

NM Single Family Audit Procedures 2023

I. Modeling Software Analysis

A. Measures considered and enabled in the energy audit software are listed below.

Energy Saving Measure	Material Cost	Labor Cost	Lifetimes	SIR	
Attic Insulation (SIR Driven R-Value)	\$ 1,240.12	\$ 972.77	30	7.4	
Belly Insulation	\$ 308.15	\$ 220.17	20	2	
Cooler Covers	\$ 24.63	\$ 19.20	10	4.7	
DHW Pipe Insulation	\$ 10.27	\$ 23.23	13	6.5	
DHW Tank Insulation	\$ 50.95	\$ 33.92	13	10.6	
Door Replacement	\$ 247.67	\$ 45.60	20	4	
Duct Insulation	\$ 1,741.00	\$ 1,691.33	20	5.3	
Duct Sealing	\$ 64.85	\$ 51.93	10	4.9	
DWH Low Flow Shower Head	\$ 45.81	\$ 17.44	15	10.9	
Floor Insulation (RX R-value)	\$ 632.63	\$ 265.26	20	10	
Combustion Furnace Replacement (>95%)	\$ 2,359.45	\$ 280.92	20	1.5	
General air sealing	\$ 196.97	\$ 142.22	10	6.2	
Heat Pump	\$ 4,517.21	\$ 1,237.30	15	1	
Infiltration	\$ 186.04	\$ 126.99	10	5.	
LED (Per Unit)	\$ 39.18	\$ 23.58	10	21.5	
Low E Window	\$ 1,163.06	\$ 272.48	20	1.3	
Low Flow Shower Heads 1.5GPM	\$ 34.88	\$ 18.40	15	10.7	
Refrigerator Replacement	\$ 796.49	\$ 22.21	15	5.6	
Replacement Heater (not furnaces)	\$ 3,219.79	\$ 1,837.18	18	3	
Roof Insulation	\$ 707.28	\$ 258.35	20	8.2	
Seal Ducts	\$ 85.04	\$ 103.04	10	5.6	
Setback thermostat	\$ 56.29	\$ 21.22	15	1.8	
Smart Thermostat	\$ 734.77	\$ 544.07	15	3.6	
Wall Insulation	\$ 511.31	\$ 254.52	30	13.3	
Window Replacement	\$ 1,884.76	\$ 114.41	20	3.9	
Incidental Repairs Measure					
Flue correction for HVAC and water heaters, appliance venting		\$450	\$250	15	SWS/Codes
Electrical correction attic		\$200	\$350	15	SWS/Codes

Minor Structural Repair	\$250	\$75	20	To protect air sealing/insulation measures
Skirting	\$658	\$352	10	IR to belly insulation
Door Replacement	\$220	\$92	20	IR to air sealing
Other SWS Requirements	\$221	\$196	10	WPN 22-4
Health and Safety Measure				
AC Units	\$1,516.83	\$765	15	Compliance with WPN 22-4, 11-6, ASHRAE 62.2016, and SWS
Evaporative Coolers	\$1,965.48	\$905	15	
Combustion Furnace Replacement	\$2,481	\$444	20	
Heater Replacement (not furnaces)	\$1,507	\$656	18	
Water Heater Replacement	1,116	\$410	13	
Ventilation Fan (ASHRAE)	\$369	\$445	20	
Carbon Monoxide Alarm (each average of two per home)	\$70	\$23	10	
CO and Smoke Alarm Combo	\$44	\$28	10	
Smoke Alarms (each average of three per home)	\$51	\$24	10	
Furnace Tune Up	\$17	\$118	3	
Furnace Filter	\$24	\$15	2	
Heating System Tune Up	\$23	\$90	3	
Other Health and Safety	\$923	\$527	Varies	

B. Fuel Costs

Fuel costs for the energy modeling are obtained from [Energy Information Administration](#) and local suppliers. These costs are updated at a minimum of once a year and are averaged over the most recent 12-month period to obtain the most recent costs, prior to the commencement of the program year.

Fuel Costs as of 11/20/2023

Fuel	South Agency	North Agency
Propane	\$2.684 Gallon	\$3.02 Gallon
Natural Gas	\$12.51 Mcf	\$12.51 Mcf
Electricity	\$0.1411 kWh	\$0.1411 kWh
Wood	\$350 Cord	\$394 Cord

C. Discount Rate

This discount rate used is by NEAT and MHEA is 3%.

II. Field Procedures

A. The field operations manual is the Technical Standards and provided with this submission package along with the data collection forms, and user manual for the online version of WA10. Included below are the field procedures and protocols.

Energy Audit Field Procedures for NEAT and MHEA

Pre-Visit Planning and Desk Monitoring

The Energy Auditor (EA) prepares for a visit by obtaining the following information:

- Location of the home
- Age of the home
- Type of home (site built or mobile home)
- Primary fuel used for heating and secondary fuel if available.
- Average annual energy costs
- Previous weatherization date if applicable
- Eligibility occupants
- Noteworthy issues that may have been communicated from client to intake.
- Utility bills and monthly usage if available
- Google Map or Earth view for proper directions and home

The EA then prepares the proper field intake sheets specific to the home and compares client statements with any known historical information.

The information gathered during this process is used to help determine if the standard field procedures are appropriate for the project. The site visits will either confirm these assumptions or reveal the need to change plans for that unit. EAs use Data Collection Forms that are arranged in a particular order and designed to collect pertinent information efficiently and accurately for energy modeling input. These forms include:

- General project information
- Structure design and layout
- Site climatic information
- All necessary envelope, baseload, and diagnostic testing NEAT/MHEA input data
- Advanced diagnostic and zonal tests
- Other data collection or tests are needed to solve unusual problems.
- Health and safety considerations and tests
- SWS requirements
- Client education
- Lead based paint documents.

The EAs then start the process of assessment:

- Eligibility is confirmed or denied.
- Client communication is initiated.
 - The client agrees to be present for assessment.
 - Directions to home are obtained if necessary.
 - Client advised to the energy audit procedures and client education begins.
 - a. Client notified about not having solid fuel burning for visit.

- Unusual circumstances are noted.
- Existing health and safety conditions and concerns are discussed.
- General location of unit is scheduled along with other units in the same area.
- Names of other contacts are verified in the event the client is not home.
- Additional EAs scheduled as team when needed.
- Proper tools are assembled for the home.
- Lead based paint test kits are gathered if necessary.
- The EA makes a preliminary estimate if the home is a candidate for fuel switching.

