REVIEW OF SELECTED HOME ENERGY AUDITING TOOLS

In Support of the Development of a National Building Performance Assessment and Rating Program

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1. EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) is embarking upon an effort to develop a national program to assess the energy performance of houses. The program will provide information to current and prospective homeowners about the energy performance of the house and potential areas of improvement, along with associated cost estimates. As a component of this program, DOE is interested in understanding the variety and characteristics of currently available audit tools that have national validity. Of particular interest is the ability of these tools to accurately analyze residential building performance--regardless of climate, fuel source, architectural style, and building system--with a reasonable level of tool inputs. Additionally, DOE is interested in the ability of these tools to produce reports on estimated fuel consumption and lists of recommended building energy efficiency improvements.

The energy audit tools reviewed in this study include REM/Rate®, BEACON Home Energy Advisor®, EnergyInsights®, Home Energy Tune-uP®, EnergyGauge®, TREAT®, the National Energy Audit Tool (NEAT®), Home Energy Saver™ Professional (HES*Pro*), and RealHomeAnalyzer®. Not included in this study are audit tools under DOE oversight or influence such as, Manufactured Home Energy Audit (MHEA), Home Energy Yardstick, and other specialized tools designed for specialized purposes such as HVAC loads or for localized utility program energy efficiency efforts.

The study is organized by task, including a literature review (of previous related studies), selection of audit tools to review, the creation of audit tool review criteria, audit tool vendor interviews, and compilation and analysis of the data. Information collected regarding audit tools includes names of currently available tools in the marketplace, accuracy, cost, accessibility, ease of use, input and output characteristics, and the purpose and reporting characteristics of each tool.

Findings of the study reveal that no one tool fully captures all the characteristics currently thought to be important to a national home performance assessment program: low cost, universal availability, ease of use with reasonable input requirements, conformance to a universally accepted accuracy standard, and the

ability to generate improvement recommendations and associated costs. The audit tools as a population, however, appear to address the potential needs of a national program.

Besides identifying tool deficiencies for application under a national program, this study is expected to assist DOE with:

- developing standards for data inputs, algorithms, and data outputs used by tools in a national program;
- standardizing the method by which home energy improvement measures are prioritized and costed;
- standardizing the benchmark by which home performance is reported; and
- standardizing the type and format of information displayed on home performance reports as well as populated into a national registry database.

2. INTRODUCTION

Home energy audit tools are used to evaluate single-family residential buildings in order to identify opportunities for energy efficiency improvements and determine energy performance. These tools vary considerably in how they collect and analyze a home's characteristics and generate energy-efficiency retrofit recommendations. The U.S. Department of Energy (DOE) is undertaking an effort to develop and/or approve the use of uniform and systematic home energy audit tools as one component of DOE's Home Energy Score Program, an overarching program to rate and create recommendations regarding the energy performance of single-family homes. The program's goal is to create a common understanding in the real estate and financial industries of the value of energy efficiency improvements in U.S. housing.

The purpose of this study is to explore widely-used energy audit tools that guide the collection of data by an energy auditor, use the data to generate an analysis of the energy efficiency of a dwelling unit, and generate an understanding of potential improvements to a home to maximize its operational efficiency. Of particular interest is the ability of currently available energy audit tools to accurately analyze residential building attributes, multiple climates, fuel types,

and other related factors with a reasonable set of inputs and meaningful outputs (e.g., reports on estimated energy savings, prioritized lists of energy efficiency measures, etc.). The tools in this study were reviewed to gauge how each might impact DOE's development of the Home Energy Score Program.

The next section briefly outlines the key types of energy audit tools. This discussion is followed by a description of the methodology employed in the review of the most widely used audit tools for single-family dwellings. The findings of the tool review are presented next, including tables displaying review criteria and attributes of the reviewed tools followed by recommendations for further study. A summary of the literature search and the corresponding literature references are provided at the end of this report, followed by attachments including the tool vendor questionnaire, sample tool input forms and output reports, and other information referenced in the body of the report.

3. Energy Audit Tool Types

Energy audit tools commonly used by the home performance and weatherization communities (as well as homeowners) to analyze a home and create strategies for energy efficiency improvement or weatherization generally consist of the following types:

- Web-based calculators
- Prioritized lists of measures
- Checklist or survey instruments
- Asset rating tools
- Operational rating and audit tools.

A description of each of these tool types follows with a focus on general category attributes, including:

- Typical tool user
- Tool output and its intended use
- Scope of home analysis by tool (simple vs. comprehensive)

- User expertise required
- Ability of the tool to accept diagnostic inputs (e.g., envelope or duct tightness readings, fan efficiency, etc.)

Web-Based Calculators

Web-based calculators consist of tools commonly offered at little or no cost to perform energy analysis on homes. Groups such as public-service non-profit organizations, utilities, and government agencies are common vendors for these tools. Representative tools from this category include Home Energy Checkup offered through the Alliance to Save Energy, ENERGY STAR® Advisor and Energy Yardstick distributed by the U.S. Environmental Protection Agency (EPA), and Home Energy Saver (HES) hosted on a website developed by the U.S. Department of Energy.

Typical users of these tools are homeowners wishing to identify areas of potential energy improvement in their homes. Output from these web-based tools typically consists of generalized improvement measures or links describing building system improvements so that homeowners gain a general idea of the types of improvements to be further investigated. Home Energy Checkup, billed as an educational tool, presents typical improvements for single-family homes across all eleven climate zones within the United States while noting that actual recommended measures and potential savings will vary. Energy Yardstick analyzes energy bill data, compares usage to other households across the nation, and provides links to the Home Energy Advisor to explore potential improvement measures. The most analytic tool in the group is Home Energy Saver; based on user inputs, the tool presents recommended energy efficiency measures with expected cost savings and payback. A professional version, Home Energy Saver Professional (HES-Pro), is under development and is described later in this report.

These web-based audit tools, while addressing the whole house, are rather simple in scope, as very few characteristics are input and the recommended measures reported are very general in nature. The exception is Home Energy

Saver. This tool directs the user to input more detailed information, such as the number of windows, square footage, desired payback period and level of efficiency improvement. The simple nature of these tools reflects their intended use by a general audience without building science expertise. As such, none of the representative web-based tools, with the exception of HES, accept values from diagnostic equipment (such as from a blower door) because the general public is not expected to have this equipment or data.

Prioritized List of Measures

Prioritized lists of measures exist in electronic software and hardcopy form. Energy efficiency measures are prioritized on the basis of local program initiatives, estimated cost-effectiveness of improvement activities, other factors such as health and safety issues, or a combination thereof. The Florida Weatherization Assistance Program Priority List Assessment and Testing Form (Attachment A) (Ref. 1) offers an example of a form of prioritization based on program goals. This form ranks improvement measures by their order of priority; work will be performed in the same order unless measures are deemed non-applicable for the situation and supporting material provided to back up the judgment. A second example of prioritization is found in the preliminary home improvement specifications developed for the Partnership for Advancing Technology in Housing (PATH) (Ref. 2). Specifications were developed as a function of cost effectiveness as well as technical ability of the improvement contractor. Low-cost, low-skilled activities are advocated over higher cost improvements requiring a more advanced contractor skill set.

Prioritized lists sometimes use inputs from diagnostic tests such as blower door and duct-tightness testing. The Florida example shows inputs for these diagnostic tests. Prioritized lists also vary in the comprehensiveness of an assessment. Some utility energy efficiency programs, for example, have focused primarily upon examining homes for compact fluorescent light bulbs, appliances, and programmable thermostats.

Prioritized lists allow programs and users to:

- Standardize how structures are evaluated and improved,

- Maximize utilization of a wide range of auditor skill sets, and
- Facilitate integration of local program priorities and initiatives such as rebates, health and safety measures, and fuel preferences.

Checklist or Survey Instruments

Checklist or survey instruments typically guide a user to input data collected during a visual energy home "inspection" – a quick audit usually done without diagnostic equipment – onto a data sheet or into a simple software package. Users are not required to possess the more extensive training and experience necessary to conduct the asset and operational ratings and audits described below. Some energy efficiency programs such as those run by utilities and state and local governments then use this data to direct prescriptive improvement measures based on parameters established by each program. For example, if a refrigerator is over 15 years old, a program might prescribe a new refrigerator regardless of condition or actual efficiency of the appliance. The output reports from these tools may also recommend home energy improvement measures either based on prescriptive or calculated measures. Improvement measures recommended may or may not have prioritization assigned to them. Programs that prioritize improvement measures may use varying financial calculations to determine the cost effectiveness of the measure. Expected life of the improvement, material and labor costs, interest rates used to account for the cost of capital, and acceptable payback periods or rates of return all influence how individual improvement measures may be prioritized.

Asset Rating Tools

Asset ratings are energy performance values assigned to a house attributable entirely to the characteristics of the structure, the applicable climate, and a standard set of operating parameters (e.g., for thermostat settings). In other words, individual inhabitant behavior is removed from the calculation. Unlike checklist or survey instruments, asset ratings are more comprehensive and generally require the use of diagnostic tools such as blower doors. Asset ratings allow different houses to be compared using a consistent methodology, which is particularly useful to homebuyers. The best example of an asset rating is found in the automobile industry, where labels are affixed to cars to indicate the gas

mileage expected for highway and city driving. Vehicle owners rarely match these values with their own driving because the ratings are calculated using a very precise protocol that an individual's actual driving habits may not mimic. The value in this rating, despite its limitations, is that different cars can be compared using a consistent metric.

The most common example in the housing industry is the Home Energy Rating System (HERS), created by the Residential Energy Services Network (RESNET) originally for new homes but now also used for evaluating the energy performance of existing homes. A HERS index is a number calculated to indicate how a house performs compared to a zero-energy home (with a HERS index of 0) and a home built to the 2004 International Energy Conservation Code (with a HERS index of 100). Currently, ENERGY STAR-labeled homes require a HERS index of 85 or lower.

Operational Rating and Audit Tools

An asset rating, while useful for comparison purposes, is often not very helpful when trying to understand how a home actually functions and where present occupants should make energy efficiency improvements. The rating useful for this purpose is termed an *operational rating*. In addition to operational ratings, energy audits typically evaluate the operational performance of homes to generate a list of possible home energy improvements and energy and cost savings estimates. Comprehensive operational ratings and audits look at the actual energy use of a home as its occupants currently use it. Operational rating and audit tools typically require the use of diagnostic equipment and can use historical utility bill data and occupant operational information obtained from occupant interviews. While extremely useful for current home occupants in determining cost-effective home energy improvements, an operational rating might have limited applicability for future occupants due to highly variable operational behaviors such as thermostat settings, lighting usage, length of showers, and plug loads.

As mentioned above, comprehensive software tools that provide asset ratings, operational ratings/audits, or both, often can be used to guide energy

improvement measures. Generally, these types of tools can more accurately determine the benefits of improvements than checklist or survey instruments that produce a list of prescriptive measures and often overestimate energy savings. For example, improving the attic insulation from an R6 to R50 might generate an estimated savings of $200 per year, while increasing the efficiency of a furnace from 80% to 95% efficient might generate $400 of savings per year. It is common for simpler, prescriptive checklist instruments to add up these two measures to report $600 of annual energy bill savings. In reality, these measures influence each other. For example, increasing attic insulation decreases the heating load placed upon the furnace and thereby decreases the benefit realized by upgrading to a higher efficiency system. Many rating and audit tool software tools take this interaction into account and adjust the expected benefits accordingly.

4. AUDIT TOOL REVIEW METHODOLOGY

A number of issues complicate the investigation of energy audit tools of potential interest to DOE. The audit tools initially considered for review varied considerably in format, function, availability for review, target audience, and complexity. Therefore, the challenge was to place parameters on the investigation to better review the audit tools and to develop evaluation criteria. To that end, a process was developed that reflects the study's emphasis on identifying industry-accepted tools and key tool attributes that might inform and shape the development of a Home Energy Score Program for Homes pertaining to residential structures.

Accordingly, this study was carried out in six major steps:

- **Literature Investigation.** A cursory investigation of the literature was conducted to identify evaluations of home energy auditing tools in recent years. Another desired result of the literature search was to limit unnecessary duplication of research. In particular, information was sought regarding:

- Audit tools in the marketplace and their corresponding attributes (including tool inputs and reporting characteristics), intended use, marketplace presence, ease of use, and similar factors
- Accuracy of existing tools (e.g., modeled versus actual energy use, or estimated energy savings vs. savings generated by an evaluation tool like DOE's BESTEST)
- Standards impacting audit tool inputs, algorithms, outputs, accuracy, and other properties
- Other relevant literature, including research and information on how existing energy efficiency programs select or approve audit tools.

