2026 WEATHERIZATION ASSISTANCE PROGRAM

MICHIGAN ENERGY AUDIT GUIDE

MDHHS
Michigan Department of Health & Human Services

Effective Date: July 01, 2026

INTRODUCTION

The mission of the Department of Energy (DOE) and the Weatherization Assistance Program (WAP) is: *"To reduce energy costs for low-income families, particularly for the elderly, people with disabilities, and children, by improving the energy efficiency of their homes while ensuring their health and safety."*

The Energy Auditor (EA) is an experienced professional who evaluates the health and safety issues, durability, comfort, and energy use of a residential building.

Depending on the level of the audit, an energy audit may include some or all of the following tasks:

- Inspect the building and its mechanical systems to gather the information necessary for decision making.
- Evaluate the current energy consumption along with the existing condition of the building.
- Diagnose areas of energy waste, health and safety, and durability problems related to energy conservation.
- Recommend energy conservation measures (ECMs).
- Diagnose health and safety problems, and how the proposed ECMs may affect these problems.
- Estimate labor and material costs for ECMs.
- Educate residents about their energy usage and proposed energy retrofits.
- Encourage behavioral changes that reduce energy waste.
- Create written documentation of the energy audit and the recommendations offered.

The health and safety of clients must never be compromised by weatherization. Weatherization work can change the operation of heating and cooling systems, alter the moisture balance within the home, and reduce a home's natural ventilation rate. Weatherization workers must take all necessary precautions to avoid potential harm to our clients from these changes.

Additional regulatory and legislative changes in the late 1990s increased flexibility for states. The average amount of spending per home was raised and the requirement that 40% of Program funds be spent on materials was removed in response to the nationwide integration of advanced energy audits. Electric baseload measures were approved and incorporated in 2000.

Also, in 2000, DOE increased flexibility for providers to ease budget constraints related to health and safety expenditures. To help Grantees weatherize more multifamily dwelling units, the eligibility criteria was changed to allow the weatherization of units where low-income tenants account for half of the building's residents in certain situations.

The Energy Independence and Security Act of 2007, which reauthorized the Program, was expanded by DOE during the rulemaking to include any territory or possession of the U.S. in the definition of "states" as an eligible grantee of the Program.

As part of the Recovery Act that was signed into law on Feb. 17, 2009, the Program was provided $5 billion in additional funding to support jobs, spur economic growth, and expedite the weatherization of more low-income homes.

Today, DOE's Weatherization Assistance Program has evolved into a sophisticated residential program that addresses whole-house energy efficiency and promotes a whole-community approach.

Now, with that perspective in mind, take a look at the significant program updates during 2020.

- The WAP was reauthorized through FY 2025.

- Authority to "reweatherize" a home if 15 years have passed since the original services were completed.

What the above history and recent updates represent is an ongoing commitment by Congress to support the WAP. Congress continues to recognize the worth of the WAP and the long-lasting benefits it provides to low-income households. Michigan's WAP Network will continue to do our part to earn their support and confidence.

TABLE OF CONTENTS

	Introduction ----------	
1.0	Certification and Training ----------	Pg 1
2.0	Tools for the Job ----------	Pg 2
3.0	Client Interview and Paperwork ----------	Pg 4
4.0	Assessment Summary ----------	Pg 7
5.0	Health and Safety Assessment ----------	Pg 11
6.0	Combustion Appliance Assessment ----------	Pg 14
7.0	Unvented Space Heaters ----------	Pg 24
8.0	WAweb Library Setup ----------	Pg 26
9.0	Optional Energy Conservation Measures ----------	Pg 39
10.0	Energy Modeling Considerations ----------	Pg 40
11.0	NEAT/MHEA Data Collection ----------	Pg 45
12.0	Energy Audit Software User Manual ----------	Pg 51
13.0	Resources ----------	Pg 116
14.0	Appendices ----------	Pg 117

1.0 Certification and Training

The training requirements outlined in this guide are current as of the publication date. All energy auditors and quality control inspectors working in the Weatherization Assistance Program are required to follow all certification and training requirements in CSPM 618. Please note that additional comprehensive training opportunities, offered by MITEC and other IREC-accredited providers, are available beyond the requirements outlined in CSPM 618 and the Energy Auditor certification standards.

1.1 Energy Auditor Certification / Training Requirements

The energy auditor must maintain the following:

- Health and Safety Training
- Lead Safe Work Practices Training
- OSHA 10 Hour Certification
- BPI EA and / or BA-P Certification
- NEAT/MHEA Data Collection Training

The BPI Building Analyst Professional and BPI Energy Auditor are recognized certifications to complete energy audits in the Michigan Weatherization Assistance Program.

Michigan's technical field staff must participate in Comprehensive Training in alignment with their JTA every three years. Comprehensive training must be completed within 180 days after beginning work in WAP.

1.2 Quality Control Inspector:

A quality control inspector is a residential energy-efficiency professional who ensures the completion, appropriateness, and quality of energy upgrade work by conducting a methodological audit/inspection of the building, performing safety and diagnostic tests, and observing the work.

Individuals must be BPI Energy Auditor certified and successfully challenge the BPI Quality Control Inspector (QCI) online exam to become BPI QCI certified.

2.0 Tools for the Job

There are many tools required to complete a full energy audit correctly and efficiently. We will cover all of the required tools as well as others that will make the job easier and help you attain the best data possible.

2.1 Required Tools:

- Computer for audit creation, work order creation, and document uploading.
- Personal CO monitor.
- Pressure pan.
- Exhaust fan flow meter (a large piece of cardboard can be used to help measure kitchen range hoods).
- Blower door.
- Manometer (2 preferred).
- Multiple long hoses for manometer.
- Combustion analyzer.
- Infrared camera (infrared scans are required per CSPM 606.1).
- Digital Camera (keep note of required photo requirements per CSPM 612).
- Gas leak detector (capable of displaying % LEL) (See BPI 1200).
- Tape measure (needed for accurate dimensions, used when inputting data for your audit).
- Watt meter (needed for evaluating refrigerators).
- Ladder (will be very difficult to do an audit in most cases without a ladder).
- Flashlight (allows you to assess poorly lit areas such as attics, crawlspaces, and basement corners).

2.0 Tools for the Job

2.2 Other Tools:

- Small brass tubing to get manometer hoses under doors or into attic spaces.
- Drill with a charged battery and drill bits.
- Smoke puffer (smoke pens, small mirror, or even glasses could be used to see spillage when testing a water heater).
- Thermometer (2 preferred).
- Duct mask (painter's tape, etc.).
- Voltage tester.
- Moisture meter.
- Hand tools (screw drivers, crowbar, utility knife, hammer).
- PPE (Tyvek suit, boots, mask, etc.) (useful for inspecting areas like dirty crawlspaces).
- Disposable shoe covers.
- Extended lighter (handy for relighting pilot lights).
- Extension cord.
- 2-prong to 3-prong plug adaptor (many homes with older electrical will require an adaptor to run your blower door).
- Shaving cream (can be used for dust control when drilling).
- Pen/paper.
- Mud/spackle with joint knife or hole plugs.
- Portable construction vacuum.

3.0 Client Interview and Paperwork

Before conducting the energy audit, it's important to communicate a few key details to the client ahead of your visit:

- If there are any pets, clients should have them secured somewhere safe and away from inspection/work areas.
- Any entryways and appliances that will be evaluated will need to be clear and accessible. Examples include the attic hatch, crawlspace accesses, furnace, dryer, refrigerator, and oven.
- They'll need to know you'll be accessing every part of their home and it could take up to four hours.
- If they have any fireplaces, they'll need to extinguish and clean them before you arrive so the blower door doesn't pull embers, coals, or ashes into the home.
- It is best practice to inform the homeowner that someone 18 years or older should be present at the time of the audit.

Subgrantee auditors are required to conduct on-site interviews with weatherization clients. This interview process should provide the auditor with enough background information to properly identify hazards that exist, health and safety (H&S) issues, and energy conservation opportunities. The following items are required components of a complete energy audit:

3.1 Problem identification, such as dwelling use, heating and cooling habits, and comfort issues. Discuss energy conservation opportunities and H&S issues with the client. Make the client aware of the methods and processes associated with installing certain measures such as insulating and patching walls from the interior of the home. The client should be informed that the audit needs to be completed before any of the discussed work can be approved to move forward.

3.2 Information about the Weatherization Assistance Program (WAP), services provided by the program and strategies that the client could employ to reduce their energy use.

3.3 Discuss any medical concerns the client may have and any possible accommodations.

3.4 Client education is required when hazards exist.

3.0 Client Interview and Paperwork

3.5 All required paperwork per CSPM 612:

- Client plan of action.
- DHS-4285, Pre-Renovation Form Confirmation of Receipt of Lead Pamphlet (or certificate of mailing) per CSPM 615.
- LRRP Documentation, when applicable.
- Michigan Weatherization Program Health & Safety Assessment Findings, DHS-552.
- Release of Liability and Waiver of Claims, DHS-552-A (per CSPM 617).
- Signed radon informed consent form.
- Any other forms that require client signature (e.g., asbestos notice, unsafe condition, infrared scan, etc.).
- A completed data collection form.
- A completed work order.
- A completed DOE-approved audit.
- State Historic Preservation Office (SHPO) Documentation – See Item 619.
- Multi-Family File Documentation Including Audit Runs and Priority Lists.

3.0 Client Interview and Paperwork

The WAP file for each building must contain at least the following information from the energy audit:

- The recommended statement of work including the savings-to-investment ratios (SIRs) of each measure and the total project SIR.
    - » If any measures were bought down or otherwise leveraged the documentation must show the pre-leveraged SIRs of each individual measure and the pre-leveraged project SIR.
    - » Documentation must include the other sources that funded each bought-down measure.
- Either a printed file showing all of the building audit inputs and outputs or the immediately accessible electronic file that shows all the audit inputs and outputs. For priority list projects the file must include all pre-weatherization measurements.
- Final installed costs of each measure and the total project cost. If the project went through the bidding process, then all bid prices – winning and losing bids – must be in the file.
- All specifications defining each measure.

4.0 Assessment Summary

In most cases, the audit is the initial assessment of the home. As part of the energy audit the auditor must complete the uniform data collection tool. The energy audit must include at least the following activities:

4.1 Upon entry into the home, test for ambient carbon monoxide and combustible gases.

4.2 Determinations are made if the building will be a deferral. Reasons for a deferral can be found in CSPM 609 and the subgrantee's deferral policy.

4.3 Detailed drawing of the house must be completed and include the following required elements:

- Identifies room labeling and corresponds with the work order.
- Shows measurements on the diagram for proper square footage calculations and verification.
- Identifies windows and doors on all sides of the dwelling.
- Establishes the thermal and pressure boundary.

4.4 An agency may choose to keep job photographs on an agency system. The agency is responsible for supplying the photographs to BCAEO staff upon request and in a timely manner (photograph requests must be met within four working days). The agency should provide photographs for any jobs pulled in the BCAEO/DOE monitoring scope. The agency will be responsible for the storage of the photographs as outlined in the DOE agreement.

Agencies that do not wish to store their photographs on an agency system must upload photographs to the database (compressed to e-mail 96PPI). Photographs must be labeled.

Photos of the home and conditions should be taken at the EA and QCI, unless otherwise noted, and labeled to identify at what stage they were taken. Required photographs for each weatherization unit include:

- All sides of house/mobile home.
- Any existing damage to finishes to ensure that weatherization workers aren't blamed for pre-existing damage. (EA, as applicable).

4.0 Assessment Summary

- Basement/foundation.
- Furnace or heating system; with venting, if possible.
- Domestic Water Heater (DWH); with venting, if possible.
- Combustion appliance venting if unable to capture in appliance photo.
- Clothes dryer with venting.
- Refrigerator.
- Initial state of attic including existing insulation, knob & tube wiring and exhaust fan ducting when applicable.
- All measures addressed with WRF or Deferral Reduction Funds – pre and post installation.
- All installed measures.
- Work areas not accessible at time of QCI or monitoring.
- Exhaust fans and/or controls for ASHRAE compliance, where applicable.
- Photographic justification of all IRMs (also requires written justification).
- Anything out of the ordinary where additional documentation supports the weatherization work (e.g. large bypasses in attic, crawlspace clutter, etc.).
- All relevant H&S items for the job. These photos include:
  - » Site containment set up for LSW (see H&S Plan for details).
  - » H&S roof repair is well documented with written explanation and photos of the biological growth in the client file.
  - » H&S Window or Door repair is well documented with written explanation and photos of the biological growth in the client file.
  - » Recommended: Stove testing results.

- All call back work completed (QCI).
- All complaint follow ups.
- Refrigerator installation if installed after the QCI (see CSPM 602).
- Document condition(s) outlined in a CSPM-required Notice (e.g., Asbestos or Potentially Unsafe Conditions, Hazard Identification and Notification).

4.5 An inspection of **baseload** use is performed:

- Refrigerators are metered as appropriate.
- Lighting Upgrades are investigated.
- Hot water consumption efficiency upgrades are investigated.

4.6 A comprehensive **exterior** inspection encompassing all building components, including structural condition, orientation, measurements, insulation levels, health and safety considerations, site grading, and potential moisture concerns.

4.7 A detailed **attic** inspection covering all relevant building components, including structural condition, measurements, air leakage points, insulation levels, health and safety considerations, moisture-related issues, and ventilation requirements.

4.8 A detailed **basement/crawlspace** inspection covering all relevant building components, including structural condition, measurements, air leakage points, insulation levels, health and safety considerations, moisture-related issues, and ventilation requirements.

4.9 Any Health and Safety (H&S) issues are documented and required notification provided to client: Mold/moisture, dryer/exhaust fan terminations, plumbing problems, electrical problems, asbestos, etc. (See CSPM 614 for a comprehensive list of H&S items)

4.10 Lead issues are documented and a determination will be made regarding the need to use lead-safe work practices.

4.0 Assessment Summary

4.11 Inspection of the **combustion appliances** is performed; reference the current version of the BPI 1200 standard. This includes being able to check for gas leaks, electrical safety, combustion air requirements, vent system visual inspection, duct system visual inspection, and visual inspection of cleanliness.

4.12 **Combustion appliance zone (CAZ) pressure diagnostics** (Worst-Case depressurization of the CAZ) and operational testing are required (establish flow in the vent under worst-case conditions, spillage, CO, and temperature rise on a forced air system). (See section 6.0)

4.13 Blower door testing is performed - looking for leakage areas (specifically high and low), making sure zones that can be isolated are investigated (sections of the home - basements), making sure additional blower door readings are obtained for pressure diagnostic purposes, if appropriate. Verify correct thermal and pressure boundaries have been established. An evaluation for presumed asbestos containing material (including vermiculite) must be done prior to any blower door testing. Upon identification of friable Presumed Asbestos Containing Material (PACM) follow the H&S section in CSPM 614. See section 11 for more blower door guidance.

4.14 Pressure diagnostics are performed - attics, basements, crawls, building sections where thermal and pressure boundary alignment are questioned (attached porches, bulkheads, etc.), attached garages, pressure pan testing on ducts as appropriate, interior room and main body pressures (done with furnace fan only) - evaluation of the results to assist in work scope development is required. Testing locations and results must be clearly documented. (See CSPM 612 for a complete list of required advanced diagnostics and assessments)

4.15 Air sealing opportunities must be identified to appropriately align the pressure and thermal boundaries.

4.16 Infrared camera used as appropriate (specifically for blower door testing).

4.17 Existing exhaust fans are measured for flow and other data gathered to calculate ASHRAE ventilation requirements.

4.18 Communicate with the client before leaving the initial audit. Set expectations for the next steps in the process and the overall weatherization workflow. Finish any client education.

5.0 Health and Safety Assessment

Guidance from this section is not meant to replace information presented in CSPM.

Health and safety (H&S) measures shall be addressed as required to eliminate hazards as defined in the H&S plan, see CSPM 614 and Attachment to 614. H&S measures must be installed in accordance with SWS aligned Michigan Field Guide, and state / local codes.

Health and Safety (H&S) funds may be used for:

- The elimination of energy related health and safety hazards, that are necessary before or because of the installation of weatherization measures.

- Only measures specified in CSPM 614 are eligible for installation using Health & Safety (H&S) funds.

Emergency Procedures

Subgrantee staff must immediately respond to all life threatening Health and Safety issues or situations. Use the following immediate responses for life threatening issues identified from testing or from other hazards requiring an immediate response. Procedures on how crews will handle life threatening hazards are observed: (Example: during testing of Combustion Gases when ambient CO is 70 ppm or greater, building structure issues, gas leaks from natural gas and/or propane, electrical fire hazards, electrical water hazards, and others hazards as identified)

- Terminate the inspection.
- Immediately notify the homeowner – occupants of the need for all building occupants to evacuate the building.
- Leave the building.
- Notify the appropriate emergency services from outside of the home.
- Call the Manager for instructions.

Reporting of Emergency Situation Requirements:

Reporting the emergency is not an indication for action to be taken by the State's Weatherization Office, it is just a reporting requirement to track emergency situations. Subgrantees must report emergency situations identified at any stage of the weatherization work (audit, installation, quality control inspection). Subgrantees must submit an email to the MDHHS-BCAEO@michigan.gov within 24 hours to report the emergency Health and Safety issues identified. The email must include job identifier, reason for the issue, and the remedy of the life-threatening situation. In addition, please provide the timeline and people involved

in the response taken in the email. Full documentation on the issues identified, response taken with timeline, results of response action, and notification email to the BCAEO must be uploaded in the client file.

Carbon monoxide alarms shall be installed by the Energy Auditor during the audit in a dwelling under the following circumstances:

Whenever a local agency must defer work and the dwelling unit contains an unsafe combustion appliance.

A combustion appliance is emitting unsafe levels of CO that cannot be immediately remedied.

A combustion appliance has a minimal draft and/or spillage and no CO is being produced.

The dwelling contains a fireplace or wood burning stove that draws combustion air from inside the dwelling.

- Please see the Michigan Field Guide Appendix A-2 for installation requirements for CO and smoke alarms.

Health and Safety Assessments

To safeguard the lives and well-being of subgrantee employees, contractors, and weatherization clients, auditors are required to conduct a health and safety (H&S) assessment during the initial home audit, before any weatherization work can begin. Identified H&S issues must be documented and corrected before work proceeds if such repairs are cost-effective and feasible. Where problems are beyond the scope of the program, the homeowner and the client must be notified of the problem(s) in writing and an explanation of the deferral process must be discussed and documented. The following areas must be assessed for H&S issues and addressed if found to be deficient (See CSPM 614 Attachment for further information on required actions, allowable actions, prohibited actions, required testing/inspection, allowable testing/inspection, required occupant education, and funding limitations):

- Air-Conditioning, Heating Systems, and Combustion Appliances
- Asbestos (Confirmed and/or Presumed Asbestos Containing Material)
- Biologicals and Unsanitary Conditions
- Building Structure and Roofing (e.g., roofing, wall, foundation)
- Code Compliance

5.0 Health and Safety Assessment

- Electrical
- Fuel Leaks
- Gas Ovens/Stovetops/Ranges
- Hazardous Materials
- Injury Prevention of Occupants
- Lead-Based Surface Coverings (Paint, Varnishes, Roofing, etc.)
- Mold and Moisture
- Occupant Pre-existing or Potential Health Conditions
- Pests
- Radon
- Safety Devices: Smoke and Carbon Monoxide Alarms, Fire Extinguishers
- Ventilation and Indoor Air Quality
- Water Heaters
- Worker Safety

6.0 Combustion Appliance Assessment

Combustion Appliance and Fuel Distribution System Inspection shall be conducted for each system in operation, please reference BPI 1100 and BPI 1200.

6.1 Where solid fuel-burning equipment is present, fire extinguishers may be provided as an allowable health and safety measure.

6.2 Ambient Air Monitoring for CO: The BPI 1200 standard requires CO monitoring at all times, during combustion testing this ensures that CO in the combustion appliance zone (CAZ) doesn't exceed dangerous levels.

Required Actions in Response to Ambient CO Measurements (from ANSI/BPI-1200, Section 7.3.3.3)

70 ppm or greater	36 ppm-69 ppm	9 ppm- 35 ppm
• Terminate the inspection. • Notify the homeowner - occupant of the need for all building occupants to evacuate the building. • Leave the building and the appropriate emergency services shall be notified from outside the home.	• Advise the homeowner - occupant that elevated levels of ambient CO have been detected. • Open windows and doors. Recommend that all possible sources of CO be turned off immediately. • Where it appears that the source of CO is a permanently installed appliance, recommend that the appliance be turned off and advise homeowner – occupant to contact a qualified professional.	• Advise the homeowner - occupant that CO has been detected. • Recommend that all possible sources of CO be checked and windows and doors opened. • Where it appears that the source of CO is a permanently installed appliance, advise the homeowner - occupant to contact a qualified professional.

6.3 Examine appliances for signs of damage, misuse, improper repairs, and lack of maintenance.

6.4 Inspect combustion venting systems for damage, leaks, disconnections, inadequate slope, and other safety hazards.

6.5 Place the Combustion Appliance Zone (CAZ) under worst-case depressurization conditions. Then perform a worst-case CAZ test.

6.6 The following steps shall be completed for the purpose of placing the Combustion Appliance Zone (CAZ) under the greatest depressurization achievable given the

weather/temperature conditions at the time of the inspection. Once it has been determined that the greatest possible depressurization has been achieved, the CAZ shall remain in this depressurized state during all spillage assessment and CO measurements conducted in the CAZ. (Step by step CAZ form located at the end of section 6)

1. Place all combustion appliances located within the CAZ in their standby mode and prepare for operation.

2. Fires in woodstoves and/or fireplaces shall be fully extinguished, with no hot coals or embers, prior to performing a depressurization test. Close fireplace dampers and any fireplace doors.

3. Close all building exterior doors and windows. Close all CAZ doors. Close the interior doors of all rooms except for rooms with an exhaust fan and rooms with a central forced air system return. Outdoor openings for combustion air shall remain open.

4. Turn off any mechanical ventilation and forced air cooling or heating system blowers.

5. Using a calibrated manometer or similar pressure measuring device intended for this purpose, measure and record the baseline pressure in the CAZ with reference to (WRT) outside. Compare this measurement with subsequent pressure measurements to determine the greatest negative pressure achievable in the CAZ.

6. Turn on the following exhaust equipment: clothes dryers (check and clean the dryer filter and look for blockage at the external vent damper prior to operation), range hoods, and other exhaust fans. If there are speed controls, operate the exhaust equipment at the highest speed setting. Do not operate a whole house cooling exhaust fan.

7. Measure and record the pressure in the CAZ WRT outside.

8. Turn on any central forced air system blowers and measure and record the pressure in the CAZ WRT outside.

9. If the pressure in the CAZ becomes more negative WRT outside after the blower is turned on, the blower shall remain on during combustion appliance safety inspection.

10. If the pressure in the CAZ becomes more positive WRT outside after the blower is turned on, the central forced air system blowers shall be turned off during the combustion appliance safety inspection.

11. Open interior door/s directly leading to the CAZ. Measure and record the pressure in the CAZ WRT outside.

12. If the pressure in the CAZ becomes more negative WRT outside after the door(s) are opened, the door(s) shall remain open during the combustion appliance safety inspection.

13. Starting with the appliance with smallest BTUh input rating, follow lighting instructions and place in operation. Adjust the thermostat or control so the appliance will operate continuously.

14. Spillage assessment and CO measurement in cold vent (except domestic water heaters).

    - Spillage shall be assessed at 5 minutes of main burner operation.

15. Action levels for spillage occurring at 5 minutes of main burner operation shall be in accordance with Annex D, Table D.1.A.

16. CO measurement of undiluted flue gas shall be taken at 5 minutes of main burner operation. The CO measurement shall be compared with the appropriate CO threshold in Section 7.9.5, Table 1, CO Thresholds for Fossil Fuel-Fired Appliances (Table 1).

17. Action levels for CO exceeding the appropriate threshold in Section 7.9.5, Table 1 shall be in accordance with Annex D, Table D.1.B.

18. Spillage assessment and CO measurement in domestic water heaters or warm vent.

    - Spillage shall be assessed at 2 minutes of main burner operation.

    - Action levels for spillage occurring at 2 minutes of main burner operation shall be in accordance with Annex D, Table D.1.A.

19. Spillage testing must be completed for all natural-draft appliances. Spillage must first be tested under worst-case conditions and then repeated for natural conditions if the appliance fails under worst-case. If an appliance fails spillage or CO at worst case depressurization, specify measures to correct CAZ depressurization.

20. CO measurement of undiluted flue gas shall be taken at 5 minutes of main burner operation. The CO measurement shall be compared with the appropriate CO threshold in Section 7.9.5, Table 1.

21. Action levels for CO exceeding the appropriate threshold in Section 7.9.5, Table 1 shall be in accordance with Annex D, Table D.1.B.

22. Multiple combustion appliances sharing chimney and/or venting system. When a chimney and/or venting system is shared by multiple combustion appliances, the auditor shall use the following procedures to test combustion appliances for spillage and measure CO level in undiluted flue gases.

    - Combustion appliances shall be tested in order from lowest BTUh input rating to highest BTUh input rating.

    - The appliance with the lowest BTUh input rating shall be assessed for spillage and CO measurement in undiluted flue gas shall be conducted in accordance with Section 7.9.2 (Cold Vent) or 7.9.3 (Warm Vent) of this document.

    - Upon completion of spillage testing and CO measurement of the first appliance, the auditor shall place the next largest BTUh combustion appliance in operation while the first appliance is still firing. Do not wait for the chimney to cool.

    - Retest the first appliance for spillage when the second appliance has reached 2 minutes of main burner operation. Test the second appliance for spillage immediately thereafter.

    - Measure CO level in the undiluted flue gas of the second appliance at 5 minutes of its main burner operation. Continue this process for each additional commonly-vented combustion appliance in order of BTUh input rating until all are running simultaneously.

    - CO measurements shall be compared with the appropriate CO thresholds in Section 7.9.5, Table 1.

- Action levels

  » Action levels for spillage on each appliance shall be in accordance with Annex D, Table D.1.A.

  » Action levels for CO for each appliance shall be taken in accordance with Annex D, Table D.1.B

Table 1: CO Thresholds for Fossil Fuel-Fired Combustion Appliances (from ANSI/BPI-1200, Section 7.95)

CO Thresholds for Fossil-Fuel Fired Combustion Appliances	
Appliance	**Threshold Limit**
Central Furnace (all categories)	400 ppm air free [4]
Boiler	400 ppm air free
Floor Furnace	400 ppm air free
Gravity Furnace	400 ppm air free
Wall Furnace (BIV)	200 ppm air free
Wall Furnace (Direct Vent)	400 ppm air free
Vented Room Heater	200 ppm air free
Unvented Room Heater	200 ppm air free
Water Heater	200 ppm air free
Oven/Broiler	225 ppm as measured
Clothes Dryer	400 ppm air free
Refrigerator	25 ppm as measured
Gas Log (gas fireplace)	25 ppm as measured in vent
Gas Log (installed in wood burning fireplace)	400 ppm air free in firebox

23. Direct-vented and power-vented appliances

- If the outlet of the exhaust is safely accessible, measure the CO level in the undiluted flue gas on all direct-vented and power-vented appliances (without atmospheric chimneys or vents) at 5 minutes of main burner operation.

- The CO measurement/s shall be compared with the appropriate CO threshold/s in Section 7.9.5, Table 1.

- Action levels for CO exceeding the appropriate threshold/s in Section 7.9.5, Table 1 shall be taken in accordance with Annex D, Table D.1.B.

Annex D | Action Levels for Spillage and Carbon Monoxide in Combustion Appliances (Normative)

D.1 Spillage assessment and CO measurement results shall be based on the following criteria:

- CO measured at 5 minutes of main burner operation
- Spillage assessed at 2 minutes of main burner operation for warm vent
- Spillage assessed at 5 minutes of main burner operation for cold vent
- CO level at or below threshold in Section 7.9.5, Table 1 for the appliance being tested is ACCEPTABLE
- CO level exceeding threshold in Section 7.9.5, Table 1 for the appliance being tested is UNACCEPTABLE

TABLE D.1.A ACTION LEVELS FOR SPILLAGE IN COMBUSTION APPLIANCES
The following actions shall be taken when spillage occurs under the specific circumstances detailed below.

TEST RESULT	ACTION REQUIRED
Greatest CAZ depressurization occurs with the air handler on*	Conduct further analysis of the distribution system to determine if leaky ducts or other HVAC-induced imbalances are the cause of the spillage. If so, recommend distribution system repairs that will reduce or eliminate the CAZ depressurization.
Greatest CAZ depressurization occurs with door to CAZ closed, but is alleviated when door to CAZ is open*	Recommend measures to improve air transfer between the CAZ and the core of the house
The cause of spillage has been traced to excessive exhaust** independent of CAZ door position, air handler, or a problem with the flue†	Verify that sufficient combustion air is available per *ANSI Z223.1/NFPA 54* for gas-fired appliances and *NFPA 31* for oil-fired appliances or recommend verification by a qualified professional and/or Recommend further evaluation/service by a qualified professional to address the venting/combustion air issues

*In the case where both spillage and excessive CO are present, in addition to the specific recommendations above, recommend that the appliance be shut down until it can be serviced by a qualified professional.
** Refers to exhaust caused by mechanical ventilation and/or other means of exfiltration.
†When a recommendation to replace atmospherically-vented combustion equipment inside the pressure boundary is made, and when cost-effective, recommend replacement with direct-vented, or power-vented equipment (or non-combustion equipment, such as a heat pump), which is ENERGY STAR®-labeled.

TABLE D.1 B. ACTION LEVELS FOR CO IN COMBUSTION APPLIANCES

TEST RESULT	ACTION REQUIRED
Unacceptable CO level	Advise the homeowner/occupant that the appliance should be serviced immediately by a qualified professional Note: If ambient CO levels do not exceed 70 ppm, testing of other appliances and other audit procedures may continue at the discretion of the auditor
Acceptable CO level	No action required

6.0 Combustion Appliance Assessment

6.7 Gas ovens shall be tested for vented CO and range top burners shall be visually inspected. Perform appliance testing procedures following the manufacturer's appliance procedure. In the absence of the manufacturer's appliance procedure, the following testing procedures and action levels shall be used:

1. Turn the appliance off.

2. Check the oven cavity for any stored materials and remove before testing.

3. Inspect the oven cavity for cleanliness. If the oven area is dirty enough to adversely impact the combustion process, recommend that the oven be cleaned to reduce the possibility of unacceptable emissions.

4. Check the bottom surface inside of the oven cabinet for air venting that may be present. Any air vent obstruction, such as aluminum foil or silicone liners, must be removed before oven CO testing.

5. Check for air blockage at the bottom of the range and drawer and/or broiler compartment under the oven and remove any obstructions before testing.

6. Inspect range top burners for cleanliness. If the burners are excessively dirty, recommend that they be cleaned to reduce the possibility of unacceptable emissions.

7. Turn the oven on to a bake temperature of 500°F. Do not turn the oven all the way up to the broil setting or self-cleaning setting.

8. After 5 minutes of the oven's main burner operation, the auditor shall place the test probe of a CO analyzing tool into the throat of the oven exhaust vent and measure undiluted CO.

