

**Track: Residential Natural Gas**  
**Unit #10: Understanding the HERS® Index and the impacts of Natural Gas Appliances**  
An overview of the Home Energy Rating System  
Eric Burgis, Energy Solutions Center

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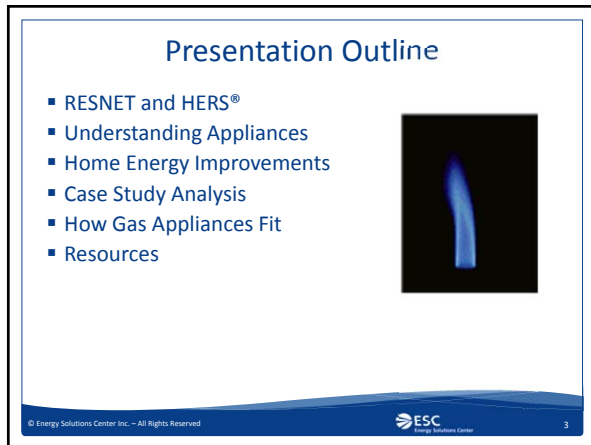
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**Presentation Outline**

- RESNET and HERS®
- Understanding Appliances
- Home Energy Improvements
- Case Study Analysis
- How Gas Appliances Fit
- Resources

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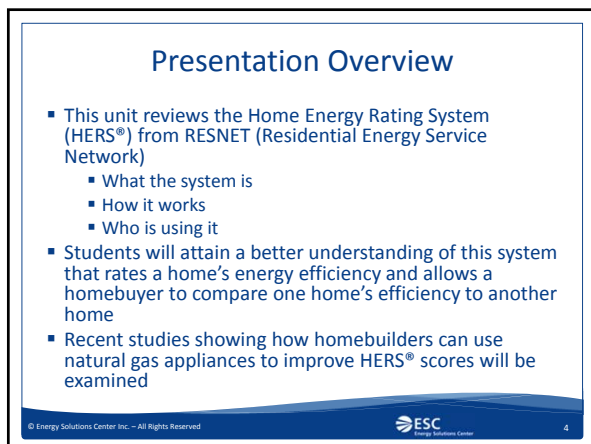
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**Presentation Overview**

- This unit reviews the Home Energy Rating System (HERS®) from RESNET (Residential Energy Service Network)
  - What the system is
  - How it works
  - Who is using it
- Students will attain a better understanding of this system that rates a home's energy efficiency and allows a homebuyer to compare one home's efficiency to another home
- Recent studies showing how homebuilders can use natural gas appliances to improve HERS® scores will be examined

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### Who Is RESNET

- An independent, non-profit organization committed to helping homeowners reduce the cost of their utility bills by making their homes more energy efficient
- RESNET is a recognized national standards-making body for building energy efficiency rating and certification systems in the U.S. involving:
  - A consensus based standard development and amendment process
  - Transparent review and adoption process
  - Formal public review and comment process



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### RESNET Standards

- RESNET's standards are recognized by a number of industry organizations and government bodies including:
  - Builders for marketing the energy performance of their homes
  - Contractors to tap the emerging retrofit market
  - Federal government agencies:
    - IRS for tax credit qualification
    - U.S. Environmental Protection Agency for ENERGY STAR labeled homes
    - U.S. Department of Energy for Building America and National Builders Challenge programs

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### Standards Development

- Interested parties can submit proposals for new or revised standards
- Proposal is reviewed by the appropriate RESNET Standing Committee, which will forward a recommendation to the Board of Directors to:
  - Accept the proposals as is
  - Accept with modification
  - Deny

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### Standards Development

- The standards provisions are posted on the RESNET website for public comment for a minimum of 30 days
- Public comments will be reconciled by the appropriate RESNET Standing Committee, with a recommendation to the RESNET Board of Directors
- The Board of Directors votes on the Standing Committee's recommendation

