

Appendix A

**Summary of Public Policy Regarding Energy Efficiency in New Hampshire and the
Delivery of Low-Income Energy Efficiency in Particular**

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I. N.H. Statutes

A. RSA 374-F Electric Utility Restructuring.

1. RSA 374-F:3, V(a). Universal Service.

(a) Electric service is essential and should be available to all customers . . . Programs and mechanisms that enable residential customers with low incomes to manage and afford essential electricity requirements should be included as part of industry restructuring.

2. RSA 374-F:3, VI. Benefits for All Consumers.

Restructuring...should be implemented in a manner that benefits all consumers equitably and does not benefit one customer class to the detriment of another. Costs should not be shifted unfairly among customers. A nonbypassable and competitively neutral system benefits charge applied to the use of the distribution system may be used to fund public benefits related to the provision of electricity. Such benefits, as approved by regulators, may include, but not necessarily be limited to, programs for low income customers, energy efficiency programs...

3. RSA 374-F:3, X. Energy Efficiency.

Restructuring should be designed to reduce market barriers to investments in energy efficiency . . . Utility sponsored energy efficiency programs should target cost effective opportunities that may otherwise be lost due to market barriers.

4. RSA 374-F:4, VIII(a). Implementation.

(a) The Commission is authorized to order such charges and other service provisions and to take such other actions that are necessary to implement restructuring and that are substantially consistent with the principles established in this chapter.

B. RSA 369-B:1, XIII. Electric Rate Reduction Financing and Commission Action.

The Commission should design low income programs in a manner that targets assistance and has high operating efficiency so as to maximize the benefits that go to the intended beneficiaries of the low income program.

C. **RSA 378:37 through 378:40. Least Cost Planning.**

1. **RSA 378:37. NH Energy Policy.**

...it shall be the energy policy of this state...to maximize the use of cost effective energy efficiency...and to protect the safety and health of the citizens, the physical environment of the state, and the future supplies of resources.

2. **RSA 378:39. Commission Evaluation of Plans.**

When reviewing integrated least cost resource plans, the commission shall consider potential environmental, economic, and health-related impacts of each proposed option. If the options have equivalent financial costs, equivalent reliability, and equivalent environmental, economic, and health-related impacts, then the Commission shall prioritize energy efficiency and other demand-side management resources over other energy sources.
RSA 378:39.

D. **RSA 125-O:5-a. Energy Efficiency and Sustainable Energy Board.**

1. **RSA 125-O:5-a, I.** An energy efficiency and sustainable energy board is hereby created to promote and coordinate energy efficiency, demand response, and sustainable energy programs in the state.

2. **RSA 125-O:5-a, I.** The board's duties shall include but not be limited to: . . .

i) Work with community action agencies and the office of energy and planning to explore ways to insure that all customers participating in programs for low-income customers and the Low Income Home Energy Assistance Program (LIHEAP) have access to energy efficiency improvements, and where appropriate, renewable energy resources, in order to reduce their energy bills.

II. **PUC Orders.**

1. **Order No. 26,095, 1/2/18, DE 17-136.**

1) P. 18. The three year plan will reduce market barriers to investment in cost-effective energy efficiency and provide incentives for appropriate demand-side management. The savings from the EE programs will benefit all customers, both participants and non-participants. The participants will enjoy the direct benefit of increased energy efficiency. Both participants and non-participants will benefit from on-peak and off peak load reduction and related system improvements. Accordingly, we find the Three Year Pan, as modified by the Settlement Agreement,

consistent with the public interest and we approve it. Page 18.

2. **Order No. 25,932, 8/2/16, DE 15-137.**

1) P. 54. In approving the EERS as proposed, we are mindful of and do not take lightly the short term increases in customer rates. When considered in the context of the benefits of increased energy efficiency, participating gas and electric customers will spend less on energy usage and, in the long run, all customers will spend less on energy supply... The record and support by parties with diverse interests, along with the customer-protection measures built into the EERS framework...give us confidence that any short-term rate impacts will be outweighed by the benefits to customers, the grid, and the NH economy. In addition... the Commission will...ensure that the energy efficiency programs funded by customers are indeed the least-cost resource available to...customers. Page 54.

2) P. 56. The proposed costs of achieving the short-term goals recommended by the Settlement Agreement appear to be just and reasonable as well as consistent with the recent legislative mandate to consider energy efficiency a first priority resource. p. 56.

3) P. 56. We take note of the Settling Parties' proposal to increase the low-income program budget. At a time of uncertainty about the future of energy supply in the New England region and consistent with the legislative directive in RSA 374-F:3, V ("Commission shall enable residential customers with low incomes to manage and afford essential electricity requirements"), we find this proposal to be appropriate. Moreover, increasing low-income efficiency funding and activities should free up some of the low-income financial assistance also collected through the SBC and LDAC, because these customers' energy consumption will decrease. Pages 56, 57.

4) P. 57. While rates may increase slightly for all customers in the short term in order to recover the cost of an EERS, customer bills will decrease when their energy consumption decreases, as well as when the impact of consumption decreases are reflected in reduced grid and power procurement costs...While the cost benefit tests ensure benefits to all customers, it is true that those who participate in efficiency programs are likely to benefit most...Non-participating customers enjoy the benefits from load and system improvements...In addition, the efficiency programs will reduce emissions and may reduce utility revenue requirements through reduced operation and maintenance (O&M) expenses. Further, the availability of direct benefits from participation, coupled with broad-based programs, should send a signal to all customers and encourage broad participation in the programs. Page 57.

5) P. 64. Energy prices have been the subject of public discussion and debate for many years. The EERS is a significant step toward addressing the business community's concerns about remaining competitive in today's economy. Page 64.

6) P. 64. We recognize that low income customers face greater hurdles to investment in energy efficiency than other customer.(sic) We have therefore approved increased funding for low income energy efficiency programs as recommended by the settling parties. We agree that these changes are appropriate in order to comply with legislative directives and to reduce energy consumption for those customers who need it most. Page 64.

7) P. 50. The record supports a finding that cost-effective energy efficiency is a lower cost resource than other energy supply.

3. **Order No. 25,976, dated 12/23/16 in DE 14-216.**

1) P. 13. Based on the record, the 2017 Plan appears to be consistent with applicable law, including the least cost integrated planning requirements promoting energy efficiency. The 2017 Plan will reduce market barriers to investment in cost-effective energy efficiency and provide incentives for appropriate demand side management. The savings from the 2017 programs will benefit all customers, both participants and non-participants. The participants enjoy the direct benefit of increased energy efficiency. Both participants and non-participants benefit from on-peak and off peak load reduction and related system improvements. Consequently, we find the 2017 Plan, as modified by the Settlement Agreement, consistent with the public interest, and we approve it. Page. 13.

