Finding Methods to Estimate Social Benefits of Low-Income Energy Efficiency Programs

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A search was made to find methods to quantify the social benefits of low-income energy efficiency programs. There were six primary hypothesized social benefits of these programs that were focused upon. These were: (1) reduced arrearages, uncollectible, termination and reconnection costs; (2) reduced public transfer payments; (3) reduced foreclosures and evictions, and delaying elders movement out of own homes; (4) increased health and safety; (5) increased housing stock value and neighborhood preservation; and (6) impact on the local economy. A literature search and snowball survey technique of experts was conducted to find what methodologies had been used in the past (if any), or what methods might prove fruitful, to quantify and monetize these benefits. The greatest inventory of previous work in these areas was found in the reduced arrearages and the economic impacts areas. Citing these works, an overview of the various methods used and their short-comings or difficulties that should be guarded against was made. Several of the other focus areas proved less likely to have viable methods that could be applied at a utility level. An examination of possible methodologies from work in the appropriate field was used to provide recommendations as to what areas had methods which could be applied at the utility level, or should be developed at the regional level, or should be studied at a national level.

Introduction

The study on which this paper is based was one of four studies being led by the New York State Low-Income Evaluation Task Force. This task force is comprised of representatives from the nine electric and gas utilities in New York State conducting pilot low-income efficiency programs. This study contained a scoping study of previous work as a search for possible methodologies appropriate to quantifyand where possible, monetize the hard to quantifyenefits in six areas identified by the New York State Department of Public Service. Then the study examined possible methods of incorporating this information into the benefit/cost analyses. The causal chain for hypothesized impacts being examined is given in Figure 1.

The scoping study used a literature search and review, and a snowball telephone survey technique (Rubin 1983) of leading experts in the field. This paper highlights the key findings of the methodology search component of the study .

Reduced Arrearages, Uncollectible, Termination and Reconnection Costs

Energy savings leads to lower customer bills. For low-income households previously incapable of paying their energy bills, energy efficiency programs may allow more customers the ability to reduce their arrearages. This can reduce the utility's costs for write-offs on uncollectible and lower the number of terminations and reconnection that are made to this group of customers.

The reduced arrearage is clearly also a benefit to the participant. However, if the amount of arrearage reduction is from measure installation, this dollar value is already captured in the participant benefit/cost test within the bill savings. Monetary participant benefits could include reduced termination and reconnection fees. The participant also benefits by being psychologically relieved if arrearages are reduced. This latter benefit, however, is a qualitative one that can not be easily added into a benefit/ cost test.

