
Small	9
Average	18
Large	30

Unit energy and demand savings data

The unit energy savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic simulation assumptions for window U-value and solar heat gain coefficient (SHGC) were taken from the ASHRAE Handbook of Fundamentals (ASHRAE, 2001), and are described below:

	Without window film		**With window film**	
Window type	**U-value (Btu/hr-SF-°F)**	**SHGC**	**U-value (Btu/hr-SF-°F)**	**SHGC**
Single	1.27	0.86	0.81	0.76

Single with storm	0.81	0.76	0.67	0.68
Double	0.81	0.76	0.67	0.68

The unit energy savings depend on the heating fuel, heating system, cooling system and window type:

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System None

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
All	0	0	0

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0.795	0.000853	0
Single with storm	0.566	0.000498	0
Double	0.566	0.000498	0

Heating Fuel Any
Heating System Heat Pump
Cooling System Heat Pump

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	4.757	0.001280	0.000
Single with storm	1.621	0.000711	0.000
Double	1.621	0.000711	0.000

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System None

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0	0	0.039
Single with storm	0	0	0.011
Double	0	0	0.011

Heating Fuel Gas, propane or oil

Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	0.795	0.000853	0.039
Single with storm	0.566	0.000498	0.011
Double	0.566	0.000498	0.011

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	None

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	8.748	0.004979	0.000
Single with storm	2.431	0.001351	0.000
Double	2.431	0.001351	0.000

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

Window type	ΔkWh/SF	ΔkW/SF	Δtherm/SF
Single	9.335	0.005690	0.000
Single with storm	2.940	0.001849	0.000
Double	2.940	0.001849	0.000

Low-Flow Showerhead

Gross Summer Coincident Demand Savings

$$\Delta kW_S = units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{3413_s} \times DF_x \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = \text{units} \times \frac{(\text{GPD}_{base} - \text{GPD}_{ee}) \times 8.33 \times \overline{\Delta T}}{3413} \times 365$$

$$\Delta\text{therm}= units \times \frac{(GPD_{base} - GPD_{ee}) \times 8.33 \times \overline{\Delta T}}{\eta_{waterheater}} \times \frac{365}{100000}$$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
units	= number of units installed under the program
GPD_{base}	= daily hot water consumption before installation
GPD_{ee}	= daily hot water consumption after flow reducing measure installation
ΔT	= average difference between entering cold water temperature and the shower use temperature
DF	= demand diversity factor for electric water heating
CF	= coincidence factor
8.33	= conversion factor (Btu/gal-°F)
3413	= conversion factor (Btu/kWh)
24	= conversion factor (hr/day)
365	= conversion factor (days/yr)
100000	= conversion factor (Btu/therm)

Showerhead

GPD_{base} = showers/week / 7 x 3.1 gpm x 5 minutes/shower

GPD_{ee} = showers/week / 7 x 1.5 gpm x 5 minutes/shower

ΔT

City	Average cold water temperature	Shower use temperature	Average ΔT
Covington	53.9°F	100°F	46.1°F

Water heater efficiency

Combustion efficiency for residential gas water heater = 0.70

Demand diversity factor = 0.1

Coincidence factor = 0.4

Showers/week = 8.23

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Faucet Aerators

This measure used the Efficiency Vermont deemed savings (Efficiency Vermont, 2003) adjusted for entering water temperature:

Demand Savings

$\Delta kW = 0.0171\ kW \times \Delta T / \Delta T_{VT} \times DF \times CF$

Energy Savings

$\Delta kWh_i = 57\ kWh \times \Delta T / \Delta T_{VT}$

$\Delta therms = 2.0 \times \Delta T / \Delta T_{VT\,i}$

City	Average cold water temperature	Hot water use temperature	Average ΔT
Covington	53.9°F	100°F	46.1°F
Burlington VT	44.5	100°F	55.5

Demand diversity factor = 0.1

Coincidence factor = 0.4

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for the residential water heating end-use in a summer peaking utility.

Insulated Water Heater

Gross Summer Coincident Demand Savings

$$\Delta kW_S = units \times \frac{(UA_{base} - UA_{ee}) \times \Delta T_s}{3413} \times DF_s \times CF_s$$

Gross Annual Energy Savings

$$\Delta kWh = units \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{3413} \times 8760$$

$$\Delta therm = units \times \frac{(UA_{base} - UA_{ee}) \times \overline{\Delta T}}{\eta_{waterheater}} \times \frac{8760}{100000}$$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
units = number of water heaters installed under the program
UA_{base} = overall heat transfer coefficient of base water heater (Btu/hr-°F) =4.6817
UA_{ee} = overall heat transfer coefficient of improved water heater (Btu/hr-°F)
=1.9217
ΔT = temperature difference between the tank and the ambient air (°F)
DF = demand diversity factor
CF = coincidence factor
3413 = conversion factor (Btu/kWh)
8760 = conversion factor (hr/yr)
100000 = conversion factor (Btu/therm)
$\eta_{waterheater}$ = water heater efficiency

Water heater tank UA

Water heater size (gal)	Electric		Gas	
	UAbase	UAee	UAbase	UAee
30	3.84	1.69	4.21	1.76
50	4.67	1.83	5.13	1.91
60	4.13	2.06	4.54	2.14
75	5.00	2.42	5.50	2.52
80+	5.72	2.53	6.28	2.64

ΔT = 140°F water setpoint temp – 65°F room temp = 75°F

DF = 1.0
CF= 1.0
$\eta_{waterheater} = 0.7$

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential water heaters meeting standby losses.

Attic Insulation

Gross Summer Coincident Demand Savings
$\Delta kW_S = SF \times (kW/SF_{base} - kW/SF_{ee}) \times DF_S \times CF_S$
$kW/SF_{base} = 0.002142316076294$
$kW/SF_{ee} = 0.002005940054496$

Gross Annual Energy Savings

$\Delta kWh = SF \times (kWh/SF_{base} - kWh/SF_{ee})$

$kWh/SF_{base} = 2.506253405995$

$kWh/SF_{ee} = 2.313866485014$

$\Delta therm = SF \times (therm/SF_{base} - therm/SF_{ee})$

$therm/SF_{base} = 0.03055422343324$

$therm/SF_{ee} = 0.02760245231608$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
SF = insulation square feet installed = 1796.49
DF = demand diversity factor
CF = coincidence factor
kW/SF `= electricity demand per square foot of insulation installed
kWh/SF `= electricity consumption per square foot of insulation installed
therm/SF `= gas consumption per square foot of insulation installed

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Insulation square foot assumptions:

Average house size from site data (Carolinas), or estimated from number of rooms (Kentucky)

Size of house = number of rooms * 330 SF/room

Average ceiling area = house size / 1.2

If partial insulation, then reduce ceiling area by 50%

R value assumptions

Rbase: = 12.19

Base thickness	R_{base}
2	7

4	14
6	21
8	28
10	35

Assumes existing insulation is fiberglass or cellulose, at R-3.5 per inch. This assumption addresses insulation R-value only. The R-value assumptions for other materials within the ceiling construction are embedded in the simulation model.

Ree =31.6011

The R-value of the wall with added insulation depends on base thickness, added insulation thickness and insulation type: Fiberglass, cellulose and "other" insulation is assumed to have an R-value of 3.5 per inch. Foam insulation is assumed to have an R-value of 5.6 per inch.

Base thickness	Added thickness	Ree	
		fiberglass, cellulose or other	Foam
	2	14.00	18.20
	4	21.00	29.40
	6	28.00	40.60
	8	35.00	51.80
	10	42.00	63.00
2	12	49.00	74.20
	2	21.00	25.20
	4	28.00	36.40
	6	35.00	47.60
	8	42.00	58.80
	10	49.00	70.00
4	12	56.00	81.20
	2	28.00	32.20
	4	35.00	43.40
	6	42.00	54.60
	8	49.00	65.80
	10	56.00	77.00
6	12	63.00	88.20
	2	35.00	39.20
	4	42.00	50.40
	6	49.00	61.60
	8	56.00	72.80
	10	63.00	84.00
8	12	70.00	95.20
10	2	42.00	46.20

	4	49.00	57.40
	6	56.00	68.60
	8	63.00	79.80
	10	70.00	91.00
	12	77.00	102.20
	2	49.00	53.20
	4	56.00	64.40
	6	63.00	75.60
	8	70.00	86.80
	10	77.00	98.00
12	12	84.00	109.20

Unit energy and demand data

The unit energy savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The unit energy and demand savings depend on the heating fuel, heating system, cooling system type and Rvalue

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
7	1.339	0.00157	0
14	1.272	0.00149	0
21	1.245	0.00145	0
28	1.231	0.00143	0
35	1.220	0.00142	0
42	1.214	0.00141	0
49	1.210	0.00141	0
56	1.206	0.00140	0
63	1.203	0.00140	0
70	1.201	0.00140	0

77	1.200	0.00140	0
84	1.196	0.00139	0
109	1.194	0.00139	0

Heating Fuel Any
Heating System Heat Pump
Cooling System Heat Pump

R-value	kWh/SF	kW/SF	therm/SF
7	6.550	0.00387	0.00000
14	6.121	0.00378	0.00000
21	5.937	0.00374	0.00000
28	5.833	0.00371	0.00000
35	5.768	0.00370	0.00000
42	5.724	0.00368	0.00000
49	5.689	0.00368	0.00000
56	5.665	0.00367	0.00000
63	5.644	0.00366	0.00000
70	5.628	0.00366	0.00000
77	5.616	0.00366	0.00000
84	5.605	0.00366	0.00000
109	5.576	0.00365	0.00000

Heating Fuel Gas, propane or oil
Heating System Any except Heat Pump
Cooling System None

R-value	kWh/SF	kW/SF	therm/SF
7	0	0	0.04418
14	0	0	0.04058
21	0	0	0.03908
28	0	0	0.03828
35	0	0	0.03768
42	0	0	0.03738
49	0	0	0.03708
56	0	0	0.03688
63	0	0	0.03668
70	0	0	0.03658
77	0	0	0.03648
84	0	0	0.03638
109	0	0	0.03618

Heating Fuel Gas, propane or oil

Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
7	1.339	0.00157	0.04418
14	1.272	0.00149	0.04058
21	1.245	0.00145	0.03908
28	1.231	0.00143	0.03828
35	1.220	0.00142	0.03768
42	1.214	0.00141	0.03738
49	1.210	0.00141	0.03708
56	1.206	0.00140	0.03688
63	1.203	0.00140	0.03668
70	1.201	0.00140	0.03658
77	1.200	0.00140	0.03648
84	1.196	0.00139	0.03638
109	1.194	0.00139	0.03618

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
7	9.063	0.00501	0.00000
14	8.254	0.00463	0.00000
21	7.915	0.00447	0.00000
28	7.728	0.00439	0.00000
35	7.610	0.00432	0.00000
42	7.528	0.00429	0.00000
49	7.468	0.00426	0.00000
56	7.423	0.00424	0.00000
63	7.387	0.00422	0.00000
70	7.358	0.00421	0.00000
77	7.334	0.00420	0.00000
84	7.313	0.00419	0.00000
109	7.262	0.00417	0.00000

Heating Fuel	Electricity

Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
7	10.184	0.00646	0.00000
14	9.327	0.00601	0.00000
21	8.969	0.00581	0.00000
28	8.773	0.00571	0.00000
35	8.645	0.00564	0.00000
42	8.560	0.00560	0.00000
49	8.497	0.00557	0.00000
56	8.448	0.00554	0.00000
63	8.410	0.00552	0.00000
70	8.380	0.00551	0.00000
77	8.356	0.00550	0.00000
84	8.331	0.00548	0.00000
109	8.279	0.00546	0.00000

Sidewall Insulation

Gross Summer Coincident Demand Savings

$\Delta kW_S = SF \times (kW/SF_{base} - kW/SF_{ee}) \times DF_S \times CF_S$

$kW/SF_{base} = 0.003607765957447$

$kW/SF_{ee} = 0.003208978723404$

Gross Annual Energy Savings

$\Delta kWh = SF \times (kWh/SF_{base} - kWh/SF_{ee})$

$kWh/SF_{base} = 4.66205106383$

$kWh/SF_{ee} = 3.860968085106$

$\Delta therm = SF \times (therm/SF_{base} - therm/SF_{ee})$

$therm/SF_{base} = 0.05971$

$therm/SF_{ee} = 0.04533334042553$

where:

ΔkW = gross coincident demand savings
ΔkWh = gross annual energy savings
SF = insulation square feet installed = 1960.03
DF = demand diversity factor
CF = coincidence factor
kW/SF '= electricity demand per square foot of insulation installed
kWh/SF '= electricity consumption per square foot of insulation installed

therm/SF `= gas consumption per square foot of insulation installed

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential cooling loads in summer peaking utilities.

Insulation square foot assumptions:

Average house size from site data (Carolinas), or estimated from number of rooms (KY)

Size of house = number of rooms * 330 SF/room

Number of walls	Wall area as a fraction of floor area
1	0.26
2	0.52
3	0.72
4+	0.92

R value assumptions

Rbase:

Base thickness	R_{base}
0	0.91

The base case assumes an uninsulated wall with 3.5 inch air gap. This assumption addresses "insulation" R-value only. The R-value assumptions for other materials within the wall construction are embedded in the simulation model.

Ree

The insulated wall R-value depends on added insulation thickness and insulation type. Fiberglass, cellulose and "other" insulation is assumed to have an R-value of 3.5 per inch. Foam insulation is assumed to have an R-value of 5.6 per inch.

Added thickness	Ree	
	fiberglass, cellulose or other	Foam
1-3	7.9	12.1
4-6	18.4	28.9
7-12	30.7	48.5

13+	46.4	73.7

Unit energy and demand data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The unit energy and demand savings depend on the heating fuel, heating system, cooling system type and wall Rvalue:

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	2.361	0.00273	0
7.9	2.046	0.00238	0
18.4	1.950	0.00227	0
30.7	1.908	0.00224	0
46.4	1.887	0.00220	0
12.1	1.988	0.00230	0
28.9	1.917	0.00224	0
48.5	1.886	0.00220	0
73.7	1.874	0.00220	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

R-value	kWh/SF	kW/SF	therm/SF
0.91	12.078	0.00655	0.00000
7.9	9.865	0.00605	0.00000
18.4	9.160	0.00588	0.00000
30.7	8.892	0.00581	0.00000
46.4	8.734	0.00578	0.00000

12.1	9.477	0.00597	0.00000
28.9	8.918	0.00583	0.00000
48.5	8.721	0.00578	0.00000
73.7	8.620	0.00575	0.00000

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
0.91	0	0	0.08530
7.9	0	0	0.06565
18.4	0	0	0.05974
30.7	0	0	0.05751
46.4	0	0	0.05623
12.1	0	0	0.06230
28.9	0	0	0.05767
48.5	0	0	0.05623
73.7	0	0	0.05543

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	2.361	0.00273	0.08530
7.9	2.046	0.00238	0.06565
18.4	1.950	0.00227	0.05974
30.7	1.908	0.00224	0.05751
46.4	1.887	0.00220	0.05623
12.1	1.988	0.00230	0.06230
28.9	1.917	0.00224	0.05767
48.5	1.886	0.00220	0.05623
73.7	1.874	0.00220	0.05543

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	None

R-value	kWh/SF	kW/SF	therm/SF
0.91	17.807	0.00963	0
7.9	13.354	0.00749	0
18.4	12.045	0.00685	0
30.7	11.552	0.00663	0
46.4	11.277	0.00650	0
12.1	12.616	0.00712	0
28.9	11.599	0.00665	0
48.5	11.254	0.00649	0
73.7	11.075	0.00641	0

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	Room/Window or Central AC

R-value	kWh/SF	kW/SF	therm/SF
0.91	12.078	0.00655	0.00000
7.9	9.865	0.00605	0.00000
18.4	9.160	0.00588	0.00000
30.7	8.892	0.00581	0.00000
46.4	8.734	0.00578	0.00000
12.1	9.477	0.00597	0.00000
28.9	8.918	0.00583	0.00000
48.5	8.721	0.00578	0.00000
73.7	8.620	0.00575	0.00000

Duct Insulation and Repair

Gross Summer Coincident Demand Savings
$\Delta kW_S = (\Delta kW/unit) \times DF_S \times CF_S \times LF$

Gross Annual Energy Savings
$\Delta kWh = (\Delta kWh/unit) \times LF$

$\Delta therm = (\Delta therm/unit) \times LF$

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
DF	= demand diversity factor

CF = coincidence factor
LF = location factor = 0.43
ΔkWunit `= electricity demand savings per dwelling
Insulate = 0.4898181818182
Repair = 0.6379347826087

ΔkWh/SF `= electricity consumption savings per dwelling
Insulate = 928.438961039
Repair = 1057.532608696

Δtherm/SF `= gas consumption savings dwelling
Insulate = 11.83695652174
Repair = 12.58181818182

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential air conditioners and heat pumps in summer peaking utilities.

