

Comfortable, Healthy, and Saving Money

Linking Building Occupants' Health to Energy Efficiency Programs

Efficiency Vermont R&D Project: Healthy Buildings

December 2022

Laura Capps



20 Winooski Falls Way
Winooski, VT 05404

Contents

Executive Summary	3
Introduction	5
Shifting from Short-Term Pilots to Long-Term Programs	6
The factors that inhibit integration of plus-health work, and their solutions	7
Valuing Health Impacts of Energy Efficiency Programs.....	7
Adding another indicator to energy efficiency program compensation	8
Quantifying non-energy benefits.....	9
The value of expanding data collection related to health benefits	10
The scope of state and national data sets.....	10
Project-specific monitoring	12
Customer outcomes.....	12
Data granularity and emphasis	13
Adding plus-health services	15
Recommendations	16
Conclusion	17
Appendix A.....	18
Proposal for New Non-Energy Benefit (NEB) Adder: Health and Healthcare benefits associated with Weatherization	18
Appendix B.....	29
Healthy Vermonters 2020.....	29

Executive Summary

Efficiency Vermont, a statewide energy efficiency program, has demonstrated that healthcare partners can take advantage of energy efficiency program infrastructure to advance improvements in population health. Further, Efficiency Vermont has shown that this collaboration benefits both the energy efficiency and the healthcare market sectors. Until the concurrent delivery of both clean-energy and health services can take place, there is significant opportunity to lay the groundwork for a system that crosses those sectors. The benefits of crossing sectors involve meaningful support of societal interests in improving population health and economic well-being. Thus, the central topics for ongoing exploration within the energy efficiency service delivery industry are:

1. The derivation of full economic costs and benefits of cross-sector participation
2. The design of effective methods for sustained coordination between the health and energy sectors

To investigate these two primary topics, Efficiency Vermont created the Advances Health Steering Committee. This internal team reports to Efficiency Vermont leadership and sets the strategic direction for the energy efficiency utility's advancement of better health outcomes for building occupants. It also determines how "energy-plus-health" services can be successfully integrated into Efficiency Vermont's program portfolio. Efficiency Vermont launched the committee in 2022.

In collaboration with healthcare partners, the committee has determined initial benchmarks for which Efficiency Vermont can determine metric targets and achievement of milestones and goals. The benchmarks are designed to be shared with participating healthcare providers to support tracking and quantifying the health value of energy efficiency and energy-plus-health programs and services. The benchmarks and metrics are based on:

- Reliable inputs from State and national data sets
- Monitoring of project-specific indoor and outdoor environmental conditions
- Self-reported and clinician-evaluated customer health conditions
- Changes in occupant behavior
- Well-documented health outcomes correlated with activities delivered by Efficiency Vermont's programs and services

Such benchmarks can provide a sound basis for obtaining long-term and right-sized sustainable funding from healthcare payers, governmental programs, and philanthropic organizations, since the achievement of well-functioning energy efficiency programs that embrace energy-plus-health work is beyond the scope of energy efficiency program funding streams alone.

This report describes Efficiency Vermont's achievements in identifying and demonstrating the calculation basis for the benchmarks and their metrics. It also provides a reference point for

informing Efficiency Vermont's internal Advances Health Steering Committee about strategic next steps in enhancing the energy-plus-health model.

To that end, the Committee has made the following recommendations to support Efficiency Vermont's next strategic steps in advancing better health outcomes:

1. Determine benchmarks and set metrics for quantifying and tracking program and service
2. Establish methods for tracking costs associated with programs and services relative to the health benefits provided by those programs and services.
3. Institute a criteria matrix for evaluating programs and services related to their effects on building occupant health, and how those programs and services are funded. Evaluate existing programs according to the matrix and identify areas to cut and grow.
4. Identify available funding opportunities, prioritizing funding aligned with Efficiency Vermont's strategy and health-related program outcomes, and providing multi-year support to enable dedicated resources for program implementation.

Introduction

When patients with chronic respiratory illness and other health problems associated with poor indoor air quality come to a health clinic, will they be better served if health workers can both treat them and get them in touch with home energy improvement specialists?

Efficiency Vermont has conducted sufficient research on this question to answer: **Yes**. Improving air sealing; insulation; lighting; and heating, cooling, and ventilation systems also improves indoor environmental quality. The result of this work is healthier occupants. The evidence to date for “Yes” is growing—not just in Vermont, but [nationwide, too](#)—and is economically promising. Nevertheless, several related topics are not yet fully explored; a deeper understanding of them will solidify the basis for making future decisions about linking energy efficiency and healthcare services to customers exposed to poor indoor air quality. These topics are:

- The full economic and societal costs and benefits of linking the two sectors’ services
- Effective methods for sustained coordination of both sectors’ service delivery

From 2017 through 2021, Efficiency Vermont collaborated with Vermont hospitals, the Vermont low-income weatherization assistance program (WAP), and the Vermont Department of Health to build health and energy industry partnerships. The result of these partnerships was the delivery of [energy-plus-health](#) residential pilot projects. The pilot projects yielded valuable insights on better outcomes for customers from a coordinated energy-plus-health system designed to reach income-qualified residents with specific health conditions.

The resulting [Healthy Homes Vermont 2021](#)¹ and the related [Weatherization + Health](#)² reports are the basis for the [Weatherization + Health Initiative \(WHI\)](#)³ (pp. 171-73), authorized by the Vermont Public Utility Commission with funds from the [Thermal Energy & Process Fuel budgets](#).⁴ The Vermont Public Service Department is administering the funds, in coordination with the Vermont Department of Health, the Office for Economic Opportunity, and Efficiency Vermont. The State is exploring expanding the WHI, including opportunities to secure long-term State and federal funding from Medicaid, making the case that an initiative that combines health service delivery and building improvements constitutes a high-value upstream and acute health intervention.

¹ Efficiency Vermont collaborated with regional hospitals and the Vermont WAP to deliver energy-plus-health services to low-income households. The pilot programs targeted customers with asthma, chronic obstructive pulmonary disorder (COPD), and those at risk of falling at home. The pilots succeeded in establishing Vermont-specific experience and positive outcomes with energy-plus-health program collaborations.

² The Vermont Department of Health summarized the published health co-benefits of residential weatherization, and estimated the health and energy economic benefits per household receiving weatherization for household occupants and the general public. The estimated 10-year economic benefit per household is \$24,757—nearly three times greater than the initial expense resulting in 191% return on investment.

³ The Weatherization + Health Initiative blends energy efficiency and healthcare funding to deliver weatherization-plus-health services to eligible households.

⁴ Vermont Public Utility Commission, Case No. 21-1616-PET. Order Determining Reallocation of Unspent 2018-2021 EEC and TEPF Funds; August 31, 2021.

In 2019, Efficiency Vermont expanded its energy-plus-health work to include buildings in the commercial and industrial (C&I) markets. The Efficiency Vermont team identified schools as an opportunity for energy-plus-health partnerships, and in 2020 launched indoor air quality programs and research. The team coordinated its work with the Vermont Agency of Education and the Department of Health. The programs continue today, with over \$30 million dedicated to updating heating, ventilation, and air conditioning (HVAC) systems in schools. The primary objective is to improve indoor air quality in those buildings and to monitor the results of the investment in building system improvements. Additional information about the team's work can be found in Efficiency Vermont's [Explorations in School Indoor Air Quality](#) report.

