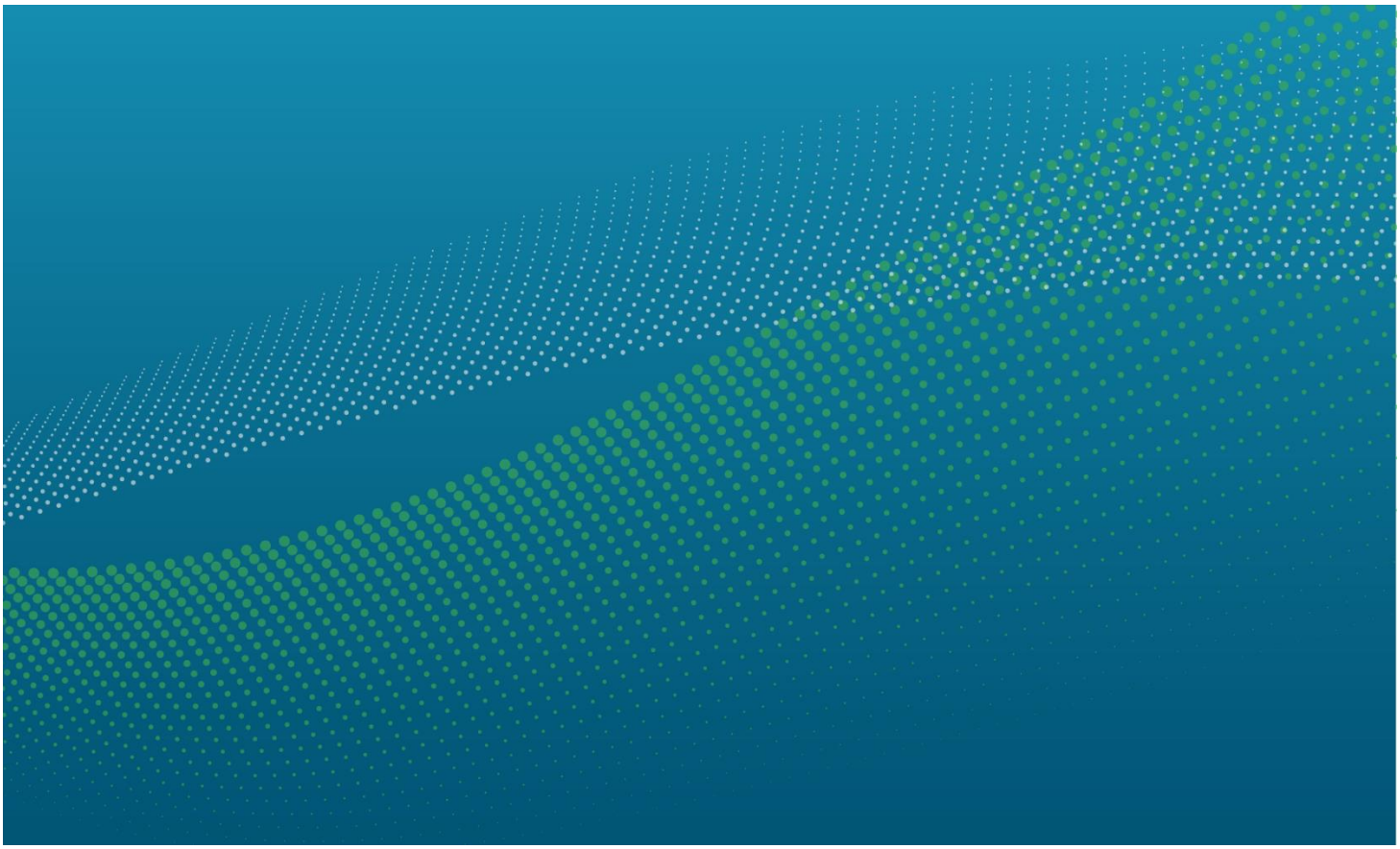

Non-Energy Benefits of Efficiency Vermont's Home Performance with ENERGY STAR Program

EFFICIENCY VERMONT WHITE PAPER

Ingrid Malmgren and Laura Capps, Co-authors
Kurt Keller, Analyst
Frances Hussey, Editor
Brian Just, Julie Michals, Ellen Tohn, Bruce Tonn, and Jonathan Wilson, Peer Reviewers

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1. Executive Summary

Non-energy benefits (NEBs) from building energy improvements—occupant comfort, safety, and health; and building durability and increased property value—are important components of all energy efficiency programs, and provide value to these programs' customers.

The challenge for program administrators and regulators is to ensure that these benefits are appropriately identified and accurately quantified so that the value of NEBs is defensibly characterized in the cost-effectiveness screening of efficiency program measures. Getting this right is essential to proving the full value of a program to the customers who support it.

Vermont regulators require Efficiency Vermont, a statewide energy efficiency utility, to use the Societal Cost Test for screening the hundreds of energy efficiency measures in its portfolio. For Efficiency Vermont's programs, or any initiative within its programs, to pass cost-effectiveness screening, the test requires that the value of the benefits of energy efficiency measures exceed measure costs. The test takes into consideration all program expenses, and some of the program benefits.

Currently, the Vermont state screening tool assumes that the collective values of participant benefits such as health, comfort, noise reduction, and home durability equals 15 percent of the value of the energy savings. The Vermont Public Utility Commission (PUC, known until 2017 as the Public Service Board) in 2012 approved this NEB value as a conservative proxy.[1] Although the literature supports the premise that real-world non-energy benefits are likely to exceed this amount, the PUC accepted the 15 percent adder as a conservative estimate, to be revisited as more evidence becomes available.

Omitting the full value of these non-energy benefits for program participants creates a cost-benefit equation that does not consider real-world effects of building energy improvements for its occupants. Without assigning a "true" value to an energy efficiency project, a potential participant might choose not to invest in that project. This failure to invest results in lower greenhouse gas reductions and perpetuates the negative health conditions of living in buildings with poor indoor air quality.

It is important that policy-makers, regulators, ratepayers, and potential program participants have the most accurate information currently available to inform decision-making processes. Over the last 20 years, a solid body of research has identified, assessed, and measured these benefits. As a result, a growing number of regulatory jurisdictions have begun to include NEBs into their efficiency program cost-benefit testing.

Efficiency Vermont has supported energy efficiency projects in more than 7,000 homes

[1] State of Vermont Public Utility Commission Order entered 2/7/2012 re: Cost-effectiveness screening of heating and process-fuel efficiency measures and modifications to State Cost-Effectiveness Screening Tool, at 26-27. https://epsb.vermont.gov/?q=node/104/98385

through the Home Performance with ENERGY STAR® (HPwES) program.[2] By surveying a sample of 318 qualifying HPwES customers (13 percent of 2,385 possible respondents), Efficiency Vermont obtained participants' perspectives regarding what non-energy benefits they experienced as an outcome of their energy efficiency investments, and how they valued those benefits.

Anecdotal evidence from prior research suggests that participants who have completed energy efficiency retrofits value NEBs from the project as much as, if not more than, the project's monetary benefits from lower energy use. The purpose of this study was to determine which benefits participants identify from their energy efficiency projects and the participants' perception of the value of those non-energy benefits.

The Efficiency Vermont survey results were consistent with existing evidence. Cost savings and energy reductions were leading factors in customer decisions to participate in Efficiency Vermont's HPwES program, and program participants perceived them to be an important benefit of the efficiency improvements. Nevertheless, respondents cited improved comfort as the most significant benefit from efficiency improvements, and collectively valued non-energy benefits from their efficiency projects as being even more valuable than their energy savings.

Overall, when participants cited all of the benefits associated with their energy efficiency projects, they valued bill savings at 40 percent of the total perceived value of their HPwES project, and they valued the combined non-energy benefits at 60 percent of the total perceived value. Therefore, compared to bill savings, participants valued combined non-energy benefits at 150 percent of the value of the bill savings. The researchers had hypothesized that NEB values would nearly equal the value of the energy savings, but they underestimated the full value of thermal comfort (from both heating and cooling) to energy efficiency program participants in Vermont.

These research results offer support for considering a change to the Vermont NEB adder in the State Screening Tool for HPwES reporting. Specifically, the research shows that the adder for experienced participant effects alone would be accurate at 150 percent, not the current 15 percent. Further, the research fills a gap in previously characterized "hard-to-quantify benefits that factor into participant decision-making."[3]

Broadly, most residential non-energy benefit studies examine benefits to low-income participants. This study provides primary NEB research specific to a market rate energy efficiency program. Since HPwES is a nationally recognized market rate efficiency and weatherization program, the results of this research in Vermont could be adapted and applied in other jurisdictions offering the HPwES program.

[2] An initiative that offers participants incentives for improving insulation, air sealing, and heating and ventilation systems in a house. https://www.efficiencyvermont.com/rebates/list/home-performance-with-energy-star

[3] February 7, 2012 Order, at 25.

2. Non-Energy Benefits

2.1 Background

Utility ratepayers typically support energy efficiency programs by paying a system benefits charge on their utility bills. In Vermont, this is known as the Electric Efficiency Charge (EEC), and it primarily funds electrical efficiency improvements to buildings. The value of the electrical efficiency improvements (MWh savings) is then sold at auction as electrical demand resources on the Independent System Operator New England Forward Capacity Market. The revenue from these sales is combined with revenue from Regional Greenhouse Gas Initiative funding (cap-and-trade carbon savings) to fund thermal efficiency programs for Vermont. To maintain reliable savings in this marketplace, regulated efficiency programs undergo rigorous measurement, verification, and evaluation to ensure accuracy of reported savings.

In 2015, efficiency programs in the United States and Canada spent $8.2 billion of ratepayer funding to procure an estimated savings of 29,588 GWh of electricity and 496 million therms of gas.[4] To ensure that this funding is invested for the benefit of the ratepayers, State regulators require that efficiency program activity—from individual energy efficiency measures to projects with bundled measures—is screened for cost-effectiveness.