9. Record the CO measurement once the CO level has become a stable reading.

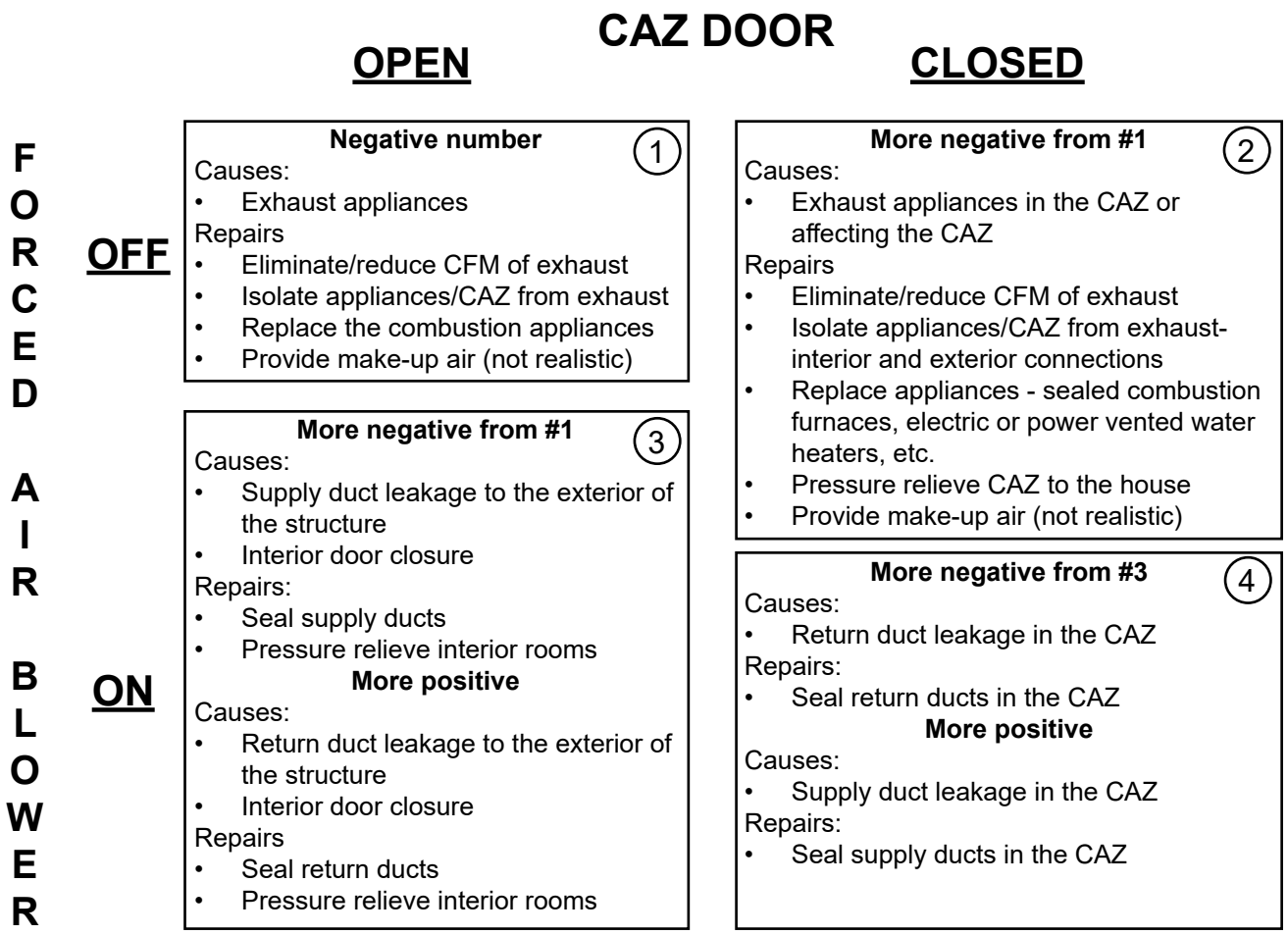
10. The CO measurement shall be compared with the appropriate CO threshold in Section 7.9.5,Table 1.

11. Actions levels for CO exceeding the appropriate threshold in Section 7.9.5, Table 1 shall be in accordance with Annex D, Table D.1.B

* DOE funds cannot be used to replace ranges.

6.8 Assess solid fuel-fired appliances to ensure safe installation before weatherization activities take place. Repair or removal is an allowed H&S measure for primary and secondary solid fuel-fired heating appliances. Replacement is allowed for primary solid fuel heating appliances but replacement is not allowed for secondary heating appliances. Repair of flues and proper installation (e.g. protection of combustibles), is required for both primary and secondary solid fuel heating appliances. Install replacement primary heaters and/or flues according to applicable codes, standards and manufacturer's instructions. Provide adequate combustion air.

Inspection/Evaluation: Assessing solid fuel-fired appliances involves inspecting the venting/chimney and the overall installation to ensure it adheres to the applicable code: NFPA 211 or other as determined by the authority having jurisdiction. Appliances must be inspected pre- and post-weatherization. (Review BPI 1200 for additional solid fuel burning appliance inspection procedures).



Baseline (Stack Effect) is present in each quadrant - neg or pos

6.0 Combustion Appliance Assessment

CAZ (Combustion Appliance Zone) Pressure Test Procedure

Step 1

- ☐ Make sure combustion appliances are unable to operate during set-up
- ☐ Remove forced air furnace filter (replace cover)
- ☐ Close all windows, doors, and other openings to the exterior of the structure
- ☐ Close fireplace and woodstove dampers
- ☐ Set up a gauge to read CAZ pressure with reference to (WRT) the outside

Record the baseline CAZ pressure: ☐ Pa (can be done CAZ door both open and closed)

- ☐ Turn on clothes dryer and all exhaust fans
- ☐ Use a blower door to simulate fireplace flow as needed (300 cfm or appropriate)
- ☐ Open supply registers in the house – close the registers in the CAZ
- ☐ Close all interior doors off the main body except to rooms that contain an exhaust fan

Obtain two CAZ pressure measurements with the forced air blower OFF: One with the CAZ door open and one with the door closed (long term averaging makes this process quicker).

	CAZ Door	
	① **Open**	**Closed** ②
Fan **OFF**	☐ Pa	☐ Pa

Note: There will be from 1 to 4 pressure measurements taken depending upon whether a blower or CAZ door exists.

Step 2

- ☐ Operate the forced air system blower (on the highest speed it can be expected to operate)
- ☐ Close the doors to rooms with exhaust fans and smoke/pressure test the rooms to determine the appropriate door position (testing is done with the CAZ at your back)
- ☐ Also, smoke/pressure test the doors to bedrooms that contain return ducts
- ☐ Reposition the doors as necessary (positive pressure in rooms – door closed, negative pressure in rooms – door open)

Obtain two CAZ pressure measurements with the forced air blower ON: One with the CAZ door open and one with the door closed.

	CAZ Door	
	③ **Open**	**Closed** ④
Fan **ON**	☐ Pa	☐ Pa

Note: For diagnostics, subtract the baseline pressure to get the actual level of depressurization due to exhaust fans, ducts, or doors.

The greatest negative pressure measured in any of the four quadrants would be considered "worst case" depressurization conditions for operational testing of combustion appliances.

- Diagnostics can now be performed using the four quadrant measurements to determine potential causes and appropriate repairs.

IMPORTANT:

- Any time you encounter a door you are unsure about positioning (ex: a bathroom in a bedroom or a CAZ with a door in a basement with a door at the top of the stairs), smoke/pressure test the door to determine its position. Complete twice – once with the fan on and once with the fan off.
- This procedure will cover most houses most of the time. Understand the concepts and apply them as needed in more complicated houses.

7.0 Unvented Space Heaters

Unvented space heaters include ventless gas fireplaces and gas logs installed in fireplaces previously designed for wood-burning or coal-burning. The unvented space heaters and fireplaces create indoor air pollution because they deliver all their combustion byproducts to the indoors. Unvented space heaters aren't safe. Replace unvented spaces heaters with vented units whenever possible. DOE forbids installing unvented space heaters in weatherized homes. WPN 22-7 prohibits DOE H&S funds to be used to replace or install secondary heating systems of any type. However, unvented space heaters may be left as secondary units, under these requirements and the requirements outlined in the Michigan State Plan:

- The heater must conform to the safety standards of ANSI Z21.11.2.
- The heater must have an input rating of less than 40,000 BTU/hr.
- The heater must be equipped with an oxygen-depletion sensing shut-off system.
- The room containing the heater must have adequate combustion air.
- The home must have adequate ventilation: See "ASHRAE Standard 62.2–2016 Ventilation".
- Unvented combustion heating appliance must have CO inspection performed.

Unvented combustion heating appliance CO inspection procedures:

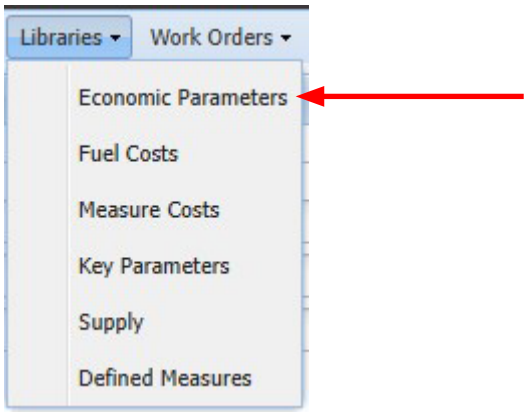
1. With the appliance on, measure CO after 5 minutes of main burner operation. Compare the CO measurement with the appropriate threshold in Section 7.9.5, Table 1.
2. Actions levels for CO exceeding the appropriate threshold in Section 7.9.5, Table 1 shall be in accordance with Annex D, Table D.1.B.
3. Gas log sets
    a. With the appliance off, if gas logs are installed in wood burning fireplaces equipped with a damper, verify that the fireplace damper is in a fixed open position.
    b. With the appliance on, measure CO in the firebox (where log sets are installed in wood burning fireplaces) or in the vent (for gas fireplaces) after 5 minutes of main burner operation. Compare the CO measurement to the appropriate threshold in Section 7.9.5, Table 1.

c. Actions levels for CO exceeding the appropriate threshold in Section 7.9.5, Table 1 shall be in accordance with Annex D, Table D.1.B.

8.0 WAweb Library Setup

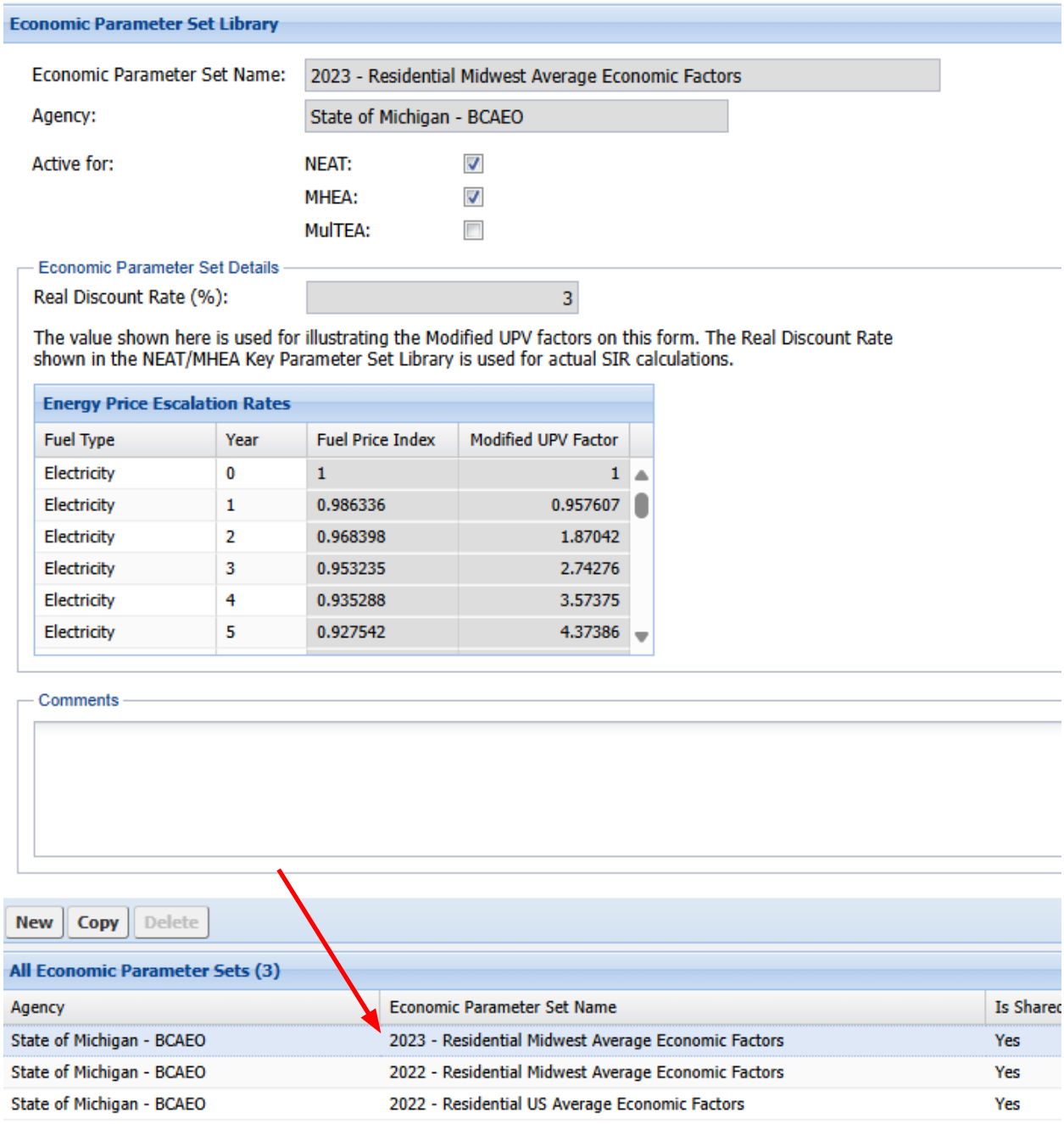
Subgrantees shall create and maintain libraries within WAweb. All libraries and/or changes to libraries must be approved by BCAEO.

8.1 Economic Parameters

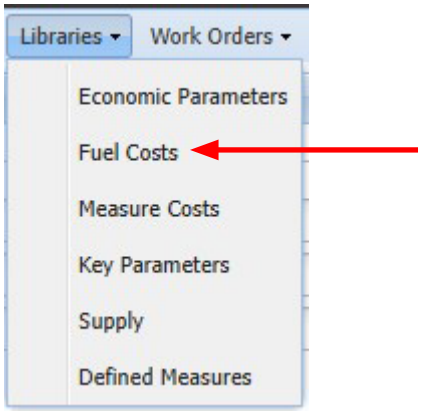


Subgrantees shall utilize the most current Economic Parameter Set library. In the example below, the 2023 – Residential Midwest Average Economic Factors would be used. These libraries will be shared by ORNL and/or BCAEO. The subgrantee will need to verify the correct library is active and all older libraries are inactive in WAweb.

8.0 WAweb Library Setup



8.2 Fuel Costs

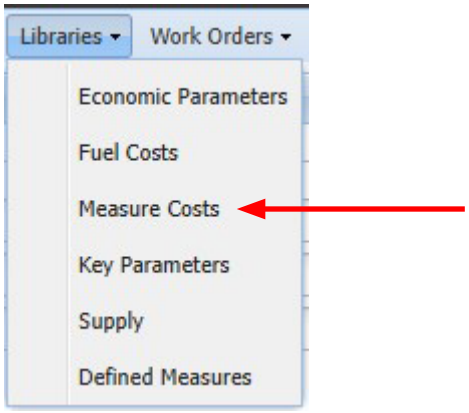


BCAEO may compile and provide justified fuel costs. In the example below statewide average costs for natural gas, electric, propane and fuel oil were determined and shared by BCAEO. These determined costs will be pushed to subgrantee WAweb libraries. Subgrantees may opt to determine fuel costs in their service territory rather than using the BCAEO determined fuel costs. If Subgrantees choose this option, they must check the costs of fuels in their service area at least once a year and update the costs if necessary. Fuel costs should be typical and avoid high or low short-term values. Subgrantees using their own determined fuel costs must have them reviewed and approved by BCAEO technical staff prior to use. (See CSPM 600 for additional details)

All Fuel Costs (23)

Agency	Fuel Cost Name	Fuel Type	Is Shared	# Audits	Date Created	Last Edited
State of Michigan - BCAEO	2025 - Michigan Avg. Propane Costs	Propane/LPG	Yes	1	07-01-2025 10:27 AM	07-01-2025 10:30 AM
State of Michigan - BCAEO	2025 - Michigan Avg. Natural Gas Costs	Natural Gas	Yes	1	07-01-2025 10:25 AM	07-01-2025 10:30 AM
State of Michigan - BCAEO	2025 - Michigan Avg. Fuel Oil Costs	Fuel Oil	Yes	1	07-01-2025 10:27 AM	07-01-2025 10:30 AM
State of Michigan - BCAEO	2025 - Michigan Avg. Electric Costs	Electricity	Yes	1	07-01-2025 10:26 AM	08-11-2025 2:30 PM

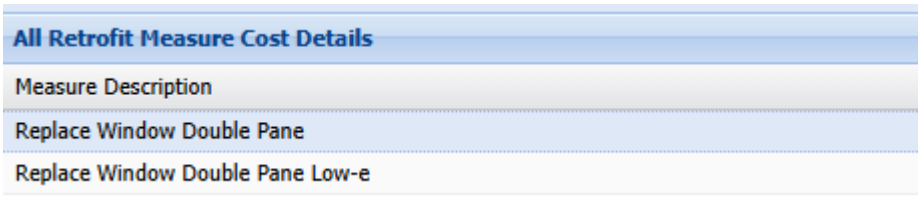
8.3 Measure Costs



Material and Labor Costs

Subgrantees shall enter their material and labor costs for the allowable NEAT/ MHEA measures. Costs shall be separated into the Material and Labor columns respectively. These can be accessed by double clicking the measure inside of WAweb.

Measure Cost libraries must include cost entries for every retrofit measure. For example, Window Replacement includes two options—low-E and non-low-E windows. These prices can be entered near the bottom of the cost-entry pop-up box.



NEAT Setup

The Measure Cost Library shall allow for the consideration of the following Weatherization Measures listed below as **Yes - Active**; the measures listed below as **No - Inactive** will not be considered.

For ‘Lighting Retrofits’ and ‘Replace HVAC System’ specific lifetimes are listed below and can be modified by clicking the ellipsis/meatballs inside of WAweb.

NEAT			
Index	**Measure Type**	**Lifetime**	**Is Active?**
1	Lighting Retrofits	...	YES
2	Refrigerator Replacement	15	YES
3	Water Heater Tank Insulation	13	NO
4	Water Heater Pipe Insulation	13	NO
5	Low Flow Showerheads	15	NO
6	Water Heater Replacement	13	YES
7	Attic Insulation R11	30	YES
8	Attic Insulation R19	30	YES
9	Attic Insulation R30	30	YES
10	Attic Insulation R38	30	YES
11	Attic Insulation R49	30	YES
12	Fill Ceiling Cavity	30	YES
13	Sillbox Insulation	20	YES
14	Foundation Wall Insulation	20	YES
15	Floor Insulation R11	20	YES
16	Floor Insulation R19	20	YES
17	Floor Insulation R30	20	YES
18	Floor Insulation R38	20	YES
19	Wall Insulation	30	YES
20	Kneewall Insulation	30	YES
21	White Roof Coating	7	NO
22	Fill Closed Floor Cavity	20	YES
23	Weatherize Window	10	YES
24	Add Storm Window	15	YES
25	Replace Window	20	YES
26	Add Awning	10	NO
27	Add Exterior Shading	10	NO
28	Door Replacement	20	YES
29	Duct Sealing	10	YES
30	General Air Sealing	10	YES
31	Duct Insulation	20	YES
32	Install Smart Thermostat	15	YES

33	Tune Up Cooling System	3	YES
34	Tune Up Heating System	3	YES
35	Replace HVAC System	...	YES

*Lighting Retrofits Lifetimes			
Index	**Lamp Type**	**Lifetime (hrs)**	**Enabled**
1	Incandescent	1000	NO
2	Halogen	4000	NO
3	Fluorescent	10000	NO
4	CFL	10000	NO
5	LED	25000	YES
6	Other	1000	NO

**HVAC Retrofit Lifetimes			
Index	**System Type**	**Lifetime (yrs)**	**Enabled**
1	Furnace - Forced Air	20	YES
2	Furnace - Gravity	20	YES
3	Boiler - Hot Water	20	YES
4	Boiler - Steam	20	YES
5	Space Heater	18	YES
6	Heat Pump - Central	15	YES
7	Heat Pump - Room/Window	15	YES
8	Heat Pump - Ductless Mini-Split	15	YES
9	Air Conditioner - Central	15	YES
10	Air Conditioner - Room	15	YES
11	Air Conditioner - Mini-Split	15	YES
12	Evaporative Cooler	15	NO
13	Heat Pump - PTHP	15	YES
14	Air Conditioner - PTAC	15	YES

MHEA Setup

The Measure Cost Library shall allow for the consideration of the following Weatherization Measures listed below as **Yes - Active**; the measures listed below as **No - Inactive** will not be considered.

For ‘Lighting Retrofits’ and ‘Replace HVAC System’ specific lifetimes are listed below and can be modified by clicking the ellipsis/meatballs inside of WAweb.

MHEA			
Index	**Measure Type**	**Lifetime**	**Is Active?**
1	Lighting Retrofits	...	YES
2	Refrigerator Replacement	15	YES
3	Water Heater Tank Insulation	13	NO
4	Water Heater Pipe Insulation	13	NO
5	Low Flow Showerheads	15	NO
6	Water Heater Replacement	13	YES
7	Wall Fiberglass Batt Insulation	30	YES
8	Wall Fiberglass Batt Insulation in Addition	30	YES
9	Wall Cellulose Loose Insulation	30	NO
10	Wall Cellulose Loose Insulation in Addition	30	YES
11	Wall Fiberglass Loose Insulation	30	YES
12	Wall Fiberglass Loose Insulation in Addition	30	YES
13	Floor Cellulose Loose Insulation	20	NO
14	Floor Cellulose Loose Insulation in Addition	20	YES
15	Floor Fiberglass Loose Insulation	20	YES
16	Floor Fiberglass Loose Insulation in Addition	20	YES
17	Roof Cellulose Loose Insulation	30	NO
18	Roof Cellulose Loose Insulation in Addition	30	YES
19	Roof Fiberglass Loose Insulation	30	YES
20	Roof Fiberglass Loose Insulation in Addition	30	YES
21	Add Skirting	10	NO
22	Add Skirting in Addition	10	NO
23	White Roof Coating	7	NO
24	White Roof Coating in Addition	20	NO
25	Door Replacement	15	YES
26	Door Replacement in Addition	15	YES
27	Storm Door	10	YES
28	Storm Door in Addition	10	YES
29	Replace Window	20	YES
30	Replace Window in Addition	20	YES
31	Add Storm Window	15	YES
32	Add Storm Window in Addition	15	YES
33	Add Awning	10	NO

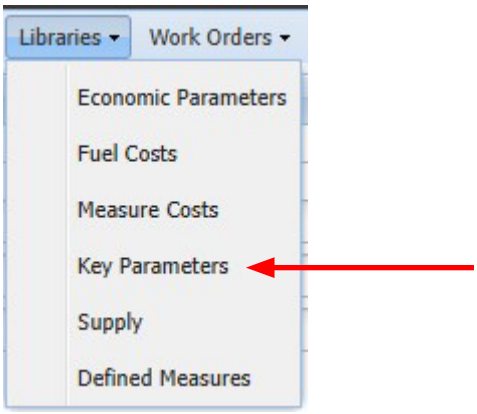
34	Add Awning in Addition	15	NO
35	Add Exterior Shading	10	NO
36	Add Exterior Shading in Addition	10	NO
37	Weatherize Window	10	YES
38	Weatherize Window in Addition	10	YES
39	Duct Sealing	10	YES
40	General Air Sealing	10	YES
41	Install Smart Thermostat	15	YES
42	Tune Up Heating System	3	YES
43	Tune Up Cooling System	3	YES
44	Replace HVAC system	...	YES
45	Duct Insulation	20	YES

*Lighting Retrofits Lifetimes			
Index	**Lamp Type**	**Lifetime (hrs)**	**Enabled**
1	Incandescent	1000	NO
2	Halogen	4000	NO
3	Fluorescent	10000	NO
4	CFL	10000	NO
5	LED	25000	YES
6	Other	1000	NO

**HVAC Retrofit Lifetimes			
Index	**System Type**	**Lifetime (yrs)**	**Enabled**
1	Furnace - Forced Air	20	YES
2	Furnace - Gravity	20	YES
3	Boiler - Hot Water	20	YES
4	Boiler - Steam	20	YES
5	Space Heater	18	YES
6	Heat Pump - Central	15	YES
7	Heat Pump - Room/Window	15	YES
8	Heat Pump - Ductless Mini-Split	15	YES
9	Air Conditioner - Central	15	YES
10	Air Conditioner - Room	15	YES
11	Air Conditioner - Mini-Split	15	YES

12	Evaporative Cooler	15	NO
13	Heat Pump - PTHP	15	YES
14	Air Conditioner - PTAC	15	YES

8.4 Key Parameters



Weatherization Assistance Program (WAP) regulations (10 CFR 440.21) require that “each individual weatherization material and package of weatherization materials installed in an eligible dwelling unit must be cost-effective…, discounted to present value.” The discount rate used in the cost-effectiveness calculation, pursuant to WAP Memo 123, shall be two percent (2%). (See NEAT and MHEA examples below)

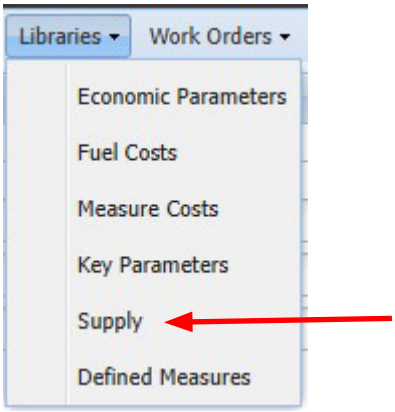
NEAT Example:

NEAT Key Parameters			
Group	Key Parameter	Value	Units
Economics			
Economics	Real discount rate	2.00	%
Economics	Minimum acceptable SIR	1.00	Factor
Equipment			
Equipment	Low flow shower head flow rate	2.50	gal/min
Equipment	Refrigerator defrost cycle energy	0.08	kWh
Insulation			
Insulation	Avg annual outside film coeff	2.25	BTU/hr-sqft-F
Insulation	Uninsulated R-value for 'Other' wall type	4.42	F-sqft-hr/Btu
Insulation	R-value for 'Other' exterior siding type	0.60	F-sqft-hr/Btu
Insulation	Water heater wrap added R value	10.00	F-sqft-hr/Btu
Insulation	Base value of free heat from internals	2,600.00	Btu/hr
Set Points			
Set Points	Heating setpoint (daytime)	68.00	deg F
Set Points	Heating setpoint (nighttime)	68.00	deg F
Set Points	Cooling setpoint (daytime)	78.00	deg F
Set Points	Cooling setpoint (nighttime)	78.00	deg F

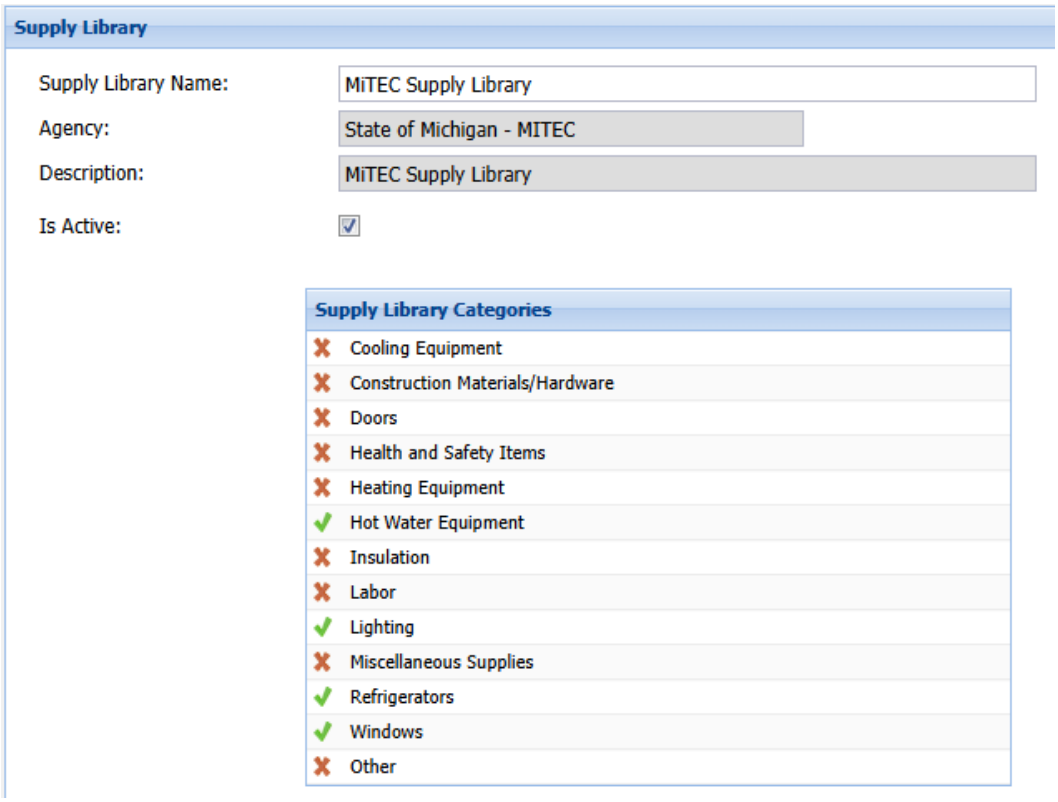
MHEA Example (Adjust bag sizes as necessary indicated by red arrows):

MHEA Key Parameters			
Group	Key Parameter	Value	Units
Base Loads			
Base Loads	MHEA Low flow shower head flow rate	2.50	gal/min
Base Loads	MHEA Water heater wrap added R value	10.00	F-sqft-hr/Btu
Base Loads	MHEA Refrigerator defrost cycle energy	0.08	kWh
Doors			
Doors	Door U-value - wood with hollow core	0.46	Btu/F-sqft-hr
Doors	Door U-value - wood with solid core	0.40	Btu/F-sqft-hr
Doors	Door U-value - standard mfg. home door	0.40	Btu/F-sqft-hr
Doors	U-value of replacement door	0.20	Btu/F-sqft-hr
Economics			
Economics	MHEA Real Discount Rate	2.00	%
Economics	MHEA Minimum Acceptable SIR	1.00	Factor
Economics	Spending limit for package of measures	2,500.00	Dollars
Heat Transfer			
Heat Transfer	Home leakiness - Loose	4,000.00	cfm
Heat Transfer	Home leakiness - Medium	3,000.00	cfm
Heat Transfer	Home leakiness - Tight	2,000.00	cfm
Heat Transfer	Free heat from interior sources - Day	1,950.00	Btu/hr
Heat Transfer	Free heat from interior sources - Night	2,350.00	Btu/hr
Heat Transfer	Evaporative cooler actual saturating eff	75.00	%
Heat Transfer	Saturating eff for evaporative tune-up	80.00	%
Heat Transfer	Saturating eff for evaporative rplcmnt	80.00	%
Heat Transfer	Cooling system fan power	60.00	Watts
Insulation			
Insulation	Bag size for loose fiberglass insulation	25.00	Lb
Insulation	Density of added loose fiberglass insulation	1.50	Lb/cuft
Insulation	Bag size for loose cellulose insulation	25.00	Lb
Insulation	Density of added loose cellulose insulation	3.00	Lb/cuft
Insulation	Interior wall R-value - Winter	0.45	F-sqft-hr/Btu
Insulation	Interior wall R-value - Summer	0.45	F-sqft-hr/Btu
Insulation	Interior ceiling R-value - Winter	1.22	F-sqft-hr/Btu
Insulation	Interior ceiling R-value - Summer	1.22	F-sqft-hr/Btu
Insulation	Interior floor R-value - Winter	3.20	F-sqft-hr/Btu
Insulation	Interior floor R-value - Summer	3.20	F-sqft-hr/Btu
Insulation	Outside wall R-value - Winter	0.42	F-sqft-hr/Btu
Insulation	Outside wall R-value - Summer	0.46	F-sqft-hr/Btu
Insulation	Existing Loose insulation R-value per inch	2.50	F-sqft-hr/Btu-in
Insulation	Existing Batt/Blanket insulation R-value per inch	3.50	F-sqft-hr/Btu-in
Insulation	Rigid insulation R-value per inch	4.11	F-sqft-hr/Btu-in
Insulation	Foamcore insulation R-value per inch	5.00	F-sqft-hr/Btu-in
Set Points			
Set Points	MHEA Heating Setpoint (daytime)	68.00	deg F
Set Points	MHEA Heating Setpoint (nightime)	68.00	deg F
Set Points	MHEA Cooling Setpoint (daytime)	78.00	deg F
Set Points	MHEA Cooling Setpoint (nighttime)	78.00	deg F

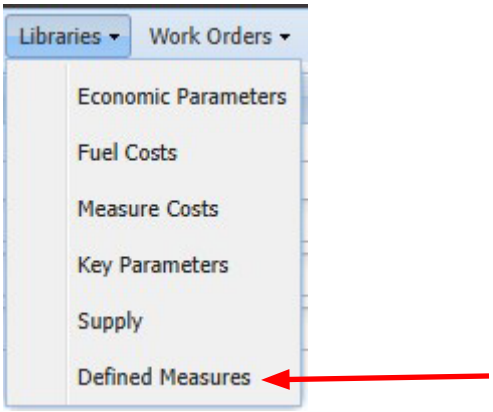
8.5 Supply



The Supply Library form provides the ability to identify materials used within your program and their costs. Although primarily used in creating work orders, information entered for refrigerators, water heaters, and lighting can be accessed from within an audit. For each material, you can enter material properties, costs, and energy-related information on the Supply Library Category Details form.



