

Quantifying and Monetizing the Non-Energy Impacts of Holistic Home Repair, Weatherization and Solar Services

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Executive Summary

The current study aims to review and evaluate the non-energy impacts (NEIs) of a novel home intervention program, Built to Last (BTL). Administered by the Philadelphia Energy Authority (PEA) and funded, in part, by a Weatherization Assistance Program (WAP) Enhancement & Innovation grant from the Department of Energy, Built to Last provides wraparound services for low-income homes throughout Philadelphia, PA, including major systems repairs, weatherization, electrification, and solar installation and readiness measures. Built to Last funds both a collaboration across pre-existing housing & energy programs and also provides direct funding for home measures that the other programs could not otherwise provide. This holistic approach to home upgrades not only reduces energy bills for residents but also provides multiple benefits in the form of improved health and well-being.

The current evaluation adapted previous studies of NEIs in Pennsylvania and comparable cold weather climates and also included a literature review to develop evidence for previously unstudied NEIs associated with the unique program characteristics and housing stock of Philadelphia. The team developed and monetized 19 unique NEIs associated with 10 different potential home measures or types of intervention (i.e. some measures are associated with multiple NEIs). For each of the 50 homes evaluated herein, the team reviewed work scopes and completion/payment documents from BTL and its partner programs to determine which measures were installed, including the 10 identified as linked directly to NEIs. If one or more of the 10 measures were installed in the home, BTL can claim the NEI(s) associated with that measure. While the exact benefits experienced by each household are likely to vary, the monetized NEIs represent the average expected benefit to a household. This creates a straightforward and easy-to-replicate system for PEA to assess program NEIs into the future.

Summary of Valuation Results Across 50 Evaluated Homes

Lifetime NEI Benefits	Average per Home	Total Across 50 Homes
Tangible	\$45,504	\$2,275,200
Quality of Life	\$50,583	\$2,529,154
Total	\$96,087	\$4,804,354

In addition to the 19 NEIs linked directly to installed measures, the team also estimated two NEIs associated with reduced energy consumption. First, by saving energy, BTL also reduces greenhouse gas emissions from burning natural gas or fuel oil and generating electricity. The benefits from these reductions can be monetized with the social cost of carbon (SCC). Second, reducing electricity use is also associated with lower air pollution from generation facilities, which leads to public health benefits. These benefits have been quantified by the U.S. Environmental Protection Agency (EPA) and can be obtained using the CO-Benefits Risk Assessment (COBRA) health impacts screening tool. However, energy modeling was available for only 37 of the 50 homes included above, and therefore these results are reported separately.

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1. Introduction

What is Built to Last?

Administered by the Philadelphia Energy Authority the Built to Last (BTL) initiative builds a scalable, replicable set of tools to complete holistic home repairs for low-income households in underserved and historically marginalized communities. Built to Last builds on the existing Weatherization Assistance Program by layering, coordinating, and supplementing home repair programs to achieve energy efficiency and weatherization, health and safety improvements needed to address social determinants of health, climate resilience, and preservation and stabilization of existing affordable housing. The program aims to reach 10,000 homes by 2033, dramatically reduce the deferral and denial rates for WAP and other programs, and create a model that can be replicated across the country.

BTL retrofits often rely on coordinated funding from partner programs, such as the City of Philadelphia's Basic Systems Repair Program, the U.S. Department of Energy's Weatherization Assistance Program (WAP), the U.S. Department of Housing and Urban Development's Lead and Healthy Homes, and local utility conservation programs. PEA and partners will evaluate holistic home repair needs and match those first with existing funding sources and then fill unmet clean energy and health needs by utilizing the requested funding.

What are Non-Energy Impacts (NEIs) or Multiple Benefits?

When homes receive upgrades like insulation, air sealing, and energy-efficient appliances, we expect them to benefit by saving energy and receiving lower utility bills. But what about all of the other benefits? Ideally, the house will now stay warmer in the winter because the home is insulated, and the family can afford to run the heat for longer. Air sealing will keep out the cold winter air, but it will also keep outdoor air pollution and noise from getting inside the home. These – and many more – are the *non-energy impacts* (NEIs) of energy-saving programs. However, Built to Last goes beyond saving energy and encompasses structural and electrical repairs, as well as solar readiness assessments. These repairs not only prevent damage to the home, but they can also improve residents' health and well-being. In this broader context, we can also refer to NEIs as the *multiple benefits* of Built to Last's work – not just the immediate impacts of repairing the home, but all of the positive ripple effects those repairs have for the people living in the home.

Report Structure

The next section of this report describes the methods used to develop the set of monetized NEIs used in valuating BTL homes. Section 3 provides an overview of the measures installed in the 50 evaluated homes and the types of conditions encountered during home assessments. Section 4 provides an overview of the broad scope of NEIs that could be linked to a holistic program such as BTL, including those that were beyond the scope of the current evaluation to include in a monetary evaluation but were still important to lift up. Section 4 then summarizes the subset of NEIs monetized for BTL. Section 5 provides a summary of the valuation results.

2. Methodology

The NEIs developed for PEA’s Built to Last (BTL) program drew on prior NEI literature and research in housing and health. The team began with extensive conversations with PEA staff to map out the scope of work performed by BTL and its partners, which can vary widely depending on the needs of the home. Key components included:

- Weatherization (including the Weatherization Assistance Program)
- Basic Systems Repairs (e.g., roof, building shell, electric, plumbing, HVAC)
- Basic Renovations (kitchens, baths, walls, floors, doors, windows)
- Lead Hazard Reduction (e.g., lead removal or containment)
- Other Health & Safety (e.g., handrails)
- Electrification
- Solar Preparedness and Installation

The repairs and work provided included many activities unique to Philadelphia’s housing infrastructure. For example, many of the homes had “BUPs” – Basement Under Porches, where, as the name implies, a home’s basement or crawlspace extends to an area under the porch that is often uninsulated but not sealed off from the home envelope, posing a threat to energy efficiency. Remediation in these cases could involve installing a door to separate the BUP from the home’s thermal envelope. Another geography-specific measure included either repairing or demolishing “add-ons” – sheds adjacent to the house that are often in disrepair and can become home to pests and or pose safety threats due to dilapidation.

PEA staff also shared benefits they had witnessed or concerns clients had shared prior to the BTL work. For example, in some cases, clients entering the program expressed fear that they would soon have to move out of their home, or in extreme cases, that Child Protective Services would take custody of their children if the house was not repaired. Home assessments sometimes revealed that household members were using basements as sleeping quarters, even if the basement was unfinished or only partially finished, which can lead to multiple possible risks and exposures (e.g., carbon monoxide and flue gases, radon).

From these collective insights, the evaluation team mapped out likely novel non-energy impacts (NEIs) associated with each measure or program, with a focus on NEIs that could be associated with a financial impact. The team then performed targeted searches of academic databases through the Web of Science to search for relevant peer-reviewed literature, as well as searches through Google to identify “grey literature”, i.e. technical reports and documents written by trusted authorities outside of academia, such as government agencies. The list of theorized NEIs and whether or not they were monetized is presented in Table 1, along with a brief description of why the NEI was or was not monetized.

Table 1. Theorized NEIs and Results of Literature Review

NEI	Monetization Developed? (Yes/No)	Literature Review Insights
Issues related to basements & living in basements		
Flooding	N	Not a strong theoretical tie from BTL work to flood damage prevention; see instead “Water Damage” below.
Radon exposure	Y	General benefit to all household members; unable to pinpoint specific increase in risk from living in basement.
Mold & Fungus	Y	General benefit to all household members; unable to pinpoint specific increase in risk from living in basement.
Carbon monoxide poisoning from improperly ventilated combustion appliances, including space heaters	N	Unable to pinpoint specific increase in risk from living in basement; general benefit is included in NEIs from Massachusetts study (see below)
Water Damage	Y	Estimated rate of water damage to homes and assumed full prevention through BTL.
Foreclosure & Displacement	Converted to credit card debt	While a serious concern, this is a construct that is difficult to measure in practice. A bulk of literature does describe that low-income homeowners are at risk of chronic debt and home foreclosure associated with being unable to afford home repairs, especially emergency repairs. While we could not estimate impacts to foreclosure risk, a strong enough relationship between needing to pay for home repairs and taking on credit card debt existed in the research data.
Safety & Crime	Y	Based on a study of PEA’s Basic Systems Repair Program performed by University of Pennsylvania researchers. ¹
Home Insurance Rates	Y	Specific to participants who receive new roofs or extensive roof repair due to evidence that homes with new roofs pay lower home insurance premiums. The methodology accounts for data that indicate only about 70% of low-income

¹ South EC, MacDonald J, Reina V. Association Between Structural Housing Repairs for Low-Income Homeowners and Neighborhood Crime. JAMA Netw Open. 2021 Jul 1;4(7):e2117067. doi: 10.1001/jamanetworkopen.2021.17067. PMID: 34287632; PMCID: PMC9435958.

		homeowners carry insurance, though it's possible the rate would be even lower among BTL participants.
Dropped from Home Insurance	N	It was theorized that home insurance companies could refuse to insure homes with extensive dilapidation. However, the team was unable to find data on the relative cost of emergency (FAIR plan) homeowner's insurance compared to regular market rate insurance. It has also been noted that rates of homeowners insurance may be especially low in this population.
Chronic Stress/ Allostatic Load	Y	Based on research linking housing quality, allostatic load, and long-term health outcomes.
Impacts of sleepiness/poor mental health on ability to manage finances	N	Insufficient data; however, other aspects of financial hardship are covered throughout the NEIs.
Health-Related Quality of Life (measure of general health)	Y	Based on research linking general health responses to health outcomes such as hospitalization and mortality.
Life satisfaction questions	N	Insufficient data.
Car crashes due to sleepiness	Y	Based on improvements in sleep reported by WAP participants and associated research on the negative impact sleeplessness has on driving and crash risk.
Reduced school absences	N	Insufficient evidence that weatherization or home repairs can reduce school absences.
Deferral	N	PEA did not track how many homes would have been deferred from WAP services in lieu of wraparound BTL work; however, the issues that would lead a home to be deferral from other programs are largely covered by other NEIs, such as mold/fungus and major systems repair.
Lead Hazard Reduction	Y	Adapted from an existing review of lead hazard control cost-benefit analyses for homes with children ages 6 and under.

The monetization approach for each evaluated NEI combines research linking housing quality to health and financial outcomes obtained through the literature review noted above, combined with data on associated costs and financial impacts. The full details of how each NEI was monetized can be found in Appendix B. These more detailed descriptions were also shared with three external (non-Three³) peer reviewers with expertise in NEIs, and their feedback was incorporated into the final algorithms. In addition to the novel NEIs explored, the team also drew on a prior

study of NEIs attributable to low-income home weatherization in cold and very cold climates of the U.S. and adapted the findings to the Philadelphia context.²

Alongside Three³'s NEI evaluation, the building science and climate resilience firm New Ecology, Inc. was also hired by PEA to perform energy modeling on 50 BTL homes and produce a framework for prioritizing energy and climate readiness measures, including electrification. However, due to the above-mentioned challenges, Three³ and New Ecology were not able to evaluate the same set of 50 homes, as some homes were missing data critical to energy modeling while others lacked data needed for NEI assessment; in total, 37 homes received both NEI evaluations and energy modeling, while 13 received only NEI evaluation. Select outputs from the energy modeling are summarized alongside NEI results in the home summaries found in Appendix C.

Estimated energy savings from the energy modeling were also used as inputs for two societal NEIs: 1) the social cost of carbon, and 2) avoided health impacts from electric generation emissions. According to the U.S. Environmental Protection Agency (EPA), the social cost of carbon (SCC) is “a comprehensive metric that includes the value of all future climate change impacts (both negative and positive), including changes in net agricultural productivity, human health effects, property damage from increased flood risk, changes in the frequency and severity of natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services.”³ Estimates of the amount of carbon dioxide (CO₂) avoided due to BTL energy savings were derived from New Ecology's energy modeling together with emission rates from the EPA's Emissions & Generation Resource Integrated Database (eGRID).⁴ Emission rates are geographically specific estimates of how much CO₂ and other pollution is emitted for each kWh of electricity produced by the grid in a given region. By calculating the amount of avoided CO₂ and multiplying by the SCC values set by the EPA,⁵⁶ we can estimate the value of the damages prevented by BTL.

