Beyond Energy Savings: A Review of the Non-Energy Benefits Estimated for Three Low-Income Programs

Nick Hall, TecMRKT Works
Jeff Riggert, TecMRKT Works

ABSTRACT

This paper presents, compares and contrasts the results of three non-energy benefits studies associated with low-income weatherization programs. The programs include Cinergy Corp's weatherization program, the State of Vermont's program and a small electric-focused program offered by one of the investor owned utilities in California. The non-energy benefits estimated in the Cinergy study are based on the accumulation of evaluation findings extrapolated from literature reviews conducted in 1998 for programs saving natural gas and electricity. The results of the Vermont study used a similar procedure, but include the use of different extrapolation calculations for the different types of fuel saved by the Vermont program (oil, propane, natural gas, and electricity). The results of the California program are estimated using the California Low-Income Public Purpose Test (LIPPT), in which the non-energy benefits are projected using values and procedures developed through a collaborative benefit-cost test design process. This collaborative process involved the five investor-owned California utilities, the California Public Service Commission, key stakeholder group representatives and three consulting firms advising the design process and who built the test's methods and models. The results from these studies indicate that the non-energy benefits associated with low-income program can be equal to or significantly greater than the value of the energy benefits for both large statewide cold-climate programs installing in excess of $2,000 worth of measures per home, to smaller electric-focused programs implemented in moderate climates.

This paper summarizes the estimation methods used, the reasons for using the estimation methods, and the estimation results across the three programs. All three estimations are based on previously published studies of non-energy benefits, but are based on different studies and use different methods for estimating the non-energy benefits. This paper also compares and contrasts the impact of the estimation methods on the benefit type and expected worth of the benefit. The value of this paper is that it compares estimated levels of non-energy benefits using different procedures, allowing the reader to understand the estimation methodologies and the impact of the methodologies on the quantification of the benefits and the relationship between the estimated value of the non-energy benefits compared to the estimated energy impacts.

Introduction

This paper compares and contrasts non-energy benefit (NEB) estimation methods and results from three program evaluations: 1. The Vermont Weatherization Program spending about $2,259 per participant, 2. Cinergy's Gas Weatherization Program spending about $1,768 per participant, and 3. a California Electric-focused limited measure installation program spending about $96.00 per participant. The NEB values for the Vermont and Cinergy program are estimated using selected methods and metrics taken from the NEB

research literature for a range of benefit types. Specifically, the NEB research literature was reviewed to identify evaluations and evaluation methods that included NEB estimates in their impact assessments. These methods were examined and sorted by the degree of rigor used to estimate the value of the NEB. This process was subjective and in general, evaluations that used or were based on field data collected by the program or evaluation staff were given a higher rating than methods grounded on general or unsubstantiated assumptions concerning the value of a benefit. However, in some cases the literature contained only values based on assumptions.

The California Low-income Public Purpose Test (LIPPT) is used to estimate the impacts of the California program. The LIPPT is based in part on original research conducted for the California low-income programs by S.E.R.A. and supported by TecMRKT Works and Lori Megdal and Associates, and on estimation methodologies and benefit metrics identified in the literature and approved for use by the California LIPPT Working Group. The LIPPT is a dynamic benefit-cost calculating tool developed for California's investor-owned utilities, and allows each user to edit, change and modify specific NEB-related values and assumptions that drive an estimation of each NEB included in the estimation formula. The LIPPT may be used to compute the energy and non-energy benefits and program costs of virtually any low-income or residential program.[1]

Estimating the NEBs

This section presents the methods used to estimate each of the NEBs included in this paper, across each of the three programs. For classification purposes we have sorted the benefits into one of three groups dealing with the primary recipient of the value of the benefit. If the NEB tends to provide a benefit to the utility, we grouped it in a class of benefits called "utility related benefits". If the NEB provides a benefit to the customer, we grouped it in a class called "customer benefits". If the NEB benefits society in general, rather than an individual or a company, then it is grouped in a class called "societal benefits". However, as was pointed out by several members of the California LIPPT Working Group, all benefits from energy programs are, in the end, societal benefits in that they in some way have an impact on rates, or costs, or on the environment in which we live. In this section each benefit is presented and defined. The definition is then followed by a brief discussion of the estimation procedures used. The results of the estimation procedures are presented at the end of this paper in a summary table.

Utility Related Benefit Estimation Methods

The following benefits are identified for the purposes of this paper as benefits that are received by the utility providing or sponsoring the low-income program examined or providing the energy that is saved.

Reduced arrearages. Arrearages are the accumulated debt customers owe to an energy provider for the energy they have already consumed.