- **Selection of Energy Audit Tools to Investigate**. This study reviews energy audit tools that exhibit the promise of generating defensible energy savings estimates, can produce prioritized lists of recommended energy efficiency measures, and are widely distributed. The more comprehensive asset rating and operational rating/audit tools met these requirements. As checklist and survey instruments were found to be more custom-tailored for local applications and less tested in the overall marketplace, they were not considered in this study. Web-based calculators and prioritized lists of measures were also not considered, as these tools would likely not satisfy minimum requirements of lenders for energy efficiency project financing.

  In particular, tools recognized by the EPA Home Performance with ENERGY STAR® program, those used in utility-based programs throughout the United States, and those accepted and widely adopted by the Weatherization Assistance Program were evaluated. Excluded were tools developed for a very particular purpose as the Manufactured Home Energy Audit (MHEA). Likewise, other than a cursory description of the software, ENERGY STAR Home Advisor, and Yardstick were also excluded from this review. HES-Pro, however, was included due to added functionality of the tool and its potential to contributing to the Home Energy Score Program.

While many other software packages exist for specific purposes such as calculating heating or cooling loads, determining appropriate ventilation, and serving as an instructional tool, this study restricted tools to those known to be applicable across the majority of climate types within the United States and capable of contributing to the Home Energy Score Program (i.e., whole-house rating and audit tools). The authors recognize and regret the possible omission of other tools also meeting these criteria that were not readily identifiable. The software packages selected for study include the RESNET-accredited tools: REM/Rate®, EnergyGauge®, Energy*Insights*®; tools commercially available and commonly used for energy audits and home performance programs: BEACON Home Energy Advisor®, Home Energy Tune-uP®, TREAT®, and RealHomeAnalyzer®; and other tools, either government-produced or benchmarking applications: HES*Pro*, NEAT®, and Green Energy Compass®. Versions evaluated were the most current at the time of study inception – February, 2010.

- **Definition of Review Criteria.** Prior energy audit tool evaluation studies were examined and a list of questions was developed to query audit tool vendors about their products (Attachment B). Questions regarding the typical purchaser, range or influence of the product, common uses for the tool, input and report characteristics, product costs, ease of use, training and certifications required, and other information of interest to DOE were included. All totaled, 40 review criteria were developed and integrated into a questionnaire.

- **Vendor Interviews**. Vendors were interviewed mainly by telephone to complete the questionnaire. In the cases where vendor representatives could not be reached, the questionnaire was emailed with a request to complete and return the information. In addition, energy audit tool vendors were interviewed at the RESNET 2010 annual conference. Information was collected for all audit tools selected for review but not necessarily for all criteria for each tool. The incomplete responses were not deemed to be

critical, given the emphasis on the timeliness of this study. Also, this study considers the attributes of existing audit tools as a whole when making recommendations as to their applicability to the Home Energy Score Program.

- **Review of Selected Audit Tools**. Results from the questionnaires and interviews were compiled into a matrix in order to view the selected energy audit tools by key attributes. This framework allows insight into potential strengths and weaknesses of each tool relative to the goals of the Home Energy Score Program. The review criteria are defined at the end of the matrix presented in the next section. Key attributes were reviewed in light of these issues:

  - ***Cost and accessibility*.** The Home Energy Score Program, if standardized, needs to be accessible to trade contractors and affordable to consumers, who ultimately bear the cost of the tools through contractor audit and retrofit pricing. Tools that are excessively expensive or require excessive training, certifications, and/or licensing or usage fees are not likely to be good candidate tools for a national program expected to reach millions of homeowners.

  - ***Ease of use*.** Related to the cost and accessibility of particular tools, the minimum level of skill and experience required to effectively use an audit tool is a key criteria of its application in a national program. In particular, with the current Presidential Administration's focus on green jobs, a tool used for the Home Energy Score Program must not require extensive training or years of experience to accurately operate and produce desired results.

  - ***Applicability to U.S. climate zones*.** To have the most value to a national program, audit tools that provide the desired outputs for the broadest set of climate zones in the United States would be favored over those tools relevant for a narrow range of climate conditions. Given the current relatively small customer base for audit tools, those

tools with adaptability to additional climate zones in the future would also be considered as candidate instruments for the Home Energy Score Program.

- ***Accuracy*.** For estimated energy savings and recommended energy efficiency measures to be deemed credible by trade contractors, lenders, homeowners, energy efficiency program sponsors, and the home performance industry at large, they must approximate real-life conditions before and after a retrofit. Tool accuracy should be evaluated on its ability to emulate the actual energy use of a dwelling, predict energy savings for improvements, estimate or report the "real-world" cost of improvements, and then use cost, energy savings, and interactions between energy efficiency measures to "package" and prioritize home energy improvements. However, limited information is available to ascertain the accuracy of most audit tools in the marketplace today, making review for this criterion difficult at best. Further complicating this review is the lack of industry consensus on the effectiveness of the few standards and instruments currently in use for evaluating the accuracy of audit tools (e.g., DOE's BESTEST and BESTEST-EX).

- ***Inputs.*** Typically, the lower the number of inputs required by audit tools, the lower the amount of time to collect and enter those inputs, thus reducing audit costs. However, fewer inputs can come at the cost of tool accuracy for a given residence, as tools then rely on generic input defaults. Ideally, a compromise between excessive inputs and inaccurate results lies in affordable yet credible audit tools. Many audit tools also allow the user to expand the level of inputs based, for example, on the number of different building systems to be addressed in the analysis. In reviewing input-related attributes or criteria for individual tools, an attempt was made to consider the nature of the minimum required inputs (i.e., the time to collect the data) in addition to the number of inputs. DOE is also interested in ascertaining common inputs among leading audit tools or a recommended set of minimum

audit tool inputs. However, this request came late in the study and, therefore, is not fully explored herein.

- ***Outputs*.** Desirable outputs from audit tools include, at a minimum: estimated energy savings from a future retrofit, prioritized lists of energy efficiency improvements, and estimated costs of those improvements. Desirable outputs from tools used under a labeling program include: a home energy rating (either asset-based or operational rating normalized for "typical" use), a list of recommended or installed home energy improvements, predicted energy savings of improvements, and standardized outputs in predetermined formats for inputting into a national registry or other tools for purposes of further analysis or benchmarking. These types of outputs were examined for each tool reviewed.

- **Findings**. The findings from the above-mentioned review were assessed and compiled for DOE action to establish the role of energy audit tools in a national residential building energy rating program. More specifically, this study attempted to answer questions such as:

  - What is the availability, attributes, costs, and level of adoption of viable existing energy audit tools in the marketplace today?
  - Can existing audit tools be employed under a consistent national home energy performance label, providing defendable ratings and energy savings estimates on retrofit measures? How?
  - Are additional software tools or applications necessary to reach the mass residential market (including key market actors such as home inspectors), either augmenting current tools or filling gaps and deficiencies unmet by existing tools?

  Additional areas of research are identified throughout this study and are also compiled and presented in the Findings section of this report.

5. FINDINGS

Study findings are organized by methodological step. It is important to note that qualitative judgments were made for items where definitive evidence is lacking or where disparate characteristics were compared. A summation of the literature search and findings from the questionnaire follows with a focus on the topics of:

- Cost and availability
- Ease of use
- Applicability to most U.S. climates
- Accuracy
- Inputs
- Outputs or reports.

Summary of the Literature Review

Available Audit Tools – The literature collected and reviewed as part of this study revealed that home energy audit tools primarily are used by the home energy rating community (through RESNET); the DOE-funded Weatherization community; the home performance industry (e.g., through Building Performance Institute (BPI) certification); or utility-, non-profit-, or state/local government-based energy programs. RESNET-accredited tools enjoy some of the widest distribution nationally but are restricted to certified home energy raters (HERS) working under the services of a RESNET-certified Provider. These Providers operate as quality assurance organizations under RESNET and sublicense the tools to energy raters working under the Provider's umbrella. Also important to note is that BPI currently does not require the use of audit or modeling tools to determine estimated energy savings; although, there is movement within the organization to go that way.

Weatherization tools include NEAT®, MHEA®, TREAT®, and a handful of others; some tools listed in the literature are no longer distributed by vendors. NEAT® or TREAT® are used by the majority of the state weatherization assistance programs. These tools are designed to facilitate ease of data entry and produce

a report detailing recommended improvement measures that comply with guidelines established by the particular agency, state program, and the national DOE Weatherization Assistance Program in terms of cost and priority.

Utility-, non-profit-, and state/local government-based energy efficiency programs develop their own tailored, one-of-a-kind audit tools or rely on proprietary third-party audit tools such as SIMPLE (not evaluated due to being new to market with limited market presence), BEACON Home Energy Advisor®, HomeCheck® (a precursor to RealHomeAnalyzer®), or Home Energy Tune-uP®. These tools are often tailored in some fashion to the individual needs of the utility program; the number and format of the inputs and reports vary considerably. A study by the Energy Trust of Oregon program chronicled the difficulty in using an audit tool as an obstacle to its adoption (Ref. 3).

Audit Tool Accuracy – Information about audit tool accuracy over the broad range of tools is virtually non-existent. Where accuracy is mentioned in available studies, it generally examines a particular tool against only one or two other tools. For example, the 2008 Energy Performance Score report compared REM/Rate® against two versions of Home Energy Saver™ and one other tool (SIMPLE) and found all tools to have issues with the accurate prediction of actual energy usage across a broad range of house types (Ref. 4). It should be noted that this reference has received criticism from the energy modeling community and conclusions from the paper are not widely embraced.

In the literature reviewed, accuracy is addressed more typically in terms of the protocols used to evaluate energy auditing tools. These protocols include BESTEST, BESTEST-EX, and ASHRAE 140 (Refs. 5, 6, 7). As the ASHRAE protocol is primarily used for tools targeting commercial structures, the BESTEST protocols are the standards currently under review for audit tools focused on residential structures. Among other issues, BESTEST is believed by some to frequently overestimate energy savings. In the case of high-performing homes or deep retrofits, the accuracy of BESTEST is particularly debated (Refs. 8, 9). RESNET, as part of its quality assurance procedures, maintains a registry of

approved software tools, all of which conform to BESTEST protocols (Refs. 10, 11). BESTEST-EX is a protocol under development to address some of the accuracy issues and to better integrate energy usage data into the algorithms used to generate predicted energy use and potential energy savings. Little publicly-available literature was found on BESTEST-EX.

Information about standards primarily pertains to how audit tools are evaluated. Again, BESTEST, BESTEST-EX, and ASHRAE 140 are the currently available or soon to be available standards relative to energy modeling tools. Otherwise, individual energy efficiency program requirements dictate the specifications for inputs, algorithms, and output in format and data type. For example, NYSERDA in a current Request for Proposal, was very specific in the desired qualities for an energy modeling tool to be used in a *Home Performance with ENERGY STAR* program. NYSERDA has detailed exactly what the tool needs to do, what kind of quality assurance mechanisms are contained within, what the data exchange file should be, and peer review required of the tool. In addition, characteristics of a sample home were provided to proposing vendors to calculate estimated energy savings and generate a recommended list of energy efficiency measures. NYSERDA reviewers would then use this information to gauge the "accuracy" of the proposing vendor's audit tool (Attachment C.) This approach presumes that the original tool NYSERDA used to develop the results upon which other vendor's calculations are evaluated is itself extremely accurate. It is more likely that NYSERDA was comfortable with results of its evaluation audit tool based on the combined experience of the organization's residential energy staff, as opposed to any extensive study as to the accuracy of its tool (beyond perhaps comparing its results with actual post-retrofit utility bills for a single home).

Summary of the Tool Review

Information was obtained from nine vendors with energy audit tools recognized by RESNET-accreditation, DOE Weatherization Assistance Program acceptance, or use by prominent utility, state/local government, and ENERGY STAR programs throughout the nation. As mentioned in the earlier discussion on methodology, tools considered too regionally anchored or restricted by climate zones were eliminated from consideration in this study. Table 1, Table 2, and

Table 3 for RESNET-accredited tools, energy efficiency program tools, and government vendor or other purpose tools respectively detail the information obtained from the vendors, organized by the review criteria defined at the end of the table. Based on review of the information collected about each tool, the following observations were made for each major criterion area studied:

Cost and Availability – NEAT®, HES*Pro*, and TREAT® are the most widely available and used tools in the study; they are available to anyone or, in the case of TREAT, with the means to purchase the tool. The cost for a Single-Family version of TREAT® is $495 with a $200 annual license renewal. NEAT® and HES*Pro* are currently free to the public although HES-Pro was under development and in its beta form when reviewed.

The RESNET-accredited tools have no cost values attributed to them because they are licensed for use through a HERS Provider who charges a license fee. These fees vary considerably depending on the business model of the Provider; for example, a Provider may choose to have a low license fee but charge more for a per-use rating. Additionally, auditors using RESNET-accredited tools must be certified raters and must typically complete a week-long training program offered by HERS Training Providers. It is not unusual for these training programs to cost over $1,500. A caveat is a tool provided by Architectural Energy Corporation called REM/Design® where many of the functions of REM/Rate® are present but is available to everyone and the cost is $327 per computer. REM/Design® was not selected for analysis in this study.

