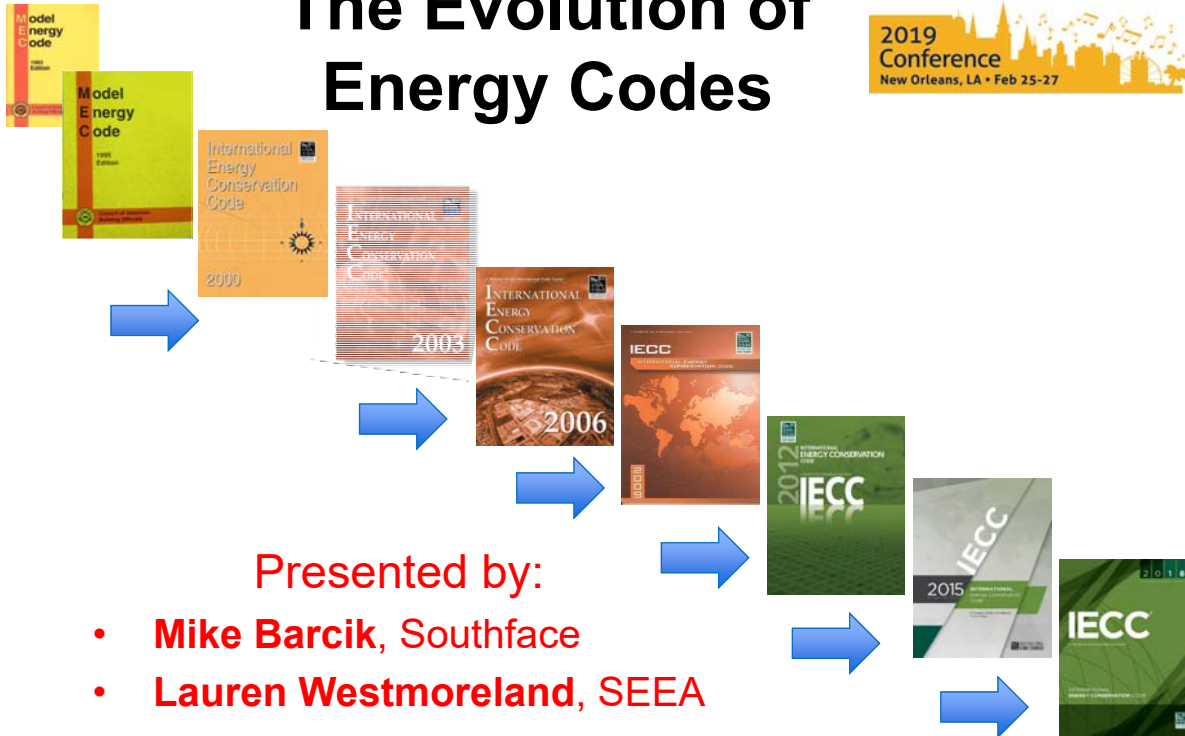


RESNET 2019 Conference

The Evolution of Energy Codes



Presented by:

- **Mike Barcik, Southface**
- **Lauren Westmoreland, SEEA**

The Evolution of Energy Codes

Description:

- By dating back to the early Model Energy Codes of the 1990's and settling on the benchmark 2006 IECC, then examining the widely adopted 2009 IECC to the landmark 2015 version and beyond, this session explores how the energy codes of old shaped where we are today and also where we are going.
- Join Mike and Lauren for an insightful look into the evolution of residential energy codes. See how game-changing technologies (such as low-e windows and blower door and duct testing) advanced through adoption and inclusion in the latest energy codes. Learn from the past (the origins of energy codes) to understand the present (our most recent codes) and grasp a sense of where future codes will lead us.
- Says Mike, "I've always loved history and tried to appreciate the perspective of those that came before me." Lauren adds, "Reviewing energy codes also helps to shape where we'd like to go and how we might get there."
- Come join us as this session will wrap with Energy Code Trivia - Win prizes!

Energy Code Trivia

How well can your team answer ten code trivia questions?

- Group exercise – split into teams of ~1-6 people, each team comes up with a name and must collectively answer question within 30 seconds of question
- We'll grade them collectively and award prizes



- Favorite comment from last year's exercise (it involved drawing):
"It's like playing Pictionary with a blind cat"

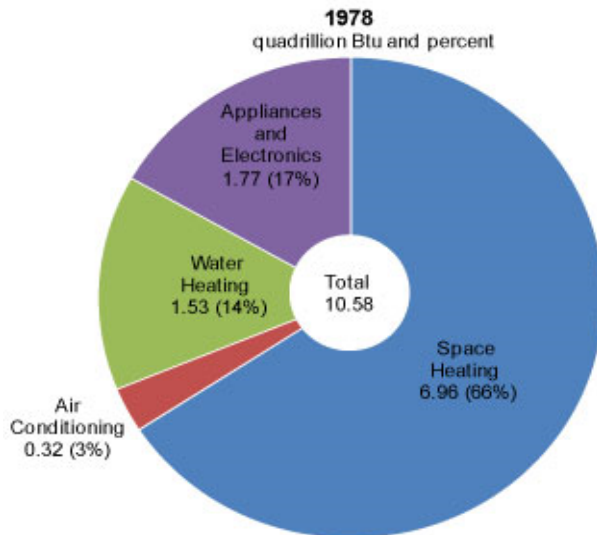
Energy Code Trivia - Warmup

0. What color is the 2009 IECC?

- a. Blue Steel
- b. Irish Spring Green
- c. Yellow
- d. Orange

Pre Energy Code Era: Home Energy Usage – Mostly Heating!

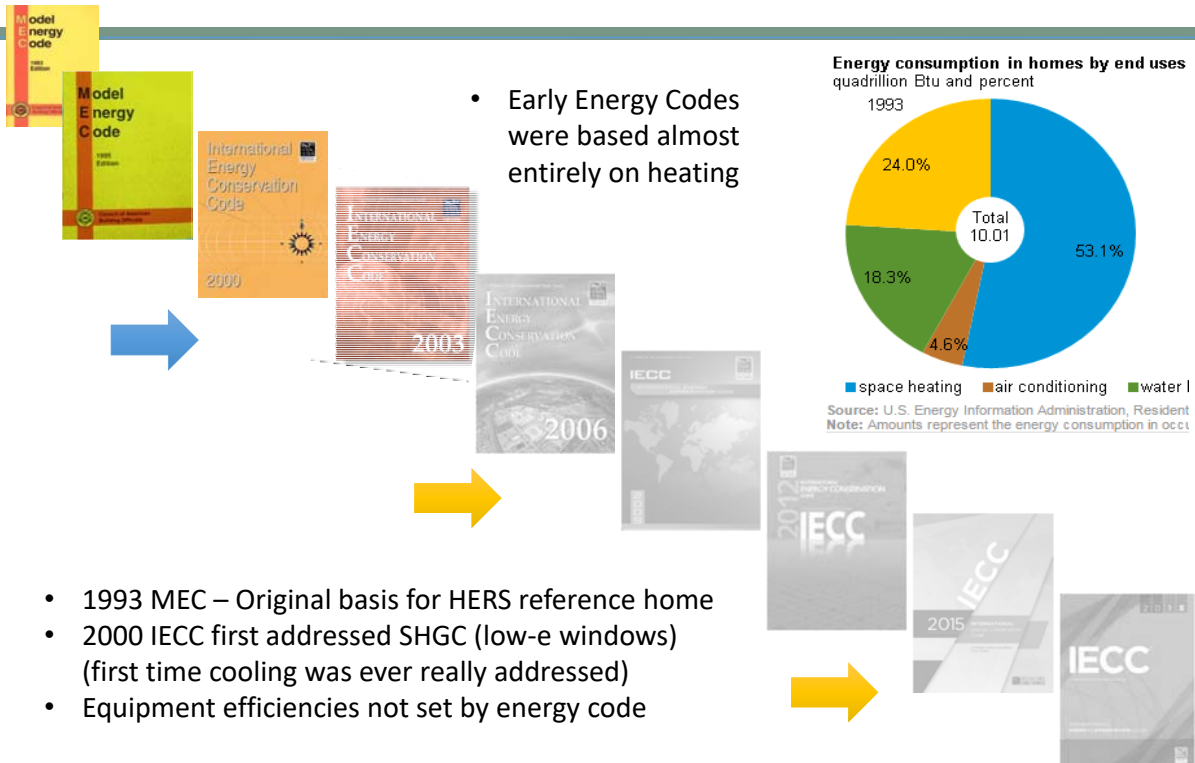
Total energy use in homes



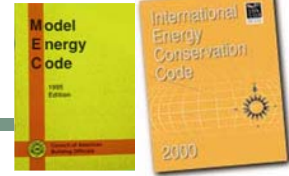
- Early “Energy Usage” pie was fairly simple

Source: U.S. Energy Information Administration, 1978 and 2005

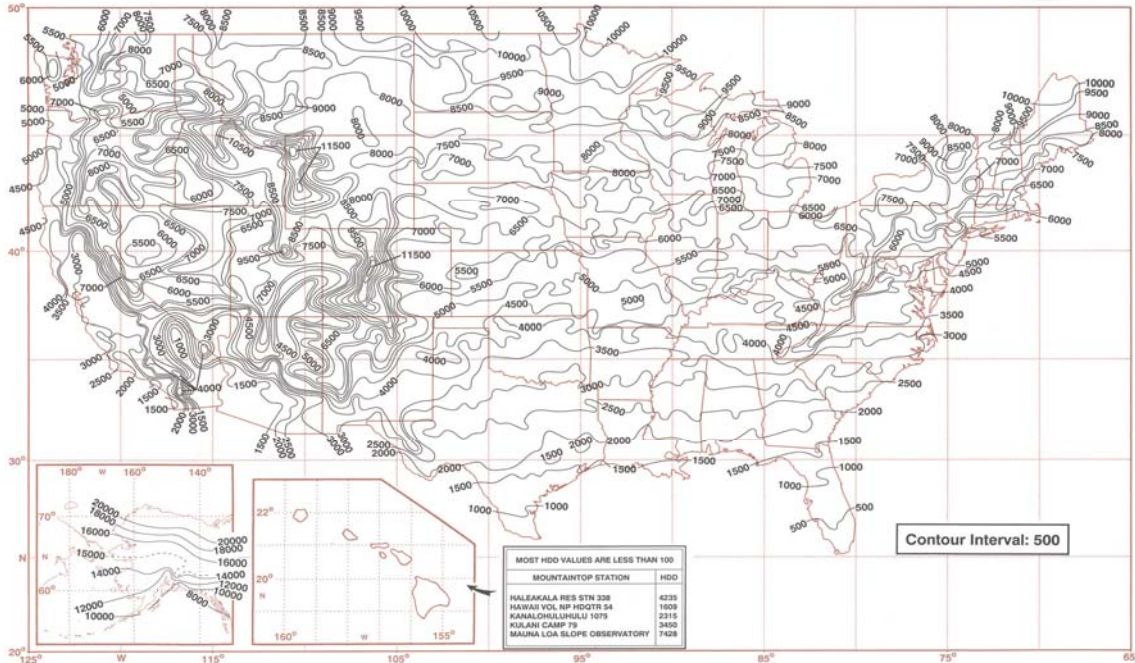
The Complicated “Yellow” Versions!



