Prepared by:

ICF International

For

Baltimore Gas and Electric Company

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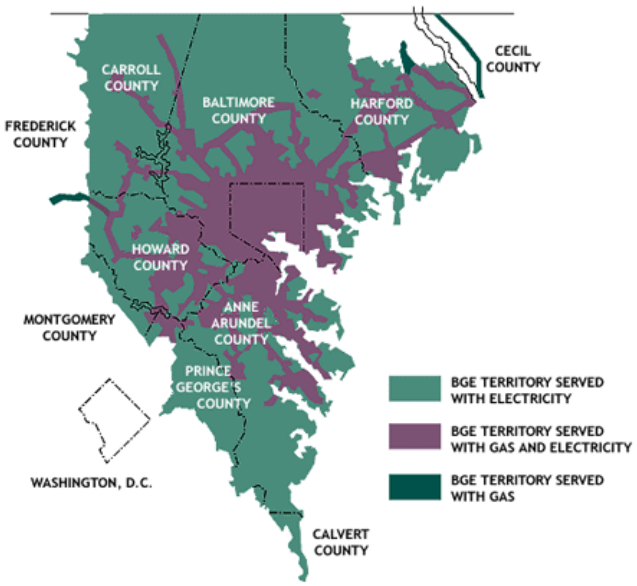
Contents

Section 1: Introduction

1.1 Program Sponsor



For nearly 200 years, BGE has been meeting the energy needs of Central Maryland. BGE serves more than 1.2 million business and residential electric customers and more than 630,000 gas customers in an economically diverse, 2,300-square-mile area encompassing Baltimore City and all or part of 10 Central Maryland counties.

As global energy prices have risen, BGE wants to provide our customers with options to help them control their energy costs, save money and protect the environment. What's more, BGE is responding to the EmPOWER Maryland Act of 2008, which aims to reduce Maryland's per capita energy consumption 15% by 2015.

BGE's Smart Energy Savers Program[SM] is a family of smart choices that will help conserve energy, save money and improve the environment. By providing a variety of programs, services and incentives, we are working to accomplish these goals together with our valued customers.

1.2 Home Performance with ENERGY STAR Program

The primary objective of the Home Performance with ENERGY STAR (HPwES) Program is to motivate residential energy consumers to use a comprehensive, whole-house approach to reducing energy consumption when considering home improvements. BGE's strategy for the Home Performance with ENERGY STAR Program is to target customers with high energy usage, as well as homes built prior to 1980.

> HPwES programs promote a broad array of measures, such as new heating and air conditioning equipment, air sealing, and adding insulation. Participating contractors are also encouraged to promote ENERGY STAR appliances and lighting.
>
> Rather than focusing on a single component or measure, the HPwES contractor conducts a battery of tests that result in a comprehensive energy audit of the home. This enables the HPES contractor to recommend a range of energy-saving measures and upgrades that result in a more comfortable home, with lower energy consumption. Required tests include a blower door test, a duct leakage analysis, combustion safety testing and analysis (gas, oil, furnace, oven), and gas leak detection.

Another objective of the program is to develop a trained and certified group of home performance contractors capable of providing whole-house energy services in the market.

HVAC, insulation, and home improvement contractors will be offered training opportunities and encouraged to have their staff certified by organizations such as Building Performance Institute (BPI). These contractors will also be encouraged to make the commitment to quality and whole-house improvements by their companies becoming a BPI Accredited Company.

BGE's HPwES program also pays cash incentives to customers for installing the recommended energy efficiency measures. For example, the program provides incentives for replacing an air conditioner or natural gas furnace, and increasing the level of insulation and air sealing.

This offer is valid for BGE residential customers applying through the Home Performance with ENERGY STAR Program only. This offer is open to all BGE residential electric and/or gas customers, regardless of their electric and/or gas supplier. Projects must be installed in the BGE service territory.

Participants applying for Home Performance with ENERGY STAR incentives must have:

a) Central A/C Unit, Air Source Heat Pump, or other primary electric heating system, and receive electricity service from BGE

or

b) Gas Furnace or Gas Boiler, and receive gas service from BGE.

Customers applying for HVAC-only incentives should submit a rebate application through the HVAC Equipment Rebate Program.

The majority of energy savings from HPwES are expected to come from the following measures:

- Air sealing
- Attic and wall Insulation
- Air conditioner and heat pump tune-ups
- Air conditioner replacements (14.5 SEER, 12 EER minimum)
- Heat Pump replacements (14 SEER, 11.5 EER, 8.5 HSPF minimum)
- Gas heating system tune-ups and replacements (minimum 92% AFUE)
- Duct sealing and duct insulation (in unconditioned spaces)
- Lighting (CFL lamps and fixtures)
- Domestic Hot Water (DHW) tank wraps, Low-flow showerheads, and faucet aerators

1.3 Program Implementer

ICF International works on behalf of BGE to implement the Smart Energy Savers Program[SM] which includes Home Performance with ENERGY STAR. ICF provides:

- Program design and development
- Contractor participation recruiting, training, and account management

- Review of job paperwork and periodic on-site verification of improvements
- Marketing outreach and reviews of participating contractor marketing materials.
- Processing of customer and contractor incentives
- Point of contact for all program activities

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Section 2: Summary of Program Participation Requirements

These requirements represent minimum standards for participation in BGE's Home Performance with ENERGY STAR Program.

2.1 Customer Participation Requirements

Any customer served by BGE at a single family attached (row house or townhome) or detached home is eligible to participate in the program. Renters must have written landlord consent. Customers may receive incentives for multiple homes (i.e., multiple locations with unique BGE account numbers).

2.2 Contractor Participation Requirements

To participate in BGE's Home Performance with ENERGY STAR program, contractors must do the following:

1. Sign a participation agreement
2. Attend BPI training for Building Analyst
    - Schedule/receive mentoring sessions (before or after certification)
    - Take BPI Building Analyst and Envelope Professional Written and Field exams
3. Receive confirmation of BPI certification (required to have at least 1 staff person with Building Analyst certification)
4. Submit required documentation (proof of insurance, copies of appropriate licensing, BPI certification)
5. Provide a guarantee for all work performed (all materials, equipment, parts, and workmanship) under the Home Performance with ENERGY STAR Program for one year. Contractors must provide customers with a written warranty.
6. Receive administrative training
    - Program incentives
    - Policies and procedures
    - Reporting process
        i. Beacon Home Energy Advisor Software
7. Become an official participant
    - Added to BGE HPwES "Find a Contractor"
    - Given access to HPwES Logo
    - Receive stock of "What to Expect Brochures"
8. Begin offering Home Performance with ENERGY STAR

9. Meet requirements of HPwES Program

   HPwES contractors must follow BGE's Home Performance with ENERGY STAR guidelines, policies, and technical standards, adhere to Maryland state laws and licensing requirements, and comply with local building code, permit, and inspection requirements. Failure to comply may result in probation, suspension, or expulsion from the program.

   - Utilize Beacon Home Energy Advisor to estimate savings from improvements
   - Submit copies of contracts with scope of work defined, and documented post-installation test-out and reporting.

2.3 Marketing Policies and Procedures

1. Participating contractors may promote the Home Performance with Energy Star program by distributing approved program materials provided by BGE.
2. You may put a link on your company's Web site to the BGESmartEnergy.com Web site.
3. You may NOT co-brand your company with BGE without the consent of BGE. This includes co-branding on:
   a. Brochures
   b. Print ads
   c. Radio ads
   d. Online ads
4. You may co-brand your company with Home Performance with ENERGY STAR, but materials must be reviewed and approved prior to use. This includes co-branding on:
   a. Brochures
   b. Print ads
   c. Radio ads
   d. Online ads
   e. Participating contractors may not present themselves as BGE employees, nor communicate in any way that they work on behalf of BGE. Below is a sample of the approved language when presenting yourself in the field to your potential customers:

      {Company Name} is participating in BGE's Home Performance with ENERGY STAR Program. Through this program we are able to install energy efficiency improvements at a reduced cost to our customers by providing energy efficiency rebates through BGE's Smart Energy Savers Program[SM].
5. Media Relations

a. BGE handles all media interviews about BGE's programs. Participating contractors may not speak to the media about BGE programs without BGE's written permission.

6. Mass Mailings: It is not acceptable to send out mass mailings that have your company's logo and BGE's logo. You may use the Home Performance with ENERGY STAR logo in your mass mailings but mailings must be pre-approved.

7. Radio Ads: Contractors may not mention BGE's programs and BGE's name specifically in radio ads. You are permitted to talk about "locally available incentives" or "incentives available from your gas and electric utility" etc. You may also state that you are a participating contractor in Home Performance with ENERGY STAR. Radio Ads must be pre-approved.

8. Recommendation: Bring your Account Manager exactly what you want to mail/email/print/distribute for review and approval.

2.4 Equipment Requirements

BGE's Home Performance with ENERGY STAR Program is designed to transform the way energy efficiency services are delivered to existing single family homes. Participating Contractors must meet all eligibility requirements stated in the "Contractor Participation Agreement" and have the equipment listed below to perform Comprehensive Home Energy Audits and Test-out upon jobs completion.

2.4.1 Required Equipment

Required ("✓")	Equipment	Description	Typical Cost
✓	Beacon Software	Energy modeling tool to analyze building energy performance	Free
✓	Calibrated Blower Door & Manometer	Tests for air infiltration	$2,000
✓	Calibrated Duct Blaster & Manometer	Tests for air leakage in forced air distribution systems	$1,775
✓	Combustible Gas Detector	Detects leaks on natural gas and propane lines	$250
✓	Temperature Humidity Meter	Fluke 971 or equivalent	$180
✓*	Exhaust Fan Flow Meter	Measures airflow of exhaust fans	$130
✓*	Pressure Pan	Used with blower door and digital manometer to measure leakiness of ducts	$90
✓**	Combustion Analyzer Or CO Analyzer	Measures oxygen, air temp, stack temp, carbon monoxide, and combustion efficiency	$500 - $900
		Measures carbon monoxide in ambient air and combustion appliances	$450
*	Calibrated Flow Hood	Measures airflow from supply / return grilles, exhaust fans, etc.	$1,750
***	Flow plate	Measures airflow through residential air handlers	$995
	Infrared Camera / Scanner	Produces thermal images for the diagnosis of air leakage and thermal boundary issues	$3,500 - $8,000
	Watt Hour Meter	Measures appliance and plug load energy	$150
	Manual-J Software	Residential HVAC system sizing software	$500
	Digital Infrared	Measures surface temperature from a	$30 - $125

	Thermometer	distance	
	Digital Thermometer	Measures temperature	$100
	Diagnostic Smoke	Chemical smoke used to identify locations of air leakage	$25 - $45
	Sling / Digital Psychrometer	Measures wet and dry bulb temperatures necessary to calculate relative humidity	$40 - $99

* A Participating Contractor may purchase a Flow Hood in place of an Exhaust Fan Flow Meter and a Pressure Pan.
** A CO Analyzer or Combustion Analyzer is a piece of required equipment.
*** Participating Contractors must be able test duct leakage and total duct air flow whenever performing duct sealing.

2.5 Equipment Maintenance Requirements

1. All test equipment used for diagnostics, evaluation, and installation of measures should be maintained according to the manufacturer's recommendations. This includes:
    a. Calibration of electronic and mechanical equipment including but not limited to:
        i. Instruments for measuring carbon monoxide
        ii. Instruments for measuring combustion efficiency
        iii. Digital manometers
        iv. Blower door and Duct blaster fans
        v. Insulation blowing machines including their motors, hoses, seals, and filters.
2. Participating contractors should develop a maintenance schedule for their equipment and maintain a record of that maintenance.