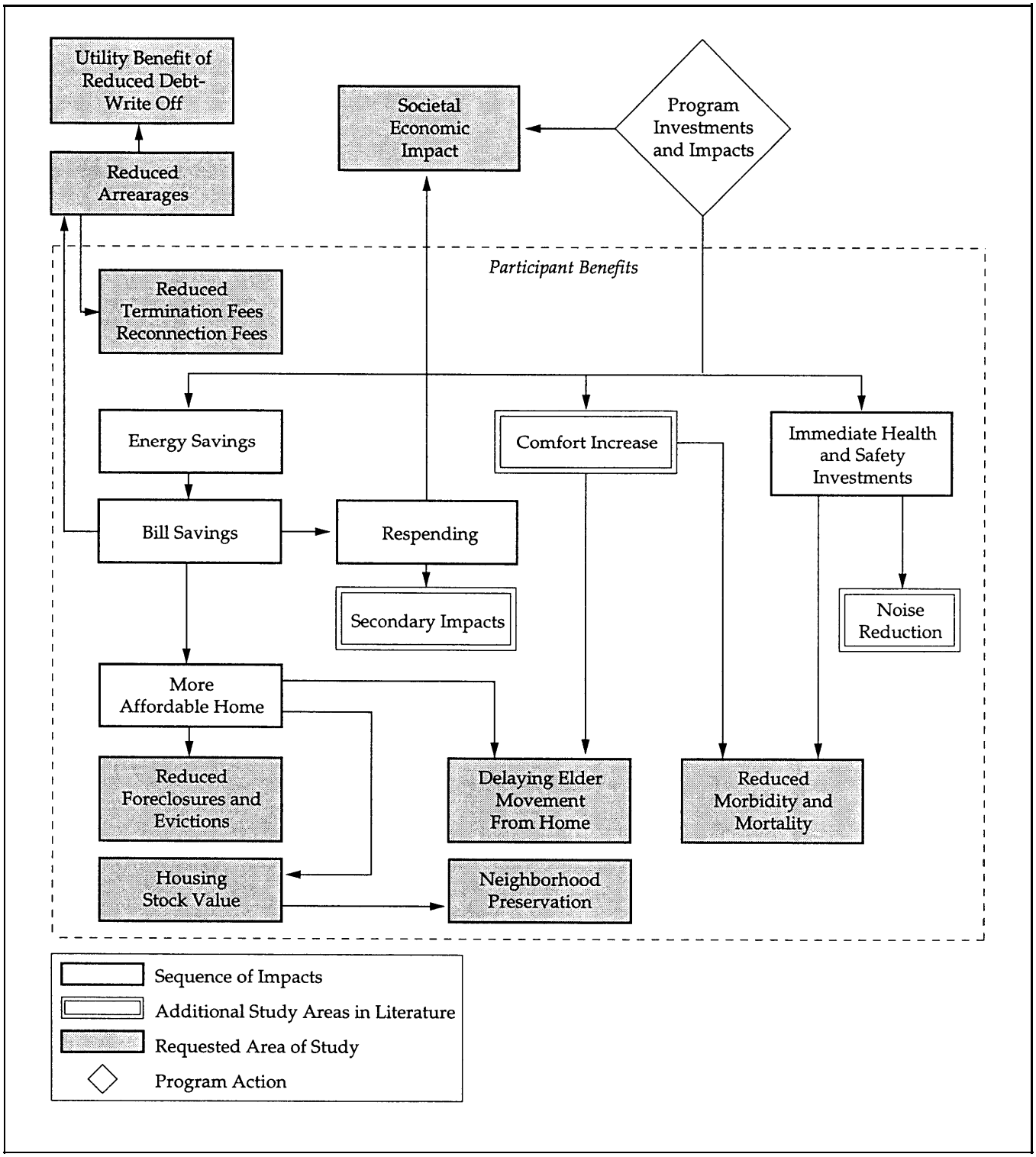

Figure 1. Hypothesized Impacts

For the utility, the benefits from reduced arrearages must primarily come from those that lead to reduced uncollectibles. An arrearage itself is not a cash cost to the utility, it is an account receivable. The cash costs are the write-off of bad debt, collection costs, and uncollected termination and reconnection costs. (This is shown in Figure 2.)

Estimating utility benefits from reduced arrearages is quite complicated. In fact, every arrow presented in Figure 2 would have to obtain an impact estimate in order to accurately estimate the utility benefits from reduced arrearages.

