



Understanding the HERS® Index and the impacts of Natural Gas Appliances

An overview of the Home Energy Rating System

Rob DiVenere , Energy Solutions Center

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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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RESNET and HERS®

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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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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
 - U.S. Department of Housing and Urban Development (HUD) now recognizes HERS ratings as part of energy efficiency mortgage 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

CONTINUED



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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)
- Over 4 million homes rated



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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
 - Perry Homes
 - Pulte Homes
 - Richmond American Homes
 - Ryan Homes
 - Ryland Homes



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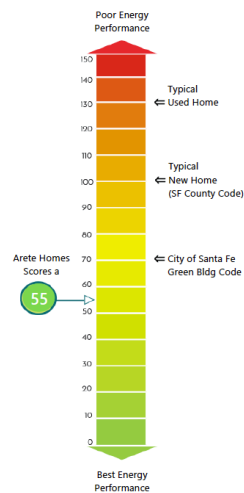
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How does the HERS® Index Work

- 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
- As of 2024, the average HERS Index Score for rated homes in the United States was 55, reflecting a 45% improvement in energy efficiency over a standard new home built to 2006 energy codes, which is benchmarked at a HERS score 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 100
- This house is a WHOPPING 45% 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 55
- The home is at the same level as a standard new home in 2025, 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 16
- This is the average HERS rating for a home that has solar panels in 2025
- This home is 71% more energy efficient than a standard new home and 84% 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

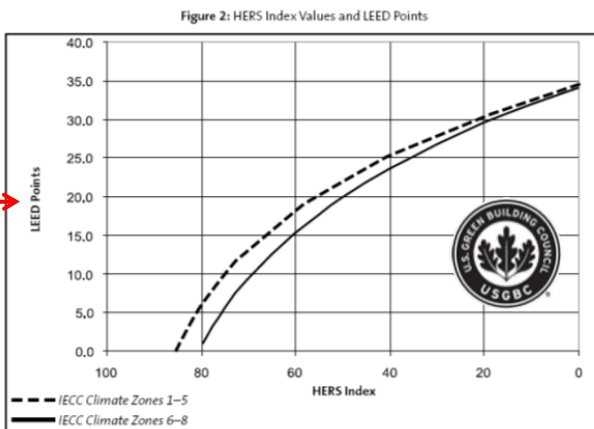


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LEED Certification Uses the HERS Score Points awarded for Exceeding HERS index

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
- Apex
 - www.pivotalenergysolutions.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 10% or more of the total residential electricity usage.



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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
 - ENERGY STAR® is a joint program of the Environmental Protection Agency (EPA) and the Department of Energy (DOE). Its goal is to help consumers, businesses, and industry save money and protect the environment through the adoption of energy-efficient products and practices. The ENERGY STAR label identifies top-performing, cost-effective products, homes, and buildings.



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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 10-50% 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
 - Replacing single-pane windows with ENERGY STAR certified ones can reduce household heating and cooling costs by up to 13% nationwide



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Home Energy Efficiency

- Lights
 - Replace 60-watt incandescent bulbs with LED fixtures
 - Uses 75% less energy than incandescent bulbs
 - Lasts 15-25% 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