The location factors used are as follows:

Heated Area	Unheated Area	DK/No Response
0	1	.43

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic assumptions are listed below:

Assumption	Pre treatment	Post treatment	Notes
Duct insulation	Uninsulated	R-19	Consistent with Smart Saver program requirements
Duct sealing	26% leakage	8% leakage	Duct leakage assumptions used in CA for Title 24 and utility program design. Evenly distributed between

			supply and return

The unit energy and demand savings depend on the heating fuel, heating system, cooling system and duct treatment as follows:

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0	0	0

Heating Fuel Other
Heating System Any except Heat Pump
Cooling System Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	384	0.10	0
Seal	466	0.25	0

Heating Fuel Any
Heating System Heat Pump
Cooling System Heat Pump

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	1,520	0.48	0.0
Seal	2,422	0.78	0.0

Heating Fuel Gas, propane or oil
Heating System Furnace
Cooling System None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	0.0	0.0	17.3
Seal	0.0	0.0	16.5

Heating Fuel Gas, propane or oil
Heating System Furnace
Cooling System Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	384	0.10	17.3
Seal	466	0.25	16.5

Heating Fuel	Electricity
Heating System	Furnace
Cooling System	None

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	3,917	3.13	0.0
Seal	3,798	2.98	0.0

Heating Fuel	Electricity
Heating System	Furnace
Cooling System	Central AC

Duct treatment	ΔkWh/unit	ΔkW/unit	Δtherm/unit
Insulate	4,285	3.18	0.0
Seal	4,211	3.18	0.0

Installed a New AC or Heat Pump

Gross Summer Coincident Demand Savings

$\Delta kW_S = (\Delta kW/unit) \times DF_S \times CF_S$

AC = 1.138835274542

Heatpump = 1.552048338369

Gross Annual Energy Savings

$\Delta kWh = (\Delta kWh/unit)$

AC = 1375.059900166

Heatpump = 2568.123867069

Δtherm = (Δtherm/unit

AC = 0

Heatpump = 0

where:

ΔkW	= gross coincident demand savings
ΔkWh	= gross annual energy savings
DF	= demand diversity factor
CF	= coincidence factor
ΔkWunit	`= electricity demand savings per dwelling
ΔkWh/SF	`= electricity consumption savings per dwelling
Δtherm/SF	`= gas consumption savings dwelling

Coincidence and Diversity Factors:

DF = 0.8
CF = 1.0

The diversity and coincidence factors were taken from *Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2* (EPRI, 1993). These values are typical for residential air conditioners and heat pumps in summer peaking utilities.

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. Unit energy savings are based on replacement of an existing SEER 8.5 air conditioner or heat pump. The unit energy and demand savings depend on the heating fuel, heating system, cooling system and replacement efficiency.

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0	0	0

Heating Fuel	Other
Heating System	Any except Heat Pump
Cooling System	Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

Heating Fuel	Any
Heating System	Heat Pump
Cooling System	Heat Pump

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	2,941	1.36	0
12	2,941	1.36	0
13	5,294	2.45	0
14+	6,496	2.98	0

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0.0	0.0	0

Heating Fuel	Gas, propane or oil
Heating System	Any except Heat Pump
Cooling System	Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

0

Heating Fuel	Electricity
Heating System	Any except Heat Pump
Cooling System	None

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
All	0.0	0.0	0

Heating Fuel	Electricity
Heating System	Any except Heat Pump

Cooling System Central AC

Replacement efficiency	ΔkWh/unit	ΔkW/unit	Δtherm/unit
<11	674	0.92	0
12	944	1.28	0
13	1,213	1.65	0
14+	1,346	1.80	0

Installed a New Furnace

Gross Annual Energy Savings
Δtherm = (Δtherm/unit)
=16.34529540481

where:

Δtherm/SF `= gas consumption savings dwelling

Unit energy and demand savings data

The unit energy and demand savings were taken from DOE-2 simulations of the residential prototype building described at the end of this Appendix. The basic assumptions are listed below:

Furnace Type	AFUE
Baseline	0.78
Standard efficiency (metal flue pipe) replacement	0.80
Condensing furnace (plastic flue pipe) replacement	0.90

The unit energy and demand savings depend on the heating fuel, heating system type, and replacement furnace type:

Heating Fuel Gas, propane or oil
Heating System Furnace

Replacement efficiency	Δtherm/unit
Standard (metal pipe)	3.0
Condensing (plastic pipe)	18.8

Otherwise 0

Prototypical Building Model Description

The impact analysis for many of the HVAC related measures are based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study (Itron, 2005), with adjustments make for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 9.

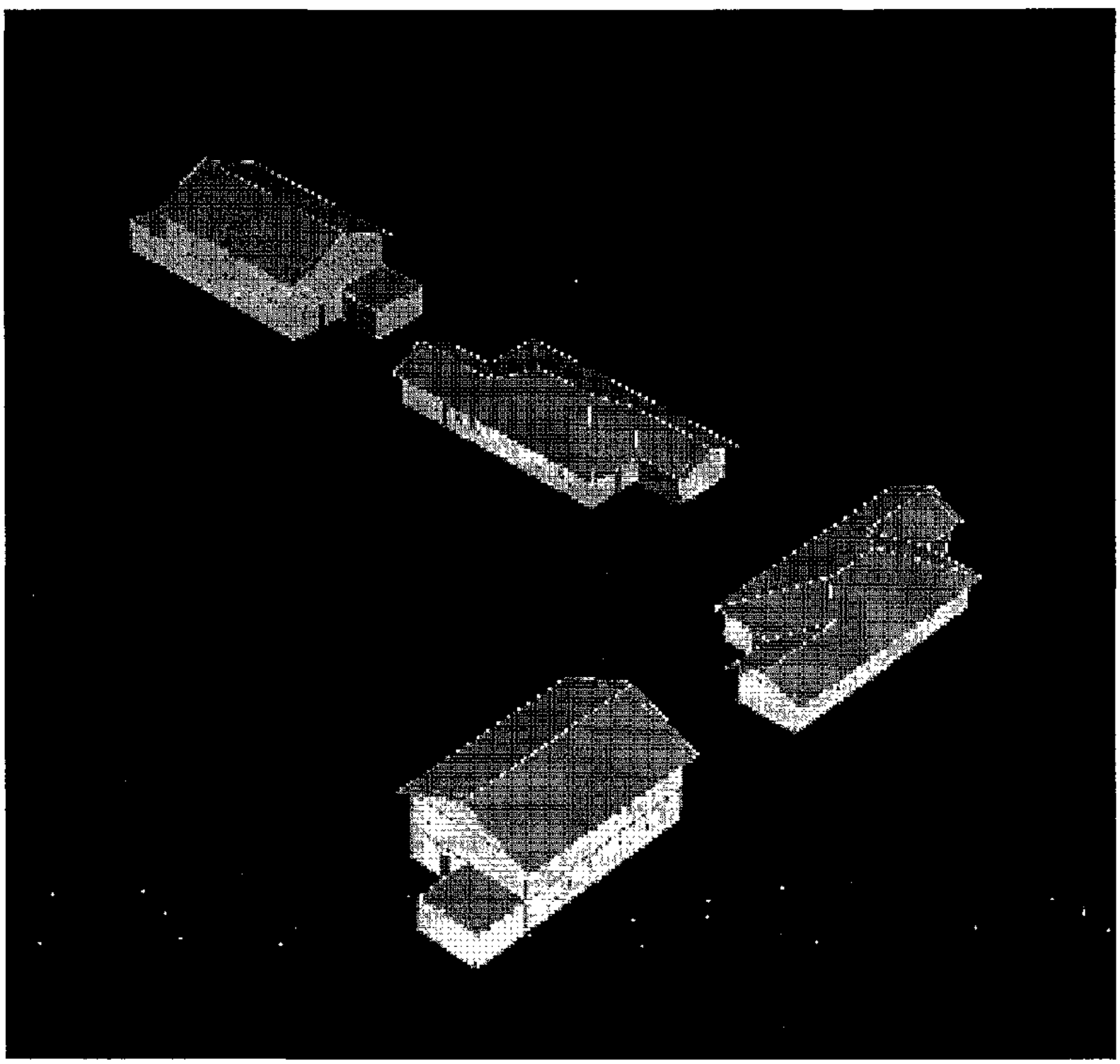

Figure 9. Computer Rendering of Residential Building Prototype Model

The general characteristics of the residential building prototype model are summarized below:

Residential Building Prototype Description

Characteristic	Value
Conditioned floor area	1 story house: 1465 SF 2 story house: 2930 SF
Wall construction and R-value	Wood frame with siding, R-11
Roof construction and R-value	Wood frame with asphalt shingles, R-19
Glazing type	Single pane clear
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Average 640 SF/ton
HVAC system efficiency	SEER = 8.5
Thermostat setpoints	Heating: 70°F with setback to 60°F Cooling: 75°F with setup to 80°F
Duct location	Attic (unconditioned space)
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Uninsulated
Duct leakage	26%; evenly distributed between supply and return
Cooling season	Charlotte – April 17 to October 6 Covington
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

References

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EPRI, 1993. Engineering Methods for Estimating the Impacts of DSM Programs, Volume 2: Fundamental Equations for Residential and Commercial End-Uses, EPRI TR-100984 V2., Electric Power Research Institute, Palo Alto, CA. 1993.

Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Appendix B: Program Manager Interview Instrument

Name: ____

Title: ____

Position description and general responsibilities:

____

____

____

We are conducting this interview to obtain your opinions about and experiences with the Home Energy House Call program. We'll talk about the Home Energy House Call Program and its objectives, your thoughts on improving the program, and the technologies the program covers. The interview will take about an hour to complete. May we begin?

Program Objectives

1. In your own words, please describe the Home Energy House Call's current objectives. How have these changed over time?

2. In your opinion, which objectives do you think are best being met or will be met?

3. Are there any program objectives that are not being addressed or not being addressed as well as possible or that you think should have more attention focused on them? If yes, which ones? How should these objectives be addressed? What should be changed?

4. Should the program objectives be changed in any way due to technology-based, market-based, or management based conditions? What objectives would you change? What program changes would you put into place as a result, and how would it affect the operations of the program?

Operational Efficiency

5. Please describe your role and scope of responsibility in detail. What is it that you are responsible for as it relates to this program?

6. Please review with us how the Home Energy House Call operates relative to your duties, that is, please walk us through the processes and procedures and key events that allow you do currently fulfill your duties.

7. Have any recent changes been made to your duties? If so, please tell us what changes were made and why they were made. What are the results of the change?

8. Describe the evolution of the Home Energy House Call Program. How has the program changed since it was it first started?

9. Do you have suggestions for improvements to the program that would increase participation rates or interest levels?

10. Do you have suggestions for improving or increasing energy impacts?

11. Do you have suggestion for the making the program operate more smoothly or effectively?

Program Design & Implementation

12. *(If not captured earlier)* Please explain how the interactions between the auditors, customers and Home Energy House Call's management team work. Do you think these interactions or means of communication should be changed in any way? If so, how and why?

13. Describe your quality control and tracking process.

14. Are key industry experts, trade professionals or peers used for assessing what the technologies or models should be included in the program? If so, how does this work?

15. Are key industry experts and trade professionals used in other advisory roles? If so how does this work and what kinds of support is obtained?

16. Describe Home Energy House Call's auditor program orientation training and development approach. Are auditors getting adequate program training and program information? What can be done that could help improve auditor effectiveness? Can we obtain training materials that are being used?

17. In your opinion, do the audits cover enough different kinds of energy efficient products or recommendations?

    1. ❑ Yes 2. ❑ No 99. ❑ DK/NS

    If no, 20b. What other products or equipment should be included? Why?

---

18. What market information, research or market assessments are you using to determine the best target markets or market segments to focus on?

19. What market information, research or market assessments are you using to identify market barriers, and develop more effective delivery mechanisms?

20. Overall, what about the Home Energy House Call program works well and why?

21. What doesn't work well and why? Do you think this discourages participation or interest?

22. Can you identify any market, operational or technical barriers that impede a more efficient program operation?

23. In what ways can these operations or operational efficiencies be improved?

24. In what ways can the program attract more participants?

25. How do you make sure that the best information and practices are being used in Home Energy House Call operations?

26. *(If not collected above)* What market information, research or market assessments are you using to determine the best target markets and program opportunities, market barriers, delivery mechanisms and program approach?

27. If you had a magic wand, what one thing would you change and why?

28. Are their any other issues or topics you think we should know about and discuss for this evaluation?

Appendix C: Participant Survey Protocol

The questions below require mostly short, scaled replies from the interviewee, and not all questions will be asked of all participants. This interview should take approximately 10 to 15 minutes.

Home Energy House Call Program

Participant Survey

Contact Module
SURVEY INTRODUCTION

If Home Energy House Call participant, then contact for survey. Use seven attempts at different times of the day and different days before dropping from contact list. Call times are from 10:00 a.m. to 8:00 p.m. EST or 9-7 CST Monday through Saturday. No calls on Sunday. (Sample size N =150-200)

SURVEY

Introduction

Note: Only read words in bold type.

Hello, my name is ______. I am calling on behalf of Duke Energy to conduct a customer survey about the Home Energy House Call Program. May I speak with ____________ please?
If person talking, proceed. If person is called to the phone reintroduce.
If not home, ask when would be a good time to call and schedule the call-back:

Call back 1:	Date: __________,	Time: ____________	❑AM or ❑PM
Call back 2:	Date: __________,	Time: ____________	❑AM or ❑PM
Call back 3:	Date: __________,	Time: ____________	❑AM or ❑PM
Call back 4:	Date: __________,	Time: ____________	❑AM or ❑PM
Call back 5:	Date: __________,	Time: ____________	❑AM or ❑PM
Call back 6:	Date: __________,	Time: ____________	❑AM or ❑PM
Call back 7:	Date: __________,	Time: ____________	❑AM or ❑PM

❑ Contact dropped after seventh attempt.

We are conducting this survey to obtain your opinions about the Home Energy House Call Program. Duke Energy's records indicate that you participated in the Home Energy House Call Program. We are not selling anything. The survey will take about 10 minutes and your answers will be confidential, and will help us to make improvements to the program to better serve others. May we begin the survey?

Note: If this is not a good time, ask if there is a better time to schedule a callback.

1. **Do you recall participating in the Home Energy House Call Program?**

1. ❑ Yes, *begin* → *Skip to Q3.*
2. ❑ No,
99. ❑ DK/NS

This program was provided through Duke Energy. In this program, you registered to receive a home energy audit. In return, the auditors provided you with custom energy-saving recommendations for you and your home, and you were provided with a free energy efficiency kit with 10 measures, such as a low-flow showerhead, CFLs, and outlet gaskets.

Do you remember participating in this program?

1. ❑ Yes, *begin* → *Go to Q2.*
2. ❑ No,
99. ❑ DK/NS

If No or DK/NS terminate interview and go to next participant.

2. Please think back to the time when you were deciding to participate in the Home Energy House Call program. What factors motivated you to participate? ***(do not read list, place a "1" next to the response that matches best)***

1. ____ The audit
2. ____ The energy efficiency kit
3. ____ The program incentives
4. ____ The technical assistance from the auditor
5. ____ Recommendation of someone else (*Probe*: **Who?**__________)
6. ____ Wanted to reduce energy costs
7. ____ The information provided by the Program
8. ____ Past experience with this program
9. ____ Because of past experience with another Duke Energy program
10. ____ Recommendation from other utility program

i. (*Probe*: **What program?** ______________________)
11. ____ Recommendation of family/friend/neighbor
12. ____ Advertisement in newspaper (*Probe:* **For what program?** __________)
13. ____ Radio advertisement (*Probe:* **For what program?** ___________)
14. ____ Other (SPECIFY)

____
15. ____ Don't know/don't remember/not sure (DK/NS)

If multiple responses: 2.a. **Were there any other reasons?** *(number responses above in the order they are provided - Repeat until 'no' response.)*

Free-Ridership Questions

3. **Before you heard about the Home Energy House Call from Duke Energy, had you already been considering getting a home energy audit?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

4. **If the audit from Duke Energy's Home Energy House Call Program had not been available, would you still have:**

4a. **Purchased an audit?**

1. ❑ Yes
2. ❑ No – *skip to question 5*
3. ❑ Don't Know – *skip to question 5*

4b. **Would you have purchased the audit within the next year?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

5. **Now I'd like to talk about the energy efficiency kit that you received for participating in the Home Energy House Call program. I'm going to read a list of the items included in the kit, and for each one, please tell me if you have installed the item. Are you using the...**

5a. **15-watt CFL** ❑ Yes – *triggers follow up questions 6a-6d.*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 6a-6d.* ❑ No ❑ Maybe/DK

❑ DK

5b. **20-watt CFL** ❑ Yes – *triggers follow up questions 6a-6d.*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 6a-6d.* ❑ No ❑ Maybe/DK

❑ DK

5c. **Low-flow showerhead** ❑ Yes – *triggers follow up questions 7a-7d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 7a-7d.* ❑ No ❑ Maybe/DK

❑ DK

5d. **kitchen faucet aerator** ❑ Yes – *triggers follow up questions 8a-8d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 8a-8d.* ❑ No ❑ Maybe/DK

❑ DK

5e. **bathroom faucet aerator** ❑ Yes – *triggers follow up questions 8a-8d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 8a-8d.* ❑ No ❑ Maybe/DK

❑ DK

5f. **outlet gaskets** ❑ Yes – *triggers follow up questions 9a-9d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 9a-9d.* ❑ No ❑ Maybe/DK

❑ DK

5g. **window shrink kit** ❑ Yes – *triggers follow up questions 10a-10d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 10a-10d.* ❑ No ❑ Maybe/DK

❑ DK

5h. **weather stripping** ❑ Yes – *triggers follow up questions 11a-11d*

❑ No **Do you plan on using this item?** ❑ Yes – *triggers 11a-11d.* ❑ No ❑ Maybe/DK

❑ DK

6a. **Did you have any CFLs installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

6b. **Were you planning on buying** <additional> **CFLs for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available sockets – *skip to next series*

6c. **Have you purchased any CFLs since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 6d. **How many?** ____________

7a. **Did you have any low-flow showerheads installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

7b. **Were you planning on buying a low-flow showerhead for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all showers – *skip to next series*

7c. **Have you purchased any additional low-flow showerheads since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 7d. **How many?** ________________

8a. **Did you have any faucet aerators installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

8b. **Were you planning on buying any faucet aerators for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available faucets – *skip to next series*

8c. **Have you purchased any additional faucet aerators since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 8d. **How many?** ________________

9a. **Did you have any outlet gaskets installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

9b. **Were you planning on buying any outlet gaskets for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available outlets – *skip to next series*

9c. **Have you purchased any additional outlet gaskets since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 9d. **How many?** ________________

10a. **Did you have any window shrink kits installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

10b. **Were you planning on buying any window shrink kits for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed in all available windows – *skip to next series*

10c. **Have you purchased any additional window shrink kits since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 10d. **For how many windows?**

____

11a. **Did you have any weather stripping installed in your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ DK

11b. **Were you planning on buying any weather stripping for your home before you received the kit from the Home Energy House Call program?**

❑ Yes ❑ No ❑ Maybe ❑ DK

❑ No, already have them installed around all available doors – *skip to next series*

11c. **Have you purchased any additional weather stripping since receiving the kit from Home Energy House Call?**

❑ Yes ❑ No ❑ DK

If yes, 11d. **For how many doors?**

____

Spillover Questions

12. **Since you participated in the Home Energy House Call Program, have you purchased and installed any other type of energy efficiency equipment or made energy efficiency improvements in your home that were recommended by the audit report?**

1. ❑ Yes
2. ❑ No
3. ❑ Don't Know

13. **What type and quantity of high efficiency equipment did you install on your own?** *PROBE TO GET EXACT TYPE AND QUANTITY AND LOCATION*

Type 1: ________	Quantity 1: ____	Location 1: ________
Type 2: ________	Quantity 2: ____	Location 2: ________
Type 3: ________	Quantity 3: ____	Location 3: ________
Type 4: ________	Quantity 4: ____	Location 4: ________

14. **Was this improvement suggested by the home energy audit provided to you through the Home Energy House Call program?**

Type 1: ________	❑ Yes	❑ No	❑ DK
Type 1: ________	❑ Yes	❑ No	❑ DK
Type 1: ________	❑ Yes	❑ No	❑ DK
Type 1: ________	❑ Yes	❑ No	❑ DK

15. *For each type listed in 13 above,* **How do you know that this equipment is high efficiency? For example, was it Energy Star rated?**

Type 1: ________________
Type 2: ________________
Type 3: ________________
Type 4: ________________

I'm going to read a statement about this equipment that you purchased on your own. On a scale from 1-10, with 0 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statement.