In its simplest form, cost-effectiveness screening divides program benefits by program costs. Most energy efficiency programs are required to result in a cost/benefit ratio of greater than one, indicating that the benefits of the energy efficiency program or measure must be greater than the costs.[5]

$$\frac{\text{Net present value of benefits}}{\text{Net present value of costs}} \geq 1$$

But which benefits and costs are counted into the equation? In theory, all of a program's measure costs and benefits would be contained in the ratio. Depending on the energy savings and other performance goals an efficiency program must meet, jurisdictions have historically relied on one or more of the cost-benefit tests outlined in the *California Standard Practice Manual*, last updated in 2002. **Table 1** presents the manual's five primary cost-benefit tests. The fourth test listed in **Table 1**, the Total Resource Cost Test (TRC) is currently the most frequently used test for screening energy efficiency programs.

While the tests provided in **Table 1** reflect the traditional tests used in the energy efficiency industry to date, in 2017, a National Standard Practice Manual (NSPM) was published based on collaboration of efficiency stakeholders and experts nationwide.[6] The NSPM provides

[4] Consortium for Energy Efficiency Annual Industry Report. 2016 State of the Efficiency Program Industry. March 31, 2017. https://library.cee1.org/system/files/library/13159/2016_CEE_Annual_Industry_Report.pdf

[5] Efficiency Vermont's minimum performance requirement for this metric is: greater than 1.2.

[6] The 2017 publication of the *National Standard Practice Manual* provides a core set of six principles and the Resource Value Framework, where a key principle is to assign value to "all relevant impacts (costs and benefits) related to" a jurisdiction's policy objectives. See Woolf, Tim, Chris Neme, Marty Kushler, Steven R. Schiller, and Tom Eckman. 2017. *National Standard Practice*

flexibility for states to develop a robust efficiency screening test that aligns with and supports state policies.

In Vermont, the primary test used for energy efficiency screening is the Societal Cost Test (SCT), listed fifth in **Table 1**. The Societal Cost Test is based on the TRC, but includes a broader range of benefits from efficiency, particularly benefits to society as a whole, such as environmental benefits or fuel security benefits.

Table 1. Cost-benefit tests used in the California Standard Practice Manual[7]

Test	Perspective	Key question answered
Participant Cost Test (PCT)	Program participants	Will program participants benefit from the measure, across the life of the measure?
Program Administrator Cost Test (PACT)	Program administrator	Will program administrator costs (and customer utility bills) increase or decrease?
Ratepayer Impact Measure test (RIM)	Nonparticipating ratepayer	Will utility rates increase?
Total Resource Cost test (TRC)	Stakeholders in service territory	Will the total costs of energy in the utility service territory increase or decrease (regardless of who pays the costs and who receives the benefits)?
Societal Cost Test (SCT)	General public	What are the overall community benefits of the energy efficiency program portfolio, including indirect benefits?

Cost-benefit testing of efficiency programs varies widely by jurisdiction. Even states that use the same test incorporate different avoided costs and program benefits in their calculations. The accuracy of cost-benefit testing is important: $9.2 billion in efficiency investment was budgeted in the United States and Canada in 2016.[8] A jurisdiction's chosen cost-effectiveness test can have a significant effect on the design, priorities, and outcomes of energy efficiency programs.

Energy efficiency program administrators frequently criticize efficiency cost-benefit testing methods that consider all of the program costs, but ignore many program benefits (particularly non-energy benefits (NEBs) which are the positive effects, beyond energy

Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources. National Efficiency Screening Project. https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf While Vermont has not yet used the NSPM in the determination of energy efficiency resources, and to date has relied on the *California Standard Practice Manual*, the NSPM can help guide Vermont in better aligning its cost-effectiveness test with its state policies.

[7] Table is derived from U.S. Environmental Protection Agency, 2008. Understanding Cost-Effectiveness of Energy Efficiency Programs; A Resource of the National Action Plan for Energy Efficiency. https://www.epa.gov/sites/production/files/2015-08/documents/cost-effectiveness.pdf

[8] Consortium for Energy Efficiency, 2016 State of the Efficiency Program Industry, Budgets, Expenditures, and Impacts, 2017. https://library.cee1.org/system/files/library/13159/2016_CEE_Annual_Industry_Report.pdf

savings, of energy efficiency programs). This practice skews the reported effects of energy efficiency investment and results in underreporting of the value of energy efficiency. One way to correct this imbalance is to measure the NEB values and present them in the numerator, or benefits, side of the equation.

Energy efficiency and government-supported Weatherization Assistance Programs have long recognized benefits from efficiency programs beyond energy savings. Researchers have developed a framework for dividing the benefits of these programs into three categories, according to the beneficiary: (1) utilities, (2) participants, and (3) society.[9]

- Examples of utility benefits are reduced notifications of service terminations, reconnections, and arrearages; more stable energy prices; a more resilient, reliable energy system; lower transmission and distribution costs; and utility insurance savings.
- Participant benefits typically include increased property value; improved building aesthetics, indoor comfort, and safety; improved health of household members and associated reductions in health care costs; and noise reduction.
- Societal benefits are public health improvements, job creation benefits, and environmental benefits.

Efficiency Vermont designed this study specifically to measure Efficiency Vermont's participant benefits and does not address utility benefits or societal benefits.

Quantifying and incorporating NEBs into cost-benefit testing can be challenging, particularly in the context of classically difficult-to-measure benefits such as indoor comfort or noise reduction. Depending on their appetite for addressing those challenges, states use several methods to integrate NEBs into cost-effectiveness screening. These range from not recognizing them at all to incorporating NEBs at the individual measure level into screening. **Figure 1** shows how New England jurisdictions currently address NEBs in cost-effectiveness screening.

[9] Skumatz, 2014. Non-Energy Benefits / Non-Energy Impacts (NEBs/NEIs) and their Roles and Values in Cost Effectiveness Tests: State of Maryland Final Report. Section 1.2 (page 1). http://energyefficiencyforall.org/sites/default/files/2014_%20NEBs%20report%20for%20Maryland.pdf see also: Lazar & Colburn, Regulatory Assistance Project, 2013. Recognizing the Full Value of Energy Efficiency. Page 10 figure 1. http://www.raponline.org/wp-content/uploads/2016/05/rap-lazarcolburn-layercakepaper-2013-sept-9.pdf see also: Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers: A Resource of the National Action Plan for Energy Efficiency. 2008. Page 4-10. https://www.epa.gov/sites/production/files/2015-08/documents/cost-effectiveness.pdf

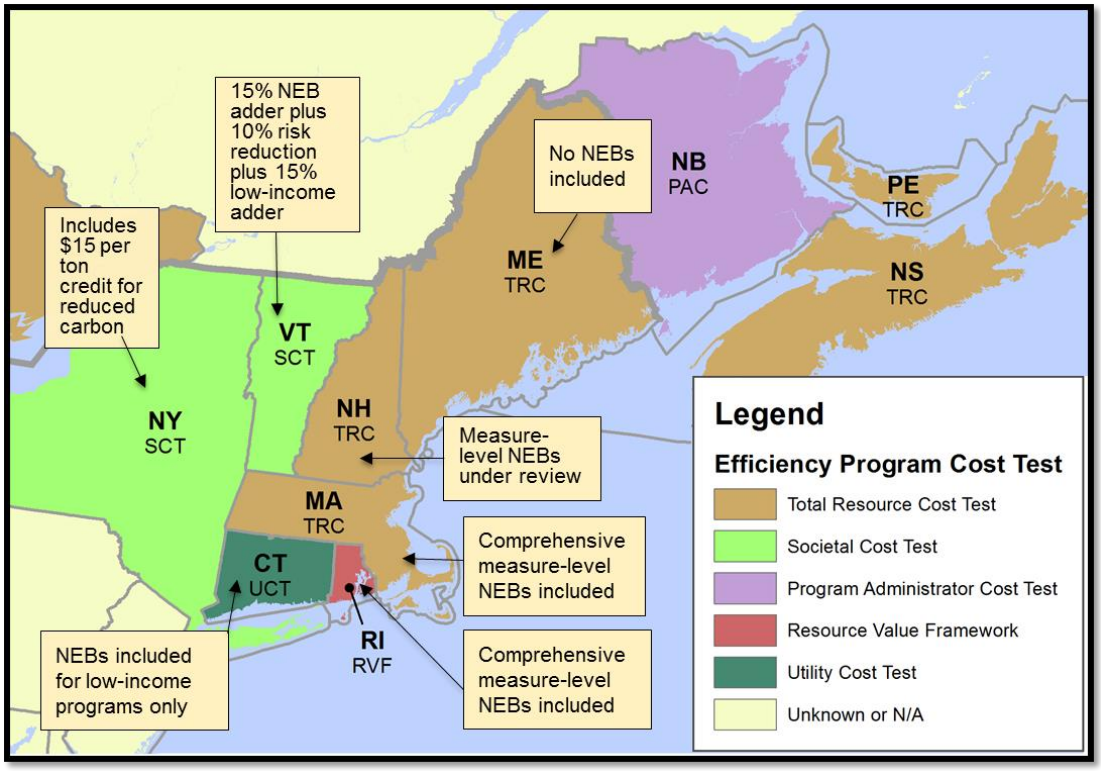


Figure 1. Map of cost-benefit tests and the extent to which each jurisdiction incorporates NEBs.[10]

2.2 Non-Energy Benefits Research

Research into energy efficiency programs' NEBs has evolved dramatically over the last 20 years. Early in the history of ratepayer-funded efficiency programs, administrators quickly recognized that program participants were experiencing benefits beyond energy savings. Early NEB research identified NEBs as outcomes of efficiency projects, and it became standard practice to categorize these benefits into participant benefits, utility benefits, and societal benefits. These categories align with the most commonly used cost-benefit tests, which reflect the perspectives of the utility (Utility Cost Test), the utility and participants (Total Resource Cost Test), and society as a whole (Societal Cost Test).

