

Energy Codes and Standards Affecting Commercial Buildings

Presented by:
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CONSTRUCT2010

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Philadelphia, PA

Learning Objectives:

Upon completing this program, the participant should:

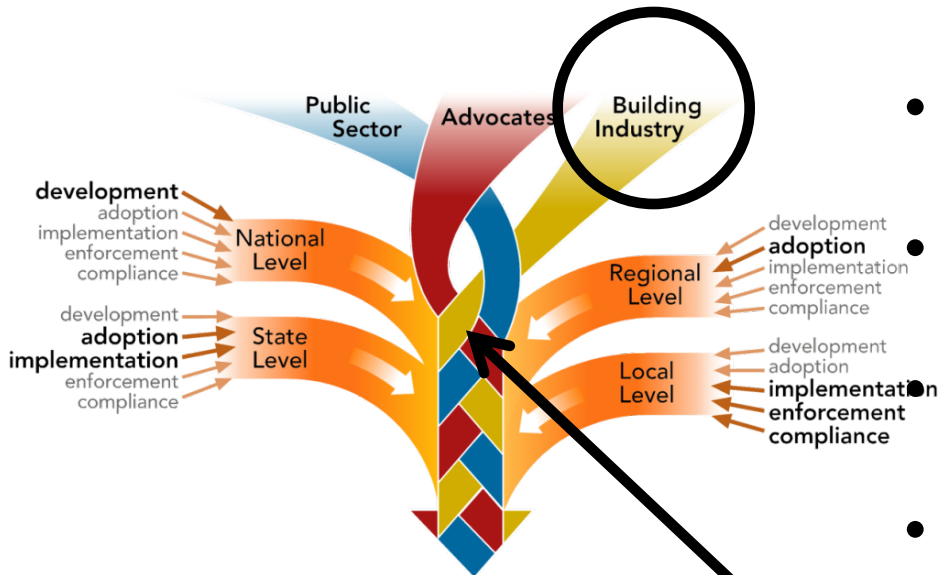
1 : Know what is occurring at the national level on energy codes and standards development

2 : Be able to identify the current status of energy code adoption by and within each of the states

3 : Understand how to better implement the adopted codes

4 : Be aware of upcoming initiatives to assess the level of compliance with the codes

Introduction



- Development at the national level
- Adoption at the national, state and local level
- Implementation and enforcement at the state and local level
- Verification of compliance at the local level

Collaboration between public interests, advocates and the building industry



Changes in the way buildings are designed and constructed

Energy Standards and Codes

- **ASHRAE/IES NA Standard 90.1**
- **ICC International Energy Conservation Code**
- **ASHRAE/IESNA/USGBC Standard 189.1**
- **ICC International Green Construction Code**

Development - ASHRAE 90.1

- **Standard 90.1-2007 is an incremental improvement to Standard 90.1-2004 and an intermediate step to significant improvement through Standard 90.1-2010**
- **Standard 90.1-2007 contains requirements for:**
 - **Envelope**
 - **Mechanical systems, including HVAC and SWH**
 - **Lighting and power systems**
- **Standard 90.1-2007 does not contain provisions for plug and process loads**

Changes on the Way – 90.1 Envelope

Approved

- High albedo roofs
- Metal building requirements
- Projection factor adjustment to SHGC
- Vestibule requirements

In Process

- Prescriptive requirements revised for all climate zones
- Continuous air barrier requirements
- Skylight requirements

Changes on the Way – 90.1 Mechanical

Approved

- VAV fan requirements for large single zone units
- Ventilation rates based on ASHRAE 62.1-2004
- Demand control ventilation requirements
- Fan power limitations
- Heat pump pool water heater requirements

In Process

- VAV fan requirements for large single zone units
- Heat pump requirements to include IEER
- Centrifugal fan cooling tower limitation
- Pump head calculation requirement
- Pipe sizing and insulation requirements

Changes on the Way – 90.1 Lighting and Power

Approved

- Lighting credits for automatic lighting controls
- Automatic lighting shutoff in guest room bathrooms
- Four-zone exterior lighting power density approach
- Daylighting requirements
- Additional occupancy based control
- Requirements for low-voltage dry-type transformers

In Process

- Interior lighting power density
- Receptacle load control requirements
- Electric motor efficiency requirements

Analysis of Proposed Changes to 90.1

- **DOE has been providing ASHRAE with a series of progress indicators showing how close ASHRAE is coming to achieving a 30% improvement between 90.1-2004 and 90.1-2010**
- **Application and use of prototype buildings to calculate energy use reduction attributable to potential changes to the standard**