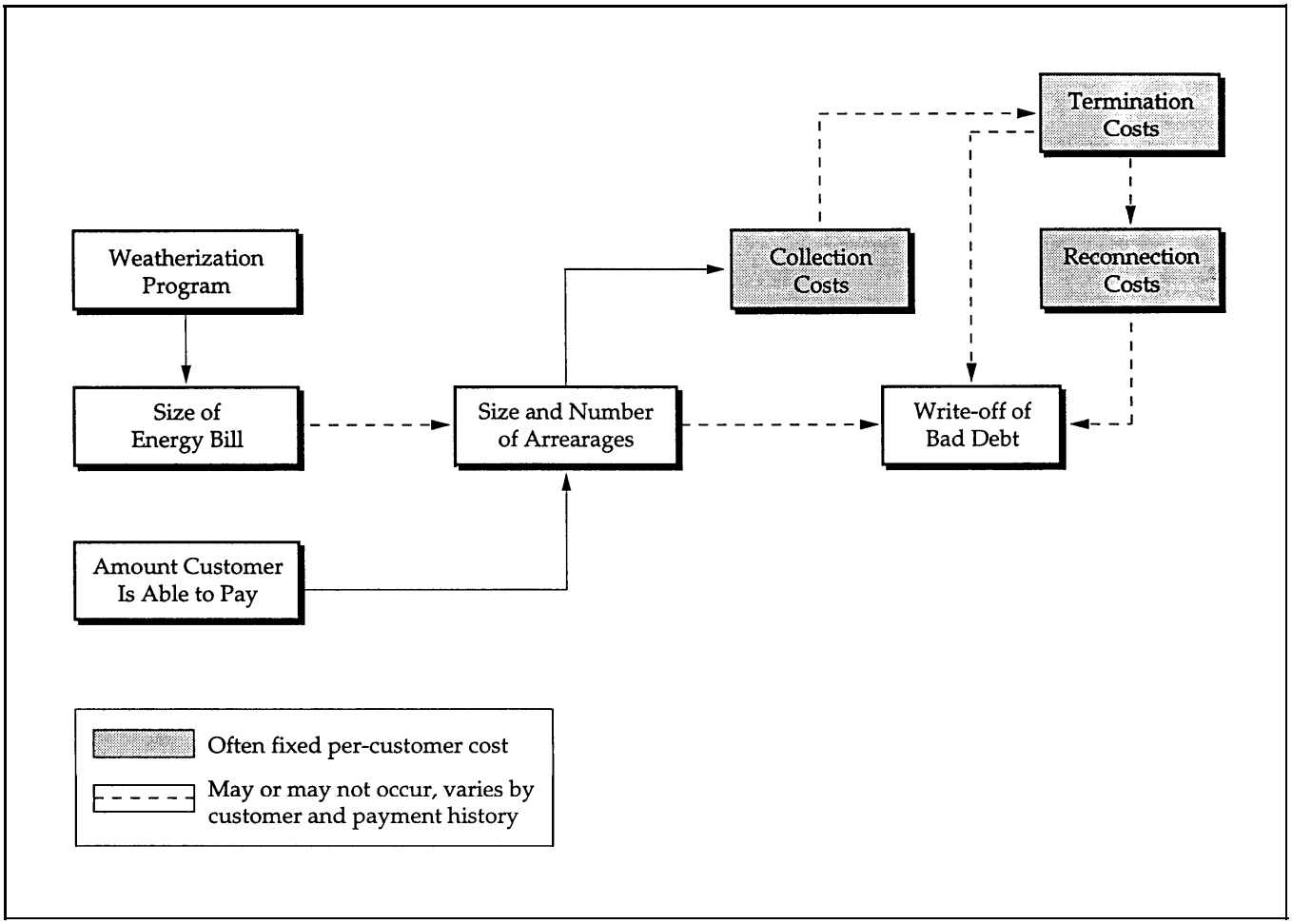

Figure 2. Relationship Between Weatherization, Arrearages and Potential Utility Cost Reductions

The utility might also benefit from reduced arrearages by the amount of financing costs it bears for working capital that could be avoided. This benefit could only occur if the efficiency program induces participants to pay off arrearages (accumulated prior to program participation) sooner than they otherwise would have. But any benefit from this effect is expected to be quite small.

Society benefits when collection, termination and reconnection costs become unnecessary and the funds can be redirected towards more productive uses. This differs from any arrearage forgiveness which represents a transfer between participant and the utility, which leaves the Societal Test unchanged. For the societal benefits to increase the utility revenue requirements would have to be reduced.

Five publications covering six previous studies were found to have examined the relationship between low-income efficiency programs and reduced arrearages or changes in payment behavior. Though none of the studies done to-date address all of the impact areas within Figure 2 that lead to measuring utility benefits, they are significant beginning for research in this area. These five papers are Harrigan and Gregory, 1992; Hart, 1993; Khawaja et al., 1992; Monte de Ramos et al., 1993; and Quaid and Pigg, 1991.

One of the primary difficulties pointed to in all of the previous work is in obtaining the appropriate payment history data. The primary purpose behind most utility customer billing systems is in ensuring that the billing amounts are correct, bills are sent in a timely manner, payments are properly recorded, amounts owed are properly accounted for, and methods progress towards obtaining payment. The goal of these systems has not been in collecting data to evaluate intervention programs on payment histories. As such, the data stored may not be those truly needed for these type of studies. Full histories are seldom kept, with data archived every one to six months. Relevant information for this type of study is often either not kept or is kept in several different databases across more than one department.

The data desired are:

- Amount due, monthly bill.
- Amount paid, monthly.
- Number of monthly payments made with no arrears.
- Average days past due (less distinction can be made with only a variable of 30/60/90 days in arrears).
- Is there a planned arrearage forgiveness?
- Account given to collection agency? When?
- Disconnection? Reconnection? When?
- Was there a security deposit? Was it taken for payment of bills?
- Were late fees charged?
- Were late fees paid?
- Were reminders sent? When?
- Costs of reminders, carrying charges, disconnection, and reconnection.
- What is the utility decision criteria for when costs are "uncollectible" and to be written-off as bad-debt?

The costs for undertaking this type of analysis will vary by utility. Whether this type of study is cost-effective to undertake will be an individual utility decision based upon the costs that utility faces in obtaining all of the above data given its billing and collection systems.

There are also analysis issues that are more problematic for this type of study than with standard demand-side management (DSM) program evaluations. Weather's impact on changes in energy consumption is generally understood by DSM evaluators. These impacts are often corrected for by use of PRISM, regression techniques, or engineering simulation model adjustments. But this effect can not be so easily adjusted and forgotten when examining payment histories. A cold winter does increase arrearages for many low-income customers. Unlike energy consumption, however, the relationship between heating degree days (HDD) and arrearages does not occur every month for every customer and is not as nearly linear. For many customers, arrearages are a result of total bills exceeding the possible payment threshold and some idea by the customer of the consequences for partial payments to each of their debtors.

The difficulties in studying program impacts on arrearages is also complicated by the need to explicitly consider various forms of attrition bias. Often missing billing points in a standard DSM billing analyses causes the customer to be dropped from the analysis. This is done with the assumptions that the customer has moved and the new occupant would not provide a consistent history, and that on average those moving will include a random subsample of the overall participation sample (i.e., those expecting greater than average program savings will equal those expecting less than average program savings). But billing and payment history records must be worked with more closely in an arrearage study. Disconnections and reconnection are an important part of the analysis. It is also important, if the information is available, if the same family is in residence when the account has a name change (i. e., the family is attempting to avoid the payment of arrearages and to maintain utility service).

Disconnections due to arrearages also cause problems with truncation of the data. Are they reconnected within the study period? If not, might their reconnection have shown up in a longer study period? How does the program's selection criteria present possible truncation biases? Does the phenomenon of "regression towards the mean" cause difficulties in obtaining the true program impacts with extreme treatment and control groups?

Many of the previous work in this area, while groundbreaking, contained problems of attrition and truncation biases. A few made laudable efforts to address these issues (Quaid and Pigg 1991, and Monte de Ramos et al. 1993). Nevertheless, a significant effort with these problems is warranted for this type of study with this type of population.