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### What is HERS®

- A nationally recognized system for inspecting and calculating a home's energy performance
- A standard by which a home's energy efficiency is measured
- Developed by the Residential Energy Services Network (RESNET)



<http://www.resnet.us/library/resnet-2-million-homes-infographic-2017/>

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### Which Builders are using the HERS Rating

- Partial list of Builders using HERS
  - Ashton Woods
  - Beazer
  - Centex
  - Del Webb
  - KB Homes
  - Lennar
  - Meritage
  - MHI McGuyer
  - Perry Homes
  - Pulte Homes
  - Richmond American Homes
  - Ryan Homes
  - Ryland Homes



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### How does the HERS® Index Work

- A certified Home Energy Rater assesses the energy efficiency of a home, assigning it a relative performance score
- The lower the number, the more energy efficient the home
- The U.S. Department of Energy has determined that a typical resale home scores 130 on the HERS® Index while a standard new home is awarded a rating of 100
  - A home with a HERS® Index Score of 70 is 30% more energy efficient than a standard new home
  - A home with a HERS® Index Score of 130 is 30% less energy efficient than a standard new home

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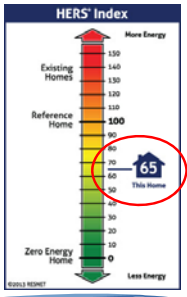
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### HERS Index Score

- A certified RESNET Home Energy Rater assesses the energy efficiency of a home, assigning it a relative performance score (HERS® Index)
- The lower the number, the more energy efficient the home
- The U.S. Department of Energy has determined that a typical resale home scores 130 on the HERS® Index while a new home built to Code is awarded a rating of 100



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### What Do the Numbers Mean

- HERS® Index functions as a MPG (miles-per-gallon) sticker for houses
- Informs homeowners about how their home compare to other similar ones when it comes to energy usage
- A lower HERS® Index Score signifies a more energy efficient home

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### Understanding the HERS Score

- HERS Index Score of 150
- This house is a WHOPPING 50% LESS ENERGY EFFICIENT than a standard new home! It could be a significant financial drain on the bank account and to the environment in general. A house like this has high energy bills and will be hot in the summer and cold in the winter. This homeowner should immediately be advised on what they can do to:
  - Improve their home's comfort level
  - Reduce their energy costs
  - Make their home more environmentally friendly

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### Understanding the HERS Score

- HERS Index Score of 100
- The home is at the same level as a standard new home, meeting the current industry standard for home energy efficiency. That doesn't mean the home is working at its optimal efficiency! There are still many energy saving measures that could be implemented to make the home much more energy efficient, resulting in a safer home environment, lower utility bills and a better effect on the environment.

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### Understanding the HERS Score

- HERS Index Score of 50
- This home is 50% more energy efficient than a standard new home and 80% more efficient than the average resale home
- There are still energy efficiency improvements that can be made, but they are no longer the low hanging fruit

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### Understanding the HERS Score

- HERS Index Score of 0 (Net Zero)
- This home is a Net Zero Energy Home. This means that this home produces as much energy through renewable resources, such as solar panels, as it consumes. Only a Net Zero Energy Home can score 0 on the RESNET HERS Index. Among the advantages of a Zero Energy Home are:
  - Improved health and comfort
  - Cost effective
  - Environmental sustainability

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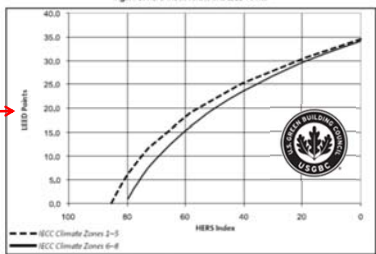
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### LEED Certification Uses the HERS Score Points awarded for Exceeding HERS index

Figure 2: HERS Index Values and LEED Points

The lower the HERS rating the more LEED points earned

→



South: LEED points =  $[(\text{Log}100 - \text{HERS Index}) / .024] - 48.3$   
 North: LEED points =  $[(\text{Log}100 - \text{HERS Index}) / .021] - 60.8$