Similar to SCC, the second health impacts NEI derives from the fact that many current forms of generating utility-scale electricity, such as burning coal or natural gas to turn steam turbines, emit not only CO₂ but also multiple other pollutants harmful to human health, such as particulate

² Hawkins, B., Tonn, B., Rose, E., Clendenning, G. and Abraham, L. (2016). MA Low-Income Single-Family Health-and-Safety-Related Non-Energy Impacts Study. <https://ma-eeac.org/wp-content/uploads/Low-Income-Single-Family-Health-and-Safety-Related-Non-Energy-Impacts-Study.pdf>

³ U.S. Environmental Protection Agency. (2023, Nov). *EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*. National Center for Environmental Economics & Climate Change Division. Retrieved from: https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf

⁴ U.S. Environmental Protection Agency. (updated 2025, Dec 12). Emissions & Generation Resource Integrated Database (eGRID). Retrieved from: <https://www.epa.gov/eGRID>

⁵ New York University School of Law. (n.d.). *The Cost of Climate Pollution*. Institute for Policy Integrity. Retrieved from: <https://costofcarbon.org/calculator>

⁶ U.S. Environmental Protection Agency. (2023, Nov). *EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*. National Center for Environmental Economics & Climate Change Division. Retrieved from: https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf

matter, SO₂, NO_x, and volatile organic compounds (VOCs).⁷ By reducing electricity consumption, BTL can also reduce these harmful byproducts. Once again using eGRID emission rates, the financial cost of health impacts from grid-generated pollution can be estimated using the EPA's CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA).⁸ In this analysis, the team disaggregated the results according to whether a home was electrified or not. Electrification removes combustion appliances that can pose risks to human health and generally increases overall energy efficiency, but it can also lead to higher electricity consumption (which reduces consumption of other fuels). Due to the general benefits of electrification, it is useful to separate out increases in electricity that were intentional from other factors that may be affecting electric consumption in the homes post-intervention.

⁷ U.S. Environmental Protection Agency. (2025, March 19). *Power Plants and Neighboring Communities*. EPA. <https://www.epa.gov/power-sector/power-plants-and-neighboring-communities>

⁸ U.S. Environmental Protection Agency. (updated 2026, Jan 20). CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA). Retrieved from: <https://www.epa.gov/cobra>

3. Characterizing Homes in the Built to Last Program

A better perspective of how residents receive multiple benefits can begin with a closer examination of the rehabilitation and upgrade measures done in the Built to Last program homes. As mentioned, non-energy benefits have typically been evaluated in the context of weatherization and energy-saving home upgrades, but Built to Last goes beyond standard home weatherization. An assessment of 50 Built to Last homes shows extensive improvements in the mechanical systems, interior and exterior health and safety risks, bulk water management, and deferral management repairs. Below is a summary of the findings from the Built to Last sample of homes categorized to help simplify the extent of the upgrades and rehabilitation measures. A full breakout by home is provided in the appendix for further reference of the multiple benefits each home received.

The program not only provided standard weatherization measures like air sealing (45 homes) and insulation (43 homes), but it prepared many homes for the future by installing solar panels on 15 homes and fully electrifying 5 homes. These measures help with energy savings and comfort related to winter and summer temperatures that are anticipated to be more extreme in the future.

Table 2. Number and Type of Weatherization & Climate Readiness Measures Installed in BTL Homes

Measure Type	Percent and Number of Homes Served
Duct System	24% (12)
Air Sealing	90% (45)
Insulation	86% (43)
Dehumidifier	14% (7)
Electrification	10% (5)
Solar	24% (12)



The home envelope is the baseline defense to prevent air and water infiltration indoors. The home envelope can be considered in two parts, the interior and exterior envelopes. The exterior envelope includes siding, masonry, or other materials on the exterior walls. While the roof is considered part of the exterior home envelope, for the purposes of this report, it has been considered separately for the NEI benefits which will be discussed in more detail later. Similarly, the windows can need rehabilitation either from the interior or exterior of the home beyond a window replacement. Examples of exterior repairs might be flashing repairs. From the interior, window framing may need replacing due to mold

from evaporation or leaks. The internal home envelope includes drywall, the ceiling, or subfloor as examples. WAP can do minimal repairs to these areas, but if damage is extensive, the home could be deferred. The BTL program did extensive repairs both to the indoor and outdoor home envelopes in the sample homes as follows:

Table 3. Number and Type of Home Envelope Repairs Installed in BTL Homes

Measure Type	Percent & Number of Homes Served
Interior	92% (46)
Exterior	76% (38)
Windows	66% (33)
Roof	70% (35)

Mechanical systems include the heating systems, cooling systems, domestic water heaters, electrical systems, refrigeration, stoves, and washer/dryers in homes. Some mechanical systems not only provide comfort such as heating in cold winters, but also health and safety in the home. For instance, aged electrical systems could pose a risk of fire if the system is exposed or overloaded. The BTL program and partnerships were able to support mechanical systems work in several ways. First, systems were assessed and maintained that were operating well. Window AC units, for example, that were operating were assessed, properly sealed, and maintenance performed to make sure they would be optimal well into the future. If systems weren't operating, they may need minor repairs, new parts, or complete replacements. The replacement units were also improved when available to more energy efficient, cost-saving models.



Examples include upgrading from an aged boiler to an energy efficient electric heat pump. These repairs, improvements, or replacements, led to comfort, reliability, health, and energy benefits to be connected to NEI reporting in later sections and enabled funding dollars to address homes with multiple system rehabilitation needs to maximize benefits.

Table 4. Number and Type of Mechanical System Repairs or Upgrades Installed in BTL Homes

Measure Type	Percent & Number of Homes Served
Heating	70% (35)
Cooling	46% (23)
Water Heater	60% (30)
Programmable Thermostat	24% (12)
Electrical System	74% (37)

Many health and safety benefits are realized through managing and reducing lead, mold, asbestos, radon, carbon monoxide, gas, and fire risks indoors, but the program also addresses health, safety, and security risks on the exterior of the home by doing repairs on steps, sidewalks, installing handrails, and lighting to prevent incidents like trips and falls. Oftentimes homes with leaks from plumbing, the roof, or deteriorating outdoor landscapes such as failing retaining walls or water redirecting from broken gutters are deferred from receiving WAP weatherization upgrades because measures cannot be preserved and most likely will be damaged in such conditions.



To remedy these issues, the Built to Last program provided measures for bulk water management in 45 out of the 50 homes. Another health and safety issue with potentially deadly consequences if left unaddressed is carbon monoxide or gas leaks that were repaired in nearly half (22) of the Built to Last sample. Additionally, the program rehabbed or removed 10 attached structures that may have presented increased safety or building integrity risks on properties.

Table 5. Number and Type of Health & Safety Measures Installed in BTL Homes

Measure Type	Percent & Number of Homes Served
Interior	70% (35)
Exterior	46% (23)
Lead Hazard Reduction	60% (30)
Asbestos Abatement	24% (12)
Radon Infiltration Reduction*	74% (37)
Mold Reduction	18% (9)
CO/Gas Leak Preventative Measures	46% (23)
Bulk Water Management	90% (45)

* Includes measures such as vapor barriers that reduce the amount of radon infiltrating from the soil into the home; does not include full mitigation systems, which were not installed to date.

The rehabilitation work in each home leads to more than just energy savings and averted hazards. Each measure and program funding dollar helps connect the home to positive health outcomes. Heating and cooling are restored for greater comfort and less thermal risk, steps and rails are repaired for less risk of trips and falls, and bulk water issues are addressed to address potential mold and mildew that aggravates respiratory conditions. The next sections will be a deeper dive into how these measures become realized household benefits.

4. Participant and Household Benefits

The previous section described common home hazards addressed by Built to Last and the improvements made through the program. Many measures installed through the program have clear and direct health benefits, such as removing lead contamination to prevent the biological damage caused by lead exposure or installing carbon monoxide (CO) detectors to prevent CO poisoning. Other measures contribute to residents' comfort, such as adding air sealing and insulation to reduce drafts and keep the home warmer in winter and cooler in summer. However, other benefits may not be as immediately obvious. For example, air sealing and insulation can also reduce the amount of outdoor noise and air pollution that gets inside the home. This can lead to better sleep due to less traffic noise, or lower risk of cardiovascular disease due to lower exposure to outdoor particulate matter. Last, the program benefits households financially by lowering energy bills and preventing the need to pay for repairs. These financial benefits mean households can better afford necessities such as healthy food and medications.

Clearly, the impacts from a comprehensive program such as Built to Last are multifaceted and complex. In this section, we attempt to outline the many types of benefits that can be expected from the program, though not all impacts were able to be quantified and monetized. Then later in this section, we describe the narrower set of benefits that the team was able to assign a monetary value. We acknowledge that the monetary values captured in this report represent only a portion of the benefit that participants likely experience.

The subsections below outline non-energy benefits for households, society more broadly, and utilities and utility customers ("ratepayers") specifically. NEIs marked with a star (*) were monetized for the current evaluation and are summarized in Table 6. More details on the monetization of these NEIs are provided in Appendix B.



Household Impacts



Health & Well-Being

Life Satisfaction. People who receive free, income-qualified weatherization services have reported higher satisfaction with their health, quality of life, and life in general following the home upgrades.⁹

Stress Levels. In both self-report surveys and qualitative interviews, weatherization recipients report fewer days with poor mental health and referred to experiencing "peace" and some relief from stress and the mental toll of worrying about utility bills and home repairs.¹⁰

⁹ Rose, E., Marincic, M., Tonn, B. & Hawkins, B. (2022, Mar 1). *TVA Home Uplift Metro Areas: Final Report on Non-Energy Impacts*. Three3. Retrieved from: https://www.threecubed.org/uploads/2/9/1/9/29191267/tva_home_uplift_metro_areas_nei_report_march_2022.pdf

¹⁰ Ibid (Rose et al. 2022).

- A concept related to stress, “allostatic load”¹¹ is a term that refers to how much long-term mental, social, and physical stress a person faces. Studies have found that high allostatic load is linked to serious health problems like heart disease and cancer, and it can increase a person’s risk of dying. Improving housing quality and satisfaction has been shown to reduce allostatic load and thereby can reduce negative health outcomes.

Better Sleep. People report fewer nights of poor sleep and less sleep disruption from outdoor noise following weatherization, as insulation and air sealing can make homes quieter and more comfortable. In interviews, participants often mention that prior to their home upgrades, very cold or hot temperatures in the home were a main cause for poor sleep.^{11,12}

- Improved sleep quality can lead to numerous immediate and longer-term benefits. While evidence is not sufficient at this time to link home upgrades to long-term health improvements, research summarized by the Centers for Disease Control and Prevention (CDC) shows that improving sleep can help people (direct quote with asterisks added):¹³

“

- Get sick less often.
- Stay at a healthy weight.
- Reduce stress and improve your mood.
- Improve your heart health and metabolism.
- Lower your risk of chronic conditions like:
 - Type 2 diabetes.
 - Heart disease.
 - High blood pressure.
 - Stroke.
- Lessen the risk of motor vehicle crashes and related injury or death.*
- Improve your attention and memory to better perform daily activities.*

”

¹¹ Ibid (Rose et al. 2022).

¹² Tonn, B., Rose, E., Hawkins, B. & Conlon, B. (2014, Sept). *Health and Household-Related Benefits Attributable to the Weatherization Assistance Program*. Oak Ridge National Laboratory. Knoxville, TN. ORNL/TM-2014/345. Retrieved from: https://weatherization.ornl.gov/wp-content/uploads/pdf/WAPRetroEvalFinalReports/ORNLTM-2014_345.pdf

¹³ Centers for Disease Control and Prevention. (2024, May 15). About Sleep. Centers for Disease Control and Prevention. <https://www.cdc.gov/sleep/about/index.html>

Improved General Health*. The CDC has long used a metric called the Healthy Days Measure to capture people’s feelings about their own health. For example, one question asks, “Thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?” While the question may seem simple, research has found that Medicare recipients aged 65 and over who report more days of poor health tend to have more chronic diseases, higher medical costs, and a higher risk of mortality. Evidence shows that people report fewer days of poor physical health after receiving home weatherization services, which can be a boon for elders’ all-around health.