Reduced Public Transfer Payments

If there were no efficiency gain by the utility's actions, the impact of reducing public transfer payments would itself be a transfer of income from the utility to the taxpayers. This is a distributional issue and there are no societal benefits to be gained. This hypothesized benefit, therefore, should only be incorporated in the Societal Test to the extent that there are efficiency gains. Yet, the efficiency gains are already reported in the Societal Test. The impact measurement issue could still be relevant if the taxpayer is seen as a stakeholder differently than society is viewed in the Societal Test and a taxpayer benefit/cost analysis is desired.[1]

For the utility programs to reduce public transfer payments one of two situations must occur. The first is where the program serves the same need as a publicly funded

transfer payment program, and in so doing replaces the expenditure of those funds. For this to occur, the number of customers who qualify and are in need of this public program must be low enough such that all of those in need are served. This then allows every participant served by the utility to be a participant that does not need to be served through the public transfer payment. Otherwise, the utility program is supplementing the public transfer program rather than reducing the public transfers. The second situation would be a utility program that added to a customers income such that a certain number of these customers no longer qualified for the public transfer payment program.

We were unable to find a case when either situation occurred concerning a utility low-income energy efficiency program. Most utility programs have been increasing expenditures in these programs as public finds of low-income energy assistance has been decreasing. This is not, however, due to a lack of perceived need but that the utility increases in this area are often driven by the increased unmet need due to the decreasing public funds in this area. On the most part, the need in this customer group has been estimated to exceed the services being offered, before or after the decrease in public funding. As regards the possibility of the second situation, most utility programs involve energy efficiency investments or budget counseling and are not income programs. In summary, it would appear that there are no benefits here to be measured.

Reduced Foreclosures and Evictions, and Delaying Elders Movement Out of Own Homes

No direct studies of the impact of low-income energy efficiency programs on reducing foreclosures, evictions, or delaying elders movement out of their own homes have been found. But one of the first closely related research efforts has been recently conducted by the Energy Coordinating Agency in Philadelphia. This work examined the relationship between utility terminations, housing abandonment, and hopelessness (Robinson 1993).

Oak Ridge's recent evaluation of the Weatherization Assistance Program (WAP) (Oak Ridge National Laboratory 1993) cited the Philadelphia study where surveys of homeless persons and emergency shelter providers have found utility terminations to be a small but consistent contributor to hopelessness, cited as a cause 7.9 percent of the time. From this and information obtained on turnovers, the Oak Ridge study estimated the reduction of occupancy turnovers due to the WAP. The evaluation estimated the avoided cost created by the WAP's ability to reduce mobility is less than $1 per weatherized dwelling.

The benefit of reduced moves could increase if the difficulties experienced by families evicted, foreclosed upon, and the elderly forced to move out of their homes is included—beyond the avoided moving costs. But these benefits have not been quantified, causation has not been proven, nor have the effects been monetized. These incidents occur infrequently. Therefore, specifically designed studies with significant sample sizes and of a longitudinal nature would be required to undertake a specific analysis estimate of these impacts.

With the proper data, as is used in other living arrangement studies, discrete choice econometric techniques could be used to prove causation and quantification of these impacts. The scope of this undertaking is beyond any one utilities ability and more appropriately should be undertaken at a national level (due to study costs and to obtain large enough sample of these incidents).

We would expect the benefits, if they exist, of energy efficiency investment in allowing the elderly to remain in their own homes to be very small. This conclusion was drawn based upon review of a leading scientific study on dementia related service expenditures (Manton et al. 1993). The Manton study used data from the 1982 and 1984 National Long Term Care Surveys (NLTCS) and one of their intermediate results included that residence in a long term care facility without significant physical impairment or dementia was rare. Given this fact, the causative effect of energy costs to movement to long term care facilities would be expected to be extremely small. Some benefits, however, might still be perceptible for elders movement from their own homes to those of relatives. But one could not expect them to be of significant size given the previous finding and the national trend away from extended family care of the elderly.

Health and Safety

Low-income energy efficiency programs are speculated to increase health and safety by reducing the following risks:

- Fire from improperly maintained heating equipment;
- Fire from improper use of alternative heating sources;
- Hypothermia; and
- Lowered resistance in general from greater physical stress caused by living in less desirable climatic conditions.

Most citations relating health and safety benefits to energy efficiency programs, including those for low-income populations, are of anecdotal evidence or qualitative

surveys. The 1993 Oak Ridge Study is one of the few to quantify any of these impacts (Oak Ridge National Laboratory 1993). They used a simplified statistics approach to quantify and monetize fire prevention impacts.

The Oak Ridge study's estimate of fire prevention impacts was derived from the following steps:

1. Estimated the number of occupants, elderly and non-elderly in participant homes.

2. Used the fire death rates for elderly and non-elderly and the ten percent caused by residential heating equipment from the Insurance Information Institute and National Safety Council, to obtain fire death rates caused by residential heating equipment, for elderly and non-elderly. These were applied to the occupant estimates from step one to estimate expected number of deaths for participants.