Through these residential and C&I programs, **Efficiency Vermont has demonstrated that health care partners can take advantage of energy efficiency program infrastructure to advance improvements in population health, and that this collaboration benefits both market sectors.**

This report describes how energy efficiency programs can move "plus-health" work from pilot demonstration into permanent programming. It also shows how to quantify such programs' value in improving health outcomes to justify continued and expanded financial support from healthcare and government sectors. Underpinning this shift are reliable data reporting of the positive health outcomes—that is, measurable health improvements—from energy efficiency and energy-plus-health programming.

Shifting from Short-Term Pilots to Long-Term Programs

The energy-plus-health pilots Efficiency Vermont has conducted since 2017 have brought to light several health-related services that could benefit Efficiency Vermont organization goals and energy efficiency programs nationwide. One such service has been to offer indoor air quality monitoring when an Efficiency Vermont representative visits a home or business—virtually or in person. These visits can involve a discussion of the principles of a healthy building, as part of a broader energy consultation about meeting a customer's energy needs.

Another example is for Efficiency Vermont to receive customer referrals from health care providers. Efficiency Vermont's electronic referral system enables patients to sign up for energy efficiency services during their healthcare appointments, contingent on a service recommendation from the healthcare provider.

Finally, Efficiency Vermont can ascertain how customers perceive changes to their indoor environmental quality, describing the "before" conditions via a survey, and the "after" conditions following participation in an energy efficiency and / or energy-plus-health program. Similarly, health care providers can measure program impacts on health using validated surveys and testing procedures before and after patients participate in Efficiency Vermont programs. These customer-reported and healthcare provider-measured data can reinforce continued collaboration with partners in delivering new or expanded programs. Absent such direct data collection, Efficiency Vermont can use secondary data to derive reasonably valid information.

The secondary data might involve health outcomes reported by other, similarly designed programs, and research-verified indoor environmental quality, with subsequent health-related outcomes of specific energy efficiency and energy-plus-health measures.

The factors that inhibit integration of plus-health work, and their solutions

Moving from pilots and integrating plus-health services into existing programs has proved difficult to sustain given the current performance targets of Efficiency Vermont. Internal resource allocation is naturally focused on provision of services to deliver results for Commission-approved performance metrics, which limits opportunities to pursue integration and tracking of other non-energy benefits into efficiency projects.

This is the primary reason for preventing or slowing the integration of plus-health services into energy efficiency programs. However, Efficiency Vermont has recognized that steering committees are an effective organizational management mechanism for strategies that cross traditional boundaries. The team used such a committee to explore effective ways of integrating flexible load management and greenhouse gas reduction into Efficiency Vermont core programs.

Thus, Efficiency Vermont created its Advances Health Steering Committee to determine and define the energy efficiency utility's role in advancing better health outcomes in Vermont. The group will also specify Efficiency Vermont's strategic direction for advancing better health outcomes for 2023, and for the 2024–2026 performance period. The steering committee's work will determine how plus-health services can be successfully integrated into Efficiency Vermont's program portfolio. The committee will also define how Efficiency Vermont funds and prioritizes plus-health opportunities, to ensure optimization of staff and budget resources.

Valuing Health Impacts of Energy Efficiency Programs

Paramount within the Advances Health Steering Committee's work is to create benchmarks and specify metrics to measure the health value of Efficiency Vermont's programs and services. Such benchmarks can provide a sound basis for obtaining long-term and right-sized, sustainable funding, since the achievement of well-functioning energy efficiency programs that embrace energy-plus-health work is beyond the scope of existing energy efficiency program funding streams. If the positive health outcomes are proven to be as high as expected and are deemed valuable to energy efficiency regulators and stakeholders,⁵ the outcomes could inform

⁵ Vermont statute contains provisions for the role of the Department of Public Service in overseeing electrical energy planning that considers the "protection of public health" ([30 V.S.A. §202\(c\)](#)). The resulting [2022 Vermont Comprehensive Energy Plan](#) acknowledges that "Vermont's energy policy is interconnected with the health and economic well-being of Vermonters..." and that "[e]nergy policy needs to consider non-energy-related objectives that can be advanced with action in the energy sphere" (p. 11). The terms *health* and *healthcare* are used throughout nearly every section of the Plan, which also contains strategies for weatherization at scale and a section on the Weatherization + Health Initiative (p. 171-73). Thus, the framework for regulatory consideration of permanent, performance-related energy-plus-health initiatives exists.

future opportunities for Efficiency Vermont to apply new funding sources for continuation and growth of energy efficiency services in Vermont.

Healthcare payers that might be interested in financially supporting energy-plus-health strategies are:

- Public and private health insurers who receive financial benefits for the improvement of downstream health outcomes from upstream interventions delivered through the programs
- Hospitals and health insurers with community benefit funds for supporting program-delivered improvements in the [social determinants of health](#): patient sense of community; housing, economic, and quality-of-life improvements; and healthful living and training in energy efficiency practices

Government programs and philanthropic organizations that might be interested in financially supporting such programs are those striving to:

- Support vulnerable and marginalized populations and businesses
- Improve and maintain local housing and building stock safety and affordability
- Adapt communities to climate change and mitigate the associated health impacts
- Reduce air pollution
- Optimize energy and health systems' reliability and affordability
- Improve community resilience

Because a single program can provide more than one benefit at a time, Efficiency Vermont can likely pool resources from several funders to support energy efficiency and plus-health work.

[Adding another indicator to energy efficiency program compensation](#)

Efficiency Vermont's at-risk performance compensation is tied to 24 quantifiable performance indicators (QPIs) and minimum performance requirements across two portfolios of service—electrical energy efficiency and thermal energy and process fuels efficiency.

Efficiency Vermont annually reports additional market-specific program performance data, service updates, market considerations, and trends. This information offers regulators real-world contexts for the QPI results. Current QPI metrics effectively capture traditional energy savings and more progressive metrics like total resource benefits and greenhouse gas savings. Although many program impacts might be of interest, not all have value as compensable performance factors in energy efficiency programming.

Currently, there is no health-related performance metric in Efficiency Vermont's QPIs. Establishing such a metric would necessitate creating a generally acceptable method for quantifying health impacts of Efficiency Vermont programs and services. Doing so may help develop pathways for integrating health services into future QPIs.

Quantifying non-energy benefits

The quintessential feature of energy efficiency is that it constitutes “energy not used,” and further, “energy not used at a specific time.” The understanding of energy efficiency’s many tangible benefits has evolved well beyond those relating only to reductions in energy consumption (megawatt-hours) and energy demand (megawatts). Since 1994, [policy researchers](#) have characterized and / or quantified non-energy benefits ranging from water savings to reduced building operating costs, increased occupant comfort, improved worker productivity, and better occupant health. The researchers’ analyses have helped to inform deemed enhancements (known as *adders*) to energy efficiency programs subject to regulatory evaluation.

One emerging frontier on non-energy benefits is now the real-world, *combined* human benefits from energy efficiency and plus-health programming.

Although a specific QPI metric for health benefits accruing from energy efficiency measures does not exist, Efficiency Vermont research and development work has laid the groundwork for it. The State’s long-standing avoided-cost screening process has approved the framework for adding such quantifiable benefits for comprehensive weatherization projects.

The avoided-cost process has enabled both Efficiency Vermont and State regulators to add to Vermont’s substantial understanding of non-energy benefits. The regular avoided-cost screening calculation of efficiency measures contains an adder representing the monetized value of the classic non-energy benefits. Evaluators include avoided costs when calculating the total resource benefits and minimum electric benefits, and total societal benefits from electricity efficiency. Together, such metrics reflect Efficiency Vermont’s portfolio-wide societal cost effectiveness.

