

**Development of 3D Simulation  
Training and Testing for  
Home Energy Score Assessor Candidates**

**Summary Report**

**February 2015**

## Acknowledgements

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### Efficiency.org Project Team

Rick Gerardi  
Matt Golden  
Chris Gerardi

### Interplay Learning Project Team

Doug Donovan  
Steve Quirk



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Prepared by:  
Efficiency.org LLC  
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## Executive Summary

The U.S. Department of Energy (DOE) developed the Home Energy Score to assess the relative energy efficiency of homes and provide a transparent metric to affect consumer behavior and markets. While the Home Energy Scoring Tool itself is free for a qualified user, broad scalability and adoption of the tool in the private marketplace requires cost-effective training, testing and qualification protocols. Given the success of computer-based 3D simulation in other industries such as defense and healthcare, DOE worked with a contractor to build out a suitable training and testing simulation for the Home Energy Score. In addition to the simulation, DOE funded a national study to determine the overall effectiveness of the simulation in preparing candidates to accurately generate a Home Energy Score in the field. This evaluation, completed in March of 2014, highlights three key outcomes:

- Performance on the 3D simulation test is a good predictor of performance generating a Home Energy Score (Score) in the field.
- Performance on a building science-related multiple choice test is a poor predictor of performance generating a Score in the field.
- Specific energy related credentials are not a requisite for successful performance generating a Score in the field.

As a result of the above findings, DOE is making the following changes to its Home Energy Score program requirements for candidates interested in becoming a Home Energy Score Assessor:

1. Professional Credential
  - Candidates must now hold a professional credential related to residential services (e.g., home inspection, contracting, energy auditing). Previously, the Home Energy Score only recognized the BPI Building Analyst and RESNET HERS Rater certifications. In addition to these, the program now accepts a much wider range of credentials as defined by relevant national organizations (e.g., ASHI, BPI, InterNACHI, NARI, NATE, RESNET).
2. 3D Training & Test:
  - Candidates must pass a 3D simulation test in which they score two virtual homes. A passing mark equates to getting 90 points or greater on each of the two homes.
  - Prior to taking the 3D simulation test, candidates must achieve an 80 or greater on three “challenge” homes also available in the 3D simulation training platform. This will ensure that candidates are familiar with the 3D tool and have gone through the training modules.

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### 3. Multiple Choice Test

- Candidates are no longer required to take a 50-question multiple choice test that includes building science questions. Instead, they must pass a 20-question test that assesses how well the candidate understands the Home Energy Score program, including how the Score is calculated. The test is intended to prepare Assessors for questions they might receive from customers.

### 4. Mentoring & Quality Assurance

- Candidates who fulfill the above requirements can provide the Home Energy Score working under any of the Home Energy Score local, state, and/or national Partners. The Partner is responsible for conducting quality assurance reviews of the scores (i.e., rescore 5% of homes scored) including providing a mentor to accompany the new Assessor on the first home that they score.

These program modifications will enhance deployment of the Home Energy Score in a number of ways. First, the broader array of acceptable credentials will tap into a large existing population of housing professionals eager to add a differentiating skill to their service offerings. Second, the elimination of the building science portion of the multiple choice test allows candidates to focus on practical skills and application of the Home Energy Score. Third, the new simulation training can all be done online at the user's own pace. Fourth, the new requirement to have a mentor accompany new Assessors on their first home score visit provides a quality test at the front end and allows new Assessors to ask questions in an actual home.

## **Section I: Introduction and Background**

### **Introduction**

The U.S. Department of Energy (DOE) developed the Home Energy Score. Similar to a vehicle's miles-per-gallon rating, the Score helps homeowners and homebuyers understand the energy performance of their homes and how they compare to other homes. The Home Energy Score also provides recommendations for energy upgrades as a way to reduce utility bills and improve the home's Score. Energy professionals and organizations can use the Home Energy Score to promote energy efficiency to homeowners and encourage investments in deeper energy improvements.

A Home Energy Score can only be generated by an individual who has met DOE program requirements and is working under a Home Energy Score Partner as an "Assessor." The Assessor collects data about the home during a brief inspection and inputs this information into the Home Energy Scoring Tool to generate the Score on a scale of 1 to 10. A Score of 10 indicates that the home has excellent energy performance; a 1 indicates the home needs extensive energy improvements. In addition to providing the Score, the Assessor provides the homeowner with a list of recommended energy improvements and the associated cost savings estimates.

To enhance Assessor training and testing, DOE worked with Efficiency.org LLC in partnership with Interplay Learning (Interplay) to create a 3D simulation training and testing tool and validate its use in Assessor training and testing materials. The project team included: Energy efficiency policy and implementation experts, simulation software developers with specific energy efficiency competencies, and a psychometrician to assure a scientifically valid approach to qualification and continual improvement.

The project included the following four primary tasks:

#### **Task 1: Conduct Job Task Analysis**

Conduct a psychometrically valid job task analysis of Home Energy Score Assessors to inventory the distinct tasks and the corresponding knowledge, skills, soft skills (interpersonal communications) and abilities needed to conduct a home walk-through, utilize the software, input the data, and deliver a Home Energy Score.

#### **Task 2: Develop 3D Simulation Software for Assessor Training**

Design, develop, and deploy Home Energy Score Assessor training software. The 3D immersive simulation program should mimic in-the-field performance and challenge candidates to master the critical skills required to effectively deliver a Home Energy Score. The 3D tool must be easily accessible via the web and offer candidates an opportunity to train with extensive variability in a life-like, simulated environment. It must be capable of being delivered through a

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standard browser (with possible lightweight, free plug-ins) and usable on a standard “everyday” laptop computer.

### **Task 3: Develop Assessor Test**

Design, develop, and deploy Home Energy Score Assessor assessment software for the purpose of qualifying applicants to conduct Home Energy Score assessments. The 3D tool should mirror the training application, again mimicking in-the-field performance, and challenging candidates to show competency in delivering a Home Energy Score. The assessment software must be accessible via the web in a secure (https) environment and be flexible and controllable to allow for test committees, as dictated by the DOE, to select specific scenarios for exam delivery. Develop a complementary, written multiple choice exam.

### **Task 4: Conduct a Validation Study of Training and Test**

Develop and conduct a study to validate if candidates trained and tested through the 3D tool possess the knowledge, skills and abilities required to properly conduct a Home Energy Score in the field.



## **Section II. Project Findings**

The project simulation programming team and a group of subject matter experts produced a simulation training tool and test that was ultimately found to be a better option for preparing and qualifying aspiring assessors than current methodologies. The tool development completed both alpha and beta phases quickly and was introduced into a real world, Home Energy Score assessment environment with working, market-based participants in less than six months. The project team interacted with hundreds of current and aspiring Assessors to ensure that the training tool was designed to teach relevant professionals the specific skills needed to effectively score homes.

Following the development of the simulation training tool, simulation test, and new multiple choice exam, the project team executed a validation study with more than 30 candidates in the field.

### **Validation Study Description**

Thirty-one candidates, none of whom had prior experience with the Home Energy Score, were given unlimited access to the 3D simulation training environment. Once they felt ready to be tested, they were asked to score two homes using the 3D simulation tool. The test homes featured in the 3D tool are different from those shown in the training portion of the 3D tool. The candidates were also asked to take a 100-question multiple choice test that was comprised of questions related to building science and use of the Home Energy Scoring Tool. Finally, after taking both the simulation test and the multiple choice test, these candidates went to two actual homes in one of the following locations: Denver, CO; Fairfax, VA; Austin Texas; Philadelphia, PA. Candidates individually scored the two homes using the Home Energy Scoring Tool. The psychometrician noted that there was no predictive value to the written multiple choice test score, whereas there was substantial correlation between the mean simulation test score and the validity of the Home Energy Scores generated in the field.

### **Additional Findings**

- Certain incorrect inputs drove scores outside acceptable range, and should be the focus of increased training efforts. Build into the 3D tool a mandatory protocol to assure competency in these core items.
  - Square feet of conditioned space (included incorrect measurement, incorrectly defined thermal envelop boundaries, use of a discouraged protocol to use internet data)
  - Wall and window area inputs
- A minimum requirement of passing a training scenario in the simulation tool is an effective early screening tool for candidate participation in actual testing.

**Task 1: Conduct Job Task Analysis**

*Conduct a psychometrically valid job task analysis of Home Energy Score Assessors to inventory the distinct tasks and the corresponding knowledge, skills, soft skills (interpersonal communications) and abilities needed to conduct a home walk-through, utilize the software, input the data, and deliver a Home Energy Score.*

The following scope statement was adopted by the team undertaking this portion of the study:

“A Certified Home Energy Score Assessor can accurately evaluate and code a home for all components of the Department of Energy Home Energy Score. The Certified Home Energy Score Assessor is not certified to explain the Home Energy Score, nor is he or she expected to be able to make recommendations regarding the impact of the Home Energy Score on home valuation.”

The job task analysis survey was administered from April 25 to May 2, 2013. There were 53 respondents. The three core issues of the survey were: certainty, difficulty, and response appropriateness. Each was evaluated in relationship to 31 specific rating topics. Eight demographics questions were administered to evaluate the backgrounds of respondents and to assess the training they had received.