8.6 Defined Measures



The Defined Measure Library form provides the ability to predefine weatherization activities, including 50 predefined health and safety measures, which are not addressed within the NEAT and MHEA library measures but that are commonly encountered during an audit. Defining the measures on this form enables copying them to any audit as an itemized cost.

User-Defined measures / Itemized Costs marked “included in SIR” must not have any assumed energy savings if DOE funds are used.

Acronyms may only be used when they appear in approved guidance. The following acronyms will be used inside the Defined Measures Library:

Acronym	Description
H&S	Health and Safety (See CSPM 614)
MISC *	Miscellaneous
LMISC	LIHEAP Miscellaneous (See CSPM 700 Series)
OP	Optional Measures (See CSPM 606.1)
IR	Incidental Repair (See CSPM 607)
EE	Energy Efficiency (See CSPM 2100, SOPL)

* At the time of issuance, the only MISC-approved measure permitted is belly repair.

9.0 Optional Energy Conservation Measures

Subgrantees may install the identified General Heat Waste (GHW) reduction measures listed below, known as Optional Weatherization Measures, on one to four-unit dwellings, without requiring inclusion in the site-specific energy modeling of the dwelling. Optional Measures are intended to be relatively low-cost items that can be quickly and easily installed. Measure costs, including labor, must not exceed $250.00 total. These measures must provide additional benefit to the client/customer and are not able to be tied to another measure.

An Optional Measure may be skipped for any documented reason (including declined by the client). Optional Measures are not prioritized by the energy audit tool and are not turned on inside the audit.

Optional Measures include:

1. Water heater tank wrap (i.e., insulating blanket).

2. Water heater pipe insulation (on first six feet of hot water pipe exiting water heater).

3. Faucet aerators.

4. Low-flow showerheads.

5. Limited weather stripping and caulking to increase comfort (does not include major air sealing work, which should be guided by blower door testing).

   * Provide a clear and detailed justification for why the associated costs are not classified under the ‘Infiltration’ category.

Turn off optional measures in each setup library. Optional measures will utilize the Itemized Cost/User Defined Measures section of NEAT and MHEA and be entered using the OP acronym (i.e. OP - Faucet Aerators). Optional measures are not included in the SIR, will appear as itemized costs on the recommended measures report, and are not prioritized by the energy audit tool. The measures may be at the top of an approved Priority List, however, there is no strict prohibition from skipping an individual optional measure.

10.0 Energy Modeling Considerations

When creating an energy model the following must be analyzed and considered to comply with applicable guidance and rules.

10.1 Allowable Measures:

All weatherization materials utilized in conjunction with work performed as a part of this program shall, at minimum, meet the NREL Standard Work Specifications and the Standards for Weatherization Materials contained in “Appendix A”, or variances approved by DOE for the State of Michigan, as published in the 10 CFR 440 and DOE WPN 23-6. Variances can be found listed in Section 14, Appendix A.

Work shall be completed in a manner so as not to detract from the general appearance and structural integrity of the home and shall be in compliance with governing codes, the requirements of this document, and manufacturer’s recommendations.

Weatherization measures are for the purpose of rendering the heated portions of dwellings energy efficient and to ensure the safety and protection of such measures, whether new or existing (e.g., any wood or other product which the manufacturer recommends to be sealed, that is used to complete weatherization and which is exposed to moisture, shall receive a minimum of prime painting or other recommended sealer). For the purpose of this program, if necessary client usage of areas requires heat to those areas, they shall be treated as heated and weatherized accordingly. Unheated utility rooms, porches, etc., are not eligible for weatherization.

Measures must be installed properly utilizing the Standard Work Specifications outlined in the Michigan Weatherization Field Guide.

10.2 Health & Safety Measures:

After a Health and Safety assessment is performed, areas that were assessed and found to be deficient must be addressed. The most common areas are outlined below:

- Installation of smoke detectors following requirements in Appendix A-2.
- Carbon Monoxide (CO) Alarm/Detector are required to comply with ASHRAE 62.2 version 2016 in all residences. CO Alarms/Detectors must be tested to verify the operation of installed alarms. Install following requirements in Appendix A-2.

- Implementation of ASHRAE 62.2 ventilation standard is required.
- Clothes dryers shall be vented to the exterior.

10.3 Order of Measure Installation

Measures installation shall be completed in the following sequence:

1. Health and Safety measures to correct hazards identified on the audit that directly affect the health and safety of occupants (WAP staff and workers included).
2. Air sealing.
3. Remaining audit measures in order of decreasing SIR.

10.4 Measure Skipping Clarification

“Measure skipping” is defined as follows: Not installing, in order of decreasing SIR, the cost justified ECMs and related Incidental Repairs Measures (IRM) included in the work scope produced by the Department of Energy (DOE) approved energy audit tool (NEAT/MHEA) or priority list. This could also be the result of failure to evaluate all applicable energy saving measures for the dwelling. Measure skipping is generally not allowed in the WAP. For further details on Measure Skipping, including required documentation, see Measure Skipping Clarification section CSPM 606.3.

- Measure Skipping of cost-justified major measures is not permitted at any time.
- Major Measure “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, thermal boundary insulation (attic, wall, floor or belly, foundation, sill, etc.).

10.5 Fuel Switching:

The Weatherization Assistance Program (WAP) does not permit the general practice of non-renewable fuel switching when replacing furnaces/appliances. However, DOE does allow the changing or converting of a furnace/appliance using one fuel source to another on a limited, case-by-case basis. These approvals will only be granted when all related costs demonstrate the effectiveness of the fuel switch over the life of the measure or with appropriate Health and Safety justification.

BCAEO reviews and approves the case-by-case fuel switch requests. See CSPM 610 for details on fuel switch submissions to BCAEO.

10.6 Recommended Measures Report:

The recommended measures for the job are developed as a result of the energy modeling. When the recommended measures report is created the following must be considered:

- Determine from the site-specific audit recommended measure report which measures are cost-effective. Only ECMs that have a SIR of 1.0 or greater may be installed with the exception of air sealing.
    - » Other funding sources, such as LIHEAP, may have alternate SIR thresholds.
- Subgrantees must evaluate ECMs in order to establish which measures are cost-effective in WAweb.
- Health and Safety, including Lead Safe Work costs, are not included in the calculation of the cumulative SIR.
- All health and safety measures will be listed on NEAT/MHEA recommended measure report.
- There are some instances where, depending on circumstances, the measure can be considered either a health and safety measure OR an energy conservation measure (e.g., furnaces). In those instances where the measure has a cost-effective savings-to-investment ratio (SIR) of one (1.0) or greater, the measure must be treated as an ECM. (See WPN 22-7)
- Determine if incidental repairs are necessary and cost-effective for the home. Incidental repairs must be listed on NEAT/MHEA recommended measure report and a cumulative SIR (total project) of 1.0 maintained. See section 10.7 of the EA Guide for further details on IRMs.
- It is best practice to provide a work order with detailed specifications for crews or contractors, as necessary, to understand the materials and procedures necessary to complete the job. Inform crews or contractors of any hazards, pending repairs, and important procedures related to their part of the work order.

10.7 Work Order:

The work order is comprised of three areas: Infiltration measures, non-itemized costs, and itemized costs. Infiltration/air sealing measures will be determined case-by-case based on the air leakage of the home. Non-itemized costs generally include Energy Conservation Measures. Itemized costs include user defined measures that are entered on a case-by-case basis. E.g. incidental repair measures (IR), Health and Safety (H&S) measures, Energy Efficiency Measures (EE), General Heat Waste Measures (OP), et al.

- **Energy Conservation Measure:** A procedure, including weatherization materials and installation, which is considered or performed for its anticipated energy savings.

- **Ancillary Items:** Items necessary for the proper installation of weatherization (energy conservation) materials are included in the cost of the ECM.

- **Incidental Repair Measure:** An Incidental Repair Measure (IR) is defined as a repair necessary for the effective performance or preservation of newly installed weatherization materials, but not part of a standard installation. IR installations must be associated with a specific Energy Conservation Measure (ECM) or group of ECMs. IRs must be justified by written and photo documentation in the client file. IR costs must be included in the SIR calculation of the total package of weatherization measures. The total costs of all IRs are added to the cost of the package of weatherization measures to calculate the whole unit SIR (CSIR). See CSPM 607 for further details.

  All incidental repairs must be included in the itemized cost section of WAweb or the latest version with the measure name starting with IR and must be attached to an ECM in the measures name or in the comments inside of WAweb (e.g. IR - Window Frame Repair / Foundation Insulation).

- **Health and Safety Measures:** Allowable health and safety measures are those measures that are necessary to maintain the physical well-being of both the occupants and/or weatherization workers where the actions must be taken in order to effectively perform weatherization work or are necessary because of weatherization activities. Reasonable costs are those that do not cause a subgrantee to exceed their annual H&S per-unit average. All health and safety measures installed must comply with CSPM 614 and applicable SWS standards. Additionally, certain health and safety categories have maximum allowable spending limits per job, which are specified in CSPM 614.

10.8 Other Considerations:

Modular homes are typically constructed using a similar design to site-built homes. Report them as Site Built “NEAT”. If the sub-floor area more closely resembles a mobile home, treat it as you would a mobile home.

10.9 Rerunning the Audit:

Due to the interaction of measures in WAweb, once a recommended measures report has been generated, “rerunning” the audit may not be advised. If an audit must be rerun, a copy must be made to preserve the original audit inputs and recommended measures.

This guidance does not supersede correcting energy modeling errors. Energy auditing errors require the audit to be rerun.

- An allowable recommended measures report is dependent on accurate audit data collection and energy modeling practices. Fundamental inaccuracies in Energy Auditing may result in findings or disallowed costs.

11.0 NEAT/MHEA Data Collection

As part of the energy audit an initial assessment and Health and Safety assessment must be performed as a component of weatherization. See sections 4.0 and 5.0 of this guide for additional details. The Uniform Data Collection Tool (UDCT) must be completed during the energy audit. The UDCT can be found at https://michigantec.org/resources/ and is comprised of the following sections:

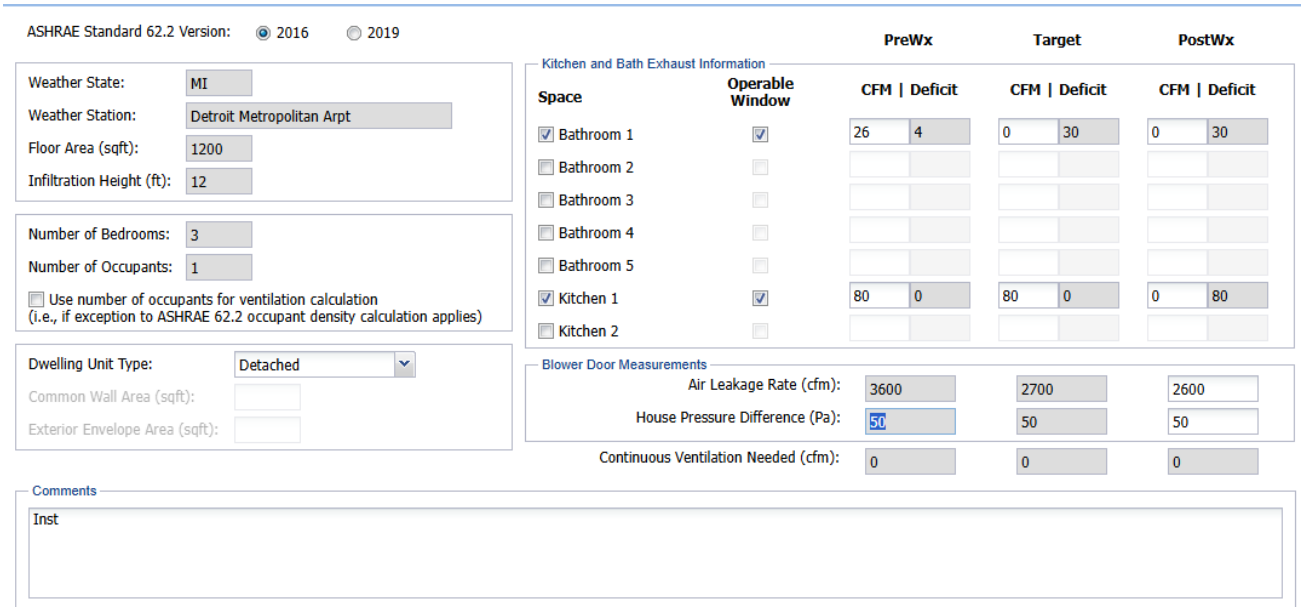
- General Info
- Area & Volume
- Walls
- Windows
- Doors
- Attics
- Foundations
- Heating
- Cooling
- Ducts / Infiltration
- Lighting
- Baseload Equipment
- Health & Safety
- Drawing(s)
- QCI

Any pertinent information not in this tool must be included in the notes section of the UDCT.

11.0 NEAT/MHEA Data Collection

ASHRAE Ventilation Calculator:

- The ASHRAE 62.2 ventilation calculation must be performed within the Health and Safety section of WAweb.
- The required testing must be performed during the initial assessment and the results recorded on the UDCT.



Documenting Diagnostic Testing:

- Must include the results and the location of where the test was performed.
- See Section 4.0 of this guide for required diagnostic testing.

Insulation

- If specific R-values or insulation levels are used, then justification for deviating from prescriptive requirements must be provided.

11.0 NEAT/MHEA Data Collection

INFILTRATION AND DUCT SEALING TARGETS:

- For air sealing, the target value is 7.5 Air Changes Per Hour (ACH).
  - » This translates to roughly 1 cfm / ft^2 of conditioned floor area. (Assuming 8' walls)
- For duct sealing, the target value is 1 Pascal per register as measured with a Pressure Pan.
- If either of these targets are not reached, the agency must provide justification to support why the goal was not achieved.
- All weatherization measures must be “cost effective” as defined by DOE, except for measures to eliminate health and safety (H&S) hazards that meet the Grantee’s approved H&S plan. “Cost effective” means that each measure and package of measures installed in a dwelling unit must have a savings-to-investment ratio (SIR) which meets or exceeds 1.0. There is a single exception: blower door guided air sealing may have an SIR less than 1.0, if the cumulative SIR of the package of measures is equal to or greater than 1.0, not including H&S measures.
  - » Additional exceptions for the SIR requirement can be found in CSPM 700.
- In the rare instance when a pre blower door reading cannot be obtained as a part of the energy audit, estimates should not exceed 15 ACH.
  - » This translates to roughly 2 cfm / ft^2 of conditioned floor area. (Assuming 8' walls)
  - » Agency must provide justification to support why estimates were used.
  - » Pre blower door and all required diagnostic testing must be obtained once reasons for doing an estimate are remedied. This must happen before weatherization measures are installed.
- It is required that a blower door and all required diagnostic testing be performed prior to weatherization measures being installed.
- A post blower door at QCI is required once all weatherization measures have been completed.
- Infiltration height is defined as the vertical distance between the lowest and highest above grade points within the pressure boundary, per ASHRAE 62.2.

Derating Heating / Cooling Systems:

The following derating formula may be utilized for modeling heating, ventilation, and air-conditioning (HVAC) systems that utilize a compressed refrigerant cycle to provide heating or cooling (i.e., heat pump and air conditioning systems, does not apply to evaporative coolers).

Derated Efficiency = (Base EFF) x $.99^{age}$

- Base Efficiency (Base EFF) = Typical efficiency of Pre-Retrofit equipment when new (Seasonal Energy Efficiency Ratio (SEER), Energy Efficiency Ratio (EER), or Heating Seasonal Performance Factor (HSPF))

- Age = Age of equipment in years.

For example: An existing HVAC unit that is 20 years old, was originally rated at 10 SEER.

Derated SEER = 10 x $.99^{20}$
Derated SEER = 10 x .818
Derated SEER = 8.18

The year of manufacture should not be entered in WAweb when using this method.

Any other variation of this process or formula currently used by Grantees is not allowed unless first approved in writing by DOE. Derating combustion appliances in lieu of testing for combustion efficiency is not allowed.

11.0 NEAT/MHEA Data Collection

NEAT/ MHEA Steady State Efficiency (SSE) data input

Purpose: For use in modifying the measured or nameplate steady-state efficiency (SSE) of existing gas-fired space heating equipment before entering it into NEAT and MHEA.

Currently, measured or nameplate values are entered in the audit software for older, existing gas furnaces. NEAT/MHEA takes SSE and converts it to estimate Annual Fuel Utilization Efficiency (AFUE), which is how newer equipment is rated. The software uses this to assess the savings potential of a furnace replacement. The current software process does not convert the SSE of older gas-fired furnaces to a realistic estimated AFUE. The following will allow for a more accurate analysis.

Criteria:

- In site-built homes -only draft hood equipped gas furnaces.
- In mobile homes -only standard low efficiency (no draft inducer fan) gas furnaces.
- Must be standing pilot.
- No vent damper.
- Cannot be used in conjunction with the Part Load Reduction Factor for oversized equipment.

NEAT Formula:
In NEAT, under the "Heating" tab, there will be a section called "Gas Furnace Details". In the box titled "Steady State Efficiency", input an efficiency for the existing unit based on the following formula:

(Measured SSE OR nameplate efficiency x .80) / .95 = SSE entered in NEAT

Meas/Calc%	72	73	74	75	76	77	78	79	80
NEAT Input	60.6	61.5	62.3	63.2	64	64.8	65.7	66.5	67.4

MHEA Formula:
In MHEA, under the "Heating" tab, there will be a sub-tab labeled "Primary". Select "AFUE" in the box titled "Efficiency Units". In the box titled "Efficiency", input an efficiency for the existing unit based on the following formula:

(Measured SSE OR nameplate efficiency x .80) = AFUE entered in MHEA

Meas/Calc%	72	73	74	75	76	77	78	79	80
MHEA Input	57.6	58.4	59.2	60	60.8	61.6	62.4	63.2	64

Examples:
Existing equipment efficiency can be measured by a combustion analyzer (78% SSE for example) or calculated (nameplate states 90,000 Btuh input and 70,000 Btuh bonnet/output capacity -70K divided by 90K = 78%).

NEAT: 78% measured or calculated on a draft hood furnace -you would input an SSE of 65.7% into NEAT.

MHEA: 78% measured or calculated on a standard low-efficiency furnace -you would input an efficiency of 62.4% into MHEA after selecting "AFUE" in the "Efficiency Units" field.

Mobile Home Insulation for Belly Repairs

Creation of a User Defined Measure per weather station locations for Michigan

In your Setup Library:

- Navigate to the User-Defined Measures tab.
- Select “New” – bottom left to create a new measure.
- Name the measure – ex: “Mobile home belly insulation – repairs” – don’t need measure # or type – just the name.
- Select “Include in SIR”.
- Select “Estimated” in the Energy Savings dropdown menu.
- Select “Mbtu” from the Units dropdown menu.
- Enter, from the list below, the number in the Amount box that correlates to the weather station you use.
- Select “Primary Heating Fuel” from the Fuel Saved dropdown menu.
- Enter “20” in the Life box.
- Lastly, enter a cost for the insulation. This will be per square foot. You can break it down to materials and labor if needed but it is not necessary. This is for JUST the cost of the insulation/labor needing to be added to the missing section of belly. Belly repair is listed as a General Air Sealing cost. If you think that it will cost you $200 to slide fiberglass batts up in a belly for a 10x10 repair, it works out to $2.00 per square foot. You can start there and always adjust the cost in the audit.

Using the UDM in Itemized Costs:

You now have a User Defined Measure that can be selected from the Itemized Cost tab in your MHEA audit. Since the information will be based per square foot, once it is selected you must modify the Cost and Annual Energy Savings.

- In the Itemized Cost tab, create a “New” cost – lower left.
- Select your created Measure from the dropdown box (upper left) – “Copy from User Defined Measures”.
- This will populate the Measure Name and all the savings information – make sure the “Include in SIR” box is checked.
- Since the Cost and Annual Energy Savings is based per square foot – multiply the number in each of those boxes by the square feet of insulation needing to be added – this way we can accommodate variations in the amount of belly being repaired.
- Make any necessary cost adjustments at this point.
- When the audit is run, this should show up as its own measure with its own SIR.

Summary: (Mbtu/square foot)

Detroit: .0127	Traverse City: .0143
Flint: .0133	Sault Ste Marie: .0176
Grand Rapids: .0131	Duluth, MN: .0188
Alpena: .0151	South Bend or Fort Wayne, IN: .0121

12.0 Energy Audit Software User Manual

For 1-4 unit buildings subgrantees are required to use the NEAT/MHEA for each dwelling. The assessment of all energy conservation measures for both site-built and mobile homes within the NEAT/MHEA software will be run to establish if the measures meet the Savings to Investment Ratio (SIR) of 1 or greater.

The qualified Energy Auditor who conducted the site visit shall enter data into the NEAT/MHEA audit. Audits must include all applicable information collected on the data collection document.

12.1 HARDWARE AND SOFTWARE REQUIREMENTS

The Weatherization Assistant needs a web browser, as it is a web-based application. The currently supported browsers, listed in preferential order, are Firefox, Chrome, and Microsoft Edge. The latest version of each browser is recommended. Current browser requirements are for Windows operating systems a Pentium 4 or higher CPU, 200 MB of free disk space, Windows 7 or higher/Mac OS X 10.5.6 or higher, and 512MB of RAM for 32-bit machines, or 2Gb of RAM for 64-bit machines.

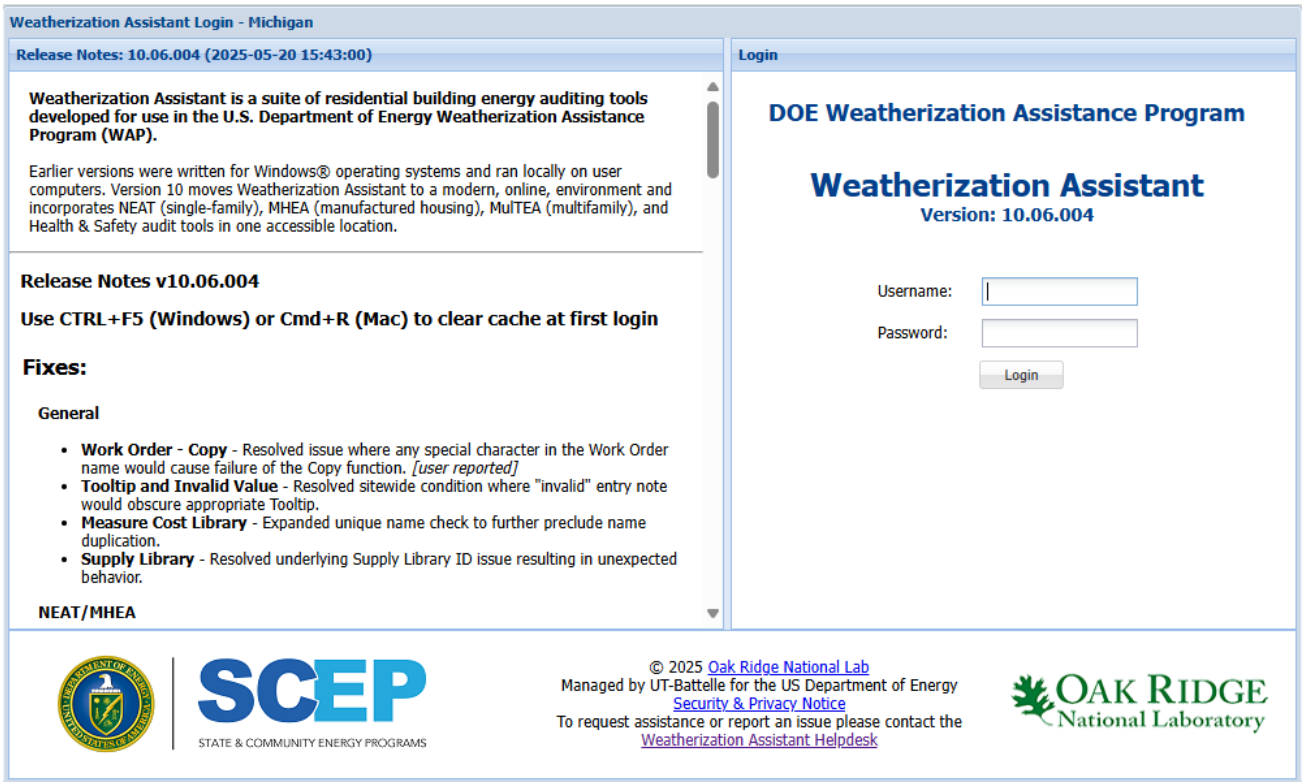
The graphic card and monitor should be able to produce a full display with a minimum resolution of 1680 x 1050 to allow the Weatherization Assistant to be seen without scrolling. Smaller resolutions will work if the browser full screen mode is used, or if the display is scaled, but there are known issues with these approaches. Scaling or zooming in the browser, anything other than 100% either direction, will also present minor issues that will only affect the appearance, and not the functionality of the Weatherization Assistant.

Reports within Weatherization Assistant are generated as PDF documents.

12.2 LOGGING INTO THE WEB-BASED WEATHERIZATION ASSISTANT

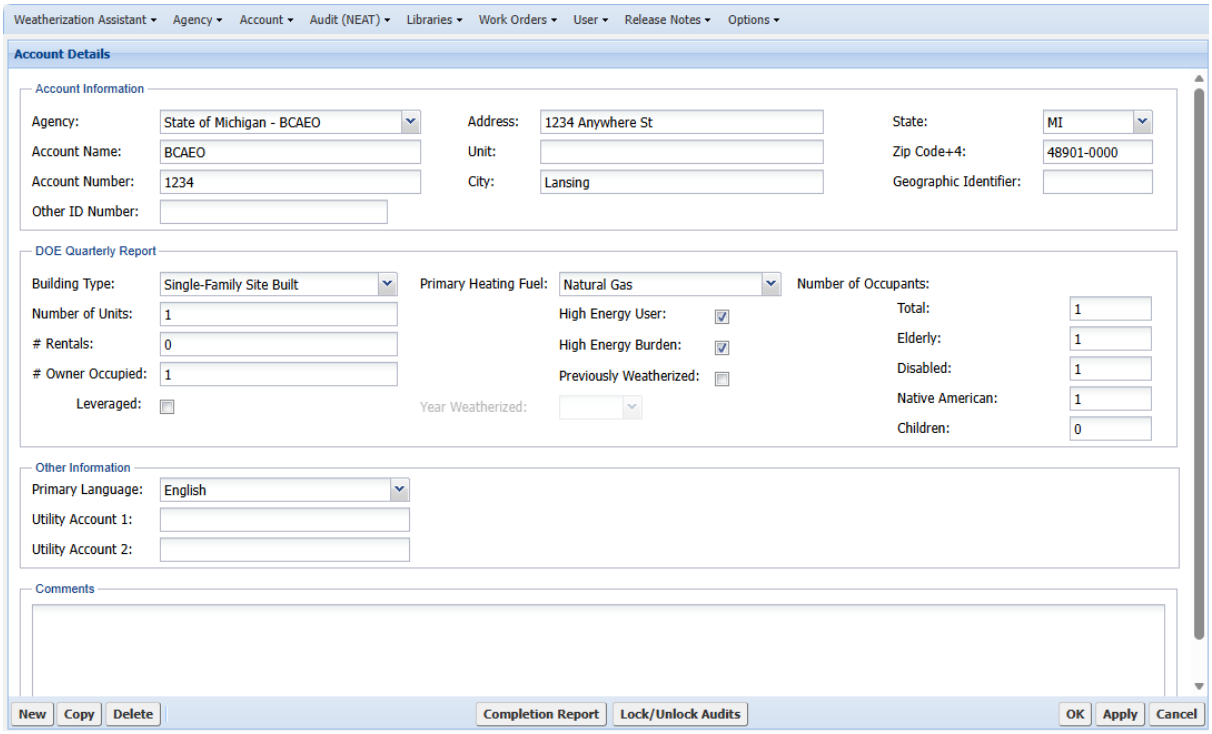
Log into the web-based Weatherization Assistant (Figure 1.1) using a link and login information (username and password). The link will often be in the form of “wa-mi.ornl.gov”. The left side of the login window provides updates made to the latest release of the software.

Figure 1.1. Web-based Weatherization Assistant login web page.



The Account form will open upon login, and the menu bar is located at the top of the user interface (Figure 1.2). The menu bar provides access to the administrative forms (agency, contacts, cost centers, account, and user), audits (NEAT & MHEA), work orders, and libraries needed to run NEAT & MHEA (Economic Parameter Set, Fuel Cost, Measure Cost Set, Key Parameter Set, Supply, and Defined Measure Set). The menu bar also provides a link to obtain more information about the Weatherization Assistant, access release notes, and log out. In the future, it may also provide access to Options and Help menus.

Figure 1.2. Account form with the menu bar at the top.



12.3 GENERAL LAYOUT AND NAVIGATION

A typical form has two sections: the main form at the top for data input and an All table at the bottom that lists the existing records that can be displayed on the main form (see Figure 1.3).

The main form has a title bar at the top, data input fields, and a task bar at the bottom. The title bar shows the name of the form. Data input fields are frequently grouped within a boundary that is called a field set (e.g., Building Information in Figure 1.3). The task bar contains New, Copy, and Delete options to create or delete a record. Selecting OK saves the record and closes the form. Selecting Apply saves the record but leaves the form open. Selecting Cancel closes the form without saving the entries made.

Data input fields are typically ghosted if not relevant in certain contexts or grayed if read-only. Some data input fields display a tooltip when you hover over the field, which describes the field, the acceptable format, and/or the acceptable range of the input. Data input in individual fields may be required or optional. The form cannot be saved if a required field is left blank or the input is out of range or in an incorrect format. If these issues occur, a red border will appear around the required field and a validation

failure message will appear when OK or Apply are selected.

The All table at the bottom of the form shows all the records that you can select to be shown on the main form. Select a record in the All table to display it in the main form. The All table has a title bar and header row at the top. In addition, the All table of Audit forms also has a pagination bar at the bottom. The column headers show key field names of the form. When you hover over a column header, a drop-down button will appear on the right. Selecting this button will allow you to sort the records in ascending or descending order. In addition, it provides a means to hide or unhide columns of the table (Figure 1.4). The All table can further be customized by changing the order and width of the columns. To change the width of a column, drag the boundary of the column heading left or right. To change the width of a column to fit the contents, double-click the boundary to the right of the column header. To change the order of the columns, drag the column heading to a new location.

Figure 1.3. NEAT Audit form consisting of the main form and All table.