[1] Readers who wish to know the details of the estimation methods are encouraged to read the full reports cited in the references section of this report.

The literature search conducted for this project identified 23 different evaluation reports with arrearage reduction estimations (Riggert 1991, Hall 2000, Hall 2001). Results from these studies report a wide range of arrearage reductions from weatherization programs. One report indicated that there was no arrearage reduction from a state agency weatherization program while another report indicated arrearages were reduced by 90% over a period of time following weatherization. The remaining 21 reports suggest that weatherization programs reduce arrearages between these extremes, with an average percentage reduction in the 20% to 40% range a year or more following program participation. One of the more rigorous studies examining arrearages for several weatherization programs was the 1993 National Weatherization Evaluation conducted by Oak Ridge National Laboratory under contract to the United States Department of Energy. This study indicates that, on average, arrearages are reduced by about $32 per year per participant following program participation.

The arrearage benefit level used for the Vermont program was taken from the Oak Ridge Study (Brown 1993) (as cited in Riggert 1999) calculated over a twenty-year life expectancy of the program measures, discounted at the energy inflation rate used by the State of Vermont in 1999. The Cinergy estimate was also based on the Oak Ridge reported average arrearage reduction, discounted over 20 years, at the USDOE's energy inflation rate as projected in 2000. The weakness of this method is that it assumes that the arrearage benefit is constant over a 20-year period and that the customer still owes an arrearage at the end of that period. We think this is an optimistic assumption.

The California program NEB estimate does not include arrearage reduction as a benefit. Because the California rate structure includes a recovery mechanism for arrearage so that there is no loss to the utility for arrearage uncollectables. As a result, arrearages are always paid, either by the customer or through the rates. Because of this recovery aspect the California LIPPT Working Group decided that arrearage reduction was not an uncollected benefit and is therefore excluded from the California estimation of NEBs.

Reduced carrying cost on arrearages (interest). This benefit is the cost of holding (financing) an arrearage until the time it is collected.

For the Vermont and Cinergy programs, the carrying cost on arrears is valued at the NPV of the cost to barrow an amount estimated as the average arrearage reduction associated with a low-income energy program. The value used in the Vermont and Cinergy estimations is the mid-point of an annual financing charge from a study conducted in California by S.E.R.A. This study found that carrying cost charges ranging from $0.50 to $7.50 per participant per year. This annual charge is then converted to a NPV over the life of the installed measures and recorded as the value of the benefit. The difference in the estimates for the Cinergy and Vermont programs are a function of the estimated cost (interest rates) to borrow dollars at the time of the study.

The California LIPPT model computes carrying cost reductions by taking the arrearage levels for an average low-income customer and multiplying that amount by 28% in order to estimate the level of arrearage reduction from program participation. The 28% was selected by the LIPPT Working Group as an appropriate mid-point after reviewing and discussing the results of an arrearage reduction literature search conducted by TecMRKT Works and SERA for programs that do not target high arrearage customers. This product is then multiplied by the selected interest rate in 2000 (8.15%) to estimate the cost of borrowing against that amount.

Lower debt written off. These are costs associated with closing-out and writing off a non-performing account after collection or recovery efforts have failed. These costs may cover a wide range of activities including court costs, attorney's fees, collection agency fees, administrative costs, etc. These costs are those beyond the costs associated with arrearage recovery or carrying costs.

The literature search identified five studies of lower debt written-off for program participants when compared to non-participants. Research in this category included work done by Clark County Washington in 1990, Quaid and Pigg in 1991, Magouirk in 1995, Blasnik in 1997, and Skumatz in 1997 (as cited in Riggert 1999, Hall 2002, and Hall 2000). For the Vermont and Cinergy programs, lower bad debt write-offs are valued as the NPV of the mid-point of a range of the per-year, per-participant estimates for this category (identified during the literature search) calculated over the useful life of the installed measures.

In the LIPPT model, lower bad debt write-offs are valued at the NPV average of the estimated annual amount of write-offs per low-income customer (from the literature search results) multiplied by 20.7% to adjust for estimated program impacts on that estimate over the life of the expected savings. Skumatz selected the percentage value used to adjust the amount written off as a result of program participation[2]. The values identified in the literature search estimated an impact of 8%, 30% and 36% for the program-induced changes to the amount of per-customer debt written off.

Fewer shut-offs and reconnects. When energy programs reduce energy bills customers are better able to pay their bills and are less likely to be shut-off and reconnected as a result of payment problems. This reduces cost by not requiring the utility to conduct as many trips to the customer's location to turn the electricity or gas supplies off and on.