Arrival and Initial Client Meeting

- The vehicle is parked at the site in a non-threatening position and in a manner the driver can easily vacate the premises quickly.
- As soon as the EA arrives at the site, the observations begin. Street view obvious problems are noted such as bent flues, broken doors, windows, etc.
- If dogs are present, it is noted on the hazard assessment form and the client is advised to contain the dogs prior to anyone exiting the vehicle.
- The EA(s) enters the home with the client's permission and their personal CO detector running. If ambient levels are 9ppm or more, the source will be found and corrected.
- The client is engaged in detailed education based on conditions already known of the home and standard client education. Client is asked to fill out necessary paperwork verifying client education.
- The refrigerator meter is placed in operation and explained to the client.
- The camera is prepared for photos and videos, client consent is obtained.
- The EA starts the determination process for priority list consideration by using the approved checklists and priority list methods.

Exterior Inspection - The exterior of the building is inspected for exterior penetrations, NEAT entry, BPI standards, and Health and Safety.

- The EA performs a general walk around for exterior inspection where all visible health and safety issues or unusual circumstances are noted, such as moisture problems.
- Gas meter and outside gas line testing are completed per NM Technical Standards.
- Exterior building measurements and perimeter are recorded.
- Exterior type(s) such as sheathing are documented and outside penetrations identified; if different walls have different exterior types, the exact location of the wall is described on the sketch map sheet.
- Each wall square footage is derived from accurate measurements.
- For MHEA entry, long wall orientation is noted.
- If accurate framing, cavity depth, and existing insulation can be determined from the outside, it is noted.

- The structural integrity of walls is examined along with insulation possibilities.
- Vapor retarder location is determined appropriate.
- Door information is gathered including area, type, performance, condition of existing weather stripping, hardware condition, needed repairs, structural integrity, and replacement needs. Lead tests are performed where applicable.
- Window information is obtained for NEAT/MHEA entry including type, frame, glazing, orientation, interior and exterior shading, condition, repairs, integrity, and replacement possibilities. Lead tests are performed where applicable. If replacement is suspected (mostly with electric or propane), measurements of windows will be accurate to avoid unnecessary overhead costs.
 - The EA considers priority list options based on the information obtained. If the home is meeting the criteria listed in the priority list methods, the EA may proceed with diagnostic testing. If at any time, it appears the home will not qualify for priority list, the EA must follow the procedures outlined in this document and forego the not use the priority list option. (Example is incidental repairs being over \$500.)

The ladder is safely set up for attic and roof inspection.

- Mobile home attics may need to be inspected from drilling a hole procedure from inside the building and the below procedures (l, m, n) will not apply.
- After the confined space procedures are followed, the attic is inspected.
- The attic area is calculated or measured if different from floor footprint.
- Insulation levels and condition in the attic are measured and photographed. The EA(s) wear protective suits and masks to perform the entire inspection correctly.
 - Electrical wire is tested for live current.
 - Open or unsafe wires are noted on the scope of work for repair by electrician.
 - Location of items such as flues are noted for damming.
 - Ventilation requirements are calculated along with the need for baffles.
 - Thermal bypass and visible attic to house open locations are photographed. Pressure plane and boundary are examined, later verified with zonal testing.
 - Existing insulation is downgraded to BPI standards.
 - Necessary repairs based on many factors including structural integrity are photographed and noted for work order with estimated cost.
 - Appropriate location and cost of possible vapor retarder is assessed.

Roof inspection

- Flue conditions are documented and photographed.
- General roof condition is recorded.
- Pitch, types of materials used, coloring, and penetrations are identified.
- Exposure and orientation if applicable are noted.
- Drainage, flashing, and any parapet walls are examined.

Crawl/Foundation inspection

- Signs of moisture are inspected.
- Electrical incidental repair needs are documented.
- Required NEAT/MHEA entries are documented:
 - Foundation type, venting, exposure, insulation
 - Floor joist measurements, existing insulation, perimeter
 - Average foundation wall height both above and below grade, insulation type
- Plumbing to be insulated and number of penetrations for infiltration are recorded.
- Rim joist insulation is documented.
- The perimeter to be insulated is recorded and photographed.
- Existing insulation type and amount is recorded and photographed.
- Need for vapor barrier is noted if warranted.

Remainder of exterior inspection

- Envelope and SWS checklist portions of Data Collection Forms are filled out.
- Water heaters, if located in an exterior closet, is examined.
 - Water heater door condition is assessed.
 - The water heater is inspected for problems including weak flooring, leaning, improper installation, improper type (site built) flue conditions, leaks, etc.
 - Diagnostic testing is performed.
 - Data from nameplate is gathered along with insulation type and thickness.
- Client education is constant if the client accompanies EA or notes are taken for a later consultation.
- Prior to audit being run, scope of work is estimated so material list can be generated. This reduces the need to go back a second time.
- The EA looks for additional problems related to weatherization needing to be solved that are not previously covered.

Interior Inspection

- Data Collection Sheet for interior is filled out.
- Personal CO detector is constantly running describing proper levels of action to client.
- Existing CO and smoke detectors are examined and assessed for replacement.
- Location and power needs of existing CO and smoke detectors are documented.
- Client continues to be engaged in client education.
- All appliances burning combustion fuel are identified and necessary information is obtained from the nameplate.
 - Non-working HVAC systems must be evaluated for repair or replacement.
- Photographs are taken of necessary items (with occupant permission)
- Lighting information is gathered including quantity, number of hours per day used, type and wattage of existing lights, and location.

- Water flow rates are measured for NEAT/MHEA entry, number of occupants and shower time is confirmed and talked with client about water saving opportunities.
- Interior condition, frame, glazing, interior and exterior shading, leakiness, size, and quantity are documented.
 - To determine tightness, use the [Window Leakiness Guidelines](#) produced by Oakridge Labs.
 - a. Very tight= Sash and frame fit snugly together
 - b. Tight= No visible gaps
 - c. Medium=Small gaps up to 1/8"
 - d. Loose= Gaps up to ¼"
 - e. Very Loose= Gaps ¼" and greater
 - For exterior shading, only include eaves, porches, or other physical barriers. Do not include temporary barriers. The percentage of shading must be determined in heating dominating climates for things such as trees that lose their leaves during the winter causing less shading. Consider deciduous trees in the summer for the cooling dominated climates.
 - Consider additional shading for unusual configurations such as courtyards.
 - a. This number should be an approximate percentage that includes trees, overhangs, and other exterior barriers. If the window is unshaded, the number to enter is zero.
- Door type, condition and tightness are documented. Default R-Values are not used with NEAT or MHEA, so it is important to document the information that is needed for the software to make that determination for both windows and doors.
- Infra-Red camera is used on each of the outside walls to look for insulation voids.
- Wall insulation level is verified with drill and patch method where possible.
- Any anomalies or inconsistencies are noted.
- Unusually high electrical usage on the client's electric bill is considered with appliances that may contribute to the high use.
- Health and Safety concerns are continuously monitored, and client education delivered.
- Existing ventilation fan information is documented, flow measured, area and volume are assessed for replacement to comply with ASHRAE 62.2 2016.
 - Red Calc must be used to determine minimum ventilation requirements.
 - EAs will determine where the continuous ventilation is most appropriate, and if additional fans will be needed in the kitchen or guest bathroom to comply with the standard.
- The EAs search for mold growth which includes client dialogue; the mold sheet is completed; photos are taken, and the presence or absence of mold is documented.
- Clothes dryer vent is inspected; dryer running for worse case is noted.
- The EAs set up for all diagnostic testing.
- Estimated scope of work and material list continues to develop.

