



Northeast Envelope Retrofit Market Assessment



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Contents

Executive Summary	2
Introduction	4
Scope and Objective	4
Background.....	4
Research Methods/Approach.....	7
Characterizing the Current Envelope Improvement Market	8
Key Actors in the Northeast Envelope Improvement Market	8
Envelope Improvement Market Data—Measures, Market Volume, Costs, and Savings	12
Envelope Improvement Programs Overview	26
Key Opportunities to Develop the Northeast Envelope Improvement Market.....	34
Maintain and Expand Current Program Infrastructure	35
Foster Workforce Development.....	35
Support Contractor Development	37
Drive Consumer Education and Awareness	41
Implement Program Enhancement Opportunities.....	45
Conclusion.....	49
Appendix A – Resource Lists.....	50
Appendix B – Deep Energy Retrofit Cost-Effectiveness Excerpt.....	53
Appendix C – Estimated Contractor Counts in Program Networks	55
Appendix D – Incentives for Northeast Energy-Efficiency Programs.....	56

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About NEEP

NEEP was founded in 1996 as a non-profit whose mission is to serve the Northeast and Mid-Atlantic to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities. Our vision is that the region’s homes, buildings, and communities are transformed into efficient, affordable and resilient places to live, work, and play.

Disclaimer: NEEP verified the data used for this brief to the best of our ability. This paper reflects the opinion and judgments of the NEEP staff and does not necessarily reflect those of NEEP Board members, NEEP Sponsors, or project participants and funders.

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Executive Summary

Increasing the rate of building envelope improvements for homes in the Northeast holds the potential for significantly reduced energy use and costs to homeowners. The U.S. has had decades of experience in retrofitting building envelopes through various programs. Still, data suggests that most single-family houses in the Northeast region can realize important energy cost savings from improved envelopes. Homes with adequate envelopes are also ideally suited for the installation of high-performance HVAC equipment, and they allow for any new HVAC equipment to be appropriately sized for maximum performance.

Fortunately, the region is home to a broad base of promotional program and market activity. All states offer some form of program to help homeowners adopt envelope improvements, some providing thousands of dollars in incentives for a range of envelope improvement measures.

This report characterizes the current regional envelope retrofit market by examining the key stakeholders and market actors and offers background and perspective on envelope retrofit measures. It then discusses program-specific topics in the Northeast and includes a summary of programs being offered to promote adoption of envelope improvements. The audience for this report is program administrators, policymakers, industry actors, and other key stakeholders in the envelope market.

Regional stakeholders and subject matter experts were interviewed to inform the “Key Opportunities to Develop the Northeast Envelope Market” section. Specific barriers and opportunities are discussed within each topic. Key topics below include a few sample insights:

- **Maintain and expand current program infrastructure.** The envelope market development is not at a stage where incentive or assistance programs should retreat.
 - Maintain consistent long-term funding, as this is the best strategy for contractors and consumers
 - Support existing programs, as they serve as established means of offering services and can trial new strategies
- **Foster workforce development.** Attraction, recruitment, and training are crucial to scaling building envelope improvements as the currently available workforce is insufficient.
 - Begin career visibility for the field in middle school and continue past high school
 - Support internship-style programs connected with contractors, which may provide strong career entry points
- **Support contractor development.** Insights focus on supplemental training and expanding services within the existing contractor bank
 - Require certifications and training
 - Develop home performance contractors from the weatherization contractor base



- **Drive consumer education and awareness.** Enhancing consumer awareness and education is necessary to drive the demand for weatherization improvements, particularly for market-rate households.
 - Leverage under-utilized consumer touch points to drive educational opportunities
 - Consider “Home energy concierge” services to support delivery of envelope retrofits
- **Implement program enhancements.** The report summarizes what programs are doing well and where there are opportunities for refinement or expansion.
 - Combine envelope programs with heat pump incentives to create synergy for programs, contractors, and residents
 - Cultivate trusted and communicative contractor relationships for program success

This discussion of the envelope market is intended to guide the reader’s understanding of the weatherization market in the Northeast and to inform future market development efforts including program strategies, contractor development, and consumer outreach. Regional market actors should collaborate on implementation of these opportunities to achieve maximum market impact.



Introduction

Scope and Objective

NEEP has a long history of leveraging engagement and support of regional actors to advance cost-saving technologies. Recognizing the potential that building envelope measures have for significant energy use reduction and homeowner cost savings in the region, NEEP conducted research to better understand the current envelope market and its most pressing barriers and opportunities. This report focuses on data and stakeholder insights into building envelope improvements for single-family homes. The objectives of this report are to:

- Characterize the current envelope improvement market in the Northeast region by providing available information and data sources.
- Report market actor perspectives on key envelope market development opportunities for the region.

This report aims to inform programs, policymakers, industry actors, and other key stakeholders on the envelope market and program landscape and provide insight into where opportunities lie to advance the rate of envelope improvement measures in the Northeast region.

Background

Existing homes represent a vast opportunity for energy savings through envelope retrofits. Remodeling and retrofit data on cost and effectiveness, outreach, and programs can guide the remodeling and retrofit markets to realize these savings opportunities for homeowners.¹ In the Northeast, space heating and cooling are among the largest energy uses in a typical single-family home.² The U.S. Energy Information Administration (EIA) Residential Energy Consumption Survey (RECS) published household data by region from 2020.³ Space heating and cooling accounted for 57.4 percent (1,124 trillion Btus) of energy used in a typical Northeast household and an average of 45 percent (\$1,014) of a typical household's yearly energy cost.

The cheapest energy is what you don't use in the first place.

A home's thermal performance and heating, ventilation, and air-conditioning (HVAC) equipment are the two primary determinants of energy use. An energy-efficient home with a high performance HVAC system is best situated for lower energy use, lower bills, reduced pollution, and greater comfort and safety. Regardless of HVAC equipment type, envelope improvements alone can increase energy savings and comfort for many homes, often dramatically improving comfort, health, and affordability compared to houses with poor envelopes.

¹ <https://www.nrel.gov/docs/fy15osti/62328.pdf>

² <https://www.eia.gov/consumption/residential/data/2020/#sh>

³ <https://www.eia.gov/consumption/residential/data/2020/index.php>



Beyond reducing a homeowner’s energy burden (i.e., decreasing energy bills), envelope improvement benefits may include:

- Health and safety improvements, including air pollutants and noise reduction
- More stable and comfortable interior
- Less strain on the electric grid during peak loads
- Improved, more resilient building stock
- Reduced environmental impacts due to decreased energy consumption
- Supporting local economies through local jobs
- Preparing and optimizing the home for heat pump installation and other high efficiency electric appliances.

A 2024 study from the Insulation Institute found that 89 percent of U.S. single-family homes can be considered under-insulated and air sealed.⁴ The study used the 2012 International Energy Conservation Code (IECC) as a benchmark for an adequately performing home. This statistic aligns with ENERGY STAR estimates of nine out of 10 homes being under-insulated.⁵

Specific data for Northeast region housing stock is limited, but it is reasonable to infer that a similar percentage of homes in the region lack adequate insulation and air sealing, particularly due to the older housing stock, lack of regularly scheduled upgrades and modifications, and the generally colder climate of the region. The percentage may be slightly lower, though, as the Northeast has longstanding programs that have made small but significant inroads with respect to envelope improvement.

RECS data from the 2020 study also published self-reported household data by region. It includes Northeast census region data that corresponds to the nine most northern states in the NEEP region.⁶ These percentages of self-reported house conditions fall below what ENERGY STAR and the Insulation Institute indicate as under-performing homes, which is not surprising. Self-reported data is open to interpretation and is perhaps best viewed as an indicator of awareness of envelope improvement potential (e.g., “adequately insulated” may indicate an optimistic homeowner assumption of their home’s condition when they have had no assessment).

Nonetheless, it indicates a level of envelope improvement opportunities that the homeowner recognizes. For air leakage in particular (see Table 1), a home recognized as drafty “some of the time” likely means there are significant and addressable air sealing opportunities. At the least, the RECS data indicates there are still roughly 8 million housing units in the Northeast where residents report inadequate conditions. Building performance contractors and home energy assessors routinely visit homes with clear envelope improvement needs that easily meet cost/benefit analyses where the homeowner is unaware that their comfort, costs, health, and safety could

⁴ <https://insulationinstitute.org/wp-content/uploads/2023/02/Under-Insulated-Single-Family-Detached-Homes-in-the-United-States-Final-20241008.pdf>

⁵ https://www.energystar.gov/saveathome/seal_insulate/why-seal-and-insulate

⁶ Includes CT, ME, MA, NH, RI, VT, NJ, NY, PA.



be markedly improved.⁷

Table 1. Condition of envelopes in the Northeast Select data from EIA – RECS 2020.

For all Northeast homes	% respondents	Housing units represented (millions)
Adequacy of insulation		
Well insulated	27%	5.82
Adequately insulated	51%	11.18
Poorly insulated	19%	4.17
Not insulated	3%	0.75
Home is too drafty during winter		
Never	38%	8.34
Some of the time	48%	10.45
Most of the time	9%	2.07
All of the time	5%	1.06

While there remains a significant opportunity to improve envelopes across the region, there is robust infrastructure of programs helping homeowners implement envelope retrofits today.

Energy-efficiency incentive programs, such as those from utilities or states, are increasingly incentivizing envelope improvements either for envelope improvements alone or for envelope improvements paired with high-performance HVAC equipment such as an air source heat pumps. These programs usually have a market-rate incentive, but often also focus on or augment incentives and assistance for LMI residents. For states with robust LMI weatherization opportunities, utility or state programs may focus more on reaching market-rate residents and customers. State and utility programs may work with the Home Performance with ENERGY STAR federal program at different levels of collaboration as well.

Weatherization programs in the region have existed for decades. New York’s EmPower+ program, various state Weatherization Assistance Programs, and other programs typically run by state agencies or utilities operate in every state. These valuable programs consider and implement cost-effective improvements that may address health, safety, and structural concerns in addition to energy efficiency. Most long-standing programs have been heavily or exclusively oriented toward LMI (low- and moderate-income) residents or communities.

⁷ As two examples of many, a household using secondary heating sources may not realize this may be due to inadequate shell insulation, and major air leaks are often in locations the homeowner may have never seen and would be difficult for them to detect (rim joist or attic chases). A distinct general lack of building science knowledge contributes to lack of awareness of improvement opportunities.



The terms “envelope improvements” and “weatherization” are used synonymously in this report. To some, the terms may indicate different levels of improvement and different income-stratified recipients. Some program administrators use “weatherization” to describe programs serving low-income households only and less extensive air sealing and insulation measures. Others use the term to indicate something as simple as minimal air sealing and installing efficient lighting. “Envelope upgrade” sometimes means something more substantial (and more costly), such as adding insulation in wall cavities, continuous exterior insulation, high- efficiency windows, basement treatments, or installing several inches of foamboard under a new roof.

We use both terms to refer to a range of measures or upgrades that improve the energy performance of a home’s exterior structure (“envelope”) but do not entail significant structural modifications or installing energy efficient appliances or lighting. We also use both terms interchangeably for households at various income levels. Both terms include a range of measures concentrating on the envelope of a house. These include but are not limited to adding depth to attic insulation, air sealing the building shell or ductwork, adding insulation to empty wall cavities, band-joint insulation, weather stripping, interior caulking, sealing wall partition caps, replacing underperforming windows or doors, or adding a secondary interior or exterior glazing to an existing window.

Appliances and HVAC upgrades are not considered envelope measures and, therefore, not directly included in this report, though there is discussion of the interaction of heat pump efforts and weatherization efforts. The term “single-family home “ in this report refers to detached residential buildings, with one to four units, or townhouses with shared walls. It does not include larger multifamily buildings.

Research Methods/Approach

Secondary research included data gathering from online sources of available program data, research, and digital source analysis. After conducting secondary research, we interviewed regional stakeholders and subject matter experts to gain insights into current practices and emerging trends. Interview discussions and attributions were kept anonymous to encourage open conversation. The types of organizations interviewees represented are noted in Table 2.

Table 2. Stakeholder interviewee list.

Interviewee Organization Type	# Interviewed
Contractor or contractor trade organization	8
State and utility representatives or program implementers	10
Energy efficiency advocacy organizations	4



Characterizing the Current Envelope Improvement Market

This section discusses key actors and stakeholders in envelope retrofits in the Northeast. It then discusses the available envelope market data, some basic program elements such as modeling, assistance programs, contractor standards and best practices, and lastly a summary of programs with weatherization elements.

Key Actors in the Northeast Envelope Improvement Market

Below are key residential envelope improvement/weatherization market actors for the Northeast. These actors have tremendous influence over the current and future market for envelope improvements. Most of these actors interact with one another, creating a web of interrelationships.

Manufacturers

Hundreds of national and internationally based manufacturers contribute to materials used for envelope work. The diverse range of products includes insulation, spray foam, insulated boards, siding, windows, doors, plastic sheeting, caulks, and specialized installation and testing equipment. In addition, this field of work routinely uses a wide range of typical construction equipment and materials. Manufacturers most closely related to weatherization often have some products available at home improvement stores (“big-box”), as well as building supply stores that focus on specific construction supplies. Most manufacturers can ship directly to a contractor or distributor outlet for larger bulk purchases. Because of the number and variety of manufacturers, representative associations are often the most effective way to understand the perspectives of not only manufacturers, but distributors and contractors. Loose-fill insulation and spray foam are among the most common products associated primarily with retrofit envelope improvements.

Examples of manufacturer associations: NAIMA (North American Insulation Manufacturers Association), CIMA (Cellulose Insulation Manufacturers Association), Spray Foam Manufacturers Association (SFMA), WDMA (Window & Door Manufacturers Association)

Distributors

Distributors sell manufactured products in the wholesale marketplace. There are hundreds of distributor locations throughout the Northeast. Contractors can access products through distributors as needed and often use distributors for advice, with distributors serving as liaisons between manufacturers and contractors.

Distributors are often a trusted source of information for contractors. Distributors may also provide contractors credit for purchases. They coordinate with manufacturers on marketing and information to best position their sales. They may also sometimes sell envelope improvement materials to builders and larger retail stores.

Distributor locations often serve as meeting locations for training, promotional programs, and meet-up sites for those involved with other aspects of construction or retrofits (contractors, architects, owners, engineers, and those involved with codes and performance).



Examples of regional distributors (among many): Service Partners, General insulation Company – Northeast Specialty, Kamco Boston, Builders FirstSource, Therm-All, Building Material Distributors, Henry Company

Retailers

Retailers (consumer big-box stores, hardware stores, and building supply stores with retail components) sell most products associated with envelope upgrades. Items like high-pressure spray foam, specialized insulated panels, and specialized installation equipment are usually not found at those locations. They are purchased through a distributor or, more often, the manufacturer. Larger envelope improvement contractors usually work with distributors or manufacturers as needed to supply their crews but will usually use retailers for the wide variety of extra items as needed. Smaller-sized envelope improvement companies may be able to work directly with manufacturers and distributors for materials but may often purchase “as needed” supplies from retailers. Nearly everyone else (homeowners, renters, landlords, maintenance workers, any “DIY,” general repair technicians, or contractors in related fields) are likely to use a retail store for products.

Contractors

An expanded, robust, and qualified set of home energy/envelope improvement contractors is essential for drastically increasing the rate of effective home envelope retrofits. In most cases, envelope improvement or home performance contractors represent the “front line” of the business from a consumer standpoint. Thousands of contractors in the Northeast region work on aspects of residential envelope improvements. They typically operate at a state or substate level. Training and capacity vary widely. Outside of incentive programs and some situation-dependent construction/retrofit or local regulation criteria, no specialized certification or training is currently necessary for envelope retrofit work.^{8,9} However, Building Professional Institute (BPI) has envelope-related certifications that are often mentioned as a standard for basic contractor knowledge. In many cases, contractors must have BPI certification holders within their company to participate in incentive programs. There is more discussion under “contractor development” later in the report.

An expanded, robust, and qualified set of home energy/envelope improvement contractors is essential for increasing home envelope retrofits.

Contractor groups include:

- **Weatherization/envelope improvement businesses**, which are focused on insulation and air sealing. Oftentimes, a company specializes in a certain type of insulation (e.g., spray foam), and they may tend to recommend that measure over viable alternatives.
- **Building performance contractors**, which typically include some level of HVAC, electrical, plumbing, or construction with projects and provide a more comprehensive overview of the building and its use.

⁸ Lead training is required by the EPA for any extensive work on houses built before 1978.

⁹ Spray foam applications are unique in that they involve large amounts of potentially hazardous materials. Spray foam applicators may have some certifications, such as SPFA (<https://www.sprayfoam.org/pcp/>), but many do not.



- **Home energy auditors/assessors**, who initially investigate a home and discuss needs and strategies with the homeowner/client. They may either be independent, associated with a company that performs envelope improvements, or hired by program implementers.
- **Associated trades**, which include any additional building development or performance trades, such as engineers, architects, plumbers, electricians, construction, or window sales and installation. In particular, **HVAC contractors** are often in positions to recommend (or install) envelope measures.