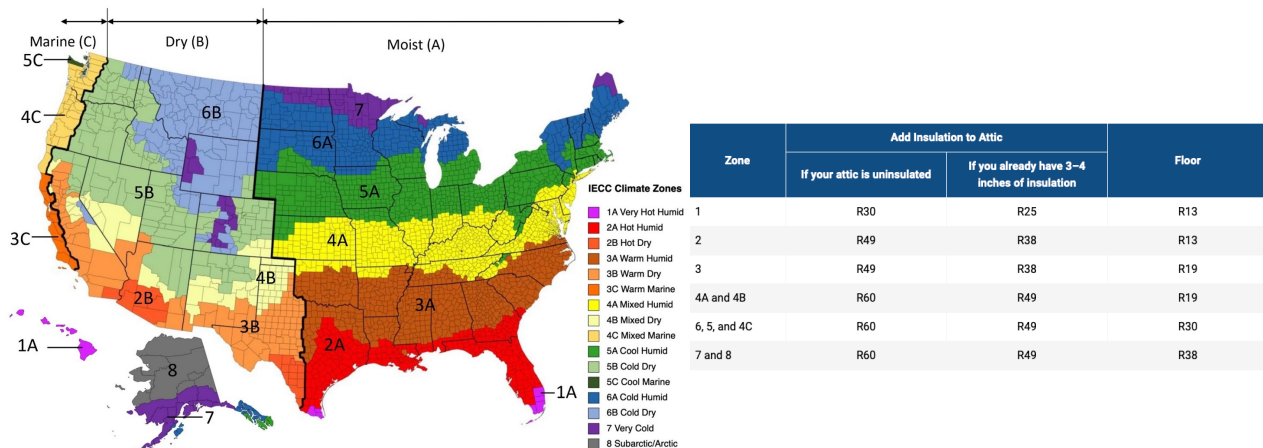


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Insulation R Values

How Much Insulation Homes Need



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Cost of Insulation

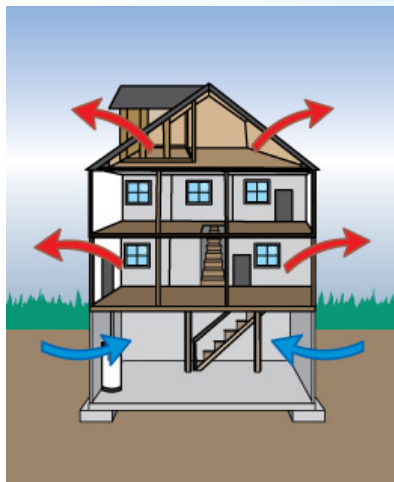
Insulation Type	R-Value (per inch)	Material Cost (per sq ft)
Fiberglass Batts or Rolls	3.1 - 3.4	\$0.40 - \$1.20
Cellulose	3.2 - 3.7	\$0.50 - \$1.50
Spray Foam (Open-Cell)	2.0 - 2.5	\$0.45 - \$0.75 (board foot)
Spray Foam (Closed-Cell)	5.0 - 6.0	\$1.00 - \$1.60 (board foot)
Rockwool	3.0 - 3.7	\$1.40 - \$2.10 (sq ft)
Mineral Wool	3.1 - 3.4	\$1.40 - \$4.00 (sq ft)
Rigid Foam Board	4.5 - 6.5	\$2.00 - \$4.00 (sq ft)



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Infiltration Effects Energy Use



- **Forces of Infiltration**
 - Stack affect
 - 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
Tankless



Minimum .58 UEF, up to .72
UEF Atmospheric water
heaters available

Direct Vent



~.6 UEF

High Efficiency



~.7 UEF, up to, 97 % efficient
tank water heaters available



Min .81 UEF,
to >= 98 % efficiency



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Energy Star Criteria - UEF



ENERGY STAR Version 5.0 Criteria for Residential Water Heaters (2025)

Water Heater Type	Tank Volume	Draw Pattern	Minimum UEF / SUEF	Additional Requirements
Gas-Fired Storage	≥ 20 to ≤ 55	Medium	≥ 0,81	First-Hour Rating ≥ 6 years *
	Any	High	≥ 0,86	Safety ≤ 6 years *
Electric Heat Pump (integrated)	Any	UEF	≥ 3,30	Max, GPM ≥ 2,8 over 67°F rise, Warranty ≥ 8 years on UL 174 and UL 1835 or UL 60335-2-40
Electric Heat Pump (120 V / 15A)	Any	UEF	≥ 2,20	Warranty ≥ 10 years collector, 6 years on sealed system, 2 years or controls, 1 year on parts
Electric Heat Pump (120 V / 15A)	Any	SUEF	3,00 (electric backup)	Certification: OG-300 for residential solar water heating systems with backup water heater
Solar Water Heaters	Any	UEF	≥ 1,80	
Residential-Duty Commercial Gas	Any	UEF	≥ 0,86	



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Furnace / Boiler Efficiencies



- Standard furnace = 82%
- Condensing furnace ≥ 97%
- Standard boiler = 82%
- Condensing Boiler ~ 98%



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Testing Duct Leakage

Duct Blaster

- Manual 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:
- <https://www.hersindex.com/find-a-hers-rater/>

State	Area	Company	Name
This directory is not a listing of all certified HERS® Raters but rather the Home Energy Rating companies that are members of RESNET. To determine if a HERS® Rater or a Rating Field Inspector (RFI) is certified go to Verify Whether a HERS® Rater or Rating Field Inspector is in good standing with RESNET. Select a State ▼ Find a HERS® Rating Company Member			

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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Case Study

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Residential Builder Case Study



A HERS Rating & Energy Performance Comparison Externship Report

Barry Hallsted, Ph.D.

