



90% Compliance

August 17, 2010

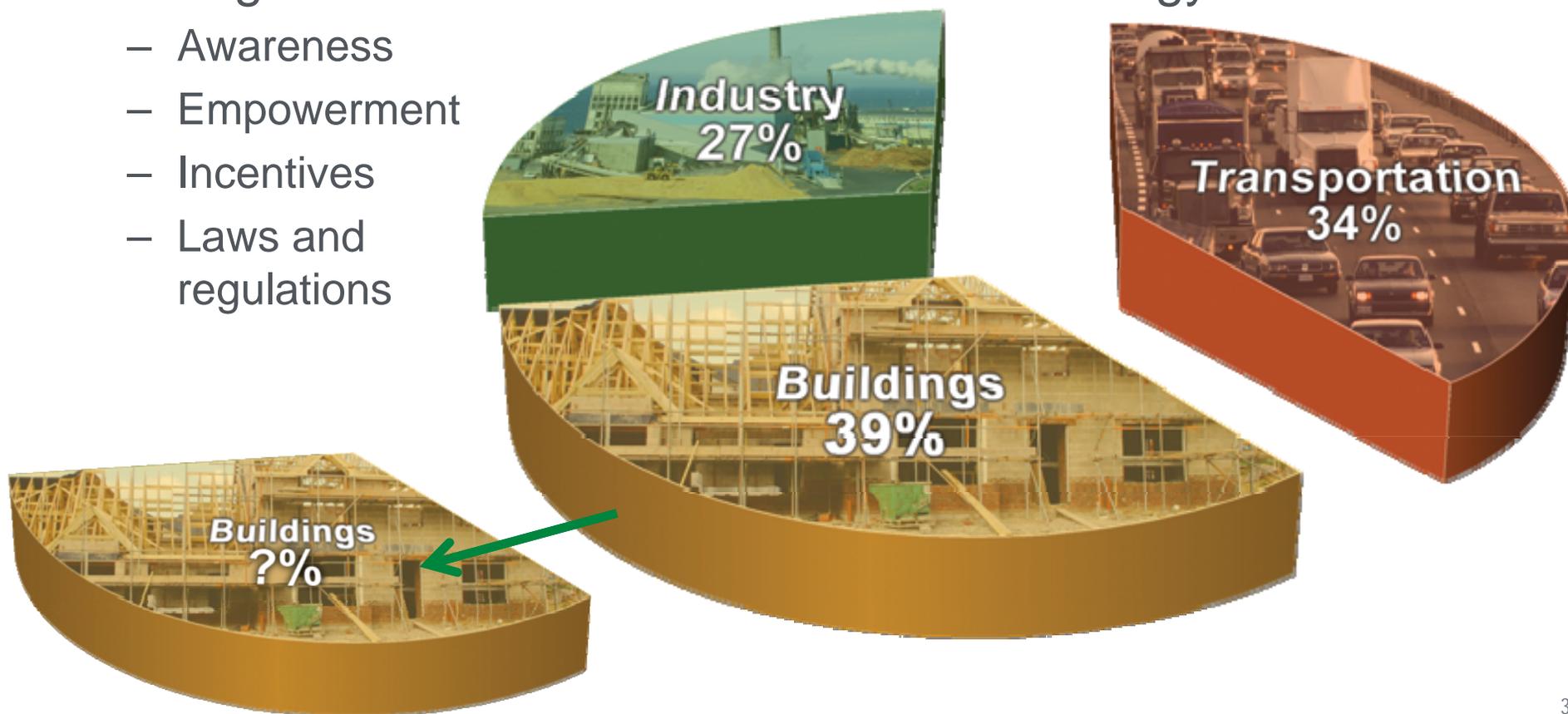
**BUILDING TECHNOLOGIES PROGRAM**

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Eric Makela, Rose Bartlett

# Introduction

# Buildings Use Energy

- Buildings use 40% of our nation's energy
- Changes in human behavior will reduce energy use
  - Awareness
  - Empowerment
  - Incentives
  - Laws and regulations

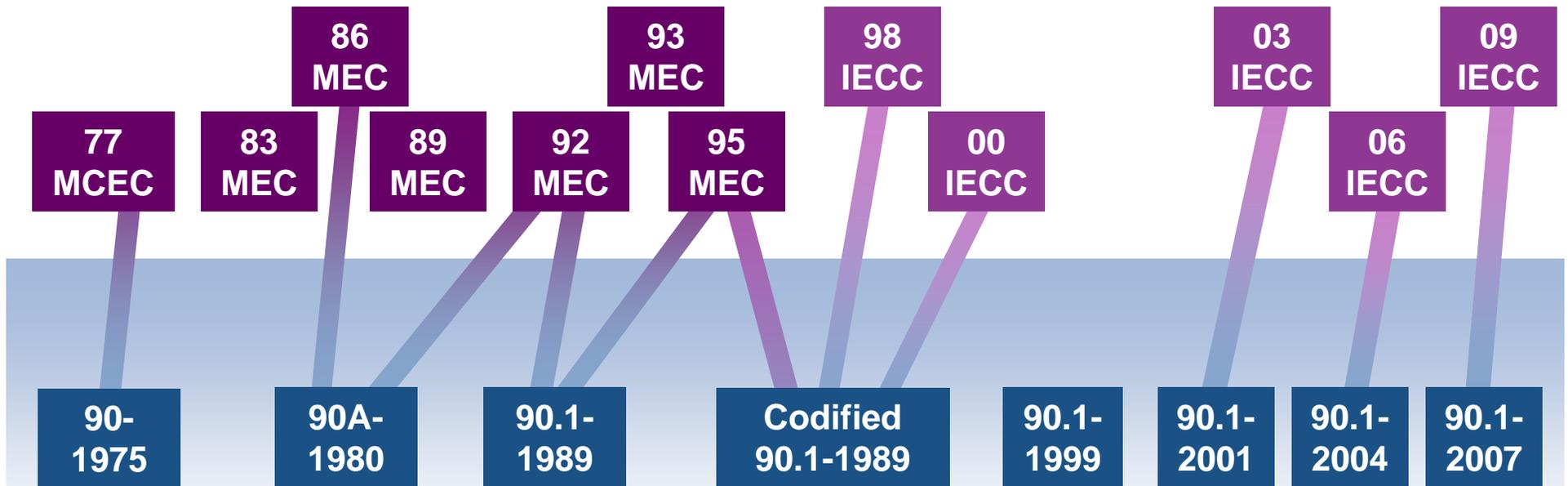


- Energy codes and standards provide a vehicle to “drive”
  - Provide minimum acceptable requirements
  - Establish a foundation for going beyond minimum
  - As time progresses and technology changes the ‘beyond’ becomes the minimum