90.1 Analysis - Prototype Buildings

Building Type	Building Prototype	Floor area (ft ²)	Number of Floors
Office	Small Office	5,500	1
	Medium Office	53,600	3
	Large Office	498,600	12 (plus basement)
Retail	Stand-alone Retail	24,695	1
	Strip Mall	22,500	1
Education	Primary school	74,000	1
	Secondary school	210,900	2
Health Care	Outpatient health care	40,950	3
	Hospital	241,410	5 (plus basement)
Lodging	Small hotel/motel	43,200	4
	Large hotel	122,132	6 (plus basement)
Warehouse	Non-refrigerated warehouse	49,500	1
Food Service	Fast Food Restaurant	2,500	1
	Sit-down Restaurant	5,500	1
Apartment	Mid-rise apartment	33,700	4
	High-rise apartment	84,360	10

Progress Indicators

variance by climate zone

Small office - 10% to 14%

Medium office - 5% to 16%

Large office - 4% to 15%

Standalone retail - 14% to 33%

Strip mall - 14% to 19%

Primary school - 11% to 37%

Secondary school - 13% to 40%

Outpatient healthcare - 6% to 14%

Hospital - 3% to 7%

Progress Indicators

variance by climate zone

- Small hotel - 5% to 7%
- Warehouse - 10% to 25%
- Fast food restaurant - 1% to 7%
- Mid-rise apartment - 6% to 14%
- Large hotel - 2% to 15%
- Sit-down restaurant - 3% to 12%
- High-rise apartment - 4% to 10%

Development – ASHRAE 189.1

- **Addresses**
 - **Building thermal envelope**
 - **HVAC and SHW systems and equipment**
 - **Lighting and power**
- **Intended for use to address green and sustainable objectives**
- **Includes in part Standard 90.1 but increases stringency**
- **Published January 2010**
- **Undergoing update**

Development – ICC IECC

- **Addresses**
 - **Building thermal envelope**
 - **HVAC and SHW systems and equipment**
 - **Lighting and power**
- **Does not address plug and process loads**
- **Is not identical to Standard 90.1-2007**
- **Adopts Standard 90.1-2007 by reference for walls when WWR is over 40% or SRR is over 3%**
- **First hearing on 2012 IECC changes held and public comments due July 1st**

Changes to 2009 IECC in play

- **Revise commercial provisions to require buildings to meet more rigorous HVAC, envelope and lighting requirements**
- **Controls on escalators and moving walkways to prevent continuous operation**
- **Modify opaque assembly insulation, based on Core Performance Guide**
- **Staggered edges for multi-layer rigid foam**

Changes to 2009 IECC in play

- **More rigorous U-factor for fenestration and cap on vertical fenestration**
- **Minimum daylighting required in areas over 10K sf**
- **Vestibules for all building entrances**
- **Requirements for commissioning**

Changes to 2009 IECC in play

- Reduction in allowable lighting power densities
- More controls associated with lighting systems in daylight spaces
- ASHRAE 90.1 efficiency requirements for unitary AC and condensing units added

Changes to 2009 IECC in play

- Efficiency requirements for gas and oil-fired boilers increased
- Supply and return air ducts to be insulated
- Alternative compliance path for airside economizers added

Commercial Energy Savings – 2006 to 2012 IECC

- **Core changes estimated to achieve 25% savings over 2006 IECC/ASHRAE 90.1-2004**
- **Additional items items could result in an additional 5% savings over 2006 IECC/ASHRAE 90.1-2004**
- **Estimates of savings are modeled using different building types, across climate zones**

ICC International Green Construction Code

- **Scope includes land use, water resources, material conservation and energy efficiency**
- **Energy provisions are minimum 10% more efficient than 2012 IECC**
- **Energy performance addressed in terms of total net annual energy use, peak demand and carbon emissions**
- **Public review draft issued, code changes due May 14th and public hearing August 2010**

Comparison of Chapter 5 of 2009 IECC and ASHRAE/IESNA 90.1-07

Purpose – to address “if a state adopts the 2009 IECC would the state be considered in compliance with ARRA-SEP guidance to adopt ASHRAE/IESNA 90.1-07 or equivalent?”

Approach – careful review of the requirements to determine differences and their impact on the issue of equivalency

Comparison - Selected Findings

- **90.1-07 has a specific designation of semi-heated space and different thermal envelope provisions for assemblies associated with such spaces.**
- **The IECC treats all semi-heated spaces as heated spaces and as such has more rigorous thermal envelope provisions for spaces that under 90.1-07 would be semi-heated.**
- **The 2009 IECC considers glazing from 15 to 30 degrees of horizontal to be part of the wall and subject to the fenestration provisions and Standard 90.1-07 considers the same glazing as skylights.**

Comparison - Selected Findings

- **Some glazing under Standard 90.1-07 would be considered skylights rather than vertical fenestration and as such could have lesser thermal requirements than if considered vertical fenestration as in the 2009 IECC.**
- **Standard 90.1-07 and the 2009 IECC vary as to which is more stringent with respect to envelope provisions.**
- **Standard 90.1-07 and the 2009 IECC both treat above and below grade walls differently, the latter being generally less onerous.**

Comparison - Selected Findings

- Under Standard 90.1-07 what is above grade is treated as above grade and what is below grade is treated as below grade. The 2009 IECC would allow any wall that is up to 15% above grade and 85% or more below grade to be considered a below grade wall in toto. Similarly a wall that is more than 15% above grade would be considered an above grade wall in toto.
- Depending on the actual building configuration with respect to the basement/first story one document or the other could be more stringent/lax with respect to insulation on the subject walls.
- Standard 90.1-07 has provisions for high albedo roofs (reflectance and emissivity) in certain climate zones and the 2009 IECC does not.