For the Vermont and Cinergy programs, fewer shut-offs and reconnects are valued at the midpoint of a range of estimated benefits reported in the literature. The literature search conducted in 1999 identified 5 studies reporting savings for avoided shut-offs and reconnects. Estimates are reported by Pye 1996, Hill 1998, Skumatz 1998, and Coton 1994 and 1999 (as cited in Riggert 1999). These estimates ranged from a low of $2 to a high of $12 per participant for the program–induced reductions, with the average cost of a disconnect or reconnect ranging between $67 to $117 dollars.

In the LIPPT model, savings from fewer shut-offs and reconnects are valued at the average annual incident rate of a shutoff or reconnect for low-income customers (identified in during a 2000 literature review) multiplied by the marginal cost of a shut-off or reconnect, multiplied by the percentage of shut-offs and reconnects (23%) that are reduced from program participation. The LIPPT Working Group chose 23% because it is a more conservative estimate than the average value reported in the literature of 34%. The 23% reduction comes from a 1997 evaluation of a Louisville Gas and Electric Company study (as cited in Hall 2001).

Fewer notices. Energy programs that reduce utility bills allow customers to stay more current in their payments, requiring less customer collection notices to be sent by the utility.

[2] This value was selected following consultation with the N. Hall and L. Megdal and the LIPPT Working Group on the identification of a somewhat more conservative value than the mid-point of three studies reporting a program-induced percent reduction

Savings from fewer utility notices for the Vermont and Cinergy studies are included in the estimated effects for a reduction in collection costs, as most of the studies examined for this benefit identified and estimated the benefits of fewer notices with the benefits of reduced collection costs, treating them as a single benefit.

Lack of separate benefit data also hampered the estimation of this value for the California estimates. For the California study, the LIPPT model uses an estimated value based on reported reductions of payment-related difficulties and collection actions associated with low-income customers. The literature reviewed for the LIPPT identified studies that estimated reductions in collection activities ranging from a 0% to 99%, a very wide range indeed. According to L. Skumatz (as cited in Hall 2001) the majority of these estimates range from 7% to 39% and average near 24.7%. During the construction of the LIPPT, the California utilities were asked about their costs for notices and the frequency of notices to customers similar to the program participants. These estimates and costs were then multiplied by .247 to obtain the estimated reduced program-induced costs associated with this benefit. To be conservative in the estimate the LIPPT values this benefit for one occurrence, rather than projecting this benefit over several occurrences or over several years.

Fewer customer calls. When bill collection efforts are reduced as a result of a low-income program, the utility makes fewer collection related calls and contacts with customers. The reduced number of phone calls and personal contacts saves the utility money.

The value of fewer customer calls is not estimated for the Vermont and Cinergy programs because few studies estimated this benefit and utility data was not available.

The California LIPPT methodology used to estimate fewer customer calls is identical to that employed for estimating fewer notices. The California utilities provided costs and estimated frequency data for customer calls and these costs were multiplied by .247 to estimate the program-induced impacts for the participant group. Again, to be conservative in the estimate the occurrence is counted only one, rather than over the life of the installed measures.

Lower collection costs. Prior to writing-off a debt the utility will spend resources trying to collect that debt. Many of these efforts are successful, meaning the debt is not written-off but is collected over time. Low-income programs that reduce collection costs can count the reduced need for collection efforts as a program benefit.

For the Vermont and Cinergy studies the value of fewer collection costs was estimated at the midpoint of a range of values reported by two studies found in the literature (Tellus 1995; Colton 1994; as cited in Riggert 1999 and Hall 2000).

The California LIPPT model sets collection cost benefits at zero dollars because there is no data available from the California utilities to support the calculation of this benefit and the LIPPT Working Group elected to not include this benefit in the estimation procedure because of the potential for double counting this benefit in other benefit estimates.

Reduction in emergency gas service calls. This benefit is the reduced number of emergency gas service calls that the utility has to make to deal with gas related customer issues that are solved via program participation.

For both the Vermont and Cinergy programs, the value of reduced emergency gas service calls are estimated by applying the results of one study found in the literature that reflected an assessment most like the two programs (Magouirk 1995, as cited in Riggert

1999). This study estimates that the annual value of reduced emergency calls is estimated at $22.57 per participant for the first year of the program. It is expected that these values decrease significantly after the first year, after the emergencies are isolated and solved. For this purpose of this paper we report this benefit as a single one-time first year benefit, knowing that there may be multi-year benefits that we are not counting.