3. Assumed none of these deaths would occur due to program participation.

4. Used values as lifetime expected earnings from the Statistical Abstract of the U.S. in 1991, $250,000 for non-elderly and $24,000 for elderly.

5. Repeated above steps to estimate the property value of reduced fires. But with the assumption that 25 percent of fires are avoided and the average property loss for low-income residents is one-half the national average.

6. Summed the values of fire death prevention and reduction in fire property losses. Calculated the net present value of these, $3 per dwelling.

There are many issues relating to this estimating procedure that cast doubt on the accuracy of the estimate. We believe the assumption that weatherization programs can eliminate all residential heating equipment fire deaths is far too optimistic. At least partially counterbalancing this, the value of life estimates they used may be very conservative compared to a willingness-to-pay perspective. Additional work also needs to be undertaken to determine if the assumptions concerning fire risk reductions are appropriate. In general, the estimate of the value of fire reduction due to a low-income efficiency program may not be accurate, but it is the only current estimate available.

The Energy Coordinating Agency in Philadelphia is also studying whether utility terminations lead to greater fire deaths. Yet, whether the primary heating fuel service has been terminated or not is not included in the fire death reporting and investigation files. They are working with the hypothesis that fires often reported as caused by overloaded systems or faulty wiring can often be those where low-income residents have had their primary non-electric heating source terminated and are heating by alternative electric means. They are also examining the fire and health consequences of heating terminations leading to the use of unsafe kerosene heating.

The Oak Ridge study acknowledges that weatherization also brings up both possible benefits and costs with regard to issues of indoor air quality. In the case of carbon monoxide, the programs are probably lowering risks in most cases. Yet, over-tightening of homes can cause other indoor air quality issues and, if the occupants heat their homes with ranges and stoves, can increase the carbon monoxide problems. This too, however, has been cited only with possibilities or anecdotal evidence and not actually studied.

Developing studies that might verify and quantify the oft discussed health and safety impacts is difficult, at best. Morbidity and mortality from each of these risks would have to be estimated. Then the link between the energy efficiency program to the risk reduction would have to be quantified. From this point, the percent reduction could be multiplied by the morbidity and mortality for a change in expected morbidity and mortality. Monetization of these impacts could then be obtained by applying values of morbidity and mortality to the number of these incidents that were decreased due to the program. Though this sounds like a step-by-step process, the first two steps are not easily accomplished.

In general, the impact of health and safety intervention programs on morbidity and mortality can be measured three ways. These are:

1. Epidemiological community studies or clinical investigations;

2. Actuarial studies or life-table changes from insurance records;

3. Statistical or comparative analysis from Vital statistics (from Death Certificates), Medicare records, or from national health surveys of the elderly; and

4. Specialized longitudinal studies.

The epidemiological studies are most often those where individuals with a given disease are followed with and without specific interventions being applied. As these studies start with an affected population, they have a particular selection bias and only collect data as considered relevant for the medical study in question.

Both actuarial studies and national statistics do not provide the necessary data for health and safety studies relating to

energy efficiency investments. These data sources would have to contain both primary and secondary causes of morbidity and mortality to begin to capture the effect hypothesized. For example, to quantify the number of deaths or sicknesses caused by hypothermia due to the lack of warmth within the victim's home, the data on mortality and morbidity would have to include hypothermia as a direct cause and the lack of warmth in the home as an indirect cause. Very little information can be gathered on direct causes of death. Almost nothing can be ascertained concerning indirect causes. This is exacerbated by the lack of any U.S. national morbidity data.

Given the above, the only way to obtain the data necessary to actually quantify these potential impacts would be to design a study for this purpose. Health and safety benefits generally can only be measured with large samples and longitudinal studies designed for these purposes. The study should be longitudinal in nature to capture changing health statuses that might be caused indirectly by the energy efficiency investments. This study would have to have a large sample design to capture incidence given the small probability of their occurrence. The probability for anyone in any particular year being injured by a specific cause or being inflicted with a particular health problem is small. For example, the fire death statistics for the elderly (significantly higher than for the non-elderly) are 5.2 per 100,000 with only ten percent of these related to residential heating equipment. This translates to five per million on an incident basis. To assess a decrease caused by an energy efficiency program in the probability of mortality of an elderly person being caused due to fire from residential heating equipment would require sample sizes in the millions. This is physically impossible for any utility or single state to consider and, if physically possible, the cost of this type of study at a utility level or state level would be prohibitive and not cost-effective.

These types of studies should also address the complicated non-linear nature of most health issues. Biological functions often operate more non-linearly than DSM evaluations and economic studies assume. They take on the nature of dose-response curves, i.e., after a threshold point the system responds more readily until a saturation point where the incremental increase generates a smaller incremental impact.