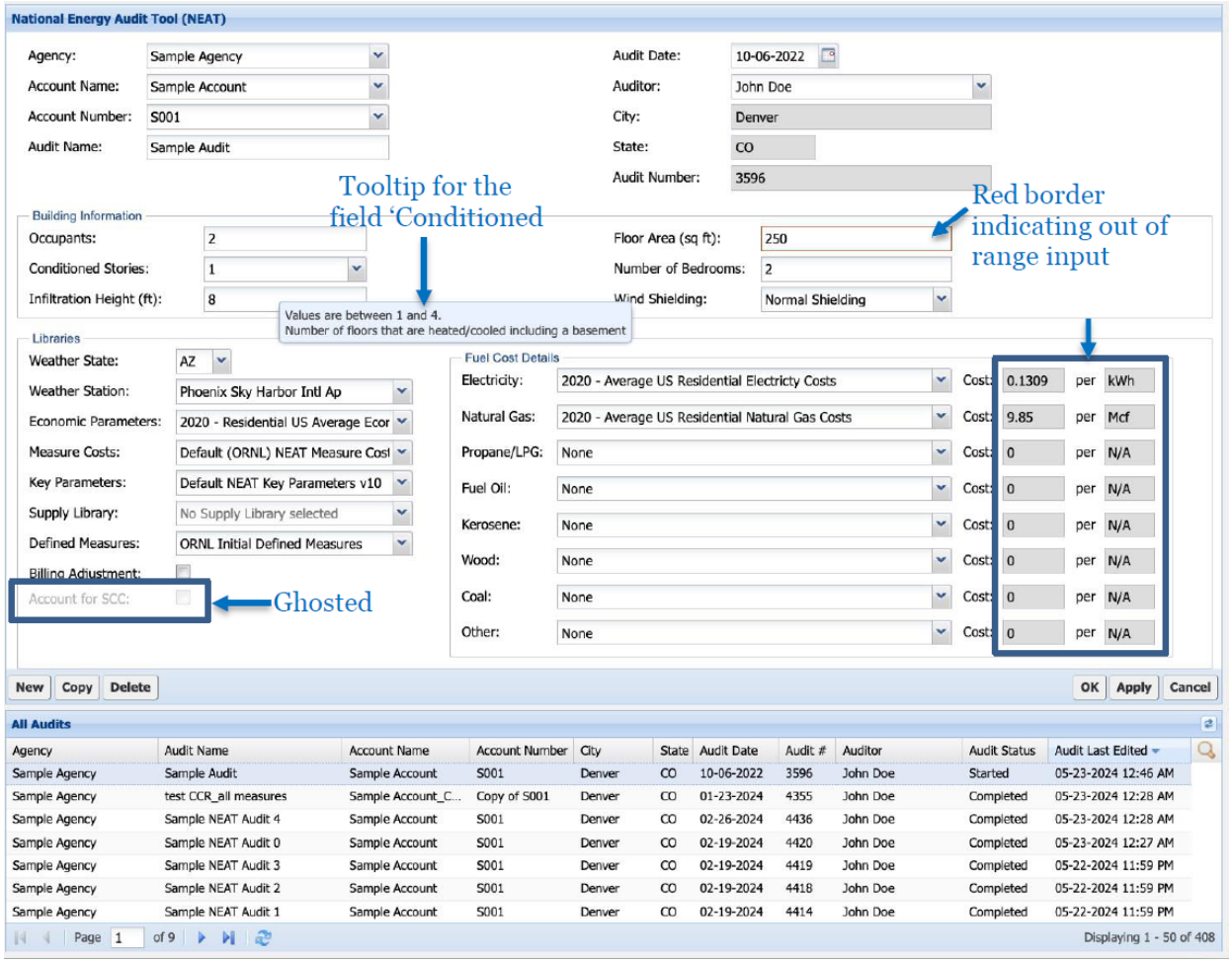
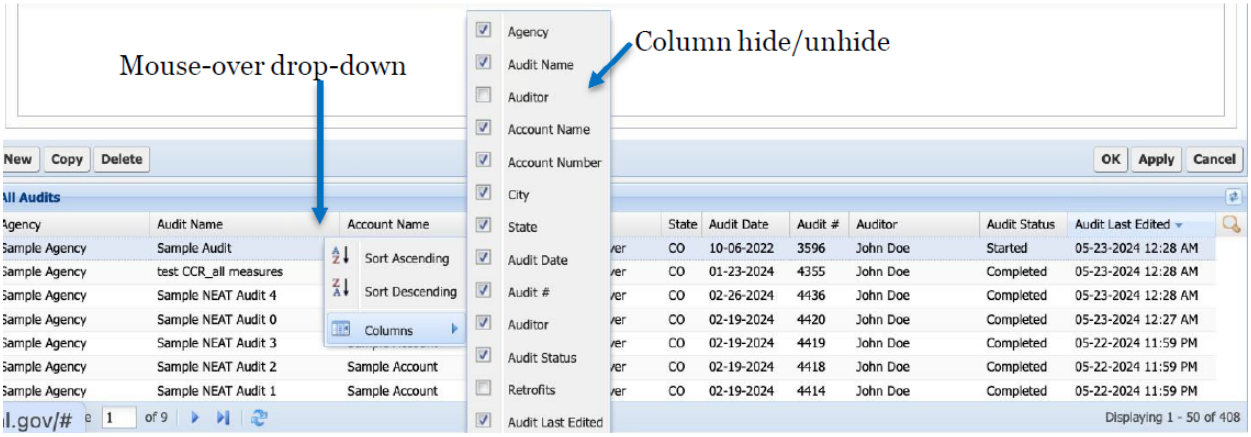
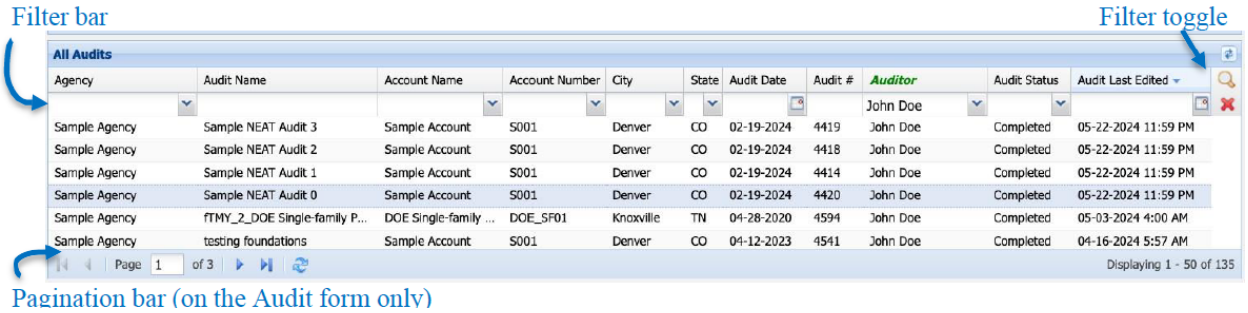


Figure 1.4. The All table displaying sorting and column hide/unhide checkbox options.



In the All table, the magnifying glass on the right side of the header row, which is available on some forms, is the filter toggle to show or hide a filter bar below the header row. To filter the records, select the filter toggle and enter the filtering criteria for one or more columns (Figure 1.5). To clear all the filters, select the cross below the filter toggle. In addition, in the All table of the Audit form, you may select the buttons on the pagination bar at the bottom to navigate between pages. Fifty audits are displayed per page.

Figure 1.5. All Audits table showing filter bar after selecting the filter toggle.



12.4 USER FORM

Figure 1.6 shows the option to select the User form (Figure 1.7; guests are not allowed access to the User form). Select User → View User on the menu bar to see the user records created by the entity that provided you with your login information. The Privilege Level field lists the privilege level that was assigned to you. Your privilege level determines your access to different forms and records. You may have one of six privilege levels. The User Privilege levels and their responsibilities and levels of access are summarized in Table 1.1.

Figure 1.6 Accessing the User form from the menu bar.



Figure 1.7. User form.

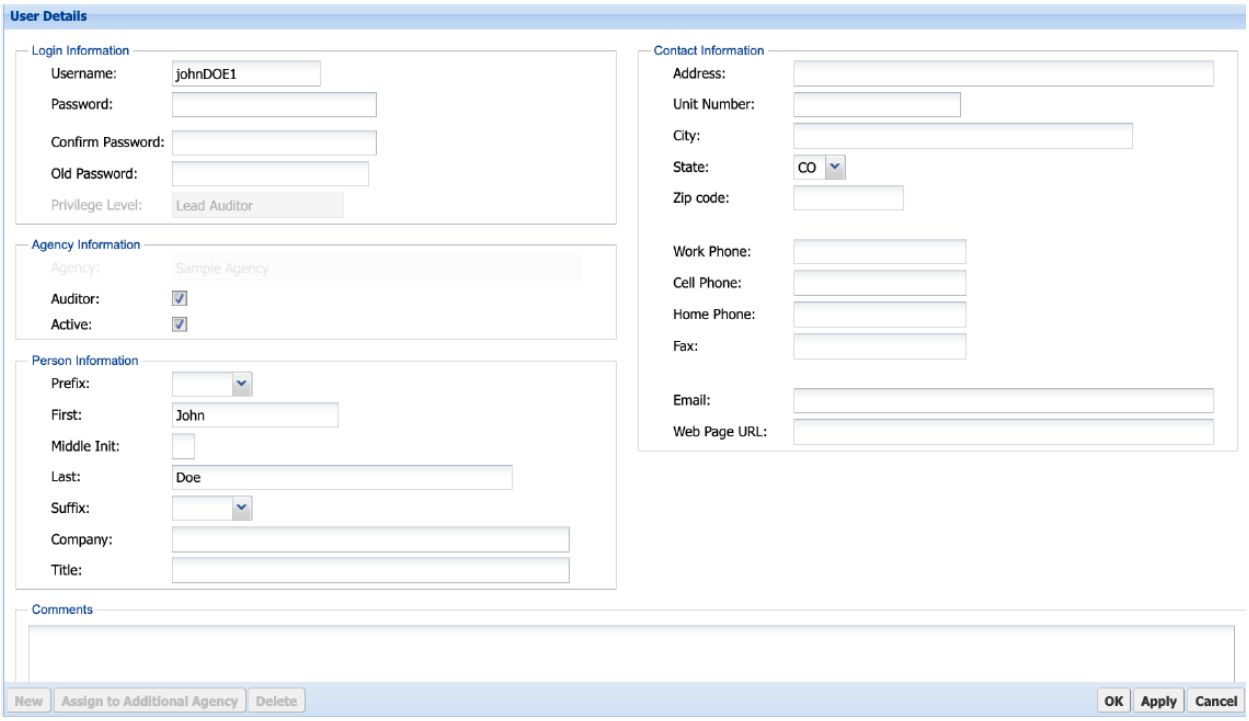


Table 1.1. User privilege

<table>
<tr><th rowspan="2">Entity</th><th rowspan="2">User privilege level</th><th rowspan="2">Scope of access</th><th colspan="6">Responsibilities (in bold) and level of access to records</th></tr>
<tr><th>User records</th><th>Agency records</th><th>Library records</th><th>Account records</th><th>Audit records</th><th>Work orders</th></tr>
<tr><td>ORNL/ developer</td><td>Site Administrator</td><td>All state-specific databases</td><td colspan="5">- Must create at least one State Administrator per state
- Can edit own user record
- Can create or edit other user records</td><td>- Have no restriction to create and edit records (for troubleshooting)</td></tr>
<tr><td>Grantee</td><td>State Administrator</td><td>State database</td><td colspan="2">- Can edit own user record except privilege level
- Can create or edit other State Administrators
- Must create at least one Agency Administrator per agency
- Can view users for all agencies</td><td>Must create all agencies in the state</td><td colspan="3">Can view libraries, accounts, audits, and work orders</td></tr>
<tr><td rowspan="4">Agency personnel and associates</td><td>Agency Administrator</td><td rowspan="4">Agency records</td><td colspan="2">- Can edit own user record except privilege level and agency information
- Must create all other users in their agency</td><td>Can edit their agency record</td><td colspan="3">Can create or edit all libraries, accounts, audits, and work orders</td></tr>
<tr><td>Lead Auditor</td><td colspan="2" rowspan="2">- Can edit own user record except privilege level and agency information
- Can view other user records in their agency</td><td rowspan="2">Can view their agency record</td><td>Can create and edit all libraries</td><td colspan="2" rowspan="2">Can create and edit all accounts, audits, and work orders</td></tr>
<tr><td>Auditor</td><td>Can view libraries</td></tr>
<tr><td>Guest</td><td colspan="4">No access</td><td>Can view all audits and work orders</td></tr>
</table>

The information that can be entered on the User form relates to login information, agency information, person information, and contact information. The only required fields on this form are Username, Password (conditionally hidden for other user accounts based on privilege level), Privilege Level, Agency, Last Name, and State. You can edit own user record except privilege level and agency information. You may want to add, edit, or update the information presented in other fields as needed. When creating a user record, make sure the Active checkbox is selected. Unchecking the Active checkbox will disallow the user to log in, which may be desired for individuals who no longer require access to Weatherization Assistant. Also make sure the Auditor checkbox is selected if the user might create audits in the future. This will list the name of the user on the Auditor drop-down field on the Audit form for NEAT & MHEA. If these checkboxes need to be updated for your user account and you are an Auditor or Lead Auditor, then your Agency Administrator may need to make the change.

12.5 AGENCY FORMS

The agency forms—Agency Details, Agency Contact, and Agency Cost Center—can be accessed by selecting Agency on the menu bar (Figure 1.8; guests are not allowed access to the agency forms). Select Agency → Agency Details to see the agency record (Figure 1.9) to which you have been assigned. Agencies are created by the BCAEO. If you are an Agency Administrator, you may want to add, edit, or update the

information as needed. The only required fields on this form are Agency Name, Agency Type, and State. Make sure the Active checkbox is selected to have the agency name listed on the Agency drop-down field on the Audit form for NEAT & MHEA.

Figure 1.8. Accessing the Agency forms from the menu bar.

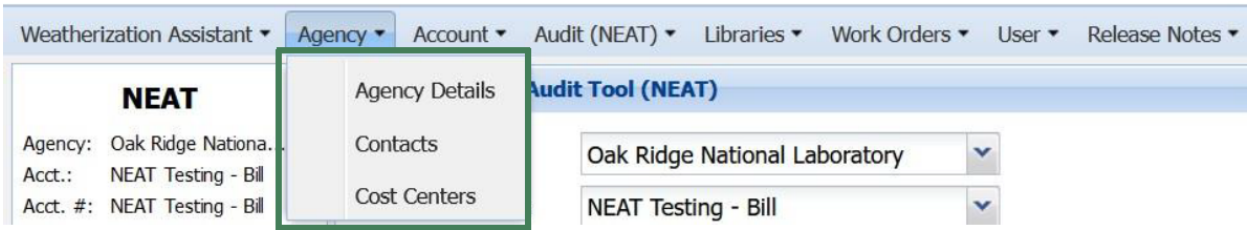
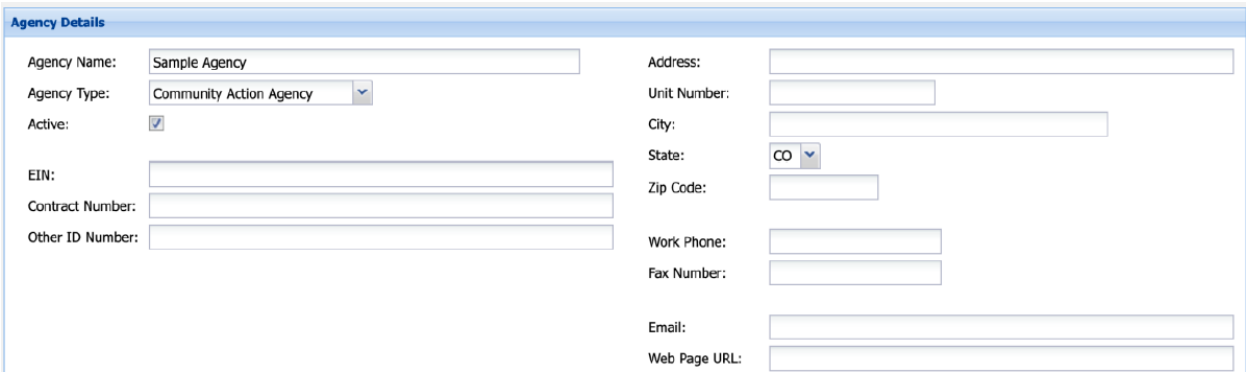


Figure 1.9. Agency Details form.



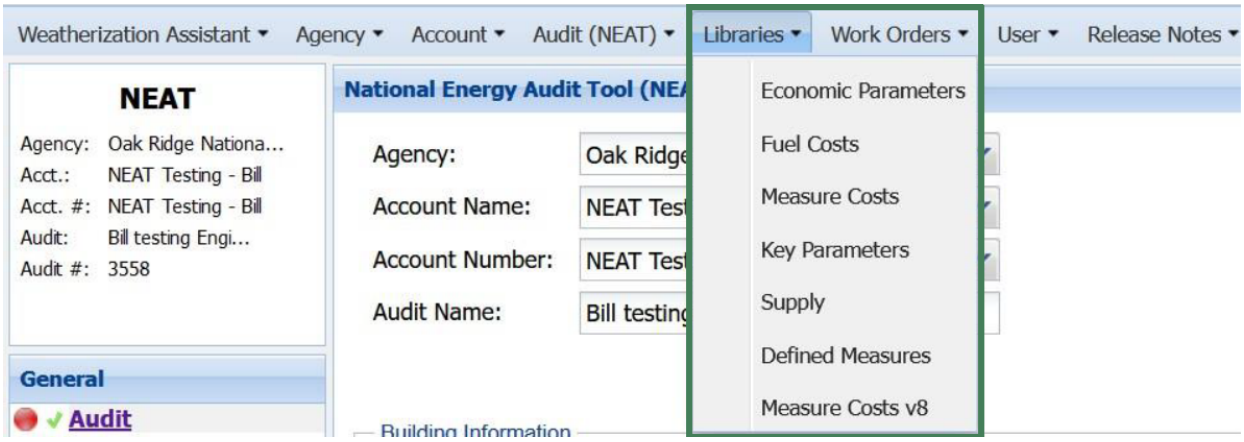
The Agency Contact form (relevant to NEAT and MHEA only) is used to enter information on certain individuals associated with the agency, specifically Contractors, Suppliers, and In-house crew members. The information on the Agency Details form is used to assign recommended measures to contractors and suppliers in the Supply Library and Work Order.

Optional: The Agency Cost Center form (relevant to NEAT and MHEA only) is used to set up cost centers or funding sources, to which the cost for individual recommended measures can be assigned.

12.6 LIBRARY FORMS (RELEVANT TO NEAT & MHEA) (See section 8.0)

Six libraries can be accessed from the menu bar by selecting Libraries → [Library Name], as shown in Figure 1.10 (guests are not allowed access to the library forms). The described libraries are used only by NEAT & MHEA.

Figure 1.10. Accessing the library forms from the menu bar.



Economic Parameter Set – These libraries (Figure 1.11) provide the fuel price indices and modified uniform present value factors required to perform economic calculations in NEAT & MHEA. These are provided for 8 fuels for 30 years: electricity, natural gas, propane, fuel oil, kerosene, wood, coal, and other.

Fuel Cost – These libraries (Figure 1.12) provide the costs for eight fuels used in NEAT & MHEA: electricity, natural gas, propane, fuel oil, kerosene, wood, coal, and other.

Measure Cost Set – These libraries (Figure 1.13) collect overall measure cost information. They provide access to Retrofit Measure Cost Details forms (Figure 1.14), which collect material and installation cost details for individual retrofit measures programmed into NEAT & MHEA for use in making economic calculations. These are provided separately for NEAT & MHEA. For NEAT and MHEA measures that have site- or system-specific costs, including air sealing, duct sealing, and replacement of HVAC equipment, water heaters, refrigerators, and lighting, costs are directly entered on the audit forms and not in the Measure Cost Set Library. The NEAT Measure Cost Set Library also provides access to a form to enter NEAT insulation types.

Key Parameter Set (NEAT and MHEA only) – These libraries (Figure 1.15) provide flexibility to modify some of NEAT's and MHEA's inputs and assumptions. The existing values on these forms may be replaced with information for your agency. These forms are provided separately for NEAT and MHEA.

Supply (NEAT and MHEA only) – These libraries (Figure 1.16) provide the ability to identify materials used within your program and their cost. Although primarily used in creating work orders, information entered for refrigerators, water heaters, and lighting can be accessed from within an audit. For each material, you can enter material properties, costs, and energy-related information.

Defined Measure Set (NEAT and MHEA only) – These libraries (Figure 1.17) provide the ability to predefine weatherization activities, including 50 predefined health and safety measures, that are not addressed within the NEAT and MHEA library measures but are commonly encountered during an audit. Defining the measures on this form enables copying them to any audit as an itemized cost.

Figure 1.11. Economic Parameter Set Library form.

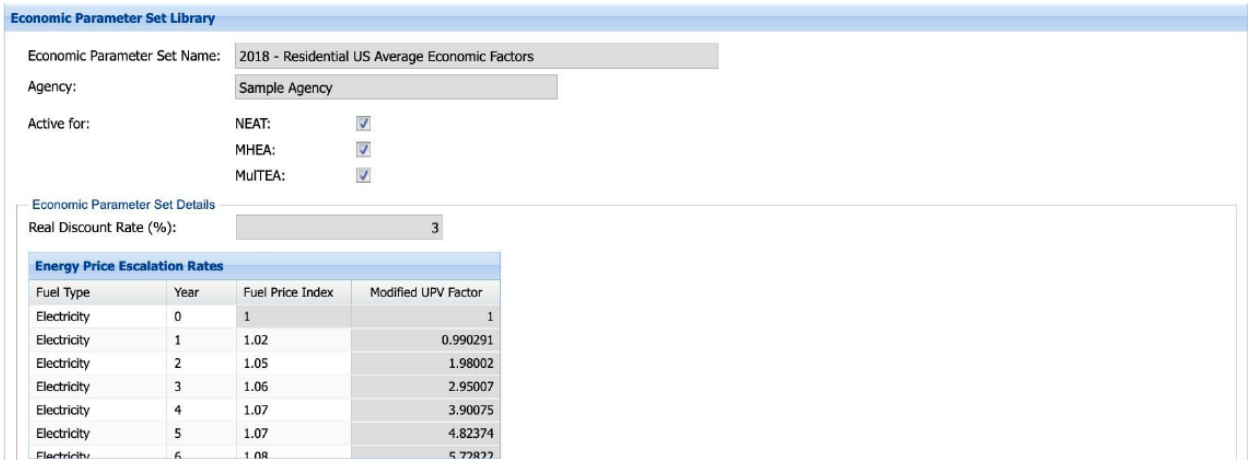


Figure 1.12. Fuel Cost Library form.

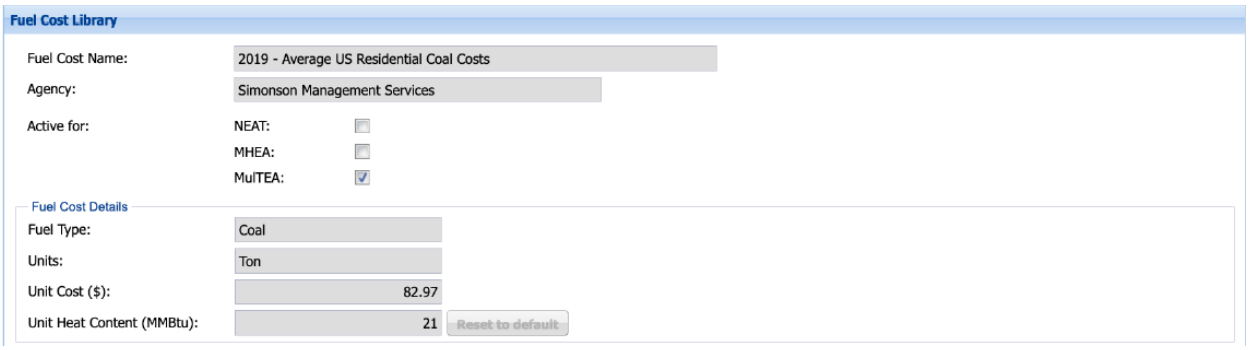


Figure 1.13. NEAT

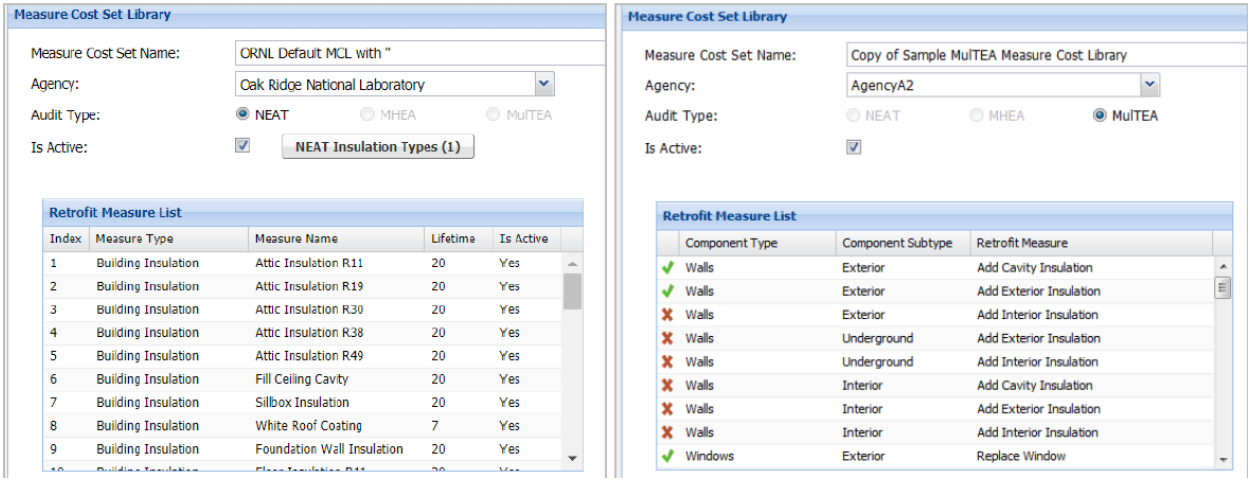


Figure 1.14. NEAT

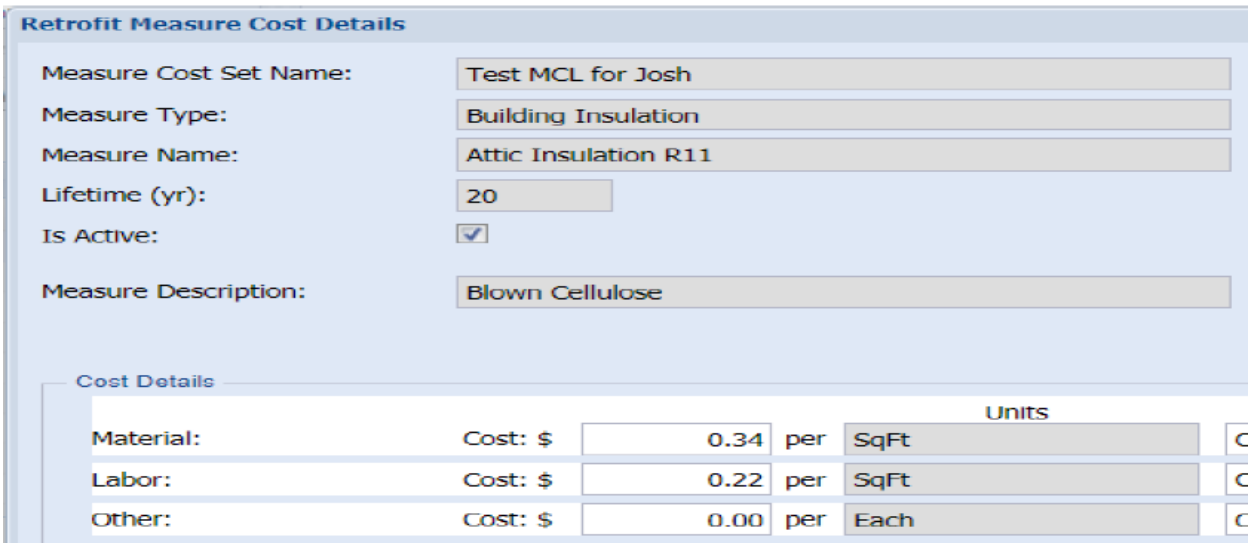


Figure 1.15. (left) NEAT and (right) MHEA Key Parameter Set Library forms.

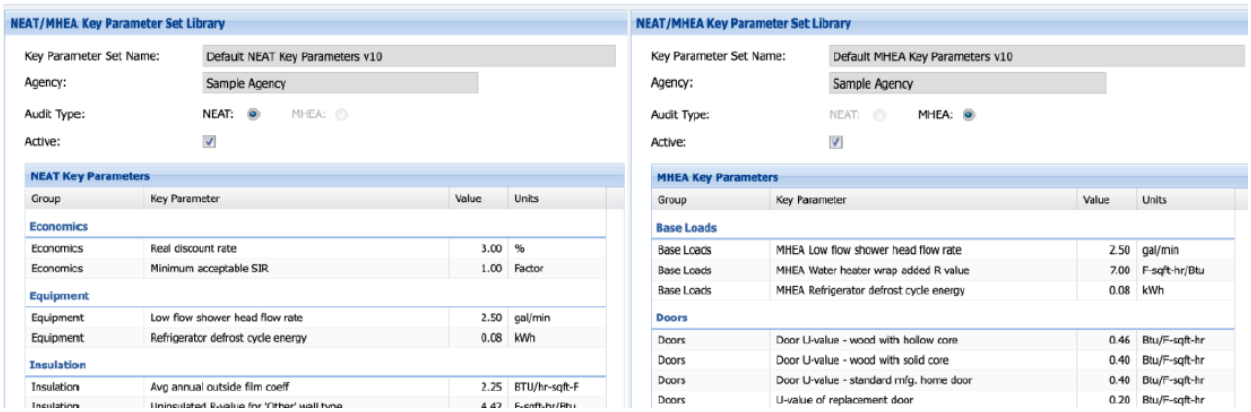


Figure 1.16. (left) Supply Library form and (right) Example Supply Library Category Details form.

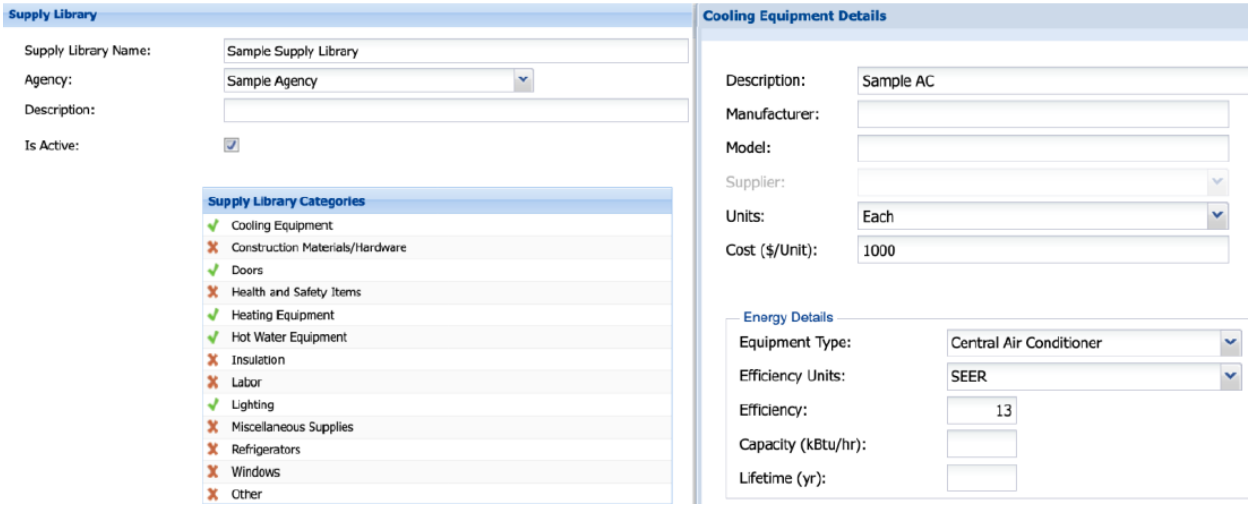
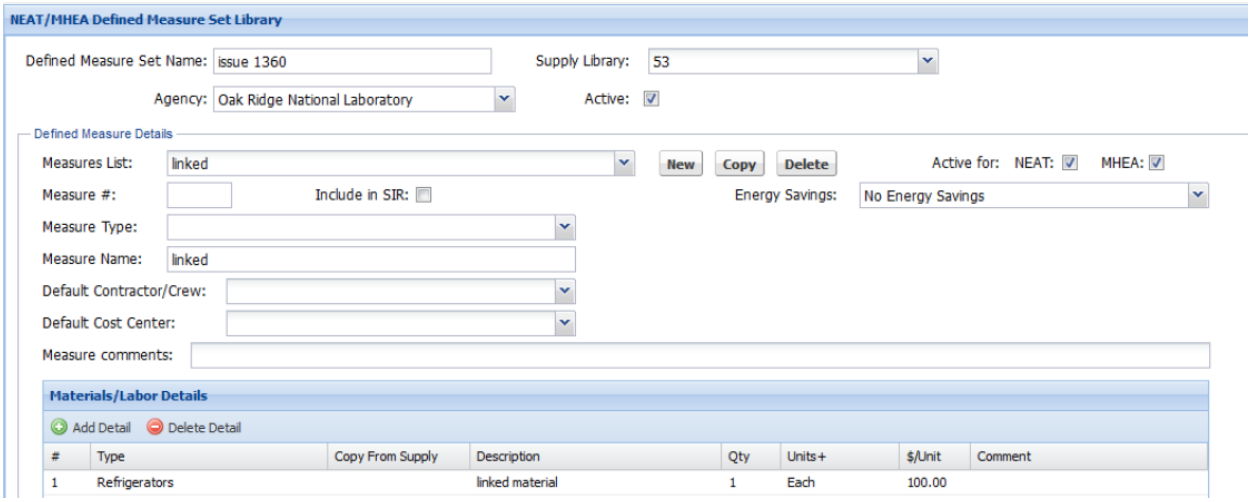


Figure 1.17. NEAT/MHEA Defined Measure Set Library form.