Today, more than 300 studies and documents comprise the NEBs literature on energy efficiency and weatherization programs.[11] The research has helped to drive the incorporation

10. It is important to note that New York and Rhode Island recently changed their cost-benefit tests (from the TRC). Note also that the only state in this region using the National Efficiency Screening Project's Resource Value Framework is Rhode Island. Sources for this map:
http://www.maritimeelectric.com/documents/about_us/Demand%20Side%20Management%20and%20Energy%20Conservation%20Plan%20-%202015-2020.pdf
https://www.nbpower.com/media/169863/dsm-plan-2016-18.pdf
http://www.neep.org/sites/default/files/resources/NEI%20Final%20Report%20for%20NH%20updated%2010.4.17.pdf

11 Skumatz, Lisa. 2014. *Non-Energy Benefits/Non-Energy Impacts and their Role & Values in Cost-Effectiveness Tests: State of Maryland.* Prepared for the Natural Resources Defense Council. Page 1. http://energyefficiencyforall.org/sites/default/files/2014_%20NEBs%20report%20for%20Maryland.pdf

of NEBs into appropriate cost-effectiveness screening as a best practice in efficiency program administration. In 2006, the U.S. Environmental Protection Agency (EPA) published its *National Action Plan for Energy Efficiency*. The document was the result of collaborative work by more than 50 leading organizations, and cited the importance of NEBs in justifying robust energy efficiency programs.[12]

One common application of NEB factors incorporates a simple "adder" to the benefits side of the equation. This adder is a proxy for the estimated value of multiple benefits such as increased comfort, convenience, and health, reduction in the number of utility shut-offs and bill complaints, and increased community health and improved aesthetics related to the decreased need for generation and associated transmission of infrastructure. The adders are typically very conservative, relative to real and perceived values of energy efficiency. In fact, regulators recognize that their values are imprecise, but suffice as a placeholder for lack of more accurate information. When Vermont regulators introduced the 15 percent NEB adder and an additional 15 percent adder for benefits of low-income energy efficiency initiatives into the state energy efficiency screening tool in 2012, the State recommended that more research and evidence of NEB values would prompt a review of the value of the adder:

> While the additional benefits to low-income customers and society can be difficult to quantify, it is clear that the current value of zero is incorrect; 15 percent appears to be an appropriate conservative estimate of their value. It is appropriate to start with a conservative estimate, and to revisit the estimate in the biennial EEU avoided-cost proceedings, with 15 percent serving as a rebuttable presumption.[13]

Another method some states use to include NEB values into cost-effectiveness screening is the incorporation of "easy-to-measure" NEBs, such as water bill savings from efficient clothes washers or faucet aerators.

The NEB valuation has begun to evolve more quickly in recent years. The Massachusetts Utility Energy Efficiency Program Administrators have spent millions of dollars on NEB value research, using defensible surveys and engineering analyses. Massachusetts has now determined detailed NEB values for many individual measures in its portfolio. Smaller jurisdictions such as Rhode Island and Maryland have appropriated Massachusetts' research, adapting some of the Massachusetts NEBs for screening measures in their own portfolios.

Throughout the evolution of valuing NEBs, stakeholders have made significant progress to understand, value, and incorporate *all* of the perceivable benefits of energy efficiency into cost-effectiveness screening. **Figure 2** offers a timeline of a small sample of research (purple), regulator decisions (green), and best-practices publications (orange), illustrating the historical progression of incorporating NEBs into energy efficiency program screening.

[12] U.S. Environmental Protection Agency, *National Action Plan for Energy Efficiency,* 2006. Page 3-18. https://www.epa.gov/sites/production/files/2015-08/documents/napee_report.pdf

[13] State of Vermont Public Utility Commission Order entered 2/7/2012 re: Cost-effectiveness screening of heating and process-fuel efficiency measures and modifications to State Cost-Effectiveness Screening Tool, Order at 30.

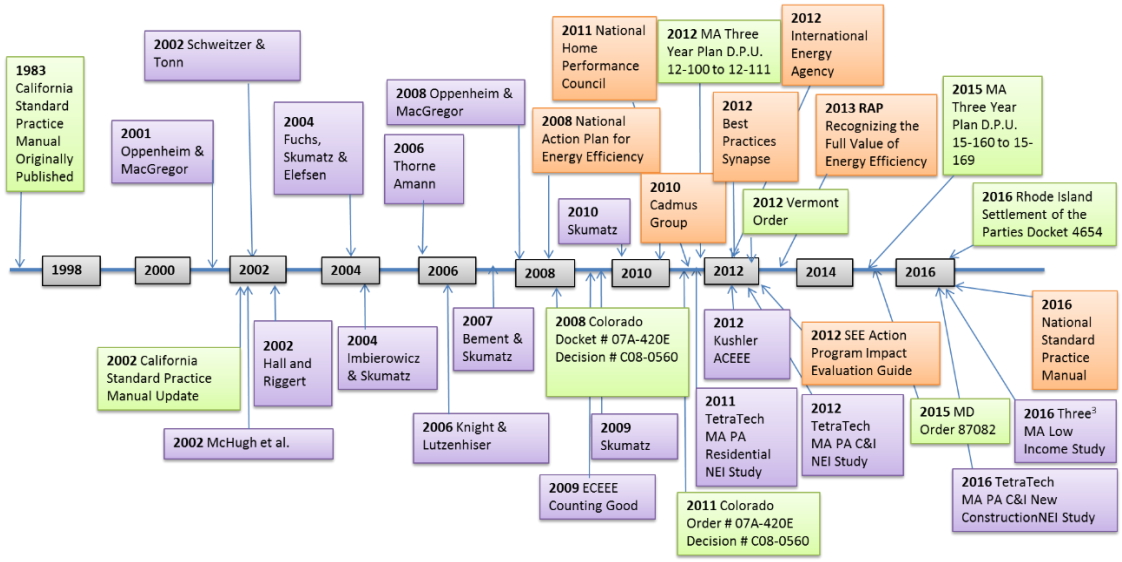


Figure 2. The quantity and nature of NEB research shows the acceleration of research, best practices, and regulatory action on NEBs.[14]

2.3 Reasons for Measuring and Incorporating NEBs

An accurate accounting of the benefits of energy efficiency programs is important for a number of reasons. Principles for incorporating NEBs into cost-benefit testing are presented in the National Standard Practice Manual. "For each type of impact included in a cost-effectiveness test, it is important that both the costs and benefits be included in a symmetrical way. Otherwise the test may be skewed and provide misleading results."[15] Additionally, while some impacts are hard to quantify the benefits are not zero and therefore should be accounted for using one of the methodologies offered in the manual. By not including the most accurate values of participant benefits available, cost-benefit testing is skewed against energy efficiency.

NEBs are also important because they can allow efficiency programs to provide more (and better-informed) options for meeting customer equity objectives. This is particularly the case if the incorporation of NEBs results in larger incentives for low- to moderate-income participants.

Market transformation—the effect of sustainable energy programs on long-term change in how customers use energy—is an all-important objective of many efficiency programs. More accurate screening of these measures for cost-effectiveness, using NEB values, will allow a wider spectrum of (quantifiably) worthy measures to screen and be completed. This is

14 Updated from 2014 ACEEE Summer Study presentation: Lessons from the Field, Practical Applications for Incorporating Non-Energy Benefits into Cost-Effectiveness Screening. Ingrid Malmgren and Lisa Skumatz. http://aceee.org/files/proceedings/2014/data/papers/8-357.pdf

15 National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources. EDITION 1 Spring 2017, page 12. https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf

especially true of appropriate, nascent technologies. This practice will accelerate market transformation, bringing consumer benefits more quickly to everyday living.

Most important, accurate capture of energy efficiency program benefits will lead to more accurate reporting of the value of efficiency, which adds value to the understanding of energy efficiency among policy makers and ratepayers.

3. Methods

About Efficiency Vermont's Home Performance with ENERGY STAR Program

Since 2005, Efficiency Vermont's HPwES program has supported the thermal and heating system efficiency improvements of over 7,000 homes in Vermont. The program is available to all homeowners outside of Burlington who are not heated with natural gas. Residents in Burlington and those serviced with natural gas are eligible for weatherization programs through the Burlington Electric Department and Vermont Gas. Qualifying low-income households (less than 80% area median income) are also serviced by the Weatherization Assistance Program and are eligible to receive free weatherization.

The program is administered by Efficiency Vermont and delivered through Efficiency Excellence Network contractors who maintain at least two Building Performance Institute (BPI) certifications, complete a mentorship program and pass regular quality assurance inspections and reviews. The program is marketed through a variety of outreach channels including, but not limited to, social media, online, print, TV and radio advertisements, and word-of-mouth. Participating contractors receive incentives for program marketing and project delivery. Participating homeowners receive incentives for weatherization and heating system improvements.

The program has changed over the years to incorporate participant feedback and accommodate market changes. The time period selected for the survey represents a consistent period for project and measure eligibility, however the incentives during this period did fluctuate with the addition of a $500 promotional bonus at varying times in 2013-2015.[16] Including the seasonal promotional bonus, homeowners may receive up to $2,500 in incentives towards their HPwES project, and the incentives received may never exceed the cost of the project.

Typical improvement measures include attic and basement air sealing and insulation, dense-packing wall insulation and heating system (space and water) replacement. The most common improvement measures are attic and basement air sealing and insulation using a combination of cellulose loose fill, cellulose dense pack, and spray foam products. All homes are required to achieve a minimum of 10 percent air leakage reduction and ASHRAE 62.2-1989 ventilation rates in alignment with the current BPI standard building air-flow standard. On average, 2012-2015 projects attained a 32 percent air leakage reduction.

[16] See Appendix B for the full list of eligible measures and incentives without the promotional bonus.

Efficiency Vermont's Hypothesis:

> *Participants in energy efficiency programs value NEBs such as increased comfort, noise reduction, and enhanced safety as much, if not more than, the energy savings associated with their efficiency retrofits.*

Efficiency Vermont conducted a NEB research project with participants of its market-rate HPwES program to identify noticeable effects of efficiency improvements to the participants' homes, and to collect information about the value the participants place on these effects, relative to the value they place on energy savings.

This method of measuring NEBs relative to energy savings is called relative valuation and operates on the premise that the value of the energy savings is known. Relative valuation is frequently used to assess NEB values for program participants. For example, it has informed values for the New York State Energy Research and Development Authority's programs, studies for the Massachusetts Utility Energy Efficiency Program Administrators, and Wisconsin Weatherization program health benefits.

