

Energy Efficiency and Conservation Branch

Single Family Tool

Fiscal Year 2021

The purpose of the guide is to establish a process for conducting energy audits on single family dwellings within the District of Columbia.- DOEE has recently implemented an owner contribution requirement for all rental properties regardless of dwelling type. -With this implementation, we would like to enhance our auditing process, so internal and external stakeholders are clear of our procedures and protocols when determining potential energy conservation measures for single family dwellings.- This guide will be updated yearly to incorporate new federal and state mandates.

1.1 Initial Assessment Summary

The audit is the initial physical assessment of the home and interaction with the client. The field audit must include at least the following activities:

- 1.2** An assessment of structural, health and safety hazards, and overall air quality which includes, but is not limited to: moisture, mold, or evidence of past moisture problems.
- 1.3** An inspection of the condition of all attics, including wiring and electrical splices, heat sources, air leakage, bypasses, mechanical ventilation, and venting.
- 1.4** An assessment of site drainage.
- 1.5** An assessment of the chimney or other vent locations/conditions and general roof condition.
- 1.6** Other energy related health and safety hazards.
- 1.7** An assessment of window/door condition.
- 1.8** Information Collection: Record the existing conditions of the dwelling and its mechanical systems.
- 1.9** Dwelling Evaluation: Evaluate the existing conditions for energy conservation opportunities and energy-related health and safety problems.
- 1.10** Dwelling Strategy: Develop a strategy for improved energy efficiency and for correcting energy-related health and safety problems.

2.1 Client Interview

Energy Program Specialist conducts phone interviews prior to

the energy audit being scheduled to determine if any pre-existing conditions exist that may prevent an energy audit from being conducted. Examples of pre-existing conditions are extensive roof damage, excessive clutter, sewer leaks, and/or damage. DOEE energy auditor(s) conduct on-site interviews with weatherization clients prior to starting the energy audit. This interview process provides the auditor with enough background information to properly identify hazards that exist, assist in the identification of any health and safety issues, and to gain a better understanding of the energy conservation opportunities. This also provides the auditor with an opportunity to identify and do the following steps:

2.2 Problem identification, such as dwelling use, heating and cooling habits, and comfort issues. Discuss energy conservation opportunities and health and safety issues with the client.

2.3 Inform the client and/or owner about any hazards.

2.4 Give all clients whose homes were built before January 1, 1978 an EPA Renovate Right pamphlet. A client signature indicating receipt of the Renovate Right pamphlet is required to be included in the client file.

2.5 Document in the file that any and all health or safety problems were indicated to owners and clients.

3.1 Hazard Assessment

To safeguard the lives and well-being of all parties, auditors are required to conduct a hazard assessment during the initial home audit, prior to the beginning of any weatherization work. Identified hazards 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 hazards and addressed if found to be deficient:

3.2 Indoor Air Quality and Ventilation: The energy audit shall include inspection of air infiltration sources, air barriers, and ventilation.

- Consider the house ventilation as a system, including both whole-building ventilation and local exhaust ventilation.
- Identification of sources of indoor air pollutants;

chemicals posing a health risk to workers or clients.

- For houses with an attached or “tuck under” garage, identification of joints, seams, penetrations, openings between door assemblies and their respective jambs and framing, and other sources of air leakage through walls and ceilings separating the garage from the residence and its attic area.
- Evaluation of terminations of all exhaust fans and clothes dryer vents.
- Evaluation of existing ventilation systems in the dwelling.
- Inspection of clothes dryer vents for restrictions, lint build-up, and appropriate venting configuration.
- Determination of the ventilation needs. Calculation of minimum ventilation rate using ASHRAE 62.2.2016. Mechanical ventilation may be necessary based on pre-existing indoor air quality issues. Calculate the Air Changes per Hour @ CFM50 (ACH @ CFM50). Assessment for non-DOE units. Calculation: $\text{CFM50}_{\text{final or estimated final}} \times 60 \text{ divided by volume}$ ($\text{CFM50} * 60/\text{volume}$). If 3 ACH @ CFM50 or less an ASHRAE assessment is required.