To estimate the value of reduced gas emergency service calls for California utilities, the LIPPT model takes the percent of participants receiving gas services multiplied by the percent of eligible participants needing gas services measures (23%) multiplied by the percent of gas service emergencies avoided by the program (25.9%). The LIPPT Working Group decided that 23% of program participants needed gas service measures because it was a more conservative estimate than the average value found in the literature of 34%. The 23% value comes from a 1997 evaluation of a Louisville Gas and Electric Company study. The 25.9% of gas service emergencies avoided by program participants is taken from a 1995 Colorado Public Service Study and is the lower percent of the two studies. However, the California program examined in this paper saved electric energy, having no effect of emergency gas service calls.

Transmission and distribution savings. The physics of transporting electrons across wires results in line-losses. While these losses must be generated, they are not sold because the energy is lost in the form of heat before it arrives at the customer's meter. Programs that reduce consumption also reduce the need to generate the extra power that is lost as heat before the customer can use it.

The Vermont and Cinergy evaluations did not include a benefit for reduced transmission and distribution (T&D) losses because the value of this loss is already included in the cost of energy saved. The literature search identified several reports that value line-losses in the 5 to 10% range for residential customers, however this level can be greater for utilities that obtain their energy from sources outside of their state, or lower for customers located near the power plant providing their electricity.

The California model uses a method that applies a T&D loss that is $0.0057 per kWh saved as established by the CBEE and accepted by the CPUC. This value was provided to the developers of the LIPPT by the California Public Utilities Commission and was accepted by the Working Group.

Societal Related Benefit Estimation Methods

The following benefits are typically identified as those received by society in general, because everyone in the region in which the program is provided may receive the benefits.

Economic impact. The spending of dollars to provide energy programs creates jobs and increases the economic activity associated with local spending streams. As labor and material dollars are "turned-over" in the local economy, the people in that economy benefit.

To value this benefit for the Cinergy and Vermont programs we used the midpoint of the results reported in two studies taken from the literature. These studies used economic input-output modeling to estimate net impacts. One study is the 1993 ORNL national weatherization program study and the other is an economic impact study on a 1992 Iowa weatherization program (as cited in Riggert 1999). Averaging the job creation benefits from these two studies indicates that about 46 jobs-years are created for each $1-million dollars of

program measure installations. The specific benefits reported in these studies include both direct and indirect employment, federal taxes generated from new employment, and the avoided cost of unemployment. For Vermont, direct and indirect employment is valued at $1,967 per home, federal taxes are valued at $123 per home and the avoided cost of unemployment at $183. These total to $2,273 per home as an economic benefit from the dollars spent. The results for Cinergy are proportional to Vermont, but less, because fewer dollars were spent on installing weatherization measures. It should be pointed out that these estimates are gross estimates and are not adjusted down for the loss of jobs associated with taking dollars out of the general economy in the form of taxes or public benefits charges, and then placing them back in that same economy in the form of energy efficiency related expenditures.

The California estimates exclude economic impact benefits. Because most energy program economic impact studies examined during the literature search are gross estimates and do not adjust effects for the dollars removed from the economy to fund the programs, the LIPPT excludes this benefit. The LIPPT Working Group decided that until there are economic impact studies for California, that look at the net effects of removing public benefits dollars from the local economy, and also examine the effects of spending those same dollars on programs within the same local economy, this benefit should not be counted. It may be that energy programs produce net economic benefits because of the different paths that the dollars take

Emissions/environmental. Programs that reduce the need to generate electricity reduce the amount of fuel burned and the emissions associated with burning that fuel. Likewise, programs that reduce gas consumption reduce the emissions associated with burning natural gas. Air emissions avoided by reduced coal-fire electric power usage include SOx, NOx, CO2, N2O, CO2, CO, NH4, *VOCs (Volatile Organic Compounds),* PMs *(Particulate Matter)* and heavy metal toxins.

For Vermont and Cinergy, air emissions are estimated using secondary studies with near geographic proximity to the State of Vermont (as cited in Riggert 1999). These studies identified "emission mass units" for each type of emission per unit of energy produced. These studies also identified emission reduction values consistent with the Kyoto Protocol agreements. The value of the emissions established for the Vermont and Cinergy programs are the estimated amount of the individual emissions by fuels type for the energy saved, multiplied the value of the emissions benefits per the Kyoto Protocol.

The California LIPPT model uses environmental "adders" developed by the California Board of Energy Efficiency (CBEE) utility filing for energy efficiency program year 2001. The CBEE specified these values at $0.0072/kWh and $0.0635/Therm saved from a low-income program. These values are applied to the California program for the net present value of the fuel types saved.

Lost rental value/Non-occupancy costs to landlords. Lost rental income may occur because of increased tenant mobility rates triggered by high utility bills. When homes are weatherized there is less of a need to move from a home to find another home with affordable utility bills.

