Guidelines for Determining When an Arrearage Impact Study is Cost-Effective to Undertake

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Utilities often conduct a variety of programs for their low-income customers. These can include: arrearage programs, reduced rates, energy efficiency programs, or some combination of these. These programs attempt to impact the participant's energy bill and/or bill payment behavior. These direct impacts can then have secondary impacts of reducing customer arrearages, thereby reducing utility collection activities, disconnections, reconnections, and bad-debt write-off. Measurement of these secondary benefits can allow them to be included in the evaluation of the cost-effectiveness of the above mentioned programs. Yet, the studies to measure these secondary impacts can also be costly and difficult to perform. It is, therefore, important for utilities to properly determine whether the additional analysis is cost-effective to undertake.

Whether a study is to be conducted or not is seldom decided based upon the cost-effectiveness of conducting it (i.e., whether the information obtained is worth the study's cost). This paper presents guidelines that have been developed for a decision-tree that examines when it might be cost-effective to perform an arrearage study of low-income energy efficiency programs. The guidelines include: (1) Immediate decision paths that minimize the effort in using the decision-tree itself; (2) When using results from another utility's study might be most cost-effective; and (3) What information should be used to decide what level of effort should be performed in the arrearage study. These guidelines were developed in a recent project sponsored by the nine investor-owned gas and electric utilities of New York (through the New York Low Income Evaluation Task Force).

PROJECT INTRODUCTION

In New York State, the investor owned gas and electric utilities formed a system of committees and subcommittees to coordinate and develop joint research. At the request of the New York Public Service Commission, one of these committees undertook projects to address four areas of concern related to evaluating low-income energy efficiency programs. The work reported in this paper is from the second phase project designed to address one of these concerns, assessment of methods and development of guidelines to address ''hard to quantify'' costs and benefits of low-income energy efficiency programs.

The first phase project (1) Searched and critiqued methods to quantify and monetize social (non-energy) impacts of low-income energy efficiency programs; and (2) determined the types of stakeholder benefits that could occur and how this included could be included in benefit/cost analyses, or within alternative policy paradigms (Cambridge Systematics, Inc. 1994).

The second phase project developed guidelines for conducting arrearage and economic impact studies, and developed a decision-tree guideline to determine when it would be cost-effective to undertake these types of impact analyses. This decision-tree guideline, as it applies to conducting arrearage impact studies, is the focus of this paper.

DISCUSSION AND PRESENTATION OF DECISION-TREE GUIDELINES

Path 1, Will a policy decision be made?

The first step in the decision-tree is to determine what policy decision could be impacted by the analyses if performed. If it is not reasonable to expect to change a policy decision with the analyses, then it would be a waste of ratepayer money to perform the analyses.

There are generally two ways in which the policy decision is not likely to change. These are when: (1) The policy decision is not going to be reviewed in the near-term; or (2) The magnitude of the results can not be expected to make a difference in the policy decision or in the design of a continuing program.

The most common occurrence of the first path is when the program has already been terminated due to an agreement from a recent rate case. In this case, a program budget is no longer available, and there is no short-term decision on continuation of the program awaiting further benefit/cost analyses.

If the utility finds itself in these circumstances, then the analysis should not be performed, and the remainder of the decision-tree does not have to be considered. That is, there is a cost to assessing the cost of these studies, and they can be avoided in these cases.

Path 2, would a reasonable expected maximum impact change the policy decision?

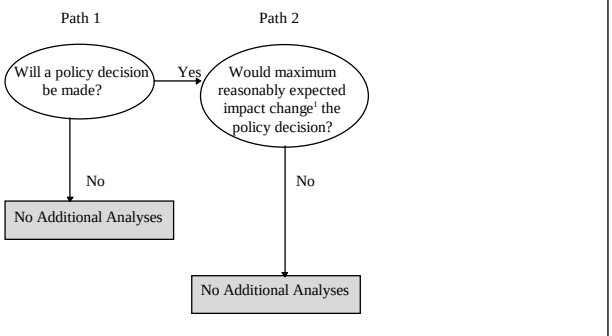
The second path involves assessing whether the analysis(es) could be expected to make a difference in action. In this case, the maximum reasonable impact to be expected from the analysis is estimated. The question is then addressed as to whether this maximum impact would create a different decision than obtained without the analysis.

The first two decision paths are illustrated in Figure 1.

