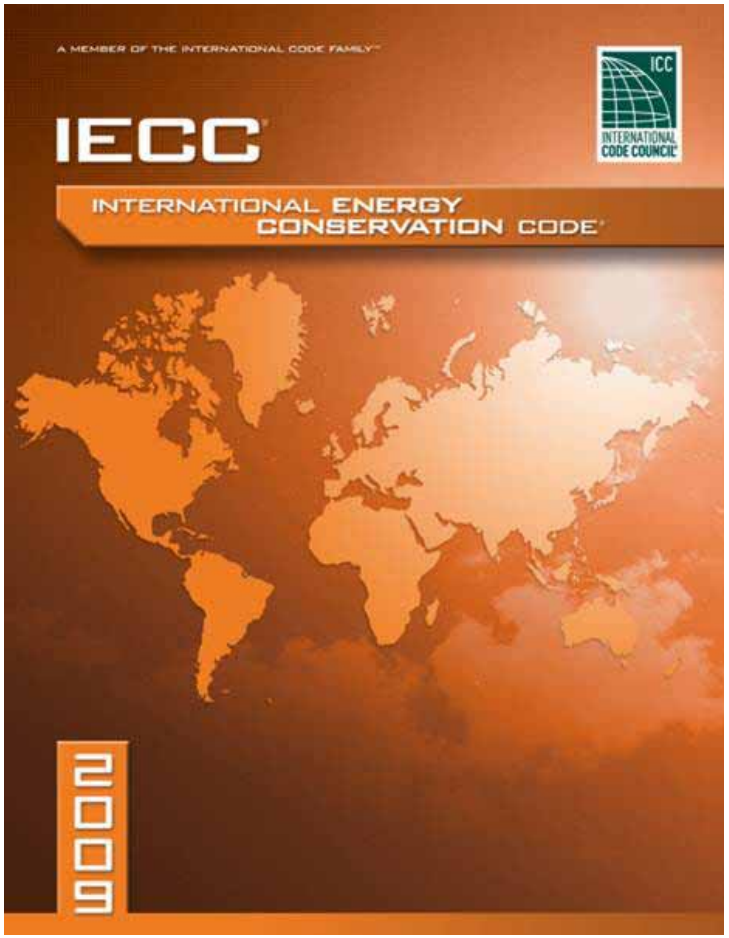
Moving from 2006 to 2009 IECC

What it means for Designers, Builders & Code Officials



Presented by:
M. Dennis Knight, P.E.
Whole Building Systems, LLC

M. Dennis Knight Background

- 38+ years experience in engineering, design and construction related services
- Registered Engineer in SC, NC & WI
- Registered Fire Protection Engineer in SC
- LEED AP 2005, LEED AP O+M, 2013
- AABC Commissioning Group Certified Commissioning Agent (CxA), 2009
- ASHRAE Distinguished Lecturer

Learning Objectives

1. Intro to the 2009 IECC
2. How IECC Relates to International Codes
3. Mandatory IECC Requirements
4. Prescriptive & Performance Paths to Demonstrate Compliance

Learning Objectives

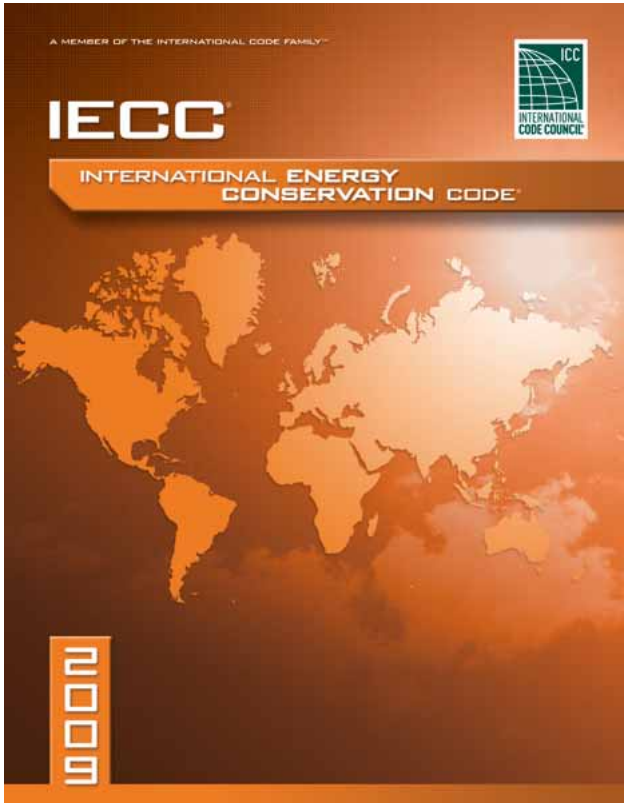
1. Major Differences between 2009 IECC & 2006 IECC
2. Intro to ASHRAE 90.1-2007
3. Various Tools to Demonstrate Code Compliance, Stay Up-to-Date & Best Practices
4. Future of Energy Codes

"Our lives succeed or fail gradually, then suddenly, one conversation at a time. While no single conversation is guaranteed to change the trajectory of a career, a business, a marriage, or a life, any single conversation can. The conversation is the relationship"

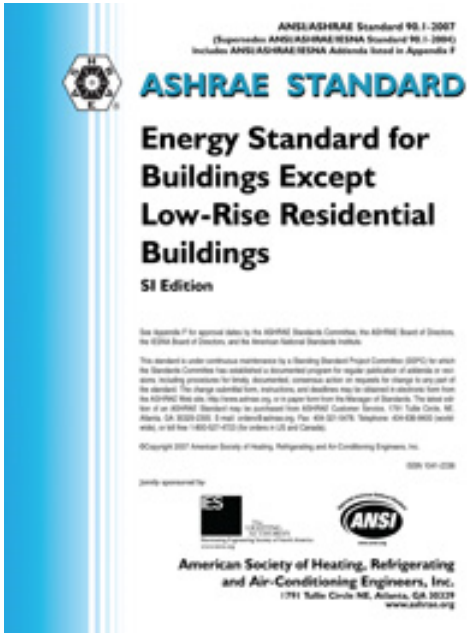
Susan Scott
Fierce Conversations

Let's Converse About The Codes

IECC 2009



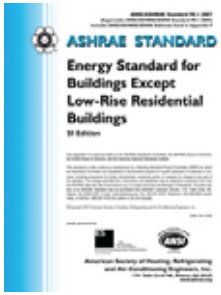
ASHRAE 90.1-2007



The Energy Codes

- The IECC – Model Energy Code
  - Regulates *minimum* energy conservation requirements for *new* buildings

- ASHRAE 90.1 – Reference Standard
  - Provides an additional Compliance Path



The Energy Codes Regulate

- The design of the following energy using systems:
  - HVAC
  - Service Water Heating
  - Electric Power Distribution
  - Electric Power Metering (IECC)
  - Lighting
  - Other electric motors, belts and drives

History of Building Codes & Energy Codes in South Carolina

History of Building & Energy Codes

Building Code

- The purpose of a *building code* is to establish:
  - the *minimum requirements* to safeguard public health, safety and general welfare
  - through structural strength, means of egress facilities, stability, sanitation, adequate light and ventilation, energy conservation,
  - and safety to life and property from fire and other hazards attributed to the built environment
  - and to provide safety to fire fighters and emergency responders during emergency operations.

History of Building & Energy Codes

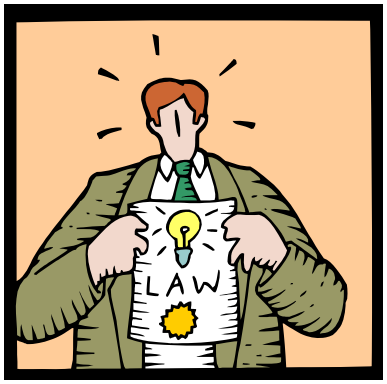
Building Codes

- **Mandatory Codes**
  - Every municipality and county in SC must enforce the mandatory codes listed in Section 6-9-50 of the SC Code of Laws, 1976 as Amended.
  - Must be used in conjunction with approved modifications.
- **Permissive Codes**
  - International Property Maintenance Code
  - International Existing Building Code
  - International Performance Code for Buildings and Facilities

History of Building & Energy Codes

Definition of Statute

- A ***statute*** is formal written enactment of a legislative authority
- This could be a…
  - State
  - County
  - City
  - Municipality



History of Building & Energy Codes

Definition of Regulation

- A *regulation* is administrative legislation issued by a government agency
- Constitutes or Constrains Rights
- Allocates Responsibilities

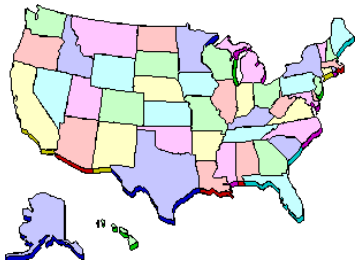
History of Building & Energy Codes

Ordinance

- A local Law
- Enforced along with State and Federal Laws
- For example, City of Charleston has two sets of ordinances:
  - City of Charleston Code of Ordinances, and
  - City of Charleston Zoning Ordinances
- May be accessed at the Municode website: http://www.municode.com/library/clientCodePage.aspx?clientID=11257.

Code Adoption & Enforcement Process

Energy Codes are typically -



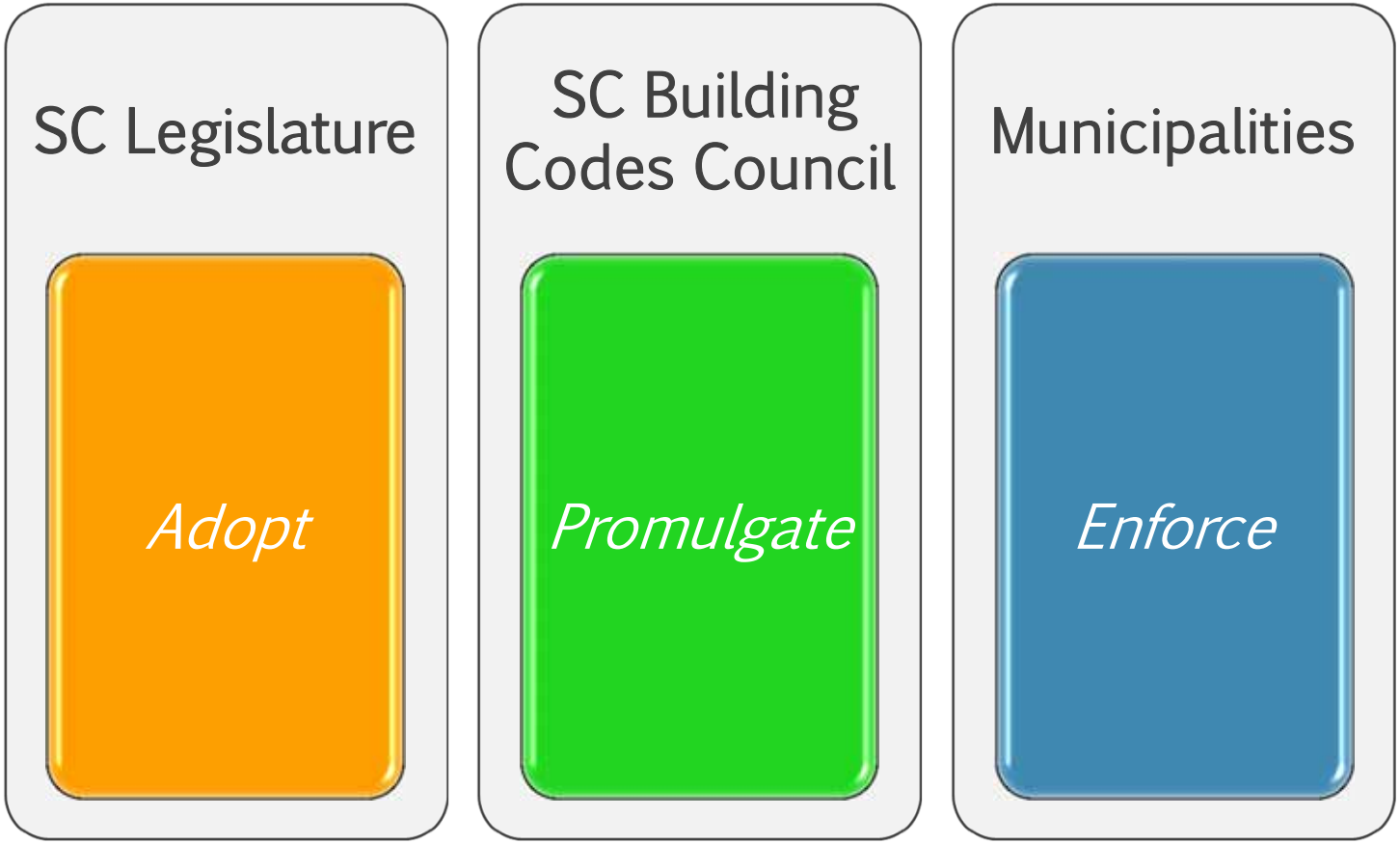
Developed at the national level

Adopted at the state level

Enforced at the municipal level

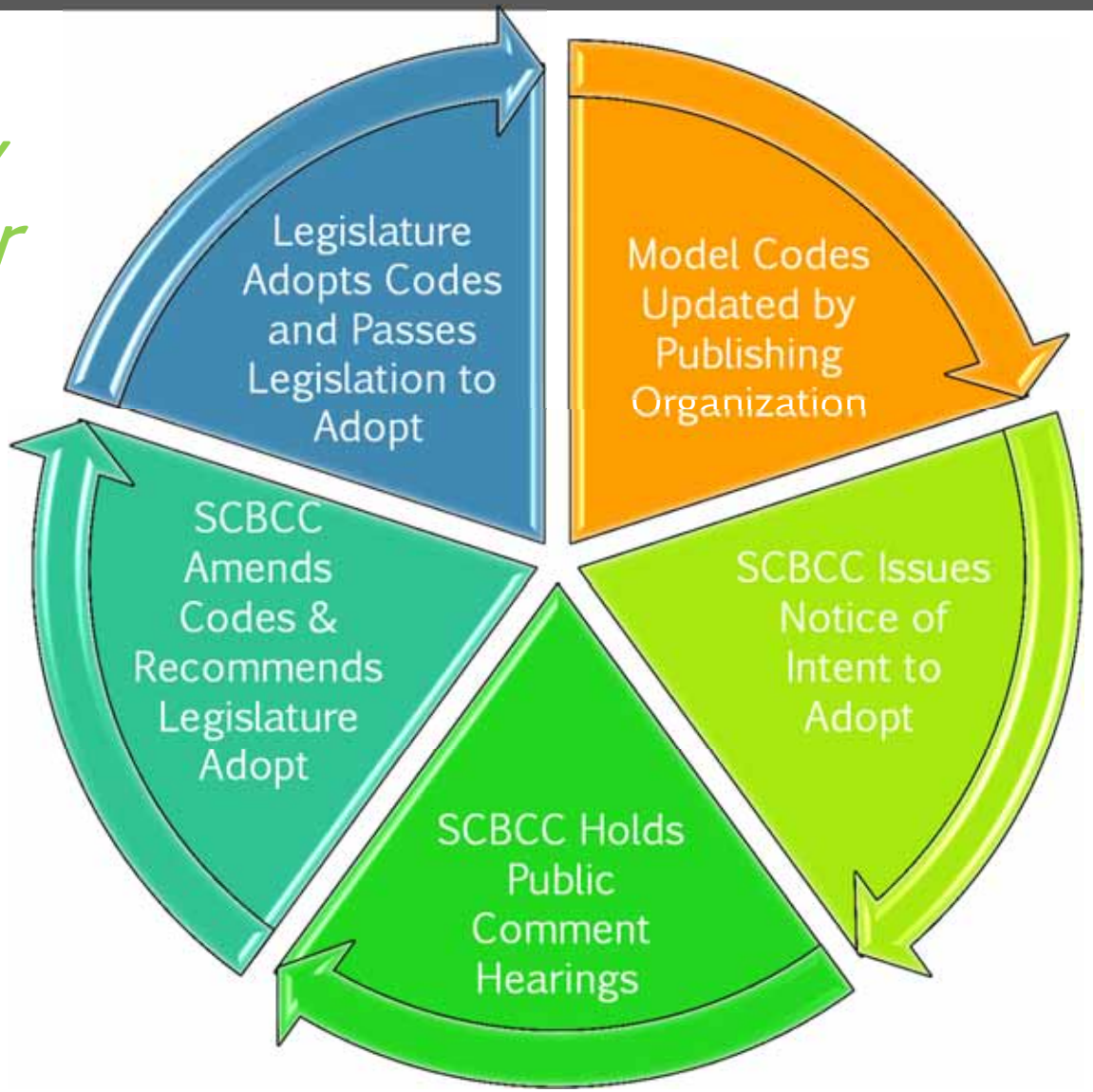
Code Adoption & Enforcement Process

3 Parties → 3 Roles



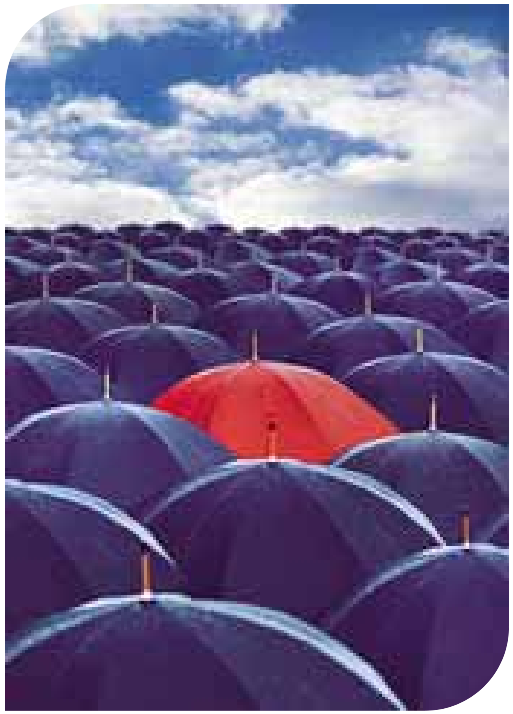
Code Adoption & Enforcement Process

Usually a 3-Year Cycle



Code Adoption & Enforcement Process

One exception – the energy code!



Energy Standards Act – Title 6, Chapter 10 SC Code of Laws

Code Adoption & Enforcement Process

Authority Having Jurisdiction (AHJ)

- The Building Official
- Fire Marshal
- State Engineer's Office
- Office of School Facilities
- SC Department of Health and Environmental Control (DHEC)

Recent History of Building Codes in SC

Energy Standards in SC

Year	Building Code Implemented	Energy Code
July 1, 2009	n/a	2006 IECC for residential and commercial
April 2, 2012	n/a	2009 IECC for residential and commercial
August 29, 2012	2012 Edition of IBC & IRC	2009 IECC for residential and commercial

Recent History of Building Codes in SC

Mandatory Building Codes Currently Implemented in SC:

2006 International Code Series (*with SC modifications):

- International Building Code*
- International Residential Code*
- International Fire Code*
- International Plumbing Code
- International Mechanical Code
- International Fuel Gas Code*

2008 National Electrical Code

2009 International Energy Conservation Code (Effective January 1, 2013)

Recent History of Building Codes in SC

Mandatory Building Codes Adopted in SC: *(Implementation on July 1, 2013)*

2009 International Code Series (*with SC modifications):

- International Building Code*
- International Residential Code*
- International Fire Code
- International Plumbing Code
- International Mechanical Code
- International Fuel Gas Code*

2011 National Electrical Code.

2009 International Energy Conservation Code (*Effective January 1, 2013*)

2009 IECC Structure & Format

IECC Structure & Format

2009 IECC Components

- Chapter 1 – Administration
- Chapter 2 – Definitions
- Chapter 3 – General Requirements
- Chapter 4 – Residential Energy Efficiency
- Chapter 5 – Commercial Energy Efficiency
- Chapter 6 – Referenced Standards

IECC Structure & Format

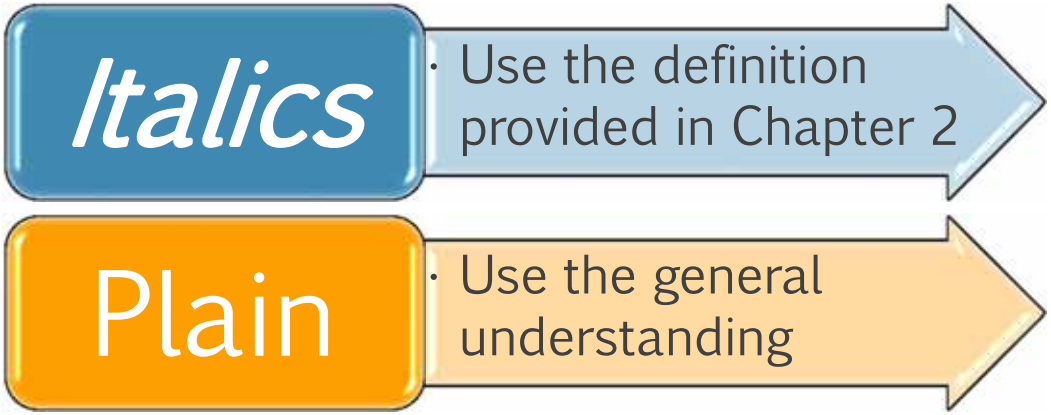
2009 IECC Components

- **Front Matter:**
  - Preface
  - Effective Use
  - Sample Ordinance
  - Table of Contents
- **Back Matter:**
  - Index

IECC Structure & Format

Chapter 2 - Definitions

- How code definitions are used:
  - Terms will be *italicized* within the code text
  - These are terms with a meaning that is unique to the code
  - If a term is not in *italics* within the code text use the general understanding of the word



IECC Structure & Format

Chapter 3 – General Requirements

- Section 301 – Climate Zones
- Section 302 – Design Conditions
- Section 303 – Materials, Systems and Equipment

IECC Structure & Format

Section 301 – Climate Zones

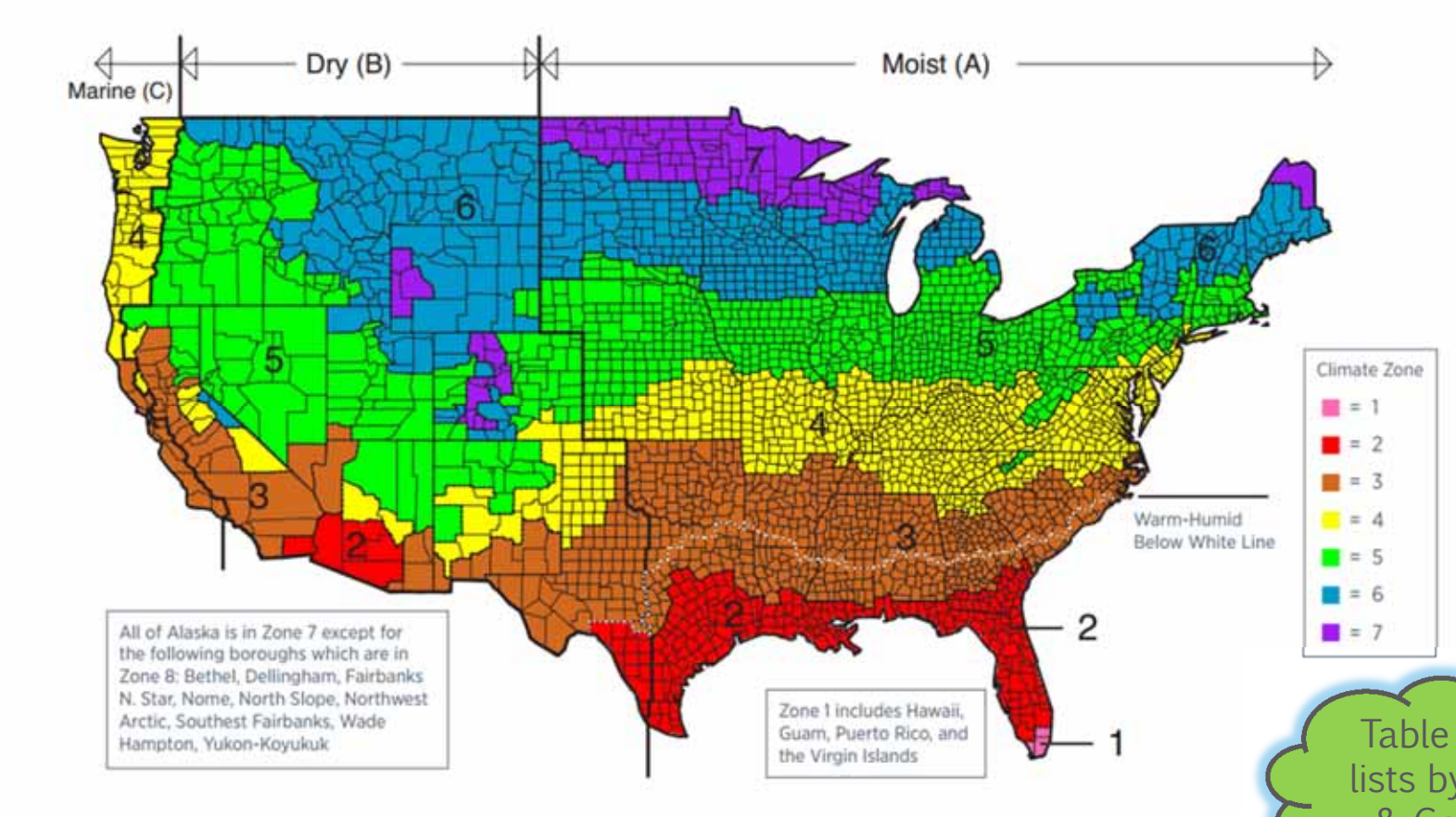


Table 301.1 lists by State & County

IECC Structure & Format

Section 301 – Climate Zones

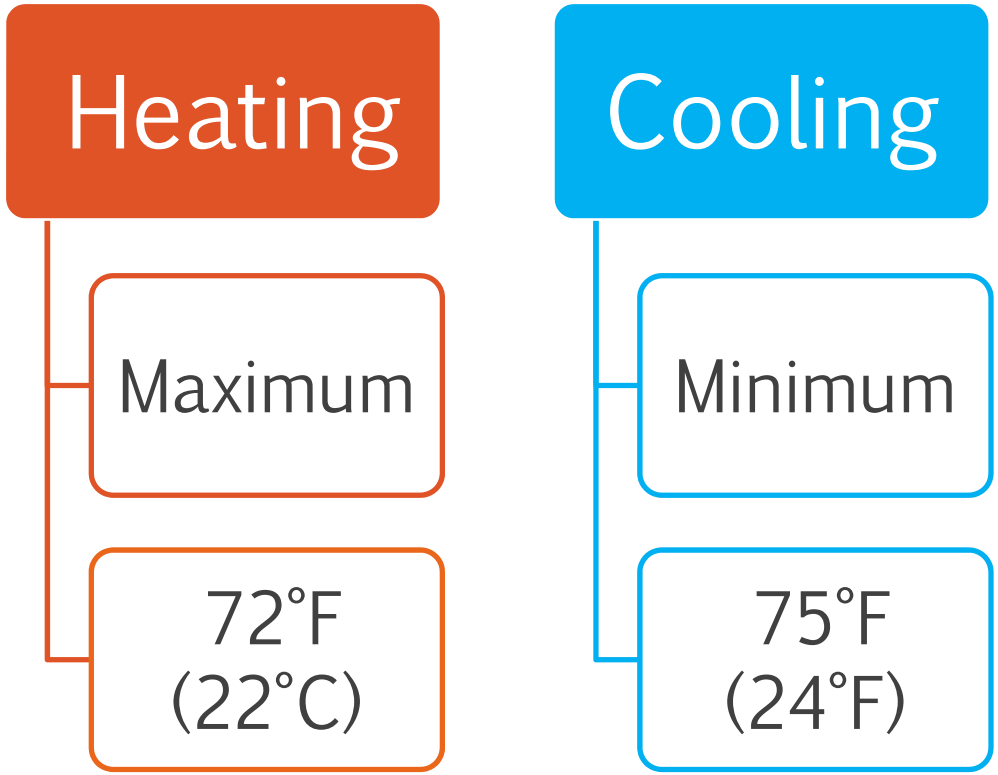
- All of SC is in Climate Zone 3
- Counties in Warm-Humid location:

  - Allendale
  - Bamberg
  - Barnwell
  - Beaufort
  - Charleston
  - Colleton
  - Dorchester
  - Georgetown
  - Hampton
  - Horry
  - Jasper

IECC Structure & Format

Section 302 – Design Conditions

Interior design temperatures used for load calculations

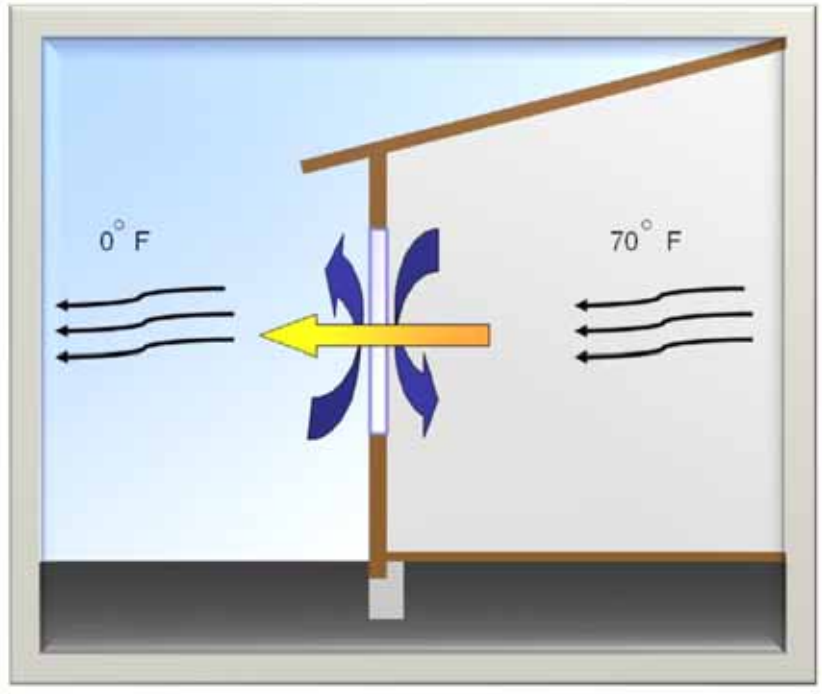


IECC Structure & Format

Section 303 – Materials, Systems & Equipment

Building Envelope:

- Insulation
  - R-Value
  - U-Factor
- Fenestration
  - U-Factor
  - SHGC
- Doors
  - U-Factor



IECC Structure & Format

Chapter 4 – Residential Energy Efficiency

- *Not discussing in this workshop*

IECC Structure & Format

Chapter 5 – Commercial Energy Efficiency

- 501 – General
- 502 – Building Envelope Requirements
- 503 – Building Mechanical Systems
- 504 – Service Water Heating
- 505 - Electrical Power and Lighting Systems
- 506 - Total Building Performance

IECC Structure & Format

Chapter 5 – Commercial Energy Efficiency

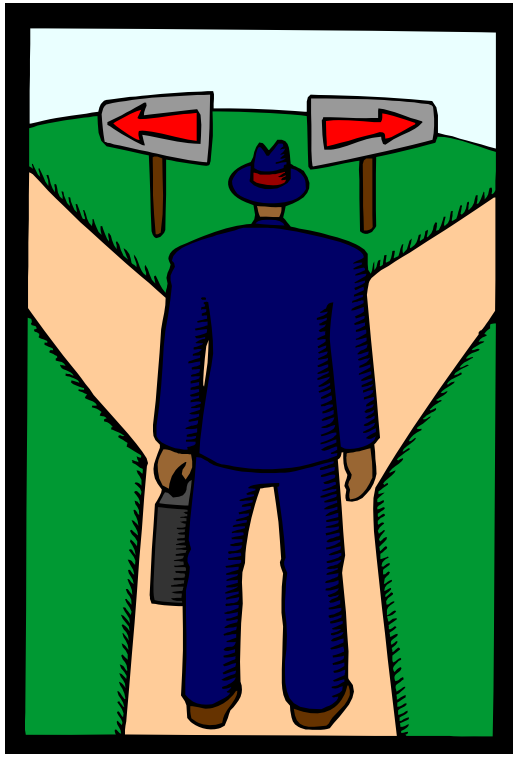
To comply with IECC, project must meet:

- 502 – Building Envelope Requirements
- 503 – Building Mechanical Systems
- 504 – Service Water Heating
- 505 - Electrical Power and Lighting Systems

IECC Structure & Format

Chapter 5 – Commercial Energy Efficiency

- **Alternatives:**
  - ANSI/ASHRAE/IESNA 90.1 *in its entirety*
  - Section 506 – Total Building Performance



IECC Structure & Format

Chapter 6 – Referenced Standards

- Listed by agency:
  - AAMA
  - AHRI
  - AMCA
  - ANSI
  - ASHRAE
  - ASME
  - ASTM
  - CSA
  - DOE
  - ICC
  - IESNA
  - NFRC
  - SMACNA
  - UL
  - US-FTC
  - WDMA

2009 IECC Compliance Paths

IECC Compliance Paths

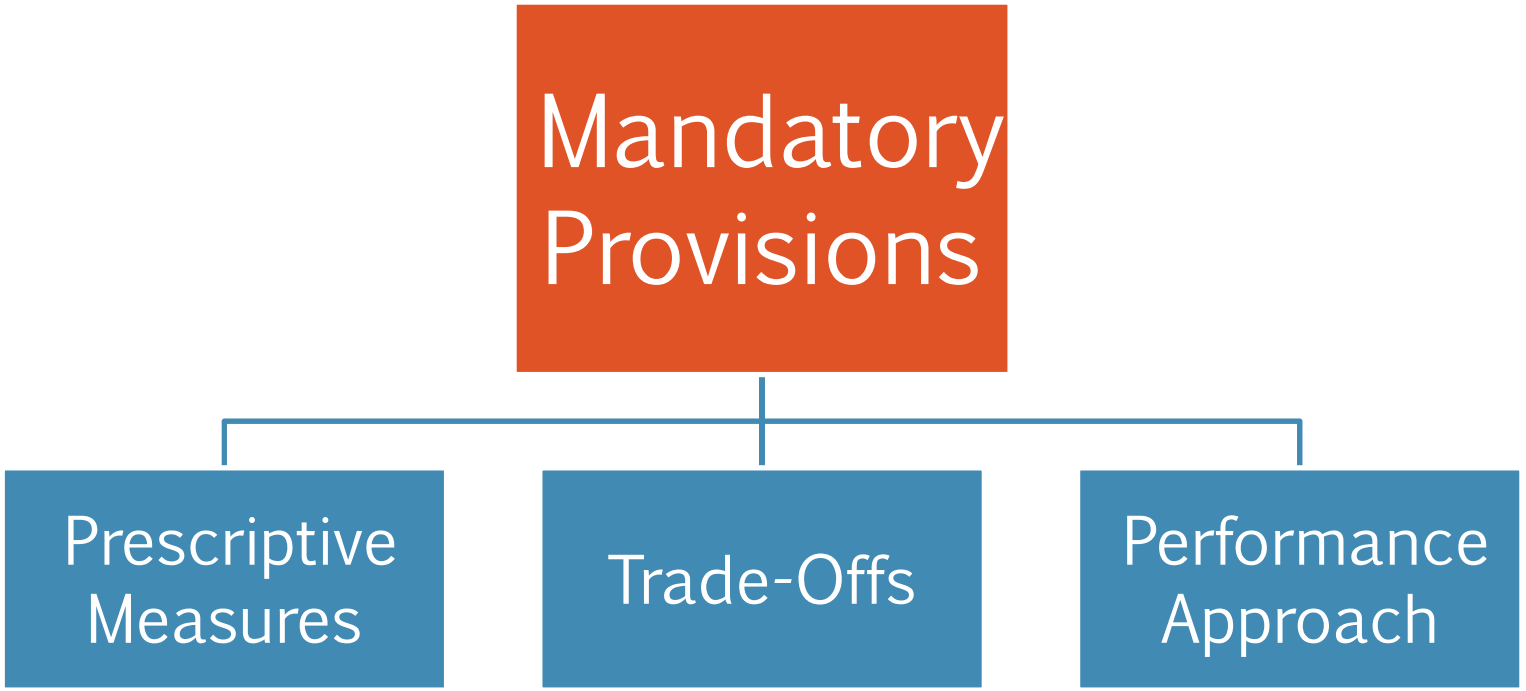
What is a Compliance Path?

- A *compliance path* in an energy code is the series of sections of the code that are used to show that a building design meets the requirements of the code.
- All current model energy codes and standards have multiple compliance paths. In addition, some may have "options."

Source: "Choosing an Energy Code Compliance Path TOPIC BRIEF," PNNL-89866, August 2012, 1, http://www.energycodes.gov/sites/default/files/documents/compliance_paths_topic_brief.pdf.

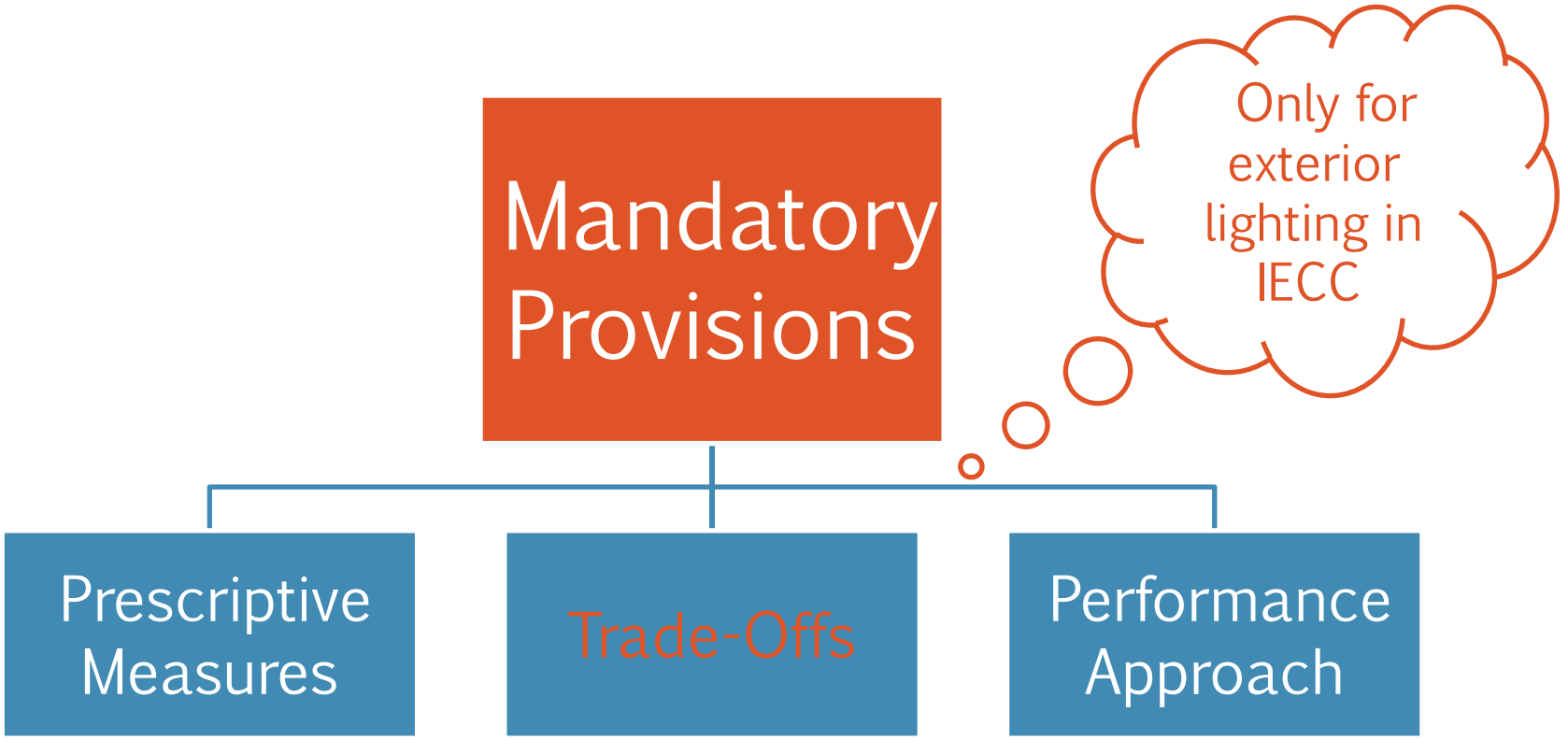
IECC Compliance Paths

Commercial Buildings



IECC Compliance Paths

Commercial Buildings



IECC Compliance Paths

What does Mandatory mean?

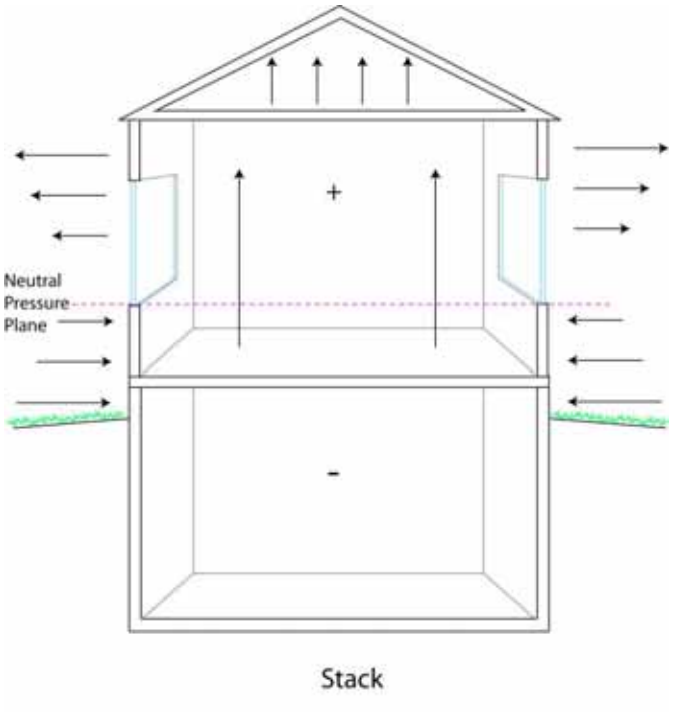
- *Mandatory requirements* are requirements that must be met in every building design no matter which compliance path is chosen.

Source: http://www.energycodes.gov/resource-center/ace/compliance/step2

IECC Compliance Paths

IECC 2009 Mandatory Requirements

- 502.4 – Air Leakage
- Under Section 502 – Building Envelope Requirements



IECC Compliance Paths

IECC 2009 Mandatory Requirements

- 503.2 - Mechanical Systems
- Under Section 503 – Building Mechanical Systems

IECC Compliance Paths

IECC 2009 Mandatory Requirements

- Section 504 - Service Water Heating
- Entire section is mandatory

IECC Compliance Paths

What does Prescriptive mean?

- The *prescriptive path* of the IECC sets minimum performance levels for each component of the building envelope (e.g. wall insulation or window U-factor) and energy-using systems.
- For each component, these prescriptive requirements must be met or exceeded, without the ability to tradeoff between components.

Source: http://reca-codes.org/about-iecc.php

IECC Compliance Paths

What does Prescriptive mean?

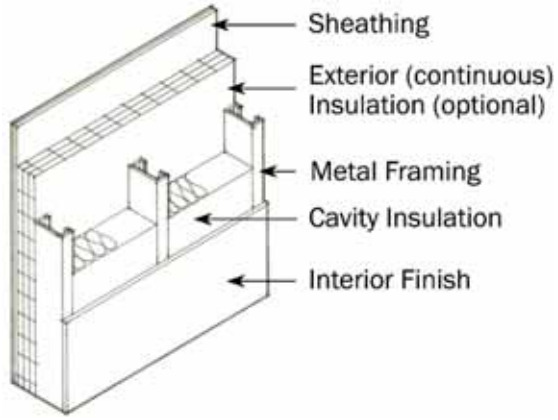
- While it allows less flexibility, this path can be more straightforward to comply with.

Source: http://reca-codes.org/about-iecc.php

IECC Compliance Paths

IECC 2009 Prescriptive Requirements

- 502.1 General Building Envelope



- 502.3 Fenestration

IECC Compliance Paths

IECC 2009 Prescriptive Requirements

- 503.3 Simple HVAC
  - Unitary or packaged equipment listed in Tables 503.2.3(1-5)

- 503.4 Complex HVAC
  - Equipment not covered in Section 503.3

IECC Compliance Paths

IECC 2009 Prescriptive Requirements

- 505 Power & Lighting Controls

IECC Compliance Paths

Prescriptive Example

- For the building envelope, a prescriptive path approach would list the minimum R-value or maximum U-factor requirements for each building component, such as windows, walls, and roofs. (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 101)
- ***Example:*** Table 502.1.2 – Building Envelope Requirements Opaque Element, Maximum U-factors states the following minimum values for a commercial building in Climate Zone 3.

Envelope Component	U-Factor for CZ 3
Roof, Metal Building	U-0.055
Walls Above Grade, Metal Building	U-0.084
Floors, Mass	U-0.107

IECC Compliance Paths

Prescriptive Examples

- For mechanical systems and equipment, a prescriptive approach would list the minimum required equipment efficiencies. (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 101)
- ***Example:*** Table 503.2.3(1) – Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements states the following values for a commercial building:

Equipment Type	Size	Min. Efficiency
Air cooled, Split system	< 65,000 Btu/hr	13.0 SEER
Water cooled, Single package	≥ 240,000 Btu/hr	11.5 EER

IECC Compliance Paths

Prescriptive Examples

- For lighting systems, a prescriptive approach would simply list the allowable watts per square foot for various building types. (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 101)
- ***Example:*** Table 505.5.2 – Interior Lighting Power Allowances states the following values for a commercial building:

Building Type	W/ft^2
Hospital	1.2
Office	1.0
Parking Garage	0.3
Retail	1.5

IECC Compliance Paths

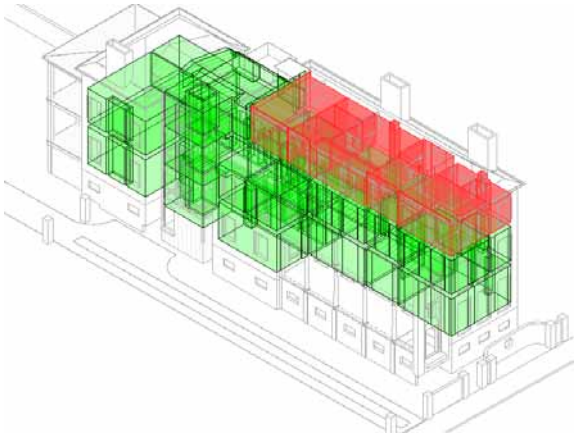
Prescriptive Tools

- Compliance Tools = 2009 IECC and 90.1-2007 contain tables that can be applied directly to demonstrate compliance (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 101)

IECC Compliance Paths

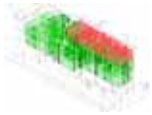
What does Performance Approach mean?

- A *performance approach* allows you to use an overall performance requirement for the building that replaces the individual prescriptive requirements for building systems and components.



Source: DOE, Choosing an Energy Code Compliance Path TOPIC BRIEF, 2, http://www.energycodes.gov/sites/default/files/documents/compliance_paths_topic_brief.pdf

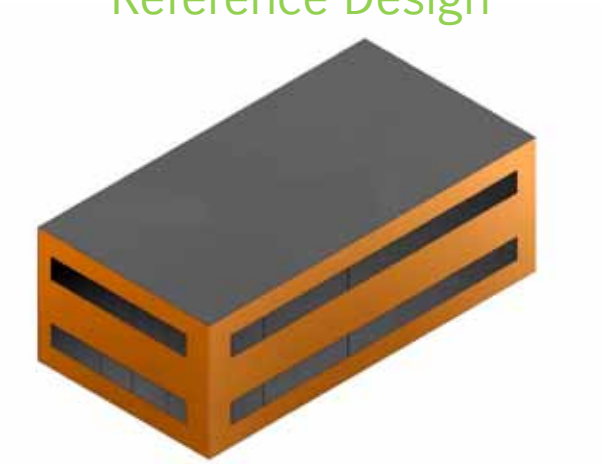
IECC Compliance Paths



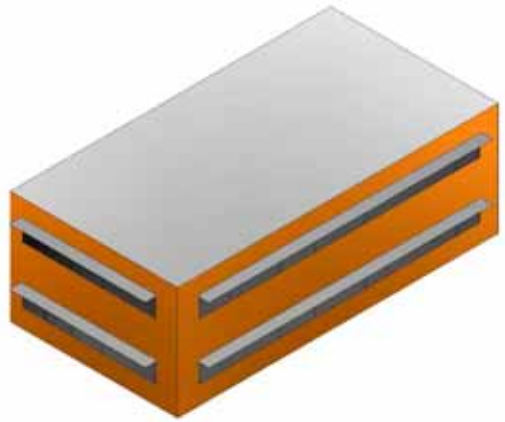
What does Performance Approach mean?

- Compare your *proposed design* to a *baseline or reference design* and demonstrate that the proposed design is at least as efficient as the baseline in terms of annual energy use. (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 102)

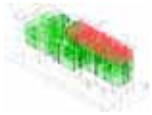
Reference Design



Proposed Design

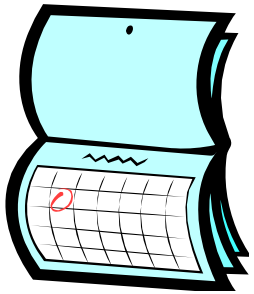


IECC Compliance Paths



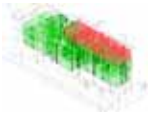
What does Performance Approach mean?

- This approach requires an *annual energy analysis* for the proposed design and the reference design.



- This approach allows greater *flexibility* -- but requires considerably *more effort*.

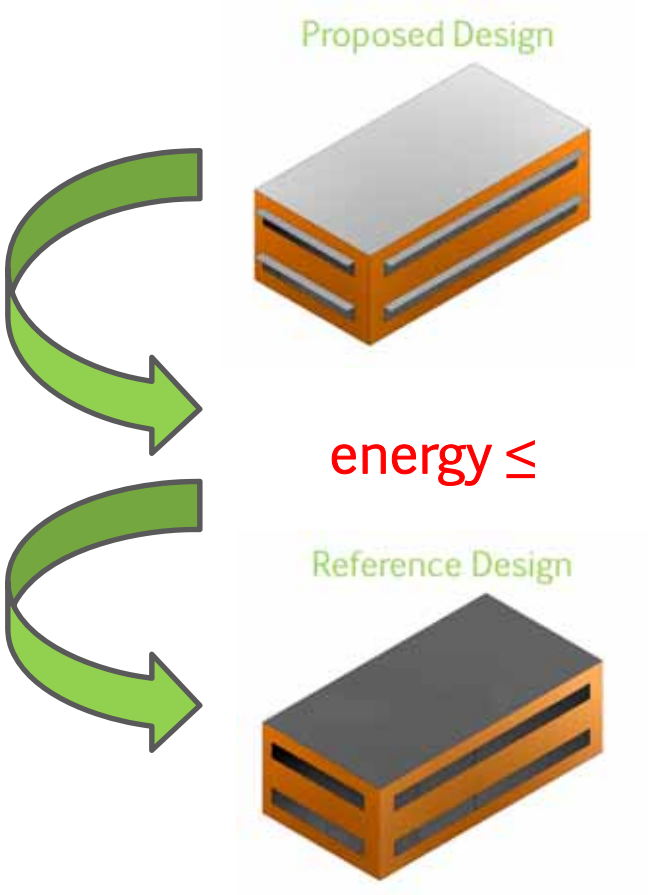
IECC Compliance Paths



IECC 2009 Section 506 – Total Building Performance

Performance-based Compliance:

- Requires that a proposed building (*proposed design*) be shown to have an annual energy cost that is less than or equal to the annual energy cost of the *standard reference design*



IECC Compliance Paths

Section 506 - Total Building Performance

Mandatory Requirements:

- 502.4 Air Leakage
- 503.2 Mechanical Systems
- 504 Service Hot Water

IECC Compliance Paths

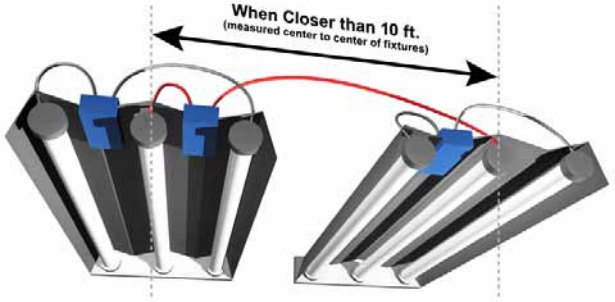
Section 506 - Total Building Performance

Mandatory Requirements:

- 505.2 Power & Lighting Controls


http://www.onestopbuy.com/

- 505.3 Tandem Wiring



IECC Compliance Paths

Section 506 - Total Building Performance

Mandatory Requirements:

- 505.4 Exit Signs

- 505.6 Exterior Lighting

- 505.7 Electrical Energy Consumption

IECC Compliance Paths

Section 506 - Total Building Performance

- Section 506.4. – Documentation
  - 506.4.1 Compliance Report requirements
- Section 506.5 – Calculation Procedures
  - how the proposed design and standard reference design shall be configured and analyzed

IECC Compliance Paths

Performance Examples

- Performance compliance path is often necessary to obtain credit for special features, such as passive solar design, photovoltaic cells, thermal energy storage, and fuel cells. (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 102)

IECC Compliance Paths

Performance Tools

- Compliance Tool Examples = EnergyPlus, Trace HAP, DOE-2, Open Studio
  - DOE's Building Technologies Program maintains a list of building energy software tools –
  - Find 400+ software tools through the *Building Energy Software Tools Directory*
  - Website: http://apps1.eere.energy.gov/buildings/tools_directory/

IECC Compliance Paths

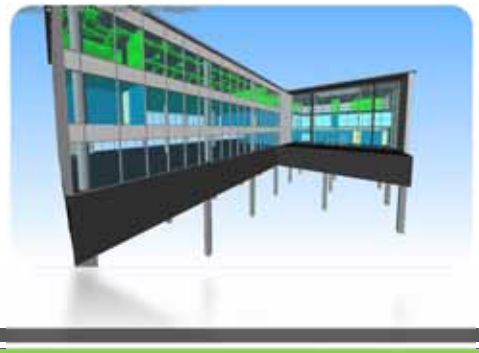
What does Trade-Off mean?

