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Quantifying Non-Energy Benefits from ComEd's Income Eligible Programs: Findings and Recommendations from Secondary Research

DRAFT

Presented to
Commonwealth Edison Company

March 6, 2018

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NAVIGANT

Quantifying Non-Energy Benefits from ComEd's Income Eligible Programs: Findings and Recommendations from Secondary Research

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E. EXECUTIVE SUMMARY

This report summarizes Navigant's findings and recommendations on quantifying non-energy benefits (NEBs) for income-eligible energy efficiency programs. NEBs are benefits that occur in addition to energy savings that are produced via energy efficiency programs. NEBs are categorized into three groups: utility, participant, and societal. Utility NEBs accrue to the utility and result from reductions in administrative costs. Participant NEBs accrue to building owners and tenants and include improvements in health, safety, and comfort and reduced operations and maintenance costs. Societal NEBs accrue to society and include improvements to the economy, environment, and health, safety, and comfort of citizens. Navigant's goal is to include appropriate NEBs in both the Total Resource Cost (TRC) test and a future Illinois Technical Reference Manual (IL TRM).

The IL TRM currently accounts for the avoided use of water and a deemed operations and maintenance (O&M) cost adjustment calculation. Water savings are based upon measurements consistent with Federal Standards. The value of the savings is determined by what actual Illinois customers would have paid for the water saved. The primary environmental benefit that could be included in the Illinois TRC test is the value of avoided CO_2 emissions. ComEd included the average carbon value proposed by the NRDC within its TRC analysis as an adder. This value ($18.50/tonne) was applied to the marginal power plant emission rate to produce an average value of $0.0139/kWh. DSMore does not provide escalation factors for externalities and emissions. Additionally, the ComEd TRC accounts for avoided water consumption.

The Illinois Stakeholders Advisory Group (IL SAG) considered expanding the number of NEBs for the IL TRM in 2015, but did not reach consensus.[1] Stakeholders provided feedback on including additional NEBs in the TRM. Feedback included:

- Calculations for NEBs need to be based on reputable studies
- NEBs quantities must be repeatable
- The process of adapting NEBs to Illinois must be robust
- Establish a logical connection between the NEBs and the related energy efficiency measures

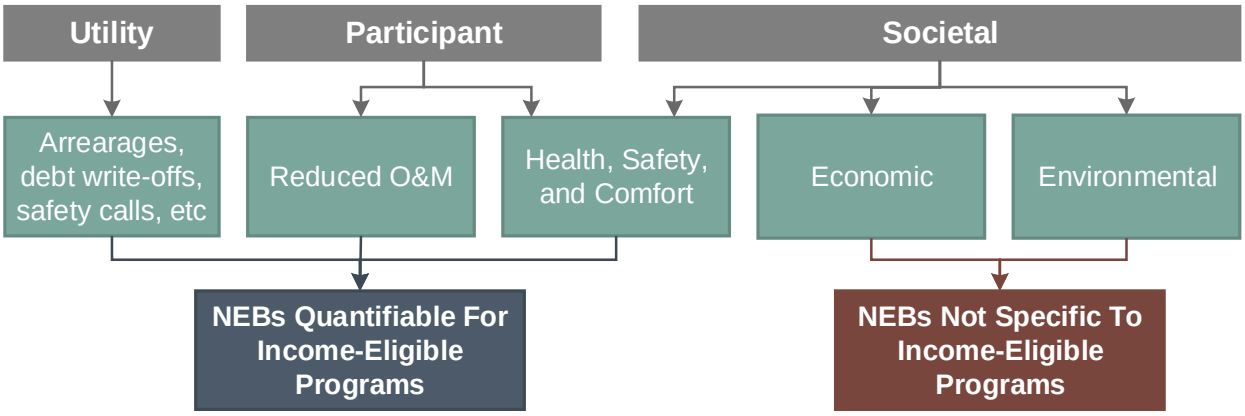
Navigant considered these issues while conducting secondary research using 32 studies and reports on NEBs. In addition, Navigant addressed these issues in our recommendations for conducting primary research to quantify NEBs from ComEd's energy efficiency programs.

Using national best practices to quantify NEBs, Navigant will focus initially on easily quantifiable and repeatable NEBs from ComEd's income-eligible programs. Navigant will conduct primary research of (1) utility NEBs and (2) health, safety, and comfort NEBs for both single-family (SF) and multifamily (MF) income-eligible, whole-home weatherization programs.

Figure E-1 shows the three categories of NEBs and the NEBs that Navigant will seek to quantify.

[1] "Documentation of TAC Review of Non Energy Benefits," Memorandum to Technical Advisory Committee on 02/09/2016

Figure E-1. NEBs Categories and Eligibility for Primary Research



Source: Navigant

1. Utility NEBs Research

Navigant will use primary data from ComEd to monetize utility NEBs. Common utility NEBs are reductions in arrearages, bad debt-write offs, terminations and reconnections, customer calls, safety calls, and collection notices. To monetize these benefits, Navigant will compare a treatment group and comparison group and gather one year of data detailing pre- and post-program behavioral payment and administrative costs. For example, Navigant plans to request ComEd data that include:

- Payment transaction dates
- Actual billed amounts by billing period
- Source and amount of external payment assistance by billing period
- Arrearage amount
- Reconnections by billing period

2. Participant NEBs Research

Navigant will conduct primary research in the form of participant surveys to quantify health, safety, and comfort NEBs for SF and MF homes. Health, safety, and comfort NEBs are the most significant for income-eligible programs based on the literature review that we conducted for this report. Navigant will monetize these NEBs starting with the following:

- Reduced asthma-related emergency room (ER) visits, hospitalizations, other direct medical costs, and indirect costs
- Reduced thermal stress on occupants (hot)
- Reduced thermal stress on occupants (cold)
- Fewer missed days at work

Our research determined that the above NEBs are the most defensible, since they have clear links to energy efficiency, readily-measured outcomes, and can be quantified with reliable data.

Navigant will also survey a broader range of NEBs identified in our research which may include:

- Reduced need for food assistance
- Reduced carbon monoxide poisonings
- Reduced need for high interest, short-term loans
- Increased ability to afford prescriptions

- Reduced home fires
- Improved worker productivity due to improvements in sleep
- Improved household work productivity due to improvements in sleep
- Reduced need to choose between heating or eating – impacts on low birth weight babies
- Reduced symptoms of chronic obstructive pulmonary disease (COPD), emphysema, and chronic bronchitis
- Reduced symptoms of arthritis
- Reduced symptoms of diabetes
- Reduced food poisoning
- Reduced occurrences of trips and falls
- Reduced operations and maintenance cost for building owners and tenants
- Improvements in property values and reduced tenant turnover

Navigant will survey participants before and after weatherization to analyze the occurrence of each NEB using the methodology outlined in Oak Ridge National Laboratory's (ORNL) "Health and Household-Related Benefits Attributable to the Weatherization Assistance Program" (2014).[2] This report will be referred to as the National WAP study. Navigant considers this report to be one of the most rigorous studies of income-eligible NEBs available. See 7.Appendix B for a summary of the methodology for the four recommended NEBs. Navigant will calculate separate values for SF and MF homes and report values on the program level or as a per participant per year benefit. These values will be applicable to income-eligible, whole-home weatherization programs.