Efficiency Vermont currently uses the following non-energy benefits adders in its societal cost-effectiveness screening:

- 15 percent of the present value of lifetime electric and fuel savings for non-energy benefits, applied to the full portfolio
- 15 percent of the present value of lifetime electric and fuel savings for non-energy benefits to participants in low-income programs
- 7.7 percent of measure / project cost, applied annually over its lifetime, for health and healthcare benefits associated with weatherization-related (Wx-Health) projects and measures, for low- and moderate-income households
- 2.5 percent for Wx-Health projects and measures to market rate households

The scope of health outcomes to which the Vermont Wx-Health non-energy benefits adder applies is narrow. This is due to the scarcity of defensible data that informed the adder (see **Appendix A** for the adder’s rationale and calculation basis). This phenomenon is consistent with other instances in which a lack of relevant data restricts the quantification of non-energy benefits.

The value of expanding data collection related to health benefits

Efficiency Vermont needs new methods to fully account for the medically informed health benefits of energy efficiency programs and services. To increase visibility into the valid and reliable health impacts of programs and services, Efficiency Vermont can use state and national data sets, conduct project-specific monitoring, and / or collect customer-reported health benefits.⁶

The scope of state and national data sets

The Vermont Department of Health monitors and reports data applicable to the desired outcomes of the [State Health Improvement Plan](#). The [Healthy Vermonters 2020 Data Explorer](#) (HV2020) data set monitors 130 population health indicators for progress toward State goals.⁷ **Appendix B** lists the data elements from HV2020 that might be applicable to energy efficiency programs and services, and which are based on previously reported health benefits of [residential](#) and [commercial](#) energy efficiency. If Efficiency Vermont adds plus-health services to program offerings, additional HV2020 data elements could apply, demonstrating additional health values delivered through energy-plus-health programs. The HV2020 data are available by County, Department of Health District Office, and hospital service area.

The HV2020 data are generated from other data sets that could be used on their own to inform Efficiency Vermont's analysis of its program impact. For example, the [Behavioral Risk Factor Surveillance System](#) (BRFSS; Centers for Disease Control and Prevention, CDC) annually collects information via phone surveys to more than 6,000 Vermont adults 18 and older. In 2020, Efficiency Vermont supported the Vermont Department of Health in adding a housing and health question to the survey.⁸

The [Green Mountain Care Board](#), Vermont's governmental body that "drives system-wide improvements in access, affordability, and quality of health care," collects and releases data through the [Vermont Health Care Uniform Reporting and Evaluation System](#) (VHCURES) and the [Vermont Uniform Hospital Discharge Data System](#) (VUHDDS). VHCURES reports medical and pharmacy claims data and eligibility data from both private and public payers in Vermont's All-Payer Claims Database (APCD). The APCD covers 90 percent of commercially insured patients and 100 percent of Medicaid and Medicare enrollees. [VUHDDS reports](#) the following data

⁶ As documented in **Appendix A**, the Wx-Health non-energy benefit adder is based on the [2016 Massachusetts Low-Income, Single Family Non-Energy Impacts study](#), including references in the report to a [2015 national Weatherization Assistance Program evaluation](#), the [2017 national study on impacts of weatherizing low-income, multifamily buildings](#), and the [2018 Vermont Department of Health Weatherization + Health](#). These reports use a combination of participant-reported health and indoor environmental quality outcomes and health data sets to derive energy efficiency program health impacts.

⁷ As of the date of this report's publication, the Vermont Department of Health was in the process of updating HV2020 to HV2030. The HV2030 data elements have not been finalized and Efficiency Vermont has offered to provide program data relevant to HV2030 goals. These involve the number of homes weatherized and / or the number of schools with improved ventilation systems.

⁸ The BRFSS housing and health question was: "In the past 12 months, did you have an illness or symptom that was caused or made worse by air quality, mold, pests, furnishings, or excessive heat or cold inside your home?" The response options were: Yes | No | Don't know / not sure | Refused.

related to inpatient discharge, outpatient procedures and services, and emergency department visits:

- *Case-specific diagnostic discharge data*
- *Some socio-demographic characteristics of the patient*
- *Medical reason for the admission*
- *Treatment and services provided to the patient*
- *Duration and status of the patient's stay in the hospital*
- *Full, undiscounted total and service-specific charges billed by the hospital*

The Vermont Department of Health hosts the [Environmental Public Health Tracking Program](#) (Vermont Tracking). The Vermont Tracking portal supports Vermont residents in understanding the connections between the environment and their own health, and combines environmental and public health data sets. Examples of Vermont Tracking's data with relevance to Efficiency Vermont's standard energy efficiency and energy-plus-health work are:

- Asthma rates
- Lead poisoning rates
- Heat vulnerability rates
- Carbon monoxide presence
- Air quality
- Radon presence
- Status on the [Social Vulnerability Index](#) (SVI)

The [Vermont Department of Health reports SVI](#) at the U.S. Census tract level.

The Vermont Tracking SVI data are pulled from the [American Community Survey](#) (ACS), which obtains social, economic, housing, and demographic data from interviews with sampled U.S. households.

The CDC maintains the [National Environmental Public Health Tracking Network](#), which combines health and environmental data from national, State, and city sources. Some relevant metrics for Efficiency Vermont's work from the CDC data set are air quality, asthma, cancer, childhood lead poisoning, community housing characteristics, internet access, community vegetation, heat and heat-related illnesses, and carbon dioxide poisoning.

The EPA's [Environmental Justice Screen and Mapping Tool](#) (EJ Screen) combines environmental and demographic data. Most metrics in the EJ Screen are also available in the National Environmental Public Health Tracking Network.

In short, Efficiency Vermont and the State can draw on valid, publicly available data sets to establish baseline health and health-related community conditions. Because of prior Efficiency Vermont projects, Vermont regulators already understand that energy efficiency programs influence several [social determinants of health](#). Efficiency Vermont is in a good position to test the effectiveness of combining these data with project-specific monitoring to show the extent to which its programs affect health impacts.

Project-specific monitoring

Efficiency Vermont regularly conducts project-specific monitoring to verify energy outcomes. During the [healthy-building pilots](#), Efficiency Vermont expanded its energy monitoring services to include tracking pre- and post-retrofit indoor air quality (IAQ) by measuring carbon monoxide, carbon dioxide, particulate matter, radon, nitrogen dioxide, relative humidity, and temperature levels. The research team also collected program participants’ medical test data from before and after the retrofit. Thus, Efficiency Vermont has the experience and the valid research methods necessary to expand project-specific monitoring and reporting to include more programs and data points, such as monitoring additional pollutants of concern.

Efficiency Vermont is also well positioned to collaborate with health professionals in tracking participant health outcomes. This information—with the pre- and post-project data described above—would allow effective quantification of Efficiency Vermont program impacts on health. For example, working with the Vermont Department of Health, Efficiency Vermont could extrapolate collected IAQ data into resulting improvements in occupant productivity and [disability-adjusted life years](#) (DALYs).⁹ A well-regarded formula for translating measured IAQ improvements into DALYs averted can be found in the National Center for Biotechnology Information’s [A Method to Estimate the Chronic Health Impact of Air Pollutants in U.S. Residences](#).

The COVID pandemic has heightened public awareness of the connections between IAQ and health, and led to increased government funding for quantification of indoor conditions and their resulting health outcomes. In collaboration with the health community, Efficiency Vermont can now take advantage of current, short-term funding opportunities to establish a baseline of performance for existing and retrofitted buildings statewide. Such information could provide a proxy for estimating program impacts in the future.