# Energy Codes & Standards History

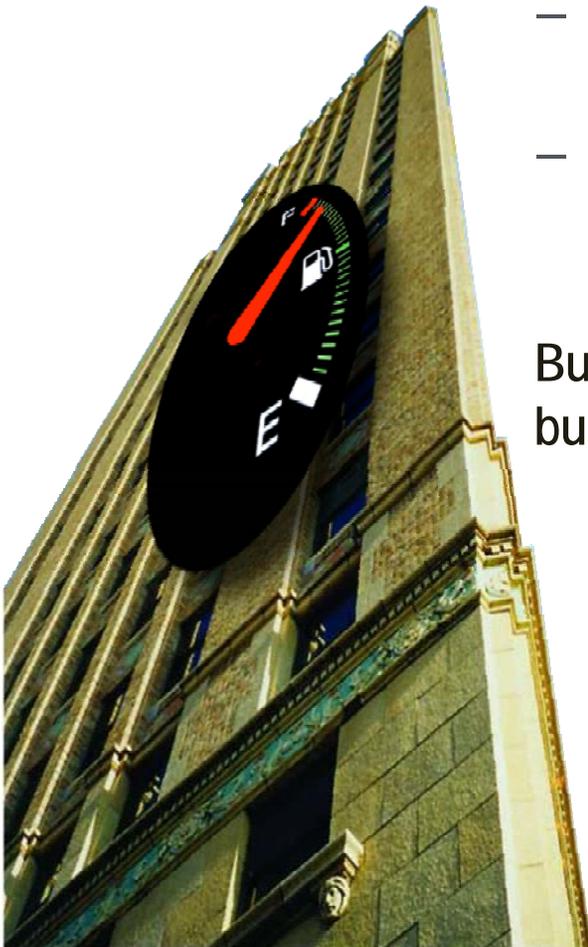
## Residential Codes



## Commercial Standards



- Energy codes and standards formats
  - Prescriptive (envelope, HVAC, SWH and lighting)
  - Performance – as designed at least as good as IF it just met minimum
  - Few based totally on expected outcomes – metered energy use



Build and operate the building to achieve X

Prescriptive do a,b,c...



- Energy codes and standards adoption – without it you cannot guide change
  - Voluntary because I want to, I derive a market advantage or I get a ‘carrot’
  - Mandatory because a law or regulation tells me to do it
- Federal, state and local adoption of energy codes and standards
  - New construction and renovations to existing residential and commercial buildings
  - Government agencies apply codes and standards to their own buildings or those receiving financial assistance
  - Government agencies apply codes and standards to private sector buildings

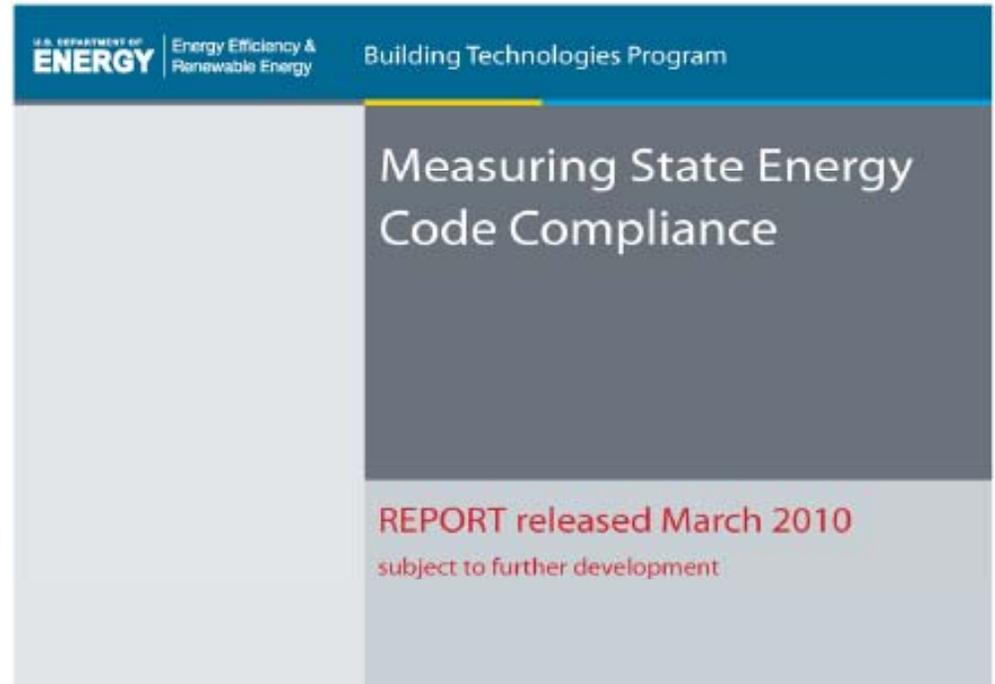
# Adoption Isn't Enough

- Conformity assessment (AKA compliance assessment) – making sure what is adopted is satisfied
  - Any activity to determine directly or indirectly that a process, product or service meets relevant standards and fulfills relevant requirements
  - Making sure the energy code or standard that is adopted is actually complied with



# Measuring State Energy Code Compliance

- 74 pages
- Contents
  - Code adoption and equivalency
  - Annual measurement
  - Planning for compliance evaluation
  - Onsite compliance evaluation sets)
  - Evaluation checklists



- [http://www.energycodes.gov/arra/compliance\\_evaluation.stm](http://www.energycodes.gov/arra/compliance_evaluation.stm)

# Step-by-Step Companion Guide

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

**ENERGY**  
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## Measuring State Energy Code Compliance

Step-by-Step Companion Guide

**MANY U.S. STATES, territories, and jurisdictions are creating plans to measure and improve compliance with their energy codes. To support this effort, in March 2010, the U.S. Department of Energy's Building Energy Codes Program (BECP) released Measuring State Energy Code Compliance, a report that collects BECP's recommended methodologies, which were developed with key input from stakeholders. The full report is available at [www.energycodes.gov/ams/compliance\\_evaluation.htm](http://www.energycodes.gov/ams/compliance_evaluation.htm).**

To supplement the report, this user-friendly action plan summarizes the main procedures, shows further options, and points to several ready-made resources and web-based tools BECP is releasing to support the process.