National cost information is not known for utility and state/local government supported tools such as BEACON Home Energy Advisor® and RealHomeAnalyzer®, as subsidy support to auditors and trade contractors by these programs varies considerably. In some areas, users may be less subsidized and therefore carry more of the cost burden.

Home Energy Tune-uP® is offered to certified auditors and home inspectors. Mandatory training consists of a three-day program. Additionally, CMC charges a nominal fee for each report delivered through Tune-uP®.

All in all, the initial costs (including initial licensing and renewal fees, per use fees, and training) of the audit tools examined were not found to be especially prohibitive to the auditor, rater, or trade contractor. These costs were deemed reasonable business expenses. However, if a user was required by program sponsors (utilities, municipalities, states, and others) to obtain a multitude of different audit tools and corresponding training, tool costs would be unacceptable. Tool standardization evolving from the Home Energy Score Program could permit individual users to purchase and use a single "approved" audit tool of their choice.

Ease of Use – The intent of this study was not to obtain every tool under review and model sample houses to evaluate first-hand the ease of use of each tool. While this method would enable the best evaluation of ease of use, time did not permit it. Therefore, a combination of the reviewers' experience with some of the tools, findings from the literature, and the number of inputs required for a report was used to generate a qualitative rating on ease of use for each tool. An ease of use rating correlated solely to number of inputs would potentially mislead the reader; tools with very few inputs might place much of the burden of decision-making or analysis on the auditor, thereby making the tool less friendly.

Tools judged to be most user-friendly include Green Energy Compass® and BEACON Home Energy Advisor®. Green Energy Compass® is not an energy modeling tool. It takes information generated by audit tools to generate a benchmark and energy-use tracking record. Home Energy Tune-uP®, NEAT®, HES*Pro* and Energy*Insights*® were judged to be average in user-friendliness primarily based on user experience and number of inputs. TREAT® and the RESNET-accredited tools were ranked as the most difficult to use. No information concerning RealHomeAnalyzer® was obtained for this draft, but its predecessor, HomeCheck®, was reported as being challenging to use.

BEACON Home Energy Advisor®, being a relative newcomer to the audit tool marketplace, was specifically designed with the goal of ease of use in mind. "Lighter" versions of TREAT® (Surveyor®) for single family, multifamily, and commercial applications are under development but were not specially reviewed under this study. Surveyor® acts as a simplified input interface with TREAT® as the engine. The release dates for these versions are unknown at the time of this writing. The evolution of these easier-to-use audit tools demonstrates the software vendors' willingness and ability to adapt their tools to the needs of the marketplace, including to an eventual national home energy rating and labeling program.

Applicability to U.S. Climate Zones – All audit tools contained within the matrix are used in the majority of the climate zones for the continental United States and, therefore, would support a national home energy rating and labeling program. EnergyGauge® is most appropriate for the warm-humid climates such as Florida.

Accuracy – Presently, audit tool accuracy is based entirely upon conformance to applicable standards, studies comparing tools to each other, or evaluations of tools against accepted baseline instruments (such as BESTEST.) As the literature identified in this study does not contain any recent comparison of all the tools, the matrix lists the standards, if any, where the tool complies. All of the tools conform to BESTEST or plan to conform to BESTEST-EX with the exception of Green Energy Compass®, which is not a modeling tool. As of this writing, it is assumed that RealHomeAnalyzer® complies with BESTEST but no confirmation has been obtained from the vendor. It should be noted that BESTEST-EX is still under development.

Inputs – The number of inputs necessary to obtain a "typical" report was asked of each vendor (for examples, see Attachment D.) The values range from approximately twenty inputs for Energy*Insights* and TREAT® to a high of approximately 100 for REM/Rate® (considerably less, 33, for Simplified Inputs

mode), Home Energy Tune-uP®, EnergyGauge® and NEAT®. BEACON Home Energy Advisor® and HES*Pro* fall in the middle. It is interesting to note that one of the tools reported as difficult to use earlier (TREAT®) also has the fewest inputs. This number of inputs for TREAT® is variable, however, and can be vastly greater depending on the goals set for the tool by its user.

All of the energy auditing tools require some knowledge of building science to effectively gather and enter the necessary information to run analysis. Particularly in cases where deeper retrofits are under consideration or where the inputs are very general in nature, the ability to finesse a tool to better account for improvements which contribute smaller improvement benefits or to adjust inputs to more accurately reflect the "as is" condition is key for accurate modeling. Knowledge of building science as well as an understanding of the "tricks" of the audit tool contributes to more effective improvement recommendations.

If a national home energy rating and labeling program "approves" audit tools (based on various criteria), a user should eventually have a choice of tools from which to select. The user can then base this choice on the level of inputs required of tools, the expertise necessary to achieve accurate results, tool costs, and so forth.

Outputs – With the exception of EnergyGauge®, all the tools can generate home energy improvement recommendations. Green Energy Compass®, NEAT®, and HES*Pro* improvement reports cannot be modified, while the other tools improvement reports have the ability to add comments. Energy Insights, Home Energy Tune-uP®, NEAT® and TREAT® can also accept photos. With the exception of EnergyGauge®, all tools can export data to a file in common database, xml, or csv formats.

A national rating program by definition will require the calculation of a rating or similar benchmark for homes. Tools such as REM/Rate®, Energy*Insights*®, and EnergyGauge® all generate ratings as a requirement for the RESNET-accredited registry of tools for HERS Providers. TREAT® can generate a home energy

baseline or label, although TREAT® is no longer on the RESNET-accredited list of software for ratings as the vendor elected not to adapt the changes in the rating system. Most, if not all, the tools reviewed can produce an estimated percent energy savings or before and after estimated energy usage as possible benchmarks.

As mentioned earlier, improvement measures can be prioritized by various energy efficiency programs in a number of different methods. Many, such as the Home Performance with ENERGY STAR and the Weatherization Assistance Program focus partly on health and safety issues with cost effectiveness following as a method of ranking energy efficiency priorities. Some utility-based programs may focus on particular incentives such as appliances through a rebate program. Prioritization of improvement measures can be based upon:

- Health and safety,
- Energy efficiency measures grouped into packages, (e.g., an air-sealing and insulation package),
- Individual or ala carte efficiency measures,
- Cost effectiveness (defined differently by different energy programs),
- Those defined by the program (such as compact fluorescent light bulbs, rebates on appliances, etc.).

The prioritization used in the reported improvement measures by the individual tools reviewed in this study varied as well. Energy Gauge does not currently generate home energy improvement reports and Green Energy Compass® produced a generic improvement report that remains consistent irrespective of the home being analyzed. The general list of improvement measures are used as an educational tool rather than a structure-specific list of energy efficiency recommendations. The recommendations portion of the tool is currently being adapted to produce a list of measures based upon utility bill disaggregation.

Home Energy Tune-uP® lists two groups of recommendations: improvements with a simple payback of 30 years or less, ranked by order of payback; and a second group of improvements that generate more savings than the cost to

finance based upon a 15-year loan at 8% interest. Indoor air quality and safety issues are included in the Home Energy Tune-uP® report. Home Energy Tune-uP® uses R.S. Means Repair & Renovation® data as the basis for developing cost of home energy improvement values. The Home Energy Tune-uP software takes into account variations in weather, state codes, labor costs, and fuel prices by reference to the zip code in the address.

The other tools that were reviewed all allowed user input to drive the home energy improvement measures that are analyzed by the tools and then reported. For example, a user may instruct a tool to generate a recommendation to improve attic insulation from R11 to R49 (based on minimum local building codes, recommended ENERGY STAR levels, or some other reasoning.) This recommendation may have little bearing on the cost effectiveness of the measure specified. Energy*Insights*® also permits automatically-generated recommendations for use with utility-based programs that may wish to control the recommendations generated.

Based on the review of how leading energy audit tools generate their respective lists of energy efficiency measures, most tools rely on the user to predetermine what improvements will be analyzed. This predetermination necessitates some level of experience by the user in local building energy codes and industry best practices. For this reason, different energy efficiency improvement recommendations can be made by different users for the same house using the same audit tool. A Home Energy Score Program for homes would benefit from a more consistent set of outputs from audit tools. However, expecting software vendors to enhance their audit tools with local energy code and climate-specific best practices libraries may be too burdensome.

Table 1. Audit Tool Criteria and Attributes Matrix – RESNET Certified

Criteria ● possesses attribute ◐ possesses some of the attribute ○ does not possess attribute	**Energy Gauge**	**REM/Rate**	**Energy *Insights***
General Information			
Vendor	Florida Solar Energy Center	Architectural Energy Corporation	Apogee Interactive
Contact/website	www.energygauge.com	www.remrate.com	www.apogee.net/energyInsights.aspx
Targeted User	Raters	Raters, auditors	Raters, auditors
Highly distributed through U.S. [1]	●	●	●
Primary use:			
Ratings[2]	●	●	●
Code compliance	●	●	○
Audits	○	●	●
Energy[3] tracking/ Benchmarking	○	●	○
Cost	$495	Provider dependent	Sponsor covers cost
Easy to use [4]	○	○	◐
Available for everyone[5]	◐	◐	◐
Upgradeable	●	●	●
Certified algorithm [6]			
BESTEST	●	●	●
BESTEST-EX	○	●	●
Inputs and Modeling			

[1] Reflects the geographic distribution and use in the United States.

[2] A number or ranking reflecting the energy efficiency of the house either from an occupant-blind basis (asset rating) or based on the actual energy use (operational rating).

[3] A tool that can be used to track future energy use and/or compare the structure relative to similar structure/occupant/climate combinations.

[4] A subjective ranking based on the number of inputs required by the tool, personal history of the researchers with the tool, and literature citations.

[5] A subjective ranking based on limitations placed on sale, licensing, or regional availability. Tools available through HERS Providers were ranked as average in availability. Tools available only through regional utility programs were ranked as less available.

[6] Criteria identifies whether a tool has been run through a standardized test, either BESTEST tier 1 & tier 2, or plan to run through BESTEST-EX.

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess attribute	**Energy Gauge**	**REM/Rate**	**Energy *Insights***
Disaggregation of energy use[7]	●	●	●
Normalization of climate/weather	●	●	●
Applicable for all climates[8]	●	●	●
Fuels accepted[9]	E, NG, O, LP	E, NG, O, LP, W	E, NG, O, LP, Other
Calculate interactions between/among measures[10]	●	●	●
Minimum inputs required (approx.)	100	100/33	20
Multiple entries for same building component allowed for:[11]			
Foundations	●	●	●
HVAC zones	●	●	●
Walls	●	●	●
Floors	●	●	●
Ceilings	●	●	●
DHW	●	●	●
Appliances	●	●	●
Accept user-input values:			
Measured inputs[12]	●	●	●
Usage data	○	●	●

[7] Ability of the tool to tease out individual energy-using features of a home and report on their contribution to energy consumption. Typically, baseloads accounting for appliance use, water heating, and plug loads are not broken out. Tools identifying plug loads and with inputs for multiple refrigerators, freezers, window air conditioning units, etc. were ranked highest. Those with an assumed baseload with no opportunity to change the assumptions were ranked lowest.

[8] All tool vendors claim their tools are applicable for all continental-U.S. climates. However, EnergyGauge was primarily designed for use in warm-humid climates.

[9] E=electricity, NG=natural gas, O=oil, LP=propane, C=coal, K=kerosene, W=wood, Ag=agricultural fuels such as corn, S= solar.

[10] The tool algorithm will adjust energy consumption estimates by building element based on the interaction between various elements. For example, increased envelope insulation should reduce the heating and cooling load, thereby minimizing the energy consumption of HVAC.

[11] Tool permits multiple inputs for the same type of building component. For example, does tool allow input for three domestic hot water systems?

[12] Measured inputs describe such values as air infiltration/exfiltration data (blower door), duct tightness, exhaust fan efficiency, etc.

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess attribute	**Energy Gauge**	**REM/Rate**	**Energy *Insights***
Permits detail in billing structure[13]	○	●	◑
Health/safety	○	◑	●
Improvement measure cost data	○	●	●
Plug loads calculated	●	●	●
Reporting and Customization			
Recommendations generated and type[14]	○	● user input	● auto, user input
Exportable data/type[15]	○	● sql, csv	● csv
Reports customizable[16]	○	●	●
Photos allowed	○	○	●
Scope of work generated?[17]	○	◑	◑
Carbon emissions or other metrics used	●	●	●
Asset/Operational rating type			
Asset	●	●	●
Operational	○	○	●
Energy use by fuel	●	●	●
Combined energy units reported (kWh/yr)[18]	○	●	○

[13] Tool permits details ranging from yearly average rates (lowest ranking) to block structure (highest ranking). Seasonal averaging is the middle rank.

[14] Tool recommendations, if generated, consist of either automatically-generated as programmed into the tool, or via user input, either through libraries or conditional lists.

[15] Is data from the tool exportable to other programs or tools and, if so, what file format is generated?