Thermal Stress*. Thermal stress refers to any health issue caused by being too hot or too cold. In many low-income homes, poor insulation and broken or aging equipment can make it difficult to keep the home warm enough in the winter – or cool enough during the summer. This leads to discomfort, and in the worst cases, it can cause heat stroke, hypothermia, and other temperature-related health impacts that could have been prevented with proper home weatherization.

Hazard Removal & Reduction. As part of its health and safety work, Built to Last installs measures to reduce common home hazards such as lead paint, severe mold, and basement conditions known to cause high radon levels. They also provide important safety equipment such as carbon monoxide and smoke detectors and proper ventilation or replacement of gas appliances. These measures are linked to important health outcomes:

- *Lead Hazard Reduction*:* Even small doses of lead can damage the nervous system and impair a child’s development. This can lead to costly medical care and lower earnings later in life. Therefore, preventing lead poisoning provides great benefits for both health and personal finances.
- *Mold Reduction*:* For people with asthma, mold can worsen their symptoms and lead to higher medical costs for inhalers and other treatments. Cleaning mold in the home has been linked to fewer asthma symptoms and lower use of inhalers, providing relief and saving money for households.
- *Radon Mitigation Systems*:* BTL has previously considered installing radon mitigation systems but has not yet done so. Radon is a gas found in the soil across every U.S. state. Even small amounts of radon can lead to lung cancer, which is often deadly. Radon mitigation systems can help save lives and lower medical and financial costs.
- *Gas Stove Replacement*:* Changing from a gas to electric stove removes the risks associated with small pollutant leaks. Even when a gas stove is turned off and in proper working condition, it can still leak small amounts of harmful chemicals known to cause cancer. Gas stoves also release nitrogen dioxide (NO₂) during use. NO₂ can both make asthma symptoms worse and also make it more likely for children to develop asthma. These wide-ranging health risks are prevented when gas stoves are replaced with electric options.
- *Carbon Monoxide Poisoning*:* Carbon monoxide (CO) is a colorless, odorless gas produced by appliances that run on natural gas. Breathing in too much CO can cause

serious damage to the body. Most homes have ventilation to keep CO from building up inside the home, but damage to the ventilation or gas equipment can cause dangerous leaks. By installing CO detectors in homes and repairing small leaks, weatherization and home repair services can prevent CO poisoning and associated medical costs.

- **Fires***: Weatherization programs often install smoke detectors and perform work that can help prevent home fires (e.g., electrical repairs, fixing or replacing gas appliances). Weatherization can also reduce people's need for portable space heaters, which are common fire hazards.



Finances

Missed Work or School. Healthier home environments can help prevent illness and potentially lead to fewer missed days of school or work. For workers without PTO, missing a day of work can directly lower their income. For children, better school attendance has been linked to higher earnings later in life. In an anecdote from a similar weatherization program, a small gas leak near the children's bedroom was causing chronic headaches and multiple missed school days during winter; fixing the gas leak cleared up the headaches and allowed the kids to think clearly again.

Home Value. While difficult to measure, programs such as Built to Last are likely to increase home values by providing critical repairs and upgrades. Further, as noted above, the Basic Systems Repair Program was found to lower local crime rates, which may also have positive impacts on home values.

Solar Bill Credit. Utility bill credits from solar panels installed by BTL directly lower residents' utility bills and provide financial relief.

Cost of Coping Mechanisms. When a home's furnace or other critical infrastructure breaks, households may incur costs from temporarily moving into motels or moving in with family, or in lesser cases, using substitutes like portable space heaters, which are not efficient and can lead to high electric bills.

Credit Card Debt*. When home plumbing gets a major leak or the furnace breaks, low-income residents can't always afford the cost of repair. Among people with credit card debt, 8% said that emergency or unexpected home repairs were the biggest reason why. Getting free home repairs from Built to Last instead of paying for repairs with a credit card can help to prevent this debt and the cost of interest.

Home Insurance Rates*. Homes that are in disrepair tend to have higher costs for home insurance. However, newer roofs in particular have been associated with lower home insurance premiums. This means lower costs for residents receiving new roofs through the Built to Last program.

Predatory Loans*. Predatory loans often target people with lower incomes who need money quickly. These loans are easy to get but usually have high interest rates and must be paid back in

a short time. This means individuals end up paying much more in the long run, which makes it harder for them to stay financially stable. Weatherization helps by lowering several costs, such as overall energy costs and fees from having services shut off, as well as the costs of medical care and missed work noted above. This reduces financial stressors and makes it less likely that people will need to take out expensive loans.



Family & Staying in the Home

Aging in Place. Measures such as grab bars in showers, repaired handrails, and other trip and fall prevention measures can help elders stay in their homes rather than moving into assisted living.

Ability to Use Whole Home. Homes coming into the program will sometimes have entire rooms or sections of the house closed off due to disrepair or inability to heat the whole home. Beyond being inconvenient, this can lead to overcrowding and unsafe living conditions, such as people sleeping in basements with mildew or poorly ventilated gas appliances.

Removal by Child Protective Services and Increased Strain on the Foster Care System.

While a rare and extreme outcome, participants coming through the program will sometimes express a fear that Child Protective Services will take away their children due to unsafe conditions in the home. Providing repair services restores safety and security to the family.

Foreclosure and Homelessness. Trying to keep up with essential home repairs can be financially straining, and households may find themselves falling behind on mortgage payments. At the extreme, failure to make mortgage payments may lead to foreclosure, displacement, or homelessness.

• • • Other

Pest Infestation. Patching and sealing holes in the building envelope can help keep out insects and rodents that otherwise could lead to costly exterminator visits. BTL also helps either repair or demolish and remove dilapidated sheds and add-ons to the home, which could otherwise harbor rodent nests and infestations.

Water Damage Prevention*. Water can damage homes in many ways, such as from broken pipes, clogged gutters, or bad weather. If water damage isn't fixed, it can lead to mold and fungus, making repairs more expensive. Preventing water damage helps keep the home strong and can save households thousands in costly repairs.

Comfort. By reducing drafts and outdoor noise, improving indoor temperatures, and providing other improvements to the home, Built to Last can improve general comfort for residents.

WAP Deferral Prevention. A key goal of BTL was to repair homes that would otherwise be deferred by the federal Weatherization Assistance Program (WAP). In order for weatherization to be effective, homes must be in basic working order; major damage or disrepair in the home can prevent it from receiving weatherization.

Utility Disconnection. BTL aims to lower household energy bills through energy efficiency upgrades to the structure and home appliances. Lower energy bills help households pay on time and avoid disconnection and the associated challenges of being without electricity (e.g., may not be able to cook or use the microwave; food in the fridge or freezer can spoil; may not have hot water and therefore not shower, leading to shame and potentially staying home from school; cannot charge phones or power alarm clocks, making it difficult to get to work or school on time).



Societal Benefits

Social Cost of Carbon. The social cost of carbon (SCC) reflects the estimated cost of releasing an additional ton of carbon dioxide. Costs result from damages such as, “changes in agricultural productivity, damages caused by sea level rise, and decline in human health and labor productivity.”¹⁴ By reducing the amount of energy used in the home, Built to Last lowers the amount of direct and indirect carbon produced.

Air Pollution. The power plants that produce electricity also emit air pollution.¹⁵ Reducing electricity consumption can also reduce these pollutants.

Crime Reduction*. Researchers at the University of Pennsylvania studied the Basic Systems Repair Program (BSRP), which is now part of Built to Last. Their analysis found that, for each home receiving BSRP services, crime in the immediate area was 21.9% lower than comparable areas without BSRP homes. According to the paper, “A disinvested housing stock, blighted vacant lots, and a lack of greenspace are widespread environmental conditions that disproportionately occur in Black urban neighborhoods and are associated with stress, fear, poor mental health, and violence... These findings support the notion that the neighborhood physical environment shapes the social connectivity between neighbors, which in turn plays a role in preventing crime.”

Health System Costs. By improving residents’ health (see the section on “Health & Well-Being”), programs like Built to Last can reduce costs and strain on the healthcare system. This

¹⁴ Stanford University. (2021, June 7). *Professors explain the social cost of carbon*. Stanford Report. <https://news.stanford.edu/stories/2021/06/professors-explain-social-cost-carbon>

¹⁵ U.S. Environmental Protection Agency. (2025, March 19). *Power Plants and Neighboring Communities*. EPA. <https://www.epa.gov/power-sector/power-plants-and-neighboring-communities>

includes lower costs for insurance companies, which helps to keep premiums down, and also lower costs for hospitals, which are required to provide care regardless of a patient's ability to pay.



Utility and Ratepayer Benefits

Lower Utility Bills. By saving energy, Built to Last creates lower bills that are easier to pay. When people are able to pay their bills on time, it reduces:

- the *overall debt* carried by the utility and by individual households.
- the number of *disconnections and reconnections* and the associated costs to turn a meter on or off.
- the costs of *debt collections* (calling people, sending mail reminders, etc.)

A study of low-income, energy efficiency programs run by Pennsylvania's electric distribution companies found that utilities in the state saved an average of nearly \$6 annually per participating customer "by reducing arrearage carrying costs, bad debt write-offs, collection notices and calls, and service shutoffs"; for PECO specifically, the savings were closer to \$16 per participant per year.¹⁶

Reducing these costs and debts can improve the overall financial health and bond rating of the utility and keep rates lower for all customers. Lowering energy consumption also reduces the need for new power plants and other grid investments, lowering overall costs.

Summary of Monetized NEIs

The sections above speak to the breadth of benefits provided by holistic home upgrades. While multiple benefits are likely for each home that participates in Built to Last, current research is not sufficient to assign a dollar value to each impact listed above. In other cases, such as thermal stress and thermal comfort, there may be overlap between monetary values found in the literature – claiming both dollar amounts could lead to "double counting" (i.e. claiming parts of the same benefit twice). Therefore, Table 6 below attempts to lay out a set of non-overlapping, research-based NEIs that may be claimed by the Built to Last program. Some NEIs apply to all homes, such as reduced stress and allostatic load, while others can only be claimed for homes that received specific measures, such as conversion of a gas stove to an electric stove. The Crime Reduction NEI is divided into two categories, *tangible* and *quality of life (QoL)*, to reflect this

¹⁶ Ucar, F. & Clendenning, G. (2025). Counting More Than Kilowatts: Monetizing Utility Cost Savings from Reduced Arrearages and Collections. *International Energy Program Evaluation Conference Proceedings*. https://www.iepec.org/wp-content/uploads/2025/09/Ucar_Ferit.pdf

distinction made in the literature on the personal and societal costs of crime. Tangible costs include items such as the cost of medical care or property damage, while quality of life costs include the types of emotional damages that cannot elsewhere be quantified; these intangible costs were most associated with homicide. The full details for how the dollar values were calculated are found in Appendix B.