- The EAs look for additional problems related to weatherization needing to be solved that are not previously covered.
- Duct plenum, boot, type of material, and branch condition and location is documented.
 - Document the sealing feasibility of these areas and determine what kind of target is realistic.
- All heating and cooling systems must have data collected for the energy audit.

Diagnostic Tests Appliances

The goals of the tests are to determine the efficiency, safety, and general operating condition of the systems. The EAs are trained to recognize when additional tests beyond the minimum are needed to support these goals and will perform the testing as necessary.

- All combustion appliances must be tested for safety.
- Testing procedures outlined in the NM Energy Smart Technical Standards are followed for the gas leaks, kitchen range, water heating, and heating systems.
- Data Collection Forms appliance section is completed.
- The need for additional testing is determined.
- Client education is continued with clients.
 - Results of testing are delivered with explanations where needed.
- Appliance size/capacity in relation to usage is documented.
- Appliance age and condition is documented.
 - Determine if this appliance should be derated.
 - a. Deration Formula: $\text{Efficiency} = (\text{Base EFF}) \times .99^{\text{Age}}$
- Appliance room/closet is assessed for combustion air, safety, how it can be separated from the unit if individual (CAZ).
- Possible tune-up needs are assessed.
- Possible replacements are assessed.
 - Coding issues are identified.
 - Space requirements are documented.
 - SWS requirements are included.
- SWS compliance is assessed.
- Material list and scope of work is continued.
- Videos and photos are recorded at each stage where documentation is needed.
- The client is interviewed about all the water leaks the home may have had and when. The team uses their senses to determine more about any damage caused by water.
- The team looks for additional problems related to weatherization needing to be solved that are not previously covered. They determine if additional testing is needed.
- The current Health and Safety Plan is followed.

Non-functional heating systems

Where there are non-working or missing heating systems, EAs must ensure the home is not left without a safe primary unit. If it has been determined the unit cannot be repaired, EAs will follow the procedures below:

Inoperable Systems

- Use the existing system's boilerplate information for energy audit entry. This includes the AFLUE, BTU input, output, pilot light, and other information NEAT or MHEA requires.
 - Unvented space heaters are always regarded as 100% efficient.
- Once the unit has been entered into the audit with all specifications entered matching what is on the unit, and the necessary information has been input into the model, the audit is run to determine if a replacement system is cost effective.
 - High efficiency units must be selected for replacement when possible.
- Health and Safety funds can be used to replace the unit if the replacement does not prove to be cost effective with an SIR of 1 or more.
- When homes are entirely missing a primary system, the EA will interview the client to gain knowledge of how the home is being heated and/or cooled. This may be coupled with examination of utility bills to look for spikes of fuel during certain periods.
 - Example: Primary heating system, the furnace, has been removed an

Missing Systems Site Built

- Determine by client discussion what the original source of heat for the home was, prior to removal. It is unlikely weatherization will occur in a home that never had a heating system.
- From the information obtained, research the type of unit described by the client to determine the minimal inputs required.
- Ask questions of the client such as where the unit used to be located, what the approximate size of the unit was, what it looked like, if they client remembers any name, color or anything that can give a clue as to the type and capacity of the furnace.
- Look for obvious signs of ducts or vents that would indicate the heating system was a furnace.
- If the client does not know, make an educated guess based on the types of systems installed historically in the neighborhood.
 - This may include contacting builders or plumbers that were known to be involved with the construction to figure out the most likely system that would have been installed in the home.
- Neat entry should include all the required fields obtained from the research conducted such as efficiency, output, fuel source, location, and equipment type.

Missing Systems Mobile Home

- Obtain information from the client about the age and type of mobile home.
- Look for clues within the home about the year it was built.
- If the client remembers the name of the furnace, research the BTU size and efficiency based on the age of the home. The age of the home is most likely the age of the missing furnace.
- The age and size of the home will help estimate the capacity and age of furnace.
- Use the information obtained from the research for MHEA entry.

Utilization of H&S Funds After Entry into NEAT or MHEA

- If the unit has been entered into the software including all the estimated fields, and the measure does not receive an SIR of 1 or higher, H&S funds may be used to install a unit.
 - The assessor must first utilize any available utility funding that is allowable for the measure to decrease the total expense load on the H&S funds. This amount of funding will be dependent on modeled savings for that unit.

- The amount of H&S funds used must be reduced in the audit by the amount covered by other funding. Do not remove the unit from the audit so that the replacement system is included in the evaluation of weatherization.
- The box, "Include in SIR" should not be checked when using H&S
 - If the utility or other fundings is enough to cover the entire cost of the labor and materials, the amount entered into the audit shall be the cost of the unit.

NEAT/MHEA Entry for Heating Unit Replacement

DOE Funds Cover Entire Cost of Unit as ECM

- When utility or other funding is not available to assist with the cost of the unit replacement, the audit entries must be sufficient to allow the model to consider all available options for cost effectiveness.
- "Replace the Equipment" is checked.
- The audit is run with "required" unchecked". The "include in SIR" will not be active because the audit will automatically consider the cost effectiveness of the heating unit. All the fields such as heating and cooling efficiency, output capacity, equipment type, and fuel source must match the replacement unit.
- The comment section should briefly describe reasons for considering replacement.
- Populate all known fields such as pilot light, vent damper, and whether the client uses set back.

HVAC Systems

* New HVAC System *

Existing Equipment		Retrofit Options to Evaluate	
HVAC System Code: H1 ✓ Equipment: Furnace - Forced Air Location: Conditioned Space Fuel: Primary: Natural Gas Backup: Efficiency Input Method: Site Measured Year Manufactured: Heating Efficiency: 75 AFUE Output Capacity: 80 kBtu/hr Fraction of Load Served: 1 <input checked="" type="checkbox"/> Estimate Equipment Features: <input type="checkbox"/> Atmospheric Burner <input type="checkbox"/> Automatic Vent Damper <input type="radio"/> IID <input checked="" type="radio"/> Pilot Light <input type="checkbox"/> On In Summer Year Installed: 1993 Maintenance Status: Seldom or Never Maintained Heating Setback Used: <input type="checkbox"/>	<input checked="" type="checkbox"/> Install Smart Thermostat: <input type="checkbox"/> Required <input type="checkbox"/> Include in SIR Heating Nighttime Setback (°F): 68 Daily Setback Hours: 8 Additional Cost (\$): <input type="checkbox"/> Tune Up: <input type="checkbox"/> Required <input type="checkbox"/> Include in SIR Efficiency Improvements (%): Heating: Cooling: Additional Cost (\$): <input checked="" type="checkbox"/> Replace the Equipment: <input type="checkbox"/> Required <input type="checkbox"/> Include in SIR Material Cost (\$): 2200 Equipment: Furnace - Forced Air Labor Cost (\$): 1600 Fuel: Primary: Natural Gas Backup: Heating Efficiency: 95 AFUE Output Capacity: 60 kBtu/hr Fraction of Load Served: 1 Also Replaces:		Other Cost (\$):
Comments Cracked heat exchanger, 30 year old unit, efficiency levels 20% lower than replacement, possibly oversized.			

