The HERS Associate and Taking the Performance Path
Module 3 – Demystifying Energy Modeling

Presented by:
Mike Barcik

Southface

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For over 35 years, EEBA has provided the most trusted resources for building science information and education in the construction industry. EEBA delivers turn-key educational resources and events designed to transform residential construction practices through high performance design, marketing, materials, and technologies. Through our educational events, annual Summit and various publications and resources, EEBA reaches thousands of key decision makers and other important industry players each year.
Introductions

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• mikeb@southface.org

About Southface

• Building a Regenerative Economy, Responsible Resource Use & Social Equity Through a Healthy Built Environment for All
www.southface.org
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Module Learning Objectives

• Review the basic energy equations
• Differentiate between a UA trade-off, load calc and a simulation
• What happens when an energy model simulates
• Review tools that can perform energy modeling
• See example modeling results to achieve a target index
The house as a system

A house is a system made up of interrelated parts:

- The site and neighboring homes
- The weather barrier
- The building thermal envelope
- Space conditioning
- Ventilation
- Lighting & appliances & plumbing

- All efficiency measures should take occupants into account (e.g., air sealing & ventilation)

Building Science:

- Employ scientific principles from a variety of fields that govern building performance
- Optimize building performance and understand, predict, prevent and correct building failures
- Systems approach to houses
- Physics of:
  - **Heat:** Flows from hot to cold
  - **Air:** Flows from high pressure to low
  - **Moisture:** Flows from wet to dry (liquid and vapor)

A. Hot-Humid
B. Mixed-Humid
C. Cold & Colder
D. Hot-Dry
E. Mixed-Dry
F. Marine
Question 1

With a full set of plans and complete specifications, how long does it take to create and run an energy model?

• A. < 20 minutes
• B. Between 30 to 90 minutes
• C. At least 2 hours

Convection Heat Flow

• Heat transfer through a fluid (liquid or gas) – usually air. For air, the formula for calculating convective heat transfer is

\[ q = 1.08 \times CFM \times \Delta T \]

= convective heat flow (Btu/hr)

• CFM = Cubic Feet per Minute of air being transported
• \( \Delta T \) = temperature difference of entering air and ambient air (°F)

Example:
A supply fan delivers 50 cfm of OA into a 75°F home when the ambient is 90°F. Sensible heat added is \( q = 1.08 \times 50 \times (15) = 810 \) Btu / hr
Conduction Heat Flow – Recap

• Heat transfer through a solid object: the formula for calculating transmission heat loss is:

\[ q = U \times A \times \Delta T \]

• \( q \) = heat flow (Btu/hr)
• \( U \) = inverse of R-Value \([U=1/R, \, R=1/U]\) (Btu/hr ft²°F)
  U is referred to as the Conductance or Thermal Transmittance
• \( A \) = area (square feet)
• \( \Delta T \) = temperature difference across component (°F)

Net Wall Area Example

\[ q = U \times A \times \Delta T \]

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>U</th>
<th>Area</th>
<th>Delta T</th>
<th>q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall</td>
<td>13</td>
<td>.077</td>
<td>280</td>
<td>20</td>
<td>4318 Btu/hr</td>
</tr>
<tr>
<td>Door</td>
<td>2</td>
<td>.5</td>
<td>20</td>
<td>20</td>
<td>2008 Btu/hr</td>
</tr>
<tr>
<td>Window</td>
<td>.55</td>
<td>60</td>
<td>20</td>
<td>20</td>
<td>660 Btu/hr</td>
</tr>
</tbody>
</table>

\[(1/13) \times 360 \times 20 = 554\]
### HVAC Sizing & Selection Process

- **ACCA Manual J & S** are the code required methods used to size and select heating & cooling equipment
- **Manual J** – used to determine heating & cooling loads of home
- **Manual S** – used to select equipment based upon **Manual J**