Table 6. Summary of NEI Values and Qualifying Home Measures

NEI	Annual Benefit	Lifetime Benefit	Measures
Credit Card Debt	\$169	\$1,345	Major Systems Repair
Crime Reduction	--	\$28,063 (tangible) \$47,400 (QoL)	Major Systems Repair
Water Damage Prevention	\$17	\$176	Bulk Water Management
Utility Operational Costs	\$16	\$154	Electric Energy Efficiency
Respiratory Health Improvements	\$148	\$1,441	Gas to Electric Stove Conversion
Stress (Allostatic Load)	--	\$597	Improved Overall Home Quality
Developmental Health and Lifetime Impacts	--	\$9 / dollar spent on hazard control	Lead Hazard Reduction
Asthma Symptom Reduction	\$42	\$413	Mold Reduction
Cancer Risk Reduction	--	\$76	Radon Mitigation System
Lower Home Insurance Premiums	\$153	\$1,490	Roof Replacement
Car Crash Reduction	\$51	\$496	WAP or Other Whole-Home Weatherization
Fewer Days of Poor Physical Health	\$211	\$2,058	WAP or Other Whole-Home Weatherization
Thermal Stress, Cold	\$559	\$5,456	WAP or Other Whole-Home Weatherization
Thermal Stress, Heat	\$689	\$6,723	WAP or Other Whole-Home Weatherization
Missed Work	\$220	\$2,147	WAP or Other Whole-Home Weatherization

Predatory Loans	\$6	\$54	WAP or Other Whole-Home Weatherization
Productivity at Home	\$44	\$434	WAP or Other Whole-Home Weatherization
Carbon Monoxide Poisoning	\$46	\$446	WAP or Other Whole-Home Weatherization
Home Fires	\$132	\$1,284	WAP or Other Whole-Home Weatherization

In addition to the NEIs listed in Table 6, the evaluation team also examined air pollution benefits that can result from reducing energy consumption. Using results from the energy modeling performed on 37 of the 50 homes, the team was able to estimate reductions in emissions of carbon dioxide (CO₂), small particulate matter (PM_{2.5}), SO₂, NO_x, and volatile organic compounds (VOCs) using emission rates from the U.S. Environmental Protection Agency's (EPA's) Emissions & Generation Resource Integrated Database (eGRID, <https://www.epa.gov/egrid>). Reductions in CO₂ were monetized using the social cost of carbon,¹⁷ while reductions in the remaining pollutants were monetized using the public health impact data found in the EPA's CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA).

The full details of how each NEI was calculated are found in Appendix B. Three NEIs –Stress, Developmental Health and Lifetime Impacts, and Cancer Risk Reduction – do not have annual values because they are based on literature that calculated lifetime rather than recurring benefits.

¹⁷ New York University School of Law. (n.d.). *The Cost of Climate Pollution*. Institute for Policy Integrity. Retrieved from: <https://costofcarbon.org/calculator>

5. Results of Valuating Built to Last Homes

The research team reviewed the files of 50 homes that were served by the Philadelphia Energy Authority. Due to Built to Last homes taking longer to complete than expected, the team reviewed both BTL homes and homes that were weatherized prior to the official start of the grant program. Based on the agency’s documentation – including home assessments, work orders, and measure lists – the team assessed which benefits could be claimed for each home based on the work performed in that home. In some cases, documentation for a home’s work scope was partially incomplete and the team retrieved the information to the best of their ability. To preserve privacy, the homes have been simply numbered #1-50 throughout this report.

Table 7 below provides a high-level summary of the valuation results across all 50 homes included in the evaluation. As noted in Section 3, the evaluation of the Basic Systems Repair Program’s impact on neighborhood crime included both tangible costs (e.g. property damage and loss, medical bills) and monetary values associated with impacts to quality of life. Because all other NEIs in the evaluation fall under the “tangible costs” category, we have broken out the results to show the impacts on both tangible and quality of life costs, as well as the total valuation. The table presents the average NEI value per home, the total NEI value across all 50 homes, and the range of NEI values (confidence interval, CI) across all 50 homes.

Table 7. Summary of Valuation Results Across 50 Evaluated Homes

	Average per Home	Total Across 50 Homes
Tangible Lifetime NEI Benefits	\$45,504	\$2,275,200
Quality of Life Lifetime NEI Benefits	\$50,583	\$2,529,154
Total Lifetime NEI Benefits	\$96,087	\$4,804,354

To get a sense of the scale of these benefits, Table 8 provides a summary of the amount spent on the 50 homes across all programs included in Built to Last (e.g., WAP, BSRP, BTL) alongside the NEI benefits, excluding air pollution because it is not available for all 50 homes. To see a comparison of all modeled costs and benefits, please see Appendix C.

Table 8. Comparison of Total Spent Across Programs (Costs) and NEI Benefits

	NEI Lifetime Benefits	Dollars Spent Across Programs	Ratio
Average per Home	\$96,087	\$38,958	2.5

Total Across 50
Homes

\$4,804,354

\$1,947,888

For the 37 homes that were included in both the energy and non-energy evaluation, the results of the air pollution reduction benefits are summarized in Table 9.

Table 9. Summary of Air Pollution Reduction Benefits for 37 Energy Modeled Homes

	Average per Home	Total Across 37 Homes
Social Cost of Carbon	\$5,730	\$212,018
Health Impacts of Other Pollutants	\$254	\$9,383
Total NEI	\$5,984	\$221,401

If we break the air pollution NEIs out by electrification status, the majority of modeled homes (29) did not receive any electrification measures (i.e. combustion appliances were not replaced with electric equivalents). Among these homes, eight were estimated to have slightly higher electric consumption following BTL, while 21 saw reductions; average energy savings across the 29 homes was estimated at 103 kWh for the first year, including both those homes that saw increases and decreases in modeled energy use. The two homes that were partially electrified (some combustion appliances replaced with electric) and three of the homes that were fully electrified (all combustion appliances replaced with electric) saw increases in modeled electric consumption; however, the remaining two fully electrified homes saw dramatically higher savings, bringing the category into the positive. The one home that was fully electric at baseline had baseboard heating, so converting the home to more efficient mini splits produced substantial electric savings. Additional details on the energy modeling and results can be found in the complementary evaluation report published by New Ecology.

Table 10. Energy Savings and Air Pollution Benefit by Electrification Status

Electrification Status	Average Year-One Electric Savings (kWh)	Average Air Pollution Related Benefits (Excluding SCC)	No. of Homes
No Electrification	103	\$47.67	29
Partial Electrification	-1,057	-\$609.88	2
Full Electrification	1,921	\$1,108.63	5
Already All-Electric prior to BTL	6,372	\$3,676.60	1
Grand Total	456	\$253.58	37

6. Guidance for Valuating Future BTL Homes

The NEIs included in this evaluation rely on information about the types of measures and programs used in each home. By tracking these inputs, the PEA team may continue valuating new BTL homes as they come through the program. Key measures and programs to track are listed below:

- Major Systems Repair
- Bulk Water Management
- Electric Energy Efficiency
- Gas to Electric Stove Conversion
- Improved Overall Home Quality
- Lead Hazard Reduction
- Mold Reduction
- Roof Replacement
- WAP or Other Whole-Home Weatherization
- (If implemented in future) Radon Mitigation Systems

As an example, any home that receives mold reduction measures can claim the \$413 benefit attributed to the average health benefits from removing mold from a home. A summary of the NEIs outlined above, their dollar values, and the measures/programs for which they can be claimed is provided in Table 6 above. Note that BTL to-date has not installed radon mitigation systems but that this measure was previously considered; the NEI monetary value is retained in Table 6 in case the program or its partners decides to install a radon mitigation system in the future.

PEA and similar organizations may choose to track these programs and measures and associated benefits in their current client management systems. Alternatively, a simple spreadsheet can be set up to track NEIs for each home. Using Table 11 as an example, the first row lists each program or measure that is associated with one or more NEIs. The second row indicates how the column should be filled in: most NEIs require a simple ‘yes’ or ‘no’ as to whether the measure was installed in the home, indicated with a 1 or 0, respectively, but lead hazard reduction is measured as a benefit per dollar spent, so the amount spent to address lead specifically must be entered. The third row contains the dollar value of the benefit for each NEI. After that, each row represents one home, numbered 1-5 in the example. The final column at right (green) adds up the NEI benefits for each home based on the measures installed. The example used the SUMPRODUCT function in Microsoft Excel; inputs to the function were row 3 and the row of the given home. (For home #1, SUMPRODUCT would add up 1 x \$597 plus 1 x \$19,297 plus 1 x \$154, and so on across the rows, including \$1900 x \$92 for lead hazard reduction.)

Table 11. Example Spreadsheet for Tracking and Calculating NEIs for Each Program Home

Home #	Improved Overall Home Quality	WAP or Other Whole-Home Weatherization	Major Systems Repair	Gas to Electric Stove Conversion	Roof Replacement	Lead Hazard Reduction	Mold Reduction	Bulk Water Management	NEI (total, lifetime)
	1 (Yes) 0 (No)	1 (Yes) 0 (No)	1 (Yes) 0 (No)	1 (Yes) 0 (No)	1 (Yes) 0 (No)	Dollars spent	1 (Yes) 0 (No)	1 (Yes) 0 (No)	
	\$597	\$19,451	\$76,808	\$1,441	\$1,490	\$9	\$413	\$176	
1	1	1	1	0	0	\$1,900	0	1	\$114,163
2	1	1	1	0	1	\$0	0	0	\$98,346
3	1	1	1	0	1	\$0	1	1	\$98,935

The team also recommends updating these values annually for inflation. The simplest way is to use the Consumer Price Index (CPI) published monthly by the Bureau of Labor Statistics, which provides a convenient and easy-to-use inflation calculator.¹⁸ Values could be updated each year at the beginning of the year once January values are published.

There is also value in routinely or periodically surveying programs participants about their experience and any changes they noticed beyond their utility bills. While not as rigorous as a full program evaluation, which might normally include a control group of untreated households, PEA could still gain qualitative insights into the types of benefits or potential challenges that participants face and use this feedback to inform programming or educate sponsors and policymakers. Administering a short questionnaire when people apply to the program (i.e. prior to receiving services) and then again after the work is complete could be another way to gather evidence about the program's impacts.

¹⁸ https://www.bls.gov/data/inflation_calculator.htm

Appendix A. Additional Detailed Results

Table 12 presents a more detailed accounting of the 50 BTL homes evaluated, which measures they received, and the NEI dollar value associated with that measure. The value for Lead Hazard Reduction is variable because it is based on the amount spent to address lead; two homes (21 and 26) did not have an itemized budget showing the amount spent specifically on lead hazard reduction, and so the median cost of the other four lead projects was substituted.

Table 12. Detailed Breakout of NEI Values Claimed per Home

Home #	Improved Home Quality	WAP or Other Whole-Home Weatherization	Major Systems Repair	Gas to Electric Stove Conversion	Roof Replacement	Lead Hazard Reduction	Mold Reduction	Bulk Water Management	Total
1	\$597	\$19,252	\$76,808	\$0	\$0	\$17,130	\$0	\$176	\$113,964
2	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$0	\$98,147
3	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$413	\$176	\$98,736
4	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$413	\$176	\$98,736
5	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
6	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
7	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
8	\$597	\$19,252	\$76,808	\$0	\$0	\$45,531	\$413	\$176	\$142,777
9	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
10	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
11	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323

12	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
13	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
14	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$0	\$98,147
15	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
16	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
17	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
18	\$597	\$19,252	\$76,808	\$1,441	\$1,490	\$0	\$0	\$176	\$99,764
19	\$597	\$19,252	\$76,808	\$1,441	\$1,490	\$0	\$0	\$176	\$99,764
20	\$597	\$19,252	\$76,808	\$0	\$1,490	\$4,193	\$413	\$176	\$102,930
21	\$597	\$19,252	\$76,808	\$0	\$1,490	\$16,026	\$0	\$176	\$114,349
22	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
23	\$597	\$19,252	\$76,808	\$1,441	\$1,490	\$0	\$413	\$176	\$100,177
24	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$413	\$176	\$98,736
25	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
26	\$597	\$19,252	\$76,808	\$1,441	\$0	\$16,026	\$0	\$176	\$114,300
27	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
28	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
29	\$597	\$19,252	\$76,808	\$1,441	\$0	\$0	\$0	\$0	\$98,098
30	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
31	\$597	\$0	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$79,071
32	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323

33	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$413	\$176	\$98,736
34	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
35	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
36	\$597	\$19,252	\$76,808	\$0	\$1,490	\$14,921	\$0	\$176	\$113,245
37	\$597	\$19,252	\$0	\$0	\$0	\$0	\$0	\$0	\$19,849
38	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
39	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$0	\$98,147
40	\$597	\$19,252	\$0	\$0	\$0	\$0	\$0	\$176	\$20,025
41	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
42	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
43	\$597	\$19,252	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$98,323
44	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
45	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
46	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
47	\$597	\$0	\$76,808	\$0	\$1,490	\$0	\$0	\$176	\$79,071
48	\$597	\$0	\$76,808	\$0	\$1,490	\$0	\$413	\$176	\$79,484
49	\$597	\$19,252	\$76,808	\$0	\$0	\$0	\$0	\$176	\$96,833
50	\$597	\$19,252	\$76,808	\$1,441	\$1,490	\$0	\$0	\$176	\$99,764

Appendix B. Monetization Equations

The NEI algorithms below combine results from previous weatherization and home repair program evaluations and published, peer-reviewed literature on health and economic outcomes associated with improved housing quality. Wherever possible, the team focused on results and data specific to Philadelphia, Pennsylvania, or the Northeastern United States, and national-level data were adjusted to reflect conditions and price levels in Philadelphia. One of the most distinctive aspects of the Philadelphia housing stock is that an estimated 80% of residences are rowhouses; however, in most cases there was not sufficient data on weatherization impacts for rowhouses specifically to be able to tailor the NEIs to this housing type, which is noted as a limitation of this work.