Comparison - Selected Findings

- The 2009 IECC limits HVAC equipment oversizing and Standard 90.1-07 does not.
- Standard 90.1-07 requires the delivery of O&M manuals for the building systems and the 2009 IECC does not.
- The lighting power limits are the same in both documents but there are subtle differences between the two documents with respect to exceptions and lighting controls.
- Some provisions such as voltage drop limitations in Standard 90.1-07 are not covered in the IECC, but that issue is addressed in other codes such as the National Electrical Code.

New Considerations

- **Many of the same issues to deal with – just better (window U-factor or tighter ducts) and more (insulation or lighting controls)**
- **New provisions to learn, implement and check**
- **Increased attention to product specifications as achieving desired performance as delivered and as installed**
- **Increased attention to detail so installation quality is enhanced**

New Considerations

- **Increased probability that the building may not perform as intended (lower lighting levels and continued use of ‘marginal’ fixtures)**
- **Increased probability that plans and specifications will be more thoroughly reviewed and issues identified for resolution**
- **Involvement in commissioning and providing more information relevant to building and system O&M**

New Considerations

- **Stringency will necessitate consideration of new technology that may need approval under alternative methods and materials provisions**
- **Increased probability that designs could impact health and life safety provisions**
- **Increased need to provide for on-site testing and evaluation by third parties**

Development – What’s Next

- **2012 IECC available in mid-2011 and likely adopted beginning at that time for stretch codes or beyond minimum code incentives and as minimum code beginning in mid-2012**
- **90.1-2010 completed in late 2010 and likely available and adopted beginning in mid-2011**
- **90.1-2010 will be adopted by reference in the 2012 IECC if published by December 1, 2011**
- **State and local government will adopt or adapt these documents as they update their energy codes and standards**

Development – What's Next

- Continuing to improve on the past
- More rigorous prescriptive provisions covering the thermal envelope
- More rigorous prescriptive provisions for building systems and equipment
- More controls
- Tighter and tested tight

Development – What’s Next

- **Introduction of new products and materials that will need code approvals**
- **Increasing emphasis on securing a portion of building energy use from renewables**
- **Mandatory use energy storage capacity in buildings**
- **More heat recovery and “exotic” systems like direct outside air systems, chilled beams, etc**

Development – What's Next

- **Plug load controls**
- **Movement from prescriptive criteria to outcome based building performance metrics**
- **Increased scope to include all building energy use including plug and process loads**
- **Increasing scope from design and construction to commissioning and to annual verification of compliance with performance metrics**

Development – What’s Next

- Limitations on peak demand capability and increasing use of controls to regulate building demand
- Increasing reduction in performance limitations
- Inclusion of consideration of carbon emissions
- Increased use of simulation software in conjunction with building information modeling
- **ASHRAE 189.1-09 and IgCC adoption**

What Does this Mean?

- More design freedom to achieve outcome based objectives as opposed to prescription
- Greater use of software in simulating building energy use tied to building information modeling
- Increased emphasis on integrated project delivery and formation of multi-disciplined project teams
- Involvement beyond design to construction, commissioning and even post occupancy validation

What Does this Mean?

- **Increased business opportunities**
- **Increased availability of prescriptive solutions that are not mandated by or delineated in code**
- **Increased opportunities to lead, to interact, and to bring more value to clients and the built environment**
- **Less time dealing with codes and standards development**

What Does this Mean?

- Increased opportunity in existing buildings as outcome based provisions can be applied to them as well
- Increased emphasis on natural ventilation and daylighting
- Changes to standard contracts
- Less hassle at plan review and approval – build to the design, and enforce based on observed outcomes
- Basis for true recognition and design innovation

Adoption - establishing the mechanisms whereby certain criteria that can improve building energy efficiency are put into place either through mandatory means such as legislation or regulation or voluntary means through market forces or incentives

