



# Energy Code Compliance: Opportunities for Raters and Program Administrators



Presented by:

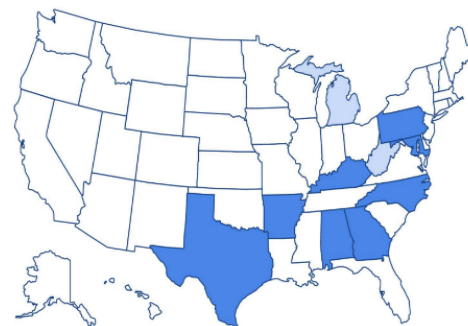
- **Mike Turns**, Performance Systems Development,
- **Amy Dzura**, Southeast Energy Efficiency Alliance
- **Mike Barcik**, Southface Energy Institute

## Residential Energy Code Field Study

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- Phase 1: Baseline field study
- Phase 2: Education and training using info from initial study
- Phase 3: Follow-up field study

Can the case be made  
for utility investment?



# Residential Energy Code Field Study

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## 8 Key Items:

- Above-grade wall insulation
- Ceiling insulation
- Foundation insulation
- Window U-factor
- Window SHGC
- Envelope tightness (ACH50)
- Duct tightness (total leakage test)
- High-efficacy lighting

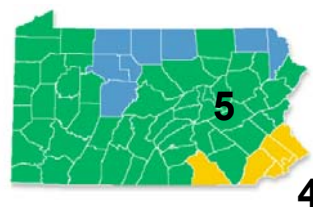


63 observations of each key item minimum

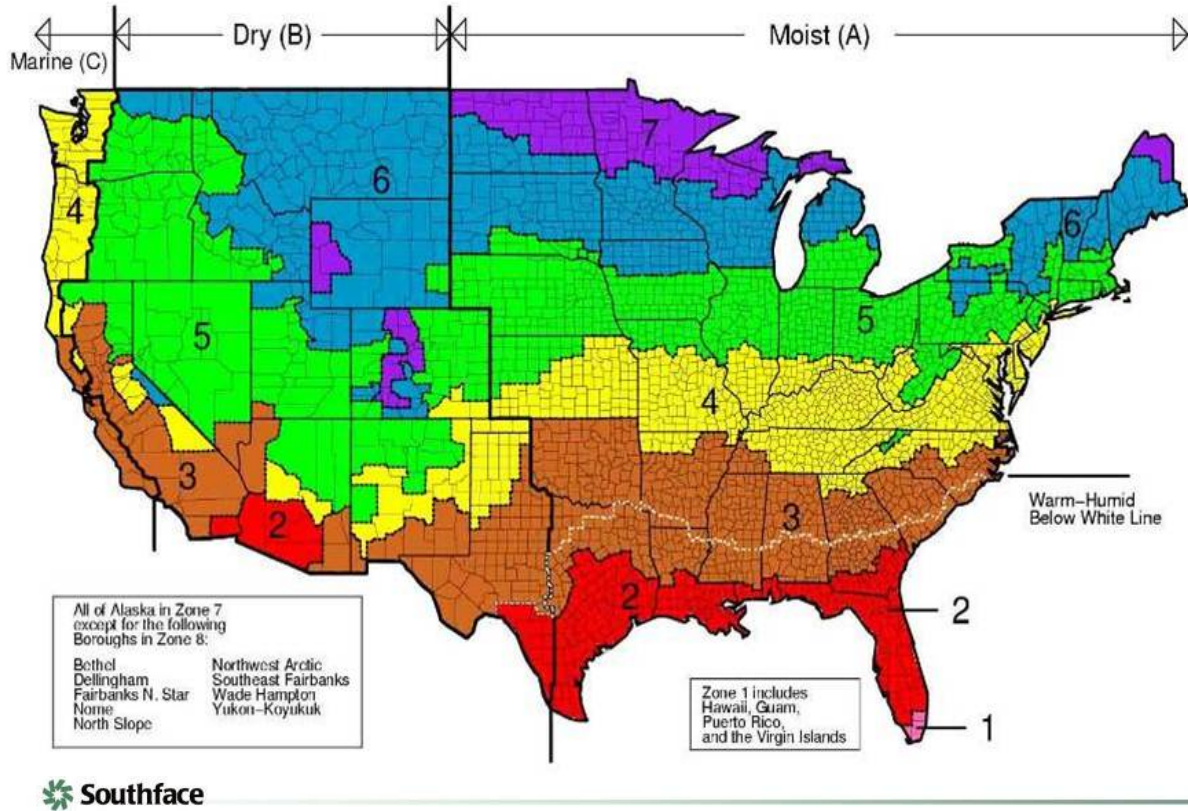
# Residential Energy Code Field Study

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- Random sample of municipalities
- Random sample of homes
- No site visited twice (site visits = 2-4 times 63)
- Modeling to determine savings potential from items with  $\geq 15\%$  non-compliance



# 2009 IECC CLIMATE ZONES



## 2009 IECC Prescriptive Code



Prescriptive envelope requirements of the 2009 IECC mostly represent common industry practice!

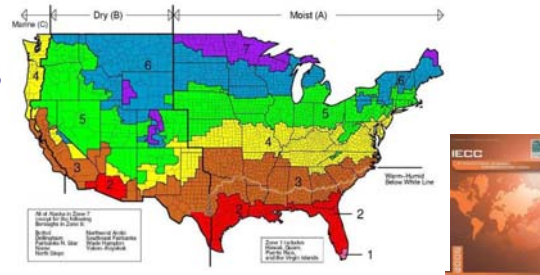


TABLE 402.1.1  
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT<sup>a</sup>

CLIMATE ZONE	FENESTRATION U-FACTOR <sup>b</sup>	SKYLIGHT <sup>b</sup> U-FACTOR	GLAZED FENESTRATION SHGC <sup>b, e</sup>	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>1</sup>	FLOOR R-VALUE	BASEMENT <sup>c</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>c</sup> WALL R-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65 <sup>j</sup>	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50 <sup>j</sup>	0.65	0.30	30	13	5/8	19	5/13 <sup>f</sup>	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5 <sup>h</sup>	13/17	30 <sup>g</sup>	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5 <sup>h</sup>	15/19	30 <sup>g</sup>	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38 <sup>g</sup>	15/19	10, 4 ft	10/13



7

State nickname:



The Keystone State

8

State bird:



Ruffed Grouse

9

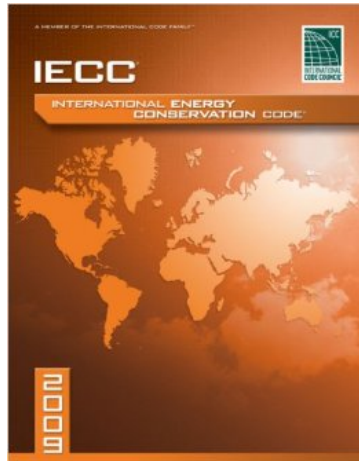
State insect:



Lightning Bug

10

State energy code:



- Duct blaster test required
- Building cavities as returns OK
- No mandatory blower door test
- No DET verifier qualification requirements

- First-year savings if 100% compliance achieved
- Assumes 16,371 homes built
- Electricity savings
  - 8,173 MWh (all PA residential new construction goals = 4,700 MWh)
  - \$1.8 million
- Gas savings
  - 1,233,000 therms
  - \$1.4 million

Total first-year savings \$3.2 million

GEORGIA



State nickname:



The Peach State



GEORGIA



State bird:



The Mosquito



# GEORGIA



State insect:



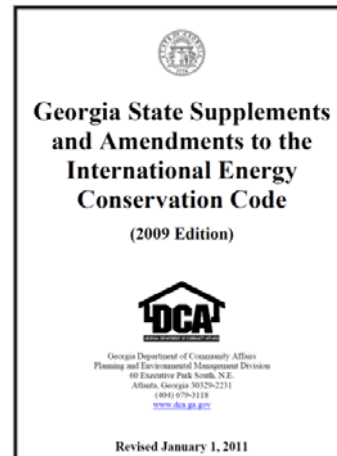
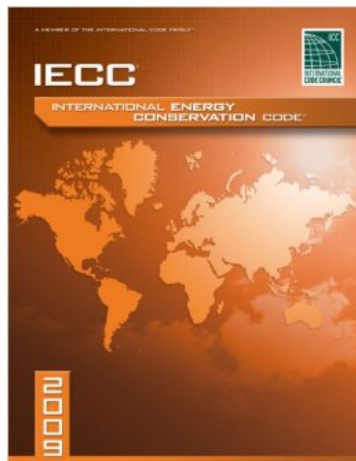
Buzz, The GA Tech Mascot