The Monte de Ramos et al. study found the greatest arrearage impact of $175 annually. A mid-ground finding was that found in the Quaid and Pigg study, with a finding of $177[1]. The lowest estimate found in the literature review for the first phase of this project (Cambridge Systematics, Inc. 1994) was a net present value of $32 given by the Oak Ridge study (Oak Ridge National Laboratory 1993). Not only is there a great variance in these findings, but there is no long-term arrearage study to estimate the persistence of the arrearage reductions.

There are generally two types of arrearage impacts reported in these studies, the average for the participants with arrearage problems and the overall average impact for all program participants. Utilities can decide whether they wish to target their programs, and to what level, to payment troubled customers. Given this, we decided to use the average arrearage impact measure for those participants with arrearage problems. This can also enable utilities to analyze how modifications in their targeting efforts to payment troubled customers will affect their benefit/cost analyses of the overall program (as long as the benefit/cost analysis incorporates the benefits of reduced bad debt write-offs). [This average arrearage impact estimate can also be used to estimate potential impacts when considering a weatherization subcomponent for an arrearage program (i.e., a program that only serves payment troubled customers.)]

Figure 1. *Initial Steps in the Decision-Tree*



Source: Cambridge Systematics, Inc. 1995, 4-9.

[1] Given the increased evaluation costs are included in the analysis of the policy decision, i.e., the benefit/cost ratios.

The 1991 study performed by Quaid and Pigg found an average impact reduction of unrecovered costs of $272 per payment troubled participant. The Columbia Gas of Pennsylvania arrearage study (Monte de Ramos et al. 1993) found that weatherization's impact varied significantly by the type of arrearage pattern the customer had previous to the program. The stable arrearage customer is also the mode of the customer groups. This group showed a change in customer deficit of $263, remarkably close to the Wisconsin findings reported in Quaid and Pigg 1991. Also, this modal group was more than twice the size of any other arrearage category in the Monte de Ramos study. Therefore, the $263 impact was used as the general Monte de Ramos study impact.

Given the wide variation in weather across the New York utilities[2] and the differences between many of these utilities' weather and that found in Wisconsin and Pennsylvania, the expected arrearage impact expected has been placed in terms of dollars per heating degree day (HDD)[3]. The heating degree days assumed for Wisconsin and Pennsylvania are 6,416 and 4,500, respectively. (These HDDs are those reported in Schlegel and Pigg's low-income efficiency program comparison study of 1990 that most closely represent the areas of the above arrearage studies.) This weather adjustment translates the Quaid and Pigg 1991 finding to $0.0424/HDD. The Monte de Ramos et al. 1993 finding becomes $0.0584/HDD.

Given the results of the New York utility interviews concerning arrearage information and the above results in arrearage studies, a figure of $0.0584/HDD per payment troubled participant per year for the first three years after participation was recommended for the assumed maximum expected impact. This would be used as the maximum expected impact for the utility benefit of reduced bad-debt write-off, and for the social benefits for reduced arrearages. (We are using the term arrearages here to represent the entire class of reductions: arrearages, collection costs, termination costs, bad-debt write-off, and reconnection costs.)

This assumed maximum expected impact should be applied to only those program participants that are payment troubled, and who use that utility as their primary heating fuel source. (Heating fuel customers have the larger utility bills, and can

have the larger arrearages. Therefore, these customers can have significant weatherization impacts on their arrearages.) More research needs to be conducted in this field before an arrearage impact estimate can be established for non-heating customers.

It is also important to recognize that these estimates are based upon arrearage impacts from single family programs. This means that these estimates are much larger than would be expected from a multi-family program. Until the necessary research is conducted, we recommend this single family household estimate be adjusted downward by the ratio of the average arrearage (or annual bill) from multi-family heating customers to the average arrearage (or annual bill) from single family heating customers to achieve an estimate for multi-family customers. Recognize also that the arrearage impact will only occur from customers who pay their heating bills. That is, if a multi-family tenant does not pay their heating bill, their arrearage will not be affected by reducing the buildings heating requirements. This means that the new multi-family estimate should only be applied to those participants who pay their own utility bills.