#### Net Wall Area Example

Net Wall Area Example

<table>
<thead>
<tr>
<th></th>
<th>R</th>
<th>U</th>
<th>Area</th>
<th>Delta T</th>
<th>q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall</td>
<td>13</td>
<td>0.077</td>
<td>280</td>
<td>20</td>
<td>431 Btu/hr</td>
</tr>
<tr>
<td>Door</td>
<td>2</td>
<td>0.5</td>
<td>20</td>
<td>20</td>
<td>200 Btu/hr</td>
</tr>
<tr>
<td>Window</td>
<td>0.55</td>
<td>60</td>
<td>20</td>
<td>1291 Btu/hr</td>
<td></td>
</tr>
</tbody>
</table>

}\[ U_{\text{avg}} = \frac{U_1 \times A_1 + U_2 \times A_2 + U_3 \times A_3}{A_{\text{total}}} \]

\[ U_{\text{avg}} = 0.077 \times 280 + 0.5 \times 20 + 0.55 \times 60 \]

\[ U_{\text{avg}} = 0.1793 \quad R = 5.6 \]

**Door** is 2 s.f.  
**Walls** are **R = 13**  
**U = 0.55**  
**U = 0.55**  
95°  

\[ 20 \times 25' \]  

\[ 9' \]  

\[ 15' \]  

\[ 5' \times 6' \]  

\[ 5' \times 6' \]  

\[ U = 0.55 \]  

\[ U = 0.55 \]  

\[ 280 \text{ Btu/hr} \]  

\[ 200 \text{ Btu/hr} \]  

\[ 660 \text{ Btu/hr} \]  

\[ 1291 \text{ Btu/hr} \]
How Does Manual J work?

- Location
- Orientation
- Envelope
- Duct & envelope tightness
- Internal gains
- Ventilation

Climate and Energy Efficiency

**Design Temperatures**
- Heating, for 99% of the season the outdoor temperature is above this value
- Only 1% of the Cooling season is hotter than this temperature

**Design Temp Example**
- Atlanta Winter 70 – 24 = 46°F ΔT
- Atlanta Summer 92 – 75 = 17°F ΔT

**Load Calcs & Energy Code**
- IECC 2009 Section 302.1: Interior design temperatures (72°F heating, 75°F cooling)
- “Heating and cooling equipment shall be sized in accordance with Section M1401.3”
- “Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.” - 2015/18 IECC R403.7
Manual J - Winter Loads

- Winter Outdoor Design Temp
  - 24°F

- Indoor Design Temp
  - 70°F

Manual J - Summer Loads

- Summer Outdoor Design Temp
  - 92°F

- Summer Outdoor Design Temp
  - 75°F, 50% RH
Manual J – Load Calculations

Load calcs are required, but there are no details about who is qualified to perform them.
Enforcement varies greatly!!

Winter Outdoor Design Temp

Summer Outdoor Design Temp

Manual J Software

1 ton = 12,000 Btu/hr

Why is sizing important?
- Equipment first-cost
- Longer/more efficient run times
- Limits equipment cycling
- Better dehumidification
Common Problems with Manual J Inputs

- Manual Js are often not correct – both intentionally & unintentionally
- The results of a Manual J are only as meaningful as the input data ("GIGO")
- Several common input errors are often found
  - Design temperatures
  - Building orientation
  - Number of occupants
  - Window area, U-value, Solar Gain
  - Air leakage

Installed AC units

*Tons Oversized*

<table>
<thead>
<tr>
<th>Tons Oversized</th>
<th># of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.5</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>0.5</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>1.5</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>2.5</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>3.5</td>
<td>2</td>
</tr>
</tbody>
</table>

MO Equipment Sizing Study
The new ERI path gives the most design flexibility – such as credit for mechanical equipment efficiency
- It also credits items not covered by the code (e.g., appliance efficiencies)
### The 2015/18 IECC: Prescriptive R-value Table