# GEORGIA CODE



GA's 2011 State Energy Code is based on 2009 IECC with GA Supplements and Amendments



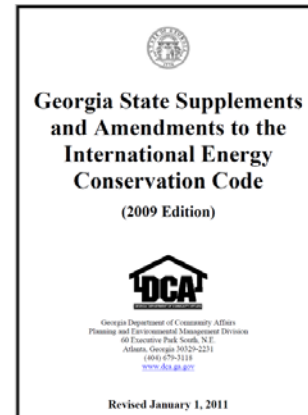


## UNIQUE TO GEORGIA

Ways we have made the code better



1. Improved Kneewalls
2. Consistent, Better Windows
3. Air Sealing Graphics
4. Minimum Insulation Backstop
5. Lighting Vacancy Sensor Credit
6. Ducts – No Cavities, Mastic Required
7. No Electric Furnaces
8. No Powered Attic Ventilators (except solar powered)
9. Mandatory Blower Door and Duct Blaster test
10. DET Verifiers– (qualified individuals who can do testing)



## GEORGIA SAVINGS POTENTIAL



First-year savings if 100% compliance achieved

Electricity savings

- 11,148 MWh
- \$2.41 million

Gas savings

- 547,700 therms
- \$0.78 million

Total first-year savings \$3.1 million



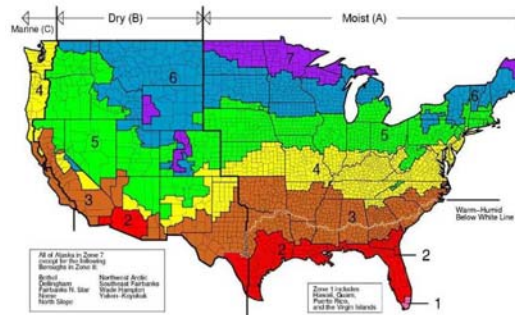


# Foundations

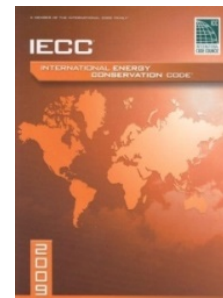
## 2009 IECC - Foundations



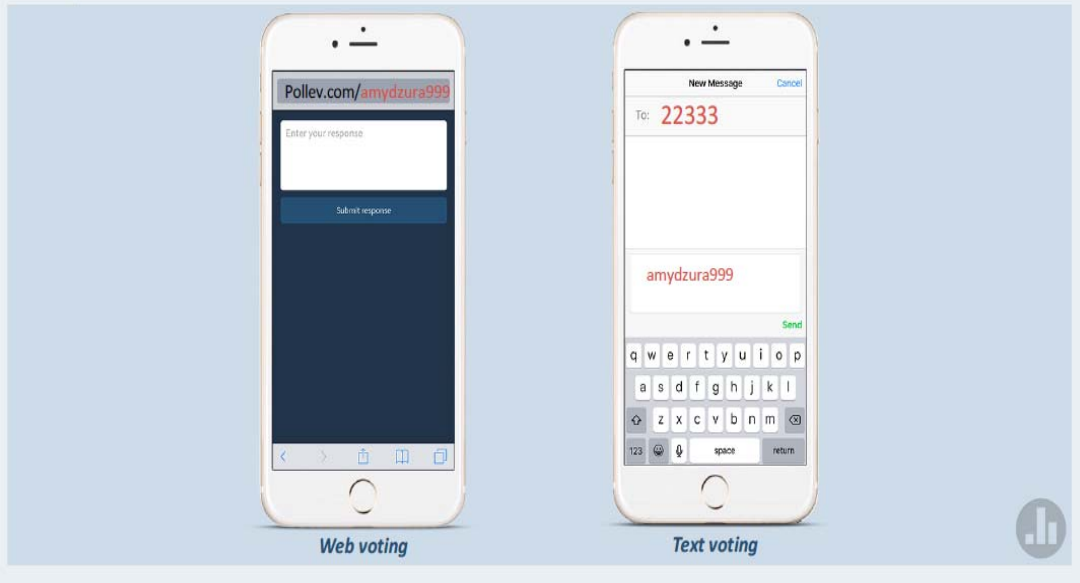
Prescriptive 2009 IECC mostly represent common industry practice!



CLIMATE ZONE	FLOOR R-VALUE	BASEMENT <sup>c</sup> WALL R-VALUE	SLAB <sup>d</sup> R-VALUE & DEPTH	CRAWL SPACE <sup>c</sup> WALL R-VALUE
1	13	0	0	0
2	13	0	0	0
3	19	5/13 <sup>f</sup>	0	5/13
4 except Marine	19	10/13	10, 2 ft	10/13
5 and Marine 4	30 <sup>g</sup>	10/13	10, 2 ft	10/13



## Participating with Poll Everywhere



[Pollev.com/amydzura999](http://Pollev.com/amydzura999)

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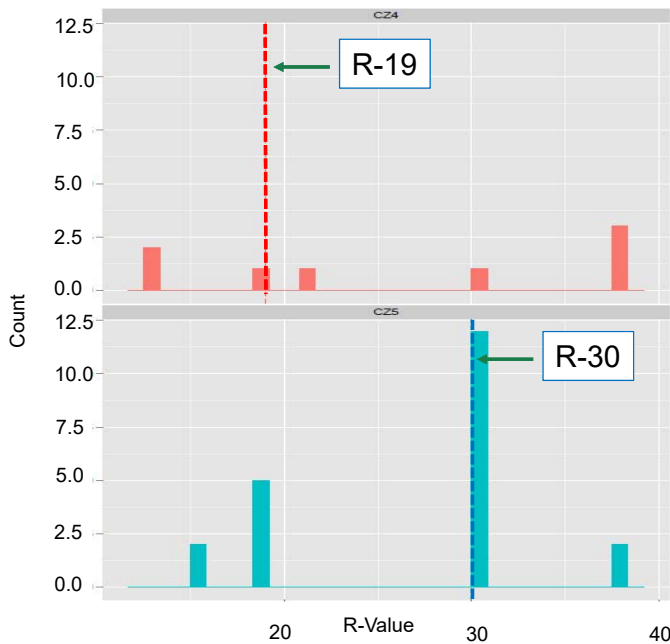
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PA Foundations



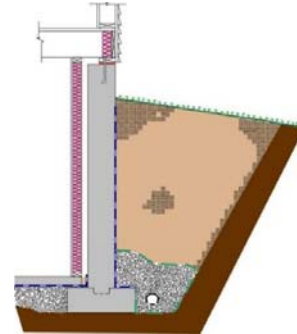
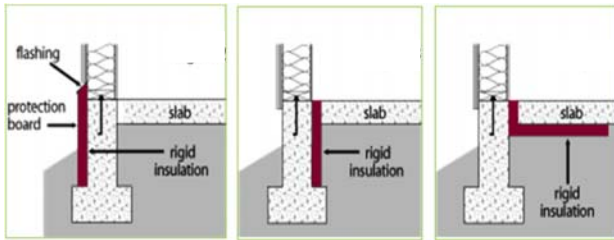
## Floor R-Value (Cavity)



**Climate Zone**  
■ CZ4  
■ CZ5

90% Compliant

- Slab and basement walls

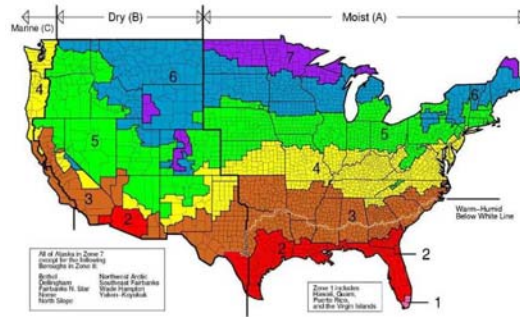


Overall 89% Compliant

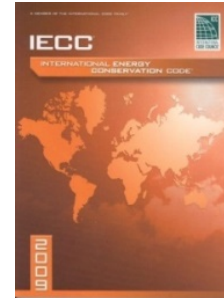


## Above Grade Walls

Prescriptive 2009 IECC mostly represent common industry practice!



