

EVALUATING MICHIGAN'S NEW
EXPANDED HOME REPAIR AND WEATHERIZATION PROGRAM:
PROCEDURES, RESULTS AND ISSUES

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ABSTRACT

Over the past several years, Michigan, like many other states, has faced a serious and increasing financial problem in meeting the energy needs of its low-income residents. Caught in the squeeze between dwindling government resources and rising energy prices, the state found that both utility bad debt accounts and the number of citizen complaints about service shutoffs were growing rapidly.

In an inspiring example of cooperation, all sides participated in passing legislation in 1984 which created the Home Repair and Weatherization Program. This program specifically targets the highest energy consuming households on public assistance and coordinates the services of several different state agencies, the utilities, and private contractors, in an effort to reduce heating fuel consumption. The program is authorized to spend up to \$5,000 per household on home repairs and weatherization services.

This paper presents the highlight results of a comprehensive evaluation of the first group of participants in this innovative program. Sources of data include (1) agency records concerning repair/conservation measures installed and their cost; (2) telephone surveys concerning demographic and behavioral information; and (3) actual utility fuel consumption records. Participants are compared with a de facto hold-out comparison group sampled from service waiting lists.

The data indicate that the program participants achieved nearly a 30% reduction in space heat fuel use, with an average direct cost of repair and weatherization of \$3,518. (The no-service group space heat fuel use declined by one percent during the same time period.)

Finally, results are also compared with a recent study by these authors of the regular Low-Income Weatherization Assistance Program in Michigan, and various related evaluation issues are discussed.

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INTRODUCTION

Background

The Problem. Over the past decade of rapidly rising energy prices, one of the most serious problems to emerge has been the impact of these higher prices on the home heating fuel bills of low-income and fixed income households. The end result has been a terrible financial burden for the residents themselves and a dramatic increase in the amount of governmental assistance needed by the households in order to cope with the high home heating costs.

The extent of this problem nationally and the degree to which government assistance has frequently fallen short of the true need has been well documented elsewhere (National Consumer Law Center, 1984). In Michigan, several factors have served to seriously exacerbate the problem. To begin, during the early 1980's, Michigan experienced a severe economic recession, often leading the nation in the rate of unemployment. This greatly swelled the number of low-income households in the state. Then, in late 1982, two events combined to create a crisis. First, the state legislature, in response to a soaring state energy assistance budget, put a limit on the amount of money a welfare recipient could receive for heat. Shortly thereafter, in response to public concern over the potential for life-threatening situations, the Michigan Public Service Commission (PSC) issued an emergency rule prohibiting shut-offs of electricity and gas service during the winter for recipients of Aid to Families with Dependent Children or General Assistance (AFDC/GA). These two actions resulted in the state's utilities becoming very concerned, because a likely situation of extensive revenue shortfall had been created. By mid-1983, the need for a constructive solution to this heating bill/fuel assistance/utility shutoff problem was widely acknowledged.

The Energy Assurance Program. In the Spring of 1984, after months of negotiations, the Michigan Home Repair and Weatherization (HR/W) Program was created as the centerpiece of a six bill legislative package known as the Energy Assurance Program (EAP). The new HR/W Program contained the following major features:

- . It was specifically targeted to households receiving public assistance (AFDC or GA).
- . Services were provided first to the highest band of energy consuming households (i.e., those in excess of 330 Mcf of natural gas--or the equivalent in other fuels--per year).

The organization of the program was very complex, involving the coordination of several state agencies and private sector firms. Some of the specific task assignments were as follows:

1. Overall administration of the program was the responsibility of the Department of Social Services (DSS), as were several specific tasks such as outreach, client intake, and supervision of the repair component of the program;
2. The specific repair and weatherization measures to be done in any particular house were determined by an expanded and specialized RCS audit--under the direction of the local utility company;
3. Repair work (including all furnace measures) was conducted by private contractors, under a competitive bid process administered by DSS;
4. The weatherization work was conducted by the Local Weatherization Operator (LWO) of the existing federally funded Low-Income Home Weatherization Assistance Program--administered by the Bureau of Community Services of the Michigan Department of Labor (BCS/MDOL).

The program was authorized to spend up to \$5,000 per dwelling in repair and weatherization costs (more than 3 times the amount allowed in the existing Weatherization Program).