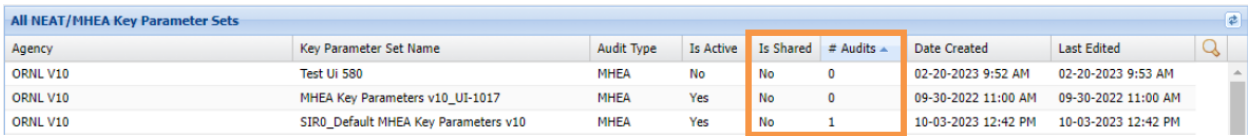
During initial setup, ORNL creates a new, read-only economic parameter set applicable to the United States and four census regions (Northeast, Midwest, South, and West) each year when new parameters are issued by the National Institute of Standards and Technology, usually in May.

BCAEO will update the Fuel Cost once a year in the audit software. Subgrantees are responsible for updating and/or checking the prices on the other audit libraries every six (6) months.

Likewise, for full compliance with Weatherization Assistance Program requirements, you will need to create your own NEAT and MHEA Measure Cost Set Libraries to reflect actual costs for your location and agency. ORNL has created example read-only Measure Cost Set Libraries for NEAT & MHEA that you can use as you become familiar with these audits.

Creating and Editing Libraries – The libraries can be created or edited only by Site Administrators, Agency Administrators, and Lead Auditors. To create a new library, access the library form and either (a) select New on the task bar and complete the form or (b) select an existing library record from the All [library type] table, select Copy on the task bar, and edit the input information as needed. It is recommended that new Economic Parameter Set and Key Parameter Set libraries be created using the latter approach. Be sure that the Active for NEAT or MHEA checkbox is selected for new Economic Parameter Set and Fuel Cost libraries that you create, and that the Active checkbox is selected for new Measure Cost Set, Key Parameter Set, Supply, and Defined Measure Set libraries to make the library available to select on the Audit form. Libraries created by ORNL during initial setup and those created on behalf of your state for access by all agencies in your state are read-only and designated as “Is Shared. ”Furthermore, libraries in use for an existing audit become read-only. The Is Shared status of a library and the total number of existing NEAT and MHEA audits using that library can be viewed in the All table, as highlighted by the orange box in Figure 1.18. You cannot modify or delete an existing library that is shared or in use for an existing audit. You can only edit a copy of a shared or in-use library to use it for future audits. Further, you can only uncheck the Active checkbox for a shared or in-use library to make it unavailable for future audits.

Figure 1.18. All table showing the Is Shared status and # Audits for library records.



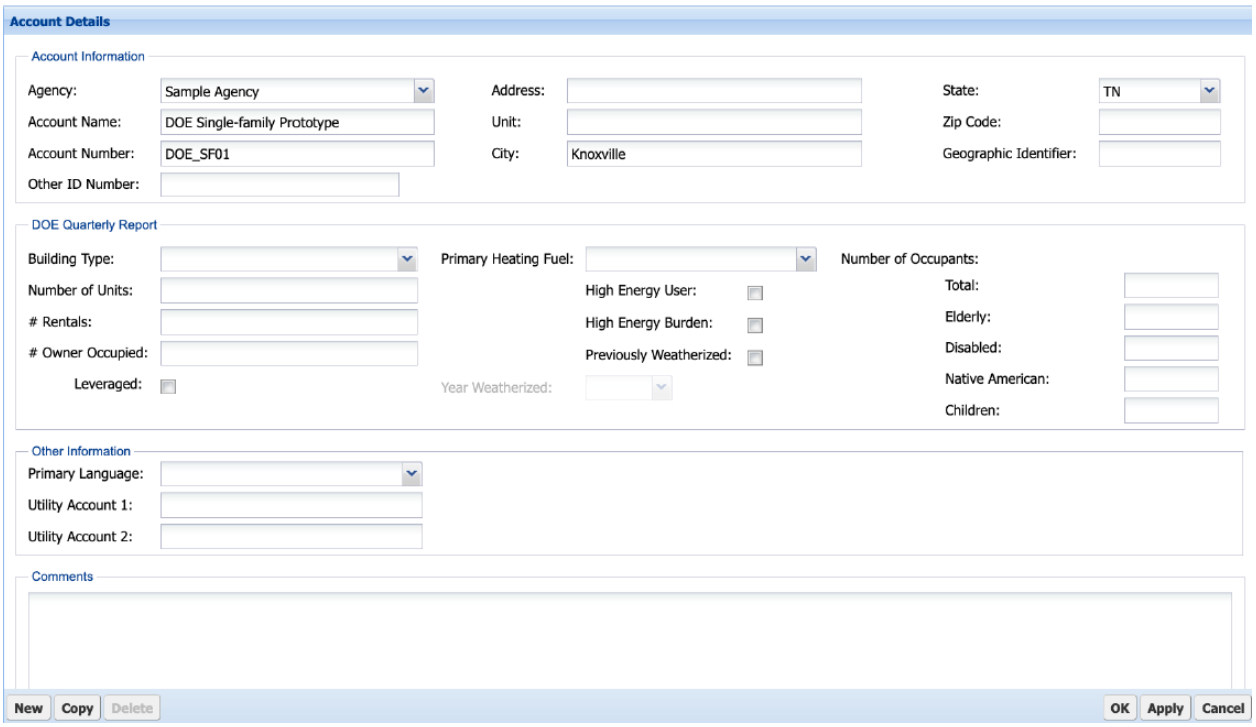
12.7 ACCOUNT FORM

You must access and fill in a new Account form (i.e., set up an account for a house, building, or project) before you run NEAT or MHEA Audit or create a work order. The Account form can be accessed by selecting Account → View Account on the menu bar (Figure 1.19) (guests are not allowed access to the Account form). To create a new account, select the New button on the task bar of the Account form (Figure 1.20). The Copy button on the task bar can also be used to create a new account. In the Account form, you can enter account information about the house, building, or project such as its name, number (e.g., job number), and address. The only required fields are Agency, Account Name, Account Number, and State. The information in the DOE Quarterly Report field set is data used by Weatherization Assistance Program Grantees in reporting results to DOE and is optional within Weatherization Assistant, as are the Primary Language and Utility Account fields.

Figure 1.19. Accessing the Account form from the menu bar.



Figure 1.20. Account form.



12.8 WORK ORDER FORMS

The work order forms are used to create, manage, and track the progress of weatherization measures to be completed (state administrators and guests are not allowed to create a work order). The work order includes materials and labor, quantities, and cost details. A work order may be created from scratch or from NEAT or MHEA Audit Recommendations.

To access work orders, select Work Orders → View Work Orders on the menu bar (Figure 1.21). The Work Order Details form (Figure 1.22) is used to enter general information about the work order and to set and track its status. To create a new work order, select the New button on the task bar. You must provide a Work Order name and select either the Account Name or Account Number; this will autofill the Agency and State fields. You may also select an Audit Name, if previously created for the selected account that you intend to link with this work order. You may select a Supply Library containing inventory items from which any materials used by the work order may be taken. You may also select a Contractor/Crew to perform the work described by the work order. Finally, you may select the Work Order Type that best describes the

work order. The choices are Weatherization, Re-Weatherization, Emergency Repair or Replacement, Response to Client Request, or Other.

Figure 1.21. Accessing the Work Order forms from the menu bar.

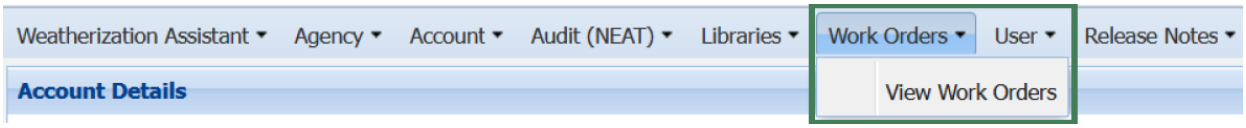
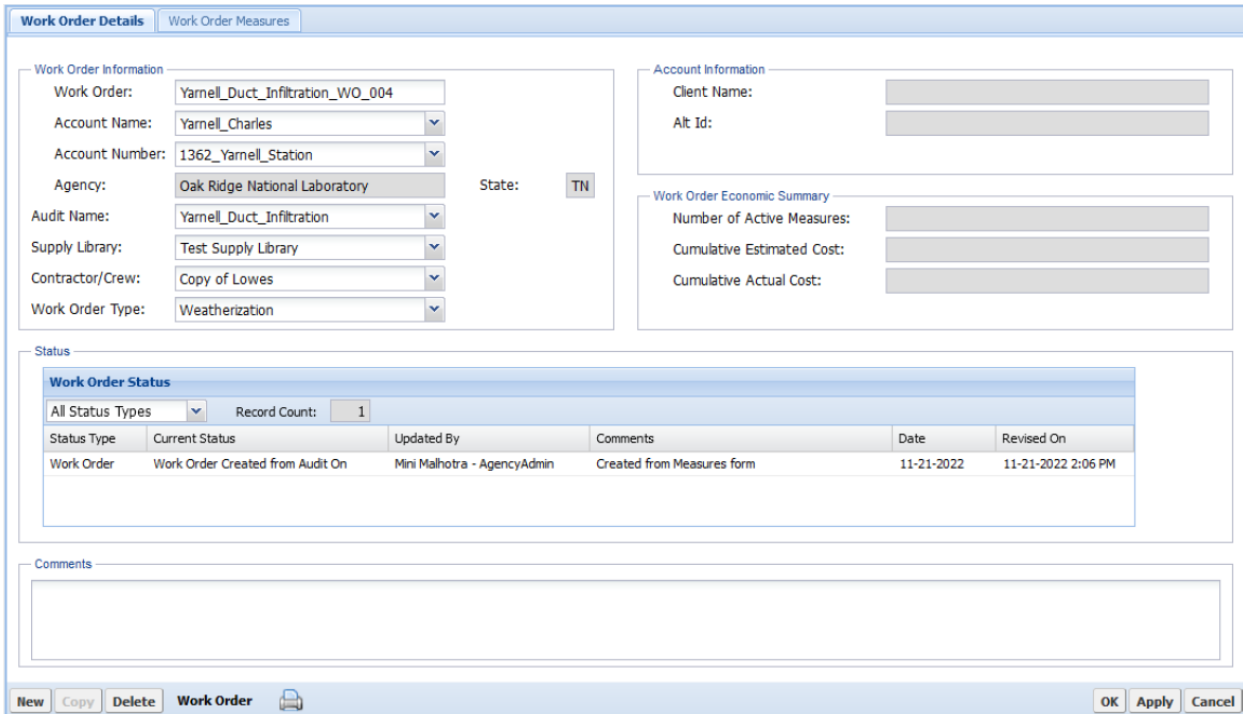


Figure 1.22. Work Order Details form.



The Work Order Status field set allows you to set and track the status of a work order for three work order status types: Work Order, Inspection, and Payment. The status categories and the available settings for these status types are listed in Table 1.2. Three specific work order status values (“Work Completed On,” “Work Refused by Client On,” and/or “Rework Complete On”) indicate the work as complete and ready for summarized reporting (e.g., the DOE Quarterly Report).

Table 1.2. Work Order Status Type and settings

Status Type	Work Order Status	Inspection Status	Payment Status
Settings[1]	Work Order Created from Audit On Work Order Details Completed On Work Order Approved On Work Order Issued On Work Scheduled to Start On Work Started On Work Completed On* Client Signed Off On* Work Refused by Client On* Work Order Canceled On* Work Order Modified On Rework Completed On* Delayed On Other	Scheduled For Passed On* Failed On Not Required* Delayed On Other	Invoice Received On Invoice Approved On Invoice Paid On* Not Required* Delayed On Other

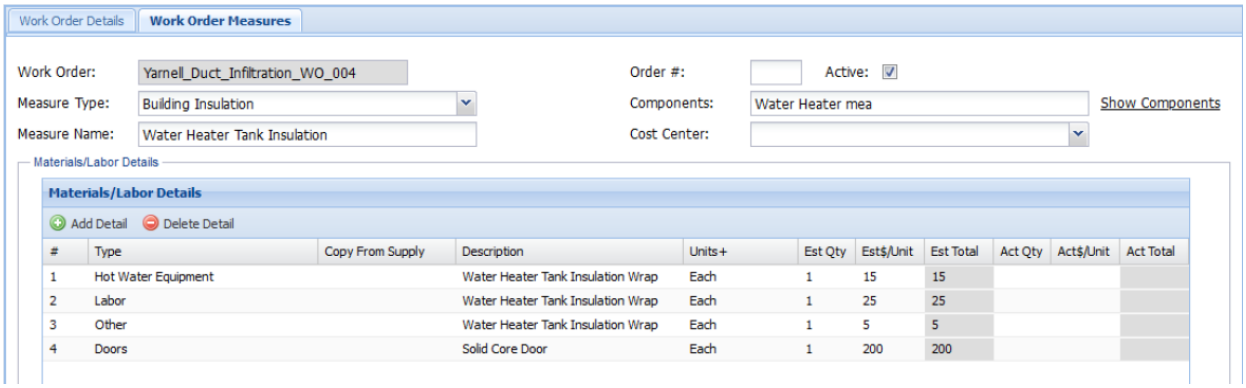
[1]Statuses tagged with an asterisk (*) are considered to represent completion.

Select the Work Order Measures tab, to develop detailed task descriptions for weatherization measures for a selected work order. The Work Order Measures form (Figure 1.23) allows you to enter a general description of measures at the top of the form and material and labor components in the Materials/Labor Details sub-form. You must enter a Measure Name to identify it in the work order. You may select the Measure Type from the drop-down list. The choices are Baseloads, Building Insulation, Client Education, Doors and Windows, General Heat Waste and Air Infiltration, General Repairs, Health and Safety, HVAC Systems, and Other. You may enter the Order # to identify the work order by a unique code. You may enter Components identifying the name or code of all the building components to which the measure will be applied. You may select a Cost Center, which is a funding source to which the actual cost of the measure will be charged. Be sure to select the Active checkbox to include the measure in the work order.

The Materials/Labor Details sub-form allows you to describe the actual quantities and unit price for different cost components of a measure. You may enter the details of cost components manually or by choosing from the Supply Library in the drop-down under the Copy From Supply column if a Supply Library was selected on the Work Order Details form.

For a work order, multiple Work Order Measures may be created by selecting the New button on the task bar. Select the Print icon to view a PDF of the work order for the measure, which will open in new tab on the browser.

Figure 1.23 Work Order Measures form.



12.9 NEAT

Once you have set up an account for a house, you can create and run NEAT on that house. NEAT has multiple forms used to describe a house; each has a main form for data input and possibly an All table for record navigation (Section 1.3). NEAT also has an Audit Dock that is a static feature anchored on the left of each NEAT input form (Figure 2.1) and provides the means of accessing NEAT's various forms and running the audit. The Audit Dock may not be displayed when creating a new audit until after the Audit form has been saved.

At the top of the Audit Dock is an information block that shows key audit information entered on the Audit form for the audit that is currently active (i.e., being viewed). Links to each of NEAT's 16 data input forms used to describe the house are provided below the information block. These links are organized into five groups: General, Shell, Systems, Baseloads, and Other. Colored icons are presented beside these links to indicate if the form is required, recommended, or optional, and if the form has been completed. A legend for the icons is shown in the Icon Key at the bottom of the Audit Dock. Links are provided in an Audit Recommendations group to run NEAT or view results of the last run for that audit. Finally, Reports can be selected to access various reports available within NEAT for the audit being viewed.

Many of the data input forms in NEAT allow multiple records to be described for a building component. For example, in Figure 2.2, multiple walls are entered on the Wall form. These forms have New and Copy options to create multiple records. For each record, a tab named by the user-entered code is created at the top of the form. The All table presented at the bottom of each of these forms lists these records (i.e., the tabs) (Figure 2.3).

To complete 1 of the 16 NEAT data input forms, select the form in the Audit Dock, input appropriate data in the main form, and select Apply to save the form or OK to save and exit the form. Select Cancel to exit the form without saving the entries that you just made. Select New or Copy (if applicable) to create additional records. The completed records will be listed in the All table. To view or edit an existing record, select the tab or the record in the All table.

On most of the Shell, Systems, and Baseloads forms, field sets on the left of the main form describe a selected component of the existing building. A field set on the right of the main form describes retrofit measure technical details for the component. For cases in which the cost of a measure is site- or system-specific (including air sealing, duct sealing, replacement of HVAC equipment, water heaters, refrigerators, and lighting), the retrofit measure field sets can be used to directly enter the total costs associated with the measure because they cannot be described in the Measure Cost Set Library. In other cases, such as on the Shell forms, the retrofit measure field sets can be used to enter an additional cost associated with installing the measure that will be added to the cost calculated from the Measure Cost Set Library.

Work orders may be exported as a PDF using the work order report and bid order form buttons. They can be exported as a “.json file” using the export work order button. (See figure 1.24)

Figure 1.24 Work Order Exports

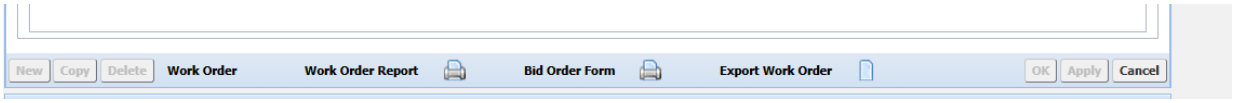


Figure 2.1. NEAT Audit Dock.

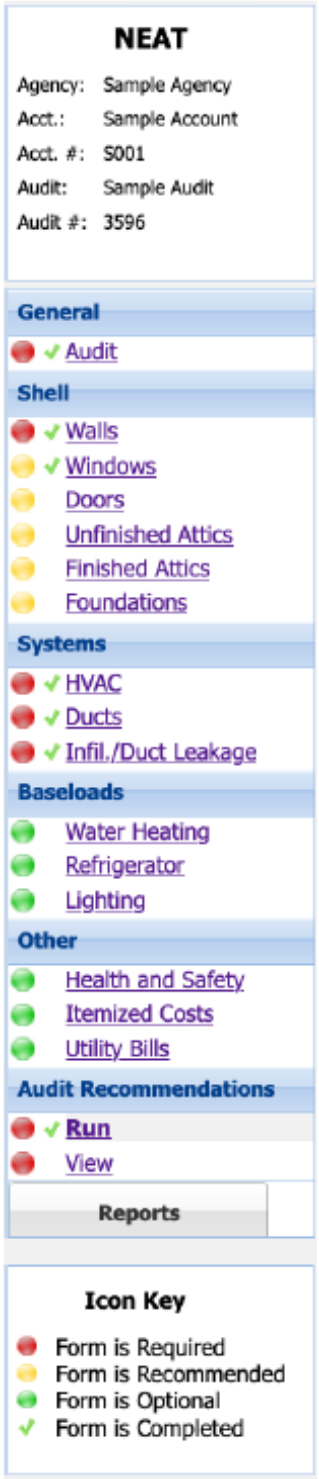


Figure 2.2. Tabs on NEAT's Walls form.

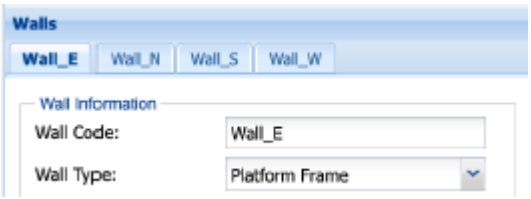
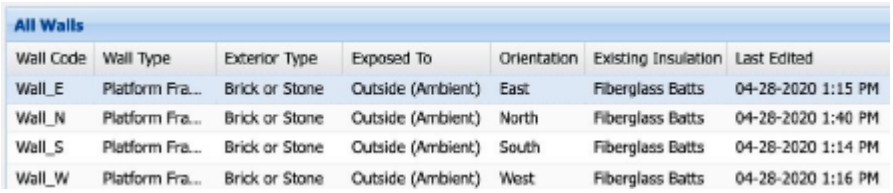


Figure 2.3. All Walls table on NEAT's Walls form.



All Walls

Wall Code	Wall Type	Exterior Type	Exposed To	Orientation	Existing Insulation	Last Edited
Wall_E	Platform Fra...	Brick or Stone	Outside (Ambient)	East	Fiberglass Batts	04-28-2020 1:15 PM
Wall_N	Platform Fra...	Brick or Stone	Outside (Ambient)	North	Fiberglass Batts	04-28-2020 1:40 PM
Wall_S	Platform Fra...	Brick or Stone	Outside (Ambient)	South	Fiberglass Batts	04-28-2020 1:14 PM
Wall_W	Platform Fra...	Brick or Stone	Outside (Ambient)	West	Fiberglass Batts	04-28-2020 1:16 PM

NEAT evaluates all retrofit measures that are indicated as being active in the Measure Cost Set Library and applicable to the house. However, many of the data input forms in NEAT provide the option to evaluate only certain measures for a component, which will exclude evaluation of other active measures for that component. In that case, NEAT also provides an option to include the energy savings and cost of the measure in calculating the package SIR. Measures for which "Required" is selected but that are not included in the package SIR are normally related to health and safety or are measures funded by a source other than the Weatherization Assistance Program. Measures with both "Required" and "Include in SIR" selected will be included in the package SIR and will always be recommended regardless of their SIR (this option is generally used for incidental repair measures). At the time of publishing this document, this is only allowed under certain limited circumstances. Please refer to the program guidance for details on allowability.

12.10 DESCRIBING A HOUSE IN NEAT

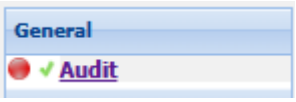
All data entered into the NEAT software shall be provided using the Uniform Data Collection Tool (UDCT) provided by BCAEO to all subgrantees. Only the UDCT provided by BCAEO has been approved for use of data collection. All ECM's must be considered for retrofit. To create a new NEAT audit, select Audit → NEAT on the menu bar and then select New on the Audit form (State Administrators and Guests are not allowed to create an audit). Select Copy to create a new audit from an existing audit. You may want to create a new audit using Copy to make multiple audit runs for a house (e.g., to evaluate different retrofit options or replacement equipment for a given

house) but still see the results of previous runs.

When creating a new audit using New, fill in the Audit form first before entering information on the other forms. Also, you will need to fill in the Wall form before completing the Window and Door forms. In general, completing forms in top to bottom order from the Audit Dock is the best practice for Audit input.

Each of NEAT's input forms are described briefly here. Section 2.2 describes how to run NEAT.

General:



Audit form (required) – The Audit form is used to enter general audit information and select weather files and libraries needed to run the audit (Figure 2.4). All the fields on this form that are not disabled or read-only are required. At the top of the form, select your Agency and then select the account using either the Account Name or Account Number field (the other data field will be auto-filled using information from the Account form). Enter an Audit Name and the Audit Date, and then select the Auditor Name (auditor names provided in the drop-down list will include all users for the Agency that are marked as Active and Auditor on the User form). The City and State fields will be auto-filled using information from the Account form. The Audit Number will be automatically assigned by NEAT.

Next, enter the building information: Occupants, Conditioned Stories (number of floors that are heated/cooled including a basement), Infiltration Height, Floor Area (length x width of all levels that are intended to be a conditioned space), Number of Bedrooms, and Wind Shielding.

Occupants
On the average during the year, enter the greatest number of people who occupy the house at any given time of the day.

Conditioned Space
Per ASHRAE 62.2, a conditioned space is any part of a building that can be thermally controlled for occupant comfort. Conditioned spaces must be connected to the primary living area of the dwelling. Zone pressure diagnostics may be used to support this determination. Spaces may be finished or unfinished, but must protect utilities from

temperature extremes typical of Michigan's climate zone.

Infiltration height
Infiltration height is defined as the vertical distance between the lowest and highest above grade points within the pressure boundary, per ASHRAE 62.2.

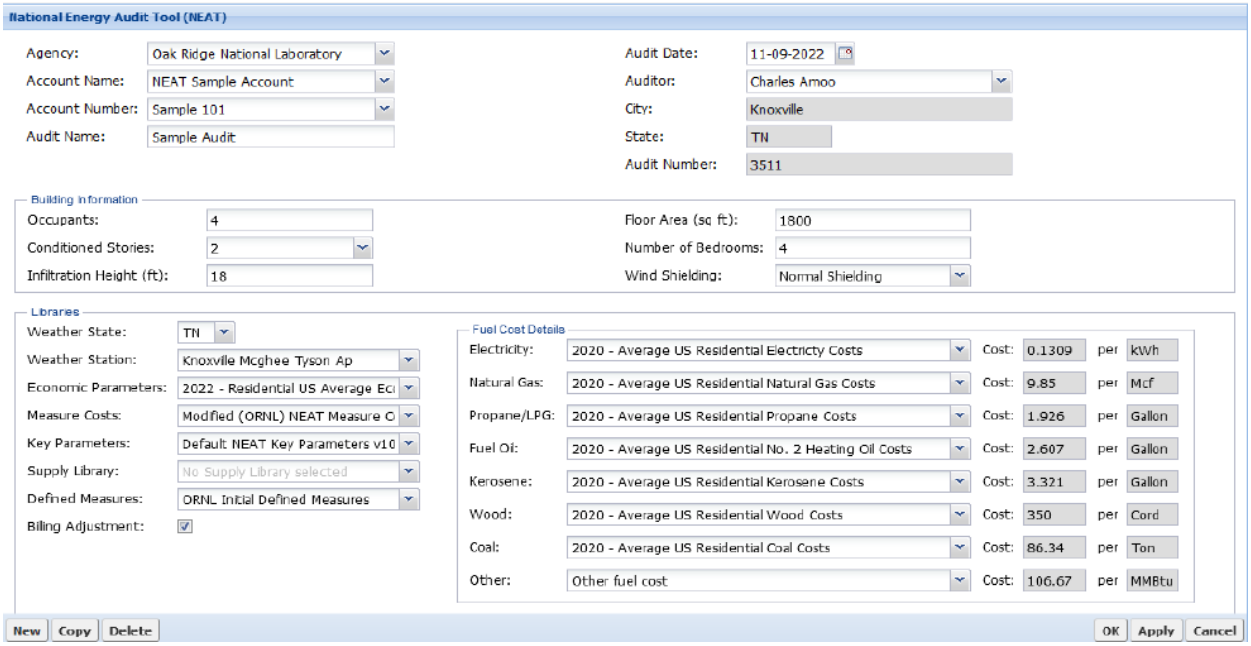
Floor Area
Enter the total square footage of conditioned, floored space. If the home has more heated area than cooled, enter the total heated floor area. Use total floor area, not building footprint. (Example: a two-story home with a 1,200 sq ft footprint should be entered as 2,400 sq ft.)

Number of Bedrooms
Enter the number of designated bedrooms in the home. Rooms that contain a bed but are not intended as sleeping areas (for example, a basement with a bed) should not be counted.

Wind Shielding
Select one of the following options based on the homes shielding: well shielded, normal shielding, or exposed.

Then, select the Weather State, Weather Station, and the following libraries: Economic Parameter Set, Measure Cost Set, Key Parameter Set, Supply (optional), Defined Measure Set, and Fuel Cost. NEAT has 1,000+ US weather stations that are filtered by weather state. You may also consider cities near you in states that border your own. The libraries listed in the drop-down lists are restricted to those that have been created in the respective libraries for this agency and marked Active for NEAT. For the Fuel Cost, you can select None for fuel types that will not be used in the audit except for electricity. The fuel costs associated with the selected Fuel Cost names will be auto-filled. Finally, for NEAT to adjust energy savings estimates and recommend measures based on the actual pre-weatherization energy consumption of the home, select the Billing Adjustment checkbox.

Figure 2.4. NEAT Audit form.



Shell:



Shell forms are used to describe the walls, windows, doors, attics, and foundations of a house. The forms are used to describe all the shell components in the house that define the thermal boundary, select retrofit options, and describe any additional costs associated with the installation of the retrofit unique to the house being audited that are not described in the Measure Cost Set Library. You must enter one wall description on the Wall form to meet the minimum requirements of NEAT; the remaining shell forms are optional. These forms are used to describe a horizontally or vertically attached house, where no heat is lost to the outside through some of the envelope components. In most buildings, though, multiple wall descriptions will be entered on the Wall form and entries will be made on the Window, Door, Attics, and Foundation forms. On the Wall, Attics, and Foundation forms, a Measure # field is provided to specify if multiple segments of a shell component should be combined into groups when evaluating retrofit measures. Select different measure numbers for segments that you want to

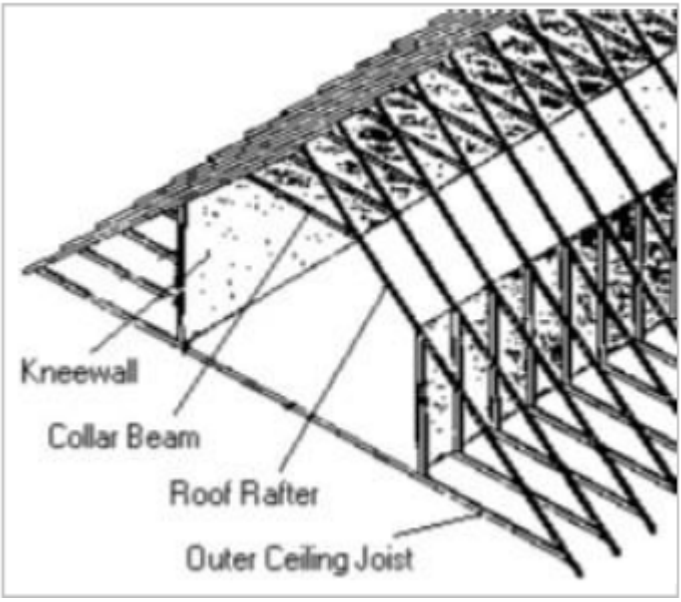
evaluate as separate measures.

The **Wall form** (required) is used to describe all the walls of the house that define the thermal boundary. Walls that differ by orientation, exposure (i.e., to the ambient conditions, buffered space (not directly exposed to ambient conditions but are adjacent to areas that are such as a garage, attic knee-wall, CAZ, or stairwell), construction, or insulation level should be described separately because the cost of insulating the walls and the energy savings from insulating the walls will differ. To describe all the exterior walls of a house most efficiently, you may combine multistoried walls or separate wall segments that have the same orientation and construction. Wall insulation is a major measure that must always be evaluated and never skipped. All exterior and buffered walls that are exposed to an unconditioned space must be evaluated and considered for added insulation. Additional cost may be needed and will vary depending on job and method of insulating such as dense packing from interior or exterior.

The **Window and Door forms** are used to describe all the windows and doors on the walls that are exposed to the outside. The number of each type of window or door is entered by their parent wall, or attic assembly in the case of skylights. Notably, a skylight cannot be defined and saved until after the associated attic assembly has been defined on the appropriate attic form. All replacement windows must be energy star rated with a minimum rated U-value of .32 and a SHGC of .40. Evaluate window replacement and storm windows must be checked for all jobs to allow the auditing software to determine the most energy efficient measure.

The **Unfinished and Finished Attic forms** are used to describe the attics in the house. The Unfinished Attic form is used to describe typical attic areas such as those built using ceiling joists and roof rafters or trusses and cathedral or flat ceilings. If an attic built from joists or trusses has flooring installed over the joists (e.g., plywood so that items may be stored in the attic), then it is Floored. Cathedral and flat ceilings are attic areas where the roof and interior ceiling are parallel. Max depth of insulation should be used when there is a physical limitation to the depth, as with floored or cathedral attics. The Finished Attic form is used to describe attic areas that result when a portion of the attic is included in the conditioned space of the home: outer ceiling joist, collar beam, knee wall, and roof rafter (Figure 2.5). Attic areas should generally be entered separately and have separate attic numbers. Added R-values should not be suggested therefore allowing the audit software to determine what R-value to be installed. The audit only generates funds for insulation and labor according to the set up library cost. Verify that all libraries are up to date and accurate on a continual basis. Any additional cost must be entered as the exact amount to be used in the selected measure. Attic insulation is a major measure that must always be evaluated and never skipped.