CLIMATE ZONE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE <sup>i</sup>
1	13	3/4
2	13	4/6
3	13	5/8
4 except Marine	13	5/10
5 and Marine 4	20 or 13+5 <sup>h</sup>	13/17



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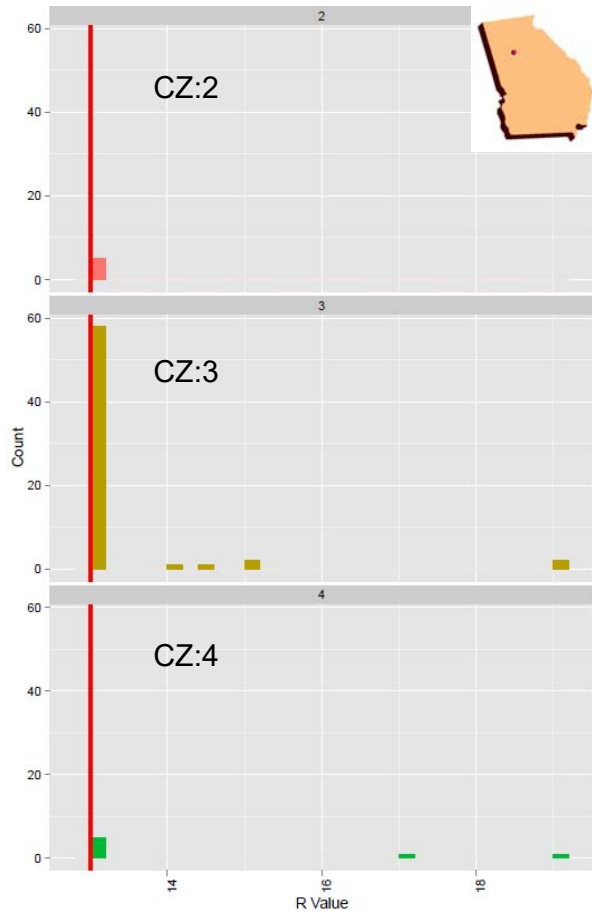
# FRAME WALL R-VALUE (CAVITY)

NO. OF OBSERVATIONS: 76

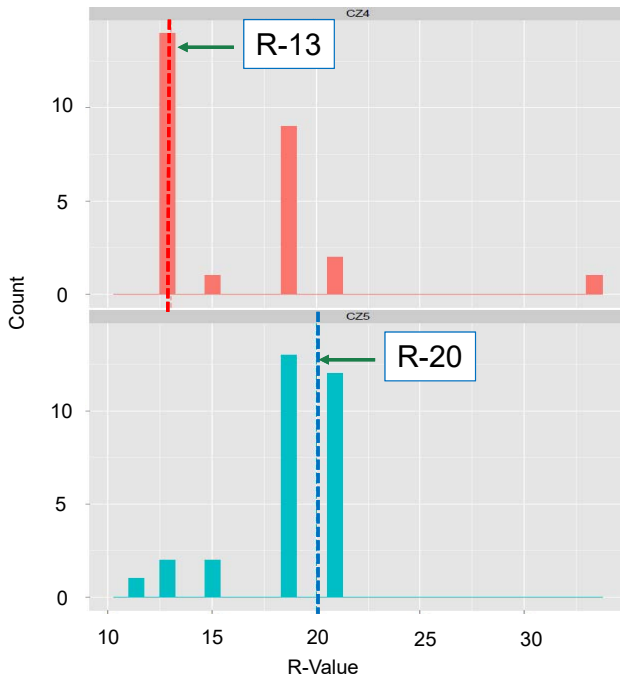
Vertical red line indicates the 2009 IECC prescriptive code requirement of R-13 for all CZ's

Quality of installation (Grade) was generally poor

*Higher is Better!*



## PENN RESIDENTIAL ENERGY CODES Frame Wall R (Cavity Only)



**Climate Zone**  
■ CZ4  
■ CZ5

In Climate Zone 5:  
 15 of 26 (58%) were below R-20





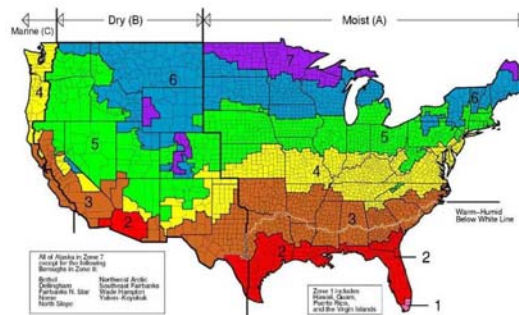
# Ceilings

31

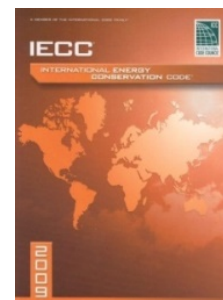
## 2009 IECC - Ceilings



Prescriptive 2009 IECC mostly represent common industry practice!



CLIMATE ZONE	CEILING R-VALUE
1	30
2	30
3	30
4 except Marine	38
5 and Marine 4	38





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Ceiling Insulations

## CEILING R-VALUE

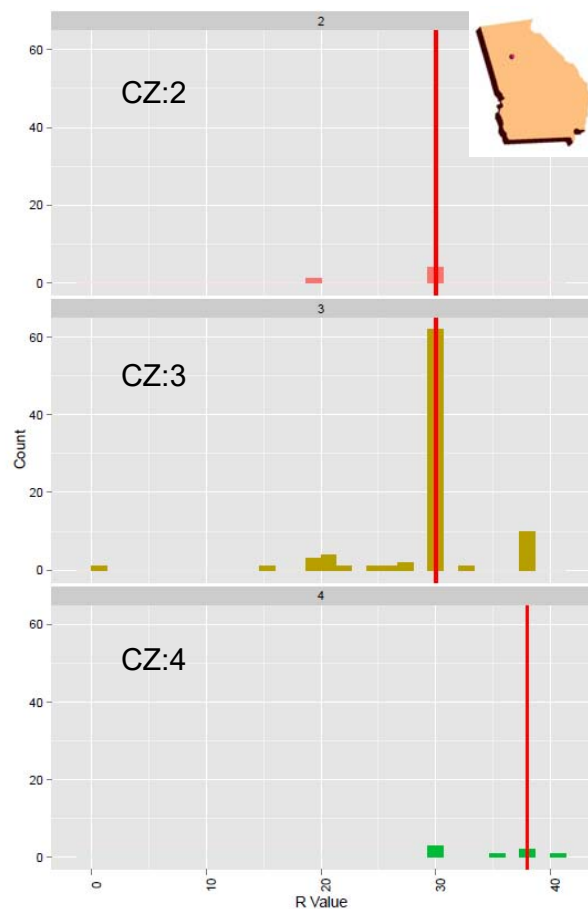
NO. OF OBSERVATIONS: 99

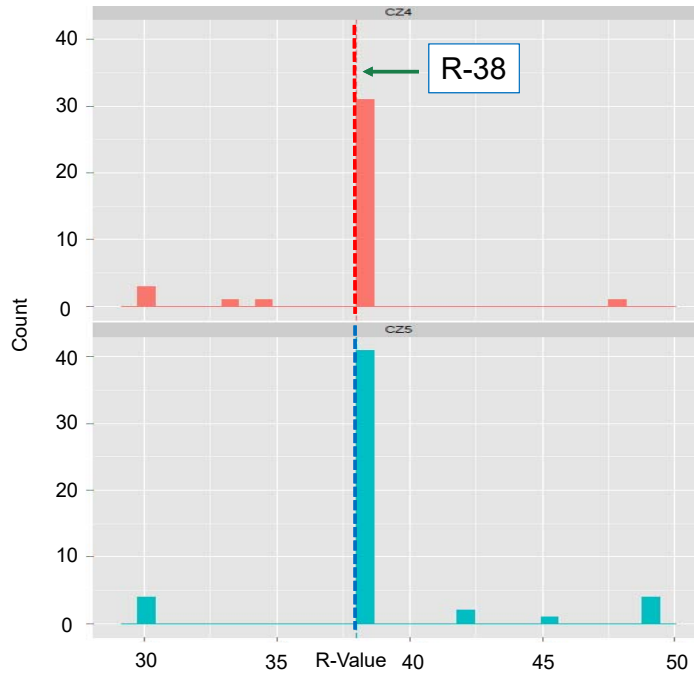
Vertical **red** line indicates the 2009 IECC prescriptive code requirement of R-30 in CZ's 2 & 3 and R-38 in CZ 4

