Interim Report on the Progress of the Home Energy Ratings of Ohio Batch Testing Protocol Pilot Project

The Home Energy Ratings of Ohio Program (HERO) has, in partnership with raters, builders, RESNET, Energy Star Homes and Fannie Mae, begun a pilot project to assess a batch testing protocol for rating new homes for the Energy Star Homes Program. OEE is interested to see the impact this program will have on the quality and reliability of the sampled rating information and on the acceptance of the program based on cost. This program was offered to 3 large-scale production builders in Ohio. It was reviewed and approved by RESNET, Energy Star Homes and Fannie Mae.

The protocols include a plan review/consulting component, a builder training component, an initial testing (or base-lining) component, a sampling component, and a component that tracks utility usage of all homes in the project. The sampling component requires 1 in 5 homes be inspected rather than every home. Plan review, training and testing occur prior to any homes being constructed and rated using the sampling protocols. The evaluation component will compile usage information when the houses are occupied.

Plan review, training and testing are start-up or fixed costs whereas sampling and certification are variable costs. Currently, for a builder to have homes rated, all these tasks and costs are combined and assessed on every building at approximately $300 per unit. The predicted per unit cost using the batch testing method is $60-$80 for the sample size in the pilot.

In the year 2000, HERO completed 67 ratings on new homes within the State of Ohio, all of which achieved Energy Star certification. The proposed completions through the sampling pilot will exceed 2000 units. Ohio builds approximately 50,000 new homes each year. Given these figures, Energy Star Homes program penetration will grow from 1/10 of 1 percent in the year 2000, to 4 percent of new home construction in the year 2001.

The OEE is interested in evaluating how the protocol may improve builders' use and acceptance of ratings, HERO's ability to meet increased volume, and the reliability of the rating results. OEE is also interested in evaluating the price sensitivity of the rating program. The review of consumption information that will be ongoing will help all energy rating providers and the software producer understand the relation of predictions to actual usage. This component has not been performed on such a large scale before. The results of these questions will have implications that could affect the number of ratings performed and the accuracy and reliability of rating systems on a national basis.

Below is a breakout of the costs incurred as of January 1, 2001, and an estimate of future costs that will be incurred as the pilot project progresses. Costs thus far have been shared by the builders and OEE. OEE has contributed through existing training program grants

and through OEE staff and administration support. The training and consulting components are not as yet complete and costs for these components will rise.

To date, most of the models that the builders will construct during the pilot program period have had initial plan review and changes made to the designs. MI Homes and Avenbury Lakes have had ratings performed to prepare the baseline figures for the protocols. More work will be done on these models as well as the performing baselining on Summit Homes models. The builders are currently in the process of collecting information to determine which of the models they build can be aggregated into a single model for batch testing purposes. The extent that the fixed costs will change is modest (est. $2,000 - $5,000) relative to the total cost of the project.

Sampling Pilot Costs
(to January 1, 2001)

Costs by Resource (Fixed)

Total

Codes and Standards Grant	*HERO Grant*	*Paid by Builder*
$6210	$3660	$5670

Total = $15540

Costs by Resource per Builder (Fixed)

MI Homes

Total Costs	*Grant*	*Paid by Builder*
$8310	*$5550*	*$2760*

Avenbury Lakes, Inc.

Total Costs	*Grant*	*Paid by Builder*
$5100	*$2190*	*$2910*

Summit Homes

Total Costs	*Grant*	*Paid by Builder*
$960	*$960*	*$0*

General Costs, Paid by Grant = $1110

Costs by Activity (Fixed)

Activity	*MI Homes*	*Avenbury Lakes*	*Summit Homes*
Audits	*$2700*	*$1350*	*$0*
Training	*$2910*	*$1300*	*$390*
Consulting	*$2700*	*$2330*	*$570*

The OEE processes each rating as a part of its State Energy Program. The software provider requires a $15 per rating fee for each full rating processed by HERO. These costs are paid by the builder or rater. The rater charges a $25 processing fee for all ratings to cover ongoing, usage information data management. The estimated cost for OEE to process each rating is $35 for a full rating and $15 for each un-inspected rating.

