

State of Wisconsin Department of Administration Division of Energy

Low-income Public Benefits Evaluation

*The Non-energy Benefits of Wisconsin's
Low-income Weatherization Assistance
Program: Revised Report*

Final November 9, 2005

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PA Government Services Inc.



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TABLE OF CONTENTS

1.	Executive Summary	1-1
2.	Introduction	2-1
2.1	Program Summary	2-2
2.2	Data Collection	2-2
2.3	Respondent Characteristics	2-3
3.	Methods Used to Quantify Non-energy Program Effects	3-1
4.	Participant NEB Valuation Results for the Program	4-1
4.1	Perceptions of Non-energy Program Effects	4-1
4.2	Share of Value by NEB Category	4-4
4.3	Non-energy Benefits Dollar Estimates	4-5
4.4	Participant Water Bill Savings	4-7
4.5	Summary of Participant NEB Results	4-8
5.	Societal and Utility NEB Results	5-1
5.1	Introduction	5-1
5.2	Computing the Utility and Societal NEBs	5-1
5.3	Estimated NEBs	5-2
6.	Comparisons to NEBs from Other Low Income Programs	6-1
7.	Summary and Conclusions	7-1
 Appendices		
	APPENDIX A: Non-energy Benefits Approach	A-1
	APPENDIX B: Participant Survey Instrument	B-1

1. EXECUTIVE SUMMARY

In Federal Fiscal Year 2004 (FFY04), PA Government Services (PA) completed a billing analysis of the Wisconsin Weatherization Assistance Program. According to the analysis, weatherized households, on average, save approximately \$220 a year due to program benefits. This monetary savings was a result of decreased natural gas and electric usage.

The Wisconsin Department of Administration (DOA) recognized that while a critical component to weatherization assistance program benefits, decreased energy usage does not provide the full story behind all the benefits the program offers. The program also provides a range of non-energy benefits (NEBs). NEBs cover the array of impacts other than the direct energy savings realized through program services and measures. They include impacts such as the change in comfort, the ability to pay for energy or other bills, and change in health conditions, just to name a few. These benefits are important, but often unrecognized, from low-income energy efficiency program efforts such as the Weatherization Assistance Program.

In response, the evaluation plan for FY05 included a NEBS valuation of the Weatherization Assistance Program. PA hired Skumatz Economic Research Associates (SERA), a leader in the field of NEBS valuations, to provide the research design and analysis to this non-energy benefit valuation study of Weatherization Assistance Program participants.

It is important to note that although the term in the literature is non-energy benefits, the effects measured are actually net impacts—including both positive and negative effects from the program. For example, the program could have an effect on the health of the household – but it cannot be assumed that the program only provides positive health benefits to the client. Clients could also feel that due to program services they now have more headaches, thereby decreasing their health situation.

The bulk of this study examines the difficult-to-measure participant impacts. The research used information from detailed surveys of 362 WAP participants. The net benefits attributable to the program were estimated using valuations derived from participant surveys as well as from computations of net impacts using program data and impact values from the literature.

This executive summary briefly discusses the results, methodology, and analysis framework of the NEBS valuation conducted by SERA. The intent of this summary is to provide a general overview of the method and study design employed by SERA. The full-scale technical report, which follows this executive summary, provides a more thorough discussion of the methods and calculations used for the analysis. The reader is referred to the report for specific findings, results, and calculations.

Appendix A provides a more technical description of the approach by SERA, including computation formulas, and Appendix B contains the data collection instrument.

1.1 NEBS CATEGORIES

NEBS falls into three categories—utility, societal, and participant. This report primarily focuses on participant NEBS; however, the analysis also includes utility and societal benefit

1. Executive Summary...

values derived using economic and environmental impact analysis provided by PA and DOA¹, as well as SERA's own primary and secondary research.

Table 1-1 summarizes the values attributed to each NEB category. The values are derived using different methodologies appropriate to the benefit category.

- **Utility benefits** (shutoffs, notices, and customer call impacts) are estimated based on changes in frequency of calls and notices multiplied times a proxy incremental cost per unit for utilities.²
- **Economic benefits** data use an economic multiplier derived for the State of Wisconsin Focus on Energy, reported in the Low-income Public Benefits Evaluation Economic Development Benefits report³.
- **Environmental benefits** are derived using an emissions model that estimates the changes in pounds of emissions due to the Weatherization Assistance Program (from PA Consulting), valued by an average cost per pound of emissions based on data from the literature.
- **Participant benefits** analysis reviews changes in household conditions such as change in comfort, ability to pay energy bills, maintenance in equipment, etc. The results are based on interviews with 362 Weatherization Assistance Program clients. These participant benefit computations are based on perceived values.

The results are presented separately rather than added up as a total NEBS value. This is because the inputs that feed into the categories are not mutually exclusive. This is particularly true for the economic benefits, where the Gross Regional Product (GRP) and labor economic values overlap. To report them as a total, combined value would overstate the economic NEB.

¹ Reported to DOA in the Fiscal Year 2005, final annual report (dated 9/6/05).

² Arrearage savings are computed in a similar manner, except an interest rate also enters into the computations (See Section 5). In addition, T&D savings are computed using a different methodology .

³ Sherman, Mike, Lisa Petraglia, and Glen Weisbrod, (Economic Development Research Group Inc.), *State of Wisconsin Department of Administration Division of Energy, Low-income Public Benefits Evaluation, Economic Development Benefits, Final Report*. May 2, 2003.

1. Executive Summary...

Table 1-1. NEBs Summary

Non-energy Benefit Category	Estimated Annual NEBs per Participant per Year
<i>Utility Benefits Subtotal</i>	\$4.82
Lower carrying cost on arrearages	\$1.37
Fewer shutoffs and reconnections	\$0.13
Fewer notices	\$0.30
Fewer customer calls	\$0.43
Transmission and/or distribution savings (distribution only)	\$2.59
<i>Societal Benefits</i>	
Economic NEBS: GRP ⁴	\$340.94
Economic NEBS: Labor income	\$186.09
Environmental / emissions ⁵	\$128.35
<i>Participant Benefits Subtotal</i>	\$272-348
Water / sewer bill savings	\$4.89
Customer-valued participant benefits (see next table)	\$268-344

1.2 PARTICIPANT BENEFITS: AN OVERVIEW OF STUDY DESIGN AND METHODS

The literature provides numerous methods for conducting a non-energy benefit analysis. One such method is to simply ask program participants what monetary value they place on the benefits themselves—or willingness to pay / contingent valuation. This can be asked of respondents outright, or in context of how much they would pay to have the benefits again if they lost them. For example:

“How much value would you place on the increased comfort of your home due to program services?”

- or -

“If your home is more comfortable now due to program services, and that benefit went away, how much would you pay to get it back?”

This approach is problematic for several reasons. For one, it is difficult for respondents to simply provide a value to items that are not traditionally valued, such as comfort, convenience, and capabilities. It is difficult for respondents to grasp what it means to place a monetary value on “soft” measures such as increased comfort. Also, due to the difficulty in answering the questions, there could be a significant amount of missing data or respondents who refuse to complete the survey. This missing data or missing respondents could bias the results, or lead to inconsistent results across studies. Last, respondents tend to overstate the values in willingness to pay questions, inflating the participant NEBS value.

⁴ Economic benefits estimated on a per household per year basis, based on FY2002 data (the most current economic NEBS estimation available for Wisconsin Focus on Energy). Total benefits per household are \$4,837/participant and 0.11 jobs. The values in Table 1-1 assume that the program costs are a one-time up-front investment, and last 15 years.

⁵ The largest component of the high estimate is Carbon dioxide, valued at \$96.

1. Executive Summary...

Based on SERA's extensive experience evaluating NEBS, they design their NEBS valuations using a comparative analysis and relative valuation technique. Based on the limitations discussed above, they believe this technique is more successful estimating the true value of the NEBS for clients. Comparative or relative valuations ask respondents to compare the value of the benefit to the energy savings they realized through the program. This provides the respondent with a basis to rate the benefit, rather than ask for a dollar value they feel the benefit is worth.

1.2.1 Relative scaling approaches

The survey included two relative scaling approaches to value the NEBS—verbal scaling and reported percentage. This section briefly outlines the two approaches.

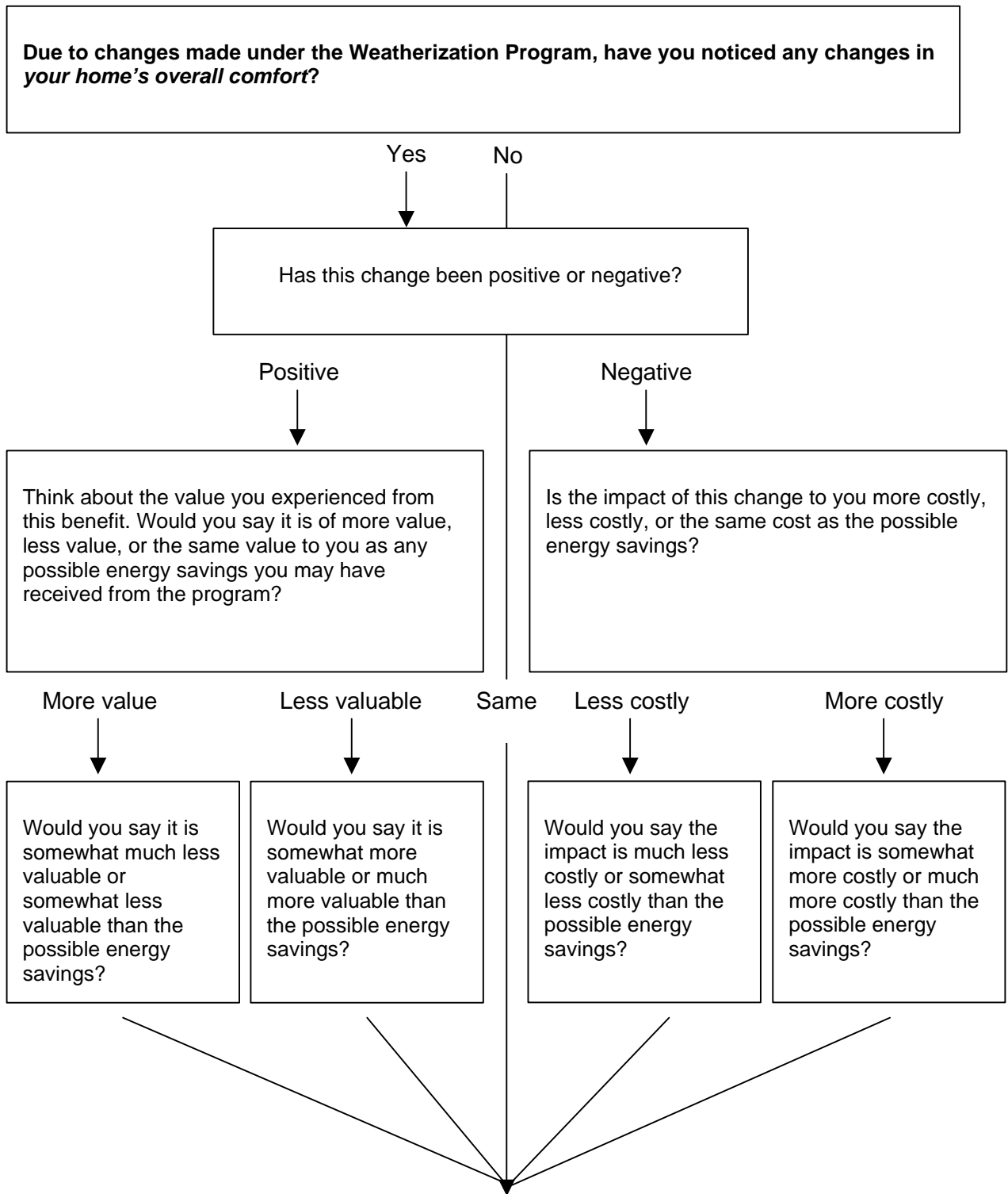
A. VERBAL SCALING

Verbal scaling uses verbal responses and translates them into numeric multipliers that are applied to the energy savings value for each NEB discussed for each respondent. Interviewers asked respondents if they experienced a change in each NEB due to program benefits. If the client answered yes, then interviewers asked respondents if the change was negative or positive and what the value or cost was of the change compared to the potential energy savings. If positive, respondents were asked whether the change was “somewhat more valuable, much more valuable, somewhat less valuable, or much less valuable” when compared to the possible energy savings. If negative, respondents were asked if the change was “somewhat more costly, much more costly, somewhat less costly, or much less costly” than the potential energy savings.