4. **Order No. 25,747, dated 12/31/14 in DE 14-216.**

1) Pages 11, 12. RSA 378:38 empowers the Commission to make energy efficiency a high priority resource:

“It shall be the energy policy of this state to meet the energy needs of the citizens and businesses of the state at the lowest reasonable cost while providing for the reliability and diversity of energy sources; to maximize the use of cost effective energy efficiency and other demand side resources; and to protect the safety and health of the citizens, the physical environment of the state, and the future supplies of resources, with consideration of the fiscal stability of the state's utilities” [emphasis original]. Pages 11,12.

“Where the Commission determines [a utility’s supply or resource] options have equivalent financial costs, equivalent reliability, and equivalent environmental, economic, and health-related impacts” it shall prioritize “energy efficiency and other demand-side management resources.” RSA 378:39.

Energy efficiency programs provided to customers constitute “public benefits” appropriately supported by the SBC. RSA 374-F:3, VI. Page 12.

2) P. 14. We commend the Settling Parties for the proposal to increase the budget for the residential Home Energy Assistance Program, which provides weatherization services to income-qualified households. At a time of increasing electricity and natural gas rates and uncertainty about the future of energy supply in the New England region, we find this modification of the Core programs to be timely and appropriate. Page. 14.

5. **Order No. 24,109 dated 12/31/2002, in DG 02-106, 87 NH PUC 892 (2002).**

1) P. 897. Costs associated with the residential Low Income Program will be recovered from all firm customers since benefits from the low income program can be ascribed to all customer classes. 87 PUC at 897.

2) P. 898. The Staff and Parties answered in the affirmative the following ten threshold issues for the natural gas energy efficiency programs: . . .

6) that separate consideration was appropriate for programs targeting low-income customers. 87 PUC at 898.

3) P. 899. Low Income Energy Efficiency Programs. Key Span and Northern’s low income program budgets are dedicated and those budgets cannot be siphoned away to other programs. Section E.1 of the Agreement states Key Span and Northern have no discretion to transfer funds to or from the low income programs without prior Commission approval. We believe this provision safeguards our interest in seeing low income customers are not left out of energy efficiency programs due to the pressure that each program meet a cost effectiveness threshold. 87 PUC at 899.

4) P. 899. We expect the companies to continue their collaboration with CAAs, the GOECS, and SOHO as described in section C of the Agreement to ensure the needs of the low income community are met

and that these programs are fully implemented. (Emphasis added).
87 PUC at 899.

6. **Order No. 23,982 dated 5/31/2002 in DE 01-057, 2002 NH PUC
LEXIS 67; 218 P.U.R. 4th 421 (2002).**

1) In an effort to advance and implement these legislative determinations of public policy [RSA 374-F; 374-F:1, I; 374-F:1, III; 374-F:3, X] the Commission entered Order No. 23, 574 on Nov. 1, 2000, adopting with certain modifications, the recommendations of the NH Energy Efficiency Working Group (see 85 NH PUC 684 (2000)), to develop a series of Core Energy Efficiency Programs, to be funded by ratepayers via the System Benefits Charge authorized by RSA 374-F:3, VI (Pages 1-3).

2) Provisions from the Restructuring Act discussed above make clear that energy efficiency is a crucial and key element of the electric industry transformation contemplated and mandated by the Act. (Page 18).

3) Accordingly, we find that it is consistent with the public good to make the Core Energy Efficiency Programs available to NH electric customers as soon as practicable (Page 18).

4) We intend to open a docket to consider the role of the gas utilities in making energy efficiency a reality for all NH energy consumers, regardless of heating method employed (Page 24).

7. **Order No. 23,574 dated Nov. 1, 2000 in DR 96-150.**

1) Pages 13, 14. We will accept the cost-effectiveness test as proposed in the Working Group's Report...Although the Commission has not previously authorized the use of adders, we will do so here and permit such a mechanism until some material change occurs that would warrant our reconsideration of the [15%] adder or its magnitude (Pages 13, 14).

2) Low income energy efficiency programs will be funded out of the general energy efficiency budget of the electric utilities. Low income energy efficiency programs should reflect an agreed-upon set of Core programs. This is an area where we believe well-designed statewide programs could help to alleviate the apparent persistence of "undesirable market conditions." (Page 17).

3) It is hereby ordered . . . that except as specifically noted above, the Commission adopts the recommendations of the [1999] NH Energy Efficiency Working Group Report. (Page 26).

III. Other References to and Discussions of NH Public Policy Regarding Energy Efficiency.

1. NH PUC Annual Report on Results and Effectiveness of the System Benefits Charge, October 1, 2018.

1) Page 1. The EERS is the framework within which the Commission's energy efficiency programs will be implemented, and it consists of three-year planning periods and savings goals as well as a long-term goal of achieving all cost-effective energy efficiency. (emphasis added) Page 1.

2. New Hampshire 2018 Ten Year Energy Strategy Dated April 2018.

1) Energy Efficiency (EE) is the cheapest and cleanest energy resource. Investing in efficiency boosts the state's economy by creating jobs and reduces energy costs for consumers and businesses. New Hampshire should prioritize capturing cost-effective energy efficiency in all sectors, including buildings, manufacturing and transportation. Page 14.

2) On August 2, 2016 NH PUC issued Order No. 25,932 approving an Energy Efficiency Resource Standard (EERS). The primary goal of the Order is to achieve all cost-effective energy efficiency. Page 39.

3) The legislature created the Energy Efficiency and Sustainable Energy (EESSE) Board to promote and coordinate energy efficiency, demand response, and sustainable energy programs in the state. RSA 125-O:5-a (2008). Page 40.

4) Reducing our energy use, especially during expensive peak times saves money for everyone on our energy systems. Pages 14 and 39.

3. Northeast Energy Efficiency Partnerships, Inc. (NEEP) 2017 Report. Non-Energy Impacts Approaches and Values: an Examination of the Northeast, Mid-Atlantic, and Beyond.

1) Page 1, 3d paragraph.

The use of adders or combined approaches in which adders and monetized NEIs are included have enabled states to be more comprehensive in terms of the types of NEIs included in cost-effectiveness analysis.