On May 8, 2013, following the job task analysis survey, the subject matter experts were asked to evaluate, on the basis of their expertise, what appropriate weightings should be for each domain. After extensive discussion, the panel of subject matter experts unanimously agreed on the following weightings for each domain, with target weights and minimum and maximum ranges (see Figure 1). This resulting graph, referred to as the “blueprint,” served as the foundation for the development of the 3D simulation training and testing tool and guided the extent to which topics were covered in more or less detail, and weighted in terms of importance in the simulation tests. Considerably more detail on the survey and final selection of topics and weighting is included in *Appendix A*.

Home Energy Score Blueprint					
			Allocations		
#	Domain	Topics Included	Min	Target	Max
1	Structure	Orientation, Floor, Ceiling, Stories	7%	9%	11%
2	Air Seal	Air leak; Air sealed	10%	12%	14%
3	Roof	Construction, Finish, Insulation	8%	10%	12%
4	Attic, Basement	Type, Insulation, Foundation	13%	15%	17%
5	Window	Area, Frame, U-Factor, Solar	8%	10%	12%
6	Skylight	Area, Frame	4%	6%	8%
7	Walls	Construction, Finish, Insulation	10%	12%	14%
8	Equipment	HVAC, Water Heater: Type, Efficiency	13%	15%	17%
9	Ducts	Location, Insulation	9%	11%	13%
<b>Total:</b>			<b>82%</b>	<b>100%</b>	<b>118%</b>

Figure 1. Home Energy Score Blueprint

**Task 2: Develop 3D Simulation Software for Assessor Training**

*Design, develop, and deploy Home Energy Score Assessor training software. The 3D immersive simulation program should mimic in-the-field performance and challenge candidates to master the critical skills required to effectively deliver a Home Energy Score.*

Interplay employed an agile design and development process to design, develop, and deploy the Assessor training software. This process ensured the software would be user friendly and developed on time and within budget. Given the wide range of learner demographics (age, experience, computer literacy) in the target population, Interplay designed the Home Energy Score training tool with learner engagement and efficacy in mind.

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Based on the results from the job task analysis, Interplay developed a simulation with one learning objective for a candidate: to learn to effectively deliver a Home Energy Score. The final training product is a robust, engaging and powerful learning tool. It is web-based and works on all browsers and both Mac and PC operating systems. It requires a light browser plug-in that enables the 3D appearance and interaction.

Interplay created and the project team marketed participation in the project with a demonstration video: <https://www.youtube.com/watch?v=GHHj4nMZM88>

The Home Energy Score 3D Simulation Training Tool is a full learning platform that offers a learning path from simple PowerPoint presentations to immersive practical simulations. Built on a Learning Management System, users can be tracked by identity and all information is stored in the database.

- With the help of subject matter experts, Interplay built a common sense, web-based curriculum that features more than 100 PowerPoint slides with assessor instruction and content background. By design, this curriculum is intended to stand on its own, but would also support any formal training offered by Home Energy Score training partners.
- Interplay developed an “onboarding” program, which includes a PDF user guide, a narrated video, and an in-tool tutorial (see Figure 2). This provides a solid framework for candidates/students with little-to-no simulation experience an opportunity to easily build comfort with the graphical user interface.

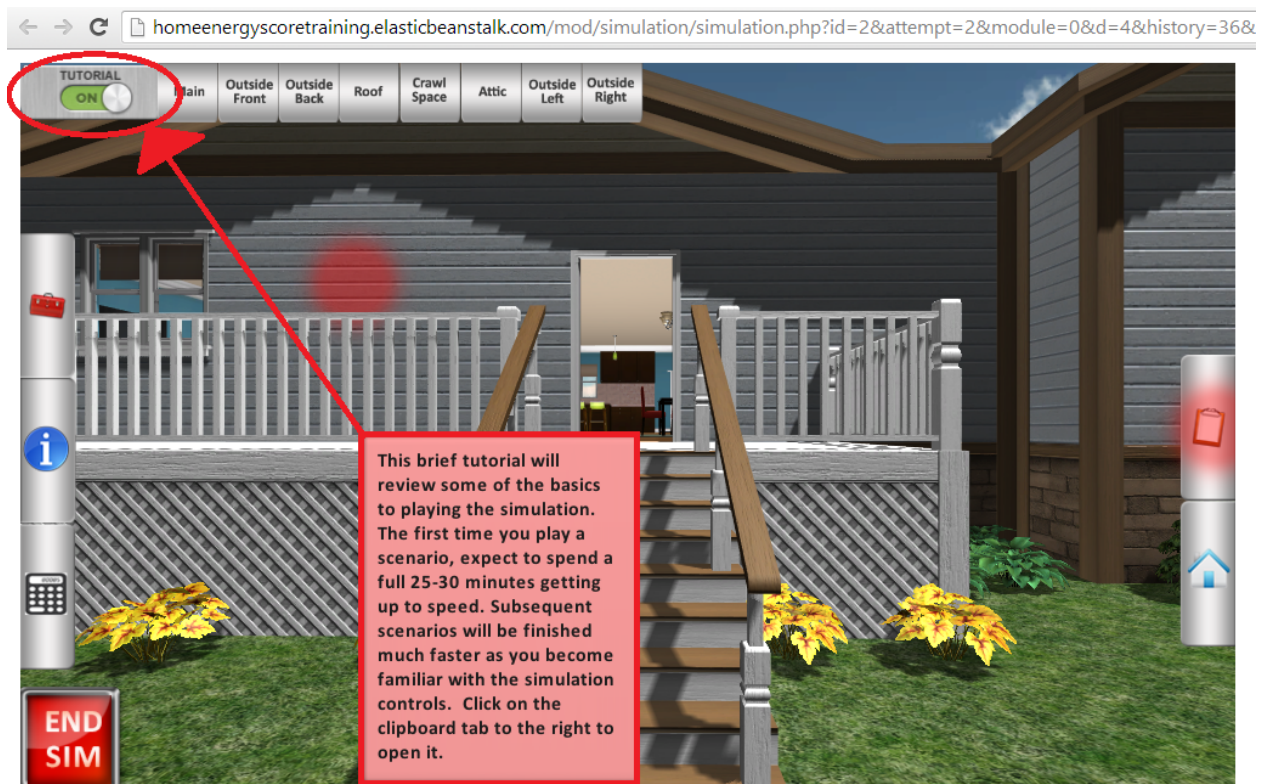


Figure 2. In-tool tutorial

The simulation is a 3D, Point of View immersive simulation that does not use any avatars.

- The training simulation features three (3) distinct types of homes that represent a national cross section of homes and home features: home #1: simple one story ranch
- with vented crawl space; home #2: two story single family home with a high ceiling and basement; home #3: end unit on a two story townhome on a slab with skylights and a vaulted ceiling.
- Each house has over 50 variables which mimic the inputs on the Home Energy Score itself. This includes things like conditioned floor area, window glazing, HVAC system type and efficiency, among many others.
- Data entry in the simulation mimics exactly the actual “live” data entry process for the current Home Energy Score process. This includes all drop-down options and gating mechanics.
- Users are offered 10 scenarios for each of the three houses in the Training Mode, totaling the equivalent of 30 houses. Each scenario has a completely different set of variables giving the candidates a chance to practice item identification or calculation on more than 1,500 characteristics.

Users can launch Challenge Scenarios as well for each of the three houses (see Figure 3).

Challenge Scenarios are randomized, and act like a simulation exam, where the primary variables are not known prior to launching the scenario.

- Users are provided a scenario report card for each attempt. The report is immediately available after each simulation attempt (training or challenge) and identifies each of the data entry points and compares them to the answer sheet. The report can help the user quickly identify areas of misunderstanding. The report card is also available to any instructor/administrator to monitor ongoing candidate performance and progress.

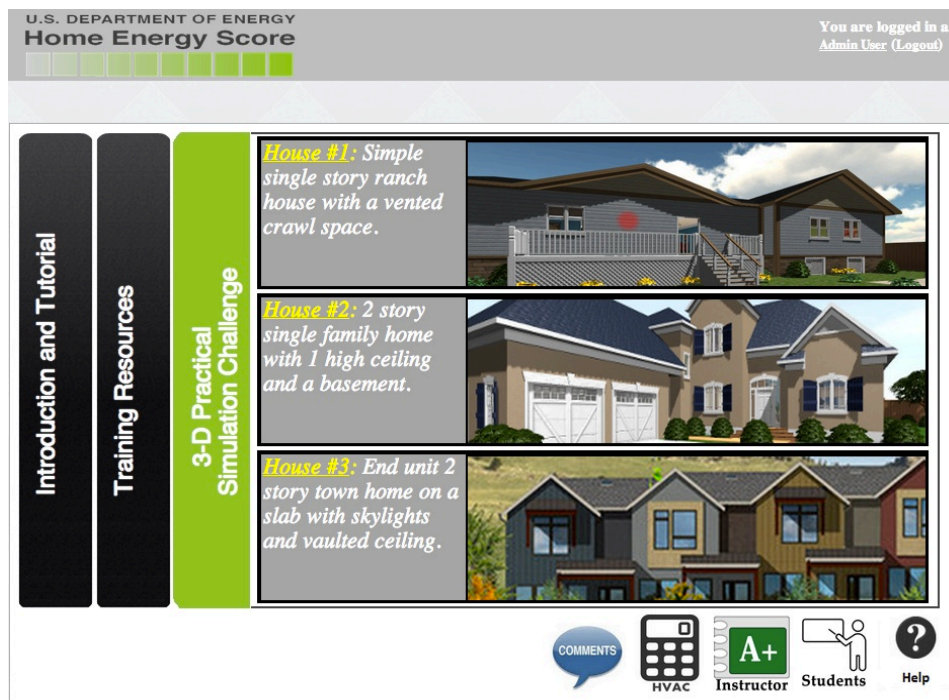


Figure 3. 3D Practical Simulation Challenge with three house types

*The Home Energy Score 3D Training tool provides new guidance tools to provide a more consistent path for assessors to identify variables. This includes an Excel-based calculator for HVAC efficiency and insulation de-rating. Interplay also sourced a number of industry standard charts and embedded them in the 3D simulation tool to give assessors easy access to pertinent information, like the Huang and Gu wall cavity R-value guide.*

- In the simulations, Interplay developed “jump links” which allow a user to immediately jump from the simulation to the content in the PowerPoint on any data entry point. For example, if a user is on the roof in the simulation, and needs to declare what color it is, the user can “jump” to the PowerPoint page on roof color, then seamlessly return to the simulation. This contextual learning is incredibly powerful to quickly learn material.