GA Code allows ceiling insulation to be traded down to as low as R-19

Quality of installation (Grade) was generally average to poor

**Higher is Better!**





**Climate Zone**  
■ C24  
■ C25



# Windows

# IECC 2009 - Fenestration Performance

*Industry Standard Low-e complies!*

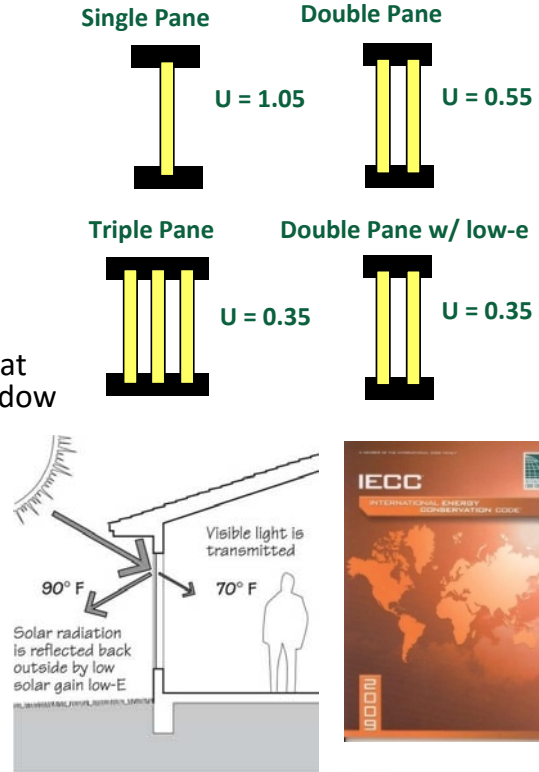
## U-factor

- Lower U-factor means better insulated ( $U = 1/R$ )
- Area-weighted U-factor

## Solar Heat Gain Coefficient

- The SHGC is the fraction of the solar heat from the sun that enters through a window
  - SP clear glass  
SHGC: ~ 0.8
  - DP clear glass  
SHGC: ~ 0.6-0.7
  - DP low-e (low solar gain)  
SHGC: ~ 0.3

 World's Best Window Co. Millennium 2000® Vinyl Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider	
ENERGY PERFORMANCE RATINGS	
U Factor (U.S./F)	Solar Heat Gain Coefficient
<b>0.30</b>	<b>0.30</b>
ADDITIONAL PERFORMANCE RATINGS	
Visible Transmittance	Air Leakage (U.S./F)
<b>0.51</b>	<b>0.2</b>
<small>Manufacturer requires that these ratings conform to applicable NFRC procedures for determining energy performance. NFRC ratings are determined by a third party in environmental conditions and a qualified window lab. NFRC does not recommend any product and does not warrant the suitability of any product for any specific use. Contact manufacturer for change or other product performance information.</small>	



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## WINDOW U-FACTOR

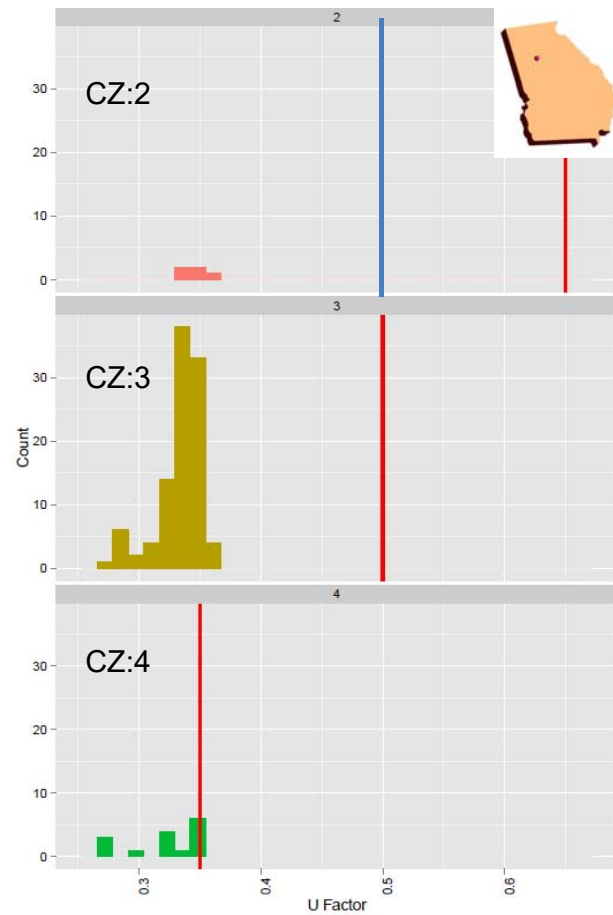
NO. OF OBSERVATIONS: 122

Vertical red line indicates the 2009 IECC prescriptive code requirement – maximum Ufactor for each CZ:

CZ:2 – 0.65 – GA amended to 0.50

CZ:3 – 0.50

CZ:4 – 0.35



*Lower is Better!*



## WINDOW SHGC

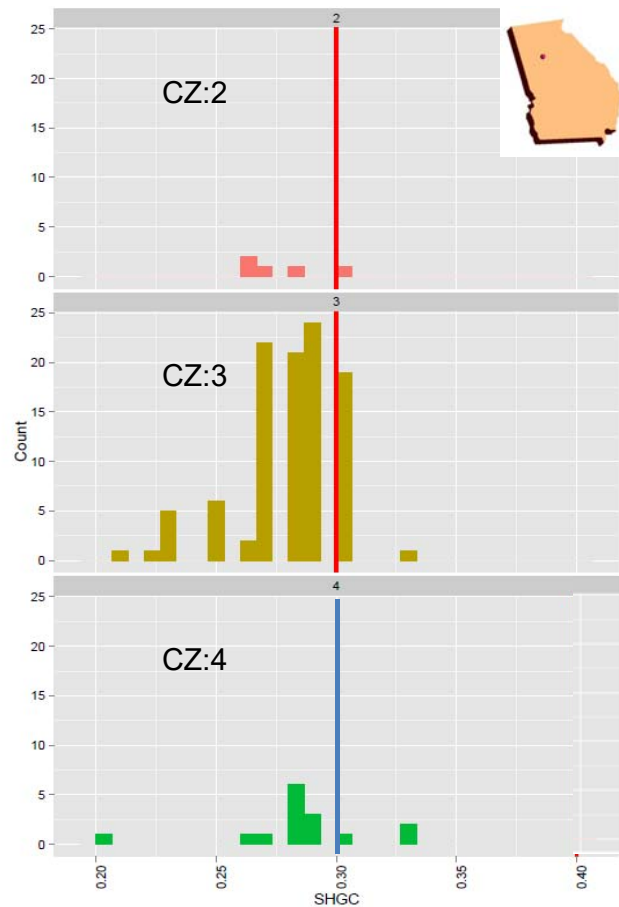
NO. OF OBSERVATIONS: 122

Vertical red line indicates the 2009 IECC prescriptive code requirement – maximum SHGC for each CZ:

CZ:2 – 0.30

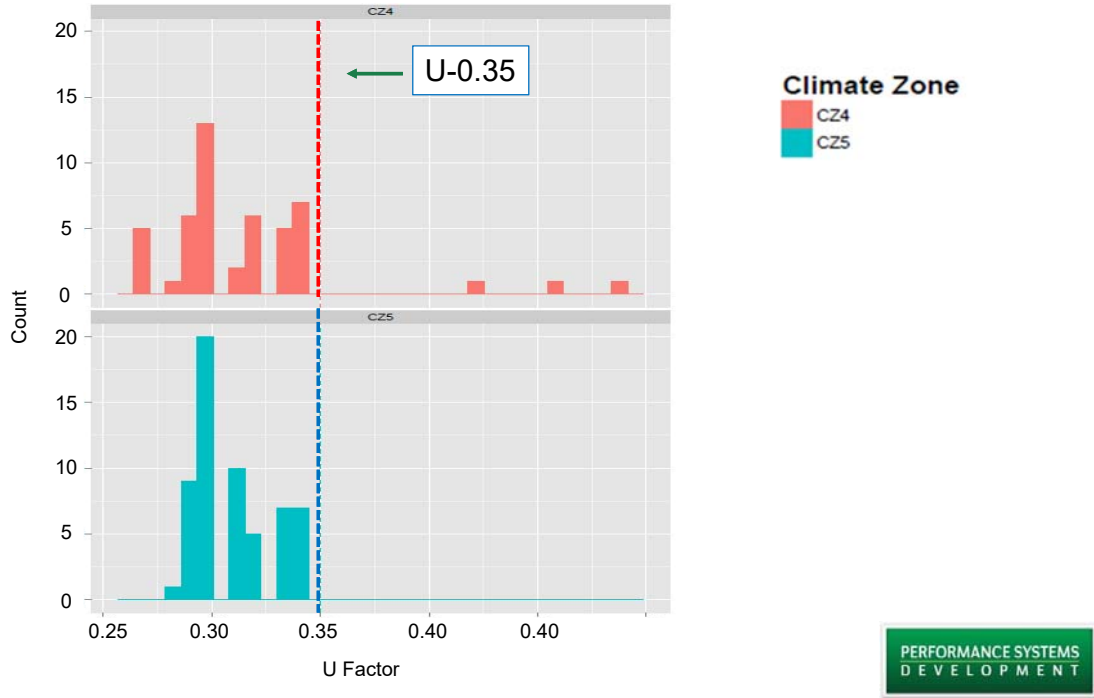
CZ:3 – 0.30

CZ:4 – NR – GA amended to 0.30



*Lower is Better!*





## Envelope Tightness

# IECC 2009 - Proving Air Sealing & Insulation

- Performance Testing Option for house leakage
  - Blower door result must be less than 7 ACH<sub>50</sub>

- Visual Inspection Option

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



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 permanent. Exposed earth in unretarder with overlapped.
8	Shafts, penetrations	Duct shafts, utility penetrations are sealed exterior or unconditioned.
9	Narrow cavities	Batts in narrow cavities are sprayed/blown insulation.
10	Garage separation	Air sealing is provided.
11	Recessed lighting	Recessed light fixture is sealed. Exception—fixtures are sealed.
12	Plumbing and wiring	Insulation is placed behind plumbing and wiring. Batt insulation is cut around plumbing and wiring. Sprayed/blown insulation is used.
13	Shower/tub on exterior wall	Showers and tubs are sealed to exterior wall separating them from exterior.
14	Electrical/phone box on exterior walls	Air barrier extends behind electrical/phone boxes on exterior walls.
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.



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# ENVELOPE TIGHTNESS (ACH50)

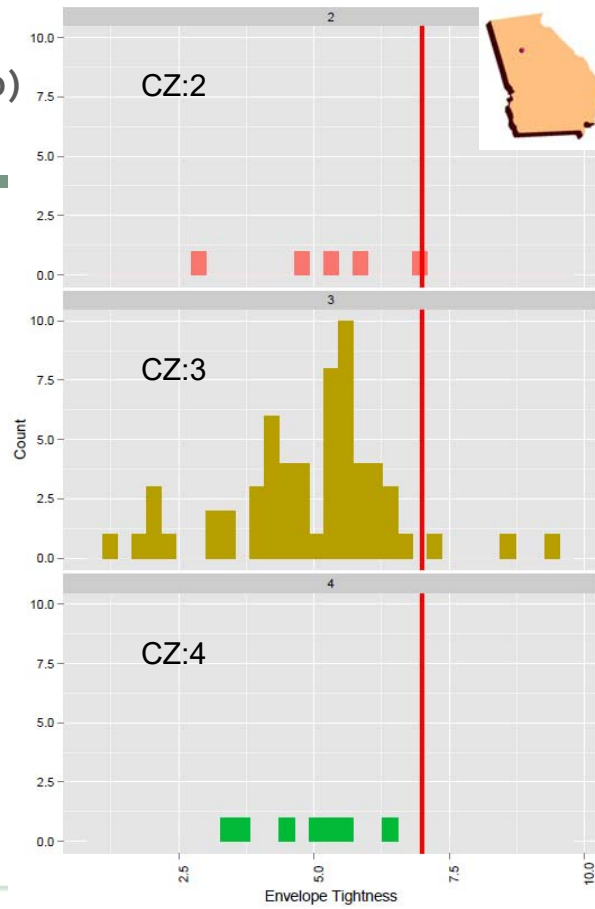
NO. OF OBSERVATIONS: 73

Vertical red line indicates the 2009 IECC prescriptive code requirement of 7 ACH50 (max.)

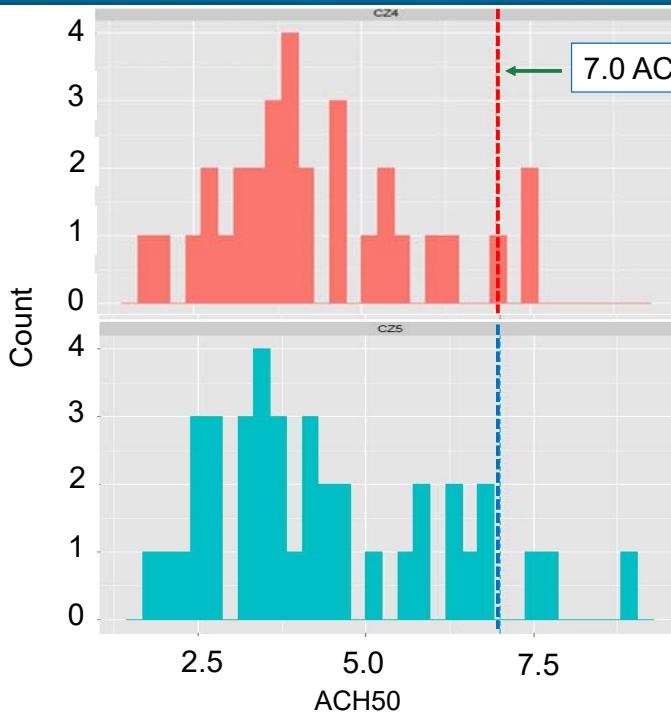
Only 4 results worse than code of 73 tests conducted

The average ACH50 for all homes tested was 4.9

*Lower is Better!*



## PENN RESIDENTIAL ENERGY CODES Envelope Tightness (ACH50)



**Climate Zone**  
 CZ4  
 CZ5

All Climates	
Count	70
Number > 7.0	5
Percent > 7.0	7%
Average	4.3
Max	8.9
Min	1.7





# Duct Leakage

47

## IECC 2009 - Duct Sealing

- Performance testing of duct system\*

When tested at rough-in

- Max. 6% leakage with AHU installed
- Max. 4% leakage before AHU installed

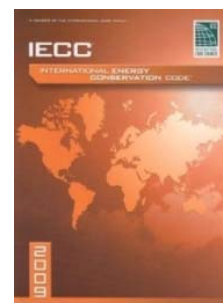
When tested at final

- Maximum 8% – Leakage to Outside
- **Maximum 12% – Total Leakage**

\*duct leakage in CFM<sub>25</sub> based on % floor area;

**Exception:** Testing not required if ducts and air handler are inside the envelope

**Example:** 59 CFM<sub>25</sub> total duct leakage measured at rough-in (AHU installed) for a system serving a 1,000 sq. ft. zone:  
(59 / 1,000) x 100 = 5.9% (Passes!)