Recent guidance from the National Standard Practice Manual provides important direction for states developing or revising cost-effectiveness practices because it defines core principles that avoid biased, asymmetrical application of cost-effectiveness tests and it

recommends that states make their energy efficiency policy context a key element in deciding about what to include in NEIs.

2) Pages 2, 3 (last paragraph on p. 2; top of p. 3)

The 2009 New Hampshire Climate Action Plan connects energy efficiency, greenhouse gas reductions, and long term economic benefits. “The most significant reductions in both emissions and costs will come from substantially increasing energy efficiency in all sectors of our economy, continuing to increase sources of renewable energy, and designing our communities to reduce reliance on automobiles for transportation...”

3) Page 3, first paragraph.

The 2014 New Hampshire Ten-Year Energy Strategy, at page iii, called for the PUC to open a proceeding that directs the utilities in collaboration with other interested parties “to develop energy savings goals...aimed at achieving all cost effective efficiency over a reasonable timeframe.”

4) Page 44, last paragraph, last sentence.

Looking ahead, development of a cost-effectiveness framework starting from the Rhode Island template...and taking key policy goals into account would also help guide the development of unbiased, comprehensive, forward-looking energy efficiency cost-effectiveness assessment.

4. NHLA Presentations and Testimony of R. Colton Regarding Public Policy.

1) See Direct Testimony of Roger Colton dated 11/2/18 in DE 17-136, page 45.

2) See Direct Testimony of Roger Colton dated 11/1/17 in DE 17-136, page 35.

The use of a separate low income adder would allow the Commission to incorporate NH public policy favoring the delivery of energy efficiency to low income households into the NEI determination. Page 35 (Bates page 037). See also the following pages of Roger Colton’s testimony in which he discusses N.H. public policy with respect to energy efficiency, including low income energy efficiency, at pages 12-14 (Bates pages 014-016), 25 (Bates page 027), and 35 (Bates page 037)

Appendix B

Public Service of New Hampshire d/b/a Eversource Energy
Docket No. DE 17-136

Date Request Received: 10/09/2018

Request No. CLF 2-011

Request from: Conservation Law Foundation

Date of Response: 10/23/2018

Page 1 of 1

Witness: Katherine W. Peters

Request:

Please state whether the NH utilities could effectively accomplish additional efficiency measures if they did not lower their spending for 2019 from previously planned spending levels for 2019.

Response:

If the Utilities had additional funding for 2019, that additional funding could be utilized to achieve additional energy savings. However, the specific goals of the EERS are to achieve an energy savings goal of 1% of 2014 sales for electric and 0.75% of 2014 sales for natural gas. The EERS goals were set with the agreement of all parties in DE 15-137. Page 8 of the Settlement Agreement states: "The Settling Parties agree that the savings goals balance the goals of capturing more cost effective energy efficiency and benefits to ratepayers with the goal of gradually increasing funding for efficiency while minimizing the impacts on all ratepayers." It is the role of the utilities to develop budgets and propose the funding levels that are required in order to cost-effectively meet the agreed-upon goals. See OCA 2-001 for additional detail regarding the requirements of the EERS and the utility funding proposal.

(Joint Utility response)



Memorandum

HEA Program Non-Energy Impact Analysis

To: New Hampshire EM&V Working Group

From: 2016-17 HEA Program Evaluation Team

Date: November 2, 2018

Re: Review of Selected NEI Research and Analysis Approach Recommendations

Introduction

This memorandum summarizes a review of recent non-energy impacts (NEI) literature focused on the potential NEIs associated with low-income energy efficiency programs, such as the NHSaves 2016-17 Home Energy Assistance (HEA) Program. Based on this literature review and the current scope for the HEA impact evaluation, this memo also provides our recommendation for what NEIs we will attempt to quantify in the current evaluation of the HEA program and our recommended methods.

This memo is comprised of the following:

- A list of NEI literature sources reviewed for this effort;
- Common categories of low-income program NEIs and the methodologies by which they are commonly estimated;
- Input from NHSaves stakeholders about which NEIs to include in the analysis;
- Pros and cons of estimating NEIs at the program versus measure level, and which approach fits for the HEA NEI analysis; and
- A recommendation for the NEIs the evaluation team will include in the HEA NEI analysis, along with the recommended methods by which the team will quantify them.

Recommendation Summary

In summation, we recommend quantifying the NEIs in the 2016-17 HEA evaluation outlined below. In Table 1, we differentiate between NEIs experienced by utilities, program participants, and the broader public (i.e., societal NEIs), along with an explanation of the evaluation team's justification for quantifying those NEIs.

Table 1. NEI Recommendation Summary

NEI Category	NEIs Considered for Analysis	NEIs Recommended for Analysis	Justification
Utility	Reduced arrearages	✓	Easy to directly monetize if utility data is available.
	Reduced debt write-offs	✓	
	Decreased terminations/reconnections	✓	Well established proxy values are available to use as multipliers (see Table 2), assuming utility data is available that allows the evaluation team to calculate changes in these NEIs.
	Fewer collection notices	✓	
	Reduced customer calls	✓	
	Reduced safety calls	✓	
Participant	Reduced asthma symptoms	✓	The evaluation team can rely on the survey approach to assess changes in these participant attributes due to the program and can use unit values secondary sources to monetize these NEIs for single-family low-income programs with similar climates (e.g., 2016 Three ³ and NMR Low Income Single Family study for MA Program Administrators). According to Table 2, these participant NEIs are easy to quantify and are high priority NEIs.
	Reduced cold-related thermal stress	✓	
	Reduced heat-related thermal stress	✓	
	Fewer missed days at work	✓	
Societal	Improved air quality	✓	Relatively easy to include in analysis using secondary or modeling approach to monetization or adder/proxy value.

The remainder of this memo outlines all of the NEIs we considered through the literature review and our justification for prioritizing the NEIs outlined above compared to other potential NEIs from low-income programs. In summation, the NEIs outline above are recommended in our current evaluation based on the following decision-making factors:

- The current evaluation is largely impact and process focused while also attempting to capture NEIs where possible. The NEI analysis in the evaluation plan was intended to complement any other evaluation tasks that are already planned for impact and process purposes such as analyzing utility databases, and surveying participants and non-participants.
- While there are many participant NEIs that can be captured by surveying participants and non-participants (or a comparison group), the survey instrument can become too lengthy especially when the survey also has other research objectives that are more process evaluation-related. To keep survey length reasonable for respondents, we have prioritized the participant NEIs that appear to be of the highest value and easiest to quantify through survey methods

NEI Literature Sources

Evaluators and researchers have contributed to the literature on NEIs over the past few decades by identifying NEIs, describing the methodologies to quantify them, and discussing how evaluators incorporate them into cost-effectiveness tests. The literature is expansive, covering evaluations that estimate NEIs at the measure level for specific energy efficiency programs to studies that evaluate NEIs for programs operating at

a national level, such as the Department of Energy's Weatherization Assistance Program (WAP). The literature also describes NEIs for programs that operate in residential and non-residential sectors, and even those that are fuel specific in some cases. Some experts in the field (e.g., Skumatz Economic Research Associates, Inc., Three³, Tetra Tech, and NMR Group) provide summaries of studies that present the ranges of specific NEI values estimated to date.