Efficiency Vermont can also use project-specific monitoring results from other energy efficiency and energy-plus-health programs as a close proxy for the outcomes that Efficiency Vermont’s own, programs could deliver. For example, to support the acceptance of the Wx+health non-energy benefit (NEB) adder in cost-effectiveness screening, Efficiency Vermont used the customer-reported outcomes of Weatherization Assistance Program evaluations, coupled with the Vermont Department of Health’s [Weatherization + Health](#) report to estimate the health outcomes from weatherization services. The Efficiency Vermont team then collaborated with efficiency regulators, other efficiency utilities, and program partners to derive values to be used in Vermont’s efficiency cost-effectiveness screening.

Customer outcomes

When delivering services in coordination with healthcare providers, the healthcare providers can provide valuable data collection and evaluation for the program. Of special interest for assessing

⁹ This [measure, created by the World Health Organization](#), assesses “the overall burden of disease on a person,” and “combines the number of years of life lost, due to premature mortality, and years of life lost, due to time lived in states of less than full health, or years of healthy life lost from disability.” One DALY signifies the loss of one year of full health.

the efficacy of energy efficiency retrofits and other projects, the data can include monitored and self-reported changes in customer health.

For its regular operations, Efficiency Vermont surveys program participants about their experience with energy efficiency services; the program could also work with healthcare partners to collect customer-reported health impacts from these services. Although these data are less reliable than medically reported outcomes, they offer feedback on program effects on health, and can identify areas for improvement and for further data collection.

Adding a health impact question(s) to existing program participation surveys is a relatively easy step toward increasing visibility into program health-related outcomes. Clearly, participant confidentiality must be coordinated with the privacy standards in the regulations governed by the Health Insurance Portability and Accountability Act (HIPAA). Thus, any such question from Efficiency Vermont would need to address *occupant-perceived* indoor environmental quality and / or productivity changes, rather than actual health experience. Aligning the survey question with questions asked in local and national surveys can support wider data analysis.

Data granularity and emphasis

In expanding data collection, Efficiency Vermont will want data that are most relevant to the health care industry and will want to present the data in a format meaningful to the energy efficiency program funder. Although rolling the data up into DALYs may be advantageous from a portfolio-wide analysis and for establishing a compensation-based metric for Efficiency Vermont performance, health payers might prefer more condition-specific visibility in data reporting.

Table 1 lists examples of known and understood energy efficiency measures’ effects on environmental conditions, and corresponding benchmarks whose metrics can be used in assessments of health outcomes. The list illustrates the variety of benchmarks that can be correlated with health outcomes—including changes in indoor and outdoor environmental conditions, self-reported and clinician-evaluated health conditions, and changes in occupant behavior.

Table 1. Sample benchmarks a program could collect for establishing metrics for health outcomes of energy efficiency measures

Efficiency measure	Environmental upgrade	Benchmarks, data collection strategies, and data points to inform program metrics
HVAC upgrades or replacements	Improved IAQ	<ul style="list-style-type: none"> • IAQ pollutant levels, sound levels, temperature, and relative humidity • Validated health surveys for: <ul style="list-style-type: none"> ○ Asthma control ○ Hypertension ○ Mental well-being ○ Thermal stress • Occupant rates of: <ul style="list-style-type: none"> ○ Absenteeism ○ Cancer

Efficiency measure	Environmental upgrade	Benchmarks, data collection strategies, and data points to inform program metrics
		<ul style="list-style-type: none"> ○ Cardiovascular disease ○ Comfort ○ Infectious diseases ○ Productivity / performance ○ Respiratory disease ● Specific to measures influencing site heating emissions: <ul style="list-style-type: none"> ○ Outdoor air quality pollutants ○ Community rates of cancer, cardiovascular disease, and respiratory disease
Air sealing and insulation	Improved thermal control	<ul style="list-style-type: none"> ● Temperature and relative humidity ● Pest activity ● Validated health surveys for: <ul style="list-style-type: none"> ○ Arthritis ○ Asthma control ○ Mental well-being ○ Thermal stress ● Occupant rates of: <ul style="list-style-type: none"> ○ Absenteeism ○ Infectious diseases ○ Productivity / performance ○ Comfort ○ Respiratory disease
Lighting efficiency and controls	Brightness, improved security	<ul style="list-style-type: none"> ● Foot candles ● Validated health surveys for: <ul style="list-style-type: none"> ○ Mental well being ○ Quality and duration of sleep ● Occupant rates of: <ul style="list-style-type: none"> ○ Absenteeism ○ Trips and falls, or other accidents, resulting in medical care ○ Productivity / performance ○ Comfort ● Building-specific, and neighboring, break-ins / crime ● Specific to pre-1978 lighting replacement: presence of polychlorinated biphenyls (PCBs)

In cases where the health outcomes are difficult to track or the data are inaccessible, Efficiency Vermont can calculate defensible estimates from measurable program activities and well-documented health outcomes associated with those types of activities. The estimation method would need to be agreed upon by Efficiency Vermont and program funders, to quantify the health benefits of the program.

Adding plus-health services

As demonstrated by the energy-plus-health pilots and long-term school IAQ monitoring program, Efficiency Vermont’s infrastructure can cost-effectively go beyond energy efficiency and integrate plus-health services. Braiding energy and health services into a single service delivery program provides comprehensive support for the customer and streamlines customer acquisition, administrative processes, service implementation, and evaluation.

Table 2 lists sample plus-health service measures Efficiency Vermont could offer, the connection the measure has to energy efficiency program delivery, and proposed benchmarks for measuring health impacts from these services. For all plus-health measures, Efficiency Vermont could track resulting energy consumption, compared to buildings that have received plus-health services outside the framework of an energy efficiency program. These data can establish a baseline for plus-health measure outcomes that benefit from energy efficiency program integration.

Table 2. Selected plus-health program services and sample benchmarks for measuring health outcomes of those services

Plus-health measure	Connection to energy efficiency programming	Benchmarks, data collection strategies, and data points to inform program metrics
Radon testing & mitigation	<p>Radon levels often increase with weatherization.</p> <p>Testing for radon at the time of the building energy assessment and after the energy retrofit can identify radon presence in buildings.</p> <p>Radon mitigation through energy efficiency supports system optimization for IAQ and energy.</p>	<ul style="list-style-type: none"> • Building radon levels • HVAC design and operation specifications • Occupant rates of: <ul style="list-style-type: none"> ○ Lung cancer
Healthy building operations training, technical support, and / or continuous IAQ monitoring	<p>HVAC equipment and controls optimization and preventive maintenance</p>	<ul style="list-style-type: none"> • Facility maintenance and procurement logs • IAQ pollutants, temperature, and relative humidity measurements • Validated health surveys for: <ul style="list-style-type: none"> ○ Asthma control ○ Hypertension ○ Mental well-being ○ Thermal stress • Occupant rates of: <ul style="list-style-type: none"> ○ Absenteeism ○ Cancer ○ Cardiovascular disease

Plus-health measure	Connection to energy efficiency programming	Benchmarks, data collection strategies, and data points to inform program metrics
		<ul style="list-style-type: none"> ○ Comfort ○ Infectious diseases ○ Productivity / performance ○ Respiratory disease ● Specific to measures influencing site heating emissions: <ul style="list-style-type: none"> ○ Outdoor air quality pollutants ○ Community rates of cancer, cardiovascular disease, and respiratory disease
Trips and falls prevention	Installation of basic fall prevention measures during energy efficiency retrofits	<ul style="list-style-type: none"> ● Trip and fall hazards identified, repaired, and referred for future repair ● Validated health surveys for: <ul style="list-style-type: none"> ○ Mental well-being ● Occupant rates of: <ul style="list-style-type: none"> ○ Trips and falls by count and severity
One Touch referrals	Referring customers to other social services at the time of energy efficiency services	<ul style="list-style-type: none"> ● Number of customers referred ● Number of referrals by service type ● Change in customer acquisition cost for programs receiving referrals ● Validated health surveys for: <ul style="list-style-type: none"> ○ Mental well-being ○ Participation rates and health outcomes associated with social services customers were referred to

Efficiency Vermont can add plus-health services, beyond **Table 2’s** examples, depending on current and planned energy efficiency program offerings and funder priorities.