Even more difficult, however, is to improve this work to include the much more complicated nature of the interactions truly seen in health and safety intervention programs with previous health status, demographic factors, and other risk factors. Each factor needs to be interrelated with transition probabilities of moving from one physical health state to another. For example, if the risk of an elderly person dying in a fire accident due to faulty heating equipment is reduced, then their mortality is postponed yielding increasing risks at a later time period of alternative causes of death. Changes in functional state should also be examined at several levels, such as active life expectancy (ALE), functional status scores of activities for daily living (ADL), and mortality. Predicting this postponement in various health statuses will yield the probable increase in ALE, ADL, or life extension. It is these increases that should be monetized.

A study design for these issues can be accomplished but would be quite difficult. This type of sophistication has just begun in the state-of-the-art work for predicting the health of elderly populations using direct causes of health status changes. Developing a study of indirect effects of energy efficiency investments could be premature at this time. At best, to derive reasonably reliable estimates would require a significant level of research at the national level.

Housing Stock Value and Neighborhood Preservation

Energy efficient investments involve making improvements to the participants' homes. These investments should increase the value of their homes.

Important for accurate benefit/cost analyses, however, is recognizing that this benefit to the participant is only actualized if the participant sells their home prior to the end of the useful life of the efficiency investments. The operating cost, at least theoretically, should be a determinant of the price of the house, all other things being equal. The participant can either obtain energy savings or sell their home at a higher price—given the lower energy bills the occupant can enjoy. Both benefits, energy savings and a higher home sales price, cannot be received by the participant. As such, the maximum participant benefit is the energy savings which is already included as part of the current Participant, Total Resource Cost, and Societal Tests.

There is a small body of literature relating energy conservation investments and housing value. We reviewed four studies as part of this study (Zaki and Isakson 1983; Johnson and Kaserman 1983; Walsh 1989; and Horowitz and Haeri 1990). Of these four studies, two found significant relationships and two did not. The Walsh study found that energy tax credits did not lead to more energy conservation while Zaki and Isakson found that energy price was not a significant determinant of housing price. Johnson and Kaserman, however, found the annual fuel bill and home price to relate in such a way that the consumer's discount rate indicates that the housing market fully captures future fuel savings. Horowitz and Haeri similarly found that thermal efficiency measures in

relatively new homes were fully captured in the home's resale price with a discount rate of eight percent. Nevertheless, these previous studies did not involve the low-income housing market. Their methodologies could be replicated but their findings may not be indicative of what might be found in a very different housing market. No relevant quantitative work involving the low-income housing market was found.

The only previous work that addresses energy efficiency investments in low-income housing markets is assumptive. The Oak Ridge study (Oak Ridge National Laboratory 1993) assumed these investments would increase housing value by the same amount as the investment. This involves a double-counting of the energy savings and we do not recommend this assumption or methodology.

The true participant value for the Participant Test cumulatively for all participants would be the energy savings that participants obtain that use the energy efficiency investments through the investments' useful life, plus the sum of the energy savings of participants who will move for the time they remain in these dwellings, and the increased price the moving participants receive when they sell their homes. The upper bound of this estimate is the lifetime value of the potential (without take-back) energy savings. To derive the actual total participant benefits (according to this advanced definition) requires estimating the distribution among participants of the time they will remain in the dwelling and the increased home value amount they receive from selling their homes. (For tenants, this increase would be seen for the landlords in increased rent or greater occupancy and then an increased sales price for the rental property, if there is remaining energy savings potential from the initial efficiency investment.)

If this more well defined measure of participant benefits is desired, then an explicit study of the energy efficiency investment's impact on housing values within the low-income housing market would have to be undertaken.

Besides the aforementioned studies, many econometric studies using housing value as the dependent variable have been performed in the field of urban economics. These could be used as the starting point for study design and proper model construction.

Designing the study, however, would be much simpler than arriving at statistically significant estimates of the impact of these energy efficiency investments. There are a number of factors that affect housing value. Most of these would be expected to have larger impacts than the energy efficiency investments. This means that the difficulty in performing this type of analysis would be in achieving a model that has a close enough fit to the actual data, reducing most "noise" in the model, so that the smaller impacts such as would be found for the energy efficiency investment, can be differentiated from other variables.

These types of models are termed hedonic price models as they estimate the implicit value of characteristics that determine the price by the underlying supply and demand functions. The primary determining characteristics are those that describe the house itself and those that provide characteristics of the location. There are many determinants of housing value that should be controlled in order to assess the impact of the home's efficiency from other characteristics in an unbiased way (avoiding spurious correlations). The following is a list of some of these: size; acreage; number of rooms; number of bedrooms; transportation access; local crime (level and type); access to cultural activities; local employment conditions; and percent minority in the neighborhood.

The data needed for this study would also be quite immense. The sample size would need to be significant to achieve the necessary precision. The data collected would also have to be measured more precisely than possible with a participant/non-participant survey scheme. The study design would also have to address potential selection biases.

Given the data issues and costs involved, studying the impact of energy efficiency investments on housing stock value would best be undertaken at the state or national level.

The quantification of the energy efficiency program's impact on neighborhood preservation would be difficult, and monetization even more so.[2] Obviously, the study would need to be conducted as a longitudinal study and would require that program efforts be concentrated enough within neighborhoods and universally lacking in similar neighborhoods to ascertain an impact that can be differentiated from other factors.