By asking participants to assign a relative value to specific non-energy benefits and comparing the assigned value to the known value of the energy savings, researchers can attribute a dollar value of these NEBs, and can apply it to cost-effectiveness screening. The value can be attributed either in dollars or as a percentage of energy savings.

Sample Design

Efficiency Vermont sampled 318 participants (from a pool of 2,385 qualified participants) who completed projects in its HPwES program between 2012 and 2015[17] to determine:

- Which non-energy benefits participants experience, and
- The value to participants of those non-energy benefits, relative to the energy savings benefits that customers identify.

Efficiency Vermont scrubbed the initial participant list to remove those who had participated in programs sponsored by Vermont Gas Systems or Burlington Electric Department,[18] and OptiMiser participants, as the detailed data from those programs are tracked separately from other Efficiency Vermont data sets. Researchers also reviewed the list for data quality, removing participants without active e-mail addresses on file, participants who occupy their homes only seasonally, and those with out-of-state addresses. Thus, Efficiency Vermont ensured it could maximize its outreach and contact participants who would qualify for the survey criteria. If participants had been involved in more than one HPwES project, Efficiency Vermont asked them to report on the first project that had been completed.

The several data-cleaning phases gave Efficiency Vermont 2,385 qualified, possible respondents. Using simple random sampling, researchers chose 1,050 participants as the sample population. Each of those participants received an e-mail inviting them to participate

[17] Researchers used this date range to ensure the participants had experienced at least one full calendar year of home occupancy after the retrofit was complete.

[18] Costs for Burlington Electric Department and Vermont Gas Systems customers are covered by the allocations those utilities receive for their own HPwES programs.

in the study, involving a 10-minute online survey accessible by computer, smart phone or tablet. To motivate survey participation, researchers offered a $20 e-gift card for completing the survey.

Efficiency Vermont determined a target number of 315 respondents, and to ensure the survey would not be over-subscribed, divided the randomized sample into three waves. Researchers sent an e-mail to each wave cohort, with a reminder e-mail sent a week later to maximize likely participation. The cohort in the first wave consisted of 750 participants; the second, 200; and the third, 100 participants.

Survey

Efficiency Vermont's consultants and consumer insights experts collaboratively drafted the survey. The survey draft was then peer-reviewed by Ellen Tohn of Tohn Environmental Strategies. The objectives were to screen respondents for likely reliable participation, understand motivators for program participation, collect expectations of bill savings and perceptions of bill savings, identify non-energy impacts of HPwES program participation, and assign a value to these impacts. The e-mail invitation and the complete survey instrument (exported from Qualtrics® to Microsoft® Word) can be found in **Appendix A**.

Efficiency Vermont adapted the survey instrument from seminal research conducted by NMR Group for the Utility Energy Efficiency Program Administrators in Massachusetts.[19] In their work, NMR Group conducted a thorough literature review of frequently mentioned participant NEBs and structured the survey to minimize participants' response burden. Massachusetts, Rhode Island, and Maryland have incorporated the NEB values resulting from the NMR Group's study into their cost-benefit screening, while other jurisdictions are currently considering incorporating NEB values based on the report, as well. The strength of the research methods of the NMR Group's study, demonstrated by the approval of these values by regulators in other jurisdictions, prompted the Efficiency Vermont research team to use the NMR Group survey instrument as a model for valuing NEBs from Efficiency Vermont's HPwES efficiency projects.

Figure 3 shows the geographic distribution of respondents and of the qualifying populations for the Efficiency Vermont research.

19 The survey can be found in Appendix F of this report: NMR Group Inc., and TetraTech. 2011. Massachusetts Special and Cross-Sector Studies Area, Residential and Low-Income Non-Energy Impacts (NEI) Evaluation. Prepared for the Massachusetts Program Administrators.
http://ma-eeac.org/wordpress/wp-content/uploads/Special-and-Cross-Sector-Studies-Area-Residential-and-Low-Income-Non-Energy-Impacts-Evaluation-Final-Report.pdf

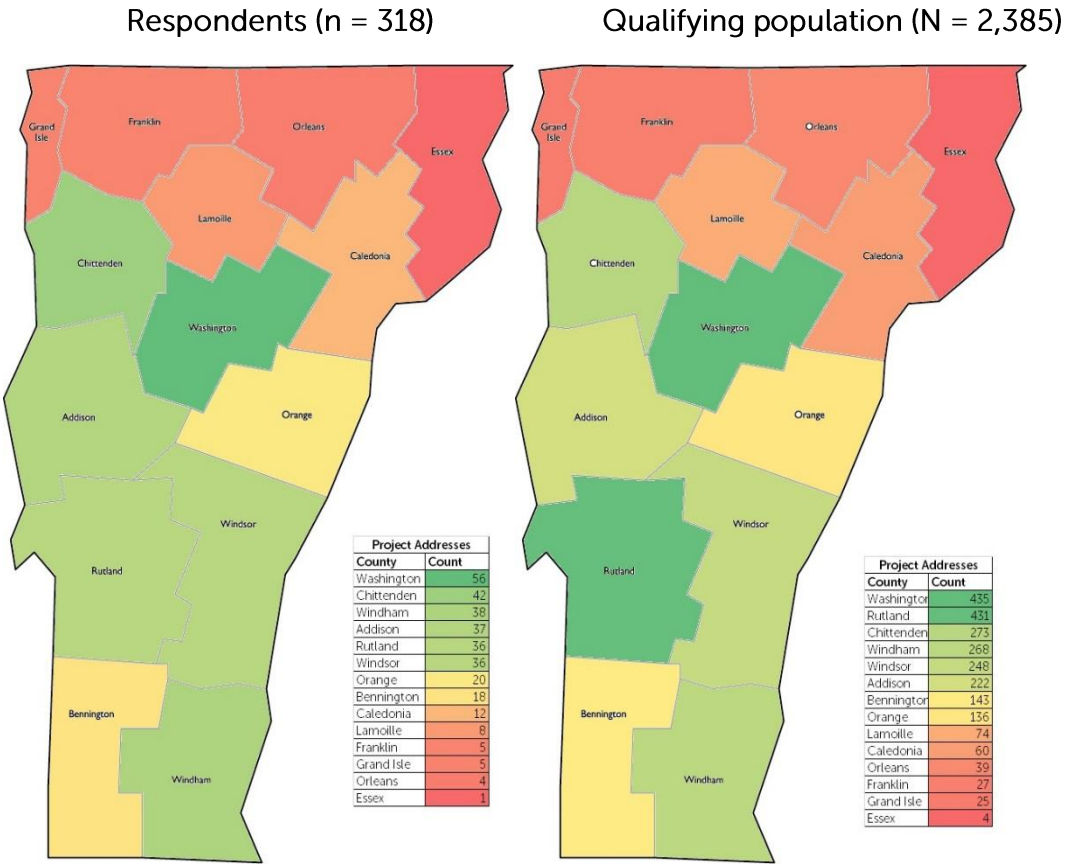


Figure 3. Geographic locations of respondents, compared to population density of qualifying participants.

Results

The Efficiency Vermont research team received 342 responses, of which 318 met the inclusion criteria for the study. To ensure that respondents had ample time to observe any changes that might have occurred as a result of completing their HPwES projects, the team disqualified participants who no longer lived in homes where the HPwES project was completed. The evaluation factors and their values were:

- Response rate[20]: 32.6%
- Confidence interval: 95%
- Margin of error: +/- 5.5%
- P-value: .05, indicating statistical significance

[20] Total number of responses, divided by the number of surveys distributed.

4. Study Results

4.1 Results and Analysis

Using a relative valuation approach, the research team asked participants to assign a value to each of the effects they experienced, following the completion of their HPwES project.

The team then matched participant program and utility data from Efficiency Vermont's database to individual survey participants, to obtain participant demographic information. Over 80 percent of respondents were Green Mountain Power customers, mirroring that utility's wide scale penetration of the state. Other characteristics:

	Survey Respondents:	All 2012-2015 Projects:
• Average age of homes:	75 years	73 years
• Average home size:	2,183 square feet	2,222 square feet
• Average HPwES project cost:[21]	$9,077	$8,618
• Average incentive amount from Efficiency Vermont:	$1,583	$1,504

These home and project characteristics are consistent with the characteristics of the full HPwES dataset. The majority of respondents reported spending at least 12 hours a day in their home on both weekends and weekdays.

As illustrated in **Figure 4**, respondents cited money savings as the primary motivator for undertaking and completing an efficiency project, accounting for 31 percent of all possible responses. Indoor comfort was the Number 2 reason, followed by energy efficiency and reducing energy or fuel use, environmental responsibility, and maintenance. Efficiency Vermont categorized answers to all open-ended questions according to the principle of symmetry from the respondents' first-listed response to the question. For example, if the participant responded with "environmental impact, save money, and improve comfort," the team categorized the (Number 1 reason) response as "environmental concerns / social responsibility."

[21] Average HPwES project cost includes costs for energy efficiency measures, health and safety measures and other measures related to the efficiency project and as reported by the HPwES contractor.

