

Road to Net-Zero Energy Homes

**NEW ENGLAND BUILDING OFFICIALS EDUCATION
ASSOCIATION (NEBOEA)**

October 6 - 8, 2014

Discussion Topics

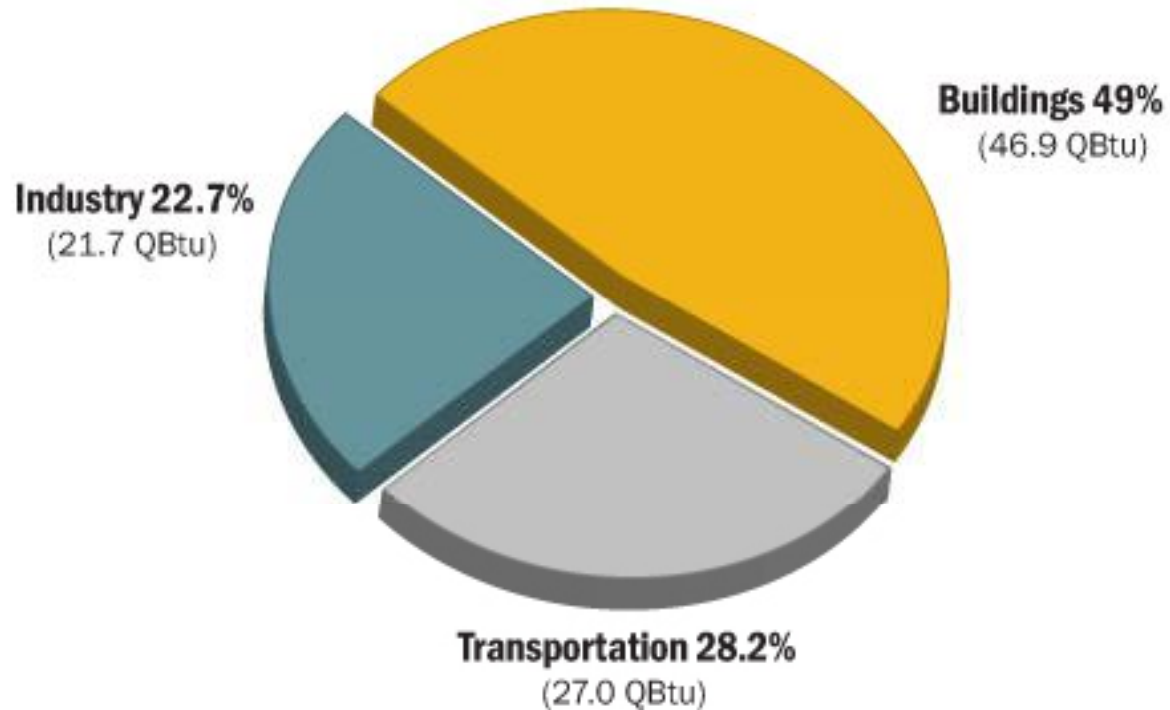
**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



- United States Energy Usage and Trends in the Building Industry
- Building Enclosure Influences on Energy Efficiency
 - Air Tightness
 - Thermal Resistance (R values and U factors)
 - **Structural**
- Energy Rating Index
- Renewable Energy

U.S. Energy Consumption by Sector

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



U.S. Energy Consumption by Sector

Source: ©2010 2030, Inc. / Architecture 2030. All Rights Reserved.
Data Source: U.S. Energy Information Administration (2009).

U.S. Energy Consumption

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



115+ million
households in US

Consume 22
quads+ of energy
per year ...or one
oil supertanker
per day just for
residential
housing

Represent 5% of
world's
population...but
27% of energy
consumption

Each residence
consumes 1.5-2x as
much energy as
needed for
comfort/convenience

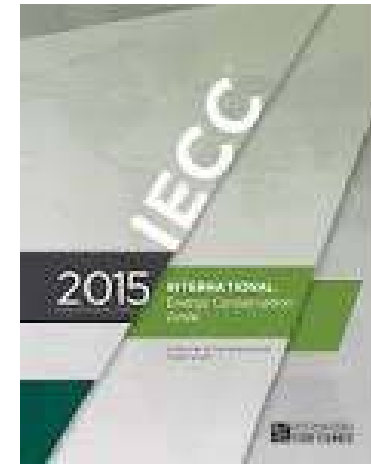
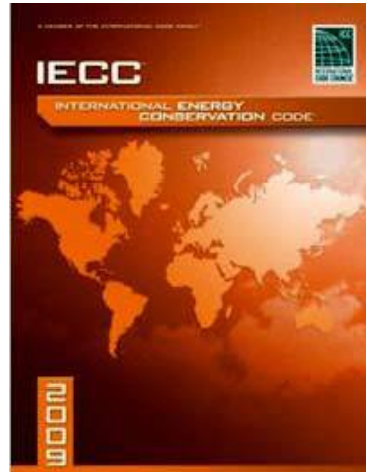
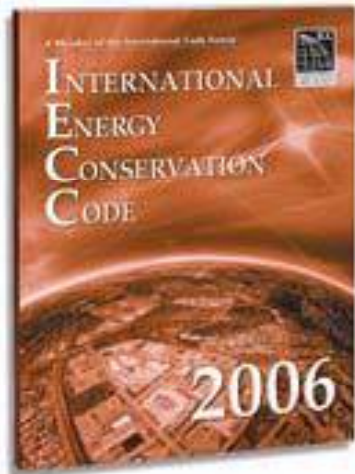
U.S. demand
for Energy
increases 3%
per Year



Current U.S. energy consumption is not sustainable and could threaten our national security. We have an opportunity to reduce U.S. dependence on foreign oil, and improve the health of the planet.