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### What Variables are Considered

- All exterior walls (both above and below grade)
- Floors over unconditioned spaces (like garages or cellars)
- Ceilings and roofs
- Attics, foundations and crawlspaces
- Windows and doors, vents and ductwork
- HVAC system, water heating system, and your thermostat
- Air leakage of the home
- Leakage in the heating and cooling distribution system

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### Software Used to Calculate HERS Score

- REM/Rate™ is a user-friendly, yet highly sophisticated, residential energy analysis, code compliance and rating software developed specifically for the needs of HERS providers



<http://staging.remrate.com/>

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### Software Used to Calculate HERS Score

- EnergyGauge® is a family of user-friendly PC software tools that allow simple yet detailed performance-based analysis of building energy use and perform economic analysis of proposed energy improvements



<http://energygauge.com>

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### Other HERS Rating Software

- Ekotrope
  - [www.ekotrope.com](http://www.ekotrope.com)
- Right-Energy HERS
  - [www.wrightsoft.com](http://www.wrightsoft.com)

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### Understanding Appliances

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### Energy and Appliances

- Phantom Energy – electricity that is drawn from outlets by equipment that’s been switched off but still plugged in
- phantom energy can account for up to 15% or more of the total electricity used by electronics



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### Energy and Appliances

- Use Energy Efficient Products (ENERGY STAR)
  - In a typical American household, appliances account for 21 – 25% of the utility bill
  - One way to reduce this cost is by replacing older appliances with energy efficient ENERGY STAR models



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### Home Energy Efficiency

- Appliances
- Windows
- Lights
- Insulation
- Water heating
- Heating



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### Home Energy Efficiency

- Appliances
  - ENERGY STAR® qualified appliances are certified as being energy efficient and use 20 – 30% less energy than non ENERGY STAR models
- Windows
  - Windows can be responsible for anywhere from 10 – 25% of heating and cooling costs
  - Windows that aren't energy efficient are drafty in winter and let in too much hot air in summer

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### Home Energy Efficiency

- Lights
  - Replace 60-watt incandescent bulbs with 13-watt energy efficient CFLs (Compact Fluorescent Lamps)
  - Use 75% less energy than incandescent bulbs
  - Last 10 times longer than incandescent light bulbs
- Insulation
  - Reduce energy costs by up to 50% by properly insulating walls, crawlspaces, floors and garages
  - Ensure the home has the correct R-Value for the region

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### Insulation R Values

How Much Insulation Homes Need



Zone	Attic		Floor		Wall	
	Uninsulated Attic	Existing 3-4 inches of insulation	Uninsulated Floor	Uninsulated Wood-Frame Wall	Insulated Wood-Frame Wall	
1	R30 to R49	R25 to R30	R13	-	-	N/A
2	R30 to R49	R25 to R38	R19 to R19	-	-	-
3	R30 to R49	R25 to R38	R19 to R25	* and add R5 insulative wall sheathing beneath the new siding	-	-
4	R38 to R60	R38	R25 to R30	* and add R5 insulative wall sheathing beneath the new siding	-	-
5	R49 to R60	R38 to R49	R25 to R30	* and add R5 to R5 insulative wall sheathing beneath the new siding	-	-
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7						
8						

http://energy.gov/sites/prod/files/guide\_to\_home\_insulation.pdf  
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### Cost of Insulation