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Duct Leakage

## DUCT TIGHTNESS (CFM<sub>25</sub>/100 FT<sup>2</sup> CFA)

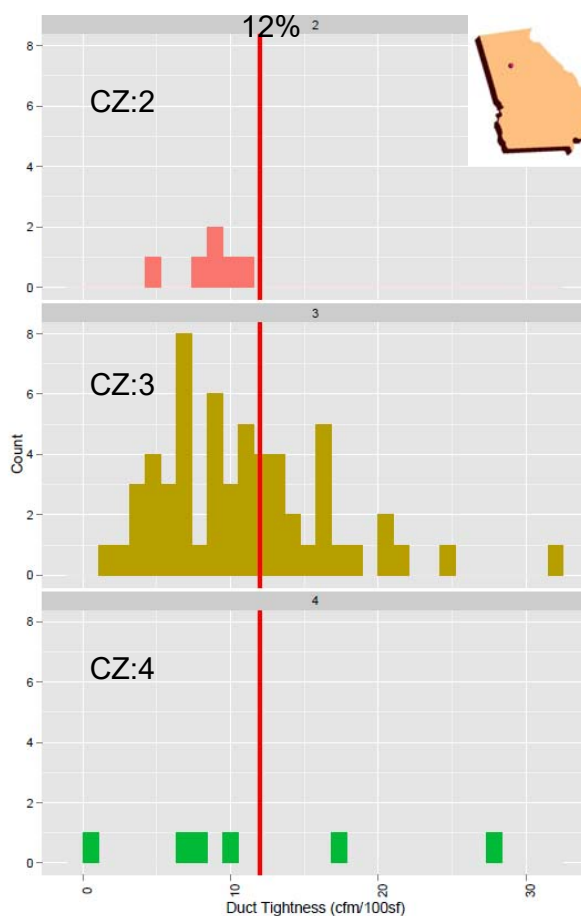
NO. OF OBSERVATIONS: 70

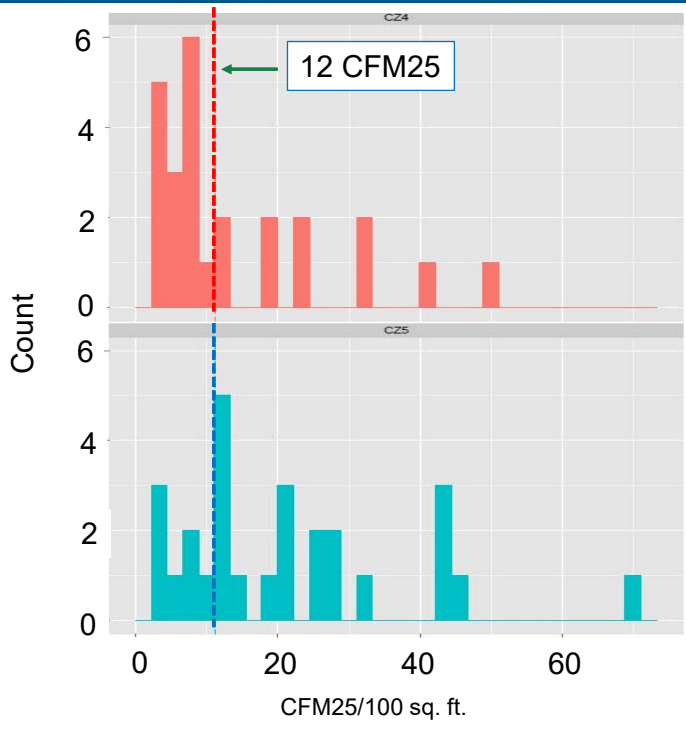
Vertical red line indicates the 2009 IECC prescriptive code requirement of maximum 12% Total Leakage

While many duct systems complied with the 2009 IECC most would not comply with 2012/15 codes

Many duct systems installed completely inside the thermal envelope tested much worse than 12% duct leakage

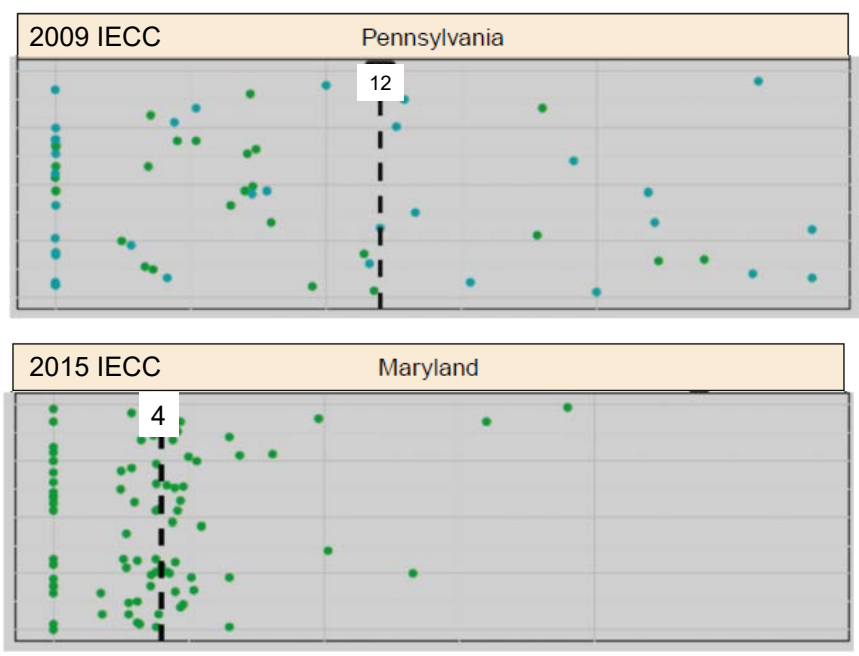
*Lower is Better!*





**Climate Zone**  
■ C24  
■ C25

All Climates		
	Count	52
	No. > 12	26
	Percent > 12	50%
CFM25	Average	18
	Median	12
	Max	69
	Min	2.4





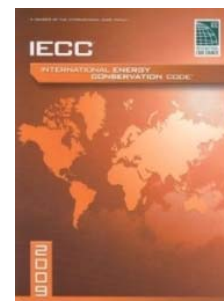
# High-Efficacy Lighting

53

## 2009 IECC - Lighting



- A minimum of 50 percent of bulbs in permanent fixtures must be high-efficacy
- High efficacy =
  - + CFL,
  - + T8 or T5 fluorescent bulb or,
  - + Meet certain lumen/W requirements (good LEDs)
  - NOT incandescent/ halogen
  - NOT T12 fluorescent bulbs



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Lighting

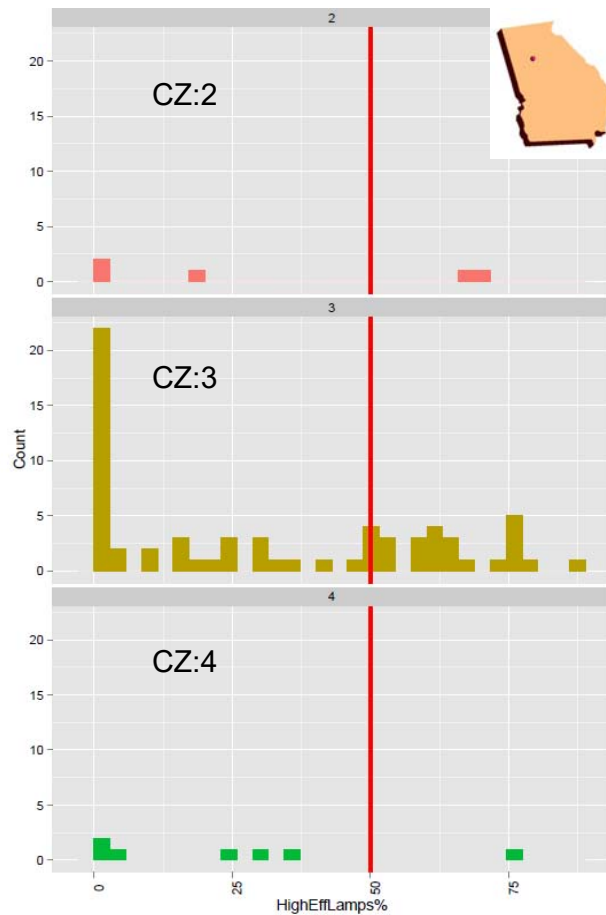
## HIGH EFFICACY LAMPS (%)

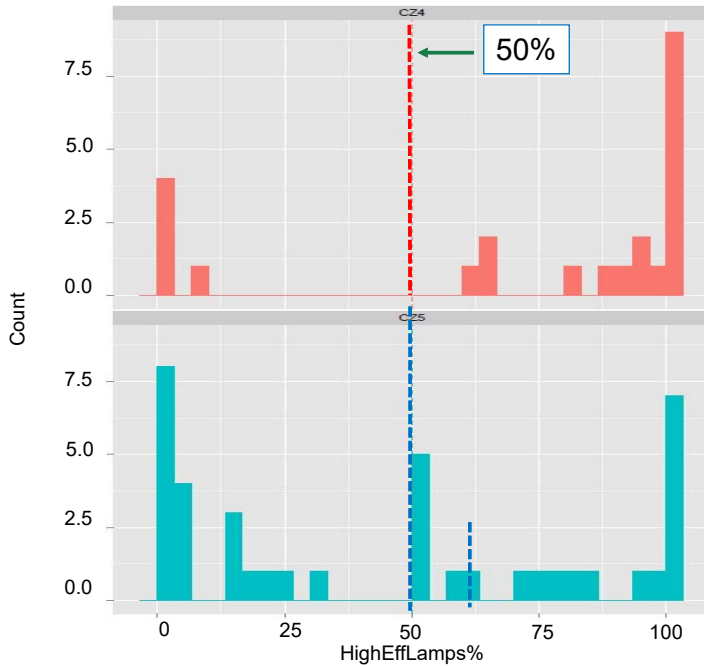
NO. OF OBSERVATIONS: 79

Vertical **red** line indicates the 2009 IECC prescriptive code requirement of 50% of all lamps

Of 79 homes observed only 27 complied with the minimum Standard (~35% compliance)

*Higher is Better!*





**Climate Zone**

- C24
- C25

All Homes		
	No.	%
≥50% HE	39	62%
<50% HE	24	38%



## PREDICTIONS - HOW DID WE DO?



While most people predicted the overall results would be low (~30%), a few people predicted it would be much higher...