NEBs Not Currently Recommended for Primary Research

Navigant also explored additional societal NEBs, specifically environmental and economic NEBs. Environmental NEBs account for avoided pollutants and greenhouse gases and avoided use of water. Economic NEBs consider job growth due to energy-efficiency programs. Navigant will not attempt to monetize these societal NEBs as they are not specific to income-eligible programs and would be more appropriate for research at the portfolio level.

Summary of Recommendations

Recommendation 1: Navigant recommends monetizing utility NEBs. Navigant will request and analyze one-year of pre- and post-program billing data for a treatment and comparison group to estimate benefits on a per participant per year basis.

Recommendation 2: Navigant will conduct primary research to quantify health, safety, and comfort NEBs for income-eligible, whole-home weatherization programs. Following the methodology outlined in ORNL's National WAP study, Navigant will survey participants before and after weatherization to analyze the occurrence of all possible health, safety, and comfort NEBs as well as reduced O&M for participants. Navigant will start by monetizing the most defensible NEBs that benefit both participants and society: reduced asthma symptoms, reduced cold-related thermal stress, reduced-heat related thermal stress, and reduced missed days at work. Separate values will be calculated for SF and MF homes and values will be reported on the program level or as a per participant per year benefit.

Recommendation 3: Navigant recommends monetizing the avoided death benefit to more accurately estimate the true value of NEBs. Navigant will calculate the avoided death benefit for reduced cold-

[2] Oak Ridge National Laboratory (2014). Health and Household-Related Benefits Attributable to the Weatherization Assistance Program

related thermal stress and reduced-heat related thermal stress in addition to the benefit of avoided medical costs.

Recommendation 4: Navigant does not recommend monetizing NEBs on the measure-level because it is the combination of measures, not individual measures, that provide the benefits. Navigant recommends monetizing NEBs on the program-level, or value per participant per year.

Recommendation 5: Although adapting national-data for state-specific NEBs has been done in Massachusetts, Navigant does not recommend monetizing NEBs without primary research. Navigant recommends conducting primary research to produce more defensible and applicable results for Illinois.

Recommendation 6: Although economic and environmental impacts are significant, Navigant does not recommend quantifying economic and environmental societal NEBs specifically for income-eligible programs. Neither is specific to income-eligible programs and this research would be more appropriate at the portfolio level.

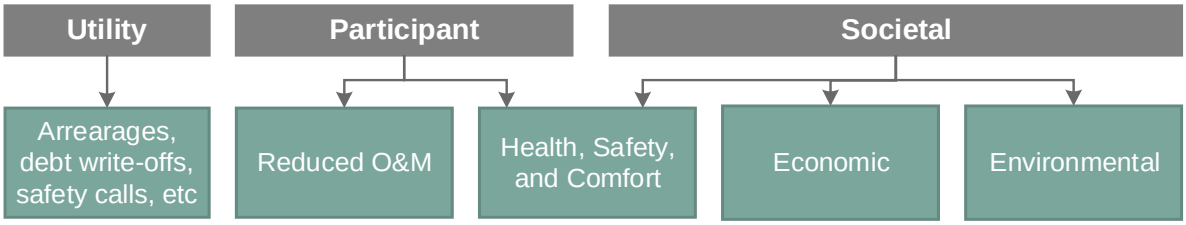
2. INTRODUCTION

Navigant's goal is to include appropriate NEBs in both the Total Resource Cost (TRC) test and a future Illinois Technical Reference Manual (IL TRM). ComEd has prioritized quantifying NEBs for income eligible programs because NEBs are generally more significant for income eligible programs[3]. Quantification of NEBs for income eligible programs could improve the programs' cost-effectiveness, if income eligible programs are required to show cost-effectiveness in the future.

2.1 Non-Energy Benefits Definitions

NEBs are typically considered in three categories: utility, participant, and societal. Utility NEBs accrue to the utility and result from reductions in administrative costs. Participant NEBs accrue to building owners and tenants and include improvements in health, safety, and comfort and reduced operations and maintenance costs. Societal NEBs accrue to society and include improvements to the economy, environment, and health, safety, and comfort of citizens. Figure 2-1. NEBs CategoriesFigure 2-1 summarizes common NEBs under each category.

Figure 2-1. NEBs Categories



Source: Navigant

Societal and participant benefits are intertwined in health, safety, and comfort NEBs; therefore, this report will combine health, safety, and comfort NEBs for society and participants.

2.2 Inclusion of NEBs in Other Jurisdictions

There is no standard for including or excluding NEBs among different jurisdictions. The most common practice is employing an adder or multiplier – a simple and typically conservative value that acknowledges the gap in omitted energy efficiency benefits and broadly accounts for NEBs. Few jurisdictions have quantified specific NEBs.[4]

2.3 Summary of 2015 SAG Discussion on NEBs

The IL SAG considered additional NEBs in the beginning of 2015 when the Technical Advisory Committee (TAC) considered a NEBs proposal during the development of IL TRM v5.0. The Vermont

[3] Skumatz Economic Research Associates, Inc. (2016). Non-Energy Benefits / NEBs – Winning at Cost Effectiveness Dominos: State Progress and TRMs

[4] Northeast Energy Efficiency Partnerships (2017). Non-Energy Impacts Approaches and Values: An Examination of the Northeast, Mid-Atlantic, and Beyond. http://neep.org/sites/default/files/resources/NEI%20Final%20Report%20for%20NH%20updated%2010.4.17.pdf.

Energy Investment Corporation (VEIC) submitted the attachment, "Attachment B: Illinois Statewide Non Energy Benefits Methodologies," after compiling two separate proposals:

1. *Adding Non-Energy Benefits to Residential "Whole House" Measures and Multifamily Measures* submitted by Chris Neme on behalf of the NRDC.
2. *Adding Non-Energy Benefits to C&IMeasures* submitted by Phil Mosenthal on behalf of the Illinois Attorney General.