These algorithms follow a general pattern and methodology first developed during the American Reinvestment and Recovery Act (ARRA) WAP evaluation led by a team at Oak Ridge National Laboratory (ORNL). The evaluation collected direct data through occupant surveys administered at two time periods, one year apart, to both WAP program homes and a comparison group of previously weatherized homes. Changes in outcomes measured by the survey were monetized based on estimated direct costs, such as the average cost of an Emergency Department (ED) visit; if residents reported fewer asthma-related ED visits following weatherization, the average reduction could then be multiplied by the cost to both patients and insurers for a visit. Data from the WAP evaluation were used in the following NEIs in a few cases and were the underlying data for the Massachusetts Low-Income Single-Family NEI report (Section 3) adapted for this work. Because the WAP evaluation did not include a control group, outcomes were calculated by taking the difference of the Treatment group pre-weatherization with both the Treatment group at one year post-weatherization and the Comparison group one year post-weatherization and then taking the average of the two comparisons; this is noted as a limitation of the work, though the evaluation still represents some of the most comprehensive primary data on weatherization health outcomes in cold-climate, single-family homes to date.

For the BTL evaluation, there was not an opportunity to collect primary data from program participants; but the following algorithms are able to build on data from previous evaluations of similar programs and interventions. It should be noted that all of the following NEIs are reported as all-inclusive of both household and societal benefits, in line with PEA's mission to serve low-income residents while also generating societal and economic benefits to the Philadelphia area. Future iterations of the algorithms may divide out societal versus household benefits, as is common for NEIs used for cost-benefit analysis or regulatory purposes, but at this time it is not relevant to PEA's goals. As we expect these benefits to last over the lifetime of the measures, estimated at 10 years as a standard rule of thumb, we also calculate the present value (PV) of the benefit over ten years where applicable.

Whole-Home NEIs

Crime Reduction

The first NEI developed for the BTL program derived directly from a study conducted by researchers at the University of Pennsylvania (UPenn) who sought to measure the impacts on crime of the Basic Systems Repair Program – one of the programs integrated into BTL’s services. This NEI received the highest priority due to the strength and direct applicability of the evidence. Another strength of the NEI was that the costs associated with crime are well studied and quantified in the U.S.; a peer-review study by Miller et al., "Incidence and Costs of Personal and Property Crimes in the USA, 2017", reported costs associated with each type of crime studied by the UPenn researchers. The NEI is then calculated by multiplying the reduction in each type of crime by its associated costs, which were originally reported in 2017 dollars and have been updated to 2023 dollars using the Consumer Price Index (CPI). This a one-time rather than annual NEI, as the costs are all-inclusive and calculated per crime event; the final NEI would apply only to homes that receive either BSRP or equivalent major systems repair measures as a part of their BTL package.

	Annual Reduction ¹⁹	Tangible Costs ²⁰	Total Costs ²¹	Change in Tangible Costs (2017)	Change in Total Costs (2017)	Change in Tangible Costs (2023)	Change in Total Costs (2023)
Burglary	0.081	\$2,675	\$2,675	\$217	\$217	\$267	\$267
Theft	0.499	\$3,263	\$3,263	\$1,628	\$1,628	\$2,006	\$2,006
Assault	0.083	\$8,745	\$29,326	\$729	\$2,446	\$898	\$3,013
Robbery	0.098	\$16,578	\$27,723	\$1,632	\$2,730	\$2,011	\$3,363
Homicide	0.004	\$2,658,319	\$7,809,155	\$9,447	\$27,751	\$11,638	\$34,189
Public drunkenness	0.006	\$1,819	\$1,819	\$10	\$10	\$12	\$12

¹⁹ South EC, MacDonald J, Reina V. Association Between Structural Housing Repairs for Low-Income Homeowners and Neighborhood Crime. JAMA Netw Open. 2021 Jul 1;4(7):e2117067. doi: 10.1001/jamanetworkopen.2021.17067. PMID: 34287632; PMCID: PMC9435958.

²⁰ Miller TR, Cohen MA, Swedler DI, Ali B, Hendrie DV. Incidence and Costs of Personal and Property Crimes in the USA, 2017. Journal of Benefit-Cost Analysis. 2021;12(1):24-54. doi:10.1017/bca.2020.36

²¹ Ibid.

Disorderly conduct	0.048	\$1,819	\$1,819	\$87	\$87	\$107	\$107
Household Benefit						\$16,940	\$42,957

Improvements in General Health

Weatherization evaluations consistently find evidence of improvements in general as measured by questions in the Health-Related Quality of Life Core Four (HRQOL-4) developed by the Centers for Disease Control and Prevention (CDC). The HRQOL-4 have been used for public health surveillance to monitor the overall health of the U.S. population, and researchers have additionally found that responses to the HRQOL-4 are sensitive to changes in a person's health status and are associated with a person's risk of hospitalization and mortality. As such, the HRQOL-4 may be useful for weatherization programs that are interested in measuring health outcomes but have limited capacity to implement evaluation measures and wish to impose minimal burden on their clients.

The present NEI algorithm relies on data from the WAP evaluation, which incorporated three of the four HRQOL-4 questions. Much of the research on HRQOL-4 and related risk levels has focused on the first question, "Would you say that in general your health is excellent, very good, good, fair, or poor?", but unfortunately this question was not included in the WAP survey. However, research on elders age 65 and over in the U.S. found that risk of all-cause hospitalization in a 12-month period was associated with self-reported days of poor physical health in the past 30 days when divided into tranches of zero days versus 1-10 days, 11-20, or 21-30 days. The NEI was then calculated as follows for each non-zero tranche and summed across:

Net number of people who decreased from higher tranche to zero days of poor physical health
** Risk ratio associated with tranche * Average cost of a PA hospital stay * Percent of program households with a resident age 65 or over * Baseline hospitalization rate for those age 65 or over*

Specific input values are outlined below.

Input	Value
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Risk ratio, 0 days of poor physical health (baseline) ²²	1.0
Risk ratio, 1-10 days of poor physical health ²³	1.3
Risk ratio, 11-20 days of poor physical health ²⁴	1.6
Risk ratio, 21-30 days of poor physical health ²⁵	1.8
Average Cost of a PA Hospital Stay ²⁶	\$12,713
Percent of program households with residents age 65+ ²⁷	0.33
Baseline hospitalization rate, age 65+ ²⁸	16.6%
Annual Household Benefit:	\$210.80
Present Value of Household Benefit:	\$2,057.89

Reductions in Allostatic Load

One of the major topics that arose when discussing benefits associated with the program was the stress of living in a deteriorated, potentially unsafe dwelling and struggling to afford utility bills. In health literature, researchers have developed the term allostatic load (AL) to refer to the accumulation of chronic stress and repeated negative life events.²⁹ Allostatic load is associated with measurable physiological impacts to the body, such as high cholesterol and high blood pressure. A peer-reviewed article by Morales-Jinez et al. (2018) indicated that allostatic load was lower in occupants of higher quality housing and those who rate their home as more satisfactory, and higher allostatic load has been associated with higher rates of neighborhood crime, poverty and deprivation.^{30,31} Given BTL's positive impact on dwelling quality and crime reduction, as

²² Dominick, K. L., Ahern, F. M., Gold, C. H., & Heller, D. A. (2002). Relationship of health-related quality of life to health care utilization and mortality among older adults. *Aging Clinical and Experimental Research*, 14(6), 499–508. <https://doi.org/10.1007/bf03327351>

²³ Ibid.

²⁴ Ibid.

²⁵ Ibid.

²⁶ Davis, M. (2023, October 16). Typical US Hospital Stay Costs 384 Hours of Work With Average Earnings. ValuePenguin. <https://www.valuepenguin.com/hospital-bill-costs-study>

²⁷ Tonn, B., Rose, E., Hawkins, B., & Conlon, B. (2014). Health and household-related benefits attributable to the weatherization assistance program. *ORNL/TM-2014/345, Oak Ridge National Laboratory, Oak Ridge, Tennessee, September*.

²⁸ Centers for Disease Control and Prevention. (n.d.). Table HospStay. People with hospital stays in the past year, by selected characteristics: United States, selected years 1997–2019. Centers for Disease Control and Prevention. <https://www.cdc.gov/nchs/data/hus/2020-2021/HospStay.pdf>

²⁹ Guidi J, Lucente M, Sonino N, Fava GA. Allostatic Load and Its Impact on Health: A Systematic Review. *Psychother Psychosom*. 2021;90(1):11-27. doi: 10.1159/000510696. Epub 2020 Aug 14. PMID: 32799204.

³⁰ Katherine P. Theall, Stacy S. Drury, Elizabeth A. Shirtcliff, Cumulative Neighborhood Risk of Psychosocial Stress and Allostatic Load in Adolescents, *American Journal of Epidemiology*, Volume 176, Issue suppl_7, 1 October 2012, Pages S164–S174, <https://doi.org/10.1093/aje/kws185>

³¹ Prior L. Allostatic Load and Exposure Histories of Disadvantage. *Int J Environ Res Public Health*. 2021 Jul 6;18(14):7222. doi: 10.3390/ijerph18147222. PMID: 34299672; PMCID: PMC8308019.

well as qualitative data from weatherization participant interviews indicating reductions in stress and improvements in both household financials and peace of mind, BTL may have a positive impact on allostatic load and its impacts on physical health. Two estimates were found of the association between mortality risk and a 1-point change in a person's allostatic load score (calculated as the sum of biomarkers that exceed healthy thresholds); the average of the two estimates was used.^{32,33} However, due to some differences in which biomarkers were included in the study estimating housing impacts on allostatic load and the study estimating AL's impact on mortality, we have adjusted the result using the percent of overlapping biomarkers as a proxy. The NEI was calculated as a one-time benefit (mortality can only be counted once per person) using the following equation:

*Average of housing-related AL score reduction estimates * Change in mortality per 1-point change in AL score (ages 60+) * Adjustment for differences in AL biomarkers * Philadelphia age-adjusted death rate (.008944) * Value of a statistical life (lower bound of 90% confidence interval) * Percent of program participants age 60 and over*

Input	Value
Reduction in AL score associated with housing quality ³⁴	-0.14
Reduction in AL score associated with satisfaction with home ³⁵	-0.12
Change in mortality per 1-point change in AL score, ages 60+ ³⁶	18.5%
Adjustment for differences in AL biomarkers	60%
Philadelphia age-adjusted death rate per 100k ³⁷	894.4

³² Akinyemiju, T., Wilson, L. E., Deveau, A., Aslibekyan, S., Cushman, M., Gilchrist, S., Safford, M., Judd, S., & Howard, V. (2020). Association of Allostatic load with all-cause and cancer mortality by race and body mass index in the REGARDS cohort. *Cancers*, 12(6), 1695. <https://doi.org/10.3390/cancers12061695>

³³ Zheng, D. D., Christ, S. L., Lam, B. L., Tannenbaum, S. L., Bokman, C. L., Arheart, K. L., McClure, L. A., Fernandez, C. A., & Lee, D. J. (2014). Visual acuity and increased mortality: The role of allostatic load and functional status. *Investigative Ophthalmology & Visual Science*, 55(8), 5144. <https://doi.org/10.1167/iovs.14-14202>

³⁴ Morales-Jinez, A., Gallegos Cabriaes, E., D'Alonzo, K., Ugarte-Esquivel, A., López-Rincón, F., & Salazar-González, B. C. (2018). Social factors contributing to the development of allostatic load in older adults: A correlational- predictive study. *Aquichan*, 18(3), 298–310. <https://doi.org/10.5294/aqui.2018.18.3.5>

³⁵ Ibid.