Chapter 5 - Component Performance - Based on HDD

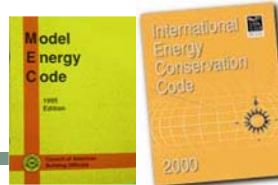


BASED ON NORMAL PERIOD 1961-1990



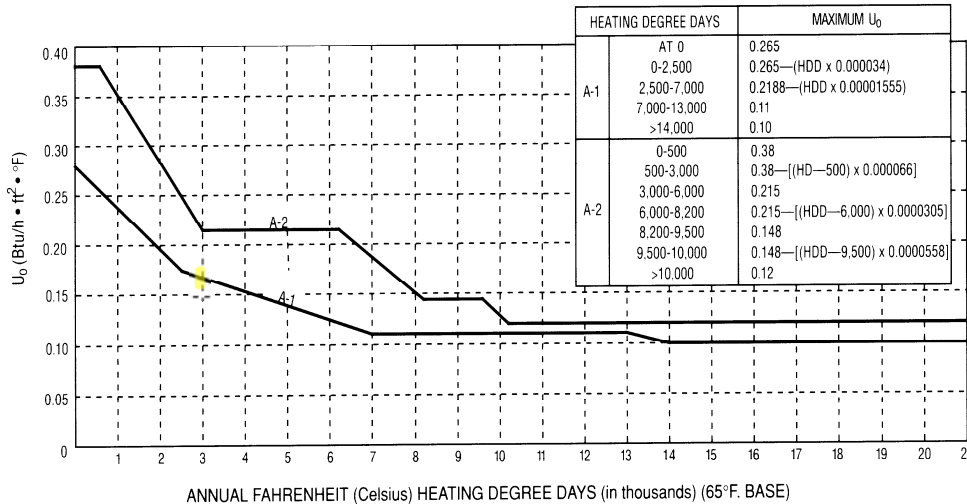
From the National Climatic Data Center website: <http://lwf.ncdc.noaa.gov/oa/ncdc.html>

Chapter 5 - Component Performance



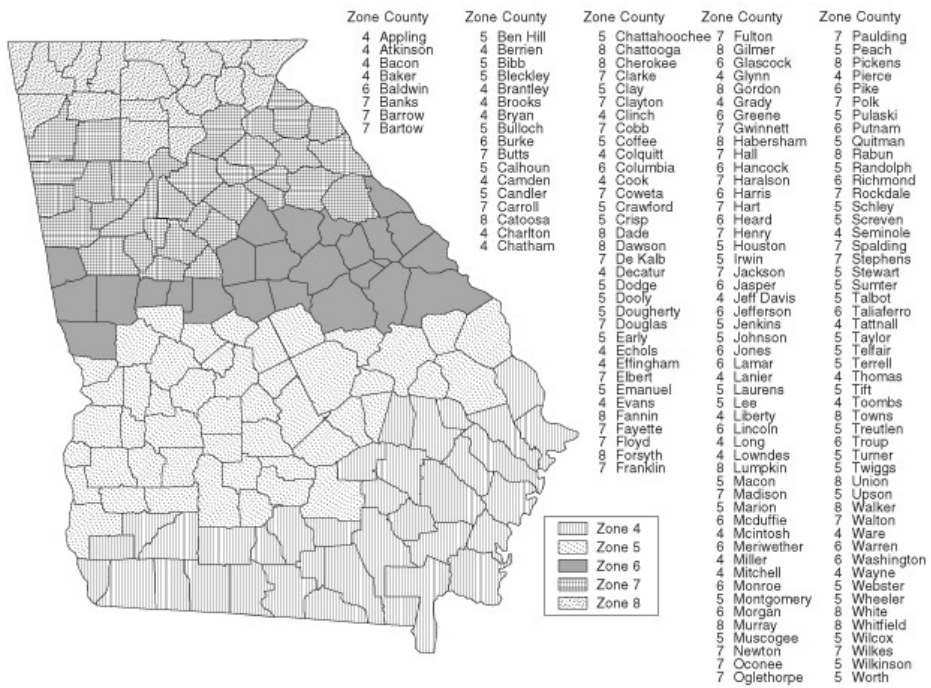
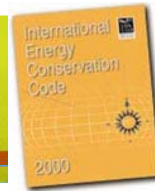
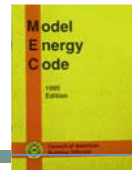
City	HDD ₆₅
Atlanta	3,000
Augusta	2,550
Columbus	2,250
Dalton	3,550
Gainesville	3,500
Macon	2,300
Savannah	1,850
Valdosta	1,550
<i>Miami</i>	<i>200</i>
<i>Fairbanks</i>	<i>14,000</i>

U_0 WALLS—GROUP R BUILDINGS—HEATING



ANNUAL FAHRENHEIT (Celsius) HEATING DEGREE DAYS (in thousands) (65°F. BASE)

Five Climate Zones for Georgia (~500 HDD increments)



Chapter 5 - Component Performance

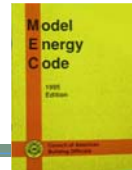


Table 502.2.4(2)
PRESCRIPTIVE BUILDING ENVELOPE REQUIREMENTS, TYPE A-1 RESIDENTIAL BUILDINGS
WINDOW + DOOR AREA IS PERCENT OF GROSS EXTERIOR WALL AREA

CLIMATE ZONE FROM FIGURE 302.1(11)	Maximum		Minimum					
	Glazing U-factor ¹	SHGC ¹	Ceiling R-value ^{2,3}	Exterior Wall R-value ⁴	Floor R-value	Basement Wall R-value	Slab Perimeter R-value ⁵	Crawlspace wall R-value
4B	0.65	0.40	R-30	R-13	R-11	R-5	R-0	R-5
5A	0.55	0.40	R-30	R-13	R-11	R-5	R-0	R-6
6B-1	0.55	0.40	R-30	R-15	R-19	R-6	R-0	R-7
6B-2	0.55	0.40	R-38	R-13	R-19	R-6	R-0	R-7
7A-1	0.55	0.40	R-38 ³	R-16	R-19	R-7	R-0	R-8
7A-2	0.55	0.40	R-38	R-15	R-19	R-7	R-0	R-8
7A-3	0.45	0.40	R-30	R-13	R-19	R-7	R-0	R-8
8-1	0.50	0.40	R-38 ³	R-16	R-19	R-8	R-0	R-10
8-2	0.45	0.40	R-38	R-13	R-19	R-8	R-0	R-10

- Note 1: Up to 5% of the fenestration may be exempt from meeting the window U-factor and Solar Heat Gain Coefficient (SHGC) requirements to allow for decorative glazing.
- Note 2: Up to 25% of sloped ceiling area may be R-19 in Climate Zones 4B, 5A, 6B, 7A, and 8.
- Note 3: May use R-30 for these packages instead of R-38 where construction techniques are employed to obtain the full height of insulation. See paragraph 502.2.4.5.
- Note 4: When the Exterior Wall R-value is cavity insulation and continuous insulated sheathing, 25% of the gross wall area may be Plywood/OSB (for corner bracing/structural requirements) or gypsum fastened direct to the garage wall studs.
- Note 5: Foam plastics shall not be installed on the exterior of below grade foundation walls or below grade on slab foundations. See paragraph 502.2.1.4.

Chapter 5 - Component Performance

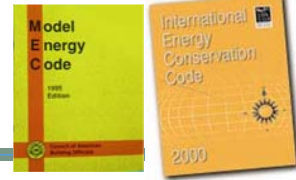


Table 502.2.4(1)
PRESCRIPTIVE BUILDING ENVELOPE REQUIREMENTS, TYPE A-1 RESIDENTIAL BUILDINGS
WINDOW + DOOR AREA 15 PERCENT OF GROSS EXTERIOR WALL AREA

CLIMATE ZONE FROM FIGURE 302.1(11)	Maximum		Minimum					
	Glazing U-factor ¹	SHGC ¹	Ceiling R-value ²	Exterior Wall R-value ³	Floor R-value	Basement Wall R-value	Slab perimeter R-value ⁴	Crawlspace wall R-value
4B	0.65	0.40	R-30	R-13	R-11	R-5	R-0	R-5
5A	0.65	0.40	R-30	R-13	R-11	R-5	R-0	R-6
6B	0.65	0.40	R-30	R-13	R-19	R-6	R-0	R-7
7A-1	0.55	0.40	R-30	R-13	R-19	R-7	R-0	R-8
7A-2	0.65	0.40	R-38	R-16	R-19	R-7	R-0	R-8
8	0.55	0.40	R-30	R-16	R-19	R-8	R-0	R-10

Note 1: Up to 5% of the fenestration may be exempt from meeting the window U-factor and Solar Heat Gain Coefficient (SHGC) requirements to allow for decorative glazing.