	Average HPwES Project Costs				
	Energy Efficiency Measures	Health and Safety Measures	Other Measures	Total Work Scope	Efficiency Vermont Incentives
Survey Respondents	$8,239	$389	$449	$9,077	$1,583
All 2012-2015 Projects	$7,794	$290	$534	$8,618	$1,504

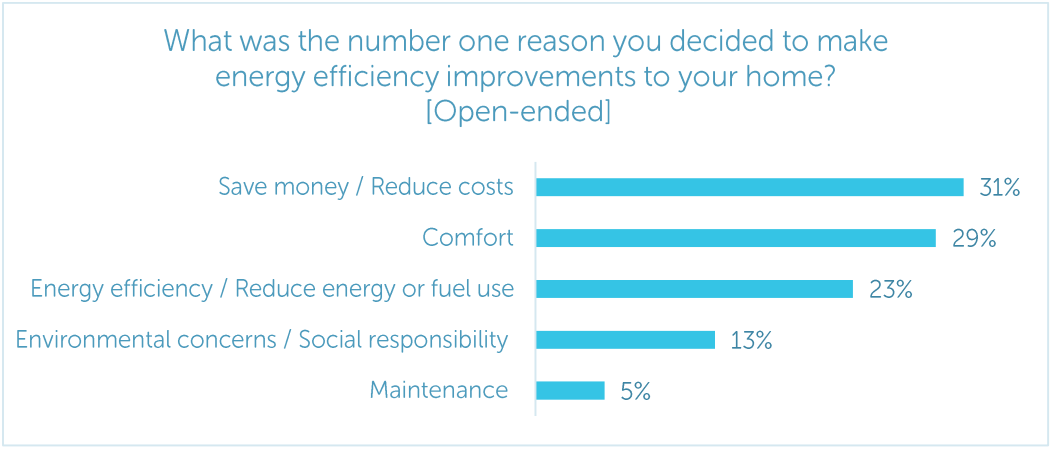
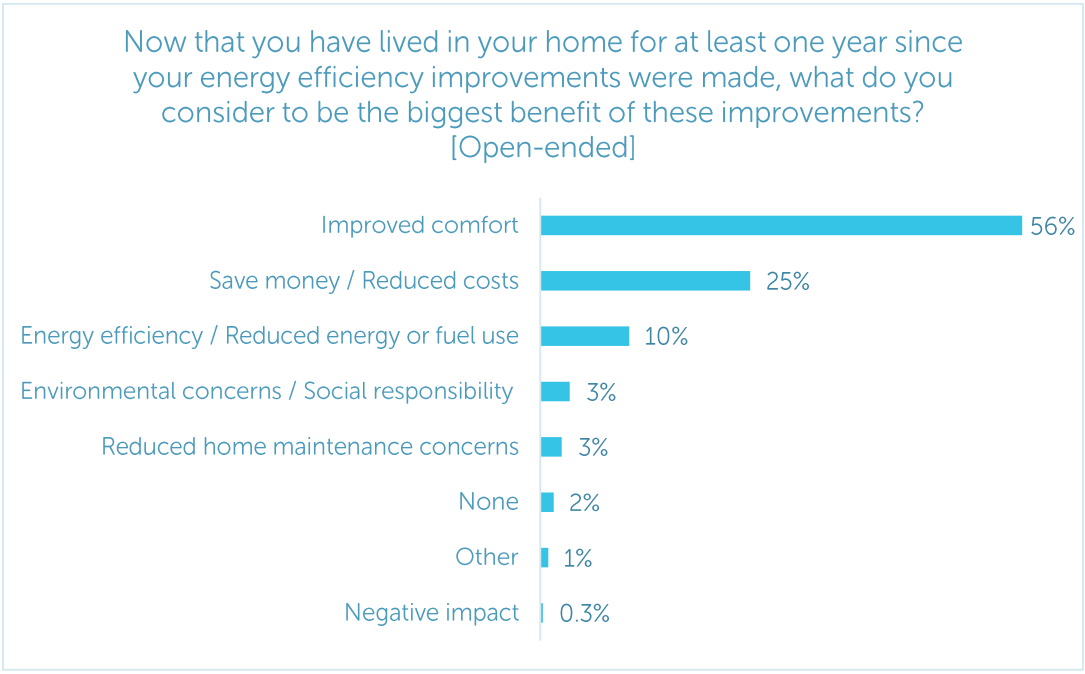


Figure 4. Motivations for deciding to undertake HPwES projects.

Figure 5 shows participants' perceptions about the most significant benefit from making the energy efficiency improvements. In this case, the Number 1 reason was improved comfort, followed by saving money, reduced energy use, reduced environmental impacts, reduced home maintenance concerns, and no benefit. One participant expressed a negative effect.[22]



[22] The customer with the negative response expressed throughout the survey a dissatisfaction with the contractor. In reviewing the customer's history, the research team found no complaints by the customer at the time of the project. The customer did submit a complaint a few years after the project. By that time, the contractor had been terminated from the program for failing to meet HPwES program requirements. Efficiency Vermont regularly conducts quality assurance procedures to ensure that all Participating Contractors are technically qualified, produce high-quality work, and are consistently active in pursuing and completing projects.

Figure 5. Perceptions about benefits from HPwES projects.

Figure 6 juxtaposes participants' primary motivators with participants' perceptions about the most significant benefit from making the energy efficiency improvements. (**Figure 10**, later, shows all benefits reported, with 94 percent of participants reporting an improvement in comfort and 90 percent reporting a reduction in electric or heating bills.)

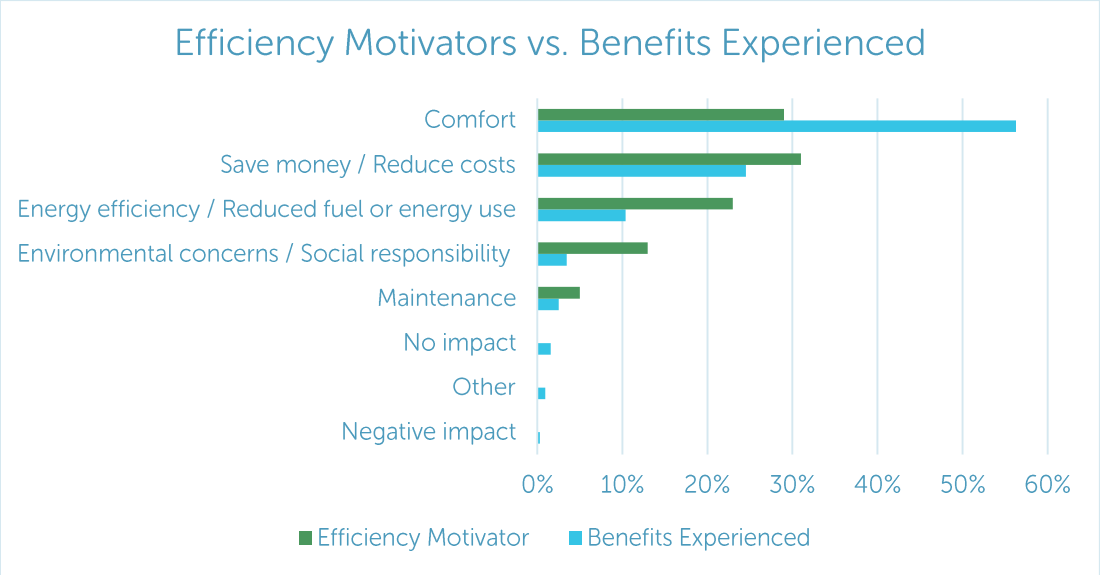


Figure 6. Comparison of primary efficiency project motivators with primary efficiency project observations

The research team also asked participants about expected and actual changes related to their electricity and fuel / heating bills, using a 5-point scale ranging from "spend a lot less" to "spend a lot more." Most participants (52 percent) expected to see savings on their electricity bills as a result of their efficiency project. In actuality, 44 percent of participants saw electricity bill savings. Further, 96 percent of participants expected to see savings on fuel and heating bills, while 88 percent actually saw savings.[23]

Interestingly, while 32 percent of participants expected to spend a lot less on their heating / fuel costs, in practice, a greater number (42 percent) actually spent a lot less as a result of their efficiency projects.

To determine if energy efficiency improvements resulted in behavioral changes that led to higher energy use (referred to as the *Jevons effect* or *rebound*),[24] the survey asked participants who saw an increase in their energy bills (12 percent of respondents) about

[23] As reported by participants.

[24] The Jevons Paradox, also known as *energy efficiency rebound*, is based on the 1865 publication, "The Coal Question" by the English economist William Stanley Jevons. He asserted that increased efficiency leads to increased consumption through behavioral changes. The assumption is that a consumer who installs more efficient lightbulbs will be more likely to leave the lights on for a longer time. Although this phenomenon, to the extent that it pertains to today's energy environment, might not entirely eliminate the energy savings of the lightbulbs, it may reduce the expected amount of savings.

changes in their household size and whether they changed their behavior to use more energy in their home.

Results showed that household size stayed largely constant with 8 percent of households having more people and 8 percent having fewer people; the balance of households with increased energy bills stayed the same size. Of the 37 respondents with higher bills, 24 percent said they used their air conditioning more frequently in the summer; 16 percent said they had set their thermostats to a higher temperature in the winter. Five percent of the respondents in this group said they used their household appliances more frequently and one person reported leaving lights on more frequently.

Survey participants largely reported having an overall positive experience living in their homes after their HPwES projects were completed. Of the 318 survey participants, 95 percent reported that living in their home was a better experience as result of their efficiency improvements. Five percent of survey participants reported no changes to their home living experience; and only one participant indicated that it was a worse experience. The survey also asked participants about other non-energy aspects of living in their homes, posing questions with possible responses ranging from "much better" to "much worse." **Figure 7** shows that most respondents believed the projects improved home maintenance and home value. A few respondents indicated improvements in noise levels and safety, with the majority of respondents not noticing a change in either noise or safety.

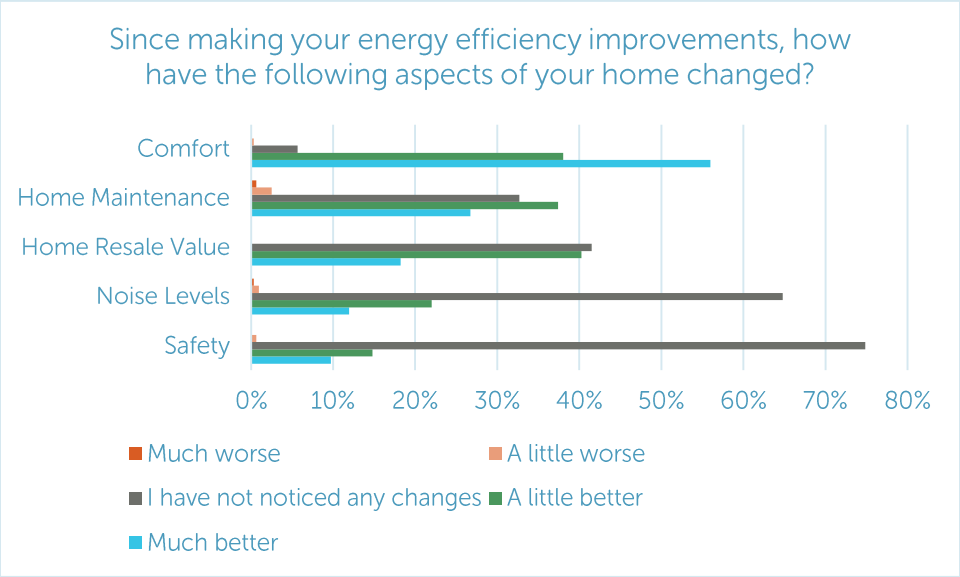


Figure 7. Responses to questions about other non-energy benefits following an HPwES project.

