## P3 – Proposed Guidelines for a Home Performance with ENERGY STAR® Comprehensive Home Assessment

Background

One of the features of home performance contracting that makes it unique is the employment of a comprehensive evaluation of the home to determine how the buildings critical subsystems (building envelope, mechanical systems, appliances, lighting and inhabitants) are performing individually and together. This whole house or building science-based approach leads to more comprehensive home improvements, increased energy savings and better attention to health and safety than traditional product sales focused contracting. For this reason, home performance contracting is promoted nationally by EPA and DOE through Home Performance with ENERGY STAR (HPwES). The HPwES Partnership Agreement is clear on the whole house diagnostic approach under the Partner requirement section: "An energy specialist trained in building science principles will perform a complete visual and diagnostic energy inspection of all of the home's thermal and mechanical systems…."

However, as interest in home performance contracting spreads nationally, it has become evident that people have different perceptions of what constitutes the "complete visual and diagnostic energy inspection" of the home and what it should be called. Various utility programs in the past have delivered "energy audits" of one form or another. Since these have not typically come close to the comprehensiveness that home performance evaluations achieve or have resulted in significant home energy improvements, some HPwES program sponsors and supporting organizations developed alternative terms such as "whole house assessment" or "comprehensive home assessment." While implying an activity more in depth than an "energy audit," these terms are still, as of this date, somewhat imprecise and subjective.

Concerned that this imprecision will undermine the credibility and effectiveness of home performance contracting, EPA and DOE propose to adopt the attached guidelines under the term "Comprehensive Home Assessment" (CHA). We would like to receive your comments on them. EPA and DOE will then finalize the guidelines and, if necessary, amend the HPwES program participation agreement to require contractors participating in Home Performance with ENERGY STAR to complete a CHA that meets or exceeds these guidelines.

This proposal does not define the format of the CHA *report,* which, according to the Partnership Agreement, is "a summary report including results and recommendations, including expected costs and savings, and non-energy benefits of implementing the recommendations" that is given to each homeowner or tenant. In addition, this proposal does not define a form or a list of information that must be recorded on a form, nor does it attempt to provide guidance on how to effectively communicate and *sell* the home performance upgrades that are recommended. The CHA is simply the process of assessing a home's performance. The information gathered during the assessment will be used by the contractor as a baseline to make recommendations and to sell home

performance work. Guidance on what information should be included in a summary report to the customer and what information should be reported to the program sponsor for quality assurance purposes will be provided after comments on the CHA are received. We anticipate that the amount of information reported to the homeowner or program sponsor will be much less than what the contractor must consider when completing a CHA in order to make a proposal. In addition, we plan to develop materials that will help in selling home performance work based on this proposed CHA structure.

Proposed Change or New Policy

The proposed CHA guidelines (pages 5 -10 of this document) are based on reviews of existing sponsor based programs, Building Performance Institute (BPI) technical standards, and practices of contractors and consultants. The intent is to minimize confusion in the market and to protect the integrity of the HPwES brand without unduly burdening participating contractors and consultants. Program sponsors may, if they wish, choose to adopt local program standards that exceed the national guidelines in order to address local market needs or as a justification for program incentives. The attached elements of the CHA are laid out in an order to facilitate review; however the CHA can be conducted in whatever order the evaluator is most comfortable with, as long as all of the requirements are met.

Comments Requested

Reviewers are asked to comment on whether the proposed guidelines adequately help the contractor/consultant understand energy usage patterns, health and safety issues and building durability issues without overburdening the contractor/consultant. Reviewers should consider such questions as:

- Does the proposed required element enhance the contractor's/consultant's understanding of the home's energy usage patterns, health and safety or durability?
- Which elements of the CHA should be required or recommended?
- Are the testing methods accurate for gathering home performance data? (e.g. duct testing methodology)
- How much effort does it take? Is the effort justified by the information collected?
- Are there easier, quicker or more reliable ways to obtain the information?
- Do the requirements as a whole take too long – can the contractor/consultant complete them within an acceptable timeframe and cost and without "wearing out their welcome" with the customer?

Areas of Particular Interest to EPA and DOE

There a few elements of the proposed CHA guidelines for which EPA and DOE are particularly interested in receiving comments:

What Do We Call It? As noted above, we propose to adopt the term Comprehensive Home Assessment (CHA) to clearly distinguish the home performance evaluation from other types of evaluations. However, the term "energy audit" appears often in both popular and trade press and may continue to cause market confusion. In fact, members of the media and opinion leaders such as Al Gore and Oprah Winfrey have recently been telling homeowners to get an "energy audit."
Is "CHA" an appropriate term, or should we meet the issue of familiarity halfway with a term such as "Comprehensive Home Energy Audit" or "Home Performance Energy Audit?" Should we meet the issue head-on by simply using the term "energy audit?"