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>GLAZED FENESTRATION SHGC</th>
<th>CEILING R-VALUE</th>
<th>WOOD FRAME WALL R-VALUE</th>
<th>MASS WALL R-VALUE</th>
<th>FLOOR R-VALUE</th>
<th>BASEMENT WALL R-VALUE</th>
<th>SLAB R-VALUE</th>
<th>CRAWL SPACE WALL R-VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NR</td>
<td>0.75</td>
<td>0.25</td>
<td>30</td>
<td>13</td>
<td>3/4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.25</td>
<td>38</td>
<td>13</td>
<td>4/6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.35</td>
<td>0.55</td>
<td>0.55</td>
<td>38</td>
<td>13</td>
<td>4/6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.35</td>
<td>0.55</td>
<td>0.40</td>
<td>40</td>
<td>20 or 13+5</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10.2 ft</td>
<td>10.3 ft</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>40</td>
<td>20 or 13+5</td>
<td>8/13</td>
<td>19</td>
<td>10/13</td>
<td>10.2 ft</td>
<td>10.3 ft</td>
</tr>
<tr>
<td>6</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>40</td>
<td>20+5 or 13+10</td>
<td>15/20</td>
<td>19</td>
<td>10/13</td>
<td>10.4 ft</td>
<td>10.3 ft</td>
</tr>
<tr>
<td>7 and 8</td>
<td>0.32</td>
<td>0.55</td>
<td>NR</td>
<td>40</td>
<td>20+5 or 13+10</td>
<td>15/20</td>
<td>19</td>
<td>10/13</td>
<td>10.4 ft</td>
<td>10.3 ft</td>
</tr>
</tbody>
</table>

Only changes in 2018 code

### Fill in the prescriptive code R-values

Determine Climate Zone

- **Uninsulated Flat ceiling**
- **Insulated roofline**
- **Attic**
- **3rd Floor**
- **2nd Floor**
- **1st Floor**
- **Crawlspace**
- **Garage**
- **Cond Basement**
Prescriptive code R-values
Climate Zone 2

Example: Climate Zone 5A

- 1st Floor: R-13
- 2nd Floor: R-20
- 3rd Floor: R-49
- Attic: R-20
- Uninsulated Flat ceiling
- Insulated roofline
- Exterior Wall: R-20
- Cantilever Floor: R-30
- Exterior Wall: R-20
- Flat Ceiling: R-20
- Third floor: Insulated roofline
- 2nd Floor: R-20
- 1st Floor: R-20
- Exterior Wall: R-20
- Conditioned Slab: R-10, 2 ft
- Exterior Wall: R-13
- Flat Ceiling: R-13
- Attic: R-13
- Window: U-0.32/.30 SHGC-NR
- 16. Window: U-0.40 SHGC-0.25
- 15. Conditioned Slab: R-0
The 2015/18 IECC: Prescriptive Ufactor Table

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR</th>
<th>SKYLIGHT U-FACTOR</th>
<th>CEILING U-FACTOR</th>
<th>FRAME WALL U-FACTOR</th>
<th>MASS WALL U-FACTOR</th>
<th>FLOOR U-FACTOR</th>
<th>BASEMENT WALL U-FACTOR</th>
<th>CRAWL SPACE WALL U-FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.50</td>
<td>0.75</td>
<td>0.035</td>
<td>0.084</td>
<td>0.197</td>
<td>0.064</td>
<td>0.360</td>
<td>0.477</td>
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<tr>
<td>2</td>
<td>0.40</td>
<td>0.65</td>
<td>0.030</td>
<td>0.060</td>
<td>0.098</td>
<td>0.047</td>
<td>0.059</td>
<td>0.065</td>
</tr>
<tr>
<td>3</td>
<td>0.35 0.32</td>
<td>0.55</td>
<td>0.026</td>
<td>0.080</td>
<td>0.098</td>
<td>0.047</td>
<td>0.059</td>
<td>0.065</td>
</tr>
<tr>
<td>4 except Marine</td>
<td>0.35 0.32</td>
<td>0.55</td>
<td>0.026</td>
<td>0.080</td>
<td>0.098</td>
<td>0.047</td>
<td>0.059</td>
<td>0.065</td>
</tr>
<tr>
<td>5 and Marine 4</td>
<td>0.32 0.30</td>
<td>0.55</td>
<td>0.026</td>
<td>0.045</td>
<td>0.060</td>
<td>0.033</td>
<td>0.050</td>
<td>0.055</td>
</tr>
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<td>6</td>
<td>0.32 0.30</td>
<td>0.55</td>
<td>0.026</td>
<td>0.045</td>
<td>0.060</td>
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<td>0.050</td>
<td>0.055</td>
</tr>
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<td>7 and 8</td>
<td>0.32 0.30</td>
<td>0.55</td>
<td>0.026</td>
<td>0.045</td>
<td>0.057</td>
<td>0.028</td>
<td>0.050</td>
<td>0.055</td>
</tr>
</tbody>
</table>