The first proposal was based on a literature review done by Lisa Skumatz of Skumatz Economic Research Associates (SERA) and the second proposal was based on recommendations developed by a Massachusetts study released in 2011. The TAC did not reach consensus and many stakeholders provided feedback on Attachment B, which are summarized in Table 2-1.

Table 2-1. Key Stakeholder Comments during 2016 IL Discussion on NEBs

Stakeholder	Key Comments
Ameren IL	• NEBs are too difficult to measure • NEBs may be highly variable from state to state • Adding NEBs will allow vendors to increase program administration costs and increase their profitability, thus harming ratepayers
Future Energy Enterprises	• Would like to see negative and positive NEBs broken out, clear source documentation and citations, what is being included and excluded, and how NEBs are being defined by jurisdiction
Nicor Gas	• Questioned the thoroughness of the literature review • Does not agree that values from Massachusetts would be applicable between income eligible and non-income eligible programs • Questions the applicability of Massachusetts values to Illinois • Hard to "feel" NEBs in large C&I locations • Benefits accrued from new equipment do not represent incremental benefits that should be considered in cost benefit analysis
ComEd	• Workpapers and references do not include sufficient detail on how the values were determined and if they can be applied in Illinois • Need logical connection between NEBs and measures, comparison to baseline, and how each value is uniquely determined • Problem with bundled attributes, definitional confusion, and double counting • Unclear if methods could be replicated by evaluators
ICC Staff	• NEBs may lead to adoption of measures/programs that are not actually energy efficiency measures/programs • Worried about program cost-effectiveness tests relying too much on NEBs • Potential negative implications to ratepayers • Only positive NEBs are being studied • Need greater transparency on NEB calculations and what they represent
Illinois Industrial Energy Consumers	• NEBS are hard to quantify and not transferable to IL • Too subjective to base TRM values on customer surveys • Doubtful that NEB values can be more than 100% of bill savings
Opinion Dynamics	• Need to verify that these NEBs are not actually "transfers" • Verify that questions to Illinois customers would not yield different answers • Worried about double counting other benefits

Source: "Documentation of TAC Review of Non Energy Benefits," Memorandum to Technical Advisory Committee on 02/09/2016

The most broadly expressed concerns included:

1. Calculations for NEBs need to be based on reputable studies
2. NEBs quantities must be repeatable
3. The process of adapting NEBs to Illinois must be robust
4. Establish a logical connection between the NEBs and the related energy efficiency measures

With these concerns in mind, Navigant made a point to choose only articles where primary research was:

- Conducted or vetted by third-party entities such as trade organizations, national laboratories or government organizations, or
- Meta-analyses conducted by third-party organizations that showed some level of evaluating the study's dataset, or
- Described a clear and logical cause-and-effect between measures and benefits, or
- Able to demonstrate calculations of NEBs values with transparency.

2.4 Three^3, Inc. and Seventhwave MF NEBs Research

Three^3, Inc. and Seventhwave are conducting NEBs research on MF buildings in ComEd territory in 2018. They were awarded a grant from the JPB Foundation, a New York City-based organization, to estimate the health and resilience benefits of weatherizing income-eligible (MF) buildings.[5] The research is similar to Navigant's but the sample size in ComEd territory is not large enough to develop a robust data set. Navigant met with Three^3, Inc. and Seventhwave and is coordinating with them to leverage the research effort and supplement Navigant's MF research.

Three^3, Inc. and Seventhwave's study's goals include measuring and validating health, household, and resilience benefits as well as benefits accruing to property owners. The data collection activities comprise of (1) conducting a pre- and post- weatherization survey (2) interviewing building owners, (3) conducting field studies of buildings to assess resilience and (4) conducting an indoor environmental air quality monitoring study.

The study's results are intended for energy efficiency programs in the New York City area, but may be valuable to stakeholders in many regions. To ensure a large enough sample size, researchers will collect data from the Northeast region as well as the Midwest region due to their comparable climates. The study seeks an even sample between the two geographic regions and a mix of building sizes, ownerships, and functions. The total target is over 300 buildings (2,000 units) across three categories: (1) buildings already weatherized, (2) buildings in the queue to be weatherized, and (3) buildings that will not be weatherized until after May 2019. The study's goal is to complete surveys in 70 buildings in Chicago. The study's full results are expected in 2019.

Navigant is working with Three^3, Inc. and Seventhwave to ensure our NEBs efforts are not duplicative.

[5] Three^3, Inc. and Seventhwave (2017). Estimating the Health and Resilience Benefits of Weatherizing Affordable Multifamily Buildings: Call for Project Participation.

3. METHODOLOGY

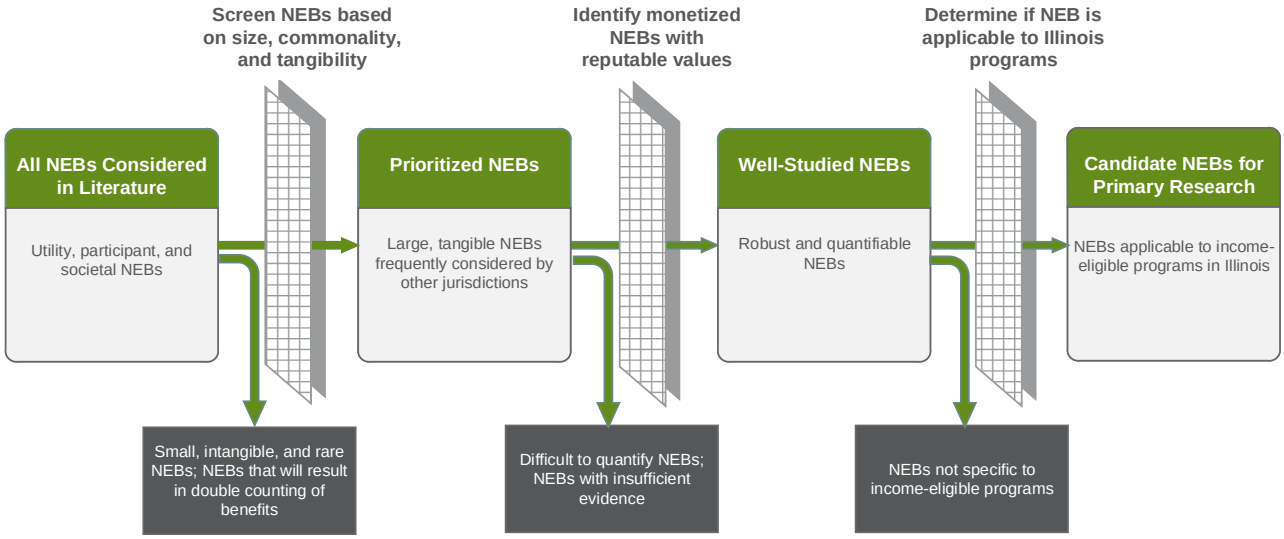
Navigant reviewed 32 documents including research reports, white papers, webinars, webpages, presentations, and discussion forums that discussed utility, participant, and societal NEBs. Navigant sought to answer the following research questions:

1. What are the most commonly researched and quantified income-eligible energy efficiency program NEBs?
2. What is the relative difficulty of quantifying each of the NEBs typically attributed to income-eligible energy efficiency programs?
3. What is the range of researched values reported for the most common income-eligible energy efficiency program NEBs?
4. Which NEBs could be adapted or borrowed directly from existing secondary research, versus which require primary research to quantify savings?
5. Which NEBs does Navigant recommend for primary research?