[16] Are reports customizable by the auditor? Tools with report customizable only with comments received an average rank.

[17] It was felt that all tools that generated a recommendation could be altered to produce a scope of work. As they currently exist, however, an adequate scope of work that would enable a contractor to then bid on the project is not generated by any of the tools listed.

[18] Tools often report energy use in terms of kWh/yr and therms if both electricity and natural gas are used. An overall energy consumption value is desired by DOE, such as converting other fuel consumption values to a metric such as kWh/yr.

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess attribute	**Energy Gauge**	**REM/Rate**	**Energy *Insights***
Illustrated on scale[19]	●	●	●
Other Relevant Features			
Estimated input time	>1 Hour	1 Hour	Sponsor dependent
Low level of expertise required[20]	○	◑	◑
Little training necessary[21]	◑	◑	◑
Estimated energy usage compared to actual[22]	◑	◑	◑
Energy savings estimates compared to actual	○	○	○

[19] Asset or operational rating compared to homes with similar characteristics. ENERGY STAR Home Energy Yardstick is an example of such a comparison tool.

[20] Level of expertise ranked purely as a subjective measure based on investigator experience with tools.

[21] Training time of 1 hour or less evaluated as fully meeting the criteria; up to a half-day of training was judged as partially meeting the criteria; and training longer than a half-day was judged as least meeting the criteria.

[22] Subjective evaluation due to the variety of comparison methods. EnergyGauge has performed laboratory comparisons, and EnergyInsight is currently collecting data for this comparison.

Table 2. Audit Tool Criteria and Attributes Matrix – Tools Used by Energy Efficiency Programs

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess attribute	**Home Energy Tune-uP**	**TREAT**	**BEACON HOME ENERGY ADVISOR**	**RealHome Analyzer**
General Information				
Vendor	CMC Energy Services	Performance Systems Development, Inc.	ICF International, Inc.	Conservation Services Group
Contact/website	www.cmcenergy.com	www.TreatSoftware.com	www.icfi.com	www.csgrp.com
Targeted User	Auditors & home inspectors	Auditors	Auditors	Auditors
Highly distributed through U.S. [23]	●	●	◑	●
Primary use:				
Ratings[24]	○	○	○	○
Code compliance	○	○	○	○
Audits	●	●	●	●
Energy[25] tracking/ Benchmarking	○	●	○	○
Cost	$20 per audit	$495	Sponsor covers cost	Contractural with CSG
Easy to use [26]	◑	○	●	◑
Available for everyone[27]	◑	●	○	○
Upgradeable	●	●	●	●
Certified algorithm [28]				

[23] Reflects the geographic distribution and use in the United States.

[24] A number or ranking reflecting the energy efficiency of the house either from an occupant-blind basis (asset rating) or based on the actual energy use (operational rating).

[25] A tool that can be used to track future energy use and/or compare the structure relative to similar structure/occupant/climate combinations.

[26] A subjective ranking based on the number of inputs required by the tool, personal history of the researchers with the tool, and literature citations.

[27] A subjective ranking based on limitations placed on sale, licensing, or regional availability. Tools available through HERS Providers were ranked as average in availability. Tools available only through regional utility programs were ranked as less available.

[28] Criteria identifies whether a tool has been run through a standardized test, either BESTEST tier 1 & tier 2, or plan to run through BESTEST-EX.

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess attribute	**Home Energy Tune-uP**	**TREAT**	**BEACON HOME ENERGY ADVISOR**	**RealHome Analyzer**
BESTEST	●	◑	○	○
BESTEST-EX	●	●	●	●
Inputs and Modeling				
Disaggregation of energy use[29]	○	●	◑	●
Normalization of climate/weather	●	●	●	●
Applicable for all climates[30]	●	●	●	●
Fuels accepted[31]	E, NG, O, LP, C, K, W, Ag, S	E, NG, O, LP, C, K, W, Ag	E, NG, O, LP	E, NG, O, LP, Other
Calculate interactions between/among measures[32]	●	●	●	●
Minimum inputs required (approx.)	80	25	50	25
Multiple entries for same building component allowed for:[33]				
Foundations	●	●	◑	●
HVAC zones	◑	●	◑	●
Walls	●	●	◑	●
Floors	●	●	◑	●
Ceilings	●	●	◑	●

[29] Ability of the tool to tease out individual energy-using features of a home and report on their contribution to energy consumption. Typically, baseloads accounting for appliance use, water heating, and plug loads are not broken out. Tools identifying plug loads and with inputs for multiple refrigerators, freezers, window air conditioning units, etc. were ranked highest. Those with an assumed baseload with no opportunity to change the assumptions were ranked lowest.

[30] All tool vendors claim their tools are applicable for all continental-U.S. climates. However, CMC indicated their tool is most applicable for colder climates.

[31] E=electricity, NG=natural gas, O=oil, LP=propane, C=coal, K=kerosene, W=wood, Ag=agricultural fuels such as corn, S= solar.

[32] The tool algorithm will adjust energy consumption estimates by building element based on the interaction between various elements. For example, increased envelope insulation should reduce the heating and cooling load, thereby minimizing the energy consumption of HVAC.

[33] Tool permits multiple inputs for the same type of building component. For example, does tool allow input for three domestic hot water systems?

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess attribute	**Home Energy Tune-uP**	**TREAT**	**BEACON HOME ENERGY ADVISOR**	**RealHome Analyzer**
DHW	●	○	●	●
Appliances	●	●	●	●
Accept user-input values:				
Measured inputs[34]	●	●	●	●
Usage data	○	●	●	●
Permits detail in billing structure[35]	●	○	○	●
Health/safety	●	●	●	●
Improvement measure cost data	●	●	●	●
Plug loads calculated	◑	●	○	◑
Reporting and Customization				
Recommendations generated and type[36]	● auto	● user input	● user input	● auto, user input
Exportable data/type[37]	● csv	● xml, csv	● xml	● ?
Reports customizable[38]	◑	●	◑	◑
Photos allowed	●	●	○	○
Scope of work generated?[39]	◑	◑	◑	●
Carbon emissions or other metrics used	●	◑	●	●
Asset/Operational rating type				
Asset	○	◑	○	○

[34] Measured inputs describe such values as air infiltration/exfiltration data (blower door), duct tightness, exhaust fan efficiency, etc.

[35] Tool permits details ranging from yearly average rates (lowest ranking) to block structure (highest ranking). Seasonal averaging is the middle rank.

[36] Tool recommendations, if generated, consist of either automatically-generated as programmed into the tool, or via user input, either through libraries or conditional lists.

[37] Is data from the tool exportable to other programs or tools and, if so, what file format is generated?

[38] Are reports customizable by the auditor? Tools with report customizable only with comments received an average rank.

[39] It was felt that all tools that generated a recommendation could be altered to produce a scope of work. As they currently exist, however, an adequate scope of work that would enable a contractor to then bid on the project is not generated by any of the tools listed.

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess attribute	**Home Energy Tune-uP**	**TREAT**	**BEACON HOME ENERGY ADVISOR**	**RealHome Analyzer**
Operational	○	●	●	●
Energy use by fuel	○	●	●	●
Combined energy units reported (kWh/yr)[40]	○	●	○	●
Illustrated on scale[41]	○	○	●	○
Other Relevant Features				
Estimated input time	½ Hour	1 Hour	½ Hour	?
Low level of expertise required [42]	◑	○	○	?
Little training necessary[43]	◑	◑	◑	?
Estimated energy usage compared to actual[44]	●	●	○	●
Energy savings estimates compared to actual	○	●	○	●

[40] Tools often report energy use in terms of kWh/yr and therms if both electricity and natural gas are used. An overall energy consumption value is desired by DOE, such as converting other fuel consumption values to a metric such as kWh/yr.

[41] Asset or operational rating compared to homes with similar characteristics. ENERGY STAR Home Energy Yardstick is an example of such a comparison tool.

[42] Level of expertise ranked purely as a subjective measure based on investigator experience with tools.

[43] Training time of 1 hour or less evaluated as fully meeting the criteria; up to a half-day of training was judged as partially meeting the criteria; and training longer than a half-day was judged as least meeting the criteria.

[44] Subjective evaluation due to the variety of comparison methods. Tune-uP, and TREAT have had analyses performed either under a third-party or as part of a government-subsidized (NYSERDA) research effort.

Table 3. Audit Tool Criteria and Attributes Matrix – Government Vendor or Other Purpose Tools

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess the attribute	**NEAT**	**HES-Pro**	**Green Energy Compass**
General Information			
Vendor	Oak Ridge National Laboratory	Lawrence Berkeley National Laboratory	Performance Systems Development, Inc.
Contact/website	http://weatherization.ornl.gov/assistant.shtm	http://HESPro.lbl.gov	www.psdconsulting.com/greenenergycompass
Targeted User	Weatherization providers	Auditors, home inspectors	Program administrators, auditors, facilities management
Highly distributed through U.S. [45]	●	●	◑
Primary use:			
Ratings[46]	○	●	○
Code compliance	○	○	○
Audits	●	●	○
Energy[47] tracking/ Benchmarking	●	○	●
Cost	free	free	Sponsor covers cost
Easy to use [48]	○	◑	●
Available for everyone[49]	●	●	●
Upgradeable	●	●	●
Certified algorithm [50]			

[45] Reflects the geographic distribution and use in the United States.

[46] A number or ranking reflecting the energy efficiency of the house either from an occupant-blind basis (asset rating) or based on the actual energy use (operational rating).

[47] A tool that can be used to track future energy use and/or compare the structure relative to similar structure/occupant/climate combinations.

[48] A subjective ranking based on the number of inputs required by the tool, personal history of the researchers with the tool, and literature citations.

[49] A subjective ranking based on limitations placed on sale, licensing, or regional availability. Tools available through HERS Providers were ranked as average in availability. Tools available only through regional utility programs were ranked as less available.

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess the attribute	**NEAT**	**HES-Pro**	**Green Energy Compass**
BESTEST	○	◑	○
BESTEST-EX	○	○	○
Inputs and Modeling			
Disaggregation of energy use[51]	○	●	◑
Normalization of climate/weather	●	●	●
Applicable for all climates[52]	●	●	●
Fuels accepted[53]	E, NG, O, LP, C, K, W	E, NG, O, LP	E, NG, O, LP, C, K, W, Ag
Calculate interactions between/among measures[54]	●	●	●
Minimum inputs required (approx.)	100	30	N/A
Multiple entries for same building component allowed for:[55]			
Foundations	●	○	N/A
HVAC zones	●	○	N/A
Walls	●	●	N/A
Floors	●	○	N/A

[50] Criteria identifies whether a tool has been run through a standardized test, either BESTEST tier 1 & tier 2, or plan to run through BESTEST-EX.

[51] Ability of the tool to tease out individual energy-using features of a home and report on their contribution to energy consumption. Typically, baseloads accounting for appliance use, water heating, and plug loads are not broken out. Tools identifying plug loads and with inputs for multiple refrigerators, freezers, window air conditioning units, etc. were ranked highest. Those with an assumed baseload with no opportunity to change the assumptions were ranked lowest.

[52] All tool vendors claim their tools are applicable for all continental-U.S. climates.

[53] E=electricity, NG=natural gas, O=oil, LP=propane, C=coal, K=kerosene, W=wood, Ag=agricultural fuels such as corn, S= solar.

[54] The tool algorithm will adjust energy consumption estimates by building element based on the interaction between various elements. For example, increased envelope insulation should reduce the heating and cooling load, thereby minimizing the energy consumption of HVAC.

[55] Tool permits multiple inputs for the same type of building component. For example, does tool allow input for three domestic hot water systems?

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess the attribute	**NEAT**	**HES-Pro**	**Green Energy Compass**
Ceilings	●	○	N/A
DHW	●	○	N/A
Appliances	◑	●	●
Accept user-input values:			
Measured inputs[56]	●	◑	N/A
Usage data	●	○	●
Permits detail in billing structure[57]	○	◑	○
Health/safety	●	◑	●
Improvement measure cost data	●	●	●
Plug loads calculated	●	●	◑
Reporting and Customization			
Recommendations generated and type[58]	● user input	● auto	◑ user input
Exportable data/type[59]	● csv	● xml	● xml
Reports customizable[60]	○	○	○
Photos allowed	●	○	●
Scope of work generated?[61]	●	◑	○
Carbon emissions or other metrics used	○	●	●
Asset/Operational rating type			

[56] Measured inputs describe such values as air infiltration/exfiltration data (blower door), duct tightness, exhaust fan efficiency, etc.

[57] Tool permits details ranging from yearly average rates (lowest ranking) to block structure (highest ranking). Seasonal averaging is the middle rank.

[58] Tool recommendations, if generated, consist of either automatically-generated as programmed into the tool, or via user input, either through libraries or conditional lists.

[59] Is data from the tool exportable to other programs or tools and, if so, what file format is generated?