Non-DOE Funds Cover Full Cost of Unit

- Determine how much non-DOE funding is available for the unit replacement unit first.
- If the non-DOE funding is enough to cover the entire cost of the **unit**, the model must be run as if the unit had already been replaced with the efficiency, output, year, and features all matching the new replacement unit. The new unit specs will replace the existing unit specs in the model.
- **“Replace the Equipment”** is not checked.

The screenshot displays the 'HVAC Systems' software interface for configuring a 'New HVAC System'. The 'Existing Equipment' section includes fields for HVAC System Code (H1), Equipment (Furnace - Forced Air), Location (Conditioned Space), Fuel (Primary: Natural Gas), Efficiency Input Method (Site Measured), Year Manufactured, Efficiency (95 AFUE), Output Capacity (60 kBtu/hr), Fraction of Load Served (1, Estimate checked), Equipment Features (IID selected), Year Installed (2023), Maintenance Status (Annual Professional Maintenance), and Heating Setback Used (unchecked). The 'Retrofit Options to Evaluate' section shows 'Install Smart Thermostat' (unchecked), 'Tune Up' (unchecked), and 'Replace the Equipment' (checked). The 'Comments' field at the bottom contains the text: 'Non-DOE funds covering entire cost of unit replacement. Replacement unit entered as existing unit.'

Non-DOE Funds Cover Some/**Most** Cost of Unit

- If the non-DOE funding is not enough to cover the entire cost of the unit, the remaining funding is used for the material, labor, and other costs fields under retrofit options.
 - The audit is run with “required” **unchecked**. The “include in SIR” **will not be active** because the audit will automatically consider the cost effectiveness of the heating unit. All the fields such as heating and cooling efficiency, output capacity, equipment type, and fuel source must match the replacement unit.
 - **“Replace the Equipment”** is checked.
 - List in the comments what funding sources are used and estimated amounts.
 - The material, labor, and other costs should be the difference between the full actual cost of the replacement and the amount the other funding will cover.

HVAC Systems

*** New HVAC System ***

Existing Equipment

HVAC System Code: ✓

Equipment:

Location:

Fuel: Primary: Backup:

Efficiency Input Method:

Year Manufactured:

Heating **Cooling**

Efficiency: Heating: AFUE Cooling:

Output Capacity: Heating: kBTU/hr Cooling:

Fraction of Load Served: Heating: Estimate Cooling:

Equipment Features: Atmospheric Burner Automatic Vent Damper IID Pilot Light On in Summer

Year Installed:

Maintenance Status:

Heating Setback Used:

Retrofit Options to Evaluate

Install Smart Thermostat: Required Include in SIR

Heating Nighttime Setback (°F): Daily Setback Hours: Additional Cost (\$):

Tune Up: Required Include in SIR

Efficiency Improvements (%): Heating: Cooling: Additional Cost (\$):

Replace the Equipment: Required Include in SIR

Material Cost (\$): Labor Cost (\$): Other Cost (\$):

Equipment:

Fuel: Primary: Backup:

Heating **Cooling**

Efficiency: Heating: AFUE Cooling:

Output Capacity: Heating: kBTU/hr Cooling:

Fraction of Load Served: Heating: Cooling:

Also Replaces:

Comments

Available utility funding is \$3,500 from NM Gas for this unit.

- If the recommended measures show an SIR of 1 or greater, the unit can be replaced as an Energy Saving Measure (ECM) and no health and safety funds will need to be used. If the recommended measures show an **SIR of less than 1**, then the unit may not be replaced as an ECM using DOE funds.

Unit Does Not Receive SIR but Qualifies for Health and Safety Replacement

- If it has been determined that replacing the unit is consistent with the Health and Safety Plan, and the above steps have been followed including utilization of non-DOE funds, and the SIR is less than 1, then re-run the audit with "Required" checked and "Include in SIR" unchecked. The unit will show up on the list of recommended measures with no SIR and the health and safety category will be used to fund the replacement.
- "Replace the Equipment" is checked.
- The comment section should describe the reason for replacement.
- Enter the full cost for the replacement for materials, labor, and other.

Existing Equipment

HVAC System Code: H1 ✓

Equipment: Furnace - Forced Air

Location: Conditioned Space

Fuel: Primary: Natural Gas Backup:

Efficiency Input Method: Site Measured

Year Manufactured:

Efficiency: Heating: 75 AFUE Cooling: Output Capacity: 80 kBtu/hr

Fraction of Load Served: 1 Estimate

Equipment Features: Atmospheric Burner Automatic Vent Damper IID Pilot Light On in Summer

Year Installed: 1993

Maintenance Status: Seldom or Never Maintained

Heating Setback Used:

Retrofit Options to Evaluate

Install Smart Thermostat: Required Include in SIR Heating Nighttime Setback (°F): 68 Daily Setback Hours: 8 Additional Cost (\$):

Tune Up: Required Include in SIR Efficiency Improvements (%): Heating: Cooling: Additional Cost (\$):

Replace the Equipment: Required Include in SIR Material Cost (\$): 2200

Equipment: Furnace - Forced Air Labor Cost (\$): 1600

Fuel: Primary: Natural Gas Backup: Other Cost (\$): 50

Efficiency: Heating: 95 AFUE Cooling: Output Capacity: 60 kBtu/hr

Fraction of Load Served: 1

Also Replaces:

Comments

Cracked heat exchanger

Diagnostic Testing Blower Door, Ducts, Zonal Tests, Connectivity

- At this point a very close assumption has been made as to whether the living space is connected to other spaces, a general guess on what the blower door reading will be, and what the duct pressure pan readings will be.
- The diagnostic testing is conducted in accordance with NM Energy Smart Standards.
- During the testing, the scope of work and material lists are updated with the new air leakage information.
- Infra-Red is used with blower door running when inside-outside delta T allows.
- The house is thoroughly inspected with the blower door running.
- Client "hints" of where problems may be are investigated.
- High and low leaks are carefully noted with comments on how to correct them.
- Zonal tests to attic, crawl, garage, soffit, or other areas are conducted.
- Addition if present is specifically explored for leaks where the addition connects with the home. Notes are made of the discoveries.
- If the home is a double wide mobile home, the marriage is carefully examined for air sealing opportunities.
- For double wide mobile homes, particular attention is paid to both halves with the ducts and whether one side is significantly stronger than the other. Crossover duct will have already

been examined during the assessment process and notes can be compared with the blower door readings.