### **Task 3: Develop Assessor Test**

*Design, develop, and deploy Home Energy Score Assessor assessment software for the purpose of qualifying applicants to conduct Home Energy Score assessments.*

Interplay developed a simulation testing software program that delivers a virtual environment for a life-like practical exam for Home Energy Score Assessor candidates. The value of a live practical exam is well documented as the candidate is tested on explicit knowledge rather than the required inference of competency from a multiple choice paper exam. However, the challenges are just as well documented: cost, proctor bias, logistics, and inconsistency of the testing environment, among others. The virtual solution addresses many of those concerns and offers significant advantage over many other testing modalities. With 3D simulation testing, DOE can:

- Have exact control over testing scenarios
- Measure candidates with increased objectivity
- Measure explicit actions that closely match those of actual job performance
- Avoid the risk of in-the-field dangerous situations
- Significantly lower ongoing cost for both the organization and candidates
- Deliver the test anywhere at any time.

The exam itself uses the exact programming as the training software so candidates will be familiar with the interactions and scoring rules. To complete the exam, the candidate must deliver two mock Home Energy Scores by identifying and entering all the data required in the Home Energy Scoring Tool (the 3D mimicked tool) in the virtual environment. The candidate is measured on his/her input value choices versus the answer sheet as developed by the subject matter experts.

Both of the test houses represent a cross section of the types and feature sets seen in homes across the country (see Figure 4). For testing variety and integrity, six different testing scenarios of equivalent challenge level have been designed for each home. This means there are 36

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different testing combinations allowing candidates to challenge the exam multiple times and make it highly unlikely that they will see the same exam. This also protects information transfer from one candidate to the next as each of their test scenarios will be different.

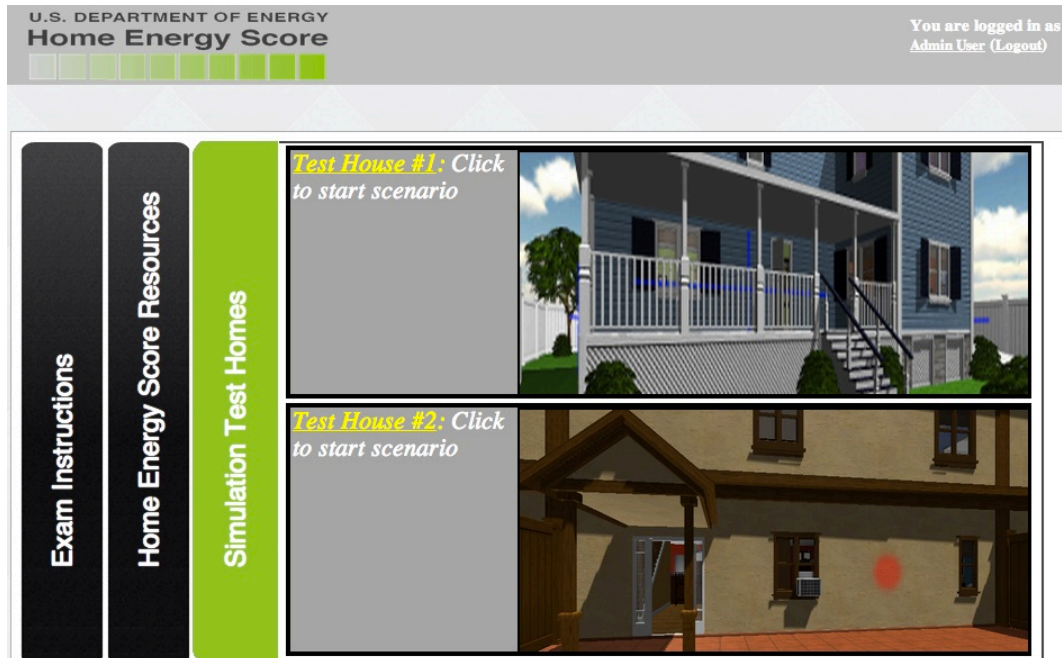
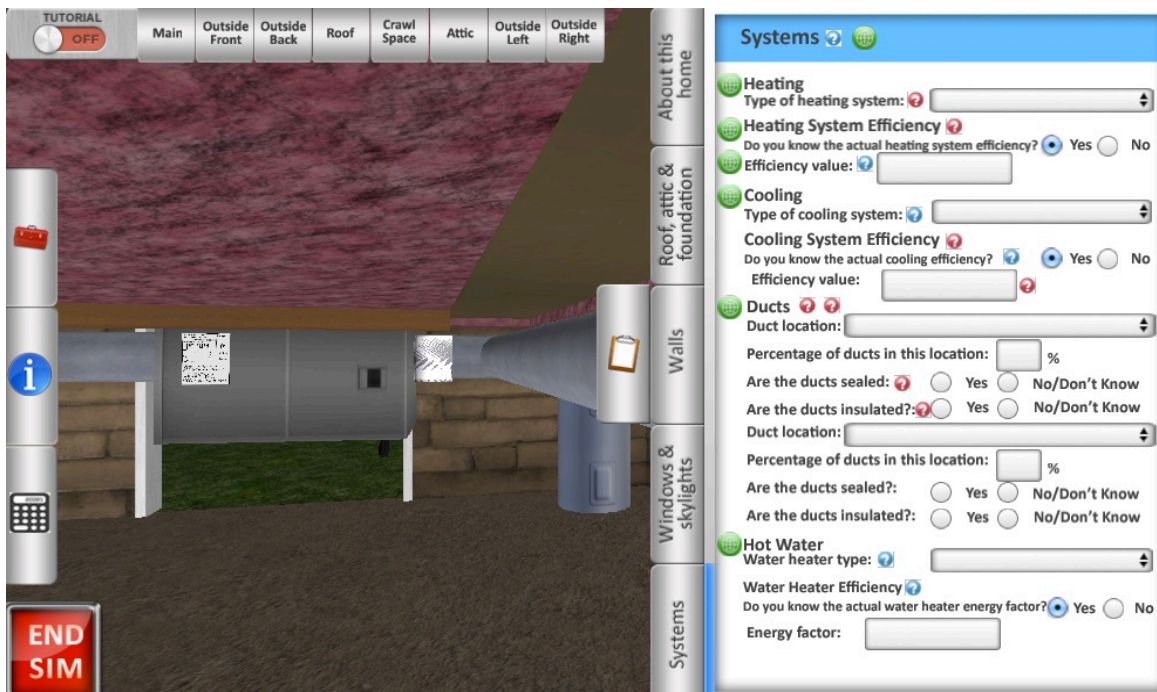


Figure 4. Screenshot of simulation test houses

Figure 5 shows the effectiveness of being able to navigate around an HVAC system to determine appropriate Home Energy Score inputs, just as an Assessor must do in performing an actual assessment.



**Figure 5. Screenshot of HVAC system and associated inputs in the 3D simulation tool**

*Valuable Feedback.* The 3D simulation training tool also provides a feedback report which allows the candidate, his organization, and testers (from a data analysis standpoint) to understand where the candidate excelled or needs improvement (see Figure 6). Evaluated over multitudes of tests, this is an extremely valuable way to determine targeted training.

Home Energy Score Section	Correct Answer	Your Answer	Points Available	Points Awarded
<b>+ About This Home</b>				
<b>Subtotal</b>			<b>20</b>	<b>3</b>
<b>+ Roof, Attic, and Foundation</b>				
<b>Subtotal</b>			<b>15</b>	<b>4</b>
<b>- Walls</b>				
Townhome or Duplex?	Yes	No	1.0	0.0
Position of Townhome/Duplex	Left	N/A	1.0	0.0
Wall construction same on all sides? (actual text/value)	No	Yes	1.6	0.0
Wall/Front Construction	N/A	N/A	1.0	1.0
Wall Exterior Finish	N/A	N/A	1.0	1.0
Wall Insulation Level (R-Value)	N/A	N/A	3.0	3.0
Front Wall Construction	Wood Frame	N/A	0.2	0.0
Front Wall Exterior finish	Brick Veneer	N/A	0.2	0.0
Front Wall Insulation Level (R-Value)	19	N/A	2.2	0.0
Back Wall Construction	Wood Frame	N/A	0.2	0.0
Back Wall Exterior finish	Brick Veneer	N/A	0.2	0.0
Back Wall Insulation Level (R-Value)	3	N/A	0.2	0.0
Right Wall Construction	N/A	N/A	0.2	0.2
Right Wall Exterior Finish	N/A	N/A	0.2	0.2
Right Wall Insulation Level (R-Value)	N/A	N/A	0.2	0.2
Left Wall Construction	Wood Frame	N/A	0.2	0.0
Left Wall Exterior finish	Brick Veneer	N/A	0.2	0.0
Left Wall Insulation Level (R-Value)	11	N/A	2.2	0.0
<b>Subtotal</b>			<b>15</b>	<b>5.6</b>
<b>- Windows &amp; Skylights</b>				
House have skylights?	Yes	No	1.0	0.0
Skylight Area	36	N/A	0.5	0.0
Skylight Specification?	No	N/A	0.5	0.0
Skylight type/# of panes	Double Pane	N/A	0.5	0.0
Skylight Frame	Wood or Vinyl	N/A	0.5	0.0
Skylight Glazing Type	Solar Control Low-E	N/A	0.5	0.0

**Figure 6. Feedback report on candidate’s performance on the test**

*A better solution to testing competency.* The benefits of this testing solution are significant for the Home Energy Score program that aspires for nationwide distribution in a short timeframe and at a reasonable cost for the participating Assessors. An effective online solution could make this possible and, as the validation study suggests, a simulation exam could do it well enough to effectively train and assess candidates.