Aggressive Code Changes

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



+15%
Improvement

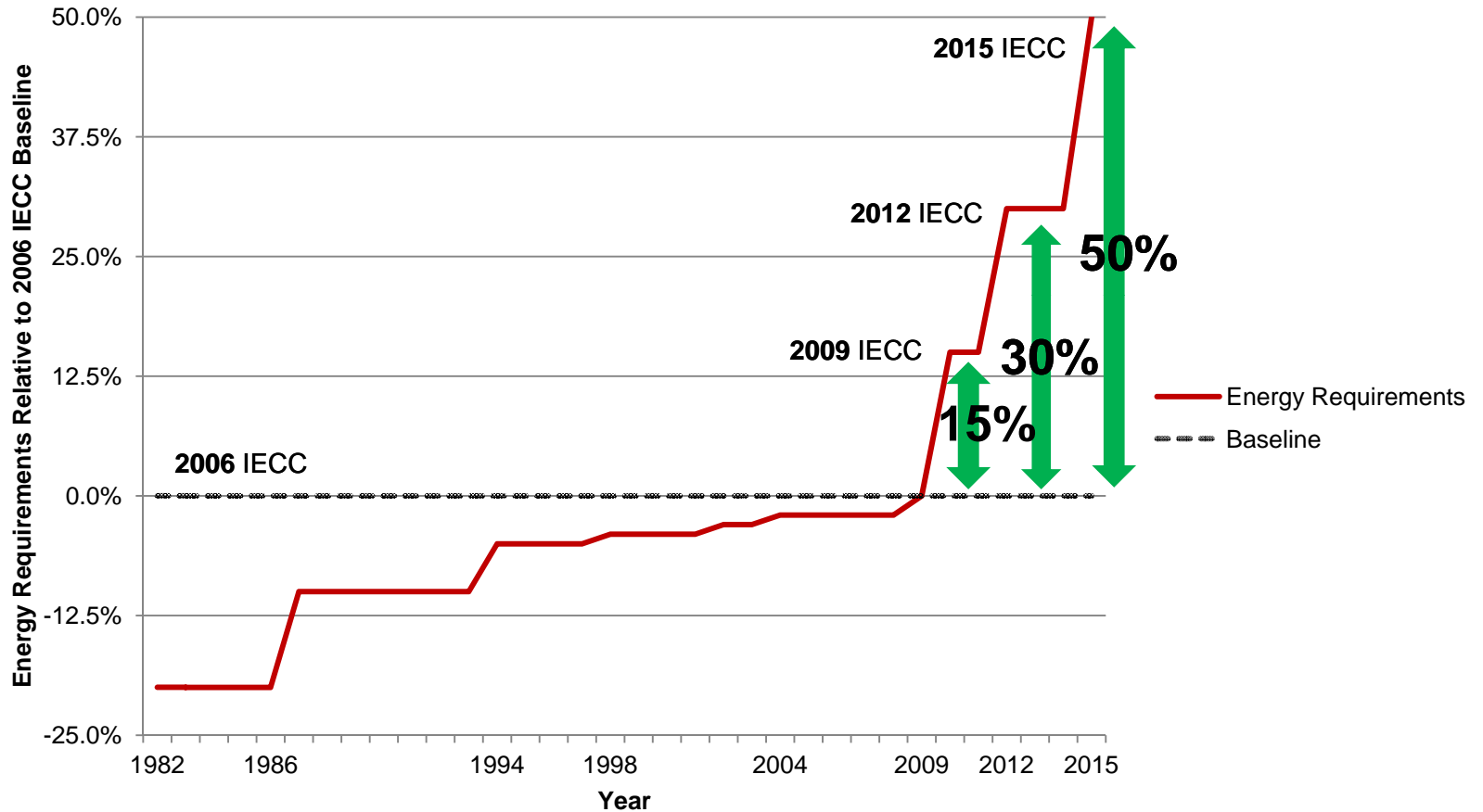
+15%
Improvement

+20%
Improvement

50% improvement in energy efficiency

“Energy net zero” is in sight...

Residential Energy Codes Improving Faster



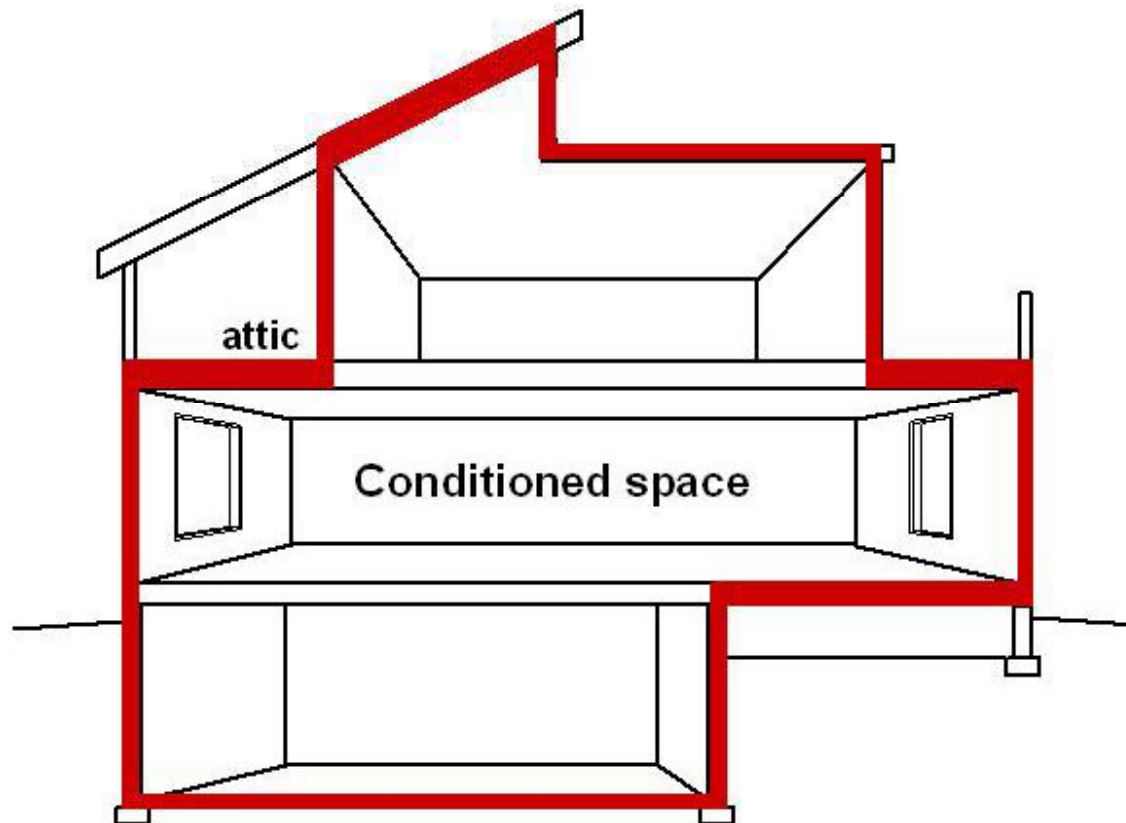
* IECC – International Energy Conservation Code