Air Sealing Target (AST) is determined for NEAT and MHEA entry.

- The AST is partly determined by dividing volume within the thermal/pressure envelope by 10. For example, if the volume of the thermal/pressure envelope is 12,000 ft³, the AST is 1200 CFM₅₀. This number is only used as a guideline and starting point. The assessor must then apply their knowledge of the house, calculate equivalent leakage area, location, and size of any large holes found during blower door testing, and consider accessibility of the leakage areas to adjust the guideline number. This should reflect what is realistically possible for each individual home.

Mobile Homes Duct Testing

- Duct testing using pressure pan or subtraction is measured and recorded.
 - Cross check this number with the visual observations and modify target if necessary.

MHEA Pressure Pan Entry

Duct Operating Pressures Before Duct Sealing

- Measure the operating pressure of the return and supply plenums with a pressure probe through holes drilled near the air handler. The supply plenum hole can be the same as used for static pressure. The air handler should be on and record the numbers in units of Pa. These will be the *before duct sealing* numbers.

Duct Operating Pressures After Duct Sealing

- ② This number should be 5 Pa higher than the number that was just obtained with the previous step. For example, if on the previous step, the number was 25 Pa, then what should be entered is 30 Pa.

Before Weatherization Air Leakage Rate and Pressure Difference

- ② The leakage rate is your blower door reading found during the assessment of the home. This is expressed in Cubic Feet Per Minute (CFM). The pressure difference is 50 Pa. as a default unless another pressure was used in cases when reaching the CFM 50 was not possible.

After Weatherization Air Leakage Rate and Pressure Difference

- ② This is the target number that is determined using the AST methodology described in the section above. The pressure difference is 50 Pa. as a default.

Sum of Pressure Pan Measurements Before Duct Sealing

- ② These are the sum of all the supply pressure pan readings which is the difference between the supply duct pressures and the house when depressurized to 50 Pa.

Sum of Pressure Pan Measurements After Duct Sealing

- This is the target sum of all the supply pressure pan readings when the house is depressurized to 50 Pa. The default number for each register is 1.

Site Built Duct Testing

- Use the subtraction method to determine duct leakage values. This is a four step method with an added uncertainty factor and is found here: <http://energyconservatory.com/wp-content/uploads/2017/08/Blower-Door-Subtraction-Method.pdf>
 - Conduct whole house blower door depressurization test
 - Conduct envelope only test using sealing tape on all the supply and return registers, or using vent cap systems.
 - Measure the pressure in duct system with registers taped off WRT the building.
 - Calculate the duct leakage using the correction factor in the linked chart.
- The calculated leakage number is entered into NEAT
 - Pressure pans are used to determine which ducts are the largest contributors to the leakage.
 - Client education is communicated.
 - Photos and videos are taken
 - The need for additional testing is determined and the EAs ensure there are no additional problems related to these tests that need to be solved. They determine if additional testing is needed.

NEAT Entry for Subtraction Method

Duct Operating Pressures Before Duct Sealing

- ② Before taping the registers, measure the operating pressure of the return and supply plenums with a pressure probe through holes drilled near the air handler. The supply plenum hole can be the same as used for static pressure. The air handler should be on and record the numbers in units of Pa. These will be the before duct sealing numbers.

Before Weatherization with Registers and Grills Open

- ② This is your blower door reading before any work is done and corresponding pressure and prior to taping the registers. The default for House Pressure Difference is 50 Pa.

Before Weatherization with Registers and Grills Closed/Sealed

- ② This is your blower door reading before any work is done and corresponding pressure (default 50 Pa.), after taping the registers.

Duct Operating Pressures After Duct Sealing

- ② This number should be 5 Pa higher than the number that was just obtained with the previous step. For example, if on the previous step, the number was 25 Pa, then what should be entered is 30 Pa.

Duct to House Pressure Difference Before Weatherization

- ② This is measured by inserting the probe through the temporary tape of a supply or return register. The default for this number is 50 Pa.

After Duct Sealing and Before Weatherization with Registers and Grills Open

- ② This is the estimate of what the blower door reading should be after duct sealing. This is based off the blower door reading with the registers taped and gives the assessor a base number while evaluating the condition of the ducts. Taping of the registers will usually show a number lower than what is possible through sealing accessible locations of boots, elbows, connections, and plenum. This means the assessor must consider how much of the ducts can reasonably be sealed and accessed. The assessor must inspect the entire duct system to decide how much to add to this number that accurately reflects the condition of the system. This number should be the same if duct sealing were to take place before any other air sealing, and the blower door test were to be run.
- ② The default for House Pressure Difference is 50 Pa.

After Duct Sealing and Before Weatherization with Registers and Grills Closed/Sealed

- ② This is your blower door reading after duct sealing and before other weatherization with the corresponding pressure (default 50 Pa.), after taping the registers. This number should be lower than the After Duct Sealing and Before Weatherization with Registers and Grills Open from the step above, because there is the added difference of closing/taping the registers. This is not a required test. Final inspectors are encouraged to tape the registers upon final inspections of common housing types or floor plans to obtain this number for future entry considerations of those common housing types. If there is no post weatherization data obtained from the final inspectors, this number should be 50 CFMs lower than the number entered in the above step because it is assumed this number will be lower after both actual duct sealing and taping. The graphic below is to be used as a guide for these entries and only an example.

Duct to House Pressure Difference After Weatherization

- ② This can be measured by inserting the probe through the temporary tape of a supply or return register after weatherization, however the measurement is not required because the model must be run prior work. It is typical to enter this number as 50 Pa into the model. After Weatherization (Target or Actual)
- ② This is the AST that has been determined using the methodology described in the above section. The house pressure is entered at 50 Pa.