Households agreeing to participate in the HR/W Program were granted protection from utility shut-offs (under the assumption that after receiving the HR/W services, the home's heating fuel consumption would be below the state's energy assistance limits).

The Evaluation

Origin. Frequently, one of an evaluator's most difficult tasks is to secure the approval for an evaluation in the first place. Fortunately, that was not a problem in this case. By the time the HR/W Program was initiated, the Evaluation Unit of the Michigan Energy Administration had already performed evaluation work for several of the state agencies involved in this project. Therefore, these agencies were fairly comfortable with the concept of an evaluation and with the ability of the Energy Administration to accomplish the task. Furthermore, the somewhat politicized atmosphere surrounding the creation of the program had led to a requirement in the original legislation for an evaluation to be conducted (although the particular form and methodology were not specified).

The end result was that the Michigan Energy Administration, being (a) the Governor's agency responsible for overall energy policy; (b) not involved in administering the HR/W Program (and therefore able to be more objective); and (c) the one agency with an evaluation staff technically qualified and experienced in this area, was selected to perform the HR/W Program evaluation.

Funding. The evaluation of the HR/W Program was added to a multi-component evaluation contract which the Energy Administration already had with the BCS/MDOL. The overall cost of the HR/W evaluation, including in-kind contributions by the Energy Administration, was approximately \$30,000. Staffing requirements included the evaluation manager, an evaluation technical analyst, and six data clerk/interviewers.

Context. Several factors surrounding the HR/W Program contributed to the challenge of conducting this evaluation. Perhaps most significant was the overall complexity of the program. No fewer than three state agencies, a local government agency, a local non-profit agency, numerous private contractors and a major utility company were all involved in designing and/or delivering services as a part of the HR/W Program. In addition to creating major coordination problems for the program itself, this situation substantially increased the normal data gathering problems associated with evaluating a government program (e.g., some type of archival data had to be obtained from almost every one of the above-listed organizations). Fortunately, cooperation and patience were in great supply.

Another challenge had to do with the politicized nature of the program itself and the multiple layers of oversight that were created. In the executive branch, there was the Governor's Weatherization Monitoring Committee, comprised of representatives of seven state agencies or departments either directly involved or having a policy interest in the HR/W Program. At the legislative level, there was a special joint legislative oversight committee, with members from both the State House and State Senate. Although neither of these groups was conducting an actual "evaluation" of the program, there were occasional instances of conflicting or overlapping roles in the oversight and assessment of the HR/W Program as well as in the determination and operational definition of the program goals.

A final area of difficulty involved the nature of the target population being served. These were all public assistance recipients, living in some of the worst housing in the state. This tended to compound many of the typical problems facing an evaluator, including change of residence, lack of a telephone, and bad or missing fuel data (e.g., due to more frequent service disconnections, missed readings, adjusted billings, etc.). The problem of the degree of generalizability of findings from this first group of HR/W participants to later participants is also a factor. (That issue will be addressed later in the Discussion section.) All things considered, however, this somewhat unique service program presented a good opportunity to conduct an evaluation under rather challenging circumstances.

METHOD

Samples

Participants. The sampling frame for the HR/W Program participants was essentially determined by outside circumstances. Only 59 homes, all in the Detroit Metropolitan area, completed the program prior to the 1984/85 heating season. (November 1 was chosen as the cut-off date.) All of those homes were initially selected for examination in this study.

To ensure data consistency, several screening criteria were then applied to the sample, including: (1) must use metered utility natural gas as a heating fuel¹; (2) should not use a major supplemental fuel (such as wood); (3) should reside in an individually metered single family dwelling unit; and (4) must have lived in that dwelling for at least one year prior to the study period. The final criteria was that usable fuel bill data (with sufficient actual meter readings) before and after service must be available from the utility company. A total of 41 participant households met all of these criteria for inclusion in this study.

Non-participants. As is often the case in this type of evaluation, random assignment of cases to service and control conditions was not possible. However, the fact that this was a new program, with a large eligible population, presented a good opportunity for the use of the "waiting list" technique of identifying a comparison group. At the end of the post-service heating season (to assure non-service status), a random sample of 77 households was selected from the next pool of eligible households. After applying the above screening criteria, 54 households remained in the no-service comparison sample of this study.²

Subsequent analysis of demographic and housing characteristic data indicated that this no-service sample was indeed a well-matched comparison group for the participant sample. (See Results.)