**Step 1**

### OBTAIN EVALUATION CHECKLISTS

A reliable measurement of energy code compliance calls for onsite evaluations of a valid sample of building projects—both new construction and renovations. To “check off” compliance, the first step is to have a proper checklist. BECP offers evaluation checklists for both residential and commercial buildings, complete with instructions to help evaluators. The checklists offer weighted scoring in order to focus on the most important code requirements and help states produce accurate metrics.

**BECP Tool:**  
Download inspection checklists and corresponding instructions at: [www.energycodes.gov/ams/compliance\\_evaluation.htm](http://www.energycodes.gov/ams/compliance_evaluation.htm)

**Step 2**

### GENERATE SAMPLES

With checklists in hand, the next step is to determine which buildings to inspect. BECP recommends that evaluation of a statistically significant number of buildings in each of the following four building populations:

- Residential new construction
- Commercial new construction
- Residential renovations
- Commercial renovations

Within each population, roughly 44 building projects\* should be selected randomly, and in such a manner as to provide a representative sample with respect to building type and size, location by county and climate zone, and other factors.

\*This number may vary by state/building population.

**BECP Tool:**  
Leave the math to us—BECP offers State Sample Generator, an automated solution for your state. You can find your state's custom Sample Generator at: <http://energycodes.gov/generator>

**Step 3**

### CONDUCT ON-SITE EVALUATIONS

So you've identified the projects, and you know where to go and how to go. But who and how? Formal procedures are typically conducted by third-party evaluators. For most evaluations, inspecting new construction and renovation projects according to the energy code is a straightforward task, but not everyone is trained to inspect. Of course, there are many ways to help—some more in-depth than others. See the full report at [www.energycodes.gov/ams/compliance\\_evaluation.htm](http://www.energycodes.gov/ams/compliance_evaluation.htm) for more information on how to help answer your compliance-related questions. In particular, you'll find Education and Training Solutions and Tips, and Software Tools.

**BECP Tool:**  
BECP is beginning to launch Building Energy Codes University (BECU), your one-stop resource for energy codes education and training. New offerings include a series of training presentations for compliance evaluators, complete with real-world video clips: [www.energycodes.gov/becu](http://www.energycodes.gov/becu)

**Step 4**

### ANALYZE YOUR STATE'S DATA

Now that you've gathered the information, what do you do with it? Do you have a good picture of how you should be doing? Are you looking at the right things and your data consistent? For a state-by-state compliance picture, BECP offers a BECP's Checker Score and State Tool. With its overall compliance rate and project-by-project data, BECP's Checker Score and State Tool will provide considerable insight into the state-wide compliance of your buildings. But don't forget to use the data to identify and address areas where you need to improve.

**BECP Tool:**  
Don't waste your staff's valuable time writing through paper checklists to determine compliance. Instead, enter raw data into BECP's Checker Score and State Tool (coming soon to [www.energycodes.gov/ams/compliance\\_evaluation.htm](http://www.energycodes.gov/ams/compliance_evaluation.htm)) to generate building and state-wide metrics.

### ALTERNATIVE OR PRACTICE ROUTES

In some states, Steps 1-4 may not be feasible initially, for a variety of reasons. In fact, BECP offers various suggested alternatives to the formal procedures. For example, training and annual measurements can be implemented by code, using self-assessment forms, which will help improve compliance rates over time. The graphic represents how an assessment can fit into the compliance measurement process—more details are found within the larger Measuring State Energy Code Compliance document.

Additional methods for better understanding compliance rates in local jurisdictions include surveys, interviews, and spot checks. “Spot checks” are defined as single evaluations of a smaller number of buildings than those allowed necessary in the more formal evaluation procedures.

**BECP Tool:**  
Additional surveys are available in online and downloadable formats. In states to date, back compatibility is modest and we're still improving. [www.energycodes.gov/ams/compliance\\_evaluation.htm](http://www.energycodes.gov/ams/compliance_evaluation.htm)

**ENERGY**  
Energy Efficiency &  
Renewable Energy

U.S. DEPARTMENT OF ENERGY  
1000 POWERLINE AVENUE  
WASHINGTON, DC 20548

**Building Energy Codes**  
A BECP/DOE Initiative  
www.energycodes.gov  
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**We Need Your Feedback**

As your state's first energy code compliance measurement, BECP wants to know how it really works for you. Please take a few minutes to complete our online survey, and help us make our “checklist to Data Card” at [info@becu.org](mailto:info@becu.org).

**Thank you!**

This effort has benefited everyone who has helped us get started. We're grateful to the many individuals and organizations who have helped us get started. We're grateful to the many individuals and organizations who have helped us get started. We're grateful to the many individuals and organizations who have helped us get started.

- Evaluate a statistically valid sample of  $44 \pm$  buildings in the state in each of the following four populations:
  - New residential
  - New commercial
  - Residential renovations
  - Commercial renovations

# Gearing up to Measure Compliance

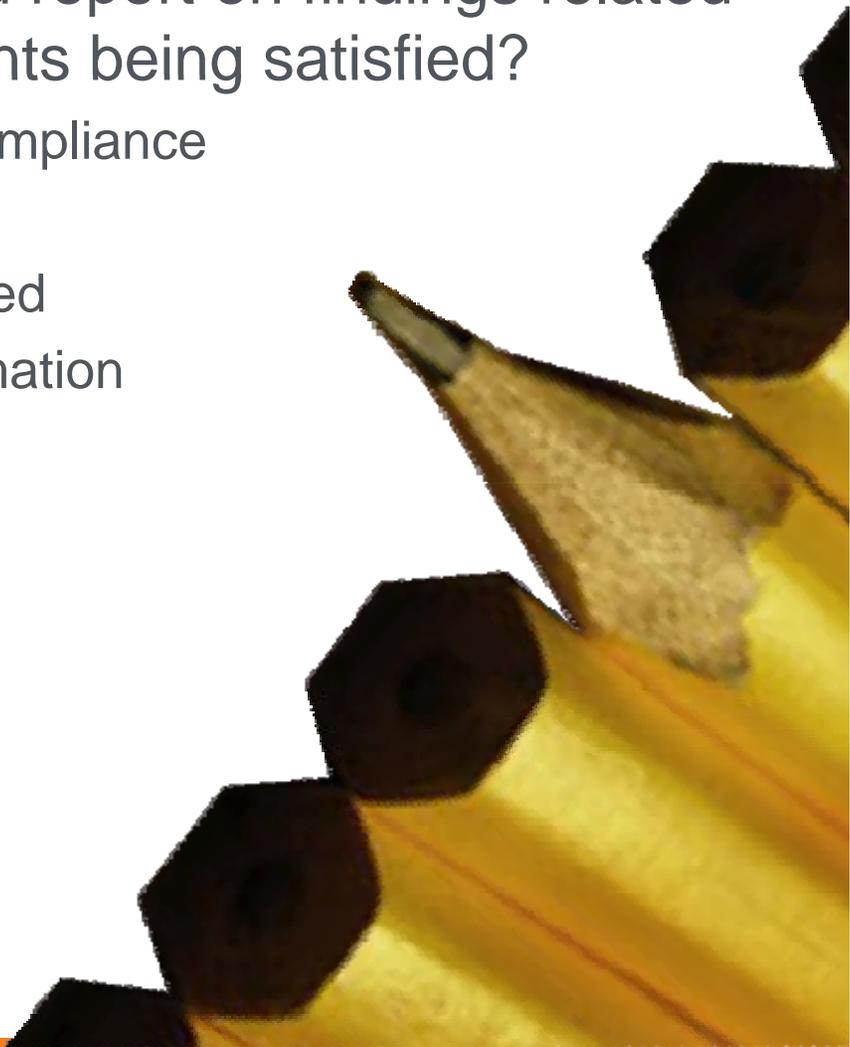
- Key questions needing to be answered
  - Verify what has been adopted (the pass/fail metric) and if affected parties are aware of the adoption
  - Determine what compliance assessment process is relevant to specific criteria in what has been adopted
    - Scope as to building types and criteria covered
    - The actual technical, administrative or other provisions
    - Review of data, plans, actual inspection, testing, etc.
  - What actions and information are needed to verify compliance