Note 2: Up to 25% of sloped ceiling area may be R-19 in Climate Zones 4B, 5A, 6B, 7A, and 8.

Note 3: When the Exterior Wall R-value is cavity insulation and continuous insulated sheathing, 25% of the gross wall area may be Plywood/OSB (for corner bracing/structural requirements) or gypsum fastened direct to the garage wall studs.

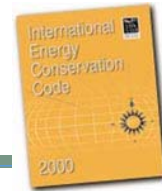
Note 4: Foam plastics shall not be installed on the exterior of below grade foundation walls or below grade on slab foundations. See paragraph 502.2.1.4.

- Upshot is that single pane windows were mostly eliminated by energy code

Energy Code Trivia #1

1. Which version of the code specifically calls out the requirement that low-e window technology be installed?
 - a. None, low-e windows aren't specifically referenced in the code
 - b. IECC 2006 and beyond
 - c. IECC 2015 and beyond
 - d. All energy codes since the MEC 1992 have specified low-e technology

2000 IECC Major Energy Code Impact



- 502.1.5 Fenestration Solar Heat Gain Coefficient

- “In locations with heating degree days less than 3,500, the combined solar heat gain coefficient (the area weighted average) of all glazed fenestration products (including the effects of any permanent exterior solar shading devices) in the building shall not exceed 0.4.”

- **0.40** SHGC for all of GA (GA 502.1.5 amendment)

- 5% exemption (section 502.2.4.4)

- REScheck offers SHGC compliance tools

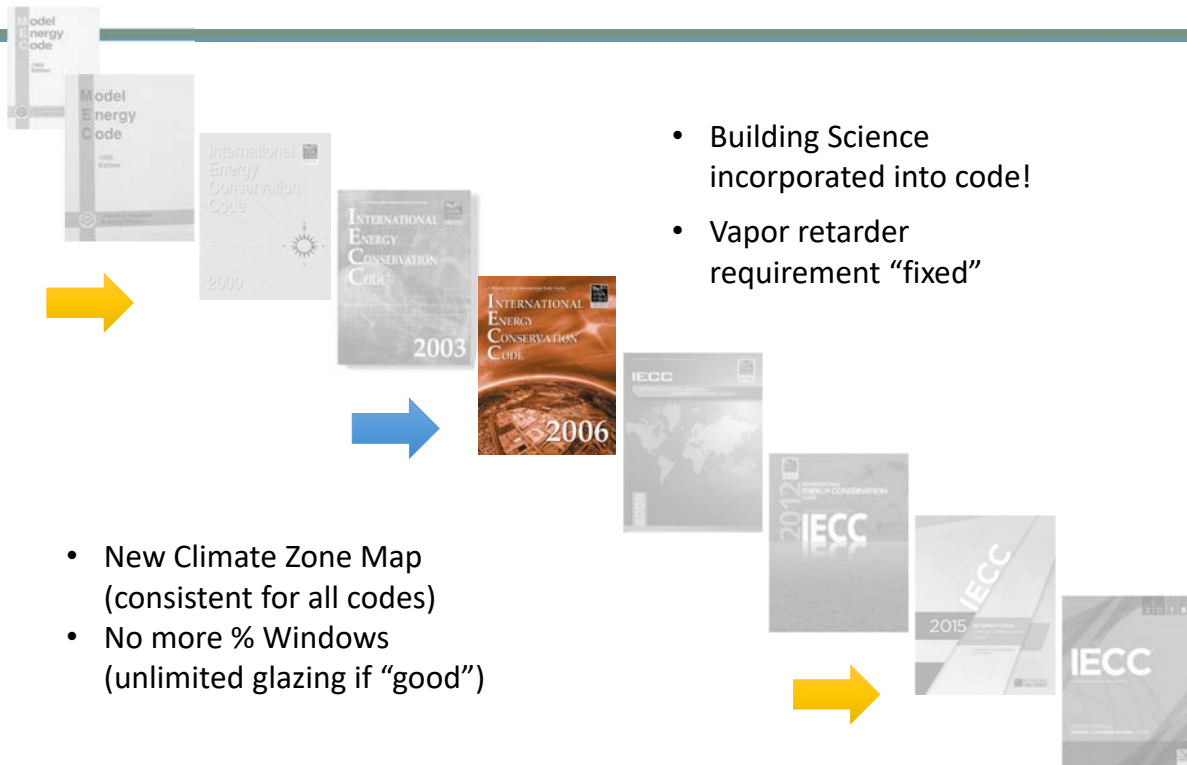
- Labels with U-factor and SHGC info in 2003

- **Max. U-factor = 0.65 and SHGC = 0.40 for GA in 2004**

- “Low-e” never actually mentioned in code (but low-e effectively required everywhere in south)



Energy Codes – Big Overhaul in 2006!



Energy Code Trivia #2

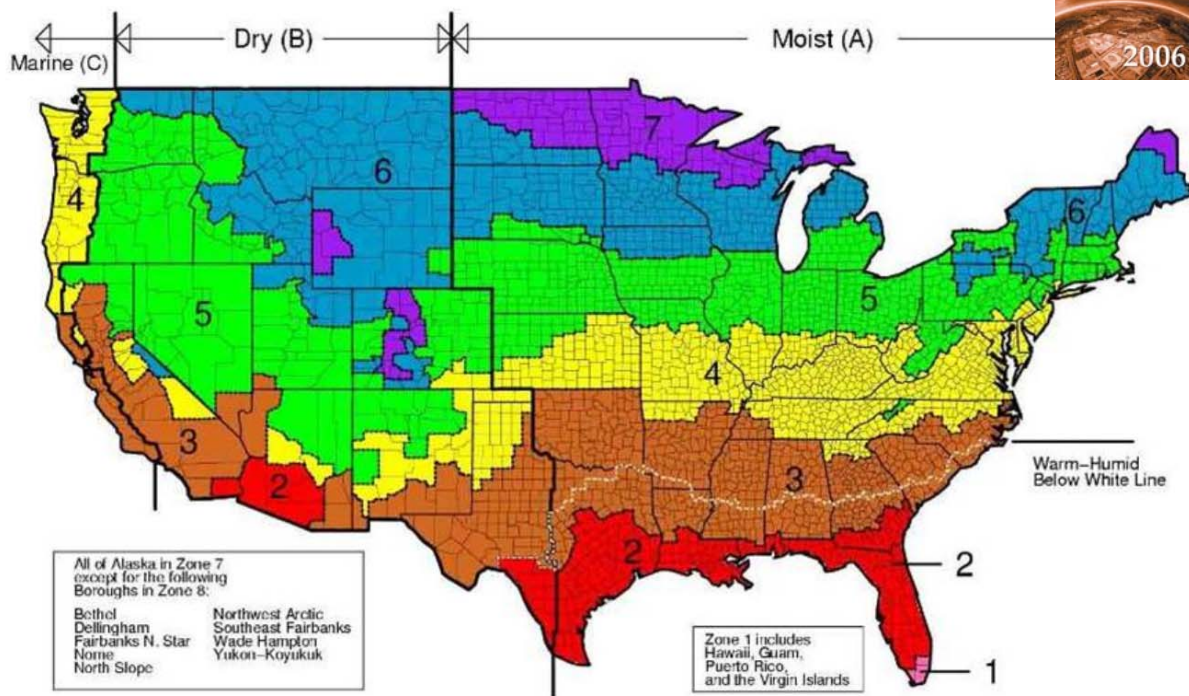
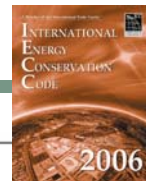
2. For the 2006 IECC CZ map simplification, how many Climate Zones for the *continental US*?

- a. 4
- b. 5
- c. 6
- d. 7

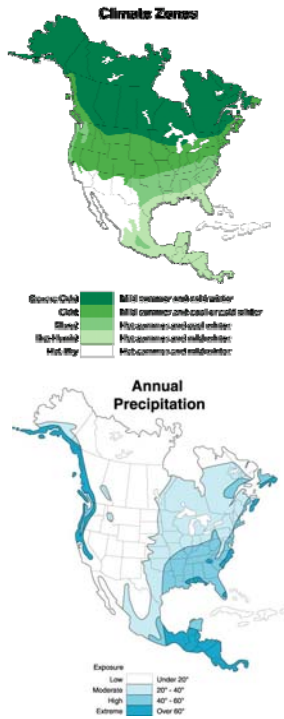
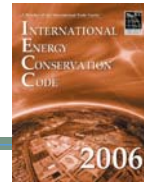
15

2006 IECC Climate Zones

- New Climate Zones (CZ) are a blend of politics and climate!
- Based on counties
- Fewer CZ's = simpler