Recommendations

Efficiency Vermont has begun to demonstrate the value that energy efficiency and energy-plus-health services offer in improving health outcomes of building occupants. It can continue to do this work, with targeted coordination among appropriate stakeholders.

To achieve a wider and deeper impact from these proven services, Efficiency Vermont recommends that the Advances Health Steering Committee adopt the following next steps that support Efficiency Vermont’s strategic direction for advancing better health outcomes:

1. Create benchmarks and assign periodic metrics for quantifying and tracking program and service health benefits in a way that aligns with the interests of health care payers.
2. Establish methods for tracking costs associated with programs and services, relative to the health benefits provided by those programs and services.

3. Institute a criteria matrix for evaluating programs and services related to their health impacts and how the programs and services are funded. Evaluate existing programs according to the matrix and identify areas to cut and grow.
4. Identify available funding opportunities. Prioritizing funding that aligns with Efficiency Vermont's strategy and health-related program outcomes, and provides multi-year support will make dedicated resources available for program implementation.

Conclusion

Efficiency Vermont programs positively affect population health. By quantifying and valuing those health impacts, Efficiency Vermont can ensure program optimization for energy efficiency and improved health, and generate new revenue streams for sustaining energy efficiency services.

Efficiency Vermont can identify new, non-energy quantifiable performance metrics that can be of high value to funders. The metrics' related benchmarks can account for and support the health benefits of Efficiency Vermont's work. Efficiency Vermont is in a strong position to collaborate with health partners in using State and national data sets, program-specific monitoring, and customer-reported experiences to measure—and report on—the effects of efficiency programs on human health.

Efficiency Vermont's infrastructure lends itself to supporting the delivery of effective plus-health services aligned with energy efficiency measures, streamlining program delivery costs for the health sector, and mutually enhancing program outcomes.

Efficiency Vermont can advance better health outcomes by quantifying and tracking its program and service health benefits in collaboration with healthcare partners. Tracking costs associated with those programs can justify program funding from healthcare payers, governmental programs, and philanthropic organizations, since the energy-plus-health work is beyond the scope of existing energy efficiency program funding streams.

Appendix A

Proposal for New Non-Energy Benefit (NEB) Adder: Health and Healthcare benefits associated with Weatherization

Case No. 21-2436-PET

Exhibit No. EVT-2

October 13, 2021

Proposal for New Non-Energy Benefit (NEB) Adder: Health and Healthcare benefits associated with Weatherization

Introduction

This document represents a proposal from Efficiency Vermont for consideration by the Vermont Public Utility Commission (the “Commission”) in Case No. 21-2436-PET, Petition to Open a Proceeding to Update Energy Efficiency Utility Avoided Costs, Eternality Adjustments, and Other Screening Components. The proposal deals specifically with creating a new, non-energy benefit¹ (“NEB”) “adder” to account for enhanced health and healthcare benefits shown to be associated with weatherization-related projects and measures that are intended to be largely incremental to the benefits captured in the two current NEB adders: portfolio-wide NEB adder (“NEB adder”) and low-income NEB adder (“LI adder”).

Summary of Proposal

Upon approval by the Commission, a new NEB adder should be included in the Vermont state tool for societal cost-effectiveness screening. This NEB adder would be referred to as the “Wx-Health adder,” to distinguish it from the two, more general NEB adders that already exist in the screening tool for portfolio-wide application and low-income application.

The Wx-Health adder would be applied at two value levels to differentiate between low- to moderate-income (“LMI”) programs and participants, and market rate/non-LMI programs and participants. The Wx-Health adder would be valued at a higher level for “LMI” participants and programs and at a lower value for market-rate participants and programs. When income information indicates a participant is above LMI criteria (*i.e.*, household income above 120% of area median income), or when income information is not available, the lower, market-rate adder value would be applied. The two monetized values would be proportional with final measure/project cost. This is different from the method used for calculating the two existing NEB adders, which are calculated as a percent of the present value of a measure’s lifetime electricity and fuel savings.

The Wx-Health adder LMI value would be 7.7% of measure/project cost annually for the life of the measure. The Wx-Health adder market-rate value would be 2.5% of measure/project cost annually for the life of the measure, which is 33% of the LMI value.

¹ Some studies use the terminology of “non-energy benefits,” and some use “non-energy impacts.” In this document, the terms are considered to be interchangeable, and the terminology of non-energy benefits, or “NEB,” is used throughout to avoid confusion and maintain consistency with earlier Vermont regulatory proceedings.

The Wx-Health adder would be applied to specified measure categories for residential single family and multifamily buildings that are typically associated with comprehensive weatherization projects. At this time, the adder would only apply to residential existing homes, though residential new construction measures could be added in the future. Applicable measure categories would include:

- thermal shell (e.g., airsealing, insulation),
- health and safety (e.g., smoke alarms, carbon monoxide detectors),
- space heating (fuel switch, replacement, efficiency),
- ventilation,
- air-conditioning/dehumidification.

In most cases associated with heating, cooling, and ventilation measure categories, the lower market-rate adder would be applied since income information is not collected in midstream rebate programs.

Foundation for Wx-Health Adder

The foundation for the “Wx-Health adder” recommendations in this proposal are based on the following external reports:

- 2016 Massachusetts Low-Income, Single Family Non-Energy Impacts (“NEI”) study,² including references in the report to a 2015 national Weatherization Assistance Program (“WAP”) study. (This Report is hereafter referred to as the “2016 Massachusetts Study” or “2016 Massachusetts Report.”)
- 2017 national study on impacts of weatherizing low-income, multifamily buildings³ (hereafter referred to as the “2017 WAP Multifamily Study” or “2017 WAP Multifamily Report”).
- 2018 Vermont Department of Health Weatherization + Health report⁴ (hereafter referred to as the “2018 Vermont Study” or “2018 Vermont Report”).

As identified below, these sources have been used to estimate a monetized value for a set of benefits associated primarily with improved health outcomes and avoided health and healthcare costs that exist beyond what is already captured in the current portfolio-wide NEB adder and LI adder. The proposed Wx-Health adder is intended to be a distinct set of benefits, and it is specifically intended not to have overlap with the current NEB and LI adders. From the perspective of screening efficiency measures, this should avoid “double counting” benefits for those measures that may have one or more of these adders applied to them.

Vermont Regulatory Background

The February 7, 2012 Public Service Board (predecessor of the Commission) Order re Cost-Effectiveness Screening of Heating and Process-Fuel Efficiency Measures and Modification to State Cost-Effectiveness Screening Tool describes non-energy benefits as “any real or perceived, financial or intangible benefit

² <https://ma-ecac.org/wp-content/uploads/Low-Income-Single-Family-Health-and-Safety-Related-Non-Energy-Impacts-Study.pdf>

³ http://www.threecubed.org/uploads/2/9/1/9/29191267/impacts_of_weatherizing_low_income_multifamily_buildings_a_summary_report_prepared_by_threecubed_final.pdf

⁴ https://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_CH_WxHealthReport.pdf

accrued by a project and not reflected in energy savings.”⁵ The Order also clarifies that non-energy benefits can be considered from three different perspectives: customer, societal, and utility.⁶

Furthermore, the 2012 Order articulates the reason for proceeding with quantifying non-energy benefits even when some uncertainty remains in the exact value. The Order provides:

While there is a high degree of uncertainty surrounding the magnitude of non-energy benefits, it is clear that the current value of zero is incorrect, and that 15 percent is on the lower end of the range of estimates. 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.⁷

Consistent with the Board’s 2012 Order, it is recognized that the health and healthcare benefits associated with weatherization activities are inherently difficult to quantify, but that they are *greater than zero*. As such, this proposal is intended to continue with the precedent established by the 2012 Order and is based on a reasonably conservative framework intended to be distinct from the current NEB and LI adders as authorized by the Commission and in use in EEU screening activities.