Only changes in 2018 code

UA Analysis

- The UA for a house is determined by the surfaces and the amount of insulation
- Against a version of the house built exactly to the U-factor prescriptive code, the as-built or as-proposed version can be compared
- As long as the proposed UA is no worse than the code UA, the envelope is in compliance

www.southface.org

2020 Georgia Energy Code Resources

<table>
<thead>
<tr>
<th>Energy Code Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020 Georgia Energy Code Overview and Certificate</td>
</tr>
<tr>
<td>2020 Southface Presentation Slides Georgia Residential Energy Code</td>
</tr>
<tr>
<td>2020 Georgia Supplements and Amendments</td>
</tr>
<tr>
<td>Appendix IIA Air Sealing and Insulation Key Points</td>
</tr>
<tr>
<td>2015 IECC Excerpt, Chap4</td>
</tr>
</tbody>
</table>

Tools and Support

- Appropriate Ventilation Strategies White Paper
- Southface Weighted Average Calculator (U and SHCC)
- UA Trade Off Tool
- 2020 Georgia Commercial Field Guide
- 2020 Georgia Residential Field Guide
REScheck for UA Compliance

- [www.energycodes.gov](http://www.energycodes.gov)
- Software evaluates specific designs quickly
- Demonstrates SHGC compliance
- Allows trade-offs
  - Building envelope components
  - No trade-offs for better heating & cooling equipment efficiencies

---

Simple House

```
6'  14'  20'  6'  14'

35'

12'

A: 3'0 x 4'0 window
B: 3'0 x 3'0 window
C: 5'0 x 4'0 window
D: 6'0 x 6'8 (Sliding Glass Door)
```
Simple House

- Perimeter: 54\times 2 + 40 \times 2 = 188 \text{ ft.}
- Gross Wall: \ 188 \times 9 = 1,692 \text{ sq. ft.}
- Floor Area: 
  - 12 \times 14 +
  - 20 \times 31 +
  - 20 \times 40 =
  - 1,588 \text{ sq. ft.}
- Ceiling Area: 1,588 \text{ sq. ft.}
- Windows
  - A: 12 \times 7 = 84 \text{ sq. ft.}
  - B: 9 \times 2 = 18 \text{ sq. ft.}
  - C: 20 \times 2 = 40 \text{ sq. ft.}
- Windows: 142 \text{ sq. ft.}
- Glass Doors: 20 \times 2 = 40 \text{ sq. ft.}
- Solid Doors: 40 \text{ sq. ft. (R-3)}

Garage
Laundry
Kitchen
Living / Dining
Bedroom #1
Bedroom #2

A: 3'0 \times 4'0 \text{ DP low-e (U.31, SHGC.24)}
B: 3'0 \times 3'0 \text{ DP low-e (U.33, SHGC.26)}
C: 5'0 \times 4'0 \text{ DP low-e (U.32, SHGC.25)}
D: 6'0 \times 6'8 \text{ DP Sliding Glass Door with tint (U.47, SHGC.30)}

RESCHECK FOR UA TRADEOFF

- www.energycodes.gov
- Software evaluates specific designs quickly
- Demonstrates SHGC compliance
- Allows trade-offs
  - Building envelope components
  - No trade-offs for better heating & cooling equipment efficiencies