While several studies have identified the relationship between high utility bills and the lost rental value of people moving from their homes, the Vermont and Cinergy studies use an estimate of this impact identified by L. Skumatz in 1997 (as cited in Riggert 1999).

This study identified a range of impacts of high utility bills on moving (including lost rental income) and the effect on occupants associated with the move. The Vermont and Cinergy studies used the mid-point of the range of estimated rental loss benefits identified in the Skumatz study.

This benefit is not included in the California LIPPT model following a discussion with the California LIPPT Working Group who expressed that this benefit was not reliably quantifiable within the current data reported in the literature.

Avoided national security expense. Reliance on imported oil and the effects of this reliance on the security and economy of the United States has taken a front stage following the events of 9/11/01. The relationship between cheap oil and the dollars needed to guarantee the continued supply of cheap oil is a major issue for our national defense strategies. This benefit values the relationship between oil saved and the national security costs to secure that oil.

Only participants in the Vermont program saved heating oil. As a result, we have counted this benefit only for the Vermont program. The estimate for this benefit is taken from a 1994 Pennsylvania PUC filing that pegs the national security value of a barrel of oil at $2.56. This value was applied to the amount of oil saved by the Vermont program. The value for this benefit may be substantially larger after 9/11/01 and the worldwide events that have followed; however we have no other information at this time to estimate this value.

Participant Related Benefit Estimation Methods

The following benefits are typically identified as benefits that are received by the participants in energy programs.

Water/sewer savings. This benefit is the retail value of water saved as a result of participating in a program in which water saving measures are installed, and, for the Vermont and Cinergy studies, the impact on wildlife populations associated with water use.

For the Vermont and Cinergy evaluations, an estimate of the water and sewer bill reduction effects is based on a report by Skumatz published in 1997 (as cited in Riggert 1997) citing a range of values associated with California energy programs, depending on the value of water in the local area and the measures installed. The estimation for this benefit for the Vermont and Cinergy studies is set at the lower level of this range because of the general tendency of east coast and midwestern states to have less expensive water supplies. Both programs installed water conservation devices.

The California LIPPT model takes the number of participating homes with water saving measures installed and multiplies this by the estimated amount of water saved and the value of that savings. For example, low-flow showerheads are assumed to save 4, 271 gallons per year (for an average of 3 years of measure life) and faucet aerators similarly save an estimated 1,168 gallons per year. This savings in water volume is then multiplied by the average California cost of water and sewer service per unit of water saved.

Fewer shutoffs and reconnects. This benefit values the cost to the participant in time and resources spend responding to a utility shutoff and reconnect event.

Fewer shut-offs and reconnect benefits are not counted as participant benefits in the Vermont and Cinergy evaluations, as that study did not value the time or costs for participants to become reconnected. These studies value participant's time at zero dollars.

For the California programs the LIPPT model assumes that participants spend an average of 8 hours of their personal time dealing with each incident of utility service shut-off. Reconnect benefits are valued at an estimated reconnect savings of nine cents per participant per year over the life of the expected effects. This value was established during the development of the LIPPT in consultations with the Working Group. No participant time is included in the reconnect estimation other that a brief phone conversation with the utility at the rate of .0205 conversations per 100 low-income customers, as estimated by the utility. The model assumes that the participants' time is valued at the minimum wage in California, of $6.75/hour in 2000.

The California shut-off benefit is estimated based on utility estimates of shut-off frequencies for low-income customers of 0.0299 shut-offs per year per home. The reduction of incidences for program participants is based on evaluation literature reporting impacts ranging from a 1% to 84% reduction with an average reduction of 34%. For shut-offs the LIPPT uses a more conservative estimate made by Blasnik in 1997 (as cited in Hall 2000) of 23% is used. To be conservative the developers of the LIPPT and the LIPPT Working Group cut the benefit projections for shut-offs in half, essentially reducing the hours credited for a shut-off from 8 to 4 per incident.

Fewer problem calls to the utility. Participants who have significant energy savings also have less need to contact the utility to solve billing and supply related issues. This saves time to the participant, and has a value.

Fewer calls to the utility are not counted as a participant benefit in the Vermont and Cinergy evaluations because in these studies participant's time was valued at zero.

The California model employs the same methods and assumed values to compute this benefit as those used to value fewer calls to the utility for shut-offs and reconnects. That is, the frequency of problem calls is estimated at 1.865 per year per participant (utility data). The same percent reduction is estimated at 23% from the Blasnik study, but the time period for each call is estimated at the average call period for a customer call of about 3.5 minutes per call as reported by several California utilities.