The Monte de Ramos et al. 1993 study estimated arrearage impacts as an annual impact. Yet, no true persistence study of arrearage impacts has been conducted to-date. Given this and the likelihood that a participant would have been allowed to continue to increase arrearages annually for decades, it is not recommend that an annual impact for the life of the measures be used for the reasonable maximum impact assumption. Instead, a still optimistic assumption, we recommended that a three year persistence figure is assumed to be the maximum likely impact expected. The three year persistence figure was selected as it seems unlikely that the same customer would be disconnected for non-payment annually for more than three years and then be reconnected each year for more than three years. It is this occurrence, continual utility reconnection in the face of a history of bad-debt write-off, that would be required for a persistence of this benefit. Otherwise, there are no social costs to be reduced. In other words, if a customer's service is disconnected, the unrecovered bills and disconnection costs are a cost to the utility and society. If a customer is disconnected and reconnected and the utility collects its disconnection and reconnection fees, the utility does not face a loss but society has lost (or wasted otherwise productive funds) the costs of the disconnection and reconnection costs.[4]

The above provides that to complete path two in the decision-tree requires the use of the assumed maximum expected arrearage impact to determine if this would change the policy decision. This can be accomplished in a six step process easily performed by the utility analyst that performs the program's benefit/cost analyses. These steps are presented in Table 1.

Steps one and three use the percentage of payment troubled that will be served. This accomplishes two things. First, only the payment troubled participants will achieve arrearage reduction benefits. Second, it reflects the decision-making use of the benefit/cost analysis by asking that the selection be based upon what will be served instead of what was served.

This distinction of using a future perspective is made because the benefit/cost analysis is to determine if the program will be cost-effective to continue. Given its use for future program implementation, it is appropriate that it use historical information to represent the likely future benefit/cost. This means that if the percentage troubled has been falling over time with a similar concentrated effort at having this type of customers participate, it is not realistic to expect this percentage in the future to be the average of its historical experience. Similarly, if the program is being redesigned to target pay-

Table 1. *Steps to Calculate Maximum Reasonably Expected Arrearage Impact*

1. Select the percentage of participants that will be payment troubled heating customers that pay their own utility bills.
2. Calculate annually for the first three years after the participation year the lesser amount of the difference between participant bill savings and avoided costs, and $0.0584 times the HDD times the number of participants. (This benefit is zero for year four onward.)
3. Multiply the annual number by the percentage from step one.
4. Take the net present value of this stream of benefits as was done for the other benefits in the TRC.
5. Add this net present value of benefits to that of the normal benefits. Then divide by the normal TRC net present value of costs.
6. Check the modified TRC benefit/cost test to see if it provides a different policy decision than the normal TRC test. (Also, check if the modified TRC benefit/cost is now greater than 0.90 when the normal TRC was below this tipping value for the economic impact effects.)

Source: Cambridge Systematics, Inc. 1995

ment troubled customers where it did not have this design in the past, the selected percentage would be expected to be higher than the historical percentage.

Step two calculates the maximum feasible arrearage benefits. This is the $0.0584 times HDD per participant or the participant benefits minus the avoided costs. Using the lesser of the $0.0584 multiplier or the participant's bills ensures that the estimate of the impact is not more than the participant's total bills. The participant benefits (bill savings) are the maximum the participant would place in arrears that can be reduced due to the efficiency program. The avoided costs are subtracted from the participant's bills so they are not double-counted, as they are already included in the TRC benefits.

The remaining steps calculate the modified TRC test. The comparison between the normal TRC and the modified TRC provides the answer for path two on the decision-tree.

Paths 3–5, what assumptions or level of analysis is cost-effective to undertake?

After knowing the analyses could change the policy decision, the next steps in the decision-tree are to assess how much the analysis would cost and what alternatives there are for performing the analysis or accepting an assumption of a result from another utility's analysis. This is where the cost-effectiveness of the analysis to be employed is examined.

There are three factors used in the proposed decision-tree guideline to determine what level of arrearage or economic impact analyses should be conducted or whether an assumption from another utility's study should be used. These factors are: (1) The size of potential movement in the policy decision-making benefit/cost ratio; (2) The estimated cost for each of the three levels of analysis; and (3) The size of the potential maximum benefits that could be expected from the analysis.

