

# ENERGIZE MISSOURI

MISSOURI DEPARTMENT OF NATURAL RESOURCES

## Resource Inventory and Lessons Learned for the Commercial Portion of the 2009 IECC and 90.1-2007 Workshop 1



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## Introductions

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Code officials

Name

Municipality

Status of Commercial Codes



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## Overview

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Project funded by the Missouri Department of Natural Resources (MDNR) with American Recovery and Reinvestment Act of 2009 (ARRA) funding.

2 Locations:

1. St. Louis
2. Springfield

*Objective of the Workshop:* Work with municipalities and counties across the state to identify opportunities to adopt or enhance compliance with the 2009 International Energy Conservation Code (IECC) at a local level.



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## Overview

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- BCAP (Building Codes Assistants Program)
- BECP (Building Energy Codes Program)



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## What are the topics for today?

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1. Overview of best practices and lessons learned in Missouri.
2. Commercial compliance approaches and their corresponding tools.
3. Commercial Resources - building data collection checklist and *COMcheck*.

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## Agenda

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Topic	Approx. Time
Introduction, Project Background, Workshop Overview	15 minutes
Overview of best practices and lessons learned in Missouri.	20 minutes
Commercial compliance approaches and their corresponding tools	25 minutes
Break	10 minutes
Overview of the commercial envelope requirements	35 minutes
Summary/Questions	15 minutes
Total Time	2 Hrs



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## Some Important Points

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### Overall

- Focused on commercial
- Discussion-based
- Forum for ideas and practices

### What can you expect?

- Code citations in [ ]
- Printed slides

### Before we get started...

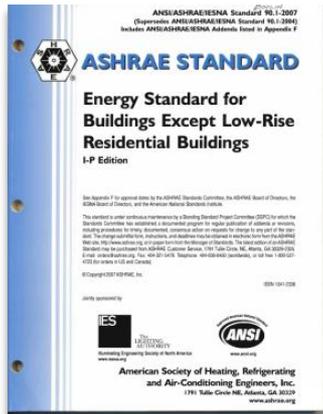
- Cell phones



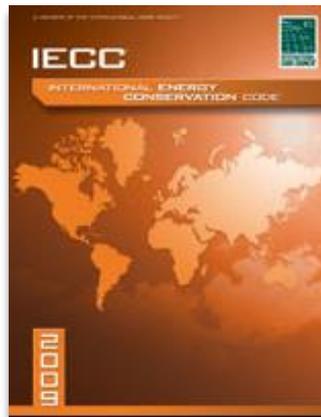
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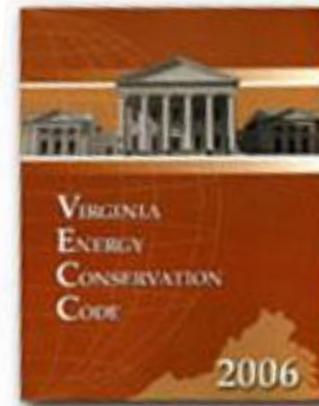
## Building Energy Codes



### ASHRAE Standard 90.1



### International Energy Conservation Code



### State and Locally Adopted Codes

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## Comparison of 2009 IECC and ASHRAE 90.1-2007

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### 2009 IECC

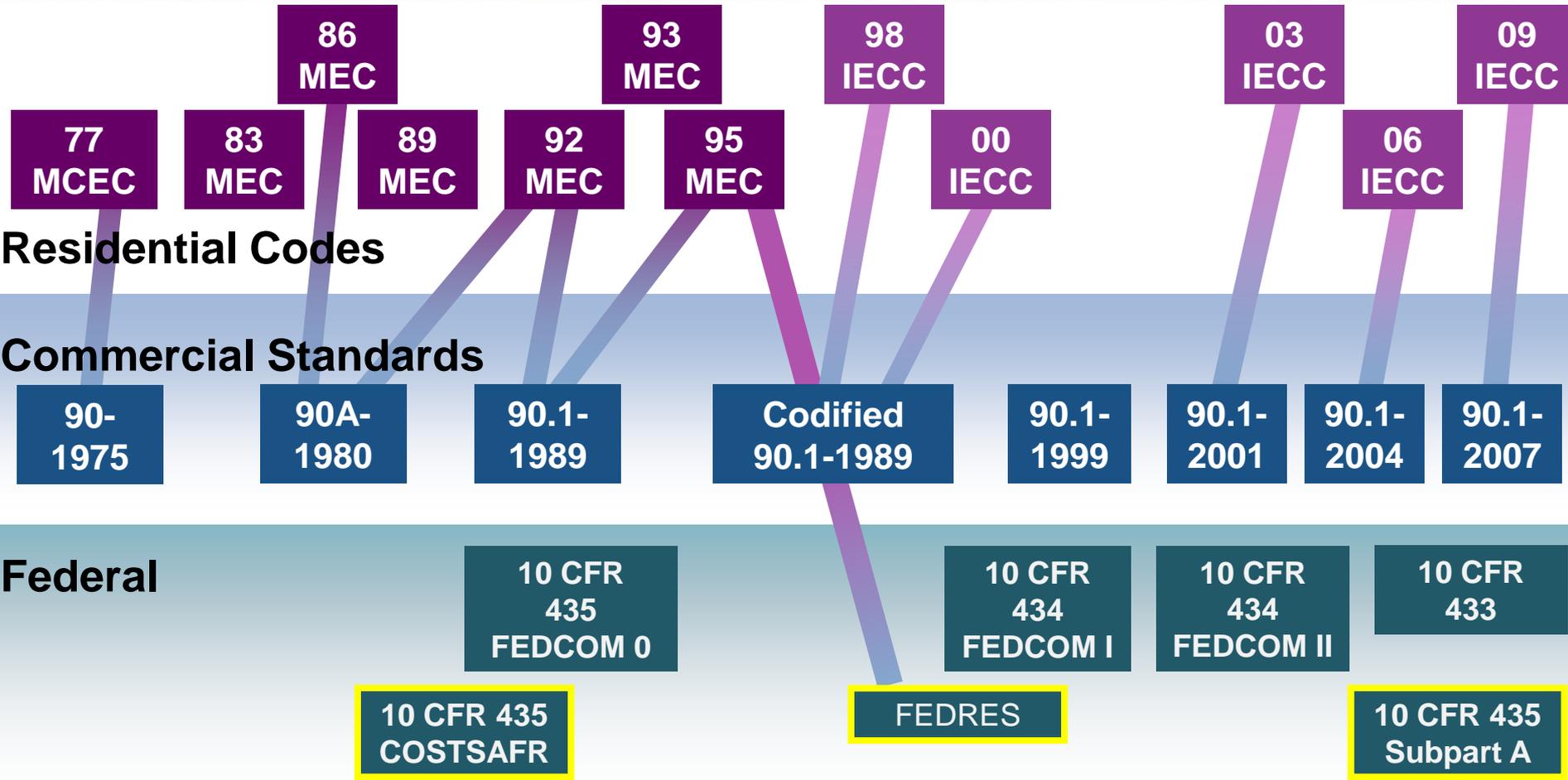
- 2009 IECC developed by the *International Code Council (ICC)*
- New version every three years with more stringent requirements

### ASHRAE

- ASHRAE 90.1-2007 developed by *American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)*
- ASHRAE 90.1 is the referenced standard in IECC
- Compliance with ASHRAE 90.1-2007 results in 4% more energy savings than ASHRAE 90.1-2004

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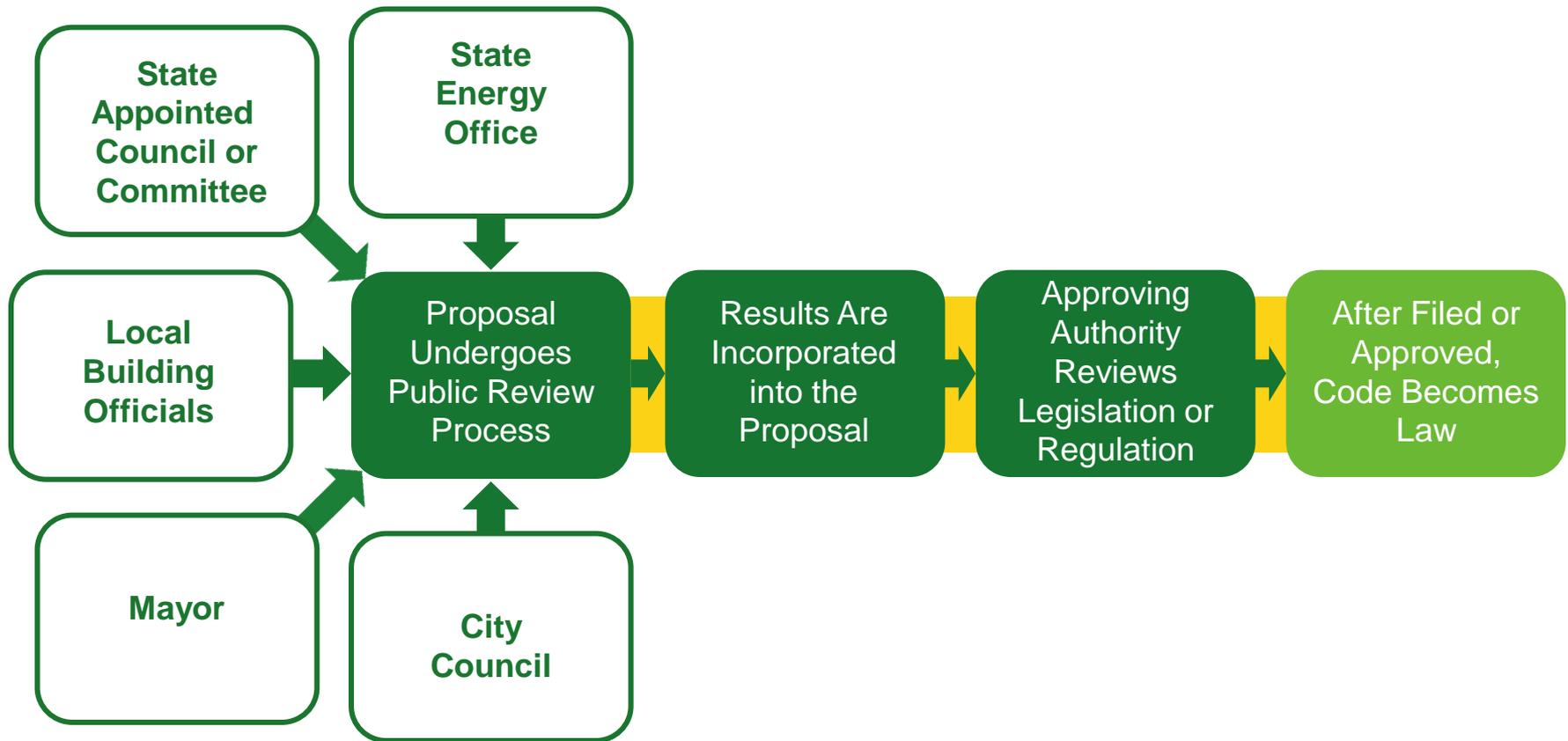
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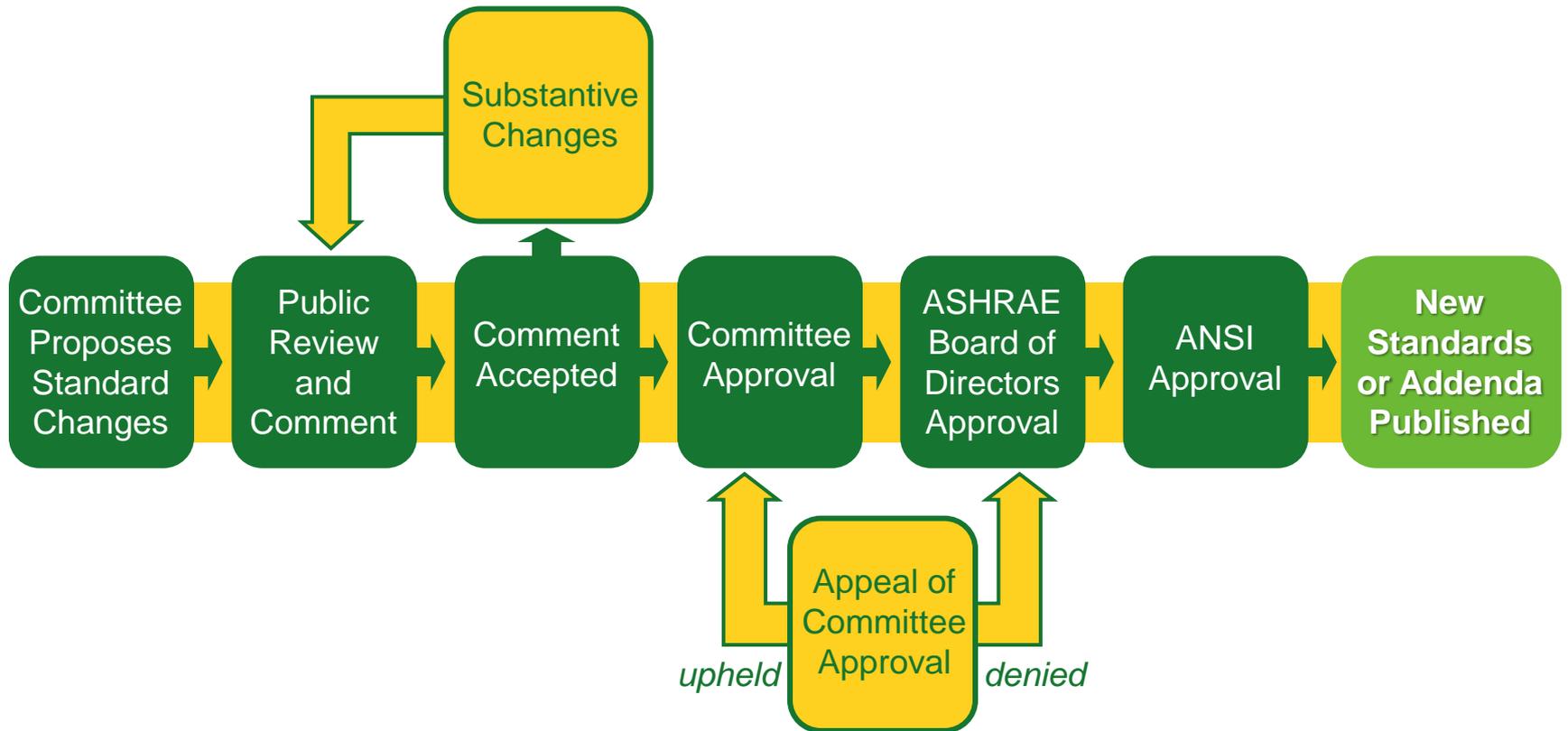
## Typical Adoption Process, State, and Local