[60] Are reports customizable by the auditor? Tools with report customizable only with comments received an average rank.

[61] It was felt that all tools that generated a recommendation could be altered to produce a scope of work. As they currently exist, however, an adequate scope of work that would enable a contractor to then bid on the project is generated only by NEAT. Green Energy Compass produced only generic recommendations consistent for all homes and was least associated with being able to generate a scope of work.

Criteria ● possesses attribute ◑ possesses some of the attribute ○ does not possess the attribute	**NEAT**	**HES-Pro**	**Green Energy Compass**
Asset	○	○	○
Operational	○	○	●
Energy use by fuel	●	●	●
Combined energy units reported (kWh/yr)[62]	○	○	●
Illustrated on scale[63]	○	●	●
Other Relevant Features			
Estimated input time	>1 Hour	1 Hour	10 Minutes
Low level of expertise required [64]	○	◑	●
Little training necessary[65]	◑	◑	●
Estimated energy usage compared to actual[66]	●	●	●
Energy savings estimates compared to actual	●	○	●

[62] Tools often report energy use in terms of kWh/yr and therms if both electricity and natural gas are used. An overall energy consumption value is desired by DOE, such as converting other fuel consumption values to a metric such as kWh/yr.

[63] Asset or operational rating compared to homes with similar characteristics. ENERGY STAR Home Energy Yardstick is an example of such a comparison tool.

[64] Level of expertise ranked purely as a subjective measure based on investigator experience with tools.

[65] Training time of 1 hour or less evaluated as fully meeting the criteria; up to a half-day of training was judged as partially meeting the criteria; and training longer than a half-day was judged as least meeting the criteria.

[66] Subjective evaluation due to the variety of comparison methods. NEAT, HES-Pro, and Green Energy Compass have had or are currently undergoing analyses performed either under a third-party or as part of a government-subsidized (NYSERDA) research effort.

6. LITERATURE REVIEW

A review of the literature comparing energy auditing and modeling software resulted in few citations, most dating back at least six years. The variety and format for energy auditing and modeling software has changed greatly over the last six to eight years since the last comprehensive reviews of software tools were published. However, the literature describes many of the software packages investigated during this study and reaches conclusions still relevant today.

General Overview of Audit Tools

The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) has a Building Technologies Program that maintains a directory of energy-related software tools including auditing and modeling software (http://apps1.eere.energy.gov/buildings/tools_directory/) (Ref. 12). This directory is not intended to provide a comprehensive review of all features for listed products or to compare and contrast products in similar categories. It does, however, list major features and, in many cases, provides comment regarding strengths and weaknesses of the tool under review. Review database fields include keyword, validation/testing protocol, expertise required to navigate the software, number of users, intended audience, input and output fields required or generated by the tool, computer platform required to operate and programming language used, strengths and weaknesses of the tool, and contact information for the tool vendor including price information. At an elevated hierarchy, the tool reviews can be sorted by subject area such as energy modeling, load calculations, codes and standards conformity, water conservation, and so forth.

The State University of New Jersey Rutgers Center for Energy, Economic and Environmental Policy performed an evaluation of home energy audit tools as part of a comprehensive review of the New Jersey Clean Energy Program (Ref. 13). In this study, only four audit tools were evaluated including Home Energy Checkup, Home Energy Advisor, Home Energy Saver, and a utility-sponsored

tool called Home Analyzer. All tools were web-based audit tools designed to provide recommendations or to educate homeowners on energy savings.

Mills (Refs. 14, 15) performed an analysis of multiple energy analysis tools with residential capabilities ranging from web-based tools focused on particular functions such as HVAC load calculations to disk-based, multi-functional software packages. In all, sixty-five programs were evaluated; 50 web-based and 15 disk-based packages. Mills determined that out of the web-based tools, only 21 performed whole-house analysis and out of these, 13 provided open-ended energy calculations, five tools permitted bill disaggregation and only three contained both functions. Of the disk-based tools, six performed whole-house analysis and three performed both open-ended energy calculations and bill disaggregation. Mills noted a wide disparity in intended audience, ease of use, purpose, accuracy of predicted versus actual energy use, number and type of inputs and outputs in all of the tools and presented a matrix as a suggestion for further analysis.

Paradis (Ref. 16) presented an overview of energy analysis tools to help designers select a tool for a particular project. While presenting a mix of tools, the focus of this overview was on commercial structures and multi-family residential for federal audiences. Paradis segmented tools into categories including screening, architectural design, load calculation/HVAC sizing, and economic analysis.

Kim et al. (Ref. 17) performed an overview of energy analysis tools listed within the DOE EERE's Building Energy Software Tools Directory to provide the Texas energy office with a list of tools and associated recommended uses. This study did not assess accuracy or make judgments of tool value; rather the study was an effort to characterize the use of each tool within the directory of potential interest to the energy office.

Audit Tool Accuracy

Stein and Meir (Ref. 7) evaluated HERS ratings and actual billing data for 500 homes in four states. Conclusions were that over large populations, HERS ratings could predict annual energy usage and cost but the accuracy diminished

considerably when individual homes were considered for predicted versus actual cost. In particular, a wide disparity was found for older homes. It was further concluded that using actual billing data to calibrate HERS ratings could improve average accuracy over the whole population of rated homes, but does not affect variance.

Hendron, Farrar-Nagy, Anderson, and Judkoff (Ref. 8) also probed the subject of software accuracy as it pertained to the calculated energy savings for high-performance housing as part of the Building America program. Their analysis looked at simulation tools that met the requirements of HERS BESTEST or compared to the International Energy Conservation Code (IECC) and determined that high-performance homes showed vastly different efficiency ratings based upon the energy analysis methodology used. They concluded that high-performance homes required analysis tools with four important features:

- Clearly defined reference home
- Consistent set of operational assumptions that mimicked realistic occupant behavior
- Accurate predicted energy savings modeling
- Reporting process that communicates effectively where energy savings are being realized and to what magnitude.

The paper further states that programs with lower energy-savings expectations, such as *Home Performance with ENERGY STAR*, do not require such accuracy from analytic tools.

A report for Energy Trust of Oregon (Ref. 4) compared the accuracy of four energy modeling software tools over 190 homes in the cities of Portland and Bend, Oregon. REM/Rate®, SIMPLE, and two versions of Home Energy Saver were compared for accuracy of the predicted energy use compared with actual use obtained from billing records. The conclusion was that none of the software was extremely accurate, but SIMPLE performed the best out of the entire population of houses. Recommendations about energy modeling software were:

- Develop energy modeling tools that are more accurate and require less time to input
- Have models better predict and report actual energy usage
- Use standard normalized assumptions for baseloads and plug loads from typical usage patterns (somewhat contradictory to the prior recommendation)
- Produce recommendations for energy improvements based on specific guidelines (to be determined) and be able to model savings of the upgrades.

7. REFERENCES

The following literature was identified and reviewed as part of this study:

(1) Florida Department of Community Affairs. 2002. Florida Weatherization Assistance Program Priority List Assessment and Testing, Form PLAT-08/02, Division of Housing and Community Development, Tallahassee, FL.

(2) Team IBTS. 2006. PATH 36 Uniform Protocol for Energy-Efficient Remodeling of Existing Housing, C-CHI-00800/CHI-T0001, HUD, Washington, D.C.

(3) Opinion Dynamics Corporation. 2010. Process and Impact Evaluation of the 2007-2008 Energy Trust of Oregon Home Energy Solutions Program Volume 2, Opinion Dynamics Corp., Oakland, CA.

(4) Earth Advantage Institute and Conservation Services Group. 2009. Energy Performance Score 2008 Pilot, Findings & Recommendations Report, Earth Advantage Institute, Portland, OR.

(5) Judkoff, R. and J. Neymark. 2006. Model Validation and Testing: The Methodological Foundation of ASHRAE Standard 140, NREL/CP-550-40360, NREL, Golden, CO.

(6) Judkoff, R. and J. Neymark. 1995. Home Energy Rating System Building Energy Simulation Test (HERS BESTEST) Volume 1, NREL/TP-472-7332a, NREL, Golden, CO.

(7) Stein, J.R., and A. Meier. 2000. Accuracy of Home Energy Rating Systems, Energy (25) 339-354.

(8) Hendron, R., S. Farrar-Nagy, R. Anderson, R. Judkoff, P. Reeves, and E. Hancock. 2003. Calculating Energy Savings in High Performance Residential Buildings Programs, NREL/CP-550-33622, NREL, Golden, CO.

(9) Hendron, R., R. Anderson, C. Christensen, M. Eastment, and P. Reaves. 2004. Development of an Energy Savings Benchmark for all Residential End-Uses, NREL/CP-550-35917, NREL, Golden, CO.

(10) Residential Energy Services Network (RESNET). 2009. National Registry of Accredited Rating Software Programs, RESNET, San Diego, CA.

(11) Residential Energy Services Network (RESNET). 2006. Procedures for Verification of RESNET Accredited HERS Software Tools, RESNET, San Diego, CA.

(12) U.S. Department of Energy (DOE). 2008. Building Energy Software Tools Directory, DOE, Washington, D.C.

(13) New Jersey Clean Energy Program. 2007. New Jersey's Clean Energy Program: Protocols to Measure Resource Savings (Draft), New Jersey Board of Public Utilities Office of Clean Energy, Trenton, NJ.

(14) Mills, E. 2002. Review and Comparison of Web- and Disk-based Tools for Residential Energy Analysis, LBNL-50950, LBNL, Berkeley, CA.

(15) Mills, E. 2004. Inter-comparison of North American Residential Energy Analysis Tools, Energy and Buildings (36)865-880, LBNL, Berkeley, CA.

(16) Paradis, R. 2007. Energy Analysis Tools, Whole Building Design Guide, National Institute of Building Sciences, Washington, D.C.

(17) Kim, H., J. Haberi, and M. Verdict. 2009. Review and Recommendations of Existing Methods and Tools for Building

Energy Analysis, ESL-TR-09-04-01, Southern Energy Efficiency Center, Energy Systems Laboratory, Texas A&M University, College Station, TX.

ATTACHMENTS

Attachment A: Florida Weatherization Program Prioritization of Improvement Measures

Attachment B: Vendor Questionnaire

Attachment A. Florida Weatherization Program Improvement Prioritization List

Weatherization Works in Florida

FLORIDA WEATHERIZATION ASSISTANCE PROGRAM
Priority List Assessment and Testing Form (PLAT-08/02)

ALL BOXES THAT ARE HIGHLIGHTED MUST BE FILLED IN UNLESS THE TESTING PROCEDURE OR THE MEASURE/PRIORITY LIST ITEM DOES NOT APPLY TO THE DWELLING.			
TO BE CHECKED IN EACH DATA COLLECTION SECTION:	If Not Applicable:	N/A	

CUSTOMER NAME:					PHONE:		
ADDRESS:							
DIRECTIONS:							
JOB NUMBER:				PREVIOUS WX DATE (If applicable):			
INSPECTOR(S):				DATE INSPECTED			
TYPE OF DWELLING	MH	SITE BUILT	OTHER	SQUARE FOOT		NO. OF OCCUPANTS	

PRIORITY LIST SUMMARY

	Priority List	PWOA			Comments
1	Air Sealing / General Heat Waste	N/A	Y	N	
2	Attic and Floor Insulation	N/A	Y	N	
3	Dense-Pack Sidewalls	N/A	Y	N	
4	Solar Window Screens	N/A	Y	N	
5	Smart Thermostat	N/A	Y	N	
6	Compact Fluorescent Lamps	N/A	Y	N	
7	Seal and Insulate Ducts	N/A	Y	N	
8	Refrigerator	N/A	Y	N	
9	Heating and Cooling Systems	N/A	Y	N	
10	Water Heater	N/A	Y	N	

Initial Evaluation for Health & Safety (Section VI of Procedures and Guidelines)

HOUSEHOLD HEALTH

Are there any household occupants health issues that will effect performing blower door testing:	Y	N

CARBON MONOXIDE & GAS TESTING - All combustible appliances and gas lines will be tested first. No weatherization activities will be performed until an unacceptable CO reading on any combustible appliance is corrected.

Appliance	Fuel Type		Location	Unit Type		Venting		Required Monoxor Readings
Primary Heating unit (See note below)	NG	LP		Fixed	Space	Unvented	Vented	Primary heating - pre & post Space heaters - pre & post Cook Stove – 5 - pre Water Heater - 3 - pre Final (ambient) 1 for each room with a combustible appliance (Staple CO printouts here)
Secondary Unit # 1	NG	LP		Fixed	Space	Unvented	Vented	
Secondary Unit # 2	NG	LP		Fixed	Space	Unvented	Vented	
Cook Stove (See C below)	NG	LP				Unvented	Vented	
Dryer	NG	LP				Unvented	Vented	
Water Heater	NG	LP				Unvented	Vented	

1

Note: All combustible appliances must be vented to the outside.*
***(exception - unvented secondary heaters meeting program guidelines)**

Test all GAS Fittings for leaks:	Pass	Fail	**Testing included under stove top and at tank.**	Y	N
Comments:					
If not applicable:	N/A				

Note: – ALL HEATING AND COOLING UNITS DIAGNOSTIC TESTING PROCEDURES AND EVALUATION DATA IS REPORTED UNDER PRIORITY ITEM # 9

COMBUSTIBLE FUEL STOVE REPAIR or REPLACEMENT (Charged to Health & Safety)

Top burner(s) need replacing	Y (1 2 3 4)	N			
Oven burner needs replacing	Y	N			
Stove deteriorated condition warrants replacement:	Y	N			
Comments:					
If not applicable:	N/A				

Staple photo documentation and technician inspection form here or place in client file.