# Establish Steering Committee

- Establish a compliance working group to lead the effort
  - Individuals representing all facets of the design, construction and compliance verification process
  - Recognition as experts in their field
  - Availability to organize and lead
  - Ability to identify and secure needed resources
- Review evaluation materials
- Establish reporting mechanisms



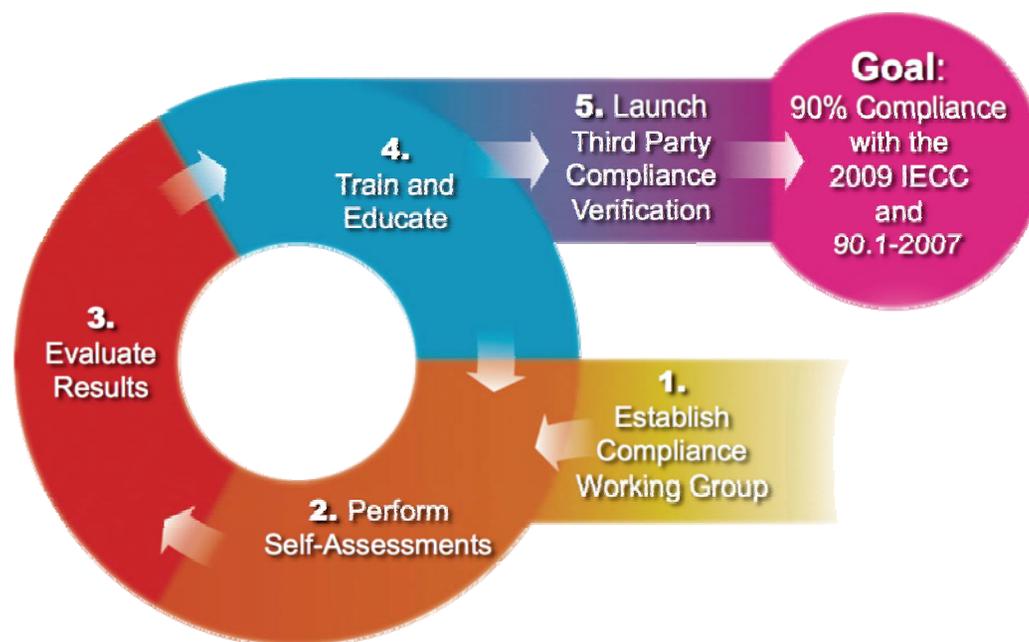
- Develop a plan to measure and report on findings related to compliance – are requirements being satisfied?
  - What information is relevant to compliance
  - Who can get that information
  - What qualifications might they need
  - Where do you go to get the information
  - When is it available
  - How will it be procured
  - How will it be collected, stored, analyzed and reported on
  - How much information is needed to provide a valid assessment



- Determine how to manage the plan
  - Identify tasks, responsibilities and schedule
  - Task interaction and integration
  - Meetings
  - Reporting
  - Communications and information sharing (internal and external)
  - Teeing up questions and getting responses



- Implement the plan – for instance;
  - Take small bites and conduct small assessments
  - Refine the assessment tools
  - Use assessment results to identify needed design and construction improvements
  - Widen the net and make more assessments having a larger scope
  - Refine the assessment
  - Identify tools
  - Identify additional design and construction improvements
  - Re-refine tools and fully implement assessment study



# Evaluate Results

- Regular oversight by the steering committee
- Regular reporting of progress
- Regular release of findings
- Regular release of suggested changes based on findings
- Continue to communicate, train and educate



# Compliance Evaluation Checklists

- Checklists and instructions available for:
  - 2009 IECC Residential (Chapter 4)
  - 2009 IECC Commercial (Chapter 5)
  - 90.1-2007 Commercial
- Alternative checklists for other codes may be requested
- Evaluator training covers use of checklists

# Residential Checklist

- Developed by climate zone
- Contain prescriptive requirements for each climate zone
- Contain instructions for each requirement

**Residential Data Collection Checklist**  
2009 International Energy Conservation Code  
Climate Zone 5 and Marine 4

Date: \_\_\_\_\_ Name of Evaluator(s): \_\_\_\_\_

Building Name & Address: \_\_\_\_\_ Conditioned Floor Area: \_\_\_\_\_ ft<sup>2</sup>

Building Contact Name: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Compliance Approach:  Prescriptive (402.1.2 or 402.1.3)  UA Trade-Off (402.1.4)  Building Performance (405)

State: \_\_\_\_\_ Jurisdiction: \_\_\_\_\_

Building Type: 1- and 2-Family, Detached:  Single Family  Modular  Townhouse  
Multifamily:  Apartment  Condominium

Project Type:  New Construction  Addition to existing building  Existing building renovation

Item Number <sup>1</sup>	Pre-Inspection/Plan Review	Code Value	Verified Value	Complies			Comments/Notes/Findings
				Y	N	N/A	
PR1 [103.2] <sup>2</sup>	Construction drawings and documentation submitted and available. Documentation sufficiently demonstrates energy code compliance.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
PR2 [103.5] <sup>2</sup>	HVAC loads calculations: Heating system size(s) Cooling system size(s)		180: 180:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Additional Comments: \_\_\_\_\_