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## ASHRAE 90.1 Process



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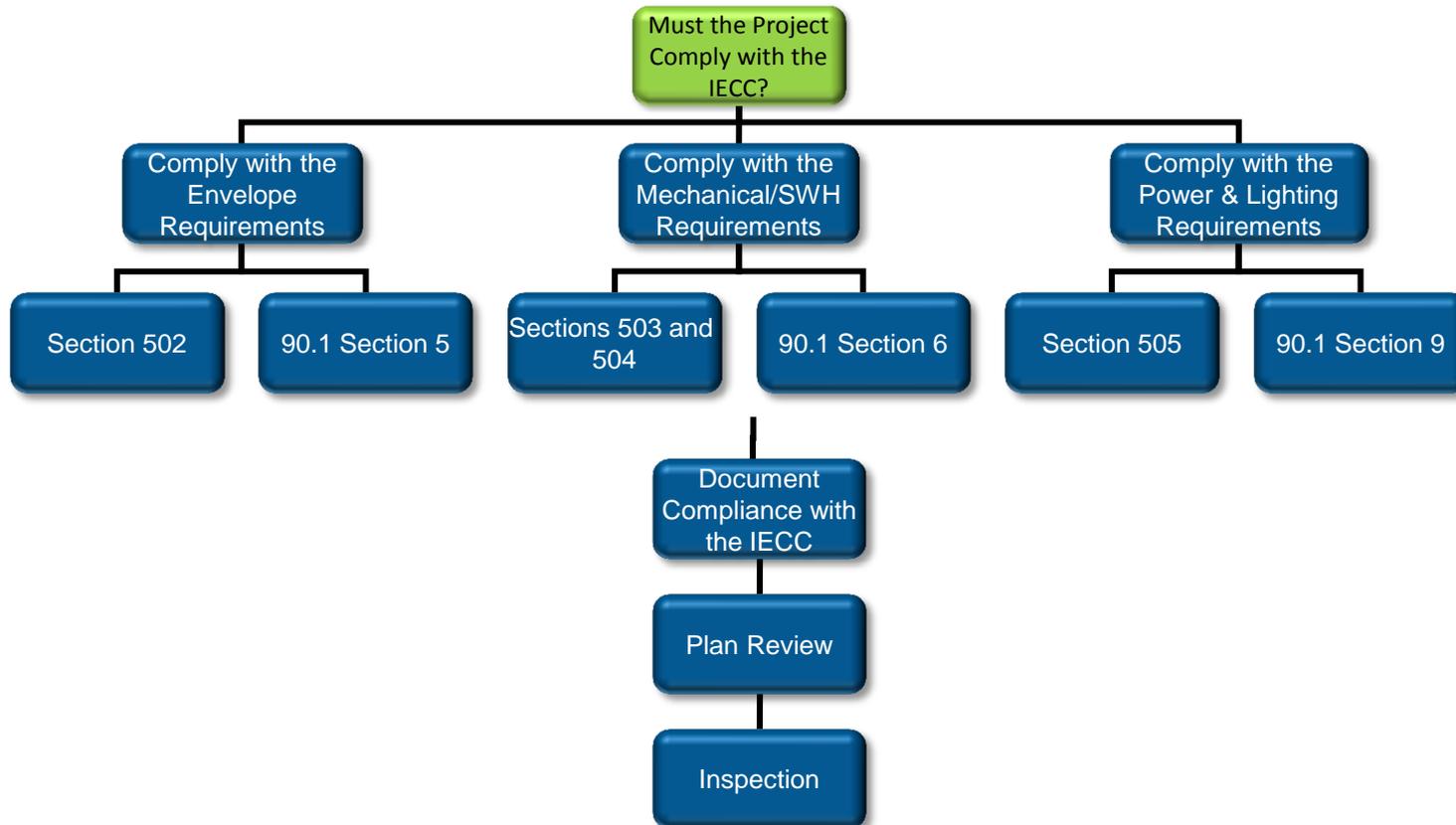
## Model Codes & Standards

Title	Type	Applicability	Common Versions
International Energy Conservation Code (IECC)	Model Energy Code	Residential & commercial buildings; mandatory, enforceable language	2000IECC 2003 IECC 2006 IECC 2009 IECC 2012 IECC
ASHRAE Standard 90.1 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings	Energy Standard	All buildings except residential 3 stories or less	90.1-2001 90.1-2004 90.1-2007 90.1-2010

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## 2009 IECC Compliance



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## Commercial Provisions Contained in Chapter 5

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- Chapter 5 is dedicated to Commercial buildings in IECC
- ASHRAE 90.1-2007

Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical).

**\*\*The Code does not allow for mixing and matching of IECC and ASHRAE**

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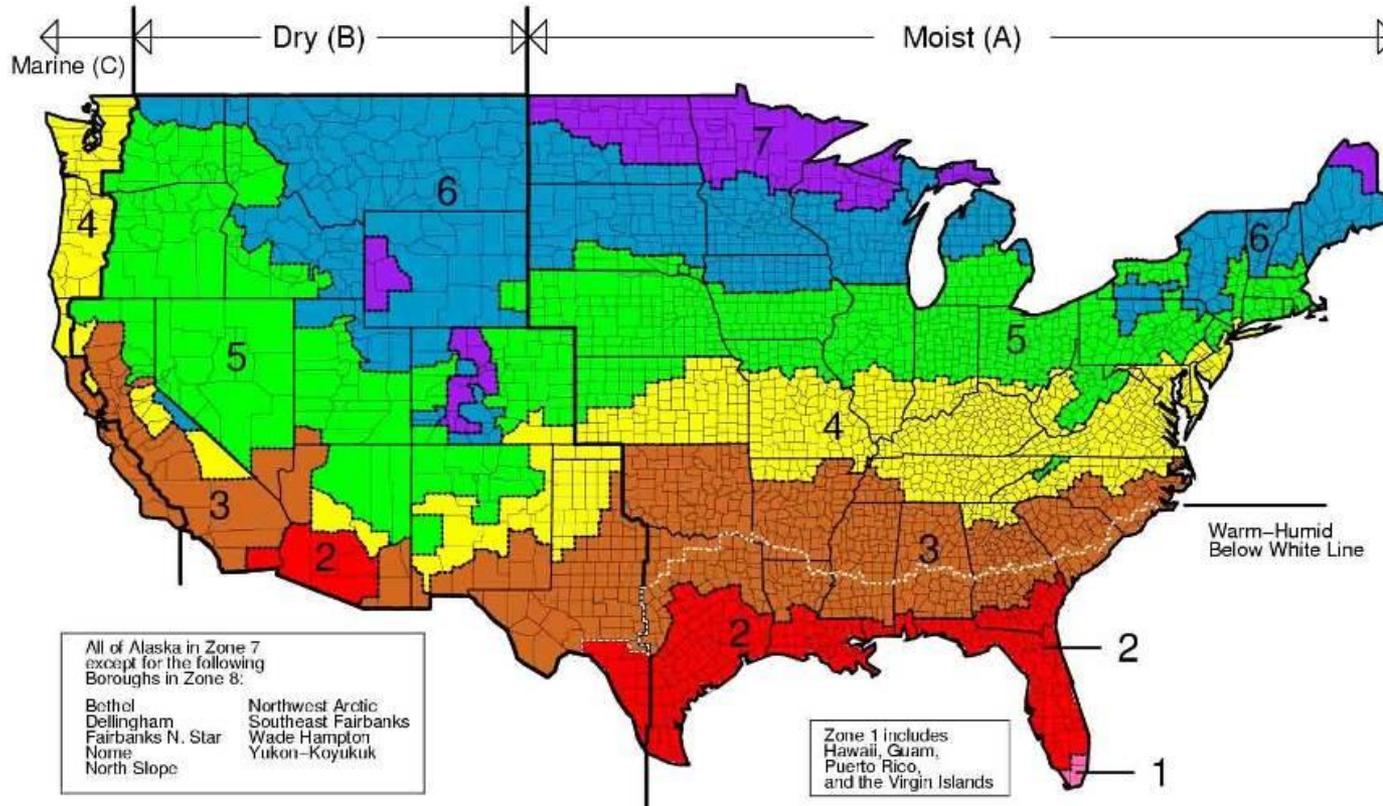
## IECC or ASHRAE 90.1