¹Over 80% of all homes in Michigan heat with natural gas. In the Detroit area, the figure is even higher. All of the 59 homes initially selected met that criteria.

²Note that the dropout or subject mortality rate was almost identical for the service and comparison groups (approximately 30%). Also note that self-selection bias was not a factor in this study, since participation was mandatory and service was initiated by the Department of Social Services, rather than by the client. Generalizability is an issue which will be discussed later.

Data Collection

Several sources of data were utilized in this study, including: (1) agency records on the nature and cost of the repair services and weatherization services provided to each home; (2) detailed telephone interviews covering demographic information and client reactions to the service; and (3) monthly utility fuel consumption records before and after receiving service.

For the agency records and utility fuel bill information, data was obtained from the pertinent agencies in hard copy form. Data was cleaned and coded onto machine readable optical scanning forms for computer entry by trained data clerks. Telephone interviews were also conducted by trained agency staff, and data was entered onto the computer through the same optical scanning system.

Data Analyses

The data obtained from agency service records and from the telephone interviews were used in two principal ways: to provide a description of the participating households and the services received and to provide a basis for understanding and interpreting the fuel savings results obtained. Toward these ends, the evaluation incorporated a broad range of statistical analyses, including simple frequency distributions, cross tabulations, analysis of variance and various correlational and regression analyses. As appropriate, certain of these analyses are presented and discussed in this report.

For the fuel bill analyses, a simple pre- versus post- mean difference analysis on space heat fuel use was conducted. The average of July and August consumption was used to estimate baseload (in Ccf/day) and that figure was subtracted from gross consumption to estimate space heat fuel use (in Ccf/heating degree day, using a 65° F base). The November through April time period was used to define the heating season. The post-service estimate of Ccf/HDD over that period (really an estimate of space heat fuel use efficiency) was then subtracted from the pre-service value and a percentage savings was computed. That percentage savings was then multiplied times a weather-normalized estimate of pre-service space heat fuel use, to estimate normalized annual savings.

There were not enough actual meter reads available before and after service to utilize a regression technique of consumption with heating degree days, such as might be used with a Normalized Annual Consumption (NAC) analysis (e.g., see Hirst, White & Goeltz, 1984). However, comparisons in other similar studies (Kushler and Witte, 1985; Kushler and Witte, 1986b) have shown this simple mean difference methodology to produce almost identical estimates of annual savings to a regression-based NAC methodology (e.g., correlations between the two methods of greater than .90 and mean Ccf savings estimates within $\pm 2\%$).

One additional factor influenced the choice of this methodology. The simple mean difference analysis is easier to explain and easier for a non-technical audience (such as the legislative target audience for this evaluation) to visualize and understand. That is not a small consideration in this type of political context.

RESULTS

Demographic and Housing Characteristic Data

The analysis of demographic and housing characteristic data was intended to serve two fundamental purposes: (1) to provide a descriptive "profile" of those receiving HR/W services and (2) to determine how well the no-service comparison group matched the HR/W participant sample. In order to accomplish these ends, a total of 17 descriptive variables were examined, ranging from such items as the number of occupants in the household, to the age of the dwelling, to the pre-program space heat fuel consumption.

The results of the analysis of these variables are presented in tabular form elsewhere. (See Kushler and Witte, 1986a.) In the interest of saving space in this report, only the summary conclusions will be provided here.

First, the participant profile was found to be very consistent with the intended target population for this program. All participants were AFDC or GA recipients with correspondingly low educational, employment and income levels. The housing stock was much larger ($\bar{x} > 1600 \text{ ft}^2$) than had been the case in earlier studies of the statewide weatherization program (recall that these first HR/W participants were targeted because they had the highest fuel use), and homes were quite old ($\bar{x} > 50$ years) and in serious need of repair and weatherization.

As for the second purpose, the data revealed that the no-service sample was an exceptionally well-matched comparison group for the HR/W participant sample. There were no significant differences between the two groups on any of the 17 demographic and housing characteristic variables examined. With these results in mind, the data on program costs and fuel savings can now be considered.