In July 2018, the Opinion Dynamics team met with the NH Utilities Evaluation, Measurement and Verification (EM&V) Working Group and the Benefit/Cost (B/C) Working Group to solicit their feedback on the NEIs they would like the evaluation team to consider for the 2016-17 HEA program evaluation. During these meetings, the Working Groups recommended sources the evaluation team should review.

The Opinion Dynamics team also met with DNV-GL and a member of the EM&V Working Group to coordinate research efforts and discuss reports and studies worthy of consideration since DNV-GL is currently developing a NEI database for the NH Utilities based on secondary research. Through these discussions, the evaluation team identified several sources worth reviewing to determine which NEIs are feasible and applicable to the analysis of the NHSaves HEA program and what methods are available to quantify them:

- 2018-2020 NH Statewide EE Plan, Testimony from Michael R. Goldman and Roger Colton, "Accounting for Non-Energy Impacts in New Hampshire's Cost-Effectiveness Test", Docket #17-136 Attachment L, September 1, 2017
- 2018-2020 NH Statewide EE Plan, "Order Approving Settlement Agreement", Order# 26.095, January 2, 2018
- 2018-2020 NH Statewide EE Plan, "Supplement to Section V of NHLA Memo Dated February 14, 2018 on Adopting a Separate Low-Income Adder in New Hampshire", Docket #17-136, June 13, 2018
- National Efficiency Screening Project, "National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources", Spring 2017.
- Navigant and Johnson Consulting Group, "Quantifying Non-Energy Benefits from ComEd's Income Eligible Programs: Findings and Recommendations from Secondary Research: Draft", March 6, 2018.
- Navigant, "ComEd Non-Energy Impacts Research Plan – Part 1: Draft," July 31, 2018.
- NMR Group, Inc. and Tetra Tech. "Massachusetts Program Administrators: Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation: Final", August 15, 2011.
- NMR Group, Inc., Tetra Tech, and DNV-GL. "Program Administrators of Massachusetts: Non-Energy Impact Framework Study Report", January 23, 2018.
- Northeast Energy Efficiency Partnerships (NEEP). "Non-Energy Impacts Approaches and Values: An Examination of the Northeast, Mid-Atlantic, and Beyond", June 2017.
- Oak Ridge National Laboratory. "Health and Household-Related Benefits Attributable to the Weatherization Assistance Program", ORNL/TM-2014/345, September 2014.

- Skumatz, Lisa, Ph.D. “Non-Energy Benefits / NEBs – Winning at Cost-Effectiveness Dominos: State Progress and TRMs”, 2016 ACEEE Summer Study on Energy Efficiency in Buildings.
- Three³ and NMR Group, Inc. “Massachusetts Special and Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study”, August 5, 2016.

Further, there is a current study by Three³ and NMR Group to estimate low-income program NEIs in multifamily residences. This study focuses mostly on properties located in the Northeast and will include three New Hampshire multifamily properties. Based on 2016-17 HEA program tracking data, we know that one of the properties did not participate in the program. Upon receipt of further data about the other two properties, we will check whether they appear in the program tracking data.

During discussions the evaluation team held with the EM&V Working Group, members of the group expressed interest in focusing the HEA NEI analysis on utility and participant NEIs. The B/C Working Group concurred, but also noted that the evaluation team should also consider including certain societal NEI that are easy to quantify and that fall into the scope of the analysis (e.g., NEIs from reduced GHG emissions through less use of energy).

Common NEB Categories

NEIs are the positive and negative effects that stem from energy efficiency programs apart from the energy and demand savings. NEIs fall into three categories that describe the party to which the NEIs accrue: utility, participant, and societal NEIs. Each of these categories is described below:

- **Utility:** Outcomes for the utility sponsoring the energy efficiency program. Impacts commonly focus on reduced (avoided) utility administrative costs due to customers’ program participation (e.g., reduced arrearages, improved services).
- **Participant:** Ancillary outcomes that participants experience from program upgrades at their home or business, with impacts commonly focusing on, but not limited to, changes in occupant health, safety, and comfort.
- **Societal:** Changes in the general population’s welfare due to the economic, environmental, health and safety, and distribution system outcomes that spill over from program upgrades. These types of NEIs are generally captured at a portfolio-wide level, given their societal scale. Job creation and emissions reductions are examples of societal benefits.

Each NEI category includes numerous NEIs and the degree of difficulty in identifying and quantifying each endpoint varies greatly, as shown in Table 2 taken from a study by Navigant and Johnson Consulting Group (2018).¹

Utility NEIs, particularly those from low-income programs, can be simpler to quantify because they are estimated from utility records of arrearage payments, debt collections, service terminations and reconnections, and from changes in the frequency of customer calls and safety calls. The data used to

¹ Navigant and Johnson Consulting Group, “Quantifying Non-Energy Benefits from ComEd’s Income Eligible Programs: Findings and Recommendations from Secondary Research: Draft”, March 6, 2018. pg. 22.



calculate many of these NEIs is already monetized. Though utility NEIs are generally straightforward to estimate, the ability to arrive at these impacts is highly dependent on the quality of data tracked by the utility.²