- A *trade-off approach* allows you to trade enhanced energy efficiency in one component against decreased energy efficiency in another component. These trade-offs typically occur within major building systems: envelope, lighting, or mechanical. (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 101)

IECC Compliance Paths

IECC 2009 Trade-Offs

- Exterior lighting Trade-offs are allowed for specific applications
- Envelope trade-offs allowed by weighted UA
  - Included in ASHRAE 90.1-2007
- Performance Path allows for trade-offs between systems



IECC Compliance Paths

Trade-off Examples

- Trade decreased wall efficiency (lower R-value) for increased window efficiency (lower U-factor), or increase the roof insulation and reduce or eliminate slab-edge insulation.
  (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 101)

Insulation has a lower R-value

Windows have a low U-factor

Performance Path only

IECC Compliance Paths

Trade-off Examples

- Trade decreased wall efficiency (lower R-value) for increased window efficiency (lower U-factor), or increase the roof insulation and reduce or eliminate slab-edge insulation.
  (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 101)

Insulation has a lower R-value

Windows have a low U-factor

Performance Path only

IECC Compliance Paths

Trade-off Examples

- For lighting systems, the trade-off typically would occur between proposed lighting fixture wattages in various spaces within a building. (*Source:* Building Energy Codes Resource Guide: Code Officials Edition, 101)

IECC Compliance Paths

Trade-Off Tools

- Compliance Tools = COMcheck, a free software, automates the trade-off approach for easy compliance checks. Users input a building's features, and the program easily generates compliance certificates for each major building system.

IECC Compliance Paths

IECC 2009 Paths

Section of 2009 IECC	Compliance Paths
502 Building Envelope Requirements (502.1)	1) Mandatory + Prescriptive (R-value) 2) Mandatory + Prescriptive (U-factor)
503 Mechanical Systems (503.1)	1) Mandatory + Simple Systems (503.3) 2) Mandatory + Complex Systems (503.4)
504 Service Water Heating (Mandatory)	1) Mandatory
505 Electrical Power & Lighting	1) Mandatory + Prescriptive
506 Total Building Performance (506.2 & 506.3)	1) Performance

Source: "Choosing an Energy Code Compliance Path TOPIC BRIEF," PNNL-89866, August 2012, 7, Table 5. Commercial and High-Rise Multi-family Residential Compliance Options by Section in the 2009 and 2012 IECC, http://www.energycodes.gov/sites/default/files/documents/compliance_paths_topic_brief.pdf.

IECC Compliance Paths

ASHRAE 90.1-2007 Paths

Section of ASHRAE 90.1-2007	Compliance Paths
5. Building Envelope Requirements (5.2)	1) Mandatory + Prescriptive (R-value) 2) Mandatory + Prescriptive (U-factor) 3) Mandatory +Envelope Trade-off
6. Heating, Ventilating and Air Conditioning (6.2)	1) Simplified Approach Option 2) Mandatory + Prescriptive
7. Service Water Heating (7.2)	1) Mandatory +Prescriptive
8. Power (8.2)	1) Mandatory
9. Lighting (9.2)	1) Mandatory + Building Area 2) Mandatory + Space-by-Space

Source: "Choosing an Energy Code Compliance Path TOPIC BRIEF," PNNL-89866, August 2012, 7, Table 5. Commercial and High-Rise Multi-family Residential Compliance Options by Section in the 2009 and 2012 IECC, http://www.energycodes.gov/sites/default/files/documents/compliance_paths_topic_brief.pdf.

IECC Compliance Paths

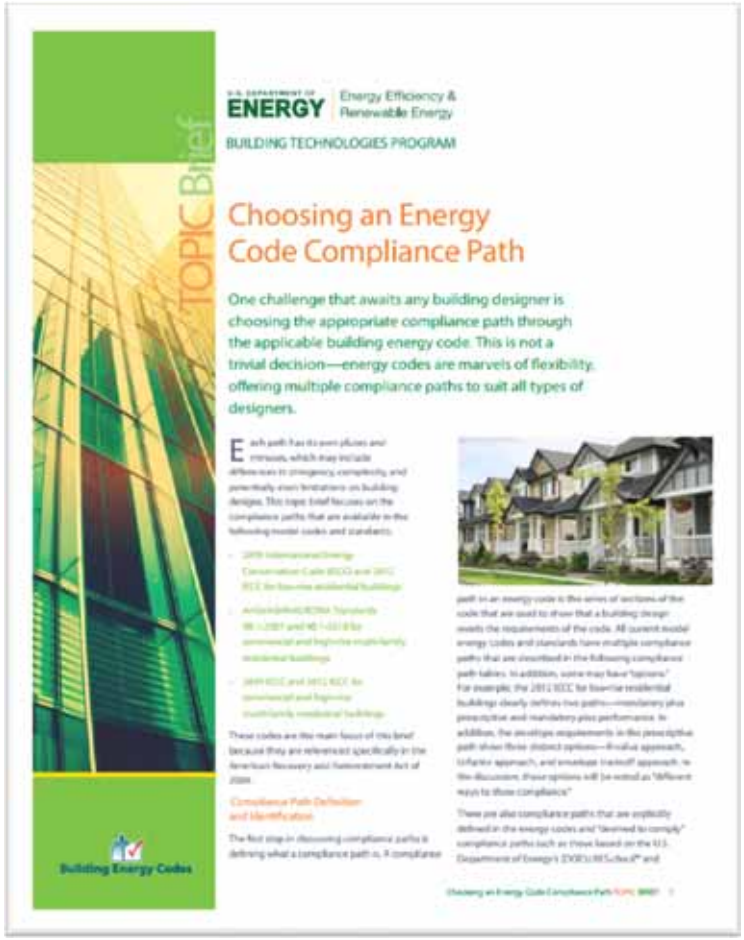
ASHRAE 90.1-2007 Paths

Section of ASHRAE 90.1-2007	Compliance Paths
10. Other Equipment (10.2)	1) Mandatory
11. Energy Cost Budget Method (11.1.4)	1) Mandatory requirements from Section 5-10 plus use of Energy Cost Budget (ECB) Method

Source: "Choosing an Energy Code Compliance Path TOPIC BRIEF," PNNL-89866, August 2012, 7, Table 3. Commercial and High-Rise Multi-family Residential Compliance Options by Section in ASHRAE Standard 90.1-2007 and ASHRAE Standard 90.1-2010, http://www.energycodes.gov/sites/default/files/documents/compliance_paths_topic_brief.pdf

IECC Compliance Paths

IECC & ASHRAE 90.1 Paths



TOPIC Brief

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES PROGRAM

Choosing an Energy Code Compliance Path

One challenge that awaits any building designer is choosing the appropriate compliance path through the applicable building energy code. This is not a trivial decision—energy codes are marvels of flexibility, offering multiple compliance paths to suit all types of designers.

Each path has its own pluses and minuses, which may include differences in stringency, complexity, and potentially, even limitations on building designs. This topic brief focuses on the compliance paths that are available in the following model codes and standards:

- 2009 International Energy Conservation Code (IECC) and 2012 IECC for low-rise residential buildings
- ANSI/ASHRAE/IESNA Standards 90.1-2007 and 90.1-2010 for commercial and high-rise multi-family residential buildings
- 2009 IECC and 2012 IECC for commercial and high-rise multi-family residential buildings

These codes are the main focus of this brief because they are referenced specifically in the American Recovery and Reinvestment Act of 2009.

Compliance Path Definition and Identification

The first step in choosing compliance paths is defining what a compliance path is. A compliance path in an energy code is the series of sections of the code that are used to show that a building design meets the requirements of the code. All current model energy codes and standards have multiple compliance paths that are described in the following compliance path tables. In addition, some may have "options." For example, the 2012 IECC for low-rise residential buildings clearly defines two paths—mandatory plus prescriptive and mandatory plus performance. In addition, the envelope requirements in the prescriptive path show three distinct options—R-value approach, U-factor approach, and envelope tradeoff approach. In the discussion, these options will be noted as "different ways to show compliance."

There are also compliance paths that are implicitly defined in the energy codes and "deemed to comply" compliance paths such as those based on the U.S. Department of Energy's (DOE's) REScheck™ and

Choosing an Energy Code Compliance Path TOPIC BRIEF 1

Building Energy Codes

Table 6. Commercial and High-Rise Multi-family Residential Compliance Paths in the 2009 IECC and ASHRAE Standard 90.1

Compliance Path Number	Compliance Path Description
ICC-IECC-Com-1*	Sections 502 (R-value), 503 (simple), 504, and 505 of the 2009 IECC
ICC-IECC-Com-2*	Sections 502 (R-value), 503 (complex), 504, and 505 of the 2009 IECC
ICC-IECC-Com-3*	Sections 502 (U-factor), 503 (simple), 504, and 505 of the 2009 IECC
ICC-IECC-Com-4*	Sections 502 (U-factor), 503 (complex), 504, and 505 of the 2009 IECC
ICC-IECC-Com-5*	Sections 506, 502.4, 503.2, 504, 505.2, 505.3, 505.4, 505.6, and 505.7 of the 2009 IECC
ICC-IECC-Com-Above Code	Mandatory + above-code program deemed by code official or other AHJ to exceed the energy efficiency required by the 2009 IECC. (May not be available in all jurisdictions.)
ASH-90.1-1*	90.1 Compliance Path 1 from Table 4
ASH-90.1-2*	90.1 Compliance Path 2 from Table 4
ASH-90.1-3*	90.1 Compliance Path 3 from Table 4
ASH-90.1-4*	90.1 Compliance Path 4 from Table 4
ASH-90.1-5*	90.1 Compliance Path 5 from Table 4
ASH-90.1-6*	90.1 Compliance Path 6 from Table 4
ASH-90.1-7*	90.1 Compliance Path 7 from Table 4
ASH-90.1-8*	90.1 Compliance Path 8 from Table 4
ASH-90.1-9*	90.1 Compliance Path 9 from Table 4
ASH-90.1-10*	90.1 Compliance Path 10 from Table 4
ASH-90.1-11*	90.1 Compliance Path 11 from Table 4
ASH-90.1-12*	90.1 Compliance Path 12 from Table 4
ASH-90.1-13	90.1 Compliance Path 13 from Table 4

*Indicates COMcheck can be used to show compliance.

IECC Compliance Paths

Common Question

- Can you use both codes (the IECC and Standard 90.1) in one building?

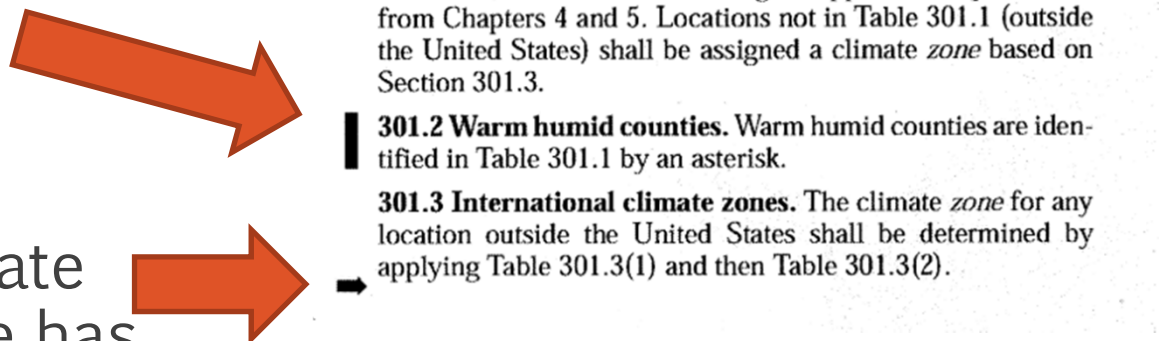
- No, mixing and matching provisions from the two codes does not demonstrate a building's compliance. If a building shows compliance with Standard 90.1-2007 in one building system (e.g., envelope, lighting, mechanical), then all systems must comply with 90.1-2007. The same rule applies with the IECC.

Key Differences Between 2006 & 2009 IECC

2006 & 2009 IECC Key Differences

Changes & Revisions

- Solid vertical lines in the margins indicate a technical change from 2006 requirements
- Arrows in the margins indicate text or a table has been deleted



SECTION 301
CLIMATE ZONES

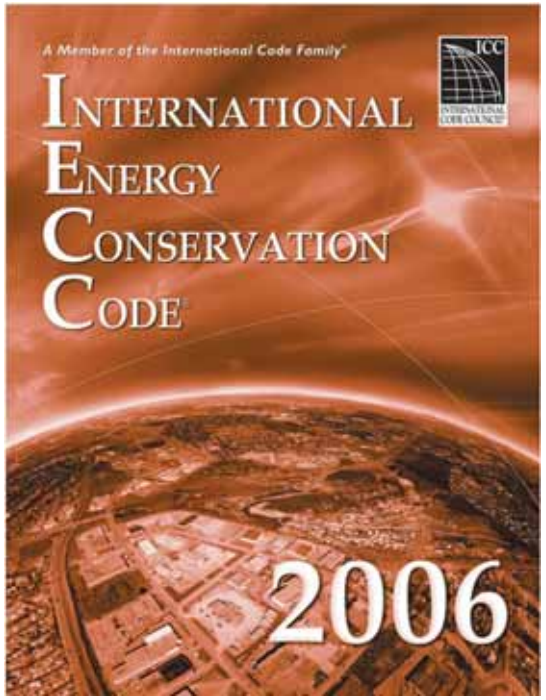
301.1 General. Climate *zones* from Figure 301.1 or Table 301.1 shall be used in determining the applicable requirements from Chapters 4 and 5. Locations not in Table 301.1 (outside the United States) shall be assigned a climate *zone* based on Section 301.3.

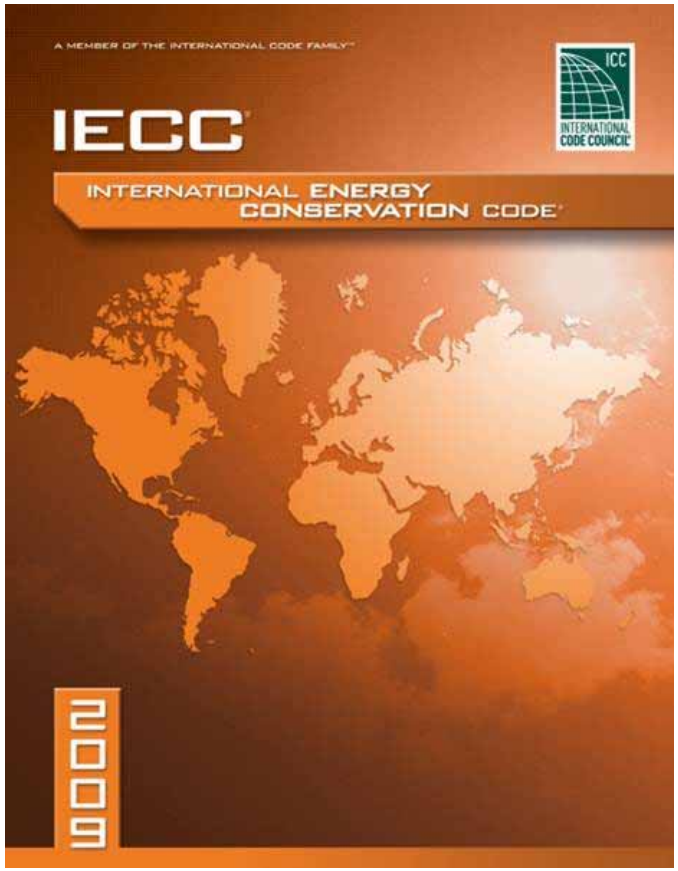
301.2 Warm humid counties. Warm humid counties are identified in Table 301.1 by an asterisk.

301.3 International climate zones. The climate *zone* for any location outside the United States shall be determined by applying Table 301.3(1) and then Table 301.3(2).

2006 & 2009 IECC Key Differences

Chapter 1 Differences





2006 & 2009 IECC Key Differences

Applicability for additions, alterations, renovations or repairs:

2006 IECC	2009 IECC
Only lists four exceptions (exemptions) for to the code. Applicability requirements for "buildings" undergoing a change in occupancy. No requirement for changes in space conditioning.	Increases exceptions (exemptions) to eight in total. Increases applicability requirements to "spaces" undergoing a change in occupancy or use. Adds an applicability section for changes in space conditioning.

2006 & 2009 IECC Key Differences

Above code programs requirements:

2006 IECC	2009 IECC
Section 103.1.1: No statement of meeting "mandatory" requirements of the code.	Section 102.1.1: The requirements identified as "mandatory" in Chapters 4 and 5 of the code, as applicable, shall be met.

2006 & 2009 IECC Key Differences

Additional information for Construction Documents:

2006 IECC	2009 IECC
Section 104: Contains two sections: General and Information on construction documents.	Section 103: Adds several sections including: Examination of documents; Amended construction documents; and Retention of construction documents.

2006 & 2009 IECC Key Differences

Additional information for Construction Documents:

2006 IECC	2009 IECC
Section 105: Contains four sections: General; Required approvals; Final inspection; and Re-inspection.	Section 104: Adds several sections including: Approved inspection agencies; Inspection requests and Approval. Adds to requirements of section 104.2 Required approvals.

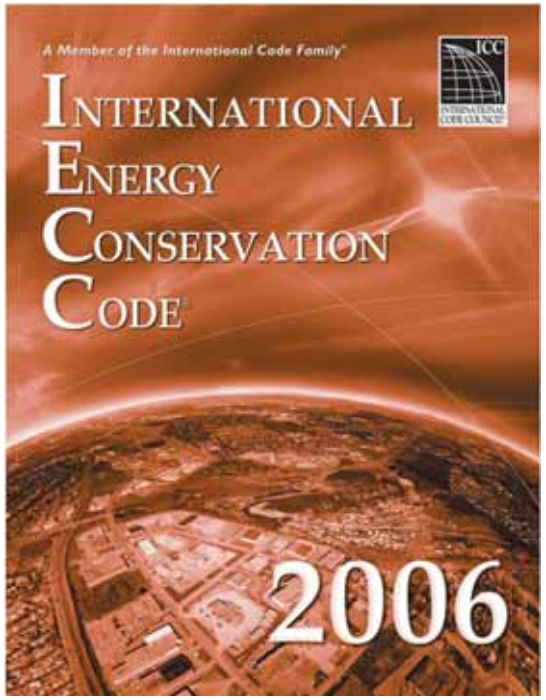
2006 & 2009 IECC Key Differences

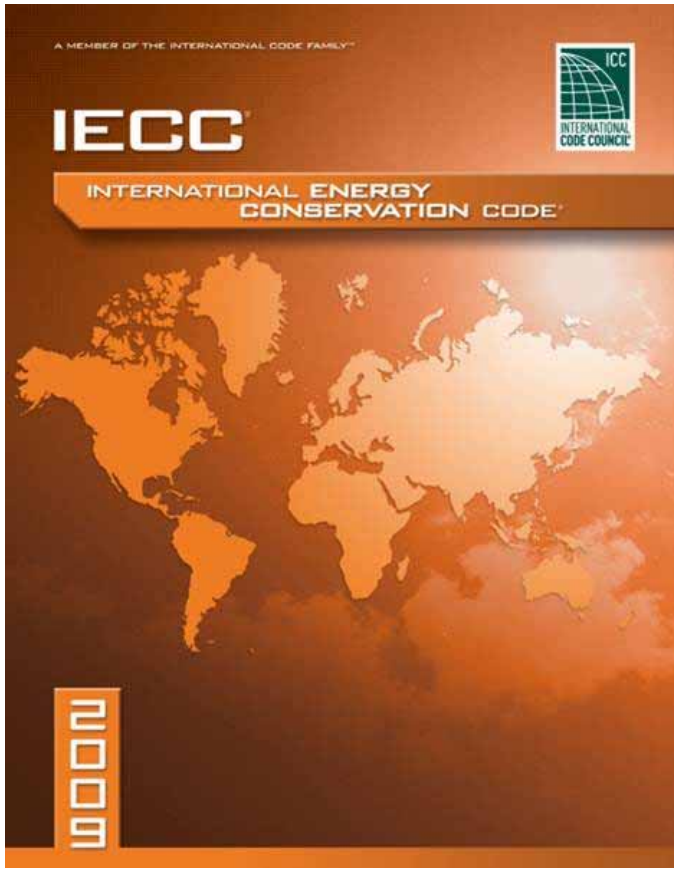
Adds new Fee, Stop Work Order & Board of Appeals sections:

2006 IECC	2009 IECC
No requirements	Added the following sections to the end of Chapter 1: Section 107 Fees Section 108 Stop Work Order Section 109 Board of Appeals

2006 & 2009 IECC Key Differences

Chapter 2 Differences





2006 & 2009 IECC Key Differences

New definitions added to Chapter 2:

Air Barrier =

Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or a combination of materials.

2006 & 2009 IECC Key Differences

New definitions added to Chapter 2:

C-Factor =

The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces (Btu/h ft^2 x F°) [W/(m2 x K)].

2006 & 2009 IECC Key Differences

New definitions added to Chapter 2:

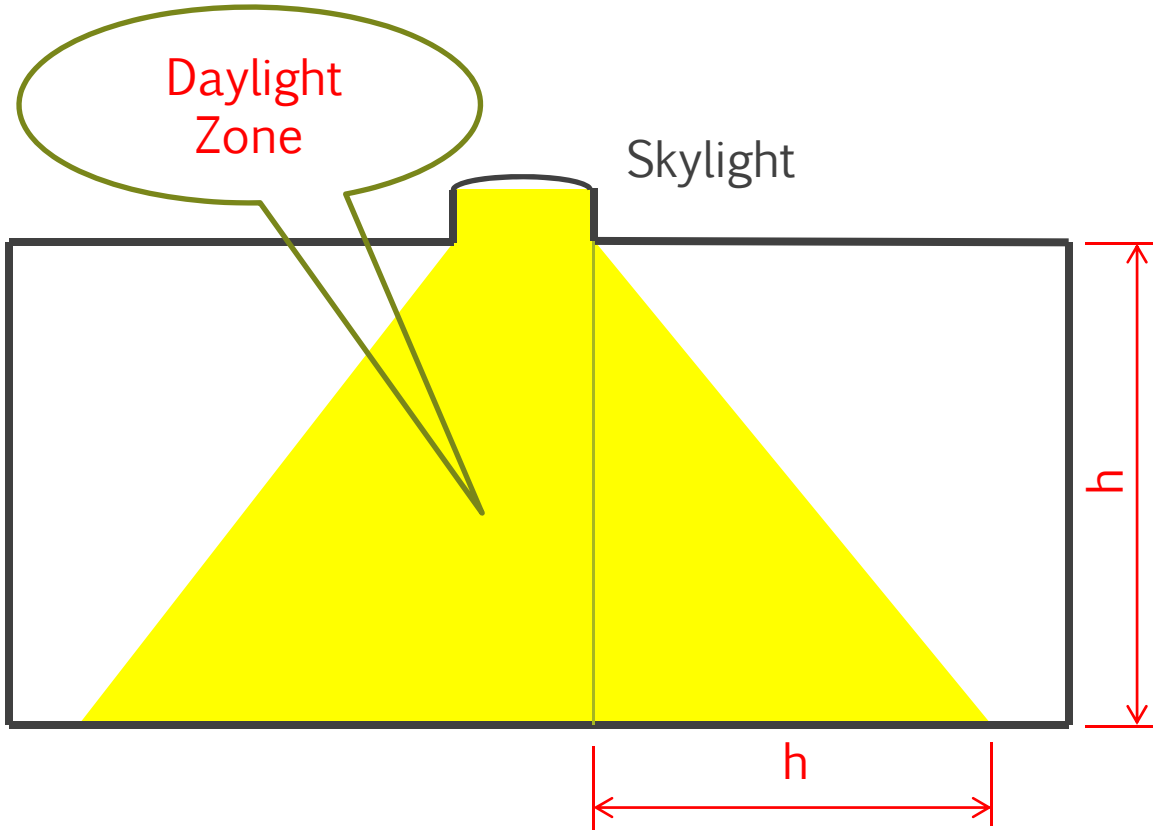
Daylight Zone =

1) *Under skylights* – The area under skylights whose horizontal dimension in that direction plus either the floor-to-ceiling height or the dimension to a ceiling height opaque partition, or one-half the distance to adjacent skylights or vertical fenestration, whichever is least.