Building science climate zones



2006 Energy Code – Prescriptive R & U Tables



TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT*

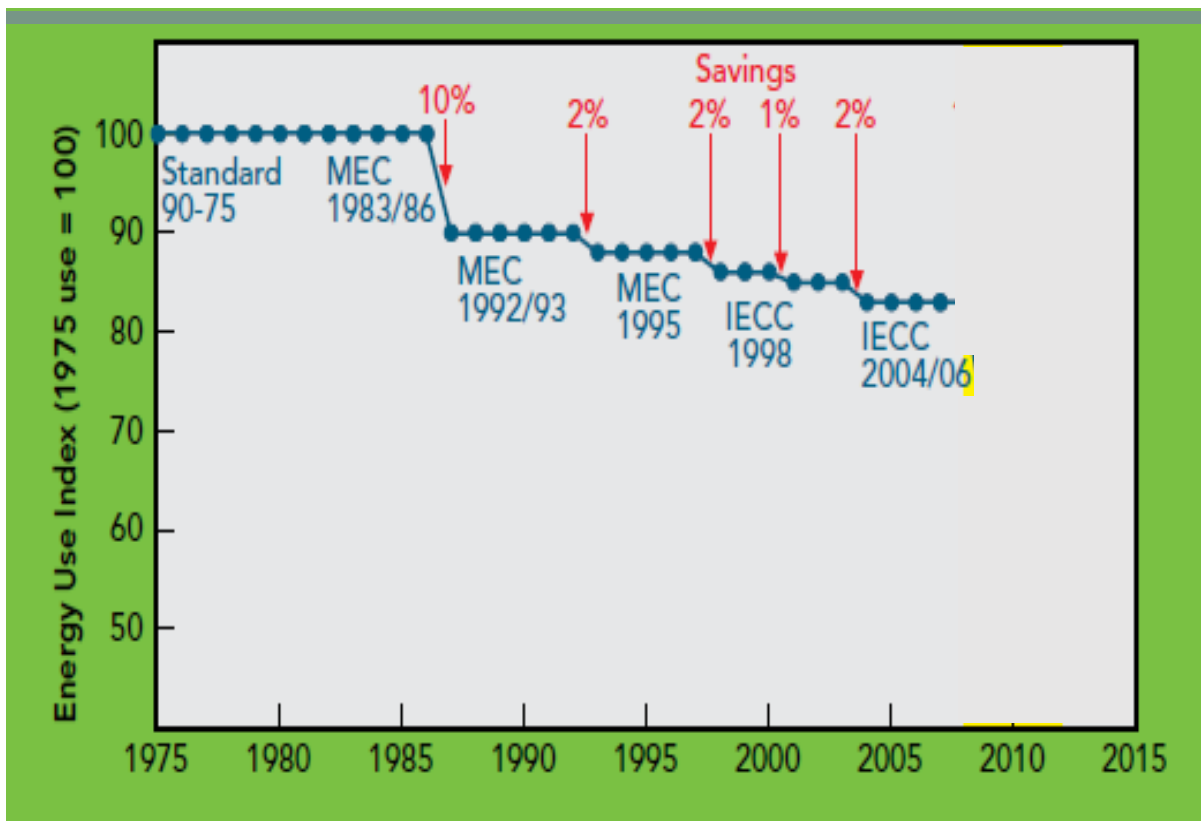
CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT ^c WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^e WALL R-VALUE
1	1.20	0.75	0.40	30	13	3	13	0	0	0
2	0.75	0.75	0.40	30	13	4	13	0	0	0
3	0.65	0.65	0.40 ^f	30	13	5	19	0	0	5 / 13
4 except Marine	0.40	0.60	NR	38	13	5	19	10 / 13	10, 2 ft	10 / 13
5 and Marine 4	0.35	0.60	NR	38	19 or 13+5 ^g	13	30 ^f	10 / 13	10, 2 ft	10 / 13
6	0.35	0.60	NR	49	19 or 13+5 ^g	15	30 ^f	10 / 13	10, 4 ft	10 / 13
7 and 8	0.35	0.60	NR	49	21	19	30 ^f	10 / 13	10, 4 ft	10 / 13

TABLE 402.1.3
EQUIVALENT U-FACTORS*

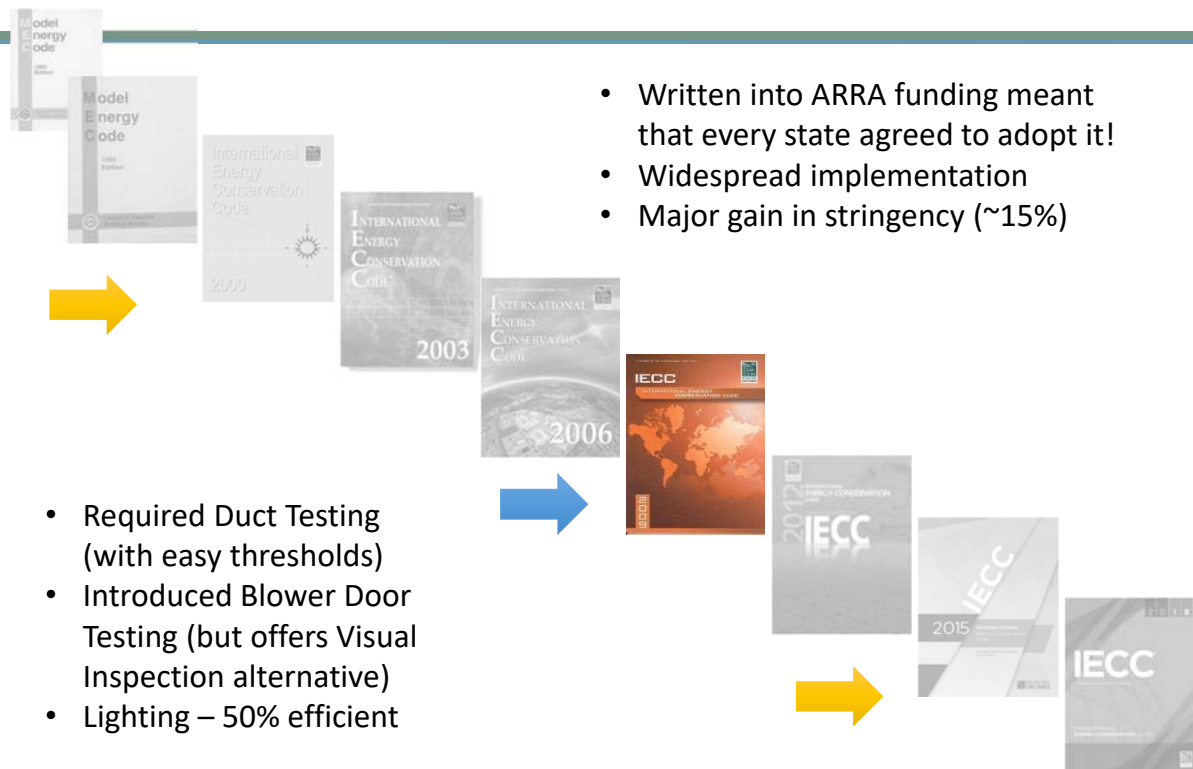
CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	1.2	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.75	0.75	0.035	0.082	0.165	0.064	0.360	0.477
3	0.65	0.65	0.035	0.082	0.141	0.047	0.360	0.136
4 except Marine	0.40	0.60	0.030	0.082	0.141	0.047	0.059	0.065
5 and Marine 4	0.35	0.60	0.030	0.060	0.082	0.033	0.059	0.065
6	0.35	0.60	0.026	0.060	0.06	0.033	0.059	0.065
7 and 8	0.35	0.60	0.026	0.057	0.057	0.033	0.059	0.065

- Why is this table important to HERS Raters?
- (Same as '04 IECC)

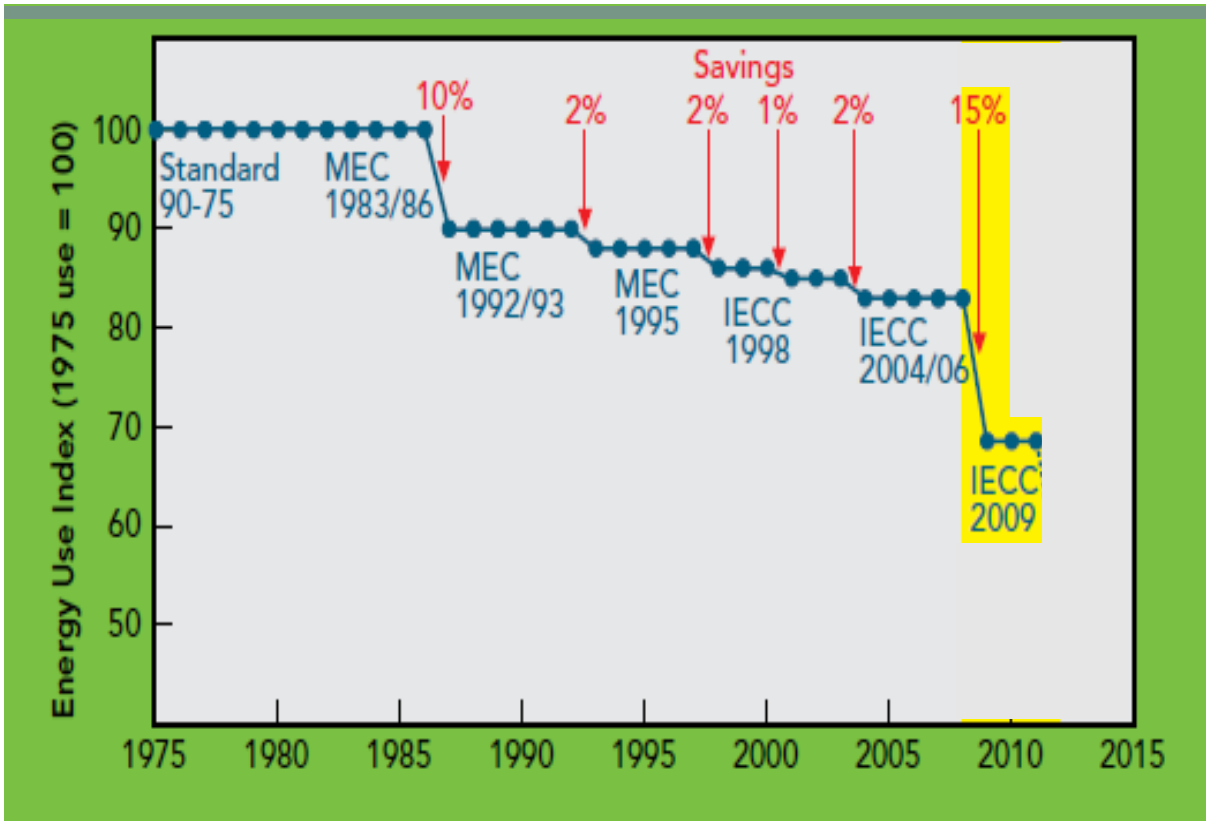
Trajectory of Energy Codes



Energy Codes – Huge Impact of 2009 IECC!