Within the envelope retrofit field, some occupational distinctions are useful: A **building performance specialist**, **home energy assessor**, or **auditor** is a professional who focuses on optimizing the energy efficiency, comfort, safety, and overall performance of a building. They assess a building's insulation, air sealing, HVAC systems, ventilation, and moisture control to ensure optimal energy usage and occupant comfort. They may also consider code compliance, certifications, and renewable energy integration. A **weatherization specialist** or **envelope improvement specialist** is a professional who helps improve the energy efficiency and comfort of buildings by installing insulation, air sealing, and other weatherization measures. Their goal is to reduce energy waste, lower utility costs, and improve indoor comfort, particularly for low-income households or energy-efficiency programs. They are particularly trained in installation techniques. However, their job may not include the comprehensive view that the building performance specialist considers. There are other positions and categories within envelope improvement, but generally the envelope retrofit field involves these two groups. Both groups benefit from understanding the other's perspective, difficulties, and concerns. And in many cases, a person may incorporate both elements during any given job. (For example, a weatherization crew chief needs to understand blower-door guided air sealing techniques and science very well to perform their job best, and the auditor needs to understand the practical capabilities of a crew, such as the difficulty of addressing hard-to-reach sections of a house.)

Customer/Consumer

The key market actors here are mainly homeowners (or residents, renters, or landlords) considering or acting on plans to improve their home envelope. Awareness, interest, and practical financial management are all necessary for this critical stakeholder group to make smart decisions that lead to much wider regional adoption of envelope improvement opportunities. Homeowners/residents may be particularly open to considering envelope improvements at certain times, such as during particularly cold or hot spells of weather (comfort issues), during or shortly after purchasing a home, during remodels/renovations, when concerned about utility or heating costs, and potentially during an assessment of their HVAC system. Various outreach efforts can be used to educate and persuade residents to consider upgrades: through utilities, contractors, retailers, or wider education programs (from state-wide programs to more local grassroots, non-profit venues). Consumers also play an important role in educating friends and family by sharing thoughts and experiences.

Unlike other home energy components such as HVAC, homeowners/consumers frequently attempt to install basic envelope upgrades themselves with vastly different rates of success. These intended improvements may be practically ineffective or even exacerbate problems, though the homeowner may perceive the issue as resolved. In addition, many homeowners lack knowledge relating to their home's construction and of the beneficial effects of envelope improvement measures.



National/State/Local Policymakers

Energy and environmental agencies at the national level and state level (e.g., New York State Energy Research and Development Agency (NYSERDA)) set policies and have programs that encourage the adoption of energy-efficient building systems. The long-standing Weatherization Assistance Program (WAP) is an example of a national program.

Many states also have their own long-standing energy-efficiency incentive programs to support adopting certain measures, including envelope improvements. Overall, these programs are considered key funding sources to assist consumers in adopting effective envelope improvements.

Local and state building energy stretch codes and efficiency standards can also encourage envelope retrofits. Local policies in some municipalities opt to set higher standards or incentives than the state would otherwise require and serve as examples of forward-thinking governance. Likewise, a state can enact codes that enable or require retrofit opportunities. Code departments represent an excellent opportunity to educate, improve a design, and point the homeowner toward available assistance, particularly for homeowners preparing major remodels such as gut rehabilitations.

Envelope Improvement Influencing Organizations

Many nationally influential organizations provide thought leadership and data on home performance. Many Northeast professionals coordinate with these organizations to develop and disseminate techniques and standards.

Examples of national-scope organizations: BPI (Building Professional Institute), BPA (Building Performance Association), NREL (National Renewable Energy Laboratory), ORNL (Oak Ridge National Laboratory), CEE (Consortium for Energy Efficiency), MNCEE (Minnesota Center for Energy and Environment), Building Energy US, REEOs (Regional Energy Efficiency Organizations) including NEEP (Northeast Energy Efficiency Partnerships)

Examples of regional training and trade representative organizations: NETO, Inc. (Northeast Employment and Training Organization), NYSWDA (New York State Weatherization Directors Association)

State/Regional Organizations and EEU (Energy Efficiency Utilities)

Ratepayer funded energy-efficiency (EE) programs exist in every state in the Northeast. These programs promote adopting energy-efficient products and practices in homes, buildings, and industries. Programs often achieve this through financial incentives, marketing, and education. In the Northeast, programs are typically administered by electric and gas utility companies (i.e., ConEd, Eversource, etc.), while some states look to quasi-governmental agencies for administration (i.e., Efficiency Vermont, Efficiency Maine). Programs and their administrators are critical players in supporting the adoption of energy-efficient and cost-effective measures for retrofit envelope improvements.



Examples of statewide EEUS and EE organizations: Efficiency Maine, MaineHousing, NYSERDA (Comfort Homes and EmPower+ programs), Efficiency Vermont, Mass Save, CT-DEEP, WAP/CAP agencies per state, Home Performance with ENERGY STAR (HPwES, administered at state or substate level)

Consultants and Program Implementers

These organizations with wide capacity are often tasked with assisting state or utility programs to operate effectively and address knowledge gaps. They often work in several states and may include analysis and research on weatherization/envelope improvements.

Examples include: TRC, VEIC, Steven Winter Associates, PSD, ICF, ABCD (for MassSave)

Community-Based Organizations (CBOs)

CBOs are typically non-profit organizations with missions to assist a population or area, often including outreach to marginalized populations. They carry a strong directive to serve the population and assist with capacity-building. CBOs are emerging as a force to address and promote envelope retrofit benefits, specifically through advocacy and outreach and even initial assessments or minor installations. Many assist a homeowner through an often-daunting envelope improvement process. CBOs may receive assistance from larger programs with similar goals.

CBO examples: Mid-Hudson Energy Transition (MHET), York Ready for Climate Action, Regional Clean Energy Hubs (NY), Vermont Works for Women, VT Sustainable Jobs Fund, Advance Vermont

Envelope Improvement Market Data—Measures, Market Volume, Costs, and Savings

This section discusses numbers and types of envelope retrofits being conducted along with cost estimates and potential savings of typical measures. The types of retrofits covered include whole home, attic/roof insulation, wall insulation, windows, air sealing and pre-weatherization.

The Challenge of Envelope Improvement Market Data

Estimating actual numbers of market-rate and supplemented single-family envelope retrofits is challenging. No reliable national or Northeast regional collection of program data was found for the number of houses that have received general envelope upgrades or specific envelope measures. Subsidized and incentive program numbers do not cover the breadth of market-rate upgrades that are happening. Those programs that do report improvements report data according to their unique business interests (e.g., total energy saved or cost reduction for clients) or using inconsistent data formats. These data are often varied and not granular enough to obtain usable cost data per measure.

Part of the difficulty is that the cost of a specific measure may vary greatly from house to house, depending on the age, structural condition, and materials present in the building. For example, a measure such as wall insulation may be straightforward, relatively inexpensive, and easily pass a chosen cost/benefit assessment.



Alternatively, it may be nearly impossible to justify given the high price of addressing structural limitations, potential asbestos, difficult access, or mold. Often, these varied costs per measure are simply subsumed into the total price for a given retrofit job. Finding a “typical” cost and benefit for the Northeast region is difficult, particularly given the large percentage of older, varied houses that have undergone additions and renovations.

None of the interviewees for this report had firm sources of information on the total numbers of retrofitted homes or measure-specific information for the Northeast states.

Recommendation: Assemble a representative sample of envelope improvement contractors from the region who work on market-rate projects to identify typical costs (per house and selected measures) and estimated projects per year. This can provide estimated and extrapolated numbers of houses addressed. Cost ranges may be possible for general house type and square footage as well. Contractors should include both envelope specialists and building performance contractors. General contractors and associated trades could also be surveyed to understand their knowledge of and involvement with energy-efficiency upgrades.

Several sources offer general guidance and analysis on retrofits appropriate to the Northeast climate. Please refer to “Resources for retrofit guidance and analysis” in Appendix A for a list with short explanations and web links.

Whole Home Envelop Improvement Market Data

Numbers of homes

We were unable to identify a regional total of weatherization/envelope improvement efforts. As mentioned in the background section, a reasonable estimate is that roughly 90 percent of regional homes can benefit from some level of additional air sealing and insulation. With a rough estimate of over 13 million single-family homes in the Northeast, a conservative estimate is that at least 10 million homes in the region (77 percent) could benefit from basic envelope improvements.

It is also difficult to count “weatherized” homes data from various state and federal programs, as these programs do not offer opportunities for “apples to apples” comparisons, and some homes may be counted as weatherized with minimal envelope treatments. It is difficult to quantify which homes have been adequately addressed without significantly more extensive analysis of the assessments performed and measures installed. That said, some WAP housing data totals are presented in the section below.

Housing stock data

Northeast estimates of year of construction can offer a sense of envelope improvement opportunity.¹⁰ Of the Northeast homes, 75 percent are single-family, mobile homes, or up to four-unit apartments. Of all Northeast homes, 46 percent were built before 1960, and 70 percent were built before 1980. Common knowledge is that few of these older houses have received significant envelope improvements, and often

¹⁰ RECS data HC 2.7 <https://www.eia.gov/consumption/residential/data/2020/index.php?view=characteristics#structural>



what has been done is inadequate.¹¹ If we consider houses built after the IBC 2002 building construction codes to be “reasonably weatherized” (a standard which we have improved upon since then), that still leaves 88 percent of Northeast homes built before 2000 and needing significant envelope retrofits. Some more recently constructed homes also fail to meet envelope standards regardless of the relevant building code in effect due to poor construction and inadequate oversight. All told, the RECS data indicates that the Insulation Institute and ENERGY STAR studies mentioned in the introduction seem reasonable: Roughly nine out of 10 houses could benefit from an upgrade. Indications from New York’s baseline study are that perhaps 5 percent of homes have received some form of weatherization measures through a program. If market-rate homeowners adopted quality envelope improvements at a similar rate, an estimated 70 to 80 percent of houses in the Northeast could benefit.

Residential baseline studies can highlight the number of houses needing envelope improvements. NYSERDA conducted a wide-ranging and thorough Residential Statewide Baseline Study that included a single-family focus.¹² New York housing stock may be considered a proxy for the region as houses are roughly of similar vintage and climate to much of the Northeast. Although this study is several years old (2015), there is no indication that rough percentages would have changed drastically. (NYSERDA indicated they may be conducting another similar baseline assessment soon.) Findings from the 2015 study included:

- Existing homes have considerable opportunities for improving the quality of the insulation compared to new homes.
- About 42 percent of all homes have no foundation insulation (e.g., basement or crawlspace walls).
- Almost 7 percent of all homes have no wall insulation.
- Door weatherstripping was lacking or poor for one out of five doors in existing homes.
- Close to 25 percent of single-family homes are 75 years old or older (indicating a higher likelihood of weatherization opportunities).
- Roughly 25 percent of gas or fuel oil systems are over 20 years old. Weatherization can optimize these homes to be ready to install right-sized and energy-efficient HVAC systems.
- Roughly 5 percent of single-family homes received insulation and/or weatherization measures through a program. The primary reason cited for lack of participation in such programs was lack of awareness (~50 percent).

Baseline studies from Maine and New Hampshire indicated that, in general, the further north a house is situated the better the quality and level of levels and windows. This might be expected given that these areas face correspondingly colder winters. Appendix A lists several other baseline studies with more limited data from the Northeast region under “Northeast Region Residential Baseline Studies.”

¹¹ A classic example would be an older house that did not have any initial attic insulation and subsequently received an installation of several inches of vermiculite or now-degraded fiberglass with no air sealing treatments. This house would have been considered “weatherized” for the time in a way that we now understand is wholly inadequate.

¹² <https://www.nyserdera.ny.gov/-/media/Project/Nyserda/Files/Publications/building-stock-potential-studies/residential-baseline-study/Vol-1-Single-Family-Res-Baseline.pdf>



Savings for whole home retrofits

On average, homes in the Northeast that pursue weatherization may save between **12 percent and 30 percent** on their energy usage. Relevant studies and data include:

- A Home Performance with ENERGY STAR program study in New Jersey estimated a **30 percent** energy reduction for most retrofitted homes.¹³
- For Northeast U.S. climate zones, an ENERGY STAR study estimated annual energy bills could decrease between **12 percent and 20 percent** with adequate air sealing and insulation.¹⁴
- An ACCA study estimated **30 percent** of total energy loss from inadequate envelopes is due to air sealing deficiencies.¹⁵
- Weatherization Assistance Programs, on average, reduce energy costs by **18 percent** and reduce electrical consumption by 7 percent, and provide additional benefits for recipients.¹⁶

A nationwide study by ACEEE showed that moderate home envelope improvements can decrease the lifetime cost of operating a heat pump by \$3,000 to \$11,000. Deeper improvements (including advanced insulation and new windows) offered savings of \$8,000 to \$22,000 over the lifetime of new heat pump equipment.¹⁷ The annual savings from such improvements typically range between \$150 and \$1,200 per household, averaging \$500-\$800 annually. For the Northeast region, with typically higher energy and heating costs, one could anticipate that average savings would be on the higher end of these numbers.

The ACEEE study indicated that, nationwide, modest weatherization measures (air sealing, attic insulation upgrade) reliably reduce energy use by **12 percent to 18 percent**, though a typical retrofitted house will still fall short of newer code levels. Deeper building retrofits (addressing walls, basements, rim joists, and better windows) could lower energy use between **11 percent and 47 percent**, averaging **33 percent** nationally. For Northeast states with colder weather than much of the nation and older vintage homes, an average house would likely save more heating energy from retrofits than reflected in these national averages.

Maine's baseline assessment estimated that 34 percent of a typical home's energy loss is due to air leaks.¹⁸ This is similar to other estimates. Envelope improvements in electrified buildings can reduce peak electric loads 7 to 10 percent for residences.

Housing stock is extremely varied, though construction has tended to improve over the past several decades since the 1980s. In the Northeast, houses built to today's standards should have adequately air-sealed and insulated envelopes, and more recent housing stock should need few to no major energy-efficiency improvements on the envelope.

¹³ <https://www.nrel.gov/docs/fy15osti/62328.pdf>

¹⁴ https://www.energystar.gov/saveathome/seal_insulate/methodology

¹⁵ <https://accaathome.com/insulation-options-for-northeast-homes>

¹⁶ https://www.energy.gov/sites/prod/files/2021/01/f82/WAP-fact-sheet_2021_0

¹⁷ <https://www.aceee.org/blog-post/2023/06/weatherization-key-effective-low-cost-building-electrification>

¹⁸ <https://www.efficiencymaine.com/docs/2015-Maine-Residential-Baseline-Study-Report-NMR.pdf>



PNNL offered an analysis of deep energy retrofits from 2015 through a synopsis of Less & Walker (2015) *LBNL-184443*.¹⁹ “Deep energy retrofits” (DERs) are retrofits, but they involve thorough improvement measures to an extent beyond which many programs and homeowners would typically think of going. The study mentions that deep energy retrofit measures, when incrementally added to other remodeling activities, can equal or exceed annual loan costs (i.e., neutral net-monthly costs). As may be expected, the most cost-effective projects were for homes in generally poor condition, with little to no insulation and low-efficiency equipment throughout, high energy bills, and where the owners chose not to pursue extremely expensive retrofits.

Appendix B is an excerpted list from the report on what works well and what problems to look out for to ensure cost-effective DERs. These points apply to any current consideration of retrofits, including presenting clear cost/benefit analyses for homeowners to understand net- neutral costs. (See Table 3 for the 2015 example.) This kind of assessment, applied to today’s financial landscape, is a helpful guide to assess personal and programmatic decisions on envelope improvements.²⁰

Table 3. Cost savings from retrofits necessary for neutral net costs
Less & Walker (2015) *LBNL-184443*

Interest Rate	Energy Upgrade Costs (\$)					
	\$5,000	\$10,000	\$15,000	\$20,000	\$50,000	\$100,000
Required Annual Savings for Neutral Net-Costs						
3.0%	\$204	\$408	\$612	\$817	\$2,041	\$4,083
3.5%	\$221	\$442	\$663	\$884	\$2,211	\$4,421
4.0%	\$239	\$477	\$716	\$954	\$2,386	\$4,771
4.5%	\$257	\$513	\$770	\$1,026	\$2,566	\$5,132
5.0%	\$275	\$550	\$826	\$1,101	\$2,752	\$5,503

Table 1 Quick guide to determining the necessary energy cost savings for a cost-neutral retrofit, for a variety of project costs and interest rates. This table assumes a 30-year loan term, no down payment and a 25% mortgage interest deduction.

There *may* be *economies of scale* in broadly prescribing envelope upgrades where multiple houses have very similar construction. For example, a housing development or several related housing developments may have dozens to hundreds of homes of a certain model or set of models (manufactured or stick-built). If these homes show clear energy savings opportunities for specific measures, good weatherization contractors should be able to more efficiently and quickly enact a similar work plan for each house with few variations.