3.3 Moisture Control: Energy audit shall include the following:

An inspection for evidence of exterior water intrusion, such as roof leaks, foundation leaks, fenestration assembly leaks, and groundwater intrusion.

- Homes with non-correctable standing water will not be considered for a closed crawl space.
- Inspection for evidence of damage caused by interior water sources, such as plumbing leaks or condensation on piping, ductwork, or other interior surfaces.
- Inspection for effects of water damage on buildings, such as structural damage, mold, mildew, efflorescence, and stains.
- Identification of existing vapor retarders, flashing, gutters, or other moisture-control strategies.

3.4 Structural & Other Problems:

- Roofing condition
- Window and door condition

- Siding condition
- Foundation condition
- Interior wall, floor, and ceiling condition
- Homes under renovation or under construction

3.5 Electrical Wiring: An electrical wiring inspection assessment must be conducted.

- Inspect and assess the house to identify knob and tube wiring. Non-contact testing method must be used to determine if wiring is live.
- Home electrical circuits must be grounded where a new refrigerator will be installed. Repairs to ground the outlet and/or circuit must be charged as an IRM associated with the refrigerator.
- Before installing insulation over electrical wiring the following must be assessed and corrected.
- Wiring types #14 Copper or #12 aluminum should be protected by a fuse or breaker rated for no more than 15 amps.
- Wiring types #12 copper or #10 aluminum should be protected by a fuse or breaker rated at no more than 20 amps.
- S-type fuses must be installed to replace T base fuses.
- Outlets and switches must be checked and documented prior to installing insulation in walls or ceiling cavities.
- Wiring splices must be enclosed in metal or plastic electrical boxes and fitted with cover plates before being covered with insulation.

3.6 Asbestos: Assess potential asbestos hazard.

- If one is unsure whether material contains asbestos, they must contact a qualified asbestos professional to assess the material and sample and test as needed.
- Blower door testing is not allowed, be it pressurization or depressurization, unless testing results prove negative - for vermiculite materials containing asbestos or friable asbestos.

3.7 Lead Paint:

- Presence of lead based paint in pre-1978 homes will be assumed unless testing confirms otherwise.
- The Environmental Protection Agency (EPA) Renovation, Repair, and Painting (RRP) Program Rule

(40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/May 6, 2010) will be complied with, to be superseded by any subsequent final rulemaking or any more stringent state or federal standards.

4.1 Emergency Assessment

All hazardous situations, including gas leaks, fire hazards, carbon monoxide(CO), etc. that present an immediate threat, require immediate action. At a minimum, this includes notifying the client and contacting a Branch Chief so an emergency report can be generated to address the condition if leverage funding is available.

4.2 Clients may not be left without heating during the heating season.

4.3 If there is a strong smell of leaking gas, auditor must tell the client and ask them to leave the home. The auditor must leave the home and call the Branch Chief, the utility company, and/or 911, depending on the seriousness of the matter.

5.1 Health and Safety Policy

The energy auditor prepares the report to ensure that the health and safety activities such as emergency or urgent health and safety deficiencies are addressed prior to beginning any work on the building shell. Non-urgent health and safety activities may be completed after building shell activities. The energy auditor will take pictures to document hazards, concerns, questionable situations, etc., and make sure digital images can be linked back to the job. Once the job is assigned to the Subgrantee they are charged with documenting findings as well. In accordance with 10 CFR 440 and WPN 17-7, which defines those activities allowed as health and safety measures according to DOE, 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:

- A health and safety measure cannot be performed in a unit unless an energy conservation measure (ECM) is also part of the scope of work.
- Repair of health and safety issues do not cause a subgrantee to exceed their annual per unit average (PUA).
- The repairs **MUST** be undertaken in order to effectively perform weatherization work, or the

actions are necessary because of weatherization activities.