In addition to the simulation exam, the project team developed a psychometrically valid written exam as a complement to the 3D tool. The written exam is intended to similarly test the knowledge needed by a candidate to accurately and effectively collect the data, utilize the software, input the data, and deliver a Home Energy Score. The new written exam may draw from the existing Assessor written exam but will be modified based on the job task analysis outlined in Task 1, and will properly complement the simulated portion of the exam.

The multi-step process of the creation of the written exam is outlined below.



*Recruited an exam development taskforce:* The taskforce was made up of subject matter experts including building scientists, current assessors, program implementers, and auditors. There were 11 participants on the taskforce who:

- Received the Blueprint from the job task analysis and refined the scope of the exam. The taskforce reviewed the blueprint originated by the job task analysis effort and developed a plan of execution for the exam.
- Conducted a gap analysis with Assessor content. The taskforce reviewed the existing Assessor test content, evaluated the quality of the test items, and conducted a gap analysis. The outcome of the gap analysis included a list of Assessor items that need to be modified, a list of Assessor items that adequately cover specific content, and a list of new items which needed to be written to fulfill the contents required by the blueprint.
- Conducted an item-writing workshop. With the results of the gap analysis, the taskforce convened to revise existing items and write new items. The taskforce worked together and independently over a two week period to craft and review all the questions for the exam.
- Developed two final exam forms. The questions were broken up into two groups of 100 questions. These two forms would be used for the validation testing. The results of item analysis, if required, would be more precise using the two forms.

### **Task 4: Conduct a Validation Study of Training and Test**

*Develop and conduct a study to validate if candidates trained and tested through the 3D tool possess the knowledge, skills and abilities required to properly conduct a Home Energy Score in the field.*

#### **Validation Study Process and Participants**

The goal of this validation study was to see whether a newly developed written multiple choice test and/or a simulation test could predict the accuracy with which candidates could produce a Home Energy Score in the field. It also included ten demographic factors that might predict Home Energy Score ratings as well.

The process to identify project participants was comprehensive and detailed. No funds were available to provide stipends or incentives to participants, so the team developed a value proposition to encourage them to be a part of the study. Voluntary participation was encouraged and an outreach and marketing strategy was developed outlining the benefits to participating organizations and candidates and the expectations and commitments of all parties to the project.

Specific tools were developed to facilitate participation such as the Home Energy Score 3D validation study website, created for the organization and candidate sign-up process and demographic information collection. The project also developed a 3D sim demonstration video, which was used as a key component of the team's talking points for engagement. The type of participant organizations recruited were existing Home Energy Score Partner organizations and organizations new to the Home Energy Score, including for profit businesses, not-for-profit organizations, and training and certification entities. Over 1,000 potential candidates were

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initially touched by the team’s study recruitment effort, mainly through co-branded recruitment with participating organizations resulting in:

- 340 candidates who registered nationally;
- 153 candidates who qualified to take the 3D sim and online written tests; and
- Onsite validation at four regional venues (Philadelphia, Fairfax, Denver, Austin) where more than 30 candidates conducted Home Energy Score assessments on two houses at each venue.

### Written Test

Two parallel forms of a written test were developed by item writers experienced in Home Energy Score inspections. The tests consisted of 100 scored items and were substantially parallel.

### Simulation Test

For this study, all candidates were allowed to use the simulation training at their own pace. Before testing actual homes, candidates were required to score at least 80 out of 100 points on one of the simulation homes available in the training environment. The simulation training environment had three different homes to explore with multiple variations. The simulation training required the candidates to use a rating process that mirrors the Home Energy Score rating system.

### Home Energy Score Item Difficulty

The Home Energy Score rating involves ratings on 54 variables. Some variables are categorical, such as roof color or floor assembly code. Other variables are values, such as right window area or skylight area. In this study, a categorical rating was scored correct only if it was rated the same as the Gold Standard categorical rating. Other ratings that were values were scored correct if they were within +/-10% of the Gold Standard value.

In Figure 7, the percent correct is the percentage of ratings for a specific topic that was correct. Only 9% of the ratings for front wall assembly code were correct. The ratings are shown in ascending order of percent correct. Percent correct scores under 70% are highlighted in purple. Note that the lowest 11 topics are less than 60%.

Item Number:	% Correct	Topic
1	9%	Front wall assembly code
2	18%	Left window area
3	29%	Front window area
4	31%	Ceiling assembly code
5	36%	Conditioned floor area
6	41%	Right window area
7	43%	Back window area
8	53%	Duct 1 fraction
9	55%	Roof color
10	56%	Back wall assembly code
11	56%	Duct 2 fraction

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12	60%	Year built
13	60%	Right wall assembly code
14	60%	Left wall assembly code
15	60%	Duct 2 location
16	63%	Front window assembly code
17	64%	Skylight area
18	65%	Heating efficiency
19	66%	Number of bedrooms
20	68%	Wall construction same
21	69%	House orientation
22	69%	Duct 2 insulated
23	76%	Duct 1 sealed
24	79%	Foundation insulation level
25	83%	Back window method
26	83%	Right window method
27	83%	Right window assembly code
28	83%	Left window assembly code
29	84%	Ceiling height
30	84%	Window construction same
31	84%	Back window assembly code
32	84%	Left window method
33	85%	Heating efficiency method
34	86%	Cooling efficiency method
35	88%	Floor assembly code
36	88%	Domestic hot water (dhw) efficiency method
37	88%	Dhw energy factor
38	88%	Duct 1 location
39	90%	Heating type
40	90%	Dhw year installed
41	90%	Duct 1 insulated
42	91%	Foundation type
43	91%	Cooling type
44	94%	Stories above ground
45	94%	Skylight method
46	94%	Heating fuel
47	94%	Dhw fuel
48	98%	Attic type
49	98%	Dhw category
50	98%	Dhw type
51	98%	Duct 2 sealed
52	99%	Single Family or Townhouse
53	99%	Front window method
54	100%	Roof assembly code

**Figure 7. Accuracy Associated with Individual Required Data Inputs**

Based on findings in Figure 7, training should be focused on specific topics: either the lowest 11 or the lowest 22. Another insight from the figure is that most of the items in the lower rankings are value ratings and not categorical ratings. Specifically, items such as conditioned floor area, window area, and skylight area must be taught with high intensity.

### **Field Validation**

Candidates who lived in one of four regions in the country were then asked to rate two actual houses using the Home Energy Score rating system. Every home was also rated by two expert Home Energy Score Assessors who conferred and established a ‘gold’ score or Gold Standard rating. Candidates’ Home Energy Score ratings of each house were then compared to the gold ratings for the corresponding house to see how accurately they had completed the ratings.

For the purposes of this validation study, rating accuracy was evaluated in two ways. The first was in terms of the Home Energy Score rating scale from 1 to 10. Each of these ratings from 1 to 10 can be thought of as a ‘bin’. For a candidate’s bin Score rating to be correct, the candidate’s rating had to be within one bin of the gold Home Energy Score rating. So for a house with a gold Home Energy Score of 6, the candidate’s rating had to be a 5, 6 or 7 in order to be deemed as accurate or “Correct”.

The other method of evaluating the accuracy of a candidate’s home rating was comparing the estimated source BTU number generated through their assessment with that of the gold Home Energy Score rating. For this score to be rated as correct, the candidate’s estimate of source energy BTU consumption had to be within +/-10% of the gold source energy BTU rating. The candidates’ Home Energy Score accuracy -- the ability of a candidate to score a home correctly in the field – was then compared with their performance on both the written and simulation tests.

### **Conclusions**

There was a substantial correlation between the mean simulation test score and Home Energy Score accuracy in the field; however, as a predictor of Home Energy Score accuracy, the 100-item written multiple choice test was no better than chance. This was demonstrated both through correlation studies and classification consistency measures.

As Figure 8 below indicates, all candidates (4) who scored 90 or greater on the simulation training, scored BOTH homes in the field correctly. Some candidates (8) scored less than 90 on the test homes and still scored both homes in the field correctly. However, most importantly, at a cut-off score of 90, there were no false positives – that is, no one who scored at least 90 on both simulation test homes inaccurately scored at least one of the homes in the field. Furthermore, most candidates who did NOT score 90 or greater on the simulation homes actually incorrectly scored the homes in the field (19). The key with this type of analysis is to NOT have any false positives. As a result, the Home Energy Score program will require all future candidates to score at least a 90 or greater on the two simulation test homes.