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## Climate Zones – 2009 IECC

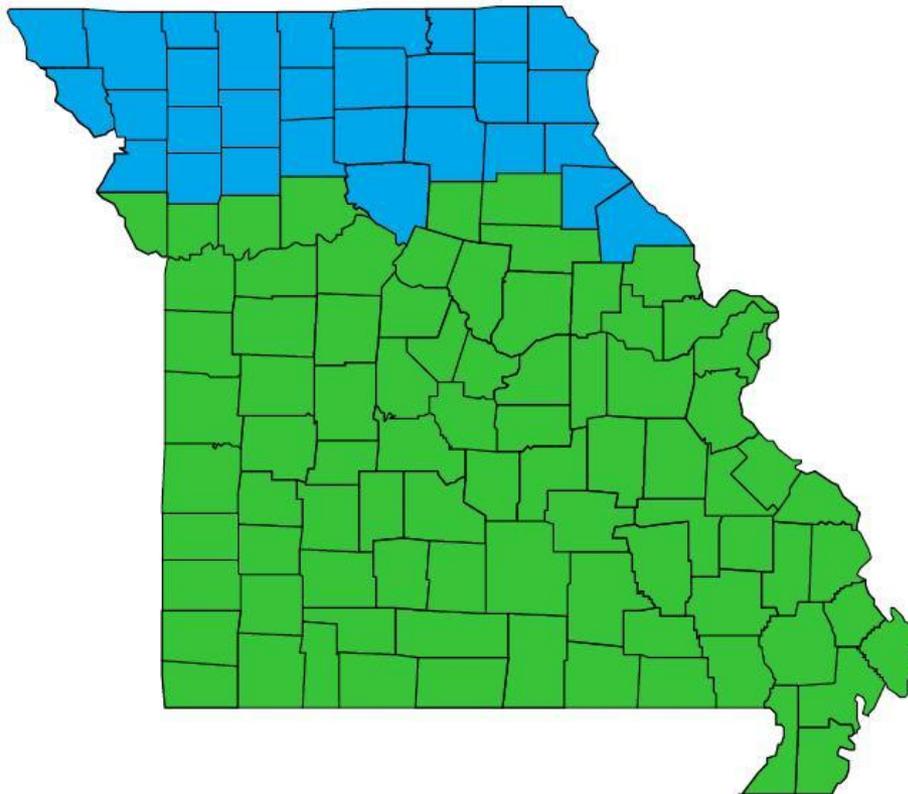


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## Climate Zones – 2009 IECC

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## Missouri Facts

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### Missouri: A Patchwork of Codes

Due to its history of strong local government, **Missouri does not have a mandatory statewide energy code**, however all local jurisdictions except class III counties have the right to adopt an energy code. As expected, this system creates a sometimes confusing patchwork of different codes throughout the state.

Regardless of the system in place, the bottom line is that **many jurisdictions in Missouri still don't have an energy code**—meaning that many residents do not receive the benefits of energy-efficient construction.



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## Missouri Facts

### Energy Costs

**\$20 billion**

Amount spent annually on energy in Missouri.

**95%**

Percentage of primary energy imported from other states.

**22%**

The rise in the cost of residential electricity, 2004 to 2009.<sup>1</sup>

**Missouri residents spend billions every year** importing energy from other states and abroad. Energy codes can help the state retain some of these dollars and improve Missouri's economy.

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## Missouri Facts

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Statewide  
Savings

**\$318 million**

Annual energy savings by 2030.

**26 trillion**

Btu of energy avoided annually by 2030.

**1.4 million**

Metric tons of CO<sub>2</sub> prevented annually by 2030.<sup>3</sup>

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By adopting and enforcing the 2009 IECC starting in 2011, Missouri municipalities and counties would **significantly improve the state's economy and environment** now and into the future.

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## Topic 1

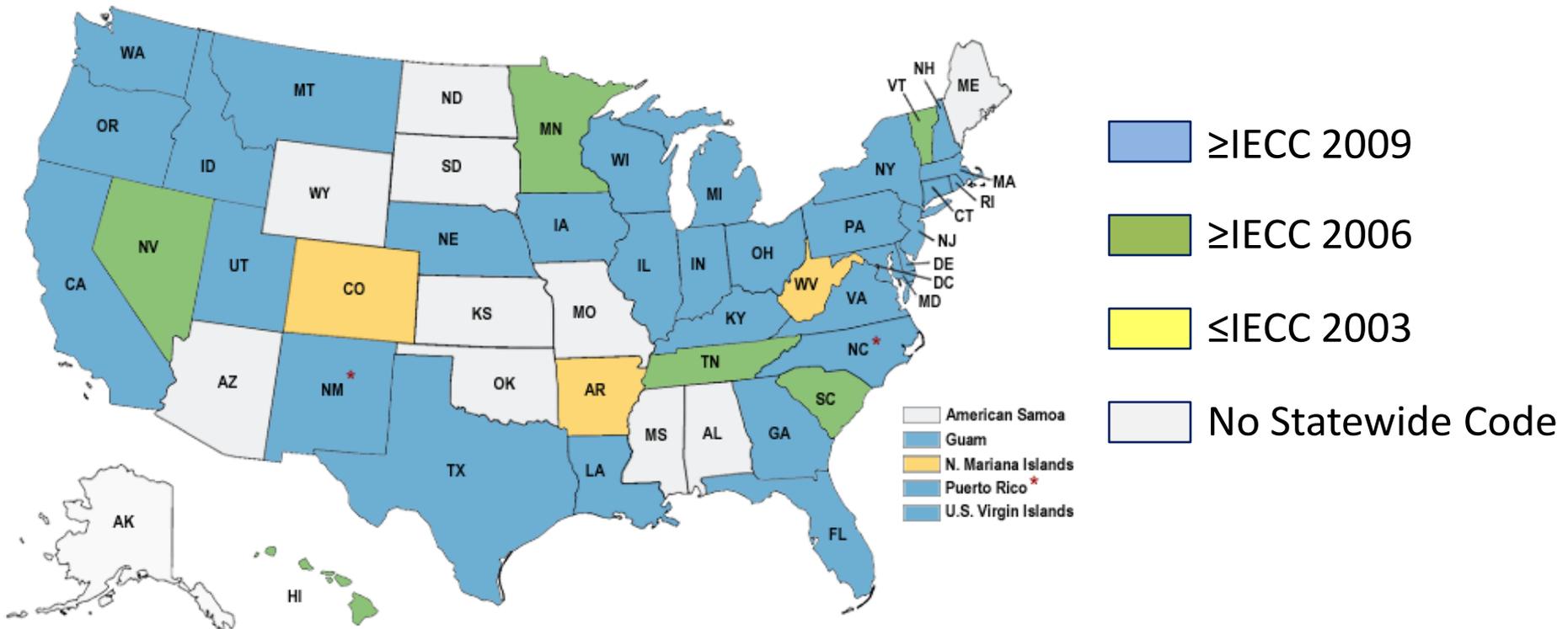
### Overview of Best Practices and Lessons Learned in Missouri



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## Commercial State Energy Code Status (\*)

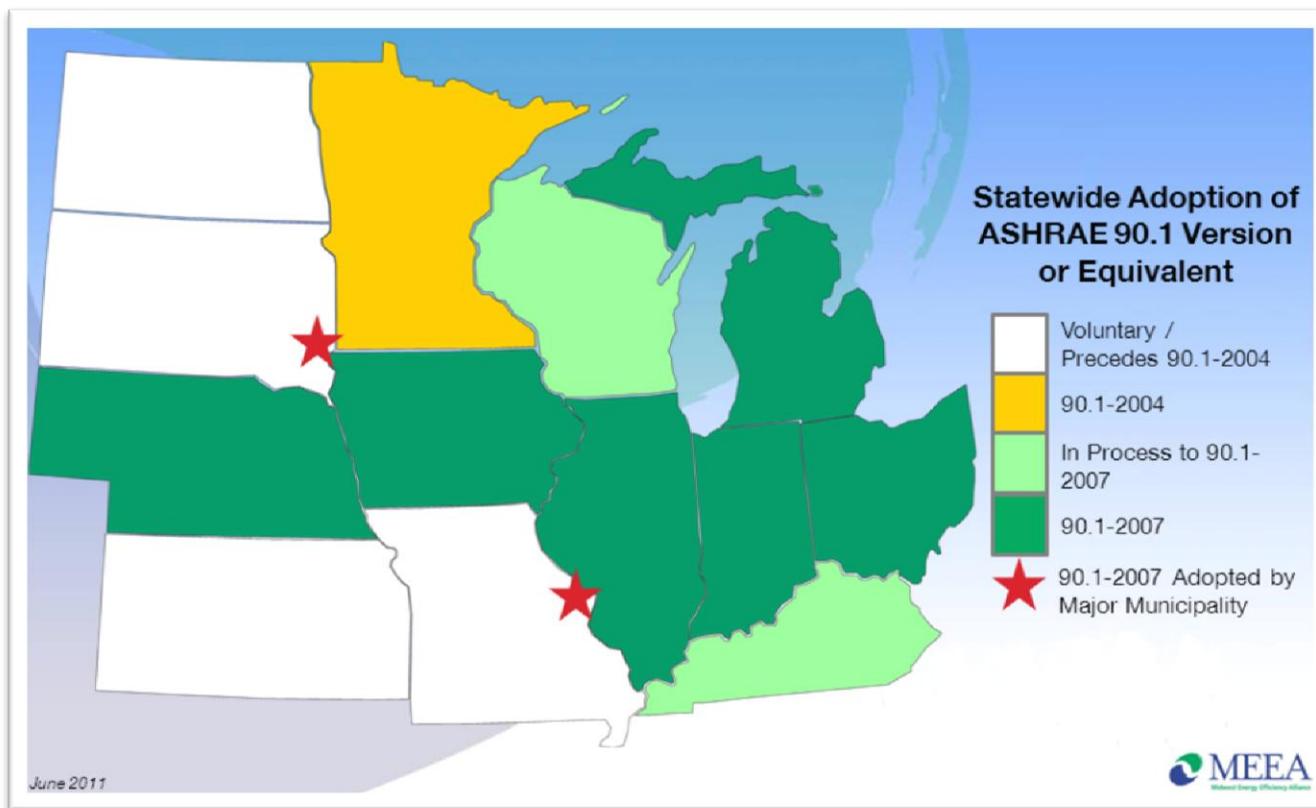


(\*) as of November 1, 2011, DOE – Building Energy Codes Program

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## Commercial Energy Code - Midwest



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## Missouri: No statewide code adoption

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- **Missouri does not have a mandatory statewide energy code**, however all local jurisdictions except class III counties have the right to adopt an energy code.
- **Many jurisdictions in Missouri also still don't have an energy code** – meaning that many residents do not receive the benefits of energy-efficient construction.
- Various codes are currently used throughout the state.