To identify candidate NEBs for research and quantification, Navigant used the following screening process in Figure 3-1. NEBs Screening Process

to prioritize NEBs based on relative size, relevancy, and rigor of evidence.

Figure 3-1. NEBs Screening Process



Source: Navigant

7.Appendix A includes a full list of all NEBs considered and shows ranges of values, methods, how common NEBs are in other jurisdictions, difficulty of quantifying, priority, and if it is transferable, adaptable, needing primary research, or not recommended.

4. FINDINGS ON UTILTY NON-ENERGY BENEFITS

Utility NEBs are defined as savings that accrue to the utility and subsequently may result in lower rates for ratepayers. The source of these savings comes from reduced administrative activities related to fewer arrearages, late payments, uncollected bills, bad debt write off, termination and reconnections, customer calls, collection notices, and safety calls. Utility NEBs are well-studied and relatively easy to quantify.

Utility NEBs are comparatively small for income-eligible programs, comprising approximately 10% of overall NEBs.[6] Navigant anticipants the overall value of utility NEBs to be between $5 - $50 per participant per year. From Tetra Tech and NMR's "Residential and Low-Income Non-Energy Impacts (NEI)" (2011), a literature review conducted for Massachusetts in 2011, Table 4-1 provides median values for the most common utility NEBs.[7]

Table 4-1. Range of Values for Common Utility NEBs

Utility NEB	Per Participant Per Year Benefit
Arrearages	$2.61
Bad debt write-offs	$3.74
Terminations/reconnections	$0.43
Customer calls	$0.58
Collection notices	$0.34
Safety calls	$8.43
Total	**$16.13**

Source: MA 2011

Navigant found two methods of monetizing utility NEBs. The first method is to multiply the program-induced reduction in arrearage by the utility's interest rate for carrying short-term debt. The second method is a quasi-experimental method using one year of pre- and post-program payment data and administrative cost data for a treatment group and comparison group. Navigant will follow this second, more rigorous method to quantify utility NEBs.

Navigant will request ComEd data that includes:

- Payment transaction dates
- Actual billed amounts by billing period
- Source and amount of external payment assistance by billing period
- Arrearage amount
- Reconnections by billing period

The treatment group will be customers who participated in income-eligible weatherization programs. The comparison group will be a select group of customers who did not participate but are eligible for the same income-eligible programs. Navigant will filter data to ensure that the same account number stayed with the premise and full 12 billing periods in both the pre and post periods are included. Using a difference-of-difference technique, Navigant will analyze both customer payment and utility cost metrics. For customer payment metrics, Navigant will compare arrangement metrics including the portion of households receiving payment arrangements, the total arrangement in dollars, and the percentage of bill paid by arrangements. Navigant will also compare payment and billing metrics including average annual billed

[6] Skumatz Economic Research Associates, Inc. (2014). Capturing the Multiple Benefits of Energy Efficiency – Roundtable on Energy Provider and Consumer Benefits

[7] NMR Group (2011), Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts Evaluation

amount and on-time and late payments. On the utility side, Navigant will analyze the amount of disconnections and reconnections, collection action, average carried arrearage, and apply a dollar value to determine avoided utility cost.

Recommendation 1: Navigant recommends monetizing utility NEBs. Navigant will request and analyze one-year of pre- and post-program billing data for a treatment and comparison group to estimate benefits on a per participant per year basis.

5. FINDINGS ON HEALTH, SAFETY, AND COMFORT NON-ENERGY BENEFITS

Health, safety, and comfort NEBs represent, on average, 30-50% of NEBs and often higher for income-eligible energy efficiency programs.[8]

5.1 Findings from Key Secondary Research Studies

Among the 32 documents reviewed, two emerged as key documents that quantified these NEBs in income-eligible programs. The first study was conducted by Oak Ridge National Laboratory (ORNL) in 2014 called "*Health and Household-Related Benefits Attributable to the Weatherization Assistance Program.*" [9] This report will be referred to as the National WAP study. This study used survey responses to monetize 12 health, safety, and comfort NEBs for society and participants who weatherized income-eligible homes. The second study was conducted by NMR and Three[3] in 2016 called "*Low-Income Single-Family Health- and Safety- Related Non-Energy Impacts (NEIs) Study".*[10] This will be referred to as the MA 2016 study. This study applied data gathered in the National WAP study and used it to quantify NEBs more specifically for income-eligible programs in the state of Massachusetts. A list of all 12 benefits are shown in Table 5-1.

[8] Skumatz Economic Research Associates, Inc. (2014). Capturing the Multiple Benefits of Energy Efficiency – Roundtable on Energy Provider and Consumer Benefits

[9] Oak Ridge National Laboratory (2014). Health and Household-Related Benefits Attributable to the Weatherization Assistance Program

[10] Three[3], Inc. and NMR Group (2016). Massachusetts Special Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study

Table 5-1. Range of Values for Health, Safety, and Comfort NEBs

#	NEB	Participant/ Societal	Range of values (per participant per year)	Source of Savings
1	Reduced asthma symptoms	Both	$202.00 - $332.00	Lower medical costs
2	Reduced cold-related thermal stress	Both	$393.26 - 496.94	Lower medical costs and avoided death
3	Reduced heat-related thermal stress	Both	$87.45 - $173.93	Lower medical costs and avoided death
4	Reduced missed days at work	Both	$20.25 – $186.81	Increased wealth due to fewer sick days
5	Reduced need for food assistance	Societal	$84.00	Retained wealth due to reduced energy bills
6	Reduced use of short-term, high-interest loans	Participant	$4.72 - $7.12	Retained wealth due to reduced energy bills
7	Reduced CO poisoning	Both	$31.43 - $38.85	Lower medical costs and avoided death
8	Increased ability to afford prescriptions	Societal	$193.98	Retained wealth due to reduced energy bills
9	Increased home productivity due to improvements in sleep	Participant	$37.75 - $133.67	Higher productivity for housekeeping
10	Increased worker productivity due to improvements in sleep	Societal	$182.33	Higher worker productivity
11	Reduced home fires	Both	$84 - $111.71	Lower medical costs, avoided death, and avoided property damage
12	Reduced need to choose between heating or eating	Societal	$19.92	Lower medical costs for infants

Source: National WAP and MA 2016 Study

Table 5-1 represents values on the program level or per participant per year, and reported as a first-year benefit. First-year per unit benefit captures benefits that immediately accrue upon the completion of weatherization. The MA 2016 and National WAP studies also delivered results in present value (PV) per unit benefit.

The National WAP study defined its methodology and process for monetizing these NEBs. For each one, the report detailed survey questions employed, additional data mined, and equations used. The study also discussed the rigor of each process, classifying NEBs into either Tier 1, Tier 2, or Tier 3. The most defensible NEBs are those in Tier 1 that had the most measurable outcomes, the most reliable data, and the clearest link to energy efficiency. Tier 1 NEBs also have some of the largest values. Because of their rigor, Navigant will monetize the first four NEBs in Table 5-1, which were all classified in Tier 1 and benefit both participant and society. Reduced need for food assistance is also in Tier 1 but this benefit accrues exclusively to society so will not be included in this initial study. All other NEBs in Table 5-1 are classified in Tier 2 or Tier 3, which signify NEBs that may have lacked direct observations of improved health or needed more assumptions to monetize. Appendix B summarizes the methods for calculating the first four Tier 1 NEBs.

The MA 2016 study identified key limitations of the National WAP study. One broad limitation was that results are only applicable to low-income SF homes which include housing units in small MF buildings consisting of two-four units in total. Large MF homes were not considered. Navigant's primary research will include both SF and MF homes. Navigant also recognizes that these 12 NEBs are not the only health, safety, and comfort NEBs; however, these are the ones that are most readily quantified.

Additional participant NEBs such as reduced O&M cost for building owners and tenants may also be included in such a study to quantify improvements in property values and reduced tenant turnover. The IL TRM does include calculations for reduced O&M for certain measures but those represent longer lifetimes of measures, not participant benefits.

Recommendation 2: Navigant will conduct primary research to quantify health, safety, and comfort NEBs for income-eligible, whole-home weatherization programs. Navigant will use the methodology outlined in the National WAP study and will survey participants before and after weatherization to analyze the occurrence of all possible health, safety, and comfort NEBs as well as reduced O&M for participants. Navigant will start by monetizing the most defensible NEBs that benefit both participants and society: reduced asthma symptoms, reduced cold-related thermal stress, reduced-heat related thermal stress, and reduced missed days at work. Separate values will be calculated for SF and MF homes and values will be reported on the program level or as a per participant per year benefit.

5.1.1 Avoided Death Benefit

MA 2016 and National WAP studies included results for avoided death benefit. This benefit accounts for avoided participant deaths and avoided firefighter deaths for reduced home fires based on the Value of a Statistical Life (VSL), or the value of change in one's mortality risk. At the time of the National WAP study, VSL values were more variable and reported between $5-9 million depending on the government agency. The National WAP study used a conservative value of $6 million that they adjusted for inflation to $7.5 million in 2008.[11] At the time of the MA 2016 study, the estimates from government agencies were in closer agreement around $9 million and the MA 2016 study used $9.6 million as reported by the Department of Transportation (DOT).[12] **Error! Reference source not found.**Table 5-2 compares the value of NEBs with and without the avoided death benefit.

Table 5-2. Comparison of NEBs With and Without Avoided Death Benefit

NEB	National WAP – PV of Per Unit Over 10 years		MA 2016 – PV Per Unit Over 20 years	
	Total (Without)	Total (With)	Total (Without)	Total (With)
Reduced cold-related thermal stress	$171.93	$3911.14	$733.77	$9494.18
Reduced heat-related thermal stress	$84.77	$869.76	$674.05	$3303.81
Reduced CO poisoning	$7	$153.45	$10.53	$192.58
Reduced home fires	$175	$831	$522.96	$2123.39

Source: National WAP and MA 2016 study

The avoided death benefit represents a significant portion of the value of NEBs for those listed in Table 5-2. In the cases of reduced CO poisoning and reduced home fires, the avoided death benefit also has implications in policy-making.[13] Although this benefit may be controversial among Illinois stakeholders, Navigant considers quantifying avoided deaths important in estimating the true value of NEBs.

[11] Oak Ridge National Laboratory (2014). Health and Household-Related Benefits Attributable to the Weatherization Assistance Program
[12] Three^3, Inc. and NMR Group (2016). Massachusetts Special Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study
[13] Three^3, Inc. and NMR Group (2016). Massachusetts Special Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study

Recommendation 3: Navigant recommends monetizing the avoided death benefit and will report this NEB separately. Navigant will calculate the avoided death benefit for reduced cold-related thermal stress and reduced-heat related thermal stress in addition to the benefit of avoided medical costs.

5.2 Measure-Level Monetization

During the 2015 IL discussion on NEBs, the TAC agreed that NEBs should be calculated on a "measure-specific basis."[14] Navigant explored monetizing NEBs on the measure-level. Navigant determined that the most rigorous method was assigning measure-level values based on the portion of average energy bill savings attributed to each measure. This monetizing process has the following steps:

1. Identify measures that reasonably contribute to a NEB and deem a list of measures for each NEB in the IL TRM.
2. Calculate the percentage of bill savings for each measure that contribute to that NEB for each unique energy efficiency program.
3. Multiply the average percentage of bill savings by the IL TRM-deemed NEBs value to calculate the savings at the measure-level.

Another method was to use ordinary least squares (OLS) regression to determine the monetary relationship between each measure and a NEB. Although this method could be helpful in detecting the main measures contributing to a given NEB, the inconsistency between regression results and interpretation of the results is problematic.[15]

The primary issue with both methods is that they seek to isolate the impact of individual measures; however, the combination of measures installed in a home produces a certain benefit. Measure-level monetization will lead to disagreement on which measures should be considered with which NEBs and to what degree. Program-level NEBs would also be more appropriate for the cost-effectiveness test.

Recommendation 4: Navigant does not recommend monetizing NEBs on the measure-level because it is the combination of measures, not individual measures, that provides the benefits. Navigant recommends monetizing NEBs on the program-level, or value per participant per year.

5.3 Adapting NEBs Without Primary Research

The MA 2016 report used data from the National WAP study to monetize NEBs specifically for Massachusetts, adapting NEBs without conducting primary research. The MA 2016 report considered two components: (1) climate zone data and (2) data mined from additional resources.

(1) The National WAP study grouped their findings by climate zone: very cold, cold, moderate, hot-humid, and hot-dry. The MA 2016 report used cold climate zone data only for weather-dependent benefits such as cold-related thermal stress and all data for weather-independent benefits such as asthma-related costs. MA 2016 found that the sample sizes for cold-climate data only were large enough to be statistically significant for weather-dependent NEBs.

(2) The data mined from additional resources included modified context-sensitive inputs with state-specific values. For reduced asthma and thermal stress-related symptoms, the MA 2016 report used Massachusetts-specific data for average medical costs and percent of income-eligible with and without insurance. For reduced missed days at work, the MA 2016 report increased the

[14] "Documentation of TAC Review of Non-Energy Benefits," Memorandum to Technical Advisory Committee on 02/09/2016
[15] NMR Group (2011), Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts Evaluation-

average hourly wage. In cases where state-specific data could not be found, the MA 2016 report updated values with the most current available data or adjusted for inflation.

Recommendation 5: Although adapting national-data for state-specific NEBs has been done in Massachusetts, Navigant does not recommend monetizing NEBs without primary research. Navigant recommends conducting primary research to produce more defensible and applicable results for Illinois.

6. FINDINGS ON SOCIETAL NON-ENERGY BENEFITS

Societal impacts make up approximately 30-50% of NEBs for non-income-eligible programs and typically a lower portion for income-eligible programs.[16] Societal NEBs include health, safety, and comfort benefits, discussed in the previous section, in conjunction with participant benefits, economic benefits, and environmental benefits. Societal NEBs also involve reduced tax burden, reduced societal disparity and cost savings to social service agencies; however, these latter items have not yet been quantified and are rarely reported.

Economic impacts are associated with job creation and net incremental labor income. In a recommendation to Maryland in 2014, SERA recommended a value of $690,000 per million dollars of program installation dollars or a multiplier of 0.69[17]. This value was the most conservative found from an earlier study that used third party macroeconomic models to analyze money transferred from electricity generation to energy efficiency programs in Wisconsin, California, and Nationwide. Economic NEBs are generally non-transferrable and require a local study.[18]

Environmental and emissions impacts involve avoided use of water and reduced carbon dioxide and greenhouse gas emissions. The IL TRM already accounts for avoided use of water, and ComEd's total TRC accounts for carbon dioxide emissions within environmental benefits. The intention of carbon dioxide emissions in the TRC is to represent the cost of compliance with regulation, not the societal effects of greenhouse gases. Some research has been done on the value of avoided emissions as a NEB of weatherization programs and

Table 6-1 shows a range of reported values from a TecMRKT Works study published in 2000.

[16] Skumatz Economic Research Associates, Inc. (2014). Capturing the Multiple Benefits of Energy Efficiency – Roundtable on Energy Provider and Consumer Benefits

[17] Skumatz Economic Research Associates, Inc. (2014). Non-Energy Benefits/Non-Energy Impacts (NEBs/NEIs) And Their Role & Values In Cost-Effectiveness Tests: State of Maryland.

[18] Skumatz Economic Research Associates, Inc. (2014). Non-Energy Benefits/Non-Energy Impacts (NEBs/NEIs) And Their Role & Values In Cost-Effectiveness Tests: State of Maryland.

Table 6-1. Range of Values for Common Utility NEBs

Air Pollutant	$ / ton of Pollutant	$ / lb. of Pollutant	Cents per kWh
Sulfur Oxides (SOx)	110 - 2,030		1.15
Nitrogen Oxides (NOx)	44 - 8,143		1.86
Volatile Organic Compounds (VOCs)	530 - 6,673		
Particulates	40 - 9,953		0.19
Carbon Monoxide (CO)	1,086 - 9,200		0.02
Carbon Dioxide (CO_2)	10 - 77		2.1
Methane (CH_4)	150 - 252		0.01
Nitrous Oxide (N_2O)	4,140		0.08
Arsenic		920	
Beryllium		359 - 94,488	
Cadmium		143 - 37,795	
Trivalent Chromium		0 - 55	
Hexavalent Chromium		1,430	
Copper		0 - 70	
Lead		540	
Manganese		55 - 1,404	
Mercury		14 - 3,779	
Nickel		1 - 210	
Selenium		*0 - 70*	

Source: http://aceee.org/files/proceedings/2000/data/papers/SS00_Panel8_Paper25.pdf

Recommendation 6: Although economic and environmental impacts are significant, Navigant does not recommend quantifying economic and environmental societal NEBs specifically for income-eligible programs. Neither is specific to income-eligible programs and this research would be more appropriate for research at the portfolio level.

7. CONCLUSION AND NEXT STEPS

After reviewing 32 documents on non-energy benefits, Navigant recommends monetizing utility NEBs and conducting primary research to quantify health safety and comforts NEBs. Navigant will continue to pursue quantifying non-energy benefits and take the following next steps:

- Navigant will conduct primary research to quantify utility NEBs in 2018 and request and analyzing one-year of pre- and post-program billing data for a treatment and comparison group to estimate benefits on a per participant per year basis.
- Navigant will conduct primary research to quantify health, safety, and comfort NEBs for single-family and multifamily income-eligible, whole-home weatherization programs and draft a survey for ComEd's review

A summary of the complete recommendations provided in the report is provided below.

Recommendation 1: Navigant recommends monetizing utility NEBs. Navigant will request and analyze one-year of pre- and post-program billing data for a treatment and comparison group to estimate benefits on a per participant per year basis.

Recommendation 2: Navigant will conduct primary research to quantify health, safety, and comfort NEBs for income-eligible, whole-home weatherization programs. Following the methodology outlined in the National WAP study, Navigant will survey participants before and after weatherization to analyze the occurrence of all possible health, safety, and comfort NEBs as well as reduced O&M for participants. Navigant will start by monetizing the most defensible NEBs that benefit both participants and society: reduced asthma symptoms, reduced cold-related thermal stress, reduced-heat related thermal stress, and reduced missed days at work. Separate values will be calculated for SF and MF homes and values will be reported on the program level or as a per participant per year benefit.

Recommendation 3: Navigant recommends monetizing the avoided death benefit to more accurately estimate the true value of NEBs. Navigant will calculate the avoided death benefit for reduced cold-related thermal stress and reduced-heat related thermal stress in addition to the benefit of avoided medical costs.

Recommendation 4: Navigant does not recommend monetizing NEBs on the measure-level because it is the combination of measures, not individual measures, that provide the benefits. Navigant recommends monetizing NEBs on the program-level, or value per participant per year.

Recommendation 5: Although adapting national-data for state-specific NEBs has been done in Massachusetts, Navigant does not recommend monetizing NEBs without primary research. Navigant recommends conducting primary research to produce more defensible and applicable results for Illinois.

Recommendation 6: Although economic and environmental impacts are significant, Navigant does not recommend quantifying economic and environmental societal NEBs specifically for income-eligible programs. Neither is specific to income-eligible programs and this research would be more appropriate at the portfolio level.

APPENDIX A. MATRIX OF ALL RESEARCHED NEBS

A matrix of all researched NEBs is shown in Table A-1. It includes range of values, methods, how common they are in other jurisdictions, difficulty of quantifying, priority, and if it is transferable, adaptable, needing primary research, or not recommended.

Table A-1. Matrix of All Researched NEBs

Category	NEB	Source of Monetary Savings	Range of values or reported value	Considered by other jurisdictions? (1)	Difficulty of quantifying	Priority	Recommended?	Reference
Societal and Participant	Reduced asthma	Lower medical costs	$202.00-$322.00/participant/year	Only 2 states include these specific NEBs. 5 use an adder for health, safety, and comfort NEB	Easy	High	Recommended for Primary Research	(2) and (3)
Societal and Participant	Reduced cold-related thermal stress	Lower medical costs and fewer deaths	$393.26-$496.94/participant/year		Easy	High		(2) and (3)
Societal and Participant	Reduced heat-related thermal stress	Lower medical costs and fewer deaths	$87.45-$172.93/participant/year		Easy	High		(2) and (3)
Societal and Participant	Reduced missed days at work	Reduction in lost income	$20.25-$186.81/participant/year		Easy	High		(2) and (3)
Societal	Reduced need for food assistance	Reduced cost of food assistance	$84/participant/year		Easy	High		(2)
Utility	Arrearages	Avoided utility administration cost	$2.61/participant/year	5 account for utility-related benefits	Easy	High		(4)
	Bad write-offs		$3.74/participant/year		Easy	High		
	Terminations/reconnections		$0.43/participant/year		Easy	High		
	Customer calls		$0.58/participant/year		Easy	High		
	Notices		$0.34/participant/year		Easy	High		
	Safety Calls		$8.43/participant/year		Easy	High		
Tenant/ Participant	Reduced use of short-term, high interest loans	Lower interest payments and loan fees	$4.72-7.12/participant/year	Only 2 states include these specific NEBs. 5 out of 13 states use an adder for health, safety, and comfort NEB	Moderate	Medium		(2) and (3)
Societal and Participant	Reduced CO poisoning	Lower medical costs and fewer deaths	$31.43-$38.85/participant/year		Moderate	Medium		(2) and (3)
Societal	Increased ability to afford prescriptions	Lower medical costs for hospitalizations	$193.98/participant/year		Moderate	Medium		(2)
Tenant/ Participant	Increased home productivity	Higher productivity for housekeeping	$37.75-$133.67/participant/year		Moderate	Medium		(2) and (3)
Tenant/ Participant	Increased worker productivity	Higher productivity for work	$183.33/participant/year		Moderate	Medium		(2)
Societal and Participant	Reduced home fires	Fewer injuries, deaths, and property damage	$84-$111.71/participant/year		Moderate	Medium		(2) and (3)
Societal	Reduced need to choose between heating or eating	Lower medical costs for infants	$19.92/participant/year		Moderate	Medium		(2)
Owner	Equipment maintenance	Lower cost to maintain equipment	$3.91/participant/year for heating and cooling system, $66.73/participant/year for lighting	5 states account for property value benefits	Moderate	Medium		(4)
	Marketability	Lower cost associated with finding renters	$0.96/participant one time		Moderate	Medium		(4)
	Reduced tenant turnover	Lower cost associated with finding renters	$0		Moderate	Medium		(4)
	Home improvements	Higher value of home	$17.03/participant one time		Moderate	Medium		(4)
	Durability of property	Savings on maintenance	$36.85/participant/year		Moderate	Medium		(4)
	Tenant complaints	Fewer labor hours	$19.61/participant/year		Moderate	Medium		(4)
Societal	Economic impacts	Job creation	0.69 multiplier.	3 states account for societal benefits	Moderate	Low	Not Recommended for this study	(5)
Societal	Environmental/Emissions Impacts	Amount of CO2 equivalent emissions avoided and decreased use of water	$0.017/kWh, $22/participant/year or 12%	10 states account for resource benefits	Moderate	Low		(5)
Tenant/ Participant	Reduced water use	Savings on water bill	$0		Easy	Low		(5)
Tenant/ Participant	Participant comfort/noise		10.1% for comfort alone, or 26.6% for comfort/noise/light-related benefits	5 states use an adder for health, safety, and comfort NEB	Moderate	Low		(5)
Tenant/ Participant	Participant health and safety	Reduction in lost income	12.8% or $16.50/participant/year		Moderate	Low		(5)
Societal and Participant	Reduced wood smoke	Fewer injuries, deaths, and property damage	-	None	Difficult	Low		(6)
Non-resource	Appliance recycling	Avoided landfill space	$1.06/participant one time	None	Difficult	Low		(4)
	Appliance recycling	Reduced emissions due to recycling plastic and glass	$1.25/participant one time		Difficult	Low		(4)
	Appliance recycling	Reduced emissions due to incineration of foam	$170.22/participant one time		Difficult	Low		(4)

(1) Synapse Energy Economics Inc. (2014). Driving Efficiency with Non-Energy Benefits

(2) Oak Ridge National Laboratory (2014). Health and Household-Related Benefits Attributable to the Weatherization Assistance Program

(3) Three3, Inc. and NMR Group (2016). Massachusetts Special Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study

(4) NMR Group (2011), Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts Evaluation

(5) Skumatz Economic Research Associates, Inc. (2014). Non-Energy Benefits/Non-Energy Impacts (NEBs/NEIs) And Their Role & Values In Cost-Effectivenses Tests: State of Maryland.

(6) RTF Staff (2014). Preliminary Report: Quantifying the Health Benefits of Reduced Wood Smoke from Energy Efficiency Programs in the Pacific Northwest

APPENDIX B. SUMMARY OF NATIONAL WAP METHODOLOGY

This appendix summarizes the National WAP method for monetizing the four recommended NEBs.

Reduced Asthma Symptoms

Quantifying the Impact of Weatherization

The National Occupant Survey asked the following question before treatment:

- Have you ever been told by a physician that you have asthma?

And after treatment:

- If the above is yes, do you still have asthma?
- During the past 12 months did you have to stay overnight in the hospital because of asthma?
- Not counting hospitalizations, during the past 12 months, did you go to an emergency room because of asthma?

The result was that 16.8% of adults in the WAP population have asthma, and asthma-related emergency department (ED) visits and hospitalizations for all respondents reporting current diagnosis of asthma was reduced by 11.5% and 3.1%, respectively, due to weatherization.

The study also sought to monetize potential reductions in indirect costs for "high-cost" asthma patients pre-weatherization who became "low-cost" patients post-weatherization. High-cost patients are characterized by those that needed medical attention less than 3 months after weatherization and are thus subject to many more indirect costs such as reduced housekeeping loss, loss of school and work productivity, and restricted activity. The result was that the reduction in high-cost patients was 11.8%.

Monetizing the Benefit

These additional inputs were found from reputable secondary databases:

- Average cost for hospitalizations per adult and child and ED visit for all individuals (state-specific where available and adjusted for inflation)
- Percentage of income-eligible with Medicare, Medicaid, Private/Other Insurance, or Uninsured (state-specific where available)
- Frequency of re-admittance to hospital for adults and children and ED visits for all individuals
- Other direct medical costs and indirect costs associated with high-cost asthma patients adjusted for inflation

Those inputs were used to help quantify benefits associated for ED and hospitalizations:

*Benefit = (number of persons served by WAP in PY 2008) * (asthma prevalence for adults and children) * (reduction in ED visits or hospitalizations) * (frequency of re-admittance (adults and children)) * (average hospital costs (adults and children))*

and quantify other direct and indirect medical savings for high-cost patients:

*Benefit = (number of persons served by WAP in PY 2008) * (asthma prevalence for adults and children) * (reduction in high-cost patients) * (difference in high and low-cost patients after extracting the ED visit and hospitalization costs already claimed))*

Reduced Thermal Stress on Occupants

Quantifying the Impact of Weatherization

The National Occupant Survey asked the following questions:

- In the past 12 months, has anyone in the household needed medical attention because your home was too cold?
- In the past 12 months, has anyone in the household needed medical attention because your home was too hot?

They compared answers from the weatherization group before and after treatment during the study, and a comparison group that had received treatment one year prior to the weatherization group receiving treatment. The impact of treatment was calculated using this equation:

Reduction in medical needs = [(Pre-treatment – Post-treatment) + (Pre-treatment – Comparison group)] / 2

The result was that in 2008 the number of times occupants needed medical attention was reduced by 1.4% with 113 hospitalizations and 4 potential deaths prevented for cold-related stress and 1.1% with 25 hospitalizations and 1 potential death prevented for heat-related stress. The reduction was 0.004776% for cold-climate zone data only.

Monetizing the Benefit

These additional inputs were found from reputable secondary databases:

- Percentage of hospitalizations, ED visits, and physician office visits for cold- and heat-related stress (state-specific where available)
- Average cost for each type of medical treatment including hospitalizations, ED visits, and physician office visits (state-specific where available and adjusted for inflation)
- Percentage of income-eligible with Medicare, Medicaid, Private/Other Insurance, or Uninsured (state-specific where available)

Those inputs were used to help quantify the number of occurrences of (a) hospitalization, (b) ED visit, and (c) physician office visit avoided:

N (a, b, c) = [*(Number of WAP units completed in PY 2008) * (decreased rate of seeking medical care) * (% of type of medical treatment sought for cold and heat-related thermal stress (for a, b, and c)*]

And the percent of annual medical costs for (a, b, and c) for those with (p1) Medicare, (p2) Medicaid, (p3) private/other, and (p4) uninsured or out-of-pocked payers:

*% of annual medical costs—(for p1, p2, p3, p4)—for WAP population (for a, b, and c) = [[(% of WAP population by medical coverage type) * (% of medical costs—by payer—for Population (for a, b, and c)] / (% of population by medical coverage type)]]*

And finally, the benefit associated:

*Benefit (without avoided deaths) = [(N (a, b, c) * % WAP medical costs (for p1, p2, p3, p4)) * Average cost for treatment (for a, b, and c)]*

Monetizing Avoided Death Benefit

To incorporate the benefit of avoided deaths, these additional inputs where needed from secondary sources:

- Number of deaths following hospitalization (state-specific where available)
- Percentage of hospitalizations resulting in deaths (state-specific where available)
- Current Value of Statistical Life

And the following equations were used:

*# of avoided deaths= [(% of hospitalizations resulting in deaths (U.S. population) * (# of hospitalizations prevented by WAP in PY 2008)]*

*Total benefit of avoided deaths = [# of avoided deaths * VSL]*

Reduced Missed Days at Work

Quantifying the Impact of Weatherization

The National Occupant Survey asked the following questions:

- In the past 12 months, about how many days of work did you (or the primary wage earner) miss at a job or business because of illness or injury?
- In the past 12 months, about how many days of work did you (or the primary wage earner) miss because of illness or injury of another household member?

They compared answers from the weatherization group before and after treatment during the study, and a comparison group that had received treatment one year prior to the weatherization group receiving treatment. The impact of treatment was calculated using this equation:

Reduction in medical needs = [(Pre-treatment – Post-treatment) + (Pre-treatment – Comparison group)] / 2

The estimated change was 0.52 fewer days missed work.

Monetizing the Benefit

These additional inputs were found from reputable secondary databases:

- Average hourly wage (state-specific where available and adjusted for inflation)
- Percent of income-eligible worker without sick leave

Those inputs were used to help quantify the benefit:

*Benefit = (number of Wx Jobs completed in PY 2008) * (% of WAP households with an employed primary wage earner) * (reduction in missed days work) * (average hourly wage) * (8 hours/day)*

The societal and household benefit was calculated by multiplying the above result by the percentage of low income workers with and without sick leave, respectively.

Reduced Need for Food Assistance

Quantifying the Impact of Weatherization

The National Occupant Survey asked the following question:

- Some households receive additional assistance to help pay for food. In the past 12 months did you or any members of your household receive food stamps or WIC assistance (Women, Infants, and Children nutrition program)?

They compared answers from the weatherization group before and after treatment during the study, and a comparison group that had received treatment one year prior to the weatherization group receiving treatment. The impact of treatment was calculated using this equation:

Reduction in medical needs = [(Pre-treatment – Post-treatment) + (Pre-treatment – Comparison group)] / 2

The estimated reduction in those needing food assistance was 6%.

Monetizing the Benefit

This additional input was found from a reputable secondary database:

- Average monthly per person food assistance subsidy (state-specific where available and adjusted for inflation)

This was used to help quantify the benefit:

*Benefit = (number of Wx Jobs completed in PY 2008) * (percent of reduction in households requiring food assistance) * (average annual per person food assistance subsidy) * (average WAP household size)*