Section B. Utility Bill Review & Analysis. This section calls for the contractor/consultant to disaggregate the customer's electricity and fossil fuel consumption history to gain insight on energy usage patterns. We recommend that the contractor/consultant obtain the information before going out to the home in order to save time and to be better prepared. EPA and DOE recognize that in current sponsored programs which require computer simulation modeling, there is typically no requirement to collect and enter the consumption history, and in most cases the contractor doesn't collect this information because it adds to an already significant time burden. Ironically, contractors using sophisticated modeling tools that accommodate consumption data are not collecting consumption data that will help them during the evaluation *and* improve the accuracy of their modeling. Is the requirement to collect this data and use it too much of an additional burden for programs using simulation models? Is it an appropriate guideline for programs not requiring simulation modeling?

Section F.3: Radon Test Recommendation If Home is in a High Radon Area. EPA and DOE are concerned about unintended health and safety consequences of tightening up homes in high radon areas. Radon concentrations are relatively well known and mapped out nationally. Should there be a requirement to educate homeowners on this potential threat and offer to conduct additional testing (noting that a 3-day period is usually required)? If a requirement is justified, should the contractor recommend the test before and after tightening the house, or just after the installation?

Sections E.3.b.i and ii: Duct Leakage and Air Flow Tests for Furnaces and Central Air Conditioners.

Duct leakage and air flow testing during the comprehensive home assessment is not currently required by all local and regional HPwES programs. Duct leakage diagnostic tests are an important method of evaluating the air tightness of a duct system and determining the need and locations for duct sealing. Air flow tests help the contractor determine whether the furnace or air conditioning system has been designed or is working properly. BPI standards state that "when duct sealing is recommended, the work scope must include pre and post-installation duct leakage and system airflow testing."[1] However, BPI doesn't explicitly require the tests as a standard part of every

[1] Building Performance Institute, "Technical Standards for Certified Building Analyst I", Malta, NY, v2/28/05mda, p. 17.

home assessment. Some contractors have chosen not to focus on sealing ducts in order to avoid this extra testing, thereby missing the opportunity to deliver an important energy efficiency and health and safety measure. Others may perform duct sealing but fail to conduct the tests or report the work.

Duct testing and air flow testing are now recognized by the HVAC industry as essential components of central heating and cooling system installations. The new HVAC Quality Installation Specification published by the Air Conditioning Contractors of America (ACCA), under the auspices of the American National Standards Institute (ANSI), includes requirements on duct leakage, air flow across the heat exchanger and total air flow balance that require testing, verification and documentation.[2] The attached CHA guideline applies the ANSI/ACCA principals to the CHA in order to ensure that system duct leaks and air flow deficiencies are addressed in all homes receiving home performance services, not just homes for which new central HVAC systems are installed.

In Section E.3.b.i, the proposed guideline provides for a duct leakage test to complement the visual duct inspections that occur during the attic and basement inspection. The guideline allows for a choice of test based on the contractor or consultant's judgment of the most appropriate test (or sequence of tests) for the type of home and the configuration of the ductwork. Much debate remains about the most appropriate form of duct testing. Based on the availability of alternative testing methods, the guideline leaves the decision of which test(s) to perform up to the contractor. Is this appropriate?

Air flow is another very important diagnostic test. Derivation of a reliable air flow number (or a proxy total system static pressure or temperature rise/drop) can help the contractor/consultant diagnose whether a central heating or cooling system has been designed and is working properly. Many industry experts consider the duct blower (blaster) test to be the most accurate in measuring total air flow. However, given the reluctance by many to deploy a duct blaster because of the time to set the test up, are the other listed airflow testing methodologies accurate enough to justify their use as a basis for a requirement in this area? The idea in this section is to provide choice, but to ensure that the least rigorous test from an accuracy and informational standpoint is still good enough to protect the integrity of the program.

[2] Air Conditioning Contractors of America, "HVAC Quality Installation Specification," Standard Number ANSI/ACCA 5 QI-2007, Arlington, VA, March 2007.