2006 & 2009 IECC Key Differences

New definitions added to Chapter 2:

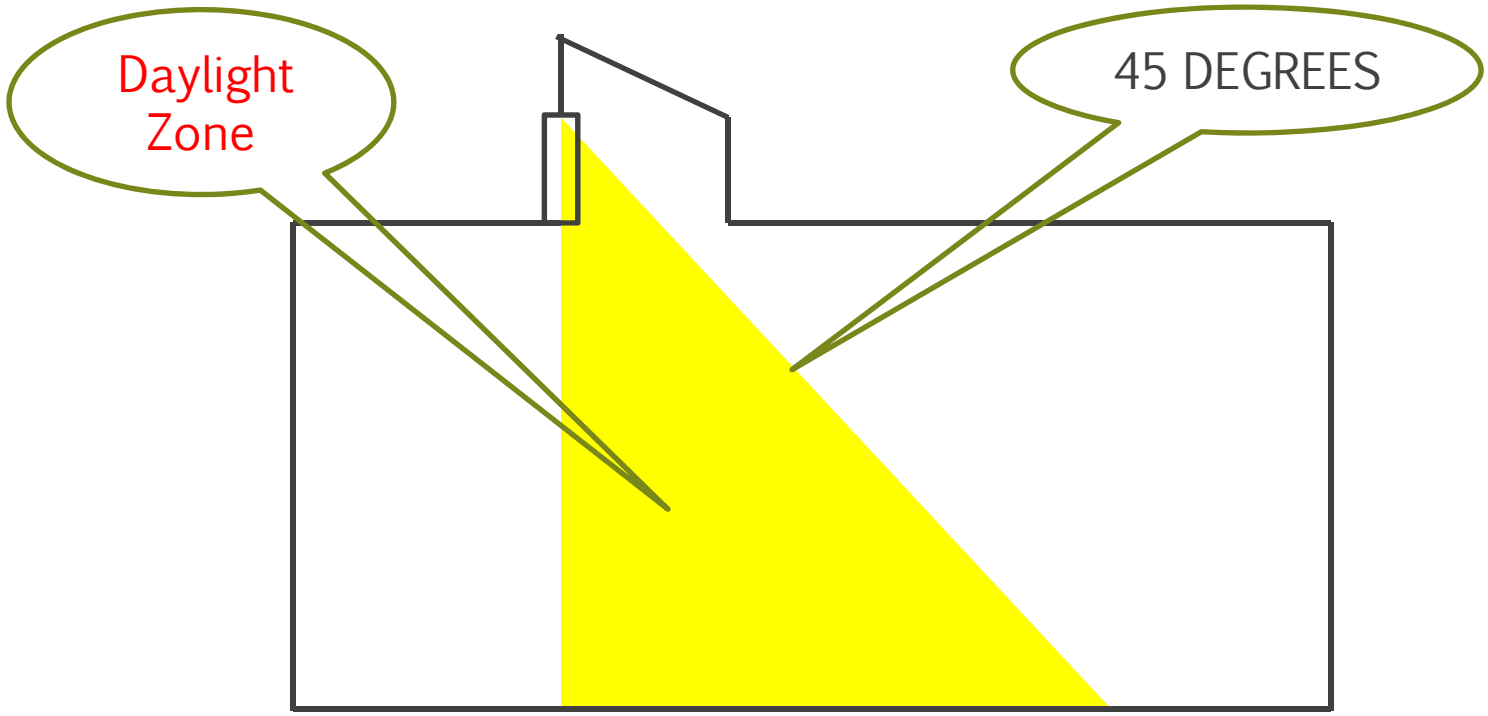
Daylight Zone =



2006 & 2009 IECC Key Differences

New definitions added to Chapter 2:

Daylight Zone =



2006 & 2009 IECC Key Differences

New definitions added to Chapter 2:

Daylight Zone =

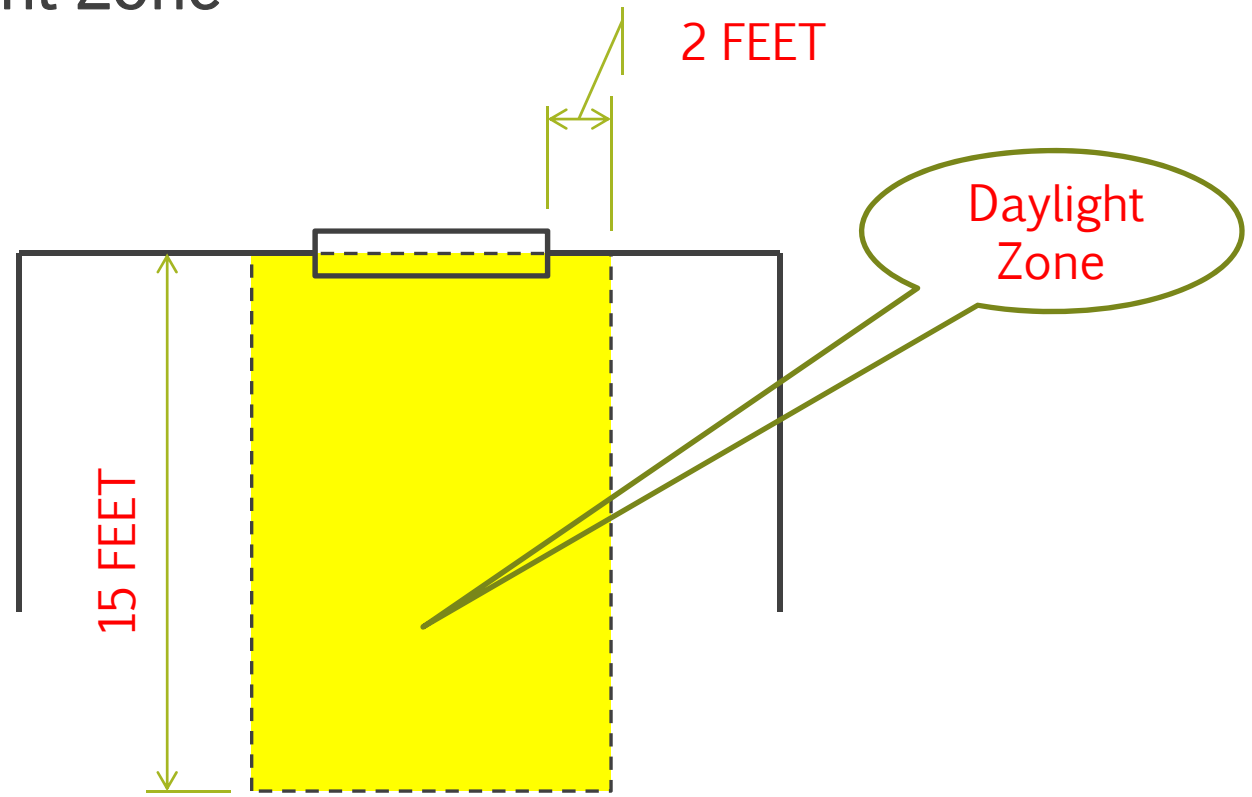
2) *Adjacent to vertical fenestration.* The area adjacent to vertical fenestration which receives daylight through the fenestration. For purposes of this definition, the daylight zone depth is assumed to extend into the space a distance of 15 feet or to the nearest ceiling height opaque partition, whichever is less.

The daylight zone width is assumed to be the width of the window plus 2 feet on each side, or the window width plus the distance to an opaque partition, or the window width plus one-half the distance to adjacent skylight or vertical fenestration, whichever is least.

2006 & 2009 IECC Key Differences

New definitions added to Chapter 2:

Daylight Zone =



2006 & 2009 IECC Key Differences

New definitions added to Chapter 2:

Entrance Door =

Fenestration products used for ingress, egress and access in nonresidential buildings, including, but not limited to, exterior entrances that utilize latching hardware and automatic closers and contain over 50% glass specifically designed to withstand heavy use and possibly abuse.

2006 & 2009 IECC Major Differences

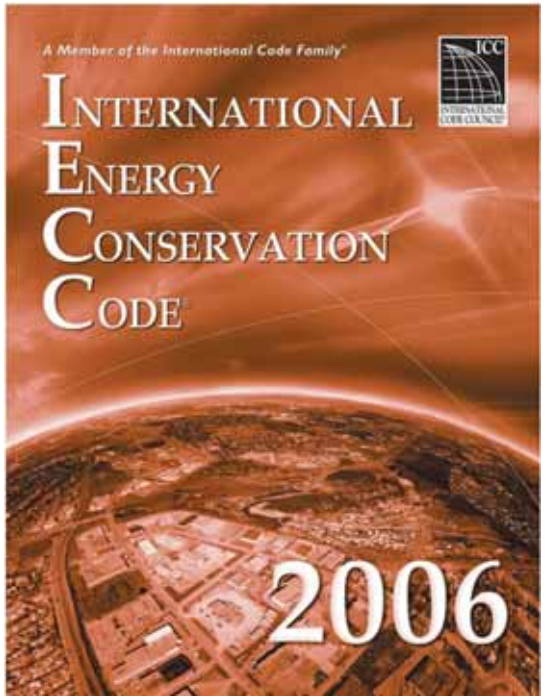
New definitions added to Chapter 2:

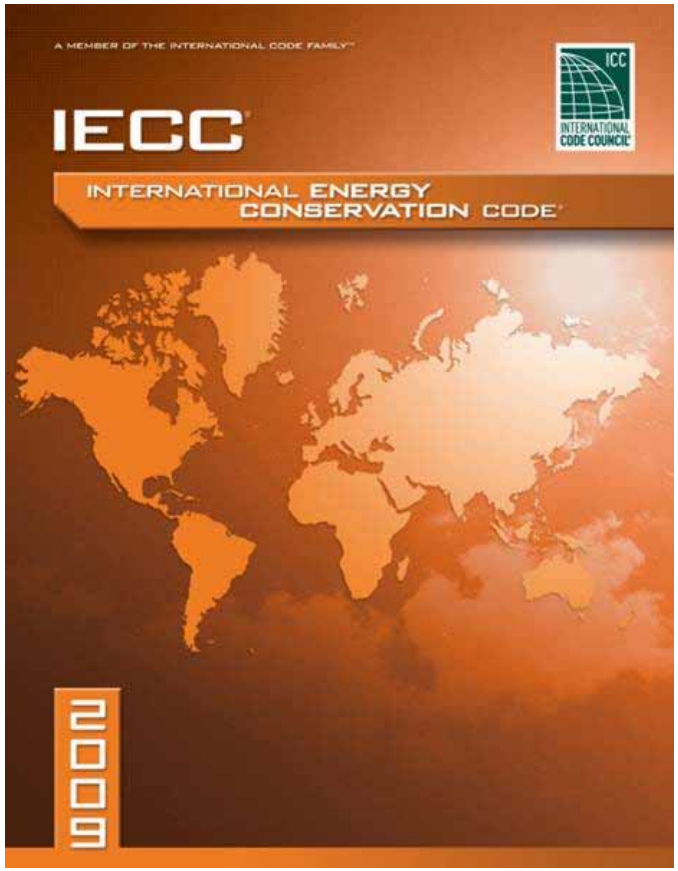
Fan Brake Horsepower (BHP) =

The horsepower delivered to the fan's shaft. Brake horsepower does not include the mechanical drive losses (belts, gears, etc.).

2006 & 2009 IECC Key Differences

Chapter 3 Differences

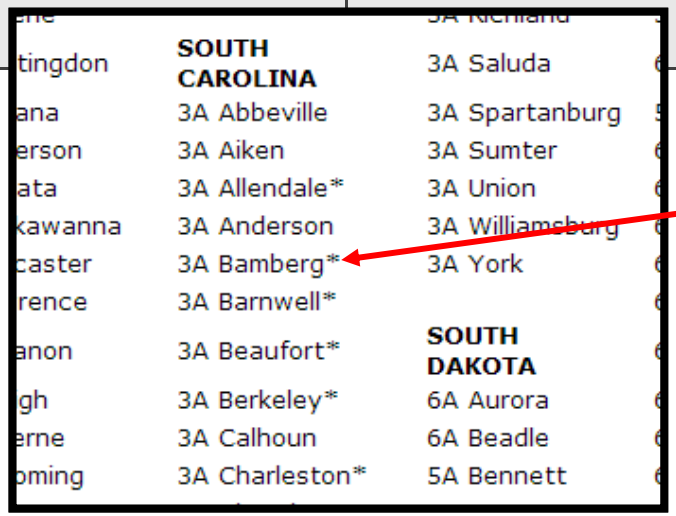




2006 & 2009 IECC Key Differences

Warm humid counties listed in same table:

2006 IECC	2009 IECC
Warm humid counties listed in a separate table than all non-warm and humid counties	All counties listed in Table 301.1 with the warm humid counties identified by an asterisk.

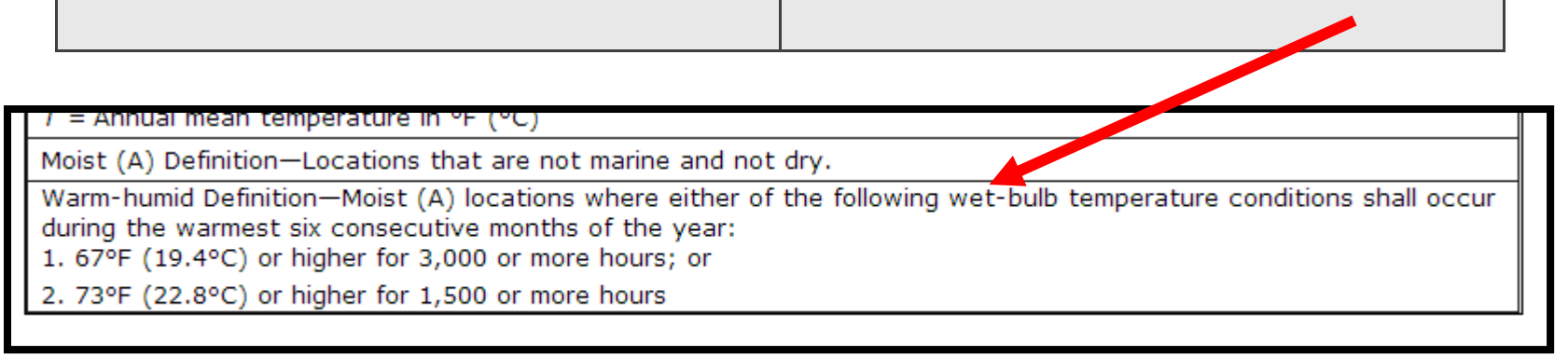


	SOUTH CAROLINA		
tingdon		3A Saluda	
ana	3A Abbeville	3A Spartanburg	
erson	3A Aiken	3A Sumter	
ata	3A Allendale*	3A Union	
kawanna	3A Anderson	3A Williamsburg	
caster	3A Bamberg*	3A York	
rence	3A Barnwell*		
anon	3A Beaufort*	**SOUTH DAKOTA**	
gh	3A Berkeley*	6A Aurora	
erne	3A Calhoun	6A Beadle	
oming	3A Charleston*	5A Bennett	

2006 & 2009 IECC Key Differences

Warm humid listed in international climate zone definitions table:

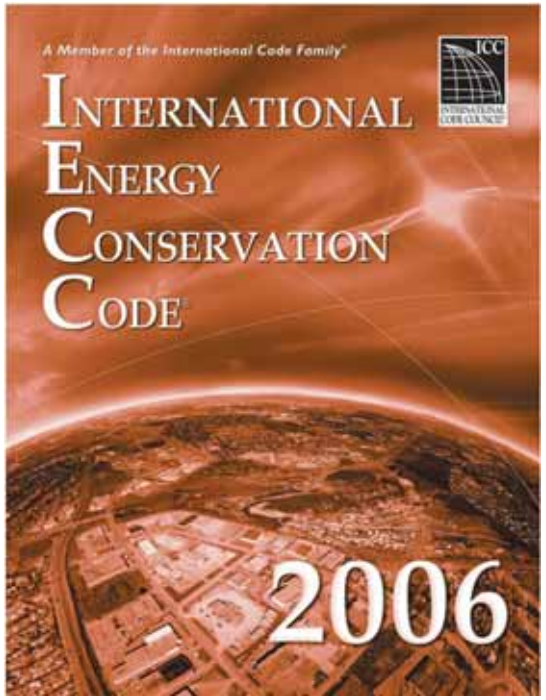
2006 IECC	2009 IECC
Not included	Warm-humid Definition included in Table 301.3(1) International Climate Zone Definitions, under Moist (A) Definition.

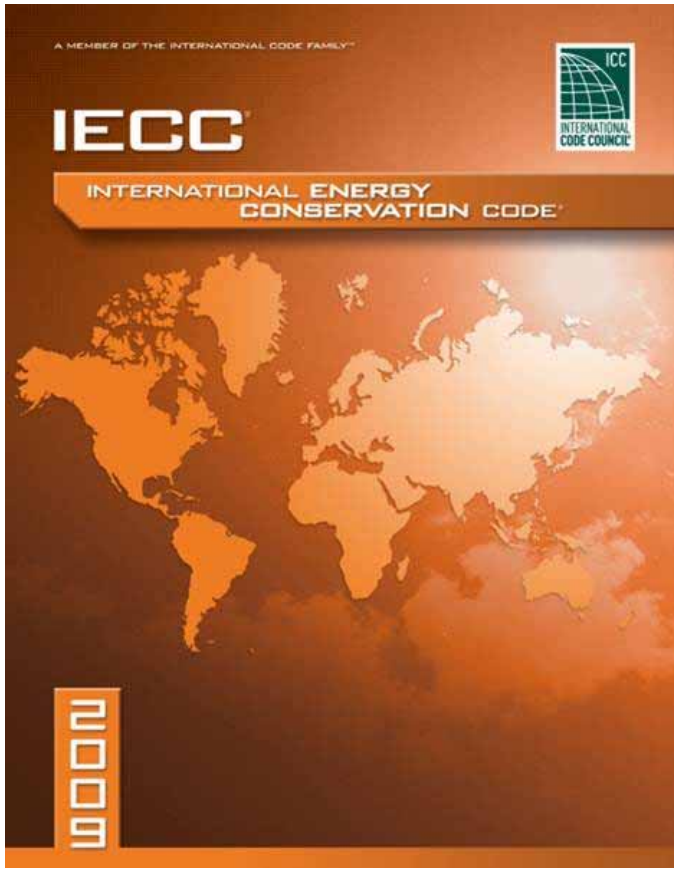


T = Annual mean temperature in °F (°C)
Moist (A) Definition—Locations that are not marine and not dry.
Warm-humid Definition—Moist (A) locations where either of the following wet-bulb temperature conditions shall occur during the warmest six consecutive months of the year: 1. 67°F (19.4°C) or higher for 3,000 or more hours; or 2. 73°F (22.8°C) or higher for 1,500 or more hours

2006 & 2009 IECC Key Differences

Chapter 5 Differences





2006 & 2009 IECC Key Differences

Design by acceptable practice for commercial buildings:

2006 IECC	2009 IECC
Requires that the code user must demonstrate compliance with sections of Chapter 5 on an individual basis. If one or more of these sections are not satisfied, compliance can be demonstrated using ASHRAE 90.1-2004.	Requires that the code user must demonstrate compliance with Chapter 5 in its *entirety* or ASHRAE 90.1-2007, but *cannot mix* compliance approaches on the same project.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Envelope U-Value Table Added in 2009:

2006 IECC	2009 IECC
New to 2009 IECC	Table 502.1.2 was added to provide a comparable assembly U-factor table to correspond with the R-value requirements in Table 502.2(1). An assembly with a U-factor equal to or less than specified in Table 502.1.2 is permitted as an alternate to the R-value in Table 502.2(1).

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Envelope U-Value Table Added in 2009:

- Climate Zone 3A Values:

2006 IECC (U-Factor)	2009 IECC (U-Factor)
n/a	Insulation above deck = 0.027 Mass wall above grade = 0.123 Below grade wall = 1.140 (C-factor) Mass floors = 0.107 Unheated slabs –on-grade = 0.730 (F-factor)

2006 & 2009 IECC Key Differences

References ASHRAE 90.1–2007 ILO 2004 as an alternative compliance path:

2006 IECC	2009 IECC
References ASHRAE Standard 90.1-2004 *Energy Standard for Buildings Except for Low-Rise Residential Buildings*	References ASHRAE Standard 90.1-2007 *Energy Standard for Buildings Except for Low-Rise Residential Buildings*

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Group R specific envelope requirements added in Chapter 5:

2006 IECC	2009 IECC
n/a	Adds a Group R column to the envelope requirements tables in Section 502. *Group R refers to residential buildings over three stories in height.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Above grade roof, walls and floors are more stringent:

2006 IECC	2009 IECC
	Increases the envelope insulation requirement in Section 502 tables for commercial (and high-rise residential) in several climate zones. *Group R was added in this edition.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Above grade roof, walls and floors are more stringent:

- Climate Zone 3 Values:

2006 IECC (R-value)	2009 IECC (R-value)
Insulation above deck roof = R-15 Attic & other roof = R-30 Mass wall above grade = R-5.7 Mass floors = R-5	Insulation above deck roof = R-20 Attic & other roof = R-38 Mass wall above grade = R-7.6 Mass floors = R-6.3

2006 & 2009 IECC Key Differences

Above grade roof, walls and floors are more stringent:

- 2006 & 2009 IECC allow buildings up to 40% of the window area to gross above-grade wall area. Buildings that exceed this level are to use 90.1 or Section 506.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Metal building requirements more strict – continuous insulated sheathing in metal building walls:

2006 IECC	2009 IECC
Provides a description for meeting the metal building wall requirements	Adds additional information in descriptions for metal building walls in Table 502.2(2) Increased from four to five descriptions, with the inclusion of Standing seam roof with two insulation layers.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Skylight requirements more strict:

2006 IECC	2009 IECC
Skylight U-factor based on climate zone and material (either glass or plastic). Maximum SHGC also required for skylights. Skylight percentage limited to 3% of gross roof area.	Consolidated the U-factor and SHGC requirements for skylights into one skylight category. Reduced (made more stringent) the U-factor and SHGC requirements.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Skylight requirements more strict:

- Climate Zone 3 Values:

2006 IECC	2009 IECC
Glass U-factor = 0.90 Glass SHGC = 0.40 Plastic U-factor = 1.90 Plastic SHGC = 0.35	U-factor = 0.65 SHGC = 0.35

2006 & 2009 IECC Key Differences

All recessed lighting must be IC-rated (Insulation Contact) and sealed:

2006 IECC	2009 IECC
Non-IC rated fixture allowed	All fixtures shall be IC-rated and sealed with a gasket or caulk per Section 502.4.8 Recessed Lighting

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

All recessed lighting must be IC-rated (Insulation Contact) and sealed:

2006 & 2009 IECC Key Differences

Minimum efficiency of unitary HVAC is SEER 13 ILO SEER 10 :

2006 IECC	2009 IECC
Table 503.2.3(2) requires minimum efficiency for Air conditioners, air cooled < 65,000 Btu/h to be SEER 10.0 for split systems	Table 503.2.3(2) requires minimum efficiency for Air conditioners, air cooled < 65,000 Btu/h to be SEER 13.0 for split systems. Also allows for alternative for water-cooled centrifugal water-chilling package efficiency. Revises equipment efficiency tables for water-chilling packages.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Minimum pipe insulation thickness increased:

2006 IECC	2009 IECC
Allows hot water and chilled water piping ≤ 1.5 inch to have minimum insulation thickness of 1 inch.	Increases minimum piping insulation thickness by ½ inch for piping ≤ 1.5 inch.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

HVAC fan power section with limitations added:

2006 IECC	2009 IECC
No requirement	Adds a section that requires fan systems greater than **5 hp** to meet maximum fan power horsepower requirements. •Section 503.2.10.1 Allowable fan floor horsepower •Section 503.2.10.2 Motor nameplate horsepower

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Economizers required in systems greater than 54,000 Btu/h , except Climate Zones (CZ) 1, 2A, 7 & 8: With Exceptions!!!

2006 IECC	2009 IECC
Requires economizers for all cooling systems ≥ 54,000 Btu/h. No exceptions for economizers in CZ 5B & 6B	Requires systems ≥ 54,000 Btu/h in warm humid climates (Zone A) to meet the economizer requirements for CZ 3 and above. Eliminates the category for systems ≥ 135,000 Btu/h and sets the threshold for requiring an economizer to 54,000 Btu/h for all systems.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Economizers required in systems greater than 54,000 Btu/h , except Climate Zones (CZ) 1, 2A, 7 & 8: With Exceptions!!!

2006 Economizers

TABLE 503.3.1(1)
ECONOMIZER REQUIREMENTS

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B, 2A, 3A, 4A, 7, 8	No requirement
2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B	Economizers on all cooling systems ≥ 54,000 Btu/h
5A, 6A	Economizers on all cooling systems ≥ 135,000 Btu/h

For SI: 1 British thermal unit per hour = 0.293 W.

2009 Economizers

TABLE 503.3.1(1)
ECONOMIZER REQUIREMENTS

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B, 2A, 7, 8	No requirement
2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B	Economizers on all cooling systems ≥ 54,000 Btu/h[a]

For SI: 1 British thermal unit per hour = 0.293 W.

a. The total capacity of all systems without economizers shall not exceed 480,000 Btu/h per building, or 20 percent of its air economizer capacity, whichever is greater.

2006 & 2009 IECC Key Differences

Hydronic heat pump system requirements have been revised:

2006 IECC	2009 IECC
Provides requirements for the use of heat injection and heat rejection into the heat pump loop. Places requirements for bypassing the cooling tower when it is not needed.	Reorganizes the code provision (Section 503.4.3.3) to make it more understandable. Splits the requirements for bypassing the cooling tower when no heat rejection is needed based on climate zone.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Supply air temperature reset controls:

2006 IECC	2009 IECC
No requirements	Requires controls to be placed on systems serving multiple zones to be able to reset the supply air temperature by 25% based on the supply air temperature and the room temperature.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Lighting exemption for dwelling units:

2006 IECC	2009 IECC
No requirements	Requires at least 50% of the permanently connected lighting in dwelling units to be fitted with high efficacy lamps ICC defines high efficacy as: 60 lumens/W for lamps over 40W; 50 lumens/W for lamps over 15W to 40W; 40 lumens/W for lamps 15W or less.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

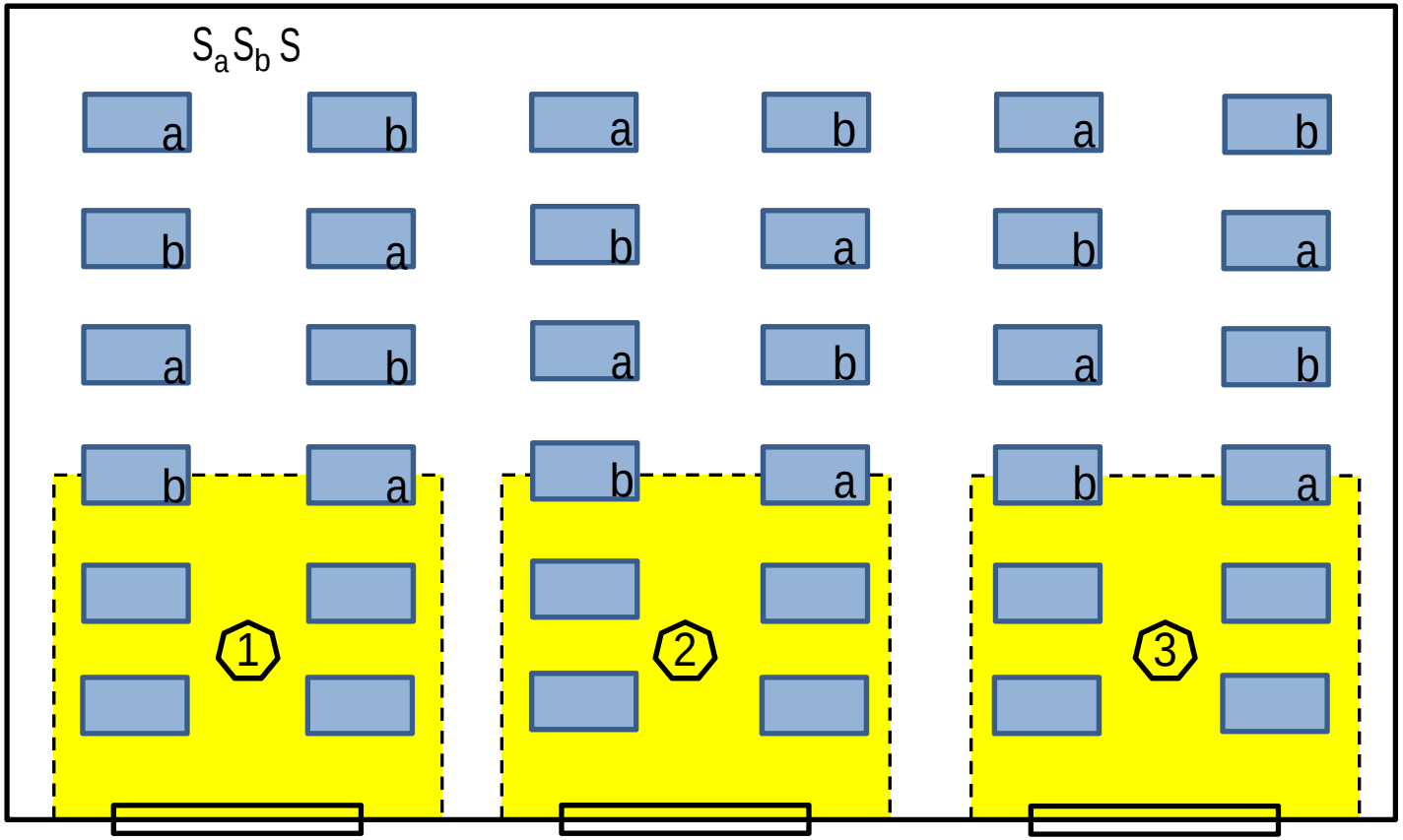
New section added for manual daylight zone controls:

2006 IECC	2009 IECC
No requirements	Requires that connected lighting that is installed in daylight zones be separately switched from other lighting in the space. Daylight zones are defined for spaces with vertical fenestration and also for skylights.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

New section added for manual daylight zone controls:



2006 & 2009 IECC Key Differences

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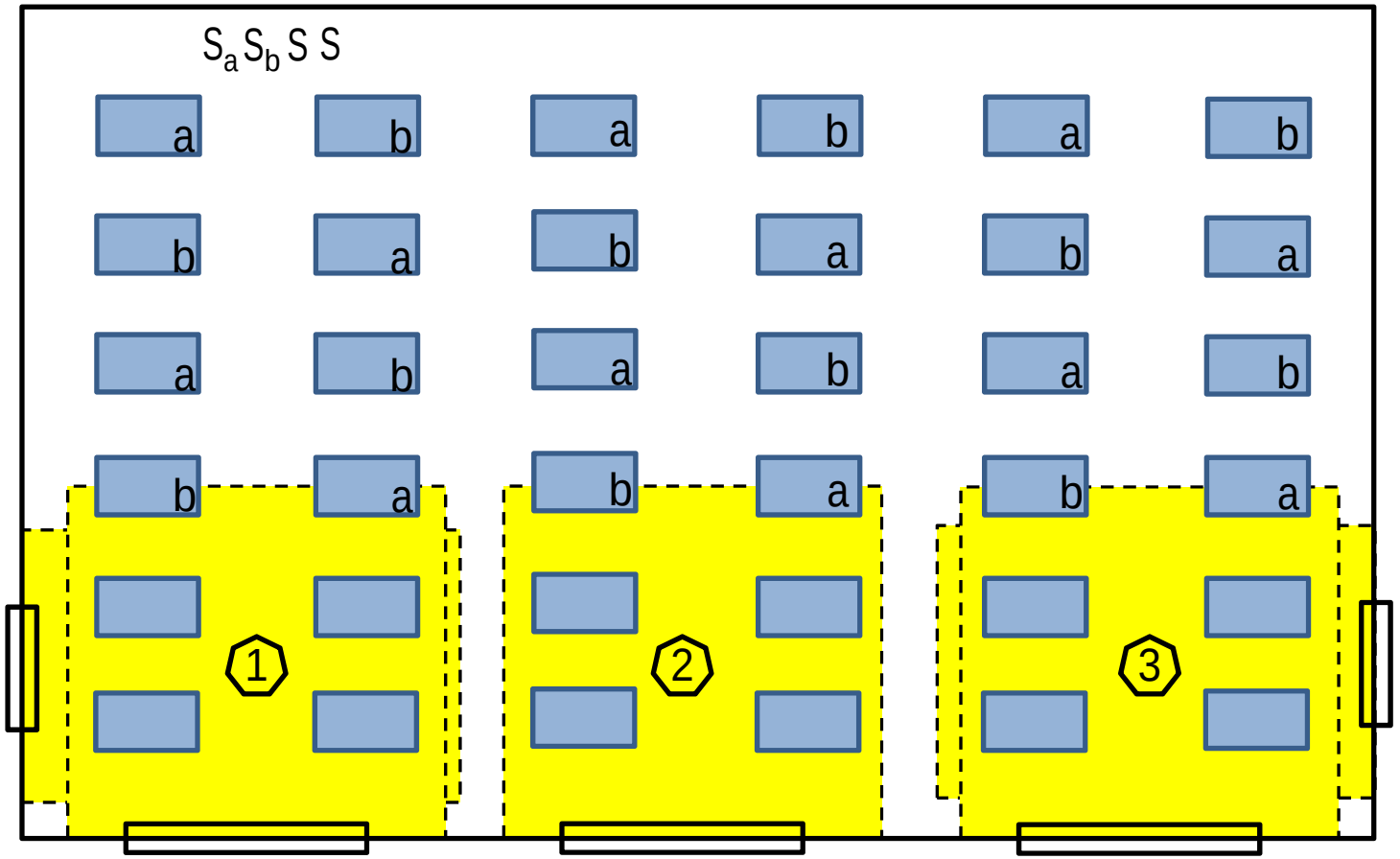


2006 & 2009 IECC Key Differences

Total connected interior lighting power:

2006 IECC	2009 IECC
Provides five *exemptions* for lighting used for specialized lighting and associated with life/safety including: Specialized lighting for medical & dental; Professional sports arenas; Display lighting for exhibits in galleries, museums and monuments; Sleeping unit lighting in hotels, motels, or similar buildings; and Emergency lighting off during normal building operation.	Section 505.5.1 Total connected interior lighting power requirements exemption list has been revised and expanded to specify more detailed functions such as photographic process, lighting in refrigerator/ freezer cases, and furniture-mounted task lighting that is controlled by automatic shut off.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Quick Definitions…

- Exemption: these items are excluded from or not subject to the lighting power density requirements of the code
- Allowance: these items are an addition to the lighting power density requirements of the code

2006 & 2009 IECC Key Differences

Interior lighting power allowances for Retail revised:

2006 IECC	2009 IECC
Provides a 1.6 W/ft^2 for general merchandise display lighting for up to 50% of the display floor area and 3.9 W/ft^2 for the actual shelf or case area for displaying jewelry, china and silver	Interior lighting power allowance adjustments have been revised for retail display area based on the type of products on display. Reference Table 505.5.2 and calculation on next slide.

Source: PNNL Study for Kansas City, MO, March 2011

2006 & 2009 IECC Key Differences

Retail additional lighting power is calculated as follows:

Additional Interior Lighting Power Allowance =

1000 watts + (Retail Area 1 x 0.6 W/ft^2) + (Retail Area 2 x 0.6 W/ft^2) + (Retail Area 3 x 1.4 W/ft^2) + (Retail Area 4 x 2.5 W/ft^2)

- Retail Area 1 = floor area for all products not listed in retail area 2, 3 or 4.
- Retail Area 2 = floor area used for sale of vehicles, sporting goods and small electronics.
- Retail Area 3 = floor area used for sale of furniture, clothing, cosmetics and artwork.
- Retail Area 4 = floor area used for sale of jewelry, crystal, and china.

2006 & 2009 IECC Key Differences

Lighting-zone-based power allowance requirements are specified for exterior lighting:

2006 IECC	2009 IECC
No exterior lighting zones	Creates exterior lighting zones for exterior lighting based on lighting need. Allowances are defined by four lighting zones with the lowest levels allowed in Zone 1 (e.g. national parks) and the highest levels allowed in Zone 4 (e.g. major metropolitan commercial areas).

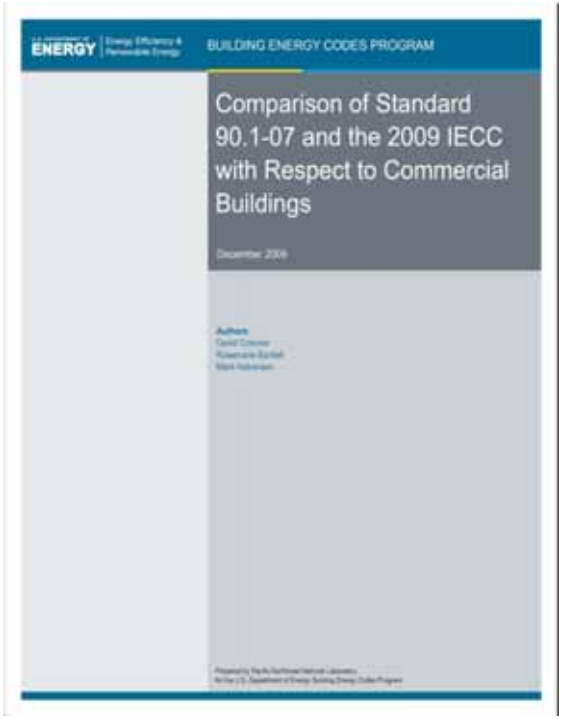
Source: PNNL Study for Kansas City, MO, March 2011

Relationship Between IECC and ASHRAE 90.1

2009 IECC vs. ASHRAE 90.1-2007

Key Differences

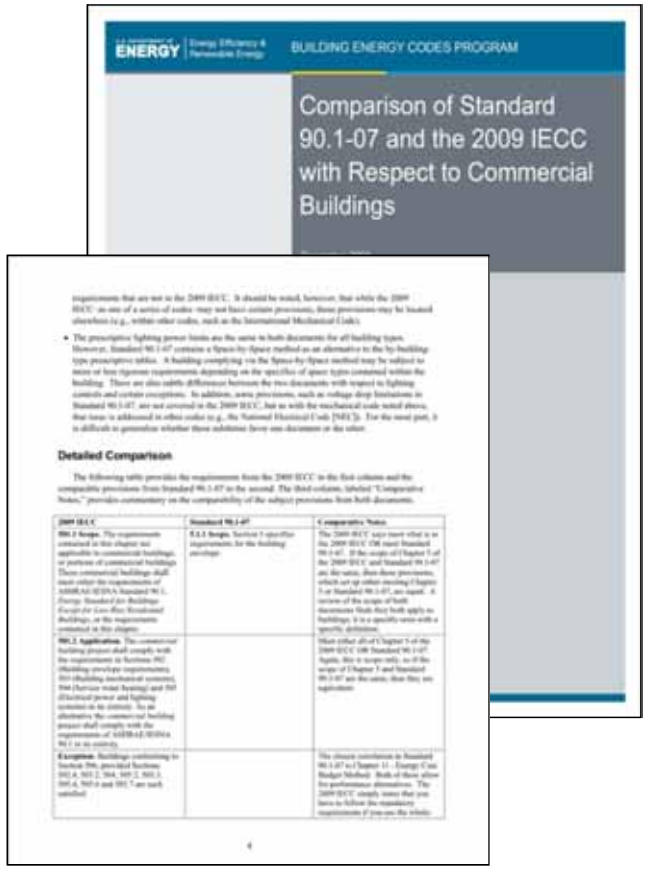
- Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings
  - Prepared for the U.S. Department of Energy by Pacific Northwest National Laboratory
  - http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf



2009 IECC vs. ASHRAE 90.1-2007

Detailed Comparison Table

- Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings
  - Prepared for the U.S. Department of Energy by Pacific Northwest National Laboratory



2009 IECC vs. ASHRAE 90.1-2007

Specific designation of semi-heated space:

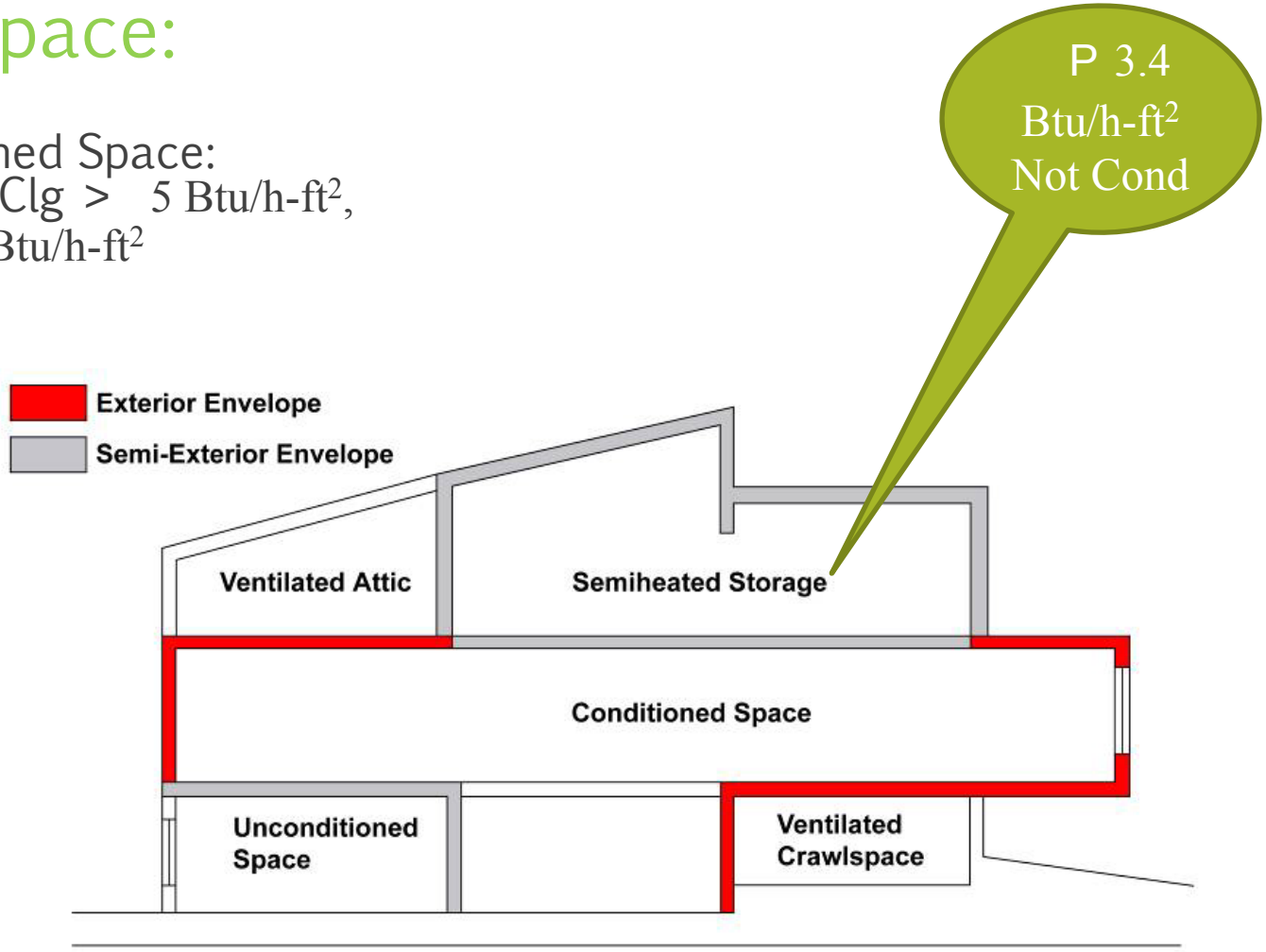
2009 IECC	ASHRAE 90.1-2007
Has no specific designation of semi-heated space and, therefore, treats all semi-heated spaces as heated spaces	Has a specific designation of semi-heated space and comparable thermal envelope provisions for assemblies associated with such spaces that are less rigorous than those for heated spaces
Generally more rigorous thermal envelope requirements	

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Specific designation of semi-heated space:

Conditioned Space:
Sensible Clg > 5 Btu/h-ft^2,
Htg > 10 Btu/h-ft^2



2009 IECC vs. ASHRAE 90.1-2007

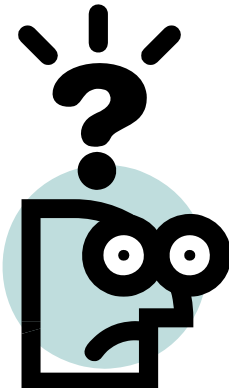
Sloped glazing within 15 to 30 degrees of horizontal:

2009 IECC	ASHRAE 90.1-2007
Considers sloped glazing within 15 to 30 degrees of vertical to be part of the wall and subject to the vertical fenestration provisions of the code	Considers glazing 30 degrees or more from vertical as skylights
More rigorous than the provisions for skylights (glazing less than 15 degrees from vertical)	Could have lesser thermal requirements than under the 2009 IECC for vertical fenestration

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

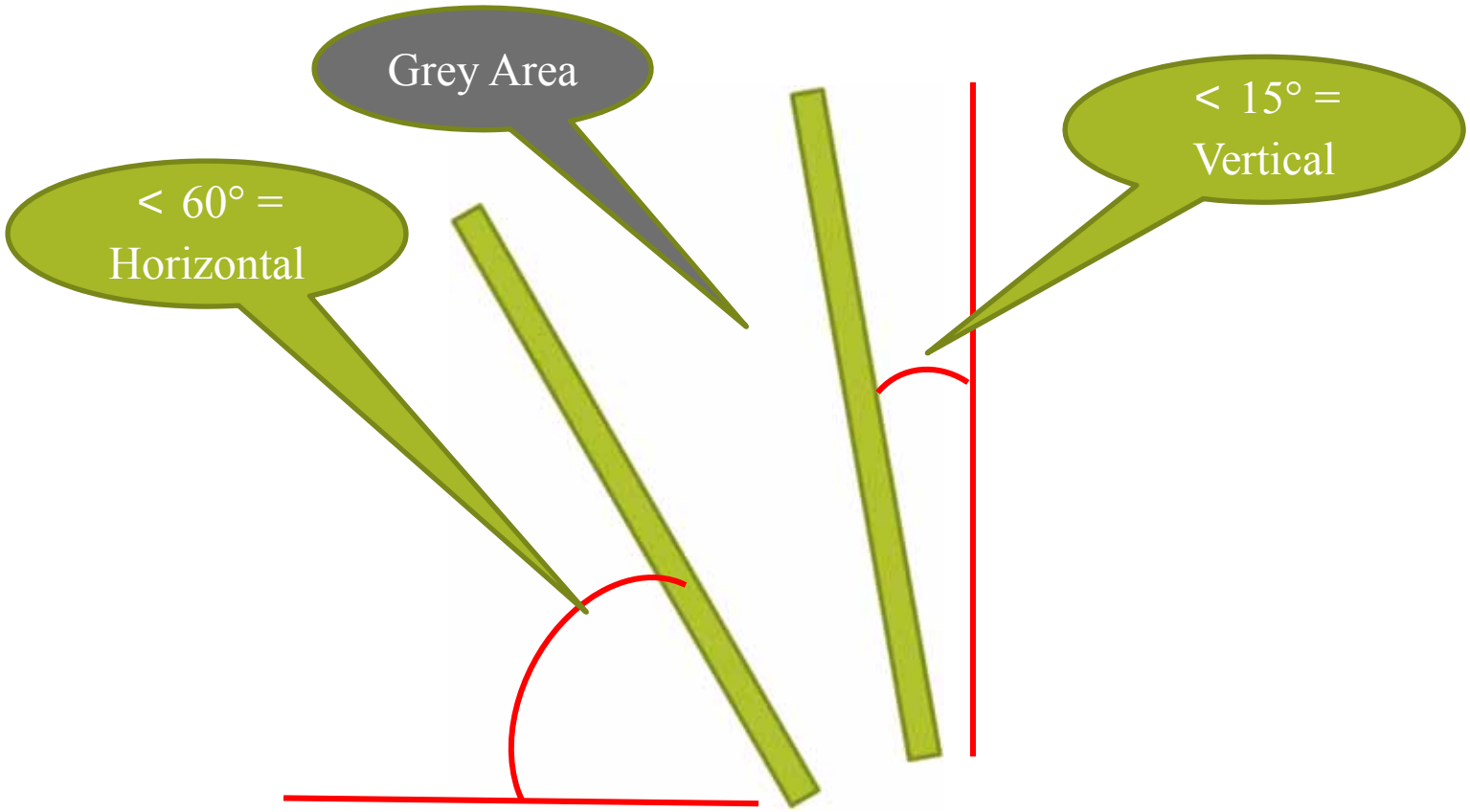
Reaching the 40% maximum Window-to-Wall-Ratio (WWR) limitation:

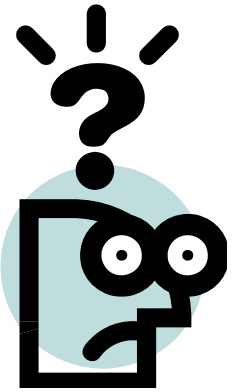


2009 IECC	ASHRAE 90.1-2007
Glazing within 15 to 30 degree tilt angle considered vertical fenestration – Could reach 40% Window-to-Wall-Ratio (WWR) limit with less total glazing area than under Standard 90.1-2007	Adding glazing beyond the 40% limit imposes requirement for buildings under 2009 IECC to meet Standard 90.1-2007
*Eliminates any basis for difference between the 2009 IECC and Standard 90.1-07	

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007





2009 IECC vs. ASHRAE 90.1-2007

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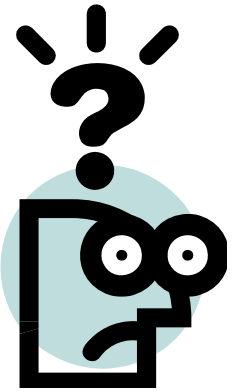

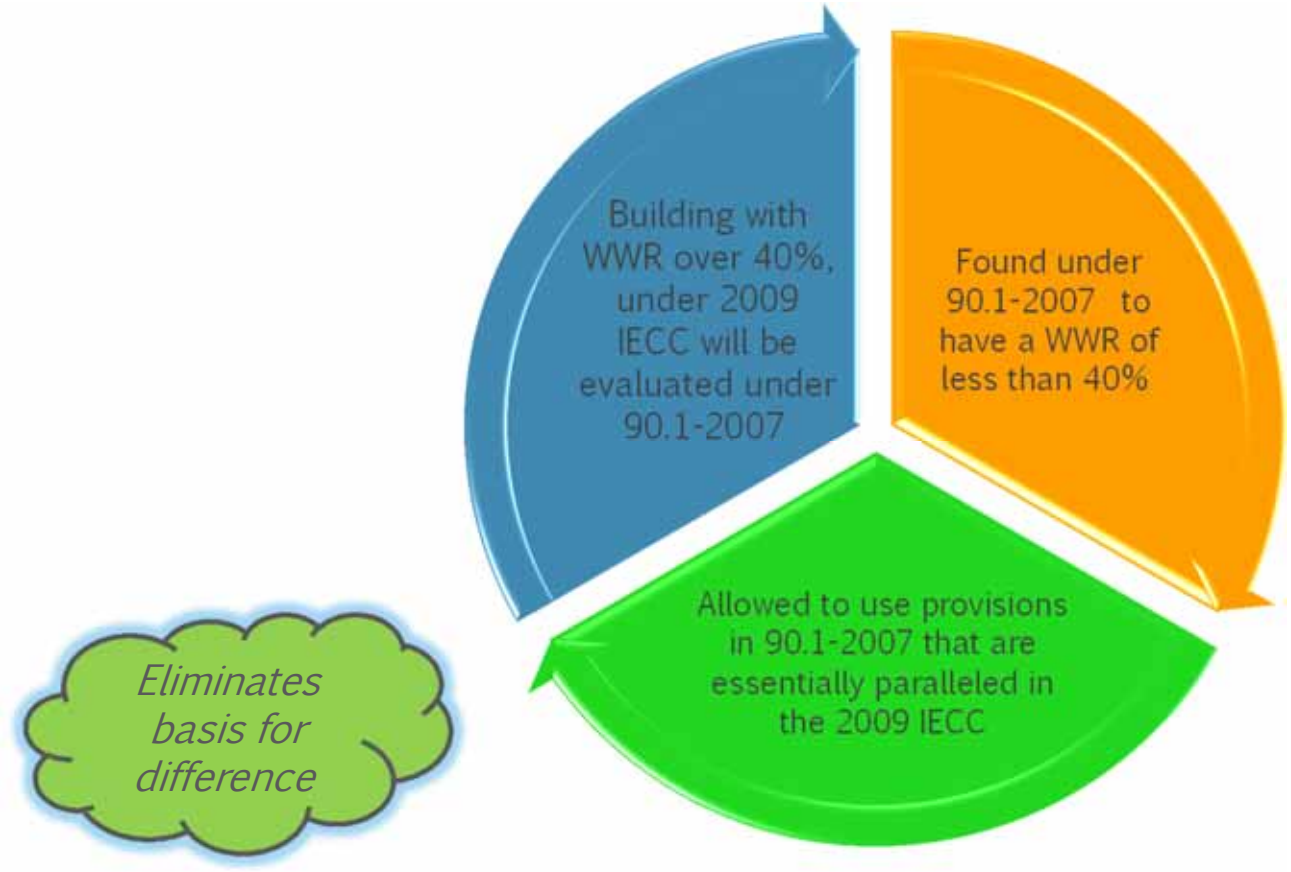

2009 IECC vs. ASHRAE 90.1-2007

Different definitions of above-grade wall area:

2009 IECC	ASHRAE 90.1-2007
Allows any wall that is up to 15% above grade and 85% or more below grade to be considered entirely a below-grade wall	Portions of walls above grade are treated as above grade and portions of the same walls that are below grade are treated as below grade
Any wall that is more than 15% above grade would be considered entirely an above-grade wall	a building with below-grade walls is effectively allowed a higher vertical fenestration area under Standard 90.1-07

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

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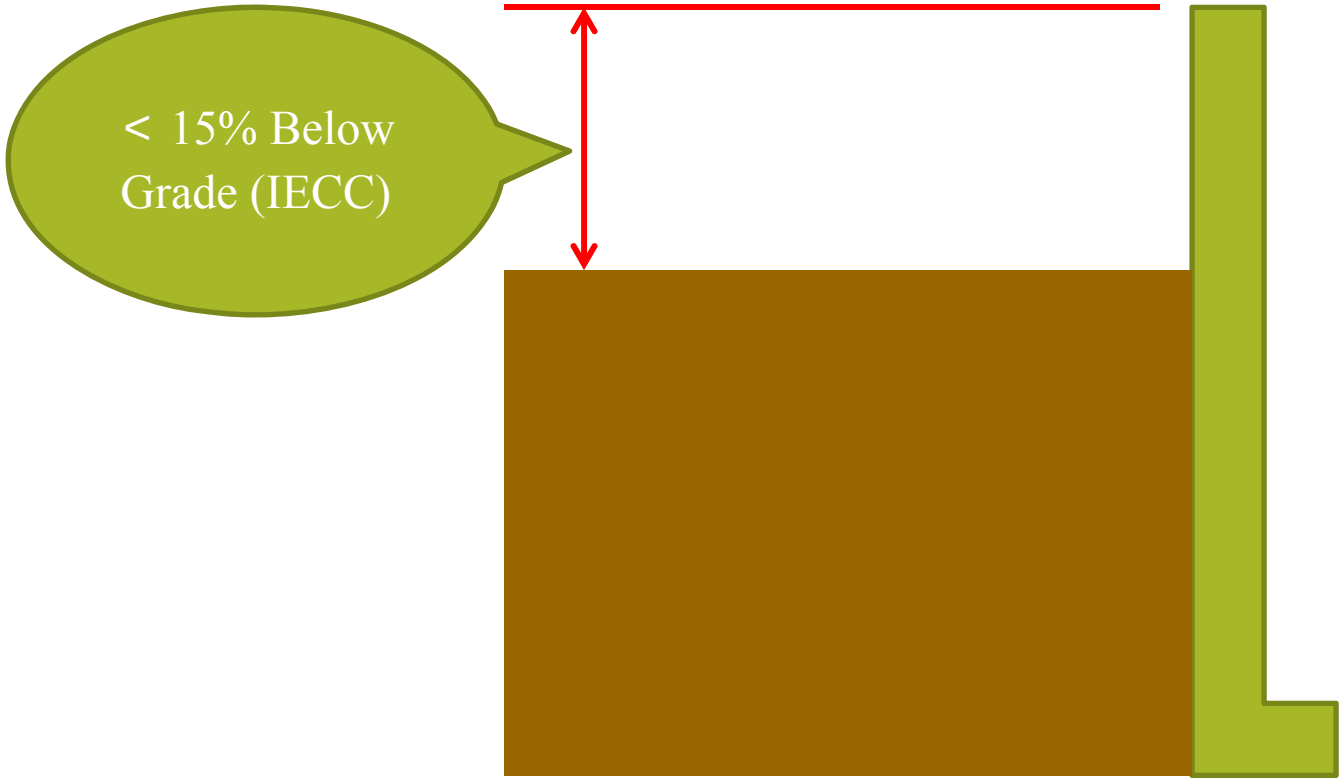


2009 IECC vs. ASHRAE 90.1-2007

Different definitions of above-grade wall area:

2009 IECC	ASHRAE 90.1-2007
May be more stringent on average because a relatively small fraction (15%) above grade pushes the entire wall toward the more rigorous above-grade criteria	

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Calculations of Window-to-Wall-Ratio (WWR):

2009 IECC	ASHRAE 90.1-2007
Calculates the WWR with respect to above-grade wall area only	Uses the gross wall area, which includes below-grade walls
	A building with below-grade walls is effectively allowed a higher vertical fenestration area under Standard 90.1-2007

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Thermal requirements for opaque and non-opaque assemblies

2009 IECC	ASHRAE 90.1-2007
Some instances thermal requirements for opaque and non-opaque assemblies are more stringent	In other instances thermal requirements for opaque and non-opaque assemblies are more stringent
The thermal requirements for opaque and non-opaque assemblies are not always identical between the two documents, although the climate zones are identical.	