Figure 1 shows the flow of the comparative analysis questions. For the purpose of this illustration, “Your home’s overall comfort” will be the NEB included. (The reader is referred to Appendix B to see the questionnaire in its entirety.)

1. Executive Summary...

Figure 1: Comparative valuation question flow



Go to next NEB and ask series again

1. Executive Summary...

The questions asking respondents to grade the value or cost of the change against the possible energy savings are used to compute the dollar value associated with each NEB. Each category of value or cost (i.e., much more valuable/costly, somewhat more valuable/costly, etc) are assigned a coefficient, or multiplier. Based on responses, these multipliers are applied to the average energy savings to develop the dollar value per NEB per participant. SERA developed these coefficients based on in-house SERA research on NEBS.

To ascertain the total value of the NEB to a participant, the multipliers are applied to the average energy savings of \$220. A “much more valuable” response, for example, receives a multiplier of greater than 1, whereas a “much less valuable” response receives a multiplier less than 1. SERA’s model determines the average value across all respondents and reports the value as an average NEBS participant value for all participants⁶.

B. REPORTED PERCENTAGE

A number of respondents will find it difficult to respond to this series for all NEBS, and despite interviewer probing efforts, will say “Don’t know.” Therefore, SERA included a second valuation question to capture an overall NEBS value.

“Think about the combination of all the positive effects you received from the Weatherization Assistance Program beyond the possible energy savings. Would you say the combination of these effects is overall positive, negative, or no effect?”

Based on the response to this question, respondents were asked a series of questions similar to the above comparative analysis series. If respondents felt the overall effect was positive, interviewers asked them to compare the value to the possible energy savings. If negative, interviewers asked them to compare the cost to the possible energy savings.

To ascertain the degree to which respondents felt the program affected them, they were finally asked *“by how much, or what percent, more or less valuable/or costly were the benefits, overall, when compared with the possible energy savings.”* This response was translated into a percent value for all respondents, applied to the monetary energy savings value derived from the billing analysis, and averaged across respondents.

1.3 PARTICIPANT BENEFITS: THE RESULTS

The report provides the detailed results of both these methods. In short, the total participant NEBS values ranged from \$268 to \$344 (1.2 – 1.56 of energy savings) for the relative verbal and self-reported percentages, respectively.

The analysis also presents a dollar value attributed to each individual NEB reviewed in this study. SERA assigned the dollar value using the following steps:

- 1) Determine the range of NEBS dollar values per the valuation methods discussed above

⁶ This method ensures that “no effect” responses are taken into account because those respondents are part of the denominator as the population as a whole, reducing the value of the effect.

1. Executive Summary...

- 2) Compute the “share” that each NEB contributes relative to the other NEBs. This formula is outlined in Appendix A. In short, it determines how much effect each individual NEB has on households in proportion to all other NEBS, where all NEB proportion values add up to 100%. This computation takes into account all the positive and negative effects.
- 3) Multiply the total dollar value determined in Step 1 by the share value in Step 2 to determine the dollar value per individual NEB.

The two NEBS categories that comprise the greatest share of the NEBS value are the home’s overall comfort, and the ability to control the energy bill or understand energy use. Table 1-2 details the share of total benefits and resulting dollar amounts for all NEBS reviewed in the study.

Table 1-2. Estimated Participant NEB Dollar Value by Category⁷

Benefit category	Share of total benefits	Approximate dollar value using \$268-\$344 total Participant NEB value per year ⁸
Home’s overall comfort	16%	\$44-\$56
Ability to pay energy/other bills	8%	\$22-\$29
Quantity or quality of your lighting	7%	\$19-\$25
Noise from appliances or noise inside home	6%	\$15-\$20
Amount of noise from outside home	5%	\$13-\$17
Reliability/amount have had to maintain of new equipment	7%	\$19-\$24
Appearance of home or property value	6%	\$17-\$22
Ability to control energy bill or understanding of energy use	11%	\$28-\$36
Likelihood of moving because of energy costs	0%	\$1
Equipment performance or features	5%	\$14-\$18
Number of calls to utility related to bills	2%	\$6-\$8
Number of bill payment or shutoff notices received	3%	\$9-\$12
Impacts on environment	2%	\$4-\$6
Number of sick days lost from work/school	1%	\$4-\$5
Water bill costs	3%	\$8-\$10
Frequency or intensity of chronic conditions such as asthma	3%	\$9-\$12
Frequency or intensity of other illnesses	2%	\$5-\$6
Headaches for you or other residents	2%	\$5-\$6
Doctor or hospital visits and related costs	2%	\$4-\$5
Medication costs	0%	\$1
Safety of your home	8%	\$20-\$26
Total Participant NEBs	100%	\$268-\$344

⁷ Based on results from participant surveys. Weighted by group.

⁸ Based on \$220 in total energy bill savings times overall participant NEB multiplier 1.2 – 1.56, a value that is derived later in this report.

1. Executive Summary...

While somewhat complicated to measure, the results provide useful information to guide program planning, implementation, and outreach. These results have several uses:

- **Financial applications:** The results or subsets of the results may be useful in augmenting benefit-cost analyses for the program, or integrated into regulatory tests related to the WAP.
- **Program outreach:** The results provide information on benefits provided by the program that may be particularly valuable and appealing to potential program participants. The program may find it beneficial to incorporate some of these benefits into outreach materials on the program.
- **Progress toward program goals:** The WAP has goals—stated and unstated—that go well beyond energy savings or direct bill savings to residents. The program aims to reduce hardship among participating households. The array of participant benefits makes it clear that participants are realizing these kinds of benefits and recognize they are coming from the program. Residents recognize increased quality of the home environment (increased comfort, appearance, noise, appliance features, lighting), reductions in equipment-related problems (maintenance), financial savings and benefits (reduced water bills, increased housing value), quality of life (reduced illness and related costs, improved safety), and other hardship related improvements (improved ability to control and pay bills, lower likelihood of moving, etc.), and ability to “do good” outside themselves (environment).

The remainder of the report presents the research undertaken to measure the WAP NEBs, and the results of that research.

2. INTRODUCTION

The Wisconsin Low Income Weatherization Assistance Program (WAP) provides weatherization benefits to qualified low-income households in the State⁹. While the primary purpose of most energy efficiency programs is to save energy or reduce peak demand, these programs lead to a host of effects beyond these outcomes. These non-energy effects are commonly called Non-energy Benefits (NEBs)—though not all the effects are positive.¹⁰

These effects are delivered as a consequence of the measures and interventions supplied by the energy efficiency program. Although many programs do not spend much effort examining NEBs, low-income programs are different. In many cases, the goals of low-income programs go beyond energy savings and specifically identify reductions in hardship and a variety of other factors as specific objectives of the program interventions. For low-income programs, then, an analysis of NEBs is an important part of the program evaluation work.

To conduct this analysis of NEBs for the program, the Wisconsin Department of Administration (DOA) hired PA Government Services Inc. (PA) and its subcontractor, Skumatz Economic Research Associates, Inc. (SERA). SERA was responsible for survey development and analysis, and PA conducted the data collection work and advised on the project.

There are three main types of net non-energy benefits based on who is the beneficiary:

- **Utility benefits:** things that benefit or affect ratepayers and utility and reduce revenue requirement—for example, lower bad debt because of lower arrearages, lower line losses, power quality issues, and reduced labor cost from fewer bill-collection-related calls. These are generally valued at utility (marginal) costs.
- **Participant benefits:** things that benefit or affect the participants beyond energy savings. This includes comfort, improved ability to pay bills, and a wide variety of factors included in the tables below. These are valued in terms relevant to the participant.
- **Societal benefits:** things that benefit or affect society or that cannot be attributed directly to utility/ratepayers or participants. These include emissions/environmental benefits/health benefits, direct and indirect economic multipliers, water system benefits (if they need fewer treatment plants, etc.), or similar items. These are valued as appropriate to the benefit category.

This report is based on a survey of participants in Wisconsin's Low Income WAP. The primary focus of this report is the participant benefits. The research involved detailed surveys with a random sample of 362 program participants and analysis of the results. The report also provides an estimate of societal and utility benefits, but these analyses are less in-depth and use secondary and program data for the research.

⁹ Qualified households must have incomes at or below 150% Federal Poverty Level, or deemed categorically eligible.

¹⁰ We most commonly call them "net non-energy benefits" to account for the negative benefits as well. We have also called them non-energy impacts, non-energy effects, non-utility benefits, and others, but the commonly accepted term in the literature is NEBs, so we use that convention.

2. Introduction...

2.1 PROGRAM SUMMARY

The Wisconsin WAP seeks to help low-income households attenuate high energy costs by providing them with a variety of energy-efficient measures, such as attic, wall, and floor insulation and inefficient furnace replacement. The program also addresses home health and safety issues by taking actions such as installing new carbon monoxide and smoke detectors and replacing or repairing hot water heaters.

Wisconsin residents at or below 150% of the Federal Poverty Level are eligible to participate in the program. In some cases, residents that live above this eligibility cutoff are able to participate in the program if they are deemed categorically eligible by partaking in other low-income programs.

WAP's primary funding sources are the federally funded Low-Income Home Energy Assistance Block Grant (15% transferred to weatherization by state law), the WAP through the US Department of Energy, and Public Benefits.

2.2 DATA COLLECTION

Based on previous work in low income NEBs, SERA prepared a draft questionnaire, which was reviewed by the project managers. A round-table discussion of tradeoffs for questionnaire focus and length provided guidance for developing the revised pre-test version of the questionnaire. PA conducted 85 pre-test interviews, after which refinements were made to the wording and flow of several questions. The final questionnaire is attached in Appendix A.

The sample was randomly selected from a database of program participants provided by DOA. The sample consisted of program participants from Contract Year 2005 who received benefits between July 1 and December 31, 2004. The sample was stratified by Wisconsin regions (Eastern, Western, Southern, Southeastern, and Northern) and housing types (single-family structures, two to four unit structures, multi-family structures with greater than 4 units, and trailer/mobile homes) for a total of 20 stratification groups.

Because the survey was implemented prior to a full year's weatherization services, the pool from which the sample was selected did not represent a typical weatherization year, particularly when reviewing the types of housing units served. The sample was therefore designed to proportionately represent a typical weatherization year, modeled after Contract Year 2004 participation totals.

PA pre-tested the instrument from March 4 through March 13. Data collection immediately followed, and ran from March 14 through April 8. The overall response rate was 44% (Table 2-1).

Table 2-1. Response Rate

Description	Sample Count
Starting Sample	816
Ineligible - Deceased	1
Adjusted Sample	815
Refused	23
No/bad phone number	175
Incapable/language barrier	17
Not available for duration	4
R not at number	36
R does not recall weatherization work	47
Remaining sample	151
Complete	362
Response Rate	44.4%

2.3 RESPONDENT CHARACTERISTICS

Table 2-2 presents some basic characteristics of the 362 program participants interviewed for this study. The average household size was 2.5 members—38% of which had an elderly member.

Table 2-2. Respondent Characteristics

Characteristics	Average Response
Percent of households with elderly residents	38%
Percent of households with children	23%
Average annual income	\$14,230
Average number of household members	2.51
Percent of respondents living in multi-family units	29%

Table 2-3 gives a more description of respondents' views on how the program altered their energy use and energy bills. More than two fifths (41%) of the participants interviewed felt that their energy use decreased "somewhat" as a result of their participation in the WAP. Almost one-fifth (19%) felt that their energy use decreased "a great deal," and 32% reported no appreciable change. Only 8% felt that their energy use had increased at all.

Table 2-3. Perceptions of Changes in Energy Use and Bills

	Energy use	Energy bills
Increased a great deal	2%	3%
Increased somewhat	6%	6%
Stayed about the same	32%	33%
Decreased somewhat	41%	45%
Decreased a great deal	19%	14%

2. Introduction...

The distribution of perceived changes in energy bills was similar to that for energy use. 45% felt that their energy bills decreased “somewhat,” 14% felt that their energy use decreased “a great deal,” 33% reported no appreciable change, and 9% reported an increase in energy bills. For both energy use and energy bills, most of those reporting an increase thought that their bills or energy only increased “somewhat.” These findings are consistent with customer surveys with WAP recipients in the Low-income program evaluation. Year 1 reported that 64% of respondents believed their bills were lower, 30% believed their bills were unchanged, and 6% believed their bills were higher due to benefits received through WAP.¹¹

Finally, Table 2-4 summarizes which measures were installed through the program in terms of the percentage of participants in the sample receiving each measure. Participants could receive multiple measures, and the average number of measures installed was 10.85.