Ducts and Infiltration

Evaluate Duct Sealing:

Duct Leakage Method: Blower Door Subtraction Measurements

Whole House Blower Door Measurements

	Before Weatherization (Existing)	After Duct Sealing and Before Other Weatherization (Target or Actual)	After Weatherization (Target or Actual)
With Registers/Grills Open:			
Air Leakage Rate (cfm)	3000	2700	1000
at House Pressure Difference (Pa)	50	50	50
With Registers/Grills Sealed:			
Air Leakage Rate (cfm)	2500	2450	
at House Pressure Difference (Pa)	50	50	
Duct to House Pressure Difference (Pa)	50	50	

Duct Operating Pressures

	Before Duct Sealing	After Duct Sealing
Supply (Pa)	30	40
Return (Pa)	30	40

Costs

Infiltration Reduction (\$): 300

Duct Sealing (\$): 85

Site Visit Final Walk Through

- Prior to leaving site, all field notes are viewed.
 - If it has been determined that a priority list will be used for the home, the EA goes through the checklist for the building type to be sure all answers to questions 1-7 will not result in energy modeling:
 1. Age of home _____
 2. Is the construction something other than wood frame? If it is a mobile home, has it been manufactured after 2009? Yes No
 3. If it is a mobile home, are there barriers and limitations for the belly/subspace? Yes No
 4. If it is a mobile home, is there an attached addition? Yes No
 5. Is the building more than 3 stories? Yes No
 6. Is the primary heating system sealed combustion rated >89%? If it is a mobile home, is the primary heating system natural gas rated >79%? Yes No
 7. If it is a site-built home, is the primary heating system a heat pump manufactured after 2006? Yes No
 8. Are incidental repairs expected to be more than \$500? Yes No
 9. Does it appear the home will need measures that are not listed on the PL? Yes No**Any answers of "yes" will result in energy modeling and audit; a PL will NOT be used**

- Air sealing target is reviewed and determined if it is a realistic expectation.

- Data Collection Sheets are reviewed for completion.
- Additional samples, tests, or photos may be needed to deliver a completed package and completed at this point.
- Refrigerator meter is viewed for kW usage, recorded, and removed. The refrigerator is verified to be plugged in again and working.
- The final property walk through is done to look for anything that was missing.
- Summary of client education is delivered to appropriate parties, including:
 - Next steps and what to expect are communicated.
 - Health and safety concerns with an action plan are recorded.
 - For energy saving measures, the client is informed that only items that are listed on the energy audit will be installed when using DOE funds. The auditor briefly describes how the energy audit will calculate rather something or not is cost effective and the final scope of work is dependent on the audit.
- The team verifies there are no additional problems related to weatherization that were missing.
- Appliances that have been turned to pilot during testing are put back into operation.

Anything moved during assessment such as attic entries, crawl entries, AC covers etc. are put back into place exactly as they were before the crew arrived unless it is a health and safety correction.

1. Data collection for accurate model- If all the steps outlined within the interior and exterior inspection are followed, there will be sufficient data collected for energy model entry. Every item is visually verified for accuracy.
The building diagnostics listed affects all the entries needed to run an accurate NEAT or MHEA model.
2. Assessment affecting auditor actions- The EA may know what the home needs from experience but will always rely on the final numbers of the energy audit to develop the scope of work when using DOE funds.
 - ♣ Measures that are listed in an audit are not to be skipped.
 - ♣ **All applicable energy saving measures must be evaluated and listed in the audit.**
3. Advanced diagnostic and assessment techniques- Include regular zonal testing to help identify the pressure boundary, infra-red with the blower door running, and the use of covering large holes to estimate targets.
4. These policies cover both mobile homes and site-built structures. Although there are similarities between them, there are different data points needed for each. The data collection sheets list exactly what each building type needs for a proper model to be run.

III. Energy Modeling Procedures

- A. Modeling Procedures- Support materials, data collection forms, training videos can all be found at the Oak Ridge National Laboratory website. The web based user's manual is found at this location: <https://weatherization.ornl.gov/wp-content/uploads/2022/07/Web-Based-WA-Getting-Started-Guideline-05-08-2020.pdf>
NM is moving away from the desktop version and is expecting the full transition to be completed by August 2023.

Energy Modeling Procedures for NEAT

- When timing allows, data entry into the software happens as close to the collection time as possible. Entry at the site with a laptop or pad is preferable but not always practical.
- Libraries are updated at a minimum of 1 time per year, and after procurement.
- Client information is verified.
- Utility data is viewed but not required for entry.
- Field notes are questioned and compared with photos and diagrams.
- Audit information is entered or verified against field notes with weather file being the closest in heating degree days and location to the actual site.
- Even if another funding source is being used for a measure, it must be entered into the audit so that the package of measures show interaction with other measures.
- Wall type, stud size, exterior type, exposure, orientation, area, and insulation of each wall is verified against field notes and photos. If there are differences in walls, then that will be properly entered into NEAT. Scope of work will reflect that.
- Window type, frame, glazing, condition, interior and exterior shading, leakiness, size, and quantity are verified and entered NEAT with appropriate replacement/weatherization options.
- Door type, area, condition, storm door condition, door leakiness, size, wall orientation, and replacement options are verified against notes and photos before NEAT entry.
- Attic type, joist spacing, area, roof color, effective insulation levels are entered after note and photo verification. Added insulation costs are evaluated.
- Foundation type, area, floor insulation levels, perimeter, foundation wall height, foundation wall insulation levels, sill insulation levels and needs are entered.
- MHEA Floor joist direction, skirting presence, joist size, insulation levels, location, type, maximum depth of belly, condition of belly, configuration of belly, and any notable comments are verified and entered.
- Heating and cooling information for primary and **all** supplementary units are verified against diagnostic testing and data plate notes. Entries are made for type, fuel, location, kBtuh input, output, efficiency, percent of heat supplied, and replacement options.

- Use the deration formula **only for heat pumps and air conditioners:**

$$\text{Efficiency} = (\text{Base EFF}) \times .99^{\text{Age}}$$

- For non-working units:
 - Use the existing system's boilerplate information for energy audit entry. This includes the SEER or AFUE, BTU input, output, pilot light, and other information NEAT or MHEA requires.
- Unvented space heaters are always regarded as 100% efficient.
- Once the unit has been entered into the audit with all specifications entered matching what is on the unit, and the necessary information has been input into the model, the audit is run to determine if a replacement system is cost effective.
- **If a measure is installed in the home using non-DOE funding sources, a cost effectiveness evaluation (energy audit) must be performed so that it reflects the**

installation of this measure as part of the package of measures to ensure that all other measure installed as Energy Conservation Measures (ECM) are truly cost-effective when interacted as required by 10 CFR 440.21(e)1.