IECC implications for building enclosure

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR

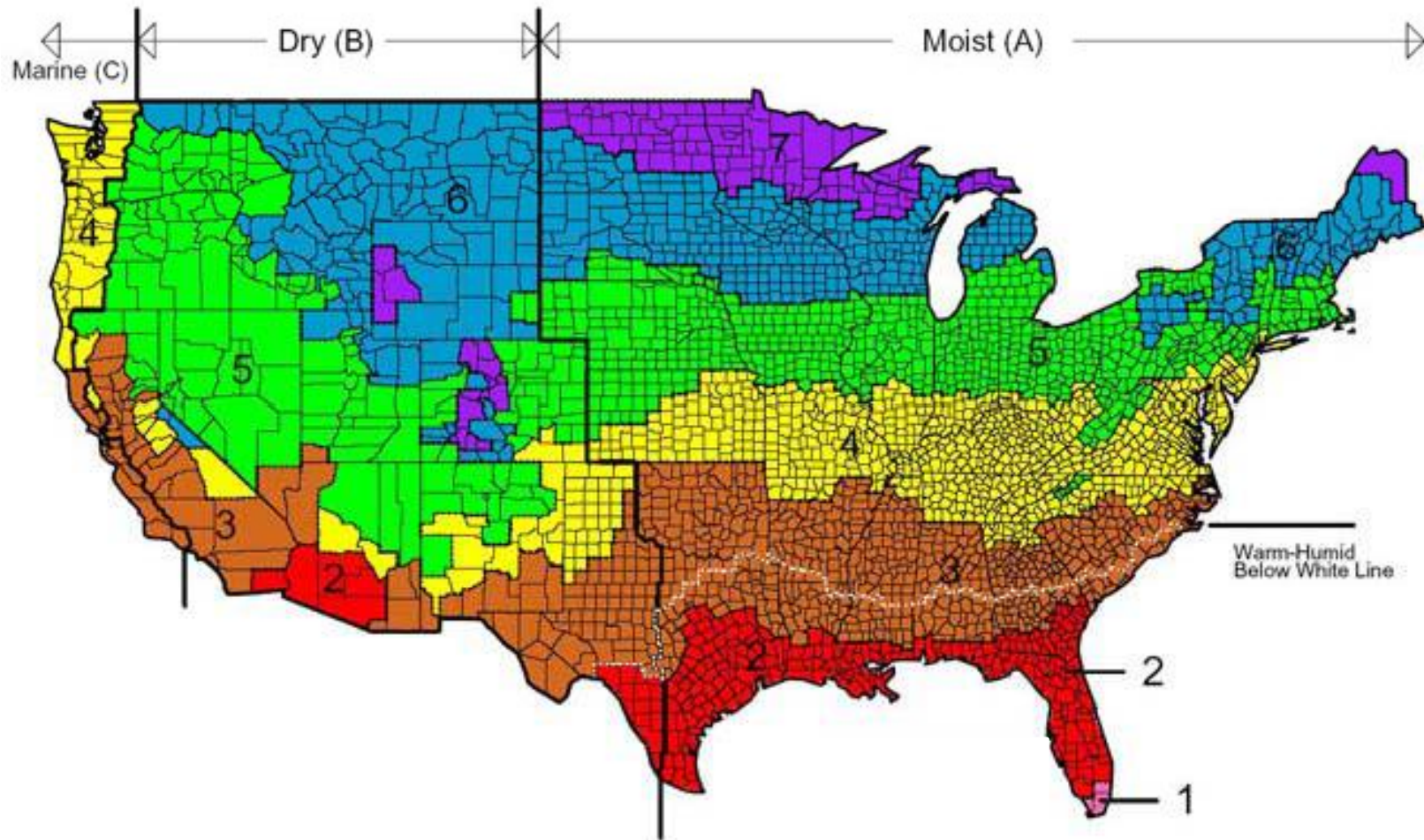


- Insulation
- Air tightness



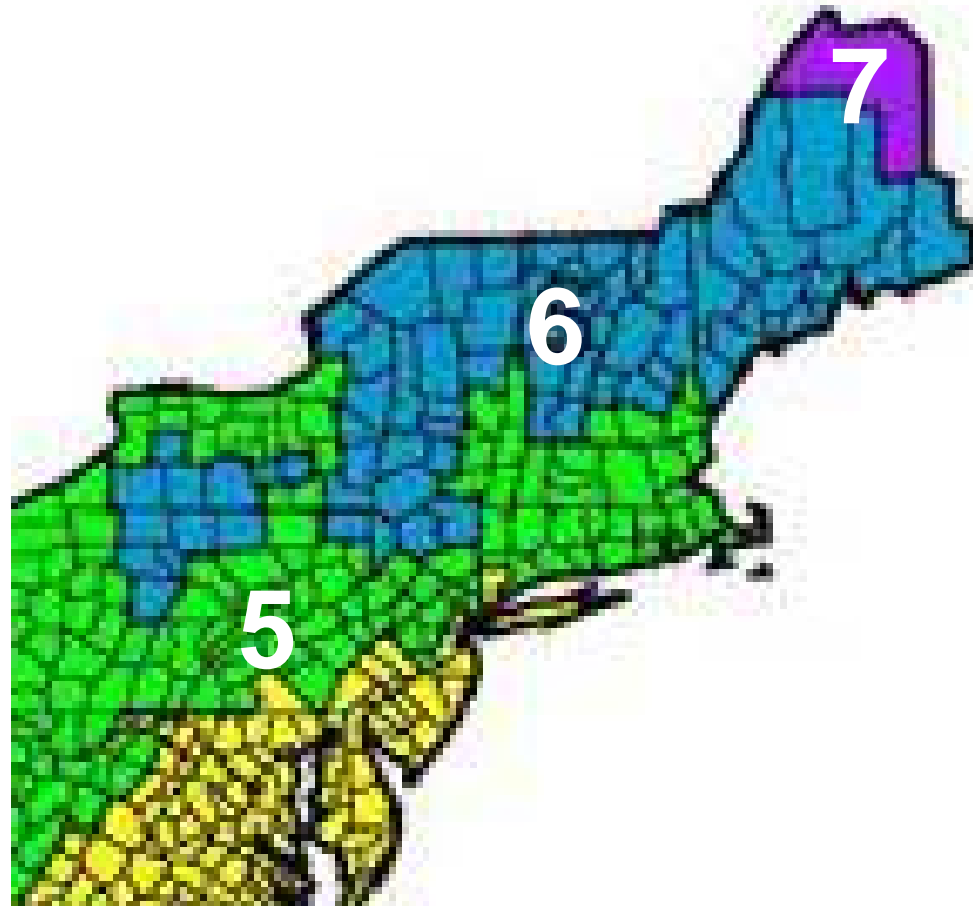
IECC Climate Zone Map

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



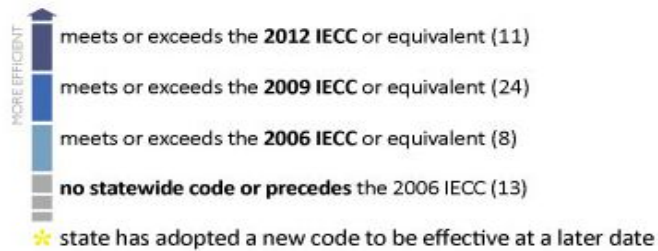
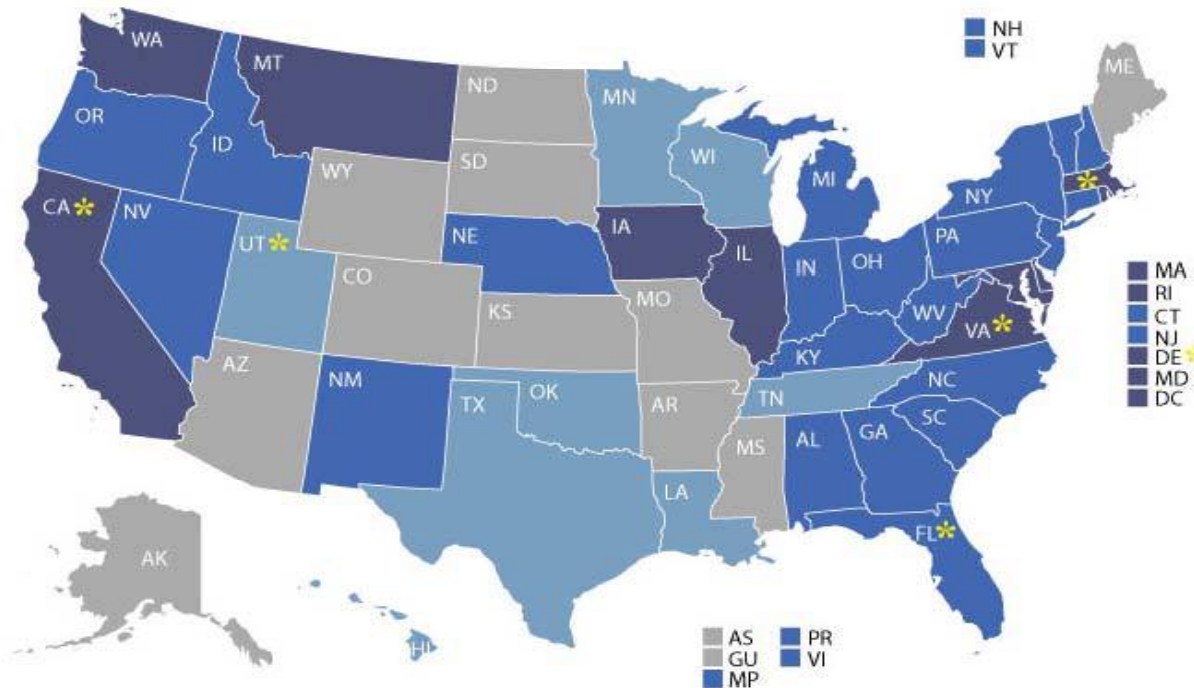
NEBOEA Climate Zone Map

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



IECC Residential Adoptions (7/15/14)

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Insulation requirements for Wood-Framed Walls