The most commonly installed measures were:

- Installation of Compact Fluorescent Light Bulbs (93%)
- Air sealing (91%),
- New CO detector installation (70%),
- Attic insulation (61%),
- Insulation of hot water heater pipes (59%), and
- New smoke detector installation (56%).

¹¹ Lee, Lark, Pam Rathbun, and Laura Schauer. Year 1 Low-Income Program Evaluation Report – Volume 2: Appendices A-H. Prepared for the State of Wisconsin Department of Administration Division of Energy. Madison, Wisconsin. October 18, 2002.

2. Introduction...

Table 2-4. Measure Installations

Measure type	Measure	Percent with measure installed	Measure type	Measure	Percent with measure installed
Health and safety	New carbon monoxide detector	70%	Heating and cooling systems	Other heating system work	45%
	New smoke detector	56%		Install programmable thermostat	45%
	Water heater work	22%		Heating system replace	37%
	Exhaust vent	17%		Heating system clean	35%
	Water heater replace	11%		Change heating system filter	31%
	Windows	10%		Heating system repair	3%
	New co and smoke detector	8%	Insulation	Attic insulation	61%
	Furnace replace	7%		Insulate hot water heater pipes	59%
	Draft remediation	6%		Sill insulation	28%
	Appliance repair or replace	5%		Wall insulation	24%
	Other remediation	4%		Floor insulation	19%
	Furnace repair	4%		Foundation insulation	16%
	Chimney	4%	Water system	Install low-flow showerhead	39%
	Doors	3%		Insulate hot water tank	18%
	Upgrade or repair electric	3%		Reduce temp of hot water heater	13%
	Asbestos removal	2%		Replace water heater	11%
	Stove repair or replace	2%		Water heater repair	7%
	Central ac new or replace	2%		Other	Install CFLs
	Duct repair	2%	Air sealing		91%
	Chimney liner	2%	Indoor air quality		47%
	Boiler replace	1%	Structural repair (doors, windows, walls, roof, etc)		46%
	Space heater replace	1%	Replace fridge		42%
	Lead paint removal	1%	Install windows		14%
	Ventilator	1%		Electric repairs	8%
	Boiler repair	1%		Freezer replacement	5%
	Wood heater replace	1%		Remove fridge	1%
	Water heater repair	1%		Freezer removal	1%
	Roof	1%			
	Walls	1%			

3. METHODS USED TO QUANTIFY NON-ENERGY PROGRAM EFFECTS

A key objective of this research was to “value” previously unvalued or undervalued benefits to participation in the WAP. Past analysis of NEBs from low-income weatherization programs indicates that participants may assign high values to these program effects—and in many cases, these benefits exceed the value of direct energy savings. The total of NEBs from all three perspectives (utility, societal, and participant) often exceed the energy savings; similarly, the value of the total perceived benefits just to participants (a portion of the total) often equal or exceed the energy bill savings as well.¹²

The study used best practices to measure the effects.¹³ First, special efforts were made to measure “net” impacts.¹⁴

- The NEBs were not presumed to be positive, even though the NEB name suggests “benefits.” The respondents were asked about both positive and negative effects, and the reported results are “net” of the positive and negative impacts.
- We also report the final impacts in terms that are “net” of free ridership. If participants in the program would have replaced the equipment without the influence of the program, the NEBs associated with those participants are not included in the computation.¹⁵

We also normally ask the impacts to be expressed as those effects above and beyond what the respondent would have experienced from the standard efficiency equipment that would have been used as replacements. However, in this case it was argued that the equipment would not have been replaced, at least not for quite a long time, and that the equipment comparison would be from the existing equipment.

Second, the study used one main method of valuing the benefits; however, variations and secondary methods were used to “bracket” the results and provide confirmatory information about the results. Through many years of research, it has become clear that asking respondents directly how much they value individual categories of non-energy benefits is problematic. Respondents are not used to assigning dollar values to benefits like comfort or other factors. The responses are highly variable and unreliable. Instead, we used a method that has proven more successful—we ask “relative” valuations.

Respondents were asked about the value of the benefits relative to possible energy savings (relative verbal scaling). They were asked if there were any effects noted, and if so, whether the effects were positive or negative (to make sure both benefits and problems from the new measures are included). If they noted an impact, they were asked whether the impacts (positive or negative) had a higher or lower value to them than the potential energy savings.

¹² Skumatz, Lisa. Techniques for Getting the Most from an Evaluation: Review of Methods and Results for Attributing Progress, Non-energy Benefits, Net to Gross, and Cost-Benefit. ECEEE 2005 Summer Study Proceedings, May/June 2005. In addition, later in the document we compare the results for participant (and other) NEBs for the Wisconsin program to others from around the country.

¹³ These issues are explained in more detail in the appendix.

¹⁴ Skumatz, Lisa A. and John Gardner. Methods and Results for Measuring Non-energy Benefits in the Commercial / Industrial Sector. ACEEE 2005 Summer Study Proceedings (Forthcoming, July 2005).

¹⁵ As will be described later in the report, however, the free ridership figure for low income weatherization programs are very near zero, so this is a small to negligible adjustment for this program.

3. *Methods Used to Quantify Non-energy Program Effects...*

This “relative” value was then clarified into more detailed categories using a five-point scale (much less valuable, somewhat less valuable, same value, somewhat more valuable, and much more valuable).¹⁶ In addition, for a subset of categories, they were also asked to report how much more (or less) valuable the benefits were as a percentage of the value of the energy savings. We find respondents can answer the verbal scale more quickly; the percentage figures are used to derive and check the multipliers assigned to the verbal scale.¹⁷

¹⁶ For items with negative value (e.g., non-energy costs) the respondents are asked if the non-energy effects are much more costly, somewhat more costly, same value/cost, somewhat less costly, or much less costly than the energy bill savings. The total benefit for each respondent was then calculated as the sum of benefits, minus the sum of costs.

¹⁷ For those interested, we also asked about overall / total value using willingness to pay and willingness to accept approaches. Evidence from numerous previous studies indicates results using these approaches are more volatile because respondents find them difficult to answer. However, these results are presented in the Appendix.

4. PARTICIPANT NEB VALUATION RESULTS FOR THE PROGRAM

The survey asked a number of detailed questions about non-energy impacts or non-energy benefits (NEBs) related to the programs. The results provide information on both perceptions of positive and negative impacts from the program, and on the value of those NEBs to participants.

4.1 PERCEPTIONS OF NON-ENERGY PROGRAM EFFECTS

Respondents were read a variety of categories of NEBs and were asked to report whether they experienced positive, negative, or no effects as a result of their participation in the program. These results are summarized in Table 4-1.

The categories in which respondents were most likely to report positive effects were:

- Change in home's overall comfort (64%)
- Change in ability to control energy bill or understanding of energy use (46%)
- Change in quantity or quality of your lighting (42%)
- Change in ability to pay energy/other bills (28%)
- Change in reliability/amount have had to maintain of new equipment (28%)
- Change in safety of your home (28%)
- Change in noise from appliances or noise inside home (25%)
- Change in appearance of home or property value (25%).

This simple comparison suggests these were among the NEB categories in which the non-energy effects of the program were the most pronouncedly positive.

4. Participant NEB Valuation Results for the Program...

Table 4-1. Changes in Non-energy Areas¹⁸

NEB Category	Positive	Negative	No Effect
Change in home's overall comfort	64%	3%	33%
Change in ability to pay energy/other bills	28%	3%	69%
Change in quantity or quality of your lighting	42%	10%	47%
Change in noise from appliances or noise inside home	25%	8%	68%
Change in amount of noise from outside home	18%	0%	82%
Change in reliability/amount have had to maintain new equipment	28%	1%	71%
Change in appearance of home or property value	25%	1%	75%
Change in ability to control energy bill or understanding of energy use	46%	1%	53%
Change in likelihood of moving because of energy costs	3%	2%	95%
Change in equipment performance or features	21%	4%	75%
Change in number of calls to utility related to bills	7%	1%	91%
Change in number of bill payment or shutoff notices received	9%	0%	91%
Change in impacts on environment	8%	0%	91%
Change in number of sick days lost from work/school	5%	1%	94%
Change in water bill costs	8%	1%	91%
Change in frequency or intensity of chronic conditions such as asthma	8%	4%	88%
Change in frequency or intensity of other illnesses	5%	3%	91%
Change in headaches for you or other residents	5%	2%	92%
Change in doctor or hospital visits and related costs	5%	2%	93%
Change in medication costs	2%	2%	97%
Change in safety of your home	28%	1%	71%

Across non-energy categories, fewer respondents identified negative changes resulting from their experience with the program--10% of those responding reported negative changes in the quality or quantity of the light in their home, and 8% reported negative changes in the amount of noise they heard from their appliances or elsewhere inside their homes. Beyond those effects, however, only slim proportions reported any detrimental changes at all.

In contrast, large proportions of respondents reported that they experienced no effect in many of the benefit categories about which they were asked. For example, at least 90% of those responding reported that they experienced no effect in the following categories:

- Change in medication costs
- Change in likelihood of moving because of energy costs
- Change in number of sick days lost from work/school
- Change in doctor or hospital visits and related costs
- Change in headaches for you or other residents
- Change in number of calls to utility related to bills
- Change in number of bill payment or shutoff notices received

¹⁸ These results do not include missing or "don't know" responses. These results have been weighted according to the group strata to reflect the population proportion of participants by housing type and region.

4. Participant NEB Valuation Results for the Program...

- Change in impacts on environment
- Change in water bill costs
- Change in frequency or intensity of other illnesses.

Similar results were found for other program valuations. SERA’s NEB evaluation of four low-income weatherization programs in California found that 20% or fewer of participants noted any impact for noise, illness, notices, and shutoffs. In two NEB evaluations for low-income weatherization programs in the northeast (CT and MA) we found 20% or fewer of participants noticed any impacts in home appearance, noise, or illness.

These are useful results—both from a program design perspective, and the information it provides for understanding values from programs. The results suggest several possibilities:

- The measures and interventions provided through the WAP did not provide benefits to the respondents in these categories either because the new measures do not provide the benefits or they are not perceived to provide these benefits above and beyond what would have been provided without the program; or
- These benefits take a long time to obtain for program participants, and therefore are not obvious to them yet; or
- These benefits are difficult to observe for participants.

Regardless of which of the above explains the high “no effect” percentages reported, further work should be undertaken to establish the extent to which benefits accrue to program participants in the given categories.

In addition to the questions described above, respondents were asked to give a more detailed assessment of their perceptions of the program’s effects on several related, more general, non-energy categories. Table 4-2 summarizes their responses.

Table 4-2. Changes in Non-energy Areas—Detailed¹⁹

NEB Category (Change in...)	Much better	Somewhat better	No impact	Somewhat worse	Much worse
Ability to pay energy or other bills	13%	14%	71%	1%	0%
Pressure related to bills or debt	8%	12%	79%	1%	1%
Financial hardship	10%	10%	79%	1%	1%
Health and safety of the home	22%	14%	62%	1%	1%

The responses to the more general non-energy effects questions presented in Table 4-2 are similar to those presented previously in Table 4-1. In particular, positive effects on health and home safety were more pronounced than those related to bill-paying and finances. Across the NEB categories, respondents reported more positive effects than negative. However, for each category, the majority of those interviewed reported that they experienced no discernible effect.

¹⁹ Weighted by group.

4. Participant NEB Valuation Results for the Program...

4.2 SHARE OF VALUE BY NEB CATEGORY

The average share of the participant NEBs for each category was estimated. Table 4-3 presents a by-category breakdown of non-energy benefits shares.²⁰ To compute these shares, several steps were involved. The survey asked respondents whether there was an impact from each category, and if there was an impact, whether that impact was positive or negative (reported in Table 4-1). As a follow-up, respondents were then asked how valuable the impact was. These responses were then translated into numeric multipliers and averaged across all the respondents to derive the results in Table 4-3.

Table 4-3. NEB Shares by Category²¹

Category	Percent of Total NEBs for the Category
Home's overall comfort	16%
Ability to pay energy/other bills	8%
Quantity or quality of your lighting	7%
Noise from appliances or noise inside home	6%
Amount of noise from outside home	5%
Reliability/amount have had to maintain of new equipment	7%
Appearance of home or property value	6%
Ability to control energy bill or understanding of energy use	11%
Likelihood of moving because of energy costs	0%
Equipment performance or features	5%
Number of calls to utility related to bills	2%
Number of bill payment or shutoff notices received	3%
Impacts on environment	2%
Number of sick days lost from work/school	1%
Water bill costs	3%
Frequency or intensity of chronic conditions such as asthma	3%
Frequency or intensity of other illnesses	2%
Headaches for you or other residents	2%
Doctor or hospital visits and related costs	2%
Medication costs	0%
Safety of your home	8%
Total	100%

Among these categories, "Home's overall comfort" held the greatest share of total benefits, accounting for 16-17%, depending on the imputation scheme employed.