Using the estimated total units, there will be 400 full ratings and 1600 un-inspected units. The variable costs therefore are as follows:

Sampling Pilot Costs Projected

Predicted OEE/Builder Costs Per Unit (Variable)

Fee Category	*Number of Units*	*Builder/Rater $*	*OEE $*	*Total $*
Rating Fee	*400*	*$200*		*$80,000*
Rater Processing Fee	*2000*	*$25*		*$10,000*
Software Fee	*400*	*$15*		*$6,000*
OEE Processing (Full)	*400*		*$35*	*$14,000*
OEE Processing (Un-inspected)	*1600*		*$15*	*$24,000*
TOTAL (ave. per unit)	*2000*	*$48*	*$19*	*$67*

Sampling Pilot Costs - Actual and Projected

Total Costs (Fixed + Variable)

Fee Category	*Number of Units*	*Builder/Rater $*	*OEE $*	*Total $*
Fixed Costs	*2000*	*$2.84*	*$4.94*	*$7.78*
Variable Costs	*2000*	*$48*	*$19*	*$67*
Total Costs (ave. per unit)	*2000*	*$51*	*$23*	*$74*
Total Costs	*2000*	*$101,700*	*$47,870*	*$149,570*

OEE's responsibility also includes evaluating the reliability of the sampling protocols in regard to those units that do not have on-site inspections performed. We have contacted NAHB Research Center and had discussions concerning the methodology of the study. Determining the scope of the evaluation will take place immediately after the model aggregation and baselining work is completed.

OEE had not planned to subsidize training or start-up costs, however much of the training is being paid for from grant funds. The overall costs with grant funds included have not,

however, gone beyond predictions. With rising fuel costs and a colder winter than recent years, the price of the rating seems to be less an issue for builders. Those builders from the more competitive housing markets, who have been loyal to the Energy Star program, will, however, enjoy the reduced cost of ratings from this project.

PILOT SAMPLING PROTOCOLS – ENERGY STAR HOMES

OVERVIEW

Working with production builders is an opportunity to change the building practices that will result in a shift in the quality of new homes and an improvement in the energy efficiency of these homes on a large scale. Large-scale production builders are, however, concerned about the cost of individually rating buildings. The approximate cost of completing a full HERS rating on each unit is $300 or more. Preliminary costs for a sampling program would be approximately $60 per unit for the Energy Star certification and as yet undetermined costs for training. Builders are also concerned that the capacity of the rating system is not adequate to complete the volume of work if all buildings must be rated.

To meet these concerns a sample audit process will be tested. A summary of the process is:

1) Audit baseline performance on a minimum of 3 units of the same energy model in the same climate zone (+/- 5%) to assure Energy Star compliance using HERS protocols. Once the baseline group is satisfactorily completed, required changes to the plans are filed, and training is complete, sampling will proceed.

2) Test a 20% random sample (1/5). As the sample passes, buildings in the batch will be certified Energy Star in batches of 5 as they are completed. For the pilot phase, a control group of units that would normally not receive a full rating will be tested using HERS protocols against the baseline using the sampling protocols.

OEE is interested to see the impact this program will have on the quality and reliability of the sampling information and on the acceptance of the program based on cost. OEE therefore will fund the portion of the program above and beyond normal practice and the building industry will be responsible for costs that would be normally incurred in this type program. OEE does not intend to subsidize any portion of the process that would be normal practice of the industry. Homes certified by the sample audit program would be tracked for at least one year with a normalized consumption index used to compare the consumption for FH and SA units.

This pilot project will study the implications that sampling protocols will have on:

- The reliability of the sampled ratings based on these protocols,
  - Can a sampling process assure quality in 100% of the homes in a production run?
  - If all homes processed in fact meet the E-Star criteria,
  - The ability of the rating system to process in volume.
- The definition of what is a production built house, model or batch.
- The level of oversight that would result in acceptable performance by the builders;

What systems must be in place to assure quality?
What baseline data will give a good indication for future direction?

- Training programs that would be necessary for builders and subs to achieve acceptable long term performance,
  - The effect of these programs on the cost to the builders,

The effect these programs will have on the acceptance of the EEM's and Energy Star Homes Program by the production builder community,
Most effective way of institutionalizing best practices.

- If a defect is found, what procedures/measures are necessary to return the builder to compliance?
- What failure rate results in non-acceptable compliance that then removes a builder from the program?

Sample Audit Procedures

Objectives:
* Assure complete and adequate audits of homes to certify as Energy Star homes (an adequate baseline will show predictable results of repeatable building practice).
* Establish a random audit sample of repeat energy models.
* Assure acceptable audit system control.

Step One:
The Rating organization identifies the major design variations that can effect the ratings and Energy Star status. These variations encompass both the different energy feature requirements (i.e., basement wall vs. slab insulation) as well as building performance issues (i.e. attached vs. living space over garage, kneewall vs. flat attic, recessed lights, duct sealing methods, etc.).