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## Best Practices Missouri

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- Jackson County, Lake St. Louis, Marshall, O'Fallon, and the City of St. Louis ([St. Louis County Public Works](#)) have adopted the 2009 IECC.
- Creve Coeur and Independence are currently in the adoption process.
- St. Charles County and St. Louis County have adopted the 2009 IRC with amendments.

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## Best Practices Missouri

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### **Kansas City incorporates energy codes into its broader sustainability effort:**

- 1) The Environmental Management Commission advises the city on energy/environmental issues.
- 2) The Chamber of Commerce's Climate Protection Partnership brings together 180 businesses and institutions that support energy efficiency implementation.
- 3) The Sustainability Coordinator works regionally to promote efforts.
- 4) The *Climate Protection Plan includes energy codes as a policy tool.*
- 5) Kansas City joined with ten municipalities and the Mid-America Regional Council to create a regional energy strategy and promote the adoption of the 2012 IECC.

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## Best Practices Missouri

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**Columbia created commissions to advise the city council on energy code issues:**

- The Building Construction Codes Commission (BCCC) reviews codes and provides a construction industry perspective.
- The Environment and Energy Commission adds input on the benefits of energy codes, stimulates public interest, and engages public/private agencies.

### University City

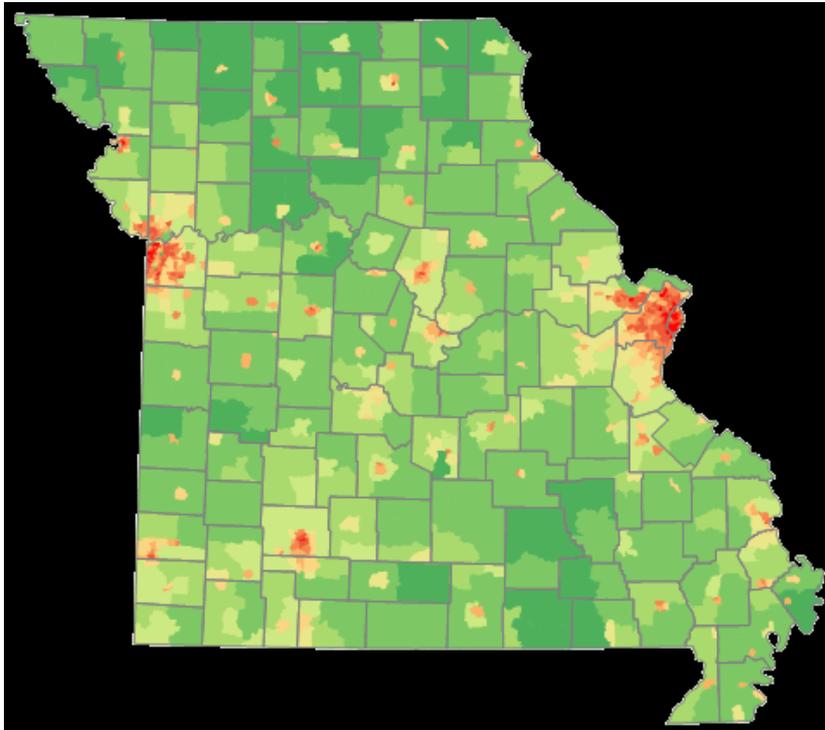
- The University City Green Practices Committee provides input into energy code adoption efforts.



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## Local Jurisdiction – Adoption Status



Arnold  
Ballwin  
Belton  
Bethany  
Boonville  
Branson  
Camdenton  
Cape Girardeau  
Carthage  
Chillicothe  
Clayton  
Columbia  
Eldon  
El Dorado Springs  
Farmington  
Florissant  
Fulton  
Gladstone  
Hannibal  
Harrisonville  
Hazelwood

Hazelwood  
Higginsville  
Highlandville  
Joplin  
Kansas City  
Kirksville  
Kirkwood  
Knob Noster  
Lake St. Louis  
Loch Lloyd  
Lebanon  
Lee's Summit  
Macon  
Marshall  
Maryville  
Mexico  
Mountain Grove  
Neosho  
Nixia  
O'Fallon  
Osage Beach

Ozark  
Pacific  
Park Hills  
Pineville  
Platte City  
Raytown  
Republic  
Riverside  
Rolla  
Sedalia  
Sikeston  
Sni Valley  
Springfield  
St. Charles  
St. Joseph  
St. Louis  
St. Peters  
Sugar Creek  
Troy  
Warrensburg  
Wentzville  
West Plains

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## Topic 2

### Commercial Compliance Approaches and their Corresponding Tools



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## Different compliance paths

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- Prescriptive compliance
- Trade-off\*
- Total building performance

\*The 2009 International Energy Conservation Code (IECC) contains a U-factor alternative (Section 502.1.2).

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## Prescriptive compliance - Based on the code being used

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If documentation supporting a trade-off or performance approach is not available, the evaluation of the building is based on the prescriptive compliance path.

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## Trade-off or Performance Approach

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If there is documentation supporting a trade-off or performance approach, the evaluator is instructed to evaluate the building construction based on the documentation provided with the plans and specifications for that non-prescriptive compliance approach

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## Trade-off

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- For example, a building may have windows more efficient than the prescriptive requirements in the code. These windows may offset a ceiling design that does not satisfy the minimum thermal requirements of the code. If compliance documentation demonstrating this trade-off was submitted and approved, the evaluator will need to verify that the window U-factors and areas, and installed ceiling construction type and R-values match the trade-off documentation.
- If no documentation was submitted, the building will fail the ceiling prescriptive R-value requirement, even if it can be shown that it meets the code requirements based on a trade-off approach.

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## Trade-off

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While this approach might penalize buildings that do comply but haven't documented that compliance, it is a justified penalty in that the code requires such documentation be submitted. There are two different scenarios that could apply to this example:

- The ceiling insulation R-value(s) are marked on the plans and match those installed in the field, but no trade-off documentation is submitted. Under this scenario, the building fails one code requirement for not meeting the prescriptive ceiling R-value requirements.
- The ceiling insulation R-value(s) are not marked on any submitted plans or other documentation, nor is trade-off documentation submitted. Under this scenario, the building will fail two code requirements.

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## Total Building Performance Approach

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### Greater Flexibility

- Detailed Picture of overall building
- Baseline Analysis and Comparison

### Obtain Credit for Special Features

- Solar PV / Solar Thermal
- Heat Pump System

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## Total Building Performance Approach

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Samples of performance software available are listed in the

- [Building Energy Software Tools Directory](http://apps1.eere.energy.gov/buildings/tools_directory/),  
[http://apps1.eere.energy.gov/buildings/tools\\_directory/](http://apps1.eere.energy.gov/buildings/tools_directory/)

and on the

- [Building Technologies Program website](http://www1.eere.energy.gov/buildings/),  
<http://www1.eere.energy.gov/buildings/>

eQuest is a software that can do an energy analysis.

- <http://doe2.com/equest/>

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## More Resources

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- <http://www.ashrae.org/technology/page/121>
- <http://www.iccsafe.org/cs/Pages/opinions.aspx>
- <http://www.energycodes.gov/help/>

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## Compliance for additions or alterations

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One of the keys to showing compliance for additions and alterations is to remember you are only considering the new space, or the new walls, etc.

You have the option of showing compliance for the entire space, but this is not necessary or typical.

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## Compliance for additions or alterations

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Using COMcheck, you will indicate "addition" or "alteration" on the project information tab, and need to enter the following information, as it applies to your project:

- Ceiling – gross area (ft<sup>2</sup>) and insulation R-value of new ceiling
- Exterior walls – gross area (ft<sup>2</sup>) of new exterior walls and insulation R-value (any existing exterior wall(s) that will become interior wall(s) once the addition is built are not be entered as part of the addition wall area)
- Windows/Doors – gross area (ft<sup>2</sup>) of windows and/or doors with U-factor from NFRC label or default table in the help section of COMcheck™
- Floor – gross area (ft<sup>2</sup>) of addition and insulation R-value. If the floor is a slab, the length of the exterior slab edge should be entered in linear feet

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## Compliance for Remodels and Alterations

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COMcheck will calculate compliance for your project as you define it. For example, if your project is a tenant improvement with new interior lighting, new exterior lighting and mechanical, you would not need to fill in the envelope tab.

Conversely, if your project is new construction of an unoccupied commercial shell and there is no interior lighting or mechanical system, you would not fill out those tabs.

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## Please explain how to use different wattage luminaire and comply with the code.

For example, does my lighting comply, if my building that is using a Halo H71CT 6" ceiling insulated Recessed Housing which accepts a R-30 type bulb, the bulb specified is a "15 Watt CFL, Light Bulb - 65 W Equal-Warm White 27000K - R30 Reflector - Energy Miser FE-R30-15W-27k", can this information be input into the COMcheck Compliance Software as 15 Watt CFL, instead of a 65 Watt incandescent to show that it is compliance?

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## [How do I create an energy code compliance report to get my building permit?](#)

If your building official is asking to see a compliance report when you apply for a building permit, you can [download software](#) at no charge. You will fill out forms with information about your project, such as square footage of the floors, walls, and ceilings, insulation levels, information about your windows and heating and cooling system. The menu driven software will show you when the building has complied with the energy code, and then you can print out the reports to submit for the building permit.

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## Where can I get a copy of the energy code?

We suggest checking with your local jurisdiction to verify which code version (year) they are enforcing before purchasing the code book. Copies of the International Energy Conservation Code can be purchased from the [ICC website](#) .

Copies of ASHRAE 90.1 can be purchased on the [ASHRAE website](#).

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## What are the minimum insulation and window requirements for my building?

- Minimum insulation levels and window requirements depend on your climate zone, whether you are complying with the IECC or ASHRAE 90.1. In the IECC you will need the information from Table 502.2 (1) and 502.3.
- In ASHRAE 90.1 the information is found in Table 5.5-1-8, insulation levels for high albedo roofs can be found in Table 5.5.3.1, and SHGC multipliers for permanent projections is in Table 5.5.4.4.1
- There are several ways to get this information: Call, or stop by, your local building department and ask them. Obtain a copy of the code book if you will be needing other information for ongoing projects.
- Submit your question to [BECP Technical Support](#). Please include your state and local jurisdiction so we can determine your climate zone.

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## My project has both businesses and homes, is it residential or commercial?

For mixed use buildings that are three stories or less and have residential and commercial, the way to determine if the entire building can shown to meet code under residential or commercial is the percentage of the space types.

If the residential is 10% or less of the overall building then the entire building can fall under commercial. It is always easier to show compliance for the entire exterior thermal building envelope instead of breaking the building apart.