**Home Performance with ENERGY STAR**
**Comprehensive Home Assessment (CHA) Guidelines**

## A. Homeowner Interview

1) (Recommended) Conduct homeowner telephone interview to get basic information on the home and the homeowner's concerns, as well as to obtain energy consumption history and get head start on disaggregating bills
2) Conduct homeowner interview to collect information on:
    a) Year home built, time in the home, remodeling, renovations, bonus rooms, number of inhabitants, age of roof, heated or unheated basement; level of attic and wall insulation if known; age and condition of windows (drafts, condensation)
    b) Allergies, comfort complaints (cold rooms/hot rooms), excessive dust, moisture issues, ice damming or other common climate specific issues, indoor air quality complaints, odors, water leaks, high utility bills, other questions or complaints
    c) Number of fireplaces and use of unvented fireplaces and space heaters
        i) If there are unvented fireplaces or space heaters, educate customer on moisture problems and carbon monoxide and fire risks, and inform them that shell work can't be performed unless they are removed or, in the case of fireplaces, retrofitted with a vent kit.
    d) Swimming pool – typical open & close dates, hrs/day of pump operation, heated or not
3) Conduct quick walk-through with customer to ascertain additional information (important for making sure homeowner has opportunity to bring up any issues or concerns that s/he has with any major items in the assessment)
    a) Space heating fuel, age and service frequency, number of zones, thermostat settings, auto or manually set back
    b) Space cooling: central or room air (number), age
    c) Domestic hot water (DHW) fuel & age
    d) Clothes Dryer age, fuel and whether vented to outside
    e) Age of refrigerator(s), freezer, dishwasher, clothes washer, dehumidifier
    f) Number and location(s) of carbon monoxide and smoke alarms
    g) Use of CFL's or fluorescent fixtures – educate on energy savings and ascertain customer's acceptance of CFL's

## B. Utility Bill Review & Analysis

1) Disaggregate Cooling, Heating, DHW, Base-load fossil and electricity usage
    a) (Recommended): Receive information and disaggregate the bills before going out to the house in order to save time
2) Discuss observations about disaggregated energy usage with homeowners, & identify measures to reduce it
3) Educate customer on base-loads, generate interest in high-efficiency appliances and lighting, as well as in core air sealing, insulation, HVAC, water heating measures

## C. Appliance and Lighting Inspection

1) Record age, type and condition of major appliances and showerheads
    a) If homeowner has any older appliances, educate them on ENERGY STAR

b) Educate them on water and energy savings from low-flow showerheads

2) Inspect lighting for any obvious opportunities to upgrade to ENERGY STAR compact fluorescents (CFLs) or fixtures

**D. Building Envelope Inspection**

1) Basic home information
   a) Record house type, age and condition
   b) Note key features of home typical of house type (porch roof, multiple roof lines, cantilevers, bay windows, dormers, kneewall attics, crawlspaces, attached garage)
   c) Note configuration of home additions, if any
   d) Record house orientation and look for opportunities for renewable technology (e.g., access to sunlight on south and west sides)
   e) Draw house floor plan with orientation, exterior measurements, measure volume and calculate Building Performance Institute (BPI) minimum ventilation guideline (MVG)/building air tightness standard (BAS)
2) External features affecting shell of home
   a) Note condition/durability of siding, trim, fascia, soffit areas
      i) Looks for signs of moisture or ice dam damage in walls and soffits resulting from a building performance failure
      ii) Check for roof moisture damage (stains, soft or rotted deck or rafters, wet or moisture-damaged insulation) from roof leaks or inadequate ventilation
   b) Count attic vents, estimate their total area, and determine whether attic venting is adequate (make sure attic vents are not blocked if they are to be counted)
   c) Note any issues with shading or exposure to sun (linked to issues with hot/cold rooms and can help prioritize window-related measures)
   d) Note any grading features that may direct water to basement or crawlspace
3) Shell Thermal Characteristics (Insulation, Windows and Doors)
   a) Determine thermal boundary of home
   b) Insulation: Record type(s), amount, and condition of insulation in all components of the thermal boundary:
      i) Attic flats, slopes, knee walls and knee wall flats, as appropriate for type of home and per configuration of additions
      ii) Exterior Walls (use probe if necessary)
      iii) Basement and crawlspace walls or ceilings
      iv) Rim joists
      v) Attic staircase walls
   c) Window Inspection
      i) Count windows & measure window area and orientation
      ii) Record number of panes/presence of storm windows
      iii) Note condition of windows – age, condition, signs of moisture damage around windows. ~~Record possible presence of lead paint if suspected~~
   d) Door Inspection
      i) Note type and condition of all doors to exterior (including garage) – especially note if doors are uninsulated, interior doors or in poor condition
4) Shell Air Leakage Characteristics (Determining the Opportunity for Air Sealing)