# Residential Checklist Instructions

## Checklist

## Instructions

**Residential Data Collection Checklist**  
2009 International Energy Conservation Code  
Climate Zone 5 and Marine 4

Date: \_\_\_\_\_ Name of Evaluator(s): \_\_\_\_\_

Building Name & Address: \_\_\_\_\_ Conditioned Floor Area: \_\_\_\_\_ ft<sup>2</sup>

Building Contact: Name: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Compliance Approach:  Prescriptive (402.1.2 or 402.1.3)  UA Trade-Off (402.1.4)  Building Performance (405)

State: \_\_\_\_\_ Jurisdiction: \_\_\_\_\_

Building Type: 1- and 2-Family, Detached:  Single Family  Modular  Townhouse  
Multifamily:  Apartment  Condominium

Project Type:  New Construction  Addition to existing building  Existing building renovation

Item Number <sup>1</sup>	Pre-Inspection/Plan Review	Code Value	Verified Value	Complies			Comments/Notes/Findings
				Y	N	N/A	
PR1 [103.2] <sup>1</sup>	Construction drawings and documentation submitted and available. Documentation sufficiently demonstrates energy code compliance.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
PR2 [403.6] <sup>2</sup>	HVAC loads calculations: Heating system size(s): Cooling system size(s):		\$Btu: \$Btu:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Additional Comments: \_\_\_\_\_

Item Number	Pre-Inspection/Plan Review
PR1 [103.2] <sup>1</sup>	<p><b>Documentation.</b> 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"> <li>• The location and R-values of insulation materials</li> <li>• U-factors and SHGC values for windows, doors, skylights, and other fenestration products</li> <li>• Information related to duct and piping location, insulation type and R-value, and means of sealing</li> </ul> <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] <sup>2</sup>	<p><b>HVAC Load Calculations</b> 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>

- Instructions provided for each requirement

# Commercial Checklist

- One checklist for all climate zones
- Expectation of evaluator knowing and/or having the code or standard

**Commercial Building Data Collection Checklist**  
ANSIASHRAEIESNA Standard 90.1-2007

Drawn: \_\_\_\_\_ Name of Evaluator(s): \_\_\_\_\_

Building Name & Address: \_\_\_\_\_ Conditioned Floor Area: \_\_\_\_\_ ft<sup>2</sup>

Building Contact Name: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Compliance Approach:  Prescriptive  Trade-Off (Section 5.6)  Performance (ECB Section 7.1)

Zone: \_\_\_\_\_ Jurisdiction: \_\_\_\_\_

Building Use:  Office  Retail  Storage  Education  Lodging  Dining  Public  Health  Residential  Other \_\_\_\_\_

Project Type:  New Construction  Addition  Renovation Valuation (if Renovation): \$ \_\_\_\_\_

Item # ANSIASHRAE 90.1-2007	Plan Review	Complies			Comments/Notes/Findings
		Y	N	N/A	
10.2.2.1	Plans and/or specifications provide all information with which compliance can be determined for the building layout and design and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.2	Plans and/or specifications provide all information with which compliance can be determined for the mechanical systems and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.3	Plans and/or specifications provide all information with which compliance can be determined for the service water heating systems and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.4	Plans and/or specifications provide all information with which compliance can be determined for the lighting and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.5	Plans and/or specifications provide all information with which compliance can be determined for the power distribution and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.6	Plans and/or specifications provide all information with which compliance can be determined for the service water heating systems and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.7	Plans and/or specifications provide all information with which compliance can be determined for the lighting and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.8	Plans and/or specifications provide all information with which compliance can be determined for the power distribution and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.9	Plans and/or specifications provide all information with which compliance can be determined for the service water heating systems and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.10	Plans and/or specifications provide all information with which compliance can be determined for the lighting and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.11	Plans and/or specifications provide all information with which compliance can be determined for the power distribution and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.12	Plans and/or specifications provide all information with which compliance can be determined for the service water heating systems and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.13	Plans and/or specifications provide all information with which compliance can be determined for the lighting and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.14	Plans and/or specifications provide all information with which compliance can be determined for the power distribution and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.15	Plans and/or specifications provide all information with which compliance can be determined for the service water heating systems and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.16	Plans and/or specifications provide all information with which compliance can be determined for the lighting and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.17	Plans and/or specifications provide all information with which compliance can be determined for the power distribution and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.18	Plans and/or specifications provide all information with which compliance can be determined for the service water heating systems and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.19	Plans and/or specifications provide all information with which compliance can be determined for the lighting and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10.2.2.20	Plans and/or specifications provide all information with which compliance can be determined for the power distribution and equipment and documents where exceptions to the standard are allowed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Additional Comments: \_\_\_\_\_

# Evaluation Checklists

- Checklists are arranged by stage of construction
- Multiple buildings may be used
  - Must be of same use type and in same jurisdiction
  - Construction Phases approach
    - One building for one stage of construction, building information captured for each building
  - Primary building approach
    - One primary building for most requirements
  - May use newly constructed/occupied buildings
- Same checklists used for new construction and for renovations