DETECTORS – (Charged to Health & Safety)

Smoke Detectors	Existing	Y	N	Functioning	Y	N	Install:	Y	N	Location(s):	
CO Detectors	Existing	Y	N	Functioning	Y	N	Install:	Y	N	Location(s):	
Comments:											
If not applicable:	N/A										

POLLUTION SURVEY OF CHEMICALS AND POLLUTANTS:

There	**were**	**were not**	**pollutants stored within the living area**
TYPE			**LOCATION**
Brought to attention of client for removal or outside storage:			Y N
Comments:			
If not applicable:	N/A		

ELECTRICAL PANEL

Location		**Name**		**Size**		**Covered**	Y	N
Condition				**Comments:**				

MOLD & MOISTURE EVALUATION (Reference Section III of Procedures and Guidelines)

Existing:	Y	N	**Weatherization measure related**			Y	N	**Postponement of services required**						Y	N		
Is venting needed for:	**Stove**	Y	N	**Clothes dryer**		Y	N	**Bathroom**		Y	N	**Whole house**		Y	N		
Comments:																	
If not applicable:	N/A																

LEAD PAINT EVALUATION – Pre 1978 dwellings (Reference Section III of Procedures and Guidelines)

Visual exterior inspection indicates possible lead paint (deterioration) is existing:													Y	N	N/A		
Visual interior inspection indicates possible lead paint (deterioration) is existing:													Y	N	N/A		
Areas of suspected lead	**Win dows**	Y	N	**Doors**	Y	N	**Walls**	Y	N	**Ceiling**					Y	N	
After determining weatherization measure to be addressed, would LSW be required to be performed:															Y	N	
Is there flaking paint present			Y	N	**Postponement of services required**										Y	N	
Comments:																	
If not applicable:	N/A																

Diagnostic Testing

Building Tightness Limit (BTL) / Minimum Ventilation Rate (MVR)

Final blower door must be higher than following calculations or ventilation must be installed.

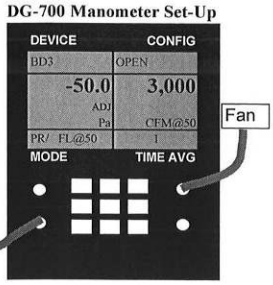
# of Bedrooms Plus 1: _____ X 15= _____ x n factor _____ = _____ **CFM_{50}**

# of People & Large Pets: _____ X 15= _____ x n factor _____ = _____ **CFM_{50}**

Building Volume: _____ X .35 / 60= _____ x n factor _____ = _____ **CFM_{50}**

Note: Smokers count as two occupants. Large or multiple pets count as occupants.

DG-700 Manometer Set-Up



Pre-Wx Blower Door Reading

☐ **Turn off all heating/cooling devices** ☐ **Close all windows** ☐ **Open interior doors**

Outdoor Temp: _____ **Wind:** _____ **Ring:** _____ **House Pressure:** PA

Notes: _____ **Pre-Reading:** CFM_{50}

Target Blower Door Reading

If final blower door is not close to target, justification must be provided in Final-Wx Reading notes.

25%		30%		35%		40% beginning @7500cfm50							
Pre	**Target**	**Pre**	**Target**	**Pre**	**Target**	**Pre**	**Target**	**Pre**	**Target**	**Pre**	**Target**	**Pre**	**Target**
3,000	2,250	4,000	2,800	5,000	3,250	6,000	3,900	7,000	4,550	8,000	4,800	9,000	5,400
3,100	2,325	4,100	2,870	5,100	3,315	6,100	3,965	7,100	4,615	8,100	4,860	9,100	5,460
3,200	2,400	4,200	2,940	5,200	3,380	6,200	4,030	7,200	4,680	8,200	4,920	9,200	5,520
3,300	2,475	4,300	3,010	5,300	3,445	6,300	4,095	7,300	4,745	8,300	4,980	9,300	5,580
3,400	2,550	4,400	3,080	5,400	3,510	6,400	4,160	7,400	4,810	8,400	5,040	9,400	5,640
3,500	2,625	4,500	3,150	5,500	3,575	6,500	4,225	7,500	4,500	8,500	5,100	9,500	5,700
3,600	2,700	4,600	3,220	5,600	3,640	6,600	4,290	7,600	4,560	8,600	5,160	9,600	5,760
3,700	2,775	4,700	3,290	5,700	3,705	6,700	4,355	7,700	4,620	8,700	5,220	9,700	5,820
3,800	2,850	4,800	3,360	5,800	3,770	6,800	4,420	7,800	4,680	8,800	5,280	9,800	5,880
3,900	2,925	4,900	3,430	5,900	3,835	6,900	4,485	7,900	4,740	8,900	5,340	9,900	5,940

- Sealing is optional if the Pre-Wx Blower Door reading is below 3,000.
- If the Pre-Wx Blower Door reading is above 9,900 then calculate the target as: Pre-Wx Reading x .6

Target Reading: CFM_{50}

Final-Wx Blower Door Reading

☐ **Turn off all heating/cooling devices** ☐ **Close all windows** ☐ **Open interior doors**

Outdoor Temp: _____ **Wind:** _____ **Ring:** _____ **House Pressure:** PA

Notes: _____ **Final-Reading:** CFM_{50}

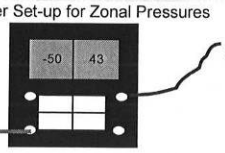
RING REMINDER: All the rings should be left covering the fan while taking the baseline. Then all the rings should be removed to turn on the fan. The rings are for "tight" houses - only put the rings on if the manometer is flashing "Lo" on the screen. To put a ring on, simply reduce the fan speed to zero, and put it on. Then push the "CONFIG" button until the "CONFIG" setting in the top right corner of the manometer matches the ring set-up (For instance, if you are using no rings, it should read "OPEN", if you are using the first ring, it should read "A1").

Each of these tests should be conducted with the blower door depressurizing the house to -50 Pascals WRT Outside. All heating and/or cooling appliances should be turned off prior to any blower door operation.

Zonal Pressures (Zone WRT House)

Any reading under 45 Pa indicates significant air leaks between living space and zone.

Manometer Set-up for Zonal Pressures



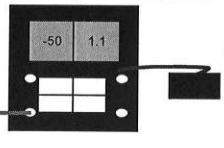
House Pressure: _____ PA

		Pre-Wx	Final-Wx			Pre-Wx	Final-Wx
1.	Attic 1			5.	Garage		
2.	Attic 2			6.			
3.	Crawlspace			7.			
4.	Bellyboard			8.			

Pressure Pan (Duct WRT House) Zone Pressure Duct Location_____

Any reading over 1 Pa indicates need to seal around register and boot using mastic and/or seal/repair duct work.

Manometer Set-up for Pressure Pan



House Pressure: _____ PA

Returns:

Location	Pre-Wx	Final-Wx	Location	Pre-Wx	Final-Wx

Supplies:

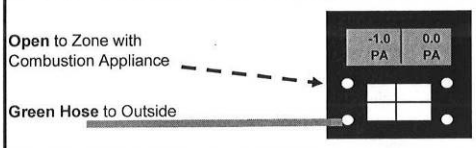
	Location	Pre-Wx	Final-Wx		Location	Pre-Wx	Final-Wx
1.				6.			
2.				7.			
3.				8.			
4.				9.			
5.				10.			

Can't Reach Fifty Factors for Pressure Readings, Multiply by factor to determine Reading if Could get to 50PA

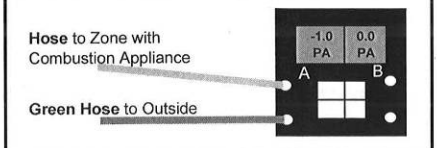
50= 1.0	45= 1.1	40= 1.25	35= 1.42	30= 1.66	25= 2.0	20= 2.5	15= 3.5	10= 5.0	5= 10.0

5

Combustion Appliance Zone (CAZ) Testing



Use this setup when you **ARE** located in the Combustion Appliance Zone



Use this setup when you **ARE NOT** located in the Combustion Appliance Zone

a. VISUALLY INSPECT VENTING (of each Combustion Appliance)
b. TURN OFF ALL COMBUSTION APPLIANCES.
c. CLOSE ALL OPERABLE VENTS AND DAMPERS.
d. CHECK DRYER VENT and LINT FILTER
e. CHECK FURNACE FILTER (clean or replace if needed)
f. OPEN ALL INTERIOR DOORS.

NOTE: IF BLOWER DOOR IS SET UP, BE SURE FAN IS COVERED.

1. Setup Manometer and Pressure hoses to measure CAZ (WRT) Outdoors
2. Take Baseline Pressure
3. Turn on all exhaust fans (do not turn on whole-house fans).
4. Close all interior doors to rooms that do not have exhaust fans.
5. If the house has a fireplace that the client uses, turn on the blower door to 300 CFM with Ring B to simulate.

		Appliance 1		Appliance 2		Appliance 3	
		Pre	Post	Pre	Post	Pre	Post
6.	Open door, if present, between CAZ and Main Body of house. Record reading.	Pa	Pa	Pa	Pa	Pa	Pa
7.	Close door between CAZ and Main Body of house. Record reading. (*If no door, skip to Step number 8)*	Pa	Pa	Pa	Pa	Pa	Pa
8.	Turn on Furnace Blower. Check position of interior doors with smoke puffer for worst case. If the smoke blows towards the CAZ, leave the door shut.	Pa	Pa	Pa	Pa	Pa	Pa
9.	Open door between CAZ and Main Body of house. Record reading. (*If no door, skip step*)	Pa	Pa	Pa	Pa	Pa	Pa

10. Recreate Worst Case Conditions for each CAZ (Complete this and following steps on each Heating Inspection form)
11. Perform Worst Case Draft and Combustion Tests for each appliance under this worst case condition

* **If Ambient CO gets above 35 ppm, discontinue testing and remove CAZ from worst case conditions.**
* **There should be no spillage after 1 minute of Worst Case and draft should be established after 5 minutes**

Dominant Duct Leakage Test (Main Body WRT outdoors) **Dominant Duct Leakage_____PA (Take Baseline First)**

Pressure in Individual Rooms (Room WRT Main body)

Room	Bef	Int	PR	Aft	Room	Bef	Int	PR	Aft	Room	Bef	Int	PR	Aft
1.					4.					7.				
2.					5.					8.				
3.					6.					9.				

6

PRIORITY LIST AND MEASURES (Section IX of Procedures and Guidelines)

IF ANY PRIORITY LIST MEASURE IS NOT APPLICABLE, CHECK APPROPRIATE BOX AND MOVE ON TO THE NEXT MEASURE

PIORITY LIST # 1 - AIR SEALING AND GENERAL HEAT WASTE MEASURES

GENERAL HEAT WASTE MEASURES - REQUIRED

Measure	To Do		Installation / Comments
HVAC Filters	Y	N/A	
Low Flow Showerhead *	Y	N/A	
Faucet Aerator(s) *	Y	N/A	
Water Heater Wrap	Y	N/A	
Water Heater Pipe Insulation.	Y	N/A	
*** Note: Measures may not be applicable if dwelling is on well water.**			

AIR SEALING MEASURES

Measure	To Do		Installation / Comments
Wall Top Plates – attic	Y	N/A	
Caulking	Y	N/A	
Minor Ceiling Repair	Y	N/A	
Minor Wall Repair	Y	N/A	
Minor Floor Repair	Y	N/A	
Threshold	Y	N/A	
Weather-stripping	Y	N/A	

DOORS

Location	Height	Width	Repair		Replace		Either staple photo documentation here or place in client file for second Replacement Door.
Front Door			Y	N	Y	N	
Side or Back Door			Y	N	Y	N	
Comments:							
If not applicable:	**N/A**						

WINDOWS

Wall Location				Length	Width	Repair		Replace		Either staple photo documentation here or place in client file for third and fourth Replacement Window.
N	S	E	W			Y	N	Y	N	
N	S	E	W			Y	N	Y	N	
N	S	E	W			Y	N	Y	N	
N	S	E	W			Y	N	Y	N	
Comments:										
If not applicable:	N/A									

PRIORITY LIST # 2 - ATTIC AND FLOOR INSULATION

Before insulation is installed, all by pass areas must be sealed in both the attic and crawl space.