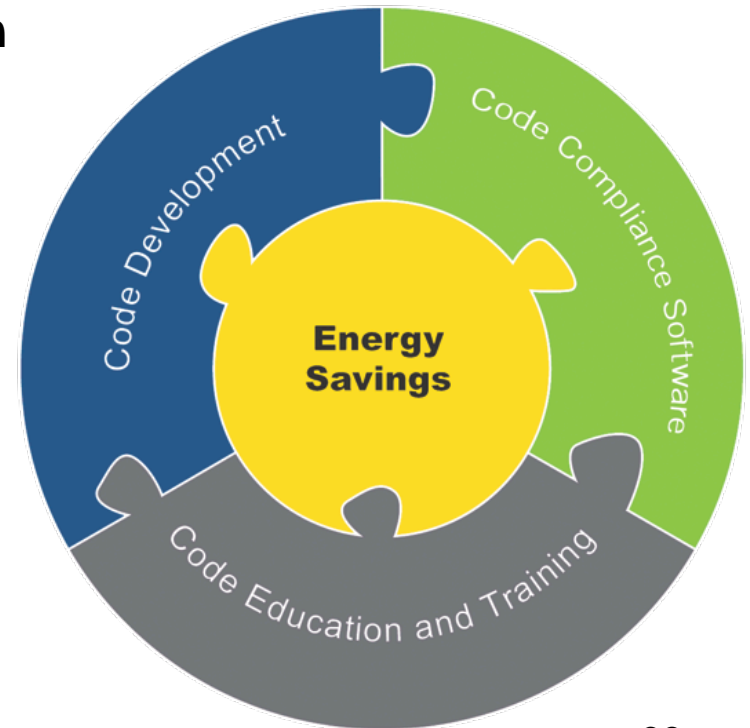


- The situation in each state is unique
 - ✓What is adopted?
 - ✓What does it apply to and when?
 - ✓Who is responsible for satisfying what is adopted?
 - ✓Penalties for not complying?
 - ✓Incentives for complying?

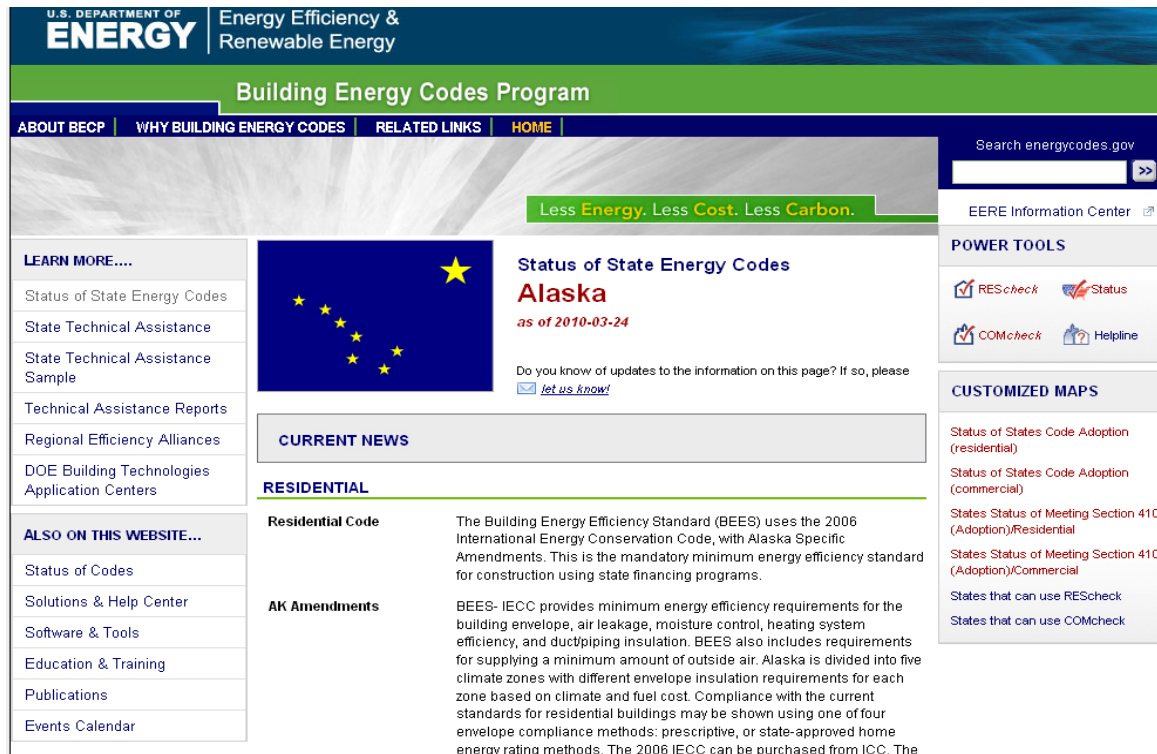
DOE's BECP

Status of State Energy Codes

- Status of state energy code adoption
- Legislative language
- State amendments
- Code development and adoption cycles
- Compliance tools used or allowed
- Enforcement
- State contacts
- Code history