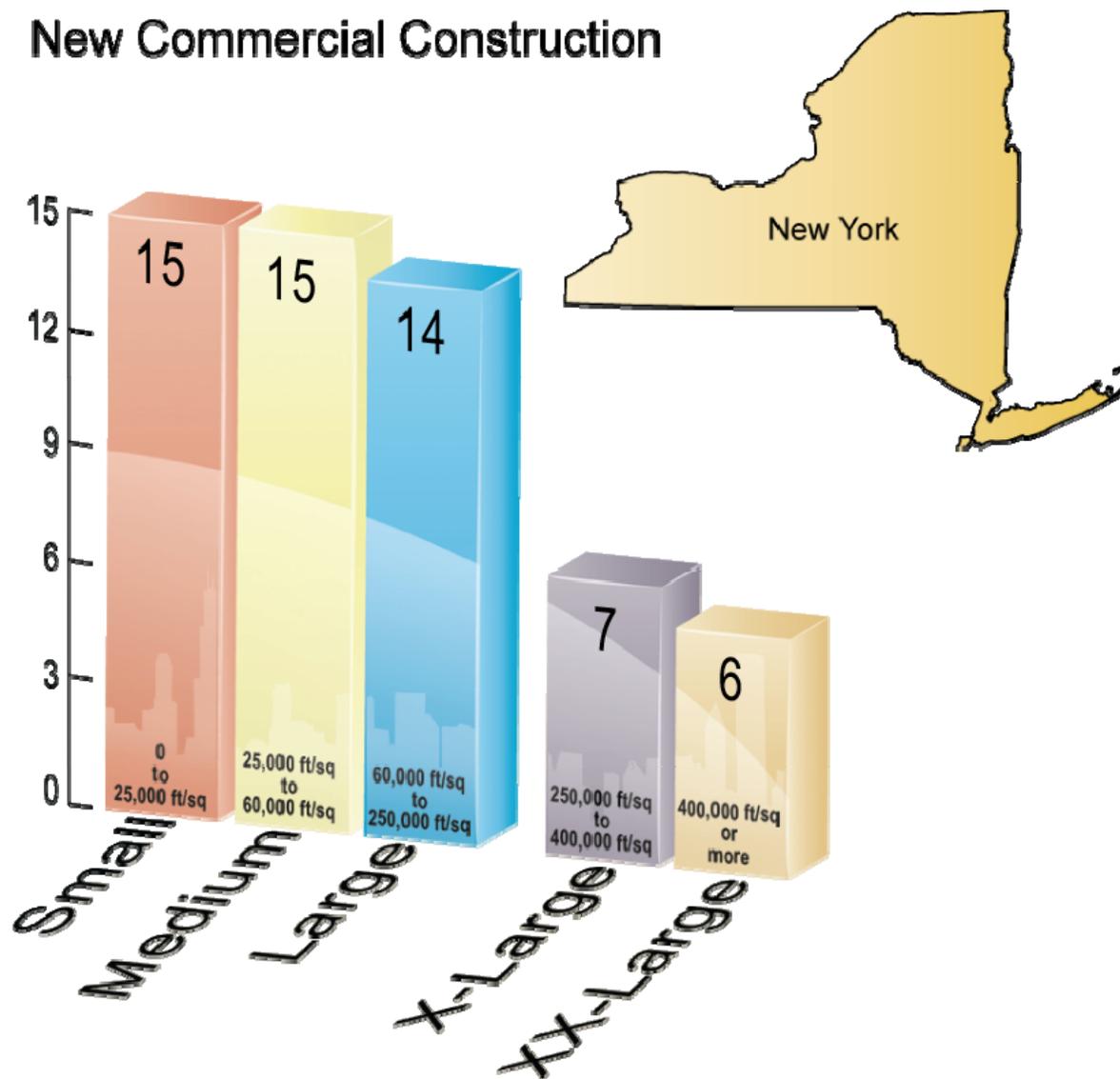
Item # 2009 IECC	Plan Review			Complies			
				Y	N	N/A	
PR1 [103.2]	Item # 2009 IECC	Footing / Foundation Inspection		Verified Value	Complies		
					Y	N	N/A
FO1 [303.1]	Item # 90.1-2007	Framing / Rough-In Inspection		Verified Value	Complies		
					Y	N	N/A
FR1 [303.1]	Item # 2009 IECC	Plumbing Rough-In Inspection			Complies		
					Y	N	N/A
PL2 [504.6]	Item # 2009 IECC	Mechanical Rough-In Inspection		Verified Value	Complies		
					Y	N	N/A

# Generating Samples

- Evaluate a statistically valid sample of  $44 \pm$  buildings in the state in each of the following 4 populations:
  - New residential
  - New commercial
  - Residential renovations
  - Commercial renovations