Figure 2.5. Components of a finished attic.



The **Foundation form** is used to model the foundations of the house, including basements, crawlspaces, slab-on-grade floors, and floors exposed directly to the outside air. Foundations can be insulated by insulating the floor, sill box(or band board that runs around the perimeter of the home where the floor joist attach to)(perimeter can be measured by adding each walls length together), and/or wall of the foundation depending on what type of foundation it is, the intended use of the foundation space, and what areas of the foundation are currently insulated. Percentage of height exposed shall be based on how much of the foundation wall is exposed to ambient air. For basements and crawl spaces, NEAT will never recommend both floor insulation and sill and/or wall insulation for the same foundation. Multiple foundations may need to be entered if some areas are insulated and some are uninsulated. Both areas' square footage would need to be entered separately as two (or more) different foundations. To describe a foundation, you must first select the Foundation Type from the following options: conditioned, non-conditioned, vented non-conditioned, unintentionally conditioned, uninsulated slab, insulated slab, and exposed floor.

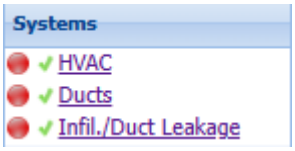
Conditioned Space

Per ASHRAE 62.2, a conditioned space is any part of a building that can be thermally controlled for occupant comfort. Conditioned spaces must be connected to the primary living area of the dwelling. Zone pressure diagnostics may be used to support this determination. Spaces may be finished or unfinished, but must protect utilities from temperature extremes typical of Michigan’s climate zone.

Height Exposed (%)
Enter the percentage of the foundation wall height that is exposed to the exterior. If exposure varies around the structure, enter an average value.

Crawlspaces are typically vented non-conditioned, and basements are conditioned, non-conditioned, or unintentionally conditioned. Conditioned foundations are those that are purposefully heated and/or cooled with at least one supply and return duct to the area. Conditioned foundations will have the pressure/thermal boundary at the foundation walls and sills. Unconditioned foundations will have the pressure/thermal boundary at the floor. All relevant uninsulated areas must be evaluated for insulation. Unintentionally conditioned foundations are those areas that are un-purposefully heated and/or cooled by things such as, but not limited to, faulty duct work, door openings left open, and/or large bypasses. If issues causing the foundation to be unintentionally conditioned are to be remedied with WX work then post-WX status may be entered. For conditioned foundations, sill and foundation wall insulation MUST be evaluated. Auditors should add Additional Costs when there may be a significant additional cost, such as to remove and replace drywall in order to install insulation. The audit only generates funds for insulation and labor according to the set up library cost. Verify that all libraries are up to date and accurate on a continual basis. Any additional cost must be entered as the exact amount to be used in the selected measure. Foundation insulation is a major measure that must always be evaluated and never skipped.

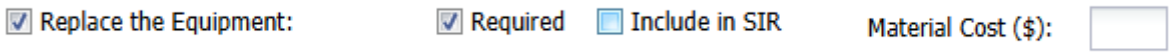
Systems:



Systems forms are used to describe the HVAC equipment, ducts, and infiltration and duct leakage associated with a house. You must enter one heating system and enter infiltration data on the Infiltration/Duct Leakage form to meet the minimum requirements of NEAT. The remaining forms are optional unless deemed required based on other inputs. For example, the Duct form may be required depending on HVAC entries. The selections made in the HVAC form, especially regarding heating, will determine whether the Duct form remains optional or becomes required.

The **HVAC form** is used to describe the heating and cooling equipment installed in the house and select retrofit options. In NEAT, you can describe as many HVAC systems as are required to describe the heating and cooling sources in the house. All equipment that provides heating and / or cooling must be described in this form. The

selected equipment may provide either heating or cooling or both. To describe the equipment, first enter the equipment type (and fuel if heating-only equipment) and then enter the data collected through proper manual testing for each appliance depending on fuel source in the applicable fields. SSE shall be used when manually testing in the field for gas fired appliances if different from AFUE ratings. If SSE readings cannot be obtained, then AFUE ratings are acceptable to use, at original rated efficiency. Inputs related to equipment type and fuel will filter out other necessary inputs, as well as the retrofit options that will be available for evaluation. For example, selecting a space heater will disable tune up as a retrofit option. The Replace the Equipment retrofit option is always enabled for possible selection and is used to specify if the measure replaces one or more existing HVAC systems described in other HVAC sub-forms. Selecting a measure as required will disable other measures that are mutually exclusive to the required measure. Replacement required shall only be selected if a unit is non-operational or has major faulty H&S issues to the point that it is unsafe to operate the equipment for manual testing. When using replacement required if SIR is checked the audit will generate the potential allowable ECM SIR for the measure. If SIR is not checked it will be considered an H&S measure. H&S HVAC replacement should not have SIR checked. If there is no existing unit applicable one shall be installed as a H&S measure.



Unlike in Weatherization Assistant Version 8, heating/cooling equipment inputs are not limited to primary and secondary systems. All existing heating and cooling equipment in the home may be entered as separate records. Weatherization Assistant Version 10 determines the primary system based on the Fraction of Load Served value that is either input or estimated by the software. Inputs made on any optional forms (e.g., other field measurements or health and safety observations) are informational only and are not used in running the audit analysis.

We recommend modeling the Year Manufactured rather than the Name Plate Efficiency for all air conditioners and heat pumps. This approach reduces the risk of entering an incorrect efficiency value, and WAweb will automatically apply age-based derating.

Note: The Year Manufactured field is available only for appliances modeled as air conditioners or heat pumps.

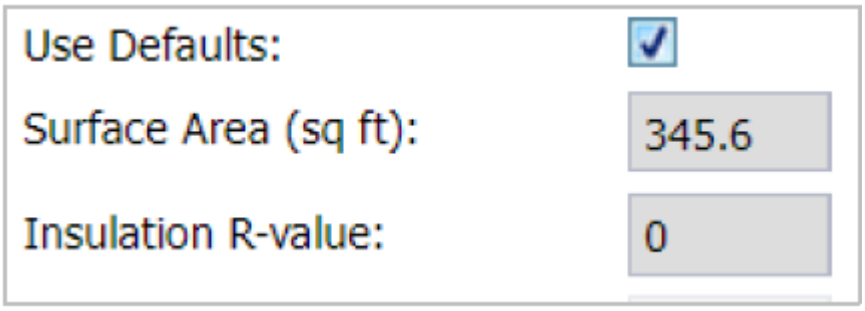
The **Duct form** (conditionally required) is used to describe the supply and return ducts for ducted HVAC equipment. A duct system with varying characteristics (e.g., location, insulation) must be described as multiple segments. All ducted HVAC equipment must be selected as served by at least one supply duct. All supply and return ducts shall be considered for modeling and properly entered in the software as is. Default methods can be used for surface area, or manual entry is allowed if proper measurements of width, height, and length (or diameter) are entered. To evaluate for duct insulation, you must enter the measured duct surface area and insulation R-value. If sufficient details relating to duct size and/or surface area and insulation R-value are unknown, then Weatherization Assistant Version 10 can estimate the values by selecting Use Defaults (Figure 2.6). To calculate these estimates and view the results, select the Use Defaults checkbox. To edit the values, clear the Use Defaults checkbox and input other values. Select Apply or OK to save the inputs.

When assessing duct systems located outside of the thermal boundary for duct insulation or duct sealing measures, actual field-measured duct dimensions must be entered into the duct form in WAweb.

These measured values are required because WAweb uses them to calculate Savings-to-Investment Ratios (SIRs) and to determine the associated costs for installing the applicable energy conservation measures.

The “Use Defaults” option may be selected only when all ductwork is located entirely within both the thermal boundary and the pressure boundary.

Figure 2.6. Use Defaults checkbox selected.



The **Ducts/Infiltration form** (required) is used to enter air and duct leakage data to evaluate the effectiveness of infiltration reduction work and duct sealing. The data input fields on the Ducts/Infiltration form change depending on whether duct sealing will be evaluated and, if so, which method—whole house blower door or duct blower measurements—will be used.

Pressure pan measurements are required to be taken for all ducts outside of the pressure and thermal boundary. If the initial pressure pan reading is above 1 PA on any duct outside the conditioned space duct sealing must be evaluated.

If the SIR for Duct Sealing is below 1.0, the ECM will still populate on the work order and should be treated as part of the general air-sealing package rather than as a standalone measure. In these cases, the auditor is responsible for ensuring that the cumulative SIR for the entire job remains at or above 1.0.

- **Whole House Blower Door Measurements:**
  The "Whole House Blower Door Measurements" method is used to assess and verify duct leakage by measuring the overall air leakage of a home before and after weatherization. This process begins with obtaining a baseline blower door reading at a pressure of 0.2 inches water column (iwc), or 50 Pascals (Pa), prior to any weatherization work. The target after weatherization blower door number shall be in accordance with targets outlined in Section 11.0. The target air leakage rate after duct sealing—but before other weatherization—is 0.5 CFM per square foot of duct surface area located outside the thermal boundary. This target value must be calculated as the pre- blower door result minus the expected reduction from duct sealing. For example, if there are 20 square feet of ductwork outside the thermal envelope, the acceptable leakage would be 10 CFM (20 × 0.5). Target duct operating pressures for both return and supply sides should be set to 5 Pa above the system's measured operating pressure before duct sealing.

  All ducts outside the conditioned space shall be modeled inside the Ducts tab. The actual surface area used in calculating the target duct sealing CFM reduction, must be included in the Ducts tab as located in unconditioned space.

- **Duct Blower Measurements:**
  Pre duct operating pressure shall be obtained by switching on the air handler and using a pressure pan to obtain readings from both supply and return ducts. When only one (1) central return exists, DO NOT COVER WITH PRESSURE PAN. Place 2-3 inches of the hose in the return at the filter grill. Target duct operating pressures shall be 5pa greater than measured operating pressure. To evaluate infiltration reduction as a retrofit measure, you must, at a minimum, enter the pre-weatherization whole-house air leakage rate (usually measured), an estimated or target leakage rate after weatherization, house pressure differences for these rates, and the cost of the infiltration/duct sealing work.
  A recommended method for duct infiltration values is: 8% of total floor area for Leakage to Outside, & 12% of total floor area for Total Leakage.

A set of optional forms (Blower Doors, Zonal Pressures, Pressure Pans, and Room Pressure Balances) can be used to enter measurements made during the infiltration and duct leakage measurements or health and safety observations related to the HVAC systems. Information entered on these optional forms is not used in running an audit. Duct Blaster Measurements must be obtained through testing and entered into the auditing software to evaluate for duct sealing. 25pa shall be entered in all 6 inputs for 'at Duct Pressure' and 'House Pressure WRT Outside'.

Baseloads:



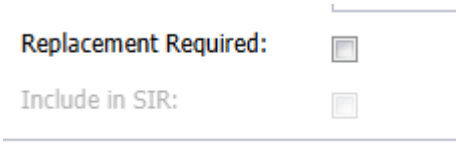
Baseloads forms are used to describe water heating retrofits, refrigerator replacement, and lighting retrofits. These forms are used to evaluate specific retrofit measures.

The **Water Heating form** is used to enter information necessary to evaluate for water heater replacement. You may describe the existing water heater by selecting from the list of manufacturer and model number, which will autofill the energy use characteristics of the water heater, or by directly entering the data on the form collected from the manufactures data plate. To evaluate a water heater replacement, you may either select a water heater you have already described in the Supply Library, which will autofill the data, or directly enter the data on the form from the manufacturers data plate. If SIR is not checked it will be considered an H&S measure. H&S Water Heater replacements should not have SIR checked.

If the Energy Factor (EF) for a water heater cannot be located through the manufacturer's label, documentation, or recognized equipment databases, the reference table in Appendix B may be used to estimate the unit's EF based on fuel type and year of manufacture.

If the year of manufacture cannot be determined, the highest Energy Factor listed for that fuel type must be used to ensure the most conservative and compliant estimate, See Appendix B.

* Optional measures include: tank insulation, pipe insulation, low-flow showerheads (See section 9.0 of this guide).



The **Refrigerator form** is used to enter information necessary to evaluate a refrigerator replacement. Here, you may specify the energy use characteristics of the existing and replacement refrigerators. For the existing refrigerator, you may either select from the list of manufacturers and model numbers in the library, which will autofill the data, or directly enter the data on the form. All refrigerators being considered for replacement must be metered a minimum of two (2) hours with an approved metering device or model number entered from the audit database and the results logged on the Base Load Record.

The **Lighting form** is used to describe lighting replacement retrofits. You may specify the quantity, usage, and energy use characteristics of the existing and replacement lighting and cost of the replacement lighting. For the existing and/or replacement lighting system, you may either select lighting you have already described in the Supply Library, which will autofill the energy and cost data, or directly enter the data on the form. All lighting retrofits are required by BCAEO to be LED and energy star rated.

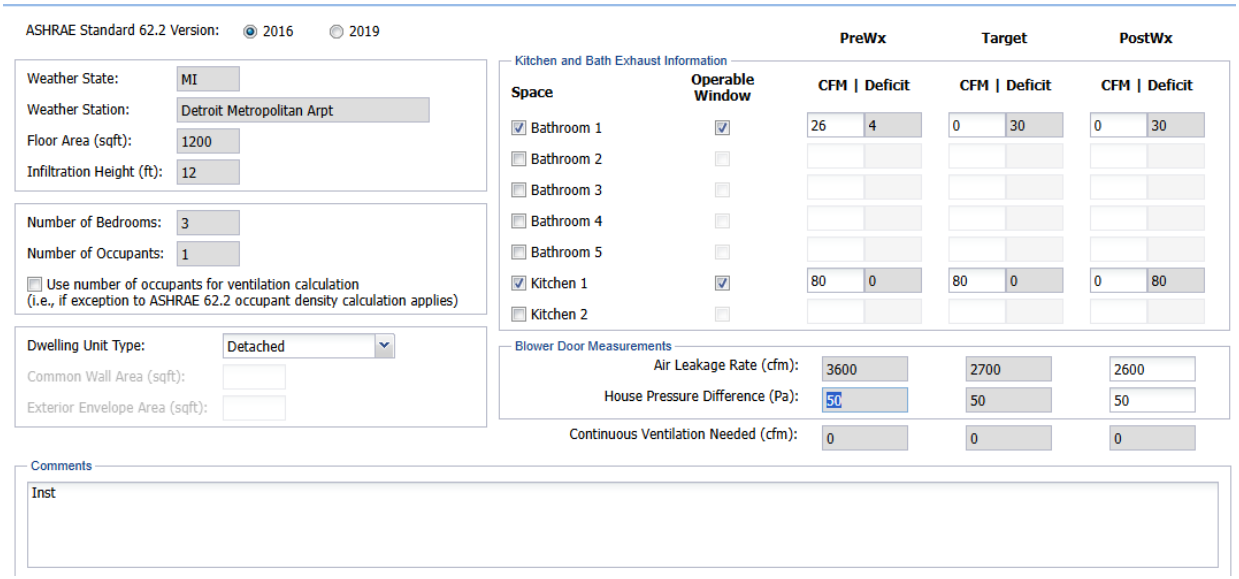
Other:



The **Health and Safety form** can be used to enter health and safety measurements and observations that you have made of the house. This form will assist in determining ventilation requirements to comply with ASHRAE Standard 62.2 2016.

- If the ventilation airflow requirement is less than 15 CFM, ASHRAE 62.2–2016 exempts the mechanical-ventilation requirement.

- The ASHRAE tab in this form is required to be filled out by the EA and QCI.



The **Itemized Costs form** (optional) can be used to enter necessary repair and health and safety measures and associated costs.

- Incidental Repair Measure (IRM): An IRM according to DOE is “A repair necessary for the effective performance or preservation of newly installed weatherization materials, but not part of a standard installation. IRM installations must be associated with a specific ECM or group of ECMs. IRMs must be justified by written and photo documentation in the client file. IRM costs should be entered as an itemized cost and must be included in the SIR calculation of the total package of weatherization measures (CSIR). IRM’s could be measures such as attic or crawl space access door repairs or replacement, wall ceiling or floor repairs, gutters, sump pumps, waterline insulation.

* Ancillary items are materials needed to properly perform that measure and are an allowable cost under the measure (for example insulation rods, baffles, junction markers, depth markers, etc.). The costs of ancillary items and their installation shall be included within the cost of an individual ECM when calculating the SIR for the individual ECM.

The **Utility Bills form** (optional) can be used to enter pre-retrofit utility bills associated with heating and cooling if you want NEAT to compare them with NEAT’s heating and cooling energy consumption estimates as part of an audit calibration process and adjust energy savings estimates for the recommended measures. For NEAT to adjust its energy savings estimates and develop a second set of recommended

weatherization measures based on the actual pre-weatherization energy consumption of the house, select the Billing Adjustment checkbox. Comparison of the predicted base case energy use against utility bills is more appropriate for metered fuels, such as natural gas and electricity. Bulk fuels such as propane, fuel oil, and kerosene, which are delivered in bulk and stored in tanks at the house, are less appropriate. Unless deliveries are relatively frequent and approximately the same amount of fuel remains in the tank at the time of each delivery, use of billing data for these fuels can lead to substantial inaccuracy.

The Michigan WAP does not require pre-retrofit utility bill comparison within the NEAT when justified fuel costs are used.

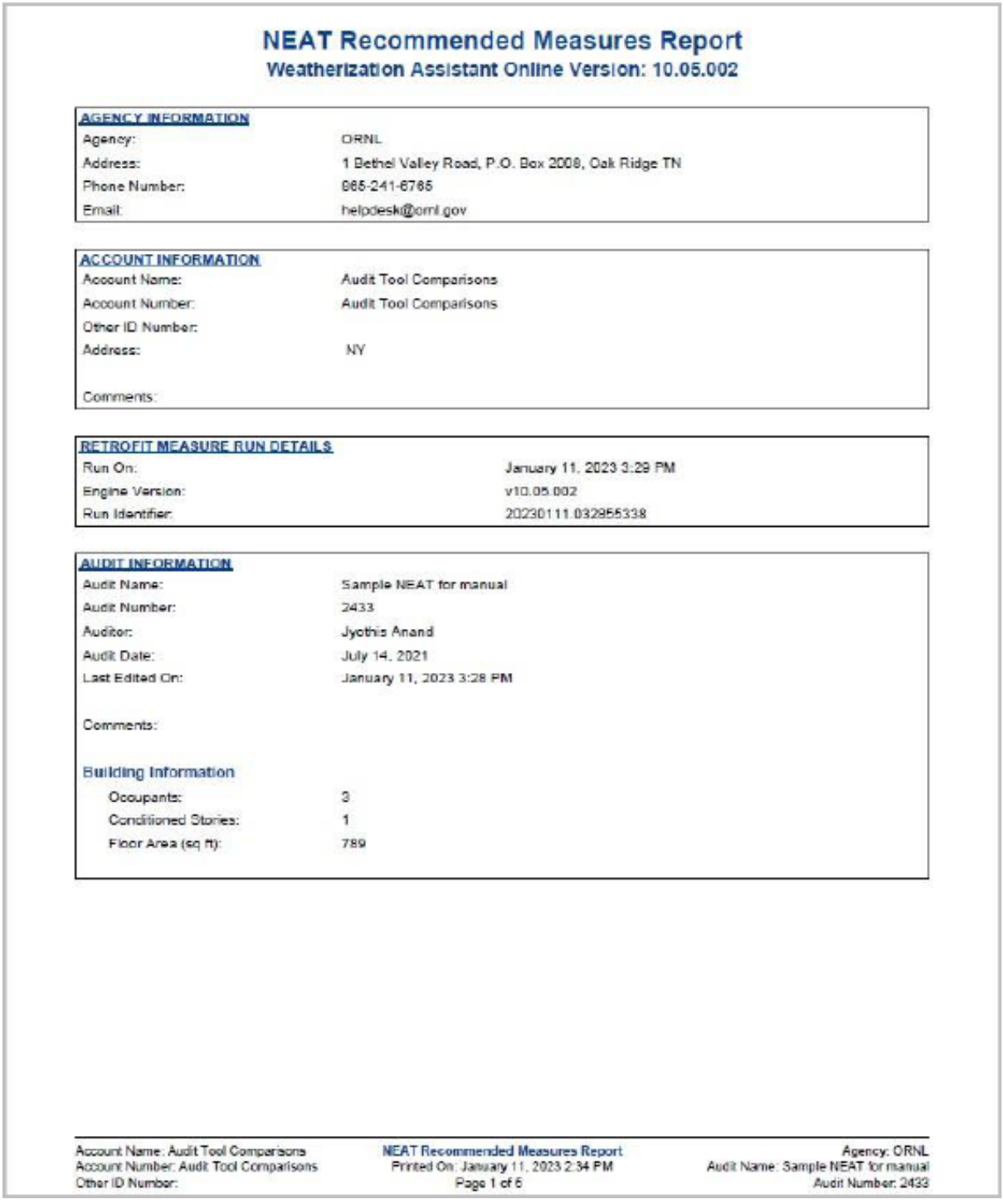
12.11 RUNNING NEAT AND VIEWING RESULTS

Audit recommendations – You can run NEAT after you have entered all the information for the house on the data input forms. The Run on the Audit Dock link will be activated as soon as all the required data input forms have been completed. When you select Run, the status of the run will be displayed, and the Recommended Measures Report will be opened in a separate window. Once an audit has been run, the link to View will be activated. You can select View to see a NEAT Recommended Measures Report that has already been created and saved from a previous run.

Figure 2.7 shows the title page of the NEAT Recommended Measures Report. The title page identifies your Agency, Account, Audit, and Audit Run; provides key information you have entered on the Agency, Account, and Audit forms; and provides additional information about the audit run to track the audit results.

After the title page, the report lists all the recommended measures along with their estimated energy and cost savings, measure costs and SIRs, and primary material quantities needed to perform them (Figure 2.8).

Figure 2.7. NEAT Recommended Measures Report: title page.



NEAT Recommended Measures Report
Weatherization Assistant Online Version: 10.05.002

AGENCY INFORMATION

Agency:	ORNL
Address:	1 Bethel Valley Road, P.O. Box 2008, Oak Ridge TN
Phone Number:	865-241-6765
Email:	helpdesk@ornl.gov

ACCOUNT INFORMATION

Account Name:	Audit Tool Comparisons
Account Number:	Audit Tool Comparisons
Other ID Number:	
Address:	NY
Comments:	

RETROFIT MEASURE RUN DETAILS

Run On:	January 11, 2023 3:29 PM
Engine Version:	v10.05.002
Run Identifier:	20230111.032955338

AUDIT INFORMATION

Audit Name:	Sample NEAT for manual
Audit Number:	2433
Auditor:	Jyothis Anand
Audit Date:	July 14, 2021
Last Edited On:	January 11, 2023 3:28 PM
Comments:	

Building Information

Occupants:	3
Conditioned Stories:	1
Floor Area (sq ft):	789

Account Name: Audit Tool Comparisons
Account Number: Audit Tool Comparisons
Other ID Number:

NEAT Recommended Measures Report
Printed On: January 11, 2023 2:34 PM
Page 1 of 6

Agency: ORNL
Audit Name: Sample NEAT for manual
Audit Number: 2433

Figure 2.8. NEAT Recommended Measures Report: recommended measures.

Annual Energy and Cost Savings

Index	Recommended Measure	Components	Heating		Cooling		BaseLoad		Total	
			(MMBtu)	($)	(kWh)	($)	(kWh)	($)	(MMBtu)	($)
1	Lighting Retrofits	LT1	0.0	$0	0	$0	206	$30	0.7	$30
2	Lighting Retrofits	LT2	0.0	$0	0	$0	263	$38	0.9	$38
3	Low Flow Showerheads	Water Heating	0.0	$0	0	$0	421	$18	1.4	$18
4	Water Heater Tank Insulation	Water Heating	0.0	$0	0	$0	476	$21	1.6	$21
5	Insulate and Seal Attic Acess	Itemized Cost	0.0	$0	0	$0	0	$0	0.7	$0
6	Refrigerator Replacement	Refrigerator	0.0	$0	0	$0	1,915	$277	6.5	$277
7	Water Heater Pipe Insulation	Water Heating	0.0	$0	0	$0	260	$11	0.9	$11
8	Weatherize Window	WD3,WD1,WD2	6.0	$77	-46	-$7	0	$0	5.9	$70
9	General Air Sealing	Ducts/Infiltration	9.7	$123	-22	-$3	0	$0	9.7	$120
10	Water Heater Replacement	Water Heating	0.0	$0	0	$0	1,362	$59	4.7	$59

Economics

Index	Recommended Measure	Components	Measure Savings ($/yr)	Measure Cost ($)	Measure SIR *
Incidental Repairs					
1	Repair Roof	51	$0	$80	0.00
Weatherization Measures					
2	Lighting Retrofits	LT1	$30	$24	9.58
3	Lighting Retrofits	LT2	$38	$32	9.17
4	Low Flow Showerheads	Water Heating	$18	$30	6.71
5	Water Heater Tank Insulation	Water Heating	$21	$45	4.48
6	Insulate and Seal Attic Acess	Itemized Cost	$9	$30	4.17
7	Refrigerator Replacement	Refrigerator	$277	$800	4.07
8	Water Heater Pipe Insulation	Water Heating	$11	$30	3.68
9	Weatherize Window	WD3,WD1,WD2	$70	$300	1.80
10	General Air Sealing	Ducts/Infiltration	$120	$600	1.56
11	Water Heater Replacement	Water Heating	$59	$450	1.28
Total			$652	$2,421	2.67

*Total [Package] SIR excludes Health and Safety measures.

Materials

Index	Material	Type	Quantity	Units
1	Weatherize Window	Weatherize Window Materials	10	Each Window
2	Water Heater Tank Insulation	Water Heater Tank Insulation Wrap	1	Each
3	Water Heater Pipe Insulation	R-1.85 (1/2") Water Pipe Insulation	1	Each
4	Low Flow Showerheads	Low Flow Showerhead	1	Each
5	General Air Sealing	General Air Sealing	1	Each Measure
6	Replacement Lighting	CFL Lamp 13.0 watts	4	Each
7	Replacement Lighting	CFL Lamp 15.0 watts	4	Each
8	New Refrigerator		1	Each
9	New Water Heater		1	Each

If you entered utility bills on the Utility Bills form, the report will also provide a revised set of tables for the recommended measures based on adjusted estimates of energy and cost savings and SIRs, and a comparison of NEAT's estimates of the house's heating and/or cooling energy consumptions with the utility bills. Notably, NEAT's estimates are based on TMY3 (Typical Meteorological Year 3) weather data, whereas the utility bills reflect energy consumption for the actual weather that occurred during the billing period. If you also entered degree days associated with the utility bills, they will be compared with the TMY3 weather data used to make the home's energy estimates so that you can determine the degree to which differences between predicted energy consumptions and utility bills might be due to weather differences.

The report also provides other information such as the annual loads and energy consumptions (in MMBtu/yr), peak (i.e., design) loads (in kBtu/hr), and output required (in kBtu/hr for heating and tons for cooling) for the house before and after weatherization (Figure 2.9).

Figure 2.9. NEAT Recommended Measures Report: annual loads, energy consumptions, and peak load components before and after weatherization.

House Loads and Energy Consumptions				
	Before Weatherization		After Weatherization	
	Heating	Cooling	Heating	Cooling
Annual Load (MMBtu/yr)	43.2	30.2	32.6	31.0
Annual Energy (MMBtu/yr)	63.9	8.8	48.1	9.1
Design Day Heat Loss/Gain (kBtu/hr)	37.9	16.1	34.5	15.0
Design Day Output Required (kBtu/hr)(ton)	45.5	1.6	39.7	1.5

Peak Heating Load				
Component Type	Component Name	Area or Volume (Infiltration)	Before Weatherization Load (Btu/h)	After Weatherization Load (Btu/h)
Wall (Btu/h)	WL1-N	348	3,096.3	3,096.3
Wall (Btu/h)	WL2-S	348	3,096.3	3,096.3
Wall (Btu/h)	WL3-E	624	5,552.1	5,552.1
Wall (Btu/h)	WL4-W	640	5,694.4	5,694.4
Window (Btu/h)	WD1	32	2,091.4	2,091.4
Window (Btu/h)	WD2	32	993.1	993.1
Window (Btu/h)	WD3	16	545.0	545.0
Door (Btu/h)	DR1	20	428.2	428.2
Door (Btu/h)	DR2	20	428.2	428.2
Attic (Btu/h)	A1	1,000	3,242.1	3,242.1
Foundation (Btu/h)	Crawlspace1	1,000	3,637.3	3,637.3
Infiltration (Btu/h)	Inf	16,000	9,144.5	5,715.3
Total heat loss (Btu/h)	Tot	0	37,949.1	34,519.9
Duct loss (Btu/h)	Duct	405	7,589.8	5,178.0
Output required (Btu/h)	Output	0	45,538.9	39,697.9

Peak Cooling Load				
Component Type	Component Name	Area or Volume (Infiltration)	Before Weatherization Load (Btu/h)	After Weatherization Load (Btu/h)
Wall (Btu/h)	WL1-N	348	899.8	899.8
Wall (Btu/h)	WL2-S	348	899.8	899.8
Wall (Btu/h)	WL3-E	624	1,613.4	1,613.4
Wall (Btu/h)	WL4-W	640	1,654.8	1,654.8
Window (Btu/h)	WD1	32	980.5	980.5
Window (Btu/h)	WD2	32	940.2	940.2
Window (Btu/h)	WD3	16	1,298.4	1,298.4
Door (Btu/h)	DR1	20	124.4	124.4
Door (Btu/h)	DR2	20	124.4	124.4
Attic (Btu/h)	A1	1,000	1,832.8	1,832.8
Foundation (Btu/h)	Crawlspace1	1,000	623.0	623.0
Infiltration (Btu/h)	Inf	16,000	3,340.8	2,272.8
People (Btu/h)	People	2	552.0	552.0
Appliances (Btu/h)	Appl	1	1,200.0	1,200.0
Total Sensible (Btu/h)	TotS	0	16,084.5	15,016.4
Ducts (Btu/h)	Ducts	0	2,412.7	2,252.5
Total (with ducts) (Btu/h)	TotW	0	18,497.2	17,268.9
Size (tons)	Size	0	1.5	1.4
Latent Load (inf) (Btu/h)	LatentI	0	0.0	0.0
Latent Load (occ) (Btu/h)	LatentO	0	460.0	460.0
Latent Load (tot) (Btu/h)	LatentT	0	460.0	460.0
Total Load (Btu/h)	Total	0	18,957.2	17,728.9
Size (tons)	Size	0	1.6	1.5

Reports – The Reports drop-down field on the Audit Dock is used to select two reports associated with the NEAT audit (attached below). The Audit Input report provides a printout of all the inputs made in NEAT. The Audit Recommendations report provides the NEAT Recommended Measures Report for the most recent run of the audit (equivalent to the View link).



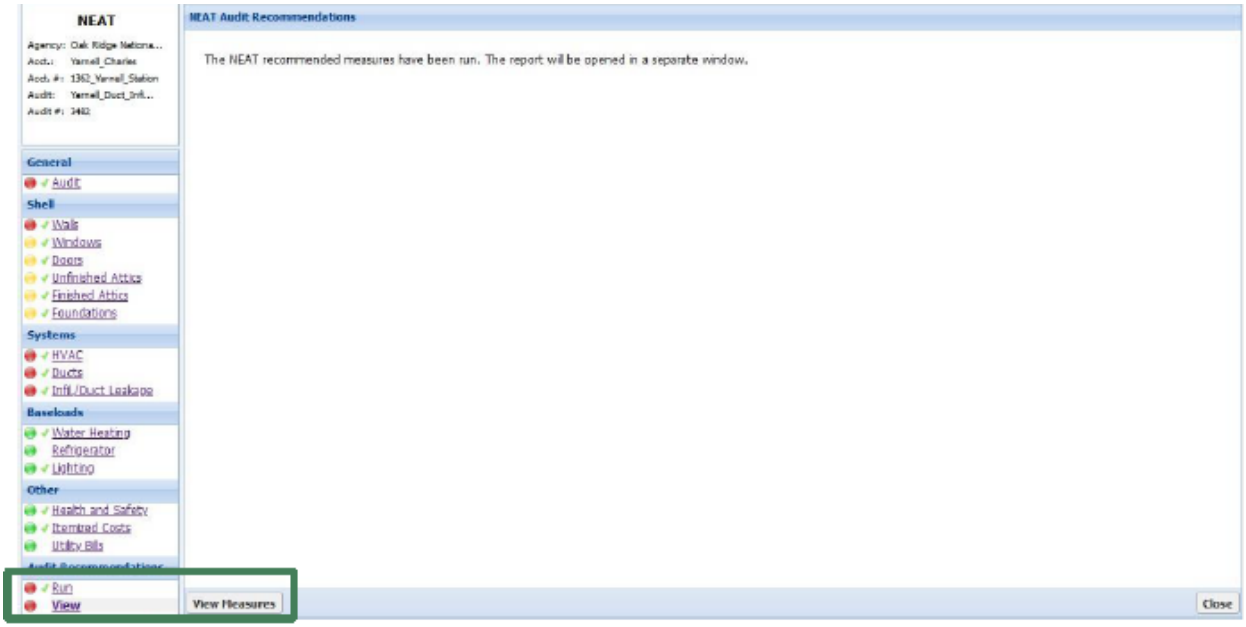
* A copy of the Audit Input Report and Recommended Measures Report must be uploaded to empowOR and retained for each weatherization job.