- ✓ ✓ ✓ ✓
- ACH50 : 85%
- SHGC : 98%
- U<sub>factor</sub> : 99%
- Ext. Wall : 90%
- R-value
- correct install : 40%
- ✓
- Ceiling
- R-value : 90%
- correct install 50%
- ✓
- Lighting : 30%
- FOUND. : 65%
- ✓
- Ducts : 80%



## Energy Savings Opportunities

### The Big Three...

- 1) Duct Leakage
- 2) Insulation Quality
- 3) Efficient Lighting

59





Poor Air / Duct Sealing



Return air cavity



Connected to attic



Ugly Wall Insulation



Ugly Wall Insulation



## Ugly Ceiling Insulation



## Inefficient Lighting



## Training, Education, & Outreach What Would You Do?

67

### What did we learn from all this?



- 1) Study proves where we are – affects adoption
- 2) Point of Sale code enforcement yields very high compliance (e.g., windows)
- 3) Insulation Quality is poor – the cheapest insulation usually had the poorest installation
- 4) Testing matters – ducts inside the envelope were leakier than ducts outside the envelope (which were required to be tested)
- 5) Theories on lighting – brand new in code, not even on the builder's radar (bulbs are installed by electrical sub), not life safety item

68

# The Economics of Lighting for Builders



Bulb Cost Assumption:		Electricity Rate:		0.12 \$/kwh	
Incandescent = \$0.25					
LED = \$2 each					
				Bulb Wattage	
	# Incand	# LED's	Price Premium	Incand	LED
All Incand House	60	0	\$ -	60	10
50% LED House	30	30	\$ 52.50	60	10
100% LED House	0	60	\$ 105.00	60	10

	\$ Cost for 1 month - ON half the time			Simple Payback	
	Incand	LED	Total	\$ Savings (months)	(days)
100% Incand House	\$ 158.11	\$ -	\$ 158.11	0	
50% Incand / 50% LED	\$ 79.06	\$ 13.18	\$ 92.23	\$ 65.88	0.80 24.3
100% LED House	\$ -	\$ 26.35	\$ 26.35	\$ 131.76	0.80 24.3

# The Economics of Lighting for Builders

**GE Bright Stik 3-Pack 10-Watt (60W Equivalent) 2,800K A19 Medium Base (E-26) Soft White Indoor LED Bulbs**

Item #: 760359 | Model #: 35665  
 ★★★★★ 8 reviews | Write a review

**\$5.98**  
 NEW LOWER PRICE  
 Was: \$9.98  
 Save 40%

***It takes 24 days to payback LED's if half the lights are left on during construction! (12 days if all on!!!)***

Description	Specifications	Info & Guides	Reviews	Community Q&A
Got an update or addition to this product's details? Share it here.				
Wattage Equivalent	60	Bulb Diameter (Inches)	1.5	
Bulb Wattage	10	Bulk Buy	No	
Indoor/Outdoor	For indoor or enclosed outdoor use only	Light Bulb Base Type	Medium base (E-26)	
Package Quantity	3	Series Name	Bright Stik	
Bulb Voltage	120	3-Way Bulb	No	
Rated Life (Hours)	15000	Vintage	No	
Lumens	760	Bluetooth Capability	No	
Bulb Shape	A19	Built-In Speakers	No	
Color Temperature (Kelvins)	2800	Works with Iris	No	
ENERGY STAR Qualified	No	Built-In WiFi	No	
Energy Efficient	Yes	Dimmable	No	
Bulb Length (Inches)	4.43	Light Color	Soft White	

## Georgia – a possible amendment to our next code



### • Insulation Installation Details

- **Wall and ceiling** insulation in the building thermal envelope in GA residences shall be installed to Passing Grade quality.

Two criteria affect installed insulation grading:

**Voids/ gaps** (in which no insulation is present in a portion of the overall insulated surface) and

**Compression/incomplete fill** (in which the insulation does not fully fill out or extend to the desired depth).

#### Voids/Gaps

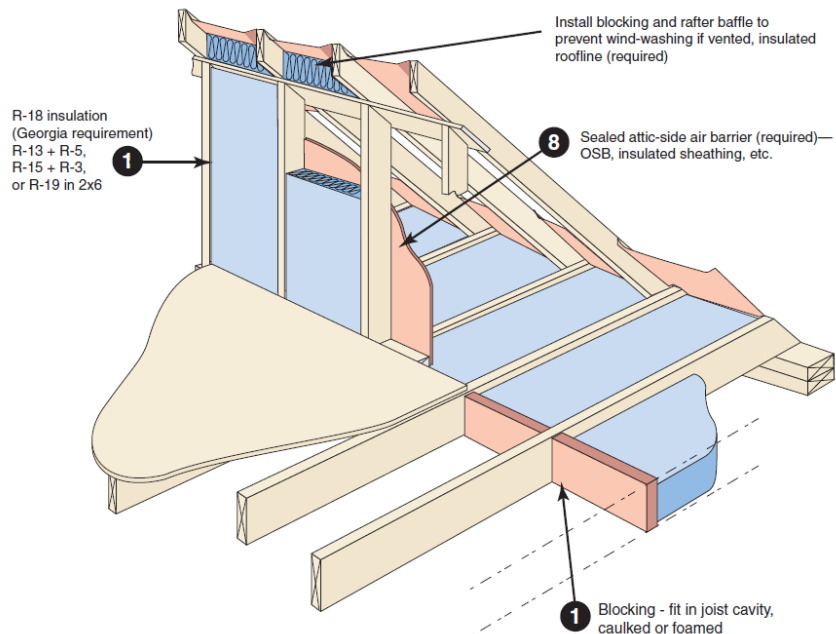
- Voids or gaps in the insulation are only occasional and very small for Passing Grade (< 1% of overall component surface area)

#### Compression/Incomplete Fill

- Compression/Incomplete Fill for both *air permeable insulation* (e.g., fiberglass, cellulose) and *air impermeable insulation* (e.g., spray polyurethane foam) must be less than 1 inch in depth or less than 20% of the intended depth, whichever is more stringent. The allowable area of compression/incomplete fill must be less than 5% of the overall insulated surface to achieve a Passing Grade.
- Any compression/incomplete fill with a **depth** greater than the above specifications (up to 1" or 20% of the intended depth, whichever is more stringent) shall not achieve a Passing Grade.

71

## Pictures & Diagrams of Good and Bad as Red Tags



## BAD - Kneewall – Pics shows need for blocking & sheathing



## GOOD - Kneewall – Sheathed and blocked



## Component Specific How-to Videos:

- Short/small – easily downloaded or streamed
- Compare / contrast images (go / no-go)
- Include Hotline information
- Templates and links to other tools

**Energy Code Hotline – 404-604-3598**  
*energycodes@southface.org*



**REBATE VOUCHER**

**One FREE Energy Code Consultation**  
**\$750 VALUE**  
 Limit (1) per builder

**ENERGY CODE CONSULTATIONS INCLUDE:**

- Plan review with description of suggested additional detail on plans (if any)
- Completed Air Barrier and Insulation Component Criteria checklist
- Blower door and duct leakage testing results
- 2009 IECC Performance Report (software modeling)
- Three possible trade-off packages for cost-effective compliance

**Voucher Code 118PBR** *Activate by: 6/10/16*

• Offer valid on a first-come first-served basis for the first 60 vouchers activated  
 • Builders contact an approved rater (see below) to redeem voucher  
 • Each voucher contains an unique code – do not duplicate this voucher.

**Raters must call Mike Turns to activate each voucher at (484) 684-5625**  
 The acceptance form must be signed and submitted to [returns@psdcconsulting.com](mailto:returns@psdcconsulting.com) for raters to receive payment.