Step Two:
Once the Energy Design Models are identified, a thorough evaluation of each model's plans and presently installed features is completed in order to assess its status as an Energy Star rated model (based on plans). Building performance testing and on-site inspections are then performed on each of the models to assess the quality of installation of measures and final compliance.

1. The plans and features are modeled in order to assess the initial heat loss rates and the rating level.
2. Performance tests on each of the energy design models are completed including overall leakage tests, zone leakage testing, duct leakage testing, infrared scans (when appropriate), and HVAC system testing.
3. After performance tests are completed on the finished houses of each type, examples of those same houses are examined in different stages of completion to assess both energy feature installation quality and the house performance test results.

Step Three:
The rating organization identifies the energy features that can be enhanced in order to increase the rating to Energy Star level or to strengthen the current Energy Star rating. At this point, the performance testing issues that will negatively effect the rating and/or issues that can potentially prevent the house from achieving the rated performance levels are identified. A plan is then developed with the various alternatives that will help the builder overcome the identified issues.

The plan is presented and negotiated with the builder and a plan of correction is agreed upon. The various feature and performance enhancements are then implemented on each of the energy design models. On-site technical assistance and training can be presented to the builder's supervisory staff and key sub-contractors as a part of the implementation process. All changes must be reflected on the building plans.

Step Four:
A thorough set of field inspection and performance testing procedures are completed on two finished houses of each of the "corrected" energy design models. Units of each energy model built will be tested using the HERS rating protocol until a unit passes. The next two units are tested and must pass. Once the two pass, the sampling process begins. At this point, a baseline for energy feature installation and building performance is established. Items that will be examined as part of the baseline include:

1. The overall blower door tested leakage related to square footage of above grade building shell (CFM@ 50Pa per sqft.).
2. The CFM@ 50 Pa leakage to the attic, garage and other critical zones related to zone Pa WRT House (or outside).
3. The CFM@ 25 Pa leakage of ducts to outside related to duct Pa WRT house as measured by a pressure pan.
4. A blower door guided visual inspection and/or pressure measurements of critical performance points in the building shell (i.e. cantilevers, recessed lights, plumbing walls, etc.)
5. Worst case depressurization, draft measurement and combustion safety testing of the heating system equipment.
6. Visual verification of insulation, fenestration, air leakage, heating/cooling equipment and distribution system feature types and installation quality. Visual verification of lighting and appliances (if applicable). This process will normally necessitate on-site visits prior to the completion and final performance testing.

Minimum performance levels and feature installation quality for Energy Star compliance is then determined for each of the energy design models. A spreadsheet or other data-base recording system will be developed to record and compare these minimum baseline performance levels to those obtained in subsequent - field testing during the sampling process.

To verify the accuracy of the sample process, the utility records of both full audited and sample audited homes will be compared. As part of this program, the builder will agree to obtain a utility records authorization form from the buyers of the houses, so that utility consumption rates can be collected.

Step Five:
The sampling process will then begin. Twenty percent (1 of 5) of each of the energy design model types will be selected at random by the home energy rater to receive an on-site field inspection and performance testing upon completion.

If a house does not pass due to either feature installation problems or performance testing failures, the builder will correct the problem in the failed house and retest the failed unit for the failed component. The next two houses of the failed energy design model will then be tested. If both pass, the sampling procedure is reinstated. If one or both fail, they are corrected and the next two houses are tested (1 failure = inspections of next 2 of that model).

The key to making this procedure work is not to just note that it has failed, but to determine what the cause of the failure is and make sure that the builder/sub-contractors understand how it can be corrected and failures can be avoided in the future. This requires that corrections are noted on the plans for future reference.

Step Six:
It is important to perform on-going maintenance of this process. This includes carefully tracking the inspection and performance points and assuring that the identified problems and their corrections are being adequately followed through on. It is also important that a senior rater oversee the process and assure the accurate collection of diagnostic performance data and that it is being accurately interpreted by the field raters. The periodic checking and adjustment of the baseline performance points will also be necessary for maintaining an accurate database.

Maintaining a positive relationship with the builder, supervisory staff and sub-contractors is critical to this process. Clear and diplomatic communication with all the parties involved will further the process of correcting identified flaws in the installation of the energy features. As noted before, it will be critical to help the builder and his/her staff to come up with specific solutions to specific problems.

Conclusion:
Our goal is to achieve a market transformation, to build better homes. The most direct strategy is the production builder. An accurate, reliable sample process can identify consistent building performance without adding unnecessary time constraints and added audit costs.