16. **My experience with the Home Energy House Call Program in** <2006, 2007, 2008> **influenced my decision to install** <Type 1/Type 2/Type 3/Type 4> **on my own.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

17. What other actions, if any, have you taken in your home to save energy and reduce utility bills at least in part as a result of what you learned in this program?

Response:1 ____________________

Response:2 ____________________

Response:3 ____________________

Response:4 ____________________

Now I am going to ask you some general satisfaction statements. On a scale from 1-10, with 0 indicating that you strongly disagree, and 10 indicating that you strongly agree, please rate the following statements.

18. **The web site's form for getting the kit was easy to understand and complete.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved?**____________________

____

19. **Scheduling the home energy audit was easy to do.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved?**____________________

____

20. **The interactions and communications I had with the energy auditor were satisfactory.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved?**____________________

____

21. **The energy auditor was friendly, helpful, and knowledgeable.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved?**______________________________

22. **The audit report was easy to read and understand.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved?**______________________________

23. **The recommendations in the audit report provided new ideas that I was not previously considering.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved?**______________________________

24. **The recommendations in the audit report confirmed by thinking and increased the likelihood that I would take recommended actions.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved?**______________________________

25. **The interactions and communications I had with Duke Energy staff was satisfactory.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know ❑ Not Applicable (no interaction)

If 7 or less, **How could this be improved?**______________________________

____

26. **The measures I installed from in the energy efficiency kit were of satisfactory quality.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved?**______________________________

____

27. **Overall I am satisfied with the program.**

1 2 3 4 5 6 7 8 9 10

❑ Don't Know

If 7 or less, **How could this be improved?**______________________________

____

28. What additional services would you like the program to provide that it does not now provide?
Response:

____

____

29. Are there any other things that you would like to see changed about the program?

Response:

____

30. **What do you think can be done to increase people's interest in participating in the Home Energy House Call Program?**

Response:1 ____
Response:2 ____
Response:3 ____
Response:4 ____

32. What do you like most about this program?

Response:

____

33. What do you like least about this program?

Response:

____

Appendix C

Final Report

An Evaluation of the Smart Saver Program in Ohio

Results of a Process and Impact Evaluation

September 29, 2008

Prepared for

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Executive Summary

About This Report

This report presents the results of a process and impact evaluation of Duke Energy's Smart Saver Program as it is operated in Ohio. The Smart Saver Program provides incentives to customers to upgrade to an energy efficient heat pump or air conditioner in existing homes. The program saves energy by helping customers obtain efficient heating and air conditioning units that out-perform older or less efficient furnaces and air conditioning. The study focuses on participants from program year 2007 to the present (November 2007 through May 2008).

The first section of this report provides the results from the process evaluation. This effort employed in-depth interviews with program design, planning and implementation staff, in-depth interviews with partnering contractors, and 100 surveys of program participants.

The second section provides findings from the impact evaluation efforts. The impact evaluation employed a tracking system review, review of monitored data on HVAC unit fan power supplied by Duke Energy, a set of contractor interviews and building energy simulation modeling of typical residential buildings to estimate the program savings.

Summary of Findings

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

Significant Process Evaluation Findings

- Contractors, builders and participants are all very happy with the program, in contrast to the last evaluation of the Smart Saver program performed in 2007 (which was done for Indiana in which many contractors were not happy with the technologies and communication and with the lack of field representatives). This program does not appear to have any significant operational issues.
- The length of time between the application submittal and the receipt of the rebate is an average of 6.6 days, with a median of 4 days. Generally, the rebates are delivered in a timely manner. However, there were a few complaints about the length of time it took to receive the rebate – with some contractors reporting a wait of more than three months.
- The ARI web site (the web site that contractors must use to obtain equipment information to complete the rebate forms) and paperwork is a minor issue reported by the respondents. The web site does not always respond, resulting in delays in completing the paperwork. Also, the ARI documentation is viewed as unnecessary by some of the contractors because they believe this is something that could be more easily done by program staff.
- There is a notable amount of spillover associated with the Smart Saver program in Ohio (see table below). Twenty-seven percent (27%) of the 5,015 Ohio customers who participated in the program since 2007 reported that the program was at least partially responsible for causing them to take additional actions. These additional actions are estimated to provide these customers with approximately 178 kW of net

energy savings. In addition, almost 600,000 spillover kilowatt hours and over 4,000 spillover therms are saved annually over the lifetime of the measures.

Spillover Impacts	kW	kWh	Therms
Gross	355.413	1,141,942	10,195
Net	178.062	572,113	5,108

Significant Impact Findings

The gross and net energy and demand savings estimated by this evaluation are summarized in Table 1 below. These savings estimates were calculated for the program as operated during the evaluation period, with a SEER 13 baseline for normal replacement units and a SEER 10 baseline for early replacement units. Baseline furnace efficiency was 0.78 AFUE.

Table 1. Evaluation Unit Energy and Demand Savings Estimates

Measure	Covington		
	kWh/ton	kW/ton	Therm/ton
Gas_seer14	356	0.181	62
Gas_seer15	431	0.215	60
Gas_seer16	584	0.315	55
Gas_seer17	637	0.330	55
Hp_seer14	1077	0.133	0
Hp_seer15	1087	0.200	0
Hp_seer16	1473	0.318	0
Hp_seer17	1539	0.266	0
Hp_seer18	1591	0.323	0
Dfhp_seer14	683	0.133	30
Dfhp_seer15	909	0.200	23
Dfhp_seer16	1231	0.318	25
Dfhp_seer17	1317	0.266	24
Dfhp_seer18	1359	0.323	25
All AC	408	0.208	61
All Heat pumps	1106	0.192	6
Measure	kWh/kSF	kW/kSF	Therm/kSF
Hi effic gas furnace	0	0.000	98
Gas furnace plus ECM	356	0.042	91

Program free ridership was estimated at 37.2%. The total gross and net energy savings for the program[1] are shown in Table 2 below.

Table 2. Duke Energy Smart Saver Program Planning Unit Savings Estimates

	kWh	kW	Therm
Gross program savings	3,315,148	933	1,019,463
Net program savings	2,081,913	586	640,223

Recommendations

1. Move to an electronic application submission. This was cited by contractors in the previous evaluation and in this current one. Online submission will make it easier and faster for the contractors to complete the application process. This approach should be established with a confirmation protocol allowing the contactors to know that their application was submitted, providing them with a tracking number and an e-mail confirmation for reference tracking. Currently, many applications are faxed to Duke. The contractors report having to wait for the rebate check to arrive before they know if the application was received and approved for payment.
2. With the move to an on-line application process, eliminate or reduce the documentation required to complete the ARI documentation requirement if feasible to do so. If the application is submitted this check can be part of the on-line automated effort.

[1] The program total savings are based on 675 air conditioner applications, 673 heat pump applications, and 3,667 high efficiency gas furnace applications. Each of the air conditioners and 160 of the heat pumps were bundled with a high efficiency furnace; the remaining furnace applications were stand-alone.

Introduction

This report presents the results of a process and impact evaluation of the Smart Saver Program. To conduct the process evaluation we interviewed program managers, product vendors/dealers/contractors/distributors, and program participants.

Program Description

Smart Saver® promotes the use of high-efficiency heat pumps, air-conditioning systems and Gas furnaces. The Smart Saver Program is available to Duke Energy residential customers in Ohio. The program offers customers an incentive to purchase an energy efficient HVAC system for new and existing homes.

Evaluation Methodology

Process Evaluation

The process evaluation included an offsite interview with the Duke Energy program manager. This interview 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:

1. Dan Welklin, Duke Energy Program Manager

The interview was conducted in July of 2008, 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 process interviews.

We also interviewed seven out of a possible 27 builders and ten of the 145 partnering dealers for which we were provided contact data and also had more than 3 projects. The builders and contractors were randomly selected for interviews.

Figure 1 below shows how the number of Smart Saver projects is dominated by a small number of these partnering dealers. These partners processed a total of 4,006 installations during the period of time covered by this evaluation (November 2007 through May 2008).

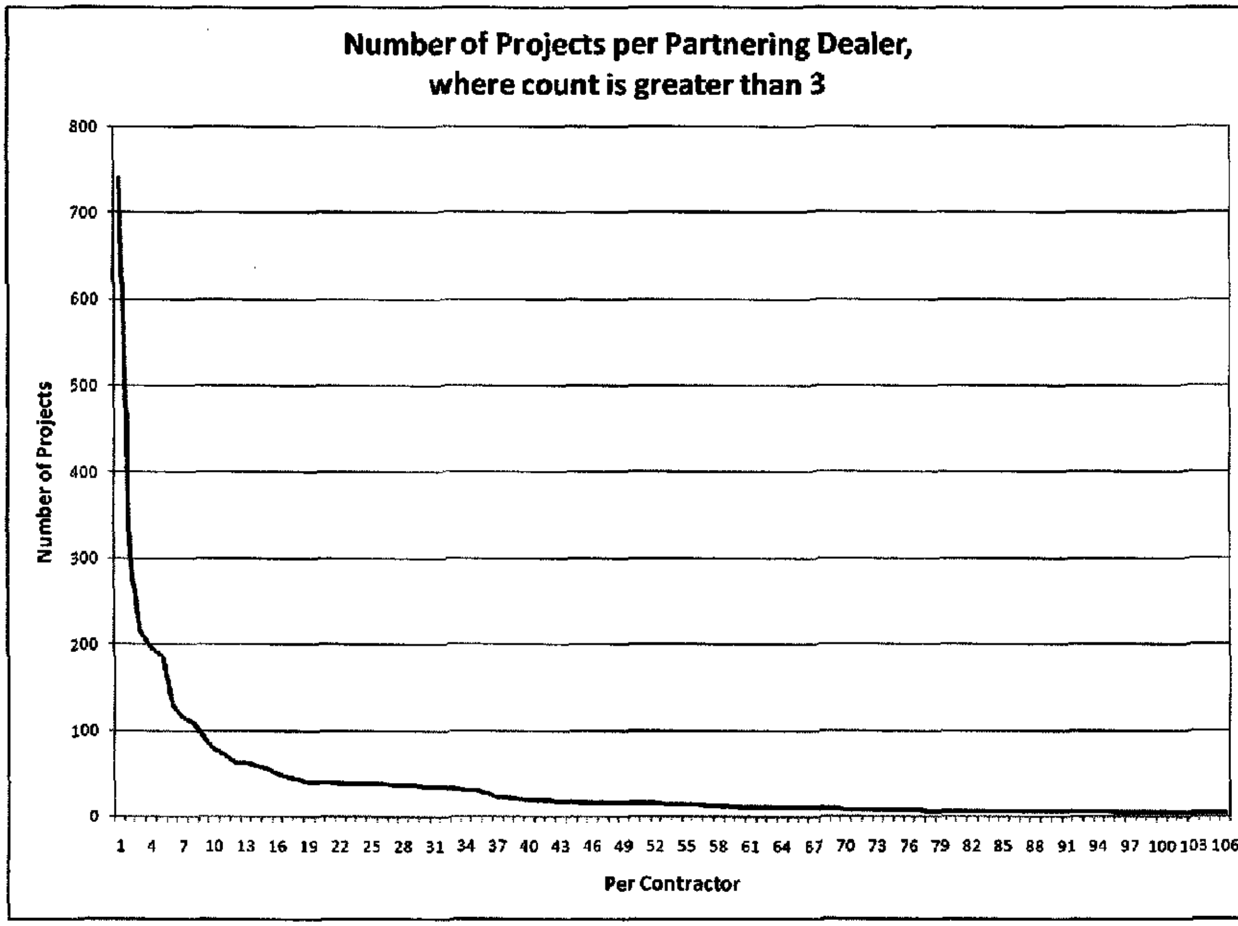

Figure 1. Number of Projects per Smart Saver Partnering Dealer

Gross Energy Impact Analysis

The impact evaluation used program participation records and the results of the interviews with program contractors to identify the range of equipment used and the installation decisions that would have been made without the program. During the interviews we asked questions about early-replacement and replace-on-failure decisions, estimates of remaining life of early replacement units and if they are installing additional measures such as duct insulation and sealing, and programmable thermostats. DOE-2 simulations of typical residential buildings were used to develop the energy savings estimates. A sample of participants had metering installed on the HVAC system fans by Duke Energy. These data were used to inform the construction of the DOE-2 models.

The impact evaluation of gross energy savings consisted of the following steps:

1. Analysis of Contractor Surveys
2. Analysis of program participation tracking system data
3. Development and calibration of prototypical building energy simulation models
4. Simulation of measure energy savings
5. Calculation of gross program energy and demand savings

The contractor surveys were used to establish remaining life on early replacement units and identify additional non-program measures commonly included by Smart Saver contractors. Appliance saturation survey data supplied by Duke Energy from a study in Indiana was used to refine the prototypical building energy simulation models, as described in the Indiana Smart Saver evaluation (TecMarket Works, 2007). The survey data provided information on the buildings, such as type, size and age of the home, types of heating and cooling system installed, use of thermostats, efficiency features, and so on. These data were used to establish residential market segments based on building vintage and HVAC system type, and establish building characteristics appropriate for each of these segments.

The tracking system review identified the types, sizes and efficiencies of air conditioners and heat pumps installed under the program, thus focusing the scope of the engineering analysis. A set of residential prototypical building models were developed using the DOE-2.2 building energy simulation program for three building vintages. The prototypes were based on the models used in the California Database for Energy Efficiency Resources (DEER) study, with appropriate modifications to adapt these models to local design practices and climate. Energy savings estimates were developed from the prototype models and applied to the HVAC program tracking system to estimate program savings.

Section I: Process Interview Results

The seven Smart Saver partnering builders and ten contractors were interviewed in July and August of 2008. All of the interviews were conducted with a sales manager within the firm or an equivalent representative. Each of the respondents indicated that they are the individual within their company who has the most experience and is the most acquainted with the program. The interview protocol used during these interviews can be found in Appendix B.

The interviews were written to cover various aspects of the program, such as program operations, aspects of contractors' involvement, incentive levels applied, covered technologies, and program effects from the contractors' perspectives. The results of the process interviews are report by the response categories presented below.

Program Operations

According to the Program Manager the program started as a labor-intensive initiative to increase high efficiency unit sales and to move customers away from the lower efficient equipment. According to the manager, Duke spent a significant amount of management resources making sure the rebated equipment was properly installed, and that dealers were trained on the program's operations. Additional resources were spent inspecting installed units to make sure they were properly installed. However, over the last few years the program has been scaled back in other states so that it is operating as a rebate program for qualifying units and ECMs in Ohio. By eliminating the technical training the program has become less complicated.

The Smart Saver program has recently changed from being managed by Duke Energy staff to being operated by a service vendor, but has always been operated by this vendor in Ohio. According to the Program Manager this change has made the program operate more smoothly and effectively. To help assure program success a number of quality control checks have been placed into operations, including:

- Every paper application is double checked to assure accuracy and content.
- The contractors use the ARI on-line manual to make sure the indoor unit matches the outdoor unit and thereby qualify for the rebate.
- A field inspection is performed to confirm compliance (5% is the requirement, but vendors almost always do more). The inspections are specifically targeted to include 5% of many subsets including, geography, program measures, heating dealer participation.
- The inspection summary reports are checked by Duke Energy to make sure the percentage requirement is being managed for many subsets in the market including geography, program measures and heating dealer participation.

Materials

We asked the contractors if they had enough program materials such as brochures, applications, and program documentation to effectively sell the program to their customers. All interviewed contractors indicated that they had the materials that they needed on hand and felt that they could obtain more when needed.

Problems That Have Come Up

Many of the questions asked of the contractors involved focused on their opinions on the operations of the program. The interviews with the contractors indicate that they are in agreement based on the dramatically reduced number of complaints about the program operations from past evaluations.

Most of the contractors said that their experiences with the program were free of any significant problems and that they were pleased with their interactions with the program. However, a few contractors expressed the following concerns:

- "Occasionally a customer complains that they haven't received the rebate in a 'timely manner,' in which case I look into it with Duke and help get them their rebate."
- "I think the only issues are some periodic time delays associated with the rebates and some contractors have been reluctant to participate because of the amount of paperwork associated with the rebate process. Also, some HVAC contractors that I know do not yet know about the program."
- "No real problems, but the ARI web site has changed a few times so we have to keep up with it. There is no advance notice of a change, so it can catch us by surprise."
- "The ARI web site won't always come up. This delays the process and we have to return to it rather than move on to other work."
- "I have had a couple of faxed incentive forms lost in transmission which delayed the rebate process. I had one that only received half of his incentive and we had to reprocess the forms to obtain the other half. I had one application in which the address got mixed up with another customer. This took 3 months for the client to receive his rebate. He was very upset with this."