³⁶ Zheng, D. D., Christ, S. L., Lam, B. L., Tannenbaum, S. L., Bokman, C. L., Arheart, K. L., McClure, L. A., Fernandez, C. A., & Lee, D. J. (2014). Visual acuity and increased mortality: The role of allostatic load and functional status. *Investigative Ophthalmology & Visual Science*, 55(8), 5144. <https://doi.org/10.1167/iovs.14-14202>

³⁷ Pennsylvania Department of Health. (2020). Pennsylvania County Health Profiles. Philadelphia Division of Health Informatics. <https://www.health.pa.gov/topics/HealthStatistics/VitalStatistics/CountyHealthProfiles/Documents/current/philadelphia.aspx>

Value of a Statistical Life ³⁸	\$1,125,000
Estimated percent of program participants age 60 or older ³⁹	39%
Final NEI Value (One-Time):	\$597

Improved Sleep and Reduced Car Crashes

Weatherization evaluations have shown improved sleep among occupants, which is associated with positive outcomes such as improved productivity at work and home (valuated later in this memo) and lower risk of car crashes, as driving while sleep deprived is estimated to be as dangerous as driving while intoxicated.⁴⁰ The following NEI was calculated as:

*(PA Annual Economic Cost Due to Motor Vehicle Crashes / Number of PA car crashes) * (Number of PA car crashes / Number of PA households) * (Increased risk of crash following a night of poor sleep – 1) * Percent of low-income households with a personal vehicle * Reduction in poor sleep attributable to WAP each month*

Input	Value
PA Annual Economic Cost Due to Motor Vehicle Crashes (2022) ⁴¹	\$29,344,951,422
Number of PA car crashes (2022) ⁴²	115,938
Number of PA households (2022) ⁴³	5,193,727
Increased risk of crash following a night of poor sleep ⁴⁴	1.3
Percent of low-income households with a personal vehicle ⁴⁵	60%

³⁸ United States Environmental Protection Agency. Environmental Benefits Mapping and Analysis Program - Community Edition (BenMAP-CE). www.epa.gov/benmap

³⁹ Tonn, B., Rose, E., Hawkins, B., & Conlon, B. (2014).

⁴⁰ <https://www.sleepfoundation.org/drowsy-driving/drowsy-driving-vs-drunk-driving>

⁴¹ Pennsylvania Department of Transportation. (n.d.). Crash Facts & Statistics. PennDOT.pa.gov. <https://www.penndot.pa.gov/TravelInPA/Safety/pages/crash-facts-and-statistics.aspx>

⁴² Ibid.

⁴³ U.S. Census Bureau. (n.d.). QuickFacts: Pennsylvania. Census.gov. <https://www.census.gov/quickfacts/fact/table/PA/PST045222>

⁴⁴ Tefft, B.C. (2016). Acute Sleep Deprivation and Risk of Motor Vehicle Crash Involvement (Technical Report). Washington, D.C.: AAA Foundation for Traffic Safety.

⁴⁵ Calculated from Census Tables C17002 (Income to Poverty Ratio) and S2504 (Household Characteristics) as the percent of households with access to at least one vehicle in Census tracts where >75% of the population lives below 200% FPL.

Reduction in poor sleep attributable to WAP each month ⁴⁶	5%
Annual Household Benefit	\$50.85
Present Value of Household Benefit	\$496.41

Credit Card Debt

Home repairs and maintenance pose a financial burden to low-income homeowners, who often forego paying for repairs even in dire circumstances. However, research on predatory lending has found that lenders often targeted low-income homeowners whose mortgages were fully paid, including targeting older, widowed Black women specifically, and convinced them to take out high-interest loans in order to pay for home repairs.^{47,48} The *Daily News* ran a feature story on predatory lending in Philadelphia specifically, where one resident reported receiving a loan with a balloon payment of \$32,000 at the end of term.⁴⁹ While further data on the overall or average amount of interest and fees taken on by these homeowners was not available, multiple surveys of people with credit card debt indicate the unexpected or emergency expenses, particularly emergency home repairs, are one of the top reasons for carrying a balance on their credit card. The following equation was used to calculate one month of interest paid on home repair-related credit card debt:

*Percent of Low-Income Households with Credit Card Debt * Average Credit Card Balance for Low-Income Credit Card Holder * Percent of Credit Card Debt Holders with Debt due to Emergency Expenses * Percent of Emergencies related to Home Repair * Average Credit Card APR*

An estimated 58% of credit card holders with debt have been indebted for one year or more, and so the amount was multiplied by (58% * 12 months) for this population; only one month of debt was assumed for the remaining 42% of debt holders in lieu of more specific estimates.

⁴⁶ Hawkins, B., Tonn, B., Rose, E., Clendenning, G. and Abraham, L. (2016). MA Low-Income Single-Family Health-and-Safety-Related Non-Energy Impacts Study. <https://ma-eeac.org/wp-content/uploads/Low-Income-Single-Family-Health-and-Safety-Related-Non-Energy-Impacts-Study.pdf>

⁴⁷ Bartram, R. (2023). Routine Dilapidation: How Homeownership Creates Environmental Injustice. *City & Community*, 22(4), 266-285. <https://doi.org/10.1177/15356841231172524>

⁴⁸ Elvin Wyly & C.S. Ponder (2011) Gender, age, and race in subprime America, *Housing Policy Debate*, 21:4, 529-564, DOI: 10.1080/10511482.2011.615850

⁴⁹ <https://www.anderson.ucla.edu/documents/areas/adm/loeb/02b15.pdf>

Input	Value
Percent of Low-Income Households with Credit Card Debt ⁵⁰	56%
Average Credit Card Balance for Low-Income Credit Card Holder ⁵¹	\$4,650
Percent with Debt due to Emergency Expenses ⁵²	43%
Percent of Emergencies related to Home Repair ⁵³	9%
Average Credit Card APR ⁵⁴	22.75%
Percent that Have Carried Debt One Year or More ⁵⁵	58%
Monthly Interest Paid	\$22.93
Annual Household Benefit	\$169.20
Present Value of Household Benefit	\$1,651.72

Measure-Specific NEIs

Because BTL provides measures above and beyond what is performed by standard weatherization programs, the team additionally explored benefits that may be attributed to individual measures and would be assessed only for homes receiving those measures.

⁵⁰ Thangavelu, P. (2024, January 8). More cardholders carrying credit card balances in high rate environment. Bankrate. <https://www.bankrate.com/finance/credit-cards/credit-card-debt-survey/#who-is-most-likely-to-carry-credit-card-debt>

⁵¹ McCann, A. (2023, December 7). Average credit card debt in 2024 & historical balances. WalletHub. <https://wallethub.com/edu/cc/average-credit-card-debt/25533>

⁵² Thangavelu, P. (2024, January 8).

⁵³ Ibid.

⁵⁴ Federal Reserve Board. (2024, January 8). Consumer Credit - G.19. Federal Reserve Board. <https://www.federalreserve.gov/releases/g19/20240108/>

⁵⁵ Thangavelu, P. (2024, January 8).

New Roofs and Lower Insurance Premiums

BTL will in some cases repair or fully replace a damaged roof, particularly if the home has been assessed as a candidate for rooftop solar. Homeowners (HO) insurance companies charge lower premiums on average for homes with new roofs due to the lower risk of structural damage. This benefit was calculated for one year only, as homeowners' insurance companies typically only reinspect and reassess homes at most once every 10 years, so not all recipients of a new roof will see this benefit if their premium is not reassessed.

*(Average annual cost of HO insurance with a 20-year-old roof – Average annual cost of HO insurance with a new roof) * (1 + Average cost of HO insurance in PA compared to National) * Percent of low-income homeowners with HO insurance*

Input	Value
Average annual cost of HO insurance with a new roof ⁵⁶	\$1,464
Average annual cost of HO insurance with a 20-year-old roof ⁵⁷	\$1,800
Average cost of HO insurance in PA compared to National ⁵⁸	-36%
Percent of low-income homeowners with HO insurance ⁵⁹	71%
One-Time Household Benefit	\$152.68

Mold Abatement and Asthma Symptoms

Burr et al. (2007) conducted a randomized controlled trial on the impacts of intensive mold remediation on asthma symptoms of asthmatics living in the remediated home. Statistically significant reductions in wheezing, rhinitis, and prescription inhaler use were found at the 12-month follow up. These improvements were monetized using the EPA's cost of illness for wheezing and rhinitis and the average cost of one inhaler for common preventer and reliever medications. The resulting dollar estimate was multiplied by the prevalence of asthma in the WAP population as a proxy for BTL. Weatherization evaluations have consistently found asthma rates much higher than those of the general population.

⁵⁶ Howard, P., & McGinley, K. (2023, October 20). 11 factors that affect home insurance rates. Policygenius. <https://www.policygenius.com/homeowners-insurance/factors-affecting-home-insurance-premiums/>

⁵⁷ Ibid.

⁵⁸ Paulus, N. (2023, January 31). Homeowners Insurance Statistics. Moneygeek.com. <https://www.moneygeek.com/insurance/homeowners/homeowners-insurance-statistics/>

⁵⁹ Insurance Information Institute. (2023). *Homeowners Perception of Weather Risks: 2023Q2 Consumer Survey*. iii.org. https://www.iii.org/sites/default/files/docs/pdf/2023_q2_ho_perception_of_weather_risks.pdf

*Sum of (Percent of Sample No Longer Experiencing Symptom at 12-Month Follow Up * Cost of Illness or Cost of Inhaler) * Asthma Rate in WA*

Symptom	Percent No Longer Experiencing Symptom at 12 Month Follow Up	Cost of Illness (1 & 2) or Cost of One Inhaler (3 & 4)
Wheezing, breathing problems ⁶⁰	29%	\$115 ⁶¹
Rhinitis ⁶²	24%	\$600 ⁶³
Use of preventer in last 4 weeks ⁶⁴	19%	\$320 ⁶⁵
Use of reliever in last 4 weeks ⁶⁶	18%	\$74 ⁶⁷
Asthma Rate in WAP ⁶⁸		17%
Annual Household Benefit		\$42.26
Present Value of Household Benefit		\$412.59

Notably this NEI does not overlap with the asthma NEI from the Massachusetts report later in this memo, as the former measures cost of illness (based on willingness-to-pay) and prescription medication, while the latter measures costs of healthcare encounters such as doctor's office visits, ED visits, and hospitalizations.

⁶⁰ Burr ML, Matthews IP, Arthur RA, Watson HL, Gregory CJ, Dunstan FD, Palmer SR. Effects on patients with asthma of eradicating visible indoor mould: a randomised controlled trial. *Thorax*. 2007 Sep;62(9):767-72. doi: 10.1136/thx.2006.070847. Epub 2007 Mar 27. PMID: 17389753; PMCID: PMC2117320.

⁶¹ United States Environmental Protection Agency. (2023, March). *Environmental Benefits Mapping and Analysis Program – Community Edition: User's Manual*. epa.gov. https://www.epa.gov/sites/default/files/2015-04/documents/benmap-ce_user_manual_march_2015.pdf

⁶² Ibid.

⁶³ United States Environmental Protection Agency. (2023, March).

⁶⁴ Ibid.