Material type	R-value	Cost per square foot	Cost per square foot per R-value
Fiberglass batt (3.5 - 12 inches thick)	13	\$0.20 to \$0.40	\$0.02
	30	\$0.60 to \$1.00	\$0.03
Loose fill such as fiberglass, cellulose, and mineral wool (8 - 23 inches thick)	30	\$0.45 to \$1.35	\$0.03
	50	\$0.75 to \$2.25	
Open cell polyurethane spray foam (3.5 inches thick)	12.6	\$1.70 to \$2.50	\$0.17
Closed cell polyurethane spray foam (1 inch thick)	6.5	\$1.30 to \$2.00	\$0.25
Expanded polystyrene foam board (1 inch thick)	3.8 - 4.4	\$0.20 to \$0.35	\$0.07
Extruded polystyrene foam board (1 inch thick)	5	\$0.40 to \$0.55	\$0.10
Polyisocyanurate foam board (1 inch thick)	6.5	\$0.60 to \$0.70	\$0.10

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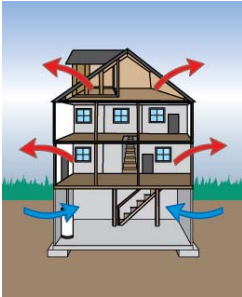
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### Infiltration Effects Energy Use



- **Forces of Infiltration**
  - Stack effect
  - Wind
  - Mechanical ventilation

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### Diagnostics, Blower Door



- **The blower door test**
  - Tests infiltration
  - Determines leak size
  - Measures air changes per hour
  - Identifies Ventilation Need

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### Water Heaters

Atmospheric	Direct Vent	High Efficiency	Tankless
			
Minimum .58 UEF, up to .72 UEF Atmospheric water heaters available	~.6 UEF	~.7 UEF, up to, 97 % efficient tank water heaters available	Min .81 UEF, to >= 98 % efficiency

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### Testing Duct Leakage

**Duct Blaster**

- Manuel D should be used for proper layout & sizing
- Ducts should be sealed with mastic
- The tightness of the ducts must be verified by a Rater
- A duct blaster is how the ducts are tested



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### EE Benefits & Credits

- Look for local or state tax credits or incentives for EE.
- Look for utility rebate programs for EE products.



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How to Get a  
HERS® Index Score

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### Obtaining a HERS® Home Energy Rating

- Contact a certified RESNET Home Energy Rater for a comprehensive HERS® rating evaluation
- The national average cost is \$450, and includes three site visits and diagnostic testing
- Use the RESNET website to locate a provider:
- <http://www.hersindex.com/get-a-home-energy-rating>



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### Accessing Public Information

- RESNET has created a National Registry that contains information on certified RESNET HERS Raters and Home Energy Ratings
- Rater Information available at:
  - <http://www1.resnet.us/registry/raters.aspx>
- Home HERS Index Information available at:
  - <http://www1.resnet.us/registry/home.aspx>

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Residential Builder Case Study

**RESNET**  
EnergySmart  
Builder

A HERS Rating & Energy  
Performance Comparison  
Externship Report

Barry Hallsted, Ph.D.  
Summer, 2014

UTAH VALLEY UNIVERSITY CLYDE INSTITUTE  
of CONSTRUCTION  
MANAGEMENT

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Purpose:

- Complete HERS Rating Requirements for RESNET HERS Rater Training
- Learn REM Rate software
- Learn BEOpt software and complete an analysis project
- Case study project provided by top national builder

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Project Home  
Bluffdale, Utah



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2012 IBC, 2006 IECC

1 <sup>st</sup> Floor	1091 ft <sup>2</sup>
2 <sup>nd</sup> Floor	<u>1311 ft<sup>2</sup></u>
<b>Finished:</b>	<b>2402 ft<sup>2</sup></b>
Unfinished Basement	<u>912 ft<sup>2</sup></u>
<b>Total Area:</b>	<b>3314 ft<sup>2</sup></b>
2-Car Garage	+503 ft <sup>2</sup>



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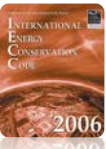
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**IECC vs. ENERGY STAR**




Home passed 2006 IECC Code



Home not designed for ENERGY STAR



ASK ABOUT ENERGY STAR CERTIFIED HOMES

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**2006 IECC Code Results**


Compliance: **Passes on equipment performance**  
Compliance: **0.1% Better Than Code**

**2009 IECC Code Results**

This home DOES NOT MEET the overall thermal performance requirements and verifications of the International Energy Conservation Code based on a climate zone of 5B. (Section 402, International Energy Conservation Code, 2009 edition.) In fact, this home is under the requirements by 17.2%.