Summary of Applicable Regional Weatherization-Benefit Studies

2016 Massachusetts Study/Report. Three³ (pronounced Three-cubed) conducted the primary Massachusetts-based evaluation to assess and monetize 8 categories of NEBs. The report further clarifies that the 8 NEB categories is a sub-set of 12 categories of NEBs identified in an earlier 2015 national WAP study and report. The 8 NEB categories identified and quantified in the 2016 Massachusetts Study were those deriving from comprehensive weatherization projects that were of most interest by the Massachusetts WAP program administrators, based on their estimated, direct impacts on households. The 8 NEB categories are:

- 1) reduced asthma (lower medical costs);
- 2) reduced cold-related thermal stress (lower medical costs and fewer deaths);
- 3) reduced heat-related thermal stress (lower medical costs and fewer deaths);
- 4) reduced missed days at work (reduction in lost income);
- 5) reduced use of short-term, high interest loans (lower interest payments and loan fees);
- 6) increased home productivity due to improvements in sleep (higher productivity for housekeeping);
- 7) reduced carbon monoxide (“CO”) poisoning (lower medical costs and fewer deaths); and
- 8) reduced home fires (fewer fire-related injuries, deaths, and property damage).

The remaining 4 NEB categories that were not quantified in the 2016 Massachusetts Study, but which were identified in the list of 12 NEB categories in the 2015 national WAP study are:

⁵ Id. at 24.

⁶ Id. Note that the Order provides examples of the different perspectives stating:

From the customer's perspective, non-energy benefits can include increased comfort, convenience, and health. From the utility perspective, non-energy benefits can include reduction in the number of utility shut-offs and bill complaints. From a societal perspective, non-energy benefits can include increased community health and improved aesthetics related to the decreased need for generation and associated transmission infrastructure. All of an efficiency investments’ costs and benefits should be considered when using the societal cost-effectiveness screening test.

⁷ Id. at 26-27.

- 9) reduced need for food assistance,
- 10) improvement in prescription adherence,
- 11) increased productivity at work due to improved sleep,
- 12) reduction in low-birth weight babies from heat or eat dilemma.

2018 Vermont Study/Report. The Vermont Department of Health (“VDH”) prepared this report “to summarize published and local evidence about the potential health co-benefits of building weatherization strategies.”⁸ The 2016 Massachusetts Report was one of the primary reports evaluated as part of this study.

2017 WAP Multifamily Study/Report. This report was focused on reviewing numerous WAP program outcomes specific to the multifamily housing sector and multifamily residents. Findings presented in the report show benefits for multifamily residents and include comparisons with single family housing benefits.

Non-Energy Benefits Weatherization-Health Adder Proposal

The general approach that was used to establish the monetized benefit value in this proposal was to begin with the values for the 8 NEB categories identified in the 2016 Massachusetts Study. From there, three of eight values for the NEB categories were updated based on the 2018 Vermont Study. Finally, the 2017 WAP Multifamily Study was reviewed to determine if monetized values should be modified for multifamily buildings versus single family buildings. Table 1 shows a comparison of values in the 2016 Massachusetts Study and the 2018 Vermont Study.

The Vermont values in particular are highly conservative compared to the 2016 Massachusetts Study since many components of benefits were not included in the Vermont-specific assessment (*e.g.*, avoided costs of physician visits). Values estimated in the 2018 Vermont Study are less than 30% of those found in the 2016 Massachusetts Study for the three NEB categories included in the 2018 Vermont Study.⁹ The final column in Table 1 shows the proposed monetized values for the 8 selected categories of NEBs. The final proposed value is rounded to a whole dollar amount.

⁸ 2018 Vermont Report at 1.

⁹ 2018 Vermont Report at 21 stating:

We expect that our estimated household health benefit is a large underestimate of the actual value of all household health benefits. ... Household health benefits were only estimated for three health impacts of weatherization - asthma and cold and heat-related thermal stress.

Table 1: Comparison of benefit values from 2016 Massachusetts Study, 2018 Vermont Study, and current proposal

	From MA 2016 study¹⁰	VT Wx + Health	Proposal
NEB category	Annual per home value	Annual per home value	Annual per home value
	Total	Total	Total
Reduced asthma symptoms	\$ 332.00	\$ 176.31	\$ 176.31
Reduced cold-related thermal stress	\$ 496.94	\$ 57.72	\$ 57.72
Reduced heat-related thermal stress	\$ 172.93	\$ 42.22	\$ 42.22
Subtotal	\$ 1,001.87	\$ 276.25	\$ 276.25
Fewer missed days at work	\$ 186.81		\$ 186.81
Reduced use of short-term, High-interest loans	\$ 4.72		\$ 4.72
Reduced CO poisoning	\$ 38.85		\$ 38.85
Increased home productivity	\$ 37.75		\$ 37.75
Reduced home fires	\$ 111.71		\$ 111.71
Total Annual Benefit	\$ 1,381.71		\$ 656
Average Project Cost		\$ 8,500	\$ 8,500

After establishing which NEB monetized values to use for each NEB category along with a final average total monetized NEB value, the next step in development of this proposal was to evaluate how the monetized values of benefits should be applied to project and measure screening. Below is a description of various considerations and related rationale for the primary recommendations associated with application of the proposed Wx-Health adder.

- Relevant portfolios/ funding streams. The Wx-Health adder would be used to calculate societal cost-effectiveness in Vermont’s screening tool. It would apply to projects and measures that are funded through both electric and TEPF portfolios. As applicable, the Wx-Health adder could also be used to screen weatherization measures being deployed through temporary funding streams for weatherization and related activities.
- Relevant project and building types. The Wx-Health adder would apply to projects associated with residential existing homes, including both single family and multifamily buildings. It could apply to residential new construction in the future pending additional discussion on the topic. It would not apply to projects associated with commercial and industrial (C&I) buildings.
- Differentiation of values for low- to moderate-income and market-rate. The studies on which this proposal is based are related to WAP projects, which provide a large data set of low-income housing projects for analysis. Although the data set consists of low-income

¹⁰ See Table E.1. in the 2016 Massachusetts Study where monetized values for healthcare costs and other health-related benefits were sometimes broken out by “household” or “societal.” The application of these terms does not match Vermont’s use of the terms as pertains to our State societal cost-effectiveness screening tool. Rather, the total value of household + societal in the reports (shown as “Total” in Table 1) is consistent with Vermont’s regulatory framing of societal benefits appropriate for the screening tool.

participants (i.e., household income less than 80% of area median income), the benefits for moderate-income participants (i.e., household income of 80%-120% area median income) are expected to be of comparable magnitude to those of low-income participants. This proposal acknowledges that health and healthcare benefits for higher-income participants (i.e., household income above 120% of area median income) may be less than those for either low- or moderate-income participants. For this reason, the Wx-Health adder is proposed as two, income-differentiated values:

- i. Low- to moderate-income (LMI) application. This proposal applies the same level of benefits to low-income and moderate-income participants to acknowledge a similar level of benefits across the two income groups. It is not uncommon for households to shift back-and-forth between low-income and moderate-income tiers. In addition, the condition of homes and many in-home health hazards are comparable between low- and moderate-income Vermonters. Furthermore, it is recognized that many moderate-income Vermonters struggle to make ends meet and do so without some of the social safety-nets that low-income-qualified Vermonters may rely upon. Therefore, this proposal includes a single value level for LMI participants and programs.
 - ii. Market-rate application. To account for the generally better condition of homes and health of higher-income Vermonters compared to LMI Vermonters, this proposal assigns a lower level of weatherization-related health and healthcare benefits to market-rate participants and projects. The proposed value for market-rate weatherization and related measures would be set at 33% of the LMI value of the Wx-Health adder. This level of differentiation for benefits would ensure that the Wx-Health adder is not over-claiming benefits for higher-income Vermonters, and it distinguishes the greater value and likelihood of avoiding health and healthcare costs by LMI Vermonters.
- Scaling of monetized value. It has become clear from the referenced studies that the level of benefits achieved is based on the magnitude of weatherization and related measures completed. Therefore, the Wx-Health adder is proposed to be scaled based on project/measure costs. The values of annual benefits shown in Table 1 are average values for WAP projects. The average cost of Vermont WAP projects is \$8,500.¹¹ Therefore, the average proposed benefit of \$656 per year per home is associated with an average \$8,500 per project/measure cost. In the case of the LMI adder value, this would be applied as an annual benefit of 7.7% of project measure costs per year for the life of the measure ($\$656/\$8,500 = 7.7\%$). In the case of the market-rate adder value, this would be applied as an annual benefit of 2.5% of project measure costs per year for the life of the measure ($\$656 * 0.33 / \$8,500 = 2.5\%$), which is 33% of the LMI value
 - Multifamily housing. Per the 2017 WAP Multifamily Study, health and healthcare benefits associated with multifamily housing accrue at a similar rate as for single family homes. Furthermore, since the value of benefits would be scaled based on measure costs (i.e., 7.7% of project measure costs per year), the same rate of 7.7% for the Wx-Health adder will typically be smaller in magnitude for multifamily housing than for single family homes because average per-unit project measure costs are lower for multifamily housing than for single family housing.¹²

¹¹ Vermont 2018 Wx + Health Report, see p iii

¹² 2017 WAP study reports average of \$3,111 measure cost per unit for multifamily housing versus Vermont \$8,500 average cost per single family home. In addition, “savings-to-investment ratio” documented in study is similar across MF and SF).

- Benefits incremental to existing NEB adders. The proposed Wx-Health adder is intended to account for benefits that are incremental to the existing NEB adders, which include a portfolio-wide general NEB value and a low-income specific NEB adder. For both of the existing NEB adders, the monetized value of the benefit is calculated as a percent of the present value associated with a *measure's lifetime electricity and fuel savings*. In practice, the value of these adders is significantly lower than the value associated with the proposed new adder based on referenced studies. For Home Performance with Energy Star projects completed in 2019-2020, the average value of the portfolio-wide NEB adder was approximately \$530 as a total lifetime value per project, which is nearly an order of magnitude smaller than the value associated with the proposed Wx-Health adder.
- Relevant Measure Categories. Given that the projects in the referenced studies on which this proposal is based include a range of measure types which are undertaken as part of "weatherization," Efficiency Vermont believes it is appropriate to apply the proposed adder to those associated measures categories. This would include thermal shell measures, such as air-sealing and insulation and health and safety measures, such as smoke alarms and carbon monoxide detectors. In addition, the adder would be applied to space heating system improvements, including fuel switches, space heating efficiency, and space heating system replacement, as all of these measures have a variety of health benefits associated with them. Other measure categories this proposal includes are ventilation, which creates improved indoor air quality, and air-conditioning, which reduces thermal temperature stress and improved humidity regulation and safety.

Conclusion

This proposal is offered to modify Vermont's current societal cost-effectiveness screening tool to include a new Wx-Health adder in recognition of enhanced health and healthcare-associated benefits and avoided costs that result from weatherization-related projects and measures.

Once approved by the Commission, there will be a period of time necessary to make program changes (e.g., incorporating income-eligibility into project details and scoping) and screening tool changes before the full effect of this proposal can be put into practice. It is difficult to estimate how much time will ultimately be needed, but for the proposal outlined above, it is anticipated that it could take the better part of a year before all capabilities are in place.

From a societal cost-effectiveness perspective Efficiency Vermont recommends that the Commission approve the Wx-Health adder, so that the screening of measures recognizes and accounts for known health and healthcare benefits and that resource decisions are appropriately directed at least-cost outcomes for customers and society.

Appendix 1: Additional details from referenced reports

Tables E.1-E.3 are from 2016 Massachusetts Report

Table E.1. Estimated MA Low-Income Household and Societal NEIs Per Weatherized Unit both With and Without Avoided Death Benefit – Annual per Unit

NEI Value	Annual Per Unit Benefit*				
	Household	Household W/O Avoided Death Benefit	Societal	Total	Total W/O Avoided Death Benefit
Tier 1					
Reduced asthma symptoms	\$9.99	\$9.99	\$322.01	\$332.00	\$332.00
Reduced cold-related thermal stress	\$463.21	\$4.67	\$33.73	\$496.94	\$38.40
Reduced heat-related thermal stress	\$145.93	\$8.28	\$27.00	\$172.93	\$35.28
Fewer missed days at work	\$149.45	\$149.45	\$37.36	\$186.81	\$186.81
Tier 2					
Reduced use of short-term, high-interest loans	\$4.72	\$4.72	\$0	\$4.72	\$4.72
Reduced CO poisoning (5-year life)	\$36.98	\$0.25	\$1.87	\$38.85	\$2.12
Tier 3					
Increased home productivity	\$37.75	\$37.75	\$0	\$37.75	\$37.75
Reduced home fires	\$93.84	\$9.77	\$17.87**	\$111.71	\$27.37**
Annual Total – per weatherized home	\$941.87	\$224.88	\$439.84	\$1,381.71	\$664.45

*For CO poisoning, the annual NEI is to be applied over the 5-year life of the CO monitor. The remaining NEIs are to be applied annually over the life of the relevant measure (e.g., 20 years for weatherization).
 **For home fires, the avoided injuries and deaths to firefighters are categorized as a societal benefit.

Table E.2. Estimated MA Low-Income Household and Societal NEIs Per Weatherized Unit both With and Without Avoided Death Benefit— Per Unit at Present Value (20 Years at 0.44%)

NEI Value	PV (20 years) Per Unit Benefit				
	Household	Household W/O Avoided Death Benefit	Societal	Total	Total W/O Avoided Death Benefit
Tier 1					
Reduced asthma symptoms	\$190.92	\$190.92	6,151.96	\$6,342.88	\$6,342.88
Reduced cold-related thermal stress	\$8,849.71	\$89.30	\$644.47	\$9,494.18	\$733.77
Reduced heat-related thermal stress	\$2,787.95	\$158.19	\$515.86	\$3,303.81	\$674.05
Fewer missed days at work	\$2,855.21	\$2,855.21	\$713.80	\$3,569.01	\$3,569.01
Tier 2					
Reduced use of short-term, high-interest loans	\$90.18	\$90.18	\$0	\$90.18	\$90.18
Reduced CO poisoning (5 years)*	\$183.30	\$1.25	\$9.28	\$192.58	\$10.53
Tier 3					
Increased home productivity	\$721.26	\$721.26	\$0	\$721.26	\$721.26
Reduced home fires	\$1,792.84	\$186.68	\$341.39**	\$2,134.23	\$522.96**
PV Total—per weatherized home	\$17,471.37	\$4,292.99	\$8,376.76	\$25,848.13	\$12,664.64

*For CO poisoning, PV is estimated for 5 years

** For home fires, the avoided injuries and deaths to firefighters are categorized as a societal benefit.

Table E.3. Number of Avoided Deaths, Hospitalizations, ED Visits, and Physician Office Visits Annually for Each Health-Related NEI, Per 1000 Units Weatherized

NEI	Deaths	Hospitalizations	ED Visits	Physician Office Visits
Asthma	-	9.9 (adult) 4.2 (child)	54.6	-
Cold-related Thermal Stress	0.05	1.9	7.6	9.5
Heat-related Thermal Stress	0.01	1.1	23.6	3.2
CO Poisoning	0.004	0.07	0.47	-
Fire Injury	0.0087	0.013	0.4	0.25

Note that the values in Table E.3 are per 1,000 homes

From 2018 Vermont Report (pp22-23) The information from Tables 5.1 and 5.2 in the 2018 Vermont study shows how conservative the \$276 value is given all the categories excluded from the analysis, including doctor office visits. Also note that values in Table 5.2 are per 2,000 homes.

