

"AN EVALUATION OF MADISON GAS AND ELECTRIC COMPANY'S
WEATHERIZATION ASSISTANCE PROGRAM FOR LOW-INCOME CUSTOMERS"

Lynn K. Hobbie, James C. Stellner, and Robert K. Stoffs
Madison Gas and Electric Company

ABSTRACT

Madison Gas and Electric Company offers weatherization assistance to its low-income customers. For low-income homeowners, assistance is provided in the form of Conditional Grants. Conditional Grants are designed to address the weatherization and efficiency needs of individual homes. Specifically, the grants include insulation, infiltration, and equipment efficiency improvements judged cost effective for a given home based on estimated paybacks.

This paper presents an evaluation of that program conducted after its first year of operation. The evaluation used actual preprogram and postprogram consumption to estimate changes in natural gas consumption among first-year participants. The paper describes methods and analyses used in the evaluation. It discusses briefly why certain methods were chosen, their strengths, and limitations.

This paper also discusses preliminary findings of the evaluation, conclusions from those findings, and some directions for future research.

At its conclusion, the paper presents an approach evaluation staff developed in the aftermath of this particular project to improve its process for conducting future evaluations.

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INTRODUCTION

Madison Gas and Electric Company (MGE) is an investor-owned utility in southern Wisconsin that provides gas and electric service to 74,000 and 104,000 customers, respectively. Over the last five years, the Company has implemented a number of energy conservation and efficiency programs and is interested in how those programs are performing. The Company needs to know both whether programs are meeting the needs of customers who participate and how programs are impacting the utility overall.

This paper discusses the initial evaluation of one of those programs--the Low Income Weatherization Assistance Program (LIWAP). This evaluation looked at customer impacts. The magnitude of those impacts, exploration of how and why they varied, and directions for future research are presented in this paper. This paper also presents, at its end, an approach MGE evaluation staff developed in the aftermath of this project to help specify the contents of future evaluations and conduct them more efficiently.

A BRIEF DESCRIPTION OF THE LOW INCOME WEATHERIZATION ASSISTANCE PROGRAM

In 1983, as a way to help low-income customers better control and afford their utility bills, Madison Gas and Electric Company (MGE) began offering weatherization assistance to eligible customers. For homeowners, assistance took the form of Conditional Grants: conservation measures, insulation additions, and efficiency improvements combined to meet the weatherization and efficiency needs of a given home. These needs were assessed by program staff who then chose a package of measures for each home based on an approximate five-year payback. Work was contracted out and then inspected by program staff. The Grants averaged roughly \$2,000 per residence, and all costs were paid for with utility weatherization dollars.

EVALUATION OBJECTIVES

Two years after the program began, program staff and management were interested in finding out if participants were saving energy and how much.

Based on a sample of first-year (1983) program participants, evaluation staff designed an initial evaluation to address the following objectives:

- To measure the effects, as possible, of program grant installations on customer energy consumption; and
- To assess the relationship of select characteristics to any energy conservation achieved.

EVALUATION APPROACH AND METHODOLOGY

Both evaluation and program staff wanted to address these objectives empirically. For this reason, actual consumption data, drawn from billing data, were compared from before and after program participation to assess savings. Regression analysis was then used to explore the relationship of several program and demographic variables to any observed savings.

The sample consisted of 41 customers who received Conditional Grants in 1983 and was arrived at by process of elimination. Initially, all of the jobs completed in 1983 were considered (approximately 85). Jobs were then dropped from consideration if:

- there had been a change of occupancy during the pre- or posttime periods; or
- there was incomplete consumption information (e.g., customers who heat with oil or wood).

The customers remaining after this screening were the 41 used for the evaluation. All of these heat with natural gas, and most have electric general service from MGE.

Homes were not considered where there had been a change in occupancy because no valid way could be found to combine the consumption data of different occupants of the same residence. This left neither a census nor a random sample of 1983 Conditional Grant recipients and raised questions about the representativeness of the sample. As a rough check, distributions of grant dollars spent and preprogram consumption for the 41 customers were compared with those of all 1983 recipients and were found comparable.