All of the factors that contribute to housing value also contribute to neighborhood preservation (or lack thereof). But neighborhood preservation is also complicated by the fact that it is much less well understood. All of these factors are also interactive and probably non-linear in nature. For example, there are probably thresholds at which some factors become intolerable (e.g., crime) or create a change in the composition of residents.

Evaluation of all of these factors and extended impacts are, obviously, well beyond the capabilities or expected responsibilities of any one utility or group of utilities. This study would best be undertaken at a national level.

Economic Impact

Besides arrearages, economic impact studies provide the greatest prior work in the hard to quantify benefit areas. Many of these studies examine energy efficiency programs as a group, though the techniques would be completely transferable. There are a few studies, or study components, that do examine low-income energy efficiency programs by themselves. This includes the economic impact estimates provided in the Oak Ridge study (Oak Ridge National Laboratory 1993). There was also a study done concerning the economic impact of the Weatherization Assistance Program in New York (New York Department of State 1991). The economic impact modeling system for energy efficiency programs created by the City of Austin (Megdal and Rarnmaha 1992) contained separate estimates by program, though these program level estimates were not given in the published paper. There is also a new study being conducted at Oak Ridge National Laboratory that will continue to examine the WAP's economic impacts.

Besides the above, economic impact studies of overall energy efficiency investments are also described in Goodman et al., 1993; Jaccard and Sims, 1991; and Laitner et al., 1992. There are also on-going studies being conducted by The Goodman Group for the Florida Energy Office, by Dr. Lori Megdal of Cambridge Systematic for the State of Wisconsin, and by HBRS for the State of Iowa.

The most common approach used in economic impact analysis is some form of input-output analysis. The most common error, both in this field of economic impact analysis and in the area in general, is assuming all investments are "free." That is, that the money just appears and subtractions for where it comes from are not made. This assumption is seldom appropriate and greatly increases the measured benefits over what they are in reality.

Utility low-income efficiency programs do use funds that must at some point come from ratepayers. These ratepayers would have made use of these funds, if they were available to them. The alternative use of these monies would also have economic benefits. The true economic impact of the program is the difference between the economic impacts of these two uses of the funds. (This impact could be positive or negative, though one would expect that if efficiency is truly gained the economy would be expected to benefit.)

A more difficult problem to correct for when using input/output coefficients is their static nature. 1/0 coefficients change significantly over time and could be expected to change with efficiency investments.

There are three levels of effort or methodologies that could be used for estimating the economic impacts of the program. A simple input-output analysis supplemented by specific multipliers derived from additional surveys of program trade allies would produce an economic impact analysis for the lowest costs, but it does not provide detail in understanding differences caused by different program designs, different utility characteristics, or a change in the areas competitiveness. The second level of effort would include additional spreadsheet modeling that can incorporate different program designs and different utility characteristics (i.e., load shapes and season or time-differentiated avoided costs). The third level of effort, and that with the greatest costs, would incorporate both the program and utility details plus incorporate any induced competitiveness changes. [3]

Other Potential Hard to Quantify Social Benefits of Low-Income Efficiency Programs

The New York study also provided an overview of other impact areas periodically discussed in support of low-income energy efficiency programs. These included comfort, reduction of outside noise, credit counseling and outside referrals, utility goodwill, secondary impacts from use of savings, self-esteem, and national security. Only two of these areas were found to have previous relevant work for use in this study. These were comfort and secondary impacts from use of savings.

Many demand-side management (DSM) program participants have some level of "take-back" or "snapback," which is where participants take some of their efficiency investment benefits by increasing their comfort level rather than their energy bill savings. Take-back or snapback has taken on negative connotations as it lowers the actual energy savings obtained from an efficiency investment from its potential savings, If the only goal of the DSM investment is energy savings, snapback is truly negative for the program. However, if the DSM investment is made based on a host of goals to include customer service and society benefits, the energy taken as a comfort increase is also a benefit.

Many studies have been conducted concerning snapback. These range from mildly quantitative customer survey responses to sophisticated studies measuring comfort changes. In a survey of previous studies on take-back (Nadel 1993), Nadel found that most studies found little if any take-back with regard to residential heating, 10 percent for residential lighting, and two percent for industrial processes. Many of these studies, however, used surveys of customers on temperature setting or measured the percent take-back against consumption rather than

expected energy savings. In the same session at the 1993 International Energy Program Evaluation Conference in Chicago, two other papers found significant take-back. Alternative regression predictions of consumption were used in Manuel et al. 1993. They found energy consumption increases of 33 percent for a low-income fuel switching program at Jersey Central Power & Light Company. A study at the City of Austin (Megdal et al. 1993) created Hybrid Duel Engineering (HDE) techniques and Engineering/Take-back/ANCOVA Set (ETAS) techniques to estimate take-back for a low-income weatherization program, a residential loan program, and a residential rebate program in the City of Austin. They found take-back as a percentage of energy savings to be 40 percent, 18 percent, and 35 percent, respectively. They also quantified the comfort change for the low-income weatherization program to be closing the temperature set-point gap between the average low-income Austin resident to the average Austin resident by 50 percent in the winter and 21 percent in the summer.