Property value benefits. When a significant number of energy efficiency measures are installed in a home, the value of the home is increased and provides a benefit to the homeowner that is beyond the energy savings.

The Cinergy and Vermont studies estimated changes in property value by using the results of a 1998 study by Nevin (as cited in Riggert 1999). This study used regression analysis across 45 cases studies resulting in an estimation of $20.70 or more in increased property value for each dollar of annual energy savings. The Cinergy and Vermont studies used the more conservative lover value of a range of property value estimates.

The California study excluded increased property value as a benefit because the LIPPT Working Group decided that increased property value is included with the value of the energy savings.

Fewer fires. When energy programs replace or repair faulty heating systems or make homes more comfortable such that liquid fuel or electric space heaters are not needed, the number of fires and fire- related losses may be reduced.

The Vermont and Cinergy Program estimates for fire and fire-related loss are based on an estimation methodology developed by Oak Ridge National Laboratory and described in the 1993 National Weatherization Evaluation Study conducted by M. Brown (as cited in Riggert 1999). This methodology is based on a reduction in fire incidents and the value of human life and property that is not lost as a program result. The value placed on a lost human life is taken from a 1990 meta-study by Ottinger (as cited in Riggert 1999) that places the value of a human life lost at from $1 million to $10 million per life. For the Vermont and Cinergy studies we used the conservative side of that range at $4 million per life saved by the program.

The California model estimates the average dollar value of property and human loss to fires using insurance industry records and Consumer Product Safety Commission on incidences with the value of a human life set at $6 million. The model assumes that 12% of household fires are prevented as a result of participation, and that 80% of these are directly comparable in their installed measures and is prevented. The value of a human life is taken from a 1991 report by Vicusi (as cited in Hall 2001). Death rates are calculated using the Consumer Product Safety Commission's estimates of life lost per household fire incident.

Moving costs/mobility. High energy bills have been identified as one of the key reasons low-income customers move from their homes, (Skumatz in 1997, Pye 1996, Collton 1995, Brown 1993) (as cited in Riggert 1999). Programs that reduce the number of moves by reducing utility bills save participants the cost of searching for a different home and moving to that home.

In the Cinergy and Vermont studies we valued this benefit at the mid-point of the range reported in the Skumatz study, at $50 per participant per year. We valued this benefit as occurring one time for each participant.

The California LIPPT model employs an estimation method based on a Blasnik 98 study (as cited in Hall 2001) and estimates the number of moves saved at 0.006 moves per participant, and then applies the costs to search for a home at 32 hours valued at minimum wage. This model does not apply other moving costs such as packing, trucking, unpacking and the time value of money lost on security deposits if applicable.

Fewer illnesses and lost days from work/school. Some evaluators report that when programs make a low-income home more energy efficient it also makes the home more comfortable and, as a result, reduces the number of illnesses and the associated need for medication. In addition, some researchers suggest that this effect reduces the number lost workdays for adults and lost days from school for children. These values are included in the NEB estimates in this paper. However, there is also a strong counter argument and a growing body of research that suggest weatherization programs increase illnesses and associated lost work and school days by making the house tighter thereby concentrating air-born germs, mold spores and dust, creating an environment that increases the likelihood of illness. There is also an argument that human immune systems that are stressed may be healthier than those that are not. This theory suggests that people who live in homes that stress the immune system (weatherized homes) may be healthier in the long run. At this time these relationship are unclear and there is a significant void in the medical research dealing

with increased or decreased illnesses as a result of more energy efficient homes or tighter homes and it is unclear at this time if this is a positive or negative "benefit". This subject needs considerable attention from the medical evaluation community.

Likewise there is considerable discussion among evaluators that reduced power plant emissions can have an effect on emissions related health problems. For example, in Wisconsin, fresh water mercury levels thought to be from coal-fired electrical generation and/or industrial facilities are at a level that has caused health experts to warn against eating fish caught in fresh water lakes and rivers. While experts are uncertain of the extent of the effects of the pollution from power plant emissions, they are certain enough to caution against fish consumption from waters containing the type of pollution emitted from coal burning power plants. It is clear however, that a reduction of generated electricity, especially base-load generation, has a direct effect on the level of emissions precipitated onto the earth and embedded the air, and in general, the health effects of reduced pollution made possible by energy efficiency programs is generally accepted as beneficial to society. However, at this time the extent of this benefit is unclear, making economic projections of net effects problematic. This conflict in hypotheses makes it hard for evaluators to estimate a net NEB value from the current literature.

For the Cinergy and Vermont studies the authors valued this benefit at the midpoint of the range of values estimated in a Skumatz 97 study (as cited in Hall 2000) at $75 per participant per year.