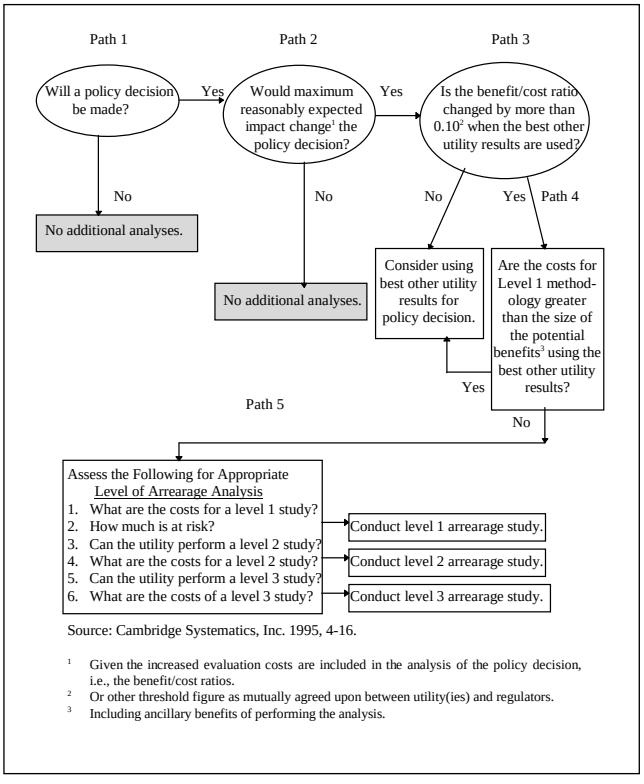
Each of these factors are themselves ordered paths. For example, if the size of the potential movement in the benefit/cost ratio is small and, yet, it would change the policy-decision, the utility may choose to continue the program without the additional analyses. This avoids both the costs of the analyses and of estimating analysis costs. This decision might be made if the utility believes that the other non-quantified benefits would provide the tipping margin to cause the program to pass the TRC test. That is, a marginal program might be accepted as passing the TRC if the utility has found that it provided significant customer service benefits and the participant surveys found that the customers gave high satisfaction ratings for participating. This decision would be the ''yes'' decision path for path 3, as shown in Figure 2.

The fourth decision path occurs when the potential benefit/cost change is significant. This is where the costs of the analysis level and the size of the potential benefits are weighed against one another. It is obvious that the utility should never pay more for analysis than the potential benefit could be, if they did the analysis costs would wipe out all the benefits that were measured.

It is important to recognize that the analysis does not increase the benefits that are there, but only measures them. This means that the value of this additional information is much smaller than the potential size of the benefits.

If an arrearage study were done and no benefits were found, the costs would be the costs for the arrearage study plus costs caused from operating a non-cost-effective program. This second cost is the difference in the net present value of benefits versus costs. This total (net NPV cost plus arrearage study cost) is the amount of money at risk. (In a pure economic framework, there is also an opportunity cost for how else these funds could have been used. The opportunity cost, however, is less tangible and more difficult to include in the analysis.)

Figure 2. *Decision-Tree Guidelines for Determining Whether, and at What Level, An Arrearage Impact Study Should be Performed*



Source: Cambridge Systematics, Inc. 1995, 4-16.

[1] Given the increased evaluation costs are included in the analysis of the policy decision, i.e., the benefit/cost ratios.
[2] Or other threshold figure as mutually agreed upon between utility(ies) and regulators.
[3] Including ancillary benefits of performing the analysis.

If the arrearage study finds benefits different from those that could have been assumed at little cost to the utility, then the value of the arrearage study is only the difference between these two alternatives. That is, the value of the arrearage study over assuming the best information available from another utility study is the net NPV costs if this difference causes a different policy decision plus the additional arrearage study cost. If, however, the same policy decisions were to occur, the additional arrearage study costs are only justified if the information has value to program design that is greater than the cost of the study.

Similarly, the higher the level of money at risk (as defined above) the more money that is justified to be spent on the analysis. This means that the dollars at risk need to be assessed as well as the cost of performing each of the levels of analysis. The dollars at risk should also include the risk of having a lack of information lead to an inappropriate future investment. From this assessment, the level of study to be performed can be ascertained, as well as whether assuming the best information available from another utility's study is the best course of action.

There should also be an assessment of whether there are ancillary benefits that would arise from the analysis. For example, an arrearage impact study could be designed to provide information to be used in other corporate decisions, e.g. how better to influence the paying habits of low income customers, how to better serve these customers, and the impacts on arrearages of potential rate changes (or a low income rate).

These last two sets of assessments are within path five in the decision-tree, as shown in Figure 2.