For comparison, Table 4-4 presents self-reports of category importance. Respondents were asked which category was the most important to them.

²⁰ The appendix provides additional detail, including the treatment of missing values.

²¹ Weighted by group. Shares calculated using relative scaling values summarized in Table 4-5.

4. Participant NEB Valuation Results for the Program...

Table 4-4. Self-reported Importance of NEB Categories²²

Category	Percent		Percent
Home's overall comfort	6%	Number of bill payment or shutoff notices received	2%
Ability to pay energy/other bills	3%	Impacts on environment	0%
Quantity or quality of your lighting	14%	Water bill costs	3%
Noise from appliances or noise inside home	4%	Frequency or intensity of chronic conditions such as asthma	6%
Amount of noise from outside home	1%	Frequency or intensity of other illnesses	1%
Appearance of home or property value	8%	Headaches for you or other residents	3%
Ability to control energy bill or understanding of energy use	22%	Doctor or hospital visits and related costs	2%
Likelihood of moving because of energy costs	2%	Safety of your home	20%
Equipment performance or features	4%		

There is a consistency between the most important categories as measured by share of total NEBs and as reported as most important. "Home's overall comfort," "Ability to pay energy/other bills," "Safety of your home" and "Quantity of quality of your lighting" all appear in the top five from each list. This level of congruence suggests that the NEBs valuation strategies effectively preserved the preferences of the participants that we interviewed for the various benefit categories listed. It also indicates a high degree of consistency on the part of the respondents throughout the survey. The questions used to determine the NEBs shares listed in Table 4-3 and the question used to establish the category importance numbers presented in Table 4-4 appear in different parts of the survey, and despite the time lag between the question sets, those that we interviewed gave corroborating answers.

Nevertheless, there are some disparities between Tables 4-3 and 4-4. It is important to remember that the shares presented in Table 4-3 are based on responses to questions about each individual category, whereas the figures in Table 4-4 derive from a question asking respondents to name the one most beneficial category—assigning 100% of the response to one category. Thus, while the results should be (and are) similar, they would not be expected to be the same.

4.3 NON-ENERGY BENEFITS DOLLAR ESTIMATES

Dollar values were computed for the total of all the participant benefits provided by the program. To estimate these values, we translated the responses on how much more valuable or less valuable participants stated the total of all NEBs were in comparison to energy savings. The average multipliers were computed (see last column of Table 4-5). These energy savings multiplier values were then multiplied times the energy bill savings (approximately \$220) to compute the value of the participant NEBs. These total dollar valuations can then be used in combination with the percentages presented in the previous section to determine the estimated dollar values for each. Table 4-5 presents average dollar estimates of total non-energy benefits.

²² Weighted by group.

4. Participant NEB Valuation Results for the Program...

Table 4-5. Dollar Estimates of Average NEBs²³

	Average Dollars/participant, annually, assuming \$220 Energy Bill Savings	Energy savings multiplier value
Overall benefit, relative verbal scaling	\$268	1.22
Overall benefit, self-reported percentages	\$344	1.56
Overall NEB value: Recommended/"Best" estimate range	\$268-\$344	1.22-1.56
Recommended overall net NEB value after NTG adjustment	\$268-\$344	1.22-1.56

The estimate of overall or total NEBs is between \$268 and \$344 per participating household per year.²⁴ The results are based on estimates from the unadjusted values from the two relative scaling approaches—verbal scaling and reported percentage.²⁵ The results are conservative and are based on a defensible measurement approach that has proved successful for other programs.²⁶

The final adjustment that may be made to this figure is to consider the net-to-gross adjustment. The figures were already based on a combination of both positive and negative impacts. Information on net-to-gross (NTG) ratios was not collected from these respondents; however, information from the literature that indicates the NTG ratio associated with low income programs around the country is approximately 1.0.²⁷ This implies an overall net NEB value, after accounting for the net-to-gross ratio, of approximately \$268-\$344 (the last row in Table 4-5).

Using this figure in combination with the percentages of value for each NEB, Table 4-6 shows the approximate dollar value of the NEBs associated with each NEB category.

²³ Weighted results.

²⁴ The appendix provides more information on the derivation of the results, but generally the results “filling in” missing data were similar to these results, which only include responses actually reported by respondents. The results from WTP/WTA methods were much larger and had a broader range than the estimates presented in the table; this is consistent with their weaker performance in other studies as well.

²⁵ Recall that verbal scaling uses the verbal responses (e.g. much more valuable than energy savings, etc.) and translates them into numeric multipliers. The second multiplier (“reported percentage”) is computed from the responses to questions about the percentage “more” or “less” valuable that NEBs are compared to energy savings. These two approaches (one based on a verbal scale and one based on a numeric scale) derived similar but not identical averages, and the two values are used as the range for the value of the energy savings multiplier.

²⁶ These multipliers were applied to the estimated total annual bill savings per participant of \$220.17 provided by PA Consulting.

²⁷ Using a low-income program Net-To-Gross ratio of 1.0. See Skumatz, Lisa, and John Gardner, “Techniques for Getting the Most from an Evaluation: Review of Methods and Results for Attributing Progress, Non-energy Benefits, Net to Gross, And Cost-Benefit.” ECEEE Summer Study Conference May 2005, Mandilieu, France.

4. Participant NEB Valuation Results for the Program...

Table 4-6. Estimated NEB Dollar Value by Category²⁸

Benefit category	Share of total benefits	Approximate dollar value using \$268-\$344 total NEB value per year ²⁹
Home's overall comfort	16%	\$44-\$56
Ability to pay energy/other bills	8%	\$22-\$29
Quantity or quality of your lighting	7%	\$19-\$25
Noise from appliances or noise inside home	6%	\$15-\$20
Amount of noise from outside home	5%	\$13-\$17
Reliability/amount have had to maintain of new equipment	7%	\$19-\$24
Appearance of home or property value	6%	\$17-\$22
Ability to control energy bill or understanding of energy use	11%	\$28-\$36
Likelihood of moving because of energy costs	0%	\$1
Equipment performance or features	5%	\$14-\$18
Number of calls to utility related to bills	2%	\$6-\$8
Number of bill payment or shutoff notices received	3%	\$9-\$12
Impacts on environment	2%	\$4-\$6
Number of sick days lost from work/school	1%	\$4-\$5
Water bill costs	3%	\$8-\$10
Frequency or intensity of chronic conditions such as asthma	3%	\$9-\$12
Frequency or intensity of other illnesses	2%	\$5-\$6
Headaches for you or other residents	2%	\$5-\$6
Doctor or hospital visits and related costs	2%	\$4-\$5
Medication costs	0%	\$1
Safety of your home	8%	\$20-\$26
Total Participant NEBs	100%	\$268-\$344

4.4 PARTICIPANT WATER BILL SAVINGS

Participants receive one additional benefit from the program—reductions in water bills due to the installation of low flow showerheads and faucet aerators. Although these measures were installed to reduce water heating bills, they also reduce the amount of water used, which reduces household water bills.

Almost half the homes received low faucet aerators (47%) and about one-third received low flow showerheads (37%). The estimated water savings from these reductions is about 2,140 per year, or 2.9 hundred cubic feet (ccf)³⁰ per average participating household per year. Multiplied by the water rate of about \$1.71 per ccf,³¹ we estimate an average savings per household per year of approximately \$4.89 per year.

²⁸ Weighted by group.

²⁹ Based on \$220 in total energy bill savings times overall participant NEB multiplier 1.2 – 1.56.

³⁰ Computation of average gallon savings from SERA research from the Water conservation literature and “Water Plan” model.

³¹ SERA survey of 10 indicator communities in the state.

4.5 SUMMARY OF PARTICIPANT NEB RESULTS

This investigation into the NEBs associated with the Weatherization Program demonstrates that there are substantial and positive effects associated with participation in the program beyond energy savings. The estimated participant NEB total value is \$273-349 per household per year—based on estimates from participant perceptions of value. The estimate was derived using a detailed survey methodology that has proven effective and consistent in similar previous studies of NEB values. Refer to Chapter 6 for more discussion relating to Wisconsin’s WAP results compared to NEBS valuations derived for other low-income programs.

Of the categories of non-energy benefits about which respondents were asked, home comfort, ability to control/understand energy bills, ability to pay energy bills, home safety, quantity and quality of light and equipment maintenance were the most important in terms of the relative share of total NEBs for which those categories accounted. Together, they comprised over half (roughly 56%) of all the participant perspective NEBs.

5. SOCIETAL AND UTILITY NEB RESULTS

5.1 INTRODUCTION

Using data on the Low Income WAP in conjunction with empirical data adapted from scores of studies, articles and research on energy efficiency, weatherization, health and safety and other programs, values were estimated of the non-participant NEBs of the Weatherization Program.

Non-energy benefits can arise in myriad categories. The analysis of the weatherization program indicated that net-positive benefits arose due to changes in the following areas:

Utility Benefits:

- Lower carrying costs on arrearages
- Fewer shutoffs and reconnections
- Fewer notices
- Fewer customer calls
- Transmission and/or distribution savings (distribution only)

Societal/Public Benefits:

- Emissions / Environmental
- Economic Benefits
 - Direct and indirect multipliers related to sales,
 - Gross state product,
 - Personal Income,
 - Job creation benefits (full-time job years).

It is important to note that NEBs from certain categories accrue to multiple beneficiaries. For example, both participants and utilities experienced a positive benefit associated with fewer customer calls to the utility. These NEBs should be counted in each place that they occur, because all of their recipients benefit separately (e.g., both the utility and the customer benefit from the time and cost savings associated with fewer customer-to-utility phone calls). Then various subsets of the benefits can be applied to different applications of the benefits. For instance, total resource tests may only be concerned with societal benefits, and measurement of progress toward hardship goals for programs may be mostly concerned with participant benefits.

5.2 COMPUTING THE UTILITY AND SOCIETAL NEBS

The estimates of utility and societal NEBs were derived using SERA's "NEB-It" model. The model uses a combination of program-specific information and secondary sources to compute impacts from programs. The approach used in the computations of most of the NEBs is to identify a starting value for a factor (e.g. average dollars of arrears) and multiply by the expected change due to the program, and assign appropriate valuation factors. In the case of

5. Societal and Utility NEB Results...

arrears, the utility perspective computation would involve dollars of arrears times the expected percentage reduction due to the program (either based on program estimates or estimates from the literature for “similar” programs). Then, to compute the cost to the utility, the relevant interest rate is applied to identify the savings in utility carrying cost for the arrears, which represents the utility NEB for arrears. SERA’s model uses these types of computations to derive NEB estimates for an array of factors.

Note that we do not estimate every possible or theorized benefit that has been mentioned by researchers. We take a conservative approach, and we have included only those benefits for which key information was available for this specific program and/or benefit categories for which there is ample information from the literature on similar programs. Program-specific information was provided on: the number of participants, participant energy savings, relevant energy rates, Wisconsin’s energy generation mix, the costs of the program, the measures installed through the program, the number of notices given by the utility, and the number of calls made by customers to the utility. Additional information on the computation methods is provided in the Appendix.

5.3 ESTIMATED NEBS

5.3.1 Utility Impacts

Table 5-1 provides the estimates of utility and societal NEBs resulting from the WAP.

Table 5-1. Utility NEBs

Non-energy Benefit Category	Annual NEB per participant per year estimated by model
<i>Utility benefits</i>	
Lower carrying costs on arrears	\$1.37
Fewer shutoffs and reconnections	\$0.13
Fewer notices	\$0.30
Fewer customer calls	\$0.43
Transmission and/or distribution savings (distribution only)	\$2.59
Total	\$4.82

Very few categories of utility benefits were estimated. For example, no estimates of the values of gas emergency calls were estimated because this was not a focus of the program. In addition, no estimates for the benefits from lower utility subsidies for low-income customers were estimated.³² Instead, we focused on the following categories of benefits:

- Lower carrying costs on arrears³³
- Fewer shutoffs and reconnects
- Fewer notices

³² A data request on this topic yielded no subsidy level, and a perusal of utility websites indicates these rates are not generally available or widely advertised.

³³ Derivations of the estimates are presented in the Attachment, Section A.6.