Wood Framed Wall R-Values			
Climate Zone	2009 IECC	2012 IECC	2015 IECC
5 and Marine 4	20 or 13+5	20 or 13+5	20 or 13+5
6	20 or 13+5	20+5 or 13+10	20+5 or 13+10
7 & 8	21	20+5 or 13+10	20+5 or 13+10

No Change

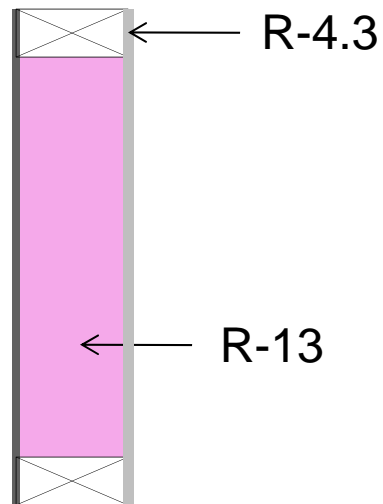
Thermal Resistance - Wall Insulation

Prescriptive requirements

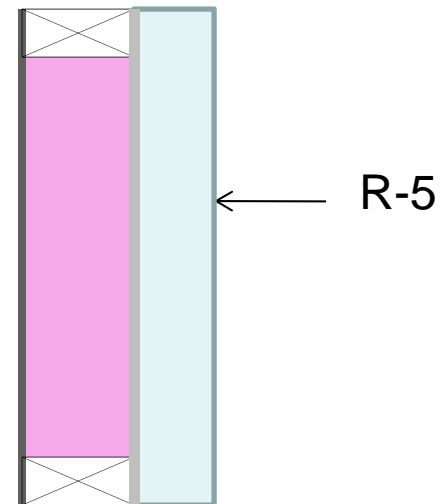
**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



**Cavity
Insulation**
Example: R13



**Cavity Insulation +
Continuous insulation (c.i.)**
Example: R13 + 5



Question:
Does $R13 + 5 = R18$?