The results from the best available study at another utility are used in the assessments for paths' three through five. Paths' one and two, however, used the maximum potential impact. This is because the first two paths were examining whether further assessment should be undertaken and this decision should be conservative (i.e., bear low risk of missing a cost-effective solution). Paths' three through five, on the other hand, are providing actual input to the final benefit/cost ratio used for the policy decision. This needs to be as accurate as possible to assure the policy decision is made from the best information that is cost-effective to obtain.

At this time, the mean or best estimate from another utility study of arrearages is approximately $0.0424/HDD for the first year after program participation. This is the median estimate from the literature review in the prior phase of this project (Cambridge Systematics, Inc. 1994), the results from the Quaid and Pigg study in 1991. As other studies become available, better (more reliable or more comparable in the circumstances found at a particular utility) estimates might be found.

The result of the decision-tree is whether arrearage analysis should be conducted, and if so, what level of analysis should be conducted. In cases where a policy decision will be made, the modified TRC is recommended for a second modification for the non-quantified program benefits. Nevertheless, the recommendation is to assume the non-quantified benefits would cause the TRC to go over 1.0 if the modified TRC is over 0.90.

LEVELS OF ARREARAGE IMPACT STUDIES

We divided possible arrearage impact methodologies into three levels of effort. The first is the simplest, though by no means easy to perform: a pre-post comparison of means, with a control group, an overall weather adjustment, statistical analysis (non-regression based), and examination of trends. The second incorporates regression analysis in a linear form. Regression analysis allows more factors that impact changes in arrearages to be controlled for a better estimate of program impact. The third incorporates discrete choice analyses, such as logits and probits. Logits and probits are regressions used when the dependent variable is a discrete choice rather than linear. For example, yes/no decisions are a discrete choice and can not be modeled well with linear regression analysis. A customer's decision of whether to make a bill payment every month is a discrete choice. The most sophisticated form of the level 3 analysis would also include consideration of, testing for, and correction of selection biases and attrition biases.

Each of the three levels of arrearage impact study has nine required steps. These steps are presented in Table 2.

There are many variables needing to be defined and culled from billing system information and collections information to perform an arrearage study. The study design possible and cost-effective to undertake would vary by what utility information is available and how the data is collected and stored. This creates a situation where the exact arrearage impact research design should be developed specific to the utility.

Historically, utilities have not taken this type of approach to DSM evaluation studies. The recommended approach for an arrearage study would be for the utility to hire its consultant for this project with a general request for proposals and upon general proposals and/or qualifications. The first phase of the project would be analyzing the data the utility has and developing the exact arrearage study design. The utility would then negotiate with the designated consultant as to

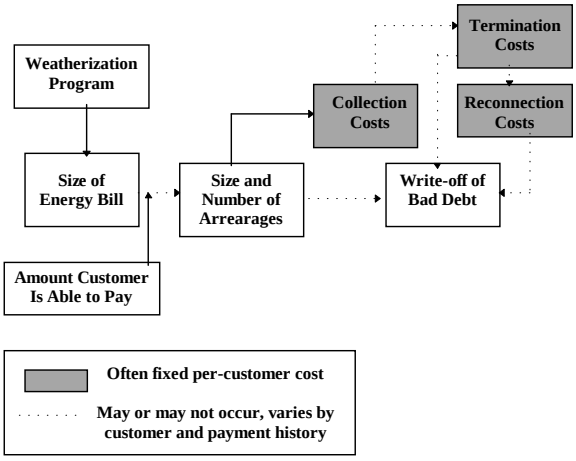
Table 2. *Required Steps for Each Level of Arrearage Impact Study*

1. The first and most important step with any study of the arrearage elements (arrearages, termination costs, reconnection costs, collection costs, and bad debt write-off) is defining what is being examined and what does it mean when you find an impact. This should cover every step in Figure 3 and an understanding of how the information from each analysis step will be used.
2. Stratification of the payment troubled customers according to prior payment patterns, and customer characteristics, is recommended. The analysis can then provide a greater understanding of what is going on by these strata. The information can then also be used for program re-design for the low-income energy efficiency program or for program design of arrearage programs1.
3. Cleaning and developing the bill payment history files for analysis is one of the largest undertakings of this type of study. A clear understanding of each available variable is important. In many cases, ascertaining previous arrearages and changes in arrearages are not straightforward from the billing system data. Yet, this is critical to this analysis. It is also very important that the bill payment history be adjusted as necessary for expected payments given payment plans (which are normally only maintained in hard-copy form outside the billing system). There also needs to be checks and double-checks that the variables and information being used conform to the proper interpretation of that information.
4. Design and obtain equivalent data for a well-matched control group. This is the easiest way to avoid biasing your results by regression towards the mean and can allow testing for potential biases caused by attrition.
5. Flags and indicators of the interactions between other programs these customers may receive must be found and properly identified. The expected impacts from these other programs must be explicitly incorporated into the methodology selected.
6. Weather normalization not only has to be conducted, but the relationship between weather, consumption, and bill payment behavior should be examined as to lags and non-linearity (i.e., inflection points).
7. Examine trends and distributions of bill payment behavior.
8. Perform analysis for each step you are analyzing (as decided from step one).
9. Examine stability of results and explore potential biasing problems.

Source: Cambridge Systematics, Inc. 1995

1. The importance of this was found in the 1993 Monte de Ramos et. al. study, which found significantly different responses to program services across sub-populations.

Figure 3. *Weatherization and Arrearage Impact Relationships*



Source: Cambridge Systematics, Inc. 1994, 2-2 and 1995, 2-2

the work expected, and contract specifications, for the second phase of the project. This second phase would be the actual arrearage impact study.

Given this proposed approach, the methodology levels described below are also general in nature. Each would need to be modified according to the utility's evaluation of its steps from Figure 3 and the information available for the analysis, to include the interpretation of each of these variables.

Arrearage Impact Level 1 Methodology

The level one methodology involves comparisons. This type of analysis can range from relatively simple comparisons of means to more sophisticated non-parametric analyses. Given the nature of the bill payment behavior data and analysis issues, the simplest comparisons could be very unreliable. Two articles of the prior work are the most helpful in guiding the analysis design. These are Khawaja et al. 1992, and Quaid and Pigg 1991.

Arrearage Impact Level 2 Methodology

The Level 2 methodology is similar to the Level 1 methodology except for its inclusion of linear regression analysis techniques. The above references should also prove useful in constructing the study design for the Level 2 methodology. In addition, the Monte de Ramos et al. 1993 study utilized linear regression. Some of the variables to be included in the regression analysis could be lagged weather variables, threshold cumulative seasonal heating bill level, customer

employment, income, and assistance information, bill payment agreements, and overall economy variables.[5]

Arrearage Impact Level 3 Methodology

Level 3 methodologies have been proposed for arrearage studies and a few may be on-going. However, no articles have yet been published using logits, and/or probits, for arrearage studies. The techniques, nonetheless, are quite applicable to the problems being analyzed. For example, one of the primary issues to be analyzed is the program's impact on the probability that the customer will become a bad-debt. There is a threshold level for the decision to terminate service to the customer. There is then a decision to write-off the bad-debt. These dependent variables are discrete choices and, therefore, should be modeled in a discrete choice framework. The research design for a Level 3 methodology could be quite similar to that for a Level 2 analysis. The only difference would be in the tools used (due to differences in selected dependent variables), the statistical significance testing, and the interpretation of the results.[5]

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ENDNOTES

1. The Monte de Ramos study finding is significantly larger than that of the other two studies, as the other studies' findings are total impact while the Monte de Ramos finding is annually.

2. The weather differences in New York are caused by both its geographic size and the fact that some of the service territories are inland and others lie upon the Atlantic coast. The range varies between 7,285 heating degree days for the average of New York State Electric and Gas Company's regions (including upper most New York bordering Canada), and 4,775 heating degree days in Brooklyn Union Gas' service territory on the coast.

3. As correctly pointed out by a reviewer, this technique overstates the weather influence on unrecovered costs given significant baseload usage. For our purposes, this adjustment was the best currently available. There are few arrearages' studies, and not enough using the same techniques such that the effect of weather on the level of arrearages could be properly estimated.

4. This issue is discussed at length in Cambridge Systematics, Inc. 1994. *Hard to Quantify Benefits and Costs of Low Income Energy Efficiency Programs*, directed by Dr. Lori Megdal for The Low Income Evaluation Task Force of the Utilities of New York. Cambridge, Massachusetts. This book was published for sale at cost, as advertised by the American Gas Association, and can be obtained for $45 from Cambridge Systematics, Inc. Attn: Energy Practice, 150 CambridgePark Drive, Suite 4000, Cambridge, Massachusetts 02140.

5. See the related discussion in Cambridge Systematics, Inc. 1994. *Hard to Quantify Benefits and Costs of Low Income Energy Efficiency Programs.*

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