5. Societal and Utility NEB Results...

- Fewer customer calls
- Transmission and/or distribution savings (distribution only).

In terms of additional annual benefits for each participant, this subset of utility-related NEBs were estimated to be worth \$4.82.

5.3.2 Economic Impacts

Public benefits spending on these low-income programs results in a number of impacts on the economy: the creation of new jobs, increases in Wisconsin business sales, increases in Wisconsin's gross regional product (GRP), and an increase in household income.

Using an input-output model to approximate the transfers of funds associated Wisconsin's Low-income Weatherization Assistance Program, the multipliers associated with economic output, labor income and employment were estimated to be 1.057, 0.577, and 0.000023, respectively.³⁴ These multipliers were applied to the estimated \$4,837 in spending per-participant³⁵ as a result of the weatherization program to estimate program lifetime total benefits (average spending value as of May 2, 2003, economic reporting). However, because benefits persist beyond the year of the initial spending on each participant, they have been divided by an estimated 15 year program length in order to obtain per-participant, per-year economic NEBs.

Table 5-2. Economics Benefits³⁶

Category	Benefit per participant per year
Output (\$)	\$341
Labor income (\$)	\$187
Employment (jobs)	.11

5.3.3 Environmental Impacts

One key environmental benefit of Low-income Public Benefits programs is the reduction of emissions from burning coal and natural gas at power plants and the reduction of emissions from the burning of natural gas by utility customers. Sulfur oxides (SO_x), nitrogen oxides (NO_x), mercury (Hg), and carbon dioxide (CO₂) are the emissions of greatest concern due to their negative impact on health, natural resources, and capital investments.

The pounds of emissions reduced due to the WAP programs were estimated by PA Consulting. PA Consulting evaluators estimated emission factors or rates for the electric generating plants serving Wisconsin (Table 5-3)ⁱ and used these data to estimate emissions

³⁴ Sherman, Mike, Lisa Petraglia, and Glen Weisbrod, (Economic Development Research Group Inc.), *State of Wisconsin Department of Administration Division of Energy, Low-income Public Benefits Evaluation, Economic Development Benefits, Final Report*. May 2, 2003.

³⁵ Expenditure based on year of analysis, FFY03. While this value is lower than the current expenditures, we use it to remain consistent with the economic reporting.

³⁶ * Based on program operations data for state fiscal year ending June 30, 2004, for WAP and federal fiscal year ending September 30, 2004, for WHEAP covering 10 years of program operations.

5. Societal and Utility NEB Results...

reductions or savings associated with the Low-income Programs (Table 5-4). The estimated generation emissions rates shown in Table 5-3 were derived using hourly measured emissions data from EPA data, and the values were incorporated into a model developed by the evaluation team to estimate emissions rates for NO_x, SO_x, CO₂, and mercury for the power plants supplying Wisconsin. Emissions factors from reduced use of natural gas at the customer site (the "On-site Therms" column in Table 5-3) were also taken from EPA data. There are also very small amounts of NO_x and SO_x in natural gas but they are not large enough to significantly affect the emissions numbers.

Table 5-3. Emissions³⁷

Emissions	Generation Lbs/MWh	On-site Therms Lbs/Therm
NO _x	5.7	
SO _x	12.2	
Mercury (Lbs/GWh)	0.0489	
CO ₂	2,216	11.76

Table 5-4 shows the pounds of these emissions that will be avoided annually due to the energy efficiency improvements installed through the WAP Low-income Public Benefits programs. Using the marginal cost emission rates and evaluation-verified net installed electricity savings estimates, the Low-income Programs together potentially avoided 200,639 pounds of NO_x; 306,306 pounds of SO_x; over 133 million pounds of CO₂; and over 1.2 pounds of mercury from inception to December 31, 2004 (Table 5-4). We then used values from the literature to estimate the dollar value of these avoided emissions. The results are shown in Table 5-4.

³⁷ Sources: Generation factors from *Estimating Seasonal and Peak Environmental Emissions Factors*. Jeff Erickson with Carmen Best, David Sumi, Bryan Ward, Bryan Zent, and Karl Hausker; PA Government Services Inc. Report for the Wisconsin Department of Administration, Division of Energy. Focus on Energy statewide evaluation. May 2004. Therm factors from EPA data (EPA's *E-Grid 2000 database* with data for the MAIN and MAPP NERC regions from 1998).

5. Societal and Utility NEB Results...

Table 5-4. Annual Reduction in Emissions³⁸

Program Area	Emissions Reductions (Pounds)			
	Nitrogen Oxides (NOx)	Sulfur Oxides (SOx)	Carbon Dioxide (CO ₂)	Mercury (Hg)
Total Reduction	200,639	306,306	133,301,133	1.226
WAP	200,639	306,306	123,418,311	1.226
Value per lb	1.73	1.20	.0163	N/A
\$/pound of emission ³⁹	\$15.43	\$16.34	\$96.58	N/A
Total per participant	\$128.35			

³⁸ Source: Focus evaluation team tracking research, 2001–2005. Emission reductions are calculated using the marginal cost emission rates. Wisconsin’s investor-owned utilities are included in the federal SO₂ regulatory structure of the Clean Air Act (acid rain provisions). In this cap-and-trade system SO₂ emissions cannot be considered reduced or avoided unless EPA lowers the SO₂ cap.

³⁹ Dollars per pound of emissions computed by SERA as 2/3 of the average value from 15 literature sources on emission values used for regulatory and other purposes. These values are included in SERA’s NEB-It model.

6. COMPARISONS TO NEBS FROM OTHER LOW INCOME PROGRAMS

We compared the results with NEB results from a number of other low-income weatherization programs. Some of the comparison programs were in California (Venture Partner’s Pilot Program, and full scale low income weatherization programs run by the 4 IOUs) and two programs in New England (Northeast Utility’s programs in Connecticut and Massachusetts). Most of these evaluations were conducted over the last 4 years; the VPP program evaluation was conducted earlier.

The NEBs being compared vary not only on the underlying differences in values assigned to the concepts by the actors receiving the benefits (which can relate to many things including the measures included / program design), but the values also vary based on factors including:

- Which NEBs the client wanted included / excluded,
- Which were relevant to the particular program or utility (e.g. rate subsidies were not relevant in some cases), and
- Refinements in estimation methodologies.

Table 6-1 shows the value of NEBs by perspective for these programs. They are provided in terms of multiples of energy bill savings (including all fuels, where relevant). All are low-income weatherization-type programs. The table illustrates and compares NEB multiplier values, and also provides notes discussing sources of differences in the results.

Table 6-1. Overall NEB results by Perspective—Multiple of Average Bill Savings⁴⁰

	California ⁴¹	PG&E VPP	NU-CT	NU-MA	Wisc
Utility Perspective Multiplier as a share of Average bill savings	53%	40%	5%	37%	2%
Utility Perspective Comparability Notes – Large and omitted components	Largest NEBs were rate subsidy value and arrearage carrying costs	Largest NEBs were avoided rate subsidy, gas emergency, and arrearage / bad debt	Largest were arrearage / bad debt and T&D	Largest were arrearage / bad debt and T&D	Bad debt and rate subsidies not included.

⁴⁰ The NEB analyses for these programs were conducted by SERA.

⁴¹ Note there were some variations between programs for the four California IOUs, but this composite is selected for illustration purposes; results for each program were similar.

6. Comparisons to NEBs from Other Low Income Programs...

	California ⁴¹	PG&E VPP	NU-CT	NU-MA	Wisc
Societal Perspective Multiplier as a share of Average bill savings	326%	251%	5%	11%	220%
Societal Perspective Comparability Notes	Very large multipliers for enviro & economic / later refined	Very large multipliers for enviro & economic / later refined	Only included very conservative emissions multiplier	Only included very conservative emissions multiplier	Emissions multiplier of 0.58; economic multiplier ⁴² about 1.61
Participant Perspective Multiplier as a share of Average bill savings	235%	307%	16%	13%	124-159%
Participant Perspective Comparability Notes	Included high water savings and property repair benefits	Included high water savings and property repair benefits	Included high water bill savings, but few to no comfort, etc. benefits	Included high water bill savings, but few to no comfort, etc. benefits	Included comfort and other benefits; highest were comfort, ability to pay bills; relatively low water savings compared to CA.
Total NEBs -- Multiplier as a share of Average bill savings	614%	307%	26%	61%	340-380%
Program Average Energy Bill Savings	\$22.02	\$84.82	\$116.45	\$83.82	\$220.17
Overall Comparability Notes	Large multipliers driven by large societal benefits (non-net) and large water benefits	Large multipliers driven by large societal benefits (non-net) and large water benefits.	Very conservative results / many categories excluded for regulatory review	Very conservative results / many categories excluded for regulatory review	High societal benefits (220%) is the main component of this multiplier value. Overall, not dramatically different from California results that include many of the same categories.

The results show that if the full value of the estimated economic⁴³ and environmental benefits⁴⁴ is included in the Wisconsin values, the results are fairly similar to the work

⁴² The methodology used for estimating economic benefits is improved over the earlier studies. Wisconsin values only include the GRP value; the economic value due to labor income is not mutually exclusive of the GRP. The earlier California studies were based on faulty literature that neglected to “net” out the initial expenditures.

⁴³ As estimated by PA Consulting

6. Comparisons to NEBs from Other Low Income Programs...

conducted for the California utilities. These are appropriate comparisons, given that the values for those programs include similar bundles of NEBs to the Wisconsin program.

There was a focus on participant benefits in this study. We compared the results for the share of benefits for the Wisconsin WAP to the results for the composite California program. The results are presented in Table 6-2.

Table 6-2. Participant Benefits as Multiples of Energy Bill Savings

NEB Category	California Programs ⁴⁵	Wisconsin ⁴⁶
Water Savings	8%	3%
Shutoffs / Reconnects	11%	3%
Calls to utility	0%	2%
Property value / Aesthetics	17%	15%
Fires, IAQ and other safety issues	0%	1%
Moving costs	10%	0%
Illnesses	9%	10%
Notices	9%	n/a
Comfort	17%	16%
Maintenance	Not asked	7%
Noise	7%	11%
Environment	0%	2%
Knowledge / ability to pay bill	12%	19%
Features / options	7%	5%
Lighting quality/quantity	Not asked	11%
Other	-7%	5%
Total	100%	100%

Although some categories of effects were not included in both surveys, the results show similar “orders of magnitude” for participant benefits. The most important benefits recognized by participants:

- Improved comfort, from fewer drafts and better ability to control temperatures (about 16-17% of the participant NEBs);
- Improved property values, from repairs to the home, improved “look” and value of changes in equipment and appliances (15-17%);
- Better knowledge of what affects energy use and resulting improvements in control over the bill (12-19%);

⁴⁴ Pounds of emissions estimated by PA Consulting; values assigned by SERA based on 2/3 of the average from 15 sources in the literature. The emissions values from PA were larger than those estimated using much less sophisticated methods by SERA, and the values consequently increased approximately ten-fold.

⁴⁵ Some rounding and reclassifications to facilitate comparisons.

⁴⁶ Some rounding and reclassifications to facilitate comparisons.

6. Comparisons to NEBs from Other Low Income Programs...

- Lower noise from the new equipment and better insulation from noise outside (7-11%);
- Fewer illnesses and resultant lost days from work or school (9-10%).

Both programs found the valuation of benefits from the ability to undertake activities that would help the environment to be fairly low, as well as benefits from improved safety.

There were some differences resulting from either exclusions of some benefits from later analysis, or differences in valuations of benefit categories. Differences include benefits from avoided moves. The California work depended partly on some studies that ascribed fairly high percentages of moves to high energy bills; the Wisconsin work asked for a self-assessment of this benefit and the values came out fairly low. There were differences in the importance of bill-payment issues including notices and calls to the utility. The California utility customers ascribed 9% of the participant benefits to fewer notices, but these bill-related benefits were only about 2% for the Wisconsin program. We are not certain whether there are different procedures for “notices and calls” for bill collection between the utilities in California and Wisconsin. Maintenance was not asked in the California study; however, if compared with “features and options” of the equipment, we find relatively comparable results (7%-12%). Information on the quality and quantity of lighting was not asked in the California work.

All in all, we find that the Wisconsin work represents an improvement in the methods, results, and reliability for NEB analysis. The work shows that improved methods for assessing the “net” NEBs for environmental and economic impacts, which have reduced the volatility and size of these effects. The reduced emphasis on utility benefits for the Wisconsin work makes the results somewhat non-comparable. The participant benefits find some variations based on program and area; California has high water bills, increasing the share of benefits attributed to this program-related impact. However, there is consistency regarding the highest-valued participant benefits, which include:

- Comfort
- Property value improvements
- Control over bills
- Fewer illnesses, and
- Better noise insulation.