12.12 CREATING A NEAT WORK ORDER

At the time of this publication, a NEAT work order is required for all weatherization jobs in Michigan. This work order will be used to import data into the empowOR Weatherization module. A work order is typically created for the measures recommended by running an audit. To create a work order for a previously run NEAT audit, select View at the bottom of the Audit Dock. This will open the Recommended Measures Report in a separate window. Switch to the Weatherization Assistant window and select the View Measures button on the task bar at the bottom of the NEAT Audit Recommendations window (Figure 2.10) to open the Audit Run Measures form. All work-orders must have a detailed explanation of work performed and reference most stringent SWS, MI-WX field guide, or ICC codes.

The Michigan Weatherization Assistance Program requires that all work orders accurately reflect and integrate the results of the completed energy audit in accordance with 10 CFR 440.21(f)(6) and WPN 22-4. Work orders must clearly document all performance and installation requirements identified by the audit, including specified R-values, U-values, installed equipment efficiency ratings, infiltration and duct-sealing targets, and all standards outlined in the Grantee's DOE-approved Field Guides and/or Standard Work Specifications. Each work order must demonstrate a complete and accurate scope of work derived from the audit, provide sufficient detail for crews and contractors to meet required performance objectives, and support verification through quality control inspections and monitoring.

Figure 2.10. NEAT audit showing View and View Measures.



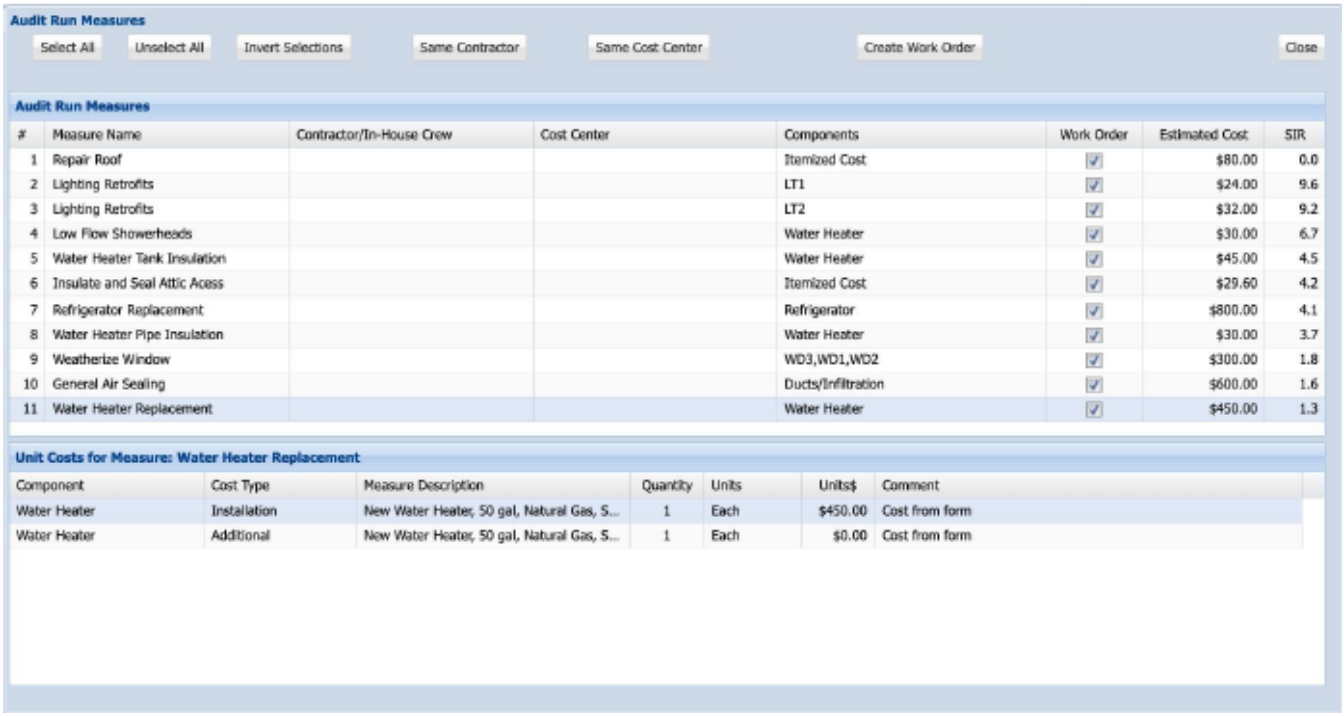
The Audit Run Measures form (Figure 2.11) displays seven buttons at the top, the Audit Run Measures sub-form in the middle, and the Unit Costs for Measure: [Measure Name] table at the bottom. The Select All, Unselect All, Invert Selections, Same Contractor, and Same Cost Center buttons help users complete the Audit Run Measures sub-form quickly. The Create Work Order button creates work orders based on information provided in the Audit Run Measures sub-form. The Close button exits the form.

The Audit Run Measures sub-form displays (a) un-editable fields under columns # (that reflect the order in which measures appear on the Recommended Measures Report), Measure Name, Components (that show the name of component[s] associated with the measure), and Estimated Cost and SIR (that display the measure cost and SIR used by the audits to make their initial recommendations); (b) drop-down fields under Contractor/In-House Crew and Cost Center columns, which allow you to assign each measure to a contractor and the cost of implementing each measure to a funding source or program, respectively; and (c) checkboxes under the Work Order column to indicate which measure to transfer to the work orders.

The Unit Costs for Measure: [Measure Name] table shows a breakdown of Estimated Cost for a measure selected in the Audit Run Measures sub-form. For a selected measure, the table lists as many cost types as were defined in the Retrofit Cost Details or Defined Measures library forms and in various building description forms. For

each cost type, Measure Description, Quantity, Unit, Units $ (i.e., cost per unit), and Comment specifying the source form for the cost per unit are displayed.

Figure 2.11. Audit Run Measures form.



To create work orders, you must select the checkbox under the Work Order column for each measure you want transferred to a work order. This work order is used to import the Recommended Measures Report into empowOR. As a result, all measures must remain checked to ensure they appear on the work order in WAweb.

You may select a Contractor/In-House Crew to assign each measure to a contractor. The selection will determine how many work orders are created from the measure list. All measures assigned the same contractor will be included in the same work order. The choices displayed in the drop-down list will be all agency contacts defined as Contractor or Crew on the Agency Contact form. All measures with an unassigned Contractor that are selected for transfer to a work order will be assigned to the same work order with the contractor undesignated. After assigning one measure to a contractor, you may use the Same Contractor button to assign all additional measures to that contractor.

Although WAweb supports cost center functionality, BCAEO will not utilize this feature

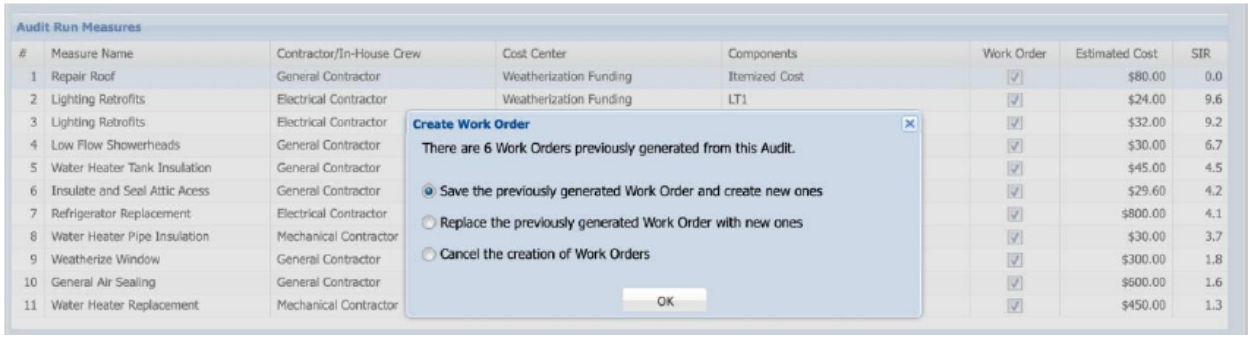
within WAweb. Expenses will instead be tracked by funding source in empowOR.

When you are ready to create the work orders based on the information provided on the Audit Run Measures sub-form, select the Create Work Order button. If you have previously created work orders from this specific audit, the Create Work Order pop-up form (Figure 2.12) will be displayed and will ask your preference among three options:

- Save the previously generated Work Order and create new ones
- Replace the previously generated Work Order with new ones, or
- Cancel the creation of Work Orders.

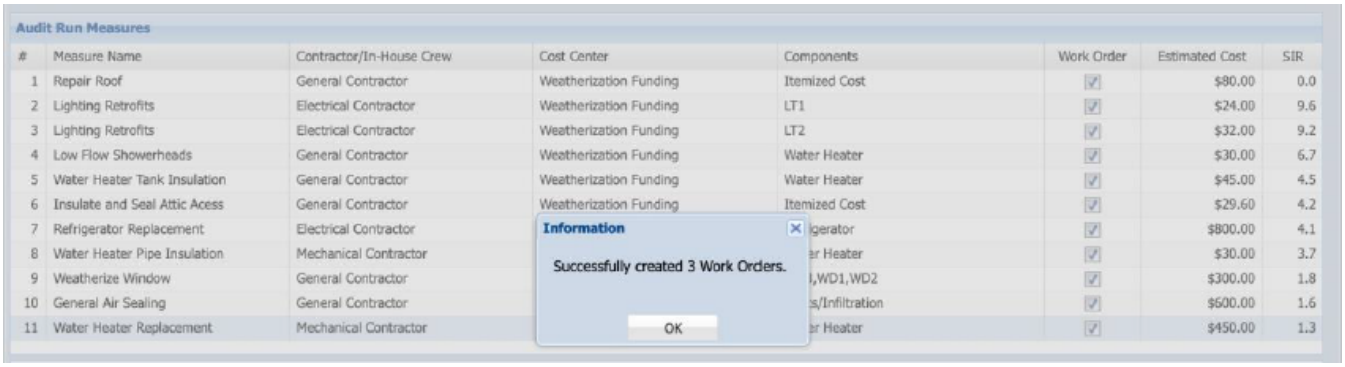
Select an option and then select OK to save and close the pop-up form. Any work orders not created from this audit will be unaffected by the request to create work orders from the Audit Run Measures form of this audit. Although multiple work orders can be created, only one work order may be imported into empowOR. Therefore, only a single work order should be generated for each client.

Figure 2.12. Create Work Order pop-up form.



The program will next display the Information pop-up window (Figure 2.13) indicating how many work orders were created because of your selections on the Audit Run Measures sub-form. This should correspond to the number of unique contractors (including undesignated) that you indicated on the Audit Run Measures sub-form. Select OK to acknowledge and close the pop-up window. Select Close to exit the Audit Run Measures form.

Figure 2.13. Information pop-up window for successfully created work orders.



After creating work orders from the audit recommendations, you may access them from the All table on the Work Order Details form (Figure 2.14) and view measure details on the Work Order Measures form (Figure 2.15). See Section 1.8 for information about making changes to a work order or measure details.

Figure 2.14. Work orders created for a NEAT audit.

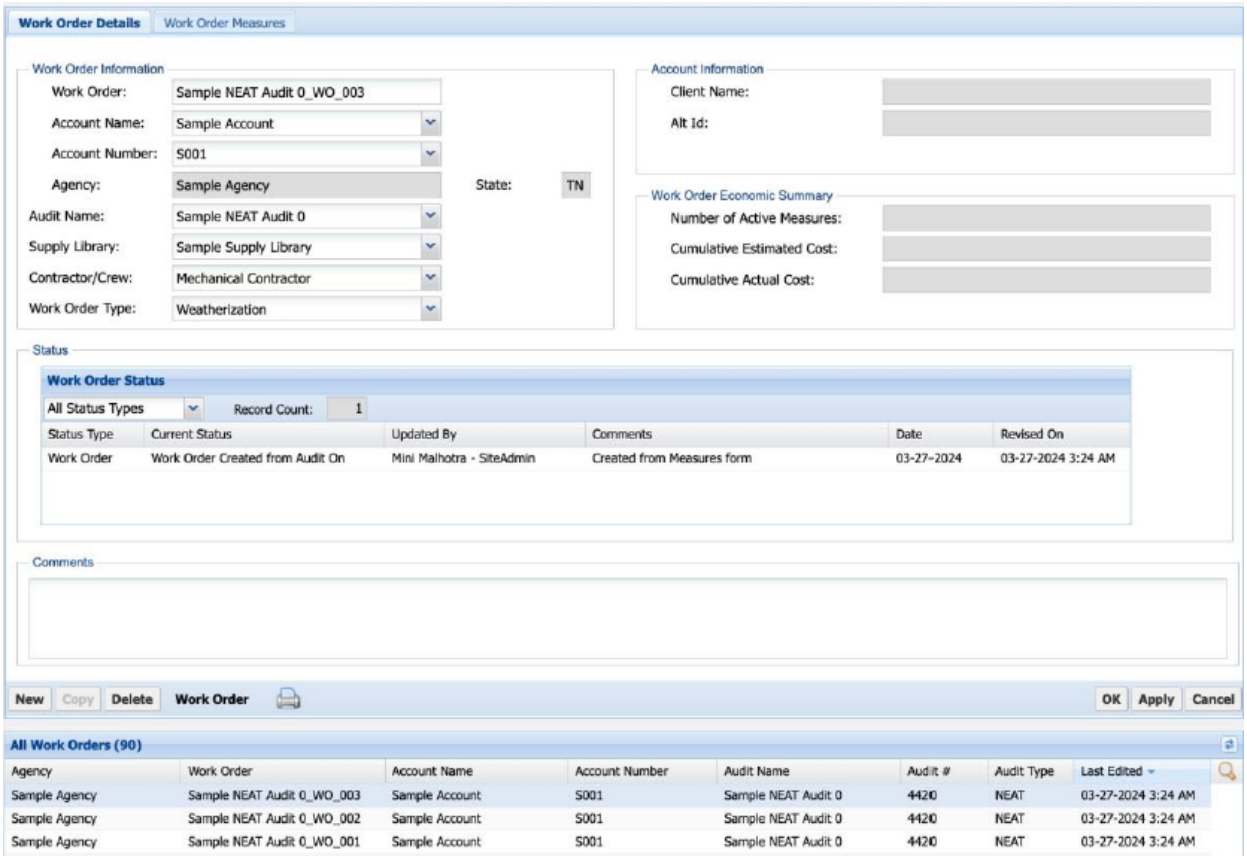
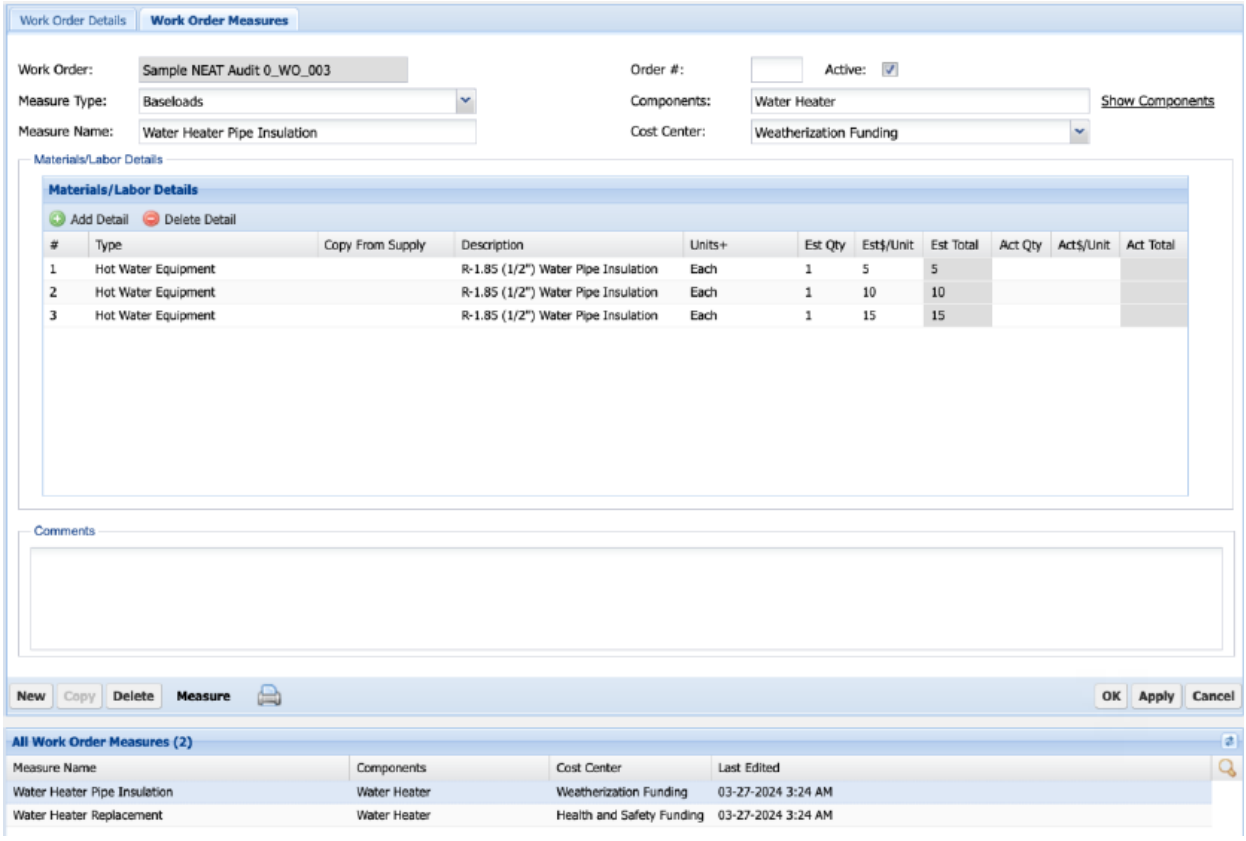


Figure 2.15. Work order measure details for a NEAT measure.



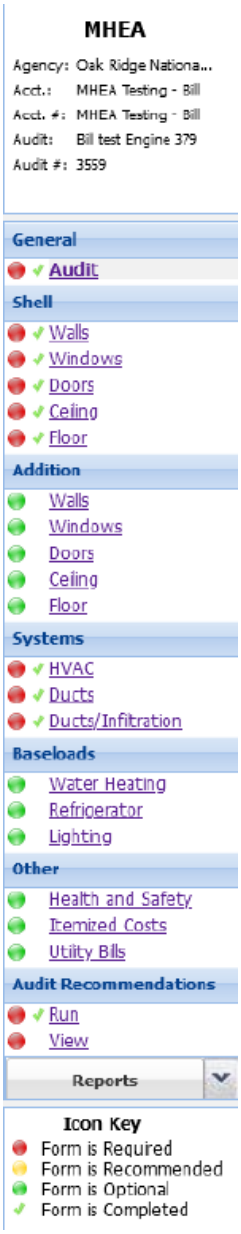
12.13 MHEA

Once you have set up an account for a manufactured home, you can create and run MHEA on that home. MHEA has multiple forms used to describe a manufactured home with each having a main form for data input and possibly an All table for record navigation (Section 1.3). MHEA also has an Audit Dock that is a static feature anchored on the left of each MHEA input form (Figure 3.1) and provides the means of accessing MHEA's various forms and running the audit. The Audit Dock may not be displayed when creating a new audit until after the Audit form has been saved.

At the top of the Audit Dock is an information block that shows key audit information entered on the Audit form for the audit that is currently active (i.e., being viewed). Links to each of MHEA's 20 data input forms used to describe the house are provided below the information block. These links are organized into six groups: General, Shell, Addition, Systems, Baseloads, and Other. Colored icons are presented beside these links to indicate if the form is required, recommended, or optional, and if the form has

been completed. A legend for the icons is shown in the Icon Key at the bottom of the Audit Dock. Links are provided in an Audit Recommendations group to run MHEA or view results of the last run for that audit. Finally, Reports can be selected to access various reports available within MHEA for the audit being viewed.

Figure 3.1. MHEA Audit Dock.



Some of the data input forms in MHEA allow multiple records to be described for a building component. For example, in Figure 3.2, multiple windows are entered on the Window form. These forms have New and Copy options to create multiple records. For each record, a tab named by the user-entered Code is created at the top of the form. The All table presented at the bottom of each of these forms lists these records (i.e., the tabs) (Figure 3.3).

To complete one of the 20 MHEA data input forms, simply select the form in the Audit Dock and then complete the form. Select Apply to save and remain on the form or OK to save and exit the form. Select Cancel to exit the form without saving the entries that you just made. Select New or Copy (if applicable) to create additional records. The completed records will be listed in the All table.

To view or edit an existing record, select the tab or the record in the All table. On most of the Shell, Addition, Systems, and Baseloads forms, field sets on the left part of the main form describe a selected component of the existing building. A field set on the right of the main form describes retrofit measure technical details for the component. In some cases, the retrofit measure field sets can be used to directly enter the total costs associated with the measure because it cannot be described in the Measure Cost Set Library. In other cases, the retrofit measure field sets can be used to enter an Additional Cost associated with installing the measure that will be added to the cost calculated from the Measure Cost Set Library.

Figure 3.2. Tabs on MHEA's Window form.

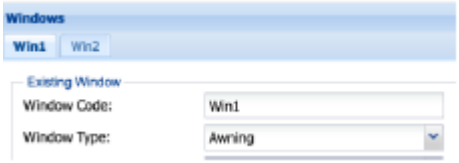


Figure 3.3. All Windows table on MHEA's Window form.



MHEA will evaluate all retrofit measures that are indicated as being active in the Measure Cost Set Library and applicable to the home. However, some of the data input forms in MHEA provide the option to evaluate only certain measures for a

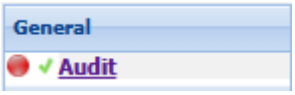
building component, which will exclude evaluation of other active measures for that component. In that case, MHEA also provides an option to include the energy savings and cost of the measure in calculating the package SIR. Measures where “Required” is selected, but not included in the package SIR are normally related to health and safety or are measures funded by a source other than the Weatherization Assistance Program.

12.14 DESCRIBING A MANUFACTURED HOME IN MHEA

All data entered into the MHEA software shall be provided using the UDCT provided by BCAEO to all subgrantees. Only the UDCT provided by BCAEO has been approved for use of data collection. To create a new MHEA audit, select Audit → MHEA on the menu bar and then select New on the Audit form (State Administrators and Guests are not allowed to create an audit). Select Copy to create a new audit from an existing audit. You may want to create a new audit using Copy to make multiple audit runs for a home (e.g., to evaluate different retrofit options or replacement equipment for a given home) but still see the results of previous runs. When creating a new audit using New, fill in the Audit form first before entering information on the other forms.

Each of MHEA’s input forms are described briefly here. Section 3.2 describes how to run MHEA.

General:

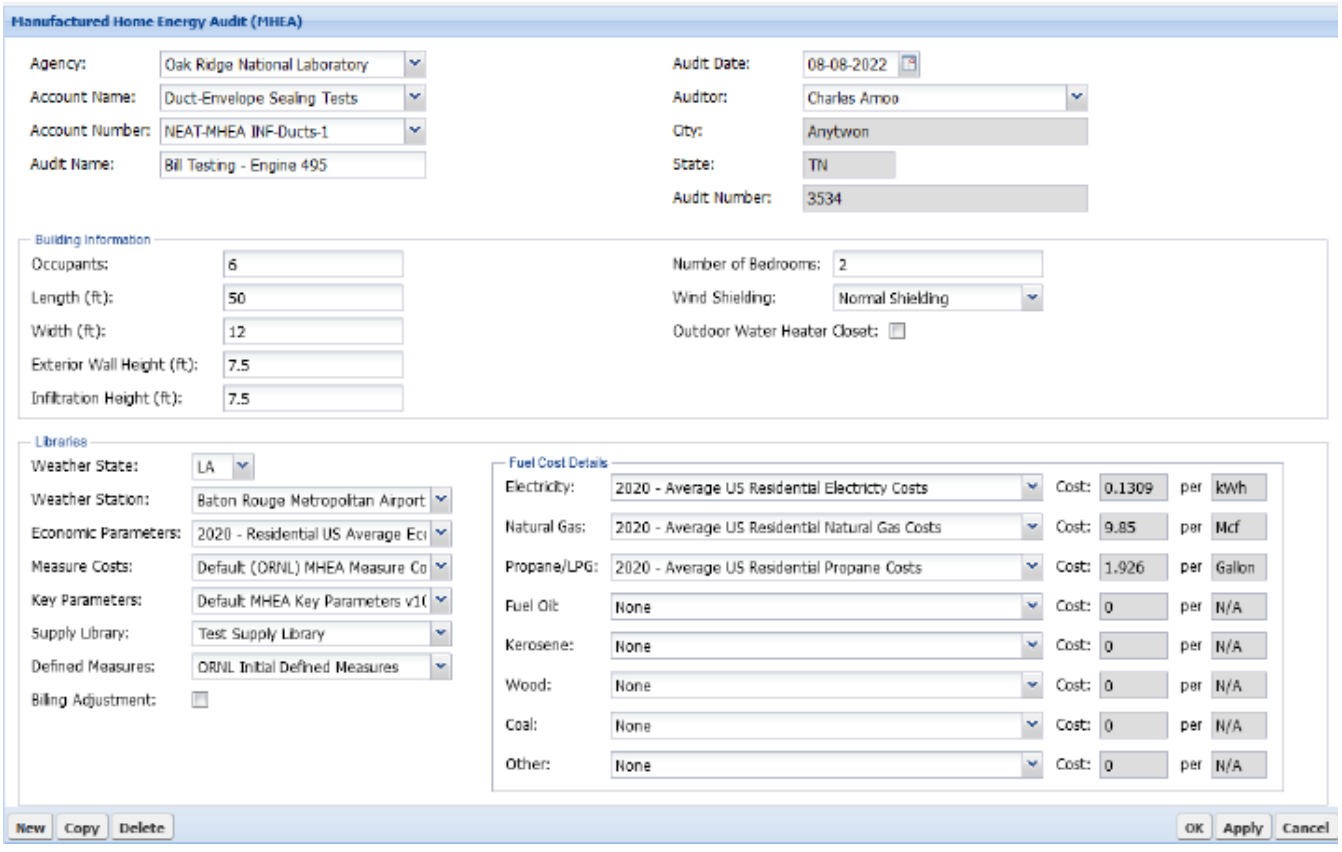


Audit form (required) – The Audit form is used to enter general audit information and select weather files and libraries needed to run the audit (Figure 3.4). All the fields on this form that are not disabled or read-only are required.

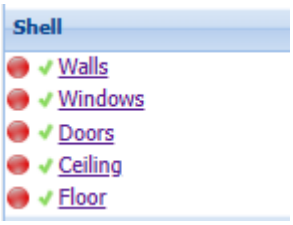
At the top of the form, select your Agency and then select the account using either the Account Name or Account Number field (the other data field will be auto-filled using information from the Account form). Enter an Audit Name and the Audit Date, and then select the Auditor Name (auditor names provided in the drop-down list will include all users for the Agency that are marked as Active and Auditor on the User form). The City and State fields will be auto-filled using information from the Account form. The Audit Number will be automatically assigned by MHEA. Next, enter the building information: Occupants, Length & Width(not including additions which will be entered in the additions tab of MHEA), Exterior Wall Height (height of exterior wall), Infiltration Height (height from floor to highest peak in ceiling on the interior of the

mobile home), Number of Bedrooms, Wind Shielding, and the presence of Outdoor Water Heater Closet. Then, select the Weather State, Weather Location, and the following libraries: Economic Parameter Set, Measure Cost, Key Parameter Set, Supply, Defined Measure Set, and Fuel Cost for each fuel type. MHEA has 1,000+ US weather stations, which are filtered by weather state. You may also consider cities near you in states that border your own. The libraries listed in the drop-down lists are restricted to those that have been created in the respective libraries for this agency and marked Active for MHEA. For the Fuel Cost, you can select None for fuel types that will not be used in the audit except for electricity. The fuel costs associated with the selected Fuel Cost names will be auto-filled. Finally, for MHEA to adjust energy savings estimates and recommend measures based on the actual pre-weatherization energy consumption of the home, select the Billing Adjustment checkbox.

Figure 3.4. MHEA Audit form.

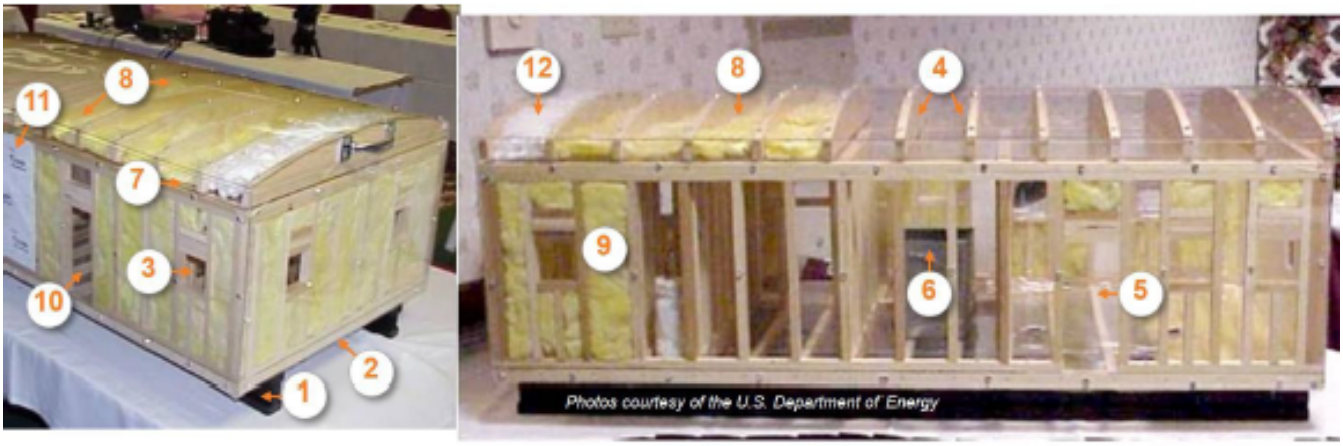


Shell:



Shell forms are used to describe the walls, windows, doors, ceiling, and floor of a manufactured home. Use these forms to describe all the shell components in the home that define thermal boundary (as illustrated in Figure 3.5), select retrofit options, and describe any additional costs associated with the installation of the retrofit unique to the home being audited that is not described in the Measure Cost Set Library. Each of the shell forms is required.

Figure 3.5. Typical mobile home components.



1. Main beam
2. Band joist
3. Rough window opening
4. Bowstring trusses
5. Floor joists
6. Heating/AC duct
7. Top plate
8. Ceiling joist cavity
9. Wall section
10. Rough door opening
11. Vapor barrier
12. Blown-in insulation

The **Wall form** (required) is used to describe the four primary walls of the home that enclose the conditioned space of the home. MHEA assumes that a manufactured

home is rectangular in shape, the walls are wood-frame construction, and the walls facing different orientations have identical construction characteristics; therefore, MHEA uses only one form to describe all four primary walls (not including any addition that will be described on the addition tab of MHEA). Wall insulation is a major measure that must always be evaluated and never skipped.