When we asked contractors about the level of customer complaints, contractors reported that other than the above reported complaints there have been very few or no other customer complaints.

Wait Time for Incentive

The length of time that passes from when the application forms are submitted, to the arrival of the rebate check are described as reasonable by all of the contractors. The stated average length of time to wait for a rebate check varied from 2 to 6 weeks.

The data provided by Duke Energy allowed us to confirm the number of days between application submittal and the date the rebate check was sent out. The minimum period was 2 days with a maximum of 100 days. The average period was 6.6 days with a median of 4 days.

However, contractors perceive that the average wait for the incentive check is between 2 to 6 weeks.

What About Smart Saver Works Well

Each interviewed contractor was asked what they think works well about the program. This question was then followed with a question about what changes should be made to the progam. The contractors responded to the question of what works well about the program with a variety of responses. The responses include:

- "It saves both parties money and improves energy efficiency / consumption."
- "I think the simple fact that it saves people money is what makes it effective."
- "It helps people save money, and I don't think that will ever stop working."
- "The customer is getting a bonus and they are benefiting in energy savings."
- "The incentive attracts customer and contractor attention to buy qualifying equipment, trying to save energy, and it helps customers make decisions."
- "It helps save both money and energy."
- "Some people won't spend the extra money on the higher efficiency equipment on their own, but the rebate helps offset the costs."
- "After the job is finished the paper work is very easy to fill out."
- "It saves both builders and homeowners money, and it also saves energy."
- "I am pleased with the whole process. It's a systematic process and once you do it one or two times you have it down and there are not a bunch of crazy calculation variables involved that can muddy the waters."

These contractors indicate that the program gives them another selling point for the energy efficient equipment option, providing them an advantage to their ability to make a sale. Likewise several reported that the program is easy to fill out.

Some contractors see the program as a way to encourage customers to upgrade their heating and cooling equipment to a higher efficiency level. These contractors noted that the rebates do provide incentives to buy the better product and that this incentive often drives the customer's decision process and makes the program work well.

What Should Change About Smart Saver

The most frequent response to the question regarding what should be changed about the program was the single word "nothing". The contractors seem to be happy with the program. However, four of the contractors did offer suggestions for changes. One suggested that more technology options should be offered, but wasn't sure if this was possible, another thought that the rebates should be larger, or that a discounted residential electric rate should be offered. Another indicated that it would be helpful to have a confirmation system in place so that the contractors know that the rebates are being processed. The comments received include:

- "Offer more equipment options, if possible."
- "Larger rebates or a different residential rate for those who use the energy saving equipment."
- "Have a convenient confirmation process put into place so the contractors know that the incentive forms have been received and are going to be processed."

Communications with Duke Energy Staff

Duke Energy distributes promotional materials to contractors and to customers to inform them about the program. The vendors are typically the customer's point of contact and answer questions about the rebates and the equipment eligible. All of the vendors have access to a field representative to help them answer questions. If the field representative cannot handle a question, it is sent up to the Program Manager who then calls to the customer or vendor to provide an answer. Field representatives are also responsible for seeking out vendors that are not currently participating in the program and encouraging them to become program partners.

The contractors are satisfied with the level of communications between themselves and Duke Energy. In fact, all but one of the contractors said that communication with Duke Energy staff was fine; the other indicated that the level of communication was acceptable. The contractor suggesting that improvement in communications was needed suggested the following:

- "Improve the ability for us to reach a person with our questions instead of leaving a message."

One contractor mentioned a specific employee to praise her attention to their questions and needs:

- "Yes, Paula Madjeski has always been available to me and has always taken the time to answer all of my questions and follow up on any issues that I have faced."

How Contractors Make Customers Aware of Smart Saver

Most of the contractors tell their customers about the program during normal sales communications. They explain the energy savings, and tell their customers about the incentives if they choose the more energy efficient option for their heating and cooling needs. Responses to the question regarding how their customers learn about the program include:

- "I explain the program to them."
- "I inform them of their options available through the program."

- "I will explain it to them during the sales call."
- "They tend to learn about it via word-of-mouth."
- "When we go out on a job estimate we advise them of the program and rebate."
- "We inform them that they have the option to have a higher efficiency unit at a slightly greater cost."
- "The program is offered when we are called out for a job estimate. We then give them the "good, better, best" estimates."
- "We tell each and every customer about it when doing an estimate."
- "Every quote we give to a customer mentions the incentive if they pick the right equipment."
- "I tell them about it. I also tell all of my clients about the Power Manager Program and how that benefits them and the rest of the world as well."

Getting Contractors Involved in Smart Saver

During the interviews we also talked to the contractors about how they got started in the program, why they participate, and what Duke Energy can do to attract more contractors to become a partner in Smart Saver.

How The Contractors Participate in Smart Saver

The contractors we spoke with had years of experience with the program, ranging from 1 year to (reportedly) over 20 years (in Indiana). Three contractors with whom we spoke said that they had been with the program since its inception.

When we asked the contractors to tell us how they participate in Smart Saver, we obtained the basic information on their operations as a partner in the program. Most of the contractors mentioned that they fill out the paperwork and submit the forms for their customers. The following responses were provided.

- "We're a small company that participates in the program in an attempt to diversify our services and offer our customers more options. If the customer expresses interest in a high efficiency unit, we inform them of the rebate."
- "I am a builder that participates in the program. I inform my customers that if they are interested in a higher efficiency unit, that equipment is available and there is a cash-back program if they go to the more efficient equipment."
- "I just handle the paperwork and ensure that the customer gets the rebate."

- "I stay updated from the web site. I use a laptop on my presentation and log on to the Duke web site."
- "We build homes with high efficiency units included as standard equipment.
- "We tell customers about the rebate and explain which equipment qualifies for the rebate and we fill out the paper work and send it in for them when the job is complete."
- "I did not know the program had a name. We include high efficiency furnaces in every one of our homes as standard, so we do not introduce the rebate program to the homebuyer. We keep the money to help offset the cost."
- "I tell the customers about the program and I make sure the customer's applications are filled out and I send them to Duke."
- "After we identify what equipment is going into their house, I let them know they are eligible for a Duke Energy rebate. I ask them for their account number and fill in the blanks on the application."
- "We build our homes with high efficiency equipment as the standard, therefore we do not give our customers an option and do not inform them of the program; we simply inform them that their homes are built with high efficiency equipment."
- "All customers are advised of the program as an encouragement to purchase our high efficiency items and qualify for the rebate. I get the orders for the equipment and our office processes and faxes in applications."
- "I sell the majority of the products for our company and our technicians will sell the rest. I process and receive all of the incentives. I introduce our product the same way to everyone and as I am explaining things I will ask if the client is a Duke customer for gas and electric and inform them of the rebate program. I process all of the rebates for all of our clients and I receive our incentives."

Why Contractors Participate

Why contractors participate varies from the basics (increased sales/profit) to the altruistic (doing the right thing for their customers). Most of them like to offer their customers the option of a more energy efficient means of heating and cooling their homes, whether it is for their comfort, long-term cost savings, the environment, or for simply providing good customer service. Contractors reported that they participate for the following reasons:

- "To offer more options to the customers and to promote high efficiency equipment."
- "To obtain the incentive for our customers and for ourselves. I believe in it professionally; to at least provide the customer with the energy efficient options."
- "To obtain the incentive and to satisfy our customers."

- "We are the leader in Heat pump installations and energy savings programs; we want to stay that way."
- "We do it for the rebates: they help sell the higher efficiency equipment, and it helps our customers."
- "To obtain the incentive and to provide the higher efficiency for customer."
- "Because it is good for our sales and helps us out."
- "We do it for the rebates and to sell efficient equipment. I became knowledgeable only through my heat company."
- "To build the best quality home at an affordable price. Part of that quality and affordability is directly related to how the homes retain heat/cool air, and at what price. We believe in this professionally and I believe in it personally. We need to do our part to help reduce our dependence upon energy sources."
- "We believe every homebuilder should do their part to build more energy efficient homes. We have committed to building 100% Energy Star rated homes. This is something we believe in professionally and believe it is a great service to our customers."
- "Helps customers save money and obtain the rebate from Duke."
- "We want to build good quality homes, and we figure that includes the heating and cooling system. Also, it shows our customers that we care about their well-being, the environment, and want to provide them with the best possible service."
- "We do it because it is lucrative for us and it is a good selling tool."
- I like the incentives and so do my clients so it only makes sense to benefit from the equipment that I am already promoting. I believe it is a wise business move as it can and does give our company an advantage when selling the high efficiency products. It offsets the price of the equipment, which is getting more and more expensive. It does help people decide to choose a higher efficiency product in many cases when they may be on the fence. It shows that we care that they can save money now on the investment end and in the long run of utility consumption, and it shows that Duke also cares about saving energy.

How To Get More Contractors to Participate

We asked the contractors what Duke Energy can do to increase the number of contractors that partner with the Smart Saver program. Three indicated that increasing the incentives would help. The other responses varied as noted below:

- "Offer a larger incentive, or maybe bonuses for certain numbers of high efficiency units sold."

- "Offer a greater incentive or market the program more effectively or something."
- "Offer more incentives or inform contractors better."
- "The dealers that stay up on our industry wants and needs are already enrolled."
- "Make them more aware of it; I'm not sure how many know about it. I heard of it at a heating association meeting and jumped on board, I think most would like to be on it."
- "Advertise more/ hold informational sessions. I didn't know about the program until one of our HVAC contractors told us about a rebate. Even then I didn't know the program had a name."
- "Place ads in newspapers and TV."
- "Simplify the paper work."
- "If they don't get it already then only a hammer to the head will make an impression."

Program Technologies and Incentives

According to the program managers, the program utilizes the expertise of a diverse group of professionals in choosing the technologies covered by the program: energy experts, consultants, load analysis experts, dealers, builders and customers, and past experience. Then the program conducts cost effectiveness tests on the technologies to determine if the savings in energy are great enough to offset the program's costs. These approaches allow Duke Energy to identify and select the technologies for the program, and which can reliably provide cost effective energy resources.

Technologies and Equipment Covered

We also talked to the contractors about the technologies offered in the program, and the incentives that are provided. The technologies covered under Smart Saver are supported by everyone we spoke with, with a few suggestions for additional technologies for consideration. The program seems to keep up with technological advancements and keeps the most efficient equipment in the program. Some of the contactors provided recommendations to consider other technologies.

- "Maybe programs for in-ground water sprinklers?"
- "It would be very helpful if Duke was to combine an insulation recommendation with the program for homes that need it, or provide helpful hints to go along with energy savings. All energy saving methods should be combined together in the same program (heat pumps, insulation, furnace, etc)."

- "Maybe some sort of incentive for building homes with high efficiency windows or some other construction approach?"

- "EnergyStar homes. When a home receives an EnergyStar label I think the homeowner should get an automatic rebate on their total energy bill every month (5% or something like that). This would practically ensure that consumer demand for EnergyStar rated homes would skyrocket."

- "Include high efficiency water heaters in the program"

- "Include ductless split air conditioners"

Incentive Levels

The incentive levels are set at the right level from the perspective of most of the contractors. However, one had an incentive comment that was targeted at specific technology of the program, believing that the incentive should be higher for geothermal heat pumps since they are more expensive and are more energy efficient than some of the other technologies included. The contractors provided the following additional responses to the incentive question.

- "Yes, they encourage the customers that are on the fence to choose the higher efficiency units."

- "It has swung a few people over as far as deciding which type of furnace to buy and that it isn't just a sales gimmick."

- "Yes, they are appropriate. They could certainly be better, but if someone is sort of in between, it can sway them over to the more efficient unit."

- "They could be larger, but that is always the case. I think they are appropriate."

- "Yes they help. Higher efficient customers want to save all they can."

- "They should get a larger rebate or a lower rate."

- "When given the choice, in about 50% of the time the homeowner will go with the higher efficiency equipment for the rebate."

- "More money back is always nice, but I can't say that the incentive attracts too many people because I have little to do with it."

- "Geothermal rebate should be more than gas furnaces since the cost is much greater to install a geothermal unit than it is to install a gas furnace and they are more energy efficient."

- "Yes they are helpful, although they could be more; it may further encourage the use of high efficiency equipment."

- "Yes. It often convinces a customer to buy the upgrade, as that cost is offset by looking forward to the incentive check."

- "It certainly helps them make the choice to go with the high efficiency equipment, but I promote the high efficiency equipment to begin with so it is mostly a bonus for my clients."

- "If the goal of the incentive is to attract more people to choose energy efficient units, then no. I do not think the incentive attracts those who would otherwise not buy one. However, if someone is already thinking about it, it may help sway him or her one way or another, but it is not enough to make someone change their mind about what they want."

Technologies that Should Not Be Included

None of the contractors indicated that any of the technologies covered should be removed from the program's offerings.

Smart Saver's Effects on Contractors

How the Program Changes Business

Overall, the contractors report that the program has not significantly changed their business or the line of products they offer. However, some report that it allows them to offer more options to their customers and it allows them to sell the higher efficiency products. It also helps achieve higher levels of customer satisfaction. The comments received from the interviewed contractors include responses that indicate that the program is moving the higher efficiency lines and other comments suggest that there are minimal impacts on the contactor's business:

- "The rebates help sell the higher efficiency equipment, as well as helping out the customer."

- "It's given us more lucrative sales by convincing a customer to buy a higher efficiency model."

- It's too hard to quantify so I am not sure if sales have increased due to this program. But I can say that it does help people upgrade to a variable speed blower air handler teamed with a higher SEER heat pump to get the rebate and save in the long run while being more comfortable.

- "It's hard to say, but as I alluded to earlier, I believe word of mouth has helped us attract more customers to the higher efficiency units."

- "It has added to our marketing and advertising programs by focusing on the higher efficiency lines."

- "It's hard to say, but giving people options helps them make good choices."

- "No it has not changed the lines we sell but we sell more of the high efficiency lines."

- "Not that I can tell, I think we sell more of the high efficiency units with the program."
- "I am not sure or at least not to my knowledge."
- "No, the program does not persuade a lot of people to buy."
- "Not particularly. We were already building EnergyStar rated homes, and already installing 92% gas furnaces standard in our homes. It is nice to have the rebate to help offset the overall price of the home and be price competitive in the market."

Contractor's Suggestions for Streamlining Participation Process

Contractors provided two suggestions for streamlining the process. Two contractors said that the ARI form could be eliminated from the process, and the other comment came from a contractor who suggested that the program applications be available via an online process and have a confirmation process so that they don't have to wonder if the fax was received and processed.

The program manager indicated in the past that Duke Energy was working on a confirmation process, and is forecasting that it will be incorporated into the program. The online application process should help reduce the turn-around time for rebates as well. An online process can be structured to reduce errors associated with models and efficiency levels. The comment received from the contractors regarding program changes include:

- "If the incentive form process could be done electronically it could make it easier to track. Faxing the information is cumbersome. I have to trust that the fax arrived and was processed and approved, and it takes weeks before I can figure out if one got lost along the way. I have no way of checking. Maybe some kind of confirmation process could be performed to inform the contractor that the faxed incentive form was received.
- "It could be streamlined by not having to send in the ARI certificate."
- "ARI copies to Duke could be done away with."

Program Results

We asked the contractors about the benefits of their participation in the program to their business and to their customers, and how the program has altered their business by changing what equipment they offer. None of the contractors have made significant changes to their marketing strategies because of the program beyond offering more options to their customers. They feel that simply telling the customer about the program, the rebate and the increased efficiency is enough to sell the rebated equipment. The contractors all offer the same equipment, but push the more efficient equipment when there are customer or dealer incentives to do so. Their goal is to obtain the best equipment for their customers at the best price. The incentives mean that they can push the energy efficient units at a reduced price allowing more customers to obtain the efficient equipment. These findings are consistent with the program theory to increase market penetration via rebates and incentives.

Benefits to the Contractors

The contractors like participating in the program for a variety of reasons. They like the incentives, the satisfaction knowing they are providing their customers with the best options for savings and comfort, and the high levels of customer satisfaction with the contractors. Contractors reported the following benefits:

- "We get a portion of the rebate."
- "We have more satisfied happy customers and extra money."
- "As the business owner, I know it's helping us. I do the reports and studies and the money that Duke is paying for it is quite a bit of pocket money for me and the customer gets better equipment."
- "I hope the equipment is good and pays off in the long run, the rebate I was able to turn over in the construction of the property was a benefit to me."
- "The program gives us extra cash and helps our customers."
- "The rebate is the primary benefit to us."
- "Our customers are more satisfied with their choice and we save some money."
- "Monetary incentive is the benefit we obtain"
- I make a living on 100% commission so the more I sell the more I have to feed my children and their mother. If I sell higher efficiency items my price tag goes up so I get a raise and my kids get fatter. I also receive the company incentives as a bonus because the owner of my company likes it when I am happy and the happier I am the easier it is to sell high efficiency. And the customer gets a better product so it is win-win.

Benefits to the Customer

The most common benefit to the customer cited by the contractors was that the customers are able to save energy and money when they purchase the rebated equipment. A few of them also mention that the equipment is quieter than the lower efficiency models. The following responses were provided by the contractors when asked about the customer benefits of the program:

- "They save money on their energy bills."
- "They save money over the life of the product."
- "They save money by getting this equipment."
- "Some are very energy conscious and like to know they are doing something to help save energy."

- "It's more eco-friendly and quiet."
- "Cash and the efficient unit saves them money."
- "They're saving money and are more comfortable."
- "They are quieter than other units."
- "Getting a good line of equipment and a price reduction in monthly usage that results in lower monthly bills. It's also nice to know that a big company is willing to give back to its customers and help them."
- "They save money and reduce their energy consumption."
- "Some people are very environmentally conscious, and higher efficiency is better for the environment."
- "They get a lower electric bills."
- "They save money over the life of the unit."
- "They are quieter and obviously use less energy."
- "They start saving faster on their investment and they will save much more over the long run and they will also have the benefit of greater comfort."
- "Comfort, quieter operation, indoor air quality, savings, helping the environment and status."

