A COMPREHENSIVE EVALUATION OF OHIO'S LOW-INCOME HWAP: BIG BENEFITS FOR CLIENTS AND RATEPAYERS

Michael Blasnik, Proctor Engineering Group, Boston, MA

Introduction

Assessing the benefits and costs of low income weatherization programs is more critical than ever as federal funding for low income energy programs declines and issues of universal service are addressed in the context of utility restructuring. The Ohio Department of Development Office of Energy Efficiency commissioned Proctor Engineering Group (PEG) to perform a comprehensive evaluation of the Ohio low income Home Weatherization Assistance Program (HWAP) in 1996. HWAP provides low income households with a comprehensive set of weatherization treatments including: dense-pack cellulose wall insulation; attic insulation; blower-door guided air sealing; energy-related home repairs; heating and water heating system safety testing, minor tune-ups, and occasional safety-related replacements; duct sealing; and energy education. In most utility service territories, HWAP and the local utility provide joint treatment for some houses.

The goals of the impact portion of the evaluation include assessing the program's impacts on:

- gas and electricity usage;
- payment behavior (arrearages, utility collection activities, and service disconnections);
- ratepayer costs of Ohio's Percentage of Income Payment Plan (PIPP);
- the health, safety and comfort of participants;
- the local economy; and,
- the environment.

In addition to the quantifying these program impacts, the program evaluation also includes a process evaluation (with participant phone interviews) and a technical review involving 60 detailed site visits to participant homes. The goals of the evaluation are not limited to a snapshot of program impacts, but are aimed at providing insights into program performance and recommendations for improvement. The evaluation will also serve to establish a base of information concerning low-income energy usage, payment behavior, and savings in Ohio.

Cost-benefit analyses of the program are being performed from several perspectives, including an analysis of the impacts on utilities and ratepayers if the program were to receive supplemental funding through utility rates. The evaluation is expected to be complete by August 1997, with additional results presented at the conference. Preliminary findings have already been used in regulatory proceedings. The final evaluation results may have an impact on policies concerning the proper role of utility/ratepayer funding for low-income weatherization in a restructured environment.

Preliminary results indicate that the program produces impressive gas savings of more than 300 ccf/yr. -- 70% larger than found in the 1989 National WAP study. Program savings are much higher for PIPP customers, averaging about 400 ccf/yr., and the direct financial benefits of these savings accrue entirely to the ratepayers. The program is also providing some electricity savings in gas heated homes -- an expected result, but one which is not typically included in evaluations. HWAP is also having a significant impact on the ability of participants to avoid collection actions and service terminations.

Although substantial data quality checks and alternative analyses have been performed, the results presented here should be interpreted with care since they are not yet "final" and do not yet include the impacts for some utility service territories.

Methodology

The impact evaluation is following a classic quasi-experimental pre/post treatment/comparison design. The treatment population includes the nearly 12,000 HWAP participants from the 1994/95 program year (treated from April 1994 through March 1995). The comparison group is defined as the approximately 10,500 HWAP participants from the 1995/96 program year. The goal for assessing energy and payment impacts has been to include as many cases as possible among those heating with utility-supplied fuel. Approximately 75% of participants heated with utility gas, 12% with electricity, and the remaining 13% with oil, propane, or wood.

The primary energy usage analysis approach involves performing PRISM analysis of the pre and post treatment data for the participants and the comparison group. The PRISM results will be compared and contrasted to a pooled time series cross-sectional (CSTS) regression analysis of the same data. The usage analysis is also examining electricity savings for gas-heated households using several approaches. A second stage analysis of the PRISM results is being performed to assess factors associated with high and low savings and usage levels.

Several analysis methods are being employed to analyze payment-related data ranging from simple pre/post summaries to complex multiple regression, ANACOVA,

and discrete choice modeling. The evaluation is also assessing and dealing with issues of representativeness through careful comparisons of analysis samples to populations and, if needed, adjustments based on stratification and/or statistical models.

Data Collection

Approximately 95% of the utility heated participants were served by one of eight local utilities owned by 6 utility companies. A key task in the study has been an exhaustive effort to collect and clean the needed data for assessing energy usage and payment behavior.