<table>
<thead>
<tr>
<th>Project</th>
<th>Simple House</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Nashville, Tennessee</td>
</tr>
<tr>
<td>Construction Type</td>
<td>Single-family</td>
</tr>
<tr>
<td>Project Type</td>
<td>New Construction</td>
</tr>
<tr>
<td>Construction Area</td>
<td>1,580 ft²</td>
</tr>
<tr>
<td>Glazing Area</td>
<td>11%</td>
</tr>
<tr>
<td>Climate Zone</td>
<td>4 (3729 HDD)</td>
</tr>
<tr>
<td>Building Envelope</td>
<td>9'</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Envelope Assemblies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembly</td>
</tr>
<tr>
<td>Ceiling: Flat Ceiling or Sister Truss</td>
</tr>
<tr>
<td>Wall: Wood Frame, 15' s.f.</td>
</tr>
<tr>
<td>Door slider: Glass Door (over 50% glazing)</td>
</tr>
<tr>
<td>Window: Vinyl Frame, SHGC 0.30</td>
</tr>
<tr>
<td>Window: Vinyl Frame, SHGC 0.24</td>
</tr>
<tr>
<td>Window: Vinyl Frame, SHGC 0.4</td>
</tr>
<tr>
<td>Floor: Slab-On-Grade (Unheated) Insulation depth: 2.0&quot;</td>
</tr>
</tbody>
</table>
2015 IECC – Section 405
Simulated Performance Alternative

- Annual energy usage simulation demonstrates that the proposed building’s energy costs are < “standard code” building
- No credit for mechanical efficiencies
- Likely to involve a HERS rater [www.resnet.us](http://www.resnet.us)
- Ekotrope, REMrate & Energy Gauge are acceptable
- “Crude” version in REScheck

2015 IECC – Section 405
Simulated Performance Alternative – Sample Report

- Compares total annual energy costs
  - Window U-factor and SHGC
  - Envelope and duct testing
  - Lighting, duct insulation
- Compares energy costs of actual home being built against 2015 IECC reference home’s energy cost
The Energy Rating Index (ERI) path

The ERI may allow more options in materials choice, technologies and innovative strategies than the simulated performance path.

- The new Energy Rating Index (ERI) path gives the most design flexibility (e.g., credit for mechanical equipment efficiency)
- It also credits items not covered by the code (e.g., appliance efficiencies)

How is the ERI determined?

- The ERI is a numerical integer value
- Lower numbers indicate lower energy usage
- The HERS Index is currently accepted for use as the ERI
- A HERS Index is generated from a HERS Rating using modeling software
- HERS stands for Home Energy Rating System
- The ERI path can be cost-effective & beneficial to builders
- Choosing the ERI can offer benefits compared to the prescriptive, UA trade-off and simulated performance approaches

HERS was developed by the Residential Energy Services Network (RESNET)
Determining the Energy Rating Index

1. Simulate two homes
   - **Rated** Home – what will be built
   - **Reference** Home – same home but exactly meets ‘06 code

2. Compare Annual Energy
   - Space Heating & Cooling, Hot Water, Lighting and some Appliances
   - Multiply by 100 (lower w/ renewables)

\[
\text{Index} = 100 \times \text{PE}_{\text{fraction}} \times \frac{\text{Rated Home's Htg + Clg + WtrH + L.A.}}{\text{Ref. Home's Htg + Clg + WtrH + L.A.}} = 75
\]

<table>
<thead>
<tr>
<th>40</th>
<th>30</th>
<th>30</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>20</td>
<td>30</td>
<td>80</td>
</tr>
</tbody>
</table>

HERS Index – What does it mean?

- **HERS Index** (lower is better)
- Rated home with Index of 100 = Reference home exactly meeting 2004/06 IECC
- Net Zero Energy Home = HERS Index of 0

\[
\text{Index} = \text{PE}_{\text{fraction}} \times 100 \times \frac{\text{Rated Home's Htg + Clg + WtrH + L.A.}}{\text{Ref. Home's Htg + Clg + WtrH + L.A.}} = 75
\]

<table>
<thead>
<tr>
<th>40</th>
<th>30</th>
<th>30</th>
<th>50</th>
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</thead>
<tbody>
<tr>
<td>70</td>
<td>20</td>
<td>30</td>
<td>80</td>
</tr>
</tbody>
</table>