Summer, 2014



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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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Project Specifications



2012 IBC, 2006 IECC

1 st Floor	1091 ft ²
2 nd Floor	<u>1311 ft²</u>
Finished:	2402 ft²
Unfinished	
Basement	<u>912 ft²</u>
Total Area:	3314 ft²
2-Car Garage	+503 ft ²



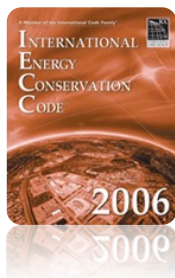
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IECC vs. ENERGY STAR



Home passed 2006 IECC
Code

Home not designed for
ENERGY STAR



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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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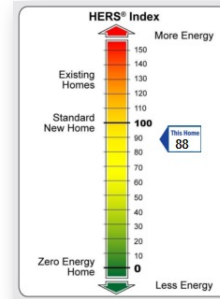
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HERS Scenario – Proposed Envelope

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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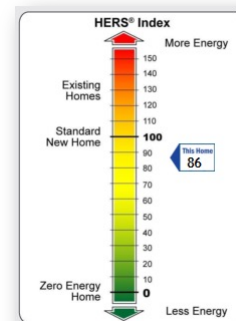
HERS Scenario – Actual Envelope

HERS Score Based on REScheck & Proposed Envelope Performance



Insulation installed per manufacturers 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	(\$0.05 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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“Seal Tight, Ventilate Right”

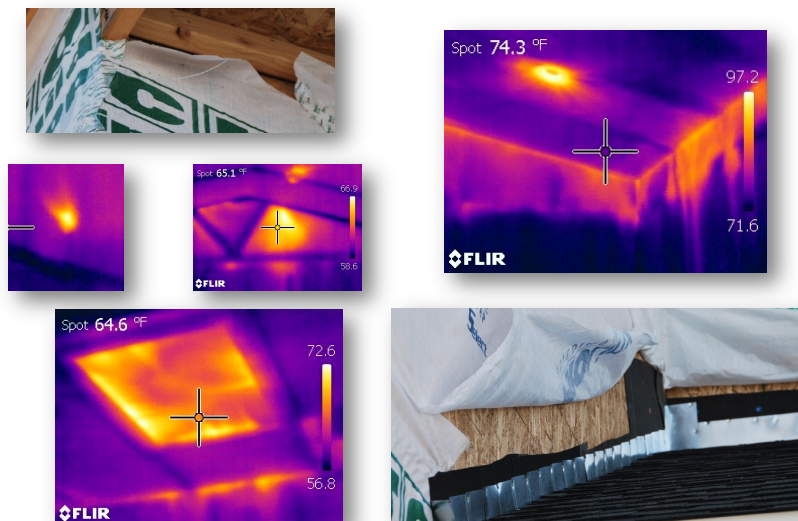
ASHRAE Mantra



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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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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

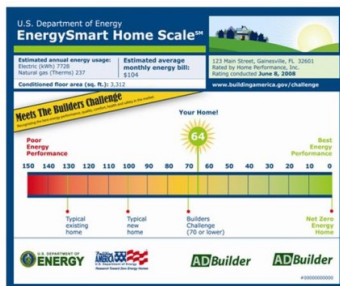


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The EnergySmart Home Scale (E-Scale)

- 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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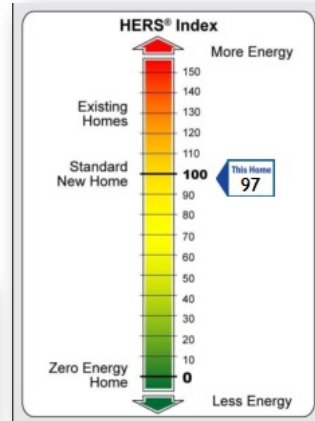
Baseline HERS Score