For analysis of consumption, a preweatherization consumption period was used that consisted of 12 months prior to the weatherization audit for a particular home. The postweatherization consumption period was 12 months after MGE's inspection of the installation on that home. Number of heating degree days and base energy use were also collected for these time periods.

(Estimates of base use are routinely made as part of the weatherization audit and are based on an average of the lowest months of consumption.)

Consumption data were normalized for weather variation in the following way:

$$\text{Normalized Annual Consumption} = \frac{\left[\text{Annual Consumption} - 12 \left(\frac{\text{Monthly Base Use}}{\text{Degree Days for Time Period}} \right) \right] * (7,642 \text{ degree days})^1}{+ 12 (\text{Average Monthly Base Use})^2}$$

where

¹Number of degrees in a day below 65 degrees Fahrenheit from the Madison Climatological Report.

²Average monthly base use was defined as the average consumption of July and August for the time period.

Changes in space-heating energy use were calculated as the difference between preperiod normalized consumption and postperiod normalized consumption. Changes in general service electric consumption were similarly calculated as the differences in consumption between the two time periods.

HOW COMPANY PRIORITIES AND AVAILABLE RESOURCES SHAPED THE EVALUATION

As mentioned earlier, both evaluation and program staff wanted the evaluation to measure actual changes in energy use for first-year program participants. It was also a Company priority to conduct this initial evaluation as soon as possible after the program's first year of operation.

Since actual savings were desired, the timeframe for the evaluation allowed evaluation staff to collect consumption data from microfiche and from the computerized customer system and transfer them to a personal computer for analysis.

However, the decision to study first-year program participants as soon as possible limited the sample size to total jobs completed that first year (which was then decreased further as described above).

Furthermore, at the time, staff could come up with no satisfactory group of customers to use for a control group. A sample of MGE program participants was used in a later, state-wide study by the Public Service

Commission of Wisconsin (PSCW) of utility low-income weatherization programs. This study used as a control group houses that were weatherized by the utility or targeted for weatherization at least 13 months after the "treated" homes were weatherized. Due to timing, that would not have been a workable solution for MGE's earlier in-house evaluation. Plus, when it turned out that the question of how much people saved without the program would eventually be answered by the PSCW study, the decision was made not to pursue it further in-house at that time.

FINDINGS AND RELATED ISSUES OF INTEREST

In 1983, Conditional Grants were designed primarily to affect natural gas consumption, and 39 of the 41 customers sampled saved natural gas in their first year after program participation. The average natural gas savings was 28 percent. Median savings was 26.5 percent. Figure 1 gives the distribution of participants' savings in CCF of natural gas. Table 1 gives corresponding summary statistics. Translating absolute savings into percent of preprogram consumption yields the distribution of savings shown in Figure 2. Figure 3 is a normal probability plot of this distribution and suggests that the variation in percent savings can be roughly approximated by a normal distribution with the mean and standard deviation given in Table 1.

As a comparison, the PSCW study found, for the sample of MGE program participants included, median natural gas savings of 16.9 percent among participants and 3.7 percent for the control group. It should be noted here that the sample used for this evaluation differed from the sample used in the PSCW study in a way which may help explain the 10 percent difference in median savings between the two groups. In addition to Conditional Grants, MGE's LIWAP program offers several other forms of assistance. One of these forms is called an Infiltration/Conservation Package. Offered primarily for renters, it consists largely of comprehensive caulking and weather stripping and water-heater insulation. The PSCW sample was a mix of customers who received Infiltration/Conservation Packages and Conditional Grants. The sample for this evaluation included only customers who received Conditional Grants. Since the Conditional Grants include much more comprehensive weatherization, one would anticipate higher savings with the Conditional Grants than with the Infiltration/Conservation packages.