Many of these benefits reflect categories that are commonly a focus or goals of low income programs—especially the reductions in hardship represented by control over bills and improved property value, and improvements in quality of life including improved comfort (and noise) and fewer illnesses. Examining the Wisconsin results relative to NEBs from other programs, we find NEB results that are comparable, and we find that estimates and methods have improved over past work estimating NEBs.

7. SUMMARY AND CONCLUSIONS

The research developed estimates of an array of NEBs for the WAP. The “net” benefits attributable to the program were estimated using valuations derived from participant surveys and from computations of net impacts using program data and impacts from the literature and the program. The results for all the various NEB categories estimated are presented in Table 7-1.

Table 7-1. NEBs Summary

Non-energy Benefit Category	Estimated Annual NEBs per Participant per Year
<i>Utility Benefits Subtotal</i>	\$4.82
Lower carrying cost on arrearages	\$1.37
Fewer shutoffs and reconnections	\$0.13
Fewer notices	\$0.30
Fewer customer calls	\$0.43
Transmission and/or distribution savings (distribution only)	\$2.59
<i>Societal Benefits</i>	
Economic NEBS: GRP ⁴⁷	\$340.94
Economic NEBS: Labor income	\$186.09
Environmental / emissions ⁴⁸	\$128.35
<i>Participant Benefits Subtotal</i>	\$272-348
Water / sewer bill savings	\$4.89
Customer-valued participant benefits (see next table)	\$268-344

The results imply that the WAP provides non-energy benefits—to participants, to the utility, and to society. The results show that the program provides benefits far beyond the value of the energy saved (which is valued at about \$220/year).

These results have several uses:

- **Financial applications:** The results or subsets of the results may be useful in augmenting benefit cost analysis for the program, or integrated into regulatory tests related to the WAP.
- **Program outreach:** The results provide information on benefits provided by the program that may be particularly valuable to and appealing to potential program participants. The program may find it beneficial to incorporate some of these benefits into outreach materials on the program.
- **Progress toward program goals:** The WAP has goals—stated and unstated—that go well beyond energy savings or direct bill savings to residents. The program aims to

⁴⁷ Economic benefits estimated on a per household per year basis, based on FY2002 data (the most current economic NEBS estimation available for Wisconsin Focus on Energy). Total benefits per household are \$4,837/participant and 0.11 jobs. The values in Table 1-1 assume that the program costs are a one-time up-front investment, and last 15 years.

⁴⁸ The largest component of the high estimate is Carbon dioxide, valued at \$96.

7. Summary and Conclusions...

reduce hardship to participating households. The array of participant benefits makes it clear that participants are realizing these kinds of benefits and recognize they are coming from the program. Residents recognize increased quality of the home environment (increased comfort, appearance, noise, appliance features, lighting), reductions in equipment-related problems (maintenance), financial savings and benefits (reduced water bills, increased housing value), quality of life (reduced illness and related costs, improved safety), and other hardship related improvements (improved ability to control and pay bills, lower likelihood of moving, etc.), and ability to “do good” outside themselves (environment).

NEBs are important but often unrecognized/omitted effects from low-income energy efficiency program efforts and evaluations. While somewhat complicated to measure⁴⁹, the results provide useful information to guide program planning, implementation, and outreach.

⁴⁹ but in many ways, less complex than full-blown impact evaluations!

APPENDIX A: NON-ENERGY BENEFITS APPROACH

A.1 NEBS SHARES FORMULA

The computation of the “share” of the NEB values for each category is computed from the survey results. The proportion of total NEBs comprised of NEBs category j is computed as:

$$SHARE_j = \frac{\sum_i (P_{ji} + N_{ji})W_i}{\sum_j \left[\sum_i (P_{ji} + N_{ji})W_i \right]}$$

where

P_{ji} = the positive benefit reported for category j by respondent i

N_{ji} = the negative benefit reported for category j by respondent i (notice that either P or N must be equal to zero)

W_i = the group weight for respondent i .

A.2 NEBS DOLLAR VALUE FORMULA

When obtained through a scaling technique (either relative or direct comparison), NEBs dollar values are computed through the following formula:

$$VALUE_{ji} = M_{ji} E_i$$

where

M_{ji} = either 1) the relative scaling multiplier or 2) the self-reported percentage-of-energy-savings multiplier, depending on the question type for the i th individual in the j th NEB category

E_i = the energy savings estimate for the i th individual.

Energy savings can be self-reported, average, deemed, or estimated from another source. Average NEBs dollar values are simply computed as the mean (weighted, if desired) of $VALUE_{ij}$.

A.3 DEFINING/REFINING THE IMPACT TO BE MEASURED

Prior to examining the results from the valuations, it is important to assure that the estimates represent those values that could be considered “attributable” to the program. Three key issues are important in deriving that “net” valuation.⁵⁰

- The results must be “net” in the sense that they allow for both positive and negative impacts from the program. In this work, both positive and negative impacts are explicitly requested—for each individual NEB and for the total of all NEBs—there is no presumption of a positive effect. The results are the combination of positive and negative valuations.
- The results must be “net” of the benefits that might have been installed without the program. The respondents are asked to specify the net non-energy benefits from the energy efficient equipment installed through the program. However, in this program it was determined that residents were unlikely to replace the equipment over the near or medium term. For that reason, we did not need to make that clarification; instead, in this case, residents were free to identify the benefits beyond the service obtained from their current equipment.
- Finally, when valuing non-energy benefits, it is important to consider the effects of free ridership and spillover. Free ridership occurs when those who would have installed the measure(s) anyway participate in the program. Because the benefits that accrue to these participants would have accrued whether or not they participated in the program, their NEBs cannot be attributed to the program, and should be deducted from total NEB estimates. Spillover, in contrast, occurs when non-participants install measures similar to those installed by the program as a result of their observations of others’ experiences with the programs, or otherwise because of indirect contact with the program. Because these non-participants would not have accrued the NEBs that they did in the program’s absence, their benefits should be added to the total level of benefits attributable to the program. Net-to-gross ratios (the free ridership rate minus the spillover rate) for low-income programs tend to be between .9 and 1.0, with a number clustered around 1.0.⁵¹

The approach used to measure and value NEBs in this analysis accounted for all these factors, and are, to the best research ability, net of these factors and therefore, the best estimate of impacts attributable to the program.

A.4 QUANTIFICATION METHODS USED FOR SURVEY-DERIVED PARTICIPANT NEBS

A number of methods have been proposed for estimating the value of NEBs. In our research, we usually attempt to incorporate at least two methods to provide a “check” or confirmation of the results from any one method. In this case, we were able to incorporate three valuation methods to estimate values for participant NEBs:

⁵⁰ Skumatz, Lisa A. and John Gardner. Methods and Results for Measuring Non-energy Benefits in the Commercial / Industrial Sector. ACEEE 2005 Summer Study Proceedings (Forthcoming).

⁵¹ Skumatz, Gardner and Bicknell. 2005. Techniques for Getting the Most from an Evaluation: Review of Methods and Results for Attributing Progress, Non-energy Benefits, Net to Gross, And Cost-Benefit. Draft Paper ECEEE Conference May 2005.

A: Non-energy Benefits Approach...

- **Relative Comparison Value.** Respondents were asked about the value of the benefits relative to possible energy savings using a five-point scale (much less valuable, somewhat less valuable, same value, somewhat more valuable, and much more valuable).⁵² The relative values were then scaled to percentage-of-energy-savings values obtained from other empirical research and academic scaling literature. Because these questions are more quickly answered than percentage responses—and because time on the surveys was limited—this was the approach used for valuing individual NEB categories as well as the overall totals.
- **Direct Comparison Value.** This approach is similar to the relative approach described above. We asked respondents to provide an assessment of the overall (across all subcategories) NEBs that they accrued in terms of their possible energy savings. However, we also asked respondents to report their response as a percentage of the possible energy savings that they experienced.
- **Willingness To Pay/Willingness To Accept (WTP/WTA).** This method requires respondents to estimate the dollars they might be willing to pay to gain specific program benefits (for example for the added comfort or other benefits associated with the program measure). As a follow up question, respondents were asked how about the monetary compensation that would be required in exchange for giving up the benefits that they may have experienced. In this survey, we only used the WTP/WTA approach to ask about the total of the non-energy benefits list associated with the program.⁵³

Relative Comparison Values

In addition to asking program participants whether they noticed positive, negative or no effects in a variety of non-energy categories, we also asked them to qualify the levels of those effects. Respondents that reported a positive effect, for example, on equipment performance as a result of the program, were asked whether that effect was much more valuable, more valuable, as valuable, less valuable or much less valuable than the energy savings that they received. If respondents reported a negative effect, they were asked how *costly* the effect was relative to their energy savings. The final relative comparison non energy-benefit values were obtained using program energy savings.

Direct Comparison Values

Following detailed and categorized questions about non-energy categories, respondents were asked a battery of questions concerning their experience with the program as a whole. They were asked to rate, in terms of the relative comparison values described above, the value of the net negative and positive non-energy effects.

Respondents were then asked to estimate the value (or cost) of the total of the NEBs that they accrued as a percentage of their possible energy savings. Using program energy savings values, these percentage values were scaled to NEB dollar estimates. In addition,

⁵² For items with negative value (e.g., non-energy costs) the respondents are asked if the non-energy effects are much more costly, somewhat more costly, same value/cost, somewhat less costly, or much less costly than the energy bill savings. The total benefit for each respondent was then calculated as the sum of benefits, minus the sum of costs.

⁵³ The question phrasing was simpler. See the Appendix to view a copy of the survey instrument.

A: Non-energy Benefits Approach...

relative comparison value dollar estimates were also created using the scaling methodology outlined in the previous section.

Willingness to Pay/Willingness to Accept

Two survey question sets were used in an attempt to directly elicit program participants' willingness to pay/accept for the NEBs that they experienced.

First, respondents were asked to estimate how much they would be willing to pay in order to buy the benefits back if they were taken away. Respondents were also asked how much they would be willing to accept as compensation (per month) in exchange for having the NEBs that they experienced taken away.⁵⁴

The use of open-ended contingent valuation questions in establishing willingness to pay/willingness to accept values, though widely used, is prone to upward biases in its estimates of nonmarket goods. In an attempt to compensate for this effect, we also asked a series of discrete contingent valuation questions.

The primary cause of potential biases in open-ended willingness to pay/willingness to accept questions is interviewees making up their values *ad hoc* in response to the question. Discrete WTP/WTA questions seek to avoid these biases by presenting respondents with a series of values, asking whether they would be willing to pay specified amounts.

Finally, respondents were asked whether the NEBs that they experienced were worth less than, more than or about the same as a series of pre-determined values. If they reported that the NEBs that they received were worth more than the highest value, they were asked an open-ended question about the estimated monthly value of the effects that they noticed.

A.5 CONFIRMING RESULTS USING MULTIPLE MEASUREMENT METHODS

To provide additional confirmation of the results, we estimated the total NEBs using a variety of measurement methods, and using alternatives for imputation of missing data. The results of these computations show that the NEBs from the comparison methods we computed and used in the report are appropriate for use, and are more conservative and less volatile than the WTP/WTA approaches.

Table A-1 presents average dollar estimates of total non-energy benefits according to the different measurement schemes described above. There are obvious variations in the overall NEBs estimates according to the question format.

⁵⁴ The first type of question is a willingness to *pay* (WTP) question, the latter a willingness to *accept* WTA question.

Table A-1. Dollar Estimates of Average NEBs⁵⁵

	Number of responses	Average Dollars per participant home/yr	Energy Savings Multiplier Value ⁵⁶
Overall benefit, relative scaling	149	\$268	1.22
Overall benefits, self-reported percentages (missing values replaced with series average)	362	\$344	1.56
Willing to accept monthly in exchange for giving up NEBs (monthly)	43	\$7,704	
Willing to pay annually to get NEBs back (annually)	113	\$1,115 (\$93/mo)	
Discrete willingness to pay (monthly)	190	\$928/year	
Discrete willingness to pay (asked monthly, top-coded at \$10/mo)	190	\$82/year	
Willingness to pay (from discrete set) if greater than \$10 (monthly)	40	\$371/month, >\$3K/year	
Overall NEB Value– Recommended/“Best” estimate range		\$268-344	1.22-1.56
Recommended Overall Net NEB Value after NTG adjustment (NTG=1.0)		\$268-344	1.22-1.56

Overall, the relative and direct comparison value techniques yielded NEBs estimates on the order of \$270-340 annually.