6.1 Health and Safety Assessment

The Energy Auditor conducts health and safety assessments of all units as a part of the audit process. The following items are documented and stored electronically in Quickbase for Subgrantee review and the original is in the client's file:

- Auditor must have health and safety inspection form completed and signed by the client;
- Evaluation of combustion appliances and testing;
- Evaluation of ventilation needs;
- Identification of existing and/or potential moisture issues;
- Identification of areas containing known or suspected hazardous materials including, but not limited to, lead, asbestos, and mold;
- Visual inspection and testing for existence of live knob and tube wiring; and
- Identification of obvious electrical hazards.

7.0 Combustion Appliance Assessment

- 7.1 CO monitors will be assessed and installed if none exist; all homes must have a working CO monitor.
- 7.2 CO warning equipment will be installed outside of each separate sleeping area in the immediate vicinity of the bedrooms in accordance with the District of Columbia Property Maintenance Code (2013). The equipment installed must be 10-year sealed-in, non-replaceable lithium ion battery, combination alarms that comply with UL 217 (Standard for Smoke Alarms) and UL 2034 (Standard for Single and Multiple Station Carbon Monoxide Alarms).
- 7.3 Where solid fuel burning equipment is present, fire extinguishers may be provided as an allowable health and safety measure.
- 7.4 Ambient CO will be monitored during combustion testing and testing will be discontinued if ambient CO level inside the home or work space exceeds 35 parts per million (ppm). If the ambient CO levels are:
 - In the range of 9 ppm - 35 ppm,

per ANSI/BPI-1200-S-2017
Section 7.3.3.3.3 the auditor shall advise the homeowner/occupant that CO has been detected and 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, the homeowner/occupant shall be advised to contact a qualified professional

- In the range of 36 ppm - 69 ppm, per ANSI/BPI-1200-S-2017 Section 7.3.3.3.2, the auditor shall advise the homeowner/occupant that elevated levels of ambient CO have been detected. Windows and doors shall be opened. The auditor shall recommend that all possible sources of CO be turned off immediately. Where it appears that the source of CO is a permanently installed appliance, the auditor shall recommend that the appliance be turned off and generate an emergency work order.
- Per ANSI/BPI-1200-S-2017 Section 7.3.3.3.1, if the ambient CO levels are 70 ppm or greater, the auditor shall immediately terminate the inspection and notify the homeowner/occupant of the need for all building occupants to evacuate the building. The auditor shall immediately leave the building and the appropriate emergency services shall be notified from outside the home.

7.5 Raw fuel leaks will be monitored for before entering building spaces. If leaks are found, testing will be

discontinued and the condition must be reported to the occupant immediately, per SWS# 2.0105.1c. Testing for gas leakage at connections of natural gas and propane piping systems will be completed.

Leakage will be located using an approved combustible gas detector, a non-corrosive leak detection fluid, or an equivalent non-flammable solution. Matches, candles, open flames, or other methods that could provide a source of ignition cannot be used. Where leakage or other defects are located, the affected portion of the piping system will be repaired or replaced and subsequently retested.

- 7.6 Examine appliances for signs of damage, misuse, improper repairs, and lack of maintenance.
- 7.7 Inspection of combustion venting systems for damage, leaks, disconnections, inadequate slope, and other safety hazards.
- 7.8 Place the Combustion Appliance Zone (CAZ) under worst case depressurization conditions.
- 7.9 Spillage testing must be completed for all natural draft space heating systems and water heaters. 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 (e.g. room pressure relief, additional combustion air, sealing return duct leakage) (Variance Request Approval).

7.10 With the CAZ in the worst case depressurized state, test spillage on smallest BTU appliance first. If spillage in a combustion appliance, with a warm vent or domestic water heater exceeds two minutes during pressure testing, measures will be specified to mitigate. Similarly, if spillage in a combustion appliance, with a cold, vent exceeds five minutes during pressure testing, measures will be specified to mitigate.

- 7.11 CO will be tested for in undiluted flue gases of combustion appliances. If CO levels exceed 200 ppm as measured, or 400 ppm air-free measurement, service will be provided to reduce CO to below these levels (unless CO measurement is within manufacturer specifications). If the outlet of the exhaust is accessible, include a CO test on all sealed-combustion, direct vent, and power-vented appliances without atmospheric

chimneys.