2.6 Project Reporting and Review Process

2.6.1 Stage 1

Home Energy Audit

1. Contractor schedules and performs the home energy audit.
2. Contractor must obtain the customer's BGE account number and enter the information into the Beacon Home Energy Advisor Record.
3. Contractor must attempt to obtain 12 months of usage for both the electric and the heating fuel so that home is accurately modeled in Beacon Home Energy Advisor.

4. Contractor enters audit data into a Beacon record. Contractor will save the job record file for each proposed job. Contractor will retain hard copy files of the field data collection form for each job.

5. Contractor has the customer sign the BGE Home Performance with ENERGY STAR Terms and Conditions;

6. Contractor flags package status as “Proposed” in Beacon.

7. Contractor generates a home performance summary report for the customer out of the Beacon software; the Beacon HPwES summary report is required by the Program but may be submitted as part of a larger customized summary report developed by the contractor.

2.6.2 Stage 2

Reporting Contracted Projects:

1. The contractor and customer agree on a work scope.

2. Contractor has the customer sign a contract showing the scope of work.

3. Contracts will include the qualifying criteria of the equipment being proposed/installed that is eligible for cash incentive. For example, if proposing/installing an gas tank-less hot water heater, the contract will specify that the energy factor is .82 or higher; if ventilation fans are proposed/installed, the contract will specify that they are ENERGY STAR labeled, etc.

4. Contractor edits and calculates the Contracted Package in Beacon (if different from the Home Performance Evaluation Package).

5. Contractor saves the Beacon file for the new Contracted Package and flags the status as “Contracted” in Beacon.

6. Contractor submits the Customer Incentive Application and Agreement by completing the online Incentive and Agreement form, uploading a signed Terms and Conditions and uploading a signed Customer Contract with a detailed scope of work. Failure to submit a complete Customer Application and Incentive Agreement will result in a rejected Application.

7. BGE reviews the contracted package and the paperwork for consistency, for reasonable energy savings, to ensure health and safety issues are addressed, and to verify which measures are eligible for incentives.

8. If the Application is accepted “as is”, the Program will flag the package as approved and a Job Scope Approval email will be generated and sent to the Contractor. Otherwise, BGE will send the contractor a Job Scope Review email with any changes or additional documentation needed to approve the application.*

2.6.2.1 Stage 2a:

If a Change Order Occurs:

1. Contractor sends the signed Change Order Form or amended contract to BGE for approval by scanning and uploading it through the BGESmartEnergy.com Web site. If there is an emergency situation or contractor is in the field, contractor can alternatively contact a Program Administrator to discuss the Change Order and get approval to proceed over the phone and follow up with a completed Change Order Form.
2. Contractor amends and recalculates the "Contracted" package in Beacon and Contractor flags the status as "Change Order" in Beacon.
3. BGE reviews the Change Order package in the same fashion as the "Contract" package, above. If the Change Order is accepted, BGE flags the package as approved and a Job Scope Approval email will be generated and sent to the Contractor. Otherwise, BGE will send the contractor a Job Scope Review email with any changes or additional documentation needed to approve the application.*

2.6.3 Stage 3

Work is Completed:

1. Contractor performs all contracted work.
2. Contractor conducts post installation tests, completes the Job Completion Form, signs it, and has the customer sign it.
3. Contractor uploads the signed Job Completion form and any necessary back-up documentation via scanning and submitting it via the BGESmartEnergy.com Web site.
4. Contractor edits the Air Sealing and Duct Sealing Improvement in the current Beacon project ("Contracted" or "Change Order" package) with the final Blower Door and Duct Blaster readings from the test-out, then re-calculates the package.
5. Contractor saves the edited project and flags the package status as "Completed" in Beacon.
6. BGE reviews the Beacon record and the Post-Installation Tests and Inspections form for completeness, accuracy, and compliance with program standards. BGE notifies contractor whether the job is accepted as complete.
7. For accepted completions, BGE processes customer and contractor incentives to process the payment.
8. BGE sends completion acceptance confirmation/certificate to the customer along with a customer survey.

*If the contractor proceeds with work without approval from BGE, incentives may not be approved. This rule can be waived in instances where there is an emergency requiring quick contractor response, such as a no-heat/no-cooling situation. In such a case, the contractor should contact Program Administrators about the emergency circumstances. BGE will review all submitted levels of the Beacon records (Proposed,

Contracted, Change Order) and/or Applications records within 3 business days of submittal by the contractor. If there is need to expedite approval, the contractor can contact Program Administrators at (410) 290-1214.

Section 3: Comprehensive Home Energy Audit Requirements

One of the most important and differentiating aspects of home performance contracting is the Comprehensive Home Energy Audit (CHEA). In order to offer the homeowner the opportunity to increase the energy performance and comfort of their home, all of the home's systems are holistically assessed to recommend improvements that work together to improve their home.

The CHEA includes the activities (i.e. inspections, tests, etc.) that are completed to assess a homes performance, and prepare a recommended scope of work. Contractors that agree to participate in a HPwES program need to have clear direction on what services they are expected to deliver. The required elements of the CHEA do not have to be completed in one home visit but must be completed prior to the commencement of home improvements. For example, a duct system may be visually inspected during the initial CHEA but a duct leakage to the outside test must be completed prior to work beginning on the duct system. The CHEA guidance below is sequenced but it is not required that contractors deliver the components of the CHEA in the order provided.

3.1 Required and Recommended Elements

3.1.1 Homeowner Interview

The contractor is required to conduct an in-person interview to collect information about the home and homeowner's concerns, motivations and goals. The information gathered can vary based on climate, housing type, site layout, etc.; the objective is to begin to establish a good base of information from which to address the homeowners' concerns. Information that may be valuable includes:

- Age of home, years that family has lived there, number of occupants.
- Remodeling, additions, window replacement, bonus rooms.
- Basic information about HVAC system(s), type of fuel, age of systems (if known).
- Use of unvented fireplaces and space heaters (if used, educate homeowner on moisture, carbon monoxide and fire risks, and inform them that envelope improvement cannot be performed unless they are removed or vented with a retrofit kit, if applicable).
- Swimming pool – dates and hours/day of pump operation, heated or not, heating source(s) and location(s), ventilation strategy if indoors.
- Utility bills
- Comfort complaints (cold rooms/hot rooms, drafts, moisture and humidity).
- Ice damming, wet crawlspaces or other common climate-specific problems.

Optional Steps for the Homeowner Interview

Pre-Evaluation Telephone Interview

When scheduling the CHEA, some participating contractors conduct a quick telephone interview with the homeowner to collect basic information on the home and the homeowner's concerns and motivations, so as to be more prepared, focused and time efficient during the home visit. A lead screening tool is available for participating contactors to use.

Disaggregate Energy Bills and Discuss Analysis with Homeowner

If energy consumption history is available, it can be extremely valuable for the participating contractor in building an understanding of the home's energy performance and motivating the homeowner to invest in recommended measures.

By breaking down the energy use, the contractor can more effectively identify the best energy improvement plan, educate the homeowner on the benefits of core air sealing, insulation, high-efficiency HVAC, water heating, and electric base-load measures such as lighting and appliances. A utility bill disaggregation tool is available for participating contractors to use.

Quick Walk-Through with Homeowner

Conduct a walk-through with the homeowner to ascertain additional information (homeowner has opportunity to bring up any issues or concerns that s/he has with any major items in the evaluation). The contractor can take this opportunity to inspect major appliances and lighting with the customer and educate them on the benefits of replacing older appliances and lighting with ENERGY STAR qualified products.

3.1.2 Building Envelope Inspection

The building envelope offers many opportunities for energy efficiency improvements. Therefore, participating contractors are required to conduct an inspection of the building envelope:

1. Collect basic information on the envelope of the home:

- Record house type, age and condition.
- Note key features of home typical of house type (porch roof, multiple roof lines, cantilevers, bay windows, dormers, kneewall attics, attic access, crawlspaces, basements, attached garages).
- Note configuration of home additions, if any.
- Sketch house floor plan with orientation and exterior measurements; calculate floor area, and volume.

Optional Step for Basic Building Envelope Inspection

Renewable Energy Opportunities

Record house orientation, observe site layout and look for opportunities for renewable energy technology (e.g., access to sunlight on south and west sides).

2. Note condition of external building envelope features (siding, trim, fascia, soffit areas, etc.):

- Look for signs of moisture or ice dam damage (if applicable) on walls and soffits that may have resulted from building performance problems.
- Check for roof moisture damage (stains, soft or rotted deck or rafters, wet or moisture-damaged insulation) from roof leaks or inadequate ventilation.
- Note any issues with shading or exposure to sun (linked to issues with hot/cold rooms and can help prioritize window-related measures).
- Note any grading features, downspout terminations, or sprinklers that may direct water towards the foundation or affect the performance of an exterior wall.

3. Envelope Thermal Characteristics

- Determine the thermal boundary of the home and identify thermal bypasses.
- Record type(s), amount and condition of insulation in all components of the thermal boundary. For guidance on default and de-rated R-values, see Building Performance Institute (BPI) Technical Standards1.
- Attic flats, slopes, knee walls, knee wall flats, dropped soffits, etc., as appropriate for type of home and per configuration of additions.
- Basement and crawlspace walls or ceilings.
- Rim joists.
- Attic staircase walls.
- Window inspection: Note condition of windows, type, age, signs of moisture damage and air infiltration around windows. Record approximate window area by orientation, framing type, number of panes and/or presence of storm windows.
- Door inspection: Note type and condition of all doors to exterior (including garage) – especially note if doors are un-insulated, in poor condition, or if they are leaky and in need of weather-stripping or door sweeps.

Optional Steps for Envelope Thermal Inspection

<u>Exterior Wall Insulation Levels</u>

An optic probe can often be used to determine wall insulation levels. It is usually inserted next to electrical outlets or behind wall hangings. This tool can also be used to inspect potential moisture problems found with an infrared camera.

4. Envelope air leakage characteristics

[1] BPI Technical Standards are currently being modified and this Guide will be updated to reflect any revisions.

- Visual Inspection of attic and basement to identify paths of air leakage
    - Attic: openings in wall top plates, electrical and plumbing runs, open areas around flues and chimneys, recessed light housings, around exhaust fans, open framing cavities, dropped soffits and ceilings.
    - Basement: openings around electrical and plumbing runs and around flue pipes and chimneys, accessible sill plate areas, basement windows, exterior doors, and accessible rim/band joist areas.
- Blower door test: This test is an effective way to locate air leaks and educate the customer on air leakage issues. Follow ASHRAE standard 119 RA-2004, Section 5.1 on blower door test procedures. However, the building may be tested at a single pressure differential of 50 Pascals.
    - With blower door depressurizing the home, identify major leakage areas in living area (e.g. window trim, baseboards, upper trim, cabinets, dropped soffits, pocket doors, recessed lighting, duct chases/plenums, band joists, transitions between porch roof and exterior walls, fireplaces, cantilevered floors, etc.).
    - Identify any significant misalignments of the pressure and thermal boundaries and ways to correct them.
    - Inspect walls or ceiling between an attached garage and the living space for air leakage.

> ***Blower Door Test***
>
> *Caution:*
> *Do NOT conduct this test if fireplace or wood stove has recently been used.*
> *Do NOT conduct this test if there is evidence of exposed and/or friable contaminants (asbestos, lead dust, bio-aerosols or other dangerous materials) that might become airborne or otherwise be introduced into the living space by conducting the test.*

Optional Steps for Inspections during Blower Door Test

Use of Infrared Camera

Some of the more successful home performance contractors have learned that using an infrared camera during a blower door test is an effective way to identify where insulation and air sealing are needed. It is also an effective sales tool when the contractor has the customer(s) involved in the evaluation. Showing the infrared images to the customer(s) and relating them to problems that were identified during the homeowner interview demonstrate expertise and builds trust, leading to higher customer motivation and stronger sales.

Zonal Pressure Differential Tests

Using the blower door and a manometer, conduct zonal pressure differential tests if needed to diagnose particular problem areas within the building (e.g., to determine how much an attic or garage is communicating with the living space compared to the outside). This test can help focus the inspection and speed up the diagnostics tests.