² Ibid. pg. 11

Table 2. Matrix of Researched NEIs

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		Easy	High		(2) and (3)
Societal and Participant	Reduced cold-related thermal stress	Lower medical costs and fewer deaths	\$393.26-\$496.94/participant/year	Only 2 states include these specific NEBs. 5 use an adder for health, safety, and comfort NEB	Easy	High		(2) and (3)
Societal and Participant	Reduced heat-related thermal stress	Lower medical costs and fewer deaths	\$67.45-\$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)
	Arrearages		\$2.61/participant/year		Easy	High		
	Bad write-offs		\$3.74/participant/year		Easy	High		
Utility	Terminations/reconnections	Avoided utility administration cost	\$0.43/participant/year	5 account for utility-related benefits	Easy	High		(4)
	Customer calls		\$0.68/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		Moderate	Medium		(2) and (3)
Societal and Participant	Reduced CO poisoning	Lower medical costs and fewer deaths	\$31.49-\$38.85/participant/year		Moderate	Medium		(2) and (3)
Societal	Increased ability to afford prescriptions	Lower medical costs for hospitalizations	\$193.98/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	Recommended for Primary Research	(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)
	Equipment maintenance	Lower cost to maintain equipment	\$3.91/participant/year for heating and cooling system, \$66.73/participant/year for lighting		Moderate	Medium		(4)
Owner	Marketability	Lower cost associated with finding renters	\$0.96/participant one time	5 states account for property value benefits	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		(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	Not Recommended for this study	(5)
Tenant/ Participant	Participant health and safety	Reduction in lost income	12.8% or \$16.60/participant/year		Moderate	Low		(5)
Societal and Participant	Reduced wood smoke	Fewer injuries, deaths, and property damage	-	None	Difficult	Low		(6)
	Appliance recycling	Avoided landfill space	\$1.06/participant one time		Difficult	Low		(4)
Non-resource	Appliance recycling	Reduced emissions due to recycling plastic and glass	\$1.25/participant one time	None	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-Effectiveness 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

Participant NEIs are traditionally more difficult to estimate, as they can require primary data collection to assess how the program affected them outside of the energy saved from the program. Some of the most studied participant NEIs in the literature include reduced asthma symptoms, reduced thermal stress (both hot and cold), reduced missed days at work, increased home productivity due to improvements in sleep and consistency of indoor climate, and reduced costs of equipment maintenance. Table 2 above includes more examples of participant NEIs and shows that the majority are moderately difficult to quantify. Experts in the field agree that this category of NEIs is the largest. In fact, participant NEIs may even exceed the energy savings from low-income energy efficiency programs.³

The table categorizes many health, safety, and comfort NEIs as accruing to both participants and society (e.g., reduced asthma, reduced thermal stress, reduced missed days at work, reduced CO poisoning, etc.). The most obvious impact of low-income weatherization programs is the benefit to program participants, but these can also be classified as societal impacts to the extent that the health, safety, and comfort of all citizens are affected.

Societal NEIs are outcomes that accrue more broadly due to changes in the environment, the economy, and overall health, safety, and comfort. For example, a direct benefit to society of reduced energy use is reduced emissions that result from electric generation. Another is the creation of jobs to carry out the implementation of the program, such as those held by individuals who weatherize homes and install energy efficiency equipment rebated through utility programs. These impacts accrue to society. Based on Table 2 above, quantifying these impacts is moderately difficult and is generally considered lower in priority than most utility and participant NEIs.

Common Methods to Capture NEIs

Based on the literature review, there is a common set of methodologies to account for NEIs in cost-effectiveness tests and these range from crude approximations, such as straight percentage or dollar adders to detailed estimations of NEIs based on primary data collection. The methods used are often dictated by the time and budget available for the analysis. Table 3 outlines these common methods.⁴

Table 3. Methods to Account for NEIs in Cost-Effectiveness Tests

Method	Description
Adders	<ul style="list-style-type: none"> ▪ Percentage or dollar adders applied to energy savings value and are included in cost-effectiveness tests to represent an approximation of NEIs. ▪ Adders are meant to represent a conservative estimate of NEIs. ▪ Adders are usually larger for low-income programs to account for policy objectives.
Proxy values	<ul style="list-style-type: none"> ▪ Existing research on NEI values is used to develop stand in values ▪ In some cases, utility or state-specific data is used in NEI algorithms to develop proxy values when primary data collection is not an option.

³ Lisa, Ph.D. "Non-Energy Benefits / NEBs – Winning at Cost-Effectiveness Dominos: State Progress and TRMs", 2016 ACEEE Summer Study on Energy Efficiency in Buildings. pg. 6-3.

⁴ Ibid. pg. 6-5.

Method	Description
Monetization of NEIs	<ul style="list-style-type: none"> ▪ Utilities select NEIs (either a subset or all known NEIs) and develop monetary estimates that are included in cost-effectiveness tests. ▪ Utilities often opt to include the NEIs that are easiest to measure and quantify because of budget constraints. ▪ This method is the costliest as it often requires primary data collection to estimate participant NEIs.
Hybrid Adder/Proxy and Estimation Approach	<ul style="list-style-type: none"> ▪ This method combines the use of an adder to represent some NEIs while also including estimated NEIs for others.

The most rigorous of these approaches is monetizing all known NEIs. This method uses primary research and data collection to gather specific utility, participant, and societal data that is then used to estimate the impacts that go beyond energy savings from an energy efficiency program. Oftentimes, utilities do not have budget available to use this approach and therefore opt for a combination of methods, as described in the last row of the above table. In this case, selected NEIs are monetized and other methods, such as adders or proxy values, are used to approximate the value of the remaining NEIs.

Figure 1 illustrates four main approaches to monetize NEIs.⁵ These are the direct approach, which relies on pre- and post-treatment utility records, the secondary approach which uses financial calculations to estimate NEIs, the modeling approach which employs top-down input-output models to generate monetized values of NEIs, and finally the survey approach which uses methods described in academic, utility, and state-specific studies to estimate NEIs based on primary data collection using survey instruments. All except the direct approach rely on secondary sources for unit values of participant and societal NEIs.⁶ These approaches are detailed further below.

Direct Approach

Evaluators can directly monetize many utility NEIs, such as arrearages and debt collections since these are already expressed in monetary terms. These NEIs are typically estimated by taking the average of pre- and post-participation data (one year pre- and post- data is ideal) and finding the difference in the NEI for a treatment group. This change is also calculated for a comparison group and the net difference between the groups is taken as the specific NEI attributable to the program. The NEI is then incorporated into cost-effectiveness testing.

Secondary Approach

The secondary approach monetizes NEIs by multiplying the quantity of an attribute change by the value of a unit change in that attribute. The value of a unit change in an attribute (e.g., thermal stress, reduced sick days) is often based on values calculated using primary data collected at the national, regional, statewide, or

⁵ Northeast Energy Efficiency Partnerships (NEEP). "Non-Energy Impacts Approaches and Values: An Examination of the Northeast, Mid-Atlantic, and Beyond", June 2017. pg. 8.