“Fluffy” insulation

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Cellulose
R = 3-4 per inch



Fiberglass
R = 3.5-4 Per inch



Cotton – Blue Jeans
R = 3.5 per inch

Fluffy insulation - Challenges

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR

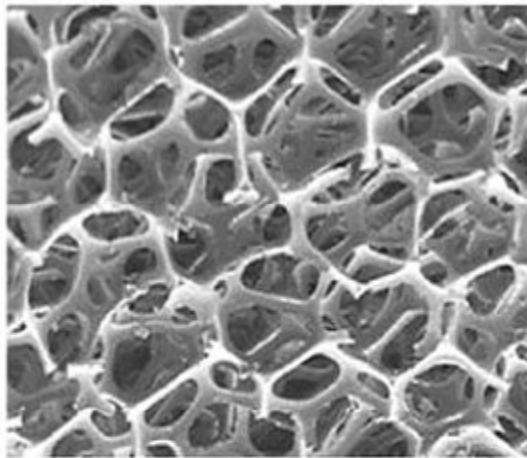


Reduction in R value

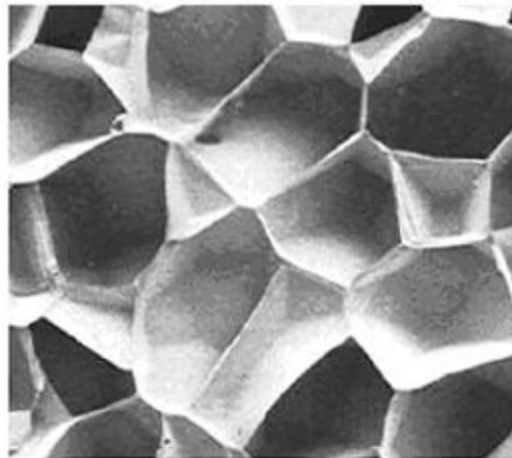


Foam Insulation

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Open cell
(cell walls are
ruptured)



Closed cell

Foam Insulation

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



EPS Expanded Polystyrene
Closed Cell
R = 4 Per inch



XPS Extruded Polystyrene
Closed Cell
R = 5 Per inch



Polyisocyanurate
Closed Cell
R = 6 Per inch



Sprayed Polyurethane Foam
Open Cell/Closed Cell
R = 3.5/6.0 Per inch

Insulation - comparison



Insulation Type	R Value per inch	Permeance (wet cup) @ 1.0"	Air Permeable @ 1.0"
Fiberglass	3.5	Highly Permeable	Yes
High Density Fiberglass	4.3	Highly Permeable	Yes
Cellulose	3.0 - 4.0	Highly Permeable	Yes
Cotton – Denim	3.5	Highly Permeable	Yes
XPS	4	1.0 - 1.5	No
EPS	5	3.0 - 5.0	Yes
Polyiso	6	1.5 - 2.0	No
SPF	Open cell – 3.5 Closed cell – 6.0	Open cell – 50.0 Closed cell – 2.0	Open cell – Yes Closed cell – No

Heat Transfer

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



R-Value: Thermal resistance

U-Factor: Heat Transmittance

R-Value = $1/U$ -Factor

U-Factor = $1/R$ -Value

Examples

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



- R-13 wall insulation, what is the U-Factor?
Answer: $1/13 = 0.077$
- Wall with a U-Factor of 0.058, what is the R-Value?
Answer: $1/0.058 = 17.24$
- A 2x4 stud has an R-Value of 4.38, what is the U-Factor?
Answer: $1/4.38 = 0.228$

- R-11 wall insulation and ½” OSB (R = 0.62), what is the U-Factor?