The sample for this in-house evaluation was small and limited, but it provides a very interesting set of data for exploring possible sources of variability. There are a multitude of variables that can theoretically affect how much energy a given home will save. For this group of customers, however, many variables were held in common and, therefore, effectively held constant. For example, these customers all fell within the same definition of a low-income household. The package of conservation measures and

improvements each received was decided upon, contracted out for installation, and inspected by the same program staff. Because these customers all lived in roughly one county, they also experienced similar weather and economic climates.

In other ways, these 41 customers varied a good deal. Since each home had its own particular set of weatherization needs, each received a somewhat unique combination of weatherization and efficiency improvements. The homes varied in age, size, and construction. Household characteristics also varied, e.g., size, numbers of children, and number of elderly people. And, certainly, lifestyles and energy-related behaviors varied as well. While the dataset included information on measures installed, building characteristics, and basic household characteristics, it contained no information on energy-related behaviors.

Since weatherization grants to these 41 participants ranged in size from \$281 to \$4,323, this is a sensible variable to compare with savings. Figure 4 shows the distribution of weatherization dollars spent per household, and Figure 5 is a plot of dollars versus percent savings for each participant. The plot reveals no obvious relationship between these two variables. And, in fact, simple linear regression confirmed that the amount of money spent did not explain much of the observed variation in percent savings.

Linear regression analysis was also used to examine the relationships between percent savings and the level of preprogram consumption, building age, building volume, and family size. No statistically significant relationships were found. Again, none of these variables explained much of the variation in percent savings.

There are at least two possible reasons for these findings. One is that, in fact, no statistically significant relationships exist between these variables and percent natural gas savings. It is also possible, however, that due to the large variation in savings, relationships that might show up in a larger sample are not apparent in a sample of 41 customers.

These initial analyses raise questions about why savings vary as they do. Certainly, one area that needs exploring is the relationship between measures installed and savings. Since Conditional Grants are tailored to the needs of individual houses, one would hope that measures installed would be somewhat related to savings. The small sample size and large variety of measures installed, however, constrained such analysis in this evaluation. That analysis should certainly be on the agenda for future evaluations.

The relationships of these and other variables to savings need to be explored further and for a larger sample of participants. At the same time,

different exploratory tools also need to be tried--possibilities could include expanded use of regression (and regression diagnostics), generalized linear models, and cluster analysis--to see if findings depend at all on the analytic approach used and, if so, why.

AN APPROACH FOR EVALUATING PROGRAMS WITHIN THE UTILITY

Certainly, one of the challenges of conducting program evaluations within a utility (or any organization) is fitting what one might, as an analyst, ideally like the evaluation to include, together with Company priorities, timeframes, and available resources. Sometimes, these two are well aligned, sometimes not.

In the aftermath of this particular project, MGE evaluation staff developed an approach to help bring sound analytic methods together with priorities, timeframes, and available resources for a given evaluation.

First, evaluation staff identify "researchable evaluation questions" for the particular program or area. Examples could include: what were savings among participants their first year after participation or, what were savings among participants their first year after participation due specifically to the program.

Once researchable questions are identified, evaluation staff develop several strategies that could be used to address each question. Then staff discuss the strategies briefly in terms of strengths and limitations and the trade-offs between strategies in addressing the question. For example, issues discussed include: which strategies are doable with existing data and in what form, which would require more data, and how extensive would their collection be. Strategies are also discussed in terms of the conclusions that can be drawn under each. For example, for this particular evaluation, staff measured the savings of customers after program participation. To have estimated their savings due specifically to their participation in the program would have required some type of control group, i.e., a different evaluation strategy.

This approach makes very explicit the choices, for a given evaluation, of what questions should be addressed, with what strategies, and what commitment of resources. This way, whoever has ultimate responsibility for these choices, be it evaluation staff, program staff, management, or a project team thereof, can make them with full understanding of what can be accomplished given what resources. MGE program evaluation staff have used this approach for several projects since this evaluation and found it very useful for planning and implementing evaluations smoothly and efficiently. In addition, evaluation staff have found that planning for the evaluation from the

program's beginning can help ensure that data necessary to implement preferred strategies for chosen questions are, in fact, collected.