⁶⁵ Bianchini, T. (2024, January 1). *How much do asthma inhalers cost without insurance in 2024?*. Mira Health. <https://www.talktomira.com/post/asthma-inhalers-cost-without-insurance-in-2021>

⁶⁶ Ibid.

⁶⁷ Bianchini, T. (2024, January 1).

⁶⁸ Tonn, B., Rose, E., Hawkins, B., & Conlon, B. (2014).

Measures to Address and Prevent Water Damage

Water damage is a common problem encountered by the BTL program. While the program does not provide measures that could prevent the effects of flooding, it will repair gutters and downspouts, direct water away from buildings and foundations, and provide other water damage prevention measures as needed. To estimate the average risk of water damage in a home, the team reviewed the rate at which homeowners file insurance claims for water damage, as well as data from the First Street Foundation on flood risk for properties in Philadelphia. As BTL cannot prevent damage from flooding, the risk of flooding is subtracted from the rate of water damage claims to estimate those claims that are only related to more minor forms of water damage preventable by BTL measures.

*(Percent of homes that file a claim for water damage each year – Percent of homes likely to flood each year, on average) * Cost to repair low-level water damage*

Input	Value
Percent of homes likely to flood each year, on average ⁶⁹	1.1%
Percent of homes that file a claim for water damage each year ⁷⁰	1.6%
Cost to repair low-level water damage ⁷¹	\$3,128
Annual Household Benefit	\$16.99
Present Value of Household Benefit	\$165.89

Lead Hazard Control

Gould (2009) estimated the benefit-cost ratio of lead hazard control programs, taking into account six categories of benefit: health care, lifetime earnings, tax revenue, special education, attention deficit–hyperactivity disorder, and the direct costs of crime. The study presented a range of estimates from conservative to optimistic; this study adopts the average of the benefit estimates. Because the final benefit is a ratio, values were not adjusted for inflation or cost of living as it would be the same adjustment for both the numerator and denominator.

⁶⁹ First Street Foundation. (n.d.). *Philadelphia, PA flood map and climate risk report*. RiskFactor.com. https://riskfactor.com/city/philadelphia-pa/4260000_fsid/flood

⁷⁰ Insurance Information Institute. (n.d.). *Facts + Statistics: Homeowners and renters insurance*. III. <https://www.iii.org/fact-statistic/facts-statistics-homeowners-and-renters-insurance>

⁷¹ See workbook.

	Conservative estimate	Optimistic estimate	Midpoint estimate
Total benefit from lead hazard control ⁷²	\$192.38	\$270.45	\$231.42
Total cost of lead control ⁷³	\$11.02	\$1.22	\$6.12
Benefit per dollar spent	\$17.46	\$221.68	\$37.81
Average Benefit Per Dollar Spent	\$92.32		

Radon Mitigation System

Based on an estimate of radon-related mortality and the prevention effectiveness of radon mitigation systems, we estimate the benefits associated with this measure as:

*(Lung cancer deaths attributable to radon exposure / U.S. population) * Percent of radon-related deaths prevented by mitigation systems * Value of a statistical life*

Input	Value
Lung cancer mortality attributable to radon exposure, annual deaths (2010) ⁷⁴	21,000
U.S. population (2010) ⁷⁵	308,745,538
Percent of radon-related deaths prevented by mitigation systems ⁷⁶	10%
Value of a statistical life (2023) ⁷⁷	\$11,164,185.58
One-Time Benefit for Homes Receiving Radon Mitigation Systems	\$75.94

⁷² Gould E. Childhood lead poisoning: conservative estimates of the social and economic benefits of lead hazard control. Environ Health Perspect. 2009 Jul;117(7):1162-7. doi: 10.1289/ehp.0800408. Epub 2009 Mar 31. PMID: 19654928; PMCID: PMC2717145.

⁷³ Ibid.

⁷⁴ American Cancer Society (ACS). (n.d.). *Estimated New Cancer Cases and Deaths for 2010 All Races, By Sex*. SEER. https://seer.cancer.gov/archive/csr/1975_2011/

⁷⁵ U.S. Census Bureau. (n.d.). QuickFacts

⁷⁶ Petersen ML, Larsen T. Cost-benefit analyses of radon mitigation projects. J Environ Manage. 2006 Oct;81(1):19-26. doi: 10.1016/j.jenvman.2005.10.005. Epub 2006 Apr 17. PMID: 16616412.

⁷⁷ United States Environmental Protection Agency. (2023, March 14).

Gas Stove Conversion

Evidence of the harmful pollution associated with gas stoves has gained public attention in recent years. A report for the Massachusetts Utility Program Administrators estimated NEIs attributable to replacing gas ranges with induction cooktops.⁷⁸ Due to a systematic review that has been published in the intervening time, the NEI estimates related to childhood asthma have been removed unless and until further evidence substantiates a causal relationship.⁷⁹ Estimates from the report were adjusted for inflation and cost of living (see Section 3 for details).

Non-Energy Impact ⁸⁰	Annual Household Benefit	Present Value of Household Benefit
Adult asthma symptom reduction	\$53.13	\$518.65
Lower respiratory tract symptom reduction	\$94.22	\$919.75
COPD-related hospitalization reduction	\$0.30	\$2.92
Total Household Benefit	\$147.64	\$1,441.32

The Massachusetts Low-Income, Single-Family NEI Study

The following NEIs are updated from weatherization NEI findings reported to the Massachusetts Energy Efficiency Program Administrators. The methodology involves adjusting for inflation from the original study year, 2014, to the most recent available year, 2023, using a ratio of the Consumer Price Index (CPI) for each year and then adjusting for differences in the cost of living (CoL) between Massachusetts and Pennsylvania using the ratio of their Regional Price Parities. Each individual NEI is updated using the same adjustment for inflation and CoL. The original report can be found on the website of the Massachusetts Energy Efficiency Advisory Council at the following link: <https://ma-eeac.org/wp-content/uploads/Low-Income-Single-Family-Health-and-Safety-Related-Non-Energy-Impacts-Study.pdf>. This report was based on findings from the most recent Weatherization Assistance Program (WAP) national evaluation at the time and adjusts those findings for Massachusetts by focusing on results for the cold and very cold climates and applying economic values specific to the state, such as the average cost of a hospitalization in Massachusetts that could be prevented by weatherization. All previous WAP evaluation reports can be found on the Oak Ridge National Laboratory website at <https://weatherization.ornl.gov/>.

⁷⁸ https://ma-eeac.org/wp-content/uploads/MA22X03-E-GSCNEI_Gas-to-Induction-Stovetop-NEIs-Study_Final-Report_1.12.2023.pdf

⁷⁹ Li W, Long C, Fan T, Anneser E, Chien J, Goodman JE. Gas cooking and respiratory outcomes in children: A systematic review. *Glob Epidemiol.* 2023 Apr 17;5:100107. doi: 10.1016/j.gloepi.2023.100107. PMID: 37638371; PMCID: PMC10446006.

⁸⁰ NMR Group, & Three3. (2023, January 12). *Residential Gas-to-Induction Stovetop Conversion NEIs Study*. ma-eeac.org. https://ma-eeac.org/wp-content/uploads/MA22X03-E-GSCNEI_Gas-to-Induction-Stovetop-NEIs-Study_Final-Report_1.12.2023.pdf

Traditionally, NEIs have been broken out between "Household" and "Societal", or benefits that accrue directly to the program recipients versus benefits to society more broadly. We recommend including both given that PEA's mission includes not only serving households but also broader community development goals related to clean energy. However, in keeping with the original report, we have retained both the individual Household and Societal as well as Total estimates for the below NEIs. As an example, if we look at the asthma NEI, the "Households" portion represents an estimate of the amount that would be paid out of pocket for medical care, while the "Society" portion represents the cost covered by insurance.

Table 13: Inputs to Update 2014 Cold Climate WAP NEIs

Metric	Value	Source
2014 Consumer Price Index (CPI)	233.916	https://www.bls.gov/cpi/data.htm
2023 Consumer Price Index (CPI)	299.17	https://www.bls.gov/cpi/data.htm
Massachusetts Cost of Living Index (2022)	109.4	https://www.bea.gov/data/prices-inflation/regional-price-parities-state-and-metro-area
Philadelphia Cost of Living Index (2022)	100.7	https://www.bea.gov/data/prices-inflation/regional-price-parities-state-and-metro-area

Table 14: Updated Asthma NEI Benefit, 2023

	Annual Household Benefit	Present Value of Household Benefit
Households	\$11.76	\$114.81
Society	\$379.09	\$3,700.73
Total	\$390.85	\$3,815.54

Table 15: Updated Cold Exposure Thermal Stress NEI Benefit, 2023

	Annual Household Benefit	Present Value of Household Benefit
Households	\$520.95	\$5,085.59

Society	\$37.93	\$370.32
Total	\$558.88	\$5,455.91

Table 16: Updated Heat Exposure Thermal Stress NEI Benefit, 2023

	Annual Household Benefit	Present Value of Household Benefit
Households	\$641.98	\$6,267.09
Society	\$46.75	\$456.36
Total	\$688.72	\$6,723.45

Table 17: Updated Missed Days of Work NEI Benefit, 2023

	Annual Household Benefit	Present Value of Household Benefit
Households	\$175.94	\$1,717.57
Society	\$43.98	\$429.36
Total	\$219.92	\$2,146.93

Table 18: Updated Reduction in Predatory Loans NEI Benefit, 2023

	Annual Household Benefit	Present Value of Household Benefit
Households	\$5.56	\$54.25
Society	\$0.00	\$0.00
Total	\$5.56	\$54.25

Table 19: Updated Increase in Productivity NEI Benefit, 2023

	Annual Household Benefit	Present Value of Household Benefit
Households	\$44.44	\$433.85
Society	\$0.00	\$0.00
Total	\$44.44	\$433.85

Table 20: Updated Reduction in Carbon Monoxide Poisoning NEI Benefit, 2023

	Annual Household Benefit	Present Value of Household Benefit
Households	\$43.53	\$425.00
Society	\$2.20	\$21.49
Total	\$45.74	\$446.49

Table 21: Update Reduction in House Fires NEI Benefit, 2023

	Annual Household Benefit	Present Value of Household Benefit
Households	\$110.47	\$1,078.46
Society	\$21.04	\$205.37
Total	\$131.51	\$1,283.84

Appendix C. Individual Home Summaries

The section below provides one-page anonymized summaries for each of the 50 homes included in this evaluation. Intended for use as individual examples/handouts or as a collective, these summaries bring together data from across all evaluation activities, including the energy modeling performed by New Ecology, Inc. under the same WAP Enhancement & Innovation grant. These summaries provide a snapshot of the investments made in each home and the resulting benefits that accrued.

BUILT TO LAST

HOME 1 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$66,763	\$114,163	Not Modelled	Not Modelled		

MEASURES

- Roof Repaired/Replaced
- Lead Mitigation
- Bulk Water Management
- Exterior Health & Safety Repairs
- Ductwork repaired/replaced
- Interior Home Envelope Repairs
- Insulation installed
- Air Sealing

PROGRAM PARTNERS

- Built to Last
- Basic Systems Repair Program
- Weatherization Assistance Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 2 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,022	\$98,422	\$1,922	\$2,185		

MEASURES

- Roof repaired/replaced
- Radon mitigation measures
- Exterior home envelope repairs
- Interior health and safety measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic System Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 3 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,535	\$98,935	\$1,786	\$2,101		

MEASURES

- Roof repaired/replaced
- Solar installed
- Mold mitigation
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety repairs
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Interior health and safety repairs
- Attached structure repairs
- Windows repaired/replaced
- Interior home envelope repairs
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 4 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,535	\$98,935	\$21,869	\$19,661		

MEASURES

- Roof repaired/replaced
- Mold mitigation
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Exterior home envelope repairs
- Attached structure repairs
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope repairs
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Habitat for Humanity Philadelphia

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 5 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,198	\$98,598	\$(6,759)	\$(7,402)		

MEASURES

- Roof repaired/replaced
- Radon mitigation measures
- Bulk water management
- Programmable thermostat
- Exterior home envelope repairs
- Interior home envelope repairs
- Insulation installed
- Air sealing
- Electrical repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Habitat for Humanity Philadelphia

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 6 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	\$(3,161)	\$(3,484)		

MEASURES

- Roof repaired/replaced
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Ductwork repaired/replaced
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.