HERS Score Based on Plans - All Electric Appliances & HVAC



Annual Energy Costs

	\$/yr
Heating	962
Cooling	135
Water Heating	345
Lights & Appliances	653
Photovoltaics	-0
Service Charges	60
Total	2155
Average Monthly(\$/Month)	180

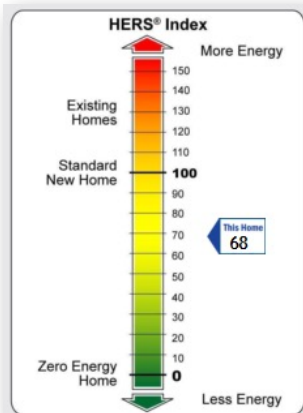


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Modest Energy Upgrades w/ Gas

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

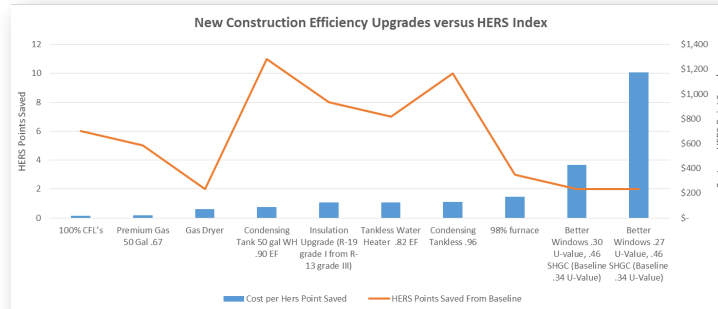


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HERS Points & Cost Projections

- 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

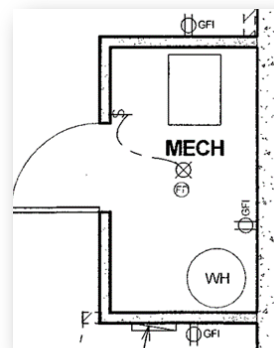


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Electric WH Options

- 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.
 - 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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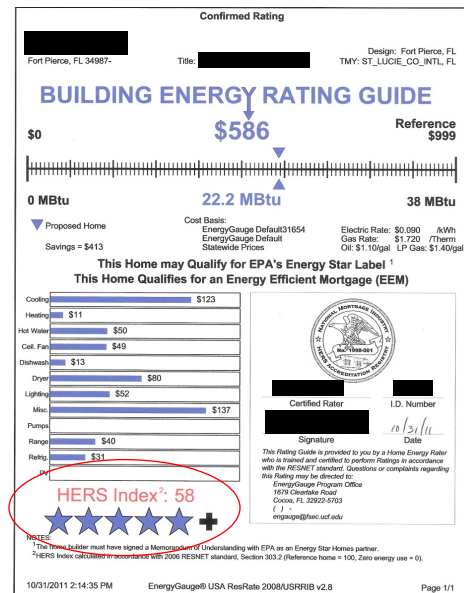
How Gas Appliances Fit



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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

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

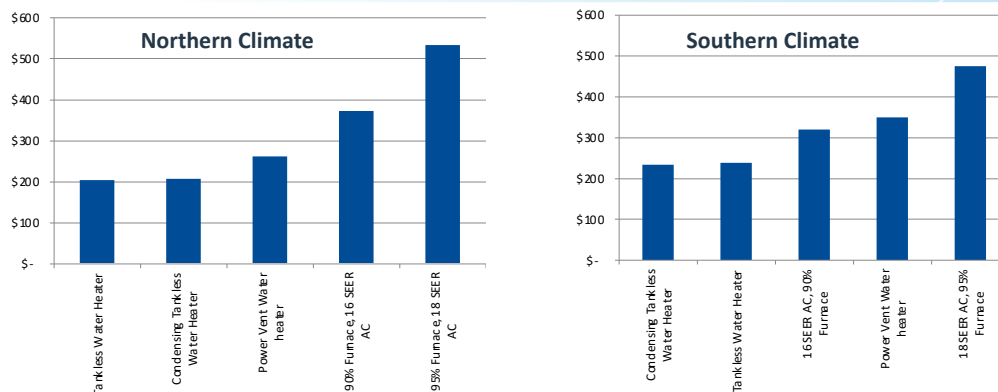
**Comparison based on 2277 Ft² Home in Central Florida & MD



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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 and 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

Consider taking the on-line test while
course material is fresh in your mind



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