⁶ Monetization approaches generally rely on values available from online national databases hosted by entities such as the Department of Health and Human Services (DHHS), National Center for Health Statistics (NCHS), the Centers for Disease Control and Prevention (CDC), and the Agency for Healthcare Research and Quality (AHRQ). Evaluators may leverage these national databases to monetize NEIs.

even utility-specific levels. When budgets are limited, utilities often look to states or utilities with similar attributes and either use their values or make adjustments based on weather, demographic, and geographic differences. The accuracy of the estimated NEI is dependent on the quality and localized nature of the attribute change value used. This is a common approach to estimating participant and societal NEIs when a more rigorous method is unavailable due to time and budgetary constraints.

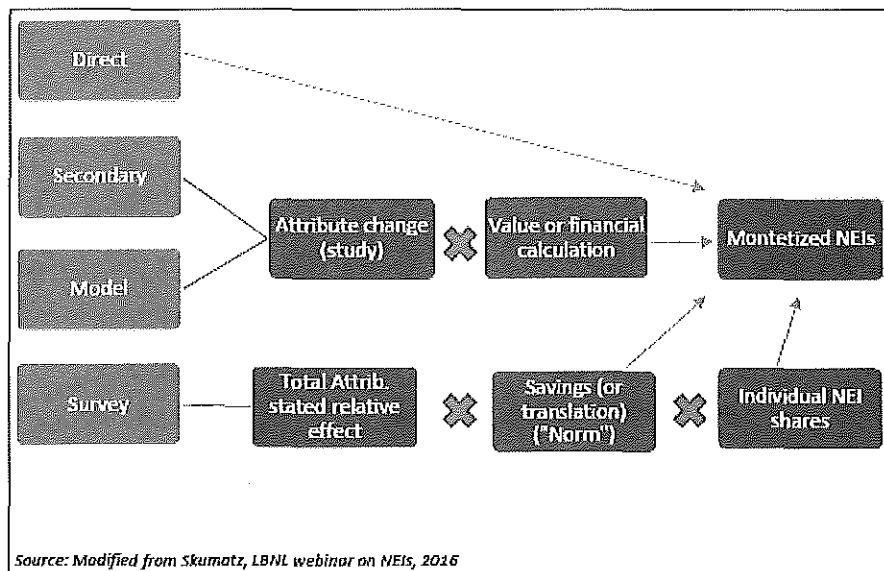
Modeling Approach

The modeling approach is like the secondary approach but uses input-output models to perform simultaneous and interactive calculations that can account for a variety of direct, indirect, and induced participant and societal NEIs. Models like the Regional Input-Output Modeling System II (RIMS-II), the Regional Economic Models, Inc. (REMI), and Impact Analysis for Planning (IMPLAN) are used to estimate NEIs when resources are transferred away from generation to energy efficiency program participants and to society. These models typically are used to estimate changes in emissions, changes in employment, changes in operation and maintenance costs, changes in tax burdens, and other NEIs.

Survey Approach

This approach relies on data collected using survey instruments to estimate participant NEIs, particularly those related to health, safety, and comfort. ORNL's 2014 study, "Health and Household-Related Benefits Attributable to the Weatherization Assistance Program" is a leading example of how the survey approach is used to estimate participant NEIs. This study uses data collected about various health, safety, and comfort attributes for a treatment group of participants both pre-and post-weatherization. The study also gathers data from a comparison group of participants at the same two junctures. The studies then calculate NEIs by estimating the difference in impacts for the treatment and comparison groups. For those differences deemed statistically significant, the study then monetizes those NEIs by multiplying the net NEI by the monetary unit value of the impact. As mentioned earlier, a variety of sources are used for the monetized unit values of various participant and societal NEIs.

Figure 1. Approaches to Monetize NEIs



Program Staff and Agency Perspective on NEIs

The evaluation team conducted in-depth interviews with the managers of the HEA programs operated by the NH Utilities as well as the community action agencies (CAAs) that implement the program to gain their perspective on the participant NEIs they felt were worth examining in this evaluation. These individuals are closest to the clientele served by the program and understand the types of NEIs participants experience once their homes are weatherized through the program. Table 4 below presents the unaided mention of participant NEIs during the in-depth interviews.

Table 4. Program Manager and Implementer Input on HEA Program NEIs

NEI Category	Specific NEI	Mentioned by HEA Program Managers	Mentioned by Community Action Agencies
Comfort	Temperature consistency in home	✓	✓
	Less noise	✓	
	Psychological benefits	✓	✓
Health and safety	Improved air quality (both indoor and outdoor)	✓	✓
	Reduced incidence of asthma	✓	✓
	Fewer sick days	✓	✓
	Lower medical costs/fewer doctor visits	✓	
Improved food security	Improved learning in school for children	✓	
	Improved health from increase in food consumption	✓	
Improved energy security	Can afford to heat home	✓	
Reduced maintenance costs			✓

Measure versus Program NEIs

Evaluators have hypothesized about the advantages of estimating NEIs for specific measures, as it may allow for the transferability of NEIs across programs. This would allow utilities to build up program NEIs through the addition of measure-level NEIs. The fact that many NEIs likely have interactive effects that would not be captured with such an approach is one hurdle that is difficult to overcome. The measure-level approach is most suitable for single-measure programs than it is for low income weatherization programs since in these cases it is the combination of measures that synergistically work to provide NEIs (as well as energy impacts).

What NEIs We Will Capture

Based on a review of the NEI literature, the evaluation team developed an expansive list of NEIs that are commonly associated with low-income weatherization programs like the HEA program. The evaluation team considered the various NEIs and narrowed the list down to those we recommend to quantify as part of this evaluation. Table 5 presents the NEIs considered, the ones proposed for inclusion in the 2016-17 evaluation

of the HEA program, and justifications for why these NEIs were selected. Note that the evaluation team will ensure not to double count NEIs, which is usually a concern when individual participant NEIs and property values are both included in an NEI analysis.⁷

Table 5. NEIs Considered and Recommended for 2016-17 HEA Program Evaluation

NEI Category	NEIs Considered for Analysis	NEIs Recommended for Analysis	Justification
Utility	Reduced arrearages	✓	Easy to directly monetize if utility data is available.
	Reduced debt write-offs	✓	
	Decreased terminations/reconnections	✓	Well established proxy values are available to use as multipliers (see Table 2), assuming utility data is available that allows the evaluation team to calculate changes in these NEIs.
	Fewer collection notices	✓	
	Reduced customer calls	✓	
	Reduced safety calls	✓	
Participant	Reduced asthma symptoms	✓	The evaluation team can rely on the survey approach to assess changes in these participant attributes due to the program and can use unit values secondary sources to monetize these NEIs for single-family low-income programs with similar climates (e.g., 2016 Three ³ and NMR Low Income Single Family study for MA Program Administrators). According to Table 2, these participant NEIs are easy to quantify and are high priority NEIs.
	Reduced cold-related thermal stress	✓	
	Reduced heat-related thermal stress	✓	
	Fewer missed days at work	✓	
	Reduced equipment maintenance costs		
	Reduced need for food assistance		
	Improved home productivity due to improvements in sleep		
	Improved work productivity due to improvements in sleep		
	Reduced CO poisoning		
	Reduced need to choose between temperature control or eating		
	Reduced use of short-term high interest loans		

⁷ The 2018 study by NMR Group, Inc., Tetra Tech, and DNV-GL recommends exclusion of property value changes when health, safety, and comfort NEIs are included for participants to ensure these improvements in living conditions are not incorporated twice. We therefore do not plan to quantify property value changes for this NEI analysis.