CONCLUSION

With this initial evaluation of the Low Income Weatherization Assistance Program, program staff and management were provided with an estimate of natural gas savings for program participants. Because the savings estimates exhibit widespread variation, however, their interpretation raises some interesting questions.

First, it would be extremely useful to know which variables contribute significantly to the savings a given home will realize and to what extent. This information would help program staff improve and refine a program's ability to deliver savings.

Secondly, understanding how benefits of any program are distributed can improve estimates of its overall impact. Average impacts per customer certainly provide some information, but understanding how those impacts vary and why can yield an even more reliable estimate of a program's overall performance.

Besides providing information on weatherization assistance program participants, this evaluation effort also gave staff insight into implementing future evaluations even more efficiently using the approach outlined in this paper. In short, the evaluation helped staff assess program impacts and improve its process for doing so in future.

REFERENCES

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Table I. Natural gas savings among conditional grant recipients, 1983 participants, N = 41.

Statistic	CCF Natural Gas	Percent of Preprogram Normalized Consumption
Mean	291	28.0%
Standard Error of Mean	42	3.0%
Standard Deviation	270	19.0%
Minimum	-118	-15.5%
Maximum	1,071	66.5%
Median	206	26.5%

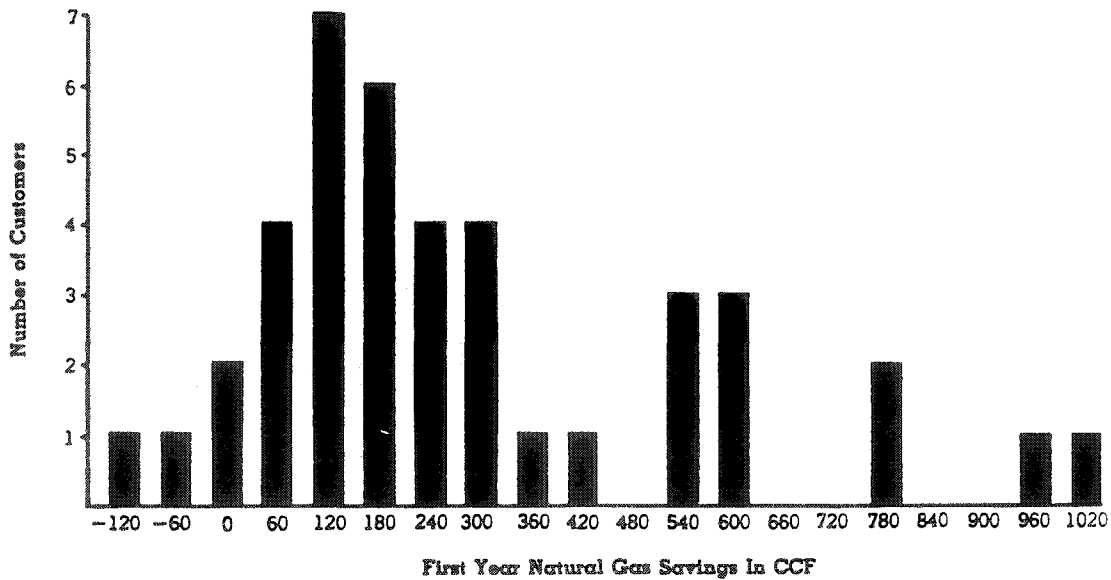


Figure 1: Frequency distribution of participants' natural gas savings (n = 41).