All of the contractors indicated that there have been no problems with the equipment offered through the program, and that customer satisfaction with the equipment is high.

Program's Influence on Business Practices

We asked the contractors if their business would change if the Smart Saver program were no longer offered. We posed the question to the builders: "*If Smart Saver were discontinued, would you still offer the energy efficient options? If yes, how would you structure pricing differently to make up for the program loss?*" None of them said they would change their offerings, though many added that they would increase their prices to cover the loss of the incentive.

- "Yes, I would just have the price of the home increase proportionately."
- "I think so; I imagine we would just price the homes proportionally more than we currently do."
- "Yes we would still offer the same equipment, and we wouldn't change the pricing structure."

- "Our pricing would not change – it didn't change when we started the program."
- "I think we would offer the same lines, but we may install more less-efficient units as well and price the homes accordingly."
- "We would increase the price of the home by the amount of the rebate."
- "We wouldn't mention Duke Energy or the rebates."
- "I'm not sure, but I don't see any reason not to offer the same line."
- "I play fair and I have never changed pricing due to the program so my pricing structure would remain the same."

We also asked the contractors what percent of their customers are aware of the program and the incentive beforehand. The contractors reported between 5% and 50% of their customers were aware of the program and that about 60% took advantage of the rebate.

Table 3. Customer Awareness of Duke Energy's Smart Saver Program

	Percent		
	Mean Percent	Range	Weighted Mean Percent[2]
What percent of the customers are already aware of the program before you present it to them?	23.5%	5% - 50%	11.7%
What percent of the customers take advantage of the program after you present it and explain it to them?	59.4%	30% - 99%	55.0%
What percent of your customers end up going to a more efficient product than they would have on their own?	61.7%	25% - 100%	50.0%

Continuing Need for The Program

We asked the contractors if they thought that the program was still needed. All of the interviewed contractors said yes, for the following reasons:

- "Yes, people need incentives to buy the more efficient lines."
- "Yes, it is a good idea and people can gain from it."

[2] Weighted to account for the number of units rebated through the program.

- "Yes, customers are interested in the higher efficiency units."
- "Yes, it encourages builders to put high efficiency units in new homes; hopefully it will become required for all new homes to have high efficiency units so we are not consuming so much."
- "Yes, plenty of people are still totally unaware of the concept of energy conservation."
- "Yes, it encourages builders to provide options rather than just lowest cost to them."
- "Not everyone wants to buy something more expensive, so I think the incentive can swing people over to buy the better product."
- "It's very customer friendly, and makes a friendly atmosphere between Duke and the homeowners. I don't believe it affects total sales a whole lot, but it makes a friendly atmosphere."
- "Yes, it is a good program and promotes energy conservation."
- "Yes. Not enough builders are committed to building with high efficiency equipment and not enough builders are committed to building EnergyStar rated homes. If consumers increase their demand for such homes then builders will start…but builders must be incentivized or they will stay on the cheap side."
- "Yes, it gives the customer the added incentive to purchase the high efficiency items."
- "Sure, like I said before, if we can up-sell another 20 to 30% that is good for me and the consumers."
- "Absolutely, because people love to get money back from Duke. It gives them a great sense of "finally getting something back" from a huge entity that takes a large part of their household income every year. When I ask a client if they have Duke gas and electric they respond with a sigh and a roll of their eyes and when I tell them about the rebate that they are "entitled" to they smile. That is just good business for Duke."
- "I think it shows people that energy providers, in this case Duke Energy, are trying to conserve energy and make energy more affordable to their customers."

Recommended Changes to Smart Saver Program

At the end of the interview we asked the contractors if they had any final suggestions for improving the program or comments to provide to Duke Energy that were not already discussed during the interview. Only one contractor had a comment:

- "Feel free to raise the incentive amounts paid to customers and contractors at any time."

Section II: Energy Impact Analysis and Findings

Overview of Impact Evaluation Approach

The impact evaluation used an engineering-based approach to estimate program savings. The impact evaluation effort consisted of the following steps:

1. Analysis of Contractor Surveys
2. Analysis of program participation tracking system data
3. Development and calibration of prototypical building energy simulation models
4. Simulation of measure energy savings
5. Calculation of gross program energy and demand savings

Contractor Survey Analysis

A special contractor survey was conducted with random sample of 20 contractors in Indiana and Ohio. One of the purposes of the contractor survey was to assess the relative fraction of normal replacement vs. early retirement installations and to estimate the remaining life on early replacement units. Individual contractor responses were weighted according to the number of systems installed under the program. The results of the weighted survey responses are shown in Table 4 below:

Table 4. Contractor Responses to Early and Normal Replacement Questions

Question	Average response
What fraction of the units you replaced were replaced before the end of its useful life?	21.9%
What is the average number of years of useful life remaining on the replaced units?	2.9 years

According to the contractors surveyed, about 22% of the units replaced were early replacement. However, the amount of remaining life on those units was fairly low; on the order of 3 years. Even though the early replacement systems had a few more years of service left in them, the majority of the units replaced were either worn out or near the end of their service life.

Another objective of the contractor survey was to assess the bundling of other efficiency improvements directly related to the system replacement but not covered under the program. The survey probed the bundling of setback thermostats, improved duct insulation and duct leakage sealing with the Smart Saver system installation. The results of the survey are shown in Table 5 below:

Table 5. Contractor Responses to Measure Bundling Questions

Question	Average response
What fraction of the units you replaced were bundled with the following measures?	
Setback thermostat	35.6%

Duct insulation	6.5%
Duct leakage sealing	0.6%
When duct insulation is added, what is the insulation R-value?	2.5

According to the contractors, about 36% of the units on average were installed with a setback thermostat. Duct insulation and duct leakage sealing were rarely included. When duct insulation was included, the R-value averaged R-2.5[3]. Contractors reported sealing ductwork on less than 1% of the systems on average, only one contractor reported using an *instrumented*[4] duct leakage sealing approach. Thus, the effectiveness of the duct leakage sealing, when applied, is unknown.

Program Tracking System Analysis

Smart Saver program participation records covering the period through June, 2008 were obtained from Duke Energy. The data, delivered as a Microsoft Access database, contained customer name and address, installing vendor contact information, system type and efficiency, unit make and model number, rebate amounts, and so on. These data were examined to identify the number and types of customers and HVAC systems that participated in the program.

The distribution of equipment type listed in the program tracking database is shown in Figure 2

[3] The Smart Saver program does have a duct insulation upgrade requirement, but their website recommends upgrading duct insulation to R-19.

[4] One contractor reported using the Carrier Aeroseal approach, which measures duct leakage before and after sealing the system, thus verifying the effectiveness of the duct leakage sealing activity.

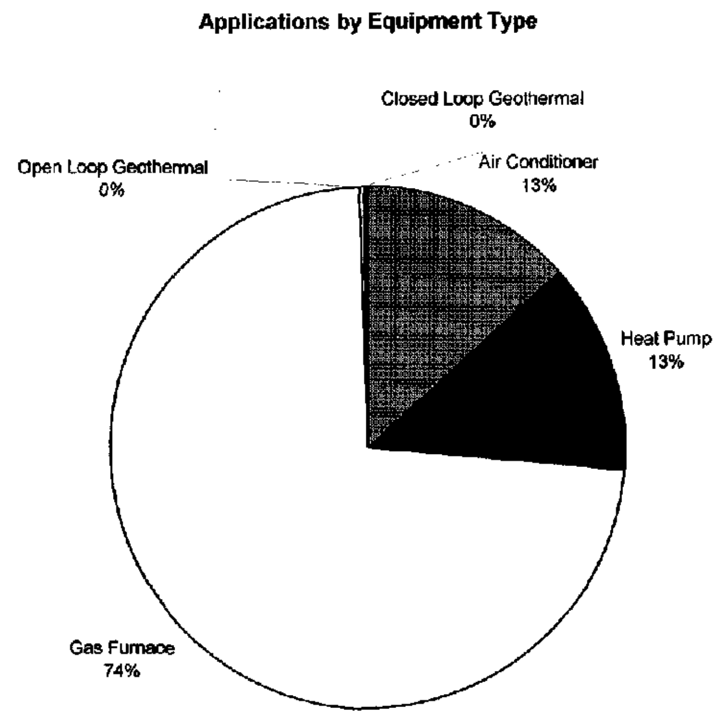

Figure 2. Applications by Equipment Type

Note, gas furnaces make up the majority of the applications listed in the program tracking database received from Duke Energy. Air conditioners and air source heat pump applications numbered about the same. A negligible number of geothermal heat pump applications were recorded. Air conditioners and some heat pumps were bundled with high efficiency furnaces, although they were recorded separately in the tracking database.

Prototypical Building Model Development

The impact analysis for the Smart Saver program is based on DOE-2.2 simulations of a set of prototypical residential buildings. The prototypical simulation models were derived from the residential building prototypes used in the California Database for Energy Efficiency Resources (DEER) study, with adjustments make for local building practices and climate. The prototype "model" in fact contains 4 separate residential buildings; 2 one-story and 2 two-story buildings. The each version of the 1 story and 2 story buildings are identical except for the orientation, which is shifted by 90 degrees. The selection of these 4 buildings is designed to give a reasonable average response of buildings of different design and orientation to the impact of energy efficiency measures. A sketch of the residential prototype buildings is shown in Figure 3.

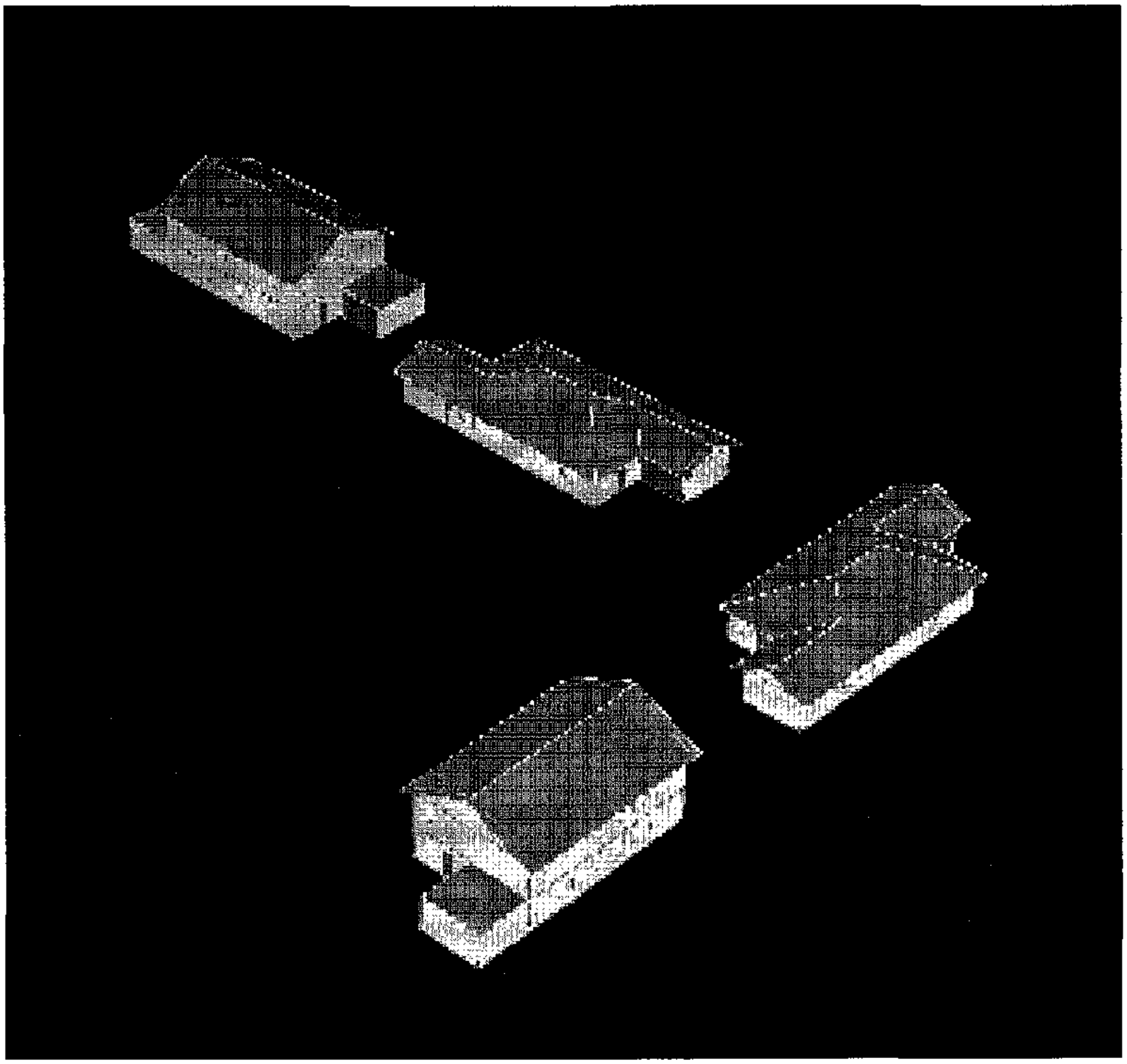

Figure 3. Computer Rendering of Residential Building Prototype Model

For this study, we added a basement to each building to create another set of 4 buildings, allowing us to simulate the impact of the energy efficiency measures on buildings with and without basements. Appliance saturation survey data collected in Indiana were used to refine the prototype models. An appliance saturation survey was not available for Ohio, so the Indiana data were used. These data were judged to be the best data available for the study. The general characteristics of the residential building prototype model are summarized in Table 6.

Table 6. Residential Building Prototype Description

Characteristic	Value
Vintage	Three vintages simulated – 1959 and older, 1960 – 1989, and 1990 and newer
Conditioned floor area	1 story house: 1465 SF (not including basement) 2 story house: 2930 SF (not including basement)
Wall construction and R-value	Wood frame with siding, R-value varies by system type and vintage
Roof construction and R-value	Wood frame with asphalt shingles, R-value varies by system type and vintage
Glazing type	Average of single and double pane; properties vary by system type and vintage
Lighting and appliance power density	0.51 W/SF average
HVAC system type	Packaged single zone AC or heat pump
HVAC system size	Based on peak load with 20% oversizing. Average 700 SF/ton
HVAC system efficiency	Baseline SEER = 13 for normal replacement; SEER = 10 for early replacement Furnace efficiency = 0.78 AFUE
Thermostat setpoints	Heating setpoint = 70, cooling setpoint =75. Night setback/setup of 5 degrees in runs with setback thermostats.
Duct location	Buildings without basement: attic Buildings with basement: basement
Duct surface area	Single story house: 390 SF supply, 72 SF return Two story house: 505 SF supply, 290 SF return
Duct insulation	Varies by system type and vintage
Duct leakage	20% total, evenly distributed between supply and return
Cooling season	Covington: April 29th – Oct 9th
Natural ventilation	Allowed during cooling season when cooling setpoint exceeded and outdoor temperature < 65°F. 3 air changes per hour

Several of the building characteristics were varied by vintage and HVAC system type to reflect the differences noted in the appliance saturation survey. These characteristics are described below:

Wall, Floor and Ceiling Insulation Levels

The appliance saturation survey contains questions about the presence of wall, floor and ceiling insulation. The penetration of wall, floor and ceiling insulation was tracked by building vintage and HVAC system type, and an average wall, floor and ceiling insulation level was established to represent the average insulation level in the population. In buildings with basements, the floor insulation levels shown below were applied to the basement walls. The assumed values for wall, floor and ceiling insulation and the assumed average R-value by vintage and HVAC system type is shown in Table 7 through Table 9.

Table 7. Wall Insulation R-Value Assumptions by Vintage and HVAC System Type

Vintage	HVAC type	Assumed R-value of insulated wall	Average R-value of insulated and non-insulated walls
1959 and older	A/C w/ gas furnace	11	5.26
	Heat pump	11	7.15
1960 - 1989	A/C w/ gas furnace	11	7.30
	Heat pump	11	8.54
1990 and newer	A/C w/ gas furnace	19	14.35
	Heat pump	19	16.05

Table 8. Ceiling Insulation R-Value Assumptions by Vintage and HVAC System Type

Vintage	HVAC type	Assumed R-value of insulated ceiling	Average R-value of insulated and non-insulated ceiling
1959 and older	A/C w/ gas furnace	19	14.71
	Heat pump	19	16.23
1960 - 1989	A/C w/ gas furnace	30	25.91
	Heat pump	30	25.48
1990 and newer	A/C w/ gas furnace	36	30.41
	Heat pump	36	34.09

Table 9. Floor Insulation R-Value Assumptions by Vintage and HVAC System Type

Vintage	HVAC type	Assumed R-value of insulated floor	Average R-value of insulated and non-insulated floor
1959 and older	A/C w/ gas furnace	11	2.19
	Heat pump	11	3.31
1960 - 1989	A/C w/ gas furnace	11	3.71
	Heat pump	11	4.03
1990 and newer	A/C w/ gas furnace	19	8.46
	Heat pump	19	5.91

Duct Insulation

The appliance survey asked a question about the presence of duct insulation. The fraction of the respondents that indicated the presence of duct insulation by building vintage and HVAC system type was used to establish baseline duct insulation levels. Note, the assumed R-value for insulated ductwork in the general population is R-4.9, corresponding to standard 1in. duct wrap or insulated flex duct.

Table 10. Duct Insulation R-Value Assumptions by Vintage and HVAC System Type

Vintage	HVAC type	Assumed R-value of insulated ducts
1959 and older	A/C w/ gas furnace	4.9
	Heat pump	4.9
1960 - 1989	A/C w/ gas furnace	4.9
	Heat pump	4.9
1990 and newer	A/C w/ gas furnace	4.9
	Heat pump	4.9

Windows

The appliance survey included questions about the presence of dual pane or storm windows, low-e windows and window film. The glazing U-value and solar heat gain coefficient (SHGC) assumptions for these systems are shown in Table 11. Note, the presence of window film was assumed to result in a 50% reduction in SHGC in the small number of buildings affected.