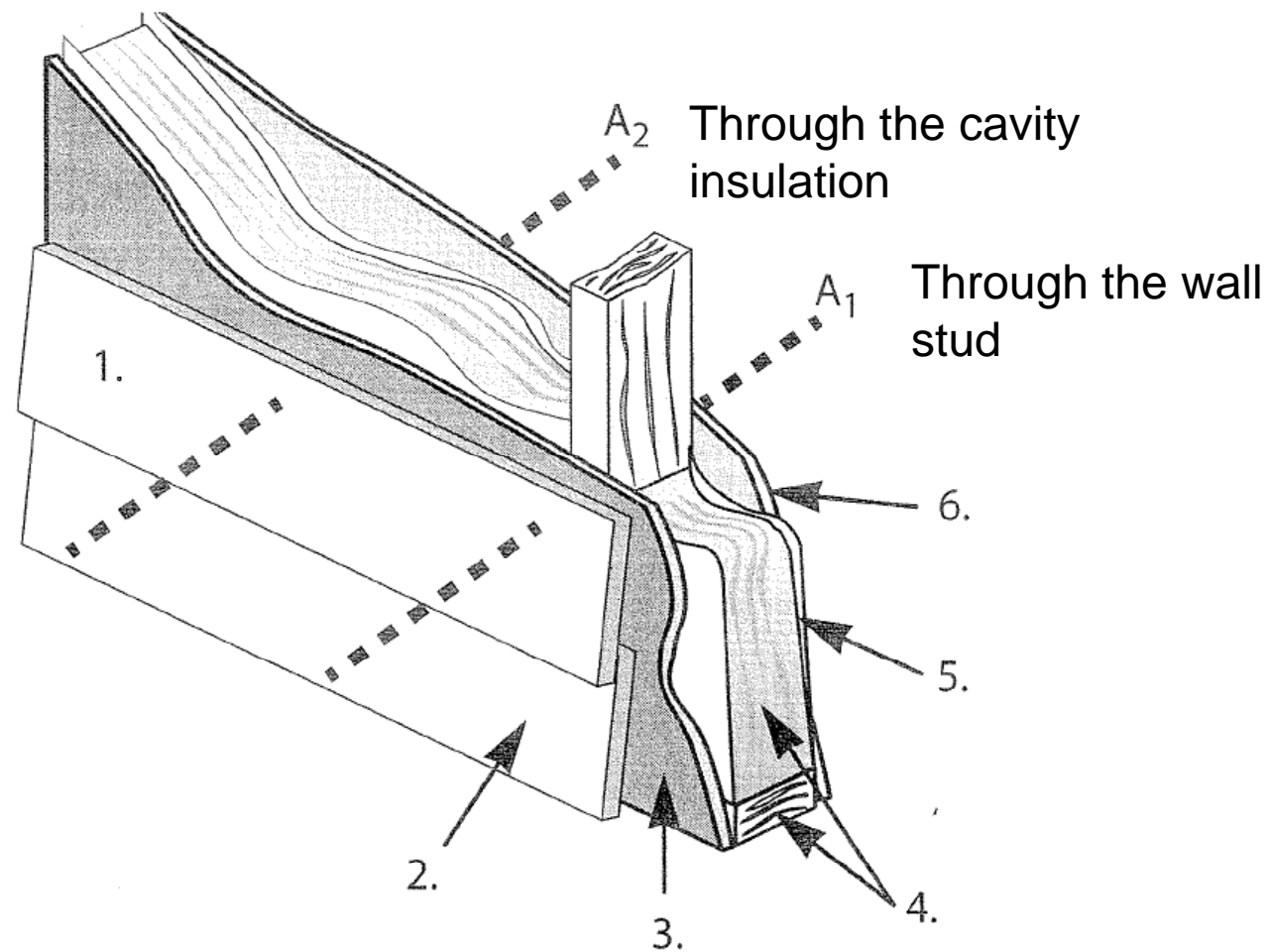
Answer: $1/(11 + 0.62) = 0.086$

- R-11 wall insulation, ½” OSB (R=0.62) and R-3 Rigid Foam, what is the U-factor?

Answer: $1/(11 + 0.62 + 3) = 0.068$

U-factor application

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



U-factor application

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Numbered Wall Component	R (A1)	R(A2)
1. Outside Air Film	0.17	0.17
2. Lapped Wood Siding	0.81	0.81
3. OSB Sheathing (1/2")	0.62	0.62
4. Framing or Insulation	4.38	13
5. Gypsum Wall Board (1/2")	0.45	0.45
6. Inside Air Film	0.68	0.68
Total R	7.11	15.7
U-Factor	0.141	0.0637
Percentage of total wall area	25%	75%

Calculation: Area weighted average U-factor

$$U = (A1 \times U1) + (A2 \times U2)$$

$$U = (0.25 \times 0.141) + (0.75 \times 0.0637)$$


$$U = 0.0830$$

$$R = 12.05$$

What about windows?

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



 <p>National Fenestration Rating Council® CERTIFIED</p>	<p>World's Best Window Co.</p> <p>Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider</p>	
<p>ENERGY PERFORMANCE RATINGS</p>		
<p>U-Factor (U.S./I-P) 0.35</p>	<p>Solar Heat Gain Coefficient 0.32</p>	
<p>ADDITIONAL PERFORMANCE RATINGS</p>		
<p>Visible Transmittance 0.51</p>	<p>Air Leakage (U.S./I-P) 0.2</p>	
<p>Condensation Resistance 51</p>	<p>—</p>	
<p>Manufacturer stipulates that these ratings conform to applicable NFRC procedures for determining whole product performance. NFRC ratings are determined for a fixed set of environmental conditions and a specific product size. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Consult manufacturer's literature for other product performance information. www.nfrc.org</p>		