- 7.12 Heat exchangers will be inspected for cracks.
- 7.13 Gas ovens will be tested for CO. A clean and tune will be conducted if measured CO in the undiluted flue gases of the oven vent at steady state exceeds 225 ppm or 800 ppm by air-free measurement.
- 7.14 Gas range burners will be tested. Specifically clean and tune if the flame has any discoloration, flame impingement, or an irregular pattern or if burners are visibly dirty, corroded, or bent.
- 7.15 Solid fuel burning appliances will be inspected and assessed for safe operating conditions. If the solid fuel burning appliance is the primary heat source and has signs of structural failure, replace solid fuel burning appliance with UL -listed and EPA - certified appliances if the existing appliance is not UL -listed.

9.0 Unvented Space Heaters

- 9.1 With the occupant's permission, unvented heaters will be removed, except when used as a secondary heat source, and when it can be confirmed that the unit is listed to ANSI Z21.11.2
- 9.2 Units that are not being operated in compliance with ANSI Z21.11.2 must be removed before the retrofit but may remain until a replacement heating system is in place.
- 9.3 Failure to remove unvented space heaters serving as primary heat sources has the potential to create hazardous conditions and thus any further weatherization services will be re-evaluated in the context of potential indoor air quality risks.
- 9.4 Improper heating system installations require remedies prior to continuing work. These systems include, but are not limited to:
 - Combustion heating systems situated in a bedroom, bathroom or closet that are not a sealed combustion system.
 - Furnaces that have no cold air return and no easy place to put one.
 - Furnaces that have no service access.

- Mobile homes with non-mobile home type furnaces.
- Any unvented combustion heater.
Permanently disable or vent (with client/owner permission) the appliance.
- Any furnace that is installed in a dangerous manner and cannot be repaired.

10.0 Carbon Monoxide, Smoke Alarms, and Fire Extinguishers

- 10.1 Every home receiving services will receive a CO and smoke alarm combination units in accordance to the District of Columbia Property maintenance Code.
- 10.2 CO and Smoke alarm combination units will be permitted to be battery operated when installed in buildings without grid power unless there is an attic, crawlspace, or basement available which could provide access.
- 10.3 CO and Smoke alarm combination units must be installed within 12 inches of the ceiling.
- 10.4 Fire extinguishers may be installed in homes with solid fuel burning appliances.

11.0 Mandatory Energy Usage Assessment

- 13.1 Assess energy use information and compare to the condition of the home.
- 13.2 If energy use information is unavailable use the condition and size of the building shell and heating system as an indicator of actual energy use.
- 13.3 Space heating energy use is to be used as a predictor of potential combustion appliance replacement savings.
- 13.4 Baseload energy use is to be used as a predictor of potential savings from the provision of client education and/or from baseload measures, including a potential refrigerator replacement.
- 13.5 ASHRAE Standard 62.2-2016, Ventilation and Acceptable Indoor Air Quality in Residential Buildings, defines the roles of and minimum requirements for mechanical and natural ventilation systems and the building envelope intended to provide acceptable indoor air quality in residential buildings.

12.0 Measure Skipping

14.1 In the event that the building owner, or occupant, refuses a measure and client education techniques are unsuccessful in persuading the building owner or occupant to install the measure, the auditor must deem the option to skip a measure as legitimate or non-legitimate. If deemed as a legitimate reason for a measure to be skipped, all other cost effective weatherization measures should be installed per the standard installation process. Documentation supporting skipping the measure must be included in the client file. Client files which do not contain proper documentation may result in disallowed costs for that, or all job measures.