3.1.3 Heating, Ventilation, and Air Conditioning (HVAC) and Domestic Hot Water (DHW) Systems Inspection

The HVAC and DHW systems can offer dramatic comfort and energy savings opportunities. Therefore, participating contractors will perform a basic visual inspection of the HVAC and DHW systems in the home as follows:

1. Determine number and type of thermostats:

- Note number of heating and/or cooling zones.
- Note whether thermostats are programmable or manual.
    - If programmable, check status of setback periods and, if not being used, educate homeowner on the benefits of scheduled setbacks based on their lifestyle.

2. Visually inspect heating system:

- Verify system information: age, model, heat in/out, general condition and maintenance history.
- Estimate AFUE of heating system and HSPF/SEER of heat pump/cooling system via product nameplate information, looking product up in Gas Appliance Manufacturers Association (GAMA) or Air Conditioning and Refrigeration Institute (ARI) directories, instrumented testing (see next section) or a combination thereof.
- Check for evidence of back draft/flame roll-out.
- If boiler, verify that pressure relief valve is present and not obstructed.
- If condensing unit, check the condensate line for signs of blockage or leaks.
- Check exhaust vent for proper fitting and termination.

3. Visually inspect air conditioning system:

- Verify system information: age, model, capacity (sometimes available on nameplate).
- Check condensate line(s) for blockage or leaks.
- Note any issues around compressor/fan unit in yard, such as recirculation/air flow obstruction from built features or plantings or problems with coil blockage from leaves, twigs or other debris.
- Record number of window or wall units, model and EER if available.
- Check for insulation on refrigerant line set.

4. Inspect distribution systems:

- Inspect air filter(s) and ask homeowner how frequently they are replaced.

- Verify presence of secondary overflow pans when air handling unit is within, above or adjacent to finished living space and verify presence of condensate drain line or float disconnect switch.
- Note the presence of any ducts or air handlers in garages (this requires a recommendation to re-locate or create air-tight enclosures to isolate them from garage and prevent transportation of carbon monoxide and other fumes from the garage to the living space).
- Record insulation level of ducts in unconditioned spaces.
- Check for ductwork leaks, disconnects, crimps, signs of moisture presence, return leaks near combustion equipment, damage or other atypical conditions (inspection will include inaccessible ducts to extent possible).
- For hydronic systems, record insulation levels and note opportunity for pipe insulation if practical, especially on long pipe runs if there are comfort issues.
- For baseboard systems, check for condition and positioning of covers and for presence of dust, webs and other material on the fins.
- If ducts or an air handler are located outside of home's pressure boundary and cannot be relocated inside, conduct a test to determine duct leakage, using a metered and calibrated duct pressurization device.

5. Visually inspect DHW system:

- Record approximate age, model, capacity, condition.
- Estimate Energy Factor (EF) of water heater based on model number.
- Check for evidence of back draft/flame roll-out.
- Verify that pressure relief valve is present and not obstructed.
- Note temperature setting on water heater. This is a good opportunity to educate homeowner on standby losses and scalding threats if it's above 120 degrees F, and reduce the setting if homeowner approves.
- Check for signs of leakage from water heater tank vessel.
- Conduct visual inspection of water heater and hot water pipes for efficiency improvements (presence or lack of insulation, convective loop, and feasibility of retrofitting insulation on tank and/or pipes.

6. Combustion appliance zone (CAZ) safety inspection:

- Make sure that there are no flammable or explosive materials near any combustion source. This is a good opportunity to recommend moving them to a safe place.

7. Living space safety inspection:

- Note number, location and operability of CO detectors and smoke detectors in living space. Codes in some jurisdictions may require them.
- Note presence of unvented gas fireplaces and propane or kerosene space heaters and discuss with and educate the homeowner – explain that envelope work cannot be performed unless they are removed or vented with a retrofit kit.

8. Inspect mechanical exhaust ventilation:

- Check whether mechanical exhaust venting systems in bathrooms and kitchen, if present, are designed, installed and terminated properly.
- If garage is attached, note whether exhaust fan is present and operable in garage.
- Note presence and operability of power attic or whole-house exhaust fans and inform homeowner of correct operation.
- Educate homeowner on the benefits of a timer-operated or humidity controlled bathroom exhaust fan.
- Determine required ventilation rate per ASHRAE 62.2-2007 or BPI Technical Standards[2].

Optional Steps for HVAC System Inspection

In addition to a basic visual inspection of the HVAC system, there is additional information that may be needed in order to produce energy savings estimates for replacement measures. This information can include:

Thermostat Settings:

Ask the homeowner about average thermostat settings for both summer and winter (this information can be important for analyzing energy consumption and savings).

Heating and Cooling Systems:

1. Review maintenance records and/or ask homeowner about frequency, type and last occurrence of maintenance.

2. Check central air conditioning systems for proper refrigerant charge and airflow across the indoor coil to determine if they are in balance to operate as efficiently as possible. EPA refrigerant certification is required to handle refrigerants and most jurisdictions may require this be completed by a licensed HVAC contractor.

Air Handlers and Ductwork:

1. Determine condition of air handler and coil and need for cleaning.

[2] BPI Technical Standards are currently being modified and this Guide will be updated to reflect any revisions.

2. Conduct a test to determine adequacy of air flow, using one of the following methods: Duct Blaster® or other plenum pressure-matching air flow test, flow plate, flow hood, static pressure test, and/or temperature rise/drop tests.

3. Inspect for condensation moisture or damage from condensation on exterior of duct liner (in hot humid climate) or interior of A/C only ducts (in cold climate) for ducts outside conditioned space.

4. Check air return grills are properly sized.

CAUTION!
In order to conduct these tests, which require drilling and/or inserting an instrument probe into a vent connector, a person in Maryland must be a fully licensed HVAC contractor. Also, it is against Maryland Building Code to drill into a double-walled vent pipe. Any heating systems adjustments are strictly forbidden unless a person is fully licensed.

3.1.4 Instrumented Tests on Combustion Appliances, Combustion Appliance Zone (CAZ) and Living Space

1. Isolated Zone Test

The isolated zone test/inspection is required to confirm eligibility as an isolated zone containing combustion equipment. If any of the following requirements is not met, including a combustion closet, attic or basement that cannot be effectively sealed from the house, the zone shall not be considered isolated. Combustion equipment cannot receive any combustion air from the living space for the zone to be considered an isolated zone. Combustion safety testing is not required for any combustion equipment installed in an isolated zone, as confirmed through the following testing methodology:

a. Preparation and equipment

   i. House shall be setup for a blower door test, turn all combustion appliances off or to pilot setting.

   ii. Digital pressure gauge capable of 0.1 Pascal and accuracy of 1% of display or twice the resolution, whichever is greater.

b. Test Procedure

   i. Visual inspection that there are no direct openings between the isolated zone and the home's interior. Direct openings may include, but are not limited to, door undercuts, and other leaks in doors and windows, gaps or openings in finish materials, framing openings, ductwork with registers or grilles, transfer grilles, missing or damaged finish materials such as drywall, open chases and building cavities, and unconnected pipes or electrical conduits. Verify outdoor combustion openings are sized in compliance with NFPA 54-2006 Sections 9.3.3, 9.3.3.1, 9.3.3.2, Annex A, figures A.9.3.3.(1) (a), (b), and (c) requirements for combustion air. Examples include a single high opening providing 1 square inch net for each 3,000 Btu per hour of combined gas input (recommended for areas that may freeze), or low and

high openings to the attic or directly to the outside, providing 1 square inch net for each 4,000 Btu per hour input in each of two vertical openings, or 1 square inch for each 2,000 Btu per hour input in each of two horizontal openings.

c. Isolated zone depressurization

    1. Measure baseline pressure from closed isolated zone to the outside.
    2. Operate blower door at 50 Pascals, measure the change in the isolated zone pressure to outside. Maximum change is 5 Pascals during the blower door operation at 50 Pascals.
    3. Turn off the blower door and seal the fan, turn on the air handler at the thermostat fan switch. Measure the change in the isolated zone pressure to outside with the air handler operating. Maximum change is 2 Pascals during the air handler operation.

d. Isolated zone combustion equipment inspection and testing

    1. Visually inspect the vent system for proper size and angle from horizontal; look for blockage, restriction, leakage, corrosion, or other visible conditions that could cause an unsafe condition. Visually inspect the vent and, where accessible, the connector attachments.
    2. Compare venting system to NFPA 54-2006, Chapters 12 and 13; NFPA 31 for oil; and NFPA 211 for solid fuels. Record system component details that do not provide at least 90% of the required capacities for attached appliance inputs as listed in the vent tables, including additional requirements.
    3. Spillage test under non-depressurization conditions.

e. If an existing combustion appliance zone's intent was to be an isolated zone but failed the above tests to verify its status as an isolated zone then it can be treated as:

    i. A CAZ attached to the living space which requires combustion safety testing outlined in 3.1.4 2) or

    ii. By including measures to establish the zone as an isolated zone within the proposed and contracted scope of work.

2. Combustion appliance and CAZ tests

Performing these tests can help identify problems that affect the health and safety of the customer. Therefore, participating contractors will perform diagnostic tests on combustion equipment including vented heating systems, water heaters and ovens, in accordance with the BPI Technical Standards or an equivalent method developed by the HPwES Program Sponsor in accordance with their Partnership Agreement and approved by EPA and DOE. These inspections are required for all combustion appliances that have not been installed in an isolated zone. This inspection includes:

- Carbon monoxide measurement at each appliance.
- Draft measurement and spillage evaluation for atmospherically vented appliances.
- Worse-case negative pressure measurement for each CAZ.

Examples of acceptable alternative diagnostic testing standards that cover a portion, but not all, of the diagnostic testing covered by BPI include:

- ASTM Standard E1998-02, “Standard Guide for Assessing Depressurization-Induced Backdrafting and Spillage from Vented Combustion Appliances”.
- Canada General Standards Board 51.71-95, “The Spillage Test Method to Determine the Potential for Pressure Induced Spillage from Vented, Fuel-fired, Space Heating Appliances, Water Heaters and Fireplaces”.
- National Fuel Gas Code (ANSI Z223.1/NFPA 54, Annex H).

Note: Vented appliances that are going to be replaced with direct vent or power vented equipment as part of the work scope do not have to be tested, except as an interim test if the home is air sealed as part of the work scope prior to installation of the new equipment (having the heating equipment installed first would prevent the need for such a test).

3. Ambient carbon monoxide readings.

The contractor will take ambient carbon monoxide readings in CAZ zones and in main living spaces and continuously monitor carbon monoxide levels in the ambient air around technician during combustion tests.

4. Gas Leak Test

Small gas leaks present a health and safety threat, waste energy, and emit methane, a greenhouse gas 22 times more powerful than carbon dioxide. Using gas leak detection equipment, check for gas leaks at all accessible gas pipe connections, T’s, elbows, unions, and fittings, from the gas meter to the inlet to each combustion appliance. Any gas leak discovered with detection equipment will be verified with a commercial soap solution before making repairs.

5. Testing Disclosure

Home performance contractor shall review and provide a disclosure form including a disclaimer with the results of any combustion appliance testing, both the customer and the contractor shall sign the disclosure form in duplicate; both shall retain a copy.

a. Disclosure form shall include language: “The results of the combustion appliance test do not represent the worst-case conditions for depressurization and do not take into account the following:

- Fireplace or woodstove operation
- Powered attic fans
- Exhaust from negative pressure sources in neighboring dwellings
- All possible configurations of HVAC fan operation and damper and door operation

- Stack effect variations overtime
- Open windows
- Wind under conditions other than the test
- Any future alterations to building components that may affect air movement in the home.