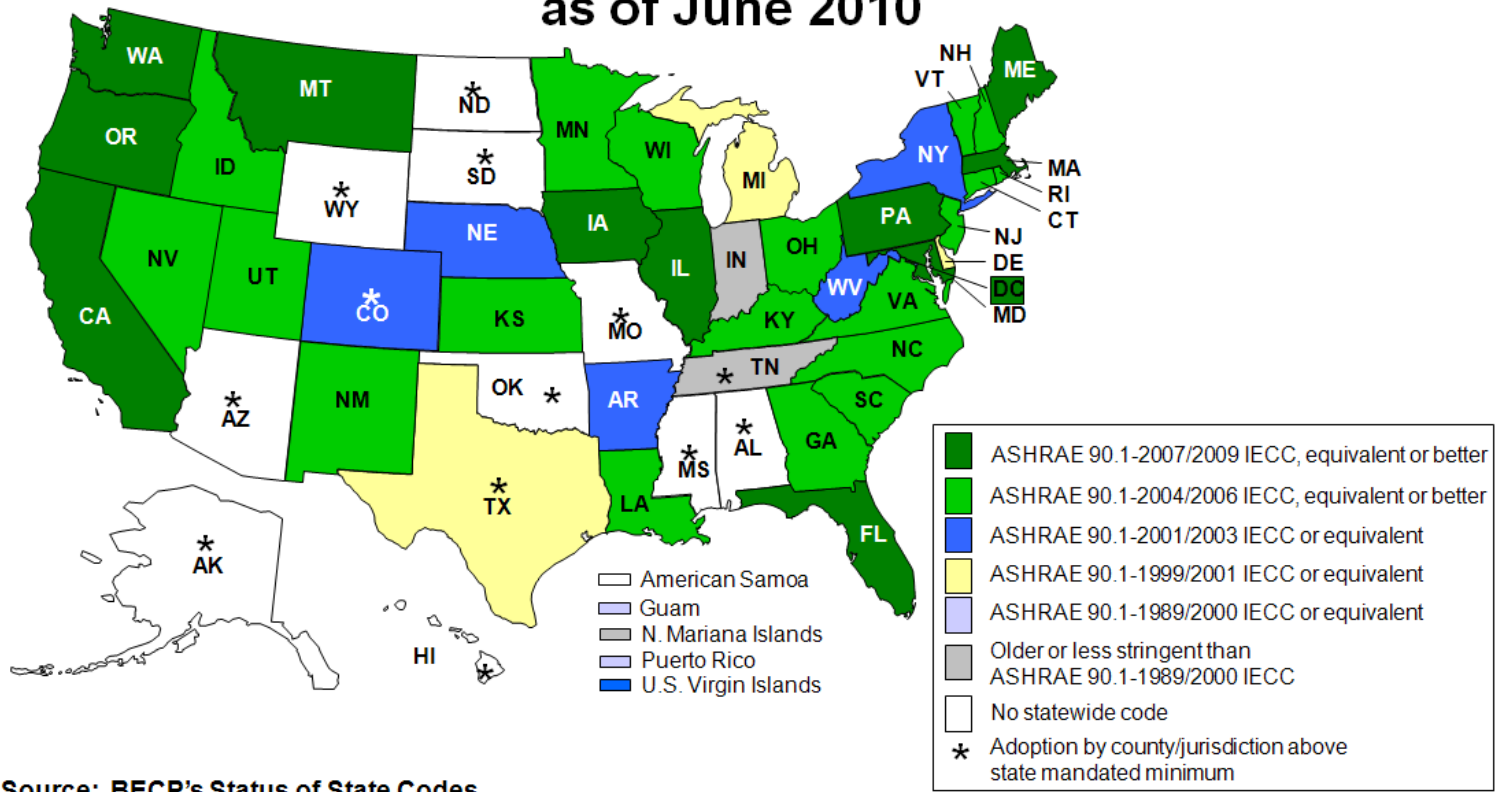


Snapshot – www.energycodes.gov/states



The screenshot shows the website interface for the Building Energy Codes Program. The header includes the U.S. Department of Energy logo and the program name. A navigation bar contains links for 'ABOUT BECP', 'WHY BUILDING ENERGY CODES', 'RELATED LINKS', and 'HOME'. A search bar is located in the top right corner. The main content area features a banner with the slogan 'Less Energy. Less Cost. Less Carbon.' and a section titled 'Status of State Energy Codes' for Alaska, dated as of 2010-03-24. Below this, there is a 'CURRENT NEWS' section with a sub-section for 'RESIDENTIAL' codes, which includes a detailed description of the BEES standard and its amendments for Alaska. On the right side, there are 'POWER TOOLS' (REScheck, Status, COMcheck, Helpline) and 'CUSTOMIZED MAPS' (Status of States Code Adoption for residential and commercial, and States Status of Meeting Section 410 for residential and commercial). A left sidebar contains a 'LEARN MORE...' section with links to various resources and an 'ALSO ON THIS WEBSITE...' section with links to codes, solutions, software, education, publications, and an events calendar.