The data collection process began in early 1996 with the gathering of the HWAP statewide weatherization databases for program years 1994 and 1995 and the HEAP tables for the same two years. The participant utility account numbers, recorded by local weatherization agencies, were checked and cross-referenced to the HEAP databases to create the most accurate and complete participant account lists. Energy usage and payment data were formally requested from utilities in June of 1996. The data requested included approximately 3 years of usage and payment data, requiring considerable effort from some companies in accessing archived data. Some utilities responded quickly, while others only acted after regulators ordered compliance with the study. Overall, more than 10 months elapsed pursuing utility company usage and payment data. The utilities also provided data on their own low-income weatherization efforts in order to properly identify households which received joint services or received two sets of treatments in the analysis timeframe.

Data Cleaning Issues

Cleaning and formatting the utility usage and payment data was a major task, particularly for data extracted from archives using older mainframe reporting tools.

Two utilities were unable to provide actual meter reading dates in the usage histories, but did include the revenue cycle month and number of days elapsed for each period. PEG developed an algorithm for estimating an anchor date for these usage histories based on selecting the date which maximized the correlation between the average daily usage and average daily degree days for each account (analogous to PRISM's method of selecting a "best" reference temperature).

One utility did not match on account numbers but instead provided usage and payment related data for all customers identified as either HEAP recipients or PIPP participants. These two groups were expected to include the vast majority of HWAP recipients, but will exclude some participants which may introduce bias. Account number changes (due to meter reading re-routing) and shifting program participation over time led to substantial difficulties in developing complete histories for many participants served by that company.

Another utility did not provide account numbers for participants in their own weatherization program, only names and addresses. Variations in name and address formatting and spelling required specialized routines to maximize the matching accuracy in comparing that database to the program database.

Preliminary analysis results revealed that the comparison groups drawn from certain local weatherization agencies apparently experienced considerable "savings". A further investigation found that these agencies reported a relatively large number of their jobs as completed very close to the end of the program year. Many of these jobs actually had most of the work completed much earlier, but for various reasons were not submitted as complete until the end of the program year. The statewide program tracking database only lists completion dates for each job, not treatment start dates. For evaluation purposes, the treatment period was defined as the sixty days prior to the job completion date. Therefore, comparison group cases drawn from 1995 PY participants which were treated much earlier than their listed completion date will exhibit savings from HWAP treatment in their supposedly "pseudo" post period. This treatment date problem creates an incorrect comparison group adjustment. Potential similar problems in the both the participant and comparison groups led PEG to request records from the local agencies indicating treatment start dates. Once these dates are available, the analysis will be re-run for cases with long treatment delays. Any corrections made through this process should result in higher net savings estimates for the program than indicated here.

Findings

The data analysis has not been completed, but preliminary results are available for several of the primary program impact areas of interest. Final results and conclusions are expected to be available for presentation at the conference.

Gas Savings (single family homes)

The industry standard Princeton Scorekeeping Method (PRISM) was used to analyze the gas usage data for the 1994 HWAP participants and the comparison group drawn from 1995 participants. PRISM provides weather-adjusted annual energy consumption estimates based on monthly usage data. Savings for each house are calculated as the difference in the normalized annual consumption rates between the pre and post treatment periods. For the comparison group, the pre period was defined as the period two years prior to actual treatment and the "post" period was the year immediately preceding actual treatment.

PRISM analysis has been performed on gas usage data from 4 utilities: Columbia Gas, East Ohio Gas, Cincinnati Gas and Electric, and Dayton Power and Light. These four utilities served 8105 HWAP participants -- 92%

of the gas heated participant population. At least some usage data were acquired for about 70% of these participants. Most of the sample attrition came from two sources: one utility only matched accounts into a special low-income database which they maintained, but was admittedly incomplete; another utility only provided usage data for HEAP and PIPP customers. Sufficient data were available to complete a pre and post usage analysis for 3828 (68%) of the remaining participants. Of these participants, 76% lived in single family homes (multifamily dwellings are being analyzed separately). Usage anomalies and/or incomplete data led PEG to exclude 23% of the PRISM savings estimates due to unreliable or physically impossible PRISM results in either the pre or post periods.