The California estimate relies upon the results of a low-income program "Willingness to Pay" survey conducted in California and directed by L. Skumatz. In this survey, participants are asked their estimate of the number of avoided sick days per year attributable to program participation. The survey indicates that the number of lost workdays is 0.07 days per year, per participant. The NEB value for this benefit is valued at the minimum wage of a single participant for 8 hours of work per year multiplied by the incident rate identified in the survey.

Reduced transactions costs. Because participants in energy efficiency programs are typically educated in how to reduce energy consumption, there is a reduction in what evaluators and regulators call transaction costs. These are the costs of an individual searching out and learning about what to do to their homes to lower utility bills.

For the Cinergy and Vermont studies these costs are calculated at the value of time at minimum wage that is saved learning about what to do or what to buy to reduce consumption. In valuing this benefit the mid-point of an estimate range identified by Skumatz 1997 of $2.50 cents a year over the life of the measures installed was used.

The California model sets the value of reduce transaction costs to zero because in the opinion of the LIPPT Working Group, it is questionable if low-income customers would take the same actions and purchase the same materials that the program installed or if they would purchase or take any additional actions as a result of program participation.

Net hardship, comfort and noise benefits. Some evaluators argue that participation in low-income programs reduce hardship, increase comfort and reduce noise levels, and these "benefits" have value to the participant.

The Vermont and Cinergy evaluations did not quantify a value for hardship, noise or comfort benefits because of the lack of published research documenting a value for these benefits.

The California study uses the results of the Skumatz 2000 California willingness to pay survey, asking participants to establish a value for both the positive and negative effects of the program. This benefit is valued at $ 9.95 per customer per year as a result of equating a portion of the balance between the positive and negative valued program attributes to the program.

Benefits Not Included in these Comparisons

There are a number of non-energy benefits that are not included in these comparisons. These benefits are also not specifically valued in the full reports, however the non-energy benefits excluded from this paper are discussed in detail in the full reports, as are the reasons for excluding these benefits from the Cinergy, Vermont and California studies. The page limits of this paper prohibit a presentation of these benefits and their exclusion rational. However, these can be examined in the primary documents cited at the end of this paper.

Results of Three Studies

The NEBs described in the paragraphs above are listed in the benefits table presented below. This table includes the net present value of each benefit included in the original studies. If the benefit was not valued in one of the three studies it is also excluded from the table below. The primary difference in the valuing of the NEBs in the Cinergy and Vermont studies are adjustments made to account for the different fuel mix used to generate saved electricity, the different fuel mix saved by participants, and the amount of energy (electricity, oil, natural gas, propane, wood, etc.) saved by each of the programs. The table provides a comparison of the NEB values across the three programs as estimated by the methods described above. The Cinergy and Vermont programs have minor differences relating to fuel mix, fuel use and savings totals. The California NEB values are estimated using the California LIPPT NEB estimation model. The table also includes the energy savings for these programs to allow the reader to see the relation between the total NEB benefits and the energy savings benefits from these programs.

The total NEB benefits are larger ($11,391) for Vermont's Weatherization program compared to the Cinergy program ($7,326). This is largely due to greater energy savings in the more comprehensive and more expensive Vermont program. Vermont benefits vary somewhat depending upon fuel type. In the Vermont study the non-energy benefits for electrically heated homes is $8,564 and $6,516 for natural gas homes. The benefit estimate for fuel oil heated homes is $12,856, $11, 165 for kerosene heated homes, and $8,844 for LPG heated homes. The total NEB estimate for the California program is $143.43 and is much smaller than the two other studies. This difference is primarily embedded in the NEB estimation methods used, the type and size of the programs examined and the estimate of fuel savings for each program. The California program is a much smaller (in per participant spending) electric targeted program that installs a limited number of electric measures.

The weakness of this three-program comparison is that each of these programs target different primary fuels and installed technologies. The California program is the smallest program, spending the least number of dollars per participant and focusing only on electric measures. The Vermont program targets a variety of fuels and spends the most on installed measures. The strength of this comparison is that this table demonstrates that across the three different programs, targeting different fuels, using different resources and technologies,