Status of Commercial Energy Codes as of June 2010

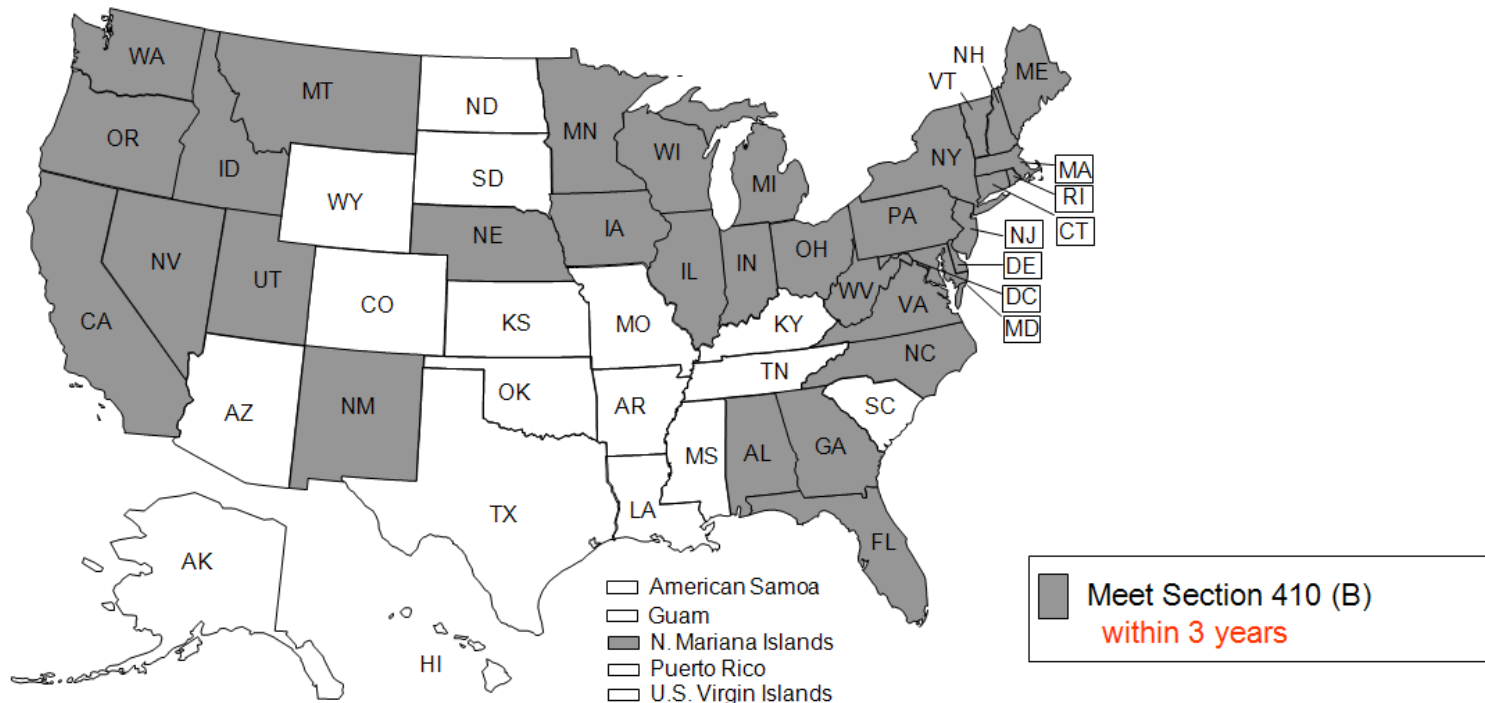


Source: BECP's Status of State Codes

http://www.energycodes.gov/implement/state_codes/index.stm

as of 6/2010

Commercial Energy Code Adoption Activity 2009 IECC/ASHRAE 90.1-2007, meets or exceeds



Source: BECP's Status of State Codes
http://www.energycodes.gov/implement/state_codes/index.stm

as of 03/2010

• **Implementation** - *the execution of a plan, idea, model, design, specification, standard, algorithm or policy - doing what needs to be done to satisfy what is adopted*

• **Who is responsible for or can influence implementation and what are their roles?**

- Architects
- Engineers
- Specifiers
- Contractors and builders
- Developers
- Utilities
- Lenders
- Insurance
- Manufacturers



Implementation

- How critical are their roles to achieving building energy efficiency goals?
- What is the current level of performance of each party and what is needed if anything to facilitate their implementation of energy code relevant actions?
- Are there any differences associated with how codes are presented, adopted, or enforced that would affect implementation?
- Are there or new processes in design and construction such as BIM that would change the method or ease of implementation?