**2012 IECC Code Results**

This home DOES NOT MEET the overall thermal performance requirements and verifications of the International Energy Conservation Code based on a climate zone of 5B. (Section 402, International Energy Conservation Code, 2012 edition.) In fact, this home is under the requirements by 25.5%.

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### HERS Scenario – Proposed Envelope

HERS Score Based on REScheck & Proposed Envelope Performance



Annual Energy Costs	\$/yr
Heating	421
Cooling	138
Water Heating	118
Lights & Appliances	653
Photovoltaics	-0
Service Charges	120
Total	1449
Average Monthly (\$/Month)	121

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### HERS Scenario – Actual Envelope

HERS Score Based on REScheck & Proposed Envelope Performance



Insulation installed per manufacturer specifications would save \$79 per year in heating and cooling and improve HERS score by 2 points!

Annual Energy Costs	\$/yr
Heating	496
Cooling	134
Water Heating	118
Lights & Appliances	653
Photovoltaics	-0
Service Charges	120
Total	1519
Average Monthly (\$/Month)	127

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### HERS Scenario Results

HERS Score Improvement Based on Insulation and Air/Vapor Retarder Installed Per Manufacturer's Specifications



HERS Score Improvement	2 Points	2.3%
Yearly Energy Savings	\$79	4.8%
Installation Cost Difference	\$120.10	(\$.05 per s.f.)
Simple Payback	1.7 Years	
Cost per HERS Point	\$60.05	

**Suggestion:**  
Modify Construction Documents to Indicate Manufacturer's Installation Specifications

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### Project Modification Considerations

- Use a 2 pipe venting system for the furnace
- Incorporate a condensing hot water heater (tank or tankless)
- Use direct outside air for combustion rather than drawing air from makeup air sources and/or air infiltration

SEE PHOTOS Next Slide

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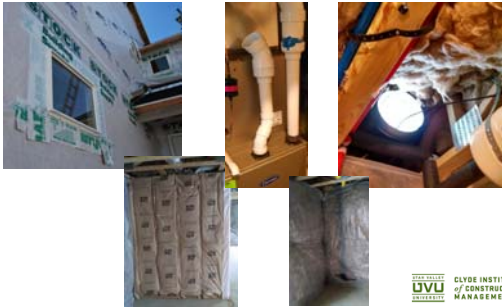
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### “Seal Tight, Ventilate Right”

ASHRAE Mantra



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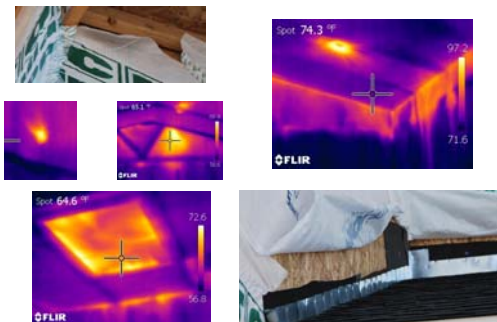
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### Actual IR Images from Case Study Home



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### Discussions with the Builders

- Indicated a lack of awareness regarding insulation specifications developed by the manufacturers
- Products can only reach the rated R-value if properly installed per specifications
- Proper install is called a “Grade I Installation” Homes under construction from this builder and most others visited in recent years would qualify as a Grade II or Grade III installation, which severely impacts the actual thermal performance