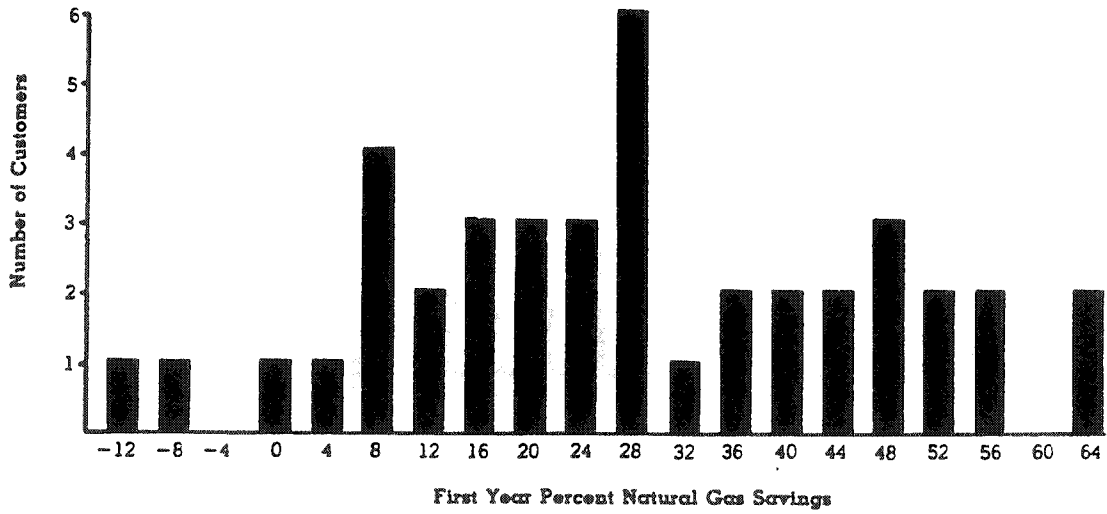


Figure 2: Frequency distribution of participants' percent natural gas savings (n = 41).

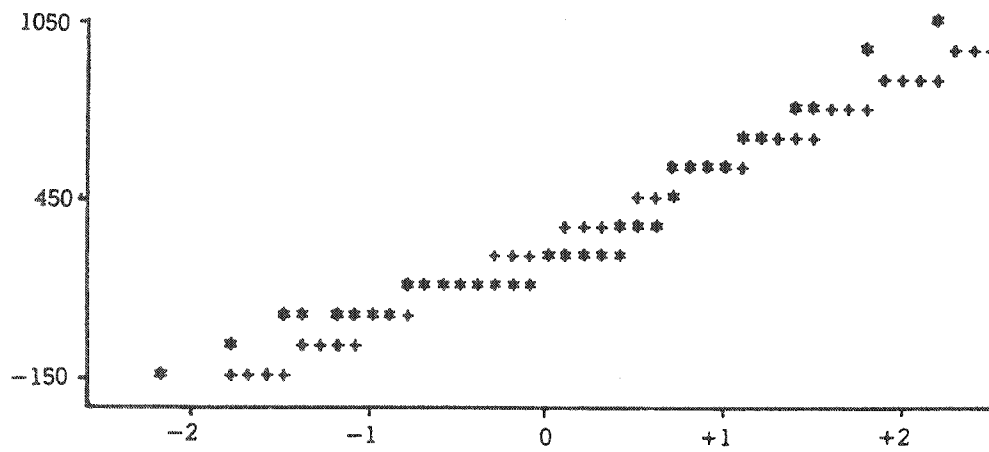


Figure 3: Normal probability plot of percent natural gas savings (n = 41)