Table 11. Basic Glazing Property Assumptions

Property	Single	Double	Low e
U-value (Btu/hr-F-SF)	1.04	0.55	0.45
Solar heat gain coefficient	0.86	0.76	0.65

The penetration of dual pane, low-e and window film features by building vintage and HVAC system type were applied to the basic window properties to develop a set of glazing property assumptions, as shown in Table 12.

Table 12. Glazing Property Assumptions by Vintage and HVAC System Type

Vintage	HVAC type	U-value	SHGC
1959 and older	A/C w/ gas furnace	0.63	0.88
	Heat pump	0.66	0.89
1960 - 1989	A/C w/ gas furnace	0.62	0.87
	Heat pump	0.62	0.88
1990 and newer	A/C w/ gas furnace	0.65	0.87
	Heat pump	0.60	0.87

Model Calibration

The DOE-2 models were refined using monitored data supplied by Duke Energy. Dent Elite Pro true electric power meters were installed on the furnace/air handler fans at a sample of sites. Time series measurements of fan power before and after the Smart Saver system installation were made. The data loggers were rotated from site to site, with some systems monitored during the heating season while other systems monitored during the cooling season. Note, only the fan power was monitored; total unit power was not included in the monitoring activity. The purpose of the monitoring was to assess the fan power differences resulting from including an electronically-commutated (EC) motor as a program requirement. EC motors are much more efficient than standard motors, improving the SEER rating of an air conditioner or heat pump. The EC motor also allows for fan speed modulation, saving additional fan energy during part-load operation. Homeowners may elect to run their systems with continuous low speed fan operation regardless of heating or cooling needs to improve comfort and indoor air quality. Under this type of control, the energy savings from EC motor installation are reduced due to longer operating hours.

The monitored data were analyzed to determine the fan operation (continuous vs. cycling with call for heat/cool) and fan power per ton of cooling capacity in the pre and post installation case. The results of the monitored data analysis are shown in Table 13.

Table 13. Summary of Furnace Fan Motor Monitoring

Unit Monitored	Cycling Fan Fraction	Continuous Fan Fraction	Average Fan Power at Full Flow (kW/ton)
Existing (Pre)	0.66	0.33	0.155
Replacement (Post)	0.59	0.41	0.095

The existing units were only slightly less likely to operate with a continuous fan (33% of existing units vs. 41% of replacement units). While continuous fan operation is a feature of systems with EC motors, only 41% of the systems monitored used the feature.

The average fan power at full flow for the existing units was 0.155 kW/ton, while the average fan power at full flow for the replacement units was 0.095 kW/ton, representing a savings of 38% in full load fan power. Additional fan savings due to reduced speed operation were analyzed using the DOE-2 simulation models described in the next section.

Measure Savings Analysis

The prototype model was simulated with a variety of efficiency measures to develop a series of savings estimates. Air conditioning systems were simulated with a baseline SEER 13 air conditioner and with a series of high efficiency air conditioners ranging from SEER 14 to SEER 17. Heat pump systems were simulated with a baseline SEER 13 heat pump and with a series of high efficiency heat pumps ranging from SEER 14 to SEER 18. Standard heat pumps were simulated with electric resistance backup, while dual fuel heat pumps were simulated with a gas furnace backup.

The basic efficiency assumptions for each of the air conditioner and heat pump measures are shown in Table 14. These data were taken from an extensive study of residential air conditioners and heat pumps conducted for the California DEER update study.[5] Besides these basic efficiency parameters, an extensive set of performance curves were developed representing mean performance of production units in each SEER category. These performance curves describe unit efficiency as a function of outdoor temperature, part-load efficiency, and so on. Fan power data were taken directly from the metering study. These curves were also applied to air conditioner and heat pump measures in each SEER category.

[5] Itron, 2005. "2004-2005 Database for Energy Efficiency Resources (DEER) Update Study, Final Report," Itron, Inc., J.J. Hirsch and Associates, Synergy Consulting, and Quantum Consulting. December, 2005. Available at http://eega.cpuc.ca.gov/deer

Table 14. Baseline and Measure Performance Assumptions

Type	Efficiency	Fan Type	EER	Sensible Heat Ratio	Air flow (CFM/ton)	Heating COP
Air conditioner	SEER 10	Std 1-speed	9.2	0.67	362	
	SEER 13	Std 1-speed	11.1	0.75	376	
	SEER 14	EC motor	12.2	0.78	395	
	SEER 15	EC motor	12.7	0.7	319	
	SEER 16	EC motor	11.6	0.81	409	
	SEER 17	EC motor	12.3	0.8	422	
Heat pump	SEER 10	Std 1-speed	9.0	0.75	416	3.1
	SEER 13	Std 1-speed	11.1	0.725	337	3.28
	SEER 14	EC motor	12.2	0.73	352	3.52
	SEER 15	EC motor	12.7	0.81	436	3.74
	SEER 16	EC motor	12.1	0.78	400	3.48
	SEER 17	EC motor	12.5	0.81	430	3.26
	SEER 18	EC motor	12.9	0.8	428	3.66

This set of measures resulted in a simulation run matrix as follows:

Category	Number	Description
Building Vintage	3	1959 and older, 1960 – 1989, and 1990 and newer
Foundation type	2	With and without basement
HVAC systems	3	Air conditioner with gas furnace Standard heat pump with electric backup Dual fuel heat pump
Air conditioner efficiency levels	7	Base and 5 measures
Standard heat pump efficiency levels	8	Base and 6 measures
Dual fuel heat pump efficiency levels	8	Base and 6 measures
Furnace fan control	2	Continuous and intermittent
Tstat type	2	Setback and no setback

The set of simulations described above were conducted for Covington, Kentucky, which is the closest weather data site to Cincinnati, Ohio. The results for each of the vintages were weighted according to the relative frequency of each vintage in the overall population. The simulated savings were normalized per ton of cooling capacity for cooling systems and per 1000 square feet of heated floor space for furnaces only. A summary of the simulation results is shown in Table 15. Savings results are shown for each SEER class and air conditioner or heat pump type. A single value for air conditioners and heat pumps was calculated using the relative participation weights for units in each SEER class. Air source and dual fuel heat pumps were combined into a single category representing all heat pumps. Furnace savings were broken out for high AFUE furnaces and combined high AFUE with electronically commutated motors (ECM).

Table 15. Normalized Measure Savings from Prototype Simulations for All Vintages

Measure	Covington

	kWh/ton	kW/ton	Therm/ton
Gas_seer14	356	0.181	62
Gas_seer15	431	0.215	60
Gas_seer16	584	0.315	55
Gas_seer17	637	0.330	55
Hp_seer14	1077	0.133	0
Hp_seer15	1087	0.200	0
Hp_seer16	1473	0.318	0
Hp_seer17	1539	0.266	0
Hp_seer18	1591	0.323	0
Dfhp_seer14	683	0.133	30
Dfhp_seer15	909	0.200	23
Dfhp_seer16	1231	0.318	25
Dfhp_seer17	1317	0.266	24
Dfhp_seer18	1359	0.323	25
All AC	408	0.208	61
All Heat pumps	1106	0.192	6
Measure	**kWh/kSF**	**kW/kSF**	**Therm/kSF**
Hi effic gas furnace	0	0.000	98
Gas furnace plus ECM	356	0.042	91

Note, the peak demand savings are not proportional to the difference in SEER, due to different strategies used by manufacturers to achieve a particular SEER rating and the influence of those strategies on energy efficiency under peak conditions. For example, units using multiple compressors can have high SEER ratings, while having relatively poor efficiency under peak conditions. Heat pumps save energy for both heating and cooling, thus the overall annual energy savings are greater for heat pumps than air conditioners. Also, heat pumps have different performance characteristics than air conditioners, causing differences in the demand savings within each SEER class.

Program Energy and Demand Savings

Gross and Net Energy and Demand Savings

The gross unit energy and demand savings estimates described in the previous section were applied to the program tracking system. The HVAC unit make and model data were used to determine the unit nominal cooling capacity. The unit type and SEER designations were used to assign the appropriate gross savings by SEER category. The savings were totaled across the participants listed the program tracking system. The net to gross ratio of 0.628 previously described was applied to the gross savings, resulting in estimates of gross and net energy and demand savings as shown in Table 16.

The program total savings are based on 675 air conditioner applications, 673 heat pump applications, and 3,667 high efficiency gas furnace applications. Each of the air conditioners and 160 of the heat pumps were bundled with a high efficiency furnace; the remaining furnace applications were stand-alone.

Table 16. Program Gross and Net Savings Estimates

	kWh	kW	Therm
Gross program savings	3,315,148	933	1,019,463
Net program savings	2,081,913	586	640,223

Energy and Demand Effective Useful Lifetime

The effective useful lifetime of all the measures installed through the Smart Saver program is 15 years according to the program design documentation, so energy and demand savings remain strong throughout the next 15 years. Kilowatt demand reduction will remain steady at 586 kW, although some units may fail before 15 years, so some drop off can be expected (though not displayed in Figure 4. Kilowatt hour and therm savings figures follow.
Figure 4

Figure 4. Lifetime kW Impact of the Smart Saver Program Participants

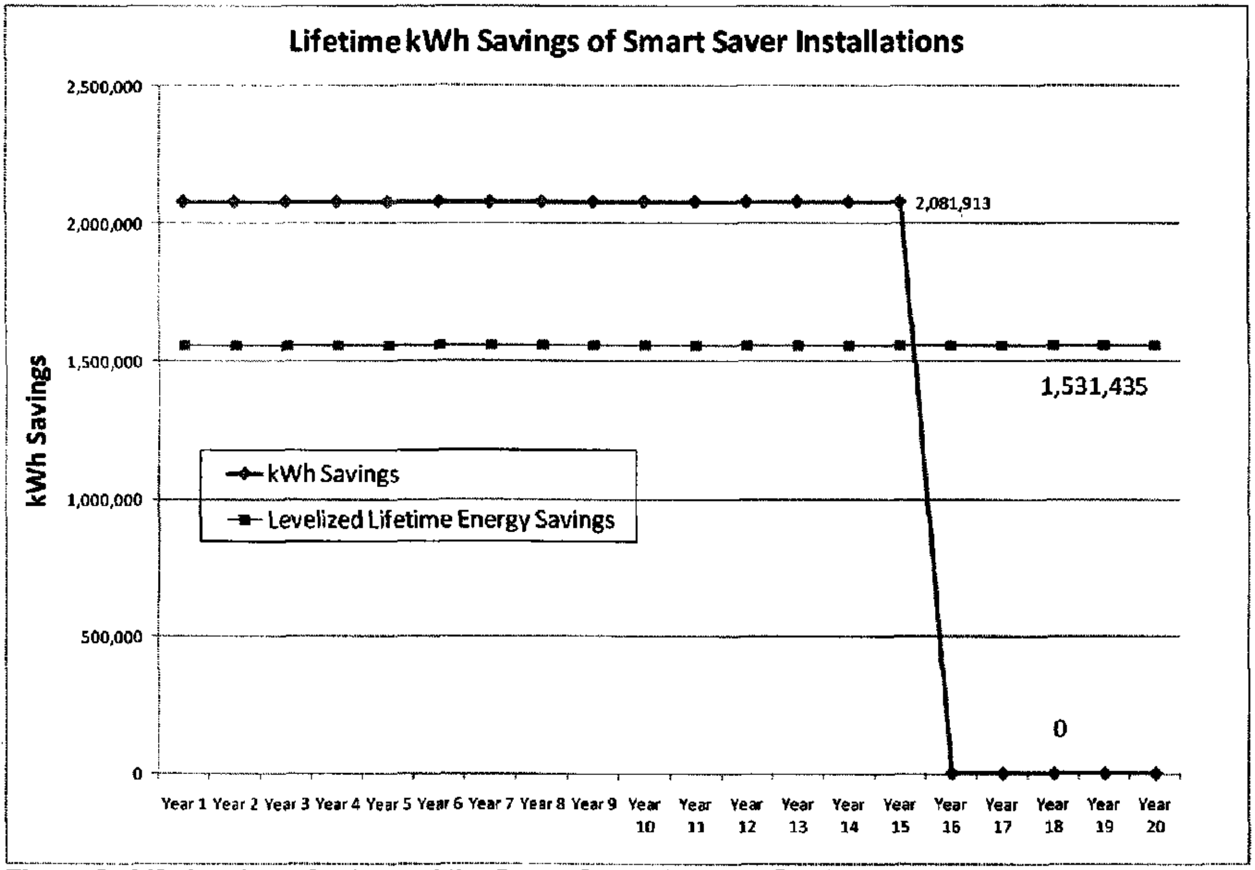

Figure 5. Lifetime kWh Savings of the Smart Saver Program Participants

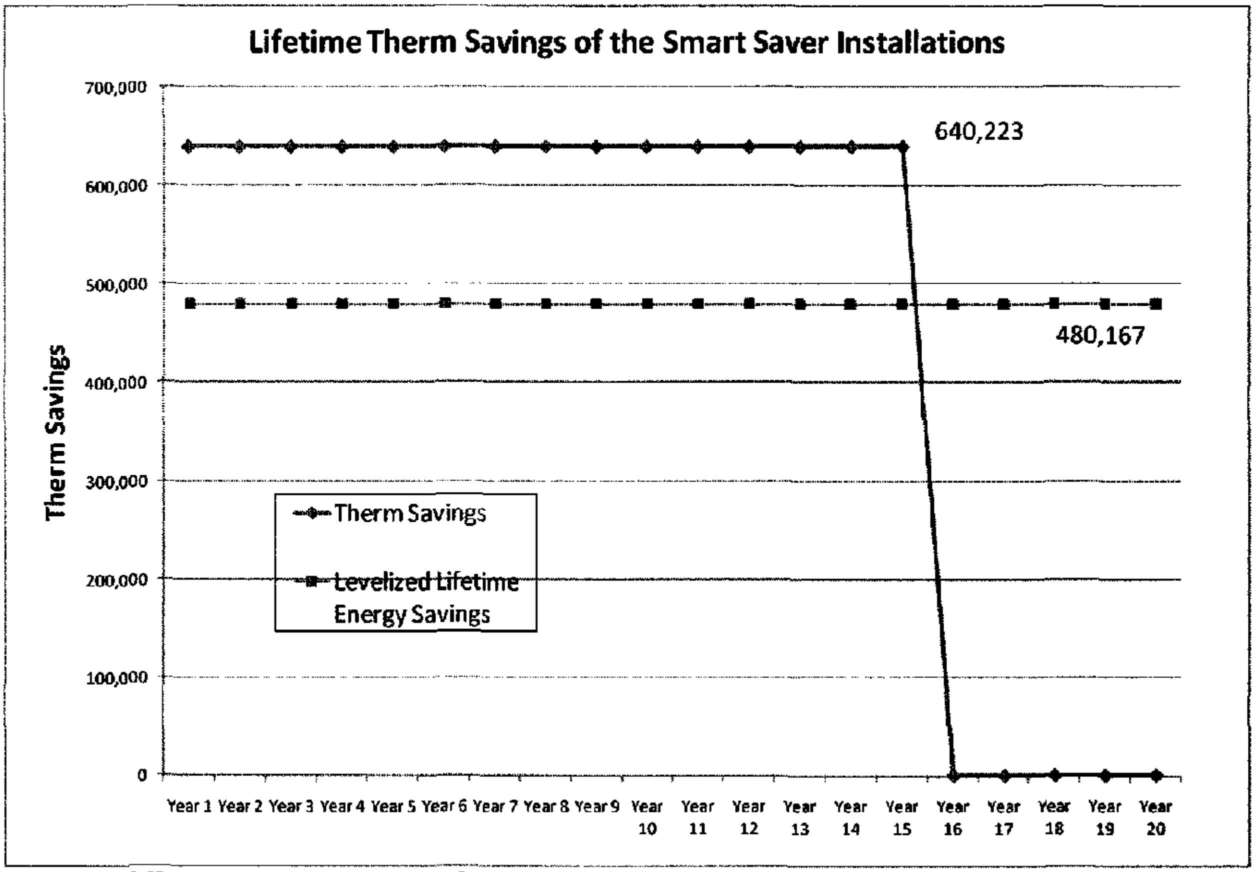

Figure 6. Lifetime Therm Savings of the Smart Saver Program Participants

Section 3: Participant Survey Results

This section presents the results of the participant telephone survey that was conducted with 100 randomly selected participants of the Smart Saver program in Ohio.

Selected Participants: Rebated Items and Purchasing Information

The appliance that was rebated for the selected participants is presented in Table 1 below. Most (64%) of the sample installed a new gas furnace through the Smart Saver program.

Table 17. Rebated Appliances of Selected Participants

Rebated Appliance Purchased			
Heat Pump	Air Conditioner	Geothermal Heat Pump	Gas Furnace
16	19	1	64

Their motivating factors are presented in Table 18 below. The most common responses was that the old equipment didn't work (n=43) or that it wasn't working properly (n=29), meaning that 72% of the participants purchased the new equipment as a "replace on failure" purchase. They did not replace the equipment just to move to a higher efficiency unit. Only 18 indicated that their motivating factor was to reduce energy costs.

Table 18. Motivating Factors for Purchasing High Efficiency Equipment

Motivating Factors for Purchasing High Efficiency Equipment N=100, multiple responses allowed	
Old Equipment Didn't Work	43%
Old Equipment Worked Poorly	29%
Wanted to Reduce Energy Costs	18%
Other	14%
Program's Incentive	4%
Recommendation of Someone Else	3%
Recommendation from Dealer/Retailer/Contractor/Builder	1%
Information Provided by the Program	1%
Recommendation from other Utility Program	1%

In many (44) cases, the replaced appliance was between 20 and 30 years old. One person said that the appliance they replaced was less than 5 years old. However, the appliance was not working properly.

