Estimating the Impacts of Weatherization Readiness Programs

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Research Report

ACEEE

About ACEEE

The **American Council for an Energy-Efficient Economy** (ACEEE), a nonprofit research organization, develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

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Data and Licensing Information

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Glossary

Deferral/weatherization deferral is the practice of delaying a Weatherization Assistance Program (WAP)-eligible client from receiving weatherization services, often due to needed repairs, presence of health and safety issues that prevent weatherizing the home or dwelling unit, or occupant behavior.

Eventual deferral occurs when resources to address issues causing an initial deferral cannot be identified, and WAP services are postponed until the issues causing the home or dwelling unit to be deferred can be addressed.

Initial deferral is the practice of, after a WAP home audit, placing a home on a list of deferred properties due to preexisting conditions (such as a leaking roof) or occupant behavior; however, in some cases, the issue(s) causing the deferral can be repaired so that the client may receive WAP services.

Kilowatt hour (kWh) is a measure of electricity defined as a unit of work or energy, measured as 1 kilowatt (1,000 watts) of power expended for 1 hour. One kWh is equivalent to 3,412 Btu.

MMBtu is one million British thermal units (Btu). This is the quantity of heat required to raise the temperature of one pound of liquid water by one degree Fahrenheit at the temperature at which water has its greatest density (approximately 39°F).

Weatherization is the practice of improving a building's envelope and ventilation systems and ensuring heating and cooling systems are operating safely to make a building more comfortable and energy efficient.

Weatherization Assistance Program (WAP) is a U.S. Department of Energy program that provides no-cost comprehensive energy efficiency retrofits for income-eligible households as established by the Energy Conservation in Existing Buildings Act of 1976.[1]

WAP grantees are agencies that receive federal funding to administer WAP in 50 states, the District of Columbia, and the five U.S. territories.

WAP subgrantees are local or regional community action agencies or other public or nonprofit entities that carry out WAP projects.

Weatherization readiness measures are necessary repairs or measures installed that will address issues causing a home to be deferred and prepare a deferred home to become eligible for weatherization. Common examples include roof repair or replacement, electrical and plumbing repairs, and removal of hazardous materials such as mold or asbestos.

[1] Energy Conservation in Existing Buildings Act of 1976, 42 U.S.C. § 6861. Part A. (1976). https://www.govinfo.gov/content/pkg/STATUTE-90/pdf/STATUTE-90-Pg1125.pdf.

Key findings

- About one in five (approximately 19% of) income-eligible households in our national survey were initially deferred from the Weatherization Assistance Program (WAP) in 2023 due to repairs needed to address existing conditions and health and safety issues.
- About 60% of these initially deferred homes were repaired and eventually served by WAP, while 40% could not be made weatherization ready (and could not gain associated benefits).
- Initially deferred homes that were ultimately served after receiving weatherization readiness repairs experienced significant benefits including an average annual $372 in utility bill savings (2022 dollars, as stated by U.S. DOE).[2] This is roughly equivalent to 23 metric tons of carbon dioxide averted per weatherized unit over the life of installed measures.[3]
- If the 40% of homes that were eventually deferred could be weatherized, we estimate that 49,236 MWh (168,000 MMBtu) of energy would be saved annually, and 153,000 metric tons of carbon dioxide emissions ($MTCO_2e$) would be avoided over the lifetime of the measures.
- The most frequently reported reasons for initial deferrals were roof leaks or repairs (estimated median 45% of deferred homes), followed by floor damage (estimated 23%), and unsafe or outdated electric service panels (estimated 23%).

Executive summary

Weatherization programs play a vital role in alleviating the high energy bills faced by millions of low-income households across the United States, contributing to improved health and safety outcomes, enhanced comfort, and reduced energy consumption. The cornerstone of these efforts is the federally funded Weatherization Assistance Program (WAP), complemented by expanding utility sector programs for low-income customers, and various other funding streams such as the Low-Income Home Energy Assistance Program (LIHEAP) and state and local programs.[4] WAP and some utility programs provide energy efficiency retrofit services at no cost to qualifying households.

Participation in these programs, however, is often hampered by existing home conditions and repair needs that restrict the ability of implementors to install energy saving equipment and measures. This report explores the frequency, causes, and factors associated with deferring homes from WAP. We estimate the costs to address issues that cause deferrals from WAP and project potential energy and greenhouse gas emissions reductions that could be unlocked by treating these homes. We examine the benefits both from the weatherization readiness repairs themselves and from enabling the deferred homes to participate in WAP.[5]

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[2] U.S. DOE (United States Department of Energy). 2023. "Weatherization Assistance Program Fact Sheet." https://www.energy.gov/sites/default/files/2023-08/2023-WAP-Fact-Sheet.pdf.

[3] To estimate carbon savings, we used rough estimates of lifetime carbon dioxide reductions per weatherized unit from Oak Ridge National Laboratory's assessment of overall carbon emissions reduction from WAP (published in 2014 using 2008 data). In that analysis, 2,246,000 metric tons of carbon dioxide were reduced from 97,965 units, roughly equivalent to 23 metric tons per weatherized unit.

[4] As of April 1, 2025, all LIHEAP staff were terminated. It is currently unclear to what extent the program will continue.

[5] We conducted a survey of WAP providers and, although utility programs for low-income customers were not included, these utility programs serve similar customers and are therefore likely to share similar driving forces.

Weatherization program background

WAP has been in operation since 1976 and is administered through the U.S. Department of Energy's (DOE) Office of State and Community Energy Programs (SCEP). WAP promotes a whole-house approach to weatherization that involves upgrading a home's insulation, reducing air leakage, repairing or replacing heating and cooling systems, and addressing health and safety issues.[6]

WAP funds are allocated by population-based formula to state and local program administrators who in turn dispatch auditors to visit homes, identify cost-effective energy-efficient equipment and measures, and implement/install energy savings projects. Through its grantees and subgrantees, WAP has served over seven million households since its inception and weatherizes an average of 35,000 households each year using WAP formula funds.[7] About 69,000 housing units were weatherized by WAP in 2022, using all sources of funds.[8] WAP saves participants an average of $372 per year in energy costs (2022$), while improving comfort, safety, and health outcomes for thousands of households annually.[9]

WAP funds can also be leveraged alongside state, local, or utility incentives to enable deeper savings for households, alleviate issues related to health and safety, and make needed repairs. In many jurisdictions, utilities combine federal and ratepayer funding to provide more flexibility than allowed by WAP requirements. This coordination of funding sources allows programs to serve families that are otherwise left behind. Utility programs are funded separately and not subject to fluctuations in allocations of federal funds. Therefore, they play a key role in implementing more comprehensive programs that reach underserved customers.

Deferral of weatherization projects

Deferrals occur when an auditor visits a residence and determines that existing conditions impede the ability to implement energy efficiency measures. Deferrals not only delay and possibly eliminate the opportunity for energy savings but also expend auditor time and resources on households that do not ultimately proceed in WAP and other similar weatherization and energy efficiency programs for low-income customers.

Homes are initially deferred for a variety of reasons. Based on our 2024 survey, these most frequently include

1. Envelope issues such as roof leaks (45%), floor/framing damage (23%), and foundation damage (15%)
2. Unsafe, damaged, or outdated electrical service panels (23%) and wiring (11%)
3. Plumbing leaks or standing water in basement (10%), or damaged or missing gutters/downspouts (10%)

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[6] U.S. DOE (United States Department of Energy). 2024. "Whole-House Weatherization." https://www.energy.gov/scep/wap/whole-house-weatherization.

[7] U.S. DOE (United States Department of Energy). 2023. "Weatherization Program Notice 23-4: Weatherization Readiness Funds—Expansion of Scope."; U.S. DOE (United States Department of Energy). 2023. "Weatherization Assistance Program Fact Sheet," https://www.energy.gov/sites/default/files/2023-08/2023-WAP-Fact-Sheet.pdf.

[8] NASCSP (National Association of State Community Service Programs). 2024. "Program Year (PY) WAP Annual Funding Survey." https://nascsp.org/wp-content/uploads/2024/08/NASCSP-PY-2023-WAP-Annual-Funding-Survey_final.pdf.

[9] US DOE (United States Department of Energy). 2023. "Weatherization Assistance Program Fact Sheet" https://www.energy.gov/sites/default/files/2023-08/2023-WAP-Fact-Sheet.pdf.

4. Presence of pests (15%), asbestos (13%), or mold (10%)
5. Occupant behavior (25%)

Many deferrals can be addressed and allow households to participate in the future. Others are too costly or not achievable. This report focuses on how to capture the opportunities and benefits associated with deferrals that can be addressed.

To resolve deferrals, weatherization providers need funding to address or repair the issues noted above. The survey results indicate that repair costs per home range from approximately $2,000 to $25,000, depending on the types of repairs and regional differences in material and labor costs. The mean cost of repairs was estimated at $13,870 (+/–$221),[10] and the weighted median cost of repairs was estimated at $15,000 per home.

Many low-income residents do not have the means to overcome an initial monetary outlay of $2,000 to $25,000, even if it means saving money in the long run. This report focuses on the value of providing additional funding to assist low-income residents in improving their homes while unlocking energy savings from WAP.

ACEEE survey and analysis

To support this analysis, we conducted surveys of WAP grantees and subgrantees that asked respondents to estimate the frequency of deferrals, types of repairs needed to address deferrals, average weatherization readiness project repair costs, and characteristics of WAP-eligible buildings in their service territories. Respondents were well distributed geographically, representing 28 different states, with 29% from the Midwest, 10% from the Northeast, 38% from Southern states, and 23% from Western states. They also represented all major U.S. climate zones (from zone 2 to zone 7). Primary findings from our survey include

- Approximately one in five homes (about 19%) that seek WAP services were initially deferred for addressable or repairable issues.
- About 60% of initially deferred homes were repaired and eventually served by WAP, while the remaining 40% could not be made weatherization ready and did not benefit from the average annual $372 in utility bill savings that WAP unlocks (2022 dollars, as stated by U.S. DOE).[11] This is roughly equivalent to 23 metric tons of carbon dioxide averted per weatherized unit over the life of the measures.[12]
- The most frequently reported preventable reasons for initial deferrals were roof leaks or damage (estimated median 45% of deferred homes), followed by floor damage (~23%), and unsafe or outdated electric service panels (~23%).

[10] The weighted mean is $13,870. The 95% confidence interval is $13,649 to $14,091. One standard deviation is $4,171.

[11] U.S. DOE (United States Department of Energy). 2023. “Weatherization Assistance Program Fact Sheet.” https://www.energy.gov/sites/default/files/2023-08/2023-WAP-Fact-Sheet.pdf.

[12] To estimate carbon savings, we used rough estimates of lifetime carbon dioxide reductions per weatherized unit from ORNL’s assessment of overall carbon emissions reduction from WAP (published in 2014 using 2008 data). In that analysis, 2,246,000 metric tons of carbon were reduced from 97,965 units, roughly equivalent to 23 metric tons per weatherized unit. Tonn et al. 2014. “Weatherization Works: Summary of Finding from the Retrospective Evaluation of the US Department of Energy’s Weatherization Assistance Program.” https://www.osti.gov/biblio/1223642.

- Most WAP-eligible homes are single-family (~63%), followed by mobile/manufactured homes (~28%) and multifamily buildings (~3.6%).

We also completed building energy modeling to estimate the potential benefits of weatherization readiness activities. Our primary findings from this analysis are

- Some weatherization readiness measures result in significant energy use reductions, while others do not produce notable savings.
- As the savings are highly dependent on the type of repair, the baseline characteristics of the modeled homes, and climate zone, there is a wide range of estimated savings.
- In general, heating system upgrades for older homes in cold and mixed climates (climate zones 5 and 4) produce the most savings, and cooling system upgrades in cooling-dominated climates (zones 2 and 3) result in significant savings.
- However, because of the relatively low frequency of heating, ventilation, and air conditioning (HVAC) replacements (estimated median 5% of projects nationally from the survey) we cannot generalize these levels of savings to all deferred homes.
- We estimate that although the overall median energy savings of weatherization readiness repairs across all measures, home types, and projects modeled is 539 kWh annually, some of the most likely weatherization readiness repair packages are projected to save between 967 kWh and 9,876 kWh annually for typical colonial-style homes.[13]

We also extrapolated that approximately $9.5 million in annual potential health and bill savings benefits and 49,236 MWh of energy savings could be realized if all eventually deferred homes in the 2023 WAP program were made weatherization ready:

- $2.5 million in annual utility bills savings (based on $372 average annual bill savings per program participant)[14]
- $3.4 million in medical expense reduction (based on $514 per year reduction in out-of-pocket medical expenses per program participant)[15]
- $3.6 million in annual benefits from reduced sick days (based on $538 annual benefit per household)[16]
- 49,236 MWh (168,000 MMBtu) of energy saved each year
- 153,000 metric tons of carbon dioxide emissions reduced ($MTCO_2e$) over the lifetime of the measures

[13] Common packages were compared across regions for a 1950s colonial-style house with two stories and 1,500 square feet (a commonly reported home type across regions). Appendix F shows a range of typical packages across regions for this home type, along with the expected savings from each.

[14] U.S. DOE (United States Department of Energy). 2023. "Weatherization Assistance Program Fact Sheet." https://www.energy.gov/sites/default/files/2023-08/2023-WAP-Fact-Sheet.pdf.

[15] U.S. DOE (United States Department of Energy). 2023. "Weatherization Assistance Program Fact Sheet." https://www.energy.gov/sites/default/files/2023-08/2023-WAP-Fact-Sheet.pdf.

[16] U.S. DOE (United States Department of Energy). 2023. "Weatherization Assistance Program Fact Sheet." https://www.energy.gov/sites/default/files/2023-08/2023-WAP-Fact-Sheet.pdf.

Value of weatherization readiness

Weatherization readiness is the process of correcting in-home issues that can or do cause deferrals. These efforts are generally focused on needed repairs and health and safety improvements. This allows households that have previously been deferred, or are likely to be deferred in the future, to participate in WAP and other similar low-income weatherization programs, and to realize the health and bill savings benefits we note above.

Weatherization readiness achieves many important outcomes, including both energy and non-energy benefits. These accrue to program participants, as well as to the utility system and society at large. We include those generated by weatherization readiness activities, and the additional benefits accrued from the completed weatherization project, because the completed project would not have occurred without the weatherization readiness work. The benefits for weatherization readiness and weatherization are described below, with a breakdown of benefits by perspective.

Benefits of weatherization readiness

- **Participant**: Improved safety, improved health, increased home value, and improved comfort
- **Societal**: Economic development, job creation and retention, reduced air emissions

Benefits of weatherization

- **Participant**: Lower utility bills (electricity, natural gas, and water), improved health outcomes, increased home value, improved comfort, and increased ability to pay other bills
- **Utility**: Avoided energy production; avoided investments in incremental capacity for generation, transmission, and distribution (which lower costs for all customers); reduction in arrearages and service disconnections/reconnections[17]
- **Societal:** Job creation and retention, reduced air emissions driven by lower power plant utilization, avoided environmental damages (harm to human health and the natural environment) driven by lower electric power air emissions,[18] and economic development

Next steps and recommendations

Weatherization programs, including WAP, are life-changing programs for families who are able to participate; however, too many are left behind due to addressable issues in their homes. There are compelling financial, social, and environmental reasons to substantially increase weatherization readiness funding, and for governments, nonprofits, utilities, and private companies to invest in expanding available weatherization readiness resources and programs.

Specifically, we recommend the following actions to improve outcomes in the low-income weatherization space:

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[17] Shingler, John. 2009. *Long Term Study of Pennsylvania's Low Income Usage Reduction Program: Results of Analyses and Discussion*. University Park, PA: Penn State University. https://aese.psu.edu/research/centers/csis/publications/long-term-study-of-pas-low-income-usage-reduction-program/@@download/file/LowIncomeUsage2008.pdf.

[18] U.S. EPA. 2025. *Progress Cleaning the Air and Improving People's Health*. https://www.epa.gov/clean-air-act-overview/progress-cleaning-air-and-improving-peoples-health#enviro.

- **Improve tracking and data collection on weatherization deferrals.** Gaining a better understanding of why low-income customers are deferred and how those issues can be mitigated is paramount to improving WAP and other, similar low-income weatherization programs.
- **Increase funding for weatherization readiness programs.** Based upon our survey and analysis, we estimate that for the 2023 WAP, increasing funding by $91.3–94.2 million per year could have funded nearly all addressable weatherization readiness work and enabled nearly 7,000 additional households to participate in WAP in 2023. We estimate the weighted average cost of weatherization readiness is $13,649–14,091 per home. The increase in funding could come from utilities, federal and state government, nonprofit organizations, and corporate investment to improve low-income communities. Appendix A presents case studies demonstrating these various funding models.
- **Engage states, utilities, localities, and nongovernmental organizations in the weatherization readiness process.** Leveraging diverse funding sources, particularly from utilities that already serve and can easily identify eligible customers, is vital to expanding coverage of weatherization readiness and reaching a previously inaccessible portion of the market.

Weatherization readiness projects and programs can save energy and money, reduce greenhouse gas emissions, and provide a host of non-energy benefits. Adopting the above recommendations will produce better outcomes, including significantly increasing access to WAP and similar programs for underserved households by reducing WAP deferrals so that thousands more homes become eligible.

Introduction and background

Improving a building's energy efficiency helps households save money on energy bills and can improve indoor air quality and comfort. Since 1976, the DOE has operated the WAP to install energy-saving measures at no cost to low-income households. DOE promotes a whole-house approach to weatherization that involves upgrading a home's insulation, reducing air leakage, repairing or replacing heating and cooling systems, and addressing health and safety issues that may be present (U.S. DOE 2024a). WAP recipients benefit from both energy bill savings and improved health outcomes (Norton, Brown, and Malomo-Paris 2017) while reducing greenhouse gas (GHG) emissions (Tonn et al. 2014). DOE allocates funding through formula grants to states and territories, which are known as WAP grantees. The grantees then partner with subgrantees, or local agencies or organizations[19] that implement the weatherization projects at a local level. WAP has served over seven million households since its inception and weatherizes an average of 35,000 households each year using WAP formula funds (U.S. DOE 2023a, 2023b). About 69,000 units were weatherized in 2022, using all sources of funds[20] (NASCSP 2024).

Potential clients (homeowners and renters) that meet initial WAP income eligibility requirements do not always receive services and may be deferred. WAP deferrals occur when a weatherization provider performs a site visit and evaluation to determine if an energy audit can be safely performed, but the evaluation reveals preexisting issues that prevent conducting the audit and installing weatherization measures (Graham 2022; E4theFuture 2022). Common reasons for WAP deferrals include leaking roofs and other needed structural repairs, outdated and unsafe wiring (e.g., knob and tube wiring) and electric service panels, presence of mold or other hazardous materials, and unsafe or failing combustion appliances (Rose et al. 2015; U.S. HUD 2020). Households may be deferred or denied services for other reasons, such as client nonresponsiveness, lack of potential weatherization measures that meet project cost-effectiveness requirements, or inability to obtain a landlord’s approval to weatherize a rental property.

Making the necessary repairs and addressing issues that may cause deferrals can often be expensive, and low-income households rarely have the resources to address them (U.S. HUD 2020; Federal Reserve Bank of Philadelphia 2019). Many weatherization-eligible households are in historically marginalized and economically disadvantaged communities and would benefit most from WAP services (Rose and Hawkins 2020; Hayes et al. 2022). We found through our survey responses that about 60% of homes that are initially deferred for addressable or repairable reasons were able to be repaired and served by WAP; however, about 40% remained deferred. Subgrantees utilize a variety of fund sources (federal, state, and local) to implement repairs and make homes “weatherization ready.” If the subgrantee does not have resources to address the issue(s) causing deferral, the client may be referred to another organization or program (NASCSP n.d.).

Because WAP is an energy efficiency program rather than a housing repair program, WAP grantees and subgrantees have limited amounts of WAP funds to support repairs, health and safety measures, and other non-energy-related measures. Individual WAP projects where measures are installed using DOE formula funds[21] must be cost effective, as determined by a Savings to Investment Ratio (SIR) of 1.0 or greater over the measure lifetimes (U.S. DOE 2022). Grantees must also adhere to an average cost per

19 Community action agencies and nonprofit housing providers are examples of typical WAP subgrantees.
20 WAP funding sources include DOE formula, DOE Bipartisan Infrastructure Law (BIL), American Rescue Plan Act (ARPA), LIHEAP, and other (state and local).
21 Formula grants are noncompetitive funding programs that distribute funds according to a formula set by federal statute.

unit (ACPU) cap, which was $8,250 for the 2023 program year.[22] This can make it challenging to complete more complex projects (such as major repairs or heating, ventilation, and air conditioning [HVAC] system replacements) that may require higher expenditures. Further, federal regulations governing the operation of WAP limit installation of energy conservation measures where existing conditions in the home, such as a leaking roof, may compromise newly installed materials, such as attic insulation (U.S. DOE 1984). To protect the health and safety of occupants and workers, procedures required for weatherization audits, such as mechanical (blower door) testing of envelope air leakage, often may not be performed if materials such as mold or friable asbestos are determined to be present in the home or unit (Rose et al. 2015).

This report is intended to inform both those who develop policy and implement programs to address weatherization readiness. Other key audiences include businesses, community-based organizations, and advocates for programs that reach low-income and marginalized households.

About the WAP

Ultimately, the purpose of weatherization readiness projects and programs is to prepare deferred homes to receive WAP energy retrofits and unlock the energy bill savings and health and safety improvements that WAP offers for low-income and energy burdened households. In addition to $372 average annual bill savings, WAP enables an estimated $514 per year reduction in out-of-pocket medical expenses, and a $538 annual benefit per household due to reduced sick days (U.S. DOE 2023b). We estimate that providing weatherization readiness repairs and remediation to all currently deferred homes and enabling their participation in WAP would unlock significant energy and carbon savings: 49,236 MWh (168,000 MMBtu) per year and emissions reduction benefits of 153,000 metric tons of carbon dioxide ($MTCO_2e$) over the lifetime of the weatherization measures.

Leading WAP providers combine funding sources to maximize the number of households they can serve. Two of these leaders include Washington state's Weatherization Plus Health program, and Virginia's Community Housing Partners (CHP). Washington's program incorporates health and safety improvements (such as reducing potential for trips and falls and triggers for residents suffering from chronic respiratory diseases) as part of its standard weatherization processes (Furze 2022). CHP serves as an implementer for WAP as well as for utility programs for low-income customers. In this role, CHP's Weatherization and Energy Solutions team can offer more comprehensive services by combining WAP and utility program funds and can serve customers that may be eligible for utility programs but not for WAP (Community Housing Partners n.d.).

Weatherization program funding

Primary federal funding sources

At the forefront of federal support is the DOE WAP. This program, authorized by Part A of the Energy Conservation in Existing Buildings Act of 1976, serves as the foundation of the nation's weatherization efforts.[23] In 2021 the Bipartisan Infrastructure Law (BIL) added $3.5 billion for WAP. The flow of funding from federal sources to homeowners is depicted in Figure 1, below. However, without adequate

[22] A table including WAP ACPU over time is available on the US DOE website (U.S. DOE 2024d)
[23] Energy Conservation in Existing Buildings Act of 1976, 42 U.S.C. § 6861. Part A. (1976). https://www.govinfo.gov/content/pkg/STATUTE-90/pdf/STATUTE-90-Pg1125.pdf.

weatherization readiness funding, the additional BIL resources may not be fully utilized and cannot benefit their intended recipients.

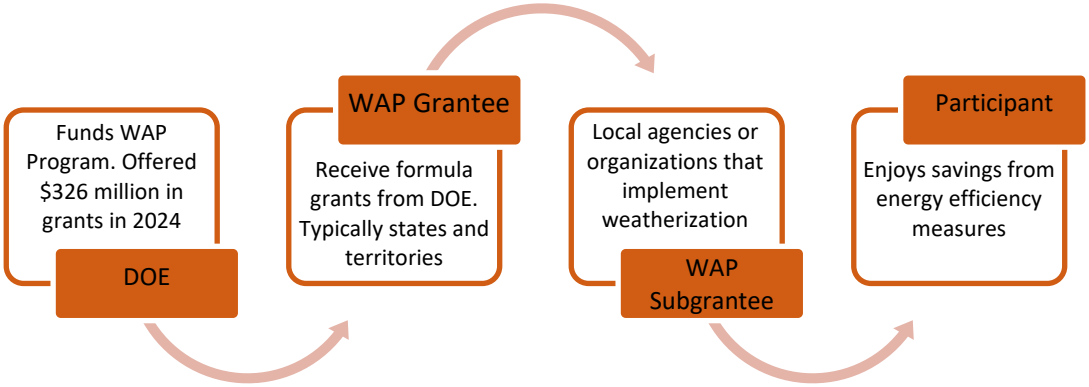

Figure 1. Flow of WAP grants

LIHEAP

Complementing the DOE's WAP is the U.S. Department of Health and Human Services (HHS) LIHEAP. Although the future of LIHEAP is currently uncertain,[24] the program has provided crucial financial assistance to states, tribal organizations, and territories to help low-income households meet their immediate home energy needs (U.S. DOE 2011). LIHEAP's primary focus is on helping families pay their heating and cooling bills and addressing short-term emergencies, but LIHEAP funds can also pay for weatherization and minor energy-related home repairs. States can dedicate up to 15% of their total LIHEAP funds for this purpose, and this allocation can be increased to as much as 25% with a waiver from HHS under certain conditions, such as demonstrating that the state will not reduce its spending on crisis benefits or serve fewer households (LIHEAP Clearinghouse n.d.). Given the regulatory restrictions on use of DOE funds, many states use a portion of their annual LIHEAP funding allocation from HHS to bolster DOE funding for WAP and help cover some of the costs of addressing deferrals and health and safety repairs (Graham 2022).

Utility supported programs

Utility-supported programs for income-qualifying customers also hold immense value for weatherization readiness. This approach can combat fluctuations in federal WAP funding and provide more diverse funding sources. Utilities and corporate programs should explore opportunities to support weatherization readiness and weatherization efforts at scale, inclusive of WAP and utility-supported energy efficiency programs for limited-income customers. For example, AES Indiana and Ameren Illinois are two utilities running Healthier Homes programs designed to provide weatherization and weatherization readiness services to their customers (Ameren Illinois n.d.; AES Indiana 2025). Additional case studies of successful weatherization readiness programs supported by public and private funding and innovative partnerships can be found in Appendix A.

[24] As of April 1, 2025, all LIHEAP staff were terminated. It is currently unclear to what extent the program will continue.

Federal weatherization readiness funds (WRF)

In 2022, DOE received approval to begin providing $15 million in federal WRF funding to support grantees and subgrantees in addressing needed repairs. With Congress' approval, WRF allocations to grantees were increased in 2023 and 2024 (U.S. DOE 2023a) but are unlikely to increase in 2025.

State and regional funds

States and localities may also provide supplemental sources of funds[25] to increase the number of WAP-eligible households where repairs causing deferrals can be addressed, or to provide more flexibility on cost-effectiveness requirements that may limit measures that can be installed.

Regional Greenhouse Gas Initiative (RGGI) proceeds represent another potential source of funding for weatherization projects. RGGI is a cooperative effort among several Northeastern and Mid-Atlantic states to cap and reduce carbon dioxide emissions from the power sector. States participating in RGGI sell emission allowances, and the proceeds from these sales can be directed toward various clean energy and energy efficiency initiatives, including weatherization programs (RGGI 2024).

Braiding and stacking funding

Some grantees, subgrantees, and municipal governments are successful in combining multiple programs/funding sources to address most WAP deferrals in their service areas and others have been challenged by lack of resources (Graham 2022). A few states, notably Virginia and Pennsylvania, have established statewide weatherization readiness and repair programs not funded by DOE and provided significant amounts of dedicated funding (Virginia DHCD 2024; Pennsylvania DCED 2024). Regional and local programs have also emerged to address known gaps in the weatherization safety net for low-income households (Sol Systems 2023). These successes are relatively rare; however, the need remains great in many states, with a large and persistent funding gap for weatherization readiness and critical home repair programs nationally.

Remaining knowledge gaps

To build support for expanding weatherization readiness programs, two critical gaps in knowledge must be filled. First, the current scope of the issue of weatherization deferrals must be investigated. Currently, no U.S.-wide comprehensive registry or repository of weatherization deferrals exists and, as such, data on the number and types of deferrals from WAP are not centralized and easily accessible. Second, the energy savings and carbon emissions reduction benefits of weatherization readiness repairs themselves are not well understood. This report is intended to help address these knowledge gaps to better understand the required scale and potential impact of weatherization readiness solutions.

Research goals

The primary goals of this research project include

1. Provide a current national estimate of the proportion of homes deferred from WAP and the reasons for deferrals, and the estimated costs to make deferred homes weatherization ready. We focus on the federal WAP because it is the largest and most representative program.

[25] Examples include state and local emergency home repair funds, investments from states that participate in the RGGI, and federal sources like the Weatherization Readiness Funds and American Rescue Plan Act (ARPA).

2. Develop estimates of energy use and carbon emissions reductions enabled by typical weatherization readiness projects and programs.
3. Highlight examples of successful weatherization readiness programs using case studies.
4. Provide information that can drive and support policy initiatives aimed at obtaining the funding needed to scale weatherization readiness programs.

Research process overview

To our knowledge, this is the first study estimating and quantifying energy savings and GHG emissions reductions that could result from typical weatherization readiness projects and repairs for households seeking WAP services. This research addresses the lack of data on this topic and focuses on two primary questions:

1. Approximately how many low-income households nationally that seek WAP services (and meet household annual income qualifications) are deferred and unable to participate due to preexisting issues or repair needs on their homes? From this, ACEEE aimed to determine what percentage of attempted audits result in a deferral.
2. What are the energy savings and carbon reduction benefits associated with the repairs that make deferred homes weatherization ready? This includes savings directly resulting from weatherization readiness repairs themselves and the savings that would be unlocked from enabling deferred households to participate in WAP.

ACEEE surveyed WAP grantees and subgrantees and received responses on weatherization deferrals in 2023 from three WAP grantees and 63 subgrantees across the United States, of whom about half answered every question. Combining the available data from these surveys with actual numbers of weatherized homes in 2022, we estimate that approximately 19,788 (about 25%) of low-income households are initially deferred from the WAP annually.[26] About 25% of reported initial deferrals are due to occupant behavior (e.g., homeowner nonresponsiveness or personal belongings restricting access to the home). Removing households that were deferred for occupant-related reasons, we estimate that one in five clients (19%) who apply for WAP services and receive an energy audit are deferred for preexisting conditions or repair needs. Our survey and analysis indicate that about 60% of these deferrals received the necessary repairs or remediation work, allowing them to be successfully weatherized, but 40% could not be addressed and remained deferred.

Energy modeling simulations were performed to estimate energy use reductions associated directly with typical weatherization readiness repairs and projects. The results predict that some, but not all, weatherization readiness measures and projects produce significant energy use and carbon emissions reductions. This variation in savings correlates with the survey responses, which show wide variability in issues or repairs needed that cause homes to be deferred from WAP and must be addressed to make homes weatherization ready. Homes where weatherization readiness repairs include significant envelope repairs and replacement of unsafe or inoperable heating and cooling equipment are projected to save the most energy. In other cases, however, weatherization readiness work (such as removal of asbestos-containing materials) will have little bearing on household energy use.

[26] NASCSP's 2023 PY WAP Funding Report notes that 68,968 units were weatherized using all funding sources in 2022. Our survey shows that approximately 25% of audited homes are initially deferred from weatherization and 55% of those are eventually deferred. Thus, we estimate 79,817 audits were attempted, 68,968 were weatherized, 19,788 were initially deferred for any reason and, of those, 10,849 were eventually deferred (NASCSP 2024).

Currently, many areas of the country have a significant funding gap for weatherization readiness, and a lack of data quantifying the benefits of weatherization readiness projects and programs. To support further investment in and expansion of weatherization readiness and repair programs by private businesses, nonprofits, philanthropies, states, energy utilities, and other stakeholders, this report estimates the benefits of these projects in terms of energy savings and GHG emissions reductions. Benefits may be translated by investors into carbon credits or offsets, meeting environment, social, and governance (ESG) goals, and other tangible outcomes. Measuring energy use and carbon emissions reductions are essential for businesses and utilities to assess progress on ESG goals and compliance with savings mandates and clean energy standards. This research may also be of interest to organizations seeking to leverage solutions to provide more resources to support and stabilize limited-income households.

Methodology

The research team first conducted a literature review of publications and data sources regarding weatherization deferrals, with a focus on identifying funding challenges for weatherization readiness and health-and-safety repairs and finding examples of successful programs. Given the currently available literature on the subject is limited, the research team also addressed the research gap with interviews, surveys, and energy modeling. The team conducted activities in four phases:

1. **Qualitative interviews** helped to better understand the current landscape of weatherization deferral issues and readiness repair programs.
2. **Survey and data collection** from state WAP grantees and local or regional subgrantees enabled estimation of deferral rates, number of homes deferred, and energy savings potential that could be unlocked through increased participation in WAP.
3. **A virtual workshop** with state weatherization agency and national lab staff, building energy modeling experts, and representatives from national nonprofits supporting weatherization informed the assumptions used in the final research activity.[27]
4. **Energy modeling and data analysis** provided data on how much energy could be saved by weatherization readiness measures and projects themselves.

For Phase 1, the team interviewed stakeholders to gather findings and lessons learned from program development, implementation, and evaluation of weatherization readiness programs. The interviews also explored any barriers or opportunities the providers faced while looking to scale weatherization readiness repairs.

In Phase 2, the team surveyed WAP grantees working with the National Association of State Community Service Programs (NASCSP) and coordinated with National Community Action Partnership (NCAP) to send surveys to the approximately 650 local WAP providers around the country (for the list of survey questions, please see Appendix B; for more information on the survey, please see Appendix E). From the completed surveys, we estimated the number of deferred properties nationally, obtained information on the most frequently needed weatherization readiness repairs, and developed a national median cost to complete repairs needed to make deferred homes weatherization ready based on the project costs (inclusive of materials and labor) reported by subgrantees. We then combined this information with data from published reports about energy savings benefits households experience from WAP to

[27] The full list of workshop contributors is available in Appendix D.

estimate the benefits that weatherization readiness programs can generate by unlocking access to WAP (DOE WAP fact sheet; Tonn et al. 2014).

For Phase 3, ACEEE facilitated a half-day workshop with subject matter experts (SMEs) in weatherization and residential building energy modeling. The workshop took place in May 2024, and included representatives from national labs, weatherization grantees, and private companies and nonprofits supporting the weatherization network (for a full roster of participants, please see Appendix D).

In Phase 4, the team synthesized the results from the workshop and surveys to determine which typical weatherization readiness measures or repairs could produce significant energy savings. These shortlisted measures were included in the energy modeling, and those unlikely to yield significant energy savings were excluded. EnergyPlus™ building energy simulation protocols in the National Renewable Energy Laboratory's (NREL) OpenStudio platform were utilized to estimate savings of commonly deferred weatherization measures.[28] Because many deferrals result from multiple issues that must be repaired on a single home, the team then selected a series of multiple-measure packages, informed by the survey results (see table F1 for the results). For more information on building energy modeling, please see Appendix E.

Results of national WAP deferral survey

ACEEE's survey of WAP grantees and subgrantees asked respondents to estimate the frequency of deferrals, types of repairs needed to address deferrals, average weatherization readiness project repair costs, and characteristics of WAP-eligible buildings in their service territories.[29] Three states (grantees) and 63 weatherization providers (subgrantees) provided responses. ACEEE conducted additional follow-up with some of the respondents to clarify the information provided via the surveys. After these follow-ups, 32 subgrantee responses and one grantee response had complete information and 31 subgrantees and two grantees had partial but usable information (i.e., responses to some, but not all, questions). When calculating deferral rates, we included all data available for each type of deferral, without excluding respondents that only provided responses to some questions (hence, some statistics included data from more programs than others).

Calculation of deferral rates from survey results

Half of the survey respondents did not answer every question in our survey. To calculate 2023 deferral rates, we requested three types of estimates from respondents: number of audits their organization conducted, number of audits that resulted in an initial deferral from WAP, and the number of homes that were eventually deferred from WAP. However, some respondents only provided one or two of these estimates. Notably, we had a larger number of respondents providing information on eventual deferrals than initial deferrals, and two respondents did not provide information on the number of audits.

To calculate the percentage of audits that were initially deferred, we needed respondents to provide the number of audits they conducted and the number of initial deferrals they noted. Forty-five respondents

[28] See Appendix B for full methodology utilized by PSD, ACEEE's subconsultant for this portion of the research project.
[29] Respondents were incentivized to complete the survey with entry into a raffle for a $300 gift card for a major online retail store of their choice. To keep the survey length manageable, standardize results across states and providers, and maximize the number of responses we could collect, we asked respondents to estimate answers to the questions rather than requiring them to submit data they may have collected or maintained on their programs. Nevertheless, four respondents opted to submit official data regarding their deferrals.

(reporting on 8,987 homes) provided both pieces of information. Using this data, we calculated that 2,228 of 8,987 homes were initially deferred (24.8%), as shown in figure 2.

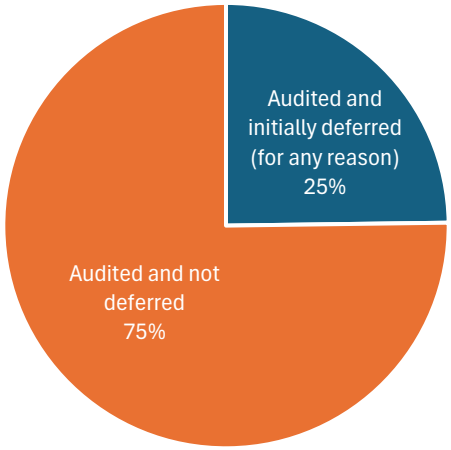

Figure 2. Percentage of homes initially deferred from WAP for any reason (including occupant-related deferrals). Some of these may eventually receive weatherization readiness repairs.

To calculate the percentage of initially deferred homes that are eventually deferred, we needed respondents to provide the number of initially deferred homes and the number of eventually deferred homes. An overlapping but slightly different group of 45 respondents (reporting on 1,988 homes) provided these two pieces of information. Using these data, we calculated that 1,090 of 1,988 initially deferred homes (deferred for any reason, including occupant-related issues) were eventually deferred (54.8%), as shown in figure 3.

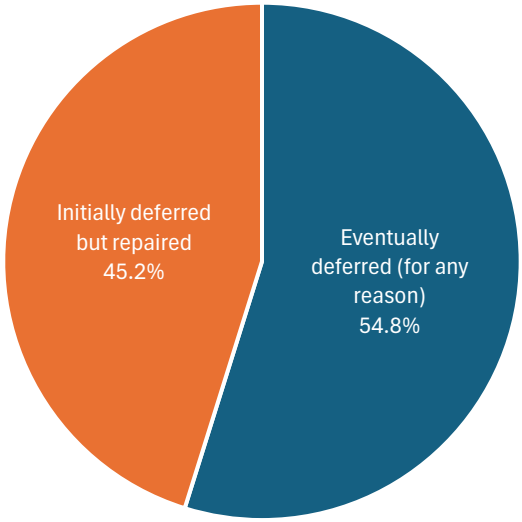

Figure 3. Percentage of initially deferred homes that could not be repaired and were eventually deferred. Some of the eventually deferred homes were deferred for occupant-related reasons and others for structural issues that could not be addressed by the WAP providers.

To calculate the percentage of audited homes that are eventually deferred, we needed respondents to provide the number of audits they conducted and the number of eventual deferrals they had. Here we had more data. Fifty-three respondents (reporting on 12,165 homes) provided both these data points. Using this information, we calculated that 1,773 of 12,165 audited homes were eventually deferred for any reason (14.6%), as shown in figure 4.

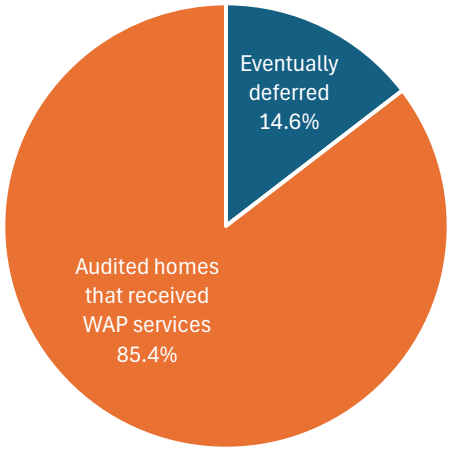

Figure 4. Percentage of total audited homes eventually deferred for any reason (including occupant-related deferrals)

We then deducted the estimated number of deferrals caused by occupant-related issues to get the number of deferrals due to preexisting conditions or repair needs that are addressable. DOE refers to these as preventable deferrals (U.S. DOE 2024c; Klusmeier 2020). We asked respondents to estimate the percentage of their initial deferrals attributable to occupant-related reasons such as hoarding, presence of drugs, nonresponsiveness, or aggressive behavior. Among 30 respondents who answered this question and provided their numbers of initial deferrals, we calculated a weighted median of 25% of deferrals being a result of occupant-related reasons. We then applied this estimate to the numbers of initially deferred homes to estimate the number of initially deferred homes that were preventable deferrals. To estimate the number of eventually deferred homes that were preventable deferrals, we reduced the estimated number of eventually deferred homes by 25% of the number of initially deferred homes.

Key findings from ACEEE's national WAP survey

Approximately one in five clients (19%) who seek WAP services are initially deferred for addressable or repairable issues. We estimate that about 79,800 WAP audits were conducted in 2023. Extrapolating from ACEEE's national survey of WAP agencies to the entire United States, about 6,686 (8.37% of all homes audited) eventually became preventable deferrals that were not made weatherization-ready. Based on estimates provided by respondents in our survey, the weighted average cost to make these preventable deferrals weatherization ready is $13,870 (+/–$221) per home;[30] therefore, an additional

[30] This national figure incorporates regional variations; thus, costs for individual weatherization readiness repairs may vary significantly, depending on the project location and the specific repairs needed. The weighted mean is $13,870. The 95% confidence interval is $13,649 to $14,091. One standard deviation is $4,171.

$91.3–94.2 million is needed to address each year's remaining preventable deferrals. This is based on the snapshot of 2023 deferrals provided by survey respondents and 2022 data on actual numbers of homes weatherized provided by NASCSP (NASCSP 2024).

Building energy modeling of weatherization readiness repairs

To estimate energy use reductions from typical weatherization readiness measures that generate energy savings (such as heating/cooling system replacements and envelope repairs), we began by developing *base cases,* reasonable assumptions about characteristics of several types of WAP-deferred homes. We then determined which repairs would be modeled to predict how much energy each repair would save. The models were run in each major U.S. climate zone to determine how savings could vary by climate. A complete summary of the findings is presented in Appendix F.

In consultation with PSD and other experts, the base case buildings for the modeling included characteristics of homes typically served by WAP, which are on average older, poorly insulated, and have less efficient heating and cooling systems (U.S. DOE 2024c; U.S. DOE Office of State and Community Energy Programs 2024). We utilized base case single-family homes reflecting 1950s- and 1990s-era construction with 1,500 and 1,900 square feet of conditioned floor space, respectively, with either one-story ranch style or two-story colonial configurations. Detailed assumptions for characteristics (foundation types, air leakage, insulation levels, existing mechanical system efficiency, etc.) of the homes utilized are shown in table 1 in "Methodology for Energy Savings Analysis of Preweatherization Deferral Repairs" (Appendix B) and are based in part on prior ACEEE research (Amann, Srivastava, and Henner 2021).

Building modeling results and key takeaways

Energy modeling predicted that some weatherization readiness measures result in significant energy use reductions, while others do not produce notable savings. As the savings are highly dependent on the type of repair, the baseline characteristics of the modeled homes, and climate zone (figure 5), there is a wide spectrum of estimated savings values.

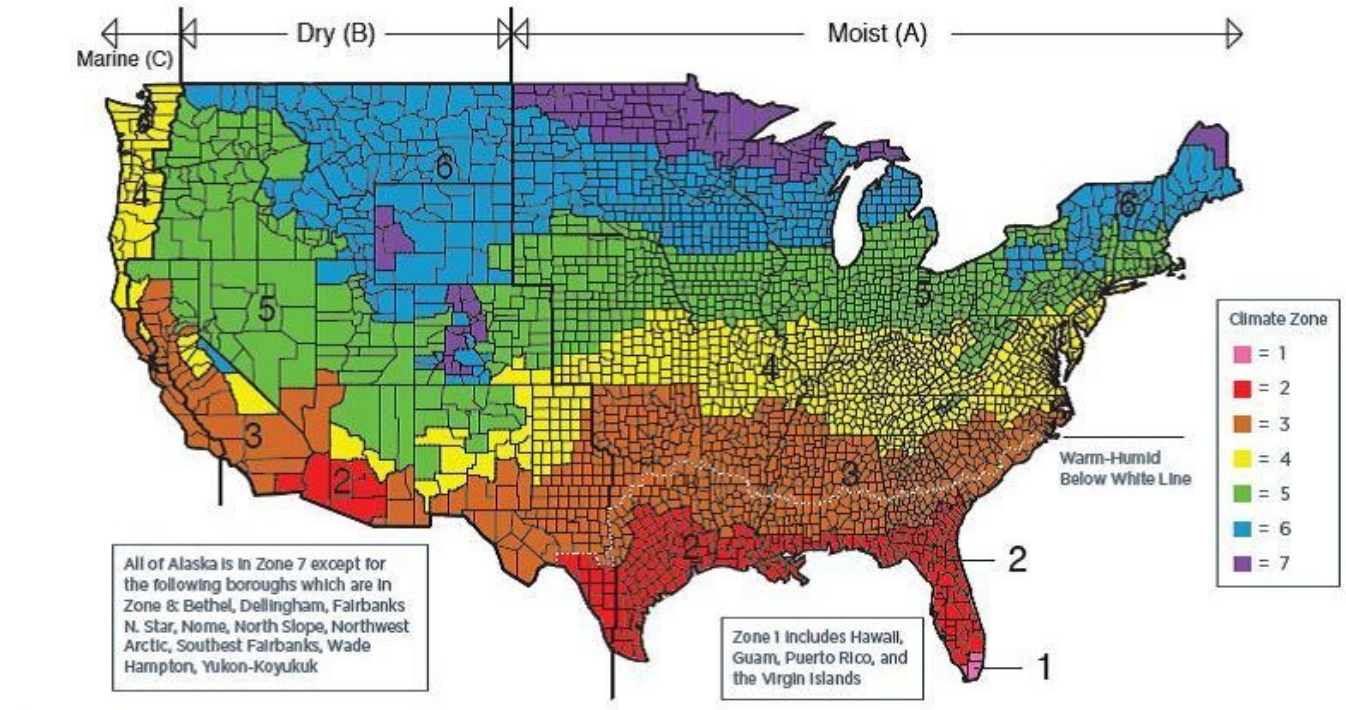

Figure 5. DOE Climate Zone Map (Source: PNNL 2015)

As shown in figure 6, the same repairs (replacement of nonworking central heat pumps and floor repairs) on a 1950s-era home produce significantly different savings levels by climate zone (with all other factors held equal).

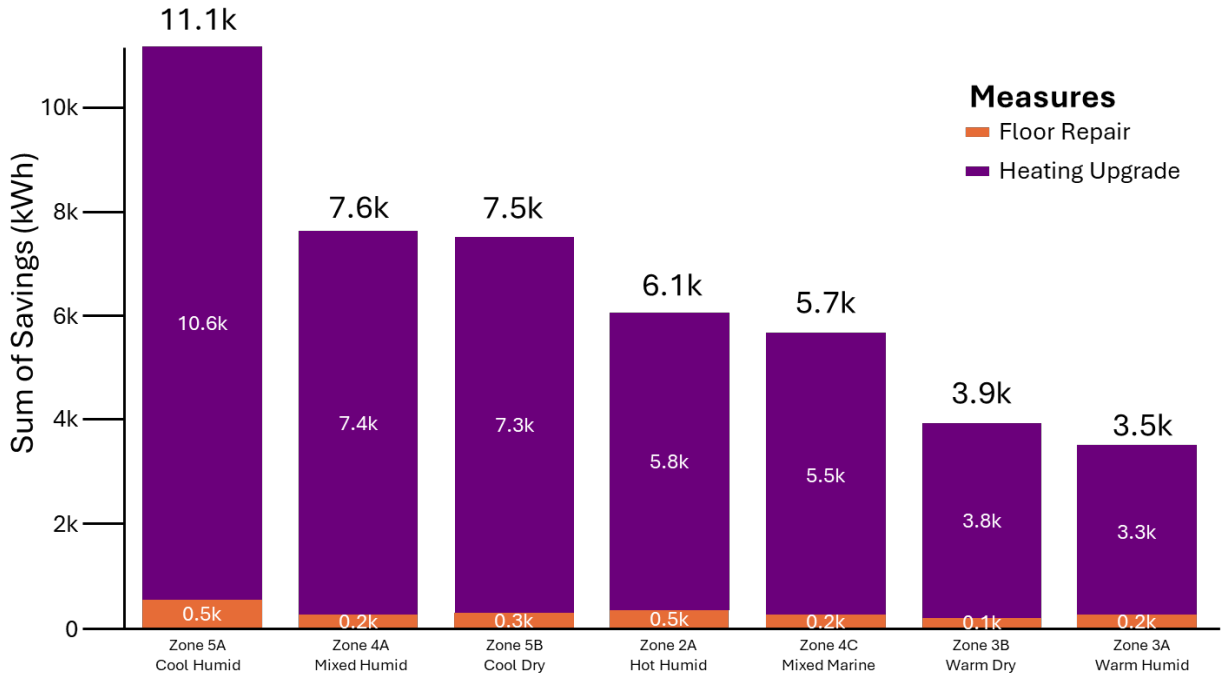

Figure 6. Example weatherization readiness annual end use savings (by climate zone) in a 1950s colonial home with electric heat pump and hot-water heater

In general, heating system upgrades for older homes in cold and mixed climates (zones 5 and 4) produce the most savings, and cooling system upgrades in cooling dominated climates (zones 2 and 3) result in significant savings;[31] however, because of the relatively low frequency of HVAC replacements (estimated weighted median 5% of projects nationally from the survey), we cannot generalize these levels of savings to all deferred homes.

Envelope repairs also have a significant impact on energy use, with savings values higher for homes in colder climates, and decreasing in warmer climates. Floor (23%) and wall (5%) repairs were reported as causes of deferral for a significant number of homes. Weatherization readiness projects that include both HVAC replacements/upgrades and significant envelope repair work will save the most energy; however, the energy modeling did not include interactive effects of these measures on projected reductions in energy consumption.

Most weatherization readiness projects do not produce high energy savings. As noted in the survey summary, there is wide regional variability in the issues or repairs needed which typically cause homes to be deferred from WAP. Several common weatherization readiness measures, such as replacing unsafe/outdated electric service panels (23% of projects) and mold remediation (10% of projects), were not expected to generate significant energy savings, based on the SME workshop, and were not included in energy models. We estimate that although the overall median energy savings of weatherization readiness repairs across all measures and projects modeled is 539 kWh annually, some of the most likely weatherization readiness repair packages (shown in Appendix F) are projected to save between 967 kWh and 9,876 kWh annually in a 1,500 square foot 1950s two-story colonial-style home (a common home type across regions).

In addition to the savings generated by weatherization readiness measures, enabling access to WAP ensures that additional energy-saving measures (such as insulation and air sealing) can eventually be installed. Weatherization readiness repairs help protect health and safety for households receiving services and workers installing the measures; they also maintain and preserve the integrity and durability of the building materials and structure.

Roof repairs: A potential savings opportunity

We anticipated that weatherization readiness programs could enhance energy savings and carbon emissions reductions through roof repairs: Leaking roofs are by far the most common cause of deferrals (a median 45% of deferrals in our sample). According to DOE, using cool roof–rated products has little or no impact on roofing material cost (U.S. DOE 2024b). Cool roof–rated products will reflect more sunlight than conventional roofing products and therefore absorb less solar energy (Cool Roof Rating Council 2024). This can help lower the internal temperature of the building and reduce energy used for air-conditioning (U.S. DOE 2024b). Energy modeling showed that replacing standard dark colored asphalt shingles with lighter colored shingles can reduce cooling loads somewhat in warm and hot climates, resulting in a predicted reduction in energy use of 0.5 MMBtu annually in climate zone 2A and 0.3 MMBtu annually in climate zone 3A. This is equivalent to annual electric savings of 146 kWh in climate zone 2A and 88 kWh in climate zone 3A.

[31] Heating and cooling system upgrades assume replacement of existing system with equipment meeting current regional ENERGY STAR efficiency levels for the equipment type.

Causes of WAP deferrals

Based on data from 45 respondents who provided information about both the number of audits and the number of initial deferrals, 24.8% (2,228) of the 8,987 homes these respondents audited in 2023 were initially deferred; however, an estimated 25% (~557) of those initial deferrals were at least partially deferred for reasons related to occupant behavior (e.g., client nonresponsiveness or belongings restricting access to the home). After deducting these from the overall number of initial deferrals, an estimated 19% (~1,671) of our respondents' audited homes were initially deferred from WAP for repairable or preventable reasons in 2023.

Turning now to data from an overlapping but slightly different subset of respondents, 45 respondents provided data on initial and eventual deferrals. We used this group to estimate the percentage of initially deferred homes that are eventually deferred. This group estimated that 1,988 homes were initially deferred and 1,090 were eventually deferred. Of the 1,988 initially deferred homes, we estimate that approximately 497 (25%) were deferred for occupant-related reasons. After removing those 497 homes from the number of initially deferred (1,988 – 497 = 1,491) and eventually deferred homes (1,090 – 497 = 593), we were left with an estimated 593 of 1,491 homes that eventually became preventable deferrals. This means approximately 40% of homes initially deferred for non-occupant reasons are eventually deferred or, conversely, that approximately 60% of homes that are initially deferred for preventable reasons received weatherization readiness repairs and were served by WAP.

There was significant variability by region in the percentage of initially deferred homes that were eventually deferred (much more than the variability in the percentage of initial deferrals). Some subgrantees were able to access resources needed for weatherization readiness repairs and, thus, only deferred homes for occupant-behavior related reasons. Others were unable to leverage additional funds and had to defer most or all homes that could not be initially served by WAP. This may reflect the variability of funds available by state or locality to address deferrals.

Table 1 lists the most frequently reported weatherization readiness repair or remediation needs for the deferrals in our sample, with weighted medians for items that are either most common (estimated to occur in at least 10% of homes) or most likely to save a significant amount of energy (such as mechanical system upgrades).[32] We weighted percentages by the number of initially deferred homes. Therefore, programs that reported more deferrals have a larger influence on the total percentages. We used the median reported percentage (rather than the mean) for each issue because of the wide variability of deferral issues across providers.

[32] A link to the full list of survey questions is provided in Appendix C.

Table 1. Reported most common reasons for WAP deferrals

Building system	Repair/Issue	Weighted median reported frequency of issue*
Envelope	Roof leaks (roof, flashing, penetration repairs needed)	45%
	Floor/floor framing damage	23%
	Foundation damage	15%
Electrical	Inadequate/unsafe electric service panel	23%
	Faulty/damaged/exposed or outdated wiring (e.g., knob and tube)	11%
Plumbing	Supply line leaking/damaged	10%
	Drain/sewer line leaking/damaged	10%
Water Management	Standing water in basement/crawlspace	10%
	Gutters/downspouts missing/inadequate/damaged	10%
Mechanical	Inoperable/failing/unsafe furnace or boiler	5%
	Inoperable/failing heat pump	5%
Other	Pests	15%
	Mold	10%
	Asbestos	13%
Occupant Behavior	Personal belongings restricting access to home, nonresponsiveness, and so on	25%

Note: *Some respondents did not answer every question about every potential reason for deferral because they did not check for it or did not record it. Measurement practices vary by region and WAP provider. Therefore, when a WAP provider left a question blank or answered "not applicable," their nonresponse was excluded from the

calculation of the percentage frequency for that issue. This led to the number of homes used to estimate the frequency of each issue varying by issue type. The number of homes used to estimate the percentages of each issue ranged from 1,437 to 1,583 homes.

There were variations in reasons for deferrals that were region or provider specific. For example, a significant number of homes in our sample were deferred for mechanical system issues, such as an inoperable or unsafe furnace/boiler, inoperable/failing heat pump, or electrical issues (e.g., faulty/damaged/exposed wires or knob and tube wiring); however, these were localized to a few WAP providers. An inoperable or unsafe furnace/boiler was a cause for deferral for the small number of homes in our sample in the Northeast (37% of 46 homes)[33] and a sizeable number of homes in the South (18% of 757 homes). Similarly, an inoperable heat pump is most frequently an issue for homes in the South (16% of 755 homes). By contrast, a very low number of deferrals in the Western states were related to unsafe/inoperable furnace/boiler (0.1% of 158 homes) or inoperable heat pump (0.2% of 158 homes). These may be in part explained by the regional variations in the average age of homes or typical HVAC equipment installed in homes in Western states based on climate zone needs. Faulty, exposed, or damaged wiring is a significant issue in the Northeast (63% of 46 homes) and for a large number of homes in the South (22% of 767 homes), but not noted frequently in the Midwest and Western regions.

Characteristics of WAP-Eligible homes and dwelling units

Most WAP-eligible homes in our sample are single family (63%), followed by mobile/manufactured homes (28%) and multifamily buildings (3.6%).[34] The foundations of these homes are most frequently either a crawlspace (40%) or slab (34%). Most of these homes were built between 1940 and 1979 (42%), but a large number were built after 1980 (30%). The most common heat source is gas/propane furnace/boiler (43%), followed by electric resistance furnace (21%)[35] and central ducted heat pump (16%).

[33] Given the small number of homes in our sample from the Northeast region, these findings should be considered tentative.
[34] Twenty subgrantees reported that at least 40% of WAP-eligible homes in their service territories were mobile/manufactured homes. We believe this created a slight overrepresentation of mobile/manufactured homes in our sample.
[35] The percentage of electric resistance heating systems may be slightly overrepresented because of the overrepresentation of mobile/manufactured homes in our sample.

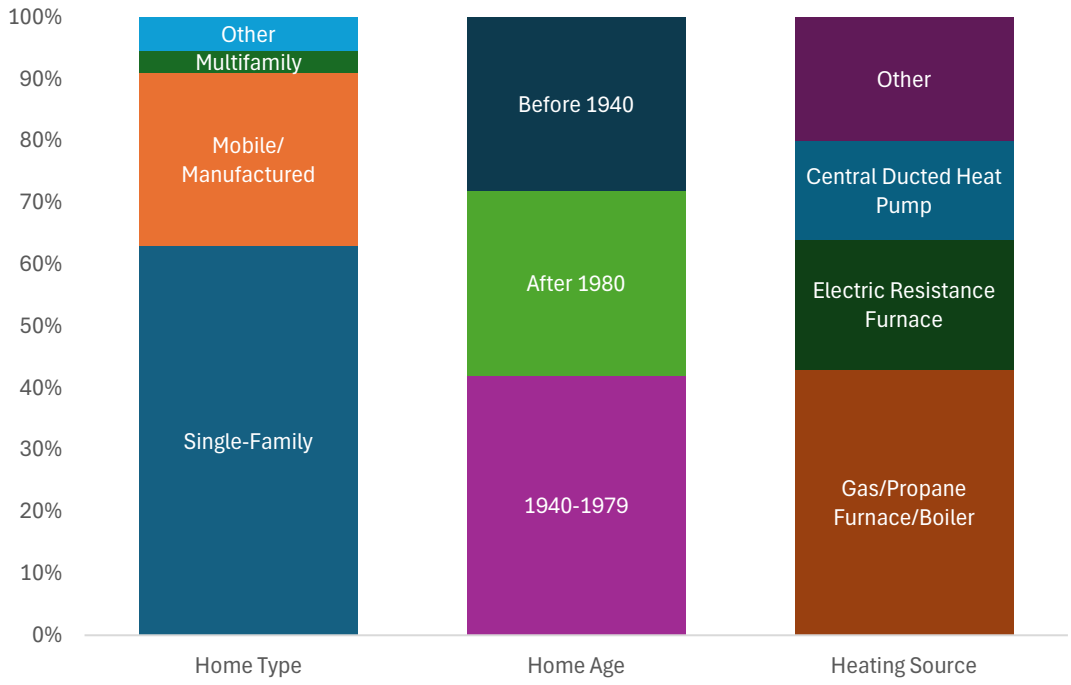

Figure 7. Characteristics of WAP-eligible homes, as estimated by survey respondents

Costs to mitigate WAP deferrals

Among respondents who provided both repair cost estimates and the number of audited homes that were initially deferred, the weighted median cost of weatherization readiness repairs was $15,000. The weighted mean was $13,870 (95% confidence interval: $13,649 to $14,091), with a standard deviation of ±$4,171. Estimates varied from $2,000 to $25,000, depending on what types of repairs respondents included in their estimates and regional differences in material and labor costs. To apply this number to deferrals across the United States, we needed to estimate the total number of eventually deferred homes and the percentage of those that are preventable deferrals.

The total number of U.S. homes currently deferred from WAP for preventable reasons can be estimated by combining the deferral rate (gleaned from our survey respondents) with data on the actual number of homes weatherized (NASCSP 2024). As noted earlier, 53 respondents provided data on the number of homes their programs audited and the number they eventually deferred (a larger number than for other analyses, representing many more homes). We used this group to estimate the percentage of audited homes that are eventually deferred.

- This group of respondents estimated that 12,165 homes were audited and 1,773 were eventually deferred.

- Of the 12,165 audited homes, we estimate that approximately 754 were deferred for occupant-related reasons. [36]
- After removing those 754 homes from the number of eventually deferred homes (1,773-754 = 1,019) we were left with an estimated 1,019 of 12,165 audited homes (8.37%) eventually deferred for preventable (non-occupant) reasons.

To determine the total number of homes eventually deferred across the United States for non-occupant reasons, we used data from NASCSP on the total number of weatherized homes and applied the deferral rate information we learned from our survey. NASCSP's 2023 PY WAP Funding Report (NASCSP 2024) notes that 68,968 units were weatherized using all funding sources in 2022. Our survey shows that 25% of audited homes are initially deferred from weatherization, and 55% of those are eventually deferred. Thus, we estimate that approximately 79,817 audits were attempted across the United States in 2023.

We then used the total estimated number of WAP audits and our estimated percentage that are eventually deferred for preventable reasons and combined that with the median cost of repairs. If 8.37% of all audited homes (8.37% of 79,817) eventually become preventable deferrals that were not repaired, then an estimated 6,686 homes across the United States are eventually deferred due to lack of weatherization readiness funding. Multiplying this figure by the mean estimated cost of weatherization readiness repairs ($13,870 +/–$221), we conclude that an estimated $91,258,263 to $94,213,509 would be needed to provide these repairs to WAP deferred homes identified in 2023. As noted in the introduction, this value refers only to repairing issues that cause homes to be deferred from WAP, not those deferred or not served by utility-sponsored programs for low-income customers. Although not the focus of this report, utility programs for income-qualified customers also experience shortfalls in funding for health and safety repairs.

Energy and GHG reductions from weatherization readiness repairs

To model energy savings from weatherization readiness repairs, we contracted with PSD, an experienced third-party energy modeling consultant able to provide savings estimates for the range of weatherization readiness repairs identified in the survey. To ACEEE's knowledge, this is the first comprehensive study to quantify the energy and carbon reduction benefits that may result from typical weatherization readiness projects and programs. This is primarily because of the many challenges around understanding the base case characteristics of homes needing repairs, and the types of repairs they may be receiving.

The type and frequency of repairs needed to address deferrals has not previously been well documented, and the savings from those repairs were particularly difficult to quantify. For example, the savings from air leakage reduction resulting from repairing a hole in the building shell depended on the size, severity, and location of the hole. Without field testing data, such as pre- and post-measured reductions in envelope air leakage based on actual repairs, PSD had to develop a methodology to estimate these reductions within reasonable bounds. Moreover, our survey confirmed that, apart from

[36] To estimate the number of homes to exclude as occupant behavior-related deferrals, we estimated 25% of initial deferrals. However, initial deferrals were not consistently reported by this group. Therefore, we estimated initial deferrals by assuming 24.79% of audits are initially deferred (12,165 * 0.2479 = 3,016), and 25% of that number are deferred for occupant reasons (3,016 * 0.25 = 754).

roof leaks, the weatherization readiness repairs needed varied greatly between, and even within, WAP subgrantee service territory.

Workshop to guide energy modeling assumptions

Given that energy modeling of WAP deferred homes (and associated weatherization readiness repairs) has not been previously conducted, the base assumptions for these models needed to be established. To do so, we conducted a half-day workshop with energy modeling experts and experienced weatherization providers. The SME workshop helped ACEEE's research team develop a comprehensive understanding of the range of issues that cause WAP deferrals, the repairs needed, and prioritization of repairs most likely to produce significant energy use reductions. This helped guide the energy modeling process. The workshop results also helped inform the development of recommended weatherization readiness project packages that accurately represent those typically installed in the field.

WAP energy savings and carbon reductions unlocked through weatherization readiness repairs

Other significant benefits of weatherization readiness repairs and remediation include enabling households to participate in WAP, and the reduction of home energy use and carbon emissions associated with WAP. Unfortunately, exact savings are difficult to estimate because a detailed analysis of energy and carbon reduction benefits of WAP-treated homes has not been calculated since program year 2008 (Tonn et al. 2014).

Calculating energy savings requires estimating the number of buildings of each type that are being weatherized across the United States. The ORNL evaluation found that, in their first years, WAP-treated buildings with one to four units saved 29.3 MMBtu of energy per unit, mobile/manufactured homes saved 16.0 MMBtu, and large multifamily buildings (only in New York City) saved 26.9 MMBtu (Tonn et al. 2014). If we assume about 79,817 annual WAP audits across the United States, with 8% of these eventually deferred for non-occupant reasons, then 6,686 additional homes across the United States could be weatherized each year if they receive weatherization readiness repairs.

Based on our survey, we can estimate the types of homes that are audited.

- A weighted average of 63% of audits per agency in our survey were for single-family homes.
- 28% were for mobile/manufactured homes.
- 9% were for multifamily buildings.
- 2% were for other building types.

If our survey is representative of the greater population of WAP agencies, of 6,686 eventually deferred buildings, then roughly 4,212 are single-family homes, 1,872 are mobile/manufactured homes, and 535 are multifamily buildings.

If these preventable deferrals received weatherization readiness repairs, the WAP program could save an estimated 123,418 MMBtu of energy from single-family homes, 29,954 MMBtus from mobile homes, and 14,388 MMBtu from multifamily buildings. Energy savings unlocked from weatherization readiness repairs across the United States could total an estimated 167,760 MMBtu or 49,236 MWh in the first year.

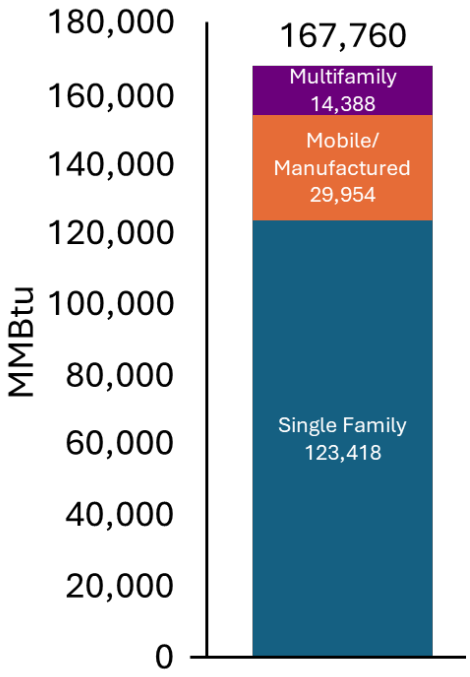

Figure 8. Energy savings unlocked from U.S. weatherization readiness repairs (MMBtu)

To estimate carbon savings, we used rough estimates of lifetime carbon dioxide savings per weatherized unit from ORNL's assessment of overall carbon emissions reduction from WAP (2,246,000 metric tons of carbon dioxide reduced from 97,965 units is roughly equivalent to 23 metric tons per weatherized unit). Based on this, we estimate that making the remaining WAP-deferred homes across the United States identified via our survey (6,686) weatherization ready could unlock additional WAP-related carbon dioxide emissions reductions of approximately 153,000 metric tons across the life of the measures. The exact amount of carbon dioxide savings will vary depending on the home type, location, and fuel mix of weatherized homes.

Non-energy benefits of WAP unlocked by weatherization readiness

In addition to the energy and GHG reductions attributable to weatherization readiness repairs, non-energy benefits of weatherization readiness are significant and positively impact the lives of household members (Community Housing Partners 2022). Mold and asbestos removals reduce respiratory problems for children and the associated healthcare costs (Norton, Brown, and Malomo-Paris 2017; Bourget et al. 2022). Repairing air leakage from holes in the building envelope reduces the likelihood of pests entering the home and reduces cold/hot drafts, making homes more comfortable (U. S. DOE 2024). Repairing or replacing faulty wiring or outdated electrical service panels can reduce the chance of house fires (ESFI 2021). Homes weatherized by WAP provide measurable quality of life improvements for households (Steiner 2023; Rose and Hawkins 2020). WAP enables an estimated $514 per year reduction in out-of-pocket medical expenses and a $538 annual benefit per household due to reduced sick days (U. S. DOE 2023b).

Takeaways

Weatherization readiness funding and programs can help fill a critical and persistent gap in the availability of repair funds in some areas in the country, enabling low-income households to access

valuable energy savings and home performance improvements through WAP. While WAP focuses on identifying and installing the most cost-effective energy conservation measures, weatherization readiness addresses preventable issues causing homes to be deferred. These repairs can provide significant energy savings in some cases, but the magnitude of the savings depends on the existing condition of the house and the specific repair(s) made.

Projects where multiple repairs are made, such as envelope repairs and replacing inoperable HVAC equipment, predictably save more energy than single-measure projects. Savings vary by location as well, with certain measures such as envelope repairs and heating system replacements providing more savings in cool climate zones, and cooling system replacements offering significant savings in hot and warm climate zones. Each year, if the remaining WAP deferred homes with addressable repairs could be made weatherization ready, we estimate the WAP program would save an additional 168,000 MMBtu or 49,236 MWh in the first year. In terms of avoided carbon emissions, this is roughly 153,000 metric tons of carbon dioxide over the lifetime of the measures. Leveraging utility partnerships and other private programs can help to realize these benefits.

Conclusion

Weatherization readiness projects and programs can save energy and money, and reduce GHG emissions, depending on the type of repairs needed to address issues causing the homes to be deferred. ACEEE conducted energy modeling of typical weatherization readiness measures and developed regionally specific project packages to estimate energy savings associated with weatherization readiness repairs: The high end of these packages results in up to 9,876 kWh savings per home while the low end saves 967 kWh.[37]

Weatherization readiness programs and home repair programs that address issues that cause deferrals can make thousands more homes eligible for WAP, increasing access to this important program for underserved households and enabling states to make fuller use of additional funding for WAP through the BIL. Additionally, if uncertainty around IRA residential rebate programs can be resolved in 2025, interest in these incentives may drive increased participation in WAP and utility low-income energy efficiency programs, which may increase the number of homes that are deferred.

A few states, utilities, and other organizations currently operate weatherization readiness programs to serve WAP-deferred homes; however, these programs could be replicated and significantly expanded to reach households most in need around the country.

Making weatherization readiness repairs unlocks an opportunity for households to receive services from WAP. If all homes deferred for addressable reasons in 2023 could receive repairs and WAP services, it would generate an estimated 49,236 MWh (168,000 MMBtu) of energy savings annually and reduce carbon dioxide emissions by 153,000 metric tons over the lifetime of the measures. In addition to energy and carbon reductions, weatherization readiness and weatherization deliver significant non-energy benefits, such as improved quality of life, comfort, and safety, and documented reductions in asthma events and health expenditures.

Available resources for weatherization readiness vary significantly by state, region, and locality. Given the historical challenges many households in economically disadvantaged and rural communities have

[37] The overall median energy savings of weatherization readiness repairs across all measures and projects modeled is 539 kWh annually. However, some of the most likely weatherization readiness repair packages are projected to save between 967 kWh and 9,876 kWh annually.

faced in receiving weatherization services, there are compelling financial, social, and environmental reasons for WRF allocations to be substantially increased. Governments, nonprofits, utilities, and private companies can play a role in expanding weatherization readiness resources and programs.

Recommendations

Based on findings from our research, ACEEE offers several recommendations, detailed below, for increasing funding for weatherization readiness programs using a variety of potential sources and innovative partnerships. Changes in data tracking systems for deferrals can provide more accessible and centralized information, which can help enable broader participation in weatherization and deliver more energy savings and carbon emissions reduction benefits to limited-income households. As more funding becomes available and weatherization readiness programs are planned and scaled, ACEEE encourages DOE, states, WAP providers, and other stakeholders to consider the following actions:

1. **DOE and federal government—Federal WRF allocations should increase to $100 million annually**: Increased federal WRF allocations will further support grantees and subgrantees in addressing deferrals, meeting increased WAP production goals, and filling state and regional/local gaps in funding sources to address needed repairs and health and safety issues. This investment is timely and much needed, particularly considering the additional WAP funding available through the BIL and expectations for increased production.
2. **DOE—The WAP deferral tracking process should be standardized and improved**: The deferral tracking processes should continue to be improved to better facilitate data collection and demonstrate the need for investment in weatherization readiness funding. Our survey was the first national survey in several years and revealed significant challenges in tracking deferrals and assessing funding needs. Although most WAP grantees and subgrantees track deferrals in some manner, the definition of deferrals and the tools used to track and report them are not yet standardized. DOE has developed a voluntary Deferral Classification Guide and Tracker; however, grantees and subgrantees are not required to use it. Moreover, much of the cost and effort of tracking and reporting deferrals falls to each subgrantee and, thus, may not always be prioritized. We recommend furnishing WAP providers with standardized tracking tools and methods that are made available at no cost.
3. **States and localities—Preventable WAP deferrals should be avoided**: Some states and WAP providers have sufficient resources to address the majority of preventable deferrals. The availability of WRF has begun to fill gaps in other states where funds are more limited; however, states are encouraged to proactively identify other sources of nonfederal funding to supplement WRF and traditional sources of repair or health and safety funding for WAP (such as LIHEAP or state/local emergency housing repair funds). States and local governments can take a leadership role and explore new and innovative public-private-non-governmental organization (NGO) partnerships to increase available funding and provide additional assistance to limited income households. The State of Michigan has successfully piloted a program to make community solar available to WAP clients (Adamsson 2023). As the Google/Sol Systems partnership with rural electric cooperatives demonstrates, coordinating weatherization service providers with community solar programs can provide important gap funding for weatherization readiness and enable clients to further reduce energy bills and energy burdens through community solar program bill credits.
4. **WAP subgrantees/providers—WAP providers should consider requiring cool roof–rated shingles or roofing replacement products**: As part of weatherization readiness projects, WAP

providers could consider requiring cool roof–rated shingles or roofing products for roofing replacements (reshingling with asphalt shingles or applying new membranes to flat or low-sloped roofs) as this can reduce building cooling loads in warm/hot climate zones. This provides a small energy savings co-benefit, in conjunction with fixing leaking roofs, which are by far the most common deferral issue noted in the survey (45% of deferred homes in our survey).

5. **Private entities (utilities and corporations)—The private sector should support weatherization readiness efforts:** ACEEE encourages the private sector to explore opportunities to support weatherization readiness and weatherization efforts at scale, inclusive of WAP and utility-supported energy efficiency programs for limited-income customers. Sources of capital such as carbon offsets or other products like the Clean Transition Tariff (Flanagan 2024) could serve as the mechanism for enabling this. This report is a first step toward developing a dataset that can form the basis for valuing the energy and carbon benefits of weatherization readiness efforts.

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Appendix A—Case studies

Case study: Google and Sol Systems community investment fund in the Carolinas	
Program partners	Roanoke Electric Cooperative, Santee Electric Cooperative, Aiken Electric Cooperative, Sustainability Institute of South Carolina
Measures offered	Weatherization readiness and critical health and safety repairs such as fixing roof leaks and remediating mold; replacement of kerosene and propane appliances with electric alternatives
Notable program features	A financial partnership between Google and Sol Systems granted $200,000 each to four organizations (three electric cooperatives and one program administrator) in North and South Carolina.
Average annual energy reductions[38]	In 2023, the four partner organizations reported energy savings that ranged from 4,111 to 7,672 kWh.
Average annual cost savings	In 2023, the four partner organizations reported cost savings that ranged from $545–729 after weatherization was completed.

In 2023, Google partnered with renewable energy developer Sol Systems to address the problem of weatherization deferrals in the Carolinas. The two companies paired a tax credit servicing agreement with establishing a community investment fund. Through this financial partnership, Google and Sol Systems aimed to develop a successful model that could inspire other private sector companies to increase access to weatherization, reduce energy burdens, and address climate change.

Google and Sol Systems identified four organizations—Roanoke Electric Cooperative, Santee Electric Cooperative, Aiken Electric Cooperative, and Sustainability Institute of South Carolina—to receive $200,000 each for addressing health and safety repairs for homes in their respective service areas. The three electric cooperatives serve rural areas where residents face high energy burdens and persistent poverty. The Sustainability Institute is a nonprofit organization that provides multiple services, including home retrofits, for disadvantaged communities in South Carolina's Lowcountry.

In 2023, the four local organizations collectively served 113 homes. The three co-ops served single- and double-wide manufactured homes, while the Sustainability Institute upgraded single-family homes, mainly historical homes in Charleston. After completing both weatherization readiness measures and weatherization measures, each organization estimated average annual energy reductions, average annual cost savings, cost savings after 20 years,[39] and carbon-dioxide-equivalent emissions reductions after 20 years. Google and Sol Systems extended their financial partnership into 2024, continuing investment in the same four partner organizations.

[38] The project team did not make any assumptions about residents' behavior and future energy consumption. These numbers represent the values that the energy auditors found.
[39] The team calculated 20-year cost savings by assessing the continual monetary value of weatherization readiness and energy efficiency upgrades.

Case study: Virginia Weatherization Deferral Repair Program

Program administrator	Virginia Department of Housing and Community Development (DHCD)
Program partners	Virginia's network of WAP providers (WAP subgrantees) and contractors
Measures offered	Repairs related to roofs and minor structural issues; electrical and plumbing; heating, ventilation, and air-conditioning (HVAC) system repairs or replacements; addressing health and safety issues such as removal of hazardous materials (mold, asbestos); some repair measures can be combined with energy conservation measures (known as *crossover projects*)
Notable program features	The program tracks deferrals to ensure that homes get added to the weatherization queue after receiving service and becoming eligible for WAP.

Virginia's Weatherization Deferral Repair (WDR) program directs state funding to repair homes that have been deferred from WAP.[40] The Department of Housing and Community Development (DHCD) provides resources for the repairs through the Housing Innovations of Energy Efficiency (HIEE) program, which are funds allocated to DHCD from the Regional Greenhouse Gas Initiative (RGGI) quarterly auctions while Virginia was a participating state in RGGI.[41] DHCD distributes the HIEE funds for WDR to weatherization agencies.

WDR funds may only be used for addressing repairs that cause deferrals; gut home rehabilitations are not eligible. Eligible repairs include roof repair or replacement, mold removal, plumbing repair, and HVAC equipment replacement. Although the WDR program primarily addresses issues that prevent weatherization, weatherization agencies can allocate some funds for *crossover projects* that simultaneously improve health, safety, and energy efficiency. Examples of crossover projects include new duct system installation or sealing existing ducts, ventilation fans, and low-flow plumbing fixture installation.

Between 2021 and 2023, the WDR program served 1,345 housing units, encompassing both single-family homes, mobile and manufactured homes, and small multifamily buildings. The most common types of repairs include HVAC systems, roof repair/replacement, and structural issues. On average, completing repairs on single-family homes costs $13,462. The average cost per project (including both single-family homes and multifamily buildings that were served) was $17,417.[42]

Weatherization providers that participate in the WDR program must follow DHCD guidelines for tracking deferrals. After completing weatherization deferral work, agencies must ensure that serviced households participate in WAP. These homes are integrated into the established WAP project queue, with priority based on the date of their original intake, rather than the date of weatherization readiness.

[40] Virginia Department of Housing and Community Development. n.d. "Weatherization Deferral Repair (WDR)." Accessed June 9, 2025: https://www.dhcd.virginia.gov/wdr.
[41] The Regional Greenhouse Gas Initiative. 2024. "The Investment of RGGI Proceeds in 2022." https://www.rggi.org/sites/default/files/Uploads/Proceeds/RGGI_Proceeds_Report_2022.pdf
[42] Program data provided courtesy of Virginia Department of Housing and Community Development

Case study: Casa Verde program

Program administrator	CPS Energy
Program partners	Participating energy assessors and contractors
Measures offered	Repairs related to roofs and minor structural issues; electrical and plumbing repairs
Notable program features	Even if households are over the program's income qualification levels, CPS will review customer's income and energy bills, and if the household's energy burden exceeds 9.9% the household can still qualify for the Casa Verde program. CPS also helps to connect customers with programs to assist with past due balances or establish affordable payment plans.
Average annual cost savings	Casa Verde participants receive an average of $4,500 in no-cost services and measures and save approximately $450 annually on their energy bills.

The Casa Verde ("Green House" in Spanish) program assists income-qualified customers in San Antonio, Texas, in reducing energy consumption in their homes and helps to lower their bills. Homeowners and renters can receive upgrades and measures designed to enhance energy efficiency through the program, such as attic and wall insulation, air-sealing gaps in the building envelope, light emitting diode (LED) bulbs, duct sealing, and solar screens. These improvements are provided at no cost for the customers and increase comfort and resilience in the homes.

CPS indicates that about one in two (47%) customers that contact the program for services cannot be served due to preexisting repair needs or issues with their homes, such as plumbing, electrical, or foundation issues, and active roof leaks. In March 2024, Congressman Joaquin Castro's office announced that CPS would receive $1 million in Community Development Block Grant (CDBG) funds to make repairs to approximately 500 homes and prevent deferral of services for these customers.[43]

The Casa Verde program has provided weatherization services to over 30,000 low-income households to date, and CPS plans to invest $82.5 million in weatherizing an additional 16,000 homes. This is a key component of CPS' five-year Sustainable Tomorrow Energy Plan (STEP) initiative, which will implement 410 MW of energy demand reduction and 1% annual energy savings system wide. CPS is the largest municipally owned utility in the United States, serving over 1.3 million electric and gas customers in the greater San Antonio metropolitan region.

[43] Nazir, M. 2024. "Congressman Joaquin Castro Secures $1 Million Grant to Grow CPS Energy's Casa Verde Home Weatherization Program." CPS Energy Newsroom (March 13, 2024): https://newsroom.cpsenergy.com/congressman-joaquin-castro-secures-1-million-grant-to-grow-cps-energys-casa-verde-home-weatherization-program/.

Case Study: Detroit and Wayne County home repairs and weatherization readiness

Program administrators	Wayne County Community Action Agency, City of Detroit, Enterprise Community Partners, DTE
Program partners	Participating contractors and community support organizations
Measures offered	Repairs of roofs, electrical systems, foundations, entry stairs and porches, plumbing, mold, and asbestos removal
Notable program features	A network of home repair programs serves the Detroit/Wayne County metro area.[44] Stakeholders are working to create a pipeline of weatherization-ready homes that can be referred to WAP or DTE's Energy Efficiency Assistance (EEA) program. Due to high demand and limited funding, some of the repair programs are closed to new applications.

The City of Detroit and the greater Wayne County region must contend with aging housing stock and decades of economic disruption and dislocation. In the Detroit metropolitan area, many homes of clients seeking WAP services have issues causing them to be deferred. In the aftermath of the COVID-19 pandemic, roughly three out of four households that sought WAP services were deferred due to repair needs such as leaking roofs, presence of hazardous materials such as mold and asbestos, and outdated and unsafe knob and tube wiring. A University of Michigan Poverty Solutions Study concluded home repair needs in Detroit are between $2 billion and $4 billion.

Wayne County Community Action Agency, the City of Detroit, and a broad-based network of community leaders and stakeholder organizations in the region have worked tirelessly for years to marshal repair and health and safety funds to address deferrals. The city launched the Renew Detroit Home Repair program in 2021 with $30 million in American Rescue Plan (ARP) funds and $15 million in funds from the State of Michigan.[45] In 2022 the Detroit Home Repair Fund was launched with contributions from public, private, and philanthropic entities totaling $20 million. The program is administered by Enterprise Community Partners and Green and Healthy Homes Initiative (GHHI).[46] All funds for both programs have been utilized and long waiting lists have been reported.

In 2024, the Michigan Department of Health and Human Services allocated $25 million of ARP funds for weatherization readiness to be available to weatherization providers in Michigan. In addition to grant funds, the City of Detroit also offers a 0% interest loan program to assist homeowners in making needed repairs.[47] The City works in coordination with Wayne County Community Action Agency to offer a property tax relief program for low-income homeowners.[48] DTE's EEA program provides no-cost energy efficiency upgrades to customers at or below 250% of the federal poverty level and can serve customers who may have annual incomes above the WAP income cutoff of 200% of federal poverty level.[49]

[44] Kling, K. 2022. "Detroit Home Repair Resource Guide." Poverty Solutions. https://poverty.umich.edu/files/2022/11/DETROIT-HOME-REPAIR-RESOURCE-GUIDE.pdf.
[45] City of Detroit. 2025. "Renew Detroit Home Repair Program." Accessed June 9, 2025: https://detroitmi.gov/government/mayors-office/renew-detroit-home-repair-program.
[46] Enterprise Community Partners. 2022. "Gilbert Family Foundation, ProMedica, DTE Energy Launch $20 Million Detroit Home Repair Fund." Accessed June 9, 2025: https://www.enterprisecommunity.org/news/gilbert-family-foundation-promedica-dte-energy-launch-20-million-detroit-home-repair-fund.
[47] City of Detroit. 2025. "Home Repair Program." Accessed June 9, 2025: https://detroitmi.gov/how-do-i/obtain-grant-information/home-repair-program.
[48] Wayne Metropolitan Community Action Agency. 2024. "Detroit Tax Relief Fund (DTRF)." Accessed June 9, 2025: https://www.waynemetro.org/dtrf/.
[49] DTE. 2025. "Limited Income Assistance." Accessed June 9, 2025: https://www.dteenergy.com/us/en/residential/save-money-energy/get-started-with/limited-income-assistance.html.

Case Study: Massachusetts Low-Income Energy Affordability Network (LEAN) Residential	
Program administrators	The seven gas and electric utilities serving customers in Massachusetts and Massachusetts' network of community action agencies
Program partners	Participating contractors and community support organizations
Measures offered	Energy efficiency measures
Notable program features	LEAN is a long-standing and well-coordinated effort between utilities and weatherization providers that leverages federal, utility, and other sources of funds to provide comprehensive no-cost energy efficiency services to income eligible customers, including homeowners and renters living in 1–4 unit family buildings.[50]

Through the LEAN Residential program, utilities and the statewide network of local Community Action Program (CAP) agencies provide coordinated delivery of energy efficiency and other energy services at no cost to income eligible clients. LEAN utilizes CAP staff with many years of experience in identifying, scoping, managing, and inspecting energy efficiency installations. In some cases, projects may involve multiple contractors and would be beyond the capacity of a typical homeowner to manage effectively. Coordination of projects with utility partners allows funding from public and private sources to pay for energy efficiency installations in residential housing. From 2010–2021, LEAN served almost 474,000 participants statewide and weatherized 255,000 housing units.[51]

In addition to energy efficiency, most of the CAPs in the LEAN Network are the providers of federal energy assistance, or LIHEAP. LEAN helps streamline participation for income-qualified customers by utilizing categorical eligibility, meaning that if a customer has already qualified for other public assistance programs such as Supplemental Nutrition Assistance Program (SNAP), Temporary Assistance for Needy Families (TANF), Women, Infants and Children (WIC), or Supplemental Security Income (SSI), they qualify for assistance through LEAN. LEAN partners coordinate on customer outreach and marketing and operate a Statewide Customer Service Center (SCSC) where all customer leads are directed and subsequently referred to the appropriate CAP agency. Live staff support is provided at the SCSC in English and eight most-spoken languages in Massachusetts.

Although LEAN is a successful model that could be more widely replicated in other states, energy burdens continue to be a critical issue for low-income households in Massachusetts. In 2023, about 17% of customers (920,000 households) were unable to pay their energy bills some months.[52] In 2024, the Massachusetts Department of Public Utilities (DPU) opened a docket and public comment opportunity for stakeholders to provide input on solutions to energy affordability and changes to rate design.

[50] Mass LEAN. 2025. "LEAN Residential." Accessed June 9, 2025: https://masslean.org/.
[51] Mass LEAN. 2024. "Low Income Energy Affordability Network (LEAN) Presentation." Accessed June 9, 2025: https://www.mass.gov/doc/low-income-energy-affordability-network-lean-presentation.
[52] State of Massachusetts. 2024. "Energy Burden Inquiry." Department of Public Utilities, D.P.U. 24-15. Accessed June 9, 2025: https://www.mass.gov/info-details/energy-burden-inquiry.

Case Study: Pennsylvania COVID-19 Whole-Home Repairs Program	
Program administrators	Pennsylvania Department of Community and Economic Development (DCED) and county governments or authorized nonprofits
Program partners	Participating contractors and community support organizations
Measures offered	Needed home repairs, such as fixing leaking roofs and addressing other moisture problems; energy and water efficiency measures; accessibility upgrades for residents with mobility challenges
Notable program features	DCED passes funding available under the Whole-Home Repairs Program to either county governments or an authorized nonprofit entity (authorized via an adopted resolution by the county government). One applicant per county may apply for funds to awarded by DCED. Households must be at or below 80% of Area Median Income (AMI) to qualify.

Initially created in 2022, Pennsylvania's COVID-19 Whole-Home Repairs Program was funded with $125 million, including some ARP dollars as an initial step to address a critical backlog of home repairs.[53] A Pennsylvania Housing Finance Authority report issued in 2020 found that the Keystone State has some of the oldest housing stock in the United States (about 60% of homes in Pennsylvania were built before 1970) and that the number of uninhabitable vacant units was rising.[54] DCED distributed Whole-Home Repairs Program funds to county governments or authorized nonprofits in 2023; however, due to high demand, by 2024 all funds were obligated. Additional attempts to add $50 million in state funding have thus far been unsuccessful and long waiting lists for the program have been reported.[55]

While the Whole-Home Repairs Program was developed to address overall home repair needs and not specifically structured to address weatherization readiness, it did have some impact on increasing the number of weatherization ready homes.[56] In addition, about $5 million of program funding were allocated to local workforce development efforts. Program implementers found that even when grant funds became available, a shortage of qualified contractors (e.g., roofers, plumbers, electricians) created delays in completing project bids and repairs. Five million dollars were utilized to engage participants and encourage interest in the building trades as a career pathway.

Current funds have all been distributed to localities or their designated nonprofit partners, but the Whole-Home Repairs Program guidelines gave local governments the authority to use these funds for loans.[57] We do not have data on what percentage of funds were issued as grants to homeowners or as loans to landlords to make repairs. Loans will eventually be repaid and could lead to eventual reinvestment in the form of additional loans, which was done successfully by several states and localities using American Reinvestment and Recovery Act (ARRA) funds.

[53] Pennsylvania Department of Community & Economic Development. 2023. "Whole-Home Repairs Program Guidelines." https://dced.pa.gov/programs/covid-19-arpa-whole-home-repairs-program/.
[54] Pennsylvania Housing Finance Agency. 2020. "Pennsylvania Comprehensive Housing Study." https://www.phfa.org/forms/housing_study/2020/pennsylvania-comprehensive-housing-study-full-report.pdf.
[55] Keith, C. 2025. "1000s Waiting as Shapiro Admin Again Tries to Convince Lawmakers to Fund Home Repairs Program." Spotlight PA (March 10, 2025): https://www.spotlightpa.org/news/2025/03/pennsylvania-new-home-repairs-program-budget/.
[56] DCED staff, personal conversation.
[57] Pennsylvania Department of Community & Economic Development. 2023. "Whole-Home Repairs Program Guidelines." https://dced.pa.gov/programs/covid-19-arpa-whole-home-repairs-program/.

Appendix B—Links to energy savings analysis methodology and WAP deferral survey questions

Full details of the methodology used by PSD to calculate energy savings from weatherization readiness repairs is available in a memo prepared by PSD.

> PSD. 2024. "Methodology for Energy Savings Analysis of Pre-Weatherization Deferral Repairs." OSF. October 16. https://osf.io/uk4d9.

The complete online survey used by ACEEE to collect data from weatherization providers on deferrals and repairs is available online.

> Sussman, Reuven. 2024. "Weatherization Deferrals Survey for Organizations Running Programs." OSF. February 20. https://osf.io/cr6e2.

Appendix C—Previous studies of WAP deferral rates

Studies to characterize the number, frequency, and nature of WAP deferrals nationally have been done, but have not been undertaken for over 10 years. Oak Ridge National Laboratory's (ORNL) retrospective study and subsequent report, published in 2014, is the most comprehensive (Tonn et al. 2014). ORNL collected data a few years prior to publication, following the increased ARRA funding allocated to WAP during this period. ORNL surveyed WAP grantees and subgrantees on the general percentage of audited homes that are deferred, not for specific counts of audited and deferred homes. Accordingly, ORNL does not estimate the percentage of deferrals relative to attempted audits but expresses results as ranges of percentages: For example, 53% of grantees and 47% of subgrantees reported that they recommended walking away/deferring 1–5% of audited homes in their service area. In this survey, only 4% of grantees and 10% of subgrantees reported that a walk-away/deferral occurred more than 21% of the time. U.S. Department of Housing and Urban Development's (HUD) "2020 Report to Congress" summarizes ORNL's results and references a 2011 report from the National Center for Healthy Housing that estimates that "roughly 10–15% of homes that are scheduled to be weatherized are deferred or referred to another program due to pre-existing health, safety, and structural problems" (NCHH 2011). HUD's report includes more recent findings from a 2018 survey conducted by NASCSP, which highlights some of the most common structural reasons for deferrals but does not provide data on deferral rates or costs of repairs (NASCSP 2018).

More recently, surveys in individual states have indicated varying WAP deferral rates, including Connecticut (20% in 2021), Vermont (10% in 2020), Virginia (18% in 2018–2019), and Washington State (30–40% statewide in 2021, and 40–50% in rural areas in 2018; Bourquet et al. 2022).

Appendix D—Subject matter expert (SME) virtual workshop participants

Name	Title	Organization
Aimee Gendusa-English	Project Director, Energy Partnership Project	National Community Action Partnership (NCAP)
Bruce Tonn, Ph.D.	Principal	Three[3]
Chase Counts	Principal	Greenbound
Ebony Mayhorn, Ph.D.	Research Engineer	Pacific Northwest National Laboratory (PNNL)
Juliana Williams	Energy Markets and Policy Specialist	National Renewable Energy Laboratory (NREL)
Laura Viik	Program Supervisor, Weatherization Innovation and Program Development	Washington State Department of Commerce
Neal Kruis	Vice President	Big Ladder Software
Rich Andrulis	Vice President, Product Design and IT	Performance Systems Development (PSD)
Scott Horowitz	Senior Research Engineer	National Renewable Energy Laboratory (NREL)
Sydney Roberts, Ph.D.	Director of Technology and Market Solutions	Southeast Energy Efficiency Alliance (SEEA)
Tabitha Artuso	Energy Research Technician	Pacific Northwest National Laboratory (PNNL)

Appendix E—Details on ACEEE survey

Notes on Survey Methodology

WAP deferral data are difficult to obtain from WAP providers because they do not collect information using standardized formats. Additionally, they have varying criteria for deferrals and repairs in different regions. Moreover, WAP providers are busy and to protect client privacy, they cannot directly share their deferral data with us. To overcome these issues, we designed our survey to request estimated (rather than actual) numbers of audits, initial deferrals, and eventual deferrals. We asked participants to estimate the percentage of their initial deferrals that were deferred for each of 26 reasons (occupant behavior, roof damage, asbestos, etc.) and, similarly, the percentage of their audited homes that had various characteristics (age, foundation type, building type, etc.). To maximize participation, we ensured the survey took about 15 minutes to complete. A link to the survey questions is available in Appendix C.

The advantage of this method is that we were able to obtain standardized data (not previously available) across a sizeable number of diverse respondents. The weakness of the method, however, is that we did not receive specific data on every home that was audited and the reason it was deferred. We did not create a database of audited homes across the country with reasons for each audit and deferral. Instead, we estimate the total percentages of deferrals and reasons for deferrals, using pooled weighted estimates from our respondents.

Survey: Results of National WAP Deferral Survey

Respondents were well distributed geographically. Subgrantees who reported their locations were situated in 28 different states, with 23% (15) from the Midwest, 8% (5) from the Northeast, 30% (20) from Southern states, and 18% (12) from Western states. They also represented all major U.S. climate zones (from zone 2 to zone 7), with the highest numbers in 4A (mixed humid, 27%, *n* = 18), 5B (cold dry, 9%, *n* = 6), and 6A (cold humid 9%, *n* = 6). The three grantees were located in the South, West, and Northeast census regions, respectively.

Of total audits completed in 2023 by our respondents, over two-thirds were conducted by the 56 subgrantee agencies who reported their total WAP audit numbers. These subgrantees reported a total of 9,780 audits conducted in 2023. The three state-level grantees (located in three different states, census regions, and climate zones)[58] all reported estimated audit numbers in 2023, with a total of 4,200 audits during the same period. Among respondents who reported audit numbers in our survey (59 of 66), a total of 13,980 units received WAP audits; however, some respondents did not provide complete information in the surveys, therefore calculations of deferral rates, deferral costs, and reasons for deferrals are not all based on the same total number of audits. We used the data available for each statistical analysis.

Subgrantees that responded to the survey ranged in size, conducting between 12 and 830 audits in 2023. The mean number of audits conducted per agency was estimated at 174. We estimate the number of attempted audits nationally to be 79,817 based on 2022 program year total number of housing units served through WAP. We believe our respondents conducted an above-average number of

[58] Service territories of the grantees and subgrantees that responded to our survey did not overlap.

audits (based on the known number of WAP-weatherized homes in 2022 and the national network of approximately 650 WAP subgrantees).[59]

[59] According to NASCSP (2023, Annual Weatherization Funding Survey), 68,968 homes were weatherized in 2022. Using our estimated overall deferral rate of 25% (including deferrals for occupant behavior), this suggests that about 79,960 audits were conducted across the United States to reach this level of production.

Appendix F—Predicted energy savings from weatherization readiness measures

Example weatherization readiness packages

Based on our survey data, workshop, and interviews with WAP providers, we determined that deferrals often involve more than one repair or issue that must be addressed to make the home weatherization ready. The median energy savings of weatherization readiness repairs across all measures and projects modeled is 539 kWh annually. However, to better illustrate differences in savings potentials, we categorized weatherization readiness repairs into regionally specific example packages. We emphasize that a relatively small number of weatherization readiness projects are likely to deliver this level of savings, and in fact, a relatively small percentage of homes will require these specific combinations of repairs. However, if these repairs are needed (our survey data indicate they are for at least 5% of homes) and included in weatherization readiness projects, this predicted amount of energy savings is feasible.

In the South and Southeast, the repairs include roof replacement, replacement of an existing failing or inoperable central heat pump with a new ENERGY STAR® certified unit, and an envelope repair (such as floor or ceiling). In the Northeast, the package includes furnace replacement and floor repair. In the Mountain West, we included roof replacement and repair of damaged exterior walls. For the two Western states packages, we included a roof replacement and envelope repairs for one, and roof and envelope repairs coupled with replacement of a nonworking electric baseboard heating system with a ductless minisplit heat pump for the other.

Table F1 details the projected savings for the regional packages, using the most appropriate base case home configurations[60] by climate zone with region-specific weatherization readiness measures applied. A detailed presentation of the energy modeling approach and methodology is provided in Appendix C.

Table F1. Savings from example weatherization readiness repair packages, 1950s colonial, two-story, 1,500 sq. ft.

Region/City (climate zone)	Existing heating/cooling system	Weatherization readiness repairs	Annual energy savings	Carbon dioxide emissions avoided ($MTCO_2e$)
Northeast, Albany NY (5A)	Natural gas furnace, room AC	Furnace replacement, floor repair	9,876 kWh (33.7 MMBtu)	1.8
Mid-Atlantic Baltimore MD (4A)	Natural gas furnace, room AC	Roof replacement, ceiling repair, furnace replacement	5,246 kWh (17.9 MMBtu)	0.95
Southeast Atlanta GA (3A)	Central heat pump	Roof replacement, floor repair, heat pump replacement	3,839 kWh (13.1 MMBtu)	0.69

[60] Base case homes used for modeling include the following ages/configurations: 1950s-era, 1,500 ft.^{2} two-story colonial; 1950s-era, 1,500 ft.^{2} ranch; 1990s-era, 1,900 ft.^{2} one-story ranch; and 1990s-era, 1,900 ft.^{2} two-story colonial; characteristics are described in detail in Appendix B.

South Houston TX (2A)	Central heat pump	Roof replacement, floor repair, heat pump replacement	4,631 kWh (15.8 MMBtu)	0.84
Mountain West, Denver CO (5B)	Natural gas furnace, no AC	Roof repair, exterior wall repair	1,407 kWh (4.8 MMBtu)	0.25
West, Sacramento CA (3B)	Electric baseboard, room AC	Roof replacement, exterior wall repair, ductless heat pump	8,704 kWh (29.7 MMBtu)	1.6
West, Salem OR (4C)	Electric baseboard, room AC	Roof replacement, ceiling repair, floor repair	967 kWh (3.3 MMBtu)	0.18

Note: AC = Air conditioning

Higher energy-saving projects

The highest energy savings from weatherization readiness repairs will occur when homes are in cool/humid climates (such as 5A) and receive HVAC equipment replacements and/or significant envelope repairs. The Albany, New York, repair package results in 9,876 kWh (33.7 MMBtu) of annual savings (equivalent to 1.8 metric tons of carbon dioxide emissions avoided, $MTCO_2e$).[61] Cooling savings based on cooling system upgrades are much higher in hot/warm climate zones (2A, 3A, and 3B). The packages applied to the baseline homes in Southern states are based on median national frequencies (45% for roof leaks, 23% for floor damage) and median frequencies specific to the South (18% for inoperable/unsafe furnace or boiler and 16% for heat pump replacement). These packages will save about 3,839 kWh (13.1 MMBtu) of energy and equivalent to 0.76 $MTCO_2e$ for the Southeast package (Atlanta, Georgia) and 4,631 kWh (15.8 MMBtu) and equivalent 0.84 $MTCO_2e$ for the South package (Houston, Texas). The Sacramento, California, repair package includes replacement of a nonworking electric baseboard heating system and room air conditioner with a ductless heat pump, providing significant energy savings of 8,704 kWh (29.7 MMBtu) and emissions reductions of 1.6 $MTCO_2e$.

Lower energy-saving projects

When HVAC system replacements or significant envelope repairs are not included in the packages, energy savings will be lower. Because a very low percentage of reported deferrals in Midwestern and Western states resulted from inoperable or unsafe HVAC equipment, these were not included in the Mountain West and one of the West modeled packages, and the savings from these packages (1,407 kWh and 967 kWh respectively (4.8 and 3.3 MMBtu) are much lower than those for the Northeast and Southern states.

[61] $MTCO_2e$ were calculated using EPA Greenhouse Gas Equivalencies calculator. MMBtu were converted to therms to produce emissions reductions. U.S. Environmental Protection Agency. 2025. "Greenhouse Gas Equivalencies Calculator." Accessed June 9, 2025: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.