Program Cost Data

This study was able to carefully monitor the direct costs incurred in delivering the home repair and weatherization services provided in the HR/W Program. The data was taken from actual contractor invoices for the repair and weatherization work, which the evaluation obtained from the participating agencies. Table 1 summarizes this cost data.

The results reveal an average home repair¹ cost of \$2,029 per dwelling, and an average weatherization cost of \$1,489, resulting in an average total direct cost of \$3,518 per dwelling for repair and weatherization.

As is often the case in this type of study, it was not possible to accurately determine the various indirect costs associated with operating the HR/W Program (e.g., administrative costs, program support such as outreach, intake, inspections, etc.). These costs were roughly estimated by the participating agencies in another report (Michigan Department of Commerce, et al., 1985). Their estimate amounted to another \$923 (including the cost of the utility home audit), bringing the total overall estimated cost of the HR/W Program to \$4,441 per household.

Fuel Savings Data

The energy savings results, of course, comprise the most important component of this study. Using the methodology described earlier, the change in space heat fuel consumption over the study time period was examined for both the participant and no-service comparison groups. This data is presented in Table 2.

The results show that the HR/W participants achieved an overall 29.7% reduction in space heat fuel use from the pre-service to post-service heating seasons.² By contrast, the no-service comparison group registered a negligible (and not statistically significant) 1.0% decline. Given these results, and the degree of comparability established between the participant and no-service groups, it would seem appropriate to conclude that the observed net savings for the participant group were, in fact, attributable to the HR/W Program. (Note: This basic net savings estimate was supported by the results of additional analysis methods, including multiple regression analyses controlling for various demographic and descriptive variables.)

The study applied the obtained percentage savings estimates to a normalized pre-service space heat consumption estimate and arrived at an overall average annual natural gas savings estimate for program participants of 933 Ccf. At the prevailing residential natural gas price (\$.60 per Ccf), that translated into an average annual savings of \$560. (See Kushler and Witte, 1986a, for a more detailed presentation of this data.)

¹All furnace mechanical measures (including replacement) were also included in the "repair" component of the program. This accounted for approximately \$800 of the \$2,029 figure reported above.

²By comparison, a recent evaluation of the Michigan Weatherization Program found a 14.7% reduction in space heat fuel use (and an average direct cost of \$913 per participant). Although the two target populations are substantially different (e.g., Weatherization participants used, on average, less than one-half the pre-service amount of space heat fuel and most were not AFDC or GA recipients), the HR/W and Weatherization Programs demonstrated very similar cost-effectiveness. (See the cost-effectiveness discussion in this paper.)

DISCUSSION

In considering the results of this evaluation, several issues merit some discussion. Three of those which will receive mention in this paper include: an examination of HR/W Program cost-effectiveness; a consideration of the likely impact and use of this evaluation in Michigan; and an identification of some areas for future research.

Cost-Effectiveness. Although this study could not be characterized as a full cost-benefit analysis, some elementary indices of cost-effectiveness were examined. For example, in response to the enabling legislation for the HR/W Program (which states rather vaguely that repair and weatherization work authorized for a dwelling must be "cost-effective"), this study computed a "simple payback" period for the direct costs of the repair and weatherization measures. A common criteria for a cost-effective residential conservation measure (often used in the RCS program and elsewhere) is that it should "pay for itself" in energy savings in less than seven years. This type of payback calculation on the direct costs and energy savings found in this study shows the HR/W Program repair and weatherization services to have a simple payback of 6.3 years (\$3,518 in direct costs divided by \$560 in annual savings).

Another basic cost-effectiveness index is the "cost of conserved energy" (e.g., see Goldman, 1983). In this case, using a 7% real discount rate and a 15 year expected life of the retrofit package, the HR/W Program was found to have a direct cost of conserved energy of \$4.05 per million Btu. (Note: the average retail residential cost of natural gas in Michigan is already in excess of \$6.00 per million Btu.)

Using these two rather basic economic indices, the HR/W Program would appear to be relatively cost-effective. By comparison, data from an earlier evaluation (Kushler and Witte, 1985) shows the regular Weatherization Program in Michigan to have a very similar cost of conserved energy (i.e., \$3.93/million Btu), while a composite of 47 U.S. residential conservation programs was found to have an average C.C.E. of \$5.00/million Btu (Goldman, 1983).

