Attachment 2

1.1 Home Performance with ENERGY STAR

In order to implement Home Performance with ENERGY STAR, there are various standards a program implementer must adhere to in order to deliver the program. The program implementer must use software that meets a national standard for savings calculations from whole-house approaches such as home performance. The software program implementer must adhere to at least one of the following standards:

- A software tool whose performance has passed testing according to the National Renewable Energy Laboratory's HERS BESTEST software energy simulation testing protocol.
- Software approved by the US Department of Energy's Weatherization Assistance Program.[1]
- RESNET approved rating software.[2]

There are numerous software packages that comply with these standards. Some examples of the software packages are REM/Rate, EnergyGauge, TREAT, and EnergyMeasure® HOME (henceforth EnergyMeasure). The EnergyMeasure software is described below as an example of a software that can be used to determine if a home qualifies for Home Performance with ENERGY STAR.

1.1.1 EnergyMeasure HOME Software Example

Conservation Services Group (CSG) implements Home Performance with ENERGY STAR in several states. CSG has developed proprietary modeling software known as EnergyMeasure HOME, The auditing software enables an energy auditor to collect information about the existing conditions of a house, recommend energy savings measures, provide estimated savings associated with those recommendations and create a proposal for the customer.

CSG previously provided a description of the methods and inputs utilized in the EnergyMeasure's predecessor (Real Home Analyzer or RHA, also known as HomeCheck) to estimate energy savings. CSG also provided a copy of an evaluation report prepared by Nexant that assessed the energy savings from participants in the Home Performance with ENERGY STAR Program managed by the New York State Energy Research and Development Authority (NYSERDA)[3]. The report concluded that the savings estimated by HomeCheck and reported to NYSERDA were in general agreement with the savings estimates that resulted from the evaluation.

EnergyMeasure is a greatly improved "second generation" of RHA (much more than a new version), though built on many of the same underlying engineering models, and evidence shows that it provides even better results. A June 2013 memo by Cadmus on the Massachusetts residential program shows that the change from RHA to EnergyMeasure resulted in significantly increased realization rates, and that

[1] A listing of the approved software available at http://www.waptac.org/si.asp?id=736 .
[2] A listing of the approved software available at http://resnet.us .
[3] M&V Evaluation, Home Performance with Energy Star Program, Final Report, Prepared for the New York State Energy Research and Development Authority, Nexant, June 2005.

for CSG (the lead vendor for two of the program sponsors) using EnergyMeasure the realization rates were exceptionally high, in the 80-87% range.[4]

The following is a summary of EnergyMeasure provided by CSG: CSG's EnergyMeasure software was designed to streamline the delivery of energy efficiency programs. The software provides the energy efficiency specialist with an easy-to-use guide for data collection of existing conditions of a house, HVAC equipment, eligible efficiency measures, and estimated energy savings. The software is designed to enable an auditor to collect information about customers' sites and then, based on what he/she finds through the audit, recommend energy-saving measures, create a proposal that includes the costs and estimated savings associated with those recommendations.

This software is a part of an end-to-end solution for delivering high-volume retrofit programs, covering administrative functions such as customer relationship management, inspection scheduling, sub-contractor arranging, invoicing and reporting. The range of existing components of the site that can be assessed for potential upgrades is extensive and incorporates potential modifications to almost all energy using aspects of the home. The incorporation of building shell, equipment, distribution systems, lighting, appliances, diagnostic testing and health and safety issues represent a very broad and comprehensive ability to assess the needs of a home.

1.1.2 Site-Level Parameters and Calculations

There are a number of calculations and methodologies that apply across measures and form the basis for calculating savings potentials at a site.

1.1.3 Heating Degree Days and Cooling Degree Hours

Heat transfer calculations depend fundamentally on the temperature difference between inside and outside temperature. This temperature difference is often summarized on a seasonal basis using fixed heating degree-days (HDD) and cooling degree-hours (CDH). The standard reference temperature for calculating HDD (the outside temperature at which the heating system is required), for example, has historically been 65°F. Modern houses have larger internal gains and more efficient thermal building envelopes than houses did when the 65°F standard was developed, leading to lower effective reference temperatures. This fact has been recognized in ASHRAE Fundamentals, which provides a variable-based degree-day method for calculating energy usage. CSG's Building Model calculates both HDD and CDH based on the specific characteristics and location of the building being treated.

1.1.4 Building Loads, Other Parameters, and the Building Model

CSG is of the opinion that, in practice, detailed building load simulation tools are quite limited in their potential to improve upon simpler approaches due to their reliance on many factors that are not measurable or known, as well as limitations to the actual models themselves. As such, the basic concept behind the model was to develop a series of location specific lookup tables that would take the place of performing hourly calculations while allowing the model to perform for any location. The data in these tables would then be used along with a minimum set of technical data to calculate heating and cooling building loads.

In summary, the model uses:

[4] http://www.ma-eeac.org/Docs/8.1_EMV%20Page/2012/2012%20Residential%20Studies/Home%20Energy%20Services%20Realization%20Rate%20Results%20Memo%206-28-12.pdf

1. Lookup tables for various parameters that contain the following values for each of the 239 TMY2 weather stations:
    a. Various heating and cooling infiltration factors.
    b. Heating degree days and heating hours for a temperature range of 40 to 72°F.
    c. Cooling degree hours and cooling hours for a temperature range of 68 to 84°F.
    d. Heating and cooling season solar gain factors.
2. Simple engineering algorithms based on accepted thermodynamic principles, adjusted to reflect known errors, the latest research and measured results
3. Heating season iterative calculations to account for the feedback loop between conditioned hours, degree days, average “system on” indoor and outdoor temperatures and the building

1.1.5 Usage Analysis

The estimation of robust building loads through the modeling of a building is not always reliable. Thus, in addition to modeling the building, EnergyMeasure calculates a normalized annual consumption for heating, cooling, and baseload using the actual fuel consumption and weather data when available. The model results are then calibrated to the normalized bill analysis to ensure that results will be within the range of actual energy usage for the home.

1.1.6 Multiple HVAC Systems

The EnergyMeasure model is fully interactive, including all thermal shell measures, internal gains from baseloads, and HVAC and distribution efficiency. If a site has multiple HVAC systems, weighted average seasonal efficiencies and thermostat load reduction adjustments are calculated based on the relative contributions (in terms of percent of total load) of each system.

1.1.7 Lighting and Appliances

Quantification of additional savings due to the addition of high efficiency lighting or other appliance upgrades are calculated based on the applicable algorithms for these appliances.