Home Energy Score 3D Simulation: Training and Testing for Assessor Candidates

	Scored Both Homes in Field <u>Correctly</u>	Did <u>NOT</u> Score Both Homes in Field <u>Correctly</u>
Scored 90 or Higher on Both Simulation Test Homes	4	0
Did not score 90 or Higher on Both Simulation Test Homes	8	19

Figure 8. Comparison of results from simulation test with in-field scores

## Appendices

## **Appendix A: Job Task Analysis**

This appendix describes the survey and survey results for the job task analysis completed prior to development of the 3D simulation tool. The job task analysis included (1) a survey of experienced Home Energy Score Assessors; (2) review of survey results by team of subject matter experts; and, (3) final determination of topics to be included in the 3D simulation tool and test, along with weighting attached to each topic given results of survey and feedback from the subject matter experts.

This appendix also includes the survey questions used as part of this analysis, responses to the questions, and final selection of topics and weighting.

### **Survey Analysis**

The survey results for each of the three rating groups (certainty, difficulty, and rating appropriateness) were averaged for each topic. The topic mean ratings are shown below.

The topics were then partitioned into four groups, depending on the mean ratings for each topic. The mean ratings were associated with a weighting for each group, as follows:

Rating	Weight
< 1.3	1
Between 1.3 and 1.7	2
Between 1.7 and 2.1	4
Between 2.2 and 2.7	8

Quadratic weightings were used because it was felt that linear weightings underrepresented the amount of training required to teach raters the skills necessary to correctly evaluate the difficult topics on the Home Energy Score rating sheet:

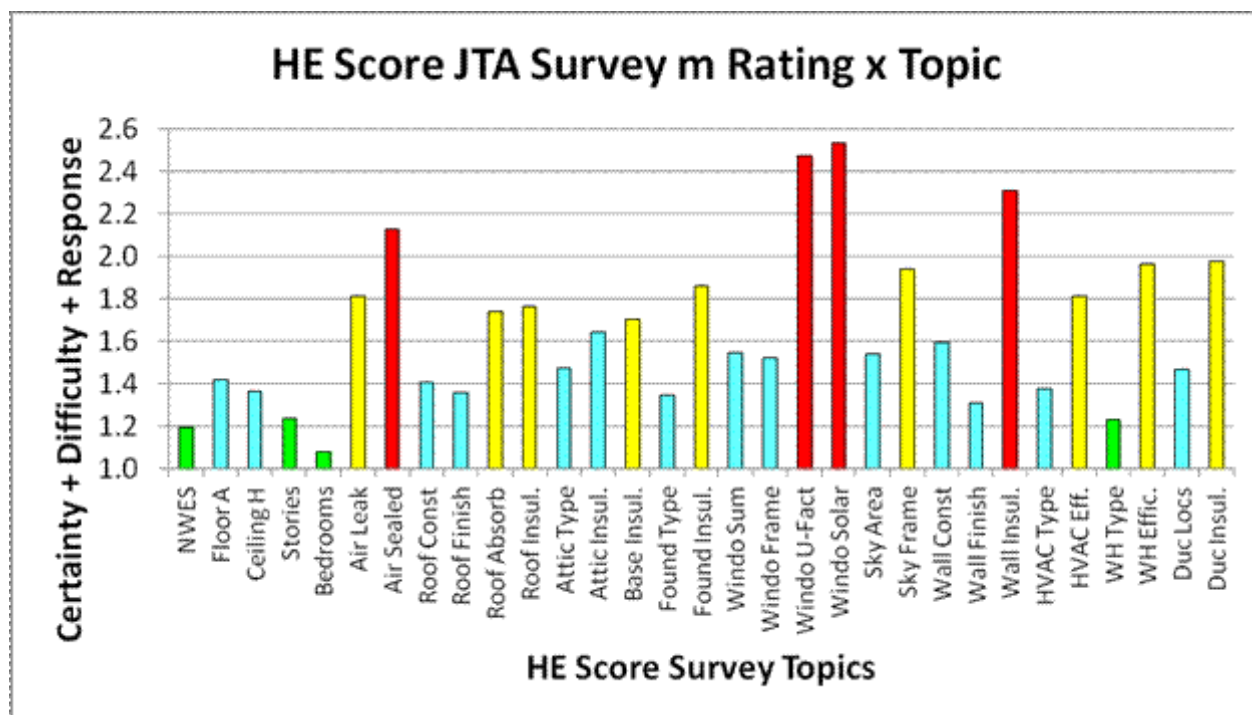
The weights and ratings for each rating group are shown below:

Rating	# Topics	Cum =	Weight	Weight
1.1	1	1	1	1
1.2	1	2	1	1
1.3	2	4	1	2
1.4	5	9	2	10
1.5	4	13	2	8
1.6	4	17	2	8

## Home Energy Score 3D Simulation: Training and Testing for Assessor Candidates

1.7	1	18	2	2
1.8	3	21	4	12
1.9	3	24	4	12
2.0	3	27	4	12
2.1	0	27	4	0
2.2	1	28	8	8
2.3	0	28	8	0
2.4	1	29	8	8
2.5	1	30	8	8
2.6	1	31	8	8
			<b>Total =</b>	<b>100</b>

The graph of all topics with their weightings is shown below.



Given the weights for each topic, the topics were grouped into content domains as shown in the table below.



## Home Energy Score 3D Simulation: Training and Testing for Assessor Candidates

Home Energy Score Job Task Analysis Content Groups & Weightings				
Domain	Short Topic	Mean Rating	Weight	Main Percent
<b>Structure</b>				<b>7%</b>
	NWES	1.19	1	
	Floor Area	1.41	2	
	Ceiling Height	1.36	2	
	Stories	1.24	1	
	Bedrooms	1.08	1	
<b>Air Seal</b>				<b>12%</b>
	Air Leak	1.81	4	
	Air Sealed	2.13	8	
<b>Roof</b>				<b>12%</b>
	Roof Construction	1.40	2	
	Roof Finish	1.36	2	
	Roof Absorbance	1.74	4	
	Roof Insulation	1.76	4	
<b>Attic &amp; Basement</b>				<b>14%</b>
	Attic Type	1.47	2	
	Attic Insulation	1.64	2	
	Base Insulation	1.70	4	
	Found Type	1.34	2	
	Found Insulation	1.86	4	
<b>Windows</b>				<b>20%</b>
	Window Sum	1.55	2	
	Window Frame	1.52	2	
	Window U-Fact	2.47	8	
	Window Solar	2.53	8	
<b>Skylight</b>				<b>6%</b>
	Skylight Area	1.54	2	
	Skylight Frame	1.94	4	
<b>Walls</b>				<b>12%</b>
	Wall Construction	1.59	2	
	Wall Finish	1.31	2	
	Wall Insulation	2.31	8	
<b>Equipment</b>				<b>11%</b>
	HVAC Type	1.38	2	
	HVAC Eff.	1.81	4	
	Water Heater Type	1.23	1	
	Water Heater Eff.	1.96	4	
<b>Ducts</b>				<b>6%</b>
	Duct Locations	1.47	2	
	Duct Insulation	1.97	4	
			<b>Total</b>	<b>100%</b>

## Survey Text

Following is the text of the survey that was administered to respondents:

How sure are you of the accuracy of your measures for these Home Energy Score variables?  
 Example: Sometimes I have no real way of seeing how much or what type of insulation is in the walls. I have a general guess because of the house construction type and age, but I am not overly confident in my estimate. Select "Not Very Sure."

<b>Sure</b>	<b>Somewhat Sure</b>	<b>Neutral</b>	<b>Not Very Sure</b>	<b>Unsure</b>	<b>N/A</b>
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How difficult is it to get measures for the following Home Energy Score variables? Example: I find it difficult to get the total conditioned floor area because many houses are oddly configured and it takes time. Mostly, I am still confident in my final result, but it is challenging to get it done. Select "Somewhat Difficult."

<b>Easy</b>	<b>Somewhat Easy</b>	<b>Neutral</b>	<b>Somewhat Difficult</b>	<b>Difficult</b>	<b>N/A</b>
-------------	----------------------	----------------	---------------------------	------------------	------------

Are the scoring choices offered good or inadequate for the following Home Energy Score variables?