Costs for whole home retrofits

To estimate costs, we considered typical weatherization program costs per house and incorporated insights from the stakeholders we interviewed. Straightforward envelope improvements can be expensive, ranging from a few thousand dollars to over \$20,000.

Recommendation: For “per measure” cost estimates, several regional weatherization agencies and other similar agencies around the country have pre-negotiated contractor prices, usually updated yearly. These price estimates could be used to inform incentive programs for anticipated costs for average homes and provide a

¹⁹ https://basc.pnnl.gov/sites/default/files/resource/DERs_CostEffectiveness.pdf

²⁰ Another resource (NREL, 2023) for NYSERDA discusses creating financial products to enable deep energy retrofits with multifamily buildings: <https://www.nrel.gov/docs/fy24osti/84912.pdf>.



basis for comparison for market-rate incentives. They include most of the basic elements of typical envelope upgrades for a house, such as cost per window replacement or storm window, insulation per square foot per R-value, pipe wrap, air sealing, ventilation fans, etc.

State WAP reports include **average program operations costs per house** for weatherization (meaning overall total costs, not just materials and labor). These amounts are reasonable indicators of what a basic market-rate retrofit may cost. However, market-rate costs may often be higher due to particularly difficult measures or decisions to include additional services that WAP programs would not cover. A typical range is \$6,000 to \$12,000 per house for a comprehensive weatherization treatment (Table 4).

Table 4. Comparative costs of envelope measures addressing whole home weatherization: WAP examples

State	Cost per unit	Approx Year	Source
CT	\$8,468	2022-2023	https://nascsp.org/wp-content/uploads/2024/11/CT.pdf
MA	\$6,972	2022-2023	https://www.mass.gov/doc/fy2023-draft-wap-annual-file-worksheet/download
MD	\$6,006	2023	https://nascsp.org/wp-content/uploads/2023/09/Maryland_EE0009907.pdf
ME	\$7,970	2024	https://www.mainehousing.org/docs/default-source/ehs-partners-library/maine-weatherization-programs/manuals-brochures/wap/doe-py2024-state-plan.pdf
NY	\$8,009	2023	https://nascsp.org/wp-content/uploads/2024/01/NY_EE0010004.pdf
PA	\$8,243	2023	https://nascsp.org/wp-content/uploads/2023/09/Pennsylvania_EE0009927.pdf
VT	\$11,869	2023	https://legislature.vermont.gov/assets/Legislative-Reports/Annual-Weatherization-Leg-Report-Jan-2024.pdf
WV	\$8,245	2024-2025	https://wvcad.org/assets/files/weatherization/WV-WAP-State-Plan-PY24-25.pdf

Interview insights

- Tendency to limit comprehensive weatherization

Outside of the Northeast, some programs are limiting the weatherization measures they offer because some measures do not meet cost-effectiveness criteria or the cost-effectiveness may be too difficult to quantify. In these cases, the envelope measures offered are typically attic insulation and air sealing, as they are often the easiest to quantify and usually have the highest cost/benefit ratio. For these programs, heat pumps for space heating/cooling and heat pump water heaters are receiving more attention. This may be because programs consider heat pump HVAC and hot water units to be more quantifiable, discrete measures; incentives for them are easier to administer; and this equipment has a more clearly defined scope of specific replacements with defined advantages over what they are replacing. If Northeast region programs are under similar stress to reduce weatherization measures, more targeted program development and careful analysis of costs and benefits may help energy-efficiency programs make a stronger case for bolstering weatherization components.

- Average costs are difficult to apply to specific houses



Contractors all iterated that it is difficult to extrapolate an estimate for a “typical” whole home envelope improvement to the needs of any particular house. If a typical whole home treatment costs \$8,000-\$10,000 for example, there is a wider range of possible costs for any given house, usually toward the direction of higher cost. For example, a house may need only some touch-up and air sealing (for about \$1,000) or it may need walls, attic, and basement treatments that, along with access issues and carpentry, could run more than \$30,000.

These figures do not include potential electrical, plumbing, windows, or other costs homeowners might incur in conjunction. There is an average cost, but values fluctuate around the mean.

As with all envelope measures, there are different costs associated with materials, labor, and overhead. Rates in the Northeast could be as much as double that of another region for essentially the same measure depending on contractor availability, material availability, competitive wages, location, and other factors.

Attic/Roof Insulation

An attic with little or no existing insulation often presents the **best opportunity** for weatherization (and air sealing). Home energy models for typical housing stock show that attic air sealing and insulation (and open rim joists²¹) are generally considered priority areas with the largest energy cost/benefit for Northeast homes. One study from MNCEE on cold climate homes showed that 80 percent of houses built before 1990 needed additional attic insulation.²² Attics are often relatively easily accessible and represent a large surface area for straightforward insulation and air sealing improvement that address a large portion of the house’s exterior envelope. Although attics and rim joists are often high on the list, each house normally still needs to be assessed individually.

Contractors primarily use blown cellulose for attic retrofits, with fiberglass (blown and batts) used second most commonly. **Most retrofits use cellulose loose-fill** for attics and for dense-packed walls as well. An estimated 20 percent of fiberglass insulation sales are used in retrofits as loose-fill or as batts.

Numbers of attic/roof improvements available

The 2023 Massachusetts residential baseline study showed that approximately 17 percent of the households indicated that they had upgraded or installed new attic insulation within the past five years, and approximately 9 percent had installed wall insulation (Figure 1).²³ Massachusetts residents are generally earlier adopters of these measures than residents of other Northeast states due to the state’s robust weatherization programs and slightly wealthier population. If 9-17 percent of households have undertaken relatively recent envelope improvements, this overall rate of retrofits may be considerably higher for Massachusetts than other Northeast

²¹ Rim joists are often leaky with no insulation and, like attics, are relatively accessible sections of the house’s envelope.

²² [It’s All About the Envelope: Prioritizing Envelope Upgrades for Electrification of Cold Climate Homes](#)

²³ *Massachusetts* (2023): <https://ma-eeac.org/wp-content/uploads/Residential-Building-Use-and-Equipment-Characterization-Study-Comprehensive-Report-2023-12-22.pdf> (Section 3.8 contain envelope data.)



states with considerably more active homeowner involvement.²⁴ However, even if the rate of adoption of these measures is higher in Massachusetts than elsewhere in the Northeast, there is little guarantee that these more widespread insulation installations were done well enough to adequately address air sealing opportunities. Although a homeowner may claim to have installed insulation, the extent, quality, and effectiveness of the installation remain uncertain.

Baseline study attic improvement data

New Hampshire conducted a baseline study in 2020 involving web-based responses.²⁵ They found homeowners undertook attic “intervention” (improvement of some kind) at a higher rate than any other type of insulation improvement. This result is understandable, as attic insulation measures are relatively inexpensive and can feasibly be a “do-it-yourself” project. Researchers noted that homes in this region had three-to-four times more additional insulation than those in a recent Midwest study and that more northerly climate residents had been more judicious with recent efforts to insulate the building shell.

Maine’s baseline study indicated an average attic has roughly half the insulation that the most recent code specifies (R-29 versus R-49), and 20 percent of the homes were considered “least efficient” with average attic insulation of R-19.²⁶ Most of the houses studied did not have nearly the required insulation levels according to recent code, but insulation could be relatively easily added for most of these situations.

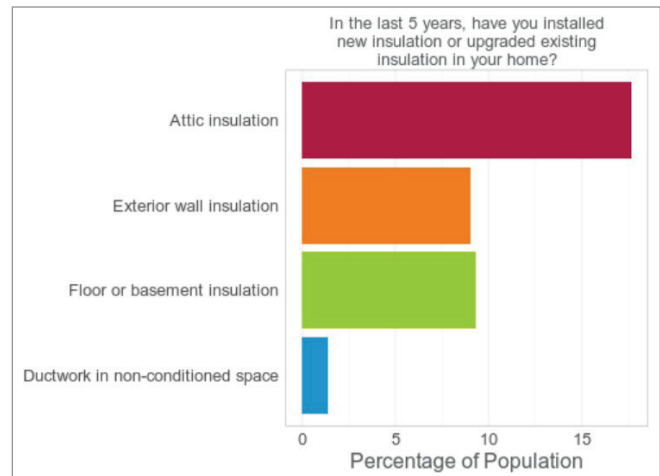
Vermont’s baseline study indicated that attic flat-ceiling R-values had remained around R-32 average for the previous six years and there are still relatively easy and economical opportunities for retrofits.²⁷

Attic insulation and air sealing together

Addressing concurrent attic air sealing opportunities should be a part of any attic upgrade, as the opportunity is otherwise effectively lost. Professional envelope improvement contractors assess air sealing opportunities and include addressing them with insulation improvements, as is proper. Attic air sealing costs vary greatly depending on the level of need. If it needs any attic air sealing, a well-constructed home may require \$200

Figure 1. Massachusetts insulation installs within past 5 years

<https://ma-eeac.org/wp-content/uploads/Residential-Building-Use-and-Equipment-Characterization-Study-Comprehensive-Report-2023-12-22.pdf>



²⁴ The New York baseline study indicated that 7 percent of houses had no wall insulation, and in Massachusetts, 9 percent mentioned they have added exterior wall insulation. If over half of Northeast houses can benefit from additional attic insulation (70 percent of all homes are built before 1980, and 80 percent of these with inadequate attic insulation = 56 percent), Massachusetts has potentially improved 17 percent of all MA houses, and so may potentially be as low as 40 percent of attics that are under-insulated.

²⁵ <https://www.energy.nh.gov/sites/g/files/ehbemt551/files/inline-documents/sonh/18-nh-residential-baseline-study.pdf>

²⁶ <https://www.energymaine.com/docs/2015-Maine-Residential-Baseline-Study-Report-NMR.pdf>

²⁷ https://publicservice.vermont.gov/sites/dps/files/documents/VT_2020_SF_EX_Baseline_Final_Report_Jan242023.pdf



or less of materials and labor for minor measures such as caulking seams, sealing electrical and lighting bypasses, or improving a hatch. For more extensive homes, air sealing alone could cost thousands of dollars to address open top plates, major bypasses, access points, and more. Some of the cost calculation for attic upgrades includes the manner in which attic air sealing is done. Different materials, with different costs and labor needs, may produce a similar result.²⁸ Good air sealing at the thermal plane is good building science and is essential for ideal results. Unfortunately, it is often not done adequately. Programs should provide quality control, and contractors should be able to offer pictures and blower-door reduction numbers to verify effective efforts.

Air seal the attic air when insulating or the opportunity is effectively lost.

Savings associated with attic/roof improvements

Attics often represent the *best cost/benefit retrofit opportunity* in a house. As with overall home energy models, modeled savings of attic insulation for a specific scenario can be calculated relatively accurately with modeling software using square footage and R-values. Generally, full attic improvements may offer 10-40 percent energy reductions depending on a host of factors such as condition of the rest of the house, quantity and quality of existing insulation if any, and coincident air sealing. The variety of circumstances encountered in homes and attics again points to the need for quality assessors and installers who can efficiently locate and fix issues during an attic retrofit.

Costs for attic/roof improvements

Attic insulation installation costs typically range between \$1,500 and \$4,500. Extra costs are associated with adding soffits or other ventilation, complicated structures such as knee walls, raised ceilings, or raising the thermal envelope to the roof deck. Simple, accessible attics may typically cost \$2,500 on average. Small attics may cost \$500 to insulate and air seal, whereas larger complicated attics may cost much more, especially if more expensive insulation materials and techniques are used.²⁹

Costs may also increase with less standard but still reasonable approaches to attic air sealing and insulation. Typically, air sealing and insulation happens on the attic floor/ceiling plane. For some houses, it makes good sense to alter this basic proposal. For houses with extensive attic air leaks, difficult framing, large HVAC equipment and ducts in the attic, or households with limited storage where they need the attic space, it can be practical to move the insulation and air sealing plane to under the roof. This is sometimes more expensive, especially when properly installing spray foam, but the ancillary benefits can outweigh the price discrepancy.³⁰ Air sealing is much more complete, ducts are now in conditioned space, and household storage is now in a tempered environment. Similarly, on a smaller scale, some households desire or require that some amount of

²⁸ As an attic example, some contractors endorse removing older insulation, spray foaming areas of concern, then reinstalling new blown insulation. For the same house, another contractor may endorse keeping some or all of the existing insulation, air sealing as necessary with caulk or one-part foam, then adding new insulation to reach desired R-values. Both such techniques can have good results through a good contractor.

²⁹ Very little reliable information is available via the web. These estimates were from informal discussions with building performance contractors.

³⁰ Closed cell against the roof deck to appropriate depths is important to prevent moisture issues. Exposed spray foam or some foam boards may need additional safeguards such as intumescent paint or drywall. These all add costs.



“platform” be created in the attic for storage or access to windows, HVAC, plumbing, etc. These platforms are often an additional cost.

Spray foam in attics

Few energy-efficiency programs are authorized to extensively use spray foam at this point.³¹ There are a few reasons for this. There are concerns about the health and safety of spray foam for installers and occupants. Spray foam applications often require the residents and pets to evacuate the house for a time. Spray foam can have a considerable carbon footprint compared to other options. The cost of materials can be substantial enough that more customary measures are still considered less expensive overall. Spray foam (particularly high-pressure two-part) often requires specialized equipment and additional contractors whereas in-house or existing weatherization installers can install measures that perform the same functions.

Despite these considerations, several interviewees mentioned that adding spray foam as an eligible measure could increase efficiency and effectiveness for some applications such as appropriate attic duct sealing, attic air sealing, and attic encapsulating measures. Likewise, encapsulating some crawlspaces/basements and sealing rim joists with two-part spray foam is now standard practice for many market-rate envelope improvement companies. Expanding their experience more widely to energy-efficiency programs would provide another “tool in the toolkit” to increase overall program efficiency. Use of spray foam for **attics and ducts** in particular has been considered for over a decade, as seen in this 2013 report through EERE.³² Homeowners may benefit from renewed consideration of spray foam for cost-effectiveness in attic spaces.

A concern regarding spray foam is the potential for moisture problems, particularly for attics, ducts, and rim joists. Open-cell spray foam is more vapor-permeable than closed-cell spray foam. Open-cell spray foam is also considerably less expensive than closed-cell. There is debate that (1) open-cell spray foam is sometimes overused in situations where it may lead to moisture issues, and (2) excessive use of closed-cell spray foam is unnecessarily driving up costs. There are established best practice installation guidelines for moisture management, but many spray foam installers do not follow these guidelines. As well, the guidelines may be revisited with newer data and modified techniques and safer or different products. In short, spray foam techniques, products, and guidelines are new enough to expect changes in assessing performance and cost.

Air Sealing

For a given house, air sealing occurs primarily in the attic as discussed above, but air sealing may also involve sealing rim joists, addressing air leaks in basements, caulking around windows and doors, addressing exterior wall issues, and a host of other techniques and strategies that require a level of expertise to locate and fix appropriately. Air sealing cost estimates for a single-family home vary widely depending on the work required, from \$600 to \$6,000.

³¹ This is primarily referencing high-pressure two-part spray foam applications that require extensive equipment, hoses, and a vehicle, and less so the smaller two-part low-pressure “kits.”

³² <https://www.energy.gov/eere/buildings/articles/buried-and-encapsulated-ducts-building-america-top-innovation>



Air sealing occasionally necessitates subsequent controlled ventilation additions or adjustments to maintain indoor air quality. These required adjustments may add \$150-\$800 for fans, ventilation, and associated controls. (ERV/HRV installations after air sealing are rarely installed for LMI households and would cost an estimated \$2,500 to \$5,000.³³) In some instances, air sealing may also result in increased radon levels in the house. If the radon level requires remediation, radon removal systems may cost several hundred to several thousand additional dollars and will incur modest additional electrical costs.

The 2023 Massachusetts report for Figure 2 offers an indication of household awareness of basic air sealing opportunities. Less than one quarter of respondents indicated they had taken some action or assessment of air leaks around windows and doors within the past five years. Fewer had examined or treated ductwork. These data are offered to indicate, again, general lack of public awareness of envelope energy savings opportunities.

The comments regarding spray foam in the “Attic/Roof Insulation” section above also apply to spray foam used elsewhere in the house for air sealing (rim joists, basement walls, exterior walls).