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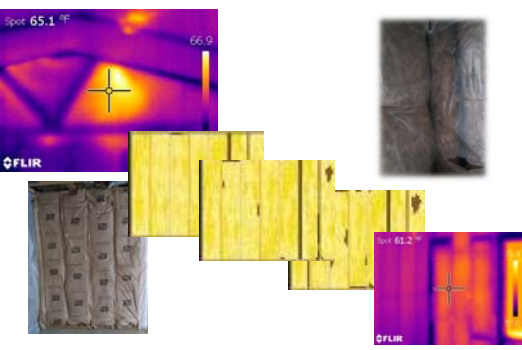
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### 2-HERS Points for Grade I Install



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### The EnergySmart Home Scale (E-Scale)

- Provided to homes that meet the Builders Challenge program requirements
- Visually shows the energy performance of the labeled home
- Homes need to score a 70 or less on the E-Scale to qualify for the Builders Challenge
- The E-Scale is based on the 2004 International Energy Conservation Code, with a 100 equating to a code built home
  - A home that scores a 70 on the E-Scale is 30% more energy efficient than a code built home.
- The E-Scale allows for an easy comparison between homes, very similar to a MPG sticker for a car but for a home

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### The EnergySmart Home Scale (E-Scale)

- Homes meeting the Challenge will receive an E-Scale with a Sunburst displaying the E-Scale rating of the home, enabling home buyers to easily compare the energy performance of homes
- The E-Scale ends at zero, which equates to the Builders Challenge goal to provide a “net zero energy home (NZEH) anywhere in the United States - a grid-connected home that, over the course of a year, produces as much energy as it uses”



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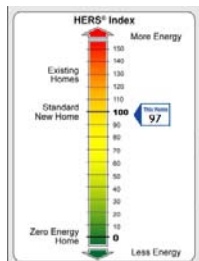
### Baseline HERS Score

HERS Score Based on Plans - All Electric Appliances & HVAC



#### Annual Energy Costs

	\$/yr
Heating	962
Cooking	135
Water Heating	345
Lights & Appliances	653
Photovoltaics	-0
Service Charges	-60
Total	2135
Average Monthly (\$/Month)	180



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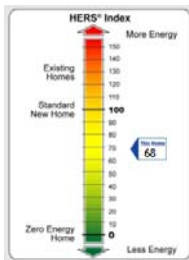
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### Modest Energy Upgrades w/ Gas

29 Point (42.6%) Improvement!



- Gas Dryer and Cooktop
- ENERGY STAR Washer\*
- Condensing Tankless WH
- 98% AFUE Furnace
- CFL Lighting\*
- Improved envelope installation & R15 batts

\* - Electric items

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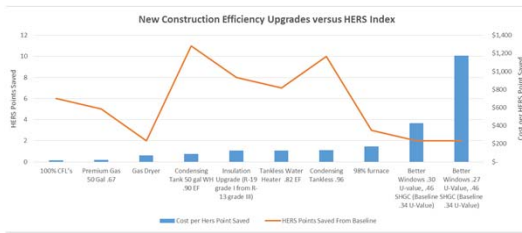
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### HERS Points & Cost Projections

- This chart shows a few energy efficiency upgrades available to consumers and the cost/benefit in relation to HERS point improvement or cost per HERS point saved



Upgrade	HERS Points Saved (Approx.)	Cost per HERS Point Saved (Approx.)
100% CFL's	6	\$100
Premium Gas Water	5	\$150
Gas Dryer	3	\$200
Condensing Tank 50 gal WH Upgrade to 1.9 Heater	11	\$1,000
Insulation R-13 Heated	8	\$250
Tankless Water Heater	7	\$300
Condensing Tankless WH	10	\$400
58% Airflow	3	\$500
Better Windows	4	\$600
Better Windows	10	\$1,000

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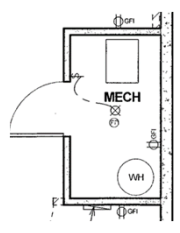
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### Electric WH Options