14.2 If deemed as a non-legitimate reason for measure skipping, only measures with a higher SIR may be installed. All measures below the skipped measure may not be installed. Installation of measures below the skipped measure may result in disallowed costs for that, or all job measures. The following examples are not legitimate reasons for measure skipping:

- Untrained staff on the installation of a measure. Subgrantees are required to have trained staff, or subcontractors, available to install all cost effective measures.
- Cosmetic appearance of finished work.
- Objection to a certain material installed. Subgrantees are allowed to re-run an audit with alternative materials and costs to determine cost effectiveness.
- Additionally associated health and safety issues. ECM may not be skipped in an attempt to avoid additional health and safety costs or job requirements.
- Other reasons which attempt to circumvent the spirit of, or verified approaches to, obtaining maximum cost effectiveness for the program.

13.0 Mandatory Energy Efficiency Measure Assessment

DOEE Quality Assurance inspector must review each audit to

ensure the energy efficiency measures identified are cost-effective. The QA must use the following criteria to establish which EEMs are appropriate for each individual unit by reviewing the documentation provided by the energy auditor:

11.1 **Insulation:** Single Family: Attic, Wall (Blown), Wall (Kneewall), Sillbox, Foundation Wall, Floor. Mobile Homes: Ceiling Cavity, Wall, Floor/Belly, Perimeter. Insulation Assessment must include:

- Measuring the building's dimensions.
- Documenting the net wall and attic square footage.
 - Determining and documenting the thermal boundary; defined as the separation between the interior and exterior environments of a building that slows heat flow and is typically the alignment of the air and insulation boundary.
- Locate and document crawl space/basement entrance.
- Additions to the dwelling.
- Inspect the attic for the presence, depth, and type of insulation.
- Check exterior walls for insulation, cavity depth, and batt thickness.
- Check remodeled areas and additions separately.
- Check the crawlspace, belly, or basement box sills for insulation.
- Note any evidence of moisture transport, condition, and amount exposed above exterior grade at the perimeter foundation and basement walls.
- Document the existing inches of insulation for building components that comprise the thermal boundary and determine the capacity of an insulating material to resist heat flow (R-value). If more than one type of insulation use the R-value for the greater amount of insulation.

11.2 **Storm Windows**

- Single pane windows must be assessed for a storm window addition or a replacement window.
- Double pane windows may also be assessed for storm window

addition.

11.3 **Baseload:** Refrigerator, Water Heater Tank and Pipe Insulation, Boiler Pipe Insulation, High Efficiency Shower Heads and Faucet Aerators, Compact Fluorescent Light bulbs or LED bulbs.

Baseload assessment must include:

- Evaluation of refrigerator energy consumption via a database or metering. At least 10 percent of replacement refrigerators must be metered.
- Refrigerators that are more than five years old must be assessed for replacement.
- Evaluation of water heater fuel type, size, location, condition, R-value of tank insulation, and efficiency.
- Water heaters must be assessed for additional tank insulation regardless of location and installed if cost effective.
- Evaluation of potential efficiency upgrades.
- Evaluation of water usage of shower heads and faucets.
- Evaluation of lighting-efficiency efficient alternatives.
- If the client declines the measure, or the landlord declines financial participation, no further assessment is required. Document reasoning on the field audit and get signatures as feasible.

11.4 **Air Sealing:** Duct Sealing, and Duct Insulation

- Blower door CFM50 assessment must be completed. Reasons not to conduct a blower door assessment include an active fire in a solid burning appliance and asbestos containing vermiculite; reasoning for not completing this assessment must be documented in the file.
- Measure and document major air leakage holes and bypasses.
- Calculate minimum ventilation rate using ASHRAE 62.2.2016. Mechanical ventilation may be necessary based on pre-existing indoor air quality issues. Calculate the Air Changes per Hour @ CFM50 (ACH @ CFM50) Assessment for non-DOE units. Calculation: CFM50 final or estimated final x 60 divided by volume (CFM50 * 60/volume). If 3 ACH or less an ASHRAE

assessment is required.

- Ducts outside the intentionally conditioned space must be assessed using either pressure pan diagnostic testing, whole house subtraction method, or duct blaster. Ducts outside the intentionally conditioned space that test under 1.0pa for pressure pan testing are not required to be sealed.
- Conduct a visual inspection of accessible ductwork.