Of the 18 surveyed that indicated that they wanted to reduce energy costs, all but two replaced items that were still in working condition. Six appliances were in "fair condition", three were in "good condition", and four were in "poor condition".

Of all respondents, 50% said that the replaced appliance was not working. The working condition of the replaced appliances that were working are shown in Figure 8. Only 12 units were in good working condition, while most of them (n=22) were in poor working condition.

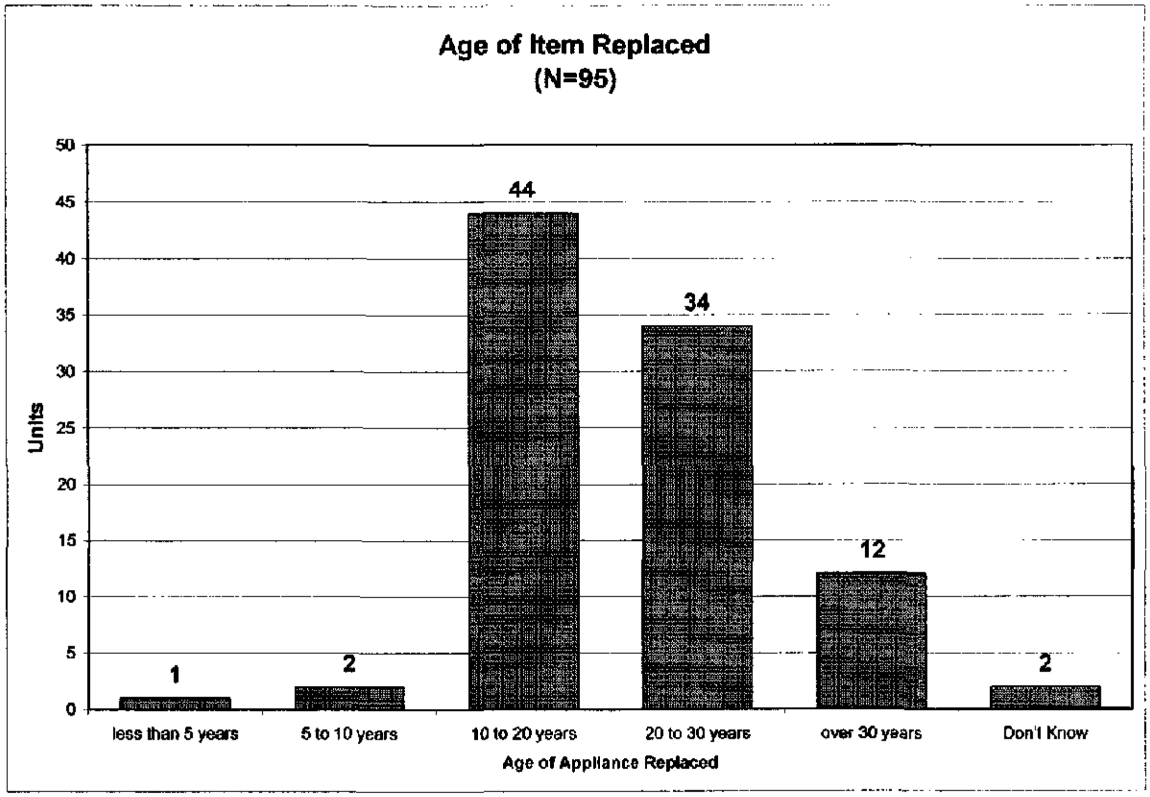

Figure 7. Age of Appliance Replaced

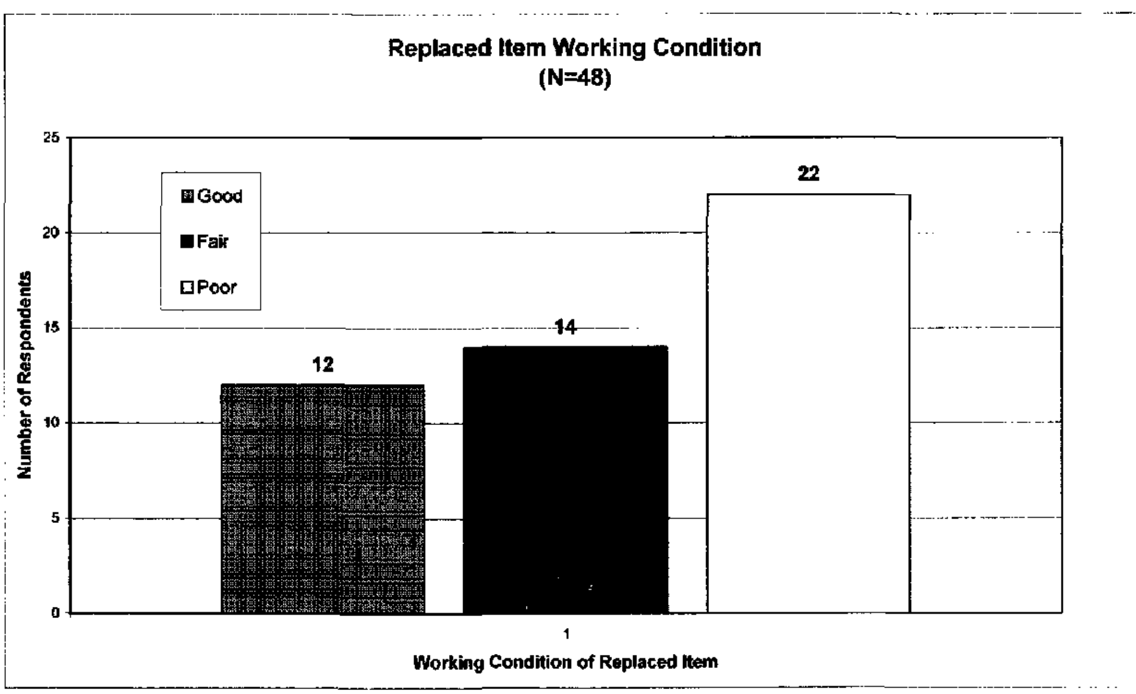

Figure 8. Replaced Item Working Condition

Participant Satisfaction

Overall, participant satisfaction with the Smart Saver program is high, with no program components getting a mean score below 8 on a 10-point scale. The lowest score was for the number of options in program-covered units and efficiency options with an 8 on a 10-point scale. However, the highest score of 9.4 is for the performance of the new high efficiency unit.

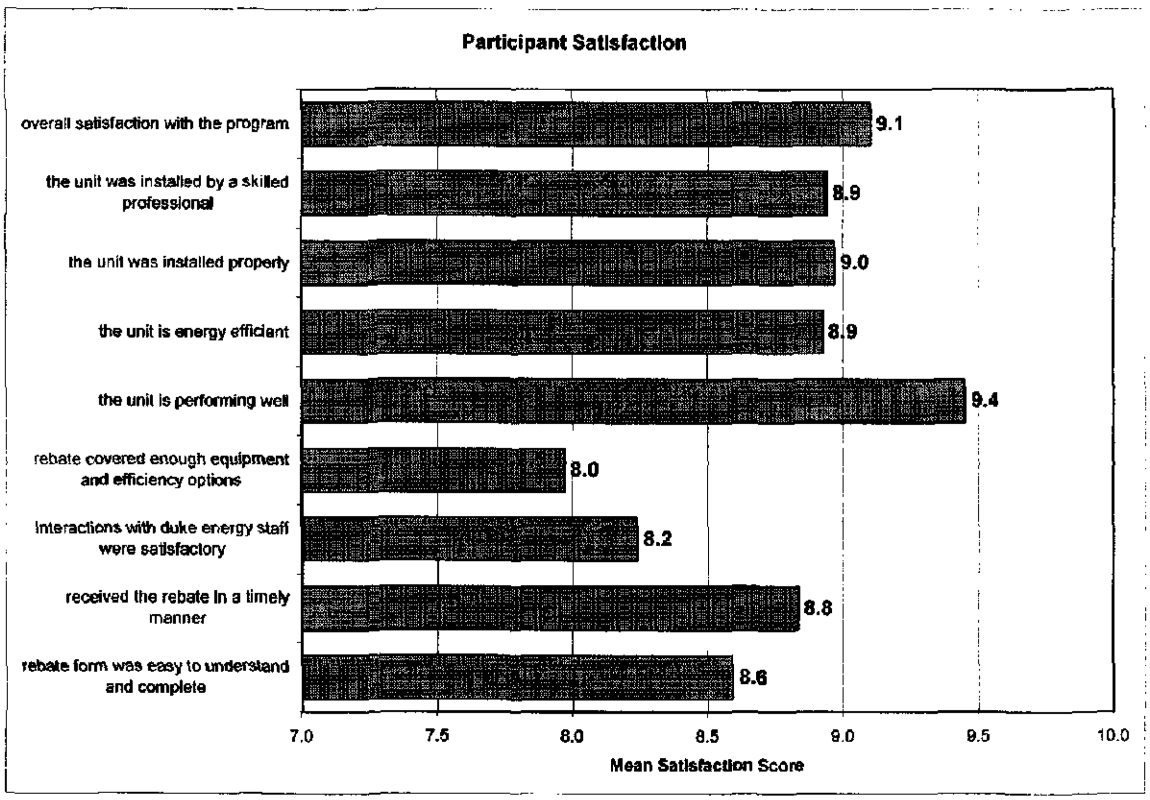

Figure 9. Participant Satisfaction with the Smart Saver Program

If surveyed participants gave a score below 8, we asked them how the program component could be improved. The responses are bulleted below:

Issues with Ease of Rebate Completion Form:

- It was somewhat time consuming
- It was difficult to acquire some of the needed information
- Some questions were applicable only to the dealers, making it tough for consumers to fill out

Issues with Rebate Timeliness:

- Took too long (4x)
- Was initially forgotten
- Had to call the vendor to send me the rebate
- Still haven't received it

Issues with Interactions with Duke Energy Staff:

- They don't understand buying gas from different places
- They need to respond more quickly
- I wasn't aware of the program before talking to the vendor
- The communication concerning the program was ok, but overall our communication is less than desirable.

Issues regarding Rebate Coverage:

- Offer a larger rebate or more options (5x)
- Variable speed vs. Non-variable speed DC Motor is too restrictive
- Didn't know it was taxable

Issues regarding Unit Efficiency:

- Expecting to see more savings over old unit
- Lack of evidence in the bill
- First few months even more expensive than old unit
- Not efficient enough to get credit on taxes

Issues regarding Unit Installation:

- Required a trip back to adjust something (3x)
- It was installed on New Year's Eve and a few things were forgotten
- Unit was missing a valve and not functioning properly
- Improper installation
- Took two months to properly wire thermostat
- Didn't check lines properly and caused a gas leak

Issues regarding Unit Installer/s:

- Improper installation (2x)

Issues hindering Overall Satisfaction:

- Would like a larger rebate (4x)

Additional Services Desired:

- Would like a larger rebate (16x)
- Offer rebates on a wider array of energy saving products (9x)
- Information regarding disposal of CFLs

- Lower rates (5x)
- An assessment of how much is actual being saved using certain products compared to less efficient models
- Lower rates for people who use less energy during peak times
- Faster delivery
- More information
- Incentives to convert to CFLs
- Get rid of automated operator on customer service line

Desired Changes to the Program:

- Larger rebate
- Change qualifications to match variable speed blower
- More publicity

Measures to Increase Participation:

- Increase rebate
- Allow contractors to advertise it
- Fliers in bills
- Inform retailers
- More advertising
- Calculate exact savings per household
- Give customers a percentage of their savings
- Add rebates for household appliances

What people liked most about the Program:

- The rebate
- Ease of participation
- Timeliness
- That it exists
- Helps vendors sell units
- Decrease in energy bills
- Brings attention to high efficiency units
- New/more features on appliances

What people liked least about the Program:

- The rebate could have been larger
- Lack of information
- The filters the new furnace requires
- Had to prod Duke to receive the rebate
- Lack of publicity
- Not enough options

- Paperwork
- Not enough vendors are involved
- Time it took to receive the rebate

In reviewing the above comments it is important to keep in mind that the vast majority of participants are very satisfied with the program. The comments noted above are those of people who indicated satisfaction at 8 or lower for a specific condition.

Section 4: Freeridership and Spillover

This section explores freeridership and spillover in the Smart Saver program. To estimate freeridership, we spoke with contractors, builders, and 100 randomly selected participants. Spillover estimates are based on the randomly selected participants' responses. In order to calculate freeridership and spillover and apply the estimates to the energy savings, there is a need to consider other factors such as self-selection and false response bias. These biases are discussed below, followed by the freeridership and spillover estimates.

Self-Selection and False Response Bias

There are substantial risks associated with relying on self-reported behavioral changes, because the foundation of the savings estimates are based solely on the participant's responses, with no means within the evaluation budget to verify that the respondent has installed the measures and are using them effectively or to document past installation or building/construction records.

There are two main sources of bias with these types of surveys that directly impact the conclusions drawn from the responses. These sources of bias are Self-Selection Bias and False Response Bias. There is also an issue regarding the accuracy of the baseline energy use conditions used by the evaluation contractor to estimate savings in that many of these conditions need to be based on assumptions about the participant population, rather than on measurements. These three conditions significantly impact the evaluation contractor's ability to provide accurate estimates of energy impact. These issues are discussed in more detail in the following paragraphs.

Self-Selection Bias

For this evaluation, we are using the self selection bias value of 29.9% on spillover estimates and 10% for adjusting freeridership estimates. This spillover value was estimated during a previous evaluation and is considered applicable for the Smart Saver spillover estimate as well. However, to guard against over estimating savings for the program's covered measures we use a more conservative 10% for adjusting freeriders impacts.

Self-Selection Bias

The participant survey effort contacted 182 participants. Of these 82 refused to participate in the survey and 100 completed the survey. This provides a response rate of 55%, a fairly high number for a participant survey. This number indicates that 45% of participants elected not to participate in the survey. These people self-select themselves not to participate in the survey because, for any number of reasons, they are less interested in the subject matter of the contact. That is, they have a bias against the subject of the contact more than those who completed the survey. In this case the respondents are more interested in the subject that those who did not participate and are more likely to have taken the action on their own, than people who are less interested in the subject. As a result we estimate the self-selection to be in the neighborhood of ¼ to ½ the non-response level. In order to not over-estimate savings we are setting the self-selection bias at ¼ off the non-response rate, or about 10%.

False Response Bias
False Response Bias is a problem with many self-reporting surveys. The participants respond not with the truth, but with the socially acceptable answer. In short, for any number of reasons they do not convey the entire story about the reasons for taking an action. In the case of this program, where the smarter or more self-serving choice is to go with the product that saves money, the bias tends to under-estimate the program as the cause of the action taken. That is, they indicate that they would have taken the action without the program, not necessarily because they would have, but because to report that they would not have made the wise choice without the program makes them appear to be illogical or non-self-serving. In short, it makes them appear to be not very smart. In the field of survey research, questions that make respondents appear to be illogical need to be adjusted for false response bias, often called social acceptance bias. False response bias can typically be as large as 50% or as low as 10%. To guard against over estimating program savings we elected to use a 20% bias adjustment and stay on the lower end of the scale.

Freeridership

We asked the contractors to estimate the level of freeriders. The responses we obtained all centered around a mean score of between 30-35% freeridership for the Smart Saver program. That is, the contractors indicated that about 30% to 35% of their sales are to people who would have purchased the more efficient line without the program rebates with 65% to 70% of sales going to people who have been convinced to move-up to the more efficient line.

The 100 sampled participants indicated a higher level of freeridership. Participant responses indicated that about 58.2 percent of sales would have been made without the program. However, this response is not adjusted for survey self selection or for false response bias. Adjusting the survey responses to account for these two biases suggests that the freeridership value is about 42%. This adjustment includes a 10% self selection bias to account for people more interested in energy efficiency to self-select themselves to take the survey and a 20% false response bias.

To arrive at a final freerider estimate we applied the average contactor assessment freerider rate of 32.5%, plus the participant response rate adjusted for self-selection bias (10%) and false response bias of 20% and averaged these two numbers. As a result the final freerider rate is estimated at (32.5 + (58.2 x .9 x .8))/2 or 37.2%. That is, about 37.2% of gross program savings would have been captured by the participants without the program. This estimate represents a reasonable estimate of the net effects adjustment for the estimated gross program savings without conducting on-site verification visits, conducting in-depth interviews with program participants or examining pre-program building and sales records of the participating contactors.

The method used to calculate unadjusted freeridership from survey responses is presented in the table below. Questions are listed in the table in the order they were asked. The first three questions were leading questions to get the participant to think about when they purchased the appliance. The following questions and their responses provided the information to estimate freeridership.

Question	Responses

At the time that you first heard about the Smart Saver Rebate from Duke Energy, had you...?	Already been thinking about purchasing a new item	Already begun collecting information about item	Already decided to buy item	Don't Know
Freeridership -->	no effect			
Just to be sure I understand, did you already have specific plans to install a high-efficiency <rebated item> before you heard about Duke's program or their rebate?	Yes	No		Don't Know
Freeridership -->	no effect			
Did you have to make any changes to your existing plans in order to receive this rebate through the Smart Saver Program?	Yes	No		Don't Know
Freeridership -->	no effect			
If the rebate from Duke Energy's Smart Saver Program had not been available, would you still have:	Purchased a new	Purchased the same efficiency of	Purchased the <rebated item> at the same time that you did?	Purchased the <rebated item> earlier than you did, or later? How much <earlier/later>?
Freeridership -->	no = not a FR; yes - move on	no = not a FR; yes - move on	no: 50%; yes: 100%	25% if earlier, FR if later
If the rebate from the Smart Saver Program had not been available, would you have done anything else differently?	Yes	No		Don't Know
Freeridership -->	no effect			
On a 0 to 10 scale, with 0 being not at all likely and 10 being very likely, how likely is it that you would have bought a less efficient <rebated item> if you had not received *any rebate from* the program?	Scale of 1 to 10			
Freeridership -->	adjust FR down by factor: 1=10% decrease, 2=20% decrease, etc.			