- Electric Water Heater**
  - 55 gal+ only heat pump WH's meet the mandatory 2015 standard
  - Mechanical room is 5x9x8 (360 C.F.F) but minimum space req. = 700 C.F.F.
  - 52-55 dB noise (Similar to Hair dryer)
  - HPWH is cooling ambient space while heating the water
  - Tank style heaters not yet available in 55 gal or less to meet new standard.
  - HPWH requires a condensation drain
  - Larger footprint & HPWH is much taller



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### Gas Water Heater Considerations

- Gas Water Heaters**
  - Many options currently available
  - Tankless has very small space requirement & unlimited hot water
    - All 2015 options meet ENERGY STAR standards
  - No changes to floor plan required
  - HERS score will see greatest improvement with condensing tank (.78-.80 EF) or tankless (.80-.98 EF) water heaters



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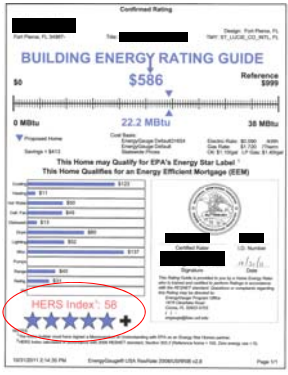
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### Rating Report

- ESC used a HERS rater to build a base model home in EnergyGauge®
- The same home was modeled in multiple regions
- Various models of water heaters and heating systems were reviewed and their impact on HERS rating documented



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### Water Heater & the HERS Index

General HERS points reduction example for various water heaters

Water Heater	EF	Energy	Southern Climate	Northern Climate
Standard Atmospheric Tank	.59	Gas	Base Model	Base Model
Direct Vent Tank	.62	Gas	Saves 1 Point	Save 2 Points
Power Vent Gas	.67	Gas	Saves 3 Points	Save 4 Points
H.E. Condensing Tank	.96	Gas	Saves 9 Points	Save 11 Points
Standard Tankless	.82	Gas	Save 6 Points	Save 7 Points
Condensing Tankless	.93	Gas	Save 8 Points	Save 9 Points
Solar with Gas Back-up	.59	Gas	Saves 9 Points	Save 13 Points
Standard Electric Tank	.90	Electric	Base Model	Base Model
H.E. Tank	.95	Electric	No Points	Save 1 Point

\*\* Comparison based on 2277 Ft² Home in Central Florida & MD

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### Heaters / Cooling & the HERS Index

General HERS points reduction example for various heating and cooling scenarios

Heater	Heating Efficiency	Cooling Efficiency	Energy	Southern Climate	Northern Climate
Standard Furnace/AC	80%	13 SEER	Gas	Base Model	Base Model
H.E. Heating/Cooling	90%	16 SEER	Gas	Saves 7 Points	Saves 6 Points
Ultra H.E. Heating/Cooling	95%	18 SEER	Gas	Saves 9 Points	Saves 8 Points
Electric Furnace (strip)		100 %	Electric	Base Model	Lose 9 Points
Standard Heat Pump		8.5 HSPF	Electric	No Gain	Base Model

\*\* Comparison based on 2277 Ft² Home in Central Florida & MD

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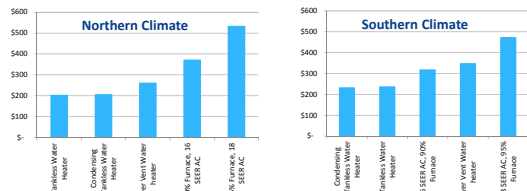
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### Cost of Energy Efficiency Upgrade per HERS Point Saved for Heating and Water Heating



- Standard and Condensing Tankless Water heaters appear to be the most cost effective way to reduce the HERS Score in warm or cold climates

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Tools & Resources

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**Web Resources**

- RESNET – Residential Energy Services Network
  - <http://www.resnet.us>
- U.S. Department of Energy
  - <http://energy.gov/energysaver/energy-saver>
- Energy Solutions Center
  - <http://escenter.org>
  - <http://naturalgasefficiency.org>

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**Thank you ...**

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