Extra samples may be required for X-Large and XX-Large buildings

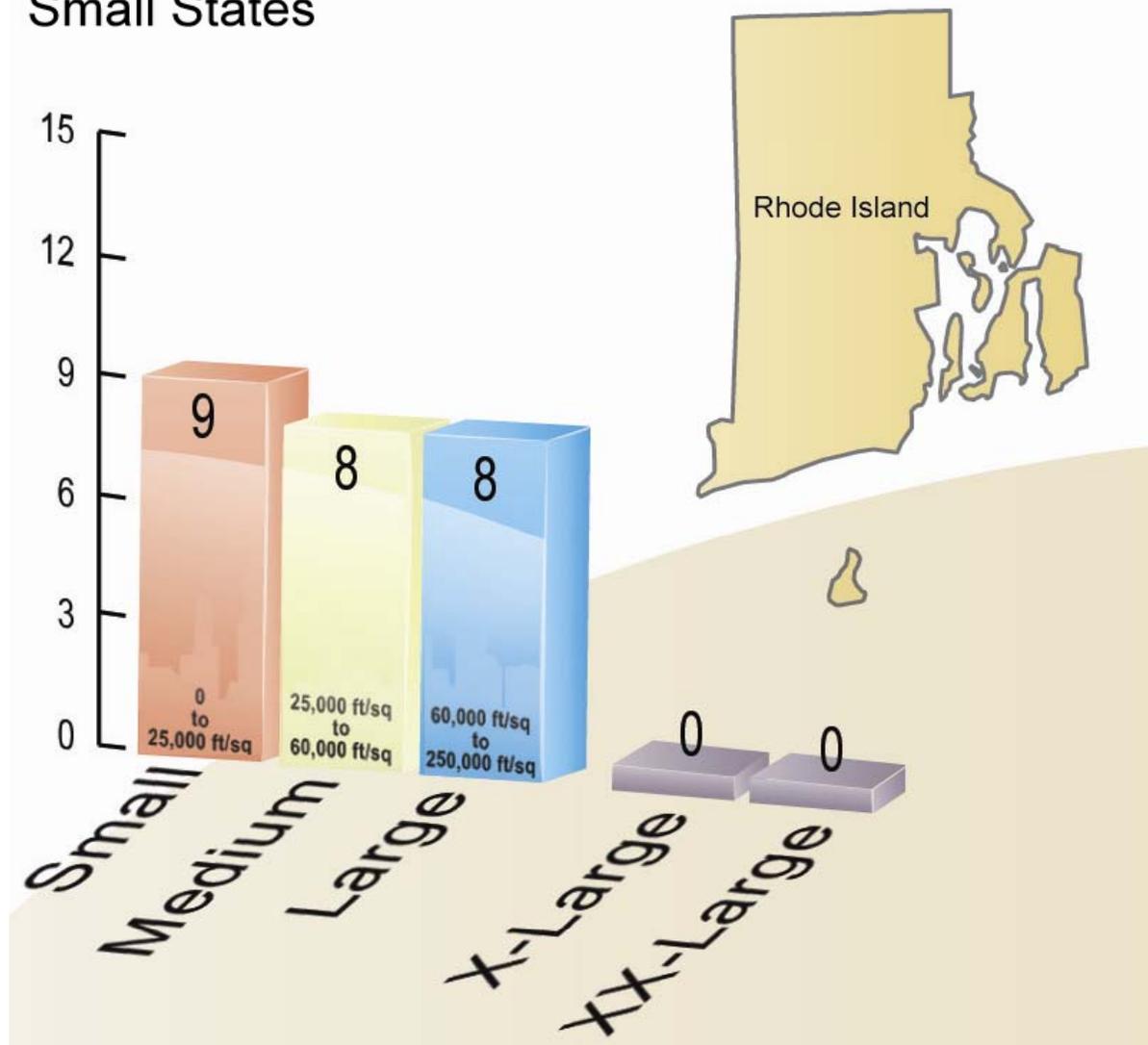
### New Commercial Construction



# Small States

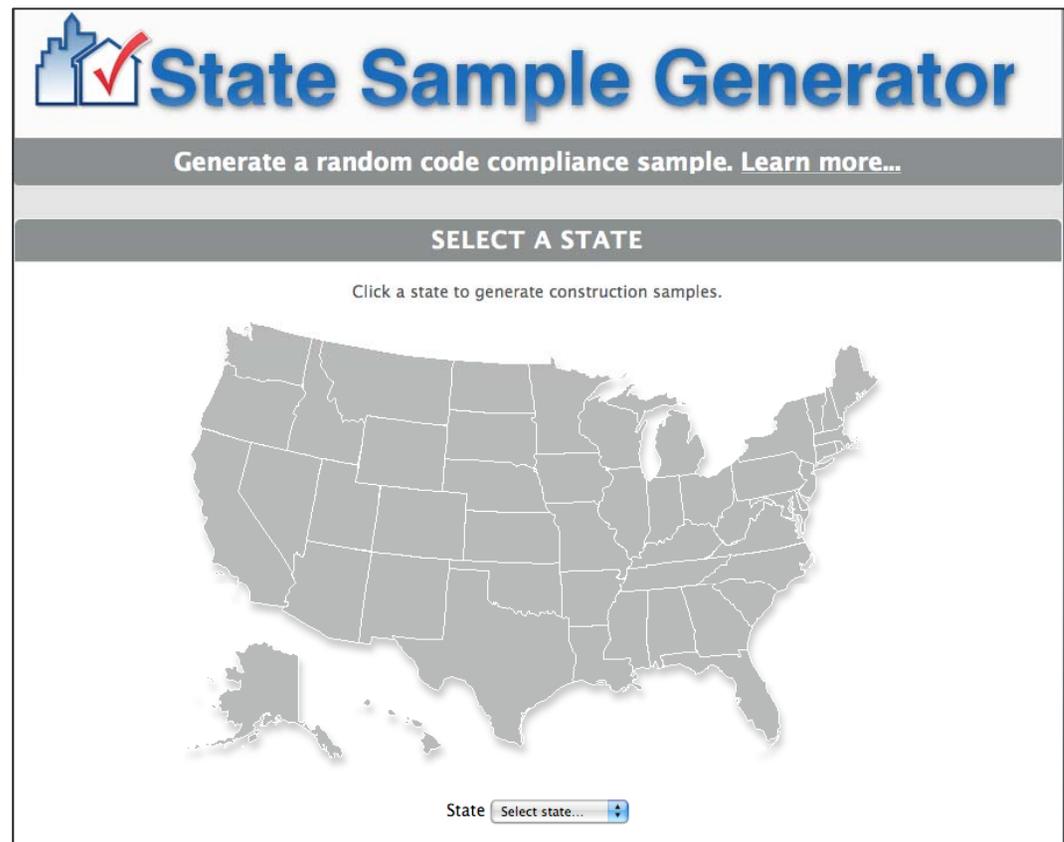
Fewer samples may be required depending on recent construction starts

Small States



# Generating Samples

- Justifications, algorithms, and other details are available in Measuring State Energy Code Compliance for those interested
- For the rest of us, the State Sample Generator is available



<http://energycode.pnl.gov/SampleGen/>

# State Sample Generator

**State Sample Generator**

Generate a random construction sample for Wyoming.

Click a state on the map to select a state.

**WYOMING**

Choose a construction category and time period to filter sample results.

Construction Category:

Time Period:  Average of 3 Most Recently Available Years,  Average of 2 Most Recently Available Years,  Most Recently Available Year

**CONSTRUCTION SAMPLES**

**Commercial New**  
Construction starts based on 2009 data.

Location	Construction Starts	Sample Size				
		Small	Medium	Large	X-Large	XX-Large
<b>State Totals</b>	<b>264</b>	<b>10</b>	<b>10</b>	<b>9</b>	<b>0</b>	<b>0</b>
<b>Climate Zone 6 Totals</b>	<b>437</b>	<b>9</b>	<b>8</b>	<b>7</b>		
Campbell County	38	2	-	3		
Fremont County	39	1	3	-		
Natrona County	59	3	-	4		
Park County	41	3	5	-		
<b>Climate Zone 7 Totals</b>	<b>87</b>	<b>1</b>	<b>2</b>	<b>2</b>		
Lincoln County	12	-	1	-		
Sublette County	12	-	-	2		
Teton County	63	1	1	-		

Download as: [CSV File](#)

**Climate Zone Color Legend**

- Climate Zone 5
- Climate Zone 6
- Climate Zone 7

- There may be unknown biases introduced
  - Selection of only “friendly” jurisdictions
  - Selection of too few jurisdictions
  - Drawing from pools of above-code buildings only
  - Lack of diversity of building types
  - Too few samples
- Generated samples are preferred, but where impractical can inform the final sample

# Approaching the Jurisdiction

- Partnering with the jurisdiction will increase the success rate of the study
  - They have the plans, energy code compliance documentation and direct access to the building sites
- Jurisdictions should be coordinated with at the beginning of the study
  - Initial buy-in will increase their rate of cooperation as the study progresses
  - Work through ICC Chapter
  - Work directly with the jurisdiction to set up the study
- Collaboration is the name of the game
- Focus on relationship building

- Jurisdiction Concerns
  - Time and manpower requirements
  - Study results
  - Reporting of the study results
    - City/County government
    - Peers
    - State agency
  - What they will get out of the study
    - E.g., an understanding of their compliance rate
  - What incentive they have for participating in the study
    - E.g., the state may offer free training

- Proposed approach
  - Jurisdiction will want to know
    - How many buildings and in what stages will be reviewed?
    - How long will it take?
    - What their involvement is in the process?
      - Only provide plans?
      - Provide plans and access to construction sites?
      - Other?
    - What will you do with the results?

- Proposed approach
  - Step 1
    - Select jurisdictions to be visited and the sample size for each jurisdiction
    - Develop a Plan A, B (and maybe C) to account for issues that may arise
  - Step 2
    - Market the study
      - ICC Chapters
      - Builder Groups
      - AIA / ASHRAE
      - Etc.