In addition, testing furnaces and boilers that do not heat the potable hot water supply, or space heaters, in weather conditions during which they would not normally be operating (i.e., warmer than 60°F) can provide positive spillage results not found when tested in their normal outdoor temperature range."

Optional Steps for Instrumented Tests

Steady State Efficiency (SSE) Test

This test can be performed relatively quickly while conducting other combustion tests on a furnace or boiler. It can provide good information for the contractor in evaluating the condition and operation of the equipment. Beacon Home Energy Advisor has an option for data entering the SSE as an input instead of manufacturer's product information.

3.1.5 Lighting and Appliances

1. Record approximate age, type and condition of major appliances and showerheads. If applicable, determine number, age and condition of room air conditioners (check with homeowner if the evaluation is performed outside of the cooling season and they could be in storage).
    - If homeowner has any older (>10 years) appliances, discuss benefits of replacing them with ENERGY STAR qualified appliances.
    - Educate homeowner on water and energy savings from efficient-flow or low-flow showerheads and toilets.
2. Inspect high-use lighting areas for any obvious opportunities to upgrade to ENERGY STAR compact fluorescent lamps (CFLs) or fixtures. Check with homeowner to get estimated daily burn-time for lighting to be recommended for replacement (important for estimating energy savings calculation).

3.1.6 Moisture Inspection

- Check the crawlspace for moisture deposition or damage on basement floors, walls, and doors.
- Determine whether there is continuous moisture barrier in the crawlspace.
- Check around exterior of foundation for signs of moisture deposition from such sources as faulty gutters or watering too close to the foundation.
- Check attic for moisture deposition or damage on roof deck, rafters, joists, and insulation (wet or moisture-compacted insulation).

- Inspect condition of windows and look for signs of condensation or other conditions that could cause damage or affect durability.
- If there is evidence of high moisture levels in the living space, check for discoloration on walls behind headboards, furniture – corners of closets on exterior walls, and other areas of stagnation and cold temperature for moisture deposition or damage and conditions that promote fungal growth.

3.1.7 HPwES CHEA Summary Report

Reviewing the findings with the customer is the culmination of the CHEA process. This is the opportunity to present the homeowner with the improvement opportunities discovered during the CHEA and solutions for improving the performance of the customer's home. Therefore, the participating contractor will discuss inspection findings and present a recommended scope of work to the homeowner.

3.2 Estimating Energy Savings

3.2.1 Software Analysis

The participating contractor shall conduct an energy analysis of the home using the Beacon Home Energy Advisor for the purpose of giving homeowners an estimate of potential savings from proposed home performance improvements.

3.2.2 Billing History

The participating contractor shall request energy consumption history from the customer for use in modeling the home and proposed improvements in the Beacon Home Energy Advisor. If energy consumption history is not available form the homeowner the participating contractor shall select a baseline derived from the Residential Energy Consumption Survey (RECS) data, which is available in the Beacon Home Energy Advisor Software. The use of RECS data may be likely to underestimate energy consumption in the home.

Section 4: Post-installation Test or "Test-out" Protocols

4.1 Introduction

One of the features that distinguish HPwES as a value-added service for residential customers is the series of instrumented tests and inspections that the home performance contractor performs after the improvements have been made to a home. These tests support the "do-no-harm" principal which is a hallmark of home performance contracting. While there is no guarantee that any home will operate safely under all conditions, the home performance contractor is uniquely concerned about health and safety of the occupants. In addition to addressing health and safety issues that may be directly affected by the home performance work, some of the tests provide valuable information on the effectiveness of air and duct sealing measures installed.

4.2 Required and Recommended Elements

4.2.1 Program Oversight of Post Installation or "Test-out" Requirements

When a participating contractor completes home performance improvements for a customer, they will perform the post-installation tests and inspections described in this section, and enter the results in a "Post-Installation Tests and Inspections" Form. If any of the tests or inspections show the need for corrective action, the contractor can record the action item(s) in the document or postpone completing the Form (including having the customer sign it) until those corrective actions have been made. The job will not be considered complete until BGE has received a signed Post-Installation Tests and Inspection Form that indicates that all standards have been met (i.e., all tests and inspections have been passed successfully) and that no further actions are required.

4.2.2 Post Installation Test or "Test-out" Requirements

The required post-installation tests depend upon the scope of work:

1. Confirmation of measures installed with a simple check-off list (Job Completion form) that the participating contractor uses to confirm that all contracted measures have been installed. The customer would also sign the test-out form signifying their agreement that the job has been completed.

2. Blower Door test will be completed after installation of any of the following measures:

- Enclosed cavity insulation representing more than 15% of the total building shell area.
- Air sealing.
- Sealing of ductwork outside the building envelope.

- Replacement of atmospherically vented combustion appliance with sealed combustion appliance (due to removal of an exhaust appliance from the home).

3. Distribution System Air Flow and Leakage Tests

If ducts are sealed or replaced as part of the job scope, the HPwES Program that duct air flow and leakage tests be conducted.

Air Flow Test: The airflow test is conducted to ensure that airflow is adequate for the system being tested. The contractor may use a test that is recognized by the industry (flow plate, flow hood, static pressure, temperature drop). The contractor enters the result in the "Airflow Test Result," indicates whether the test is a "pass" or "fail," and, if the latter, actions required to correct the failure.

Duct Leakage Test: The contractor must perform a Duct Blaster test for leakage to the outside. The contractor enters the results in the "Duct Test Result" field section of the Form.

4. Minimum house ventilation requirement calculation will be performed whenever changes to the building shell requiring a blower door test have occurred to ensure that the home is receiving adequate outside air per BPI Technical Standards3.

5. Verify isolated zone status per test specifications in section 3.1.4 after the installation of any of the following measures:

- Enclosed cavity insulation representing more than 15% of the total building shell area.
- Air sealing.
- Duct sealing or duct replacement.
- Installation of new combustion appliance.
- Creation of a new isolated zone or correcting an isolated zone failure on an existing CAZ intended to be isolated from the living space.

6. Combustion appliance tests on all combustion equipment including vented heating systems, water heaters, and ovens, in accordance with BPI Technical Standards, will be completed whenever changes to the building envelope and/or heating system have occurred. This inspection includes all of the following tests:

- Carbon monoxide measurement at each appliance (including ovens).
- Draft measurement and spillage evaluation for atmospherically vented appliances.
- Worst-case negative pressure measurement for each CAZ.

CAUTION!
In order to conduct these tests, which require drilling and/or inserting an instrument probe into a vent connector, a person in Maryland must be a fully licensed HVAC contractor. Also, it is against Maryland Building Code to drill into a double-walled vent pipe. Any heating systems adjustments are strictly forbidden unless a person is fully licensed.

[3] BPI Technical Standards are currently being modified and this Guide will be updated to reflect any revisions.

These tests do not apply for combustion appliances that are installed in an isolated zone as verified by isolated zone test per Section 3.1.4 of the Program Guidebook.

7. Inspection and testing of orphaned water heaters: water heaters may not be left venting alone into a previously shared chimney without ensuring the chimney meets appropriate NFPA requirements under the new condition and the water heater has been tested and passed all required combustion safety tests (spillage, draft, CAZ depressurization).

8. If any work affected gas/propane lines then they should be checked with a combustible gas detector.

Section 5: Health and Safety

5.1 Technician Safety

It is the responsibility of the entity performing the work to initiate and maintain programs that comply with applicable Occupational Health and Safety Act Regulations (29 CFR 1910 & 1926) and any other applicable federal or state laws enacted to protect worker safety.

All technicians performing diagnostic tests, inspections, or installations, must have access to all necessary personal safety equipment required by OSHA. Required safety equipment includes, but is not limited to:

- Fitted respirators with canister filters
- Dust masks
- Gloves
- Protective clothing
- Safety glasses
- Hard hats, as required

Technicians must be trained in proper use and applications for these devices and must adhere to OSHA regulations when on the job site.

All hand tools, power tools, ladders, and diagnostic equipment must be handled and used in a safe manner and kept in good working condition. Equipment and diagnostic tools must be maintained and calibrated according to manufacturer's specifications.

A copy of the Material Safety Data Sheets (MSDS) for all materials used on the job and installed in the home must be kept on each crew vehicle and made available to all workers and clients upon request.

Where the presence of asbestos, lead, mold and/or other potentially hazardous material is known or suspected, all relevant state and federal (EPA) guidelines must be followed to ensure technician and occupant safety. Blower door depressurization tests may not be performed in homes where there is a risk of asbestos becoming airborne and being drawn into the dwelling.

Respirators with filter cartridges must be worn when working in areas where exposure to airborne mold, asbestos, lead, fiberglass, or formaldehyde is a risk.

Carbon monoxide levels in the ambient air around the technician must be monitored throughout all combustion safety tests. Diagnostic evaluations and inspections must be aborted if ambient CO concentrations greater than 35 ppm are recorded. CO producing appliances must be disabled and repaired before proceeding with additional diagnostics or inspections.

Refer to Building Performance Institute Standards on combustion safety for complete requirements applicable to carbon monoxide exposure limits and action levels.

5.2 Asbestos Inspection

1. Prior to performing work or conducting tests, the service provider must conduct an inspection for materials suspected of containing asbestos if there is the possibility that they may be disturbed during the weatherization testing or work.

2. When major energy-saving measures might be sacrificed as a result of suspected asbestos-containing materials, the participating contractor or entity performing the work may have the suspected material tested for asbestos content.

3. All work personnel should wear high quality respirators any time they are working with or near asbestos materials.

4. Materials containing asbestos may not be cut, drilled, or disturbed in any manner that may cause asbestos fibers to become airborne.

5. Participating contractors or entities performing the work must use certified asbestos abatement contractors to remove or dispose of asbestos containing materials.

5.3 Dust and Lead

Contractors shall adhere to the Toxic Substance Control Act (TSCA) amended by Title X, EPA 40 CFR Rules, and lead-safe practices in any home constructed before 1978 where pre-existing paint finishes or dust may be disturbed as part of the work. Such compliance is not required when the owner has documentation from a certified inspector or risk assessor that the house is free of lead-based paint or has undergone lead abatement in conformance with regulations.

5.4 Occupant Health and Safety

Where moisture problems exist, moisture sources must be mitigated through elimination of the source, isolation of the source, or ventilation of the space around the source before proceeding with other shell-related measures.

The homeowner must be notified of any health and safety hazards identified during the course of inspections and installations in the home. These hazards include, but are not limited to: indoor air contaminant sources, moisture problems, structural problems, electrical problems, and fire protection issues. Wherever problems are identified or suspected that fall outside the technician's area of expertise, the technician must inform the client of the problem and recommend an evaluation by a professional who specializes in this subject.

Clothes dryers, regardless of fuel type, and bathroom exhaust fans must be vented directly outside using appropriate duct materials (metal ducts are required for gas fueled clothes dryers) before proceeding with installation of air sealing, duct sealing, or enclosed cavity insulation measures. Exhaust ducts running through unconditioned space must be insulated and have a minimum ¼" rise for every foot of run towards wall or roof terminations.

Moisture problems can be reduced or eliminated by controlling the source of the moisture. This can involve:

- Installing a ground cover on a crawl space floor.

- Venting dryers to the outside of the building.
- Sealing the foundation.
- Installing exhaust fans in bathrooms or above cooking ranges
- Correcting the venting of existing exhaust fans
- Providing drainage away from the foundation.
- Repairing the roof, flashing, gutter, and downspout.
- Educating the customer about the sources of moisture that they are able to control.

A dwelling utilizing any unvented combustion appliance should not be tightened or insulated. The service provider should explain the consequences of using an unvented space heater to the customer. When the customer has agreed in writing that they understand and will not use the unvented space heater, the HPwES work may commence.

The scope of work shall specify a minimum of one CO alarm that is labeled as compliant with UL 2034, IAS 6-96, or CSA 6.19-01, to be installed per manufacturer's recommendations in the hallway(s) outside the bedroom area at each floor level.