2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.

3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.

4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 7 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,708	\$97,108	\$889	\$1,033		

MEASURES

- Roof repaired/replaced
- Solar installed
- Radon mitigation measures
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Exterior home envelope measures
- Attached structure repairs
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 8 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$95,652	\$143,052	Not modeled	Not modeled		

MEASURES

- Lead mitigation
- Mold mitigation
- Radon mitigation measures
- Bulk water management
- Asbestos
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Water heater repaired/replaced
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electrical repairs

PROGRAM PARTNERS

- Built to Last Program
- Weatherization Assistance Program
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.

2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.

3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.

4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 9 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,708	\$97,108	\$6,039	\$6,993		

MEASURES

- Radon mitigation measures
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 10 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,198	\$98,598	\$(51)	\$37		

MEASURES

- Roof repaired/replaced
- Radon mitigation measures
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Exterior home envelope measures
- Attached structure repairs
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs
- Dehumidifier installed

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Philadelphia Gas Works
- Habitat for Humanity Philadelphia

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.

2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.

3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.

4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 11 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	Not modeled	Not modeled		

MEASURES

- Roof repaired/replaced
- Bulk water management
- Exterior health and safety measures
- Hot water heater repaired/replaced
- Ductwork repaired/replaced
- Exterior home envelope measures
- Attached structure repairs
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Philadelphia Gas Works
- Habitat for Humanity Philadelphia

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 12 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,708	\$97,108	\$12,541	\$10,215		

MEASURES

- Radon mitigation measures
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Programmable thermostat installed
- Exterior home envelope
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- US Housing and Urban Development

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 13 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	\$5,846	\$6,908		

MEASURES

- Roof repaired/replaced
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 14 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,022	\$98,422	\$2,120	\$2,479		

MEASURES

- Roof repaired/replaced
- Radon mitigation measures
- CO/Gas mitigation
- Heating repaired/replaced
- Cooling repaired/replaced
- Exterior home envelope measures
- Attached structure repairs
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Philadelphia Regional Center for Children's Environmental Health

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 15 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,198	\$98,598	\$4,305	\$5,183		

MEASURES

- Roof repaired/replaced
- Radon mitigation measures
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Programmable thermostat installed
- Exterior home envelope measures
- Attached structure repairs
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs
- Dehumidifier

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Philadelphia Regional Center for Children's Environmental Health

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.

2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.

3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.

4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 16 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,632	\$97,032	\$2,711	\$3,200		

MEASURES

- Solar installed
- Bulk water management
- Hot water heater repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Air sealing
- Insulation installed

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Philadelphia Gas Works
- Habitat for Humanity Philadelphia
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 17 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	\$2,904	\$3,021		

MEASURES

- Roof repaired/replaced
- Bulk water management
- Programmable thermostat installed
- Interior health and safety

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic System Repair Program
- Habitat for Humanity Philadelphia

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 18 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$52,563	\$99,963	\$16,370	\$15,265		

MEASURES

- Electrification
- Roof repaired/replaced
- Solar installed
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 19 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$52,563	\$99,963	Not modeled	Not modeled		

MEASURES

- Roof repaired/replaced
- Bulk water management
- Asbestos mitigation
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Ductwork repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.

2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.

3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.

4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 20 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$55,729	\$103,129	\$2,261	\$2,649		

MEASURES

- Roof repaired/replaced
- Lead mitigation
- Mold mitigation
- Bulk water management
- CO/Gas mitigation
- Heating repaired/replaced
- Cooling repaired/replaced
- Programmable thermostat installed
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 21 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$67,148	\$114,548	Not modeled	Not modeled		

MEASURES

- Roof repaired/replaced
- Lead mitigation
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs
- Dehumidifier installed

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Philadelphia Gas Works
- Habitat for Humanity Philadelphia

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 22 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	\$10,832	\$9,743		

MEASURES

- Roof repaired/replaced
- Solar installed
- Bulk water management
- Asbestos mitigation
- CO/Gas mitigation
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Ductwork repaired replaced
- Exterior home envelope measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Habitat for Humanity Philadelphia
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 23 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$52,976	\$100,376	Not modeled	Not modeled		

MEASURES

- Electrification
- Roof repaired/replaced
- Solar installed
- Mold mitigation
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.

2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.

3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.

4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 24 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,535	\$98,935	Not modeled	Not modeled		

MEASURES

- Roof repaired/replaced
- Solar installed
- Mold mitigation
- Bulk water management
- Exterior health and safety measures
- Hot water heater repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Home envelope interior
- Electric repaired/replaced

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Philadelphia Gas Works
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 25 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	Not modeled	Not modeled		

MEASURES

- Roof repaired/replaced
- Lead mitigation
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Ductwork repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs
- Dehumidifier installed

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 26 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$67,175	\$114,575	\$12,798	\$7,974		

MEASURES

- Electrification
- Solar installed
- Radon mitigation measures
- Bulk water management
- CO/Gas mitigation
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 27 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,708	\$97,108	\$1,388	\$1,645		

MEASURES

- Radon mitigation
- Bulk water management
- Hot water heater repaired/replaced
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Philadelphia Gas Works

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 28 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,198	\$98,598	\$5,191	\$6,055		

MEASURES

- Roof repaired/replaced
- Radon mitigation measures
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Ductwork repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 29 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$50,973	\$98,373	\$6,797	\$5,362		

MEASURES

- Electrification
- Radon mitigation measures
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Programmable thermostat installed
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs
- Prepped for solar

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 30 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,632	\$97,032	\$3,187	\$3,746		

MEASURES

- Bulk water management
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Ductwork repaired/replaced
- Exterior home envelope measures
- Interior health and safety measure
- Windows repaired/replaced
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 31 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$31,671	\$79,071	\$3,585	\$4,368		

MEASURES

- Roof repaired/replaced
- Bulk water management
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced

PROGRAM PARTNERS

- Built to Last
- Habitat for Humanity Philadelphia

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 32 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	\$3,932	\$4,769		

MEASURES

- Roof repaired/replaced
- Solar installed
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Exterior home envelope measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 33 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,611	\$99,011	\$3,559	\$4,087		

MEASURES

- Roof repaired/replaced
- Mold mitigation
- Radon mitigation measures
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Programmable thermostat installed
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Habitat for Humanity Philadelphia

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 34 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,198	\$98,598	\$1,825	\$(161)		

MEASURES

- Roof repaired/replaced
- Radon mitigation measures
- Bulk water management
- CO/Gas mitigation
- Heating repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Philadelphia Gas Works
- Philadelphia Regional Center for Children's Environmental Health

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 35 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	Not modeled	Not modeled		

MEASURES

- Roof repaired/replaced
- Bulk water management
- Heating repaired/replaced
- Cooling repaired/replaced
- Exterior home envelope measures
- Attached structure repairs
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs
- Dehumidifier installed

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Philadelphia Regional Center for Children's Environmental Health

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 36 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$66,044	\$113,444	\$13,068	\$15,151		

MEASURES

- Roof repair/replaced
- Lead mitigation
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Programmable thermostat installed
- Exterior home envelope measures
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Philadelphia Regional Center for Children's Environmental Health

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 37 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
N/A	\$20,048	\$20,048	Not modeled	Not modeled		

MEASURES

- CO/Gas mitigation
- Exterior health and safety measures
- Cooling repaired/replaced
- Ductwork repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Interior home envelope measures
- Air sealing

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 38 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,632	\$97,032	Not modeled	Not modeled		

MEASURES

- Bulk water management
- Heating repaired/replaced
- Cooling repaired/replaced
- Water heater repaired/replaced
- Ductwork repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 39 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$50,946	\$98,346	\$4,703	\$5,707		

MEASURES

- Roof repaired/replaced
- Asbestos mitigation
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Programmable thermostat installed
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 40 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
N/A	\$20,224	\$20,224	Not modeled	Not modeled		

MEASURES

- Bulk water management
- CO/Gas mitigation
- Hot water heater repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Philadelphia Gas Works

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 41 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	\$3,090	\$3,516		

MEASURES

- Roof repaired/replaced
- Solar installed
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Exterior home envelope measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 42 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	\$3,225	\$3,787		

MEASURES

- Roof repaired/replaced
- Solar installed
- Bulk water management
- CO/Gas mitigation
- Heating repaired/replaced
- Ductwork repaired/replaced
- Exterior home envelope measures
- Attached structure repairs
- Interior health and safety
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 43 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$51,122	\$98,522	\$8,712	\$10,138		

MEASURES

- Roof repaired/replaced
- Solar installed
- Bulk water management
- Asbestos mitigation
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Programmable thermostat installed
- Ductwork repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Philadelphia Gas Works
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 44 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,708	\$97,108	\$15,124	\$16,025		

MEASURES

- Solar installed
- Radon mitigation
- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Dehumidifier installed

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Habitat for Humanity Philadelphia
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.

2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.

3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.

4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 45 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,708	\$97,108	\$6,351	\$7,082		

MEASURES

- Radon mitigation
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Hot water heater repaired/replaced
- Exterior home envelope measures
- Attached structure repairs
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 46 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,708	\$97,108	Not modeled	Not modeled		

MEASURES

- Solar installed
- Mold mitigation
- Radon mitigation measures
- Bulk water management
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Insulation installed
- Air sealing
- Electric repairs
- Dehumidifier installed
- Major basement structural repair

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Philadelphia Regional Center for Children's Environmental Health
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 47 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$31,671	\$79,071	\$9,817	\$10,424		

MEASURES

- Roof repaired/replaced
- Bulk water management
- Exterior health and safety measures
- Heating repaired/replaced
- Cooling repaired/replaced
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 48 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$32,084	\$79,484	\$12,464	\$13,208		

MEASURES

- Roof repaired/replaced
- Mold mitigation
- Bulk water management
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Interior health and safety measures
- Interior home envelope measures

PROGRAM PARTNERS

- Built to Last
- Basic Systems Repair Program

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 49 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$49,632	\$97,032	\$7,928	\$9,286		

MEASURES

- Bulk water management
- CO/Gas mitigation
- Exterior health and safety measures
- Hot water heater repaired/replaced
- Programmable thermostat installed
- Exterior home envelope measures
- Interior health and safety measures
- Windows repaired/replaced
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Philadelphia Gas Works

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.
2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.
3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.
4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.

BUILT TO LAST

HOME 50 SUMMARY

Non-Energy Impacts Intangible (\$)	Non-Energy Impacts Tangible (\$)	Non-Energy Impacts Total (\$)	Energy Cost Savings \$	Air Pollution Reduction Benefits (\$)	Total Spent Across All Programs	Estimated Benefit-Cost Ratio
\$47,400	\$52,639	\$100,039	\$9,881	\$9,446		

MEASURES

- Electrification
- Roof repaired/replaced
- Solar installed
- Radon mitigation
- Bulk water management
- Asbestos mitigation
- Heating repaired/replaced
- Cooling repaired/replaced
- Hot water heater repaired/replaced
- Programmable thermostat installed
- Interior health and safety measures
- Interior home envelope measures
- Insulation installed
- Air sealing
- Electric repairs

PROGRAM PARTNERS

- Built to Last
- Weatherization Assistance Program
- Basic Systems Repair Program
- Solarize

1. The intangible NEI category covers quality of life benefits. See the Crime Reduction NEI for more details.

2. Energy cost savings and air pollution reduction benefits could only be assessed for homes that also underwent energy modelling.

3. Air pollution reduction benefits include 1) the social cost of carbon and 2) public health impacts estimated by the US EPA's COBRA tool for reduced emissions resulting from lower energy use.

4. Benefit-Cost Ratio should be considered incomplete for homes where energy savings could not be modelled. As noted in the report section "Participant and Household Benefits," there are also many likely benefits from the program that could not be monetized due to limited data.