There are, however, broader benefit-cost implications which were not addressed in this study. In particular, the indirect economic impact on the state from reduced energy imports (Michigan imports over 80% of the natural gas it consumes) is a very promising area for future research.

Impact of the Evaluation. It is very difficult to gauge the ultimate impact of this evaluation at the current time. On one hand, the relatively positive energy savings results are welcomed by program advocates and will likely offset, to a certain extent, some of the criticism the program has received regarding coordination problems and low service completion levels. On the other hand, this program was originally launched in a very political atmosphere, and some rather unrealistic expectations were created concerning program performance. (This problem was exacerbated when an inter-agency interim report was issued which--contrary to the advice of the evaluation

manager--cited overly optimistic projected payback periods based on "engineering projections" of savings.) On balance, however, the evaluation results will probably be perceived as positive and, therefore, contribute toward a continuation of the program, pending further information from subsequent evaluation efforts.

In addition to overall program impact assessment, there are also many operational areas where the evaluation has been able to contribute, such as improvements in program administration and service delivery. Examples of this range from decisions concerning which types of temperature control thermostats should be utilized to the design of a "client education" package, but space limitations prohibit further discussion of these factors here.

Areas for Future Study. A major limitation of this study was the fact that it was only able to include the first group of participants in the HR/W Program. This raises obvious questions concerning the generalizability of these results across later participants¹, both because of possible differences in later participants (and/or their housing stock) and also because the program itself may evolve as more experience is gained.

Future studies examining the impact of the HR/W Program across different participants, and in different regions of the state, are recommended in order to help answer this generalizability question. Furthermore, the extent to which observed savings are maintained over time should also be assessed, through the use of longitudinal follow-up studies.

These issues of generalizability and durability of conservation program energy savings effects are important concerns which have rarely been empirically assessed (Berry, 1985; Hirst and Keating, 1986). Interestingly, a recent evaluation of the Michigan Weatherization Program (Kushler and Witte, 1986b) took a look at each of those issues and found a) program impacts were quite consistent across different agencies--over two different program years, and b) fuel savings achieved were fully maintained for at least two years following the service. A study is currently being planned which would help examine these same issues with regard to the HR/W Program.

Finally, two additional useful areas of future research would include (1) an investigation of the relative cost-effectiveness of various individual measures and combinations of measures, and (2) a broader assessment of the economic benefits of this type of program for an energy dependent state such as Michigan.

¹One small attempt was made to examine this issue in this study. A subsequent sample of 27 households completing the program prior to February 1, 1985, were also assessed, and their space heat use was compared to the original sample described in this report over an abbreviated February through April time period. The data showed fairly consistent results, with the original sample achieving a 29.7% savings for this three month period versus a 25.9% savings for the second sample. (The difference was not statistically significant.)

Table I. Average direct cost per household for Home Repair and Weatherization.

Home Repair ¹		\$2,029
Weatherization		\$1,489
(Materials) ²	(\$609)	
(Labor) ²	(\$880)	
Total Direct Costs per Home		\$3,518

¹Also includes all furnace mechanical measures.

²This sub-categorization of costs is presented to facilitate comparison with other programs. (No similar delineation was available for home repair costs due to the nature of the bid process used in that component of the program.)

Table II. Space heat natural gas savings¹ for HR/W participants vs. the no-service comparison group.

	Sample Size	Average "Pre" ² Usage (Ccf/HDD)	Average "Post" Usage (Ccf/HDD)	"Gross" Percent Change Pre to Post	Signif. ³	Simple "Net" Percent Change ⁴
Participants	41	.4211	.2960	-29.7%	P < .001	-28.7%
Comparison	54	.3959	.3915	- 1.0%	N.S.	---

¹Computed for the November through April billing periods for the heating season prior to ("pre") and immediately after ("post") HR/W services were provided.

²The difference between the two groups in pre-program space heat fuel consumption is not statistically significant.

³Two-tailed T-tests with n-1 degrees of freedom.

⁴Determined by taking the nominal ("gross") percent change for the participant group and subtracting the nominal percent change of the comparison group.

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