a) Blower Door Test (do NOT conduct this test if there is presence of asbestos-like material anywhere in the home
    i) Depressurize home to -50 Pascals if possible and record CFM50 (make sure to extrapolate accurately if house can't reach -50 Pa)
    ii) Conduct pressure differential tests if needed to diagnose particular problem areas
    iii) Walk through home to determine major leakage areas in living area – use smoke pencil at a minimum, but IR is strongly recommended, not only for finding the air leaks and weak insulation spots, but also for the value of engaging the homeowner in the discovery process
    iv) Determine any significant misalignments of the pressure and thermal boundaries, and ways to mitigate them
    v) Compare CFM50 reading to MVG/BAS and note if home is already very tight or over-tight
b) Visual Inspections
    i) Attic (doesn't have to be during blower door test): openings in wall top plates, electrical and plumbing runs, open areas around flues and chimneys, recessed light cans, open framing cavities, dropped soffits and ceilings
    ii) Basement (doesn't have to be during blower door test): openings around electrical and plumbing runs and around flue pipes and chimneys, sill plates, basement windows, exterior doorways
    iii) Living Space (best during blower door test): window trim, baseboards, upper trim, cabinets, dropped soffits, pocket doors, recessed lighting, duct chases/plenums, band joists, transitions between porch roof and exterior wall, fireplaces, cantilevered floors, etc.

**Note: particular attention should be given to any walls or ceilings between an attached garage and the living space – correction of all air leaks in such surfaces must be addressed in the comprehensive workscope due to the potential for infiltration of carbon monoxide and other fumes from the attached garage.**

**E. Inspection of Mechanical HVAC (Heating, Ventilation and Air Conditioning) Systems**

1) Heating System
    a) Verify system information: age, model, heat in/out
    b) Review maintenance record for frequency of tune-ups and record of repairs
    c) Record steady state efficiency (SSE) test result (can be recorded while conducting combustion safety tests, below)
    d) If furnace, check duct connection
    e) If high-efficiency unit with condensate line, check the line for blockage
2) Air Conditioning System
    a) Name plate info on central air conditioner condenser unit (tonnage, EER or SEER – sometimes determined by model number)
    b) Note any issues around compressor/fan unit in yard, such as open exposure to sun or problems with leaves, twigs or other debris
    c) Number of window or wall units and model & EER info if available

3) Distribution System(s)
    a) Air Handlers and Coils
        i) Determine condition of air handler and coil and need for cleaning
        ii) Inspect air filter(s) and check with homeowner on frequency of change outs
        iii) ~~Check for proper slope and drainage of coil~~ overflow pans and condensate drain lines
    b) Ductwork
        i) Conduct a test to ~~determine~~ duct leakage, using one of the following methods: Duct Blaster® or other whole duct pressurization test, blower door subtraction method, Delta Q test, pressure pans or flow hood
        ii) ~~Conduct a test to determine adequacy of air flow, using one of the following methods: flow plate, flow hood, static pressure test, temperature rise/drop test, or Duct Blaster®,~~
        iii) Record insulation level of ducts in unconditioned spaces
        iv) Check for ductwork disconnects, crimps and signs of moisture damage from condensation or leaks
        v) ~~While air handler is running, check for air leakage points (especially return ducts in combustion appliance zone, which can deliver carbon monoxide to living space)~~
    c) Boiler System Hot Water Pipes, Baseboard and Radiators
        i) Record insulation levels and note opportunity for pipe insulation if practical, especially on long pipe runs if there are comfort delivery issues
        ii) If baseboard, check for condition and positioning of covers and for presence of dust, webs and other material on the fins
        ~~iii) If radiators, check for trapped air~~
4) Water Heater
    a) Record age, model, gallons
    b) Note temperature setting on water heater, educate homeowner on standby losses and scalding threats if it's high, and turn it down if homeowner approves
    c) Check for signs of leakage from water heater or boiler vessel
    d) Conduct visual inspection of water heater and hot water pipes for efficiency improvements (presence or lack of insulation, convective loop, feasibility of retrofitting insulation on tank and/or pipes)
5) Mechanical Ventilation
    a) Check whether mechanical exhaust venting systems in bathrooms and kitchen, if present are designed, built and terminated properly
    b) Note presence and operability of powered attic or whole-house exhaust fans ~~for potential to affect combustion appliance zone (CAZ) pressures; include in CAZ test, below~~.