- The average value from the relative comparison value question was \$268.
- The direct comparison value question, in which respondents were asked to value the non-energy benefits that they experienced and specifically associate a percentage value to that value, gave higher estimates: \$344.⁵⁷

The results using willingness to pay, willingness to accept, and other contingent valuation approaches were higher than the values using comparison methods. These approaches generally yielded values in the hundreds of dollars, and in some cases more than \$1,000 annually.

- The question format that yielded the highest average answer was the open-ended willingness to accept (monthly) question, with an average of \$642 per month. This question suffers from two potential biases—it is open ended, which as discussed

⁵⁵ Weighted by group.

⁵⁶ The multipliers were computed and applied to the program-measured kWh savings of 806/year, which equates to a bill savings of about \$68/year. As a “check,” participants were asked for their own estimate of their annual bill savings per year. Their perceptions were in considerable error, as they estimated savings about 6 times larger than real savings. In our previous research we have rarely identified such a large disparity between perceived and “real” energy savings. DAS notes that there was a rate change around the same time as the program implementation, and that may have served to confuse residents about the value of their energy savings. In any case, one of the benefits of the comparison method is that residents do not need to think in dollars (note the problems with the WTP and WTA figures in the discussion below).

⁵⁷ Note that, since many respondents failed to supply a percentage estimate, we replaced missing observations with the series mean from the relative scaling technique.

A: Non-energy Benefits Approach...

above tends to bias WTP and WTA values upwards, and it is a willingness to *accept* question.⁵⁸

- The open ended, annual willingness to pay (to get benefits back) question returned a more reasonable \$1,116 per year, or \$93 per month.
- The top-coded discrete contingent valuation question, for which the maximum value was \$10, generated an average value of \$7. As noted above, this is a very restrictive coding scheme; it practically omits the 40 respondents that reported a value greater than \$10 (the average of their open-ended values was \$371).
- Without the top-coding restriction, the average NEBs value was \$77, between the values obtained using the relative and direct comparison value techniques.

SERA has conducted scores of studies of NEBs, and we have found similar patterns in the results for other programs. Generally, we have found the results for WTP/WTA questions are consistently higher and more volatile (larger range and variance) than results using comparison valuation methods. We identified several problems inherent in the WTP/WTA approaches:⁵⁹

- Previous studies showed considerable problems when customers tried to answer the WTP questions. Respondents repeatedly asked whether they would be required to pay these benefits, or wondered over what time period they would be expected to pay. We found that this concept was extremely difficult for the participants in these low-income weatherization programs to understand and answer confidently.
- There was considerable hesitation prior to providing a response. The concept is complex; however, hesitation implies they are not certain of the response, and they are essentially making up an answer.⁶⁰
- In addition, in this project we found a large range for the results. Respondents have a more difficult time answering the question without a clear “link” or “leverage point,” which the comparative approaches provide.

For these and other reasons, the results cited for the program are based on results from the unadjusted values from the two relative scaling approaches—verbal scaling and reported percentage. This is our recommended range for total NEB value for the program. The results are conservative. They are in line with the “percentage” scoring approach, they are based on the largest number of respondents, and they are based on a measurement approach that has proved successful for other programs. The recommended range for “total” annual NEB impact per participating customer is presented as \$268-334 annually per participating household.

⁵⁸ WTA is often found to be exceed WTP by an order of magnitude. See Horowitz, John K. and K. E. McConnell. Willingness to Accept, Willingness to Pay and the Income Effect. 2002. <www.handels.gu.se/econ/EEU/wta-wtp%20income%20effect-October%202002.doc>

⁵⁹ Skumatz, Lisa, Chris Ann Dickerson, and Brian Coates. Non-energy Benefits in the Residential and Non-Residential Sectors -- Innovative Measurements And Results For Participant Benefits. ACEEE 2000 Summer Study Proceedings.

⁶⁰ Even when the concepts are well understood, WTP / WTA responses are subject to “gaming”.

A.6 COMPUTING THE UTILITY AND SOCIETAL NEBS

As mentioned in the body of the report, the estimates of utility and societal NEBs were derived using SERA's "NEB-It" model. The model uses a combination of program-specific information and secondary sources to compute impacts from programs. The approach used in the computations of most of the NEBs is to identify a starting value for a factor (e.g. average dollars of arrearages) and multiply by the expected change due to the program, and assign appropriate valuation factors. In the case of arrearages, the utility perspective computation would involve dollars of arrearages times the expected percentage reduction due to the program (either based on program estimates or estimates from the literature for "similar" programs). Then, to compute the cost to the utility, the relevant interest rate is applied to identify the savings in utility carrying cost for the arrearages, which represents the utility NEB for arrearages. SERA's model uses these types of computations to derive NEB estimates for an array of factors.

Note that we do not estimate every possible or theorized benefit that has been mentioned by researchers. We take a conservative approach, and we have included only those benefits for which key information was available for this specific program and/or benefit categories for which there is ample information from the literature on similar programs. Program-specific information was provided on: the number of participants, participant energy savings, relevant energy rates, Wisconsin's energy generation mix, the costs of the program, the measures installed through the program, the number of notices given by the utility, and the number of calls made by customers to the utility.

Utility Benefits

- **Arrearages:** We used a proxy for the average arrearage value and multiplied times the reduction due to the program, multiplied by an estimated utility interest rate.⁶¹
- **Fewer shutoffs and reconnections.** The value to the utility of fewer shutoffs as a result of the weatherization program was estimated using the average number of shutoffs per low-income customer per year and estimates of the program-induced reduction in shutoffs per year. The benefit was valued at the marginal cost to the utility of a shutoff.⁶²
- **Fewer notices.** The value to the utility of having to give out fewer notices was estimated using data on the average number of notices per customer and estimates of the program-

⁶¹ Although we received no Wisconsin-based information for this computation, we used an average arrearage value of about \$60 from other low income programs we evaluated. We assumed that the program was not specifically targeted at high arrearage customers and thus assumed an average reduction in arrearages of about 28% from program participation. This is an average figure from SERA's literature on arrearage reductions from programs; and we assumed the utility's discount rate was 8.1%. This led to an estimate of about \$1.37 per year in reduced costs attributable to carrying costs on arrearages.

⁶² Although Wisconsin information was not available, SERA used averages from our other projects on low income weatherization programs around the country. We assumed the utility's marginal cost for a shutoff was \$20 (and there was a reconnection fee of \$10, offsetting about half of the utility's marginal reconnection cost). We assumed there were about 0.20 shutoffs per low income customer per year, and most (0.18) reconnected rather than moved, etc. A conservative, but typical reduction in shutoffs due to similar program participation (from the literature) is about 23%, resulting in a combined value of reduced shutoffs and reconnections of about \$0.13.

A: Non-energy Benefits Approach...

induced reduction in notices. The benefit was valued at the marginal cost of notices to the utility.⁶³

- **Fewer customer calls.** The value to the utility of receiving fewer calls from customers was valued using estimates of the average number of annual calls to the utility for low-income customers and the program-induced reduction in calls. The dollar value was obtained using estimates of the marginal cost of each phone call.⁶⁴
- **Transmission and/or distribution savings (distribution only).** Benefits to the utility for this category were estimated using the household average energy savings resulting from the program, the avoided cost to the utility of that energy, the estimated transmission and distribution reduction resulting from the program, and average values of losses occurring from transmission and distribution losses.⁶⁵

Societal/Public Benefits

- **Emissions / Environmental.** Public emissions and environmental benefits resulting from the program were valued using program data on saved megawatt hours, information from the literature on emissions per megawatt hour resulting from the use of different type of fuels, Wisconsin's energy generation mix, and estimates of environmental damage in dollars per MWh of energy produced by different fuel types.
- **Economic Benefits.** Economic benefits (non-participant) were estimated using data on the average expenditure per participating household. Economic multipliers were derived through an input/output model, developed for the State of Wisconsin Focus on Energy Low-income Public Benefits Evaluation⁶⁶.

⁶³We used an average of about 0.75 notices per low income customer before the program (based on previous SERA program research), and assumed about a 25% reduction in occurrences due to the program (SERA average from literature review). The Utility's marginal cost per notice was assumed to be about \$1.60 per notice, resulting in a utility value from reduced notices of about \$0.30 per participant per year.

⁶⁴ We used an average of about 1.73 calls per low income household before the program (based on previous SERA research), and an average reduction in calls due to the program of about 25% (SERA average from literature review). The Utility's marginal cost per call was assumed to be about \$1 per call (past research), resulting in a Utility-perspective NEB for reduced calls of about \$0.43 per participant per year.

⁶⁵ We used information on the average per household annual kWh reduction of 883. We assumed a 6.5% reduction in line losses based on averages from SERA research, and multiplied the result by an estimated avoided cost per kWh of \$0.05 (based on a ratio of avoided costs to retail rates from other utilities). This yielded an estimated savings per participating household per year of \$2.59.

⁶⁶ Sherman, Mike, Lisa Petraglia, and Glen Weisbrod, (Economic Development Research Group Inc.), *State of Wisconsin Department of Administration Division of Energy, Low-income Public Benefits Evaluation, Economic Development Benefits, Final Report*. May 2, 2003.

APPENDIX B: PARTICIPANT SURVEY INSTRUMENT



Skumatz Economic Research Associates, Inc.
Boulder Office: 762 Eldorado Drive, Superior, CO 80027
Phone: 303/494-1178 FAX: 303/494-1177
email: skumatz@serainc.com; web: serainc.com; payt.org

DATE: 2/16/05

TO: PA Consulting

FROM: Lisa A. Skumatz, SERA, Inc.

SUBJECT: Weatherization NEB Questions—FINAL DRAFT

PARTICIPANTS

Intro. Hello, my name is [interviewer name], and I'm calling on behalf of the Weatherization Assistance Program, administered by the Wisconsin Department of Administration. May I speak with [sample name]?

- 0 No
- 1 Yes [Skip to Intro2]

Intro1. Is there another adult in the household who is knowledgeable about your household's experience with the weatherization assistance program, your household's energy bills and your home's comfort, safety and energy efficiency that I could speak with?

- 0 No [Schedule call-back and/or attempt to convert]
- 1 Yes [Continue]

Intro2. I'm with PA Consulting Group, an independent research firm. We have been hired to assist the State of Wisconsin in evaluating the Weatherization Assistance Program. You should have received a letter a couple of weeks ago explaining the purpose of this call.

(Why are you conducting this study) Studies like this help the state better understand how programs such as this affect households.

(Timing) This survey should take about 15 minutes of your time. Is this a good time for us to speak with you? IF NOT, SET UP CALL BACK APPOINTMENT OR OFFER TO LET THEM CALL US BACK AT 1-800-935-4277.

B: Participant Survey Instrument...

(Sales concern) I am not selling anything; we would simply like to learn about your experience with the weatherization assistance program, your household's quality of life, and your home's comfort, safety, and energy efficiency. If you would like to talk with someone about this study, feel free to call Jim Cain with the Wisconsin Department of Administration at 608-267-2736.

S1 Our records indicate that your home was weatherized through the Weatherization Assistance Program. Do you recall this weatherization work?

- 0 No [Probe to make sure understands program, then term]
- 1 Yes

NEB0 What work did you have done through the Weatherization Assistance Program?

[PROMPT CATEGORIES IF NECESSARY - CHECK ALL THAT APPLY]

- 1 Furnace repair
- 2 Furnace replacement
- 3 Hot water heater repair
- 4 Hot water heater replacement
- 5 Insulation
- 6 New CFL light bulbs
- 7 New appliances
- 8 Testing for drafts
- 9 Plastic or rope caulk on windows
- 10 New thermostat
- 11 Other (record)
- 12 Don't know

NEB1. The weatherization program provided services and measures that may have reduced your energy use and may have also helped decrease your energy bill. Other than any changes to your energy use or energy bill that you may have seen, are there any other benefits that the weatherization program provided to your household?

- 0 None
- 1 Enter program benefits [Record verbatim]
- D Don't know
- R Refused

NEB2. Has the program negatively affected you or your household in any way?

- 0 No [Skip to NEB3]
- 1 Yes
- D Don't know [Skip to NEB3]
- R Refused [Skip to NEB3]

NEB2A. How has the program negatively affected you or your household? [Record verbatim]

NEB3 THROUGH NEB6 ASKED FOR POSSIBLE PROGRAM BENEFITS, PER TABLE ON THE

NEB3. [For each NEB category in turn] Overall, have you noticed any change in ____ [Read from table] ____ from the measures installed under the Weatherization Program? [If "yes," probe for positive or negative change. If "no effect" skip to next benefit.]