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Allowance for maximum U-factor increase for some roof and ceiling assemblies:

2009 IECC	ASHRAE 90.1-2007
Allowance is not provided	Allows for and increase in the U-factor maximum (reduction in required R- value) for certain roof /ceiling assemblies if roof meets certain reflectance and emissivity requirements

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Varying damper leakage rate requirements:

2009 IECC	ASHRAE 90.1-2007
In some cases, allowable damper leakage rates are higher	In some cases, allowable damper leakage rates are higher
Sometimes more stringent	Sometimes more stringent

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Limits on HVAC equipment oversizing:

2009 IECC	ASHRAE 90.1-2007
Limits HVAC equipment oversizing	Does *not* limit HVAC equipment oversizing
In some cases would result in equipment that operates more efficiently on a seasonal basis	

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Differences between the documents related to HVAC equipment and systems:

2009 IECC	ASHRAE 90.1-2007
One of a series of codes–may not have certain provisions, because those provisions may be located elsewhere (e.g., within other codes, such as the International Mechanical Code)	Related to HVAC - tends to be more rigorous and, in some cases (e.g., fume hoods, cooling towers, dehumidification, and kitchen exhaust hoods), has requirements that are not in the 2009 IECC

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Lighting power limits:

2009 IECC	ASHRAE 90.1-2007
No Space-by-Space method	Contains a Space-by-Space method as an alternative to the by-building-type prescriptive tables
	A building complying via the Space-by-Space method may be subject to more or less rigorous requirements depending on the specifics of space types contained within the building

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

2009 IECC vs. ASHRAE 90.1-2007

Lighting controls requirements:

2009 IECC	ASHRAE 90.1-2007
Some provisions, such as voltage drop limitations in Standard 90.1-07, are not covered, but these issues are addressed in other codes (e.g., the National Electrical Code [NEC])	Provisions, such as voltage drop limitations, are covered
Difficult to generalize whether these subtleties favor one document or the other	

Source: PNNL, "Comparison of Standard 90.1-07 and the 2009 IECC with Respect to Commercial Buildings," December 2009, http://www.energycodes.gov/sites/default/files/documents/90-1_iecc_comparison_final_12-16-2009.pdf.

Compliance Tools and Resources

Compliance Tools & Resources

Useful Websites

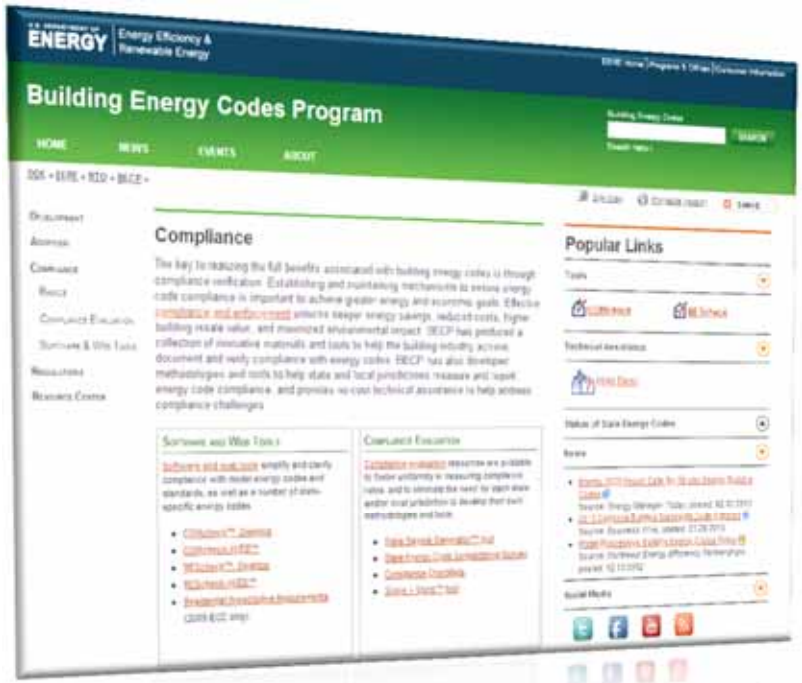
- DOE
- IECC Online
- ASHRAE

Compliance Tools & Resources

DOE Website Navigation

Compliance

- Basics
- Compliance Evaluation
- Software & Web Tools
- Technical Assistance



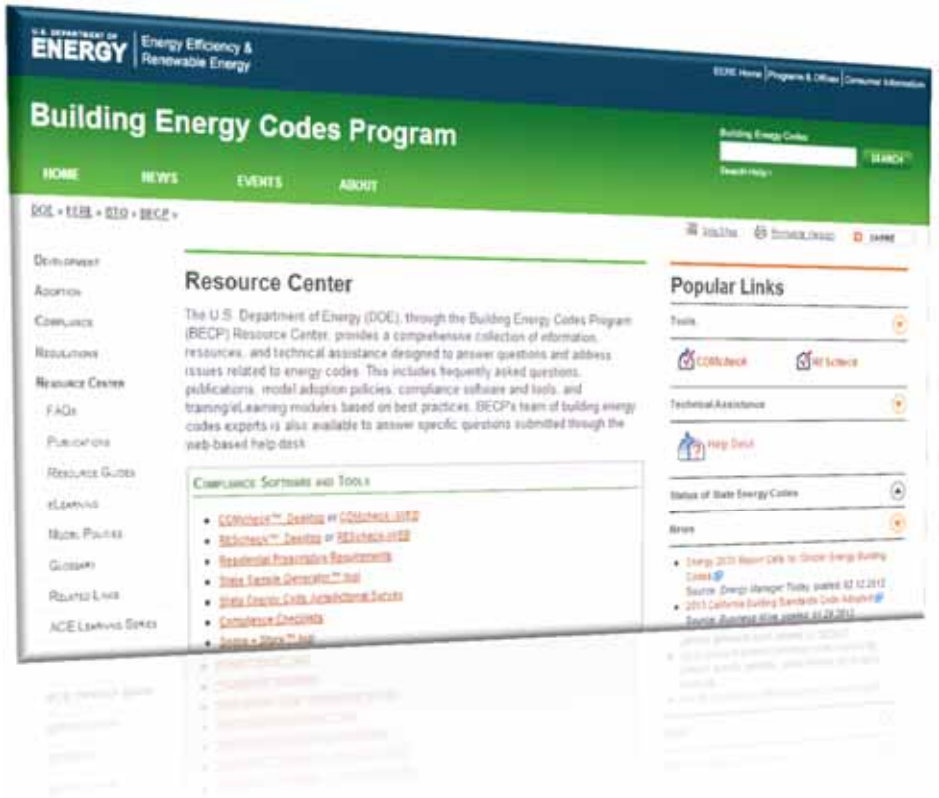
http://www.energycodes.gov/compliance

Compliance Tools & Resources

DOE Website Navigation

Resource Center

- Publications
- Resource Guides
- eLearning
- Model Policies
- Glossary



http://www.energycodes.gov/resource-center

Compliance Tools & Resources

DOE Website Navigation

Software & Web Tools

- COMcheck is a no-cost, easy-to-use software that will demonstrate *Mandatory* and *Prescriptive Path* compliance
- Example coming later… COMcheck-Web™

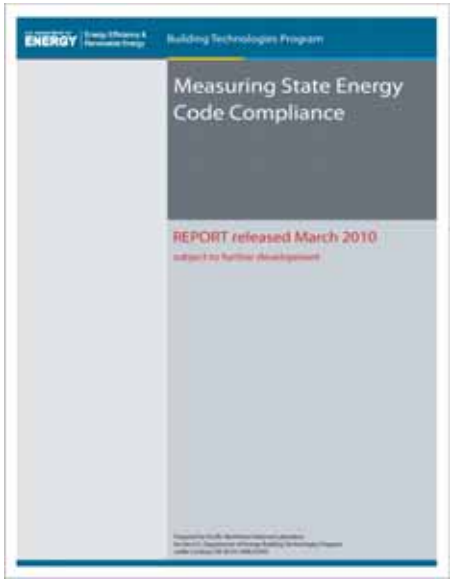
http://www.energycodes.gov/compliance/tools

Compliance Tools & Resources

DOE Website Navigation

Compliance Evaluation Checklists

- Commercial Checklists:
  - 2009 IECC Commercial Checklists & Instructions
  - ASHRAE Standard 90.1-2007 Checklist & Instructions
  - ASHRAE Standard 90.1-2010 Checklist & Instructions

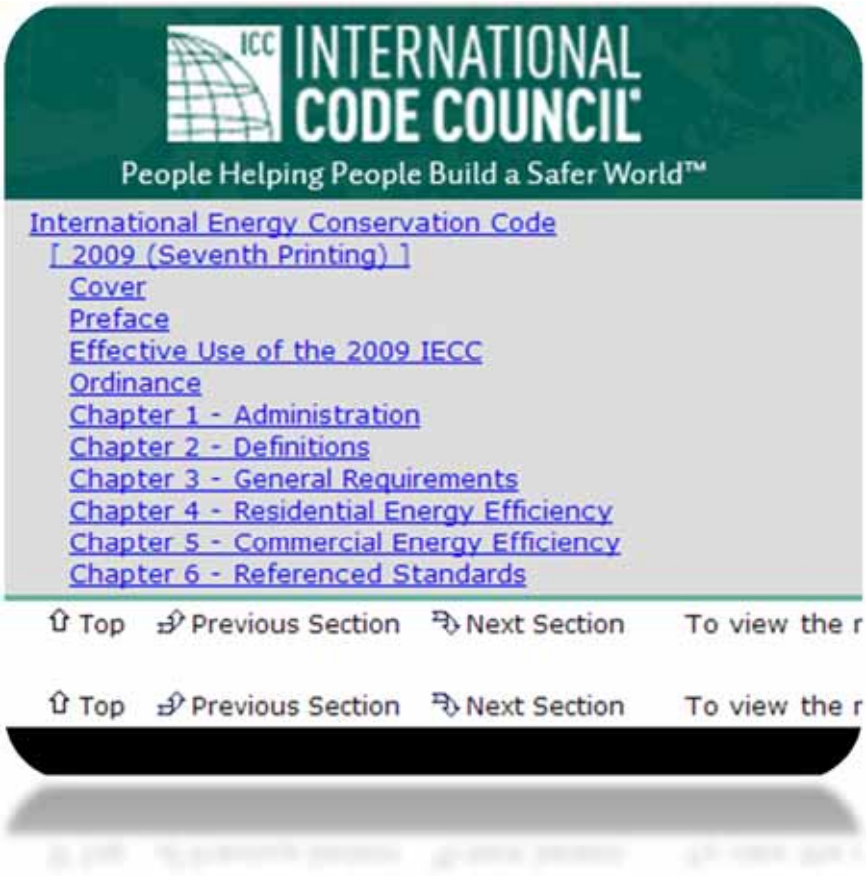


http://www.energycodes.gov/compliance/evaluation/checklists

Compliance Tools & Resources

IECC Online

- Online version of the 2009 IECC



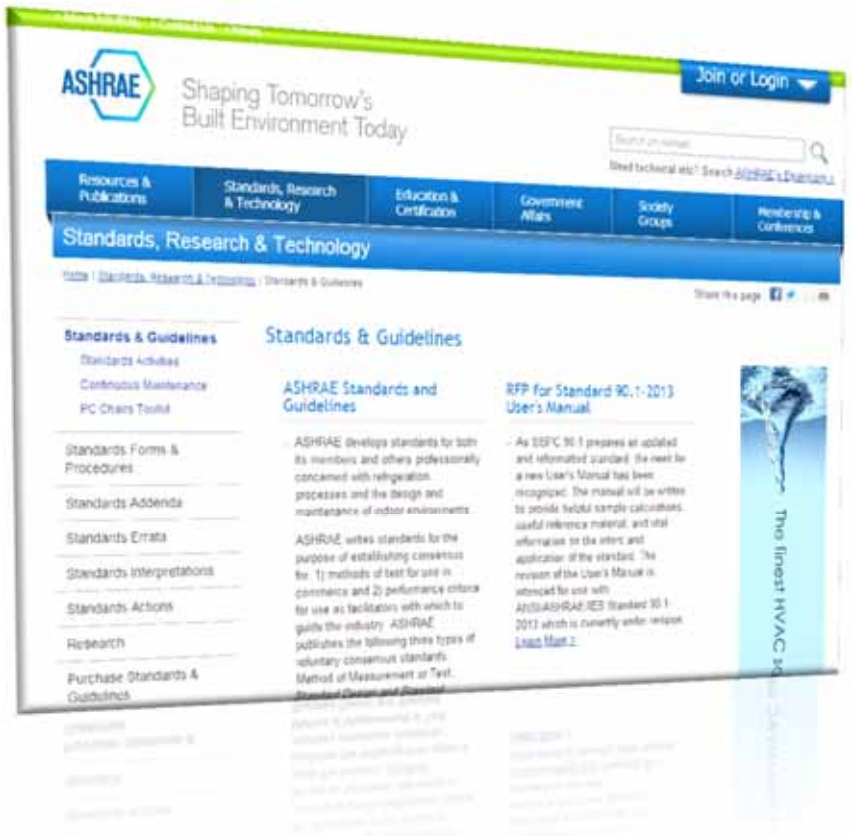
http://publicecodes.cyberregs.com/icod/iecc/2009/

Compliance Tools & Resources

ASHRAE Website

Standards & Guidelines

- Access free previews of popular standards



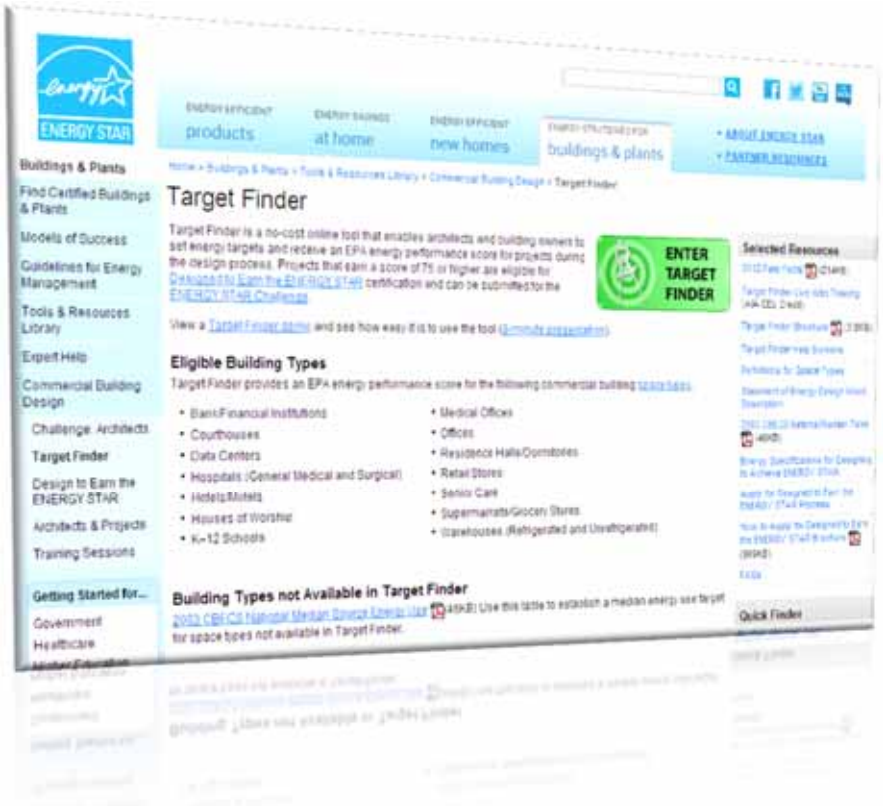
https://www.ashrae.org/standards-research--technology/standards--guidelines

Compliance Tools & Resources

EPA Website Navigation

Target Finder

- A no-cost, online tool that
- Allows users to set energy targets and receive an EPA energy performance score for projects during the design process



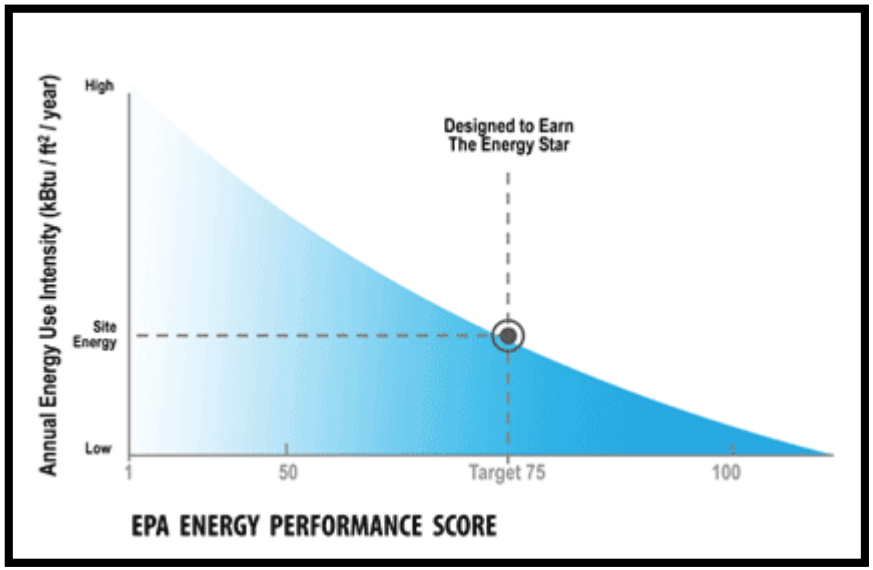
http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder

Compliance Tools & Resources

EPA Website Navigation

Target Finder

- A score of 75 or higher = Designed to Earn ENERGY STAR certification



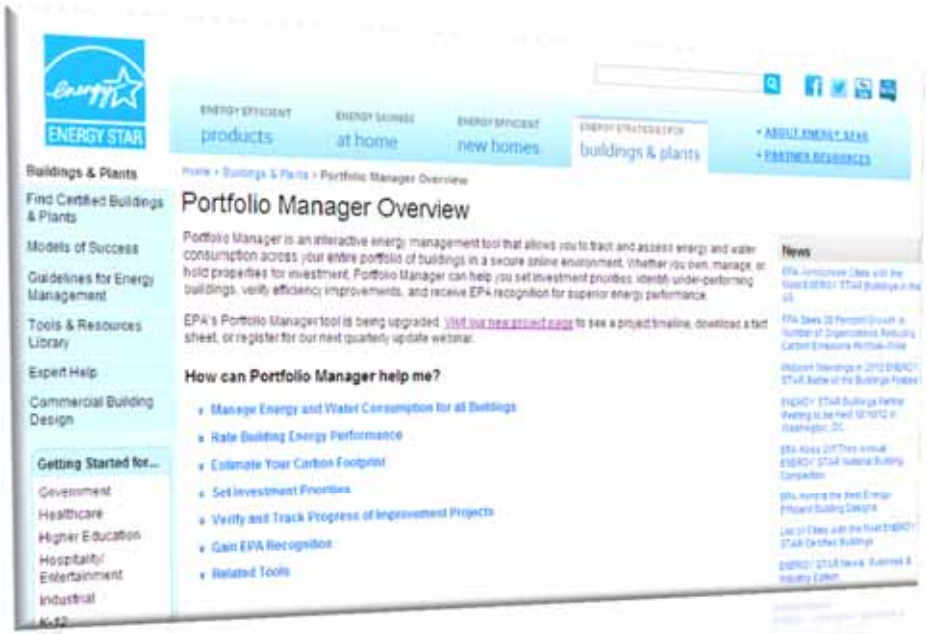
http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder

Compliance Tools & Resources

EPA Website Navigation

Portfolio Manager

- An energy management tool that allows users to track and evaluate energy and water consumption across a portfolio of buildings in a secure online environment



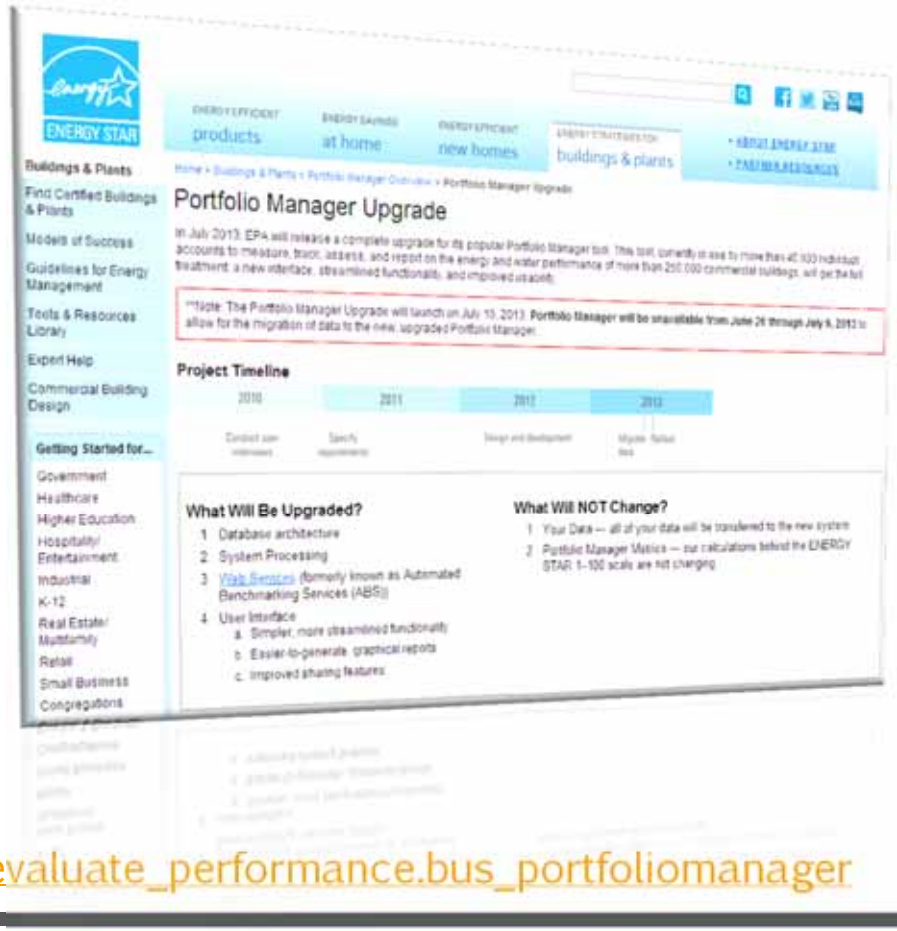
http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Compliance Tools & Resources

EPA Website Navigation

Portfolio Manager

- New upgrade will be released on July 10, 2013



http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Plan Review & Inspection Best Practices for IECC Compliance

Plan Review & Inspection Best Practices

By Building Component or System

- Building Envelope
- HVAC
- SWH
- Lighting
- Power
- Other Loads

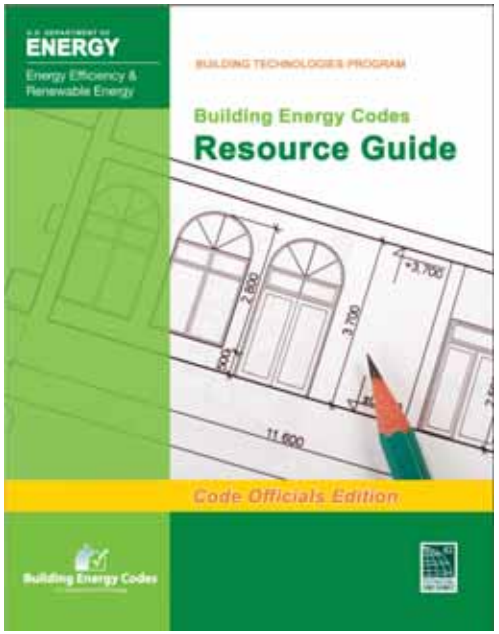
Note: Going to go through website later!

https://energycode.pnl.gov/ScoreStore/

Plan Review & Inspection Best Practices

Objectives of an Energy Code Plan Review:

- the documentation has been correctly prepared
- the levels of efficiency shown on the plans meet or exceed that shown in the documentation
- all information needed to conduct a field inspection is included in the plans or documentation for the inspector to use on site



Plan Review & Inspection Best Practices

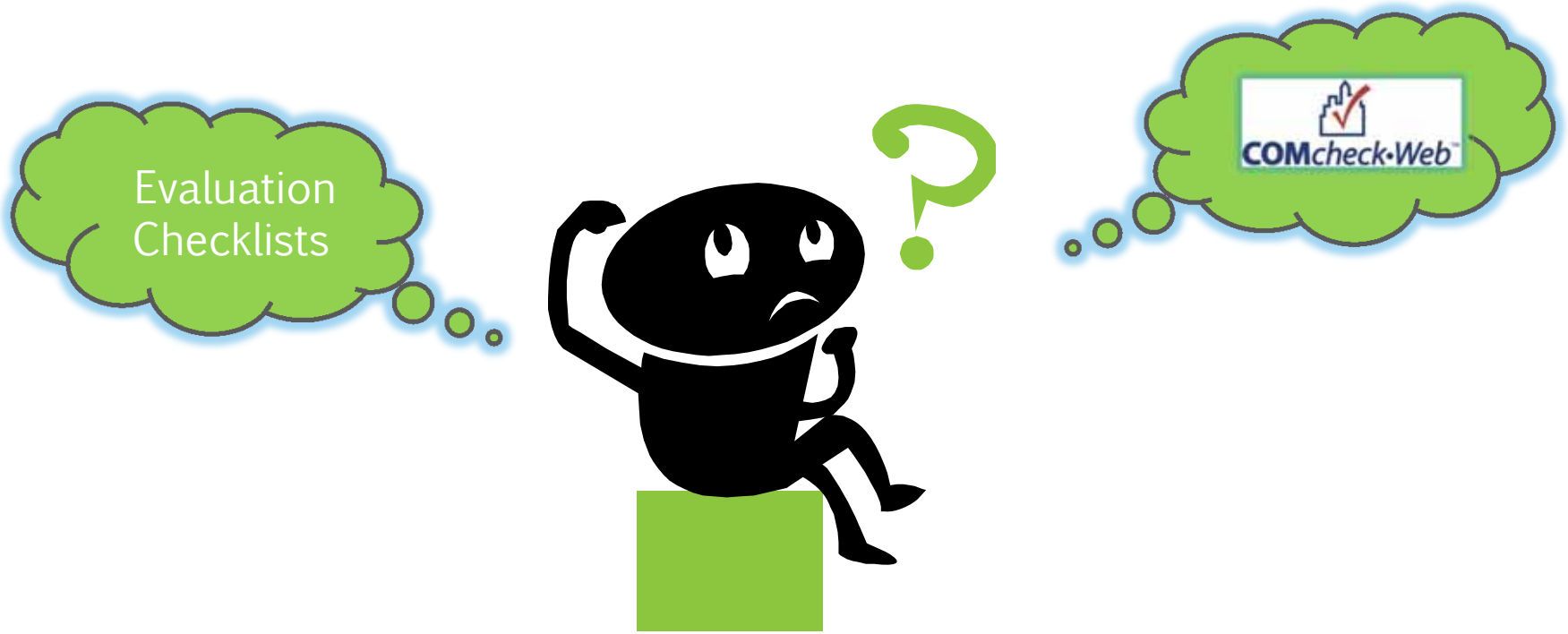
How Do I Start a Plan Review?