- This means that when a measure is installed in the home using non-DOE funds, the model must reflect that the measure is already installed. The input must show the measure is existing.
 - If it is desired to show whole house savings for all funding sources together, an audit may be run showing all measures that will be installed with comments naming each funding source.
- Duct information is entered for duct insulation options if applicable.
 - Cooling information is entered after verifying notes and photos including type, cooled floor area, capacity, SEER, and year manufactured. Replacement options are considered as an energy saving item.
 - Duct and infiltration information is entered with EAs best estimation on what the post blower door and duct numbers will be after all the air sealing items on the scope of work have been addressed in their entirety. Cost of air sealing is entered for both labor and materials.
 - Water heating information is entered and verified against notes and photos. This includes location, fuel, manufacturer, input, size, pipe and tank insulation and R Value, showerhead flow rate, and usage minutes. Replacement is run as an energy saving measure prior to health and safety consideration.
 - Refrigerator metered information is entered with replacement options and appropriate library cost considered. Measurements of refrigerator are checked against notes.
 - All lighting information is checked against field notes and entered.
 - Itemized costs are incidental repairs or health and safety and added to the scope of work and field notes. This includes items that are not energy saving such as CO detectors, mechanical ventilation, glass replacement, venting correction, or other essential items because of weatherization taking place in the home.
 - Once all relevant tabs have been populated “Run Audit” is initiated.
 - Recommended measure report is compared with scope of work. Obvious mistakes or items that do not look right are examined and re-entered. The estimated scope of work is adjusted to match the audit recommendations.
 - Input reports are compared to field notes.
 - SIRs and heating/cooling loads are examined.
 - Communication with clients is provided.
 - Input reports, recommended measures, photos, field notes, and explanations are kept in the client file.
 - NEAT Scope of Work is built and generated with accurate costs for all items and crossed checked with field notes, recommended measures, client notes, and health and safety concerns for completion.

Energy Modeling Procedures for MHEA

- When timing allows, data entry into the software happens as close to the collection time as possible. Entry to the site with a laptop is preferable but not always practical.
- Libraries are updated regularly or when needed.
- Client information is verified.
- Utility data is viewed but not required for entry.
- Field notes are questioned and compared with photos and diagrams.
- Audit information is entered or verified against field notes with weather file being the closest in heating degree days and location to the actual site.
- Wall stud size, ventilation, orientation of long wall, and insulation of each wall is verified against field notes and photos. If there are differences in walls, then that will be properly entered into MHEA. Scope of work will reflect that.
- Window type, frame, glazing, condition, interior and exterior shading, leakiness, size, and quantity are verified and entered into MHEA with appropriate replacement/weatherization options.
- Door type, area, orientation, storm door presence, door leakiness, size, and replacement options are verified against notes and photos before MHEA entry.
- Attic type, joist spacing, area, roof color, effective insulation levels are entered after note and photo verification. Added insulation costs are evaluated.
- Floor joist direction, skirting presence, joist size, insulation levels, location, type, maximum depth of belly, condition of belly, configuration of belly, and any notable comments are verified and entered.
- Addition shell information is verified and entered.
- Heating information for primary and secondary units are verified against diagnostic testing and data plate notes. Entries are made for type, fuel, location, kBtuh input, output, efficiency, percent of heat supplied, duct location, duct insulation location, and replacement options.

- Use the deration formula **for only heat pumps and air conditioners:**

$$\text{Efficiency} = (\text{Base EFF}) \times .99^{\text{Age}}$$

- For non-working units:
 - Use the existing system's boilerplate information for energy audit entry. This includes the SEER or AFUE, BTU input, output, pilot light, and other information NEAT or MHEA requires.
- Unvented space heaters are always regarded as 100% efficient.
- Once the unit has been entered into the audit with all specifications entered matching what is on the unit, and the necessary information has been input into the model, the audit is run to determine if a replacement system is cost effective.
- **If a measure is installed in the home using non-DOE funding sources, a cost effectiveness evaluation (energy audit) must be performed so that it reflects the installation of this measure as part of the package of measures to ensure that all other measure installed as Energy Conservation Measures (ECM) are truly cost-effective when interacted as required by 10 CFR 440.21(e)1.**

- This means that when a measure is installed in the home using non-DOE funds, the model must reflect that the measure is already installed. The input must show the measure is existing.
 - If it is desired to show whole house savings for all funding sources together, an audit may be run showing all measures that will be installed with comments naming each funding source.
- Cooling information is entered after verifying notes and photos including type, cooled floor area, capacity, SEER, and year manufactured. Replacement options are considered as an energy saving item.
- Duct and infiltration information is entered with EAs best estimation on what the post blower door and duct numbers will be after all the air sealing items on the scope of work have been addressed in their entirety. Cost of air sealing is entered for both labor and materials.
- Water heating information is entered and verified against notes and photos including that of the outdoor closet. This includes location, fuel, manufacturer, input, size, pipe and tank insulation and R Value, showerhead flow rate, and usage minutes. Replacement is run as an energy saving measure prior to health and safety consideration.
- Refrigerator metered information is entered with replacement options and appropriate library cost considered. Measurements of refrigerator are checked against notes.
- All lighting information is checked against field notes and entered.
- Itemized costs are incidental repairs or health and safety and added from the scope of work notes. This includes items that are not energy saving such as CO detectors, mechanical ventilation, glass replacement, venting correction, or other essential items because of weatherization taking place in the home.
- “Run Audit” is initiated.
- Recommended measure report is compared with scope of work. Obvious mistakes or items that do not look right are examined and re-entered. The estimated scope of work is adjusted to match the audit recommendations.
- Input reports are compared to field notes.
- SIRs and loads are examined.
- Communication with clients is provided.
- Input reports, recommended measures, photos, field notes, and explanations are kept in the client file.
- MHEA Scope of Work is built and generated with accurate costs for all items and crossed checked with field notes, recommended measures, client notes, and health and safety concerns for completion.

B. Documentation of Non-Energy Conservation Measures

As indicated in the procedures, all non-energy conservation measures must be entered into the energy audit to ensure all items are interacting with each other properly. This not only ensures

compliance with 10 CFR 440, but also helps data entry upon invoicing to keep consistent track of all measures installed in a home.

C. Building Model True-up

EAs are encouraged to use utility bills to true-up the models but are not required when the unit does not involve fuel switching. Utility bills must be examined prior to considering a fuel switch to prevent clients from paying higher utilities than before weatherization.

IV. Work Orders & Materials

- A. The scope of work must be developed using the energy audit as a base. Each measure must have the associated specs and funding sources listed in the work order.
1. The crew or contractor may not know where to look to find measure specifications within the energy audit so they must be listed on the work order itself. This includes **the amount of R-value of insulation to be added**, window U-value, minimum efficiency for equipment, air sealing targets, and SWS references for each item.
 2. All measures performed on a home must be listed on the work order, funding category (energy saving, H&S, incidental repair), and the expected funding source(s) to be used for that item. This can be computer generated or handwritten in the work order itself.
- B. Weatherization Materials Installed
- MFA and the NM EnergySmart Program acknowledge that only weatherization materials that meet or exceed the standards listed on the 10 CFR 440 Appendix A will be installed in eligible dwelling site built or manufactured homes when using DOE funds. The following items are not listed in Appendix A and have been approved to use:
1. Refrigerators (Energy Star) have been approved on April 10, 2019
 2. Light Emitting Diode (LED) Lighting have been approved on February 1, 2016
 3. The program is pursuing approval to use low-flow showerheads, aerators, and Energy Star water heaters.
- C. NM currently does not make use of GHW reduction lists.