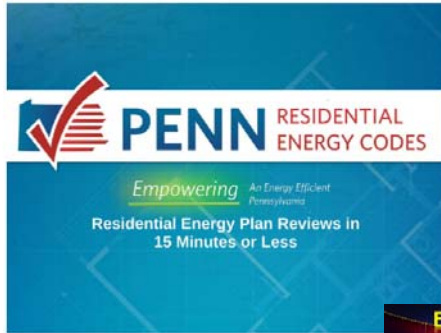
**APPROVED RATERS:**

- East Penn Energy Solutions (610) 906-3330
- Seving Green Energy Audits (484) 860-2878
- Eco-Haven Building Systems (570) 660-1122
- Affordable Energy Now (717) 633-9876
- ReVivo (888) 268-9438
- McGrann Associates (610) 666-MAGRANN
- Ideal Living Environments (610) 371-2546
- Energy Services Group (302) 324-8400
- Lowry EcoSolutions (267) 237-5898
- DSB Energy Services (215) 897-7166
- EAH Associates (732) 556-9190 ext. 210

### Rater Voucher Program:

- Plan review/software analysis
  - Air barrier and insulation inspection
  - Blower door test
  - Duct leakage test
  - Recommendations
- Limited Rater participation, seem to only focus on big fish
  - Difficulty generating builder interest

- Plan Reviews in 15 Minutes or Less
- Keys to Effective Energy Code Implementation



Keys to Effective Energy Code Implementation  
Presented by Performance Systems Development and the Penn Energy Codes Program

Over 800 attendees,  
predominantly Code  
officials



## Customizable forms/checklists

Energy Code Checklist

Air Sealing Verification Form

Duct Sealing Verification Form

Hard-copy checklist and forms distributed to over 750 people



## Fact sheets

### Duct Leakage Fact Sheet

**Pennsylvania Energy Code Field Study**  
PSC recently completed a study of 171 residential new homes in an effort to assess implementation of the 2009 energy code in eastern Pennsylvania. This study revealed three main areas for improvement: duct leakage, insulation quality, and high-efficiency lighting. The authors that correcting these areas presents good opportunities for savings of nearly \$10 million over five years. The fact sheet contains information and resources about improving the efficiency of new residential construction by testing and sealing ductwork.

**The Code on Duct Leakage**

- The 2009 E-CODE and other PA compliance paths require that all ducts, air handlers, flex ducts, and heating/cooling ducts be sealed and tested.
- Further, the code requires duct leakage testing for all systems, unless the contractor seals all portions of the ducts in compliance with the manufacturer's guide.
- Duct leakage testing also be performed at rough-in or final construction phase with leakage being determined on the type of test performed.



**Study Findings**

- The PSC study found that of the 171 homes requiring testing, 50% did not seal the code leakage levels for a 5 total leakage test.
- Many of these contractors were far in excess of the leakage limit, including serious leakage problems.

**How We Can Improve**

- Test the ducts. The only way to verify levels if the ducts have been well sealed is through performance testing, but only if testing required by code, but it can be an effective quality assurance tool.
- Limit the use of building ductwork or return ducts. With typical installation practices, this approach results in high duct leakage rates.
- Use duct materials, methods & the most effective and durable way to seal duct joints, seams, and connections.

Go to [pennenergycodes.com/resources/energy-code-field-study/](http://pennenergycodes.com/resources/energy-code-field-study/) to access the following resources:

- Duct Leakage Inclusion Sheet
- An Effective Duct Sealant Distribution Strategy
- Common Ductwork Installation Practices

Find a duct seal and leakage testing professional:

- [www.pennenergycodes.com/resources/energy-code-field-study/](http://www.pennenergycodes.com/resources/energy-code-field-study/)
- [www.pennenergycodes.com/resources/energy-code-field-study/](http://www.pennenergycodes.com/resources/energy-code-field-study/)
- [www.pennenergycodes.com/resources/energy-code-field-study/](http://www.pennenergycodes.com/resources/energy-code-field-study/)

The Penn Energy Codes Program offers a variety of free and low-cost energy code support services, including seminars, technical training, on-site demonstration, the E-CODE Assistant App, and more.

View upcoming events at [pennenergycodes.com/events/](http://pennenergycodes.com/events/) or contact Nikki Toros at 484-404-5623 or [ntoros@pennenergycodes.com](mailto:ntoros@pennenergycodes.com) to schedule an event for your organization.

[PennEnergyCodes.com](http://PennEnergyCodes.com)



### High-Efficiency Lighting Requirements for New Homes

#### Pennsylvania Energy Code Field Study

PSC recently completed a study of 171 residential new homes in an effort to assess implementation of the 2009 energy code in eastern Pennsylvania. This study revealed three main areas for improvement: duct leakage, insulation quality, and high-efficiency lighting. We estimate that correcting these three areas could result in a savings of nearly \$10 million over five years.

#### The Code on Lighting

The 2009 International Energy Conservation Code states that a minimum of 80% of lamps in permanently installed fixtures shall be high efficiency.

#### High efficiency lamp definition:

- Compact fluorescent lamps, 1.8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:
  - 60 lumens per watt for lamps over 40 watts
  - 80 lumens per watt for lamps over 15 watts and up to 40 watts
  - 40 lumens per watt for lamps 15 watts or less

#### Study Findings

Nearly 40 percent of homes visited did not have at least 80 percent high efficiency bulbs, as required by code. We estimate that homes of new homes in Pennsylvania could save over \$146,000 in the first year of all new homes that fit the requirement.

Technology	Efficiency (lumens/watt)	High-Efficiency (lumens/watt)	Color Temperature (K)
Incandescent	12-16	80	2400-3000
Halogen	16-20	80	2,000-4,000
CFL	40-70	80	4,000-10,000
Linear Fluorescent	80-100+	80	3,000-4,000
White LED	20-60	80	up to 100,000

#### Considerations for Lighting Selection

- Brightness, measured in lumens
- Estimated yearly energy cost
- lifespan
- Light appearance, measured by correlated color temperature (CCT) on the Kelvin (K) scale, from warm to cool.



## Compliance Enhancement Activities



### ENERGY CODE TOOLKIT

Below you will find energy code checklists, forms, and guidebooks to improve your knowledge and ensure compliance within the state of Pennsylvania.

Forms   Webinars   Videos   iPad App

Energy Code Guides   Related Resources

Related Websites   Newsletter Archive

#### FORMS

- Plan Review and Inspection Form C2-4
- Plan Review and Inspection Form - Climate Zone 3
- Customizable Plan Review and Inspection Form
- Air Barrier and Insulation Inspection Checklist (Table 402.4.2)

#### WEBINARS

- Pennsylvania Residential Energy Code Field Study: How Are We Doing?
- Using the E-CODE Assistant: An iPad-Based Energy Code Checklist and Educational Tool

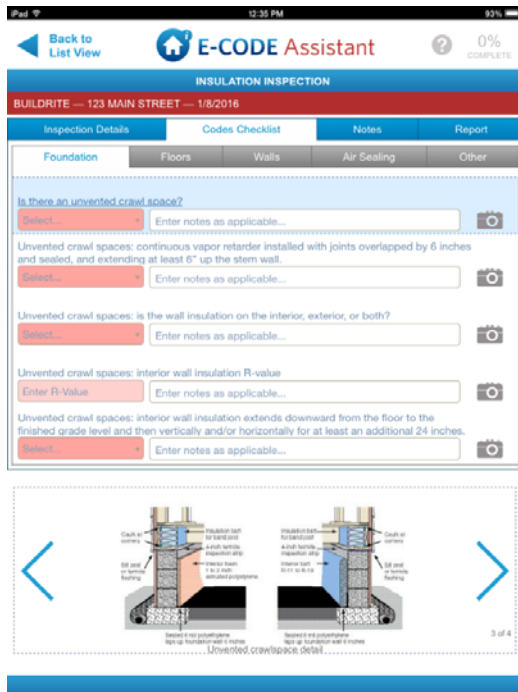
#### NEWSLETTER ARCHIVE

- Newsletter #1 - Penn Energy Codes Launch 9-3-15
- Newsletter #2 - Webinar - Energy Code Field Study 11-30-15
- Newsletter #3 - Webinar Series 12-31-15
- Newsletter #4 - Training & CEUs 1-7-16
- Newsletter #5 - Energy Code Challenge Update 1-21-16

#### IPAD APP







**The E-CODE Assistant:**  
An iPad-Based Energy Code Checklist and Educational Tool



81

Custom training and technical assistance  
Office/field visits covering >150 jurisdictions



### In-field demonstrations and training for Builders and HVAC contractors



# THANK YOU!

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