Plan Review & Inspection Best Practices

How Do I Start a Plan Review?

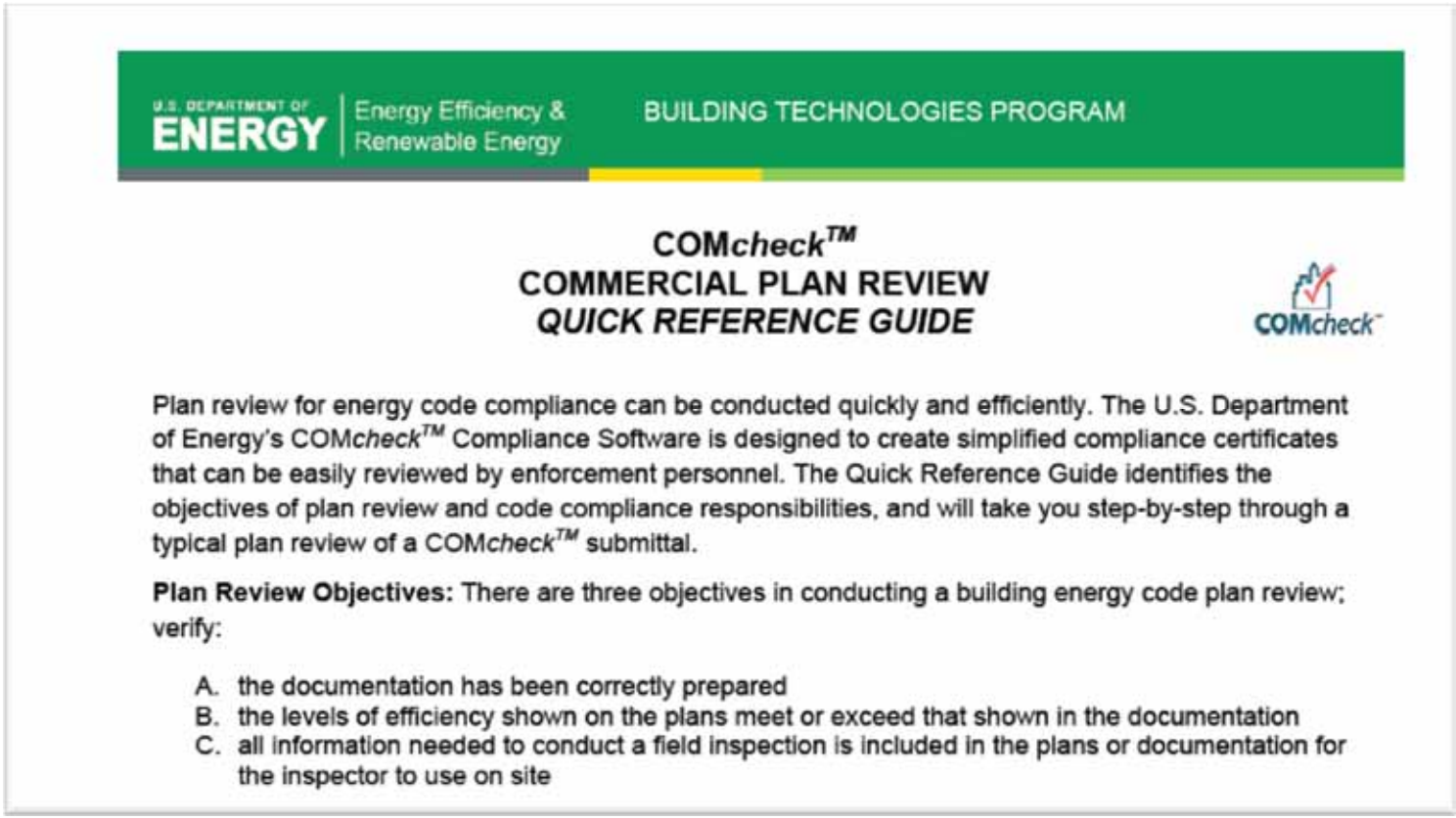
Plan Review & Inspection Best Practices

How Do I Start a Plan Review?



Plan Review & Inspection Best Practices

COMcheck Compliance Software



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy — BUILDING TECHNOLOGIES PROGRAM

COM*check*™
COMMERCIAL PLAN REVIEW
QUICK REFERENCE GUIDE

COMcheck

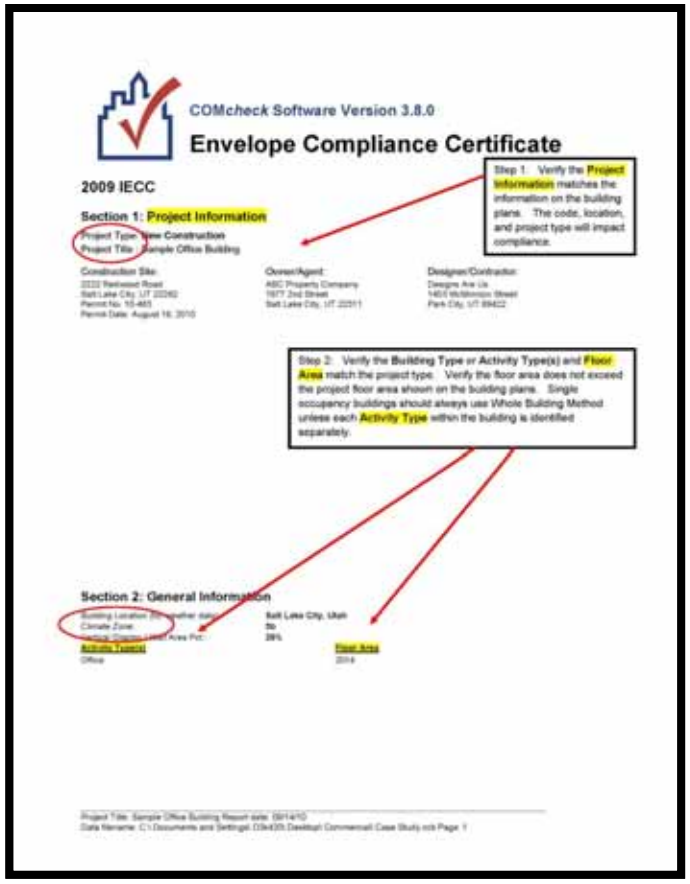
Plan review for energy code compliance can be conducted quickly and efficiently. The U.S. Department of Energy's COM*check*™ Compliance Software is designed to create simplified compliance certificates that can be easily reviewed by enforcement personnel. The Quick Reference Guide identifies the objectives of plan review and code compliance responsibilities, and will take you step-by-step through a typical plan review of a COM*check*™ submittal.

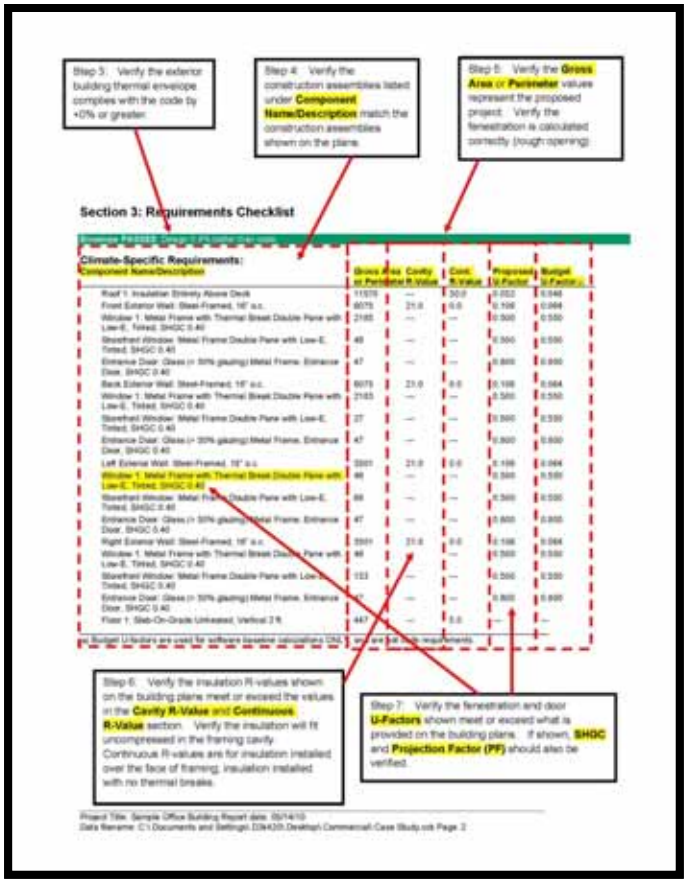
Plan Review Objectives: There are three objectives in conducting a building energy code plan review; verify:

A. the documentation has been correctly prepared
B. the levels of efficiency shown on the plans meet or exceed that shown in the documentation
C. all information needed to conduct a field inspection is included in the plans or documentation for the inspector to use on site

Plan Review & Inspection Best Practices

COMCheck Compliance Certificate Example





Plan Review & Inspection Best Practices

COMCheck Compliance Certificate Example

Let's do our own example!

https://energycode.pnl.gov/COMcheckWeb/

Plan Review & Inspection Best Practices

Compliance Evaluation Checklists

- Called "Commercial Building Data Collection Checklist"
- Find on DOE website:
  - IECC Checklist & Instructions
  - ASHRAE 90.1 Checklist & Instructions
- Developed to support state energy code compliance evaluations, and to validate compliance through ongoing code administration and enforcement processes

http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Compliance Evaluation Checklists

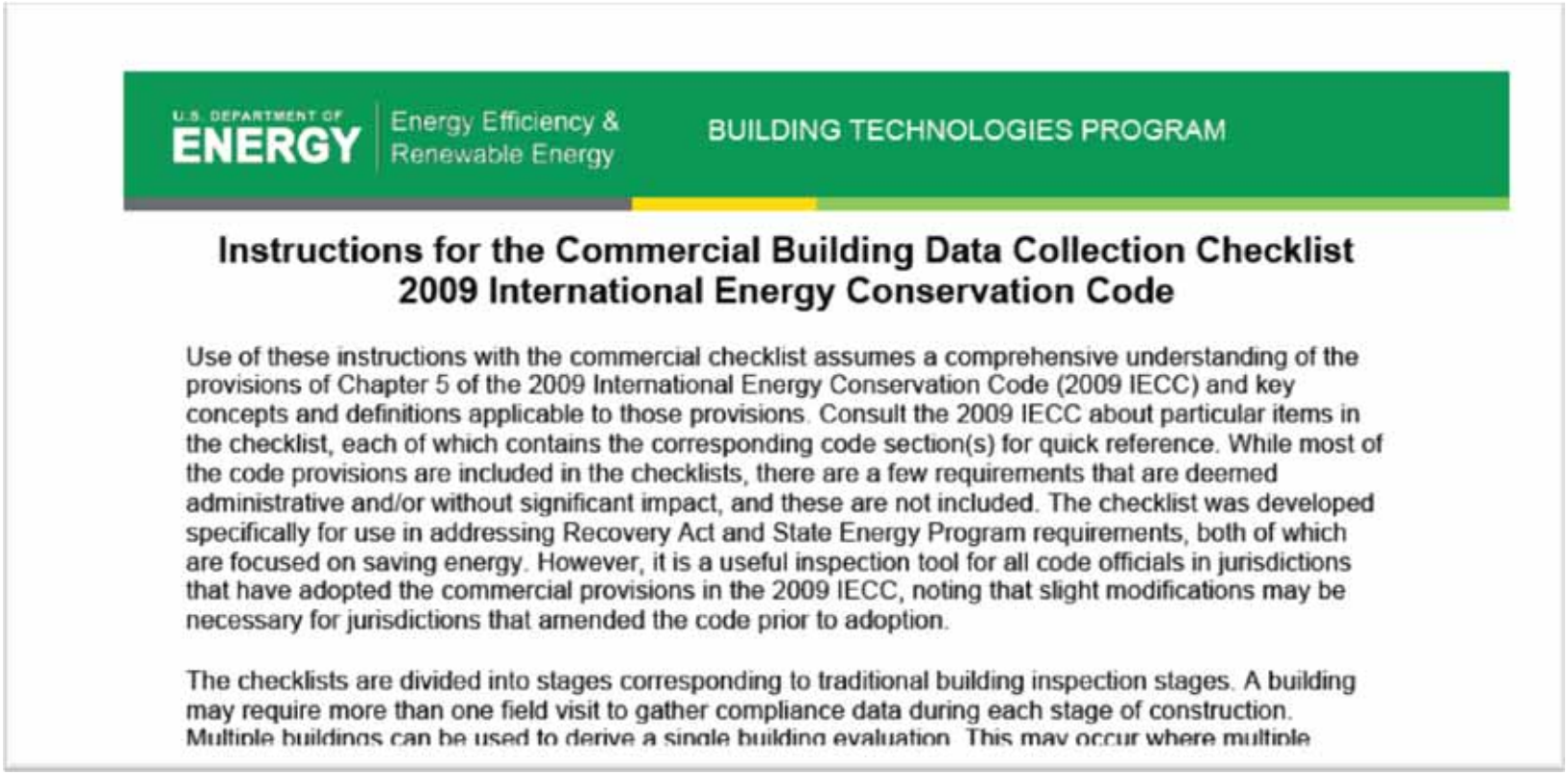
- For commercial buildings, a single checklist covers all climate zones
- The checklist can be customized by states and local jurisdictions to cover state amendments to the IECC and ASHRAE Standard 90.1

- The checklists can also be used to document information on the plans and specifications for submittal with the permit application and other required information

http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – 2009 IECC



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES PROGRAM

Instructions for the Commercial Building Data Collection Checklist
2009 International Energy Conservation Code

Use of these instructions with the commercial checklist assumes a comprehensive understanding of the provisions of Chapter 5 of the 2009 International Energy Conservation Code (2009 IECC) and key concepts and definitions applicable to those provisions. Consult the 2009 IECC about particular items in the checklist, each of which contains the corresponding code section(s) for quick reference. While most of the code provisions are included in the checklists, there are a few requirements that are deemed administrative and/or without significant impact, and these are not included. The checklist was developed specifically for use in addressing Recovery Act and State Energy Program requirements, both of which are focused on saving energy. However, it is a useful inspection tool for all code officials in jurisdictions that have adopted the commercial provisions in the 2009 IECC, noting that slight modifications may be necessary for jurisdictions that amended the code prior to adoption.

The checklists are divided into stages corresponding to traditional building inspection stages. A building may require more than one field visit to gather compliance data during each stage of construction. Multiple buildings can be used to derive a single building evaluation. This may occur where multiple

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – 2009 IECC

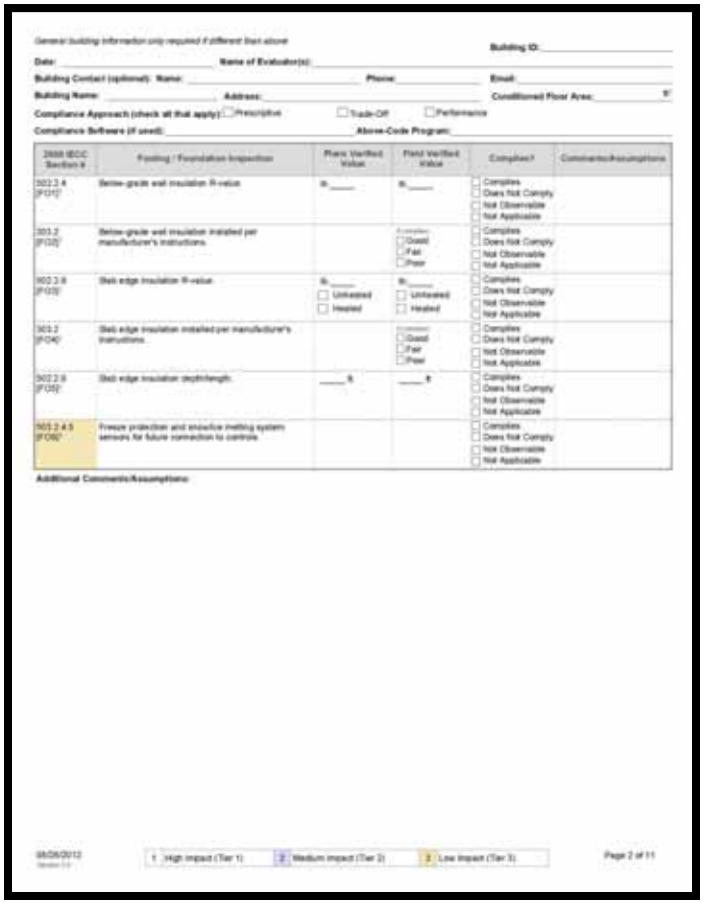
- First Section is the **General Information Section**
- First portion of the checklist is the **Plan Review** section

http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – 2009 IECC

- Page 2 is the **Footing / Foundation Inspection**

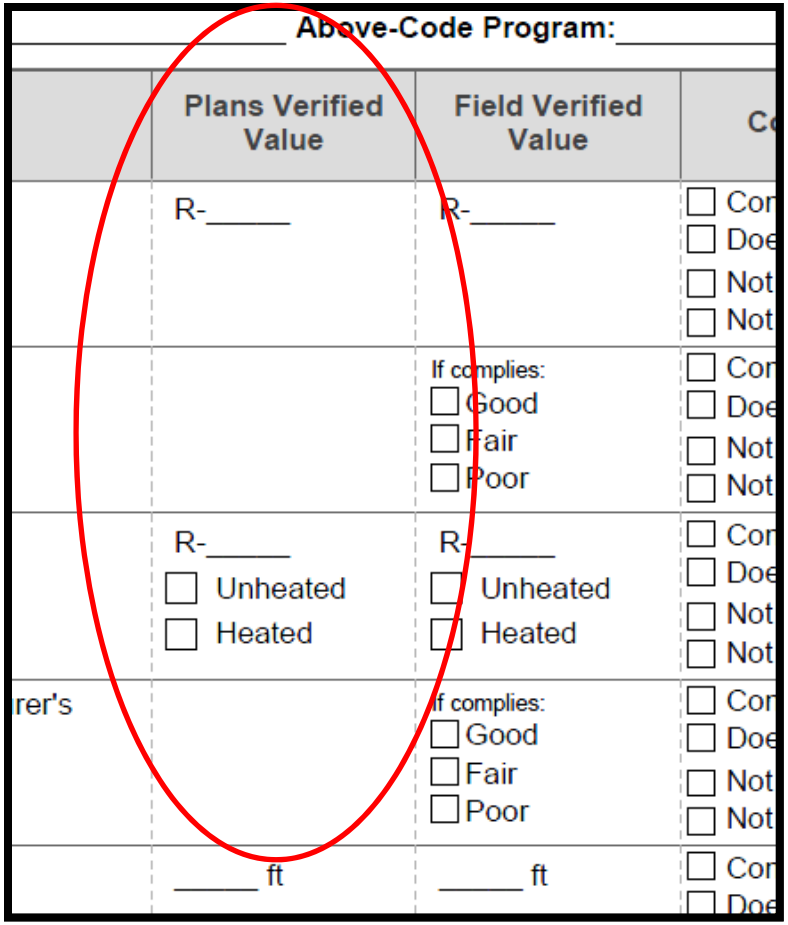


http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – 2009 IECC

- There is a "**Plans Verified Value**" column which should be completed during the Plan Review
- Allows for easier field inspections



Above-Code Program:

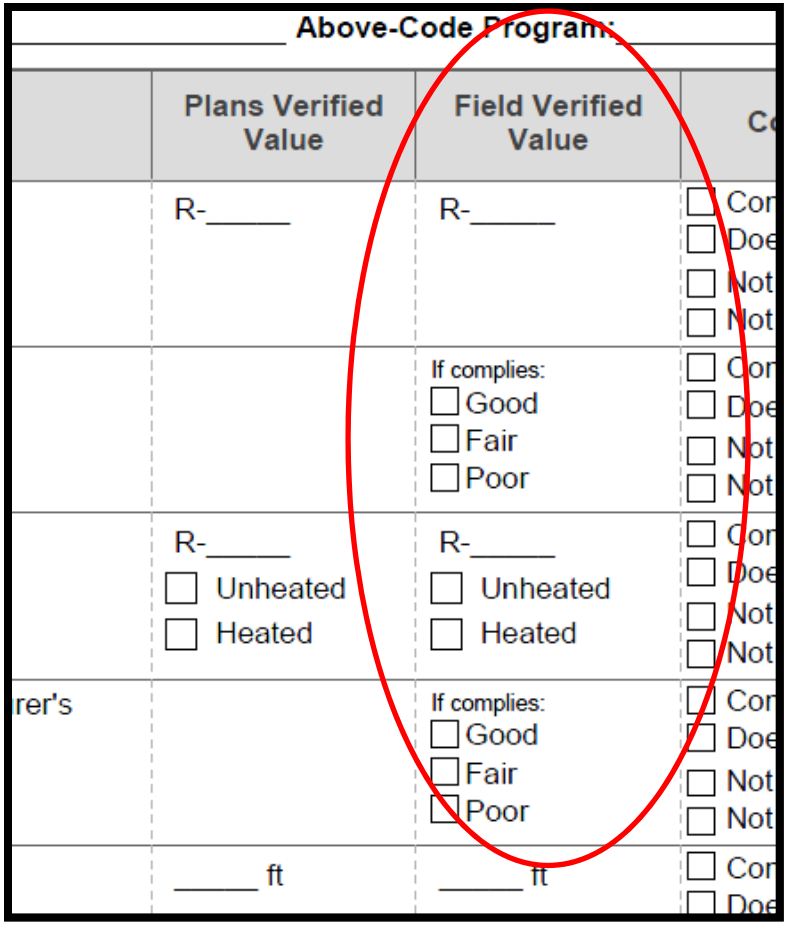
	Plans Verified Value	Field Verified Value	Co
	R-_____	R-_____	☐ Cor ☐ Doe ☐ Not ☐ Not
		If complies: ☐ Good ☐ Fair ☐ Poor	☐ Cor ☐ Doe ☐ Not ☐ Not
	R-_____ ☐ Unheated ☐ Heated	R-_____ ☐ Unheated ☐ Heated	☐ Cor ☐ Doe ☐ Not ☐ Not
rer's		If complies: ☐ Good ☐ Fair ☐ Poor	☐ Cor ☐ Doe ☐ Not ☐ Not
	_____ ft	_____ ft	☐ Cor ☐ Doe

http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – 2009 IECC

- The "**Field Verified Value**" column is completed during field inspections
- Allows for easy comparison



_____ Above-Code Program: _____

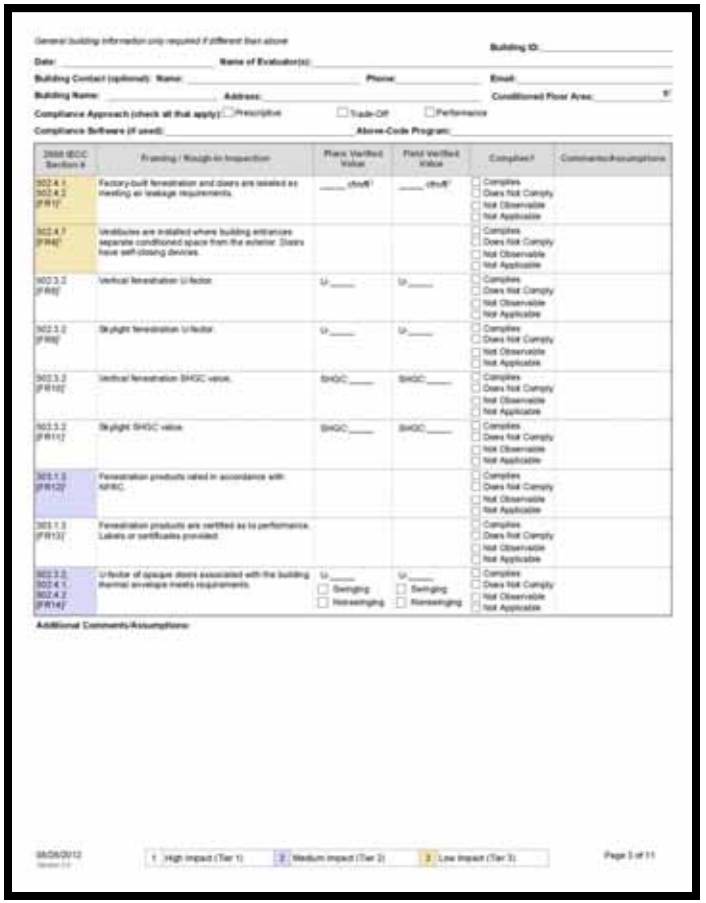
	Plans Verified Value	Field Verified Value	Co
	R-_____	R-_____	☐ Cor ☐ Doe ☐ Not ☐ Not
		If complies: ☐ Good ☐ Fair ☐ Poor	☐ Cor ☐ Doe ☐ Not ☐ Not
	R-_____ ☐ Unheated ☐ Heated	R-_____ ☐ Unheated ☐ Heated	☐ Cor ☐ Doe ☐ Not ☐ Not
rer's		If complies: ☐ Good ☐ Fair ☐ Poor	☐ Cor ☐ Doe ☐ Not ☐ Not
	_____ ft	_____ ft	☐ Cor ☐ Doe

http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – 2009 IECC

- Page 3 is the Framing / Rough-In Inspection
- Page 4 is Plumbing Rough-In Inspection
- Pages 5-7 are Mechanical Rough-In Inspection



http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – 2009 IECC

- Page 8 is Electrical Rough-In Inspection
- Page 9 is Insulation Inspection
- Pages 10-11 are the Final Inspection

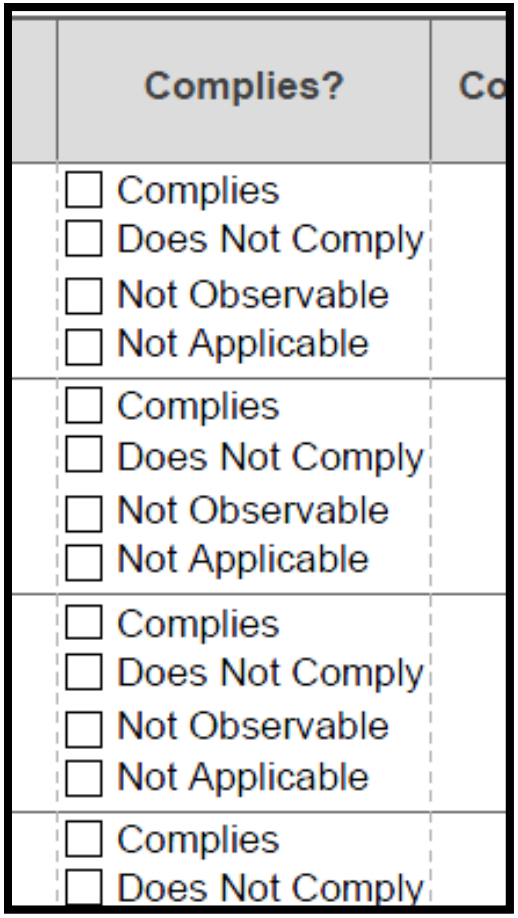
http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – 2009 IECC