If using COMcheck, the apartments would be multi-family under the space types option and the other areas should also be designated according to their activities. Remember, if the building is four stories or greater, it is commercial.

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## Do the last IECC versions reference the ASHRAE Standard in such a way as to require the commissioning work described in them?

- ASHRAE Standards 90.1-2004 and 90.1-2007 require plans and specs to include detail descriptions for Commissioning of HVAC systems and their controls in buildings with conditioned space greater than 50,000 square feet.
- The 2009 IECC allows a code user to use either 90.1-2007 in its entirety (including the HVAC requirements) or to use the requirements in Chapter 5 of the 2009 IECC. Chapter 5 of the 2009 IECC does not have any specific commissioning requirements. There are air system and hydronic system balancing requirements, but nothing specifically labeled "commissioning" or "functional testing".
- Commissioning requirements have been included in the 2012 IECC.

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## Promoting Awareness of 2009 IECC

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General Resources

***Top 10 Reasons for Building Energy Codes***, U.S. Dept. of Energy

***Frequently-Asked Questions***, U.S. Dept. of Energy



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## State-Level Technical Assistance

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Over the years, DOE's Building Energy Codes Program has provided the following types of assistance to state energy organizations:

### **Technical analysis of residential and commercial codes, including:**

- Analysis of energy savings associated with adoption of new codes
- Analysis of first cost impacts and cost-effectiveness associated with adoption of new codes
- Comparative analysis of future code options
- Suggested language for modification of national model codes for state-specific issues

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## State-Level Technical Assistance

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### **Training on residential and commercial codes**

Development of customized training materials for state codes

Web-based or in-person training on the national model codes and state codes

### **Software in support of residential and commercial codes**

State-specific energy codes in [REScheck](#)

State-specific energy codes in [COMcheck](#)

In addition, DOE's BECP has acquired databases of residential and commercial construction volume by state and county. BECP can prepare a number of summary products from these databases for state use related to energy codes.

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## State-Level Technical Assistance

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Funding to provide no-cost technical assistance is limited. In assessing each request, the following issues will be taken into consideration:

Potential overall impact of the proposed assistance, based on current codes and building practices, population and construction starts

Groups of states and individual states take priority over localities

Consistency with DOE's goal of nationwide 70% adoption of the 2009 IECC/ASHRAE 90.1-2007 or the 2012 IECC/ASHRAE 90.1-2010

Consistency with DOE's goal of state wide 90% compliance rates

Requests will be acknowledged upon receipt. Notification of request status will be sent within two weeks. Activity and progress will be monitored continuously.

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## State-Level Technical Assistance

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### Status of State-Level Technical Assistance Requests

[http://www.energycodes.gov/states/open\\_requests.stm](http://www.energycodes.gov/states/open_requests.stm)

#### Missouri

(City of Kansas City) 08/10 Analyze savings between the 2006 IECC and 2009 IECC and the 2006 IECC and 2012 IECC. - *In Progress*



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## Adopt, Implement, Enforce – Resources

[www.energycodes.gov](http://www.energycodes.gov)

The screenshot shows the homepage of the U.S. Department of Energy's Building Energy Codes Program. The header includes the U.S. Department of Energy logo and the text "Energy Efficiency & Renewable Energy". Below the header is a green banner with the text "Building Energy Codes Program". The main navigation bar includes "ABOUT BECP", "WHY BUILDING ENERGY CODES", and "RELATED LINKS". A search bar is located in the top right corner. The left sidebar contains sections for "BROWSE..." (Publications, Events Calendar, Job/Internship Opportunities), "QUICKLINKS FOR..." (Architects/Engineers/Designers, Builders/Contractors, Code Enforcement Officials, State & Local Code Adopters, Codes Advocates, Students), and "FOLLOW US!" with social media icons. The main content area features a central graphic with a computer monitor, a graduation cap, and a pencil, with the text "BECP WEBCASTS with Live Q&A" and "Registration is Open!". Below this are four buttons: "Status of Energy Codes", "Solutions & Help Center", "Software & Tools", and "Education & Training". At the bottom, there are two large buttons for "RESIDENTIAL Energy Codes" and "COMMERCIAL Energy Codes". The right sidebar contains a search bar, "EERE Information Center", "POWER TOOLS" (REScheck, Status, COMcheck, Helpline), "RECENT UPDATES" (Building Energy Codes Program Website Gets a Facelift, Energy Codes 2010 location and promotional opportunities announced), "CODES IN THE NEWS" (New IE1 Green Building Codes Launched, State Building Code Council Adopts New Rules Promoting Energy Conservation And Building Safety, North Carolina Home Guide to Energy Code Compliance), and "AROUND THE WEB" (IECC Compliance Guide for New Homes in Maine).

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## Adopt, Implement, Enforce – Resources

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BECP is developing guidelines and tools to use in measuring compliance with building energy codes, which:

- Foster uniformity and objectivity in measuring compliance rates
- Eliminate need for each state to develop its own procedures and tools
- Provide tools that states can adapt for their own preferred use
- Collect additional data and support related activities.



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Building Energy Codes Assistance for States	Status of State Energy Codes	Check on the current code status of any U.S. state or territory using BECP's interactive map tool. Also find links to state specific portions of BECP's recent nationwide analysis reports, state-level energy official contact information, and many other details.	<a href="http://www.energycodes.gov/states">www.energycodes.gov/states</a>
	Technical Assistance to States	BECP provides specialized technical assistance to the states in the form of economic analysis, code comparisons, webcast training, and compliance material development requested by states to help them adopt, upgrade, implement, and enforce their building energy codes.	<a href="http://www.energycodes.gov/states/techAssist.stm">http://www.energycodes.gov/states/techAssist.stm</a>
	State Compliance Assistance	BECP has developed an approach states can use for measuring compliance with building energy codes.	<a href="http://www.energycodes.gov/arra/compliance_evaluation.stm">http://www.energycodes.gov/arra/compliance_evaluation.stm</a>
No-cost Compliance Tools	Residential Code Compliance Software	REScheck™ and REScheck-Web™ 	<a href="http://www.energycodes.gov/software.stm">http://www.energycodes.gov/software.stm</a>
	Commercial Code Compliance Software	COMcheck™ and COMcheck-Web™ 	
Training	Building Energy Codes University (BECU)	To help stakeholders broaden and deepen their knowledge of building energy codes, BECP is collecting its diverse training resources in an extensive Building Energy Codes University (BECU) that features webcasts, training videos, self-paced online courses, presentations, and other BECP materials and tools.	<a href="http://www.energycodes.gov/training">www.energycodes.gov/training</a>
Resource Center	Building Energy Codes Knowledge Base	This knowledge base provides a variety of different media types, including articles, graphics, online tools, presentations, and videos that anyone can use to create their own training and presentations.	<a href="http://resourcecenter.pnl.gov/">http://resourcecenter.pnl.gov/</a>
Advocacy	The Building Codes Assistance Project (BCAP)	BCAP is an initiative of the Alliance to Save Energy, the American Council for an Energy-Efficient Economy, and the Natural Resource Defense Council that provides states with code advocacy assistance on behalf of DOE.	<a href="http://www.bcapp-energy.org">www.bcapp-energy.org</a>

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## Break

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10 minutes

We're going to start topic 2 again at \_\_\_\_\_



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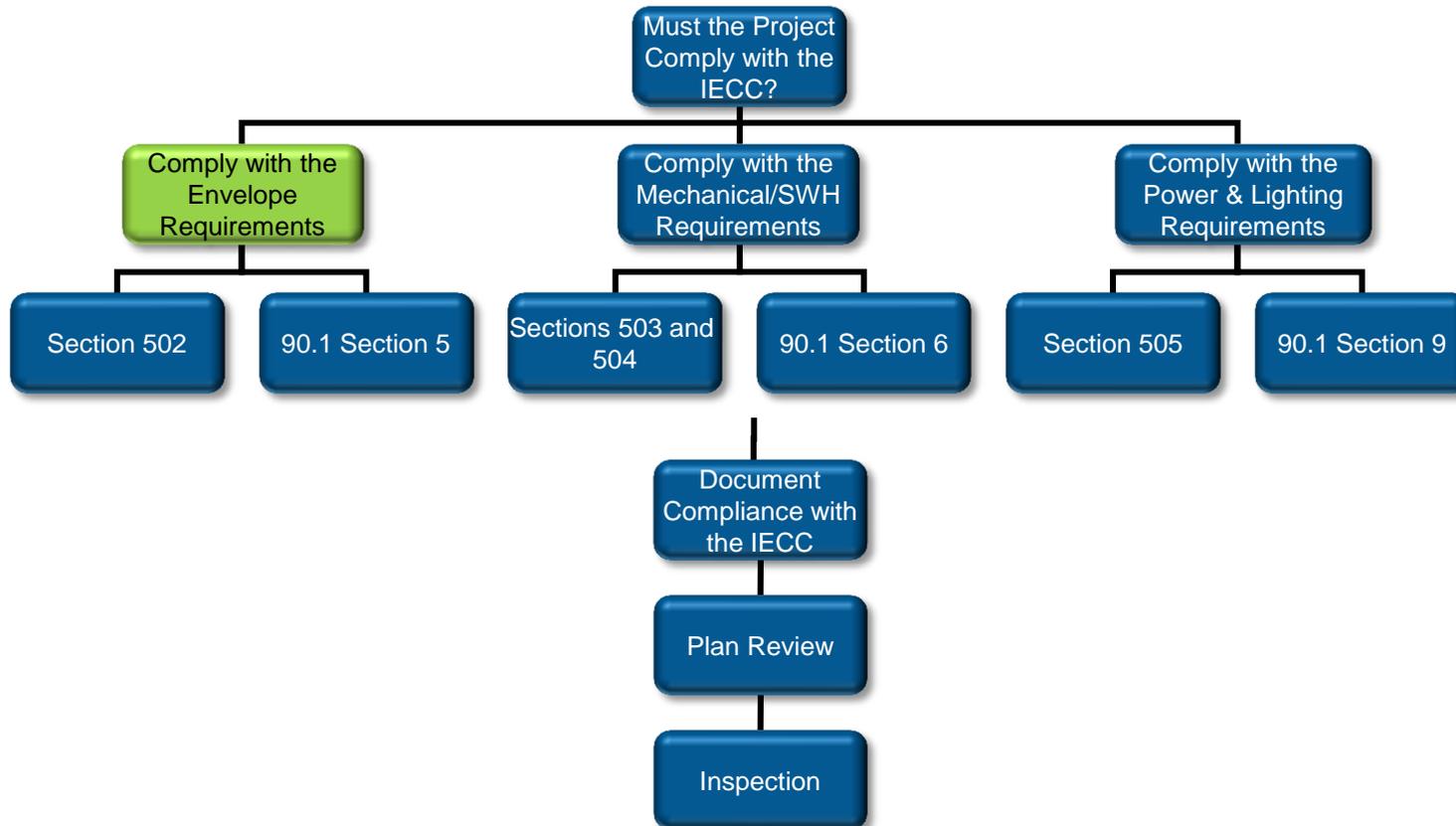
## Topic 3