V. Administrative Requirements

- A. Health and Safety- The H&S Plan is discussed on a regular basis during our Technical Committee calls, and during informal meetings/training with the service providers. All EAs are expected to know how to use the H&S Plan and its associated H&S Matrix when confronted with a question in the field. Most importantly, the plan spells out what is eligible for using DOE funds and what funding category each item falls under. EAs and crew may access the plan from the [MFA website](#) by using their devices, in addition to keeping an updated printed copy in the vehicles.
- B. The NM EnergySmart Program is only using DOE approved energy audit procedures for both mobile homes and site-built homes.
- C. Fuel and **measure** costs must be updated in the libraries at a minimum of once a year. The fuel costs are averaged over a period to gain the most sensible numbers for modeling use. Agencies must update the measure costs after each procurement and update the costs more frequently when fuel costs significantly change outside of typical monthly fluctuations.
- D. Software Maintenance
- Summary of Changes are found in the Wav10 release notes and listed below.

Added:

- Weather Data (Updated/New) - Updated and expanded with ~1000 "Weather Stations"
- Windows Form (New) - MHEA and NEAT data points aligned, new retrofit definition functionality, hidden business logic eliminated
- Infiltration Reduction Analysis (Updated) - General Air Sealing measure now applied to package in SIR order, measure interactions updated
- Duct Sealing Analysis (Updated) - Duct Sealing measure now applied to package in SIR order, measure interactions updated
- NEAT HVAC Fuel-switching Analysis (New) - Automatic HVAC fuel-switching analysis added to NEAT

Fixes:

- Lead Auditor now able to edit Measure Costs library
- Unfinished attic data copy fixed
- Run error with HVAC defined fixed
- Audit dock form completion/validation issues resolved
- "Run" preflight checks validated and errors corrected
- HVAC Gravity Furnace no longer require duct inputs
- Duct surface area maximum revised
- Heating nighttime setback min/max adjusted
- HVAC fraction load checks fixed
- Audit All Table display corrected to show Audit #
- Weather Station added to Recommended Measures report
- Measure Cost Library display corrected on Recommended Measures report

NEAT/MHEA

- Weather Station missing information inserted for 48 new stations (NEAT/MHEA)
- "Duct Leakage Method" selection fixed
- "Ducts" inputs for Gravity Furnace now optional
- Multiple measure evaluation issues fixed (not showing when required, incorrectly appearing, etc.)
- Multiple input/output validation corrections/additions implemented
- Work Order Materials/Labor Details listing fixed (Note, any work orders for v10 audits created before this version must be recreated)
- Audit Run Measure descriptions and details (found under View Measures dialog) fixed
- Winter design temperature limits expanded to allow very cold weather stations (e.g., International Falls, MN)
- Clarifying tooltip added for engine behavior regarding Required and Include in SIR measures
- Audit Run Measure descriptions and details (found under View Measures dialog) fixed
- Audit Run Measure components list, found in View Measures, and Reports fixed
- Tab switching between supply and return register type fixed
- Key Parameter library selection matches audit version (v8/v10)
- Multiple View Measure and Recommended Measures Report fixes
- SEER2 and HSPF2 inputs implemented for Replacement Equipment
- Removed v8 weather file references from engine and schemas
- Only TMY3 weather files supported, TMY2 weather files no longer supported/available
- Recommended Measures Report: Air sealing measure no longer included when measure cost is blank
- Recommended Measures Report: Component names corrected
- HVAC Form: PTHP now properly identified as a heating system
- Windows Form: NEAT and MHEA engine runs when skylights are included with other windows or are the ONLY window type entered
- Work Order - Duct Insulation additional cost from audit now shown on View Measures tab

- Refrigerator form - Adjusted Consumption for Existing and Replacement Refrigerator now showing correctly on form (after "Apply" or changes)
- HVAC/Ducts forms - Acceptable "system code" entries corrected to allow additive names (e.g. A, AB, ABC)
- HVAC form - Error message when deleting HVAC System with Ducts associated updated to better align with specific conditions
- Reports - Recommended Measures report now consistently shows non-zero (0) refrigerator replacement savings
- Reports - Recommended Measures report now shows updated HVAC fuel-switch annual energy savings
- HVAC form - Engine/Run error added when Tune-up is specified for electric furnace or boiler
- Ducts - Minimum (1) Duct entry now required with Evaluate Duct Sealing. Warnings/errors added to notify users

MHEA

- Gravity furnace now submits to the engine properly
- Heating System Tune-up now evaluated
- HVAC "Replace the Equipment" run error fixed
- HVAC measure component names, details, and costs fixed/added
- Utility Bill Adjustment output JSON added and run bug fixed
- Report values from engine fixed/updated (cooling energy unit (kWh) and final values)
- Measure costs updated/fixed
- Retrofit/measure bugs fixed (cooling tune-up, lighting, duct retrofits)
- Sliding Glass Door allowable range increased to 90"
- HVAC combustion to electricity fuel-switch error corrected
- New audit disables audit dock until Ok/Apply
- Run button enables after first Apply of last required form
- Window and Addition Windows: All List and form "Glazing Type" now consistently displaying appropriate values
- Addition Walls: Wall height warning added

NEAT

- Smart Thermostat measure properly evaluated and reported
- Window Replacement measure properly evaluated and reported
- Utility Bill Adjustment run bug fixed
- Measure materials updated/fixed
- Windows: Skylight details now copied with audit
- Attic (Finished and Unfinished): New warning displayed when deleting attic with attached skylight
- Reports - Recommended Measures report Materials Table now includes materials for Required and Required + Include in SIR measures without reprint
- Reports - Recommended Measures report Materials Table now consistently captures User Defined attic insulation type and depth/R-value without reprint
- Windows - Window latent load calculations corrected (update in WAV10 NEAT engine)

General:

- Consistent versioning information across all reports
- Commas and plus signs not allowed for resource names, programmatically enforced now
- Miscellaneous extraneous logging removed
- Filtering and search on lists not working after first filter/search fixed
- Key Parameter libraries separated for v8 and v10
- Comma and plus sign prohibited from names system wide
- Clear cache command for Mac added to Release Notes
- Lifetime Saving added to NEAT/MHEA result set
- Fuel Cost Libraries: 2021 and 2022 libraries added and available upon request

- Library and Component Names: Comma and plus sign no longer allowed
 2. The engineering methods and foundation used in WAv10 remain the same as WA8.9 and are found here: <https://weatherization.ornl.gov/wp-content/uploads/2018/05/NEATEngineering.pdf>, as the WA7 Engineering Manual. The Wav10 Engineering Manual has not been released as of the date of this submission.