Table 1. Non-Energy Per Participant Benefits

Energy and Non-Energy Benefits	Cinergy Weatherization (natural gas and electricity)	Vermont Weatherization (oil, propane, electricity & natural gas)	California Program (electric measures only)
Utility related benefits			
Reduced Arrearages	$480	$458	$0
Reduced Carrying Cost on Arrearages (interest)	$60	$57	$29.11
Lower Bad Debt Written Off	$68	$64	$3.72
Fewer Shut-offs	$105	$100	$0.41
Fewer Reconnects	Included with shut-offs	Included with shut-offs	$0.14
Fewer Notices	Included with collection costs	Included with collection costs	$11.55
Fewer Customer Calls	Not quantified	Not quantified	$11.36
Lower Collection Costs	$75	$75	$0
Reduction in emergency gas service calls	$22.57	$22.57	$0
Distribution savings (distribution only)	Included in fuel savings	Included in fuel savings	$17.61
Societal or public benefits			
Economic impact (direct and indirect employment)	$1,647	$2,273	$0
Emissions / Environmental	$838	$875	$18.91
Lost rental value / Non-occupancy costs to land-lords	$1	$1	Not included
Avoided national security expense	NA	$202	$0
Participant benefits			
Water/sewer savings	$143.12	$143.12	$0.84
Fewer shutoffs	Not quantified	Not quantified	$1.30
Fewer reconnects	Not quantified	Not quantified	$0.63
Fewer Calls to the utility	Not quantified	Not quantified	$1.31
Property value benefits	$1,905	$5,413	$0
Fewer fires	$446	$409	$0
Moving costs / mobility	$50	$50	$9.34
Fewer Illnesses and lost days from work/school	$1,125	$1,073	$27.25
Reduced transactions costs (limited measures)	$38	$36	$0
Net Household Benefits from Comfort, Noise,	Not quantified	Not quantified	$9.95
NEB value total	**$7,326**	**$11,391**	**$143.43**
Energy savings			
Energy savings – Gas	$1,133	$5,538	$0
Energy savings - Electric	$248	Included in gas savings	$94.94
Energy saving values and NEB Total	**$8,707**	**$16,929**	**$238.37**
Estimated per participant program spending	$1,768	$2,259	$96.00

producing different energy savings estimates, and using two different estimation methods, the results are comparable. That is, in each case, from the most conservative California estimation method examining a program in which the least dollars are spent per participant, to the two more aggressive Cinergy and Vermont estimation methods, the value of the non-energy benefits are greater than the value of the energy savings. Aggressive NEB estimation methods that value a wide range of benefits show considerably more NEB savings than energy savings. However, even for some small programs (per participant spending levels), using more conservative estimation methods (California LIPPT) that exclude estimates for

major benefits (economic effects) or value benefits significantly lower than other estimation methods (value of emissions reductions), the results show that the NEBs can be greater than or equal to the value of the energy savings.

Conclusion and Future Directions

It is clear from the estimation methods and values identified in the three studies presented in this paper that non-energy benefits are a major part of the total benefits package associated with low-income programs programs. For programs funded by public benefits dollars that are required to provide a return to the public at large, the estimated value of all benefits should be counted when conducting benefit-cost assessments. For the Cinergy and Vermont studies the value of the non-energy benefits, as reflect in the selected methodologies identified in this paper, is far greater than the value of the energy saved. For the smaller California electric program, the value of the non-energy benefits is less due to the more conservative estimation approach and the exclusion of major benefit categories that are included in the Vermont and Cinergy studies (i.e. economic impact). As more rigorous primary research is conducted to provide more accurate estimates of the value of program-induced NEBs we should see a generally accepted evaluation approach that calls for the inclusion of NEB estimations. Today the methods and results we use for estimating NEB values can be compared to the energy savings evaluation field in the early 1980s. As more evaluators examine the NEBs from energy and public benefits programs we will have better and more reliable estimates of the total value of these programs.

In the Wisconsin Focus on Energy public benefits evaluation we are employing new primary research methods and using recent secondary research results to estimate the value of non-energy benefits in the low-income, residential, and commercial and industrial sectors. These benefits are being quantified using customer-reported benefits and benefit values and provide a more reliable method of estimating non-energy benefits. In the Wisconsin research the benefits will be largely identified and valued by the program participants rather than evaluators estimating the value of an evaluator identified benefit. The results from the Wisconsin research will to be reported periodically over the next 2 to 3 years as research results are accumulated across all of Wisconsin's public benefits programs.

References

Riggert, Jeff, Nick Hall, John Reed, and Andrew Oh, 1999, *An Evaluation of the Energy and Non-energy Impacts of Vermont's Weatherization Assistance Program*, TecMRKT Works.

Hall, Nick, Tom Talerico, and Jeff Riggert, 2000, *Evaluation of Cinergy's Low-income Natural Gas Weatherization Program*, TecMRKT Works.

Hall, Nick, Lisa Skumatz, Jeff Riggert and Lori Megdal, 2001, *The California Low-income Public Purpose Test (LIPPT)*, Prepared for the California Public Utility Commission and four California investor-owned utilities.