Table 5.1 Summary of health conditions and impacts included in the estimated household health benefits.

	Included	Not included
Health conditions	Asthma Heat stress Cold stress	Upper respiratory Chronic obstructive pulmonary disease Cardiovascular Mental health Accidental injury Infectious disease Neurological
Health and quality of life impacts	Early deaths Inpatient hospitalizations Emergency department visits	Emergency medical services Other urgent medical care Non-emergency medical care Medication usage Productivity (days of work/ school missed) Financial stress Social health Sleep quality Other quality of life

Table 5.2 Annual health benefits expected per 2,000 low-income homes weatherized.

Health impact	Reduced emergency department visits	Reduced hospitalizations	Deaths avoided	Non-mortality economic value	Total economic value	Total economic value per household
Asthma	21.6	1.2	0.03	\$56,342	\$352,616	\$176.31
Cold-related thermal stress	0.21	0.1	0.01	\$3,051	\$115,433	\$57.72
Heat-related thermal stress	0.45	0.03	0.01	\$1,246	\$84,437	\$42.22
Total	22.3	1.3	0.05	\$60,640	\$552,485	\$276.24

Appendix B

Healthy Vermonters 2020

Data fields from Healthy Vermonters 2020 that align with energy efficiency programs and services.

Healthy Vermonters 2020 Indicator	2010 Baseline	VT Current	U.S. Current	Target	Data Source**	Geo***
ARTHRITIS & OSTEOPOROSIS						
Percent of adults with diagnosed arthritis who have activity limitations	51% (2011)	49% (2015)	50%	40%	BRFSS	(S/C/D/H)
Percent of adults with diagnosed arthritis who engage in leisure time physical activity	72% (2011)	77% (2016)	69%	80%	BRFSS	(S/C/D/H)
ENVIRONMENTAL HEALTH & FOOD SAFETY						
Percent of Vermonters served by public community water supplies that meet Safe Drinking Water Act standards	86% (2010)	97% (2015)	93% (2011)	95%	DEC Water Supply Compliance Division	(S)
Percent of children age 1-5 who have elevated blood lead levels (>10 µg/dL)	0.6% (2010)	0.5% (2016)	0.5% (2015)	0%	VT Lead Database	(S/C/D/H)
Percent of children age 1-5 who have elevated blood lead levels (5-9 µg/dL)	1.4% (2010-12)	1.4% (2016)	2.8% (2015)	0%	VT Lead Database	(S/C/D/H)
Elevated blood lead level (>10 µg/dL) from work exposure rate per 100,000 employed adults age 16 and older	10.3 (2009)	8.8 (2016)	22.5 (2012)	9.3	ABLES	(S/C)
Percent of households that install a radon mitigation system when they receive a high radon test result	34% (2013)	39% (2017)	NC	55%	Post-radon testing mitigation	(S/C/D/H)
Percent of schools completing an environmental health walkthrough	0% (2010)	17% (2017)	NA	25%	Envision Program	(S)
Percent of inspections that find critical food safety violations	43% (2010)	42% (2015)	NA	35%	F&L Program Inspection	(S)
Heat stress related emergency department visits per 100,000 Vermonters	17.3 (2010)	17.4 (2011)	NA	17.3	VHUDDS	(S/C/D/H)
HEART DISEASE & STROKE						
Coronary heart disease death rate per 100,000 Vermonters	111.7 (2009)	107.7 (2015)	108.3	89.4	Vital Statistics	(S/C/D/H)
Stroke death rate per 100,000 Vermonters	29.3 (2009)	31.3 (2015)	37.6	23.4	Vital Statistics	(S/C/D/H)
Percent of adults with hypertension	27% (2011)	25% (2015)	30%	20%	BRFSS	(S/C/D/H)
INJURY & VIOLENCE PREVENTION						
Fall-related Emergency Department visits per 100,000 adults age 65 and older	5105.1 (2010)	5628.4 (2011)	NC	4951.0	VUHDDS	(S/C/D/H)
Fall-related death rate per 100,000 adults age 65 and older	120.3 (2009)	127.2 (2015)	58.8	116.9	Vital Statistics	(S/C/D/H)
MENTAL HEALTH						
Rate of suicide deaths per 100,000 Vermonters	13.0 (2009)	14.3 (2015)	13.0	11.7	Vital Statistics	(S/C/D/H)
Percent of Vermont adults with any mental health conditions receiving treatment	54% (2008-12)	58% (2015)	NA		NSDUH	(S)
NUTRITION & WEIGHT STATUS						
Percent of households with food insecurity	8% (2006)	No new data	14% (2014)	5%	BRFSS	(S/C/D/H)
OLDER ADULTS						
Percent of adults age 65 and older who visited a doctor in the last year for routine care	85% (2011)	86% (2016)	89%	100%	BRFSS	(S/C/D/H)
Percent of males age 65 and older who are up to date on a core set of clinical preventive services	43% (2012)	45% (2016)	41%	55%	BRFSS	(S/C/D/H)
Percent of females age 65 and older who are up to date on a core set of clinical preventive services	37% (2012)	38% (2014)	36%	55%	BRFSS	(S/C/D/H)
RESPIRATORY DISEASES						
Asthma hospitalization rate per 10,000 children age 4 or younger <small>14.4 (2010)</small>		10.6 (2011)	40.6 (2009)	14.0	VUHDDS	(S/C/D/H)
Asthma hospitalization rate per 10,000 Vermonters age 5-64 <small>3.6 (2010)</small>		3.6 (2011)	10.5 (2010)	4.2	VUHDDS	(S/C/D/H)
Asthma hospitalization rate per 10,000 adults age 65 and older <small>10.8 (2010)</small>		11.7 (2011)	25.5 (2010)	9.3	VUHDDS	(S/C/D/H)
Percent of adults with asthma who are advised to change things in their environment <small>32% (2010)</small>		38% (2014)	36% (2013)	45%	ACBS	(S/C/D/H)
Percent of children age 17 or younger with asthma who are advised to change things in their environment <small>33% (2010)</small>		33% (2010)	36%	50%	ACBS	(S)
SOCIAL DETERMINANTS OF HEALTH						
Percent of Vermonters living below the poverty level	11% (2006-10)	12% (2011-15)	15%	11%	ACS	(S/C/D/H)
Percent of Vermonters age 17 or younger living below the poverty level	14% (2006-10)	15% (2011-15)	22%	14%	ACS	(S/C/D/H)
Percent of households that spend 30% or more of their income on housing	37% (2006-10)	37% (2011-15)	35%	34%	ACS	(S/C/D/H)