Section 6: Home Performance Eligible Measures

Approved Measures	Existing Condition Requirements	Minimum Efficiency for Measure	Post-Installation Performance Testing /Documentation	Rebates
Audit				
Comprehensive Home Energy Audit (CHEA)	None	The home performance job must be completed within 6 months after the CHEA	Beacon HEA, Scope of Work	Up to $250, paid to customer
Air Sealing and Insulation				
Air Sealing	None	Minimum 20% reduction in CFM50	Pre- and post-blower door test at 50 pa	15% of cost paid to customer
Attic Insulation	R-22 or less existing insulation for attic (flat)	Insulate attic flat to a minimum of R-38 and attic hatch to a minimum R-30	Post-blower door test to verify ventilation rate	
	R-10 or less existing insulation for attic (slope)	Insulate attic slope to a minimum of R-19 to R-38, as space allows	Post-blower door test to verify ventilation rate	
	R-10 or less existing insulation for attic (kneewall)	Insulate attic kneewalls to a minimum of R-13 (must fill cavity) and install air barrier on attic side	Scope of Work	
Wall Insulation	R-0 existing insulation, 50% or greater of exterior wall surface, above grade walls only	Insulate to R-13	Post-blower door test to verify ventilation rate	
Rim/Band Board	R-0 existing insulation	Air seal & Insulate Rim/Band Board to a minimum of R-13	Post-blower door test to verify ventilation rate	
Water Heating				
Gas Tankless Water Heater	BGE Gas Customer	ENERGY STAR® labeled	Make, Model, Serial Number	15% of cost paid to customer
Note: The rebates above are capped at a combined total of $1,300, paid to the customer.				
HVAC Equipment Rebate, Duct Sealing, HVAC Tune-up, Quality Installation				
Central A/C Tier 1	None	14.5 SEER, 12 EER	AHRI Ref #, Make, Model Number, Serial Number	Tier 1: $175, paid to customer
Central A/C Tier 2	None	15 SEER, 12.5 EER	AHRI Ref #, Make, Model Number, Serial Number	Tier 2: $350, paid to customer
Heat Pump Tier 1	None	14 SEER, 11.5 EER, 8.5 HSPF	AHRI Ref #, Make, Model Number, Serial Number	Tier 1: $200, paid to customer
Heat Pump Tier 2	None	15 SEER, 12.5 EER, 8.5 HSPF	AHRI Ref #, Make, Model Number, Serial Number	Tier 2: $400, paid to customer
Gas Furnace Tier 1	None	92% AFUE	AHRI Ref #, Make, Model Number, Serial Number	Tier 1: $300, paid to customer
Gas Furnace Tier 2	None	92% AFUE with ECM or ICM	AHRI Ref #, Make, Model Number, Serial Number	Tier 2: $400, paid to customer

Approved Measures	Existing Condition Requirements	Minimum Efficiency for Measure	Post-Installation Performance Testing /Documentation	Rebates
Duct Sealing or Replacement	Duct leakage greater than 10% of cooling high speed fan flow and a portion of the duct distribution system shall be located in unconditioned space	50% reduction in total leakage by comparing pre- and post-test duct leakage OR achieve a minimum total leakage reduction of 150 CFM	Pre- and post-calibrated, metered duct pressurization test	$200, paid to customer
HVAC Tune-Up	BGE Gas Customers using Gas Furnace or Electric Customers using Heat Pump, Central A/C	None	Please refer to the Contractor HVAC Tune-up Performance Worksheet on BGE's Smart Energy Savers Program℠ website	$75, paid to customer
Quality Installation	BGE Gas Customers using Gas Furnace or Electric Customers using Heat Pump, Central A/C	None	Please refer to the Contractor HVAC Quality Installation Performance Worksheet on BGE's Smart Energy Savers Program℠ website	$200, paid to customer
Direct Install Measures				
CFLs	High-use incandescent bulbs	ENERGY STAR labeled	Scope of Work	$5 each, up to 10 bulbs, paid to contractor
Electric Water Heater Tank Wrap	Tank R-value less than R-12	Insulate with an R-6.7 tank wrap	Scope of Work	$40/water heater, paid to contractor
DHW Pipe Insulation	No heat trap	Minimum ¾" thickness, hot and cold water pipes, vertical pipes, and horizontal for 6' from water heater	Scope of Work	$18/system, paid to contractor
Efficient-flow Showerheads	Existing showerhead is 2.5 gallons per minute (gpm) or greater	1.8 gpm or less	Scope of Work	$18 each, up to 2 showerheads, paid to contractor
Faucet Aerators	Existing faucet is 2.5 gpm or greater	1.5 gpm or less	Scope of Work	$6 each, up to 4 aerators, paid to contractor
Approved Measures	**Existing Condition Requirements**	**Minimum Efficiency for Measure**	**Post-Installation Performance Testing /Documentation**	**Rebates**
Audit				
Comprehensive Home Energy Audit (CHEA)	None	The home performance job must be completed within 6 months after the CHEA	Beacon HEA, Scope of Work	Up to $250, paid to customer
Air Sealing and Insulation				
Air Sealing	None	Minimum 20% reduction in CFM50	Pre- and post-blower door test at 50 pa	

Approved Measures	Existing Condition Requirements	Minimum Efficiency for Measure	Post-Installation Performance Testing /Documentation	Rebates
Attic Insulation	R-22 or less existing insulation for attic (flat)	Insulate attic flat to a minimum of R-38 and attic hatch to a minimum R-30	Post-blower door test to verify ventilation rate	
	R-10 or less existing insulation for attic (slope)	Insulate attic slope to a minimum of R-19 to R-38, as space allows	Post-blower door test to verify ventilation rate	
	R-10 or less existing insulation for attic (kneewall)	Insulate attic kneewalls to a minimum of R-13 (must fill cavity) and install air barrier on attic side	Scope of Work	
Wall Insulation	R-0 existing insulation, 50% or greater of exterior wall surface, above grade walls only	Insulate to R-13	Post-blower door test to verify ventilation rate	
Rim/Band Board	R-0 existing insulation	Air seal & Insulate Rim/Band Board to a minimum of R-13	Post-blower door test to verify ventilation rate	
Water Heating				
Gas Tankless Water Heater	BGE Gas Customer	ENERGY STAR® labeled	Make, Model, Serial Number	15% of cost paid to customer
Note: The rebates above are capped at a combined total of $1,300, paid to the customer.				
HVAC Equipment Rebate, Duct Sealing, HVAC Tune-up, Quality Installation				
Central A/C Tier 1	None	14.5 SEER, 12 EER	AHRI Ref #, Make, Model Number, Serial Number	Tier 1: $175, paid to customer
Central A/C Tier 2	None	15 SEER, 12.5 EER	AHRI Ref #, Make, Model Number, Serial Number	Tier 2: $350, paid to customer
Heat Pump Tier 1	None	14 SEER, 11.5 EER, 8.5 HSPF	AHRI Ref #, Make, Model Number, Serial Number	Tier 1: $200, paid to customer
Heat Pump Tier 2	None	15 SEER, 12.5 EER, 8.5 HSPF	AHRI Ref #, Make, Model Number, Serial Number	Tier 2: $400, paid to customer
Gas Furnace Tier 1	None	92% AFUE	AHRI Ref #, Make, Model Number, Serial Number	Tier 1: $300, paid to customer
Gas Furnace Tier 2	None	92% AFUE with ECM or ICM	AHRI Ref #, Make, Model Number, Serial Number	Tier 2: $400, paid to customer
Duct Sealing or Replacement	Duct leakage greater than 10% of cooling high speed fan flow and a portion of the duct distribution system shall be located in unconditioned space	50% reduction in total leakage by comparing pre- and post-test duct leakage OR achieve a minimum total leakage reduction of 150 CFM	Pre- and post-calibrated, metered duct pressurization test	$200, paid to customer
HVAC Tune-Up	BGE Gas Customers using Gas Furnace or Electric Customers using Heat Pump, Central A/C	None	Please refer to the Contractor HVAC Tune-up Performance Worksheet on BGE's Smart Energy Savers	$75, paid to customer

Approved Measures	Existing Condition Requirements	Minimum Efficiency for Measure	Post-Installation Performance Testing /Documentation	Rebates
			Program℠ website	
Quality Installation	BGE Gas Customers using Gas Furnace or Electric Customers using Heat Pump, Central A/C	None	Please refer to the Contractor HVAC Quality Installation Performance Worksheet on BGE's Smart Energy Savers Program℠ website	$200, paid to customer
Direct Install Measures				
CFLs	High-use incandescent bulbs	ENERGY STAR labeled	Scope of Work	$5 each, up to 10 bulbs, paid to contractor
Electric Water Heater Tank Wrap	Tank R-value less than R-12	Insulate with an R-6.7 tank wrap	Scope of Work	$40/water heater, paid to contractor
DHW Pipe Insulation	No heat trap	Minimum ¾" thickness, hot and cold water pipes, vertical pipes, and horizontal for 6' from water heater	Scope of Work	$18/system, paid to contractor
Efficient-flow Showerheads	Existing showerhead is 2.5 gallons per minute (gpm) or greater	1.8 gpm or less	Scope of Work	$18 each, up to 2 showerheads, paid to contractor
Faucet Aerators	Existing faucet is 2.5 gpm or greater	1.5 gpm or less	Scope of Work	$6 each, up to 4 aerators, paid to contractor

ELIGIBILITY:
1) This offer is valid for BGE residential customers applying through the Home Performance with ENERGY STAR Program only.
2) This offer is open to all BGE residential electric and/or gas customers, regardless of their electric and/or gas supplier.
3) Projects must be installed in the BGE service territory.
4) Participants applying for Home Performance with ENERGY STAR incentives must have:

a) Central A/C Unit, Air Source Heat Pump, or other primary electric heating system, and receive electricity service from BGE

or

b) Gas Furnace or Gas Boiler, and receive gas service from BGE.

5) Customers applying for HVAC-only incentives should submit a rebate application through the HVAC Equipment Rebate Program.

Section 7: Quality Assurance Review Process & Field Inspection Procedures

7.1 - Introduction

This document summarizes the Quality Assurance (QA) Administrative Review Process and Field Inspection Procedures for the Home Performance with ENERGY STAR Program (HPwES). The goal of this QA process is to verify that projects in the Program are meeting all Program requirements while maintaining healthy, safe living conditions.

Overall, each Home Performance with ENERGY STAR project undergoes a thorough administrative review process that includes a job scope review and approval, a project job completion review, and a review for incentives' eligible measures under the Program. In addition, a target of 5% for Home Performance (HP) projects will be field inspected through a comprehensive QA/QC field inspection process. The QA/QC administrative reviews and detail field inspections will document that the following objectives are being met:

1. Projects are completed in accordance with Program Requirements
2. Projects are completed in accordance with BPI or other applicable technical standards adopted by the program
3. All projects are completed in accordance with all Health and Life Safety Requirements
4. 5% of all contractor-installed and reported HPwES projects are field inspected through a comprehensive QA/QC Field Inspection Process
5. Customers are reasonably satisfied with all aspects of the Program and completed work
6. Audits are completed comprehensively and accurately
7. Contractors are following proper Program procedures as part of the QA/QC process
8. Projects not meeting all Program requirements will be corrected as soon as possible
9. Contractors that demonstrate a pattern of failure or are uncooperative when asked to perform corrective measures will be subject to Probation and De-Listing
10. All QA/QC procedures will be recorded by the Program Implementer and tracked in a database
11. QA/QC reporting will be completed monthly

7.2 - Quality Assurance Procedures Overview

The QA procedures include a review of the administrative approvals, detailed field inspections, feedback to the contractors, documentation of all QA inspections, and reporting of all QA information. The goal is to verify that all HPwES projects meet the requirements of the Program.

The following sections provide more detailed information on the various aspects of the Quality Assurance Process.