\text{PE}_{\text{fraction}} \text{ is ratio of renewables to purchased energy}

(e.g., a home that produces 20% of its annual energy would have a PE_{fraction} of 0.8)

In this example, 0.8 \times 75 = 60
ERI Target Values

- The 2015/18 IECC sets a maximum ERI for each climate zone
- The ERI is not a “magic bullet” or “easy cakewalk”
- However, it opens more options and allows builders more credit for innovative strategies (“the ERI shall consider all energy used in the residential building”)

The rated design must have an ERI less than or equal to the above table to comply with 2015/18 IECC

**NOTE:** The 2018 calculations were adjusted so the thresholds were amended!

The 2015/18 IECC: Overview

- Regardless of compliance path, must satisfy all the mandatory requirements of the 2015/18 IECC
- Like previous versions, the 15/18 IECC provide prescriptive and trade-off performance options
- The 2015 IECC introduced this new compliance option: the Energy Rating Index (ERI)
Benefits of choosing the ERI

Stringent prescriptive envelope requirements make the 2015 IECC prescriptive and tradeoff paths more difficult than previous codes!

The ERI may allow more options in materials choice, technologies and innovative strategies than the simulated performance path.

TABLE R021.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>FENESTRATION U-FACTOR*</th>
<th>SKYLIGHT U-FACTOR</th>
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Renewable energy is credited (with some constraints)
Better appliances are credited in ERI
High efficiency furnace (plastic flue pipe) is credited
Efficient lighting > 75 or 90% benefits the energy index
Which of these technologies are credited in the ERI path?

Check any of the following strategies that receive credit in the ERI pathway:

- 95% furnace (PVC flue pipe & combustion intake) in basement
- High efficiency mini split heat pump for bonus room
- The home features 95% LED lighting
- ENERGY STAR Washer, Dryer and Dishwasher supplied by builder
- Energy/Heat Recovery Ventilator provides fresh air for home
- Adaptive learning thermostat is used for HVAC control
- Minimum efficiency direct vent gas water heater in basement
- Solar powered clothes line is strung between house and garage

Explaining the Energy Rating Index

1. 2015/18 IECC targets
   - 50’s to Low 60’s

2. Who Can Do This?
   - 3rd party – HERS Rater
   - Approved software

3. Benefits
   - Greater design flexibility
   - High efficiency equipment & appliances credited

4. Backstoppers
   - Envelope cannot be traded to be worse than 2009 IECC
   - Must meet Mandatory Requirements
   (air sealing, duct insulation and sealing, duct and house testing, etc.)

The rated design must have an ERI ≤ to the above table to comply with 2015 / 18 IECC

NOTE: Some states have amended these numbers!
Pros and Cons?

1. Concerns
   • **Conflict of interest** because rater works for the builder
   • **Size Bias** against small houses
     - **Code** – because it uses the antiquated ACH50 term for air tightness (which favors larger, high volume homes)
     - **ERI** – small homes have less envelope load and are hindered in trade-offs
   • **Credit for unregulated items** not in the Prescriptive code
     “Should the dishwasher be allowed to trade down insulation R-values?”

2. Benefits
   • **Professional** (HERS Rater) who understands energy efficiency is now involved and energy code isn’t ignored
   • **Marketing** – Builders can market their index and guarantee performance

Approved modeling software

• Software meets requirements of the ANSI/RESNET/ICC 301 Standard
• Software must be capable of generating reports as described in R406.6.2
ERI: Rated home vs. reference

The software compares the projected energy use of the rated home against a reference home that is:

- The same shape and size, building structure, and # people (bedrooms)
- Constructed to meet the 2006 IECC

*The ERI rates the house, not the behavior of people living in the house*

...“*the ERI shall consider all energy used in the residential building*”

---

How does the ERI compare to previous codes versions?

![HERS Index](HERS_Index.png)

Adapted from RESNET
A word about renewables...

- The 2015 IECC does not directly address renewables in the ERI pathway
- There are differing opinions on how renewables should be handled with the ERI
- States handle this differently
- 2018 IECC allows but penalizes renewables with a harder 2015 prescriptive backstop

"The ERI shall consider all energy used in the residential building."