<b>Completely Adequate</b>	<b>Somewhat Adequate</b>	<b>Neutral</b>	<b>Not Very Adequate</b>	<b>Inadequate</b>	<b>N/A</b>
----------------------------	--------------------------	----------------	--------------------------	-------------------	------------

For each of the above 3 sections, respondents were asked to rate each of the following variables:

- Orientation (N, NW, S, etc.)
- Conditioned Floor Area
- Ceiling Height
- Number of Stories above Grade
- Number of Bedrooms
- Air Leakage Rate
- Knowing if the house had been air sealed
- Roofing Construction
- Roofing Exterior Finish
- Roof absorption
- Roof insulation levels
- Attic type

## Home Energy Score 3D Simulation: Training and Testing for Assessor Candidates

Attic insulation  
Insulation over basement or crawlspace  
Foundation Type  
Foundation Insulation  
Window Area Summary  
Window Panes and Frame Types  
Window Area U-Factors  
Window Area Solar Heat Gain Coefficient  
Skylight Area  
Skylight Panes, Frame, Glazing  
Wall Construction  
Wall Exterior Finish  
Wall Insulation  
Heating/Cooling System Type  
HVAC Efficiency  
Water Heater Type  
Water Heater Efficiency  
Duct Locations  
Ducts Insulated and Air Sealed

### **What techniques do you use to calculate conditioned floor area?**

Tax records or other real estate documents  
Measure room by room  
Measure the outside dimensions of the house  
Interior -- longest length and width and break the house into rectangles  
Other (please specify)

### **What tools do you use to measure floor area? Check all that apply. - Tape measure**

Tape measure  
Laser distance meter  
Use documents -- no tool used  
Other (please specify)

### **How long have you rated Home Energy Scores?**

1 year or less  
2 - 3 years  
4-5 years  
5+ years

### **How many Home Energy Scores have you completed?**

none  
1-2

3-4

5 or more

**What home types have you rated? - Split Level**

Split Level

Single Story/Ranch

Two-Story House

More than Two-Story House

Condominium/Townhome

**Where were you trained to do Home Energy Scores?**

Home Energy Score Partner

Department of Energy

National Renewable Energy Laboratory

Self-taught

Other (please specify)

**How was your Home Energy Score training delivered?**

All Online

All Classroom

Blended Online, Classroom

Other (please specify)

**Was it a stand-alone class solely focused on Home Energy Score?**

Yes

No - Blended with other material

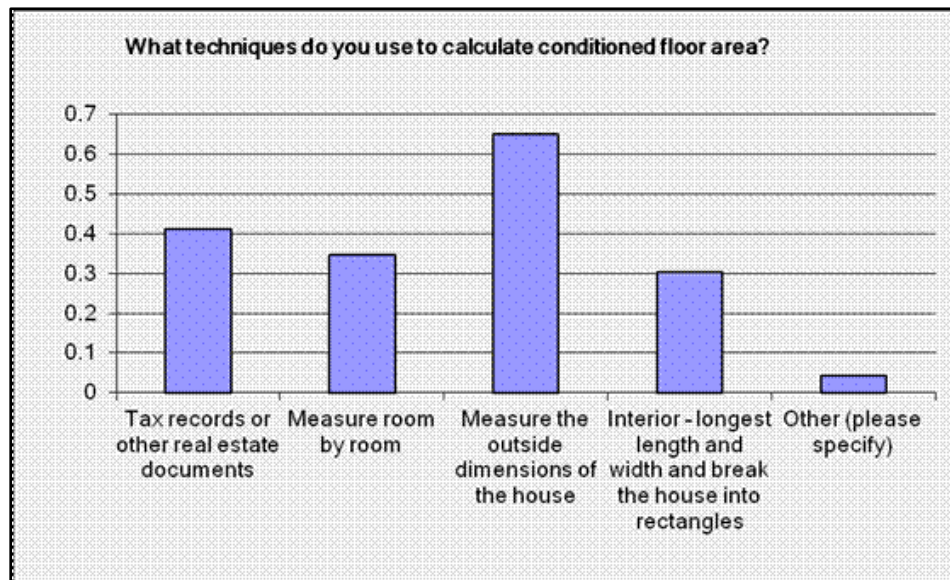
Other (please specify)

**Please enter any additional comments or feedback below:**

## Demographics

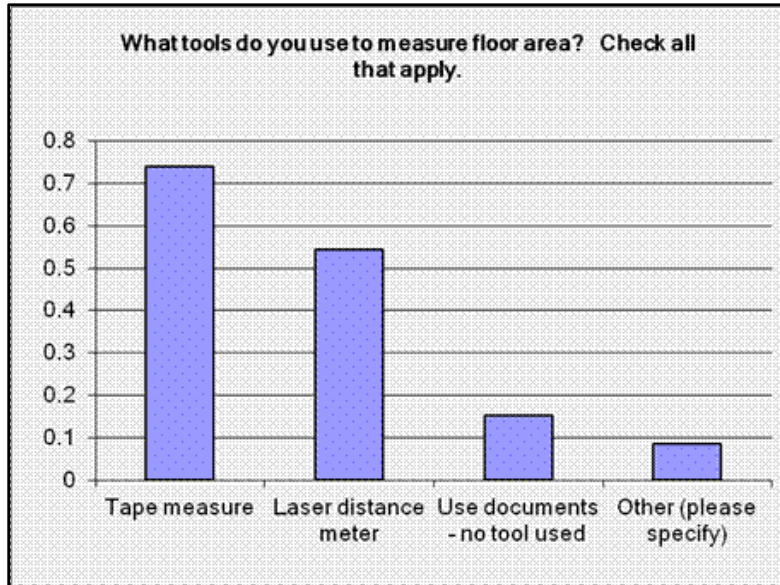
### Techniques to Calculate Conditioned Floor Area

What techniques do you use to calculate conditioned floor area?		
Answer Options	Response Percent	Response Count
Tax records or other real estate documents	41.3%	19
Measure room by room	34.8%	16
Measure the outside dimensions of the house	65.2%	30
Interior: Longest length and width; break the house into rectangles	30.4%	14
Other (please specify)	4.3%	2
<b><i>answered question</i></b>		<b>46</b>
<b><i>skipped question</i></b>		<b>5</b>



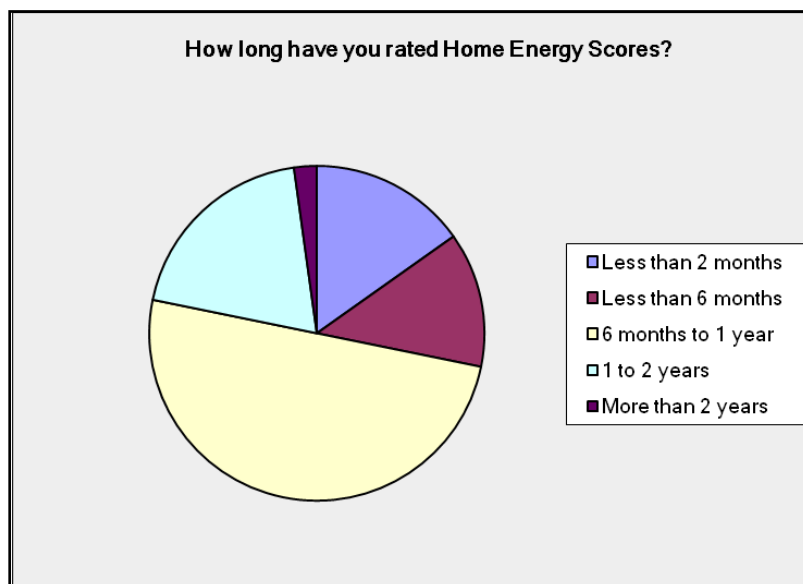
### What Tools Do You Use for Floor Area?

What tools do you use to measure floor area? Check all that apply.		
Answer Options	Response Percent	Response Count
Tape measure	73.9%	34
Laser distance meter	54.3%	25
Use documents – no tool used	15.2%	7
Other (please specify)	8.7%	4
<b><i>answered question</i></b>		<b>46</b>
<b><i>skipped question</i></b>		<b>5</b>
Measuring wheel		3
Rolotape		1



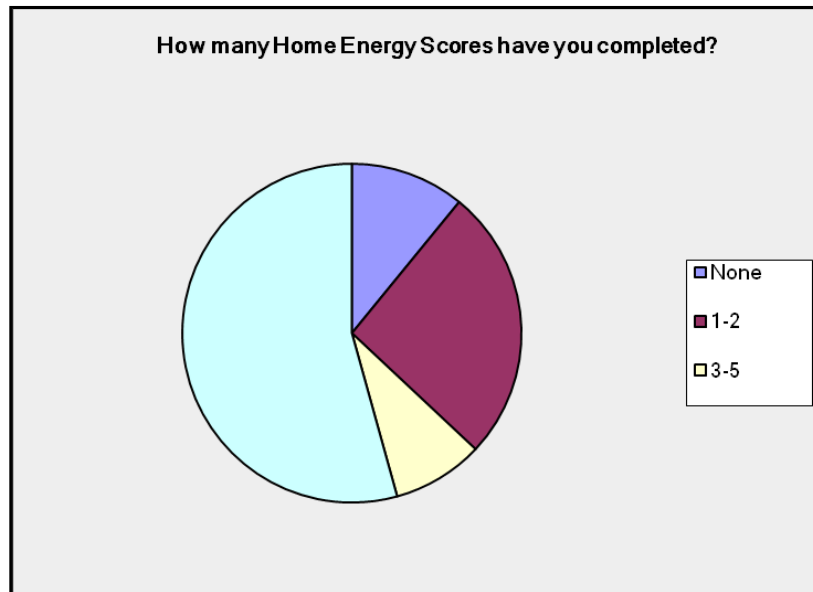
### How Long Have You Rated Homes?