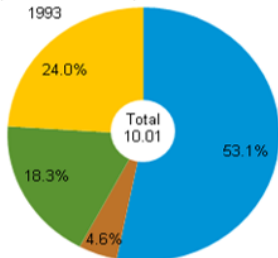


Trajectory of Energy Codes – 2009 IECC



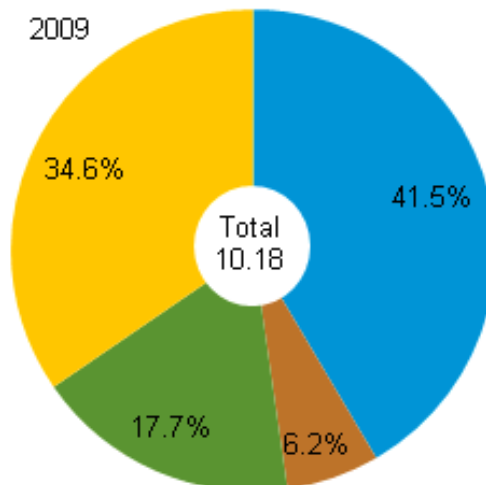
Home Energy Usage – 2009

Energy consumption in homes by end uses
quadrillion Btu and percent



Source: U.S. Energy Information Administration, Residential Energy Consumption Survey.
*Note: Amounts represent the energy consumption in occupied primary housing units.

-Goal: Shrink the pie!
-Usage shifts



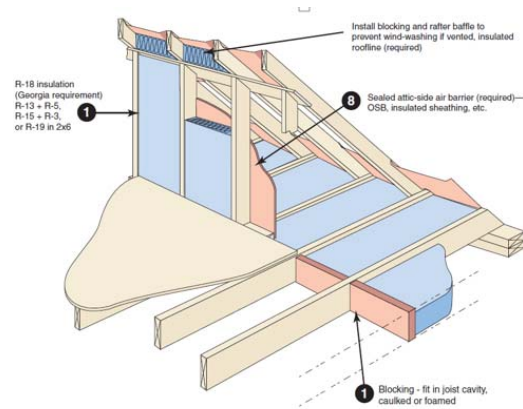
- Size of pie stayed same
- First time ever:
Heating + Cooling < 50%

2009 IECC Airsealing and Insulation Checklist

**TABLE 402.4.2
AIR BARRIER AND INSULATION INSPECTION COMPONENT CRITERIA**

NUMBER	COMPONENT	CRITERIA
1	Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material. Air-permeable insulation is inside of an air barrier.
2	Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
3	Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
4	Windows and doors	Space between window/door jambs and framing is sealed.
5	Rim joists	Rim joists are insulated and include an air barrier.
6	Floors (including above-garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of insulation.
7	Crawl space walls	Insulation is permanently attached to walls. Exposed earth in unvented crawl spaces is covered with Class I vapor retarder with overlapping joints taped.
8	Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
9	Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by sprayed/blown insulation.
10	Garage separation	Air sealing is provided between the garage and conditioned spaces.
11	Recessed lighting	Recessed light fixtures are air tight, IC rated, and sealed to drywall. Exception—fixtures in conditioned space.
12	Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or sprayed/blown insulation extends behind piping and wiring.
13	Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
14	Electrical/phone box on exterior walls	Air barrier extends behind boxes or air sealed-type boxes are installed.
15	Common wall	Air barrier is installed in common wall between dwelling units.
16	HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
17	Fireplace	Fireplace walls include an air barrier.

- Good concept
- Not a good substitute for BD test!
- Graphics would make it more valuable



Performance Testing in the Energy Code!

■ Performance testing of house leakage Option

- Blower door result must be less than **7 ACH₅₀**

■ Visual Inspection Option

- Use Code Checklist (“thermal bypass”)
- Requires multiple inspections
 - Framing stage / pre-drywall
 - Final

■ Leak testing of ducts Required*

- When tested at rough-in
 - Max. 6% leakage with AHU installed
 - Max. 4% leakage before AHU installed
- When tested at final
 - Maximum 8% – Leakage to Outside
 - Maximum 12% – Total Leakage

*duct leakage in CFM25 based on % floor area; Testing not required if ducts and air handler are inside the envelope.



Energy Code Trivia #3

3. When did Duct Leakage and Blower Door testing first become *required* by energy code?
- a. Ducts are still optional, BD required in 2015-18 IECC
 - b. Ducts: 2006 IECC, BD: 2009 IECC
 - c. Ducts: 2009 IECC, BD: 2012 IECC
 - d. Ducts: 2009 IECC, BD: 2009 IECC

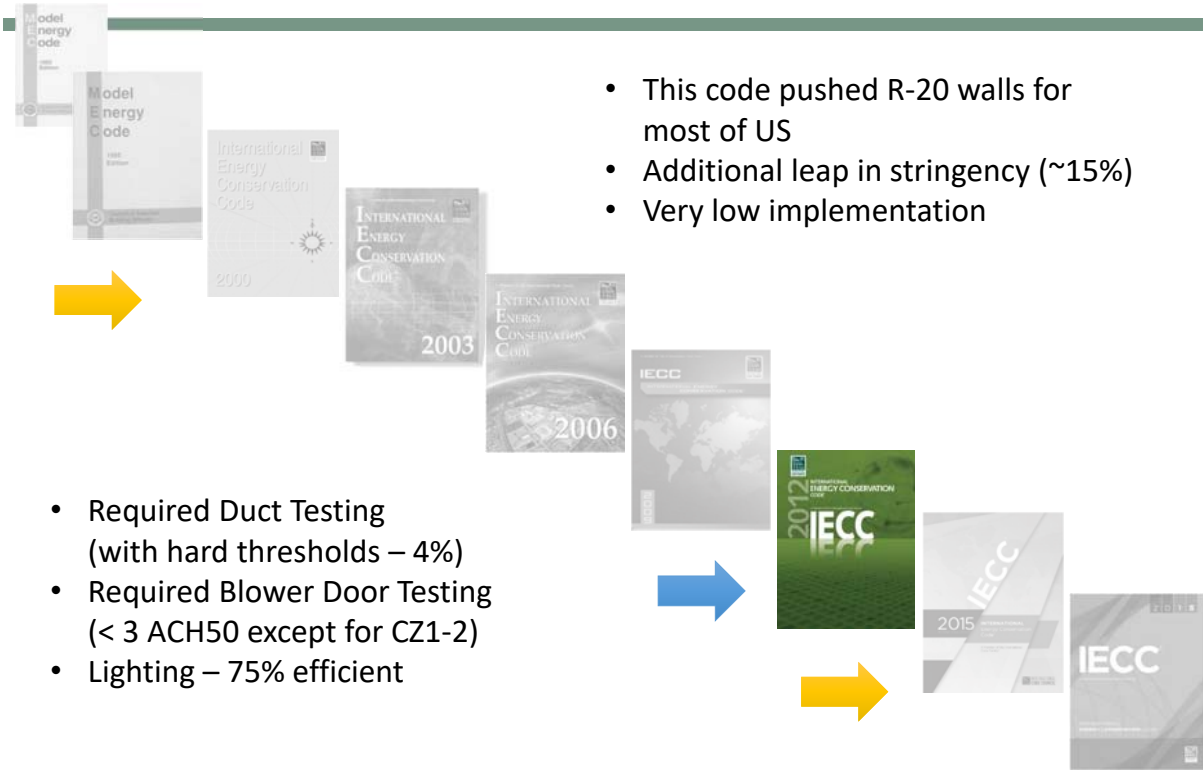
25

Efficient Lighting in the Energy Code!

- Lighting
 - 50% of lamps in permanently installed fixtures shall be high efficacy lamps
 - 60 lumens per watt if over 40 W
 - 50 lumens per watt if between 40 and 15 W
 - 40 lumens per watt if 15 W less
- Measure with lowest compliance!



2012 IECC – Pushing the Envelope



- This code pushed R-20 walls for most of US
- Additional leap in stringency (~15%)
- Very low implementation

- Required Duct Testing (with hard thresholds – 4%)
- Required Blower Door Testing (< 3 ACH50 except for CZ1-2)
- Lighting – 75% efficient

IECC 2012/15/18 Prescriptive Code: Changes from 2009 by Climate Zone



**TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT***

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^a U-FACTOR	GLAZED FENESTRATION SHGC ^{c,d}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE ^e	FLOOR R-VALUE	BASEMENT ^f WALL R-VALUE	SLAB ^g R-VALUE & DEPTH	CRAWL SPACE ^h WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5 ^b	8/13	19	5/13 ^f	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5 ^b	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5 ^b	13/17	30 ^f	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10 ^b	15/20	30 ^f	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10 ^b	19/21	38 ^f	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