U.S. General Services Administration

Implementation – More Considerations

- **Increased use of software**
- **Greater involvement in construction and commissioning**
- **More education and training needed**
- **More integrated project delivery (teaming)**
- **Enhanced contract documents**
- **Less specific guidance but more design freedom**
- **More time to document acceptability of the design and precision in specification**



Implementation Tools - COMcheck

- **90.1-2007**
 - High Albedo Roofs
 - Massachusetts and Chicago redirected to use 2006 IECC
 - Mechanical system inputs redesigned
 - Specific inputs instead of ranges
 - Preparation for whole building simulation
- **2009 IECC Chapter 5 (Commercial)**

Implementation – most commonly asked questions by designers and specifiers

- **Am I allowed to have the same amount of exterior lighting regardless of where I build?**
- **Can I define my space types for lighting using the 2009 IECC?**
- **What are the requirements for renovations?**
- **Do I have to switch my lights differently if they are located in front of or next a window?**
- **Can area calculations for exterior lighting overlap?**

Implementation – most commonly asked questions by designers and specifiers

- **Can I mix and match compliance using 2009 IECC and ASHRAE 90.1-2007?**
- **Do buildings that are heated have to comply with the energy code regardless of their use?**
- **How do you handle vestibules?**
- **Are areas of party walls technically part of the building's enclosure?**

Code Compliance

- **Measuring compliance and improving compliance through**
 - Increased training and awareness
 - Better enforcement and process improvements
 - Increased employment (trainers and inspectors/evaluators)
- **Understanding the actual compliance rates resulting in better estimation of:**
 - Potential energy savings through greater compliance
 - Return on investment
- **Understanding where energy code criteria may need revision to improve code compliance outcomes**

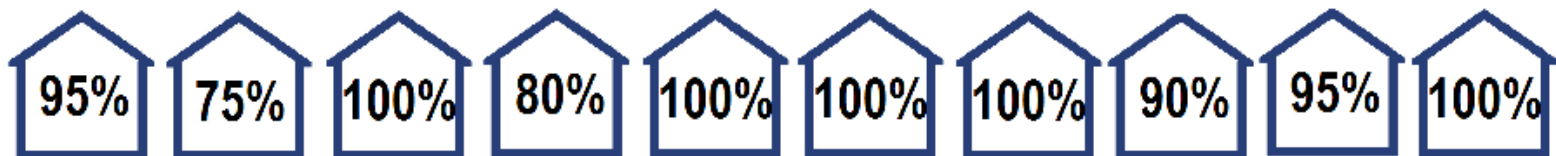


Compliance related issues

- Measuring 90% compliance
- Sample size
- Onsite compliance evaluation
- Above-Code programs
- Sample distribution and make-up
- Evaluation checklists
- Compliance roadmap
- Renovations
- Alternative codes

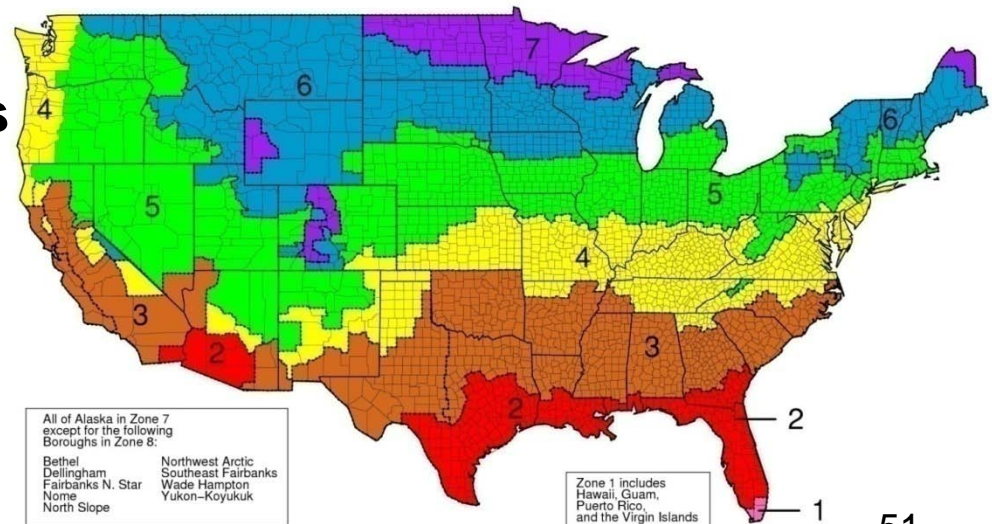
Measuring for 90% compliance - a percent compliance is assigned to each building

- Provides a truer understanding of compliance rates and areas needing reinforcement
- Reduces impact of subjective criteria
- Better addresses evaluation logistics
- Better supports data completeness



Sample Size

- 44 or more new commercial and 44 new residential buildings
- 44 renovations to existing commercial and 44 renovations to existing residential buildings
- Distributed randomly across jurisdictions within each climate zone, based on building starts



Compliance Checklists

- **Developed by Climate Zone**
- **Support for various compliance approaches**
 - **Prescriptive**
 - **Trade-Off**
 - **Performance**
- **Divided into phase of construction**
- **Code requirements are divided into tiers based on energy impact**
- **Values and comments will be captured, including generic information (building type, use, size, etc.)**
- **Checklists can be used on a daily basis as part of ongoing code enforcement programs**

Residential Data Collection Checklist

2009 International Energy Conservation Code
Climate Zone 3

Date: _____ Name of Evaluator(s): _____

Building Name & Address: _____

Building Contact: Name: _____

Compliance Approach: Prescriptive (402.1.2)