7.2.1 - Administrative Review

Projects in the Home Performance with ENERGY STAR Program go through a detailed administrative review process, which includes:

1. Comprehensive Home Energy Audit Review and Approval
2. Job Scope Review and Approval prior to the start of any work
3. Change Order Review and Approval
4. Job Completion Review and Approval

The following sections provide an overview of the administrative review process. This review process is a critical part of the Quality Assurance provided by the Program on an ongoing basis.

7.2.1.1 Comprehensive Home Energy Audit (CHEA)

In compliance with the national HPwES Program, BGE's Program requires that a participating contractor conduct a Comprehensive Home Energy Audit and generate a report for the customer that describes a comprehensive set of recommended measures for the home, including their estimated cost and energy savings. The contractor is required to use the Beacon Home Energy Advisor to fulfill this requirement. The contractor inputs the data that he/she collects on the home, creates a comprehensive package of measures, and generates a report for the customer out of the Beacon Home Energy Advisor software. The contractor also uploads the Beacon Home Energy Advisor record into the Program's reporting database as the means for reporting the energy audit to the Program.

The Program shall follow the national guidelines established by BPI (subject to changes once RESNET/BPI Comprehensive Home Energy Audit Standard is finalized). Included in the Home Performance Evaluation will be:

1. Thermal Envelope:
    a) Attic Insulation Levels
    b) Exterior Wall Insulation Levels
    c) Crawl Space
    d) Overhangs
    e) Attic Ventilation
2. Heating System
3. Duct Insulation and Sealing or Pipe Insulation (depending on HVAC system)
4. Domestic Hot Water Systems
5. Combustion Appliance Testing
    a) Worst Case CAZ Depressurization
    b) Spillage Test
    c) Draft Measurements Under Worst Case
    d) Carbon Monoxide Levels from Each Combustion Appliance
    e) Ambient Carbon Monoxide Measurements (CAZ and living space)
6. Building Air Leakage
7. Appliance and Lighting Measures

The CHEA administrative review process is required on all projects as a condition for the approval and payment of the incentives. Program implementer and administration will review the energy audit completed

on the home for comprehensiveness, appropriateness of the measures recommended, reasonableness of projected energy savings, and to ensure health and safety issues are addressed.

7.2.1.2 Job Scope Review and Approval

A job scope review and approval of work is required for all typical HP projects; the only exception is in the case of emergencies (such as no-heat situations during cold weather or serious health and safety conditions). In the case of emergencies, contractors must call and speak to a Program Administrator (ICF International) or, if after normal business hours, leave a message explaining the emergency situation. The program implementer will process work scope reviews within a 24 hour period.

Reporting a contract for review and approval under normal circumstances requires that the contractor:

- Forward a copy of the signed contract proposal to the Program Implementer
- Contracts will include the qualifying criteria of the equipment being installed that is eligible for rebates. For example, if installing an gas tank-less DHW, the contract will specify that the energy factor is .82 or higher; HVAC equipment will identify manufacturer, model number, serial number, tonnage, efficiency, and AHRI reference number, if a ventilation fan is being installed, the contract will specify that it is ENERGY STAR labeled, etc.
- Upload a Beacon Home Energy Advisor package that reflects the contract as to measures and price, and mark it as a “Contracted” package in the Beacon Home Energy Advisor.

Failure to comply with job scope submittal procedures may result in forfeiture of incentives that would otherwise be payable for the project being reported. Habitual failure to comply with this requirement over multiple projects may lead to Program disciplinary actions such as Probation or De-Listing.

The job scope review and approval is a detailed verification of the measures being purchased by the customer. Program staff shall verify the eligibility of the measures; compliance with important health and safety rules promulgated by the Building Performance Institute (BPI) and/or other applicable standards; reasonableness of the energy savings estimate for the contracted package; and consistency between the actual contract and the Beacon Home Energy Advisor record with regards to measures and their prices.

If the administrative review is favorable, approval is provided for the contractor to proceed with installing the job. Otherwise, the contractor is contacted to discuss any issues that prevent the Program Implementer from approving the job scope.

7.2.1.3 Change Order Review and Approval

Sometimes during the course of a project the scope of work needs to be changed in order to add, amend, or delete measures and/or their prices. The contractor submits a change order or amended contract in the same way that he/she reports a contract (preceding section), with the only difference being that the contractor marks the accompanying Beacon Record to be submitted as a “Change Order.”

If a change order or amended contract is submitted, the program implementer reviews all aspects of the change order or amended contract for eligibility, compliance with the BPI standards, and consistency between the paperwork and the accompanying Beacon record. If approved, the contractor will be informed

of the approval and give direction to complete the project. Otherwise, consistent with other stages of review, the contractor will be contacted to discuss any issues that prevent approval.

7.2.1.4 Project Completion Review and Approvals

After project completion, the contractor performs required tests and inspections, and completes and signs the Post-Installation Tests and Inspections Form. The customer also signs the form, attesting that s/he agrees that the job has been completed satisfactorily. The contractor submits the signed form to the Program Implementer along with any necessary back-up documentation (i.e., customer appliance receipts, if applicable). The contractor also updates the Beacon record with the final blower door number, recalculates the final package that was installed, and adds in the final combustion related test and inspection results. ICF International will review the completion information to ensure consistency and accuracy. This administrative review also confirms that all installed measures are eligible under Program guidelines. If the completion is accepted for approval, program staff flags the record in the Program database, sends completion confirmation to the contractor and the customer (the customer also receives a satisfaction survey for feedback), and processes the project for incentive payments to both the customer and the contractor as managed via the Vision database.

7.3 - Field Inspection Procedures

The program's field inspection procedures include the selection and scheduling of specific field inspections, conducting the actual field inspections, documentation of the findings of the field inspection, providing feedback to contractors on specific measures that need to be brought into compliance and providing summary information to contractors on QA inspection results of all of the projects that have been inspected. The field inspection procedures can also include notification of BGE, BPI or other agencies on deficiencies found on projects, as appropriate.

7.3.1 Field Inspection Project Selection Process

In addition to the administrative reviews on all Home Performance with ENERGY STAR projects, the program implementer conducts detailed field inspections on a percentage of all projects. The selection criteria used to determine specific inspections places an emphasis on contractors new to the Program, contractors that have a history of completing jobs that do not fully meet Program, BPI or other technical standards, and contractors that are very actively involved in the Program on a monthly basis. Additionally, all customer complaints will be reviewed administratively and, if necessary, in the field to best resolve each situation.

More specifically, the selection criteria for projects to be field inspected will include the following:

1. Each new contractor's first 3 projects will be inspected where possible[4].
2. After the first 5 jobs, the percentage of the remaining jobs to be inspected is dependent on several factors including:

[4] In some instances, customers can not be contacted to schedule a QA field inspection or they refuse to allow access to their homes.

a) The contractor's history of completing jobs that meet Program requirements
b) The type of measures installed on the project
c) The number of complaints received about a particular contractor
d) How active a contractor is in the Program

3. All Customer Complaints will be reviewed and, if necessary, field inspected

7.3.2 Summary of Field Inspection and Contractor Feedback Process

The QA field inspection process has four major components to it: a) discussion with the homeowner; b) diagnostic tests and inspections of work performed; c) determining the QA score; and d) providing a QA report to the contractor with feedback and direction to follow-up with corrective actions, if necessary.

7.3.2.1 Discussion with the Customer

The field inspection begins with the field inspector providing a brief introduction to the customer as to their name, position, procedures for the inspection, and a general overview of the testing to be completed. The inspector will also provide an overview of the Program, answer customer questions, determine if the customer has any specific concerns about their project, and describe how they can contact the Program in the future if necessary.

During this introductory conversation with the customer, the following Program compliance information will be verified with the customer:

1. Customer verification of receipt of Program "What to Expect" Brochure
2. Customer verification of presentation of Comprehensive Home Energy Audit Report
3. Customer verification of signatures on Post Installation Tests and Inspections Form
4. Customer verification of work start and finish dates
5. Verification of contracted measures, costs, and pre-existing conditions
6. Customer verification of who installed contracted measures
7. Brief discussion of customer satisfaction

7.3.2.2 Quality Assurance Field Inspection Technical Elements

After the customer has been given an overview of the field inspection process by the field inspector, the technical aspects of the field inspection are completed. The technical aspects of the field inspection process include:

1. A complete exterior visual Inspection (i.e., chimneys, ventilation, roofing, siding, windows, foundation, obstructions, and landscaping)
2. A complete interior inspection (i.e., visual inspections, place home under winter conditions, test CO levels, set up Blower door)
3. A complete crawlspace /CAZ inspection [i.e., visual inspections of condition, insulation levels and distribution system, measure CO in Combustion Appliance Zone (CAZ), gas leak detection, combustion efficiency testing, Worst Case Depressurization]
4. Conduct diagnostic tests (i.e., Blower door, combustion testing, ambient CO, duct air flow)
5. Complete building shell Inspection (i.e., insulation levels in walls, attics, floors, windows, and doors)
6. Complete appliance and lighting inspections (i.e., CFL's, fixtures, refrigerators, dishwashers, clothes washers)
7. Ensure all energy conservation measures reported to the Program are installed.

The following provides more detail on the technical aspects of the field inspection process:

Exterior Inspection

a) Full exterior inspection including building measurements, schematic diagram, and notes on type and condition of structural components including chimneys, ventilation, roofing, siding, windows, foundation, obstructions, and landscaping
b) Calibration of carbon monoxide detector and exterior measurement of CO
c) Leak inspection of gas pipe entering building

Interior Inspection

a) Check for CO detector (see the BPI standard)
b) Place home under normal conditions (i.e., closing windows, doors, fireplace dampers, etc.)
c) Measure the ambient level of carbon monoxide throughout the living space
d) Perform a complete interior inspection of the home and document any concerns about the structure including signs of moisture, mold, existing damage, or issues that could affect your testing or future treatments including locations of all exhaust fans
e) If the home is safe (ambient CO levels are less than 35 PPM) and a shell leakage test can be performed (the test will not adversely affect the home), set up the blower door in a proper location, but do not perform test yet

Basement, Crawlspace and/or CAZ Inspection

a) Conduct a visual inspection of the basement/crawlspace area documenting (see Data Collection Form) age, type, condition, and fuel for any combustion appliances including venting and distribution systems, then take the following steps with ALL COMBUSTION APPLIANCES OFF (turn gas DHW to “pilot”)
b) Measure ambient level of carbon monoxide in the CAZ (Combustion Appliance Zone)
c) Perform gas leak detection test
d) Drill holes in flue pipes for draft measurements
e) Measure the Baseline pressure in the CAZ with reference to outside
f) Perform “Worst-Case” Depressurization test for the CAZ. A typical “worst case depressurization” test:
   (1) All exhaust fans on
   (2) Bedroom doors closed (unless they have an exhaust fan)
   (3) Test with Basement door open and closed
   (4) Test with furnace blower on AND off
   (5) Each house will be different and pressures must be checked at each step of the set up process
   (6) Record “Worst-Case” CAZ depressurization test results and keep house under those conditions. Record the information for the heating systems and DHW including type, fuel, distribution, venting, and condition.

HVAC Tests

a) Furnace: measure and record temperature rise test
b) Cooling: measure and record total system air flow

Combustion Safety Tests

a) Keep the CAZ under “Worst-Case” depressurization
b) Monitor the ambient level of CO throughout all combustion safety tests
c) Refer to the BPI or other applicable standard(s) for action levels and procedures based on results of combustion safety tests
d) Inspect the smallest BTU appliance first (usually the water heater)
e) Turn the appliance on and evaluate spillage
f) Measure undiluted Carbon Monoxide levels of this appliance
g) Measure the draft of flue gases for this appliance
h) Keep the first appliance operating and fire the next largest combustion appliance (usually the heating system)

i) Repeat spillage, draft, and CO tests for the next appliance. Double check the smaller appliance at this time to ensure it is still drafting properly.
j) Repeat procedure for all combustion appliances
k) Return the house to “natural” conditions. If combustion safety tests fail under Worst-Case, it may be necessary to repeat these tests under natural conditions (see the BPI standard for Comprehensive Home Energy Audit).