The survey then asked participants if they noticed any health effects as a result of their efficiency improvements. As shown in **Figures 8 and 9,** 23 percent noticed that their quality of sleep was a little better or a lot better; 15 percent noticed reductions in their allergies, although 6 percent reported a worsening of their allergies following their efficiency projects. The figure shows reactions to three other health indicators: colds and flu symptoms, asthma,

and sick days taken at work or school. As shown in **Figure 10**, 27 percent of participants observed positive changes in health since completing their HPwES projects.[25]

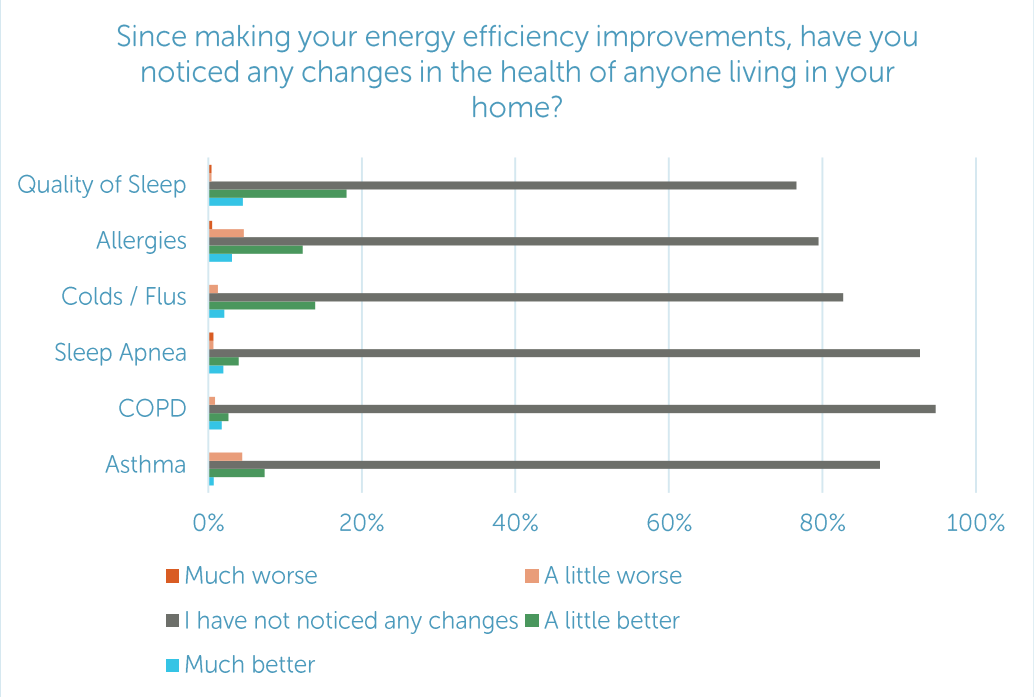


Figure 8. Reported changes in health, following the completion of HPwES energy efficiency projects.

25 Had the research been conducted on low-income programs, the researchers would have anticipated a larger change in occupant health, in keeping with research for the U.S. Department of Energy's Weatherization Assistance Program. See, for example, Tonn, B., et.al. 2014. *Health and Household Related Benefits Attributable to the Weatherization Assistance Program,* http://weatherization.ornl.gov/Retrospectivepdfs/ORNL_TM-2014_345.pdf.

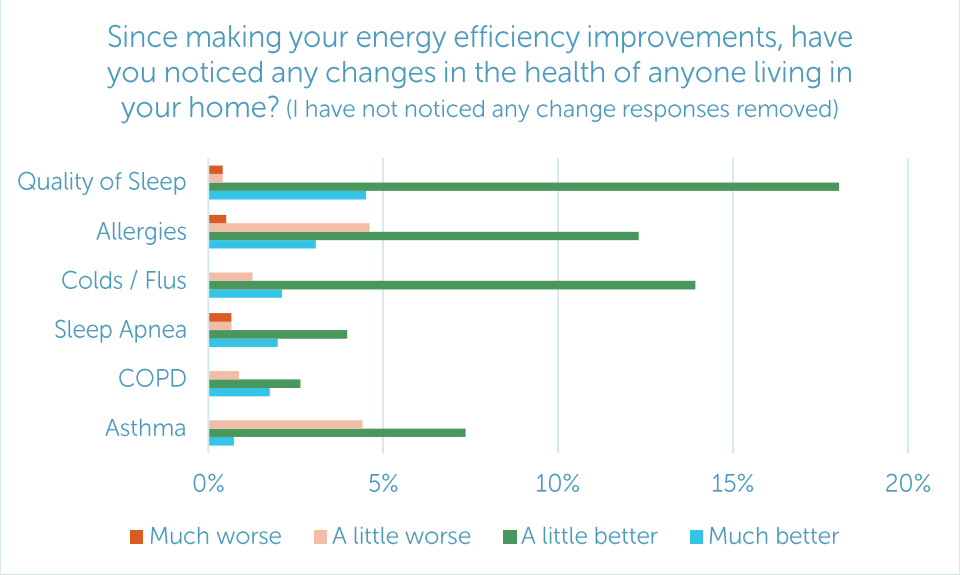


Figure 9. Reported changes in health, following the completion of HPwES energy efficiency projects with "I have not noticed any change" responses removed.

The survey also asked about other positive effects; 87 respondents said they saw additional changes to their home beyond the categories asked, up to that point in the survey. Of those, 71 reported positive effects, and 5 were neutral. The most common positive effect pertained to indoor comfort[26] (50 respondents) and maintenance (28 respondents). For example, reduced drafts, more consistent temperatures, fewer "cold spots," and better indoor air quality in the home were common responses. Some respondents also noted a reduction in in the incidence of ice dams, fewer pests, and/or reduced indoor dust (including "easier to clean" factors).

The primary concerns from the 11 respondents reporting negative effects related to ventilation and humidity. Indoor moisture accumulation was a minor problem for some, particularly with respect to the potential for mold if they did not use additional ventilation or dehumidifiers; others considered these to be much more serious areas of concern. One respondent went so far as to say the additional moisture that built up in their home after their HPwES project resulted in a roof failure. After a review of that participant's work scope and home data, the team determined that the roof failure could not have been from the project, as reported to Efficiency Vermont. Regardless, this information points to a need for additional information sharing with the customer on whole-home ventilation and spot exhaust ventilation—and a need for contractors to emphasize to customers the importance of following ventilation system procedures after energy efficiency upgrades are complete.

The survey asked participants to assign a value to each of the positive effects asked about in the survey. **Figure 9** presents a baseline of observable benefits reported through the closed-

[26] The researchers recognize that the survey asked about comfort, and therefore did not expect participants to list it as an answer to the open-ended question, "What other changes have you noticed?" However, in the targeted question about additional benefits, comfort was the first response for 50 respondents, further emphasizing the value participants place that benefit.

ended questions in the survey. On average, a majority of respondents observed four benefits: improved comfort, reduced energy bills, improved maintenance, and improved home resale value.

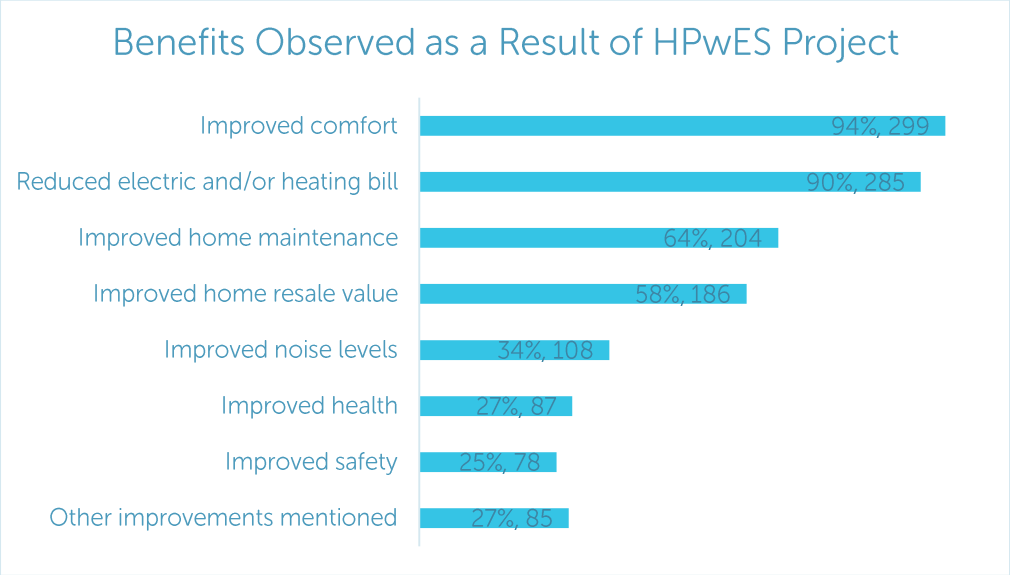


Figure 10. Respondents observed improved comfort and reductions in electricity and heating bills as primary benefits of their HPwES projects.

To assign a value to the benefits experienced by a participant, the team used survey logic to tailor the list of respondent-specific benefits indicated earlier in the survey to a request for subjective values of those benefits. The team calculated the average value score for each benefit *only* on observed measures. That is, if respondents did not observe a benefit, they were not asked to assign a value to it; therefore the value for that benefit for that respondent was "N/A," not "0." The survey asked each participant who identified experiencing a specific benefit from their efficiency project to allocate a total of 100 points, to account for the value of all of the benefits they experienced. For example, if participants experienced only bill savings and comfort, they had to allocate 100 points: 50 points each if they felt the benefits were equal, or more points to one benefit and fewer to the other, as long as the total equaled 100 points.