- TX – no solar credit
- VT, MA (2012) – cap
- AL, IL, MD, NJ, NV, UT, WA – as written in 2015 IECC
- FL, 2018 IECC – harder backstop for renewables

ERI mandatory requirements

- Home must meet mandatory requirements of sections R401.2 and R403.5.3
- The building thermal envelope shall be greater than or equal to levels of efficiency of the 2009 IECC
- Software & rating procedure must comply with specifications in section R406
- Compliance must be verified by approved 3rd party (e.g. HERS Rater)
ERI mandatory requirement
Backstop is 2009 IECC Envelope

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2009 IECC insulation and window efficiencies table

HERS Rating demonstration
HERS Rating demonstration

Example home – CZ2:
• 1400 ft², single story
• Slab foundation
• Vented attic
• 1 HVAC system
• Building envelope meets 2009 IECC prescriptive requirements
• Mechanicals and appliances typical for area

HERS Rating demonstration

• Radiant barrier roof decking
• Install more efficient appliances (refrigerator, dishwasher, laundry)
• 100% high efficacy lighting
• High efficiency HVAC & water heater
“Acme” base case 2816 s.f home

Acme Home

1st floor: 1,343 s.f.

2nd floor: 1,473 s.f.
Acme Base - 2816 s.f. home

- Two mechanical systems - both in the vented attic
- 75% of 1st floor ducts inside; all others plus 2nd floor ducts in attic
- 80% furnaces, 14 SEER A/C's, no mechanical ventilation, 50 gal gas DHW
- Basic 2009 energy code compliant R-values (assume Grade III)
  - R-30 flat ceiling, R-19 vault
  - R-13 + OSB walls
  - R-19 floor over garage; no slab insulation
- Typical DP low-e windows: U-0.35  SHGC-0.30; poor orientation
- Duct leakage is 12% Total; 8% To Outside
- Envelope Leakage is 7 ACH\textsubscript{50}, 0.45 ELR\textsubscript{50}, 3009 cfm\textsubscript{50}

- Elec rate 12.5¢/kWh + $10 base fee; Gas rate 75¢/therm + $20 base fee

HERS Rating demonstration

- Results for Atlanta
- Index drops to 71 when 2012/15 IECC prescriptive envelope values are entered
- Index drops to 67 when 2012 IECC prescriptive 75% efficient lighting values are entered
- Index drops to middle 50's when condensing furnace, 16 SEER AC, and more efficient appliances are entered
- House load drops (4 tons to 3 tons)
ERI–Impact of Renewables on Index

- Results for Atlanta
  - 80 => 70 with 2 kW
  -  => 56 with 5 kW
  -  => 32 with 10 kW
  - 57 => 49 with 2 kW
  - => 36 with 5 kW
  - => 13 with 10 kW

Compliance Options
2015/18 IECC compliance options

- Prescriptive (tables for R-, U-values)
- Total UA Alternative (REScheck)
- 405 - Simulated Performance Alternative (computer simulation using the standard reference and proposed design)
- 405 - Energy Rating Index (“HERS Rating”)

Building Thermal Envelope

- Although these three homes look identical from the outside, each has defined the building thermal envelope differently
Question: Summarize Results

1. What is the basic conduction heat flow equation?
2. How does a load calculation differ from an hourly simulation?
3. What is a key difference between the IECC Simulated Performance Alternative compliance option and the Energy Rating Index?

Thoughts / Questions?

- June 4: It All Begins with Building Science
- June 11: Cracking the Building Energy Code
- June 18: Demystifying Energy Modeling
- June 25: Healthy Homes Matter - Understanding IAQ & Ventilation
- July 2: An Industry That Puts It All Together: The World of HERS Raters

Thank you!
- mikeb@southface.org

Southface Applied BS Webinars
Third Thursdays! 11 a.m. ET
- June 18th - Combustion Safety
- July 16th - HVAC Load Calcs
- Aug 20th - High Performance Design

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