The **Window and Door forms** (required) are used to describe all the windows and exterior doors of the home (not including any addition that will be described on the addition tab of MHEA). The number of each type of window or door entered is entered by its orientation.

The **Ceiling form** (required) is used to describe the ceiling (i.e., the roof) in the home (not including any addition that will be described on the addition tab of MHEA).To describe a roof, you must first select the roof type from the following options: Flat, Bowstring, and Pitched (Figure 3.6), enter the joist size for flat roofs, height of roof at center for bowstring roofs, or desired amount of insulation to add at center for pitched roofs (Figure 3.7); select the roof color; and describe the cathedral ceiling if one exists (see Figure 3.8 and Figure 3.9 for different cathedral ceiling configurations). Attic insulation is a major measure that must always be evaluated and never skipped.

Figure 3.6. Typical manufactured home roof configurations.



Figure 3.7. Section drawings of manufactured home roof configurations (from top to bottom: flat roof, bowstring roof, pitched roof).

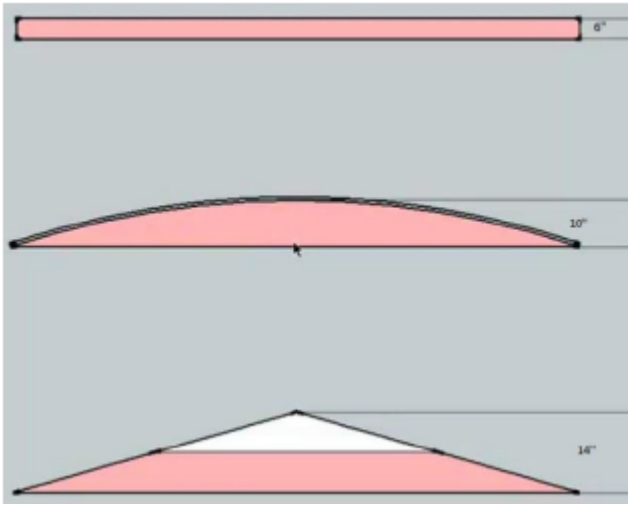


Figure 3.8. Sloped roof cathedral ceiling with step wall, typical with flat roofs.

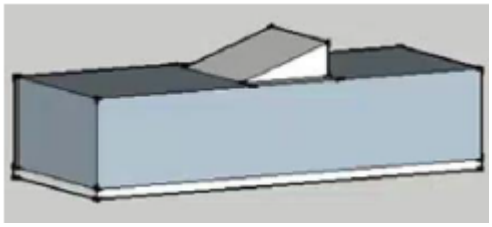
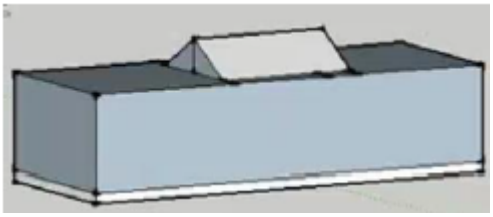


Figure 3.9. Cathedral ceiling configurations with no step wall, typical with pitched roofs.



The **Floor form** (required) is used to describe the floor of the home, defined in MHEA to comprise wing and belly sections (Figure 3.10) (not including any addition that will be described on the addition tab of MHEA). The wing and belly sections are protected from outside elements (including water, wind, and rodents) using an insulation wrap attached to the underside of the floor joists. The space available for adding insulation

depends on the direction and size of the floor joists, the location and thickness of the existing insulation in the wing and belly sections, and the belly cavity configuration (Figure 3.11). The manufactured home may also have skirting installed around the perimeter. Floor/belly insulation is a major measure that must always be evaluated and never skipped.

Figure 3.10. Widthwise floor joist direction.

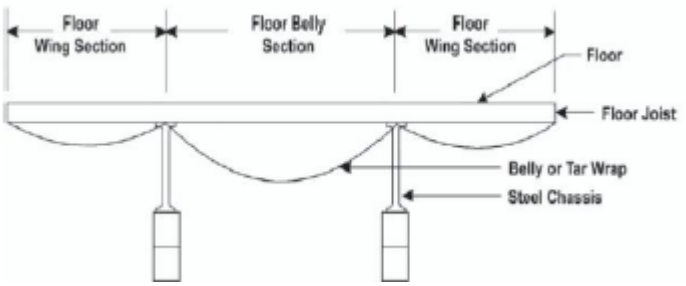


Figure 3.11. Typical manufactured home belly configurations.

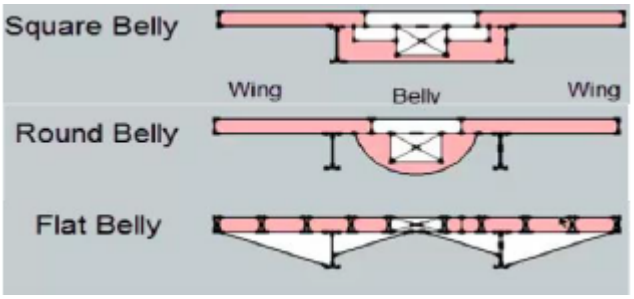
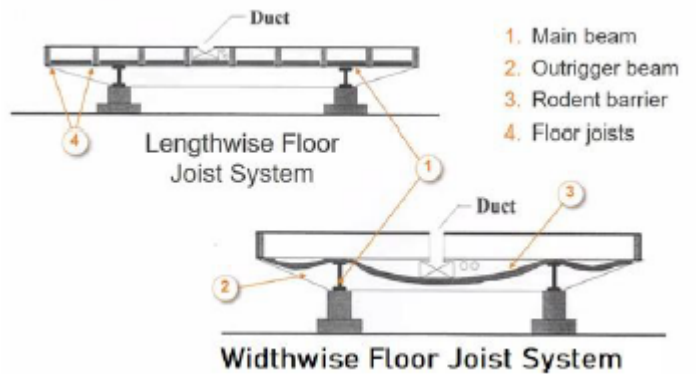


Figure 3.12. Manufactured homes joist spacing and direction.

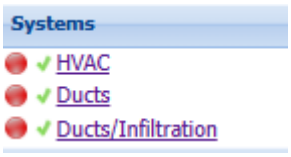


Addition:



Addition forms are used to describe the walls, windows, exterior doors, ceiling, and floor of a conditioned room attached to the manufactured home. MHEA assumes that the manufactured home addition is rectangular in shape with wood-frame construction and has three exposed walls, a flat, shed or gable roof, and a crawlspace, slab on grade, or exposed floor (see Figure 3.13, Figure 3.14, and Figure 3.15). Use these forms to describe all the shell components in the addition through which heat flows, select retrofit options, and describe any additional costs associated with the installation of the retrofit unique to the house being audited that are not described in the Measure Cost Set Library. If there is no addition, you do not need to access the addition forms. However, if entry is begun on any one of the addition forms, then the **Walls form, Ceiling form**, and **Floor form** must be completed. The **Window** and **Door forms** are optional. Wall, attic, and floor/belly insulation is a major measure that must always be evaluated and never skipped.

Systems:



Systems forms are used to describe the HVAC systems, ducts, and duct leakage and infiltration associated with a manufactured home. You must enter one heating system and enter infiltration data on the Ducts/Infiltration form to meet the minimum requirements of MHEA. The remaining forms are optional unless deemed required based on other inputs. For example, the Duct form may be required depending on HVAC entries. The selections made in the HVAC form, especially with regard to heating, will determine whether the duct form remains optional or becomes required. In most homes, though, both heating and cooling systems will be entered on the HVAC form.

The **HVAC form** (required) is used to describe the heating and cooling equipment installed in the house and select retrofit options. In MHEA, you can describe as many HVAC systems as required to describe the heating and cooling sources in the house.

All equipment that provides heating and / or cooling must be described in this form. At least one HVAC system that provides heating must be described in this form. The selected equipment may provide either heating or cooling or both. To describe an HVAC system, first enter the equipment type (and fuel source if heating-only equipment) and then enter the data collected through proper manual testing for each appliance depending on fuel source in the applicable fields. SSE shall be used when manually testing in the field for gas fired appliances if different from AFUE ratings. If SSE readings cannot be obtained, then AFUE ratings at original rated efficiency are acceptable to use. Inputs related to equipment type and fuel source will filter out other necessary inputs, as well as retrofit options that will be available for evaluation. For example, choosing a central heat pump will disenable the retrofit option for installing a smart thermostat, and selecting a space heater will disenable tune up as a retrofit option. The Replace the Equipment retrofit option is always enabled for possible selection and is used to specify if the measure replaces one or more existing HVAC systems described in other HVAC sub-forms. Replacement required selection procedure is the same process as outlined in the HVAC form section in NEAT.

Unlike in Weatherization Assistant Version 8, heating/cooling equipment inputs are not limited to primary and secondary systems. Each type of existing heating and/or cooling equipment in the home may be entered as separate records. Weatherization Assistant Version 10 determines the primary system based on the Fraction of Load Served value that is either input or estimated by the software. Inputs made on any optional forms (e.g., other field measurements or health and safety observations) are informational only and are not used in running the audit analysis.

We recommend modeling the Year Manufactured rather than the Name Plate Efficiency for all air conditioners and heat pumps. This approach reduces the risk of entering an incorrect efficiency value, and WAweb will automatically apply age-based derating.

Note: The Year Manufactured field is available only for appliances modeled as air conditioners or heat pumps.

The **Duct form** (conditionally required) is used to describe the supply and return ducts for ducted HVAC equipment. A duct system with varying characteristics (e.g., location, insulation) must be described as multiple segments. All ducted HVAC equipment must be selected as served by at least one supply duct. All supply and return ducts shall be considered for modeling and properly entered in the software in their current condition. Default methods can be used for surface area, or manual entry is allowed if proper measurements of width, height, and length (or diameter) are entered. To evaluate for duct insulation, you must enter the measured duct surface area and insulation R-value.

If sufficient details relating to duct size and/or surface area and insulation R-value are unknown, then Weatherization Assistant Version 10 can estimate the values. To calculate these estimates and view the results, select the Use Defaults checkbox (Figure 3.16). To edit the values, clear the Use Defaults checkbox and input other values. Select Apply or OK to save the inputs. Figure 3.17 shows the typical furnace and duct system layout in a mobile home.

Figure 3.16. Use Defaults checkbox selected.

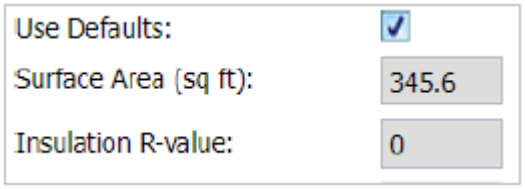
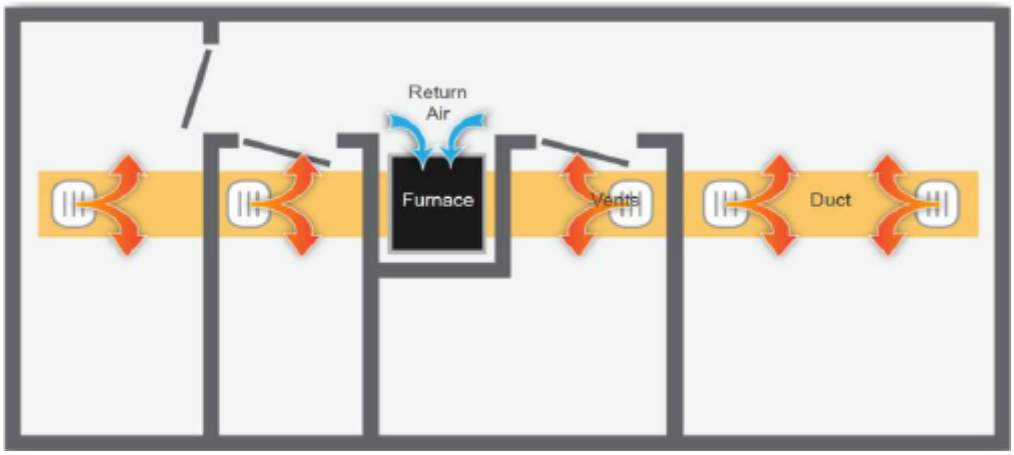


Figure 3.17. Typical furnace and duct system layout in a mobile home.

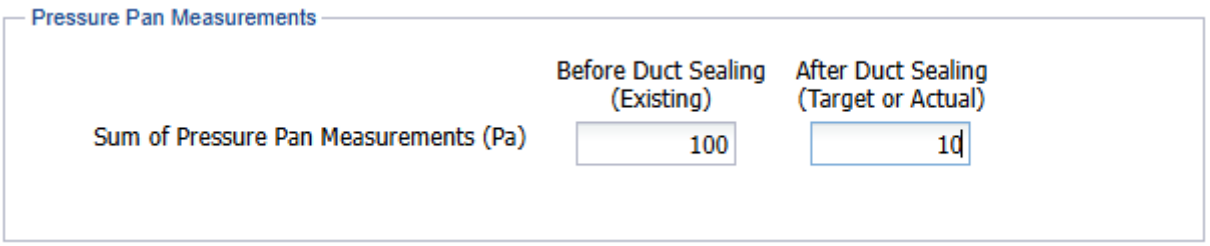


The **Ducts/Infiltration form** (required) is used to enter air and duct leakage data to evaluate the effectiveness of infiltration reduction work and duct sealing.

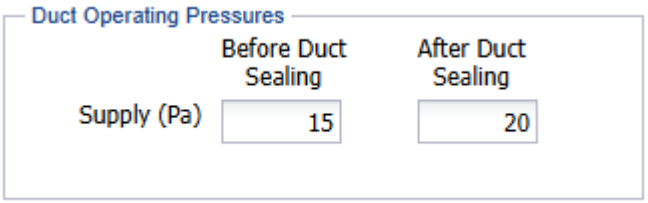
Pressure pan measurements are required to be taken for all ducts outside of the pressure and thermal boundary. If the initial pressure pan reading is above 1 PA on any duct outside the conditioned space duct sealing must be evaluated.

If the SIR for Duct Sealing is below 1.0, the ECM will still populate on the work order and should be treated as part of the general air-sealing package rather than as a standalone measure. In these cases, the auditor is responsible for ensuring that the cumulative SIR for the entire job remains at or above 1.0.

- **Pressure Pan Measurements:**
  To evaluate duct sealing using pressure pan measurements duct leakage method, start by running the blower door and obtaining a before weatherization air leakage rate (cfm). The target after weatherization air leakage rate shall be in accordance with section 11.0. Measurements using a pressure pan must be obtained on all supply ducts in the system. The sum of the pressure pan measurements must be entered in the 'Before Duct Sealing' section. The 'After Duct Sealing' target should be 1 pascal per register.



  I.E 10 registers equals 10 pascals. Duct operating pressures for supply ducts should be set to 5 Pa above the system's measured operating pressure before duct sealing. The duct operating pressure should be obtained using a static pressure probe and should traditionally be around 15 pascals in standard mobile home ductwork.



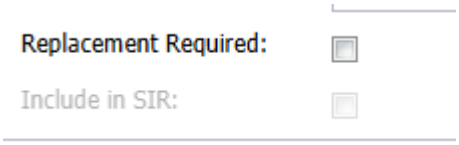
- **Duct Blower Measurements:**
  Pre duct operating pressure shall be obtained by switching on the air handler and using a pressure pan to obtain readings from both supply and return ducts. When only one (1) central return exists, DO NOT COVER WITH PRESSURE PAN. Place 2-3 inches of the hose in the return at the filter grill. Target duct operating pressures shall be 5pa greater than measured operating pressure. To evaluate infiltration reduction as a retrofit measure, you must, at a minimum, enter the pre-weatherization whole-house air leakage rate (usually measured), an estimated or target leakage rate after weatherization, house pressure differences for these rates, and the cost of the infiltration/duct sealing work.
  A recommended method for duct infiltration values is: 8% of total floor area for Leakage to Outside, & 12% of total floor area for Total Leakage.

Baseloads:



Baseloads forms are used to describe water heating retrofits, refrigerator replacement, and lighting retrofits. These forms are optional and are used to evaluate specific retrofit measures.

The **Water Heating form** is used to enter information necessary to evaluate for water heater replacement. You may describe the existing water heater by selecting from the list of manufacturer and model number, which will autofill the energy use characteristics of the water heater, or by directly entering the data on the form collected from the manufacturer's data plate. To evaluate a water heater replacement, you may either select a water heater you have already described in the Supply Library, which will autofill the data, or directly enter the data on the form from the manufacturer's data plate. If SIR is not checked it will be considered an H&S measure. H&S Water Heater replacements must not have SIR checked.
* Optional measures include: tank insulation, pipe insulation, low-flow showerheads (See section 9.0 of this guide).



If the Energy Factor (EF) for a water heater cannot be located through the manufacturer’s label, documentation, or recognized equipment databases, the reference table in Appendix B may be used to estimate the unit’s EF based on fuel type and year of manufacture.

If the year of manufacture cannot be determined, the highest Energy Factor listed for that fuel type must be used to ensure the most conservative and compliant estimate, See Appendix B.

The **Refrigerator form** is used to enter information necessary to evaluate a refrigerator replacement. Here, you may specify the energy use characteristics of the existing and replacement refrigerators. For the existing refrigerator, you may either select from the list of manufacturer's and model numbers, which will autofill the energy use characteristics of the refrigerator, or directly enter the data on the form. For the replacement refrigerator, you may either select a refrigerator you have already

described in the Supply Library, which will autofill the data, or directly enter the data on the form. Refrigerator replacement process is outlined in the refrigerator form in the NEAT section.

The **Lighting form** is used to describe lamp replacement retrofits. You may specify the quantity, usage, and energy use characteristics of the existing and replacement lighting and cost of the replacement lighting. For the existing and/or replacement lighting, you may either select lighting you have already described in the Supply Library, which will autofill the energy and cost data, or directly enter the data on the form. All lighting retrofits are required by BCAEO to be LED and energy star rated.

Other:



Other forms can be used to describe health and safety observations in the home; repair or health and safety measures or your own energy measure; and utility bills.

The **Health and Safety form** can be used to enter health and safety measurements and observations that you have made of the house. This form will assist in determining ventilation requirements to comply with ASHRAE Standard 62.2 2016.

The **Itemized Costs form** can be used to enter necessary repair and health and safety measures and their associated costs. Refer to the Itemized Cost Form for NEAT to see how to enter material and labor cost for an Incidental Repair Measure (IRM).

The **Utility Bills form** (optional) can be used to enter pre-retrofit utility bills associated with heating and cooling if you want MHEA to compare them with MHEA's heating and cooling energy consumption estimates as part of an audit calibration process and adjust energy savings estimates for the recommended measures. For MHEA to adjust its energy savings estimates and develop a second set of recommended weatherization measures based on the actual pre-weatherization energy consumption of the home, select the Billing Adjustment checkbox. Comparison of the predicted base case energy use against utility bills is more appropriate for metered fuels, such as natural gas and electricity. Bulk fuels such as propane, fuel oil, and kerosene, which are delivered in bulk and stored in tanks at the home, are less appropriate. Unless deliveries are relatively frequent and approximately the same amount of fuel remains in the tank at the time of each delivery, use of billing data for these fuels can lead to substantial inaccuracy.

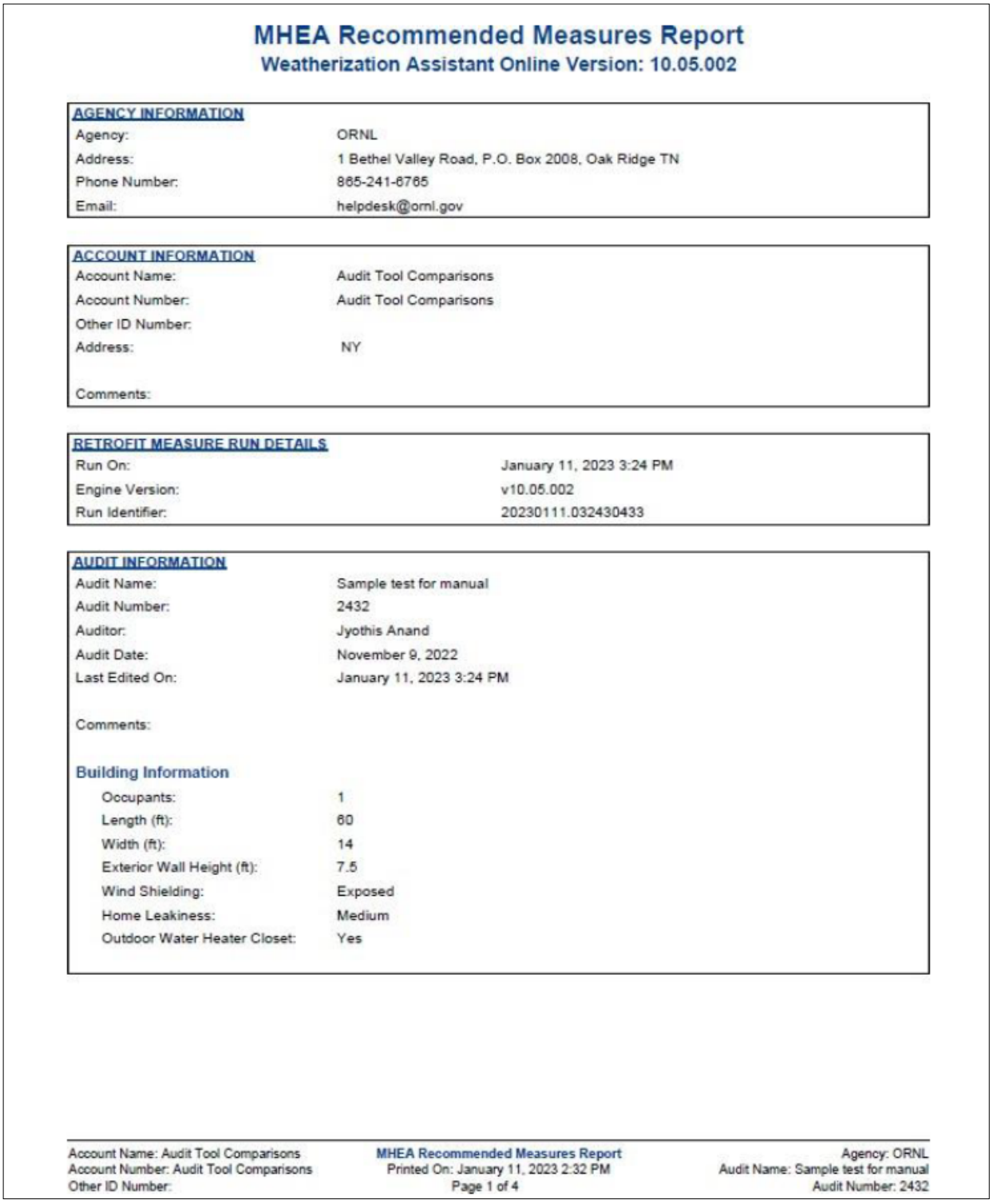
The Michigan WAP does not require pre-retrofit utility bill comparison within the MHEA when justified fuel costs are used.

12.15 RUNNING MHEA AND VIEWING RESULTS

Audit recommendations – You can Run MHEA after you have entered all the information for the home on the data input forms. The Run on the Audit Dock link will be activated as soon as all the required data input forms have been completed. When you select Run, the status of the run will be displayed, and the Recommended Measures Report will be opened in a separate window. Once an audit has been run, the link to View will be activated. You can select View to see a MHEA Recommended Measures Report that has already been created and saved from a previous run.

Figure 3.18 shows the title page of the MHEA Recommended Measures Report. The title page identifies your Agency, Account, Audit, and Audit Run; provides key information you have entered on the Agency, Account, and Audit forms; and provides additional information about the audit run to track the audit results. After the title page, the report lists all the recommended measures along with their estimated energy and cost savings, measure costs and SIRs, and primary material quantities needed to perform them (Figure 3.19).

Figure 3.18. MHEA Recommended Measures Report: title page.



MHEA Recommended Measures Report

Weatherization Assistant Online Version: 10.05.002

AGENCY INFORMATION

Agency:	ORNL
Address:	1 Bethel Valley Road, P.O. Box 2008, Oak Ridge TN
Phone Number:	865-241-6765
Email:	helpdesk@ornl.gov

ACCOUNT INFORMATION

Account Name:	Audit Tool Comparisons
Account Number:	Audit Tool Comparisons
Other ID Number:	
Address:	NY
Comments:	

RETROFIT MEASURE RUN DETAILS

Run On:	January 11, 2023 3:24 PM
Engine Version:	v10.05.002
Run Identifier:	20230111.032430433

AUDIT INFORMATION

Audit Name:	Sample test for manual
Audit Number:	2432
Auditor:	Jyothis Anand
Audit Date:	November 9, 2022
Last Edited On:	January 11, 2023 3:24 PM
Comments:	

Building Information

Occupants:	1
Length (ft):	60
Width (ft):	14
Exterior Wall Height (ft):	7.5
Wind Shielding:	Exposed
Home Leakiness:	Medium
Outdoor Water Heater Closet:	Yes

Figure 3.19. MHEA Recommended Measures Report: recommended measures.

Annual Energy and Cost Savings

Index	Recommended Measure	Components	Heating		Cooling		BaseLoad		Total	
			(MMBtu)	($)	(kWh)	($)	(kWh)	($)	(MMBtu)	($)
1	Low Flow Showerheads	Water Heating	0.0	$0	0	$0	256	$34	0.9	$34
2	Water Heater Pipe Insulation	Water Heating	0.0	$0	0	$0	159	$21	0.5	$21
3	Lighting Retrofits	L1	0.0	$0	0	$0	178	$23	0.6	$23
4	Water Heater Tank Insulation	Water Heating	0.0	$0	0	$0	230	$30	0.8	$30
5	General Air Sealing	Ducts/Infiltration	0.8	$50	16	$2	0	$0	0.8	$52
6	Roof Fiberglass Loose Insulation	Roof	1.1	$70	609	$80	0	$0	3.2	$149
7	Replace HVAC System	AC	5.7	$365	2,337	$306	0	$0	13.7	$671

Economics

Index	Recommended Measure	Components	Measure Savings ($/yr)	Measure Cost ($)	Measure SIR
Weatherization Measures					
1	Low Flow Showerheads	Water Heating	$34	$23	18.42
2	Water Heater Pipe Insulation	Water Heating	$21	$15	15.18
3	Lighting Retrofits	L1	$23	$30	11.96
4	Water Heater Tank Insulation	Water Heating	$30	$40	8.28
5	General Air Sealing	Ducts/Infiltration	$52	$101	4.47
6	Roof Fiberglass Loose Insulation	Roof	$149	$672	3.43
7	Replace HVAC System	AC	$671	$4,000	2.07
Health and Safety Measures or Other Funding Sources					
9	Smoke Detector is Needed	Itemized Cost	$0	$10	0.00
Total			$983	$5,109	2.54

Materials

Index	Material	Quantity	Units
1	Low Flow Showerheads	1	Each
2	Water Heater Pipe Insulation	1	Each
3	LED Lamp 10.0 watts	3	Each Bulb
4	Water Heater Tank Insulation Wrap	1	Each
5	General Air Sealing	1	Each
6	Roof Fiberglass Loose Insulation	16	Bag
7	Replace HVAC System	1	Each

If you entered utility bills on the Utility Bills form, the report would also provide a revised set of tables for the recommended measures based on adjusted estimates of energy and cost savings and SIRs, and a comparison of MHEA's estimates of the home's heating and/or cooling energy consumptions with the utility bills. MHEA's estimates are based on TMY3 weather data, whereas the utility bills reflect energy consumption for the actual weather that occurred during the billing period. If you also entered degree days associated with the utility bills, they will be compared with the TMY3 weather data used to make the home's energy estimates so that you can determine the degree to which differences between predicted energy consumptions

and utility bills might be due to weather differences.

The report also provides other information such as the annual energy consumption for heating, cooling, and baseloads and peak heating load of the home before and after weatherization (Figure 3.20).

Figure 3.20. MHEA Recommended Measures Report: energy consumptions and peak heating load components before and after weatherization.

House Energy Consumptions

	Before Weatherization			After Weatherization		
	Heating (MMBtu)	Cooling (kWh)	Baseload (kWh)	Heating (MMBtu)	Cooling (kWh)	Baseload (kWh)
Annual Energy	13.2	6,734.4	0.0	5.6	3,752.8	-2.8

Peak Heating Load

Component Type	Before Weatherization Load (Btu/h)	After Weatherization Load (Btu/h)
Wall	3,280.8	3,280.8
Floor	3,051.1	3,051.1
Roof	2,624.2	1,090.3
Windows	2,900.0	2,900.0
Doors	410.1	311.1
Infiltration	3,134.0	2,162.6
Duct Loss	0.0	0.0
Total	15,400.1	12,795.8

Reports – The Reports drop-down field on the Audit Dock can be used to select two reports associated with the MHEA audit (attached below). The Audit Input report provides a printout of all the input made in MHEA. The Audit Recommendations report provides the MHEA Recommended Measures Report for the most recent run of the audit (equivalent to the View link).



12.16 CREATING A MHEA WORK ORDER

The process for creating a MHEA work order is the same as for NEAT. Please refer to Section 12.12, CREATING A NEAT WORK ORDER, for details.

12.0 Energy Audit Software User Manual

If you have any questions regarding the auditing software please reach out to:

MDHHS-BCAEO@michigan.gov

13.0 Resources

ASHRAE 2016 Standard

Building Performance Institute | BPI 1200

Oak Ridge National Laboratory | ORNL Getting Started Guide for WAweb

Refrigerator Energy Usage Tool 1

Refrigerator Energy Usage Tool 2

Air-Conditioning, Heating, and Refrigeration Institute | AHRI product performance details

Michigan Training & Education Center | MiTEC

Standard Work Specifications | SWS

Community Services Policy Manual | CSPM

14.0 Appendices

Appendix A - Variances and Approved Audit Procedures

All weatherization materials used in conjunction with work performed under this program must, at a minimum, meet the NREL Standard Work Specifications and the Standards for Weatherization Materials outlined in 'Appendix A.' Appendix A Materials variances approved for use in the Michigan Weatherization Assistance Program are as follows:

- *Light Emitting Diode (LED) Lighting Approved 4/14/2019*
- *Spray Foam (SPF) Insulation Approved 4/14/2019*
- *Refrigerators (Energy Star) Approved 4/14/2019*
- *Replacement Water Heaters Approved 4/14/2019*

Per WPN 23-6, state-specific audit procedures must be reviewed and approved by DOE as part of the energy audit approval process. Michigan has received approval for the following:

- *SSE to AFUE Conversion for WAweb Approved 11/28/2018 & 9/2/2025*
- *Grantee Administered Fuel-Switching Approved 4/2/2020*
- *Lifespan Changes Approved 3/27/2019*
- *MH Belly Itemized Cost ECM Approved 2/19/2019*

Appendix B - Water Heater Energy Factor

Water Heater Energy Factor Chart

Year	Electric	Natural Gas	LPG	Fuel Oil
1972	0.798	0.474	0.474	0.54
1973	0.798	0.474	0.474	0.54
1974	0.798	0.474	0.474	0.54
1975	0.798	0.474	0.474	0.54
1976	0.799	0.475	0.475	0.54
1977	0.799	0.475	0.475	0.54
1978	0.8	0.476	0.476	0.54
1979	0.801	0.476	0.476	0.54
1980	0.802	0.477	0.477	0.54
1981	0.803	0.478	0.478	0.54
1982	0.804	0.479	0.479	0.54
1983	0.806	0.48	0.48	0.54
1984	0.809	0.481	0.481	0.54
1985	0.812	0.483	0.483	0.54
1986	0.815	0.484	0.484	0.54
1987	0.819	0.486	0.486	0.54
1988	0.823	0.488	0.488	0.54
1989	0.828	0.49	0.49	0.54
1990	0.832	0.492	0.492	0.59
1991	0.837	0.494	0.494	0.59
1992	0.842	0.496	0.496	0.59
1993	0.846	0.498	0.498	0.59
1994	0.85	0.499	0.499	0.59
1995	0.854	0.5	0.5	0.59
1996	0.857	0.501	0.501	0.59
1997	0.857	0.501	0.501	0.59
1998	0.857	0.501	0.501	0.59
1999	0.857	0.501	0.501	0.59
2000	0.857	0.501	0.501	0.59
2001	0.857	0.501	0.501	0.59
2002	0.857	0.501	0.501	0.59
2003	0.857	0.501	0.501	0.59
2004	0.9	0.55	0.55	0.59
2005	0.9	0.55	0.55	0.59