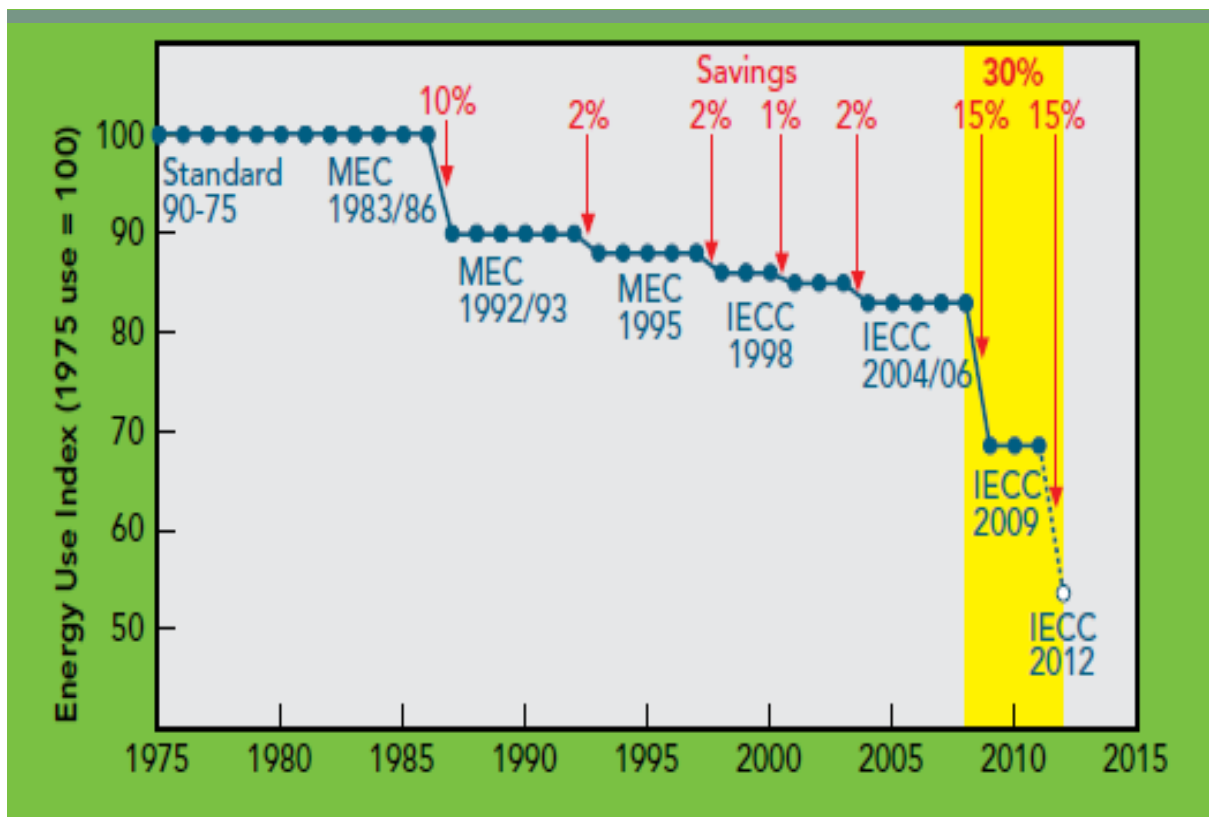
- R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.
- The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.
- "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
- R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.
- There are no SHGC requirements in the Marine Zone.
- Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.
- Or insulation sufficient to fill the framing cavity, R-19 minimum.
- First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.
- The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

Energy Code Trivia #4

4. Which two codes, when adopted, result in a net stringency gain of ~30% over the previous code?

- a. 2006 & 2009 IECC
- b. 2009 & 2012 IECC
- c. 2012 & 2015 IECC
- d. 2015 & 2018 IECC

Trajectory of Energy Codes – 2012 IECC



Energy Code Trivia #5

5. Which of these appliances does the energy code regulate?
- a. TV
 - b. Clothes dryer
 - c. Water heater
 - d. Refrigerator
 - e. None of the above

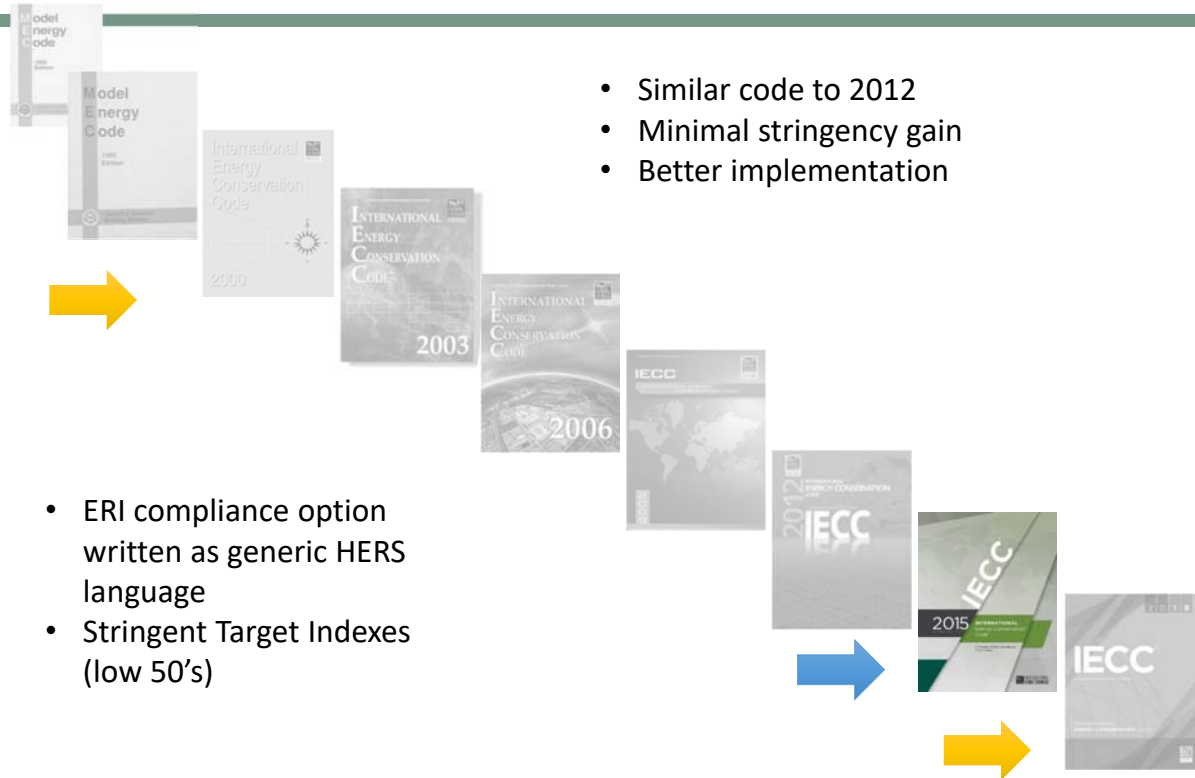
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Energy Code Trivia #6

6. Which of the following compliance options is the most recently added in the code?
- a. Prescriptive path
 - b. UA trade-off (e.g., RESCheck)
 - c. Simulated Performance Alternative
 - d. Energy Rating Index (ERI)

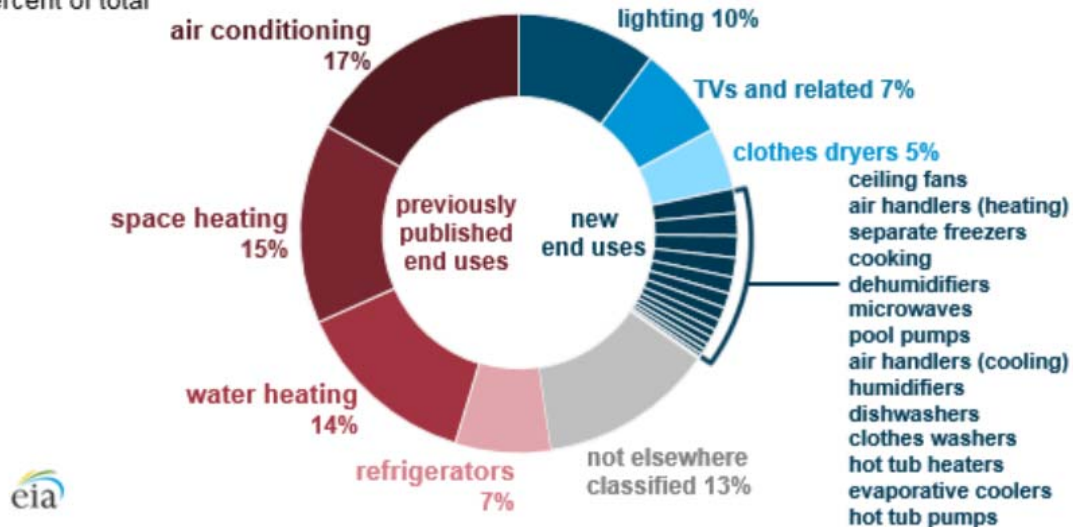
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2015 IECC – ERI: A New Compliance Option



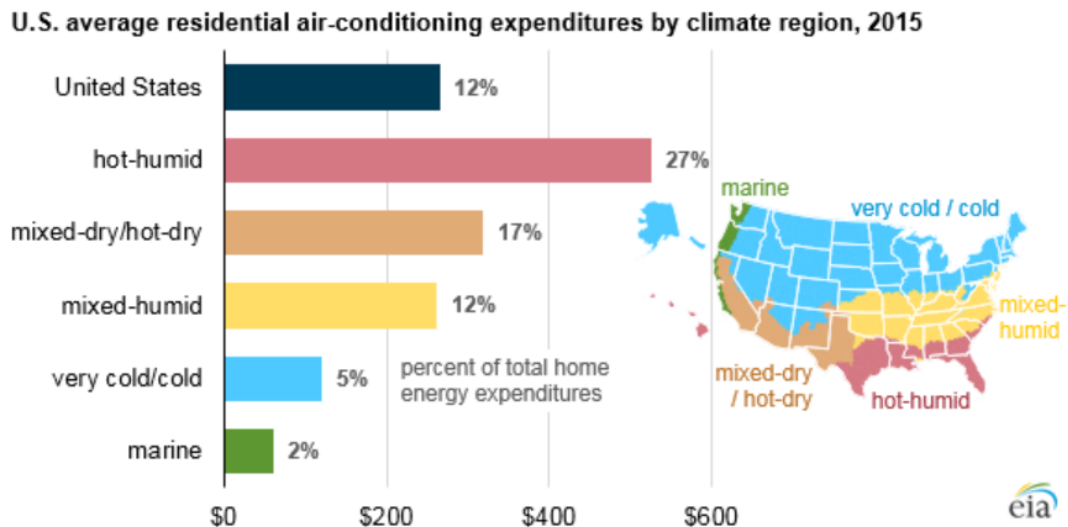
Home Energy Usage Breakdown – 2015

Residential electricity consumption by end use, 2015
percent of total



AC Usage Varies Greatly

Air conditioning accounts for about 12% of U.S. home energy expenditures



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Energy Code Trivia #7

7. Energy codes have helped homes become more efficient today than in the past, so why might homes still use about the same amount of energy?
- Heating and cooling in homes today have increased over the past 30 years
 - Ducts are tighter but insulation is the same R-value in walls and ceilings
 - Homes are larger and have more appliance and plug loads
 - Home builders no longer pay attention to solar orientation