How long have you rated Home Energy Scores?		
Answer Options	Response Percent	Response Count
Less than 2 months	15.2%	7
Less than 6 months	13.0%	6
6 months to 1 year	50.0%	23
1 to 2 years	19.6%	9
More than 2 years	2.2%	1
<i>answered question</i>		<b>46</b>
<i>skipped question</i>		<b>5</b>



### How Many Home Energy Scores Completed?

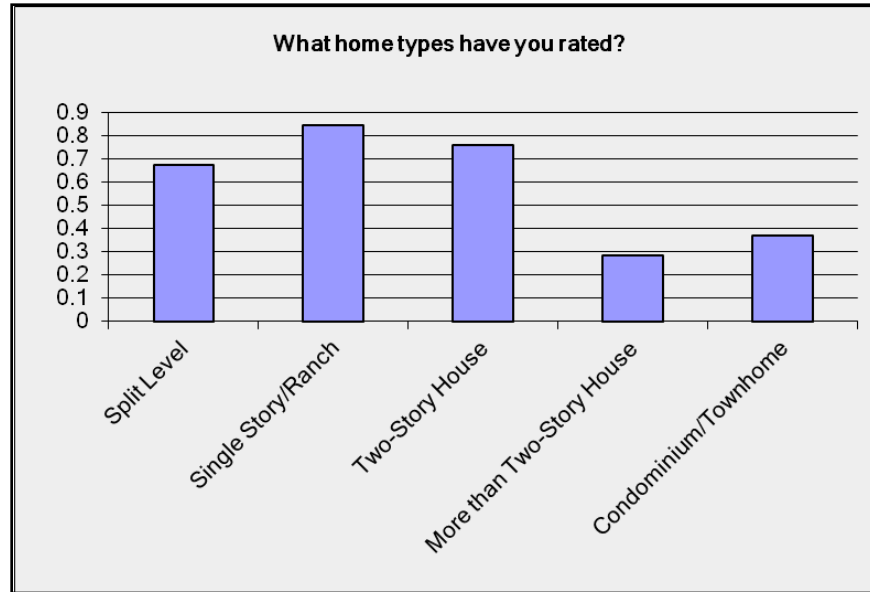
How many Home Energy Scores have you completed?		
Answer Options	Response Percent	Response Count
None	10.9%	5
1-2	26.1%	12
3-5	8.7%	4
More than 5	54.3%	25
<i>answered question</i>		<b>46</b>
<i>skipped question</i>		<b>5</b>



### What Home Types Have You Rated?

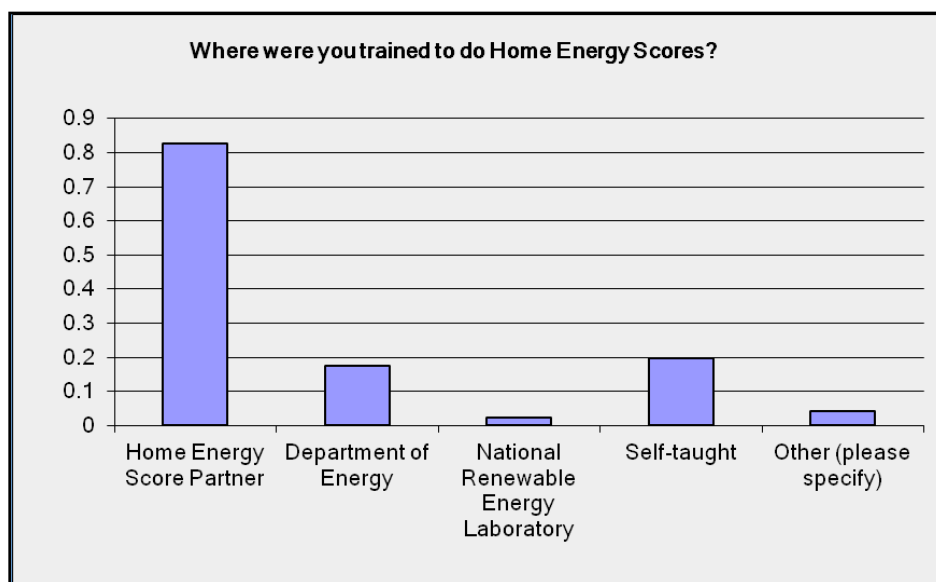
What home types have you rated?		
Answer Options	Response Percent	Response Count
Split Level	67.4%	31
Single Story/Ranch	84.8%	39
Two-Story House	76.1%	35
More than Two-Story House	28.3%	13
Condominium/Townhome	37.0%	17
<i>answered question</i>		<b>46</b>
<i>skipped question</i>		<b>5</b>

## Home Energy Score 3D Simulation: Training and Testing for Assessor Candidates



### Where Was Training Conducted?

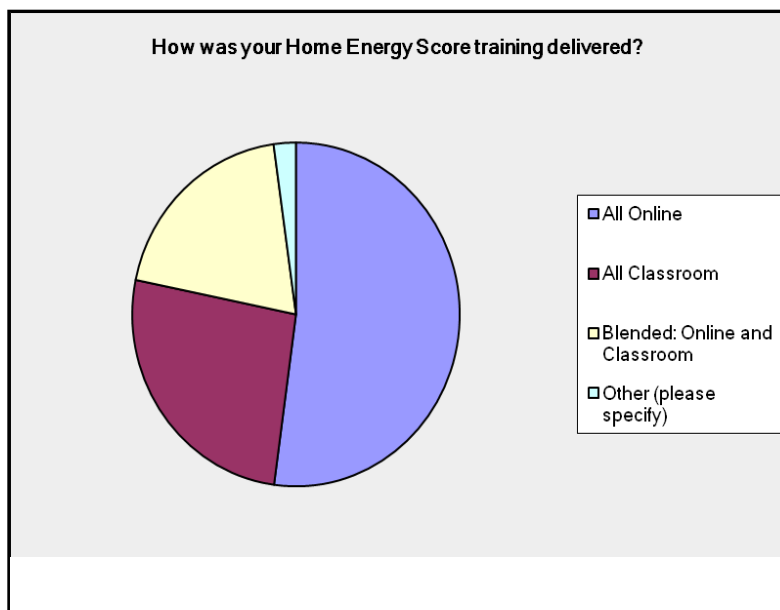
Where were you trained to do Home Energy Scores?		
Answer Options	Response Percent	Response Count
Home Energy Score Partner	82.6%	38
Department of Energy	17.4%	8
National Renewable Energy Laboratory	2.2%	1
Self-taught	19.6%	9
Other (please specify)	4.3%	2
<i>answered question</i>		<b>46</b>
<i>skipped question</i>		<b>5</b>





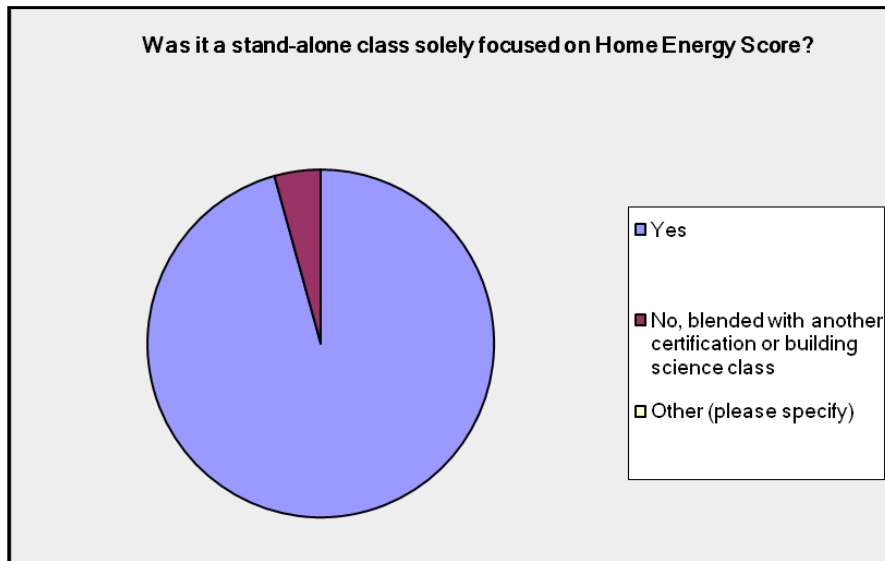
## How Was Training Delivered?

How was your Home Energy Score training delivered?		
Answer Options	Response Percent	Response Count
All Online	52.2%	24
All Classroom	26.1%	12
Blended: Online and Classroom	19.6%	9
Other (please specify)	2.2%	1
<b><i>answered question</i></b>		<b>46</b>
<b><i>skipped question</i></b>		<b>5</b>



### Stand-Alone Class?

Was it a stand-alone class solely focused on Home Energy Score?		
Answer Options	Response Percent	Response Count
Yes	95.7%	44
No, blended with another certification or building science class	4.3%	2
Other (please specify)	0.0%	0
<i>answered question</i>		<b>46</b>
<i>skipped question</i>		<b>5</b>



## Appendix B: Sample Materials<sup>1</sup> Used to Recruit and Communicate with Candidates in the Validation Study

### Candidates Wanted



The United States Department of Energy (DOE) currently relies on third-party professional certifications like yours as a prerequisite for individuals interested in becoming Home Energy Score Qualified Assessors. The Home Energy Score, developed and managed by DOE, allows consumers to quickly understand and compare the energy performance of their homes to others nationwide. Qualified Assessors collect information during a brief home walk-through and then use a standardized software tool to score homes on a 10-point scale, with a score of 10 indicating that the home exhibits excellent energy performance.

### 3D Immersive Simulation Training and Testing

The DOE Building Technologies Office is developing a 3D immersive simulation training and testing (3D sim) software program for Home Energy Score assessor candidates. The 3D sim uses computer-based simulations to recreate a range of jobsite scenarios.