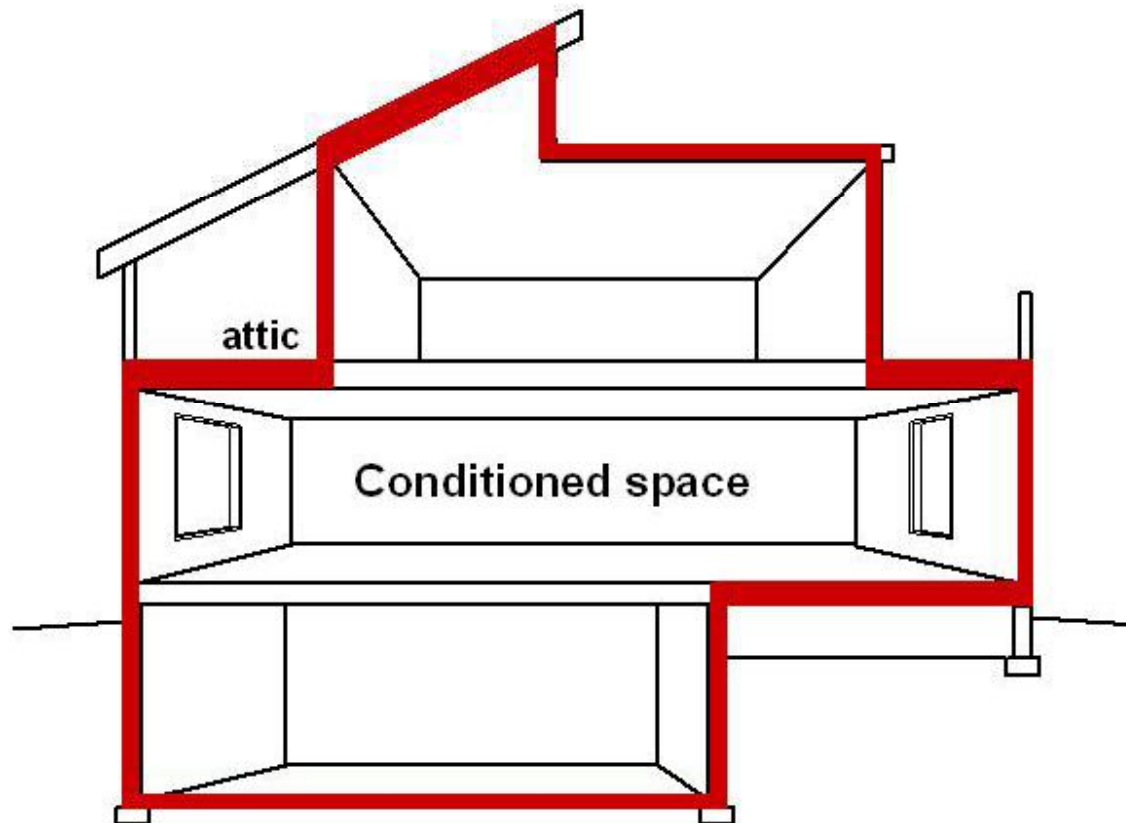


IECC implications for building enclosure

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



- Insulation
- Air tightness



IECC Air-Sealing Implications

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



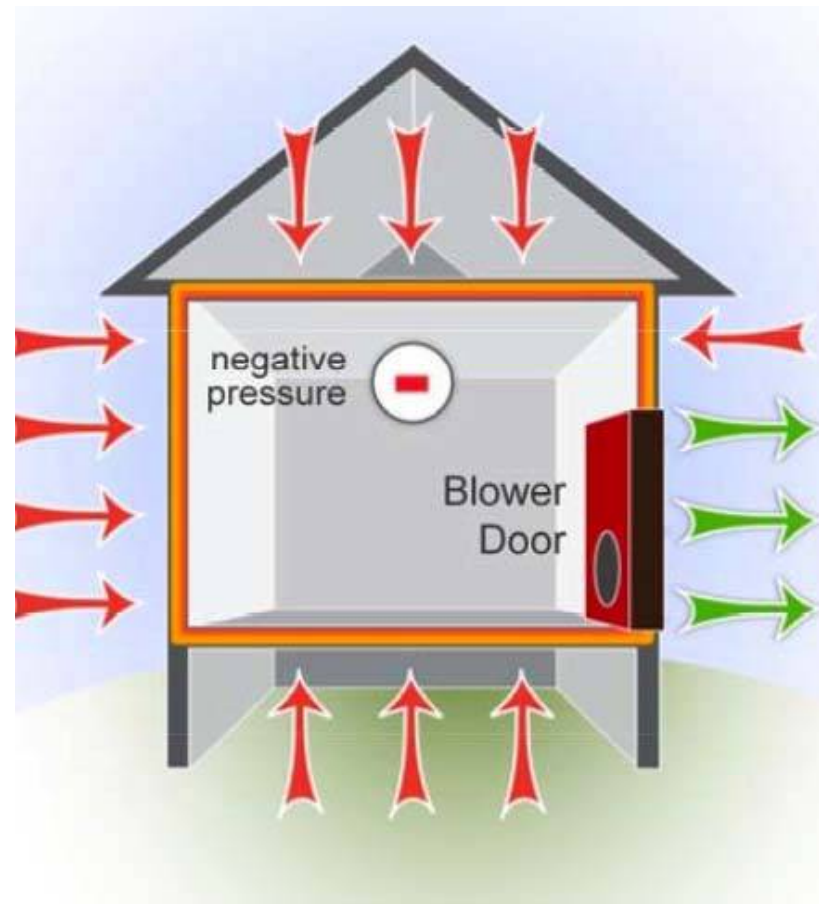
2009 IECC



- Examples:
- Caulk around rough opening framing
 - Seal top and bottom wall plates

(or)

2012 and 2015 IECC
(Mandatory Blower Door)



Building Enclosure tightness



Air Leakage Compliance Methods			
Air Changes per Hour (ACH) at 50 Pascals of pressure (50 Pa)			
Climate Zone	2009 IECC Visual inspection or blower door	2012 IECC Blower door only	2015 IECC Blower door only
5	Follow checklist or 7 ACH	3 ACH	3 ACH
6	Follow checklist or 7 ACH	3 ACH	3 ACH
7 & 8	Follow checklist or 7 ACH	3 ACH	3 ACH

No Change

Energy Codes address all components of the building envelope

FLAT OUT BEST
FOR A QUIET, STIFF FLOOR



- Where Do We Lose Energy in Residential Houses
 - 40% through attic/roof
 - 36% through basement, crawlspace or slab
 - 14% through wall cavity
 - 10% through window & door assemblies & gaps

Air sealing “targets”

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Air sealing "targets"

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Huge "Air Leak"

Air barrier



Air sealing “targets”

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Air sealing "targets"

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Air sealing "targets"

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



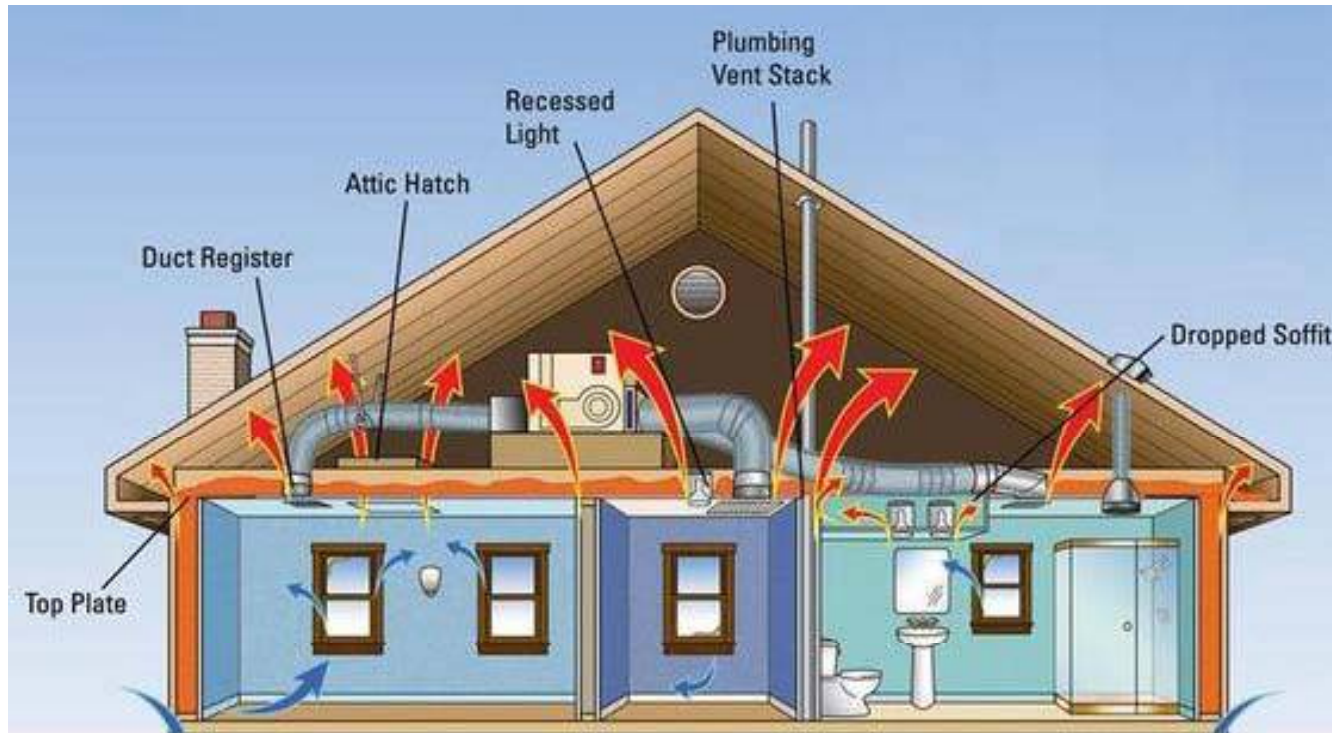
Air sealing “targets”

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Air sealing “targets”

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



What's wrong with this picture?