Figure 11 shows that participants valued bill savings more than any other benefit (40 percent). They valued indoor comfort at 34 percent. They placed the remaining 26 percent of their project value on other non-energy benefits. The researchers have assumed respondents would not value the benefits they did not observe, so when participants valued their combined non-energy benefits at 60 percent of the overall benefit of their project, this number accurately reflects their perspective on experienced benefits.

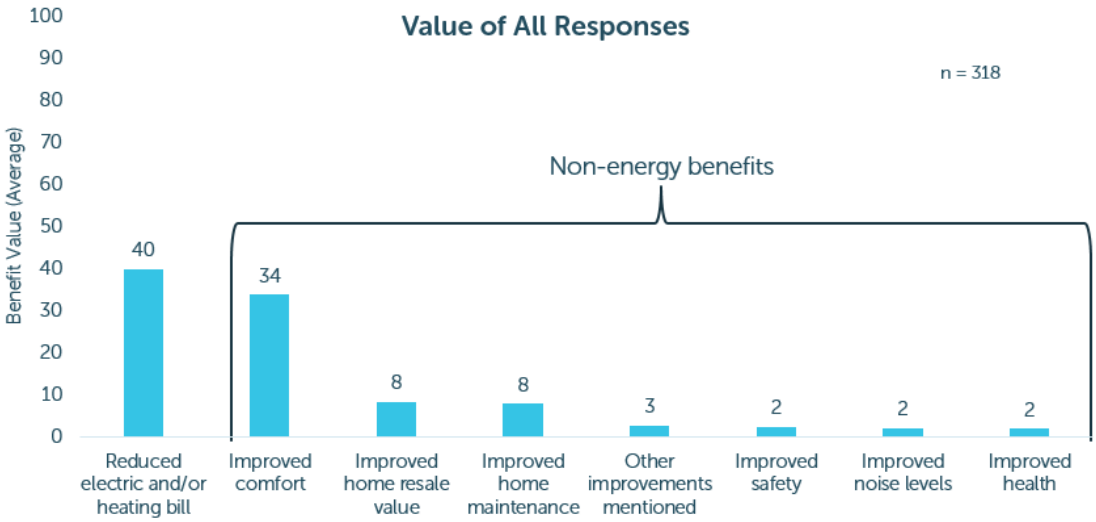


Figure 11. Customer valuation of benefits, showing that reduced electricity and other energy bills are perceived to be a less valuable benefit than the combined value of non-energy benefits.[27]

Participants viewed their non-energy benefits as accounting for 60 percent of their total perceived value of the HPwES project, and energy savings at 40 percent. This means that the NEB value, relative to the value of energy savings with this statistically significant sample, has a measurable result: Customers value non-energy benefits over energy savings.

The ratio from the 60 percent / 40 percent customer valuation preference for NEBs over energy bill savings from HPwES projects is thus 1.5 : 1. Expressed in a different way, participants valued combined non-energy benefits at 150 percent of the value of the bill savings.

This is ***ten times*** the 15 percent adder that Vermont applies in cost-effectiveness screening for non-energy benefits of the HPwES program.

Most respondents (62 percent) completed additional home energy improvement or renovation work after they finished their HPwES projects. This demonstrates and reinforces the importance of efficiency program marketing strategies on customer retention to ensure the follow-up work includes energy efficiency best practices.

[27] It should be noted there was a wide variability in answers with the following standard deviations for each benefit:
Reduced electric and / or heating bill: 23.0
Improved comfort: 22.9
Improved home resale value: 13.1
Improved home maintenance: 17.1
Other improvements mentioned: 14.2
Improved safety: 10.6
Improved noise levels: 7.8
Improved health: 8.3
The research team examined each benefit for correlations among key project data (project cost, project incentives, MMBtu savings, kWh savings, finished floor space, and building age). In most cases, the team could not establish correlation, because the data failed to meet assumptions for linear relationships, even when the team removed significant outliers. In instances where there did appear to be a linear relationship, the p-value was above .05, failing the test for statistical significance.

4.2 Relevance for Efficiency Vermont and Energy Efficiency Industry

Vermont regulation requires that Efficiency Vermont's energy efficiency programs screen for cost effectiveness, under the Societal Cost Test. As explained in Section 2.1, the Societal Cost Test takes into consideration all of the program expenses and some of the environmental benefits of the programs, but it does not base its valuation of participant benefits such as comfort, safety, noise reduction, and healthcare savings on any specific research. Section 2.2 describes the reasons, and the challenges associated with quantifying these benefits.

Vermont's last regulatory proceeding for valuing avoided costs concluded in 2015. For that proceeding, VEIC (Efficiency Vermont program administrator) offered estimates of the value of health benefits and environmental benefits for consideration in cost-effectiveness screening of energy efficiency measures. Nevertheless, Vermont's Public Utility Commission (PUC) ruled to keep the 15 percent NEB adder, established in 2012, supporting its decision with arguments by some of the Vermont distribution utilities and the Vermont Public Service Department that the evidence to change the adder was insufficient. In particular, the PUC was persuaded that there could be overlap (that is, double-counting) between health and environmental benefits, and that the studies cited by VEIC were not specific to Vermont.[28]

The results of this present research support a change in valuing NEBs and thus adjusting cost-effectiveness screening values in Vermont. As articulated in the 2012 Vermont PUC Order, the current 15 percent NEB adder is intended to account for participant benefits accrued from energy efficiency projects: comfort, convenience, and health; and utility benefits such as reduced utility terminations and reconnections and bill complaints.[29] Although the team did not capture utility benefits in this research, the results of this study on participant benefits only, support a much higher NEB value than is currently in use in the Vermont Screening Tool for HPwES projects. Evidence from HPwES program participants who completed the survey indicates that **for this program, a NEB adder of 150 percent of the energy savings is defensible—because it is evidence based.**

This study also provides sufficient evidence for more targeted marketing of the HPwES program. Data from the study show that the largest motivators for participant decision making on an HPwES project are saving money (30 percent), improving comfort (29 percent), and greater energy efficiency via reductions in energy use (23 percent). Further, 62 percent of respondents undertook and completed another energy efficiency / major home improvement project after completing the HPwES project. This makes a clear case for a strong customer retention strategy at Efficiency Vermont. This information is valuable in ensuring that Efficiency Vermont is tailoring its marketing appropriate to customers' interests and to past participants' ongoing decision making on energy and renovation projects.

The number of moisture and ventilation concerns raised by study participants is relatively minor, and in fact, a clear majority of respondents experienced an improvement in moisture control and ventilation. Nevertheless, the few negative participant responses suggests the program can improve. The team recognizes that contractors and homeowners can be

[28] Case # EEU-2015-04, Vermont Public Utility Commission Order entered December 22, 2015, at 15.
[29] Vermont Public Utility Commission Order entered 2/7/12 Re: Cost-Effectiveness Screening of Heating and Process-Fuel Efficiency Measures and Modifications to State Cost-Effectiveness Screening Tool,, at 24.

further informed or trained on the importance of properly operating and maintaining spot ventilation systems, and whole-house systems, as part of the scope of (or immediately subsequent to) efficiency retrofits.[30]

Broadly, most residential non-energy benefit studies examine benefits to low-income participants. This study provides primary NEB research specific to a market rate energy efficiency program. Since HPwES is a nationally recognized market rate efficiency and weatherization program, the results of this research in Vermont could be adapted and applied in other jurisdictions offering the HPwES program.[31]

5. Conclusions

5.1 Suggestions for Disseminating Results

This research provides valuable evidence for participant non-energy benefits from market rate weatherization services' packages. Most energy efficiency programs throughout North America offer a similar program or package of weatherization measures to residential customers. The team plans to pursue dissemination opportunities at national and international conferences such as the American Council for an Energy-Efficient Economy's Summer Study on Energy Efficiency in Buildings, the Home Performance Coalition National Home Performance Conference & Trade Show, and the International Energy Program Evaluation Conference. Presenting primary research at these conferences will showcase Efficiency Vermont and VEIC's commitment to research and evaluation.

Sharing this research will also help advance industry knowledge of the market rate residential sector, for which very little NEBs research has been conducted. Efficiency Vermont will share these results with its Efficiency Excellence Network contractors, so that the network might use the findings to better position sales pitches to reflect customer values, and adjust work scopes to meet customer needs.

6.2 Recommendations for Next Steps

The researchers have identified several applications for the findings of this study as follows.

This study provides helpful insight as to what Vermont HPwES customers value. Next steps for incorporating these insights into program design include conducting an internal review of the research results and modifying marketing and outreach programs for the HPwES program as well as other thermal efficiency programs.

The findings of this research provide evidence that could be used to support changes to the state screening tool in the upcoming 2018 Avoided Costs Proceeding. As a first step, the research team recommends that Efficiency Vermont and VEIC coordinate with the Public

30 Furthermore, the study reinforces the importance and benefits of the HPwES program's quality assurance procedures and oversight. It is noteworthy that the contractor for the sole dissatisfied customer had been terminated from the program prior to the survey, demonstrating that the program systematically catches and rectifies contractor negligence.

31 Had the research been completed on lower-income programs, the researchers would have anticipated greater health impacts as a result of the efficiency improvement projects.

Service Department and other stakeholders to consider how these results could be applied to the screening of Efficiency Vermont's programs and measures and develop a plan for the best use of this information in the upcoming 2018 Avoided Costs Proceeding. It may make sense to explore the potential for incorporating the framework of the National Standard Practice Manual depending on scope of the proceeding.

This study contributes primary research to the body of evidence supporting the widespread value of energy efficiency beyond energy savings. This data can be used by policy-makers and decision-makers to support investments in energy efficiency. Dissemination of this report will be a first step in this process. Additional surveys in other jurisdictions are recommended to increase the body of evidence regarding market-rate residential thermal efficiency improvement programs.