Take-back, or comfort increase, is also becoming a topic with greater focus as the discussion of the Value Test increases in more jurisdictions. The consumer benefit from take-back is an important part of this new benefit/cost analysis test. This can be more important for low-income energy efficiency programs as it is low-income customers who are believed to be able to benefit most from the comfort increase afforded to them through take-back (as substantiated by Megdal et al. 1993).

Low-income citizens suffer in a number of areas due to their lack of income for items most people consider necessities. The oft-cited statistic relative to energy is that low-income families spend more than 30 percent of their income on utilities.

Like other energy efficiency program participants, low-income customers obtain bill savings from these programs. The bill savings are then spent on other goods. In the case of low-income participants, however, this other spending may be on items most people would consider necessities. Some of the savings may be spent on items with greater long-term societal benefits than might be seen by the alternative spending from other residential customers. It is also possible, however, that the alternative spending might be on items with negative social impacts, e.g., illegal drug purchase, increased smoking.

An important first step in evaluating secondary impacts is being made by a three year study being conducted at Boston City Hospital. The initial findings indicate a correlation between non-disease induced lower weights among low-income children seen in the emergency rooms during and immediately after cold winter periods. The study hypothesizes that low-income families must make a choice between heating their homes and properly feeding their children. There are many studies relating illnesses and poor nutrition. With this correlation and hypothesis, an argument is made for the need for low-income energy bill assistance.

This study does not actually provide proven causation. It also does not quantify the numerical relationship between energy bill payments, poorer nutrition, and increased medical incidence with corresponding increases in medical costs. Each of these links would need to be quantified to prove a similar benefit from energy efficiency investments made for low-income households and a monetized benefit in decreased medical costs or a lowering in the probability of morbidity and/or mortality.

As in the area of health and safety, proper studies for these impacts need to obtain extremely large samples within longitudinal studies. Utility programs may not provide the best framework for these studies by themselves. The utilities could assist in a broader effort in this area, adding their participants to a sample population and adding necessary questions to their own survey efforts. The full studies themselves are probably more appropriately led by other entities, and funded by government or non-profit research funding.

Summary and Recommendations for Future Research

This study provided evidence that methodologies exist that would allow futilities to estimate low-income energy efficiency programs' impacts on reductions in arrearages, collection costs, termination costs and reconnection costs. Yet, we have also pointed out that these types of studies are much more complicated than standard DSM evaluations and could be expensive, given the data collection required. The important issues to be examined in conducting a non-biased study were presented.

We have also provided citations of previous studies that estimate the economic impact of energy efficiency programs. There are three levels of effort that could be pursued. Here too, the important issues to be examined in conducting a non-biased study were presented.

We found no evidence that low-income energy efficiency programs actually provide any reduction in public transfer payments.

The data problems and costs involved in the possible methodologies to study low-income energy efficiency program impacts on reduced foreclosures, evictions, and delaying elders movement out of own homes, increased health and safety, increased housing stock value and

neighborhood preservation strongly suggest that these issues should be studied at a state or national level.

Methods were discovered that could provide believable quantitative results of comfort increase.

There was also evidence discovered concerning the positive secondary benefits that might be contributed to by low-income energy efficiency programs. This included a correlation between the size of the extreme utility bills and the nutrition received by children in these households.

Finally, this study provided a useful consolidation of references for past work in these areas.

Acknowledgements

This paper reports the findings from a project funded by the nine electric and gas utilities in New York State. We wish to acknowledge the contributions made by the following utility representatives who served on the New York State Low-Income Efficiency Program Evaluation Task Force during this work: Mary Kay Gobris, Brooklyn Union Gas; Frank Pace and Frank Congedo, Central Hudson Gas & Electric; Pamela Lai, Consolidated Edison; David Hanna, Long Island Lighting Company; Charlie Harrigan, National Fuel Company; Dorinda Nell, New York State Electric & Gas; Melissa Piper, Niagara Mohawk Power Corporation; Peter Skywark, Orange & Rockland; and Martin Morse, Rochester Gas & Electric. We also wish to thank the anonymous reviewers for their comments. This paper and any opinions either expressed or implied are the sole responsibility of the authors and do not necessarily represent any of the utilities sponsoring this work or the firms for which the authors work.

Endnotes

1. The society is most often viewed as the collection of individuals. Whereas, the taxpaying population is the collections of individuals and firms, in-state and out-of-state, weighted by their relative tax burdens depending on the tax structure.

2. There is also no common agreement or measurement of neighborhood preservation.

3. A few studies have used the induced competitiveness changes without allowing the program detail or utility characteristics to be incorporated. This is another possible methodology but it is not recommended as the results of this methodology does not justify the costs involved and it is too easy to inappropriately use this method without truly capturing the trade-off for many energy efficiency programs between decreased average bills and increased rates.

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