The final analysis sample with "clean" savings estimates includes 2227 of the 6289 single family gas heated homes in the participant population (35% of this target group and 19% of the total units treated). The comparison group experienced greater sample attrition because of the need to exclude usage data which occurred after the true treatment and due to timing issues for jobs which received joint treatment from HWAP and the utility. Only 1059 out of 4650 single family gas heated comparison group cases are in the final analysis sample.

A detailed attrition analysis is being performed to assess how the final samples may differ from the original populations. Preliminary analyses suggest that the final samples are fairly similar to the larger population of single family gas heated homes and the modest differences found tend to imply that the attrition group would achieve higher savings than the final sample.

Table 1 summarizes the gas usage and savings results from the PRISM analysis. The savings are quite impressive, averaging 310 ccf/yr., equal to 22.5% of pre-treatment usage. When compared to the results from the 1989 National WAP evaluation, these savings are 70% greater than the 182 ccf average savings found for the moderate climate region.

Table 1 also shows a breakdown of net savings for several subgroups defined on characteristics of interest including PIPP status, joint treatment with a utility weatherization program, and the installation of wall insulation (for brevity, comparison group results are not shown or included in the # cases, but are used in the calculation of net savings). Many of these characteristics appear to be associated with the savings achieved:

- Households which received joint service from HWAP and a utility saved considerably more than those which received only HWAP.
- Absolute usage levels and savings are much higher in PIPP households than non-PIPP households.
- Houses which received wall insulation saved more than twice as much as houses which did not.
- Extremely large savings were achieved in

Table 1: Gas Usage and Savings Results for single family homes (ccf/yr.)

		Mean Usage				
Group	# Cases	Pre	Post	Mean Savings	% Savings (of total)	% Savings (of heat)
Participant Group	2227	1379	1076	303	22.0%	27.5%
Comparison Group	1059	1370	1377	-7	-0.5%	-0.6%
Net Savings				**310**	**22.5%**	**28.1%**
Usage & Net Savings for selected groups						
Jointly treated with Utility	780	1363	983	395	29.0%	36.0%
HWAP treatment only	1447	1387	1126	266	19.2%	24.1%
PIPP customers	830	1653	1256	397	24.0%	29.7%
Non-PIPP customers	1128	1210	960	266	22.0%	27.7%
Jointly Treated PIPP customers	305	1618	1130	539	33.3%	41.0%
HWAP-only PIPP customers	525	1674	1329	330	19.7%	24.8%
Received Wall Insulation	1127	1548	1143	416	26.9%	33.3%
No Wall Insulation	1100	1205	1006	201	16.7%	21.2%
HWAP only, Non-PIPP, No Wall Insulation	389	1085	974	125	11.5%	14.8%

PIPP households which received joint treatment.
- Low savings and usage were found for non-PIPP customers treated by HWAP only who did not receive wall insulation.

These simple comparisons of sub-groups point to many avenues for further exploration, one of which is pursued in the next section. A comprehensive analysis of energy savings and usage is being performed using exploratory and confirmatory data analysis techniques to help identify demographic, housing stock, and treatment characteristics associated with high and low savings; to estimate measure-specific impacts; and to assess numerous hypotheses about program performance and participant energy consumption. The findings from this analysis will be presented at the conference.

Savings, Usage and the PIPP Program

One of the most notable comparisons shown in Table 1 is the tremendous difference in usage and savings levels between PIPP and non-PIPP participants. The Ohio PIPP has approximately 250,000 participants. Gas heated PIPP customers pay 10% of their income to maintain gas service and can also pay 5% of their income to maintain electric service (or 3% if their income is below 50% of poverty). In 1995, Ohio utilities collected more than $90 million from ratepayers to fund PIPP. Based on data from four utilities, nearly half of HWAP participants are or have been enrolled in PIPP during the three year analysis period. The PIPP customers used an average of 37% more gas than non-PIPPs during the pre treatment period and saved 49% more gas. These findings raise at least two obvious questions:

1. Why do PIPPs use more than non-PIPPs?
2. Do PIPP households provide any special savings opportunities or are the higher savings simply expected given the higher prior usage levels?