NEI Category	NEIs Considered for Analysis	NEIs Recommended for Analysis	Justification
	Increased property values		
Societal	Improved air quality	✓	Relatively easy to include in analysis using secondary or modeling approach to monetization or adder/proxy value.
	Increased number of jobs		
	Value added to economy		
	Reduced reliance on welfare benefits		
	Improved public health		

NEI Methodologies for HEA Analysis

This section presents an overview of the methodologies the team will use to quantify the NEIs proposed for this analysis. There are three main sources the evaluation team relied upon to inform the selection of methodologies:

- Oak Ridge National Laboratory. “Health and Household-Related Benefits Attributable to the Weatherization Assistance Program”, ORNL/TM-2014/345, September 2014.
- “Massachusetts Special and Cross-Cutting Research Area: Low-Income Single-Family Health- and Safety-Related Non-Energy Impacts (NEIs) Study” by Three³ and NMR Group.
- Navigant and Johnson Consulting Group, “Quantifying Non-Energy Benefits from ComEd’s Income Eligible Programs: Findings and Recommendations from Secondary Research: Draft”, March 6, 2018.

Utility NEIs

The utility NEIs the evaluation team plans to include in the analysis for the 2016-17 HEA program includes arrearages, bad debt write-offs, customer notices, terminations/reconnections, customers calls, and safety calls.

Arrearages

The commonly used approach to estimate utility NEIs, such as arrearages, is a quasi-experimental method. Evaluators use a difference-in-differences (DID) approach, which is calculated by taking the difference in the average monthly pre- and post-weatherization arrearages for program participants and the difference in the average monthly change in these values for the pre- and post-periods for a comparison group. The difference in these differences yields the arrearage NEI.

The evaluation team will estimate changes in arrearages due to program participation using the following equation, since they are already available in monetary terms (see Equation 1):

Equation 1. Arrearage NEI Equation

$$\text{Arrearage NEI} = [\text{Average monthly arrearage for treatment customers pre-participation} - \text{Average monthly}]$$

$$\text{arrearage for treatment customers post-participation]} - [\text{Average monthly arrearage for control customers pre-period} - \text{Average monthly arrearage for treatment customers post-period}]$$

Typically, the pre- and post-participation periods are the full year prior and the full year after program participation. For this NEI, we will analyze 2016 pre and post data, or treatment group, and 2017 arrearage data from participants, prior to participating, as the control group. This same methodology is proposed for the change in debt write-offs as well.

Bad Debt-Write Offs

The approach used to estimate bad debt write-offs is essentially the same as it is for arrearages. The evaluation team will calculate bad debt-write off for the HEA program using the following equation:

Equation 2. Bad Debt Write-Off NEI for HEA NEI Analysis

$$\text{Bad Debt Write-Off NEI for 2016-17 HEA Program} = [\text{Average monthly bad debt write-off for treatment customers pre-participation} - \text{Average monthly bad debt write-off for treatment customers post-participation}] - [\text{Average monthly bad debt write-off for control customers pre-period} - \text{Average monthly bad debt write-off for treatment customers post-period}]$$

Terminations/Reconnections, Notices, Customer Calls, and Safety Calls

The evaluation team will use proxy values for the remaining utility NEIs the team proposes to include in its analysis, based on those presented in a 2011 study conducted by Tetra Tech and NMR Group for the Massachusetts Program Administrators that evaluated residential and low-income NEIs. The values included in the 2011 study are recommended based on a review of the NEI literature. The per participant per year NEIs for terminations/reconnections, customer calls, collection notices, and safety calls are included in Table 2 and reproduced below in Table 6. The evaluation team will multiply the number of participants per year by these values to monetize these NEIs.

Table 6. Median Values of Utility NEIs Proposed for HEA Program Analysis

Utility NEI	Annual Value per Participant
Terminations/Reconnections	\$0.43
Customer Notices	\$0.34
Customer Calls	\$0.58
Safety Calls	\$8.43
Total	\$9.78

NMR Group and Tetra Tech, 2011.

Participant NEIs

Quantifying participant NEIs, particularly those related to health, safety, and comfort, often relies upon primary data collection from both a treatment and comparison group of customers during a pre-weatherization (sometime before treatment customers participate in the program) and post-weatherization period (usually a year after treatment customers participate in the program to give them enough time to realize the impacts of the program). Surveys are generally administered to inform the estimation of the

participant NEIs, such as those listed in Table 5. Most recent studies of the NEIs that stem from low-income programs, rely on this or variants of, this methodology which served as the foundation of ORNL's 2014 National Weatherization Assistance Program study.

The current evaluation plan for the HEA program includes a non-participant survey effort. The non-participant survey can serve as a comparison group when quantifying participant NEIs. However, since the opportunity for a pre-weatherization period has passed, we will ask the treatment group to self-report data before and after participation and ask the comparison group questions about their behavior in 2016 and now in 2017. For example, the evaluation team will include survey questions to probe participants about their experiences with each of the health, safety, and comfort attributes prior to weatherization. For both participants and non-participants, the evaluation team will then ask whether respondents experienced a change in the incidence of these impacts in the post-treatment period.

The evaluation team presents the types of questions that the surveys will include about each of the participant NEIs recommended for analysis. These survey questions are similar to those included in ORNL's 2014 National Weatherization Assistance Program study and in Navigant's research plan to quantify NEIs for ComEd's Income Eligible programs. Once the incidence of each NEI is gathered through the surveys, the evaluation team will monetize them using values from secondary sources. Most of these are online national databases hosted by entities, such as the Department of Health and Human Services (DHHS), Centers for Disease Control (CDC), and the Agency for Healthcare Research and Quality (AHRQ). During the analysis phase, the evaluation team will identify state- or regional-level values to use to monetize the NEIs described below.