Blower Door Test and Diagnostics

a) Keep the home under normal conditions and disable all combustion appliances form operating during the blower door test. Record inside and outside temperature.
b) Conduct the blower door test and record the fan and house pressure measurements and measured CFM50
c) With the blower door running, complete an air leakage diagnostic and record the results (see Data Collection Form)

Building Shell Inspection

a) Perform a visual inspection of attic and note the following:
    a. Existing Insulation: Material / Thickness / Condition / R-Value / Framing Detail. Record the same information all attic types (slopes, knee walls, knee wall floors, etc.), exterior walls, crawl spaces or areas that need to be addressed for the thermal boundary.
b) Inspect the windows and doors noting glazing, type, condition and additional information as needed
c) Inspect the heating distribution system noting condition, insulation, and (if ducts are present) potential leakage in supply and return ductwork

Duct Air Flow and/or Leakage Testing

a) Complete a duct air flow (using flow plate or temperature rise) and a duct leakage evaluation appropriate to the expected work scope for the building and document the results (duct leakage test may be visual, pressure pan, or duct blaster, as deemed appropriate)

Lighting

a) Identify and evaluate interior and exterior high usage lighting in the home as indicated by the homeowner or in the project records and reports provided by the contractor
b) Record existing and proposed data for energy saving lighting retrofits

Appliances

a) Inspect major electrical appliances (refrigerators, dishwashers, clothes washers, and room air conditioners) for potential energy saving replacements
b) Record existing and proposed data for energy saving retrofits

Data Collection and Building Report

a) Complete recording building information on data collection form including existing and proposed conditions
b) If necessary, fill out a work order form requesting that the contractor perform corrective measures in the home based on inadequate or incomplete installation or on non-compliance with Program, BPI or other applicable technical standard(s)

Field inspector data collection forms that are used in the field collect the specific technical information as observed or measured on each project, provide feedback to the contractor, and specify what follow-up work is required to address problems, if any.

7.3.2.3 QA Field Inspection Scoring

It is required that the performance of contractors be evaluated as part of the in-field inspection process. This evaluation is best done with a scoring protocol in order to appropriately address any changes needed in the in-field inspection rate for that contractor, document a history of a contractor's performance, provide contractor feedback, and to provide an objective basis for contractor sanctions including cautions, reprimand, suspension, or expulsion as appropriate. The scoring methodology will refer to Program requirements and technical standards where appropriate.

7.3.2.4 Feedback to Contractor and Corrective Action

The contractor feedback process flows from the reporting paperwork review process, customer surveys or feedback, and in-field quality assurance inspections.

The Program will have a standard process for handling deficiencies when they are found through the QA process. The following list shows 5 categories of potential results from the QA process and contractor feedback and/or corrective actions:

1. If any serious deficiencies are found through the quality assurance process (typically in-field inspection) that must be addressed immediately because of imminent health and safety threats, it is required that the quality assurance inspector contact the contractor without delay and verify that the corrective action is made while the inspector is still on-site. If the contractor cannot be reached, the inspector is required to either take remedial action him- or herself or instruct the customer to abandon the site until the threat is mitigated.
2. If the customer is dissatisfied and/or if deficiencies are found that must be corrected but are not an immediate health or safety threat to the home's occupants, the QA inspector is required at a minimum to write up the findings and speak with the contractor to discuss the findings and corrective actions to be taken. The QA inspector will provide a work scope of corrective actions to the contractor and require the contractor to correct deficiencies within a specific period of time (not to exceed 30 days unless there are legitimate reasons for delay such as customer scheduling challenges). It is required that the contractor provide written documentation with the homeowner's signature to the Program in order to document the completion of the work scope of corrective actions. One way to do this is simply to have the contractor and customer fill out and sign the Program's project completion paperwork again; alternatively, the Program will consider separate forms for QA corrective action orders and completions.
3. If the customer is satisfied with the work, Program and technical standards have generally been met, but deficiencies are present in the completeness, compliance with the contract or quality of the work performed that should be corrected, it is recommended that the contractor be informed in a written report that addresses the deficiencies found and directs the contractor to correct the deficiencies within a specific period of time (recommended to not exceed 45 days). Contractor is required to provide written documentation with the homeowner's signature to the Program to document the completion of the corrective actions (e.g., filling out and signing Program completion paperwork with the customer).
4. If the customer is satisfied with the work, Program and technical standards have generally been met, but there are relatively minor deficiencies or opportunities to improve a contractor's performance such as a non-comprehensive set of recommendations in the customer report, evidence of repeatedly non-comprehensive job scopes (suggesting a lack of desire or success in selling comprehensive work), or an indication of inaccuracy in tests performed, the Program will provide constructive written feedback to the contractor to request improvement in the future and offer assistance toward that objective.

5. If there are no deficiencies in performance found and the contractor has provided comprehensive recommendations, fulfilled the work scope, and installed measures that meet all technical standards, the Program will provide positive feedback to the contractor on their performance. Exemplary performance should also be documented and, if consistent, contractors will be recognized for their contributions to the Program.

If contractor performance falls repeatedly into any of the first three categories listed above, the Program will take additional action beyond the corrective action measures in the home. Additional training will be offered or required to address the deficiencies in performance, if deemed necessary by the Program Administrator (ICF International) in consultation with the QA inspector. The Program is also very likely to increase the in-field QA inspection sampling rate until the contractor shows marked improvement on a consistent basis.

Periodic reviews of a contractor's history of performance will be performed on at least a quarterly basis. This review should focus on specific trends in deficiencies in the contractor's performance and steps needed to remediate that performance.

The Program will develop standard forms for QA in-field inspections, paperwork review, follow-up work orders, work order completion documentation, and document contractor QA meetings. In-field inspection forms will document the overall score of the contractor on the inspection and contribute to the periodic review of contractor performance.

7.4 De-Listing Procedure

Based on the results of its QA activities, the Program will document and inform participating contractors of any significant or serious deficiencies and any corrective actions that need to be taken. Contractors, who continuously deliver inconsistent results, even after intervention by the Program, will be considered for probation or expulsion from the HPwES Program. The following is the Program's disciplinary policy:

Contractors who demonstrate a pattern of failure on in-field inspections or fail to respond to corrective action work scopes or customer issues may be subject to a probationary period and/or Program expulsion and De-Listing. Probation and/or expulsion and de-listing would occur based on the evaluation of a contractor's performance during the QA process and upon recommendation of the Program Administrator (ICF International) to BGE.

1. A probationary period shall be used for contractors as the initial step towards De-Listing. The contractor shall be notified in writing via certified mail that they are now subject to the probationary period. The notification will outline the deficiencies that have been found through the QA process, the period of probation (time or number of jobs), and the corrective actions that the contractor must take in order to be re-instated to full participation status. During the probationary period, the contractor will be subjected to additional quality assurance inspections and may be required to attend additional training and/or participate in a mentoring. The probationary period will still allow the contractor to participate in the Program but additional in-field inspection failures or deficiencies could trigger Program suspension or expulsion.

2. If a contractor does not meet the corrective actions outlined in their notification of probation then they will be subject to Program expulsion and De-Listing. If a contractor receives a second probationary period during the Program period, or if they are found to engage in malfeasance, they will be subject to immediate Program expulsion and De-Listing. The contractor will be notified in writing via certified mail of their expulsion and De-Listing. The notification shall state

the deficiencies found in their performance, the reason for De-Listing, and potential steps (if any) the contractor could take in order to be reinstated.

Terminology and Definitions

ACCA- Air Conditioning Contractors Association
ACH - Air Changes per Hour
AFUE- Annual Fuel Utilization Efficiency rating. Steady state efficiency measurement which includes standby losses; average efficiency over the course of the heating season.
Air Barrier- The barrier that prevents infiltration of outdoor air into the conditioned space and exfiltration of indoor air to the outside. Also known as "pressure boundary." It should be continuous and aligned with the thermal boundary.
Air Sealing- the process of sealing bypasses in the pressure boundary to prevent air leakage. Air sealing reduces heat flow from air movement and prevents water vapor from entering the wall.
Area- the formula for area is: **length** (in linear feet) x **width** (in linear feet) = **area** (in square feet)
Asbestos- heat resistant material used previously in many building products; represents serious health hazard as an airborne particulate
ASHRAE- American Society of Heating, Refrigeration, and Air Conditioning Engineers
Atmospheric Venting System - Negative vent pressure, uses standard chimney to remove combustion by-products from the home
Attic Bypass- an air connection between the living space and the attic
Attic Ventilation- ventilation intended to remove heat and moisture from attic areas to the outside
Back Draft- Spillage of combustion by-products into the home (after running the appliance for one minute). Instead of venting out through the chimney or flue, the combustion by-products spill into the home.
Balanced Mechanical Ventilation System – a type of mechanical ventilation with a system of inlets and outlets that prevents pressure differences while ventilating the home
Balanced Heat Recovery Ventilator – functions as a supply and exhaust ventilation system. In winter, cold air is pulled from outside and tempered in an exchange of the warm air going out. The heat exchanger transfers heat to the cold, incoming air.
Balloon Framing- a construction method where the walls are framed before the floor is built, and the wall cavity is often open to both the attic and the basement
Band Joist- the framing ribbon between first and second floors of a structure
Barometric Damper- a damper actuated by air pressure differentials

Base Pressure – is the natural pressure difference between the zone you are testing and the outside (without any exhaust appliances running and with the house in "winter condition")
Baseload- the amount of energy (electric and fuel) used to operate lighting and appliances year round
Blower Door- a diagnostic tool used to test for house leakage
Bottom Plate- the bottom horizontal wall component
Btu-***British Thermal Unit*** -the amount of energy needed to heat one pound of water one degree Fahrenheit.
Btu Content of Common Fuels
#2 Fuel Oil- 139,000 Btu's/gal.
Electric- 3414 Btu's/KWh.
Liquid Propane- 92,000 Btu's/gal.
Natural Gas- 100,000 Btu's/therm., 1,000 Btu's/cu. ft.
Wood- 15-20 million Btu's/cord
Building Airflow Standard- BAS - the calculated minimum airflow required for a building and the occupants. .35 ACH or 15 CFM per person, whichever is greater, converted to CFM50. Mechanical ventilation is required if the measured CFM50 is less than 70% of the BAS.
Building Envelope/Building Shell- any part of the building that creates a boundary between indoor and outdoor space
Burner Efficiency- a measure of how efficiently combustion occurs at the burner
Cantilever- a characteristic of some houses where a floor protrudes out past the foundation wall, exposing part of the floor area to the outside.
Capillary Action- moisture transfer through which water is sucked into tiny spaces in and between building materials, caused by the attraction of water molecules to each other and to other substances.
CAZ- combustion appliance zone
Cellulose- an insulation material that is made from recycled material and treated to be flame/insect retardant
CFM_{50}- cubic feet per minute at 50 pascals pressure differential
CFMn – cubic feet per minute at natural pressure
CO- Carbon Monoxide; odorless, tasteless, poisonous combustion by-product, it is lighter than air.
CO_2- Carbon Dioxide; a combustion by-product that is heavier than air
Combustion By-Products- the transformed energy released through the combustion process. Examples are gasses, light, heat, etc.
Compact Fluorescent Lightbulbs- re-designed lights for use in most conventional fixtures; use approximately two-thirds less energy when compared to standard bulbs.