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Energy Code Trivia #8

8. Which version(s) of the code have historically been used by RESNET as the basis of creating the HERS Reference Home?
- 1995 MEC
 - 1993 MEC and 2004/06 IECC
 - 2015 IECC
 - The HERS Reference Home changes with each new code adoption

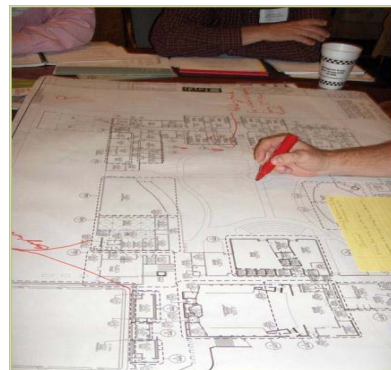
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Explaining the Energy Rating Index



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)

$$\text{Index} = 100 \times \frac{\begin{matrix} 40 & 30 & 30 & 50 \\ \text{[Rated Home's Htg + Clg + WtrH + L.A.]} \end{matrix}}{\begin{matrix} 70 & 20 & 30 & 80 \\ \text{[Refer. Home's Htg + Clg + WtrH + L.A.]} \end{matrix}} = 75$$

Energy Code Trivia #9

9. Which version of the code offers credit for a more efficient heating and cooling system?

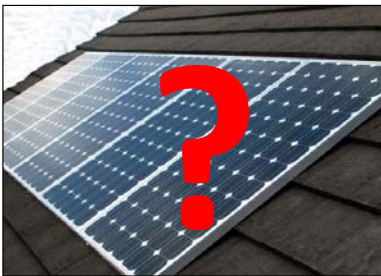
- a. 2000 IECC
- b. 2006 IECC
- c. 2009 IECC
- d. 2015 IECC

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Benefits of choosing the ERI



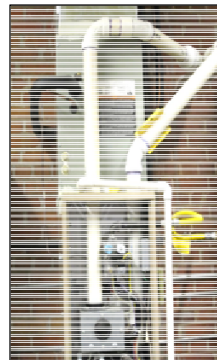
The ERI may allow more options in materials choice, technologies and innovative strategies than the simulated performance path



Renewable energy is credited (with some constraints)



Better appliances are credited in ERI



High efficiency furnace (plastic flue pipe) is credited



Efficient lighting > 75% benefits the energy index

Energy Code Trivia #10

10. Unlike a HERS Rating, which simply rates the home as built, a home complying with code using the 2015 ERI pathway limits trading the building envelope to be no worse than...?

- a. The 1993 MEC
- b. The 2000 IECC
- c. The 2006 IECC
- d. The 2009 IECC

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Explaining the Energy Rating Index



TABLE R406.4
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX
1	52
2	52
3	51
4	54
5	55
6	54
7	53
8	53

1. 2015 IECC targets

- Low 50's

2. Who Can Do This?

- 3rd party – HERS Rater
- Approved software

3. Benefits

- Greater design flexibility
- High efficiency equipment and appliances credited

4. Backstops

- 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.)



Pros and Cons of ERI?

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?”



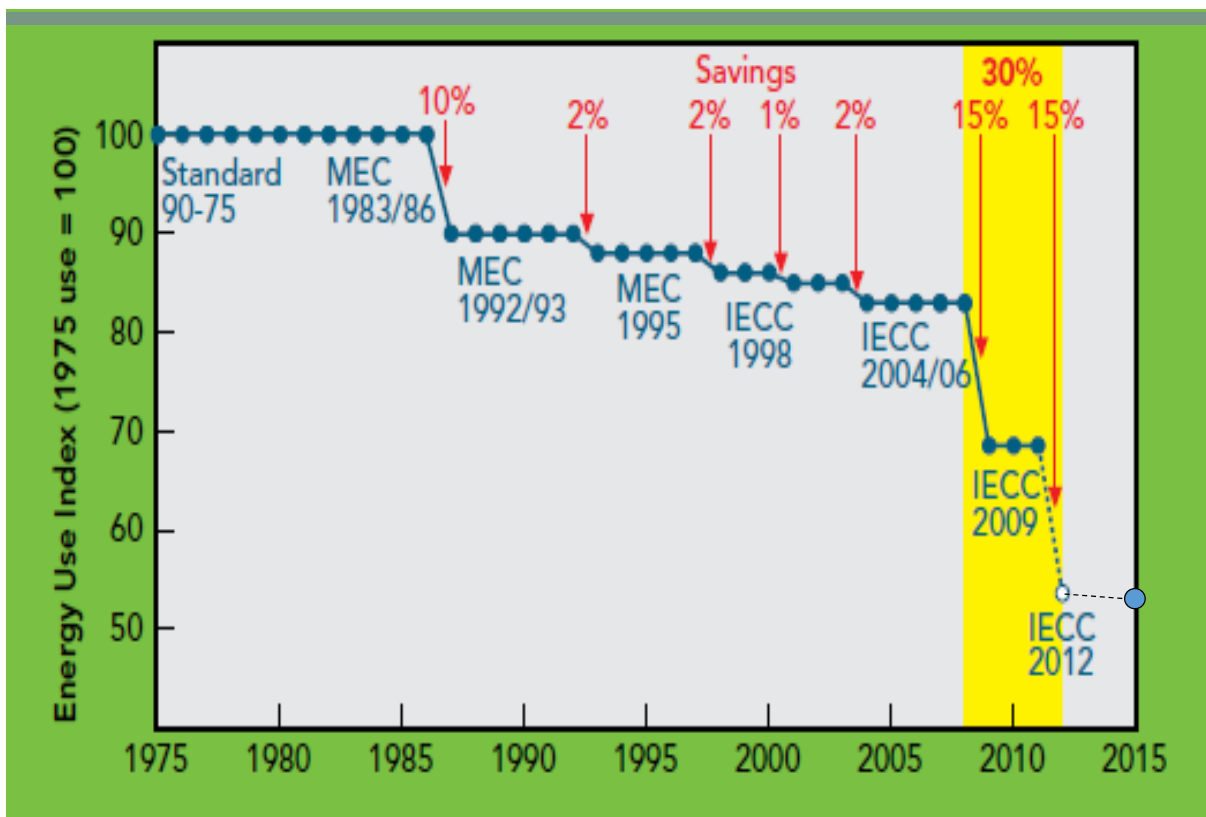
2. Benefits

- **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



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Trajectory of Energy Codes – 2015 IECC



2018 IECC – ERI: references ANSI/RESNET 301

- Similar code to 2015
- Minimal stringency gain
- Lighting 90% efficient

- ERI compliance option now references Std 301
- Target Indexes eased (Hi 50's - low 60's)

TABLE R406.4
MAXIMUM ENERGY RATING INDEX

CLIMATE ZONE	ENERGY RATING INDEX	ENERGY RATING INDEX*
1	52	57
2	52	57
3	51	57
4	54	62
5	55	61
6	54	61
7	53	58
8	53	58

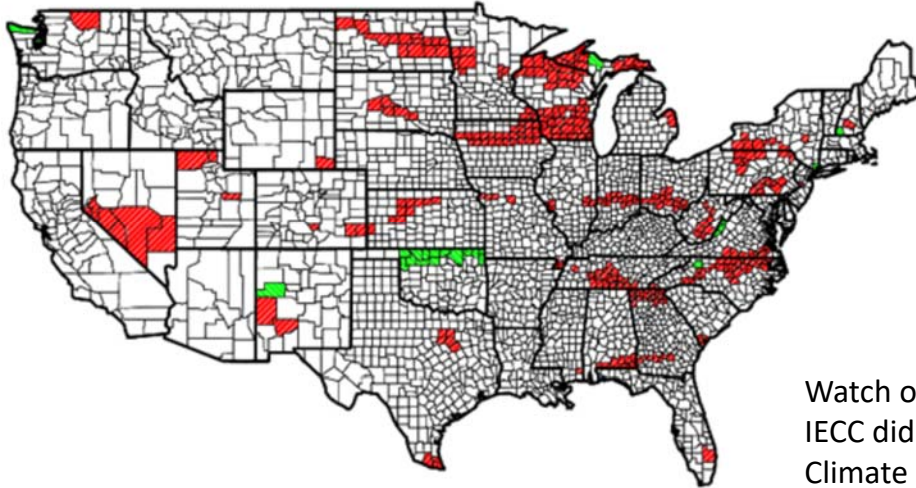
Energy Code Trivia #11

11. Both ASHRAE 90.1 and the IECC have Climate Zone maps. After 2015, these maps are the same...

True or False?

ASHRAE 90.1-2016 Climate Zones

RED: Counties moving to warmer zones (requirements generally get less stringent)
GREEN: Counties moving to colder zones (requirements generally get more stringent)



Watch out! The 2018 IECC did not change the Climate Zone map!

Energy Codes Still Aren't User Friendly (but they have gotten better!)

R401.2 Compliance. Projects shall comply with one of the following:

1. Sections R401 through R404.
2. Section R405 and the provisions of Sections R401 through R404 indicated as "Mandatory."
3. The energy rating index (ERI) approach in Section

SECTION R402 BUILDING THERMAL ENVELOPE

R402.1 General (Prescriptive). The *building thermal envelope* shall comply with the requirements of Sections R402.1.1 through R402.1.5.

R402.1.1 Vapor retarder. Wall assemblies in the *building thermal envelope* shall comply with the vapor retarder requirements of Section R702.7 of the *International Residential Code* or Section 1405.3 of the *International Building Code*, as applicable.

R402.1.2 Insulation and fenestration criteria. The *building thermal envelope* shall meet the requirements of Table R402.1.2, based on the *climate zone* specified in Chapter 3.

R402.1.3 R-value computation. Insulation material used in layers, such as framing cavity insulation or continuous

insulation, shall be summed to compute the corresponding component *R-value*. The manufacturer's settled *R-value* shall be used for blown-in insulation. Computed *R-values* shall not include an *R-value* for other building materials or air films. Where insulated siding is used for the purpose of complying with the continuous insulation requirements of Table R402.1.2, the manufacturer's labeled *R-value* for the insulated siding shall be reduced by R-0.6.