Overview of the requirements of  
Commercial **envelope**, lighting and  
mechanical provisions of the 2009 IECC

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## 2009 IECC Compliance



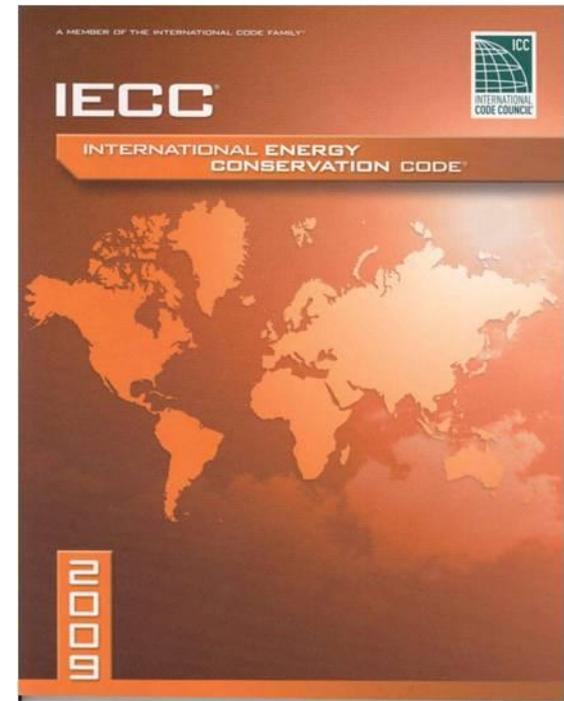
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## Major Changes to the Envelope Requirements

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- Commercial Provisions Contained in Chapter 5 IECC
- ASHRAE 90.1-2007 Tables 502.2(1) and Table 502.2(2) Building Envelope Requirements – Opaque Assemblies



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## What is the Building Thermal Envelope?

---

- Roof/Ceiling Assembly
- Wall Assembly
- Vertical Fenestration and Skylights
- Floor Assembly
- Slab Edge
- Below Grade Wall Assembly

**BUILDING THERMAL ENVELOPE.** The basement walls, exterior walls, floor, roof, and any other building element that enclose *conditioned space*. This boundary also includes the boundary between *conditioned space* and any exempt or unconditioned space.

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## What are My Options for Complying with the IECC?

- Chapter 5 of the IECC General Prescriptive Approach
- Use for  $\leq 40\%$  of gross wall area in vertical fenestration
- Use for  $\leq 3\%$  of gross roof area in skylights
- Section 506 Total Building Performance Approach
- ASHRAE/IESNA Standard 90.1-2007

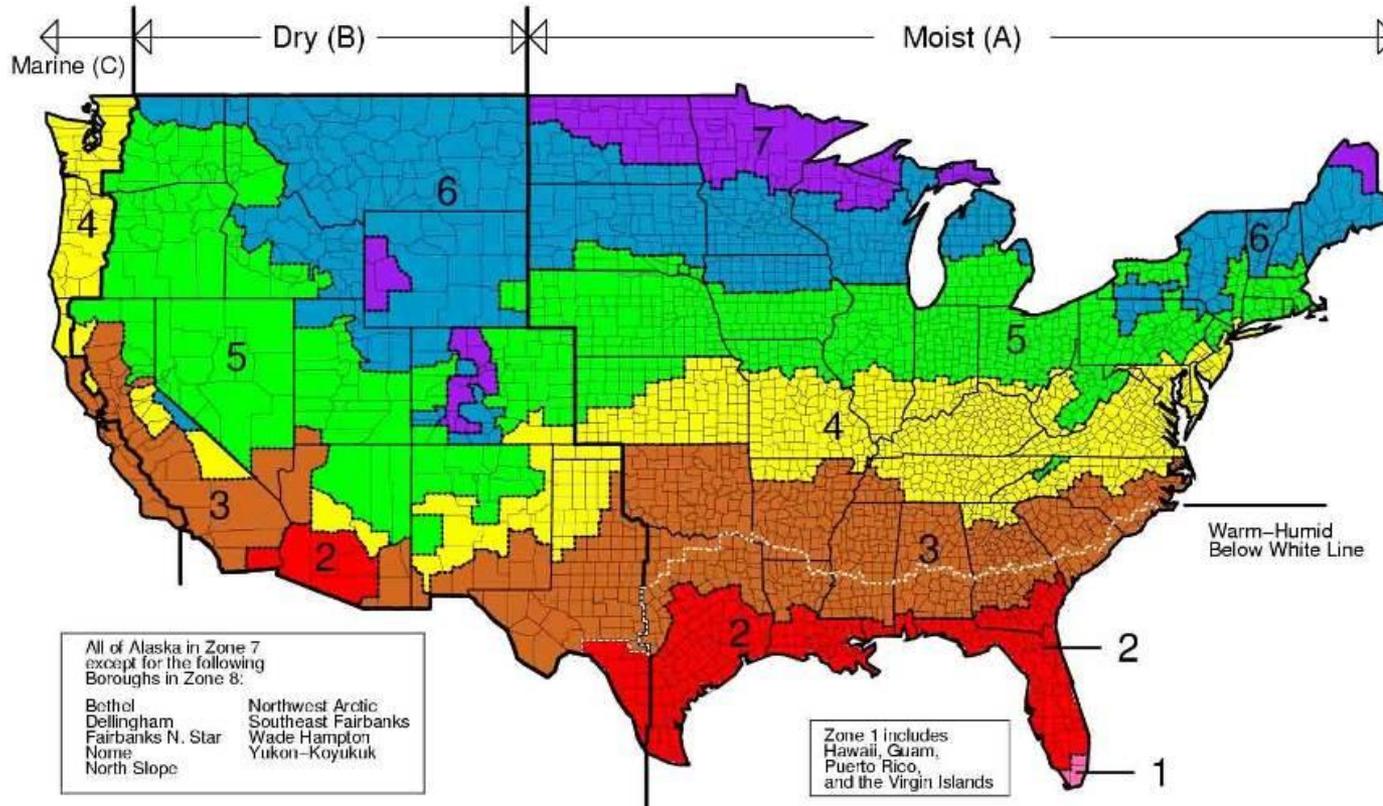
Section 501.2 “Application” requires 90.1 to be used in its entirety (Envelope, Lighting, Mechanical) if used as an alternate compliance path



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### Climate Zones – 2009 IECC

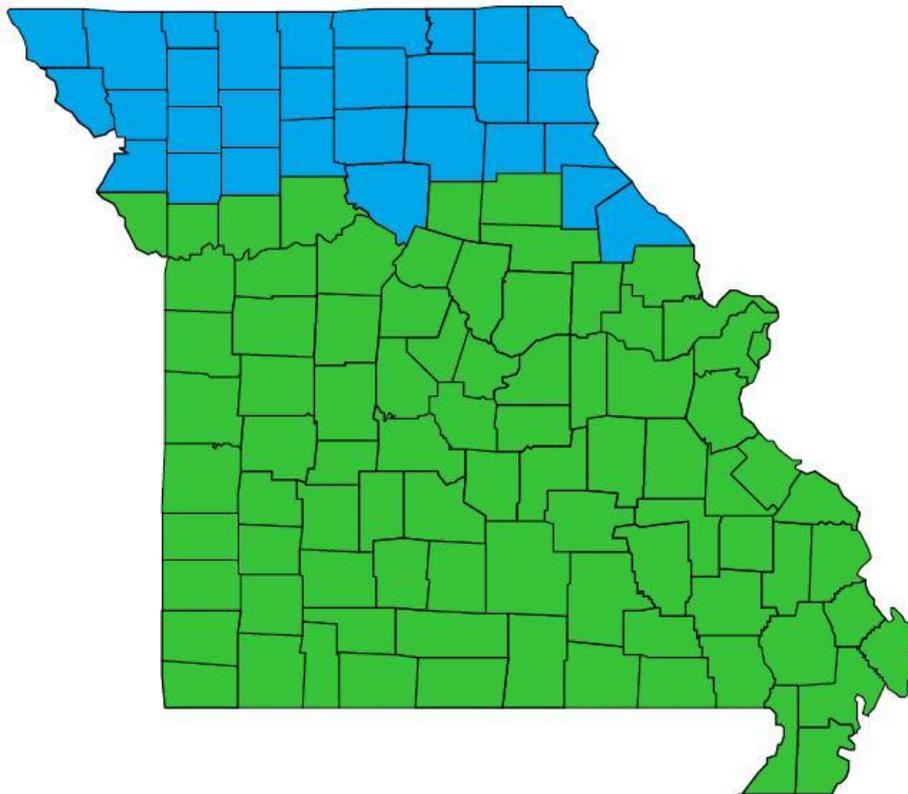


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## Climate Zones – 2009 IECC

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### Compliance with Chapter 5 Prescriptive Approach

**TABLE 502.2(1)  
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES**

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
<b>Roofs</b>																
Insulation entirely above deck	R-15ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci
Metal buildings (with R-5 thermal blocks <sup>b, h</sup> )	R-19	R-19	R-13 + R-13	R-13 + R-13	R-13 + R-13	R-13	R-13 + R-13	R-19	R-13 + R-13	R-19	R-13 + R-13	R-19	R-13 + R-19	R-19 + R-10	R-11 + R-19	R-19 + R-10
Attic and other	R-30	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49
<b>Walls, Above Grade</b>																
Mass	NR	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci <sup>c</sup>	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building <sup>b</sup>	R-16	R-16	R-16	R-16	R-19	R-19	R-19	R-19	R-13 + R-5.6ci	R-13 + R-5.6ci	R-13 + R-5.6ci	R-13 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci	R-19 + R-5.6ci
Metal framed	R-13	R-13	R-13	R-13 + 7.5ci	R-13 + R-3.8ci	R-13 + R-7.5ci	R-13 + 7.5	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13 + R-18.8ci					
Wood framed and other	R-13	R-13	R-13	R-13	R-13	R-13	R-13	R-13 + R-3.8ci	R-13 + 3.8	R-13 + 7.5	R-13 + R-7.5	R-13 + R-7.5	R-13 + R-7.5	R-13 + 7.5ci	R-13 + R-15.6ci	R-13 + 15.6ci
<b>Walls, Below Grade</b>																
Below grade wall <sup>d</sup>	NR	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	NR	R-7.5ci	R-7.5ci	R-10ci	R-7.5ci	R-7.5ci	R-12.5ci
<b>Floors</b>																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-6.3ci	R-8.3ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing Steel/(wood)	NR	NR	R-19	R-30	R-19	R-30	R-30	R-30	R-30	R-30	R-30	R-30 <sup>e</sup>	R-30	R-30 <sup>e</sup>	R-30 <sup>e</sup>	R-30 <sup>e</sup>
<b>Slab-on-Grade Floors</b>																
Unheated slabs	NR	NR	NR	NR	NR	NR	NR	R-10 for 24 in. below	NR	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below			
Heated slabs	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below	R-20 for 48 in. below										
Opaque doors																
Swinging	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.70	U-0.50	U-0.50	U-0.50	U-0.50
Roll-up or sliding	U-1.45	U-1.45	U-1.45	U-1.45	U-1.45	U-1.45	U-0.50									

For SI: 1 inch = 25.4 mm.  
 ci = Continuous insulation. NR = No requirement.  
 a. When using R-value compliance method, a thermal spacer block is required, otherwise use the U-factor compliance method. [see Tables 502.1.2 and 502.2(2)].  
 b. Assembly descriptions can be found in Table 502.2(2).  
 c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-<sup>2</sup> F.  
 d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.  
 e. Steel floor joist systems shall to be R-38.