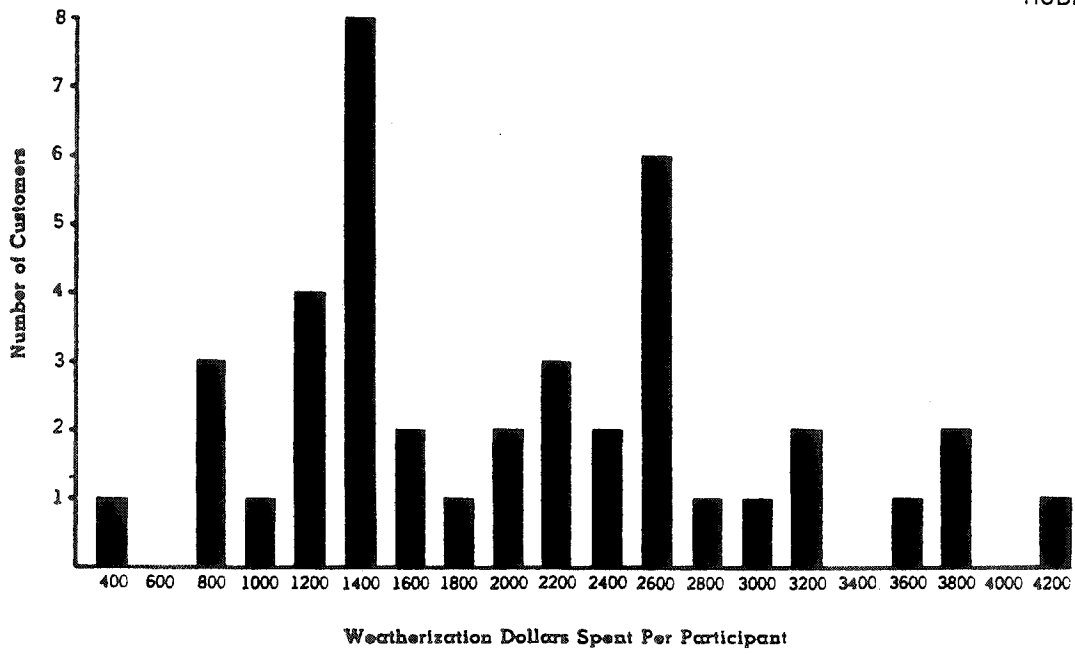


Figure 4: Frequency distribution of weatherization dollars spent per participant (n = 41).

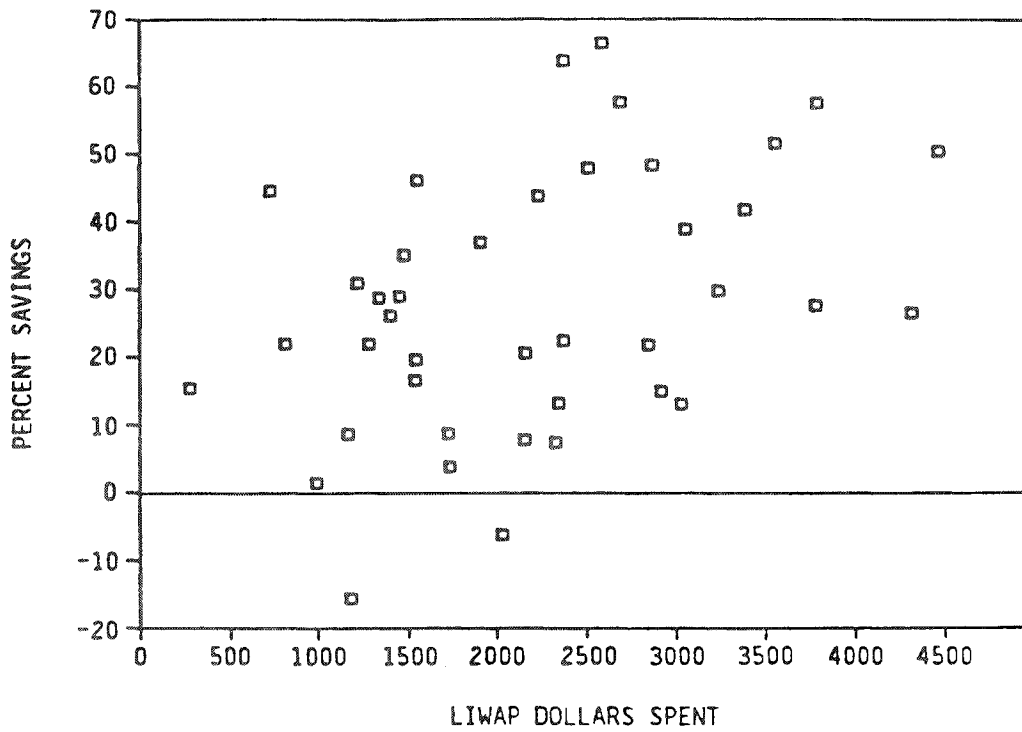


Figure 5: Percent natural gas savings versus program dollars spent (n = 41).