NEB4. [If they answered positive impact to NEB3] -- Think about the value you experienced from this benefit -- would you say it is of more value, less value or the same value to you as any possible energy savings you may have received from the program? [If more or less valuable, probe for much less, somewhat less, somewhat more, or much more valuable]

NEB5. [If they answered negative impact to NEB3] -- Is the impact of this change to you more costly, less costly or the same cost as the possible energy savings. [If more or less costly, probe for much less, somewhat less, somewhat more, or much more costly]

B: Participant Survey Instrument...

NEB6. [IF they answered positive or negative to NEB3 but can't seem to assign a relative value in NEB4 or NEB5, ask the following and record in table] On a scale of 0 to 5 with 0 meaning "not at all important" and 5 meaning "extremely important," how important to you is the [positive/negative] change in [benefit]?

	NEB3. Notice a change, and if noticed if positive or negative ⁶⁷ 1 positive 2 negative 3 no effect D DK	NEB4. IF POS: is the effect of more value, less value or the same value to you as the possible energy saving? ⁶⁸ 1 mlv 2 slv 3 sv 4 smv 5 mmv D DK	NEB5. IF NEG: is the impact of this change to you more costly, less costly or the same cost as the possible energy savings? ⁶⁹ 1 mlc 2 slc 3 sc 4 smc 5 mmc D DK	NEB6. (If NEB4/NEB5 = DK -- circle 0-5 for importance
a. Your home's overall comfort	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
g. Your ability to pay your energy or other bills	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
c. Quantity or quality of light	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
d. The noise from your appliances or the noise from inside your home	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
e. The amount of noise you hear from outside your home	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
f. The reliability of your new equipment, or amount you have had to maintain your new equipment	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
g. The appearance of the home or property value	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
h. Your control over the bill, your ability to control energy bill, or your understanding of energy use ⁷⁰	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
i. Your likelihood of avoid moving because of energy costs	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
j. Equipment performance or features	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
k. The number of calls to the utility related to bills	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D

⁶⁷ Several benefit categories are combined when it is believed they overlap too closely in the minds of respondents – and to reduce the length of the list. However, one that was eliminated was the respondent's feeling of being underserved – related to the number of programs there are to help them.

⁶⁸ Codes MLV SLV SV SMV MMV follow in order: much less valuable, somewhat less valuable, same value, somewhat more valuable, much more valuable.

⁶⁹ Codes MLC SLC SC SMC MMC follow in order: much less costly, somewhat less costly, same value, somewhat more costly, much more costly.

B: Participant Survey Instrument...

	NEB3. Notice a change, and if noticed if positive or negative ⁶⁷	NEB4. IF POS: is the effect of more value, less value or the same value to you as the possible energy saving? ⁶⁸	NEB5. IF NEG: is the impact of this change to you more costly, less costly or the same cost as the possible energy savings? ⁶⁹	NEB6. (If NEB4/NEB5 = DK -- circle 0-5 for importance)
	1 positive 2 negative 3 no effect D DK	1 mlv 2 slv 3 sv 4 smv 5 mmv D DK	1 mlc 2 slc 3 sc 4 smc 5 mmc D DK	
l. The number of bill payment notices or shutoffs received	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
m. Impacts on the environment	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
n. The number of sick days lost from work or school	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
o. Your water bill costs	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
p. Anything else? (SPECIFY)	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D
q. Anything else? (SPECIFY)	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D

NEB7A. Is there anyone in your home that is chronically ill, or more susceptible than most to illness?

- 0 No
- 1 Yes
- D Don't know
- R Refused

Next, we want to ask a little more detail about how the program may have affected your family's health or home safety.

NEB8 THROUGH NEB12 ASKED FOR POSSIBLE PROGRAM HEALTH AND SAFETY BENEFITS, PER TABLE ON THE NEXT PAGE.

NEB8. [For each NEB category in turn] Overall, have you noticed any change in ____ [Read from table below] ____ from the measures installed under the Weatherization Program? [If "yes," probe for positive or negative change. If "no effect" skip to next benefit.]

NEB9. [If they answered positive impact to NEB8] – Think about the value you experienced from this benefit -- would you say it is of more value, less value or the same value to you than the possible energy savings from the program? [If more or less valuable, probe for much less, somewhat less, somewhat more, or much more valuable]

B: Participant Survey Instrument...

NEB10. [If they answered negative impact to NEB8] -- Is the impact of this change to you more costly, less costly or the same cost as the possible energy savings. [If more or less costly, probe for much less, somewhat less, somewhat more, or much more costly]

NEB11. [If NEB8 = 1 or 2 and NEB9 or NEB10 = DK] On a scale of 0 to 5 with 0 meaning "not at all important" and 5 meaning "extremely important," how important to you is the [positive/negative] change in [benefit].

NEB12. [RECORD COMMENTS HERE IF THEY MENTION SPECIFICS ABOUT THE POSITIVE OR NEGATIVE EFFECTS]

	NEB8. Notice a change, and if noticed if positive or negative 1 positive 2 negative 3 no effect D DK	NEB9. IF POS: value of effect compared to possible energy saving? ⁷¹ 1 mlv 2 slv 3 sv 4 smv 5 mmv D DK	NEB10. IF NEG: cost of impact compared to possible energy savings? ⁷² 1 mlc 2 slc 3 sc 4 smc 5 mmc D DK	NEB11. (If NEB9 / NEB10 = DK 0-5 for importance	NEB12. Comments if mentioned
r. The frequency or intensity of chronic conditions such as asthma.	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D	
s. The frequency or intensity of other illnesses	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D	
t. Headaches for you or other residents	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D	
u. Doctor or hospital visits and related costs	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D	
v. Medication costs	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D	
w. Safety of your home	1 2 3 D	1 2 3 4 5 D	1 2 3 4 5 D	0 1 2 3 4 5 D	

NEB8W_spec [IF NEB8W = 1 or 2] What specific changes have you seen in the safety of your home?

NEB14. Which of all the benefits would you say is the most valuable to you? [List all benefits where indicated positive/negative affect and were in the highest categories of values. If did not rate in the highest category (i.e., much more) ask about those rated somewhat more) (put letter) _____

⁷¹ Much less valuable, somewhat less valuable, same value, somewhat more valuable, and much more valuable, respectively
⁷² much less costly, somewhat less costly, same cost, somewhat more costly, much more costly, respectively

B: Participant Survey Instrument...

NEB15. Think about the combination of all the positive and negative effects you received from the weatherization program beyond the possible energy savings. Would you say that the combination of these effects is overall positive, negative, or no effect?

- 1 positive
- 2 negative
- 3 no effect
- D DK

NEB15a.[If NEB15 is positive] Again, think about the combination of all the positive and negative effects. Would you say the combination of these effects is more valuable, less valuable, or the same value to you than the possible energy savings? [If more or less valuable, probe for much less, somewhat less, somewhat more, or much more valuable]

- 1 much less valuable
- 2 somewhat less valuable
- 3 same value
- 4 somewhat more valuable
- 5 much more valuable
- D DK

NEB15b. [If NEB15 is positive and NEB15a <> 3] By about what percent or how much [more/less] valuable?

Interviewer, we're trying to get relative value to energy bill savings.

HALF AS VALUABLE = 50%
SAME VALUE = 100%
TWICE AS VALUABLE = 200%
NO VALUE AT ALL = 0%

DK=don't know

____% DK

NEB16a. [If NEB15 is negative] Think about the combination of all the positive and negative effects. Would you say the combination of these effects is more costly, less costly, or the same cost than the possible energy savings? [If more or less costly, probe for much less, somewhat less, somewhat more, or much more costly.]

- 1 much less costly
- 2 somewhat less costly
- 3 same cost
- 4 somewhat more costly
- 5 much more costly
- D DK

NEB16b. [If NEB15 is negative and NEB16a <> 3] By about what percent or how much [more/less] costly?

Interviewer, we're trying to get relative cost to energy bill savings.

HALF AS COSTLY = 50%
SAME COST = 100%
TWICE AS COSTLY = 200%
NO COST AT ALL = 0%

____% NES DNK

NEB17. Think about the combination of all the positive and negative effects you received from the weatherization program beyond the possible energy-related savings. On a scale of 0 to 5, with 0 being not at all important and 5 being extremely important, how important are they to you? ____

NEB18n1 Think about all the non-energy benefits that you received that we talked about before. Would you be willing to accept [READ VALUE] to give up those benefits? [READ VALUES INCREMENTALLY AND STOP WHEN RESPONDENT SAYS YES]

- | | | |
|----|------------|-----------------|
| 1 | \$2/month | [Skip to NEB18] |
| 2 | \$5/month | [Skip to NEB18] |
| 3 | \$10/month | [Skip to NEB18] |
| 4 | \$15/month | [Skip to NEB18] |
| 5 | \$25/month | [Skip to NEB18] |
| 6 | \$75/month | [Skip to NEB18] |
| -2 | No to all | |
| -8 | Don't know | [Skip to NEB18] |

NEB18n2 How much would you be willing to accept per month to give up these non-energy benefits?

- | | |
|----|---------------------------------|
| 1 | Numerical amount - _____ /month |
| -8 | Don't know [Skip to NEB18] |

NEB18. Think about the combination of all the positive and negative effects you received from the weatherization program beyond the possible energy related savings. If we took away all these positive and negative effects, estimate what you might be willing to pay each year to get these effects back?
\$ _____ DNK

B: Participant Survey Instrument...

NEB18a. [If NEB18 = DNK] Would you estimate the value is higher, lower, or equal to \$5 per month to you? [Move along the direction of the following table until they say the figure is close. "LT" means less than the figure; 1=about equal to the figure, "MT" means more than the figure. Start at \$5/month. If more than \$10, probe for amount.]

\$0/month	\$1/month	\$2.50/month	\$5/month	\$7.50/month	\$10/month	More \$____PROBE
LT 1 MT	LT 1 MT	LT 1 MT	LT 1 MT	LT 1 MT	LT 1 MT	LT 1 MT

NEB19. I am going to read to you some changes you may have experienced because of your participation in the weatherization program . For each, please tell me whether you experienced a change due to the program, and if that change was for the better or worse. Have you experienced any changes in . . . PROBE IF IMPROVEMENT OR WORSENING: Is it much better or somewhat better; much worse or somewhat worse.

Topic	Size / direction of impact	Comments (if any, don't prompt)
a. Ability to pay energy or other bills	1 Much better 2 Somewhat better 3 No impact 4 Somewhat worse 5 Much worse D dnk	
b. Pressure related to bills or debt	1 Much better 2 Somewhat better 3 No impact 4 Somewhat worse 5 Much worse D dnk	
c. Financial hardship	1 Much better 2 Somewhat better 3 No impact 4 Somewhat worse 5 Much worse D dnk	
d. Health and safety of the home	1 Much better 2 Somewhat better 3 No impact 4 Somewhat worse 5 Much worse D dnk	
e. Are there any other impacts you can think of that we haven't discussed? _Specify_____	1 Much better 2 Somewhat better 3 No impact 4 Somewhat worse 5 Much worse D dnk	

B: Participant Survey Instrument...

NEB20a. Do you believe your energy use increased, decreased, or stayed the same because of the weatherization program [If said increased or decreased, probe for increased a great deal, increased somewhat or decreased somewhat, decreased a great deal]

- 1 Energy use increased a great deal
- 2 Energy use increased somewhat
- 3 Energy use stayed about the same
- 4 Energy use decreased somewhat
- 5 Energy use decreased a great deal
- 6 Don't know

NEB20b. Do you believe your energy bills increased, decreased, or stayed the same because of the weatherization program? [If said increased or decreased, probe for increased a great deal, increased somewhat or decreased somewhat, decreased a great deal]

- 1 Bills increased a great deal
- 2 Bills increased somewhat
- 3 Bills stayed about the same [Skip to COMMENTS]
- 4 Bills decreased somewhat
- 5 Bills decreased a great deal
- D Don't know [Skip to COMMENTS]

NEB21. Can you estimate about how much [IF INCREASED: extra you paid/IF DECREASED: how much you saved] on your monthly bills because of the program?

\$_____/month

COMMENTS. Do you have any additional comments you'd like to make?

THANK AND TERMINATE

ⁱ *Estimating Seasonal and Peak Environmental Emissions Factors*. With Carmen Best, David Sumi, Bryan Ward, Bryan Zent, and Karl Hausker. Report for the Wisconsin Department of Administration, Division of Energy Focus on Energy statewide evaluation. May 2004.