- The **Final Inspection** pages do *not* have the "**Plans Verified Value**" & "**Field Verified Value**" columns

→ only a "**Complies?**" column

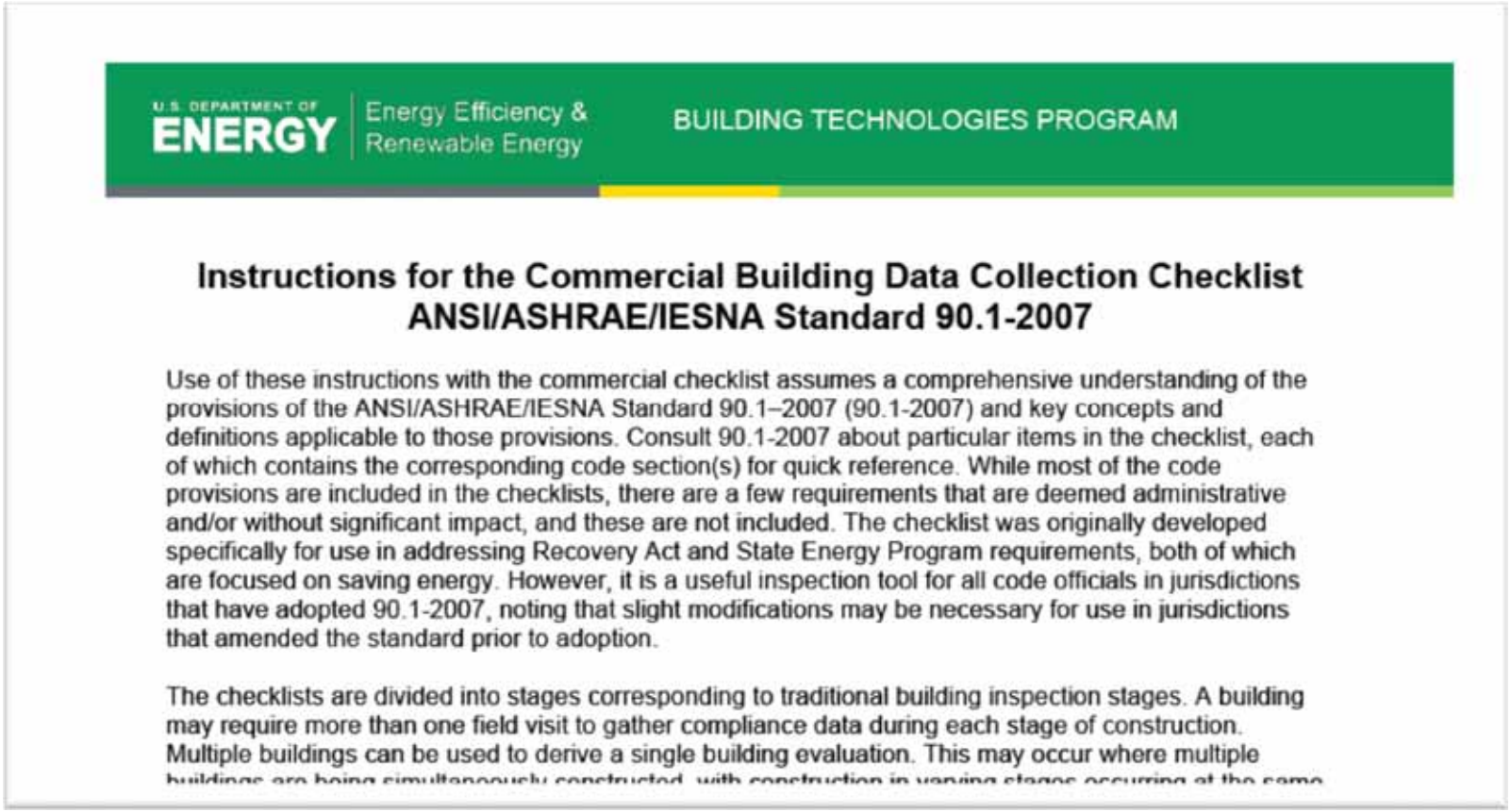


Complies?	Co
☐ Complies ☐ Does Not Comply ☐ Not Observable ☐ Not Applicable	
☐ Complies ☐ Does Not Comply ☐ Not Observable ☐ Not Applicable	
☐ Complies ☐ Does Not Comply ☐ Not Observable ☐ Not Applicable	
☐ Complies ☐ Does Not Comply	

http://www.energycodes.gov/compliance/evaluation/checklists

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – ASHRAE 90.1-2007



U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES PROGRAM

Instructions for the Commercial Building Data Collection Checklist ANSI/ASHRAE/IESNA Standard 90.1-2007

Use of these instructions with the commercial checklist assumes a comprehensive understanding of the provisions of the ANSI/ASHRAE/IESNA Standard 90.1–2007 (90.1-2007) and key concepts and definitions applicable to those provisions. Consult 90.1-2007 about particular items in the checklist, each of which contains the corresponding code section(s) for quick reference. While most of the code provisions are included in the checklists, there are a few requirements that are deemed administrative and/or without significant impact, and these are not included. The checklist was originally developed specifically for use in addressing Recovery Act and State Energy Program requirements, both of which are focused on saving energy. However, it is a useful inspection tool for all code officials in jurisdictions that have adopted 90.1-2007, noting that slight modifications may be necessary for use in jurisdictions that amended the standard prior to adoption.

The checklists are divided into stages corresponding to traditional building inspection stages. A building may require more than one field visit to gather compliance data during each stage of construction. Multiple buildings can be used to derive a single building evaluation. This may occur where multiple buildings are being simultaneously constructed, with construction in varying stages occurring at the same

Plan Review & Inspection Best Practices

Commercial Building Data Collection Checklist – ASHRAE 90.1-2007

- Very similar to the IECC checklist
- Section # column refers to ASHRAE 90.1 sections ILO IECC sections

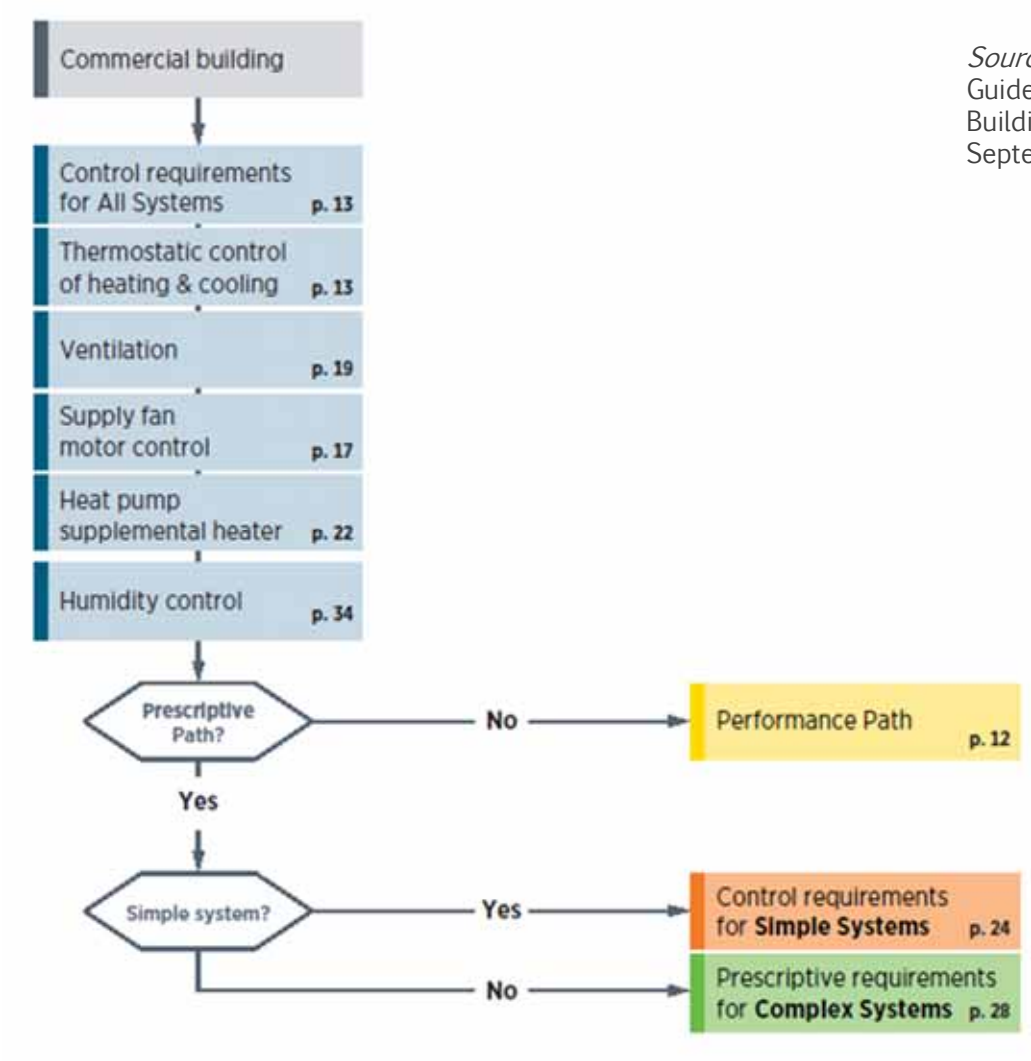
Plan Review & Inspection Best Practices

HVAC

- **Simple system** —utilizes packaged or unitary factory-assembled HVAC equipment. One unit is assigned to each zone. The exception is that IECC also allows a heat-only system serving multiple zones to qualify as a simple system.
- **Complex system** — includes various components that are assembled on site to form the HVAC system. Once assembled, the system may serve multiple zones with heating and cooling.

Source: PNNL, "HVAC Controls Guide for Plans Examiners and Building Inspectors," PNNL-83271, September 2011.

Plan Review & Inspection Best Practices



Source: PNNL, "HVAC Controls Guide for Plans Examiners and Building Inspectors," PNNL-83271, September 2011.

Plan Review & Inspection Best Practices

Thermostatic Control of Heating and Cooling

Suggested Compliance Check(s):

- Check mechanical floor plans to verify that there is at least one thermostat per distinct occupancy area (figure 1).
- Review the mechanical floor plans and mechanical schedule to locate control sequences and verify that the design engineer has specified deadband, set back and scheduling capabilities (figures 2-4).*

* If the building is equipped with a building automation system (BAS), then these capabilities will most likely be provided by the BAS. The BAS specifications or manual should indicate that the required capabilities are present.

Supply Fan Motor Control

Suggested Compliance Check(s):

- Review the fan schedule to see that large fans (5 hp and larger) are specified with variable speed drives or two speed motors.

Ventilation

Suggested Compliance Check(s):

- If the building is taller than three stories and in climate zones 4 through 8, verify that motorized dampers are specified for outside air and exhaust/relief dampers on the mechanical floor plans or mechanical schedule.
- Review the mechanical floor plans and mechanical schedule to locate control sequences and verify that the design engineer has defined a procedure whereby dampers will be closed and fans will be shut off when zones are unoccupied (figure 11).

Ventilation

Suggested Compliance Check(s):

- For large spaces (greater than 500 ft2), check the mechanical and electrical floor plans to see that CO2 or other sensors are specified and tied in to the control system to enable demand control ventilation (DCV) (figure 12).

Heat Pump Supplemental Heater

Suggested Compliance Check(s):

- Verify that the mechanical schedule or control sequence specifies that supplemental resistance heating cannot operate when the heat pump can meet the heating load. This may be accomplished by specifying a multi-stage electronic thermostat programmed to initiate the supplemental heater when the heat pump cannot meet the setpoint (figure 15).

Economizers – Simple System

Suggested Compliance Check(s):

- Check the mechanical schedule to verify that economizers are specified for systems that are larger than the thresholds shown in the table below:

IECC 2009	54,000 Btu/h in all climate zones except 1A, 1B, 2A, 7, and 8
ASHRAE 90.1-2007	65,000 Btu/h in climate zones 3B, 3C, 4B, 4C, 5B, 5C and 6B 135,000 Btu/h in climate zones 2B, 5A, 6A, 7 and 8

Plan Review Best Practices

Economizers – Simple Systems

Suggested Compliance Check(s):

- Locate control sequences and verify that the economizer control sequence meets the following requirements:
- 1) The supply of outside air varies from the minimum requirement to 100 percent.
- 2) Economizers are sequenced with the mechanical cooling equipment and continue to function until the shut-off condition is reached.
- 3) Economizers are not controlled only by mixed air temperature.

Economizers – Complex Systems

Suggested Compliance Check(s):

- Locate control sequences and verify that the economizer control sequence meets the following requirements:
- 1) The supply of outside air varies from the minimum requirement to 100 percent.
- 2) Economizers are sequenced with the mechanical cooling equipment
- 3) Economizers are not controlled only by mixed air temperature.

Economizers – Complex Systems

Suggested Compliance Check(s):

- 4) The economizer will reduce outside air to the minimum requirement when outside air no longer provides cooling or when the system is in a heating mode.

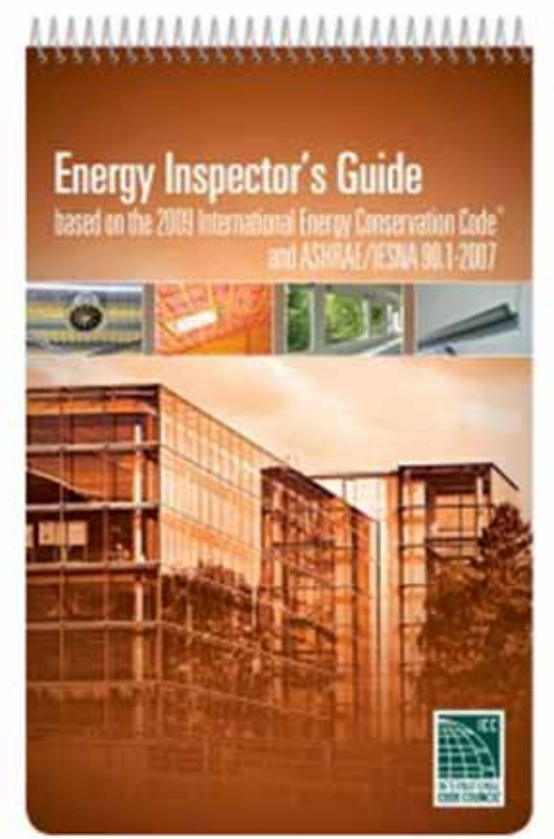
* If the building is equipped with a building automation system (BAS), then these capabilities will most likely be provided by the BAS. The BAS specifications or manual should indicate that the required capabilities are present.

Source: PNNL-83271, p.27

Inspection Best Practices

Resources

- Energy Inspector's Guide for the 2009 IECC / ASHRAE 90.1-2007
- Organized in a sequence that follows the inspection process



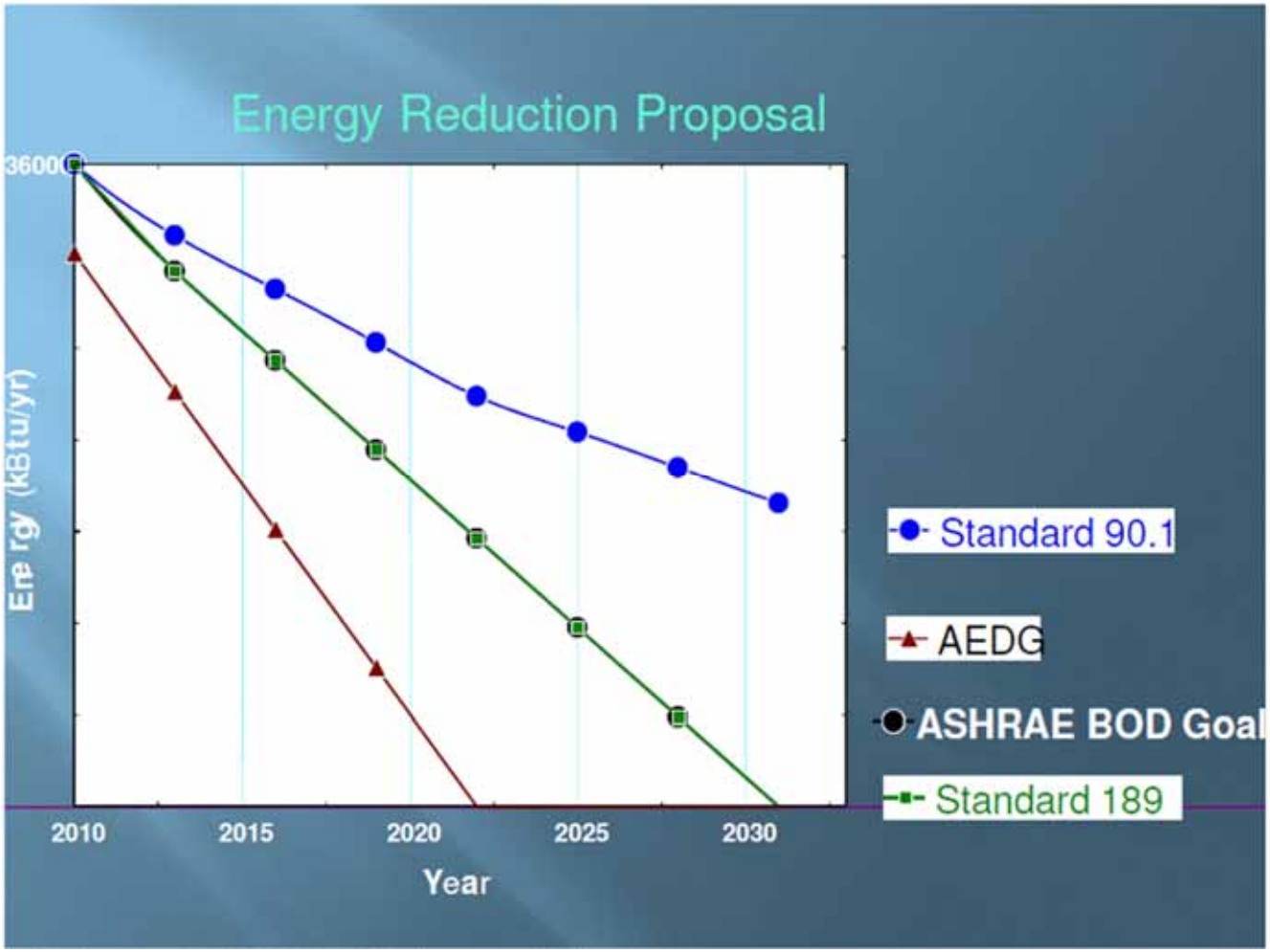
Inspection Best Practices

Hindsight is always 20/20…

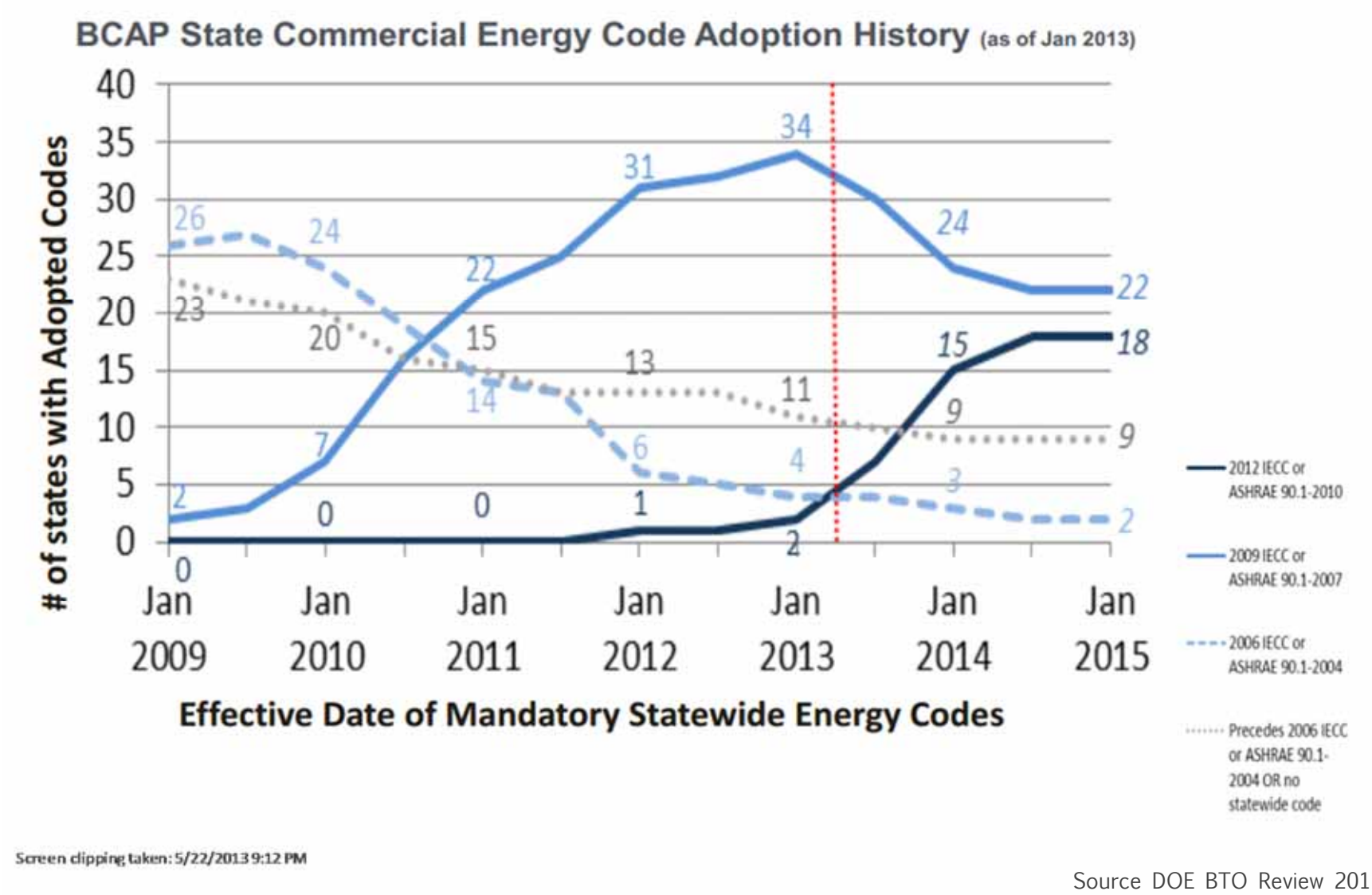
Future of Building & Energy Codes

Future of Building & Energy Codes

Where Codes Are Headed



Future of Building & Energy Codes



Source DOE BTO Review 2013

Future of Building & Energy Codes

Quick Overview of 2012 IECC

- 30% Better than IECC 2006
- Mandatory whole house pressure testing
- Duct leakage rates lowered
- Insulation increased to R38
- 2x6 framing required in some climate zones
- Continuous air barrier required in commercial construction (correct barrier, assembly or test to demonstrate compliance)

Future of Building & Energy Codes

Quick Overview of 2012 IECC

- Vertical glazing limited to 30% to trigger whole building simulation
- Lighting controls required all buildings
- Functional testing all lighting controls required
- Cx required for bldgs with 480,000 Btu/Hr clg or 600,000 Btu/Hr htg load
- LPD's reduced 10% Office, 7% Retail

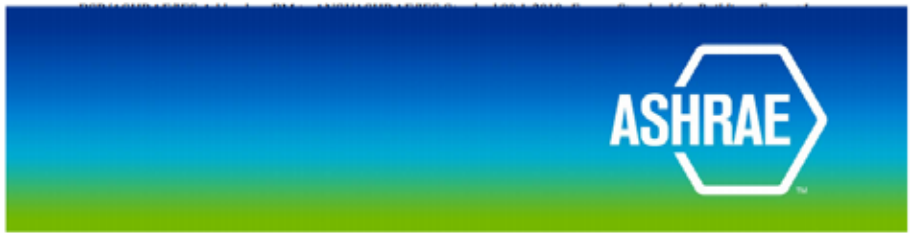
Future of Building & Energy Codes

Some Short Term DOE Goals

- IECC 50% better than 2006 by 2015. Not clear if this can be met with prescriptive measures.
- 70% adoption of current code by 2015
- 90% compliance by 2017

Future of Building & Energy Codes

Breaking News



BSR/ASHRAE/IES Addendum BM
to ANSI/ASHRAE/IES Standard 90.1-2010

Public Review Draft

Proposed Addendum BM to Standard 90.1-2010, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

First Public Review (August 2012)
(Draft shows Proposed Changes to Current Standard)

Public review is closed – an addendum to this proposal is open for review through May 6th.

Future of Building & Energy Codes

ASHRAE 90.1 Addendum BM

- Allows PRM as a code compliance path in lieu of ECB if 45% better than baseline design. Eliminates need for two models.
- Sets ASHRAE 90.1-2004 as baseline for future improvements.
- May become baseline for federal incentive programs, tax incentive programs and many utility rebate programs
- Provides more credit for integrated design for code compliance

Future of Building & Energy Codes

ASHRAE 90.1 Addendum BM

- Better than code programs now can just establish their own percent better target
- The performance path will no longer lag behind the prescriptive path
- Allows for consistent and deliberate trend in energy reduction with each version of the standard rather than encouraging use of prescriptive path

Future of Building & Energy Codes

Resources

www.energycodes.gov

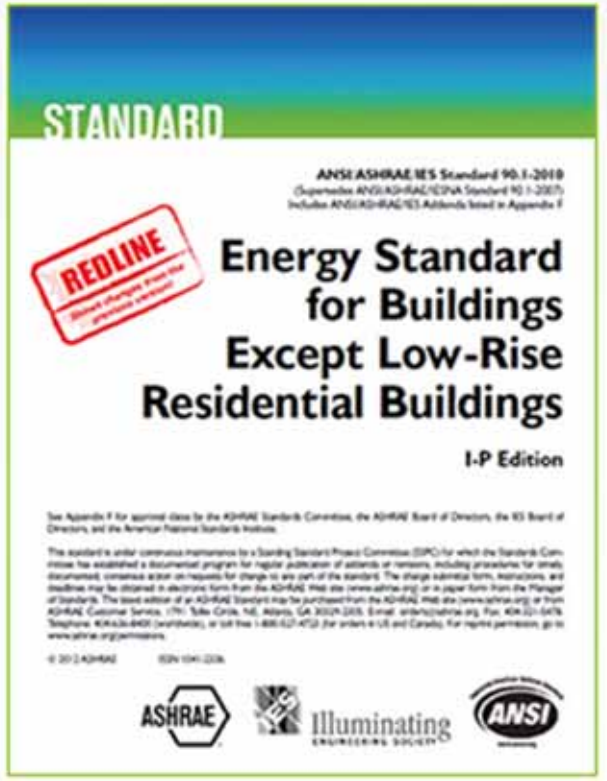
www.iccsafe.org

www.ashrae.org

Future of Building & Energy Codes

Resources

www.ashrae.org



Red Lined Standards:

https://www.ashrae.org/resources--publications/bookstore/redline-standards

Future of Building & Energy Codes

References

- DOE, "Choosing an Energy Code Compliance Path Topic Brief," PNNL-89866, August 2012, http://www.energycodes.gov/sites/default/files/documents/compliance_paths_topic_brief.pdf.
- Pacific Northwest National Laboratory, "HVAC Controls Guide for Plans Examiners and Building Inspectors," PNNL-83271, September 2011,
- 2013 DOE Building Technologies Office Program Review: http://www1.eere.energy.gov/buildings/2013_program_review.html

Q&A and Discussion