State: _____ Jurisdiction: _____

Building Type: 1- and 2-Family, Detached:

Multifamily:

Project Type: New Construction

Item Number ¹	Pre-Inspection/Plan Review
PR1 [103.2]	Construction drawings and documentation submitted and available
PR2 [103.2]	Insulation R-values and materials on plans
PR3 [103.2]	Fenestration U-factors and SHGC values on plans. Trade-off documentation provided if needed
PR4 [103.2]*	Mechanical system design criteria on plans
PR5 [103.2]*	Mechanical and service water heating equipment types, sizes and efficiencies on plans
PR6 [103.2]*	Duct and pipe insulation and duct sealing on plans
PR7 [103.2]*	Thermal envelope air sealing details on plans
PR8 [403.6]*	HVAC loads calculations: Heating system size(s): Cooling system size(s):

Item Number	Pre-Inspection/Plan Review
PR1 [103.2]	<p>Documentation. Determine if a complete set of plans/construction drawings, specifications, and energy code compliance documentation is available in the building department. If there is no building department or the locality does not conduct plan review, this information should be obtained from the registered design professional or builder having responsibility for the project. If documentation indicating a trade-off or performance approach is not provided, a prescriptive approach must be assumed for verifying compliance. Construction documents should sufficiently demonstrate energy code compliance, including but not limited to the following information:</p> <ul style="list-style-type: none"> • The location and R-values of insulation materials • U-factors and SHGC values for windows, doors, skylights, and other fenestration products • Information related to duct and piping location, insulation type and R-value, and means of sealing <p>Under the assumption that only state or local government with a responsible enforcement and/or permitting agency are included in compliance evaluations, plans and documentation are expected to be held by the responsible agency. If this is not the case, mark this code requirement and the next (PR1 and PR2) as non-compliant, unless there is another entity responsible for enforcement identified (e.g. utility, contractor licensing board, etc.) in which case they should be contacted to review PR1 and PR2 information.</p>
PR2 [403.6]*	<p>HVAC Load Calculations. Verify that HVAC load calculations have been completed and submitted. Verify the methodology used in the load calculations. List the resultant heating and/or cooling loads as applicable in the Verified Value column.</p>

4/12/2010 _____

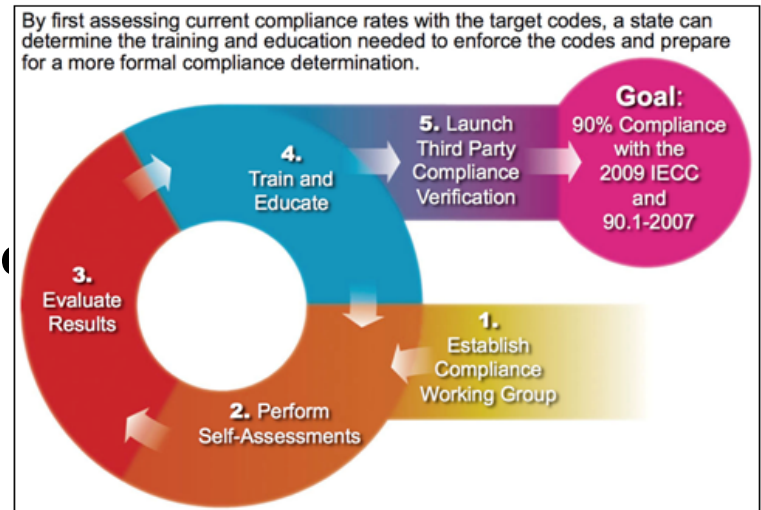
Self assessment prior to formal compliance evaluation

- Use all program resources at state and local level
- State and local agencies collaborate on implementing those resources to do a self evaluation
- Combine the self evaluation with education, training and outreach activities



Aligning Compliance and Implementation

- Establish working plan and
- Circulate relevant conduct self
- Evaluate results
- Based on results identify areas in need of improvement
- Educate and train to reinforce those areas in need
- Re-evaluate, ID areas and train
- Conduct third party evaluation when ready



Summary

- **Energy codes are not going away and will continue to be developed and adopted**
- **State and local government will be under increased pressure to adopt new codes and validate compliance with current and future codes**
- **In the short term prescriptive codes are likely to retain their dominance and changes to them will focus on envelope, mechanical and lighting system improvements – so be prepared to “tighten up” compared to specifying today**

Summary

- **In the long term outcome based performance codes will be developed and adopted, cover all building loads and compliance will be verified beyond issuance of a certificate of occupancy**
- **There will be increasing opportunities for designers in leading integrated project teams that are not only involved in design but oversee and validate compliance with codes, standards and project objectives**
- **Consider becoming involved in compliance verification studies and help use the results to address needs in today's codes and to develop future codes**

Thank You for Attending!
Any Questions?

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This concludes the American Institute of Architects
Continuing Education Systems Program.

4/12/2010