Condensation- the process by which moisture vapor changes to liquid form
Conditioned Space- areas or zones within the house that are heated or cooled for comfort
Conduction- the transfer of heat between objects that are in contact. (Heat is transferred from molecule to molecule, through solid materials.)
Consumption Analysis- an analysis of energy usage. This could be an in-depth review of month-to-month usage, or a comparative analysis before and after work is completed.
Convection- the transfer of heat by circulation or movement of the heated parts of a liquid or gas
Convective Loop- when air (or other medium) continuously circulates around in an enclosed space as it is heated and cooled
Cooling Load- the amount of energy consumed to provide seasonal cooling.
Cost Effectiveness- an indicator of how worthwhile an investment is.
Crawlspace- the space under a house; often used to distribute mechanical/electrical systems. Usually unconditioned
Cripple Stud- stud over or under a header or sill
Delta T - ΔT – the temperature difference between two zones
Delta P - ΔP – the pressure difference between two zones
DHW- Domestic Hot Water system
Diffusion – a moisture transport mechanism; the way in which water vapor moves through materials such as sheetrock and plywood, working its way from high concentrations of moisture to low concentrations
Distribution Efficiency - efficiency with which heat is transported from the heating plant and delivered to the conditioned space
Distribution System – the system through which heat/cooling is distributed throughout the house.
Draft- the movement of combustion by-products through the flue and chimney and out of the building
Draft Test- test to determine if venting systems are effectively moving combustion gases out of the house, even under worst case conditions
Duct Blaster- duct leakage testing equipment
EPA- Environmental Protection Agency
Exfiltration- air leakage. Air leaving the building through the building envelope, caused by pressurization with reference to outside. (Replaced by an equal amount of air entering the building)
Exhaust Only Mechanical Ventilation System – a type of mechanical ventilation that uses a fan assembly to remove air, moisture and contaminants from the home, but relies on building leakage or planned inlet dampers to provide incoming air

Fenestration- envelope penetration used for access/egress or lighting. Examples include windows, doors and skylights.
Fiberglass- common insulation material made from glass fibers
Firestop – material used to stop smoke, toxic fumes, and fire from migrating from one floor to another
First Law of Thermodynamics- energy is neither created nor destroyed, but merely moves from place to place and changes form
Flame Impingement- flame interference or obstruction
Floor Joist- a horizontal floor-framing member
Forced Air Distribution System – A forced warm air system uses a blower and ductwork to distribute heated air from a source (furnace or air handler) to each room.
Formaldehyde- harmful chemical vapor outgassed from many building materials
Friction Loss- loss of air velocity caused by friction within a duct
GAMA- Gas Appliance Manufacturers Association
Gravity Distribution System - depends primarily on convective heat transfer to move warm air through the house. Heat is distributed through the house by gravity, i.e. hot air rises
Gross Area- total area before subtracting fenestrations
Heating Load- the number of Btu's per hour that must to be added to provide indoor comfort. Heating load is based on worst-case Winter Design temperatures determined by local weather statistics.
Heat Loss- the calculated heat loss in Btu's through the building shell or a given component over a period of time.
Formula for Conductive Heat Loss: **Q = U x A x HDD x 24 x .75**
Formula for Convective Heat Loss: **Q = CFMn x 1.08 x 24 x HDD x .75**
Heating Degree Days- a value reflecting the amount of energy needed to heat a building. Annual Heating Degree Days are the total HDD in a year based on 30-year averages for specific climate regions.
HRV – Heat Recovery Ventilator
Hydronic Distribution System – a distribution system in which circulator pumps move hot water through the home (radiators/baseboard or hydronic heat in the floor)
IAQ- Indoor Air Quality
Induced Draft -uses fan located on the furnace at the exhaust outlet to pull air through the heat exchanger. Relies on negative vent pressure to move combustion byproducts out through the flue or chimney
Infiltration- air leakage. The air that enters a structure through the envelope; caused by depressurization with respect to outside. (Replaced by an equal amount of air leaving the home.)
Insulation- any material that slows heat transfer

Interacting Relationships- changing conditions that are inter-related and therefore, affect each other
Internal Gains- heat gains from internal sources. An example would be cooking in a home provides additional heat to the internal environment.
Interstitial Spaces- building cavities (ex. - joist area, interior spaces of walls, etc.)
Jack Stud- the stud that supports either end of a header
Jamb – the top or side piece of a door or window frame
Kilowatt Hour- 1000 watts; 1 kWh = 3414 Btu's
Kinetic Energy- energy in transition or motion
King Stud- the full length studs closest to either end of a header
Knee Wall- a short wall, usually about 3 to 4 feet high, in the attic of a home, anchored with plates between the attic floor joists and the roof joist. Sheathing can be attached to these walls to enclose an attic space. Commonly found in Cape style homes.
Liquid Flow – the movement of bulk moisture from one place to another, driven by gravity or pressure differences
Low Flow Aerators- water aerator that restricts flow to approximately 1½ gal./minute
Low Flow Showerhead- restrictive showerhead that limits water flow to 1½ gal./minute
MAD AIR House- a plexiglas model used to demonstrate interacting relationships of air movement
Makeup Air- air brought in to replace air displaced by combustion or exhaust appliances
Manometer- instrument used in building diagnostics to measure airflow and air pressure
Mechanical Effect – air movement in a structure resulting from mechanical systems
Mechanical Ventilation – intentional ventilation that allows the homeowner some control in the amount and timing of air exchange in the home
Moisture Transport Mechanisms- Liquid Flow, Capillary Action, Diffusion, Air Movement
Mold- a parasitic, microscopic fungi that make spores, which float in the air like pollen. Mold is a common trigger for allergies. Often found in damp areas like basements or bathrooms.
MSDS- Material Safety Data Sheet. Product information, provided by the manufacturer, detailing potential health/safety hazards and required precautions for dealing with a specific material
Negative Pressure – when pressure is lower inside the house than outside

Net Area- square footage of a building component minus any fenestrations or areas of different R-value
N-Factor – LBL N-factors correct the building airflow calculation to reflect the geographic location of the building. The N-factor is height-corrected to reflect the design of the house. (**NCh** is the abbreviation for the height-corrected N-factor.)
NFPA- National Fire Protection Association
NFRC- National Fenestration Rating Council
Orphaned Water Heater- DHW heater that uses a flue previously shared with another heating appliance
OSHA- Occupational Safety and Health Association
Pascal - Pa - A metric unit of measure equaling about one pound of pressure per square foot. 250 pascals is about one inch of water column
Permeability- a measure or rating of a materials' ability to permit moisture to pass through it
Perm (permeance)- a unit of measure of permeability
Platform Framing- a construction method where the floor is framed and subfloored before the walls are set up. For two-story homes, another floor assembly is framed and subfloored on top of these walls. This greatly reduces air movement from basement to attic, as compared to balloon framing.
Polystyrene- foam insulation type; available in sheet or spray
Potential Energy- stored energy
Positive Pressure – when air pressure inside the house is higher than the air pressure outside
Power-Vented System- uses positive vent pressure to remove combustion by-products to the outside. A power-venter located on the appliance pulls air through the heat exchanger and pushes byproducts out through the vent pipe.
Pressure Boundary- Refers to location of the barrier that separates indoor air from outdoor air. It should be continuous and aligned with the thermal boundary.
Pressure Differential Measurements- manometer readings used in building diagnostics; shows air pressure difference between two separate zones
Principles of Air Movement- Air movement requires a passage between two zones and a difference in pressure to push air through the passage. Air follows the path of least resistance.
Radiation- heat transfer from a warm object to a cold object, where the objects are not in contact with each other. Unlike convection or conduction, radiation does not require a "medium" to carry the heat. The objects must be "in sight" of one another.
Radon- naturally occurring radioactive soil gas; common indoor air contaminant
Rafter- roof framing member

Rate of Return – the percentage of savings from an energy investment accrued each year
Relative Humidity- the percentage of moisture vapor present in the air, relative to the total amount of moisture the air could hold at a specific temperature/pressure, expressed as a percentage
Respirator- personal safety device designed to protect against airborne particulates
Rim Joist- the external frame for a floor platform of a house; also called box sill
Rock Wool- insulation type made from glass fiber
R-Value- the measured resistance of a material to heat transfer
Savings to Investment Ratio – SIR – the life cycle savings of an energy improvement divided by the initial investment. (For every dollar invested in an energy improvement, how many dollars will be saved over the life of the improvement, in today's dollars?)
Sealed Combustion Venting System- This is a venting system that uses either a concentric or a two-pipe vent. (A concentric vent is one in which there is a small pipe inside a larger pipe.) One pipe is designated to bring in combustion air, and the other is designated for removal of combustion by-products out of the home. No combustion air comes from inside the home.
Seasonal Efficiency - total system efficiency, includes AFUE and distribution losses, average efficiency over the course of a heating season
Second Law of Thermodynamics- Energy flows naturally from high concentrations to low concentrations.
Simple Payback- the number of years it takes for annual savings from an energy improvement to equal the initial investment
Soffit – the underside of a roof overhang. A dropped soffit is a small lowered ceiling often found above cabinets.
Solar Heat Gain Coefficient- the percentage of solar heat that is absorbed vs. reflected when it contacts a window.
Solar Light Transmittance- the percentage of light that is absorbed vs. reflected when it contacts a window.
Specific Heat - the capacity of a cubic foot of material to hold heat; .018 Btu's for air.
Spillage- a temporary flow of combustion by-products from the flue or chimney of a combustion appliance into the home
Stack Effect- occurs when a building is heated, and the warm air inside the building is less dense than the colder air outside. The inside air rises up and out of any holes in the upper portions of the envelope and this escaping air is replaced with outside air that enters through holes in the lower portions.

Steady State Efficiency- measurement of the combustion efficiency of a heating system when it has reached equilibrium (i.e. system has "warmed up," usually after about five minutes)
Steam Distribution System: hot steam rises under low pressure (into standing radiators)
Supply Only – a type of mechanical ventilation that uses a fan assembly to bring air into the home, but relies on building leakage or planned outlet dampers to remove moisture and contaminants
Temperature – a measurement related to the amount of kinetic energy within a material or substance. The greater the kinetic energy, the higher the temperature.
Thermal Boundary- the insulation boundary that separates conditioned from non-conditioned spaces in a building. It should be continuous and aligned with the pressure boundary.
Thermal Bypass- a material or component piece that allows more heat transfer when compared to adjoining component pieces
Thermodynamics – a branch of physics that explains the effect of temperature and heat, and the conversion of energy from one form to another
Thermostat- control for maintaining heat at a prescribed temperature
Top Plate- horizontal framing member at the top of a wall
Unconditioned Space- an area or zone in a building that is not intentionally conditioned
Urea Formaldehyde- common glue type use in wood products
Urethane- common foam insulation; available in sheet or spray
U-Value - A measure of thermal transmittance (how fast heat moves through a material)
Vapor Barrier/ Vapor Diffusion Retarder- a material that has low permeability that is used to reduce moisture migration through building components.
Vapor Pressure – the natural force that drives moisture vapor to diffuse and equalize with other areas or zones with different moisture content
Vent Damper- barometrically controlled component that helps prevent backdrafting of flue gases.
Ventilation- air turnover (intentional and unintentional) in a house
Vermiculite- ceramic insulation type commonly used before 1950
Volume- the formula for volume is: **length** (in linear feet) x **width** (in linear feet) x **height** (in linear feet) = **volume** (in cubic feet).
Water Vapor – Water in the form of gas. Water vapor is transported by air movement caused by pressure differences.
Whole House Fan- ventilation system that draws air from the house through the attic and out via attic ventilation.

Wind Effect- the pressure related effects of wind on a structure, positive pressurization on the windward side and negative pressurization on the downwind side.
Windwashing- reductions in R-value of insulation caused by air movement through insulation
Worst Case Depressurization – a manipulation of exhaust and air-handling equipment, and interior door closures, while the house is in winter conditions, to depressurize the CAZ as much as possible.
Worst Case Depressurization Test- combustion safety testing performed in CAZ to determine the possibility of backdrafting occurring under worst-case conditions
WRT- with reference to