Wall Insulation

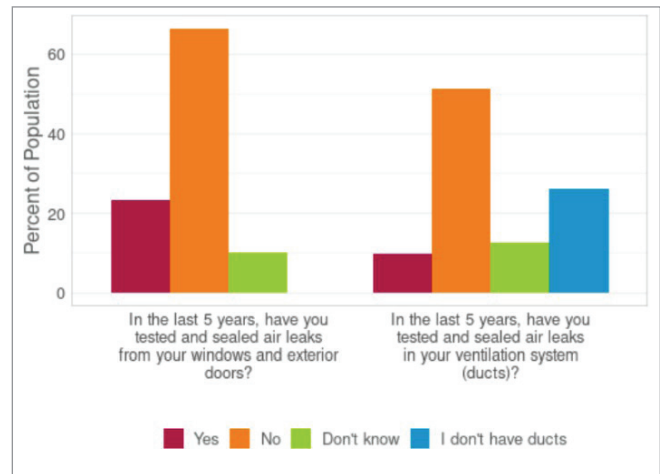
The New Hampshire baseline study cited above noted that the share of homes that had some form of additional wall and/or foundation insulation was three-to-four times higher than what was recently observed in a Midwest study, and that cold climate residents had been more judicious with recent efforts to insulate the shell.³⁴ Coldness extremes in the Northeast are likely the primary factor. Vermont’s residential baseline study showed that wall insulation values increased from R-12.8 to R-15.6 between 2015 and 2021, indicating some retrofit activity in addition to new construction.³⁵

Savings from wall insulation

It is difficult to estimate savings from wall insulation given the variability of houses undergoing retrofits. For some houses, dense packing cavities or adding exterior insulation, if done well, has a dramatic effect on air leakage, especially if other elements of the house, such as the attic and basement, have been addressed.

Figure 2: Rates of air leakage testing and sealing in Massachusetts

<https://ma-eeac.org/wp-content/uploads/Residential-Building-Use-and-Equipment-Characterization-Study-Comprehensive-Report-2023-12-22.pdf>



³³ <https://www.centerpointenergy.com/en-us/home-service-plus/products/indoor-air-quality/heat-recovery-ventilators>

³⁴ <https://www.energy.nh.gov/sites/g/files/ehbemt551/files/inline-documents/sonh/18-nh-residential-baseline-study.pdf>

³⁵ https://publicservice.vermont.gov/sites/dps/files/documents/VT_2020_SF_EX_Baseline_Final_Report_Jan242023.pdf



Insulation contractors interviewed estimated that a house could expect a 10-30 percent reduced energy use through adding wall insulation where none existed before.

Costs of wall insulation

Wall insulation—or lack thereof—is modeled to determine the cost-effectiveness of retrofit measures. MNCEE provides general guidance that walls with a two-inch or greater gap or that are empty can be considered for adding insulation. Estimates for retrofitting walls in typical 2x4 or 2x6 wall construction (removing siding, filling cavity, re-plug, and reinstall siding) are usually \$1.50 to \$4.00 per square foot.³⁶ Blown cellulose or fiberglass are the most popular options used.

Windows (new and secondary glazing)

Numbers of underperforming windows

There is little clear data from which to draw conclusions on numbers of Northeast homes that could benefit from window retrofits and replacements. However, several state studies mentioned below give an indication of general window quality and percentages of homes. These studies were conducted primarily through homeowner surveys.

New Hampshire's 2020 baseline study contained web-based responses on existing window types.³⁷ Nearly a quarter of the homes in New Hampshire were reported to have all or mostly single-pane windows (with over 40 percent of multifamily and low-income homes having most or all single-pane windows).

Maine's 2015 baseline study indicated that most windows were either double-pane or single-pane with a storm window, and even within those two categories there is a wide variety of configurations with different levels of efficiency.³⁸ Two percent were single-pane only. There is a large apparent disparity between Maine and New Hampshire for single-pane windows (2 percent versus 25 percent). This may be a result, in part, of New Hampshire respondents considering "single pane with storm" as a single-pane window.

The Massachusetts baseline study showed similar characteristics for existing windows, though slightly better than other states: Approximately 79 percent of windows were double-pane, with approximately 13 percent single-pane or single-with-storm, and 8 percent double-with-storm or triple-pane (see Figure 3). The primary frame type was vinyl (66 percent). Wood frames and metal frames (30 percent and 4 percent, respectively) rounded out the data.

From the Massachusetts surveys, low-income households had the highest likelihood of having mostly or all single-pane windows (25 percent of homes). Eighteen percent of moderate-income and 12 percent of non-LMI

³⁶ Prices vary on site-specific factors: e.g., amount of air sealing necessary, difficulty of access, adjusting or installing baffles or other ventilation, plumbing, venting, electrical repairs or corrections, treating around a chimney, etc.

³⁷ <https://www.energy.nh.gov/sites/g/files/ehbemt551/files/inline-documents/sonh/18-nh-residential-baseline-study.pdf>

³⁸ <https://www.energymaine.com/docs/2015-Maine-Residential-Baseline-Study-Report-NMR.pdf>



households had mostly or all single-pane windows.³⁹ Single-pane windows are often cost-effective to replace with respect to overall energy savings. This highlights the opportunity to focus more heavily on window replacement within LMI communities to reap greater energy savings.

Recommendation: Further analysis of specific housing baseline data per state may allow a comparison of general types of windows currently installed versus the type that would have been original or replaced at a much earlier time. Using specific vintage (and style) of homes compared to number of panes and frame composition should inform a percentage of homes that have received retrofits. (For example, a 1950s house with double-pane windows has likely had retrofits.) In addition, future baseline studies should focus on identifying where windows with high savings potential are most often found to offer better outreach to those homeowners.

Savings from window upgrades

ENERGY STAR published a study from 2005 estimating that replacing old windows with ENERGY STAR-certified windows can lower energy bills by an average of 13 percent nationwide with an average savings of \$125 to \$340 a year.^{40, 41} Table 5 outlines the cost and Btu savings estimates for the New England and Mid-Atlantic regions.^{42, 43}

Table 5. Regional savings estimates per average home using cost estimates from 2005 (EPA 2005).

Region	Savings/year over single pane window with ENERGY STAR option	Btus saved (millions)	Replacing double pane, clear glass with ENERGY STAR option	Btus saved (millions)
New England	\$340	23.5	\$65	3.9
Mid Atlantic	\$300	21.8	\$70	3.9

Figure 3. Window types across Massachusetts housing stock.



³⁹ Across demographics, a significant portion of respondents answered “don’t know” when asked what kind of windows their house predominantly had.

⁴⁰ https://www.energystar.gov/products/res_windows_doors_skylights

⁴¹ https://www.energystar.gov/ia/partners/manuf_res/windows/ES_Windows_Cost_Energy_Savings.pdf

⁴² Assuming a 2,000 square-foot single story detached house, 15 percent glazing, gas heat, electric AC, and 2005 state average utility rates.

⁴³ Specific savings for a given house are more accurately calculated using home energy models.



Costs associated with window upgrades

Weatherization program representatives shared that homeowners often expect or anticipate that windows can and should be included in their programs. These expectations stem, in part, from consumer misinformation on the relative energy savings opportunity from window replacement. Several programs interviewed noted that actual window repairs or replacements were rare. Energy-efficient replacement windows are typically expensive and do not easily meet cost/benefit criteria, though in certain cases, they do, particularly for failing, broken, or single-pane windows. For LMI households, window or door repair can sometimes be paid for through a home repair or similar program outside of energy-efficiency programs.

Single-pane windows often can meet cost-savings ratios that warrant their replacement or improvement. Adding *secondary glazing* is often the cost-effective choice. Some LMI-focused programs may install exterior storm windows. However, there is increasing interest in adding interior windowpane inserts versus exterior storm windows as a more cost-effective and easier-to-install option. These interior inserts are typically a semi-permanent glass or plexiglass with a gasket that fits into or around the sill frame. An example of a market-rate interior glazing option is Indow window inserts.⁴⁴ A Maine-based community organization known as WindowDressers⁴⁵ offers an example of a lower-cost effort to offer interior inserts. WindowDressers organizes volunteer work sessions where inserts similar to Indows are constructed and distributed to residents who might not otherwise be able to afford them. Interior inserts may limit the functionality of openable windows as they are typically one piece of glazing or Plexiglas, and they may not fit over existing frames and hardware. Thus, they may not be appropriate for all the windows in a house. Between exterior storms and interior inserts, there is a wide variety of options for adding additional panes to existing windows.

Pre-weatherization

Before envelope improvements/weatherization can happen in a home, the home must be assessed for conditions that preclude weatherization. Moisture problems, roof problems, customer clutter, and other safety and health issues may result in these houses being ineligible, also known as “deferred.” Conditions like older unsafe wiring, asbestos, or structural issues can make a home essentially impossible to weatherize without massive renovation. Compounding this issue, pre-weatherization measures often require a different set of assessment and trade skills. This is an issue of concern nationwide, particularly for LMI households, and in many instances, there is no funding to enable solutions. Some states have done better than others to address these deferrals. Pennsylvania has passed a law allowing home repair funds. Some states, such as New York and Massachusetts, have funds to address pre-weatherization issues. But most of the nation is vastly underfunded, especially in poorer areas.

⁴⁴ [Window Inserts That Provide Comfort, Quiet, & Savings | Indow Window Inserts](#)

⁴⁵ <https://windowdressers.org/>



Several interviewees highlighted pre-weatherization as a key factor slowing the scaling of envelope improvements, though not the most significant barrier. Market-rate contractors more commonly work with clients who are prepared to address or have already addressed pre-weatherization concerns, and millions of homes are still ready to be improved across all household incomes. Pre-weatherization needs create especially thorny issues with LMI residents and rental properties. For example, landlords or tenants may be reluctant to have their homes examined, and pre-weatherization work may interfere unduly with living situations. Questions of who pays, who benefits, potential rent increases, or other costs may also preclude work for LMI residents.

Some examples of programs that address pre-weatherization are:

- **Massachusetts** programs require weatherization work to be completed or the house to have met envelope criteria before receiving incentives for installing heat pumps.
- **Connecticut** has had a home repair program. Efficiency Vermont has modeled its program after Connecticut's and has launched a Home Repair program for LMI customers, separate from the weatherization program intended to address issues with houses before weatherization can continue, such as water issues, vermiculite, and foundation cracks.
- Outside of the region, **Minnesota** authorized funds to assist with pre-weatherization. There, utilities are to use 15 percent of energy-efficiency funds for pre-weatherization for LMI customer assistance. A significant portion of these LMI funds are going toward workforce development efforts. To assist pre-weatherization and to prepare the home for high performance HVAC, Minnesota also expanded funding for electrical panel upgrades to supplement the IRA tax rebate.

Envelope Improvement Programs Overview

This section discusses the current state of promotional program activity for envelope improvements and includes background on important aspects of programs, such as incentives, requirements and standards, home energy models, and LMI considerations. It then examines data on numbers of homes improved through energy-efficiency programs. Lastly, it briefly discusses lending strategies and tax credits that assist with costs.

Rate-payer funded **energy-efficiency programs** are often administered by electric and gas utility companies or by quasi-state-run organizations with mandates to reduce energy consumption. These programs often provide incentives to promote envelope improvements and other market support. These programs may offset consumer costs but do not typically offer fully paid-for services (with some exceptions for LMI customers). They also are often limited in what incentives are available—concentrating on the most impactful or manageable particular measures. **Weatherization Assistance Programs** are federally funded and state administered. They are aimed at reducing the energy burden on LMI households and often offer a slate of weatherization efforts to address a home's envelope more comprehensively.

Northeast states' efficiency programs represent several stages of development and approach toward weatherization/envelope improvement efforts. Some states such as Connecticut, Massachusetts, and New York have robust weatherization programs established with partnerships and utility coordination. These



programs often involve energy-efficiency funds through energy-efficiency programs and a form of green bank or coordination with a lending agency. State oversight and involvement is present in all programs to different degrees. The programs often coordinate with other state agencies to braid and stack funding to maximize impact.

Energy-Efficiency Incentive Program Summary

*Please refer to **Appendix D – Incentives for Primary Energy-Efficiency Programs in Northeast States Addressing Residential Weatherization**. This table describes energy-efficiency program incentives listed by incentive program administrator, incentive, and amount. Below are key takeaways from the table.*

Incentives vary widely. For many LMI households, the program absorbs most or all costs, potentially exceeding \$10,000 per house. Some less generous programs offer only several hundred dollars for basic envelope measures. However, most programs offer roughly \$2,000 to \$5,000 in incentives for a market-rate home with a “typical” upgrade of insulation/air sealing and a few other measures. Some states’ programs allow for considerably more. If a “typical” market-rate retrofit is between \$10,000 and \$12,000, these incentives would cover between 17 and 40 percent of costs. The substantial offerings from many of the Northeast states’ programs offer rather remarkable opportunities. As would be expected, general air sealing and insulation measures constitute the bulk of measures. Windows or duct sealing are only mentioned directly in four of the 23 programs listed.

Most of the programs **require a home assessment**. Exceptions include Maine and West Virginia. These assessments are mostly offered at no cost or very low cost. Several states, including New York, Vermont, and Massachusetts, are moving forward with the increasingly popular concept of “energy concierge” services where energy coaches help residents step-by-step through the process of upgrades. A few states are also offering virtual assessments with varying degrees of comprehensiveness.

Numbers of homes weatherized through EE programs

Table 6 offers an estimate of regional efforts over a year. For the region, we can estimate that there were over 150,000 homes addressed per year in the past few years. (The data gathered from individual states was not consistent. These are best estimates.)



Table 6. Homes weatherized per program (over given time frames).

State/ utility EE program	(Year) Estimated houses addressed	Links
CT Energize Connecticut	(2023) 42,243 residences – single and MF; (2022) 41,040 residences – single and MF	https://energizect.com/eeb/annual-legislative-reports
DC DCSEU	Not found. DCSEU concentrates on MF housing and other EE measures.	
DE Energize Delaware	(2023) 7,172 primarily through HPwES; (2022) 4,895. Includes pre-WX efforts on 160 units.	https://www.flipbookpdf.net/web/files/uploads/e8b4ef7791671e0396cc01dc72fbf6c99e8b370dFBP31390135.pdf
MA	(2023) 59,877 residences, primarily single-family	https://ma-eeac.org/wp-content/uploads/D.P.U.-24-65-NSTAR-Electric-Plan-Year-Report-Combined-6-3-24.pdf
MD	Not found. WX primarily for income-eligible resident through Maryland WAP, Maryland Energy Assistance Program (MEAP), and EmPOWER utility service territory.	https://energy.maryland.gov/residential/Pages/technicalassistance/weatherizing.aspx
ME Efficiency Maine	(2024) Nearly 3,000. Goal of ~2,200 homes per year to meet goal of 35,000 homes by 2030.	https://www.energymaine.com/docs/Registered-Vendor-Monthly-Report-2025-01.pdf
NH NHSaves	(2023) Home energy assistance (HEA) provided WX and EE measures to 1,200 income-eligible homes. (2023) Home Energy Performance WX to 1,590 customers.	https://www.energy.nh.gov/sites/g/files/ehbemt551/files/inline-documents/sonh/system-benefits-charge-report-2024.pdf
NJ PSE&G	(2023) 2,030 participants; (2022) 1,446 participants (may or may not include WX).	<p>2023: https://www.njcleanenergy.com/files/file/UTILITY%20REPORTING/4Q%20FY23/PSEG%20PY23%20Q4%20-%20CEEE%20Report%20Final.pdf</p> <p>2022: https://www.njcleanenergy.com/files/file/UTILITY%20REPORTING/4Q%20FY22/PSEG%20-%202022%20Annual%20Report%20-%20Executive%20Summary.pdf</p>
NY EmPower and HRC WAP (Comfort Home program data not yet available.)	(2023) 22,000 through EmPower; HRC WAP planned to assist 7,700 units in program yr 23-24.	https://www.epa.gov/system/files/documents/2024-01/empower-program-profile-draft_revised_2024-01-15_508.pdf
PA WAP, PECO, and FirstEnergy	(2023) 1,493 homes projected by DCED/WAP. LIURP (PECO) and WARM (FirstEnergy) also contribute.	https://nascsp.org/wp-content/uploads/2023/09/Pennsylvania_EE0009927.pdf
RI WAP and similar collaborators	(2022) 758 units through LIHEAP/RI Energy; (2021) 6,830 participants through WAP and collaboratives.	<p>2022: https://eec.ri.gov/wp-content/uploads/2023/05/eermc-2023-annual-report-second-draft-5-17-23.pdf</p> <p>2021: https://eec.ri.gov/wp-content/uploads/2021/05/eermc-2021-annual-report-final-5-13-21.pdf</p>
VT Efficiency Vermont	(2023) 662 through HPwES, and 388 DIY WX projects	https://www.energymaine.com/Media/Default/docs/plans-reports-highlights/2023/efficiency-vermont-2023-annual-report.pdf
WV WAP	(program year 2023-24) 374 from WAP	https://wvcad.org/assets/files/resources/Weatherization-Assistance-Program/Annual-File-DRAFT-PY23.pdf



Lending Products for Upgrades

Essentially all programs with significant rebates have low-interest loan products available for residents either through the program or an associated lender. Several programs' funds allow incentives to be spread between both envelope and HVAC upgrades. There is sometimes an allowance to cover a modest amount for health and safety-related upgrades, which can help address some minor pre-weatherization costs as part of the overall work and allow the project to proceed. This may be 25 percent or less of the pre-weatherization costs, as in the case of Efficiency Maine, or may be decided on a case-by-case basis as part of the overall cost/benefit analysis of a project, as many WAP agencies do. For example, Vermont offers \$15,000 toward pre-weatherization work for income-eligible households, which should be able to help many formerly deferred houses to be weatherized.

Mass Save offers a "pay-for-savings" option as a form of loan payment. New York's Empower program enacted a similar program "on-bill financing" with mixed results.

Contractors working with incentive programs

Several state programs have worked for years to cultivate relationships with contractor groups to enable feedback, disseminate program information, and inform contractors of program changes or contractor requirements. For example, Massachusetts has a monthly best-practices working group, which several interviewees mentioned is an important conduit that establishes consistent and frank feedback between contractors and programs. New York conducts regular open meetings with contractors as well. All interviewees involved with program and contractor relationships mentioned the importance of cultivating and maintaining a trusted, accountable relationship.

The number of contractor companies listed in various program networks is noted in Appendix C. Most utility-led energy-efficiency programs do not have a contractor network for assessors and weatherization work.

Throughout the Northeast, we found approximately 332 listings for weatherization/envelope improvement contractors and 307 listings for home energy assessors. Yet, there were nearly 6,000 HVAC and heat pump installer contractors in these program networks.⁴⁶ This illustrates the need to cultivate relationships with weatherization/envelope improvement businesses, home performance contractors, and energy assessors. There may be more envelope improvement businesses working with programs in some capacity, but the network listings do not reflect that. Select data is shown in Table 7. No contractor networks for envelope improvements or assessments were found for D.C., Maryland, New Hampshire, New Jersey (outside of Rockland Electric), or Rhode Island. Some utilities provide free home assessments through their own staff or specifically contracted assessors.

Connecticut, Massachusetts, New York (Comfort Home), and Vermont all offer standout programs in terms of contractor involvement. These four serve as valuable resources to learn from as other programs consider improving or expanding contractor networks, though clear successes in smaller programs are equally worthy of examination.

⁴⁶ Programs working with HVAC contractors have been developed over decades and would be expected to be larger. Also, a large percentage of networked HVAC contractors are either not active or minimally active in programs.



Table 7. Contractors in program networks.

Selected state data	Est. number WX/ envelope companies	Est. number energy auditors/ assessors in network.
CT	49	78
DE	20	20
MA	45	16
ME	62	No network
NJ: Rockland Elec.	7	4
NY: Comfort Homes	61	170
NY: PSEG-LI	No network	11
PA: PPL	11	10
PA: PECO	6	No network
VT	44	20
WV	16	No network

Contractor Requirements

States’ contractor participation requirements range from basic (having a certified business and complying with any building department requirements) to quite extensive (proof of contractor training and certification, 100 percent initial quality assurance checks on projects). Contractor requirements for incentive programs roughly follow the general offered incentive amounts—i.e., larger program incentives are usually associated with more contractor requirements, certifications, and training.

Table 8 outlines basic requirements for a few major energy-efficiency programs in Northeast states as examples of contractor requirements. Interviewees expressed a strong preference for requiring BPI certification as programs expand weatherization incentives. Several interviewees, including contractors, mentioned that BPI standards/certifications for contractors and installers could and do provide a reasonable and important benchmark for programs. Programs generally wish the contractor base would incorporate a BPI standard or similar certification more thoroughly in their workforce.



Table 8. Contractor requirement examples of robust Northeast programs.⁴⁷

Program	Requirements beyond insurance, business licenses, lead-safe training, and participation agreements
Mass Save⁴⁸ for Home Performance Contractors (HPC) and Independent Installation Contractors (IIC)	<ul style="list-style-type: none"> • Background checks of all applicable staff, as required by the Sponsor • MA Home Improvement Contractor License • MA Construction Supervisor’s License • Authorized boot camp and combustion safety certification or authorized crew chief training • HPCs must also be a BPI Analyst and Envelope Certified (IICs do not need this certification) • A satisfactory review of past participation/performance in Mass Save programs, like weatherization
NY Comfort Home⁴⁹	<ul style="list-style-type: none"> • One or more certifications (ASHRAE, BPI< HERS, ICP, or LEED) • Additional shell certification (BPI) or window training (manufacturer) • Read/understand Pilot Manual • Comfort Home specific trainings (3)
Energize Delaware⁵⁰ (HPwES contractor- specific example)	<ul style="list-style-type: none"> • Relevant BPI certification • Contractor Operations Manual • Active HVACR and/or Plumbing license if required.

As noted in the table, Mass Save requires BPI certifications for home performance contractors and energy specialists who do assessments. New York’s Comfort Home program also requires BPI certifications or similar credentials for assessors and contractors.

Minnesota’s MNCEE has honed its third-party verification system through a 40-year history of cooperative efforts with contractors. They provide a good example for Northeast states wishing to build a network of program assessors to perform initial home assessments. MNCEE assessors perform these assessments. For market-rate customers, MNCEE is now allowing home performance contractors to bid on a home improvement project by using priced-out measures versus one price for the entire project. This means that enough data and trust have developed that dominant contractors are comfortable with the accuracy of third-party assessments. This bid-by-measure strategy allows for more precise costs per house, more transparency for all involved, and increased customer confidence. In addition, contractor pricing can be lower because contractors are contacting “hot leads” and fewer resources need to be dedicated to sales.

⁴⁷ Not all programs had readily accessible information. List is not exhaustive, but representative.

⁴⁸ <https://www.masssave.com/trade-partners/contractors/home-energy-services-participating-contractors>

⁴⁹ [Become a Participating Comfort Home Contractor- NYSERDA](#)

⁵⁰ <https://www.energizedelaware.org/residential/home-performance-with-energy-star/contractors/>



By encouraging higher standards, states can promote contractor self-sufficiency and address quality control concerns. As market-rate weatherization programs develop, they can consider promoting higher standards or certification levels (e.g., Goldstar or Certified Pro) for contractors working on whole home measures while including additional incentives for contractors who hold those higher standards.

Interview insights on training

- Standards should be streamlined. Multiple organizations, including RESNET, ANCI, IECC, and individual manufacturers, have established standards for envelope upgrades. Though there is some overlap, they are not identical. Streamlining and matching product and installation standards can allow for simpler, consistent understanding for contractors. This concept of streamlining also applies to certifications and program rules. Given the rapid movement of technology and methodology, programs should adjust and simplify when possible. This can include new standards for the use of spray foam and virtual and remote tools and software for home assessments. LMI assistance programs, with more limited funding, can look to some market-rate progress for updating standards.
- Focus on elevating the starting point. There may be opportunities to improve weatherization installation and efficiency generally through basic training—particularly as the weatherization workforce may receive less instruction than other similar home contractors. Morning “tailgate” trainings before crews go out may raise the bar for install quality, resulting in fewer projects failing quality assurance checks. These trainings should be offered in languages and manners that best suit the makeup of the crew. There is further discussion in the “Opportunities” section of the report under “Support Contractor Development.”

Home Energy Models and Cost Benefit Assessments

Home energy models performed per house to calculate cost/benefit assessments are intrinsic to this field. Researchers and developers have created many databases and energy models to quantify home improvements. Low-income Weatherization Assistance Programs focus on a savings-to-investment ratio where measure costs are compared to their expected lifetime savings. Market-rate contractors may offer their own cost/benefit assessments to homeowners using a variety of modeling software at various levels of detail. Some contractors do not offer any cost/benefit analysis.

Cost calculations are not the only data a homeowner considers, as there are other associated pros and cons, but they are helpful as a general check of cost-effectiveness. More comprehensive cost-savings models consider expected installation lifetimes, carbon production, embodied energy, and even health and safety effects along with more complicated economic analyses. These additional factors can fine-tune basic modeling to assess different information needs.

All LMI envelope improvement programs involve benefit/cost analysis in some form of software (e.g., NY EmPower+ and MassSave). WAP agencies use the National Energy Audit Tool (NEAT) to identify cost-effective and energy-efficient retrofit measures.



Weatherization Assistance Program Landscape

The **Weatherization Assistance Program (WAP)** is a federal initiative to improve home energy efficiency. The WAP audience is primarily low-income households. Services are free or highly subsidized and focus on reducing the energy burden for LMI households. Community Action Programs (CAPs) are local agencies that help administer WAP at the community level.

Numerous documents are available regarding WAP efforts and results such as ORNL's State and Community Energy Programs Support⁵¹. Each state has metrics for buildings served and related energy saved, though data is not always reported similarly and may be aggregated such that numbers of individual metrics are not discernible.

Examples of WAP efforts over time

- **Vermont:** From a 2020 report, over the last 20 years, Vermont WAPs have weatherized 27,000 homes with an average energy cost reduction of 28 percent, which translated to an approximate savings of \$500+/year.⁵² More than half were low-income households. Vermont has some of the oldest housing stock in the nation, with almost 30 percent built before 1939. Although this usually means more complicated envelope improvements, it also often means weatherization can have a larger effect on the home.
- **New York:** New York's Homes and Community Renewal (HCR) reports that for 1977-2021, more than 744,000 housing units have been made more efficient due to WAP funds.⁵³ (Not all these would be single-family.) In 2021, HCR completed an estimated 2,486 single-family or mobile home units.
- **Massachusetts:** Since 2013, Massachusetts has weatherized approximately 350,000 homes, including 70,000 low-income households (single-family numbers not known).⁵⁴ The state's 2025-2027 Energy Efficiency Plan aims to weatherize more than 184,000 additional homes with a focus on over 75,000 LMI households and more than 51,000 rental units.

The total number of homes improved through WAP in the region is not immediately available. However, data from several programs show that over the past several decades, WAP has weatherized around a million homes in VT, NY, and MA to a degree. Other WAP programs from other states and updated numbers would potentially raise that number to approximately 2 million homes. Northeast WAP reporting by state noted approximately 9,400 homes weatherized for 2023 (Table 9).

⁵¹ <https://weatherization.ornl.gov/>

⁵² <https://legislature.vermont.gov/Documents/2020/WorkGroups/Senate%20Appropriations/FY%202020%20BUDGET/12%20Advocates%20Testimony/H.542~Paul%20Zabriskie~Capstone%20Home%20Weatherization%20Assistance%20Program~4-16-2019.pdf>

⁵³ <https://hcr.ny.gov/weatherization>

⁵⁴ https://ma-eeac.org/wp-content/uploads/MA-2025-2027-Plan_September-25th-Draft-corrected-as-of-10-22-24.pdf



Table 9. Weatherization Assistance Programs: Est. number of homes weatherized per state for 2023.⁵⁵

State	Est. houses weatherized	Est. WAP orgs
CT	241	1
(DC)	111	1
DE	55	1
MA	694	12
MD	347	8
ME	461	8
NH	Not found	5
NJ	550	17
NY	3,988	52
PA	1,493	33
RI	Not found	7
VT	1,139	5
WV	295	11

Key Opportunities to Develop the Northeast Envelope Improvement Market

The following discussion is intended to capture the top priorities articulated by interviewees with respect to growing the volume and depth of residential building envelope retrofits in the Northeast. Four topics arose as primary barriers and opportunities:

- **Maintain and expand current program infrastructure:** Continue and extend the capacity of existing incentive programs.
- **Foster workforce development:** Bring new workers into the envelope improvement sphere of work.
- **Support contractor development:** Support existing contractors in improving their knowledge, business models, and capacities and augmenting new business development. Note that workforce development and contractor development are closely connected.
- **Drive consumer education and awareness:** Education and awareness encourage homeowners, landlords, and renters to make wise decisions in a market where much of the public and contractors still lack an adequate understanding.
- **Implement Program enhancement opportunities:** This last section considers program-specific insights on program design, quality assurance elements, envelope improvement knowledge, and coordination with heat pump projects.

⁵⁵ Data compiled from state WAP annual reports on numbers of units addressed per state. Counts primarily include Weatherization Assistance Programs and Community Action Agencies.



Maintain and Expand Current Program Infrastructure

Practically every interviewee mentioned increasing funding for incentive or assistance programs as the most crucial element for increased adoption of envelope measures. Though the emphasis on continued and expanded funding is not surprising, it is worth reiterating. There was no clear consensus on where this funding could best be used, though even if current programs are adjusted or have their focus shifted somewhat, they serve as a very important, established, and consistent means of offering services to either market-rate or LMI customers. Existing programs can serve as testing grounds for new outreach, measures, technology, or processes. Many programs are also the only practical option for some LMI households to receive basic weatherization that can lower bills, along with other benefits mentioned earlier.

Consistent long-term funding allows for outreach or incentive programs to establish and mature so that contractors and homeowners can understand, adjust to, and provide feedback on them. Consistent regulation and processes between programs and states can minimize confusion in outreach, incentive program offerings, and/or envelope improvement methods themselves. Long-term and consistent funding further allows programs to establish contractor and consumer trust and benefit from outreach campaigns. Consumers and contractors often mention that sporadic programs disrupt momentum, add confusion, and compromise trust of a program.

Foster Workforce Development

Many interviewees expressed the need for workforce development to accelerate the rate of envelope retrofits. Employers need to adapt to attract and retain new and younger workers. Weatherization contractors report difficulty finding and retaining workers across the region, particularly in less densely populated areas. More qualified energy professionals are needed not only because of the anticipated growth, but also because building performance industries and ancillary trades such as HVAC, electricians, carpenters, and plumbers are experiencing a “graying of the workforce,” with a wave of retirements anticipated.

Below are predominant insights from interviewees:

Attraction and Recruitment

- **Starting wages and benefits** need to be enticing enough to match the commensurate difficulty and training of the job.
- **Increased employer-driven outreach:** Employer-driven models are often more efficient and direct than outreach through third-party programs. Efficiency Vermont’s “Talent Pipeline Management” is one example of an employer-led group.⁵⁶
- **Career visibility:** Establish home improvement/weatherization work early on as a viable and financially secure career. Candidates need to understand career paths within weatherization that can expand their

⁵⁶ U.S. Chamber site at <https://www.uschamberfoundation.org/solutions/workforce-development-and-training/talent-pipeline-management> and Vermont site at <https://accd.vermont.gov/economic-development/programs/vtprm>



skills, allow them to advance, secure their income, and increase their financial security. This can occur through early exposure and soon before/soon after hiring.

- With **early exposure**, middle school, high school, and college or technical school students receive introductions to building improvement careers alongside other careers. This can set a stage for interest and parity with other options. High school shop classes and technical college classes should include basic building science teaching to encourage visibility and interest in the trade.
- **New worker career path vision:** Organizations and contractors should offer a **career path vision** to prospects (e.g., a younger pre-apprentice option, leading up to apprentice, crew member, crew lead, starting your own business, or moving into management or training). This career path vision can explain to prospects that the field can accommodate a range of paths. For example, DEE’s Building Innovation Hub has a Green Buildings Career Map to help visualize different career paths.⁵⁷ Specializations such as outreach, business development, management, office personnel, spray foam installers, HVAC and electrical specializations, as well as weatherization and envelope improvement skills can be explained, encouraged, and developed for new workforce members as part of their career path vision.
- **Programs and potential employers should consider new workforce recruitment opportunities:** To attract the large number of weatherization contractors that will be needed, employers and programs should think creatively about where and how to reach new pools of candidates, for example working with community centers or other community-based organizations that serve historically underemployed populations. As one example, Vermont Adult Learning offers free training and support.⁵⁸ Partnerships with those involved in heavily LMI communities allow for more successful outreach. Accommodations such as wraparound services can help foster a new workforce with community members who need additional support to enter the field.

Training

Due to the industry’s high turnover rates, it is important to treat training as an ongoing and essential activity.

- **Qualified auditors/assessors** possess the primary workforce skill sets that are lacking, according to several interviewees.
- **Internships:** To coordinate on-the-job training, many interviewees mentioned internship-type relationships with community-based organizations, programs, or schools to provide practical, real-life experiences for students/trainees to understand the scope of home improvement work. **A regional clearinghouse of internship-style programs** would likely help the industry standardize trainings, compile funding opportunities, and offer templates for a variety of organizations considering such assistance. The region would need more strategically located training centers to allow opportunities for new employees or students to gain early practical training.⁵⁹

⁵⁷ https://buildinginnovationhub.org/resource/dc-green-buildings-career-map/?gad_source=1&gclid=CjwKCAiAzPy8BhBoEiwAbnM9O439iiKRRrHYfk-CLUbbB56yjYu5iCKXHJe6rRgOVAMsoSsPHLkxB6iXoC8bEQAvD_BwE

⁵⁸ <https://vtadultlearning.org/>

⁵⁹ Currently, there are only a handful (e.g., NYSWDA with three locations, ECA in PA, Green Jobs Academy in MA; Vermont is creating one, and there are some smaller training facilities).



- **Reskilling/cross-training:** Some industries seeing reductions in employment may be particularly suited for the envelope retrofit/weatherization field, particularly those with component skills of envelope improvements, manual ability, and teamwork.

Appendix A lists examples of successful workforce development programs in the region.

Support Contractor Development

“Contractor development” refers to upskilling and preparing the current base of contractors beyond bringing new workers into a field. It includes business models, employer training, and newer areas of focus. Insulation and air sealing work, especially for market-rate customers, has few standards, little enforcement, and little quality control for many contractors. In addition, many consumers rely on contractors for accurate information. Excellent contractors and companies can lead the way toward quality improvements and higher volumes of work. The Northeast needs many more quality contractors to realize its desired energy-efficiency gains and to address increased envelope retrofits. The longer-term goal with contractor development is to find ways to make business operations profitable and comprehensive without relying on rebate and incentive programs—which usually have a limited duration.

What follows is a discussion of interviewees’ insights on expanding existing companies engaged in various weatherization-related disciplines. Around the region, many existing weatherization contractors have full schedules, which can create long waits and may also increase marginal prices for the consumer. Cultivating more people to start weatherization or building performance companies is essential to increasing retrofit improvements.

Interviewees shared many comments, concerns, and insights on contractor development, which fell into the following categories: 1) *Workforce retention*, 2) *Ongoing/Supplemental training*, 3) *Expanded services*, 4) *Expanded opportunity for other contractors*, and 5) *Other opportunities*. These are followed by a list of business resources mentioned during interviews.

Workforce Retention

Continued training and advancement opportunities are essential for retention.

- **Increasing remuneration:** To retain contractors, ensure that positions provide sufficient compensation to create a career path once a candidate has reached a determined metric of advancement or proficiency. The advancement process and advanced pay structure should be clearly defined so eager and competent employees remain engaged. The lack of a clear route for advancement and low pay are often reasons employees leave. Further study could help contractors and support organizations determine the regional or local levels of pay to remain attractive. It could also help provide contractors with clarity on how best to advance generally within the industry and more specifically within their own organization.



Ongoing/Supplemental Training (beyond initial job training)

- **Short training sessions** and basic educational opportunities can raise standards for many installers. Trainings may be formal or informal, reviewing basics or teaching advanced skills. Distributors are increasingly offering envelope improvement installation training at their stores. Even short trainings can raise the bar overall for installation quality. As one example, SPEER (South-central Partnership for Energy Efficiency as a Resource) offers in-person training—along with webinars and videos—for improvements in insulation and air sealing measures among other topics.⁶⁰ The trainings are designed to be easily scheduled, such as a short on-site morning meeting.
- **Set the stage to minimize oversizing HVAC.** Some contractors need education on the importance of conducting reasonable heating load assessments. Design and Manual J training is often lacking among HVAC contractors. **Auditors/assessors** may be increasingly cultivated to provide design load assessments or at least provide an initial estimate for a reasonably sized replacement system, including expected changes/reductions after weatherization measures happen. For load assessments, there are several phone/iPad apps and other relatively simple assessment tools to provide general heating sizing requirements quickly. This information should go to the client and may also be shared with an HVAC company involved in the project. An initial sizing assessment can set the client up for a successful HVAC replacement that is right-sized and can engender trust with the assessor.
- **Certifications and training such as BPI should be highly encouraged across all envelope improvement and home performance contractor companies.** Building Performance Institute is an established leader in certifications for home performance work through their certifications for various levels of expertise (e.g., BSP, BA-T, and BA-P). States have varying levels of requirements for BPI or similar certifications for contractors. For those working with programs, such certifications are encouraged or necessary. For contractors outside of incentive programs, there are no apparent certifications. Certifications offer companies excellent opportunities to showcase their understanding of building science. *Programs and states that do not require or highly encourage envelope improvement certifications should consider doing so as a condition for program involvement.*⁶¹ Several northwest state and utility programs host and post trainings for their contractor base.⁶² Interviewees identified high-pressure spray foam as a specific training area that is generally lacking. Manufacturers would likely be interested in providing some level of this training. Similar to spray foam distribution networks, **insulation manufacturers** may be able to increase air sealing awareness and training within their contractor networks.

⁶⁰ <https://eepartnership.org/btotraining/>

⁶¹ An example of an option for a contractor to display a range of knowledge beyond the basics, BPI has a Total Building Performance certificate that covers topics associated with deep energy retrofits: <https://www.bpi.org/certificates/total-building-performance-certificate/>.

⁶² Efficiency Maine has a newsletter for upcoming trainings. They also have a scholarship per employee to undertake trainings. Efficiency Vermont has an “Efficiency Excellence Network” <https://www.encyvermont.com/trade-partners/efficiency-excellence-network> offering training



Expanded Services

Home energy assessors/auditors should be equipped to educate homeowners on the bigger picture of their homes no matter what customer segment the assessor is working with (LMI programs, utility programs, market rate). This can include planning and integration with additional opportunities such as HVAC (high-performance models, hybrid and dual fuel systems, heat pumps), remodels, or solar. The opportunities for a contractor to offer expanded services to more fully address energy- efficiency potential can result in more fully thought-out and efficient efforts, increased business, and happier customers. Assessors are typically the ones to propose expanded services given their understanding of comprehensive home needs and high efficiency HVAC systems.⁶³ Offering expanded services can also lead to long-term relationships that engender confidence and references from the homeowner and can result in service contracts or repeat business. Below are ways mentioned in interviews that allow a contractor to offer expanded services to clients:

- **Promote tax credits and incentives:** Federal 25C tax credits have existed for years. When the tax credit was widely promoted in 2023, households claiming the credit doubled. During years when it is not promoted, only 300,000-400,000 households nationwide may typically claim it. Client-facing personnel, including assessors, should be aware of the credits and promote them to anyone eligible. Otherwise, these credits are “money left on the table.” 25C credits and rebates can be promoted through **contractor marketing efforts**. If more contractors can build a routine opportunity to confidently describe market credits with simple conversation, this alone may increase a contractor’s sales and overall improvement package.⁶⁴
- **Develop more home performance contractors from the weatherization contractor base:** Having more home performance contractors (those offering a full slate of potential improvements for a house) can increase efficiency in addressing whole-home opportunities. Weatherization contractors include other similar home performance services (such as HVAC, electrical, solar) more frequently than those trades will adopt weatherization in their business models.
- **Connect with community-based organizations:** Anyone involved in outreach (contractors and programs) can connect with relevant community-based organizations (CBOs) to better understand the motivations of their target customer and hear more directly from their target population. In turn, CBOs can help programs achieve goals by serving as partners to extend outreach and assist with some program processes.
- **Combine weatherization with heat pumps:** Heat pumps are increasing in popularity. Heat pumps and weatherization go hand in hand and should be promoted together wherever practical. Regional incentive programs are likely to shift toward weatherization. Several programs encourage addressing both heat pumps and weatherization simultaneously or sequencing these upgrades closely in time. Weatherization contractors who understand these opportunities will be better situated to obtain work with interested clients. Tight coordination between weatherization contractors and heat pump installers can allow for

⁶³ An article that underscores this potential is through BPA <https://building-performance.org/bpa-journal/lets-go-beyond-the-credential/>

⁶⁴ An example of free marketing support for businesses promoting the 25C tax credit: [25C Means Business- FREE Marketing Support for your Insulation Business](#)



efficiencies.⁶⁵ Contractors who provide both services are well-situated to do this already.

- **Drive Referrals to other contractors:** In some situations, envelope specialists are positioned to recommend that a homeowner consider additional upgrades such as solar, HVAC, construction, or remodeling that can augment the envelope improvement benefits and continue the household on a path of energy efficiency. Some homeowners may appreciate the information and contacts with other businesses that can help the homeowner reach their goals. Companies may or may not obtain a small commission from referrals, but recommendations from a trusted contractor can also increase goodwill from the customer.

Expanded Opportunities for Other Contractors

- **Encourage general contractors to have value-added projects:** General contractors are often well positioned to identify potential energy savings, discuss them with homeowners, and expand their projects appropriately.⁶⁶ Outreach and training can help ancillary businesses take advantage of these opportunities and, as importantly, **do them well**. If they do not have the expertise to address a given weatherization component, the company may be able to recognize the opportunity and direct an interested homeowner to another company to work alongside them for the project.
- **Train for ancillary trades:** Much envelope improvement work, whether by an envelope retrofit company, another hired hand, or the homeowner, happens in an unregulated and unlicensed space. Appropriate training is essential. Providing basic weatherization skills and education can help residential contractors improve housing stock as they install improvements or repair buildings. Trade associations can offer trainings to orient residential contractors toward best practices as they undertake related projects (e.g., air and moisture barrier placement, air sealing, re-laying insulation, etc.)
- **Standardize training for residential trades:** Similar to the training opportunity for other contractors mentioned above, whole home principles should be encouraged and taught in each trade responsible for equipment and materials in buildings. Even minimal training on air sealing and insulation, contaminants, disposal, etc. can prevent problems and poor-quality results after a specific job is done.

Other Opportunities

- **Solicit Contractor feedback for envelope improvement programs:** Several interviewees mentioned the importance of having a very tight and responsive contractor feedback process. Regular, frank opportunities for discussions with contractors are indispensable for program development and success,

⁶⁵ Coordination for assessment data, testing schedules, system design concepts, and installation itself can prevent one contractor's efforts from hindering or damaging the others' work.

⁶⁶ As examples: For a contractor installing new siding, can they add exterior insulation? For a roofer, is the opportunity ripe for adding insulated panels? For a window installer, are they able to discuss the benefits of triple pane options? For wet basement remediators, can they spray foam open rim joists and add closed-cell insulation to the walls as part of the job?



especially for larger programs.⁶⁷

- **Enforce existing building codes and standards** are designed to promote basic efficiency. States and towns should encourage and enforce **existing retrofit codes**. There may be value in encouraging additional code development toward practical envelope improvements and testing for envelope construction/reconstruction. See NEEP report on Energy Codes and Affordability for further discussion.⁶⁸

A short list of business resources mentioned in interviews is available in Appendix A.

Drive Consumer Education and Awareness

The third main opportunity discussed in interviews was the importance of increasing homeowner, renter, and landlord awareness through education. Practically all the interviewees mentioned that public education on the benefits of envelope improvements is essential to expand envelope retrofits. Education may occur through public outreach campaigns or target populations with particular potential for efficiency opportunities.

In thinking about what drives the final decisions for a homeowner to make improvements, funds for incentives help but are often depleted quickly, and auditors/contractors are often not positioned to influence decisions if the homeowner does not have a vested interest. Public awareness and education can drive action and smart decisions for those most closely tied to the longer-term benefits of envelope improvements. Public education may have the best and longest-lasting effect on weatherization uptake and ramping up efforts for envelope retrofit projects. Marketing weatherization's importance and cost savings to customers and the public means more educated residents and thus more homes where improvement opportunities can be realized.

Homeowners' desire for cost and energy improvements is the biggest driving factor for accelerating single-family home envelope retrofits.

Homeowners' desire for cost and energy improvements is the biggest driving factor for accelerating single-family home envelope retrofits.

Within consumer awareness and education insights, several recommendations emerged: 1) Provide Information hubs 2) Deploy education programs 3) Provide Price Transparency 4) Leverage range of Consumer Touch Points and 5) Provide Directed Market Education and Concierge Services.

Provide Information Hubs

- **Programs should promote information hub websites** (and library resources) within communities of interest to reach their intended audience. States and programs should curate information from available resources to create straightforward, trusted, and well-organized messaging. *Feedback* on hub users

⁶⁷ Mass Save has regular roundtable discussions with contractor representatives who have been selected by the contractors involved with the program. Most programs have some form of contractor communication.

⁶⁸ <https://neep.org/energy-codes-and-affordability>



and the targeted audience is important to tune the utility and relevance of such a site. Two types of information can be presented: financial opportunities and building science.

Information on financial resources such as tax credits, financing, and rebates should be readily available for residents. These may be available from utility, state, federal, or local levels, or even funding or assistance opportunities from non-profits or other groups interested in helping residents lower their energy use, save money, and have comfortable, safe housing.

Programs should provide opportunities and resources for homeowners to develop a basic understanding of building science and “do-it-yourself” projects that incorporate building science principles. This resource may not need to be extensive and might incorporate existing resources or links to expert organizations at a minimum. It should be based in accurate science and practical knowledge aimed at a layperson’s level of education on the topics of whole home approaches and envelope improvements.

States, utilities, and local organizations should also point their customer-facing information to other programs or clearinghouse information sources to integrate messaging.

Deploy Education Programs

Education programs are designed to encourage homeowners to take action and invest in practical upgrades. A regional education program geared to the Northeast climate and typical housing stock could drive interest and action and reinforce other Northeast states’ messaging.⁶⁹

- **Effective Messaging:** Smart public relations marketing can create emotional drive and interest. Many people are not focused on energy efficiency, so emphasizing other benefits such as health, quality, or cost savings can highlight messages for a wider swath of consumers, depending on the audience or sub-region.⁷⁰ CBOs may help identify promotional topics, and consumer-oriented online tools can help alert homeowners to potential savings and other benefits of retrofits.⁷¹
- **“Saving money”** and energy affordability are the biggest drivers for consumers. Comfort is another strong motivator for consumer participation. Terms relating to environmental benefit may be less effective than terms focused on economic value.
- **Heat pump discussions are an ideal and appropriate opportunity to promote weatherization.** Without unduly reducing interest and desire for heat pumps, outreach and marketing should emphasize that weatherizing/improving the envelope is the best first step for the house. Contractors can explain building science basics to homeowners by emphasizing a simple order of operations for installing weatherization

⁶⁹ One example of a simple campaign slogan is from Green Building Specialists: “Have an AWESome house! Assess, Weatherize, Electrify” <https://upstatehouse.com/guide-to-decarbonization-and-electrification/>

⁷⁰ Outreach can customize messaging for differently situated homeowners depending on the audience’s interest, e.g., how weatherization/envelope improvements affect the home, finances, help prepare a home for potential disasters, or resale.

⁷¹ [Retrofit Decision Tool | Building America Solution Center](#) offers a homeowner 12 questions to begin to understand opportunities they may have for their home.



and heat pumps. Such information will likely not diminish their interest in heat pumps but may encourage them to consider basic envelope upgrades. (A home more ideally prepared for right-sized heat pumps can mean less likelihood of call-backs resulting from an under-insulated house.)

- **Outreach to homes with recent heat pump installations:** All of the weatherization/envelope improvement contractors contacted mentioned that an increasing component of their business is homeowners calling them to discuss why parts of their homes are still feeling cold and why their electric bills are higher after installing heat pumps. When a heat pump is properly installed and commissioned for the specific home, subsequent investigation of these issues almost always indicates inadequate air sealing and insulation in the areas affected, not heat pump performance issues. Outreach to homes within a year of heat pump installation may be beneficial to encourage homeowners to optimize their homes for energy efficiency and comfort through envelope improvements.

Provide Price Transparency

Several interviewees mentioned that increased price transparency would help customers be more confident in working with contractors. To that end, there were two recommendations. **Regional estimates** or actual recent pricing by contractors (anonymized as needed) per measure and amount can help customers understand project costs and confirm that a proposal is not priced too high or understand why a certain measure may be higher (or lower) than normal. In addition to prices, transparency includes educating homeowners about what constitutes a “good job” for weatherization. This can help establish reasonable expectations and can benefit quality contractors. Several contractors mentioned that the consumer will quite often go with the cheapest proposal without understanding the fuller picture and benefits. Contractor price estimates should include **contextual information** about the process to be used or the unique features of the quoted job.

Leverage range of consumer Touch Points

There are opportunities to foment a homeowner’s interest in considering envelope improvements, including:

- **Permitting/code requirement checks:** Since these often occur early in the process, they can be ideal times to inform homeowners of energy-efficiency upgrade opportunities before plans are immutable.
- **Real estate transactions** can incorporate additional explanation and detail to potential buyers as part of the sales process, i.e., energy-efficiency improvements that have been made or the potential for the buyer to make the improvements after the sale. Real estate agents generally lack this knowledge. Directed outreach and education can help them understand and identify either quality envelopes or potential for improvement, including sources of funding/credits/incentives. During a sale, at the very least, agents can share basic information on home energy improvements with the homeowner. This can include information on rebates and incentives and could be as simple as a one-page handout. Energy disclosures at time of listing can help prospective buyers understand the energy usage of the house, and signal opportunities for improvement. This information can also be useful for rental properties.



- **Home energy scores** can be promoted as a consideration for a house purchase. Weatherization upgrades are opportunities to easily gather these scores. These objective data sources that score homes (e.g., DOE Home Energy Score, Pearl Certification, RESNET) may provide additional insight and assistance for both market-rate homes and LMI weatherization programs. For example, low-income homes that receive a Pearl Certification can be quickly assigned a real estate value to the home, increasing the value for the homeowner.
- **Home inspectors** can receive training to more clearly point out deficiencies or positive elements of the building shell.
- **Audits/assessments:** Home energy assessments work differently in various states. Assessors may mostly be from weatherization and home performance companies, in-house within a program, independent third parties, or a mix. The pros and cons of these assessment programs are outside the scope of this paper. Rather, the intent of the interviewees' comments below is that customers should be aware of how an assessor may be connected to the assessment's recommendations.
 - Consumers should be informed of potential conflicts of interest from auditors/assessors associated with specific aspects of envelope improvements. For example, an assessor from a spray foam company or a company focused on basement remediation may have a difficult time extricating themselves from recommendations that do not involve their company's services.
 - Auditors from home performance contractor companies that offer or subcontract a variety of services would ideally present improvement options that best represent the customer's best interest, albeit from the same company. There is a *very strong incentive* for assessments done through a company to lead to installations done by that company.
 - Third-party auditors/assessors or those associated directly with an EE program ideally have a more defined separation of interest. Their assessments may hold more weight for some homeowners.
- **Solar, HVAC replacements (other than heat pumps) or other "green" technologies:** Homeowners interested in installing solar or replacing HVAC equipment are typically open to considering input on envelope improvements. Solar companies should use the opportunity to educate homeowners. Having solar companies endorse energy assessments as part of their outreach can help homeowners with smart decisions at a time when they are likely paying more attention.
- **Retail or distributor point-of-sale opportunities:** Several interviewees mentioned opportunities to use sales spaces as consumer touch points.
 - Information on **credits and incentives** at retail stores at the product location or at the register can inform and remind customers of envelope improvement opportunities.
 - Straightforward point-of-sale **discounts** for insulation and air sealing supplies provide direct promotion for envelope improvements. New Mexico and West Virginia offer these to varying degrees. A few interviewees mentioned the benefits of getting incentives as close to the user as possible for products with straightforward installations.
 - **Consumer education at the retail level** may offer basic reminders and instruction on quality



installation to help contractors who need best practice instruction do a better job. It can also drive consumers to learn more. Homeowners (and some contractors) often simply do not read instructions and may not install products correctly. Retail information on how to use/install the product may also serve as a sales tool and offer confidence in a particular product (not to replace instructions but rather augment them).⁷²

- **Multi-media/multi-learning:** For typical weatherization materials, customer information at the store (beyond written application instructions) may reduce poor or hazardous installations, such as a video looping best practices and reminding people to read the instructions or a brochure doing the same. Although more extensive videos may exist online, the purpose would be to more pointedly alert the consumer that installation needs to be thought through and could point them to the other sources of installation information.

Provide Directed Market Education and Concierge Services

- **Utilities** in the Northeast have conducted energy use comparisons and reported them on energy bills to encourage homeowners to consider upgrades. Some utilities are looking to refine this outreach to more carefully examine energy use and compare it to publicly available real estate metrics such as heating type and square footage to identify houses with particularly low efficiency. Exterior infrared imagery may also help make a successful case to a homeowner of the viability of an upgrade.
- **CBOs and some programs are increasingly piloting concierge services.**⁷³ This concept has garnered attention in the region within the past few years. The concept is that organizations, typically non-profits, offer objective assistance to the public to help them navigate to the programs best suited for their needs. Concierge services are available as a trusted source of information and perspective through often daunting processes. This longer-term relationship with clients can pose challenges but can build trust for solid results—not least for LMI individuals and those not familiar with or mistrustful of how upgrades and payments happen. As pilots continue and results come in for these programs, expanding concierge services and similar “one-stop shops” may be an excellent vehicle for accelerating envelope retrofits.

Implement Program Enhancement Opportunities

Combinations With Heat Pump Incentive Programs

- Several state and utility incentive programs are increasingly moving toward quantifying appropriate weatherization for homes that receive heat pump incentives, particularly for LMI residents. Coordination and shared resources amongst programs can allow for cohesive and responsive programs.

⁷² For 2-part low-pressure spray foam—often sold at retail stores—there is particular concern that some envelope improvement installations are partially or wholly ineffective and some are potentially hazardous. Bold instructions at point-of-sale may help alleviate that.

⁷³ E.g., NYS Clean Energy Hubs, Sustainable Westchester, Sustainable Putnam, and in the Northwest, Washington State.



- NEEP is publishing a report titled “Co-promotion of Weatherization and Heat Pumps in Programs Best Practice Guide.”⁷⁴ The report outlines best practices for all programs depending on the level of interaction any given program may have between heat pump promotion and envelope improvements.

Program Design

- **Prioritize assessments:** Several stakeholders emphasized the importance of assessments in determining which weatherization work should be done rather than applying blanket weatherization measures.
- **Encourage or require independent assessors:** Massachusetts’s Mass Save (and other successful programs like MNCEE) use in-house auditors for most home assessments. They feel it provides more assurance of an independent assessment and less bias toward a particular strategy/treatment or company. In-house assessments handed to contractors require an established, strong, trusting, and communicative relationship between programs and contractors. These relationships can take years to decades to cultivate.

As mentioned in the workforce development section, many parts of the Northeast region currently lack independent assessors. Some programs promote assessors associated with contractors due to the very real constraint of insufficient numbers of assessors as well as perceived inefficiencies and conflicts. As programs develop, they may wish to reinforce and promote the use of independent or in-house auditors.

- **Cultivating outstanding contractors:** Incentive programs are intended to facilitate contractor self-sufficiency and more consistent quality installations. To that end, programs may consider having higher standards or certification (e.g., Goldstar or Certified Pro) for some additional incentives. Several states in the region already require participating contractors to have some training and certifications that go above the minimum required for the industry. Other programs in the region may also move toward offering incentives only through exemplary contractors. In addition to primary contractors meeting minimum qualifications, subcontractors should be encouraged or required to meet relevant standards (e.g., BPI).
- **Coordinated assistance (braiding and stacking):** Several interviewees mentioned the need to coordinate, pay for, and address *pre-weatherization* concerns in residential buildings (e.g., health and safety barriers). Such assistance helps streamline opportunities for homeowners and can enable a building to continue through weatherization and potential HVAC replacement. All programs, utilities, and organizations are constantly looking at ways to effectively braid and stack funds. Often, funds are divided according to the services provided: pre-weatherization upgrades, weatherization, and high efficiency heat pumps. Additional stacking/braiding opportunities mentioned: Some cities and localities may augment existing programs for residents, some programs such as Empower+ and Home Performance

⁷⁴ NEEP report still to be published as of the writing of this report. Report should be accessible through www.NEEP.org or contact NEEP.



with ENERGY STAR in New York may divide up measures even within a single home service to address different upgrades, and recent IRA legislation can assist with panel upgrades.

- Limited funds from both weatherization programs and consumers means that financial tools like low-interest loans or other helpful financing plans, elongated repayment timelines, and staged installs are needed for many residents. Most programs and states have some such financing tools available.
- **Program simplicity:** Several interviewees mentioned the belief that reducing incentive program requirements and complexity increases program participation and satisfaction.⁷⁵ **Standardized measures and pricing** can provide contractors with greater assurances, particularly those serving LMI programs and residents.
- **Creating/modifying programs:** Regional communication and coordination can help refine existing programs and inform the launch of new ones. NEEP convenes regional cohorts and working groups to foster sharing of best practices and lessons learned from each other for Northeast states, programs, and communities. Programs should make full use of the assistance and leadership that NEEP and similar organizations can provide.

Simplified programs are the most effective regardless of the program structure used.

Some utility-led weatherization programs around the country have continued their programs even if they are not necessarily cost-effective, as doing so creates visible community outreach that can be augmented relatively easily by other more successful programs. If funding is scarce or cost/benefit assessments are limiting efforts for residential single-family retrofits, having a bare-bones program may allow for a rapid expansion if/when funds and cost-assessments change.

Quantifying a full range of beneficial results of envelope measures may allow those benefits to be included in cost/benefit analyses. Diverse benefits may include lower occupant health issues, hospitalizations, insurance premiums, increased structural durability, etc.

Quality Assurance Elements

Several programs mentioned that quality assurance protocols should be well-defined and provide several important program elements: 1) timelines and rectifications are spelled out; 2) contractor feedback is established and open; 3) better data is provided on the actual effects of the installations, not only on installation quality but also on homeowner awareness and use.

- When quality assurance (QA) is designed correctly, it highlights quality and integrity. Contractors should value well-designed QA. Good QA programs

Programs should highlight “golden” contractors.

⁷⁵ As an example of a drastically simplified program, one interviewee mentioned that if the predominant use for spray foam is air sealing and rim joists, simply incentivizing spray foam may increase those envelope upgrades if results could be quantified.



should highlight “golden” contractors and promote contractors with a track record of improving and learning from mistakes.

- **Subcontractors:** Many weatherization companies use “in-house” crews, while some solicit market contractors to perform a number of tasks (electric, plumbing, spray foam). Programs should be aware of which contractors are extensively using subcontractors particularly if QA indicates consistent problems. A vetted contractor network helps ensure program quality and effectiveness, and it may be prudent to include vetted subcontractors as well.

Envelope Improvement Knowledge

Utilities setting up weatherization programs often find it difficult to obtain information to create the most cost-effective programs. Pairing heat pumps with envelope improvements makes this particularly challenging, raising questions such as:

- **The ideal mix of incentives for cost-effectiveness.** Program managers need more information on overall cost/benefit modeling of different incentive structures. This includes better estimates of energy-savings results from a “menu” of options ranging from very simple measures, a more tiered approach, or using an even more graduated incentive based on varying installation capacities or efficiency results after the installation.
- For programs incorporating heat pumps and weatherization together, program managers need more data on the **minimum insulation/air sealing level** for optimizing heat pump performance versus the cost of retrofits.
- In general, programs need to be able to understand current and anticipated job costs and pricing in order to accurately forecast and prepare programs. Specific federal and state data that helps these forecasts should be available as soon as possible for decision making.

Pairing Envelope Improvements With Heat Pumps

Envelope improvement programs and heat pump programs have both expressed interest in maintaining connection with households and homeowners who have weatherized their homes with the goal of the household being ready for heat pumps when the furnace is ready to be replaced. Weatherization/envelope improvement data may inform some heat pump incentive programs or outreach efforts to help homeowners make smart decisions.

To that end, outreach could take the form of mailings/communication to households in weatherized/improved homes either through programs or contractors. Households that receive weatherization can be informed of ideal next steps and be directed to opportunities such as resource hubs or relevant programs. Depending on homeowner preference, this communication could involve a variety of outreach mechanisms, from a flyer presented after envelope improvements to follow-up emails or contact by a hub or contractor.



Conclusion

NEEP has a long history of leveraging engagement and support of regional actors to advance energy affordability for all factions of the population through energy efficiency across the region. Recognizing the potential that building envelope measures have for significant energy use reduction in the region (and thus reduce homeowner energy bills), NEEP conducted research to better understand the current envelope market and its most pressing barriers and opportunities. We presented data on the general makeup of housing stock pertaining to envelope improvement potential and concerns—a program review. Then, we presented the results of interviews with stakeholders, offering insights into barriers and opportunities for the Northeast envelope market.

This report aims to inform programs, policymakers, industry actors, and other key stakeholders about the envelope market and program landscape and provide insight on where opportunities lie for improvement. Through this discussion of envelope market particulars, current programs, and insights from stakeholders, readers may better understand the current state of the market for weatherization in the Northeast to help enlighten efforts for program direction, contractor development, and consumer outreach.



Appendices

Appendix A – Resource Lists

Resources for retrofit guidance and analysis

- *National report*: [ABC Market Guidance for Zero-carbon Aligned Residential Buildings Market Guidance Report - ABC Collaborative](#) and Navigable data for above report: [ABC Market Guidance for Zero-carbon Aligned Residential Buildings | Tableau Public](#)
- *Mass Save program data*: [Mass Save Data](#) This website is a good example of performance metrics for incentive programs going back several years.
- *Home Innovation Research Labs*: Some data sources for home improvement purchases for residential remodels are available for purchase through Home Innovation Research Labs. It may be possible to break some of the data out by region, but the usefulness and quality of the data have not been verified. [Annual Consumer Practices Survey and Reports | Home Innovation Research Labs](#)
- *MNCEE* published a paper in February 2023 titled [Minneapolis 1-4 Unit Residential Weatherization and Electrification Roadmap](#) and followed up the research with another paper in June 2024 titled [It's All About the Envelope: Prioritizing Envelope Upgrades for Electrification of Cold Climate Homes](#). Both focused on Minnesota housing stock, which can serve as a proxy for a significant portion of Northeast homes.
- *Less & Walker (2015) LBNL-184443* offers a financial assessment of costs for deep energy retrofits. Excerpt available at https://basc.pnnl.gov/sites/default/files/resource/DERs_CostEffectiveness.pdf.

Northeast Region Residential Baseline Studies

- *Massachusetts (2023)*: <https://ma-eeac.org/wp-content/uploads/Residential-Building-Use-and-Equipment-Characterization-Study-Comprehensive-Report-2023-12-22.pdf> (Section 3.8 contain envelope data)
- *Vermont (2020)*: https://publicservice.vermont.gov/sites/dps/files/documents/VT_2020_SF_EX_Baseline_Final_Report_Jan242023.pdf
- *Maine (2013)*: <https://www.energycymaine.com/docs/2015-Maine-Residential-Baseline-Study-Report-NMR.pdf>
- *New Hampshire (2020)*: Involving web-based responses. <https://www.energy.nh.gov/sites/g/files/ehbemt551/files/inline-documents/sonh/18-nh-residential-baseline-study.pdf>
- Other states may have housing assessments, but envelope data is often sparse. E.g. *Delaware (2023)* <https://www.destatehousing.com/about/housing-data> has data on general house age, but is more limited with data relating to home envelopes. However, the age of a house CAN roughly indicate potential improvement opportunities.



Workforce Examples

Several examples of successful workforce development programs were offered during discussions, including:

- **Within the Northeast**

- SMOC Green Jobs Academy (GJA) in Middlesex, NJ⁷⁶
- DCSEU example of HVAC “Externships” (Not currently involving WX but could be modified from examples with closely adjacent fields)⁷⁷
- Vermont expects to be starting a weatherization center this year for training.
- NYSWDA (New York State Weatherization Directors Association) has a fully developed training center in Onondaga County, New York.⁷⁸
- Vermont Adult Learning offers free training and support.⁷⁹
- The Philadelphia Energy Authority has “GRIT” (Green Home Immersive Training) with 12-week courses in retrofit skills and ancillary industry certifications.⁸⁰
- ECA in Philadelphia has a training center for the full slate of envelope retrofit positions.⁸¹
- Green Jobs Academy in Massachusetts has opportunities specifically for envelope retrofit fields.⁸²
- Massachusetts Climate Careers Fund offers financing to upskill entry-level workers.⁸³
- BPI outreach to regional states is available.⁸⁴ Within the Northeast states, BPA has conducted state-level workforce development needs assessments for Delaware, Maine, and West Virginia (and Virginia) and is in the process of assessing Kentucky.
- Efficiency Vermont is coordinating with the U.S. Chamber of Commerce on an outreach and coordination program called “Talent Pipeline Management.”⁸⁵ This employer-led group aims to identify barriers for employers to recruit, create a common language for job descriptions, assess actual needs, and find the best recruitment options (e.g., who, where, why). Employer-driven models can allow for very direct and efficient links toward employment.

⁷⁶ <https://smoc.org/service/green-jobs-academy/>

⁷⁷ <https://www.dcseu.com/workforce-development>

⁷⁸ <https://www.nyswda.org/>

⁷⁹ <https://vtadultlearning.org/>

⁸⁰ <https://philaenergy.org/programs-initiatives/workforce/>

⁸¹ <https://ecasavesenergy.org/training-center/>

⁸² <https://www.greenjobsacademy.org/>

⁸³ <https://socialfinance.org/work/massachusetts-climate-careers-fund/>

⁸⁴ State Support- Building Performance Association

⁸⁵ U.S. Chamber site at <https://www.uschamberfoundation.org/solutions/workforce-development-and-training/talent-pipeline-management> and Vermont site at <https://accd.vermont.gov/economic-development/programs/vtprm>



- **Outside of the Northeast**

- MNCEE career training⁸⁶
- Georgia Power Workforce Development⁸⁷
- DOL Registered Apprenticeship program⁸⁸
- For workforce development at a national level, BPA has put considerable thought into a national strategy.⁸⁹ BPA has already taken this DOL apprenticeship program and has adapted it to envelope and weatherization specialization. They can assist with developing apprenticeship programs for both installers/specialists and energy auditors as part of their state support offerings.

Business resources mentioned in interviews

- Some states have developed clearinghouses for topics relating to contractors' business operations.⁹⁰ A good example of this is MNCEE's Home Performance Business Incubator <https://www.mncee.org/home-performance-business-incubator>
- Efficiency Maine also has a marketing reimbursement (\$5,000) to help businesses grow.⁹¹
- Efficiency Vermont has its Efficiency Excellence Network (<https://www.encyvermont.com/trade-partners/efficiency-excellence-network>), which provides training, support, and job leads to help assure customers that they are receiving quality contractors.