If I had not had any assistance from the program, I would have paid the additional <$200-$600> to buy the <rebated item> on my own?	On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with this statement?
Freeridership -->	adjust FR up by factor: 1, 2, 3 = not a freerider; 4-7 = 50%; 7 = 70%, 10 = 100% freerider
The rebate from the Duke Energy Smart Saver Program was a critical factor in my decision to purchase the high efficiency/energy efficient product.	On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with this statement?
Freeridership -->	adjust FR down by factor: 1, 2, 3 = no change; 4-5 = 10%; 6-8=25%, 9-10 = 50% decrease freerider
I would have bought a <rebated item> within [a year/2 years] of when I did even without the rebate from the Duke Energy Smart Saver Program.	On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with this statement?
Freeridership -->	no effect
The rebate from the Duke Energy Smart Saver Program was not necessary to cause me to purchase the higher efficiency product when I bought my new <rebated item>.	On a scale of 0 to 10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree with this statement?
Freeridership -->	adjust FR up by factor: 1, 2, 3 = not a freerider; 4-7 = 50%; 7 = 70%, 10 = 100% freerider

Using these responses, freeridership is estimated at 58%. However, when the bias adjustments are applied, the value drops to 37.2%, which matches with the estimates provided by the contractors and builders. This is the freeridership level that is applied to the energy savings estimates.

Spillover

The contractors we talked to did not report that sales to their customers spill over into additional sales. However, of the 100 randomly selected participants that completed the survey, 27 of them indicated that as a result of their participation in the Smart Saver program, they installed 34 additional energy efficient measures in their homes. Table 19 through Table 21 present the reported measures installed and the gross and net energy impacts associated with these measures in a typical home. A summary of impacts is presented in Table 22. Gross spillover impacts have been reduced by the 29.9% false response bias and the 20% self-reporting bias, both discussed above. Again, these are additional measures that the participants indicated they had taken because of, at least in part, their participation in the program. That is, the program influenced their energy efficiency-related behaviors beyond the rebated item. These savings are not direct program savings, but can be thought of as additional benefits of the program beyond those counted by the program. We are not suggesting that these savings be counted toward the program, but report these impacts as potential added savings influenced by the program.

The most common measure installed is the CFL. Eleven out of 100 participants reported installing CFLs in their home as a result of the influence of the Smart Saver program. These 11 participants reported an average of 13 bulbs installed that were influenced by the program. Five of the 100 surveyed participants that installed a high efficiency furnace through the Smart Saver program also installed new high efficiency air conditioners, resulting in high spillover impacts from these 5 participants. The new refrigerators and new water heaters also provided for energy impact spillover from the Smart Saver program.

Table 19. Program Spillover: Installed Items and kW Impacts

Measure	# of participants installing	Gross kW Impact Per Install	Net kW Impact for 100 Surveyed	Gross kW Impact for population N=5,015	Net kW Impact for Population N=5,015
CFLs (mean of 13 bulbs)	11	0.066	0.364	36.409	18.241
new AC	5	0.902	2.260	226.177	113.314
New water heater	5	0.158	0.396	39.619	19.849
Showerhead	3	0.039	0.059	5.868	2.940
new refrigerator	2	0.210	0.210	21.063	10.553
New doors	2	0.005	0.005	0.502	0.251
new furnace	1	0	0.000	0.000	0.000
insulated garage door	1	0.031	0.016	1.555	0.779
insulated attic	1	0.196	0.098	9.829	4.925
new windows	1	0.206	0.103	10.331	5.176
Faucet aerators	1	0.001	0.001	0.050	0.025
New washer	1	0.080	0.040	4.012	2.010
TOTAL	27		3.551	355.413	178.062

Table 20. Program Spillover: Installed Items and kWh Savings

Measure	# of participants installing	Gross kWh Savings Per Install	Net kWh Savings for 100 Surveyed	Gross kWh Savings for population	Net kWh Savings for Population

				N=5,015	N=5,015
CFLs (mean of 13 bulbs)	11	759	4,183	418,702	209,770
new AC	5	1,361	3,409	341,271	170,977
New water heater	5	531	1,330	133,148	66,707
Showerhead	3	334	534	53,410	26,758
new refrigerator	2	1,509	1,512	151,353	75,828
New doors	2	18	18	1,805	905
new furnace	1		0	0	0
insulated garage door	1	77	39	3,862	1,935
insulated attic	1	346	173	17,352	8,693
new windows	1	227	114	11,384	5,703
Faucet aerators	1	1	0	27	13
New washer	1	192	96	9,629	4,824
TOTAL	27		11,408	1,141,942	572,113

Table 21. Program Spillover: Installed Items and Therm Savings

Measure	# of participants installing	Gross Therm Savings Per Install	Net Therm Savings for 100 Surveyed	Gross Therm Savings for population N=5,015	Net Therm Savings for Population N=5,015
CFLs (mean of 13 bulbs)	11	-1.1	-6	-607	-304
new AC	5	0	0	0	0
New water heater	5	25.9	65	6,494	3,254
Showerhead	3	17.3	26	2,603	1,304
new refrigerator	2	-1.9	-2	-191	-95
New doors	2	0.4	0	40	20
new furnace	1	16.3	16	1,635	819
insulated garage door	1	1.4	1	70	35
insulated attic	1	5.3	3	266	133
new windows	1	-6.9	-3	-346	-173
Faucet aerators	1	1.9	1	95	48
New washer	1	2.7	1	135	68
TOTAL	27		102	10,195	5,108

Table 22. Summary of Spillover Impacts

Impact	kW	Annual kWh	Annual Therms
Gross	355.413	1,141,942	10,195
Net	178.062	572,113	5,108

Effective Useful Life of Spillover Impacts

The measures listed in the tables above vary in their effective useful lifetime. The table below shows the effective useful lifetimes in years that were used in calculating overall spillover impacts. Graphic displays of the impacts over the next 20 years are below.

Measure	Effective Useful Lifetime (years)
CFLs (mean of 13 bulbs)	5
new AC	15
New water heater	15
Showerhead	10
new refrigerator	12
New doors	20
new furnace	20
insulated garage door	20
insulated attic	20
new windows	20
Faucet aerators	10
New washer	12

The kilowatt impacts of the spillover measures remain high and steady for the next 15 years, with a drop from about 75 kW to just over 10 kW for the last 5 years.

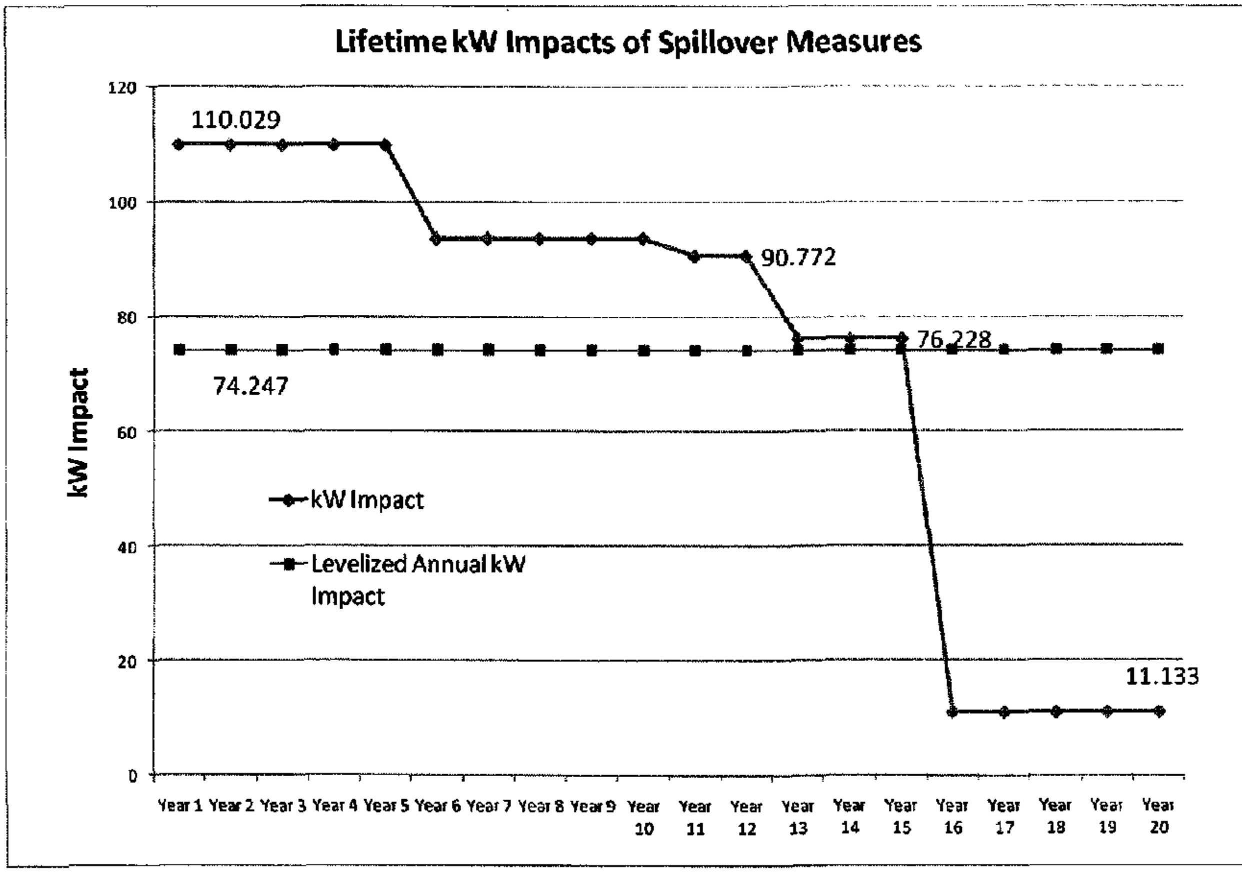

Figure 10. Effective Useful Life of Spillover Measures and their kW Impacts

The kilowatt hour savings stagger down in different years, but remain high at over 17,000 kWh in the final years (years 15-20). Over the course of the 20 years, the total savings is 6,194,327 kilowatt hours, or 1,235 kWhs per participant over the 20 years.

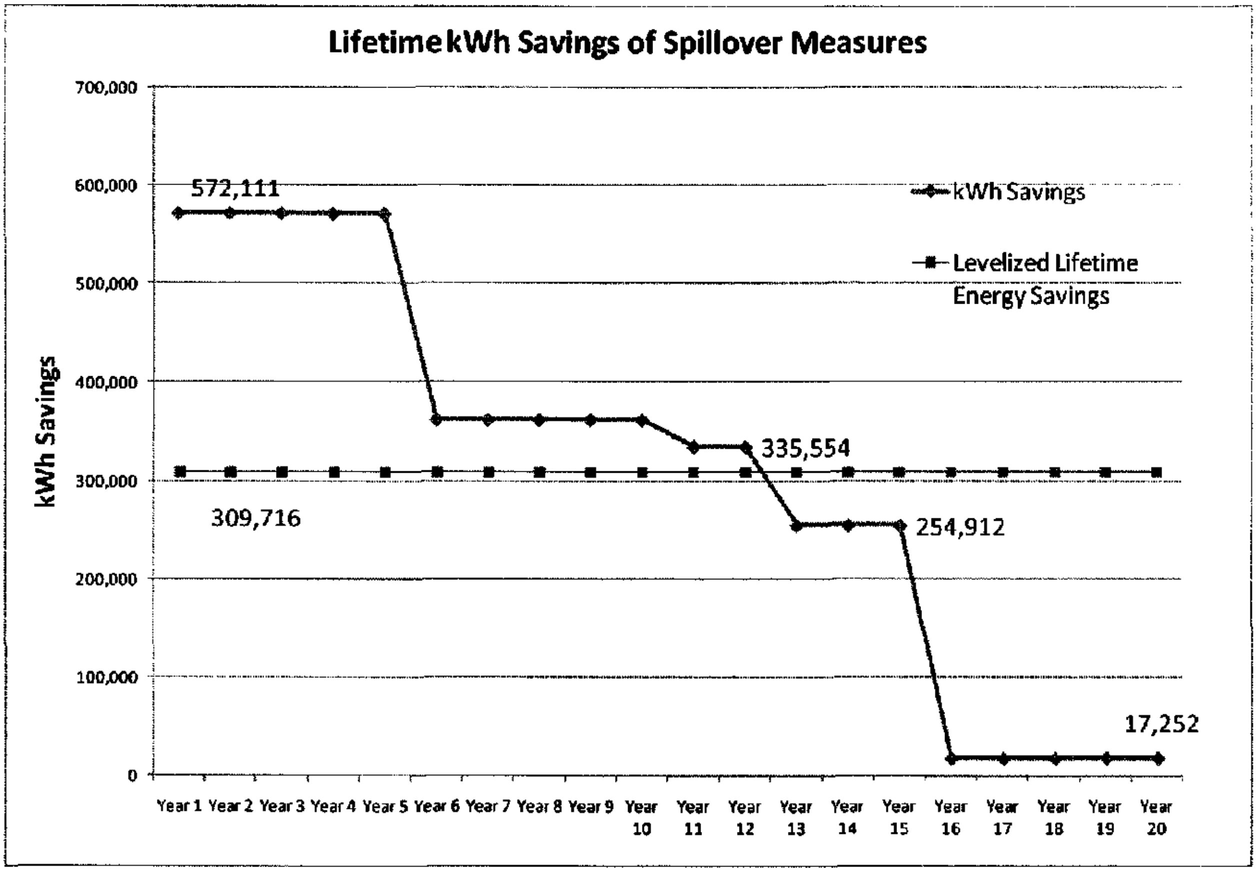

Figure 11. Effective Useful Life of Spillover Measures and their kWh Savings

The figure below presents the therm savings that can be expected over the next 20 years based on the effective useful life of the installed spillover measures. For the first five years, annual spillover savings are 5,115 therms for the 5,015 participants of the Smart Saver program. By year six, the savings increase slightly because the negative effect on natural gas usage caused as the gas impacts from CFLs use drops out of the equation, and in years eleven through twenty, annual therms drop down to about 4,500 therms per year. The total therm savings over the next twenty years for these 5,015 participants is 77,381 therms, a mean of 15.4 therms per participant over the 20 years. If the program causes the participant to permanently move to CFL use, the savings will continue. This savings would be market transformation savings and are not counted in this evaluation. As a result, these savings are less than what can actually be expected.

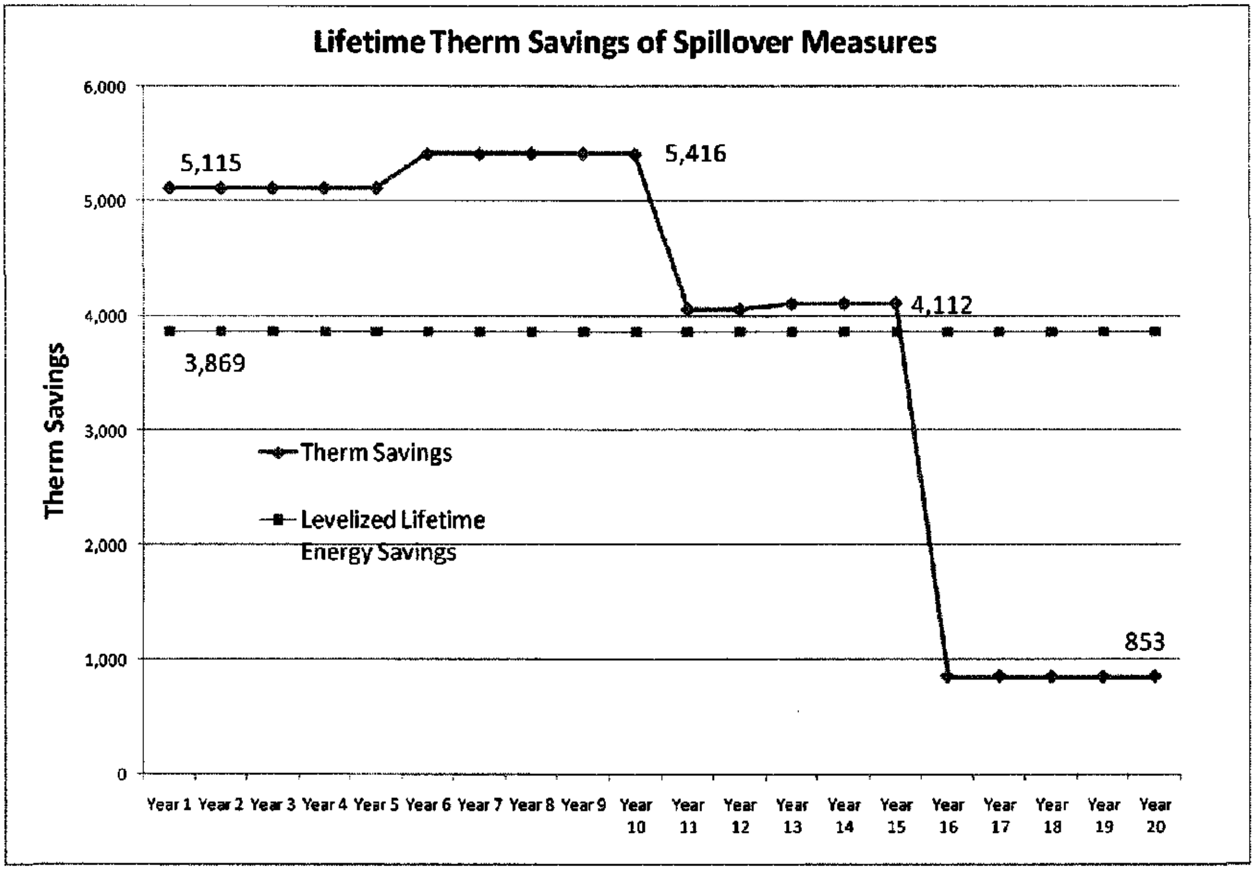

Figure 12. Effective Useful Life of Spillover Measures and their Therm Savings