**F. ~~Health and Safety~~ Tests and Inspections**

1) Combustion Safety
    a) ~~Living Space – General combustion safety issues~~
        ~~i)~~ ~~Take CO readings in living space during combustion safety testing and oven testing (below)~~
        ~~ii)~~ ~~Note number, location and operability of CO detectors in living space~~

iii) Note presence of unvented gas fireplaces and propane or kerosene space heaters and discuss with homeowner immediately – explain that shell work cannot be performed unless they are removed or, in case of some fireplaces, vented with a retrofit kit
iv) Record outside temperature for draft tests on vented appliances (water heater, furnace or boiler, below) – required to calculate BPI standard

b) Combustion Appliance Zone Safety Inspection
i) Record swing between base and worst case CAZ depressurization and compare to the BPI depressurization standard for the given CAZ's combustion equipment venting configuration
ii) Verify presence and operability of CO and smoke alarms in CAZ
iii) Monitor ambient CO in CAZ during combustion appliance testing
iv) Make sure there are no flammable or explosive materials near any combustion source – move them to a safer place and educate the customer about their danger.

c) Water Heater Health and Safety Inspection
i) Check for evidence of back draft/flame roll-out
ii) Verify that pressure relief valve is operable
iii) Check adequacy of venting (pitch, elbows, configuration of connections) and note any problems that need to be addressed
iv) Conduct worst case spillage, draft and CO tests per BPI Technical Standards for Building Analyst I, page 12 (Note that spillage test should be done on the smallest appliance in the CAZ first)
v) If either the worst case spillage or draft test fails, test under natural conditions per BPI Technical Standards for Building Analyst I, p. 12
vi) For failed tests or elevated CO levels, follow action levels in BPI Technical Standards for Building Analyst I, p. 13

d) Heating System Health and Safety Inspection
i) Check for evidence of back draft/flame roll-out
ii) Check condition of heat exchanger
iii) If furnace, check for flame disturbance when air handler goes on
iv) Check adequacy of venting (pitch, elbows, configuration of connections)
v) If present, check condensate line
vi) If boiler, verify whether pressure relief valve is operable
vii) Conduct worst case spillage, draft and CO tests per BPI Technical Standards for Building Analyst I, page 12 (Note that spillage test should be done on the smallest appliance in the CAZ first)
viii) If either the worst case spillage or draft test fails, test under natural conditions per BPI Technical Standards for Building Analyst I, p. 12
ix) For failed tests or elevated CO levels, follow action levels in BPI Technical Standards for Building Analyst I, p. 13

e) Oven Health and Safety Test

~~i) Test gas oven for CO and inspect range per BPI Technical Standards for Building Analyst I, pp. 14.15~~
~~ii) Record CO in kitchen during test~~

~~f) Dryer Health and Safety Inspection~~
~~i) Check dryer vent for obstructions (length, number of turns, lint) and for termination location~~
~~ii) Check for adequacy of vent pipe on gas dryer (should be metal flue pipe, not plastic~~

~~g) Gas Pipe Leak Inspection~~
~~i) Conduct gas leak test on all accessible gas pipe in the home (furnace, water heater, oven, dryer, fireplaces) using gas detection equipment~~

2) ~~Mold and~~ Moisture Inspections
   a) Determine whether there is an adequate vapor barrier in the basement or crawlspace (especially with open crawlspace)
   b) Check basement for moisture damage and ~~presence of mold~~ on basement floors, walls, sill plate area, around basement windows and bulkhead doors
   c) Check attic for moisture damage and ~~presence of mold~~ on roof deck, rafters, joists, insulation (wet or moisture-compacted insulation)
   d) Inspect condition of windows and look for signs of condensation or other damage
   e) If there is evidence of high moisture levels in the living space, check dark walls behind headboards, furniture ~~, mold will tend to grow where there is less light~~
3) Attached garage
   a) Inspect for visual signs of air leakage into the living space that can be corrected from the garage in order to help prevent infiltration of carbon monoxide or other gases.
4) Radon Test Recommendation
   a) Ask if the home has been tested for radon and, if not, recommend that it be tested after home performance work is complete

## G. CHA Summary Report[3]

1) Discuss overview of inspection findings and present recommended scope of work to customer
   a) Recommendations should include all measures that save energy, ensure health and safety, address homeowner concerns and improve the durability of the home
   b) Recommendations should be accompanied with a rough estimate of energy savings and some indication of the return on investment, such as simple payback

[3] During the initial CHA visit, the contractor should be prepared to *discuss* findings, recommendations and estimate the associated energy savings. It is acceptable for the written CHA report to be delivered to the customer later and for the customer to sign a contract prior to receiving the written summary report, as long as the contractor has *discussed* a comprehensive set of recommendations with estimated energy savings.