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## Changes to Tables 502.1.2 and 502.2(1)

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- Table now separated by occupancy type
- Group R occupancies use “Group R” column
- Non-Group R occupancies use “All other” column

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### Compliance with Chapter 5 Prescriptive Approach

TABLE 502.2(2)  
BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES

ROOFS	DESCRIPTION	REFERENCE
R-19	<p>Standing seam roof with single fiberglass insulation layer.</p> <p>This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</p>	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-13 + R-13 R-13 + R-19	<p>Standing seam roof with two fiberglass insulation layers.</p> <p>The first R-value is for faced fiberglass insulation batts draped over purlins. The second R-value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</p>	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-11 + R-19 FC	<p>Filled cavity fiberglass insulation.</p> <p>A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.</p>	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
<b>WALLS</b>		
R-16, R-19	<p>Single fiberglass insulation layer.</p> <p>The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.</p>	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"
R-13 + R-5.6 ci R-19 + R-5.6 ci	<p>The first R-value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.</p>	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"



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## Roof R-Value (502.2.1) / U-Factor (502.1.2)

---

Roof R-values and U-factor requirements are based on assembly type / insulation placement

- Insulation entirely above deck
- Metal buildings
- Attic and other



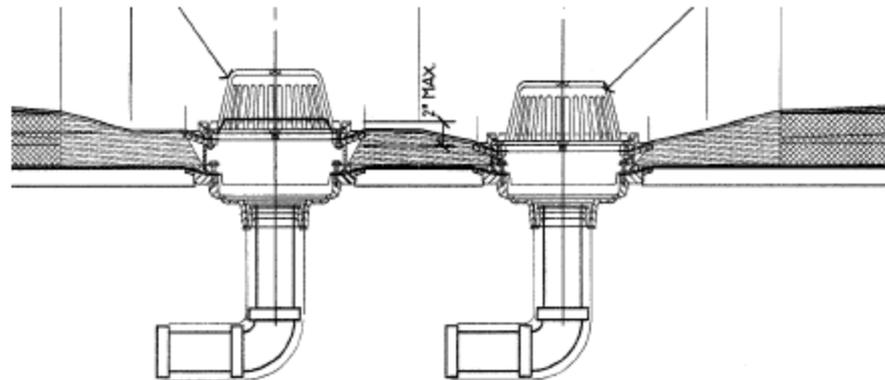
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## Roof R-Value – Insulation Completely Above Deck

---

- Insulation considered continuous (*CI*)
- Insulation thickness can vary  $\leq 1''$  and area weighted U-factor meets the requirements of Table 502.2(1)



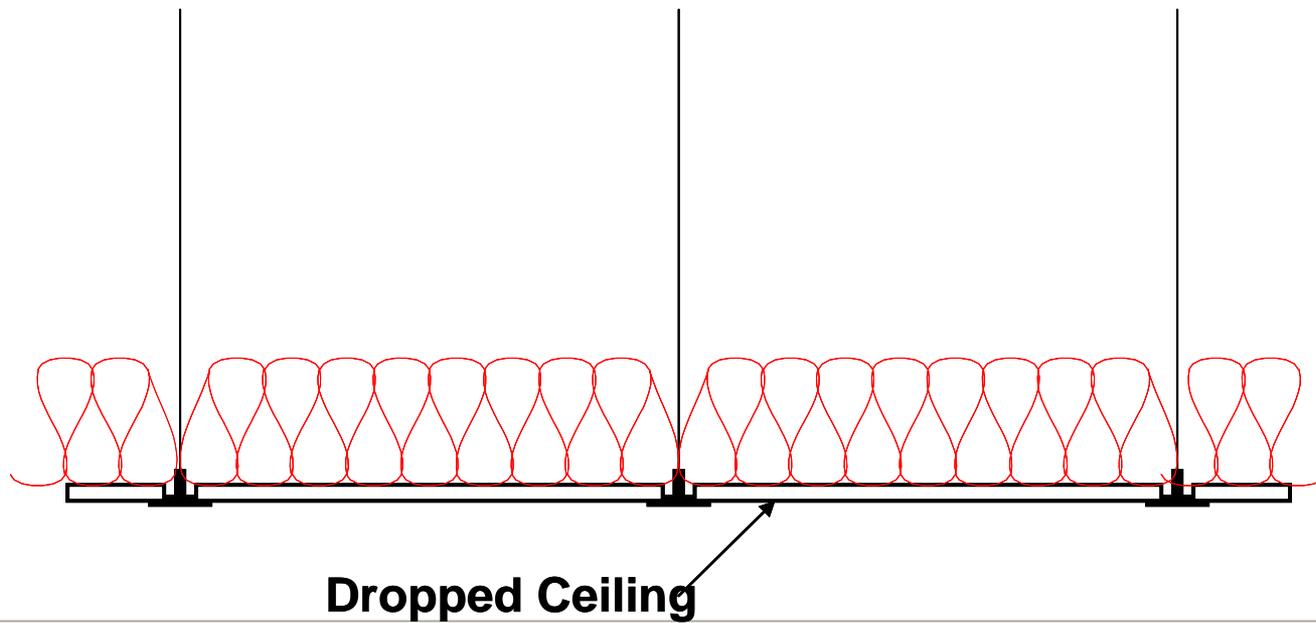
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## Roof R-Value – Insulation Placed on Suspended Ceiling with Removable Ceiling Tiles

---

- Will not count for code compliance
- Will not comply with Section 502.4.3 – “Sealing of the building envelope”

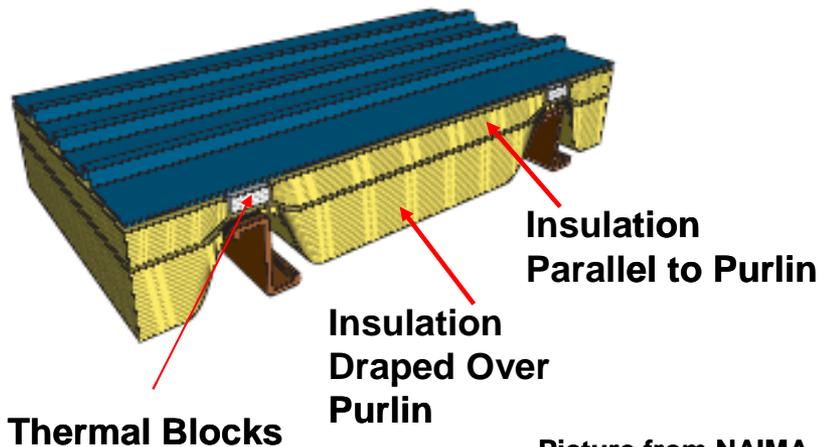


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## Roof R-Value – Metal Buildings

---



Picture from NAIMA

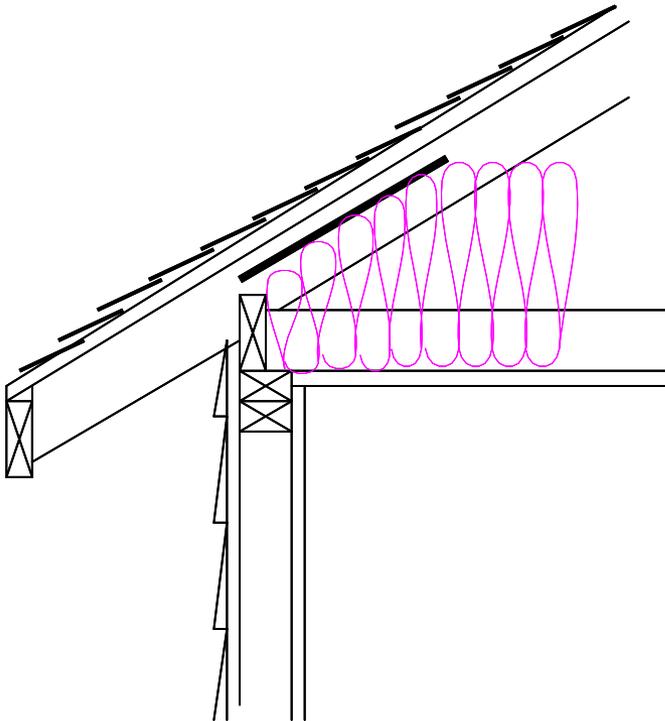
- R-5 thermal blocks required on all metal buildings or must use U-factor Compliance Method
- Climate Zones 2-8 require two layers of insulation
- CZ 2-5 and marine R: R-13+R-13
- Example (R-13+R-19):
- R-13 draped perpendicularly to the purlins
- R-19 running parallel to the purlins supported by the R-13

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## Roof R-Value – Ceilings with Attic Spaces

---



- Install insulation between framing
- R-38 in most Climate Zones
- R-30 in Climate Zones 1 and R-49 in Climate Zone 8

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## Wall R-Value – Mass Walls

---

- Walls weighing at least 35 lbs/ft<sup>2</sup> of wall surface area, or
- 25 lbs/ft<sup>2</sup> of wall surface area if material weight is  $\leq 120 \text{ lb/ft}^3$



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## Mass Walls – Concrete Masonry Units

---

- Climate Zone 4 except marine – Can use integral insulation instead of R-5.7 ci
- Concrete block walls must comply with ASTM C 90, and
- UngROUTED or partially grouted @ 32 inch. o.c. or less vertically or 48 inch. o.c. or less horizontally, and
- UngROUTED cells must be filled with insulation material  $\leq$  of 0.44 Btu-in./h-ft<sup>2</sup> F

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## Wall R-Value – Wood, Metal Frame, and Other

---

- Cavity insulation or cavity plus continuous (ci)
- Continuous insulation not broken up by framing members e.g. rigid board insulation

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## Metal Building Walls [Table 502.2(2)]



Picture from NAIMA

Climate Zone	R-Value
1-2	R-16
3-4 except Marine	R-19
Marine 4 – 6	R-13+R-5.6ci
7-8	R-19+R-5.6ci

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## Below Grade Walls (502.2.4)

---

- What is a below grade wall?
- Basement or first-story walls  $\geq$  85% below grade
- Insulation must extend down 10 ft from the outside finished grade level or to the level of the floor, whichever is less

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## Floors Over Outdoor Air or Unconditioned Space (502.2.5)

---



- Joist/Framing (Steel/Wood)
- Insulation installed between framing
- Mass Floors
- Materials weighing 35 lbs/ft<sup>2</sup>, or
- 25 lbs/ft<sup>2</sup> if material weight is  $\leq$  120 lbs/ft<sup>3</sup>

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## Slab-on-Grade Floors (502.2.6)

---

- Unheated slab – insulation required in Climate Zones 4-8
- Heated slabs – insulation required in all Climate Zones