ATTIC – Site Built

Some dwellings are considered as "good year homes" (additions added on to dwelling) thus two data collection spaces.													
Location	**Area to be insulated**	**Existing Insulation Type**				**Existing Thickness**		**Attic Access Hatch Location**		**Attic Access Hatch Needs Insulation**	
Main Attic	Sq.ft	Cell	Fbrg	Blwn	Roll	In_____ R-____		Ceiling	Gable	Y	N
Secondary Attic	Sq.ft	Cell	Fbrg	Blwn	Roll	In_____ R-____		Ceiling	Gable	Y	N
Add Insulation to R-30 (South)		Y	N			**Add Insulation to R-38 (Central & North)**				Y	N
Comments:											

	Main Attic		**Secondary Attic**			**Exit through Attic**		**Air Sealing Req.**	
Any Knob & Tube Wiring	Y	N	Y	N	**Chimney**	Y	N	Y	N
Water Leaks	Y	N	Y	N	**Insulation Blocking Required**			Y	N

By Pass Inspection areas to be addressed prior to installation of insulation for Air Sealing and Heat Waste.

All items marked **"Y"** must be addressed before insulation is installed.
Specific locations should be indicated below each inspection item or on floor plan drawing.

Exterior Wall Tops		**Interior Wall Tops**		**Wire Chases**		**Plumbing Chases**		**HVAC Chases**	
Y	N	Y	N	Y	N	Y	N	Y	N
Stairwell/Access Drop		**Closet Drop**		**Soffit Drop**		**Other:**			
Y	N	Y	N	Y	N	Y	N		

Comments:
If not applicable: N/A

Attic Ventilation

Target Net Free Ventilation Area (NFVA) – calculate square foot of attic space and multiply by .24 =			
	Main Attic	Secondary Attic	*Calculation Notes:*
Sq " of Existing Exhaust (High)			*Finned gable vent = ½ of gross area opening.*
Sq " of Needed Exhaust (High)			*Take ½ of NFVA, subtract Existing Sq " to find amount of needed exhaust*
Check - Total should equal NFVA			
Sq " of Existing Intake (Low)			*Finned gable vent = ½ of gross area opening.*
Sq " of Needed Intake (Low)			*Take ½ of NFVA, subtract Existing Sq " to find amount of needed exhaust*
Check - Total should equal NFVA			
Total of Intake (High) and Exhaust (Low) Check Totals		**This sum should equal or exceed the Target NFVA calculated above.**	
Comments:			
If not applicable: N/A			

ATTIC – Manufactured home

Some manufactured homes may have cathedral and one or more flat ceilings thus multiple data collection spaces.										
Location	**Area to be insulated**	**Existing Insulation Type**				**Existing Thickness**		**Access Location**			
Cathedral Ceiling	Sq.ft	Cell	Fbrg	Blwn	Roll	In____	R-Value____	Ceiling	Gable	Roof	Side
Flat ceiling #1	Sq.ft	Cell	Fbrg	Blwn	Roll	In____	R-Value____	Ceiling	Gable	Roof	Side
Flat ceiling #2	Sq.ft	Cell	Fbrg	Blwn	Roll	In____	R-Value____	Ceiling	Gable	Roof	Side
Kool Seal Roof	Y	N	**Square Footage to be coated**			Sq.ft					
Comments:											
If not applicable:	N/A										

FLOORS – Site Built

This measure only allowed in the northern and central climate zones.												
	Height		**Existing Insulation**		**Insulation installed w/**		**Install insulation?**		**Sq. Ft. to install**			
Crawl Space	24" -	24" +	Y	N	Wire stays	Barrier	Y	N	Sq ft.			
Space is	Conditioned		Unconditioned			**Exposed Water Lines Insulated**			Y	N		
Plumbing Leaks	Y	N	**Sub Floor Repair Required**			Y	N	**Vapor Barrier Exist**		Y	N	
Comments:												
By Pass Inspection areas to be addressed prior to installation of insulation for Air Sealing and Heat Waste.												
All items marked **"Y"** must be addressed before insulation is installed. Specific locations should be indicated below each inspection item or on floor plan drawing.												
Exterior Wall Bases		**Interior Wall Bases**		**Wire Chases**		**Plumbing Chases**		**HVAC Chases**				
Y	N	Y	N	Y	N	Y	N	Y	N			
Comments:												
If not applicable:	N/A											

FLOORS – Manufactured

This measure only allowed in the northern and central climate zones unless there is adequate crawl space clearance.														
	Height		Existing Insulation		Insulation installed w/				Install insulation?		Sq. Ft. to install			
Crawl Space	24" -	24" +	Y	N	Fabric	Bellyboard			Y	N	Sq ft.			
Direction of Joists		Longways		Crossway		Depth of Joists				2" X 4"		2" X 6"		
Space is	Conditioned		Unconditioned		Skirted		Exposed Water Lines Insulated					Y		N
Plumbing Leaks	Y	N	Sub Floor Repair Required			Y	N	Vapor Barrier Exist				Y		N
Belly board requires		Repair	Replacement					Install Vapor Barrier				Y		N
Comments:														
By Pass Inspection areas to be addressed prior to installation of insulation for Air Sealing and Heat Waste.														
All items marked **"Y"** must be addressed before insulation is installed. Specific locations should be indicated below each inspection item or on floor plan drawing.														
Wire Chases		Plumbing Chases		HVAC Chases		Comments								
Y	N	Y	N	Y	N									
If not applicable:	N/A													

PRIORITY LIST # 3 SIDEWALL INSULATION – Site Built Only

When performing the sidewall inspection process, the answers to some questions may not be possible unless a wall cavity is already exposed or if the agency utilizes an infrared camera.									
SIDEWALLS	Wall # 1		Wall #2		Wall # 3		Wall # 4		
Existing insulation	Type ____ R-___		Type ____ R-___		Type ____ R-___		Type ____ R-___		
Are walls weak / require repairs	Y	N	Y	N	Y	N	Y	N	
Moisture problems or damage	Y	N	Y	N	Y	N	Y	N	
Can sidewalls be blown	Y	N	Y	N	Y	N	Y	N	
Exterior wall surface area	Sq.ft.		Sq.ft.		Sq.ft.		Sq.ft.		
Wall area to be insulated (Less Windows/Doors)	Sq.ft.		Sq.ft.		Sq.ft.		Sq.ft.		
Exterior wall composition	Wood	Brick	Masonite Siding		Vinyl Siding		Metal Siding		
Type of Framing	Balloon	Stick	Board/Batten						
Width of Cavity	24"	16"	Other						
Infrared camera used to inspect wall cavities	Y	N							
Comments:									
Justification for not addressing this measure:									
If not applicable:	N/A								

Staple documentation to support seeking an insulation contractor for performing dense pack insulation here or place in client file.

PRIORITY LIST # 4 SOLAR WINDOW SCREENS & FILMS

Orientation	Number of windows to screen/film										Screens: Client informed about reduction of light	Y	N
East	1	2	3	4	5	6	7	8	9	10	Film Type Installed (Fill in)*		
West	1	2	3	4	5	6	7	8	9	10			
South	1	2	3	4	5	6	7	8	9	10			

**Note: Site drawing must include landscape surrounding dwelling and include shading percentage. Film only installed on East, South and West windows. Shatter/ storm mitigation film may be installed if a price comparison is performed and approved by state office*

Comments:
If not applicable: N/A

PRIORITY LIST # 5 SMART THERMOSTAT

Already exists	Y	N	Functioning	Y	N	Client uses it	Y	N	Recommend Install	Y	N
Will tamper proof thermostat cover be installed				Y	N	Client agrees to installation				Y	N
HVAC Contractor inspected existing unit to assure installation is possible				Y	N	Will a new central unit be installed					
Comments:											
If not applicable: N/A											

PRIORITY LIST # 6 COMPACT FLUORESCENT LAMPS (CFLs)

Location of Replacement	Bedrooms – 1 2 3 4		Living room		Dining Room		Bathroom		Other:	
Number of bulbs to replace										
Fixture Repairs Needed	Y	N	Y	N	Y	N	Y	N		
Explained to client and provided bulb breakage information for clean up						Y	N			

Replacement Chart:	Incandescent	CFLs	Comments
	40 watts	8-10 watts	
	60 watts	13-18 watts	
	75 watts	18-22 watts	
	100 watts	23-28 watts	
If not applicable: N/A			

PRIORITY LIST # 7 SEAL AND INSULATE DUCTS – All Dwellings

All duct work should be performed before any insulation is to be installed.

Location of duct	Attic	Crawl/Belly	Outside Dwelling	Conditioned Space	Unconditioned Space				
Type of duct	Sheet Metal	Flex	Duct board	**Other:**					
Condition of duct & boots*	Good condition	Needs repair	Replacement required	No Access					
Type of duct system	Trunk	Spider	Other						
* ***Note: Visual inspection and Pressure Pan Testing must be performed to determine condition & Photo Documentation is required in files for replacing an entire duct system.***									
After each of the following, list locations of any repair/replacement activities (reference dwelling site plan).									
Duct Insulation	Existing	Repair	Install new	Linear foot needed:	ft				
Notes:									
Registers	Good Condition	Require cleaning	Replace						
Notes:									
Supply and Return ducts	Good Condition	Require cleaning	Replace						
Notes:									
Is return adequate for system and dwelling size	Existing size:	Required size:							
Notes:									
Is supply adequate for system and dwelling size	Existing size:	Required size:							
Notes:									
Filter size	Sq. inches	**Replace**	Y	N	**Left one more with client**	Y	N		
Client instructed on how to install filters	Y	N							
Comments:									
If not applicable:	N/A								
FYI: Heating = 400cfm per 25,000 Btu output Cooling = 400cfm per 12,000 Btu (TON)									
Refer to Duct Sizing Quick Sheet for more info on Duct Sizing									

DUCT SYSTEM QUICK SIZING TABLES

Tons	Air Flow CFM	Flex Duct	Metal RD Round		Equivalent Rectangular Metal Duct Sizes		
	80	6	5				
	120	7	6	or	3.5 x 10		
	160	8	7				
	175	8	8	or	3.5 x 14	(Stud Cavity)	
	200	9	8	or	6 x 8		
	300	10	9	or	8 x 8		
1	**400**	11	10	or	10 x 8	(14 x 8 Panned Joist)	
	500	12	11	or	14 x 8	10 x 10	
4	**600**	13	12	or	16 x 8	12 x 10	
	700	14	13	or	16 x 8	14 x 10	12 x 12
2	**800**	15	13	or	18 x 8	16 x 10	12 x 12
2.5	**1000**	16	14	or	22 x 8	18 x 10	14 x 12
3	**1200**	17	15	or	26 x 8	20 x 10	16 x 12
3.5	**1400**	18	16	or	30 x 8	22 x 10	18 x 12
4	**1600**	20	17	or	32 x 8	24 x 10	20 x 12
	1800	20	18	or		28 x 10	22 x 12
5	**2000**	21	18	or		30 x 10	24 x 12

*Duct Size Calculated at 0.1 inches of available static pressure for each 100 Equivalent Feet of Duct System.