As Efficiency Vermont seeks to increase program impacts and expand program participation, this research provides a clear benchmark for the program to measure future performance. Elements of this research could also be used to inform screening in other jurisdictions that include measure or program-level NEBs.

Appendix A: Survey Instrument

INVITE EMAIL

Subject Line:
How have energy efficiency improvements impacted your home?

Copy:
Hi {First Name},

In [year] you made an investment in your home by partnering with [contractor name] to complete energy efficiency work. Now that you've had the opportunity to live with these improvements for an extended period of time, we want hear how have they impacted you! Are things better? Worse? Did you notice changes you weren't expecting? Let us know by clicking the link below to our 10-minute survey.

Survey Link: XXXXXXXXXXXXXXXXX

We value your feedback so much that we'll be providing a $20 gift card to select major retailers to everyone who completes the survey! Your feedback will help us, Efficiency Vermont (the folks that provided you with a rebate on your project), better understand how we can support homeowners just like you as they go about taking on energy efficiency improvements.

*Note: Survey link expires **[close date]**.*

If you have any questions about this study, please feel free to contact me at bashe@veic.org or 802-658-6060 X7652.

Thank you,
Bridget Ashe
Manager, Customer Support
Efficiency Vermont

SURVEY

I. Intro

Q1 Our records show that you received a rebate from Efficiency Vermont when you worked with [Contractor Company Name] to complete energy efficiency improvements through the Home Performance with ENERGY STAR® program in [Year]. In order to provide better service to Vermonters like you, we would like to hear about your experience living in your home since completing your project. This survey should take about 10 minutes to complete. As a thank you for your time, we will send you a $20 gift card to a major retailer of your choosing. Your responses will be kept confidential, so please be candid.

II. Screener

Q2 Do you still live in the house where your energy efficiency improvements were made?

- ❍ Yes
- ❍ No

Condition: No Is Selected. Skip To: End of Survey.

Q3 Do you live in this house year round?

- ❍ Yes
- ❍ No

Q4 Since making energy efficiency improvements in [Year], have you done any additional work to your home including... (Please select all that apply.)

- ❑ Added/replaced a home heating or cooling system
- ❑ Added/replaced a water heating system
- ❑ Installed a renewable energy system
- ❑ Added additional insulation or air sealing
- ❑ Added a room/addition to your home
- ❑ Replaced doors and/or windows
- ❑ Switched your primary heating source (ex. natural gas to electric heat)
- ❑ Completed other major home improvements (Please specify.) _____
- ❑ I have not done any of the items listed above.

III. Motivators

Q5 What was the number one reason you decided to make energy efficiency improvements to your home?

Q6 Now that you have lived in your home for at least one year since your energy efficiency improvements were made, what do you consider to be the biggest benefit of these improvements?

IV. Bill Savings

Q7 As a result of making your energy efficiency improvements in [YEAR], how has your electric bill changed?

	Spend a lot less	Spend a little less	See no change	Spend a little more	Spend a lot more
You expected to...	❍	❍	❍	❍	❍
You actually...	❍	❍	❍	❍	❍

Q8 As a result of a making your energy efficiency improvements in [YEAR], how has your heating / fuel bill changed?

	Spend a lot less	Spend a little less	See no change	Spend a little more	Spend a lot more
You expected to...	❍	❍	❍	❍	❍
You actually...	❍	❍	❍	❍	❍

V. Rebound Effect

Q9 Comparing your habits from before you made your energy efficiency improvements in [Year] to now, does your household do any of the following... (Please select all that apply.)

- ❑ Set your thermostat to a higher temperature in the winter
- ❑ Use your AC more frequently during the summer
- ❑ Leave your household's lights on more frequently
- ❑ Use your household's appliances more frequently
- ❑ None of the above

Q10 Since making your energy efficiency improvements in [Year], has the number of individuals living in your home changed?

- ❍ Yes, there are more people in my home.
- ❍ Yes, there are fewer people in my home.
- ❍ No, the number of people in my home is the same.

VI. Non-Energy Benefits

Q11 As a result of making your energy efficiency improvements, how has your overall experience living in your home changed?

- ❍ Much better
- ❍ A little better
- ❍ I have not noticed any changes
- ❍ A little worse
- ❍ Much worse

Q12 As a result of making your energy efficiency improvements, how have the following aspects of your home changed?

	Much better	A little better	I have not noticed any changes	A little worse	Much worse
Comfort	❍	❍	❍	❍	❍
Noise levels	❍	❍	❍	❍	❍
Home maintenance (ex. moisture issues, pest problems, ice dams)	❍	❍	❍	❍	❍
Safety (ex. reduced fire or carbon monoxide danger)	❍	❍	❍	❍	❍
Home resale value	❍	❍	❍	❍	❍

Q13 Since making your energy efficiency improvements, have you noticed any changes in the health of anyone living in your home? (If no one if your home has a certain health concern listed below, please select "N/A".)

	Much better	A little better	I have not noticed any changes	A little worse	Much worse	N/A
Colds / flus	❍	❍	❍	❍	❍	❍
Asthma	❍	❍	❍	❍	❍	❍
Chronic Obstructive Pulmonary Disease (COPD)	❍	❍	❍	❍	❍	❍
Allergies	❍	❍	❍	❍	❍	❍
Sleep Apnea	❍	❍	❍	❍	❍	❍
Quality of sleep	❍	❍	❍	❍	❍	❍

Q14 Since making your energy efficiency improvements, have you or anyone in your household experienced a change in the number of sick days they take from work and / or school? (If no one in your household attends work or school, please select "N/A".)

- ❍ Yes, fewer sick days from work and / or school.
- ❍ Yes, more sick days from work and / or school.
- ❍ No, the same number of sick days from work and / or school.
- ❍ N/A

Q15 Have you noticed any other changes in your home that you would attribute to the energy efficiency improvements you made?

- ❍ Yes, I have noticed other changes.
- ❍ No, I have not noticed any other changes.

Display This Question:

If Have you noticed any other changes in your home that you would attribute to the energy efficiency improvements you made? Yes, I have noticed other changes. Is Selected

Q16 What other changes have you noticed?

VII. Valuation

Display This Question / Answers:
If "Spend a lot less" or "Spend a little less" is selected for "You actually…" in Q7 & Q8
Or
If "Much better" or "A little better" is selected in Q12 or Q13
Or
If ""Yes, fewer sick days from work and / or school" is selected in Q14
Or
If "Yes, I have noticed other changes" in Q15

Q17 Below is a list of all of the positive changes you noticed in your home since making energy efficiency improvements. Looking at this list, please indicate how valuable you personally found each of these items by assigning them a value of 0 to 100. The more valuable something is the more points it should be assigned. (Note: You may give something 0 points, but your total must equal 100.)

_____ Reduced electric and/or heating bill
_____ Improved comfort
_____ Improved noise levels
_____ Improved home maintenance
_____ Improved safety
_____ Improved home resale value
_____ Improved health
_____ Other improvements mentioned

VIII. General

Q18 What, if anything, else would you like to share about your experience living in your home since making your energy efficiency improvements?

Q19 On average, how much time do you spend in your home each day (including sleeping)?

	Less than 8 hours	8 to 12 hours	13 to 16 hours	17 to 20 hours	More than 20 hours
Weekday	❍	❍	❍	❍	❍
Weekend	❍	❍	❍	❍	❍

IX. Follow Up

Q20 Thank you for your participation! Please list your name and the email address you would like your gift card sent to.

Name
Email address

Q21 Would you be interested in being contacted about potential follow-up interviews/surveys related to this study? Additional research incentives would be provided.

❍ Yes
❍ No

Q22 Would you be interested in sharing your experience completing your energy efficiency improvements in the form of a customer testimonial?

❍ Yes
❍ No

Appendix B: Efficiency Vermont's Home Performance with ENERGY STAR Incentives

The following incentives reflect the same categories and pricing as delivered through the program in 2012-2015. Equipment efficiencies may have been different based on standards and availability at the time, but other qualifying criteria are consistent. An additional $500 bonus may have been earned by participants during promotional periods, but the maximum cap of $2,500 was absolute.

Air Sealing and Insulation Incentive

Energy Efficiency Home Improvement	Qualifying Criteria		Customer Incentive	
Minimum Overall Requirement	Install all recommended health and safety improvements including mechanical ventilation, carbon monoxide detectors, or other essential improvements.		$500	
	Reduce air leakage by a minimum of 10% (as measured by a pre- and post-blower door test).			
Air Sealing	Reduce air leakage as measured by a pre- and post-blower door test.		20–35% reduction	≥ 35% reduction
			$250	$500
Insulation	Install insulation meeting the following R-value criteria:		$0.40 per sq. ft. of new insulation	
	Location	New Insulation[2]		
	Attic Flat Ceilings	R-value ≥ R-49		
	Vaulted Ceilings and Floors	R-value ≥ R-30		
	Walls	R-value ≥ R-12		
	Foundation and Rim-joists	R-value ≥ R-15		
Heat Distribution Improvement	Install at least $200 of duct sealing, leak repairs, boiler pipe insulation, and similar measures.		$75	
Comprehensive Retrofit Bonus Package (for whole-house projects that substantially improve air tightness and insulation)	Reduce air leakage ≥ 35% as measured by a pre- and post- blower door test.		$250	
	Install insulation in areas equivalent to at least 75% of the home's finished floor area (example: a 2,000 sq. ft. home could qualify by installing 1,000 sq. ft. of insulation in the attic and 500 sq. ft. of insulation in the walls). Insulation must meet the above criteria for R-value.			
	Maximum incentive for air sealing and insulation improvements		$2,000	

Heating System Incentive

Energy Efficient Heating System	Qualifying Criteria		Customer Incentive
Heating System Replacement	Furnaces must have efficient brushless DC motors (e.g. BPM, ICM, ECM®). Boilers must be installed with a high performance circulator pump. Minimum AFUE requirements are as follows:		$500
	Oil Boiler: 87% AFUE	LP Boiler: 95% AFUE	
	Oil Furnace: 87% AFUE	LP Furnace: 95% AFUE	
	Maximum incentive for heating system improvements		$500

Maximum incentive for air sealing, insulation, and heating system improvements	$2,500