Asthma Incidence

The participant survey instrument will ask the following questions to assess the change in incidence of asthma hospitalizations and visits to the emergency room. Prior to asking these questions, the survey will ask the respondent to report the number of adults and children in the home.

- In the year prior to participating in the program, did you/members of your family experience asthma symptoms that required you to stay overnight in the hospital?
 - If yes: How many times did you/members of your family have to stay overnight in the hospital due to asthma symptoms?
- In the year prior to participating in the program, did you/members of your family have to visit the emergency room due to asthma symptoms?
 - If yes: How many times did you/members of your family have to visit the emergency room due to asthma symptoms?
- Since participating in the program, have you/members of your family had to stay overnight in the hospital due to asthma symptoms?
 - If yes: How many times did you/members of your family have to stay overnight in the hospital due to asthma symptoms?
- Since you participated in the program, have you/members of your family had to visit the emergency room due to asthma symptoms?

- If yes: How many times have you/members of your family had to visit the emergency room due to asthma symptoms?

The non-participant survey instrument will include similar questions as those presented for the participant survey instrument, but instead of referring to “the year prior to participating in the program” and “since participating in the program”, the question will ask about asthma incidences in 2016 and 2017.

The evaluation team will monetize the impacts on the incidence of asthma using Equation 3:

Equation 3. NEI from Change in Asthma Incidences

*NEI from Change in Asthma Incidences from 2016-17 HEA Program = (number of persons served by HEA program) * (net change in asthma prevalence for adults and children between treatment and comparison groups) * (net reduction in emergency room visits between treatment and comparison groups) * (frequency of re-admittance (adults and children)) * (average hospital and emergency room costs (adults and children))*

The evaluation team will also rely on the following inputs from secondary sources:

- Average costs for hospitalizations and emergency room visits per adult and child in New Hampshire (if state-specific data is available)
- Frequency of re-admittance to the hospital for adults and children

Reduced Thermal Stress

The participant survey instrument will ask the following questions to assess the effects of thermal stress before and after program participation.

- In the year prior to participating in the program, did you/members of your family need medical attention because your home was too cold/hot?
 - If yes: How many times did you/members of your family need medical attention because your home was too cold/hot?
- Since you participated in the program, have you/members of your family needed medical attention because your home was too cold/hot?
 - If yes: How many times have you/members of your family needed medical attention because your home was too cold/hot?

The non-participant survey instrument will include similar questions as those presented for the participant survey instrument, but instead of referring to “the year prior to participating in the program” and “since participating in the program”, the question will ask about reduced thermal stress in 2016 and 2017.

The evaluation team will monetize the benefits of reduced thermal stress (cold/hot) using the following variables and equations:

H = hospital visits
E = emergency room visits
D = doctor visits

$N(X)$ = change in the occurrences of X between treatment and comparison groups where X = hospital visits (H), emergency room visits (E), and doctor visits (D)

Equation 4. Change in Occurrences of Seeking Medical Attention from Thermal Stress

$$N(X) = (\text{number of homes treated through the HEA program}) * \text{average change in rate of seeking } X \text{ due to cold/hot thermal stress between treatment and comparison groups}$$

Equation 5. NEI from Change in Seeking Thermal-Stress Induced Medical Attention

$$\text{NEI from Change in Seeking Thermal Stress-Induced Medical Attention due to HEA Program} = N(X) * (\text{average total out-of-pocket medical costs paid by households})$$

The evaluation team may also rely on the following inputs from secondary sources to estimate the NEI related to changes in medical attention due to thermal stress:

- Percentages of hospital visits, emergency room visits, and doctor visits for cold- and heat-related stress (state specific if available)
- Average cost for hospitalizations, emergency room visits, and doctor visits per adult and child in New Hampshire (if state-specific data is available)

Fewer Missed Days at Work

The participant survey instrument will ask the following questions to assess whether the program led to fewer missed days at work.

- In the year prior to participating in the program, how many days did you (or the primary wage earner) miss work because of illness or injury?
- Since you participated in the program, how many days have you (or the primary wage earner) missed work because of illness or injury?

The non-participant survey instrument will include similar questions as those presented for the participant survey instrument, but instead of referring to “the year prior to participating in the program” and “since participating in the program”, the question will ask about fewer missed days at work in 2016 and 2017.

The evaluation team will monetize the benefits of fewer missed days at work using the following equation:

Equation 6. NEI From Change in Number of Missed Days at Work

$$\text{NEI from Change in Missed Days at Work} = (\text{number of homes treated through HEA program}) * (\text{percent of participating households with an employed primary wage earner}) * (\text{difference in the reduction of missed days of work between treatment and comparison groups}) * (\text{average hourly wage}) * (8 \text{ hours/day})$$

The evaluation team will also rely on the following inputs from secondary sources:

- Average hourly wage for New Hampshire
- Percent of low-income workers without sick leave

Future NEI Analyses for HEA Program

We recommend that the NH utilities start to implement a pre-weatherization survey in 2019 to ensure that participant NEIs are fully captured. Prior to weatherization, ideally at the time of the home audit, the implementation team could survey participants about the health, safety, and comfort NEIs by asking the questions above and gathering this data. At the time of the program evaluation, the evaluation team can implement a post-weatherization survey to gather data about how incidence of the health, safety, and comfort attributes have changed.

Societal NEIs

The evaluation team will estimate the monetary value of an improvement in air quality, specifically a reduction in carbon dioxide emissions (CO₂) emissions, that results from the reduced use of energy by HEA program participants. As participants use less energy, fewer CO₂ emissions are released. The reduced amount of energy is multiplied by an emission factor to estimate CO₂ reduced per kWh.⁸ This value is then multiplied by the Social Cost of Carbon (SC-CO₂)⁹ to monetize impact of reduced CO₂ emissions.

⁸ This factor is 7.44×10^{-4} metric tons CO₂/kWh, taken from the following EPA website: <https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>

⁹ The Social Cost of Carbon (SC-CO₂) is a monetary measure of the value of damages avoided for an emission reduction of CO₂ (i.e., the benefit of a CO₂ reduction) and varies by discount rate applied. For example, the 2015 value when a 3% average discount rate is applied is \$36 per metric ton of CO₂ (in 2007 dollars). Values are available at the following EPA website: https://www.epa.gov/sites/production/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf