



Single Family/ Manufactured Home Energy Audit Protocol

Oregon Weatherization Assistance Program

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I. OVERVIEW

The Oregon Weatherization Assistance Program (WAP) Single Family/Mobile Home Audit Protocol is a guidance document that defines the required criteria for the development of an energy audit designed to justify the cost effectiveness of energy efficient building retrofits under Oregon's WAP. This document specifically addresses the audit protocol for Single Family site-built structures and manufactured homes.

Underlying this protocol are the principles of transparency, consistency, and accountability: data contained in the audit must be transparent in terms of methodology of collection and calculation; report content must be consistent; and persons completing the audit must be accountable for their work by adhering to protocol requirements, maintaining professional certifications, and providing quality assurance measures.

A key objective of an energy audit is to identify feasible and relevant energy conservation measures (measure) that qualify for funding under Oregon's WAP. In addition to identifying ways to reduce the energy burden, the audit process must also conduct evaluation of the building's integrity to identify deficiencies that could result in health and safety issues as defined by Oregon's WAP.

The outcome of the site-specific audit process is a report that identifies cost effective weatherization measures based on the:

- Location, climate zone, utility information and other relevant site information;
- Building profile, configuration, and existing energy systems;
- Related health and safety checks and conditions;
- Calculated savings-to-investment ratio (SIR) of each measure including interactive effects of higher SIR measures (calculated in REM/Design™);
- Total calculated reduction in energy usage for the recommended measures (calculated in REM/Design™).

The four main processes that constitute the Oregon WAP Single family/Manufactured Home Small Multi-Family Audit Protocol standards include:

1. The on-site audit visit
2. The energy modeling and energy savings analysis
3. Report generation
4. The on-site final inspection

For energy audit purposes, OHCS considers single family buildings to be those containing four dwelling units or less.

II. ON-SITE PROCESS

The purpose of the on-site visit is to collect all necessary information to conduct an appropriate energy usage and health and safety analysis, including sufficient information to complete an energy model. The intent is to evaluate building envelope, assess building airflow, inventory HVAC and other energy systems equipment, identify ventilation systems, and perform diagnostic testing.

The following process includes site built and manufactured homes. In most cases, the process is similar for all housing types.

1. Auditor Conduct Standards and Minimum Credentials

- All sub-grantees and their consultants shall conform to the OHCS contracts, policies, and referenced standards.
- Auditors and Inspectors conducting audits shall have the minimum skills, credentials and experience detailed under section 2.20.1 of the Oregon USDOE state plan. At a minimum, Auditors shall be capable of effectively performing the following tasks:
 - Energy modeling utilizing REM/Design™ software.
 - Building assessment (identifying safety, code, durability, and energy systems issues).
 - Diagnostic testing (Blower door, duct pressure testing, pressure diagnostics etc.)
 - Combustion appliance safety testing.
 - Feasibility analysis for the installation of energy efficient building improvements.

2. Scheduling the Site Visit and Tenant Notification

- Notification of the client(s), whose home(s) will be reviewed during audit site visit, will be the responsibility of sub-grantee, the property owner, or their representative.
- The Auditor shall schedule the site visit(s) with the designated person(s) at a time that is convenient for the project contact person(s). The site visit should seek to cause minimal disruption for the client.

3. Site Visit Preparation

To facilitate the on-site portion of the energy audit, it is recommended that the following items be addressed prior to arrival.

- Review the income verification to verify the client(s) is/are eligible to participate in the weatherization program.
- Review 12 months of prior utility bills, if available. (Including gas and electric) to know annual utility cost by fuel type and seasonal variations.
- Review existing mechanical equipment information as available.
- Verify with contact that you will have access to all portions of the property.
- Verify that wood burning equipment will not be in use on the day of the audit if possible.

4. Site Visit Field procedures

The on-site energy audit shall be comprised of an in-person visit to the project by a qualified Auditor to complete the following tasks:

4.1 Project Interview(s)

The Auditor shall interview at least one of the following designated person(s) prior to or at the time of the site visit:

- Building Occupant/Client
- Owner or Owner Representative

The purpose of the interview(s) is to:

- Discuss the structures energy performance.
- Discuss occupant comfort, health, and safety.
- Discuss any behavioral or other factors affecting energy performance.
- Address any other occupant questions or concerns.

The interview shall include questioning on site conditions and deferred maintenance issues. If an occupant wishes their responses to remain confidential, the Auditor shall respect those requests.

4.2 Safety and Code Observations During the Site Visit

Each site visit must address specific minimum health and safety checks. The Health & Safety plan contained in the Oregon USDOE state plan, as well as the Oregon WAP Field Guide & Standards, apply to this policy. Where not referenced specifically, the following minimum health and safety checks shall be conducted and recorded in the Energy Audit Report or supporting documentation.

- Note likelihood of lead presence based on age of building as relevant to EPA & Oregon CCB RRP Rules.
- Mold and Mildew Assessment per Exhibit 6 of the USDOE State plan.
- Structural, electrical, and mechanical systems visual inspections.
- If a combustion appliance of any type is present, the following testing is required as per Appendix D, Section V – 2 of the USDOE state plan:
 - Ambient CO testing
 - Worst case depressurization (excludes sealed combustion appliances, ranges, and ovens)
 - Draft & spillage testing where applicable (excludes fireplaces, woodstoves, pellet stoves and sealed combustion appliances)
 - Undiluted flue gas CO testing (excludes fireplaces, woodstoves, pellet stoves)

4.3 Visual Inspection and Diagnostic Testing Protocols

The site visit shall include visual inspections and diagnostic testing of the building envelope, HVAC, and combustion appliances. Minimum visual and diagnostic testing criteria are provided in the Oregon USDOE Health & Safety Plan and the Oregon WAP Field Guide & Standards. These standards provide the minimum required testing procedures for Combustion Appliance Safety, Blower Door, and Duct Leakage Testing. *All testing, both pre and post, must be documented on a diagnostic testing form. The form must be signed and dated by the person doing the testing for both pre and post testing.* An overview of diagnostic testing protocols is listed below. For more detail refer to the referenced documents.

- Blower door testing: Pre and post blower door testing is required on all single family and mobile home projects unless conditions prohibit. All blower door tests must include zonal pressure testing of all attached garages (connected to conditioned space) and exterior combustion water heater cabinets (manufactured homes). To determine the

thermal and pressure boundary of each home, auditors will use the following methods in the field: advanced pressure diagnostics, visual/tactile observation, client interview, and assessment of feasibility. See section 8.08 of the Oregon WAP Field Guide & Standards.

- Duct leakage testing: Pre and post duct leakage testing is required on all homes with forced air heating systems unless conditions prohibit. See section 8.03 of the Oregon WAP Field Guide & Standards.
- Ventilation airflow testing: All exhaust fans must have airflow measured if possible. ASHRAE compliant fans must be tested post weatherization. See section 9 of the Oregon WAP Field Guide & Standards.
- Room pressure testing: Room to room pressure testing must be completed on all homes when forced air heating is present. See appendix Q of the Oregon WAP Field Guide & Standards.

4.4 On Site Audit

The on-site energy audit shall be comprised of an in-person visit to the project by a qualified Auditor (or Audit Team) to complete the following tasks:

4.4.1 Dwelling Assessment

The dwelling assessment shall be performed by a person or team qualified to perform assessments under Oregon's DOE WAP program and as described herein. The assessment is used to ensure that all health and safety concerns are identified and the information collected during the assessment may be used in the modeling and analysis phase of the energy audit.

4.4.2 On-Site Audit

In addition to the standard assessment, the information needed to populate an energy model must be collected for a REM/Design™ energy audit. This includes the information listed below.

- General Building Design Characteristics
 - Type of building. (Mobile home, site built, multi-family)
 - Number of units in building. (If applicable)
 - Number of floors above grade.
 - Foundation type
 - Total conditioned area

- Conditioned area of each floor
- Number of bedrooms
- Ceiling height and ceiling/attic characteristics
- Building Envelope Characteristics
 - Ceiling type: calculate area and insulation level by identifying type and depth at multiple locations of each accessible attic.
 - Above-grade wall: calculate area and insulation level by accessing enclosed wall cavities where reasonable. Auditors are encouraged to use existing penetrations as low-impact access points wherever possible.
 - Foundation wall: calculate area and insulation level visually/tactically at multiple locations of each accessible assembly.
 - Frame floor: calculate area and insulation level visually/tactically at multiple locations of each accessible assembly.
 - Rim Joist: calculate area and insulation level visually/tactically at multiple locations of each accessible assembly.
 - Doors: calculate area, types, and R-values by either documenting manufacturers markings or utilizing default values found in REM Technical Policies.
 - Windows:
 - Window Area (for each window/glazed area.) Includes: sliding glass doors, glass block, etc.
 - Window Type (single pane, dual pane low-E, etc.)
 - Window Material (metal frame, wood, vinyl, metal clad etc.)
 - Window Orientation (typically associated with each wall surface)
 - U-values by either documenting manufacturers markings or utilizing default values found in REM Technical Policies.

- Mechanical Equipment Properties
 - Heating Equipment
 - Fuel Type
 - Location and Type
 - Model number and manufacturer
 - Rated Output Capacity (in KBTUH)
 - Seasonal Equipment Efficiency (AFUE, HSPF, %EFF, COP)
 - Number of units
 - Cooling Equipment
 - Fuel Type
 - Location and type
 - Model number and manufacturer
 - Rated Output Capacity (In BTUh)
 - Seasonal Equipment Efficiency (SEER, EER, %EFF, COP)
Note: For most AC systems, SEER or EER are the most common metrics.
 - Number of units
- Ventilation
 - Ventilation Rate (CFM)
 - Hours/Day of Operation (if known)
 - Ventilation Strategy for Passive Cooling (i.e., natural ventilation or whole house fan installed)
 - Data collection for calculating ASHRAE 62.2-2016
 - Occupants must be bedrooms +1 (or # of occupants, whichever is higher)
 - Blower Door reading use the target, not the pre-wx result
 - Building height: must be calculated from the lowest point of possible air infiltration within the pressure boundary.
 - Floor area must include occupiable finished and unfinished basements if they are within the pressure boundary.
- Distribution Systems for HVAC Systems (When present)
 - Square footage of supply ductwork.
 - Square footage of return ductwork.
 - Location of ductwork.
 - R-value on ductwork.

- Water Heating Equipment
 - Water Heater Type
 - Location of water heating equipment
 - Fuel Type
 - Energy Factor
 - Tank Size
 - Extra Tank Insulation R-value

4.5 Health & Safety

The Oregon WAP requires that the clients' safety and well-being must be considered throughout the weatherization process. The audit process must include all aspects of Appendix D of the USDOE state plan as well as specific testing protocols contained in the Oregon WAP Field Guide & Standards. Health & Safety repairs do not have to be included in SIR calculations.

4.6 Energy Education

During the site visit both auditors and inspectors will provide basic client education to the client. At the initial audit, the auditor provides the initial information and the Inspector must provide additional energy education to reinforce the information provided at the audit. Subgrantees are required to provide client education that encourages households to reduce their home energy needs. Each Subgrantee has the latitude to develop their own client education program but they must provide at least the following:

- Written information that describes energy saving behavioral adjustments that will decrease the energy consumption of the household;
- Discuss the importance of indoor air quality, the purpose, and benefits of the ASHRAE 62.2 requirement and the importance of using and maintaining ventilation equipment.
- Information in the use and maintenance of any equipment installed including but not limited to, CO Alarms, furnaces, and ventilation equipment. This must be provided verbally as well as any users/maintenance manuals must be provided to clients.
- Any health and safety issues identified must be discussed with the client and appropriate actions taken as stated in the Appendix D of the USDOE H&S plan.

- Discuss the benefits that can be expected of the weatherization measures to be installed and how to maximize the effect of each measure.

4.7 On-Site Inspection

100% of all completed units must be inspected by the subgrantee. The final inspection must include an assessment of the energy audit that confirms the accuracy of the field site data collection, energy audit software inputs, and that measures called for on the work order were appropriate and in accordance with the DOE approved energy audit procedures and protocols.

A thorough on-site inspection and documentation of each dwelling unit including pre and post weatherization blower door testing, pre and post duct blaster testing when a forced air system is in use, pre and post health and safety testing results, ASHRAE compliant fan flows measured and review of all installed measures for compliance with the standards set forth in the Oregon WAP Field Guide & Standards. Inspection results must be documented on an inspection form listing all measures installed signed and dated by the inspector. Diagnostic and H&S testing must be documented on a diagnostic testing form signed and dated by the inspector.

See section 8.02 of the Oregon WAP Field Guide & Standards. OHCS QA inspectors will perform inspections of the installed weatherization measures on a minimum of 5% percent of completed projects. These inspections will be comprised of a statewide random sampling of the homes weatherized.

Diagnostic tests will be re-performed on a sampling of dwellings to ensure that the tests are being properly conducted.

II. ENERGY MODELING AND ANALYSIS PROCESS

An energy model of the building's pre and post-retrofit performance shall be completed using initial inspection data and diagnostic data collected during the on-site visits. REM/Design™ energy modeling is used to estimate annual energy consumption and energy cost savings of most potential energy conservation measures for dwellings as defined in Section III, 1.1. All energy and cost savings results from the REM/Design™ model must be verified against known conditions and usage profiles existing at the residence. All REM/Design™ models must be trued to actual metered usage to the greatest extent possible.

All Energy Auditors/Inspectors are required to obtain and maintain REM/Design certifications as outlined in the US DOE State Plan.

1. Energy Modeling Software Requirements:

The REM/Design™ energy modeling software platform has been approved by DOE for use in the OR WAP program for single family, manufactured and small multifamily dwellings. The energy audit software policy is provided below.

REM/Design™ Dwelling Criteria

As defined in the policy, REM/Design™ audit is to be used for the following building types:

- Single-family dwellings up to 4-plexes,
- Manufactured homes, and
- Low-rise multifamily buildings:
 - Containing five to 25 dwelling units,
 - Having 3 stories or fewer and,
 - Where buildings containing 5 to 25 dwelling units are heated and cooled independently.

The REM/Design™ energy audit process requires a physical inspection of the home, specific diagnostic tests, and proper data input into the software program.

An energy profile of the existing home is compared to a set of improvements recommended for installation. Each measure is then evaluated, and a report is generated with the cost-effectiveness of each measure listed by SIR (Savings to Investment Ratio).

2. SIR Requirements

- All measures must be interacted.
- Economic Factors: The Calculation Methodology must be “Oregon”.
- Discount rate must be set at “2.0” (effective 03/01/2024). All other factors will be set to “Default”.
- Measure costs modeled must include the cost of materials, labor, and on-site supervision.
- Individual measures, except air sealing (see section 8), must have an SIR 1.0 or greater by themselves.
- All cost-effective measures, air sealing costs, and any applicable incidental repair costs, must have a grouped SIR of 1.0 or greater.

3. User Defined Measures

REM/Design™ allows that users may define measures that are not included the existing libraries. Any user defined entries must be reviewed for accuracy by a person certified by OHCS in the use of REM/Design™. User defined entries must follow criteria listed in the OHCS REM/Design™ Technical Policies.

Compliance in the use of user defined measures will be ensured though the monitoring process. Projects will be randomly selected for the monitoring process. Agencies are required to supply the REM/Design™ electronic files to be reviewed to OHCS for all aspects of modeling including user defined measures.

4. Single family (2-4 UNITS) Modeling Considerations

These considerations apply to all single-family dwelling composed of more than one individual unit.

Parameter	Requirement
REM/Design™ Input Mode	Detailed
Housing Type	Multi-family whole building
Walls	Account for all walls adjacent to unconditioned space such as garages or outdoors. (Do not model walls between units)
Floors	Account for all floors adjacent to unconditioned space such as garages, ground, crawlspace, etc. Do not include floors adjacent to other apartments or common areas.
Ceilings	Account for all ceilings adjacent to unconditioned space such as attics or vaulted ceilings adjacent to outdoors. Do not include any ceilings adjacent to other apartments or conditioned space.
Number of Bedrooms	Include all bedrooms in the building
Mechanical Equipment	Each model of similar equipment types must be accounted for. Instances of similar models may be input as increased quantities of that model.

As seen in the specifications above, all interior walls and ceilings are omitted. When inputting the number of bedrooms, the model must account for the TOTAL number of bedrooms in the entire building, not just the number of bedrooms per dwelling.

The model must also account for all mechanical equipment in the building. When inputting mechanical equipment each piece can be manually created or if all pieces of equipment are identical the number of units can be increased on the “Mechanical Equipment Properties Summary” page in REM/Design™.

5. Mobile Home Special Considerations

Although REM/Design™ allows for modeling shell measures using “quick fill mobile home”, it is allowable and encouraged to model mobile home shell measures using “quick fill site built”.

6. Mechanical Equipment Properties

Whenever possible, actual equipment information indicated on the mechanical equipment, or made available by manufacturer or professional web site, are to be input as existing properties, e.g., AFUE, SEER and EF, for the furnace, air conditioner, and hot water heater, respectively. Further, a performance adjustment of 100% (functions as new) is used when modeling mechanical equipment for the building. Reducing the performance adjustment is only allowed when actual energy usage justifies a reduction **and** the equipment is in need of repair. Any time a performance adjustment is used, the equipment must be repaired and the cost justified with an SIR of 1.0 or better. Default properties are to be used ONLY when values are unavailable from equipment nameplates, equipment tags, etc. Using the REM/Design™ energy audit for change out of mechanical equipment is strictly for “efficiency” purposes. However, before a faulty furnace may be replaced as a health and safety measure, the existing furnace to new furnace upgrade must be proven non-cost effective with an SIR of less than 1.0.

7. Duct System

The duct system may be sealed and insulated during weatherization. Energy savings must be based on leakage measured through the use of the Duct Blaster. Both a pre and posttest must be performed when duct sealing is completed. Estimated post Wx leakage numbers should be calculated at 10% of the conditioned floor area for the system being modeled. For example, if the

duct system covers 100% of a 1,000 sq ft home, then the target leakage number for that system will be calculated at 100 CFM@50PA. To model the reduction, simply subtract the estimated post leakage from the pre-leakage number to identify the targeted leakage number to model in REM.

If the final duct leakage reduction does not achieve 75% of the targeted reduction, the post duct leakage rate must be input into the REM/Design™ model and an updated SIR produced.

Example: Pre leakage 300 cfm
Estimated Post leakage 100 cfm
Targeted reduction 200 cfm
 $200 \text{ cfm} \times 75\% = 150 \text{ cfm}$ minimum reduction is required.

8. Air Infiltration

The building envelope must be sealed during weatherization. Air infiltration, as an individual conservation measure, is not required to have an SIR of 1.0 or better. However, when all cost-effective measures are packaged together with the infiltration measure, the overall job cost must have an SIR of 1.0 or greater.

Energy savings for air infiltration in Manufactured and single-family homes must be based on actual measured flow using a blower door. Both a pre and post weatherization blower door test must be completed. Estimated post Wx blower door numbers should be calculated using a 1:1 ratio of the conditioned floor area of the home. For example, if the conditioned floor area of the home is 1,500 sq ft, the estimated post blower door should be calculated at 1500 CFM@50PA. To model the reduction, simply subtract the Estimated post blower door number from the Pre Blower door number to identify the Targeted reduction and model that improvement in REM.

If the final blower door results do not achieve 75% of the targeted reduction, the post blower door measured flow must be input into the REM/Design™ model and an updated grouped SIR produced.

Example: Pre Blower door 2000 cfm
Estimated post blower door 1500 cfm
Targeted reduction 500 cfm
 $500 \text{ cfm} \times 75\% = 375 \text{ cfm}$ minimum reduction is required.

9. Model Calibration:

The energy model for all buildings shall, when possible, be calibrated to actual utility billing data. Modeled baseline energy consumption shall be calibrated to monthly utility bills for a minimum of twelve months when billing data is available. The intent is to qualify the energy model by demonstrating similarity to the metered energy usage over a 12-month time frame. See REM Technical Policies Truing Protocols for more information.

10. Incidental Repairs

Incidental repairs necessary for the effective performance or preservation of weatherization materials are allowed. When a repair activity is a component of an energy efficiency measure that is being installed then the installation and materials are part of the efficiency measure and are classified as incidental repair. The cost of incidental repairs must be included in the cost of the package of measures. The entire package of measures installed on a project, including incidental repair costs, must be cost justified with an SIR of 1.0 or better.

All Incidental repairs must be justified in the client file with an explanation for their need and a relationship to a specific energy conservation measure and include photo documentation.

Ancillary items necessary for proper installation of weatherization materials are not considered incidental repairs. These items include small items such as nails/screws, other fasteners, adhesive, sealant, etc. Ancillary items are items required by materials manufacturers; general construction and /or WAP field standards to achieve a finished product in a typical installation where no unusual or extensive repairs are needed. The costs of ancillary items and installation are to be included in the cost of an individual energy conservation measure (ECM) when calculating the SIR for the individual ECM.

See REM Technical Policies for more information regarding Incidental Repair and examples of ancillary items.

11. Measure Buy Down

In the event that non-federal financial resources are leveraged to buy down a particular measure, the following criteria must be met:

- 1) The SIR of the discounted measure must be 1.0 or greater when SIR is calculated with only the WAP funds contribution.
- 2) The file must contain a funding summary sheet clearly identifying which measures needed to be discounted using non-WAP funds, the type of funding used and the amount of funds necessary to accomplish the buy-down.
- 3) Discounted measures may not be installed before non-discounted measures and are only to be installed when all other available cost-effective measures not requiring buy-down have been installed. In no case shall measures with higher SIRs be skipped or "leapfrogged" for measures with lower SIRs.
- 4) The cost-effective portion of measures may be calculated by entering the full measure cost into REM/Design™ and subtracting the present value from the full cost to determine the cost-effective portion. When using this method, when creating the grouped report, only the cost-effective portion should be included.

12. Utility Rates

Utility rates used in REM models must be the OHCS five-year averaged EIA rates for these utilities: electric, natural gas, oil and propane or the published actual utility rate, whichever is greater. For EIA rates, the set utility rates must be consistent across all rate tiers and include a monthly service charge if applicable to the client. OHCS will set the rate annually based on a five-year average obtained from the energy information administration. OHCS will release updated rates, every year by October 1st, through a Weatherization Memorandum. If actual published rates are used, there must be documentation of the published rate that coincides with the audit date.

For fuel not covered by the EIA-averaged rates, sources such as wood or pellets, actual rates (supported by documented usage) or local rates at the time of the energy audit must be used.

13. Report Generation

The following Reports must be generated and included in the building file:

- Improvement analysis Reports showing:
 - Measures and SIR's listed individually.
 - All cost-effective measures as well as air infiltration and any incidental repair costs grouped for an overall SIR.
 - Fuel summary report
 - Performance summary report: A two building report comparing the improved building to the unimproved building.

14. Measures Considered

All materials/measures considered by the audit must conform to requirements contained in 10CFR440, Appendix A (See Appendix C)

Measures considered by the audit include:

- Ceiling Insulation;
- Primary window replacements;
- Storm window installation;
- Primary door replacement;
- Wall insulation;
- Floor insulation;
- Rim Joist Insulation;
- Heating duct Insulation;
- Heating duct sealing;
- Water heater replacements;
- Heating system replacements;
- Cooling system replacements;
- Mechanical equipment performance adjustments;
- Air infiltration;
- LED Lighting
- Energy related incidental repairs

15. Measure Skipping

“Measure skipping” is defined as follows: *Not installing, in order of decreasing Savings to Investment Ratio (SIR), the cost-justified Energy Conservation Measures (ECMs) and related Incidental Repairs Measures (IRM) included in the work scope produced by REM/Design. This could also be the result of failure to evaluate all applicable energy saving measures for the dwelling.*

“Major Measure” is defined as follows: *A high priority measure, which if skipped, would result in “partial” weatherization of a unit. Major measures are as follows: air sealing, duct sealing of ducts outside the thermal boundary, attic insulation, wall insulation and floor or belly insulation.*

Measure Skipping of cost-justified major measures is not permitted at any time.

Alteration of the cost-justified work order must be addressed in the following ways:

Funding limitations: If all funds available to be spent on the job will not cover the entire work scope, then measures may be removed from the work order starting with the lowest SIR measure and working up the list from there. The work order must remain overall cost-effective or the job must be deferred. Necessary Health and Safety (H&S) measures may NOT be removed from the work order; however, ECMs can be removed.

Prior to work beginning: Client education is important to inform a client of planned measures and material use. Resistance from a client to install any measures and/or materials planned as a result of an energy audit directed work order should be addressed with either additional education and/or re-running the energy audit with a different - but acceptable - material to determine if the substitute material is cost effective. If no cost-effective option for the material can be identified, the auditor should again explain and discuss the situation with the building owner or occupant. If the building owner or occupant still declines a measure, not defined as a *major measure*, the auditor must include in the client file a comprehensive justification, including background/source documents that support the decision to skip a specific measure. All other weatherization measures must be installed. If the auditor cannot access background/source documents that justifies the building owner/occupant's decision to decline a measure **or** the measure is defined as a “major measure,” the situation must be fully documented in the client file and the job must be deferred due to client refusal.

Inadequate training: A lack of training for Subgrantees is not an allowable reason to skip measures. Standard procedure should be to postpone job(s) requiring priority measures that cannot be installed due to lack of trained staff until adequate training is acquired.

After a job has begun: Due to scheduling, measures are sometimes installed with a lower priority first. If during the installation process, the client declines a higher priority measure, work must stop at the time the client declined the higher priority measure. No further installation is allowed and the job must be inspected by a Quality Control Inspector (QCI) and closed out as a completed unit. This should be clearly explained in client file documentation. Some agencies include a statement for client signature that states the client is aware and accepts all WAP rules, including the specific services and measures determined by an energy audit.

16. List of General Heat Waste Materials

The following measures are determined to be generally cost effective and do not have to be cost justified in a site-specific energy audit. The total cost of all general heat waste items, including labor, must not exceed \$250.

- Water heater insulation;
- Water pipe wrap (On the first 6 feet of water pipe on an existing water heater)
- Low flow showerheads and faucet aerators;
- Limited weather-stripping and caulking to increase comfort
- Furnace filters;
- Compact fluorescent and LED light bulbs where fixtures are used more than three hours a day.
- Furnace/Air Conditioner filters

APPENDIX A: PROJECT REPORT CONTENT REQUIREMENTS

This section identifies the scope and level of detail that should be included in all project files.

Section 1: General Information

- 1) General information
 - a. Project Description
 - i. Address of project
 - ii. Building configuration. Include a general description of the following:
 1. Type of structure(s)
 2. Number of stories
 3. Heating source/fuel type.
 - b. Measures completed/funding summary. List the following:
 1. Description of measure
 2. Cost of measure
 3. Funding sources utilized and amounts for each measure
 4. Identify measure as health & safety, incidental repair, energy improvement measure, or general heat waste.
 5. If non-federal dollars were utilized to buy down the cost of a measure, provide an explanation of the cost-effective amount of the measure and the amount of non-federal funding necessary to accomplish the buy down of the measure.
 - c. Summary of site visit (dates, participants, any relevant notes)

Section 2: Existing Conditions

The audit documentation should guide the reviewer through the steps taken to conduct the energy audit and analysis. The audit form must identify the auditor completing the audit as well as the date the audit was performed. When applicable, labeled photos should be included in the appropriate sections.

- 1) Existing building conditions. Provide a detailed description of the following:
 - a. Building diagram
 - b. Site layout and number of units for Multi-family Units
 - c. Building construction types

- d. Number of stories
- e. Year Built
- f. Total building area identified by use. (residential, common, commercial)
- g. Other significant building/project features
- h. Include photos of buildings to document existing conditions
- 2) Existing building components and energy systems
 - a. Building envelope
 - i. Wall construction: List the following for wall sections by type (exterior, buffered, foundation etc.)
 - 1. Construction type (concrete, brick, wood framed etc.)
 - 2. Existing R-value
 - 3. Gross wall area
 - 4. Net wall area
 - ii. Roof construction: List the following for all ceiling sections.
 - 1. Construction type (vaulted, flat roof, attic space etc.)
 - 2. Existing R-value
 - 3. Ceiling area for each identified type
 - iii. Floor/basement construction: List the following for all floor types
 - 1. Crawlspace/ basement
 - 2. Conditioned or unconditioned
 - 3. Existing R-value
 - 4. Floor area for each identified type
 - iv. Windows:
 - 1. Types of windows for each orientation of the building
 - 2. Area of glazing for each window type broken down by orientation.
 - v. Doors:
 - 1. Types of doors
 - 2. Location of doors
 - vi. HVAC Systems
 - 1. Heating system description for all heating equipment
 - a. Make, model, type, and age of equipment
 - b. Required testing results
 - c. Characterization of the distribution system if applicable
 - d. Notes of any special circumstances

- e. Photos if relevant
 - 2. Cooling system description for all cooling equipment
 - a. Make, model, type, and age of equipment
 - b. Required testing results
 - c. Characterization of the distribution system if applicable
 - d. Notes of any special circumstances
 - e. Photos if relevant
 - 3. Ventilation systems
 - a. Type of ventilations system
 - b. Measured capacity if possible
 - c. Notes of any special circumstances
 - d. Photos if relevant
- vii. Water Heating Systems
 - 1. Make, model, type, capacity, energy factor and age of equipment
 - 2. Required testing results of any fuel fired water heaters
 - 3. Notes of any special circumstances
 - 4. Photos if relevant
- viii. Utility Bill Breakdown
 - 1. One year's utility bill data for all fuel types utilized on the project.
 - 2. Analysis of the utility bills to break out baseload and heating load.

Section 3: Evaluated Measures

- 1) Recommended energy efficiency measures
 - a. A short narrative of each recommended energy efficiency measure
 - b. Recommended replacement specifications
 - c. Projected annual monetary savings
 - d. SIR
- 2) Energy efficiency measures not recommended
 - a. A short narrative of any measures that were evaluated, but not completed. Narrative should explain any special circumstances that prevented the installation of the measure.
- 3) Recommended health & safety measures
 - a. A Short narrative of recommended health and safety measures.

Section 4: Report Generation

- 1) Energy Model reports for REM/Design™
 - a. Fuel summary report
 - b. Performance summary report
 - c. Improvement analysis report
 - i. One copy with all measures run individually
 - ii. One copy with all cost-effective measures as well as air infiltration and any incidental repair costs grouped for an overall SIR of 1.0 or better.

Section 5: Notifications and Documentation

- 1) Lead Notifications:
 - a) Confirmation of receipt of lead pamphlet for each tenant and landlord
 - b) Photo documentation of lead safe practices
 - c) Copy of the test kit documentation form if any testing is completed
 - d) Completed and signed renovator checklist
- 2) Testing Documentation: A diagnostic testing form must document the following:
 - a. Blower doors: Include test results, for both pre and post testing.
 - b. Zonal pressure testing of combustion water heater cabinets (manufactured housing) and attached garages (connected to conditioned space).
 - c. Duct testing: include test results, both pre and post for all units requiring a duct test.
 - d. Combustion testing: Results for both pre and post testing.
 - i. Worst Case Combustion Appliance Zone (CAZ) pressures (excludes ranges) and spillage.
 - ii. Draft pressures under worst case. Include outdoor temperature at the time of the testing. (Excludes sealed combustion appliances, woodstoves, ranges, and pellet stoves)
 - iii. CO testing results. Include ambient CO for unit and measured CO in each combustion appliance.
 - e. ASHRAE 62.2 Documentation: Include documentation of final fan settings and flow measurements on all fans installed for ASHRAE 62.2 compliance.

Note: The Diagnostic testing form must identify the auditor/inspector completing the testing both pre and post weatherization. The form must be signed and dated by the auditor/inspector completing the testing.

- 3) Mold & Mildew:
 - a) Completed copy of the mold & mildew checklist.
 - b) If mold & mildew problems are identified, provide documentation of steps taken to resolve the problem.
 - c) Documentation of mold & mildew pamphlet being delivered. See exhibit 6 of the Oregon USDOE State plan
- 4) Health & Safety Hazard form: If health & safety hazards are identified, a health & safety form must be included in the file. See Appendix D, section V in the Oregon USDOE state plan for details.
- 5) Radon:
 - a. Testing is allowed. Client must be provided test results and documented in the client file.
 - b. Client must sign Informed Consent form and maintain in client file.
 - c. Informed Consent form must include:
 - i. IAQ Study
 - ii. List of allowable precautionary measures
 - iii. Benefits of Weatherization
 - iv. Confirmation of client receipt of Radon pamphlet.

See Appendix D, section IV of the USDOE State Plan for more information.

APPENDIX B: EFFECTIVE USEFUL LIVES

Effective Useful Lives

	US DOE/BPA	ECHO/LIHEAP Stick Built	ECHO/LIHEAP Mobile Home
<i>Measure</i>	<i>Life (yrs)</i>	<i>Life (yrs)</i>	<i>Life (yrs)</i>
Ceiling Insulation: loosefill and batt	30	45	25
Ceiling Insulation: all other types	20	45	25
Floor Insulation: loosefill and batt in enclosed cavity	30	45	25
Floor Insulation: all other types (loosefill and batt NOT in enclosed cavity)	20	45	25
Wall/Kneewall Insulation: densepack, batt type in enclosed cavity, rigid foamboard	30	45	25
Wall/Kneewall Insulation: all other types (loosefill and batt NOT in enclosed cavity)	20	45	25
Rim/Band Joist Insulation	20	45	25
Slab/Foundation Wall Insulation	20	45	25
Replacement Doors	20	20	20
Windows	20	25	25
Low-E Storm Windows	15	20	20

	US DOE/BPA	ECHO/LIHEAP Stick Built	ECHO/LIHEAP Mobile Home
Water Heater Replacement	13	15	15
Duct Sealing	10	20	20
Duct Insulation	20	20	20
Refrigerators	15	15	15
Infiltration	10	15	15
Heating Systems: Fuel-Fired Furnace/Boiler	20	20	20
Heating Systems: all other types, except Heat Pumps	18	20	20
Central Heat Pump/Air Conditioning System	15	15	15
Ductless Heat Pump	15	15	15
Smart/Programmable Thermostat	15	15	15
Heating/Cooling System Tuneup	3	3	3

APPENDIX C: DOE APPROVED MATERIALS (10CFR440, APPENDIX A)

Standards for Weatherization Materials

The following Government standards are produced by the Consumer Product Safety Commission and are published in title 16, Code of Federal Regulations:

Thermal Insulating Materials for Building Elements Including Walls, Floors, Ceilings, Attics, and Roofs Insulation—organic fiber— conformance to Interim Safety Standard in 16 CFR part 1209;

Fire Safety Requirements for Thermal Insulating Materials According to Insulation Use—Attic Floor—insulation materials intended for exposed use in attic floors shall be capable of meeting the same flammability requirements given for cellulose insulation in 16 CFR part 1209; Enclosed spaces—insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting the smoldering combustion requirements in 16 CFR part 1209. The following standards which are not otherwise set forth in part 440 are incorporated by reference and made a part of part 440. The following standards have been approved for incorporation by reference by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. These materials are incorporated as they exist on April 5, 1993 and a notice of any change in these materials will be published in the FEDERAL REGISTER. The standards incorporated by reference are available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to:

<http://www.archives.gov/federalregister/codeofregulations/ibr/location.html>.

The standards incorporated by reference in part 440 can be obtained from the following sources:

- **Air Conditioning and Refrigeration Institute**, 1501 Wilson Blvd., Arlington, VA 22209; 703-524-8800.
- **American Gas Association**, 1515 Wilson Blvd., Arlington, VA 22209; 703-841-8400.
- **American National Standards Institute, Inc.**, 1430 Broadway, New York, NY 10018; 212-642-4900.
- **American Society of Mechanical Engineers, United Engineering Center**, 345 East 47th Street, New York, NY 10017; (212) 705-7800. American

Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103; 215-299-5400.

- **American Architectural Manufacturers Association**, 1540 East Dundee Road, Palatine, IL 60067; 708-202-1350.
- **Federal Specifications, General Services Administration**, Specifications Section, Room 6654, 7th and D Streets, SW, Washington, DC 20407; 202-708-5082.
- **Gas Appliance Manufacturers Association**, 703-525-9565.
- **National Electrical Manufacturers Association**, 2101 L Street, NW, Suite 300, Washington, DC 20037; (202) 457-8400. National Fire Protection Association, Batterymarch Park, P.O. Box 9101, Quincy, MA 02269; 617-770-3000.
- **National Standards Association**, 1200 Quince Orchard Blvd., Gaithersburg, MD 20878; 301-590-2300. (NSA is a local contact for materials from ASTM).
- **National Wood Window and Door Association**, 1400 East Touhy Avenue, Des Plaines, IL 60018; 708-299-5200.
- **Sheet Metal and Air Conditioning Contractors Association**, P.O. Box 221230, Chantilly, VA 22022-1230; 703-803-2980. Steel Door Institute, 712 Lakewood Center North, 14600 Detroit Avenue, Cleveland, OH 44107; 216-899-0100.
- **Steel Window Institute**, 1230 Keith Building, Cleveland, OH 44115; 216-241-7333.
- Tubular Exchanger Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591; 914-332-0040.
- **Underwriters Laboratories, Inc.**, P.O. Box 75530, Chicago, IL 60675-5330; 708-272-8800.

More information regarding the standards in this reference can be obtained from the following sources:

- **Environmental Protection Agency**, 401 M Street, NW, Washington, DC 20006; 202-554-1080.
- **National Institute of Standards and Technology, U.S. Department of Commerce**, Gaithersburg, MD 20899, 301-975-2000
- Weatherization Assistance Programs Division, Conservation and Renewable Energy, Mail Stop 5G-023, Forrestal Bldg, 1000 Independence Ave, SW, Washington, DC 20585; 202-586-2207.

**Thermal Insulating Materials for Building Elements Including Walls, Floors,
Ceilings, Attics, and Roofs** [Standards for conformance]

<p>Insulation-mineral fiber: Blanket insulation..... Roof insulation board..... Loose-fill insulation.....</p>	<p>ASTM C665-98. ASTM C726-00a. ASTM C764-99.</p>
<p>Insulation-mineral cellular: Vermiculite loose-fill insulation..... Perlite loose-fill insulation..... Cellular glass insulation block..... Perlite insulation board.....</p>	<p>ASTM C516-80 (1990). ASTM C549-81 (1986). ASTM C552-88. ASTM C728-89a.</p>
<p>Insulation-organic fiber: Cellulosic fiber insulating board..... Cellulose loose-fill insulation.....</p>	<p>ASTM C208-72 (1982). ASTM C739-88.</p>
<p>Insulation-organic cellular: Preformed block-type polystyrene insulation.. Rigid preformed polyurethane insulation board..... Polyurethane or polyisocyanurate insulation board faced with aluminum foil on both sides Polyurethane or polyisocyanurate insulation board faced with felt on both sides.....</p>	<p>ASTM C578-87a. ASTM C591-85. FS HH-I-1972/1 (1981). FS HH-I-1972/2 (1981). And Amendment 1, Oct. 3, 1985.</p>
<p>Insulation—composite boards: Mineral fiber and rigid cellular polyurethane composite roof insulation board..... Perlite board and rigid cellular polyurethane composite roof insulation..... Gypsum board and polyurethane or polisocyanurate composite board..... Materials used as a patch to reduce infiltration through the building envelope.....</p>	<p>ASTM C726-88. ASTM C984-83. FS HH-I-1972/4 (1981). Commercially available.</p>

Thermal Insulating Materials for Pipes, Ducts, and Equipment Such as Boilers and Furnaces [Standards for conformance]

<p>Insulation—mineral fiber: Preformed pipe insulation..... Blanket and felt insulation (industrial type)... Blanket insulation and blanket type pipe insulation (metal-mesh.covered) (industrial type)..... Block and board insulation..... Spray applied fibrous insulation for elevated temperature..... High-temperature fiber blanket insulation..... Duct work insulation.....</p>	<p>ASTM 1 C547-77. ASTM C553-70 (1977). ASTM C592-80. ASTM C612-83. ASTM C720-89. ASTM C892-89. Selected and applied according to ASTM C971-82.</p>
<p>Insulation—mineral cellular: Diatomaceous earth block and pipe insulation..... Calcium silicate block and pipe insulation.... Cellular glass insulation..... Expanded perlite block and pipe insulation..</p>	<p>ASTM C517-71 (1979) ASTM C533-85 (1990). ASTM C552-88. ASTM C610-85.</p>
<p>Insulation—Organic Cellular: Preformed flexible elastomeric cellular insulation in sheet and tubular form..... Unfaced preformed rigid cellular polyurethane insulation.....</p>	<p>ASTM C534-88. ASTM C591-85.</p>
<p>Insulation skirting.....</p>	<p>Commercially available.</p>

Fire Safety Requirements for Insulating Materials According to Insulation Use
 [Standards for conformance]

Attic floor	Insulation materials intended for exposed use in attic floors shall be capable of meeting the same smoldering combustion requirements given for cellulose insulation in ASTM C739–88.
Enclosed space	Insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting the smoldering combustion requirements in ASTM C739–88.
Exposed interior walls and ceilings	Insulation materials, including those with combustible facings, which remain exposed and serve as wall or ceiling interior finish, shall have a flame spread classification not to exceed 150 (per ASTM E84–89a).
Exterior envelope walls and roofs	Exterior envelope walls and roofs containing thermal insulations shall meet applicable local government building code requirements for the complete wall or roof assembly.
Pipes, ducts, and equipment	Insulation materials intended for use on pipes, ducts and equipment shall be capable of meeting a flame spread classification not to exceed 150 (per ASTM E84–89a).

Storm Windows [Standards for conformance]

Storm windows:	
Aluminum insulating storm windows.....	ANSI/AAMA 1002.10–83.
Aluminum frame storm windows.....	ANSI/AAMA 1002.10–83.
Wood frame storm windows.....	ANSI/NWWDA I.S. 2–87.
Rigid vinyl frame storm windows.....	(Section 3) ASTM D4099–89.
Frameless plastic glazing storm.....	Required minimum thickness windows is 6 mil (.006 inches).
Movable insulation systems for windows.....	Commercially available.

Storm Doors [Standards for conformance]

Storm doors—Aluminum:	
Storm Doors.....	ANSI/AAMA 1102.7–89.
Sliding glass storm doors.....	ANSI/AAMA 1002.10–83.
Wood storm doors.....	ANSI/NWWDA I.S. 6–86.
Rigid vinyl storm doors.....	ASTM D3678–88.
Vestibules:	
Materials to construct vestibules.....	Commercially available.
Replacement windows:	
Aluminum frame windows.....	ANSI/AAMA 101–88.
Steel frame windows.....	Steel Window Institute recommended specifications for steel windows, 1990.
Wood frame windows.....	ANSI/NWWDA I.S. 2–87.
Rigid vinyl frame windows.....	ASTM D4099–89.

Replacement Doors [Standards for conformance]

Replacement doors—Hinged doors:	
Steel doors.....	ANSI/SDI 100–1985.
Wood doors:	
Flush doors.....	ANSI/NWWDA I.S. 1–87. (exterior door provisions)
Pine, fir, hemlock and spruce doors.....	ANSI/NWWDA I.S. 6–86.
Sliding patio doors:	
Aluminum doors.....	ANSI/AAMA 101–88.
Wood doors.....	NWWDA I.S. 3–83.

Caulks and sealants: [Standards for conformance]

Caulks and sealants:	
Putty.....	FS TT-P-00791B, October 16, 1969 and Amendment 2, March 23, 1971.
Glazing compounds for metal sash.....	ASTM C669-75 (1989).
Oil and resin base caulks.....	ASTM C570-72 (1989).
Acrylic (solvent types) sealants.....	FS TT-S-00230C, February 2, 1970 and Amendment 2, October 9, 1970.
Butyl rubber sealants.....	FS TT-S-001657, October 8, 1970.
Chlorosulfonated polyethylene sealants.....	FS TT-S-00230C, February 2, 1970 and Amendment 2, October 9, 1970.
Latex sealing compounds.....	ASTM C834-76 (1986).
Elastomeric joint sealants (normally considered to include polysulfide, polyurethane, and silicone).....	ASTM C920-87.
Preformed gaskets and sealing materials.....	ASTM C509-84

Weatherstripping [Standards for conformance]

Weatherstripping.....	Commercially available.
Vapor retarders.....	Selected according to the provisions cited in ASTM C755-85 (1990). Permeance not greater than 1 perm when determined according to the desiccant method described in ASTM E96-90.
Items to improve attic ventilation.....	Commercially available.
Clock thermostats.....	NEMA DC 3-1989.

Heat Exchangers [Standards for conformance]

Heat exchangers, water-to-water and steam-to-water.....	ASME Boiler and Pressure Vessel Code, 1992, Sections II, V, VIII, IX, and X, as applicable to pressure vessels. Standards of Tubular Exchanger Manufacturers Association, Seventh Edition, 1988.
Heat exchangers with gas-fired appliances.....	Conformance to AGA Requirements for Heat Reclaimer Devices for Use with Gas-Fired Appliances No. 1-80, June 1, 1980. AGA Laboratories Certification Seal.
Heat pump water heating heat recovery systems.....	Electrical components to be listed by UL.

Boiler/Furnace Control Systems [Standards for conformance]

Automatic set back thermostats.....	Listed by UL. Conformance to NEMA DC 3-1989.
Line voltage or low voltage room thermostats.....	NEMA DC 3-1989.
Automatic gas ignition systems.....	ANSI Z21.21-1987 and Z21.21a-1989. AGA Laboratories Certification Seal.
Energy management systems.....	Listed by UL.
Hydronic boiler controls.....	Listed by UL.
Other burner controls.....	Listed by UL.

Water Heater Modifications [Standards for conformance]

Insulate tank and distribution piping	(See insulation section of this appendix).
Install heat traps on inlet and outlet piping.....	Applicable local plumbing code.
Install/replace water heater heating elements.....	Listed by UL.
Electric, freeze-prevention tape for pipes.....	Listed by UL.
Reduce thermostat settings	State or local recommendations.
Install stack damper, gas-fueled	ANSI Z21.66–1988, including Exhibits A&B, and ANSI Z223.1–1988.
Install stack damper, oil-fueled	UL 17, November 28, 1988, and NFPA 31–1987.
Install water flow modifiers.....	Commercially available.

Waste Heat Recovery Devices [Standards for conformance]

Desuperheater/water heaters.....	ARI 470–1987.
Condensing heat exchangers.....	Commercially available components and in new heating furnace systems to manufacturers' specifications.
Condensing heat exchangers.....	Commercially available (Commercial, multi-story building, with teflon-lined tubes institutional) to manufacturers' specifications.
Energy recovery equipment.....	Energy Recovery Equipment and Systems Air-to-Air (1978) Sheet Metal and Air-Conditioning Contractors National Association (SMACNA).

Boiler Repair and Modifications/Efficiency Improvements

[Standards for conformance]

Install gas conversion burners.....	ANSI Z21.8–1984, (for gas or oil-fired systems), ANSI Z21.17–1984, ANSI Z21.17a-1990, and ANSI Z223.1–1988. AGA Laboratories Certification seal.
Replace oil burner	UL 296, February 28, 1989 Revision and NFPA 31–1987.
Install burners (oil/gas)	ANSI Z223.1–1988 for gas equipment and NFPA 31–1987 for oil equipment.
Re-adjust boiler water temperature or install automatic boiler temperature reset control.....	ASME CSD–1–1988, ASME CSD–1a-1989, ANSI Z223.1–1988, and NFPA 31–1987.
Replace/modify boilers	ASME Boiler and Pressure Vessel Code, 1992, Sections II, IV, V, VI, VIII, IX, and X. Boilers must be Institute of Boilers and Radiation Manufacturers (IBR) equipment.
Clean heat exchanger, adjust burner air shutter(s), check smoke no. on oil-fueled equipment. Check operation of pump(s) and replacement filters.....	Per manufacturers' instructions.
Repair combustion chambers.....	Refractory linings may be required for conversions.
Replace heat exchangers, tubes	Protection from flame contact with conversion burners by refractory shield.
Install/replace thermostatic radiator valves	Commercially available. One pipe steam systems require air vents on each radiator; see manufacturers' requirements.
Install boiler duty cycle control system..	Commercially available. NFPA 70, National Electrical Code (NEC) 1993 and local electrical codes provisions for wiring.

Heating and Cooling System Repairs and Tune-ups/Efficiency Improvements
 [Standards for conformance]

Install duct insulation.....	FS HH-I-558C, January 7, 1992 (see insulation sections of this appendix).
Reduce input of burner; derate gas-fueled equipment.....	Local utility company and procedures if applicable for gas fueled furnaces and ANSI Z223.1-1988 (NFPA 54-1988) including Appendix H.
Repair/replace oil-fired equipment.....	NFPA 31-1987.
Replace combustion chamber in oil-fired furnaces or boilers.....	NFPA 31-1987.
Clean heat exchanger and adjust burner: adjust air shutter and check CO2 and stack temperature. Clean or replace air filter on forced air furnace.....	ANSI Z223.1-1988 (NFPA 54-1988) including Appendix H.
Install vent dampers for gas-fueled heating systems.....	Applicable sections of ANSI Z223.1-1988 (NFPA54-1988) including Appendices H, I, J, and K. ANSI Z21.66-1988 and Exhibits A & B for electrically operated dampers.
Install vent dampers for oil-fueled heating systems.....	Applicable sections of NFPA 31-1987 for installation and in conformance with UL 17, November 28, 1988.
Reduce excess combustion air: A: Reduce vent connector size of gas-fueled appliances.....	ANSI Z223.1-1988 (NFPA 54-1988) Part 9 and Appendices G & H.
B: Adjust barometric draft regulator for oil fuels.....	NFPA 31-1987 and per manufacturers' (furnace or boiler) instructions.

Replace constant burning pilot with electric ignition device on gas-fueled furnaces or boilers.....	ANSI Z21.71–1981, Z21.71a-1985, and Z21.71b-1989.
Readjust fan switch on forced air gas or oil-fueled furnaces.....	Applicable sections and Appendix H of ANSI Z223.1–1988 (NFPA 54–1988) for gas furnaces and NFPA 31–1987 for oil furnaces.
Replace burners.....	See power burners (oil/gas).
Install/replace duct furnaces (gas).....	ANSI Z223.1–1988 (NFPA 54–1988).
Install/replace heat pumps.....	Listed by UL.
Replace air diffusers, intakes, registers, and grilles.....	Commercially available.
Install/replace warm air heating metal ducts.....	Commercially available.
Filter alarm units.....	Commercially available.

Replacement Furnaces, Boilers, and Wood Stoves [Standards for conformance]

Chimneys, fireplaces, vents and solid fuel burning Appliances.....	NFPA 211–1988.
Gas-fired furnaces.....	ANSI Z21.47–1987, Z21.47a–1988, and Z21.47b–1989. ANSI Z223.1–1988 (NFPA 54–1988).
Oil-fired furnaces.....	UL 727, August 27, 1991 Revision and NFPA 31–1987.
Liquified petroleum gas storage.....	NFPA 58–1989.
Ventilation fans: Including electric attic, ceiling, and whole house fans.....	UL 507, August 23, 1990 Revision.

Air Conditioners and Cooling Equipment [Standards for conformance]

Air conditioners:	
Central air conditioners.....	ARI 210/240–1989.
Room size units.....	ANSI/AHAM RAC–1–1982.
Other cooling equipment:	
Including evaporative coolers, heat pumps and other equipment.....	UL 1995, November 30, 1990.

Screens, Window Films, and Reflective Materials [Standards for conformance]

Insect screens.....	Commercially available.
Window films	Commercially available.
Shade screens:	
Fiberglass shade screens	Commercially available.
Polyester shade screens	Commercially available.
Rigid awnings:	
Wood rigid awnings.....	Commercially available.
Metal rigid awnings	Commercially available.
Louver systems:	
Wood louver systems	Commercially available.
Metal louver systems	Commercially available.
Industrial-grade white paint used as a heat-reflective measure on awnings, window louvers, doors, and exterior duct work (exposed).....	Commercially available.

APPENDIX D: FUEL SWITCHING PROTOCOL

A. Policy

1. OHCS does not permit the general practice of fuel switching when replacing heating systems and hot water tanks. OHCS does allow the changing or converting of a heating system/ hot water tanks on a limited case-by-case basis for projects that involve OHCS administered funding.
 - a. Local agencies must notify OHCS in writing (email acceptable) if they intend to switch fuels as part of their weatherization services.
 - b. Local agencies may switch fuels under the following conditions:
 - (1) Energy efficiency if the total cost is justified using an evaluation of cost-effectiveness where the Savings to Investment Ratio (SIR) is 1.0 or greater.
 - (2) When installing a heating system/water heater using the existing fuel is not possible.
 - (3) Client health and safety.
 - (4) Any other extenuating circumstance not covered above.
2. When fuel switching, all costs associated with the installation of a heating system or water heater, and all required elements of the new heating system (providing a new supply line, flue, chimney, ducts, electrical upgrades etc.), must be considered as part of the total cost.

Allowable Costs

Switching fuel is an allowable cost under all grants with prior OHCS written notification and approval. DOE funds may be used to fuel switch **only** when the fuel switch is cost effective. Fuel switching must be included in the SIR calculation for all grant sources. LIHEAP funding may be used to replace equipment/fuel switch as a health and safety consideration outside the cost-effective requirement.

B. Procedure

1. Programmatic
 - a. Submit the following to OHCS:
 - (1) A completed [Fuel Switch Request](#) Form to the OHCS T&TA Coordinator.
 - (2) Supporting documentation.

- (a) Photo documentation of existing equipment – including data plates (Model/serial numbers) outlining current conditions;
 - (b) Relevant testing documentation – i.e. CAZ diagnostics for health/safety;
 - (c) Documentation of upgrade costs – i.e. bid proposal, contract price sheet, etc;
 - (d) Utility Consumption Analysis (UCA) or Client utility bills for baseload and metered fuel sources;
 - (e) Un-metered fuel source bills if available. If documentation of fuel usage is not available, Agency will utilize the “modeling conservatively” approach according to the [REM Technical Policies](#).
- (3) A REM/Design .blg electronic file will be sent to OHCS for review. An improvement analysis with the appliance to be fuel switched upgraded to the new appliance and interacted with all other energy conservation measures for the building. The installed fuel switch must have an SIR of 1.0 or greater. Building model must include approved utility rates for metered fuel types.
- b. OHCS will:
- (1) Review fuel switch request form;
 - (2) Review supporting documentation;
 - (3) Request any additional information if necessary;
 - (4) Review REM/Design file;
 - (5) OHCS program manager will sign and return the fuel switch request form as either approved or denied.
- c. Client files must include the following documentation:
- (1) Copy of the approved fuel switch request form submitted to OHCS.
 - (2) Supporting documentation if health and safety related or using the existing fuel is not possible
 - (3) All necessary measure-specific justification.