Round Duct Square Inch Equialency	
Size	**SQ. IN.**
5	20
6	28
7	38
8	50
9	64
10	79
12	113
14	154
16	201
18	254
20	314
22	380
24	452
26	531
28	616
30	707

NON - FILTER GRILLE

300 CFM per sq ft Gross Grill area			
Ton	CFM	Gross Sq Ft	Gross Sq inches
1.5	600	2.0	288
2	800	2.7	384
2.5	1000	3.3	480
3	1200	4.0	576
3.5	1400	4.7	672
4	1600	5.3	768

(Doug Garrett Building Performance & Comfort)

FILTER GRILLE

200 CFM per sq ft Gross Grill area			
Ton	CFM	Gross Sq Ft	Gross Sq inches
1.5	600	3	432
2	800	4	576
2.5	1000	5	720
3	1200	6	864
3.5	1400	7	1008
4	1600	8	1152

Common Grille Sizes (GROSS SQUARE INCHES)

16 x 20	16 x 25	20 x 20	20 x 24	20 x 25	20 x 30	24 x 24	24 x 30	30 x 14
320	400	400	480	500	600	576	720	420

GAS FURNACE (2 SQ. IN. PER 1,000 BTU's)	
INPUT BTUS	**SQ IN Ducts Needed Supply and Return**
40,000	80
60,000	120
80,000	160
100,000	200
120,000	240
140,000	280

(DELTA-T INC, Gas Furn & AC CHARTS)

AIR CONDITIONER (6 SQ. IN. PER 1,000 BTU's)	
INPUT BTUS	**SQ IN Ducts Needed Supply and Return**
18,000	108
24,000	144
30,000	180
36,000	216
42,000	252
48,000	288

PRIORITY LIST # 8 REFRIGERATOR ASSESSMENT

Brand name					**Model number**									
Type	Side by Side	Top Freezer	Bottom Freezer		**Total Cu. Ft**		**Door Hinge**	Left	Right					
Dimensions of space	" - W	" - D	" -H		**Number of household occupants**	1	2	3	4	5	6	7		
Replacement "Options" to be utilized for determining energy efficiency and replacement recommendation														
Option #1* - Metering for a 24 hour period = kWhY usage														
Option #2 *- Metering for a 2 hour period w/o defrost cycle = kWhY usage							**Peak Watts**							
Note: For Option #1 & #2, reference the Priority List for Single Family Dwellings pamphlet, Table 3 chart.														
Option #1 and/or #2 was used and the pamphlet recommended replacement	Y	N												
Option #3 – Enter all required dwelling data in the NEAT and/or MHEA for recommended replacement													Y	N
Old refrigerator was decommissioned/ removed from the premises	Y	N	**Disposal Fee (BWR charge)**	$										
Comments:														
If not applicable:	N/A													

PRIORITY LIST # 9 HEATING AND COOLING

WINDOW UNITS (Including reverse cycle and/or heat pump)

#	Wall Location (N,S,E,W)	Brand name	BTU output rating	EER or Year Manufactured	Cooling Only	Reverse Cycle	Coils need to be cleaned	
1					Y	Y	Y	N
2					Y	Y	Y	N
3					Y	Y	Y	N
4					Y	Y	Y	N

Unit(s) have a removable filter	Y	N	**Clean**	Y	N	**Dirty**	Y	N	**Replace Filter**	Y	N					
Inspection reveals	Base rusted out	Noisy when operating	Vibrates when operating	Doesn't cool	Undersized for space	Over 6 years old	Doesn't work									
Two filters left and changing instructions provided	Y	N	**Maintenance service to be provided**										Y	N		
Replacement(s) recommended	Y	N	**# units to be replaced**	1	2	3	4									
Note: A photo of each unit to be replaced must be included in the client file.																
Reverse cycle or heat pump to be installed to address inadequate existing heating situation													Y	N		
A new unit (cooling or reverse cycle) is to be installed to create a conditioned living space													Y	N		
Notes:																
If not applicable:	N/A															

HEAT PUMP / CENTRAL AIR CONDITIONING

Orientation	Brand name	Model or Serial #	BTU	SEER or Year Manufactured	Disconnect (Designated Breaker)	Refrigerant Line Insulated
N S E W					Y N	Y N
N S E W					Y N	Y N

Coil	Clean	Dirty				Filter	Clean	Dirty	Changed	Size	Sq. in.

Two filters left and changing instructions provided	Y	N	Maintenance service to be provided	Y	N

If the visual inspection indicates a need for possible replacement, the NEAT or MHEA must be utilized. The General House Data Form is used for collecting all of the required data for population.

Audit recommended replacement	Y	N	Pad and tie downs meet existing codes for new unit	Y	N	N/A
Existing duct size compatible with replacement unit	Y	N	Duct inspection performed (Priority #7)	Y	N	

Comments:

If not applicable:	N/A	

VENTING HEATING UNIT INSPECTION

If primary unit is unvented, proceed to next data collection section as this section is not applicable	N/A
Unit Description	

1	Location_____	**Type of Fuel** Nat Gas LP Elec Wood	**Type of Unit** Forced Air Space Heater	
2	Make _____	Model _____	Serial Number_____	
3	Rated BTU Input _____	Rated BTU Output_____	IF Natural Gas (Clock Meter) within 10% Yes No	
4	Thermostat Location_____	Mercury? Yes No	Temp Day_____ Night____	Install Smart Tstat?_____
5	Gas Leaks? Yes No	If Yes, Location of Leak_____		
6	Visual Inspection of Wiring and Safety Controls OK? Yes No	If No List Problem(s)_____		
7	Filter Location _____	Type _____ Missing ___ Clean ___ Dirty ___	Cleaned and Replaced____	
	Filter Size _____ X _____	Qty _____ Does Blower Need Cleaning? Yes No	Noisy? Yes No	
8	**Is Main Vent / Chimney O.K. ? (circle any problems below)**		Y	N
	Type, Location, Clearance, Height, Size, Cap, Liner, Mortar, Flashing, Unused flue holes, Thimble, Clean out, Other _____			
	Chimney Type _____	**Chimney Size** _____inches	**Chimney Height** _____feet	
	Liner Existing Needed N/A	**Type**_____	**Liner Size** _____inches	**Liner Height** _____feet
9	**Is Vent Connector from Heating System to Chimney O.K. ? (Circle any problems below)**		Y	N N/A
	Proper type pipe, Connected properly, Leaky or Corroded, ¼" Rise per Ft, Excessive elbows, Clearance Other_____			
	Vent Connector Type _____	**Vent Connector Size** _____inches	**Vent Connector Run** _____feet	
10	Is Clearance from Heating Unit to Combustibles OK? (Ceiling, Walls, Floors)		Y	N
11	Is Heat Exchanger O.K.?		Y	N
12	Is this Unit Sealed Combustion ? *(Unit gets Combustion Air from Outdoors)*		Y	N
13	Is Combustion Air OK? *(More than 50 cubic ft per 1000BTU's or Volume More than BTU's / 20)*		Y	N
14	If No, How Many SQ Inches Needed? And From Where _____			SQ"
15	**Pass**	**Fail**	**If Fail Why**	
Repair or will Replace with :				
If not applicable:	N/A			

All holes that are drilled must be resealed with a Stainless Steel Plug and high temperature caulk.

Heating System Diagnostic Inspection

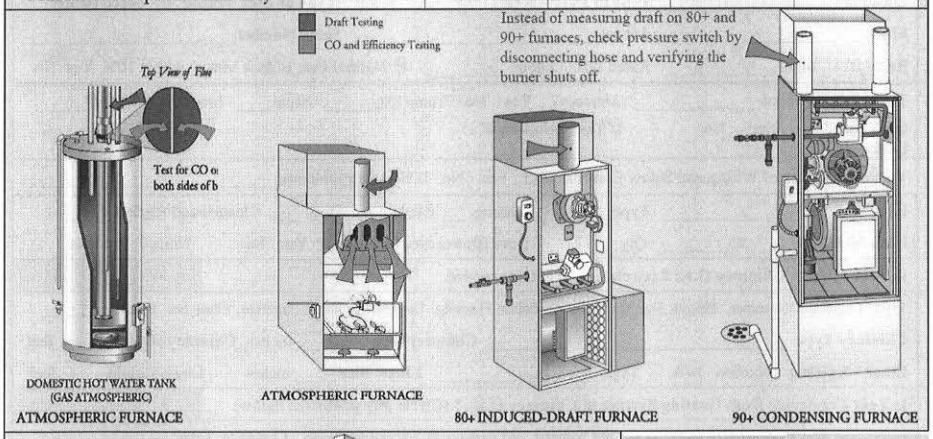
16. From CAZ page, determine worst case draft scenario and recreate conditions (the worst case is the one with the ***most negative*** depressurization of the CAZ. For example -4 PA would be worse than -1 PA).

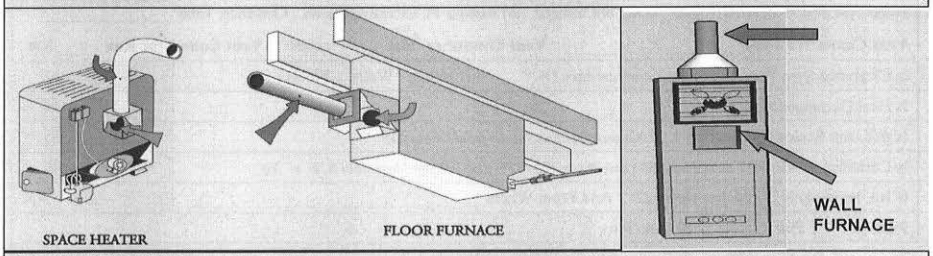
17. Does the **Draft Inducer** function properly? **Y N N/A** Does the **Pressure Switch** function properly? **Y N N/A**

	PRE Tests	POST Tests
18. Worst Case Draft (reference diagrams below for where to test):		
19. CO - Living Area (should be less than 9ppm)		
20. CO - Flue Gases (should be less than 100ppm)		
21. Heat Rise (Air temp at supply minus temp at return)		

Comments:

HEATING UNIT TYPE & VENTING SYSTEM TYPE	Acceptable Draft Reading for Worst Case Draft Test at Listed Outdoor Temperatures (°F)				
	<20	21-40	41-60	61-80	>80
Gas Furnace or Water Heater with an Atmospheric Chimney	-5 Pa -0.020" wc	-4 Pa -0.016" wc	-3 Pa -0.012" wc	-2 Pa -0.008" wc	-1 Pa -0.004" wc





16

COMBUSTIBLE HEATING UNITS - VENTED OR UNVENTED

Is an unvented heater being used as primary heating source:			Y	N	**Can it be used as secondary heating source:** (Meets Procedures and Guidelines Requirements)						Y	N
How many unvented units are operating in dwelling	1	2	3		**Have CO readings been completed for any acceptable secondary unvented space heaters**						Y	N
Number to be removed from dwelling to proceed with weatherization activities:	1	2	3		**Will a direct vent heater be installed as the primary heating source:**						Y	N
Cubic foot heated space per heater	**Primary**		**Secondary #1**			**#2**		**#3**				
Installed Vented Heater final CO readings:												
Secondary heater(s) final CO readings:	**#1 -**		**#2 -**									
Comments:					**(Staple CO printouts here)**							
If not applicable:	N/A											

PRIORITY LIST # 10 WATER HEATER

Location	Conditioned Space	Unconditioned	Exterior to dwelling		**Fuel**	Natural	Propane	Elec						
Condition	Good	Rusted	Stained	**Size**	"h	"dia	gallons	**Rated BTU/Watts**	/hr					
Measured water temperature at sink	Degrees	**Gas line leaks**	Y	N	N/A									
Tank Insulation	Existing	Install	No room	**Water lines insulation**	Existing	Install	**Length**	Lin. Ft.						
Pressure relief line plumbed to exterior of dwelling	Y	N	Install											
Replacement recommended	Y	N	**Floor repair required**	Y	N									
Comments:														
Chimney and Venting OK ? Yes No N/A														
WCD Pre	**WCD Final**	**CO Pre**		**CO Final**		**Combustion Air OK?**		**If NO, how much and where from?**						
						Y	N							
Comments:														
If not applicable:	N/A													

Attachment B. Vendor Questionnaire

Software Package/Company

Audience	
What is the software focus? (ratings, audits, weatherization)	
How is the software used by your customers?	Primary: Secondary:
Has the software been certified by any organization? If so, which one(s)?	
Is the software being BESTTEST EX tested?	
Is the software used in any utility or state programs? Which ones?	
How widespread is the software being used? # of clients geographic reach	
Modeling	
To what level does the software report usage disaggregation? (heating, cooling, hot water, appliances, lighting, etc.)	
What method is used to model weather?	
Is energy usage weather	

normalized?	
Is there a recognized calculation engine used (e.g. DOE-2) or is it using proprietary algorithms?	
Are there any climate limitations or focus, e.g. better results for cold as compared to hot climates?	
Which fuels can be modeled?	
Does the software perform green house gas calculations (existing usage and improvements)?	
If it calculates GHG impact, what source level is used (e.g. local, regional, national averages)	
Does the software account for interactions from implementation of multiple improvements?	
Inputs	
What are the minimum number of data inputs to get accurate result for usage and improvements?	

Are multiple heating/cooling systems allowed?	
How many of same building component can be input (floors, walls, ceilings)?	
Will the software accept measured inputs, e.g. blower door, duct leakage, etc.?	
Does the software require usage data input?	
How much billing structure flexibility is included – tiers, demand rates, seasonal rates	
Does the software include Health and Safety and/or IAQ info data capture/reporting?	
If so, what information is included?	
Will the software accept user input improvement cost values.	
How does the software deal with plug loads?	
Report/Recommendations	
Will the software allow fuel switching?	
Does the software generate recommendations	

automatically or does it require user input?	
What types of recommendations are included/assessed? Report output/flexibility: Can the report be modified? Can photos be attached?	
Misc	
Have any comparisons been done between calculated and actual energy use? If so, to what level (total, heating, cooling, hot water, lighting, appliance, etc)	
Have energy savings estimates been compared to actual savings?	
What other features of the software make it useful to contractors?	
How long has the software been commercially available?	
What improvements enhancements are planned	

and when are those improvements expected to be released?	
Can data from the software be output to a flat file?	
Additional Features of the software?	
Do you know of any studies doing similar review?	
Who is your competition?	
What can DOE do for you?	
Are you aware of the National Home Rating Program and its Implementation? Due to be release by September.	
What do you think of it?	
How do you believe your company/software would fit into a National Home Rating system?	
What can DOE do to help you? Database Software engine Cost Data Usage info	