PEG examined available housing stock, usage, and demographic information to identify potential reasons for the difference in gas usage between PIPP and non-PIPP gas heating customers in single family homes. This analysis found that, compared to non-PIPP customers, PIPP customers:

- have slightly larger houses (8% greater floor area);
- have larger households (3.1 vs. 2.5 people);
- are less likely to have senior occupants (14% vs. 44%)
- are more likely to rent (37% vs. 14%);
- have slightly older houses (62 vs. 55 yrs. old)
- have 20% lower income ($8219 vs. $10273); and,
- have 27% leakier houses, measured by a blower door.

The difference in air leakage rate is considerably greater than the difference in house size, implying that PIPP houses are generally in worse condition than non-PIPP. Although the differences noted above tend to imply that PIPP houses are likely to use more gas than non-PIPP, these factors only explain about a third of the difference in actual usage (based on engineering analysis and confirmed with a regression analysis).

A key question is whether the remaining difference in usage is due to other differences in the condition of the houses or if PIPP customers engage in wasteful behavior, as economic theory might suggest given their zero marginal cost for gas. PEG examined this question by comparing the balance point temperatures estimated by PRISM for PIPP and non-PIPP households. The estimated balance point temperature should be related to the thermostat setting, which is the largest behavioral influence on gas usage. The average balance point temperature for PIPP participants was 62.1°F , only 0.4° higher than the 61.7° found for the non-PIPPs. This small difference indicates that PIPPs do not set their thermostats any higher on average than non-PIPPs. The difference in balance point temperatures is actually smaller than expected from building shell effects alone given the difference in overall heating usage (less efficient building shells provide less temperature float from internal gains).

The conclusion from this analysis of usage levels is that PIPP customers use more gas than non-PIPPs because they tend to live in larger and leakier houses which are in worse condition than non-PIPP customers' houses. The combination of high gas usage and low income leads them to choose PIPP because their regular bills would be unaffordable and PIPP offers a better deal. As a percentage of household income, PIPP customers would have to spend about 15% of their income on average to pay their full gas bills while non-PIPPs paid about 8%. Most non-PIPP households likely choose not to participate in PIPP because it isn't as good a deal as paying their regular bills.

The higher energy savings achieved in PIPP houses were examined using regression modeling and testing whether PIPP status was a significant explanatory variable. This analysis indicated that the higher savings for PIPP customers are fully explained by their higher pre-treatment usage rates -- there is no "PIPP" effect beyond high usage. Somewhat surprisingly, PIPPs were no more likely than non-PIPPs to receive joint treatment from utility programs and had about the same installation frequency for attic insulation. Only two treatment differences were found: PIPPs were about 25% more likely than non-PIPPs to receive

wall insulation, and air sealing crews achieved nearly 50% greater air leakage reductions in PIPP houses.

In summary, it appears that PIPP customers are an excellent target group for improving the average savings from HWAP because of the relatively poor condition of their homes and the associated high usage levels.

Electricity Savings

HWAP should produce electricity savings for electrically heated participants and for gas heated participants, particularly those with heavy use of air conditioners or supplemental electric space heaters. Results for a significant sample of electrically heated houses are not yet available. However, a preliminary analysis has been performed for the gas heated participants of the two dual fuel utilities.

Several analysis approaches were explored for assessing these secondary program impacts. Some of the key challenges which need to be addressed in analyzing non-heating electricity usage data in moderate climates include: the substantial variability in air conditioning and space heating penetration and usage intensity; fundamental difficulties in modeling moderate cooling loads; the relatively small expected impacts; and the limited number of data points available for many cases due to estimated meter readings. PEG performed two different house-level weather normalization approaches analogous to PRISM -- one involving a fixed reference temperature heating/cooling degree day regression model and the other involving a simple summary of winter and summer usage increases adjusted for seasonal degree days. In addition to these normalization approaches, pooled time series cross-sectional regression analysis of the average daily usage rates was also employed with heating and cooling degree day variables and participation represented by a fully interacted indicator variable.

The different approaches yielded a range of results due to methodological differences as well as to the varying analysis samples which each approach could include. Although a reconciliation of the results is still being pursued, it appears that savings in the range of 200 to 500 kWh/yr. are being achieved in the homes of gas heated participants. These savings are mostly in the weather dependent portion of the loads, as would be expected for a program with no measures targeted to electric baseload. The savings are likely from a combination of reduced electric consumption of gas heating equipment (mostly furnace fan operation), reduced use of electric space heaters in some homes, and reduced cooling loads due to thermal measures. Although the relative savings are modest (approx. 3%-6% of usage), the additional savings on participant bills may significantly add to the overall net benefits of the program.

Payment Impacts

The impact of HWAP on bills, payments, arrearages, collection actions, and service disconnections were identified by the Office of Energy Efficiency as a key research question for the evaluation. These impacts may play a key role in assessing the overall cost-effectiveness of HWAP and the value of low-income weatherization to utilities and their ratepayers. One major gas utility (Columbia Gas) was able to provide an extensive dataset concerning payment and collections. Other companies provided varying levels of payment-related data which are being analyzed but are unlikely to provide the same opportunity for assessing impacts in detail.

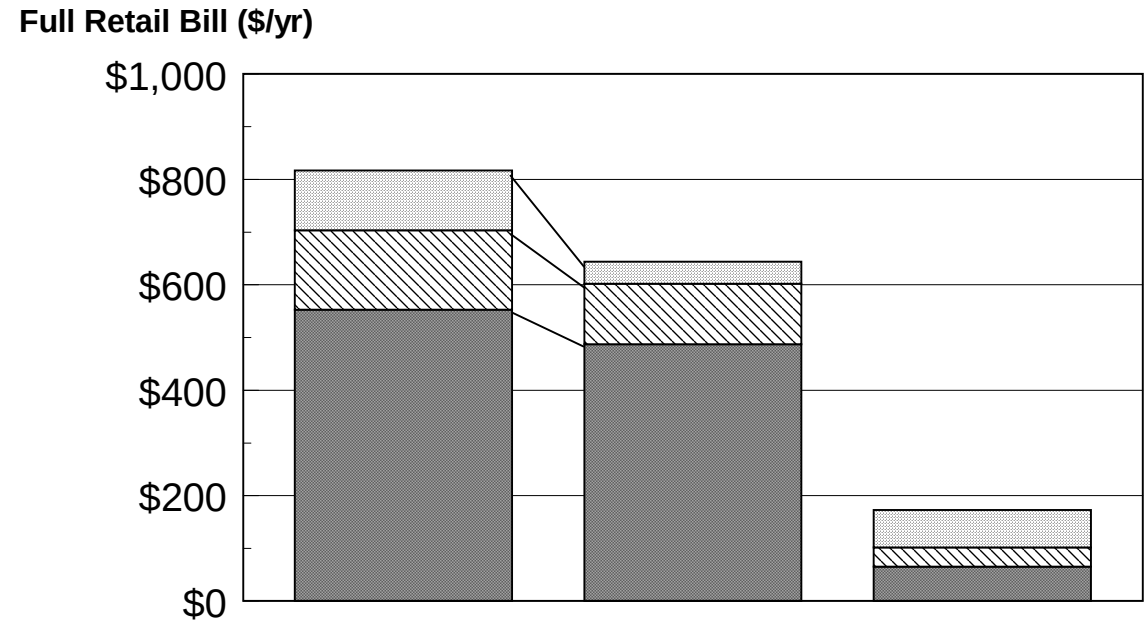
There is no "standard" approach for analyzing payment data and the task is complicated by incomplete data, shifting payment arrangements, fuel assistance levels, and weather effects. To minimize the potential for misleading results, payment impacts were assessed using several approaches, including common sense.

The main analysis approach employed was the simplest -- calculating the average total retail bill amounts (the full retail price based on usage), customer payments, and all other payments for all available periods before and after treatment and annualizing these figures to 12 months. The difference between retail bill amounts and payments, called the shortfall, is a combination of current arrearages and, for PIPP customers, the PIPP shortfall reflected in the PIPP rider and paid by ratepayers. The results from this approach for the participants are shown in figures 1 and 2.

Figure 1 shows that the average annual shortfall between retail bill and all payments declined by 63% after HWAP, from $114/yr to $42/yr. The comparison group's shortfall (not shown) actually increased by 7% over the same period, partially reflecting the reduction in HEAP payments over the period. Total fuel assistance payments received by the participants declined at a greater rate than for the comparison group primarily because of a 35% decline in the number of emergency HEAP recipients among the participant group. This decline can be considered a positive outcome because emergency HEAP is only available to avoid shut-offs in emergency situations and therefore is not available to customers who can keep up with their bills.

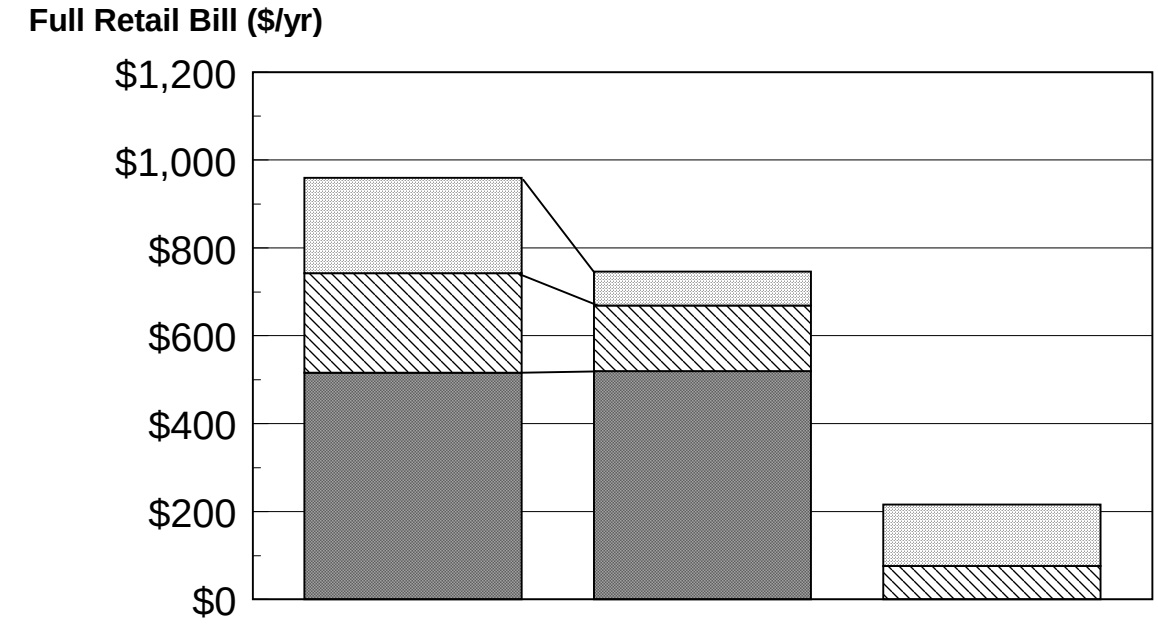
Approximately one third of the 50,652 customer-months of bills included in the analysis supporting figure 1 were rendered under PIPP agreements. The analysis was repeated for PIPP and non-PIPP bills to assess the different effects anticipated for the two groups.

Among non-PIPP bills, three quarters of the $159 in average bill savings went to reducing out-of-pocket expenses and covering HEAP reductions. The remaining quarter of the savings were reflected in a reduction in their average annualized payment shortfall from $65 to $24. For the subset of customers who never participated in PIPP, the bill savings went entirely to reducing out-of-pocket expenses. These customers were quite successful at paying their bills and little improvement could be expected. The results for PIPP participants are, as expected, quite different.



	Pre	Post	Reduction
Customer Payments	$552.65	$487.44	$65.21
Other Payments	$150.87	$114.42	$36.45
ShortFall	$113.68	$42.42	$71.26
Total Retail Bill	$817.20	$644.28	$172.92

Figure 1. HWAP Impact on Bill Payment Coverage - All Customers (Columbia Gas)



	Pre	Post	Reduction
Customer Payments	$516.60	$519.36	-$2.76
Other Payments	$226.28	$149.99	$76.29
PIP Shortfall	$216.98	$76.97	$140.01
Total Retail Bill	$959.86	$746.32	$213.54

Figure 2. HWAP Impact on Bill Payment Coverage - PIPP Customers' Bills Only

Figure 2 shows the analysis results for PIPP customers' bills. The average PIPP shortfall declined by 65% after HWAP, from $217/yr to $77/yr. The PIPP comparison group's shortfall declined by 7%. About 70% of the bill savings reduced the PIPP shortfall while 30% covered the reduction in HEAP payments (PIPP customer payments actually increased slightly after weatherization). The PIPP shortfall would have been essentially eliminated (less than $1/yr) if HEAP payments had remained at prior levels. Instead, the PIPP shortfall went from 23% of the full retail bill before weatherization, to 10% of the smaller bill after weatherization.

Several variations on the payment/shortfall analysis have been performed and all have led to similar results. The analysis was repeated using only 12±1 months of pre and post data and only including cases with complete data. This approach led to smaller samples without materially affecting the results. Another alternative involved using an analysis of variance (ANOVA) approach on the full data set and including month of year as a factor to account for seasonal variations. The ANOVA approach has greater theoretical appeal than the simple averaging method, but is somewhat more complicated to explain and present to stakeholders. The results indicated slightly greater impacts on the net shortfall ($155 for PIPP bills, $46 for non-PIPP bills, and $4 for never-PIPP customers' bills).

The consistency of the payment analysis results from different approaches should be expected. The real conclusion to be drawn is somewhat obvious: PIPP customers will continue to pay their PIPP agreement amounts as well (or as poorly) after weatherization as they did before because their bills are unchanged -- they still need to pay the same amount to maintain service. It would make little sense for PIPP customers to suddenly stop paying their bills simply because they use less gas. However, one might expect some customers to leave PIPP if their bills become affordable after weatherization (this effect is being examined, but the analysis timeframe may be too short to determine its extent).

For never-PIPP participants, the conclusions are almost as obvious. These customers are eligible for PIPP and could join PIPP if unable to pay their bills. Therefore, the never-PIPP customers are generally already paying their full bills. If they use less gas, they pay less and enjoy the savings.

For non-PIPP bills rendered to customers who have changed PIPP status over the analysis period, the results are somewhere in the middle. Many of these customers have had some problems paying their bills and therefore enrolled in PIPP. Some of the savings from HWAP reduced payment shortfalls while most of the savings reduced out-of-pocket expenses and covered HEAP payment reductions.

In summary, the energy savings of PIPP customers will accrue to the direct financial benefit of ratepayers who subsidize PIPP. The savings of non-PIPP customers will accrue to the customer if they have been paying their bills and will help some customers to cover their full bills. Some of the savings from HWAP are likely helping to keep some non-PIPP customers off PIPP and may enable some PIPP customers to leave PIPP. The overall net effect of the energy savings provided by HWAP is to reduce the cost and size of the PIPP program and enable low income customers to better afford paying regular gas bills.

Collection Actions and Service Terminations

PEG also examined the rates of collection actions and service terminations taken by the same gas utility during the pre and post treatment periods for the participants and the comparison group.

The frequency of collection activities (e.g., late payment notices, termination notices, phone calls, referrals to collection agencies, etc.) declined by 6.4% for the treatment group while increasing by 20.8% for the comparison group over the same period, yielding a net 27.2% reduction in collection activities due to HWAP compared to pre-weatherization levels.

In terms of service disconnections, HWAP participants experienced a 39.3% decline in terminations (from 3.7% to 2.3%) while the comparison group experienced a 28.5% increase over the same period, yielding a net reduction of 67.8% in service disconnections due to HWAP relative to pre-weatherization levels. In absolute terms, these findings indicate that approximately 2.5% of participants had a service disconnection avoided due to HWAP treatments. For the 1500 participants in the analysis, this impact translates into avoiding approximately 40 service terminations in the year following weatherization.

A more detailed analysis of collection actions and disconnections is planned to help provide further insights into factors associated with payment problems.

Other Impacts

In addition to saving energy and reducing payment shortfalls, collection actions, and disconnections, the evaluation is also assessing a number of other potential benefits provided by HWAP, including:

- improved health and safety of participants through identification and repair of combustion equipment safety problems and from reduced incidence of service disconnections (with associated use of potentially dangerous alternatives);
- reduced environmental impacts associated with the energy savings;
- job creation and related economic impacts due to the labor intensive nature of weatherization work and reduction in fuel imports into the state; and,

- a more comfortable and improved housing stock for low income participants.

We are attempting to quantify and monetize these impacts to the extent feasible. Although assigning a specific value to such non-energy benefits is speculative, to exclude them from a cost-benefit analysis effectively values them at zero. The evaluation will therefore include ranges of values based on available information as appropriate.

For example, avoided emissions of CO_2 and NOx can be estimated in terms of pounds per year per participant based on the energy savings. A range of monetary values for these emission reductions is being developed based on available literature and approaches which have been adopted in other regulatory jurisdictions. Unfortunately, these ranges are quite wide, covering two orders of magnitude in the case of CO_2. The net benefit calculations will be performed at the extremes of the range as well as a "middle" value. In the case of avoided emissions, this approach yields benefit estimates ranging from about $5 to $300 per gas heated participant per year with a "middle" value of about $50 per year.

Pollution emission reductions are perhaps the most easily quantified of the non-energy benefits. Alternate approaches may be needed to assess the value of safety testing and repairs for heating equipment or health-related benefits from reduced service disconnections. The key difficulty in quantifying these potential benefits is that the expected impact is a reduction in the frequency of an extremely rare, but high "cost", event. The sample sizes and timeframes needed to quantify such impacts are unlikely to be available.

In the case of health and safety testing and repair of heating equipment, an alternative valuation approach may be employed. Instead of attempting to directly quantify the benefits, one could simply value the work at cost. Health and safety related work is undertaken explicitly to promote health and safety and correct dangers in the home, not to save energy. The policy decision to perform such work can be viewed as an implicit valuation of the work as at least as valuable as its cost.

Each non-energy benefit identified will require exploring a range of approaches and valuations to ensure that all program impacts are considered in assessing program cost-effectiveness.

Cost Effectiveness Analysis

Assessing the cost effectiveness of a program such as HWAP involves addressing many questions such as:

- Which non-energy benefits should be included and how should they be valued?
- Which program costs should be included? Should a marginal cost approach be used?
- From whose perspective should energy savings be valued -- participant, utility, or ratepayers?
- How should avoided collection actions, service terminations, arrearages, and write-offs be valued?

The assessment of cost-effectiveness depends upon how one answers these questions. To address the needs of multiple stakeholders in the evaluation, cost-effectiveness results will be presented using a range of approaches and assumptions suitable for differing perspectives, opinions, and purposes. Readers of the evaluation will be able to construct their own custom version of cost-effectiveness based on how they believe each issue should be addressed.

Cost-effectiveness results will also be provided separately for key segments of the participant population including PIPP vs. no-PIPP customers and for other identifiable target groups which show particularly high or low cost-effectiveness. The results for particular segments may help in developing recommendations concerning program targeting and potential roles for utility funding of weatherization.

Conclusions and Next Steps

The impact evaluation of Ohio's HWAP is not yet complete and there are many research questions which are still being addressed. However, preliminary results show a program which is achieving a high level of savings, particularly for PIPP customers and other high use households. Much of the savings accrue to the benefit of the ratepayers who fund the PIPP program. The savings are also enabling low income customers to better afford their utility service, avoiding collection actions and service disconnections, and potentially allowing some customers to leave PIPP and resume paying their full bill.

The preliminary results have already been used in regulatory proceedings and the final evaluation report is expected to have an impact on the future design of HWAP, on policies concerning the proper role of utility/ratepayer funding for low-income weatherization in a restructured environment, and on other issues of universal service and PIPP design in the on-going restructuring in Ohio.