⁸⁶ <https://www.mncee.org/career-training>

⁸⁷ <https://www.georgiapower.com/our-impact/community/education/workforce-development.html>

⁸⁸ <https://www.dol.gov/agencies/eta/apprenticeship>

⁸⁹ [Webinar: Powering the Future- Building & Sustaining the Energy Efficiency Workforce | Resources | Building Performance Association](#)

⁹⁰ A good example of this is MNCEE's Home Performance Business Incubator <https://www.mncee.org/home-performance-business-incubator>

⁹¹ <https://www.encyvermont.com/docs/Benefits-of-Becoming-an-RRV.pdf>



Appendix B – Deep Energy Retrofit Cost-Effectiveness Excerpt

Excerpt from Deep Energy Retrofits - Reducing Costs and Increasing Cost-Effectiveness
Brennan Less & Iain Walker, [Less & Walker (2015) LBNL-184443]

What works well for cost-effective DERs?

- Begin by **comprehensively addressing low- and no-cost efficiency solutions**, such as behavior, controls, window operation, lighting, hot water fixture upgrades, etc.
- **Select simple, off-the-shelf, high-efficiency systems.** In addition to lower up-front costs, this also makes it much easier to find capable suppliers, installers and service providers.
- When facing decisions among equivalent strategies/products, **select the lower-cost options** (e.g., blown cellulose versus spray polyurethane foam, air-source mini-split heat pump versus ground-source heat pump). The perceived benefits of the higher-costs alternatives rarely lead to substantially better energy performance.
- **Target homes with high pre-retrofit energy use and costs.**
- **Target homes that lack intermediary efficiency measures** (e.g., single-pane window homes versus existing double-pane windows, uninsulated walls versus those you think are “poorly” insulated, existing SEER 8 A/C versus existing SEER 13).
- **Target existing remodeling projects and equipment replacement** for incremental DER measures. These projects will typically already be engaging design and construction professionals, as well as code officials, and the added DER energy upgrade measures will therefore cost less than usual. For example, if replacing a furnace or air conditioner, use the highest efficiency model, as the additional cost of a high efficiency unit are typically justified relative to a condominium unit. Or when re-siding a home, install insulation in the wall cavity and consider exterior continuous insulation, as the cost of re-siding is already being spent.
- **Address all building systems and end-uses** without an obsessive focus on any one use (e.g., space heating). For example, during an aggressive envelope upgrade, very low-cost improvements, such as upgraded lighting, appliances, low-flow hot water fixtures, or plug controls are often overlooked.
- **Engage the home occupants** (if willing and available) early and often in the planning process. How the home is used and what owners expect will provide strong insight into which investments are appropriate and what outcomes are desirable and reasonable. This engagement also provides opportunities to better match outcomes to owner expectations.
- **Be sure to assess the impacts of DER measures on energy costs**, rather than relying solely on-site energy reductions. Some improvements (e.g., heat pumps) can increase the use of more costly energy sources, despite providing site energy reductions.



- Where applicable, **aggressively target peak load reductions**, to avoid higher electricity rates at those times. This includes passive measures, such as solar shading and selective glazing applications for different faces of the home, or HVAC controls that pre-cool a home prior to the peak period.
- It is useful to have **estimates of pre-retrofit energy costs** to provide a sense of the possible gains efficiency measures can provide, particularly for homeowners wishing to pursue a cost-effective retrofit. Pre-retrofit billing data from the home is best, but other estimates could be from regional averages, simulations, or the occupants' current usage (if in another property), adjusted for home size if applicable. For example, if the current usage (or estimated pre-usage) is \$1,100 per year, then a retrofit >\$15,000 is not likely to be cost-effective, based on cash-flow alone. [*excerpt references table*]

What are the problems to look out for in cost-effective DERs?

- **Avoid custom-engineered, complex systems.** Rarely do these perform as advertised, and commissioning, repairs and maintenance can be burdensome, as can simply identifying a contractor who is capable of working on the system.
- **Budget for unanticipated needs.** Contingencies emerge in all projects and must be accommodated and budgeted for. Identify potential contingencies and unknowns, and develop plans for dealing with them, or prioritize the various elements of a project early on, so that trade-offs can be made in an informed and careful manner.
- **Be flexible about performance targets.** Be wary of aggressive performance targets that mandate precise levels of performance, and that may lead a project down a high-cost path. There is no one-size-fits-all approach that will guarantee either success or failure in every circumstance.
- **Beware the perceived performance benefit of higher cost systems and strategies.** For example, while spray foam (SPF) insulation is costly, it is often seen as the best way to establish an air barrier. Nevertheless, SPF provided no benefits in terms of airtightness relative to other air sealing strategies in a community of DERs in Massachusetts and Rhode Island.
- **Be aware that the addition of energy-consuming features** is common in DER projects. These have the potential to offset savings or even increase electricity usage.
- **Fuel switching** from gas to electricity may seem to provide great site energy savings, but energy costs may increase, because electricity is on average three to four times more expensive than natural gas per unit of delivered energy (and it also often has higher carbon emissions).
- **Homes with low pre-retrofit utility bills do not have as much potential for cost-effective savings.** There may be other reasons to deeply retrofit these properties, but cost-effectiveness may not be one of them unless project costs are kept low.



Appendix C – Estimated Contractor Counts in Program Networks

List of estimated contractors in program networks per specialty. Data as of Fall 2024. Some data not available. Income-qualified program contractors are not included in these counts if they are not part of the public network listing. We estimate that 10-to-30 percent of contractors listed may be engaging in little to no activity.

STATE	Heat pumps, HVAC contractors	Contractors with WX, Air sealing, etc.	Energy Auditors, etc.	Notes
CT	630	49	78	
DC	288	No network	No network	
DE	42	20	20	
MA	1,706	45	16	For Wx: https://www.weatherizationcontractorlist.com/ For Energy Auditors, “Home Performance Contractors” at: https://www.masssave.com/en/residential/find-a-contractor/find-a-contractor-hpc .
MD: SMECO	188	No network	No network	
MD: BGE	415	No network	No network	
ME	681	62	No network	Find-a-contractor tool includes contractors in adjacent states like NH and MA
NH: NH Elec Co-op	No network	No network	No network	
NH: Eversource, Liberty, Unital	No network	No network	No network	
NJ: Atlantic City	No network	No network	No network	Free energy check-ups provided from within JCP&L. No list.
NJ: PSEG	319	No network	No network	Free energy check-ups provided from within JCP&L. No list..
NJ: Jersey Central	No network	No network	No network	Free energy check-ups provided from within JCP&L. No list..
NJ: Rockland Elec.	24	7	4	Wx contractors are only mentioned under the heading of “Duct and Air Sealing.” Doesn’t include Insulation.
NY: Comfort Home	No network	61	170	Auditors found at https://www.nyserda.ny.gov/Contractors/Find-a-Contractor/Residential-Energy-Assessment Wx contractors found at: https://www.nyserda.ny.gov/All-Programs/Comfort-Home-Program/Comfort-Home-Contractors-by-County
NY: Clean Heat	1500	No network	No network	Estimate is of likely <i>active</i> contractors statewide minus Long Island.
NY: PSEG-LI	75	No network	11	Assessor webpage: https://findapseglicontractor.com/
PA: PPL	36 “HVAC”	11	10	
PA: First Energy	no network	No network	No network	Utility can provide assessment
PA: PECO	6	6	No network	Utility can provide assessment
RI	139	No network	No network	
VT	190	44	20	
WV	42	16	No network	
TOTALS	6000	332	137	Totals are estimated. Not a sum.



Appendix D – Incentives for Northeast Energy-Efficiency Programs

Incentives for Primary Energy-Efficiency Programs in Northeast States Addressing Residential envelope measures

Local electric and gas utilities not mentioned in the table may have different programs that offer increased or decreased incentives.

Incentives for Primary Energy Efficiency Programs in Northeast States addressing Residential Weatherization				
Some programs mentioned below include HPwES or WAP when they were more visibly mentioned on utility/program websites. This list is not intended to be exhaustive.				
State	Incentive Program Administrator	Envelope Measure Incentive	Assessment information Envelope incentives included with heat pump installs	Link
CT	Energize Connecticut	Residential advanced duct sealing Up to \$2,750	Home Energy Solutions (HES) assessment required. HES contractor must recommend and install the measures.	https://energizect.com/rebates-incentives/residential-advanced-duct-sealing
		Insulation Up to \$10,000 (Up to \$1.70 per sf or 75% cost. \$0.25 per sf for DIY) ⁹²	HES assessment required. \$500 additional bonus with heat pump incentives if paired with insulation.	https://energizect.com/rebates-incentives/insulation
		Triple pane windows \$100 per window for ENERGY STAR triple pane (No DIY)	Home assessment recommended but not required	https://energizect.com/rebates-incentives/insulation-windows-triple-pane-window
DC	DC Sustainable Energy Utility (DCSEU)	None. (Primarily focused on multifamily.)		https://www.dcseu.com/home-owners-renters
DE	Energize Delaware (HPwES ⁹³ and Assisted HPwES)	Comprehensive rebates up to approximately \$5k depending on improvements, including air sealing, duct sealing, insulation throughout the house, including crawlspace encapsulation and insulated siding . (Income-qualified customers qualify for higher rebates.)	Home energy assessment required (co-pay of \$50/\$25 LMI) \$300 bonus with heat pump incentives if paired with air sealing.	https://www.energizedelaware.org/residential/home-performance-with-energy-star/homeowners/
MA	Mass Save	Insulation and air sealing 75% to 100% off approved measures. (Expected changes in 2025)	Home Energy Assessment required. No cost. WX contractor may do the assessment. Homes receiving heat pumps must have sufficient envelope quality to participate.	https://www.masssave.com/en/residential
		Windows \$75 per window for ENERGY STAR windows replacing single-pane.	Home Energy Assessment or virtual visit required. If air seal/insulation needed, must include those.	

⁹² DIY = Do-It-Yourself, homeowner installed. Needs approval via an assessment or other qualification.

⁹³ Home Performance with Energy Star program



MA	Mass Save	Renovations & additions with Pay- for-Savings up to \$60,000. Also includes assistance for home certifications. For fossil-fuel free improvements only.	HERS rater visit required before project begins. 500+ sf and 50%+ of original home.	https://www.masssave.com/en/residential/programs-and-services/renovations-and-additions
MD	BGE	None (BGE refers to HPwES program for Wx incentives for up to ~\$10k per house.)		https://bgesmartenergy.com/residential/rebates-and-discounts
ME	Efficiency Maine	Air Sealing and insulation Up to \$4,000 per home (LMI = \$6k-\$8k) Health and Safety costs capped at 25% of total cost.	No assessment required, but must use registered vender for install	https://www.energymaine.com/home-insulation/
NH	NHSaves (Eversource, Liberty, NH Elec. Co-op, Unitil)	General weatherization 100% for income-qualified customers through Home Energy Assistance (HEA) Up to \$6,000 for qualified incentives.	Assessment required For NHEC, <i>if applicant has previously done Wx, add \$250/ton to HP incentive</i>	https://nhsaves.com/residential/weatherization/ and https://nhsaves.com/residential/income-eligible-energy-assistance-program/
	NHSaves	Residential “gut rehab” Refers to up to \$10,000 through ENERGY STAR Homes Program		https://nhsaves.com/residential/new-home-construction/
NJ	PSEG	Whole Home Energy Solutions Program Up to \$6,000 in rebates and up to \$25,000 interest-free, on-bill repayment. LMI requirements with either income or location.		https://homeenergy.pseg.com/
	Orange & Rockland	Home weatherization for income-qualified customers Up to \$7,500	Free energy assessment offered	https://www.oru.com/en/save-money/rebates-incentives-credits/new-jersey-customers/incentives-for-residential-customers-nj/weatherization-program
	ACE (Atlantic City Electric)	Whole Home Energy Solutions Program Up to \$6,000. <i>Program currently on hold until further notice.</i> Home weatherization program (WAP) Income-eligible up to \$14,000 and \$2,500 in health and safety improvements.		https://homeenergysavings.atlanticcityelectric.com/residential/energy-assessments/home-performance-with-energy-star-program
	JCPL (Jersey Central Power & Light)	HPwES Program Rebate potential up to \$5,000 Home weatherization for income- qualified customers Rebate potential to \$6,000, and \$1,500 in health and safety improvements.	Assessments required	https://residential.energysave.nj.com/jersey-central/home-performance/ https://residential.energysave.nj.com/jersey-central/MIWX/
	NJ Clean Energy Program	(WAP) Comfort Partners for income- eligible no-cost weatherization including envelope upgrades.		https://www.njcleanenergy.com/residential/cp



NY	NYSERDA	<p>EmPower+ Income-qualified. Low- income projects capped at \$10,000. Moderate-income projects capped at \$5,000. Covers a range of upgrades prioritizing core energy efficiency improvements which includes insulation and air sealing (along with health and safety and refrigerator/freezers). HEAR funding (through IRA) can add incentives accordingly: Air seal, insulation, ventilation, \$1,600. Electrical service upgrade, \$4,000. Electrical wiring upgrade \$2,500, along with heat pump incentives.</p>	<p>Assessment required. Energy advisors are available through regional Clean Energy Hubs</p> <p><i>When air sealing and insulation are completed, contractors can make recommendations for improved HVAC.</i></p> <p><i>HEAR includes incentives for heat pumps and heat pump water heaters.</i></p>	<p>https://www.nyserda.ny.gov/A-II-Programs/EmPower-New-York-Program</p> <p>Clean Energy Hubs https://www.nyserda.ny.gov/A-II-Programs/Regional-Clean-Energy-Hubs</p>
		<p>Comfort Home All-income. Tiered between \$1,600 and \$4,000 for shell insulation and air sealing. May include ENERGY STAR windows.</p>	<p>Assessments often done through insulation contractor.</p>	<p>https://www.nyserda.ny.gov/A-II-Programs/Comfort-Home-Program</p>
	NYS Clean Heat (ConEd and the other Joint Utilities)	<p>Currently, Clean Heat is focused on heat pump technology for single- family homes, but recommends envelope assessment be considered. Weatherization program components may be forthcoming.</p>		<p>https://cleanheat.ny.gov/</p>
	PSEG-Long Island	<p>Whole Home Energy Solutions Moderate income, census tract, or OCB requirements. Up to \$6,000.</p> <p>Home weatherization program for income-qualified customers Data not found.</p>	<p>Assessment required. LMI through Comfort Partners.</p> <p>All-income through Whole Home Energy Assessment <i>If applicant has heat pumps installed, there is an additional window rebate.</i></p>	<p>https://homeenergy.pseg.com/WHES</p> <p>https://homeenergy.pseg.com/homeweatherization</p>
PA	PPL	<p>Air sealing: Up to \$200</p> <p>Attic insulation: 75% up to \$500</p> <p>Basement wall insulation: 75% up to \$500</p> <p>Insulation rebates are higher for homes with electric heat.</p>	<p>Virtual assessments available. Air sealing requires BPI standards and blower door pre and post. <i>If applicant includes a retrofit HP, add \$250-\$350 to Wx incentive. If applicant includes insulation & air sealing, add \$350 to HP incentive.</i></p>	<p>https://ppl.clearesult.com/rebates/weatherization</p> <p>Rebate Flyer https://www.pplelectricsaving.com/ppl/sites/ppl/files/2024-05/2024_All_Res_Rebates_Flyer_May2024.pdf</p>
	PECO, First Energy	<p>PECO – info not found. Requires login.</p> <p>First Energy – No envelope improvement incentives</p>		



RI	RI Energy	Air sealing and insulation Up to \$4,000 off.	Assessment required	https://www.rienergy.com/site/ways-to-save/save-money-with-rebates-and-incentives/insulation-and-air-sealing
	Clean Heat Rhode Island	None. <i>RI Clean Heat refers income-eligible customers to WAP:</i>	Virtual consults offered <i>100% of heat pump cost for LMI but home must have sufficient Wx.</i>	
	Block Island Utility District	Air/duct sealing \$800 Pipe and wall insulation 40% off. Totals up to \$2,000	Assessments through Energy New England <i>If including a HP, add \$250 for exterior wall insulation only</i>	https://ene.org/ene-sustainability/block-island-utility-district/
VT	Efficiency Vermont	General air sealing/ insulation 75% up to \$4,000 for Air sealing; \$100 for DIY Insulation and air sealing Moderate-income = 75% up to \$9,500. Low-income = 90% up to \$9,500 Home repairs (pre-weatherization) up to \$15,000 through HPwES for income-eligible. Income qualified WAP Free	Financial and energy coaching available Minimum 10% leakage reduction and health and safety improvements are made.	https://www.encyvermont.com/rebates
WV	Appalachian Power	Insulation \$0.20 to \$0.30/sf. Air sealing (30% reduction) 50% up to \$250 Duct sealing Up to \$300	Free assessment offered. Not required for incentives.	https://takechargewv.com/programs/for-your-home/home-performance-home-energy-assessments