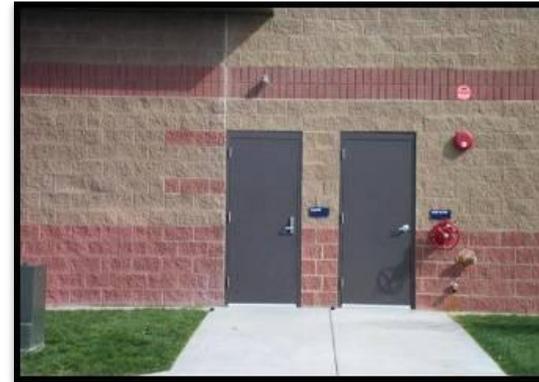
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## Opaque Doors (502.2.7)

---

- Doors having < 50% glass area
- Swinging doors
- Meet U-factor requirement
- Roll-up or sliding doors
- Climate zones 1 - 3: U-1.45
- Climate zones 4 including Marine - 8: U-0.50



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### Compliance with Chapter 5 Prescriptive Approach

**TABLE 502.3  
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION**

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
<b>Vertical fenestration (40% maximum of above-grade wall)</b>								
<i>U-factor</i>								
<b>Framing materials other than metal with or without metal reinforcement or cladding</b>								
<i>U-factor</i>	1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35
<b>Metal framing with or without thermal break</b>								
Curtain wall/storefront <i>U-factor</i>	1.0	0.70	0.60	0.50	0.45	0.45	0.40	0.40
Entrance door <i>U-factor</i>	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All other <i>U-factor</i> <sup>a</sup>	1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45
<b>SHGC-all frame types</b>								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
<b>Skylights (3% maximum)</b>								
<i>U-factor</i>	0.75	0.75	0.65	0.60	0.60	0.60	0.60	0.60
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.  
 PF = Projection factor (see Section 502.3.2).  
 a. All others includes operable windows, fixed windows and nonentrance doors.

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## Vertical Fenestration Requirement (502.3.1)

---

- Based on above-grade wall area (gross)
- Includes walls between conditioned space and unconditioned space or the great outdoors
- Total fenestration area (includes frame and glazing)



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## Fenestration U-Factor (502.3.2)

---

Framing Materials Other Than Metal  
w/ or w/o metal reinforcement or  
cladding

- Includes vinyl and wood frame products or other non-metal frames
- Typically manufactured fenestration products



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## Fenestration U-Factor – Curtain Wall

---



By definition: Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments

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## Fenestration U-Factor – Storefront

---



- By definition: A nonresidential system of doors and windows mullioned as a composite fenestration structure that has been designed to resist heavy use.
- Storefront systems include, but are not limited to, exterior fenestration systems that span from the floor level or above to the ceiling of the same story on commercial buildings.

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### Fenestration U-Factor (303.1.3)

 <p>National Fenestration Rating Council <b>CERTIFIED</b></p>		<p><b>World's Best Window Co.</b></p> <p>Millennium 2000+ Vinyl-Clad Wood Frame Double Glazing • Argon Fill • Low E Product Type: Vertical Slider</p>	
<b>ENERGY PERFORMANCE RATINGS</b>			
U-Factor (U.S./I-P)	Solar Heat Gain Coefficient	<b>0.35</b>	<b>0.32</b>
<b>ADDITIONAL PERFORMANCE RATINGS</b>			
Visible Transmittance	Air Leakage (U.S./I-P)	<b>0.51</b>	<b>0.2</b>
Condensation Resistance		<b>51</b>	—
<p><small>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. Consult manufacturer's literature for other product performance information. www.nfrc.org</small></p>			

### How Do You Meet the Requirement?

- Fenestration product rating in accordance to NFRC 100
- Labeled and certified by the manufacturer
- Non-NFRC 100 rated fenestration
- Default Glazed Fenestration U-factor Table 102.1.3(1)

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## Default U-Factors from Tables 303.1.3(1) and (2)

**TABLE 102.1.3(1)  
DEFAULT GLAZED FENESTRATION U-FACTOR**

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

**TABLE 102.1.3(2)  
DEFAULT DOOR U-FACTORS**

DOOR TYPE	U-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

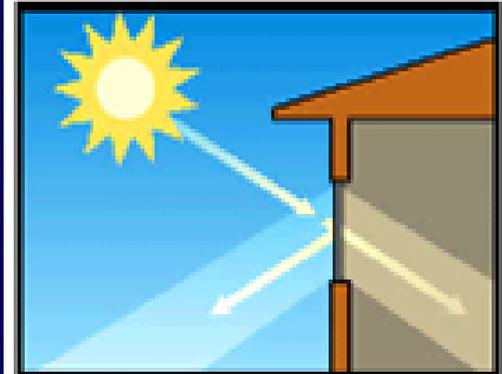
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## Glazed Fenestration SHGC (502.3.2)

What is Solar Heat Gain Coefficient?

“The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation.”



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## Fenestration SHGC Requirements – Table 303.1.3(3)

---

Two Options for Meeting the SHGC Requirements

- Fenestration product rated and labeled to NFRC 200, or
- Select default from Table 303.1.3(3)

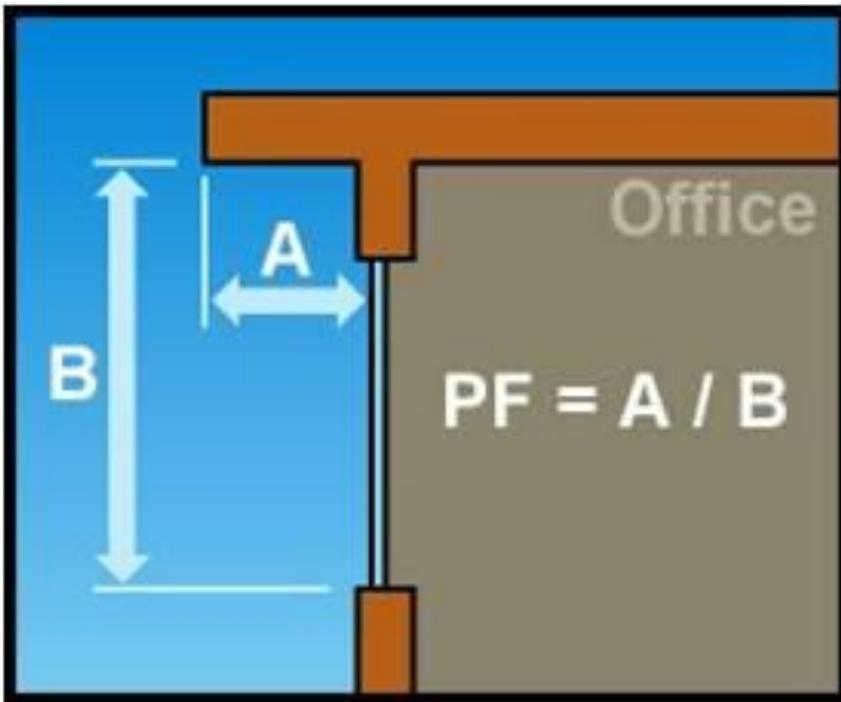
**TABLE 102.1.3(3)  
DEFAULT GLAZED FENESTRATION SHGC**

SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
Clear	Tinted	Clear	Tinted	
0.8	0.7	0.7	0.6	0.6

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## Fenestration SHGC Requirements



### The Effect of Overhangs on Fenestration SHGC

- Overhangs allow a higher SHGC product to be installed
- Projection factor must be calculated

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## Skylight U-Factor / SHGC

---

- Limited to  $\leq 3\%$  of Roof Area
- U-factor and SHGC Based
- NFRC 100 Rating for U-factor or Default Table



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## NFRC 100 Rating for U-factor or Default Table

---

TABLE 303.1.3(1)  
DEFAULT GLAZED FENESTRATION  
U-FACTOR

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

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## Mandatory Requirements – Sealing of the Building Envelope (502.4.3)

---

- All penetrations, openings, joints and seams in the building envelope must be sealed. Materials that can be used include:
- Moisture vapor-permeable wrapping material
- Sealing materials spanning joints between dissimilar materials must allow for expansion and contraction



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## Hot Gas Bypass (502.4.4)

---

- Cooling systems can't use unless system designed with
  - Multiple steps of unloading OR
  - Continuous capacity modulation
- Capacity limited per Table 502.4.4
- Exception
  - Unitary packaged systems with cooling capacities < 90,000 Btu/h

<b>Rated Capacity</b>	<b>Maximum Hot Gas Bypass Capacity (% of total capacity)</b>
≤ 240,000 Btu/h	50%
> 240,000 Btu/h	25%

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## Mandatory Requirements – Outdoor Air Intakes and Exhaust Openings (502.4.5)

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- Buildings  $\geq 3$  stories in height above grade
- Class 1 motorized leakage-rated damper
- Maximum leakage rate  $\leq 4\text{cfm}/\text{ft}^2$  @ 1.0 inch w.g.



# ENERGIZE MISSOURI

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## Mandatory Requirements – Loading Dock Weatherseals (502.4.6)

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- Equip cargo doors and loading dock doors with weather seals
- Goal is to restrict infiltration

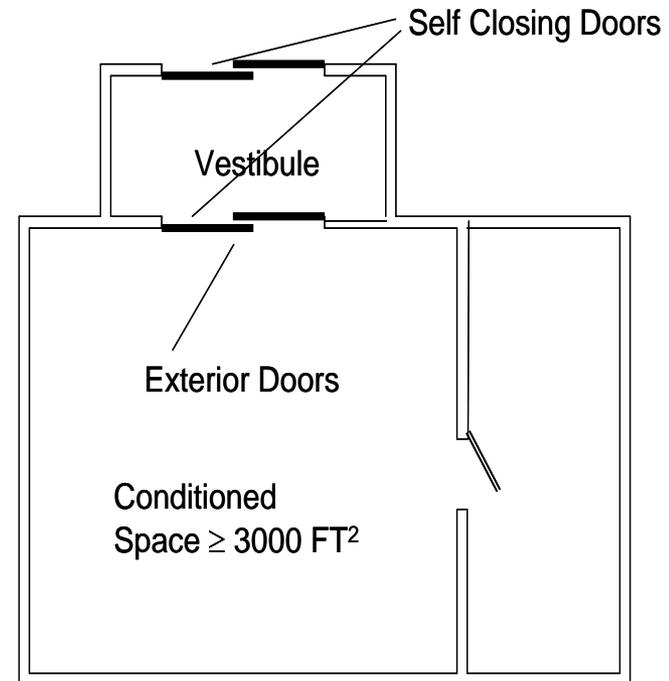
# ENERGIZE MISSOURI

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## Mandatory Requirements – Vestibules (502.4.7)

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- Required to reduce infiltration into spaces
- Required on entrance doors leading into spaces  $\geq 3,000$  ft<sup>2</sup>
- Doors must have self-closing devices



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## Mandatory Requirements – Recessed Lighting (502.4.8)

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All recessed luminaires installed in the building envelope

- Type IC rated and sealed with gasket or caulk between housing and interior wall or ceiling covering
- Type IC rated and labeled in accordance with ASTM E 283 to allow  $\leq 2.0$  cfm of air movement from conditioned space to ceiling cavity



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Thank You!  
Comment card