- *Get ahead of your competitors by becoming a qualified HES assessor*
- *Add depth to your resume with a DOE backed qualification*
- *Free training and potential qualification at NO COST.\**

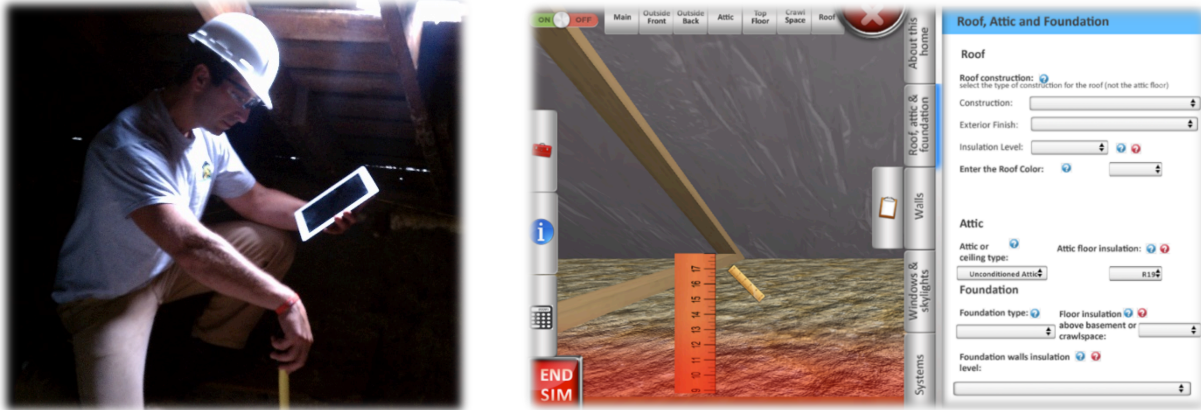
\*The Training and Testing will not be free in the future.



<sup>1</sup> Interplay Energy is now Interplay Learning

## Here's your chance!

DOE will validate this innovative 3D simulation approach to training and testing through a comprehensive, psychometrically-supported study. The study will ascertain whether simulation can deliver effective training and whether simulation testing can provide an accurate assessment of competency to deliver the Home Energy Score.



The Home Energy Score 3D Sim software features cutting-edge technology from Interplay Energy, the makers of the popular InterCAZ simulation. The simulation facilitates your career and learning demands through features like:

- Optimizing online access
- Focusing on procedural competencies
- Using First Person, Point-Of-View interaction
- Showcasing multiple scenario homes
- Representing a national cross section of homes & energy features
- 20-40 variables for each home align with inputs specific to the Home Energy Score

*If you are selected as a study participant you will be asked to commit to taking the training and testing associated with the study.*

To become a candidate for the Home Energy Score 3D Sim study, please register through the link below:

[www.ency.org/candidate-registration.html](http://www.ency.org/candidate-registration.html)

# Welcome

HES 3D Sim Orientation



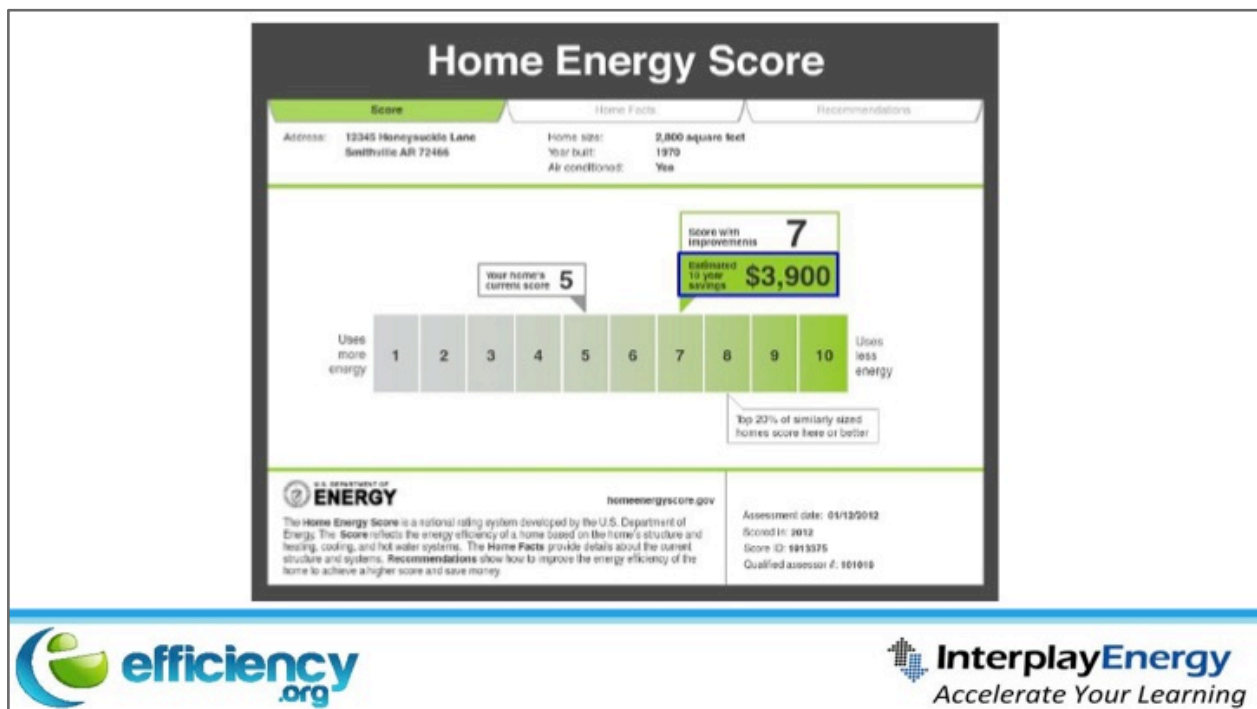
## Agenda

- Background information about the Home Energy Score
- Purpose behind the development of the 3D Training and Testing Simulation
- Demonstration of the 3D Sim
- Goals of the validation study
- Tasks associated with participation of the study
- Benefits for candidates in the study



## Home Energy Score Overview

- The Home Energy Score is similar to a vehicle's mile-per-gallon rating.
- The Home Energy Score allows homeowners to compare the energy performance of their homes to other homes nationwide.
- A Qualified Assessor then scores the home on a scale of 1 to 10.
  - A score of 10 indicates that the home has excellent energy performance.
  - A score of 1 indicates the home needs extensive energy improvements.
- Currently, it also provides homeowners with suggestions for improving their homes' efficiency.
- Developed by the Lawrence Berkeley National Laboratory.



## The Next Chapter

- Develop a new way to train and test Qualified Assessors
  - in as efficient and cost effective manner as possible
- Increase market share
  - committed to reaching out to adjacent stakeholder groups to broaden the exposure and business opportunities
- Create a ubiquitous tool and score to provide a consumer with information about the relative energy efficiency of their home or a home they wish to buy
- Develop a deployment vision for the Home Energy Score that will be integrated into the housing marketplace nation-wide, and
- Ultimately act as a catalyst to spur demand for energy efficiency upgrades.



## 3D Simulation

- Developed by Interplay Energy
  - uses computer-based simulations to recreate a range of jobsite scenarios
  - enables individuals to identify situation-specific solutions
- Demonstration of Simulation Tool from Interplay Energy



## Validation Study

- DOE will validate this innovative 3-D simulation approach to training and testing through a comprehensive, psychometrically-supported study.
- The study will ascertain whether simulation can deliver effective training and whether simulation testing can provide an accurate assessment of competency to deliver the Home Energy Score.
  - Identify a range of candidates with different existing skills and experience



## Study Candidate Requirements

As an aspiring assessor in the study, candidates are required to fulfill the following, while adhering to the terms of the signed Candidate Confidentially Agreement:

- Take both the Home Energy Score Written and Simulation tests, and if selected,
- Conduct HE Score evaluations of a maximum of three calibrated houses.





## Study Progression

- Take Written Beta Test
- Train and Test in the 3D Sim
- Do Home Energy Scores in Test Houses



## Online Written and Sim Tests

- All registered candidates are eligible for the on-line written and SIM tests;
  - **provided they have completed 1 scenario** within the tool,
  - submitted the results and **scored 80 or above**.
  - Only those candidates who have met this requirement **by February 27, 8pm EST** will be eligible to take the on-line tests.
- The dates for the written test and Sim scoring are set for a window of between **March 1-8**.
- Fifty percent of the candidates will perform the online Simulated Home Energy Score first, with the other set taking the online written test first.
  - Once completed they will move to the other component.
  - We will issue passwords for each candidate and attendant component within the instruction email.
- The written test will have 110 questions and must be completed within a 2 ½ hr. time limit.
- The 3D SIM test must be completed within a 2 hr. time limit.



## Online Testing Instructions

- **On March 1**, each candidate will receive an email with the rules of the test taking and instructions on how to access both the Home Energy Score written and SIM tests. Both tests must be taken within the **one week window between March 1-8**.
  - This instruction email will specify the order of the tests to be taken.
  - The candidate is expected to take the test alone and will not collaborate or work with anyone else on either test component.
  - **The order of test taking and distinct log-ins and passwords will be issued in the instruction email** so make sure you print that out and have it handy when you start the test taking process.
- As of **March 8, 5pm PST** the testing web sites will be closed.



## Candidates

- **Benefits:**
  - Free access to the HE Score web site for completion of assessments
  - Free immersive 3-D simulation training and testing.
  - Bring added value to your customers with a more robust and federally recognized score.
  - Train without losing time or cost for travel\*
  - Gain an edge over your competition with this certificate



# 3D Sim Walkthrough

Mr. Steve Quirk, Interplay Energy



# Question & Answer