R402.1.4 U-factor alternative. An assembly with a *U-factor* equal to or less than that specified in Table R402.1.4 shall be an alternative to the *R-value* in Table R402.1.2.

R402.1.5 Total UA alternative. Where the total *building thermal envelope UA*, the sum of *U-factor* times assembly area, is less than or equal to the total UA resulting from multiplying the *U-factors* in Table R402.1.4 by the same assembly area as in the proposed *building*, the *building* shall be considered to be in compliance with Table R402.1.2. The UA calculation shall be performed using a method consistent with the *ASHRAE Handbook of Fundamentals* and shall include the thermal bridging effects of framing materials. In addition to UA compliance, the SHGC requirements shall be met.

R402.2 Specific insulation requirements (Prescriptive). In addition to the requirements of Section R402.1, insulation shall meet the specific requirements of Sections R402.2.1 through R402.2.13.

SECTION R404 ELECTRICAL POWER AND LIGHTING SYSTEMS

R404.1 Lighting equipment (Mandatory). Not less than 90 percent of the permanently installed lighting fixtures shall

R403.1 Control (Mandatory). Not less than 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

R403.1.1 Programmable thermostat. The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature setpoints at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C).

R403.1.2 Heat pump supplementary heat (Mandatory).

Heat pumps having supplementary heat shall have controls that, except supplemental heat operation when

SECTION R405 SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)

R405.1 Scope. This section establishes criteria for compliance using simulated energy performance analysis. Such

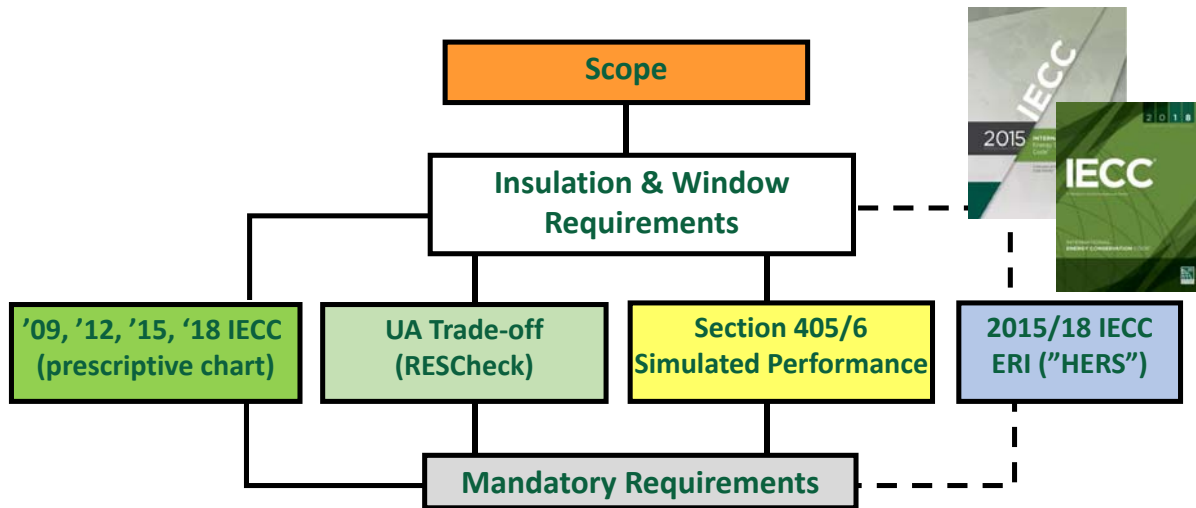
TABLE R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT*

CLIMATE ZONE	FENESTRATION U-FACTOR†	SKYLIGHT‡ U-FACTOR	GLAZED FENESTRATION SHGC**	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASK WALL R-VALUE	FLOOR R-VALUE	BASEMENT‡ WALL R-VALUE	SLAB‡ R-VALUE & DEPTH	CRAWL SPACE‡ WALL R-VALUE
1	NR	0.75	0.25	30	13	3/4	13	7	—	—
2	0.40	0.65	0.25	38	13	4/6	13	7	—	—
3	0.32	0.55	0.25	38	20 or 13+5‡	8/13	19	3†	—	—
4 except Marine	0.32	0.55	0.40	49	20 or 13+5‡	8/13	19	10	—	—
5 and Marine 4	0.30	0.55	NR	49	20 or 13+5‡	13/17	30†	15	—	—
6	0.30	0.55	NR	49	20+5‡ or 13+10†	15/20	30†	15	—	—
7 and 8	0.30	0.55	NR	49	20+5‡ or 13+10†	19/21	38†	15	—	—

R406.1 Scope. This section establishes criteria for compliance using an Energy Rating Index (ERI) analysis.

R406.2 Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 indicated as "Mandatory" and Section R403.5.3 be met. The *building thermal envelope* shall be greater than or equal to levels of efficiency and *Solar Heat Gain Coefficients* in Table 402.1.1 or 402.1.3 of the 2009

Make Energy Codes More User Friendly!



- Thanks to the ERI option, there are four compliance pathways for the home to comply with energy code

A Few Lessons Learned from the Code Trenches

6. The code represents the bottom of the legal barrel – we are boot-strapping up the building stock by raising the code
5. Codes should be seen as an opportunity (but usually somebody will experience some pain)
4. Change is hard (but code change creates a level playing field when implemented)
3. Code enforcement is most easily accomplished at point of sale (low-e windows, HVAC efficiency)
2. Trade-offs provide code flexibility but create confusion for code officials (yes or no is best for them) – *KISS principle reigns*
1. The rater industry can be a huge driver for codes!



Energy Code Trivia #12

12. New homes with federally backed mortgages (e.g., FHA, VA) are required to comply with which code?
- There are no federal requirements
 - 2004/06 IECC
 - 2009 IECC
 - 2018 IECC (or more current)

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Code Resources

From Lauren:

- www.southface.org
- www.seealliance.org
- www.energycodes.gov
- www.iccsafe.org
- [Success with Energy Code Tech Tips for HVAC](#)
- [Insulation installation resources in Spanish](#)
- [DOE Field Study resource](#)
- Nice ventilation video ~30 minutes long, but they do a good job of talking through the why: <https://www.youtube.com/watch?v=PqW-b5GU03c>

Residential Energy Code Field Guides

- Contextual description of code item
- Diagrams & photos to illustrate details

2009 IECC + 2011 GEORGIA AMENDMENTS
RESIDENTIAL ENERGY CODE
FIELD GUIDE

Attic KneeWall

Code Section: 602.1.1.402.1.4
Checklist Item #: F13(g)
Code Value: R-18
Description: An attic kneewall is defined as any vertical or near vertical wall in the building envelope that has conditioned space on one side and attic space on the other side. All attic kneewalls must be insulated and air-sealed. Attic kneewalls may be insulated using R-13-R-2 insulated sheathing, R-15-R-2 insulated sheathing, or R-19 compressed into a 2x6 cavity. The attic side of the kneewall must have a sealed air barrier (rigid is preferred). The top and bottom of the kneewall stud cavity must be blocked and sealed to enclose insulation. Note: If RSI values is used, minimum insulation value for attic kneewalls is R-18 with attic-side air barrier.

Kneewall Air-sealing and Insulation Diagram

CORRECT: Blocked Joist Cavity/Sealed Attic-side Air Barrier

INCORRECT: Unblocked Joist Cavity

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Residential Energy Code Field Guide | 36

Success with Energy Code Series

- Code items broken out by discipline
- “Good” & “Bad” photos show comparative details

Success with 2009 IECC in Georgia:
Tech Tips for Builders
HVAC INSTALLATION

advanced energy
SEEA

5. Do not compress insulated flexible ducts more than the thickness of the insulation.

UNINSULATED BOOT **INSULATED BOOT** **COMPRESSION** **NO COMPRESSION**

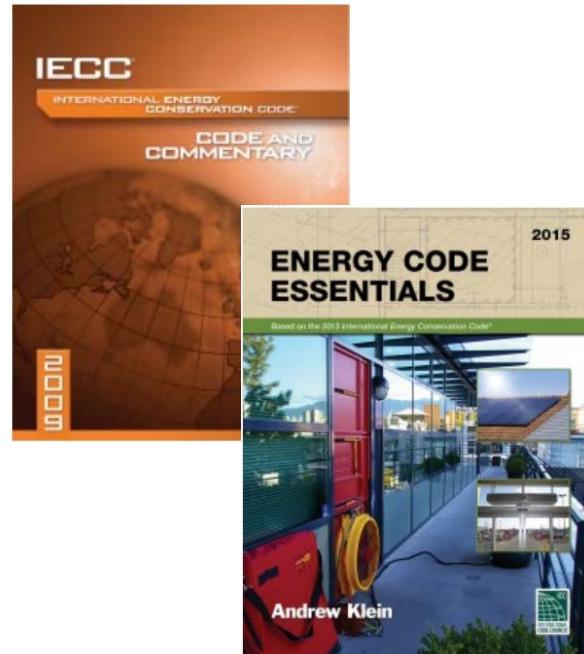
6. Support flexible duct (including spot ventilation) at least every 4 feet and do not bend greater than 90°.

NO SUPPORT **SUPPORT** **GREATER THAN 90°** **LESS THAN 90°**

Success with 2009 IECC in Georgia for Builders

Residential Energy Code – IECC Code Commentary

- Code with descriptive language and some background and context
- Some crude photos and diagrams
- 2015 has “Companion Guide”



Energy Code Trivia #13

13. Experience has shown which of the following tends to lead to the highest code compliance?
- a. When permit fees are collected to send code official to RESNET conference
 - b. When insulation manufacturers offer deep discounts on out of date insulation products to clear inventory
 - c. Point of sale enforcement – only legally complying components can be sold in the state / jurisdiction
 - d. When energy code inspectors are provided with pepper spray & small firearms

Energy Code Trivia - ANSWERS

1. A
2. D
3. C
4. B
5. E
6. D
7. C
8. B
9. D
10. D
11. False
12. C
13. C



THANK YOU!



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