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Structures must resist loads from – snow, wind & seismic events

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Snow
Loading



www.finehomebuilding.com

Wind
Loading



Seismic
Loading



Structural – Lateral Loads

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



VIDEO

Structural failures can be catastrophic

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Beyond the 2012 IECC – What's next?

FLAT OUT BEST
FOR A QUIET, STIFF FLOOR



ILLUMINATED ENTRY
TILT/TELESCOPE STR COLUMN
60/40 SPLIT FOLD REAR SEAT
FUNCTIONAL
ADVANCETRAC W/ESC

WARRANTY
• 3YR/36,000 BUMPER / BUMPER
• 5YR/60,000 POWERTRAIN
• 5YR/60,000 ROADSIDE ASSIST

EPA Fuel Economy Estimates

CITY MPG	Estimated Annual Fuel Cost	HIGHWAY MPG
27 Expected range for most drivers 22 to 32 MPG	\$1,454 based on 15,000 miles at \$3.00 per gallon	37 Expected range for most drivers 30 to 44 MPG

Combined Fuel Economy
This Vehicle **31**
14 ————— 41
All Compacts

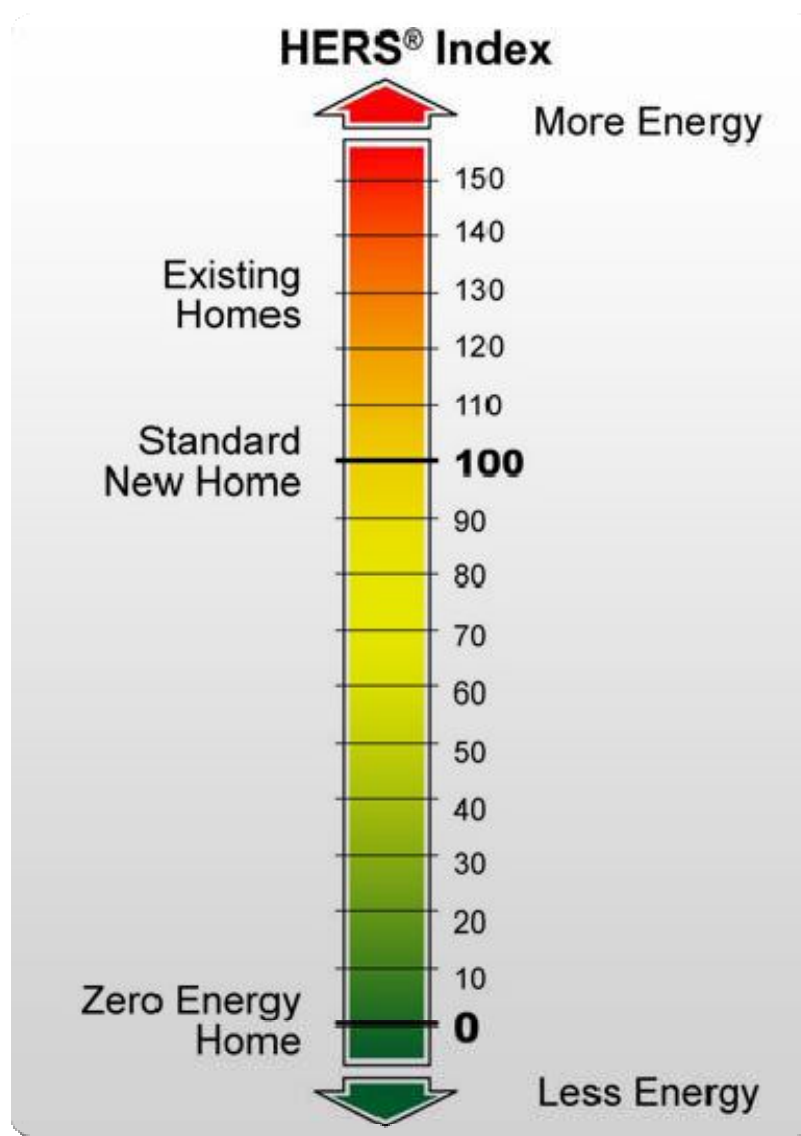
See the FREE Fuel Economy Guide at dealers or www.fueleconomy.gov



HERS Path in 2015 IECC

HERS Index is the MPG sticker for new homes

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



HERS Index = 100
Standard New Home
Using pre-2006 IECC energy requirements

HERS Index of 51-55 required under 2015 IECC

HERS Index = 0
Zero Energy Home
No Net Purchased Energy

Maximum Energy Rating Index Per 2015 Energy Rating Index Alternative

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Climate Zone	Energy Rating Index
1	52
2	52
3	51
4	54
5	55
6	54
7	53
8	53

Builder use of HERS Index



With us, it's personal.™



“builders are using HERS scores to compete with the foreclosure and older home market. It’s not so much the initial cost of a home that’s important, but the long-term costs of running it.”

Real Estate Industry recognize value of Energy Efficient Homes

FLAT OUT BEST
FOR A QUIET, STIFF FLOOR



Area:
Style: Craftsman , Traditional
Beds: 3
Full Baths: 2
Half-Baths: 1
HERS Rating (Year Tested): 48 (2011)
Split BR Plan: Yes
Year Built: 2010
Total Ht/Cool SF: 2,250
Total SF Under Roof: 3,006
SqFt Source: SF from Plans/Appraisal
Parcel Size-Range: Up to .33
Apx Lot Dim.: 60x110

County: Alachua
Subdivision: Belmont
New Constr.: Yes
Condition: (NEW)New Construction

Sect-Twp-Rng: 27-9-18
Assoc. Fee: Yes
Assoc. Fee \$: 92
Assoc. Fee Pd: Monthly
Parcel Size: .20 Acres
Bank Owned: No
Short Sale: No



Multiple Listing Service (MLS)

Net-Zero Energy Homes by 2030

**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



Challenge Home: DOE program that promotes the use of innovative energy efficient solutions that will enable the eventual construction of **net zero energy homes**



**FLAT OUT
BEST**
FOR A QUIET, STIFF FLOOR



THANK YOU