11.5 **Heating System:** Heating System Replacements and Smart Thermostats

- Evaluation of heating appliance(s) operation, condition, and efficiency.
- Evaluation of heating and cooling distribution system/s operation, condition, and efficiency. Include R-value of duct system.
- Assess and evaluate existing thermostat for ECM replacement with Smart or programmable thermostat.
- Assess and evaluate the heating system for ECM replacement.
 - If the client or the landlord declines the measure and client education techniques are unsuccessful in persuading the landlord or client to install the measure, the auditor must deem the option to skip a measure as legitimate or non-legitimate. If deemed as a legitimate reason for a measure to be skipped, all other cost effective weatherization measures should be installed per the standard installation process. Documentation supporting skipping the measure must be included in the client file. Client files which do not contain proper documentation may result in disallowed costs for that, or all job measures. If deemed as a non-legitimate reason for measure skipping, only measures with a higher SIR may be installed. All measures below the skipped measure may not be installed. Installation of measures below the skipped measure may result in disallowed costs for that, or all job

measures.

12.1 Optional Energy Conservation Assessment Measures

Based on the energy audit report and supporting documentation the QA should review the findings to determine if the following Non Mandatory Energy Conservation Measures for each unit are justifiable since they have an SIR of 1:0 or greater:

- Replacement Windows, Low E Windows, Window Shading, Sun Screens, (fabric, louvered), Window Films
- Electric Vent Dampers & IID
- Flame Retention Head Oil Burners
- Water Heater Fuel Conversion (waiver required)
- Cooler Covers
- Air-Conditioner Tune-up or Replacement for Efficiency
- Water Heater Tank Replacement
- Basement Wall Insulation.
- Rooftop solar photovoltaic power system

15.0 Work Order Determination and Development

15.1 Energy Efficiency 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.

15.2 Incidental Repair Measure: is a repair that is necessary for the effective performance or preservation of weatherization materials. IRM require cost justification through the electronic energy audit; however they are not to be included with the cost of an ECM. Written justification for the necessity of the repair must be in the client file and the repair must be associated with an ECM identified on the Recommended Measures Report. Include the documentation in the comments section of the ECM that the IRM is associated with in NEAT.

15.3 Health and Safety Repair: 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.

- Determine from the site-specific audit recommended measure report which measures are cost-effective. Only ECM measures that have a SIR of 1.0 or greater may be installed. Get bids for repairs, if necessary.
- Select energy related health and safety problems to correct. All health and safety repairs will be listed on NEAT 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 should be treated as an ECM. See WPN 17-7
- Determine if incidental repairs are necessary and cost-effective for the home. Incidental repairs must be listed on NEAT recommended measure report and a cumulative SIR (total project) of 1.0 must be maintained.
- Calculate the estimated number of insulation bags, rolls of insulation, or other materials needed to complete the job.
- Provide a work order with detailed specifications for Subgrantee, as necessary, to understand the materials and procedures necessary to complete the job.
- Inform Subgrantee of any hazards, pending repairs, and important procedures related to their part of the work order.

16.0 Energy Audit Site-Specific Procedures

Energy Auditor(s) are required to use NEAT, for each assessed unit. Electronic documentation of all NEAT reports for each unit assessed must be maintained in the Weatherization Assistant Database and Quickbase. Energy Auditor(s) must assess all mandatory, and any selected non-mandatory energy efficiency measures using the following processes:

16.1 Initial NEAT Assessment: The initial assessment of all mandatory, and any selected non-mandatory energy

conservation measures for single family dwellings within the NEAT software will be run to establish if an assessed measure meets the Savings to Investment Ratio (SIR) of 1:0 or greater.

- All ECM that have a SIR 1.0 or greater must be installed if feasible. The cumulative SIR must be 1.0 or greater.
- Assumptions used for defining “User Defined Measures” in the Weatherization Assistant audits must be approved by supervisor.
- Measures from the audit and any applicable re-run audits, must be included in the work order.