- Proposed approach
  - Step 3
    - Send brochure/letter out to jurisdiction (building official) announcing the study and requesting their participation
      - Brochure provided by the BECP
      - Provide contact information to answer questions
      - Provide information on number and type of buildings
  - Step 4
    - Follow-up with jurisdiction (via phone) to answer any questions, provide more information, etc.
      - Ensure that you can get access to the plans, energy code compliance documentation and determine what arrangements must be made to access the building site
  - Step 5
    - Repeat Steps 3 and 4 until you have access to the desired number of buildings in the sample size (see Step 1)

# Evaluator Training

- Use of 3<sup>rd</sup>-party contractors and/or building officials (see Measuring State Energy Code Compliance)
- Making sure they have the necessary tools and knowledge of those tools and the program at large to go into the field and do the job (interact with the locals and gather the data and schedule additional visits if necessary)

- Goal of evaluator training
  - Provide the tools needed and specific training on those tools to evaluate statewide residential and commercial compliance with the 2009 IECC or ASHRAE 90.1-2007
  - Ensuring that the evaluators have the knowledge of the program at large to go into the field and perform an effective evaluation (interact with the locals and gather the data and schedule additional visits if necessary)
- Target audience for training
  - 3<sup>rd</sup>-party contractors
  - Building officials
  - State Energy Office staff
  - Others interested in providing evaluation services to states

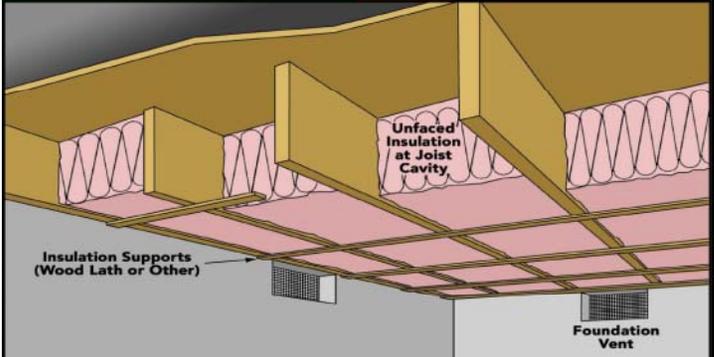
- Recommended background/knowledge
  - Understanding of the IECC and the provisions contained within the residential and commercial provisions of the code.
  - Understanding of ASHRAE 90.1 and the provisions contained within the Standard
  - Experience with plan review for residential and commercial energy code compliance
  - Experience in inspection for residential and commercial energy code compliance

# Evaluator Training

- Two presentations and associated video clips available
- Full day of instruction each for residential and commercial
- Based on evaluation checklists
- ½ - day overview and objectives of setting up an evaluation program
  - E.g., the materials covered in this webcast
- Designed for evaluators, but good resource for inspectors

Using the Evaluation Checklists  
**Floor Insulation R-Value**

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



FR1 [402.1.1, 402.2.5, 402.2.6, 303.2]<sup>1</sup>

Floor insulation R-value (requirement varies depending on floor type). Installed per manufacturer's instructions.

BUILDING ENERGY CODES UNIVERSITY 27 [www.energycodes.gov/training](http://www.energycodes.gov/training)

Using the Evaluation Checklists  
**Roof Insulation**

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



FR9 [5.8.1.8]<sup>3</sup>

Roof insulation not installed on a suspended ceiling with removable ceiling panels.

BUILDING ENERGY CODES UNIVERSITY 38 [www.energycodes.gov/training](http://www.energycodes.gov/training)

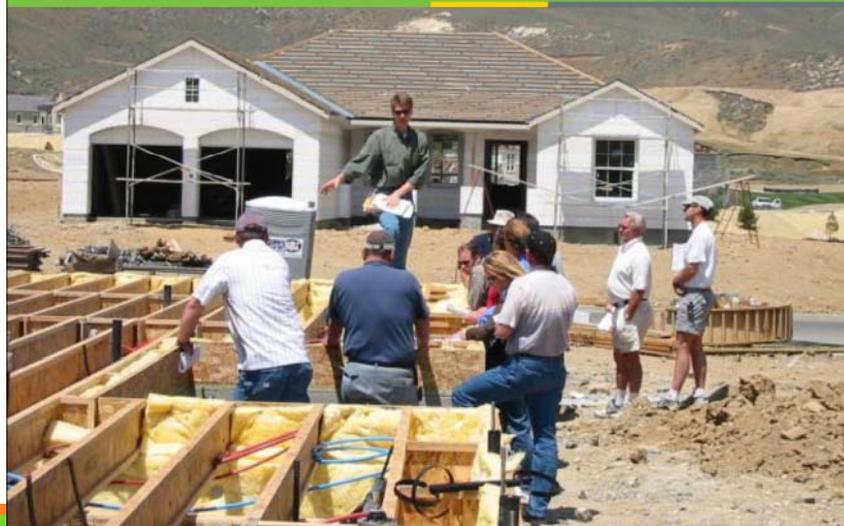
- Residential Training
  - 1-½ day Training
    - One day of classroom training, focused on evaluator checklist training
  - ½ -day field inspection practicum conducted on-site
- Commercial Training
  - 1-day Training
    - One day of classroom training, focused on evaluator checklist training

## Training Outline

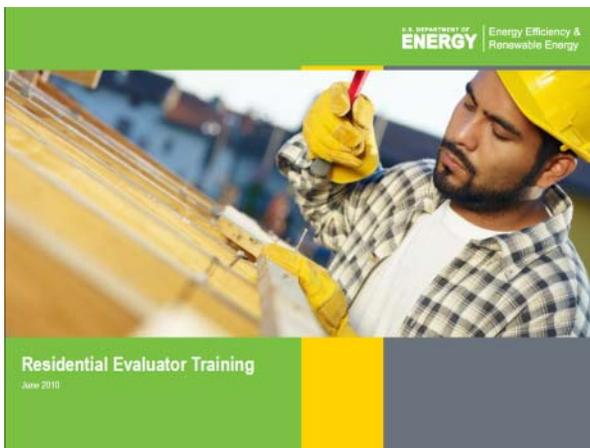
- Objectives and Benefits of Adopting Building Energy Codes and Measuring Compliance
- Compliance Evaluation Procedures
  - Sample Populations
  - Sample Size
  - Sample Distribution
  - Sample Makeup
  - Assigning Compliance Rates
    - Individual Building Metrics
    - State Compliance Rates
- **Using the Evaluation Checklists**

4

## Practicum



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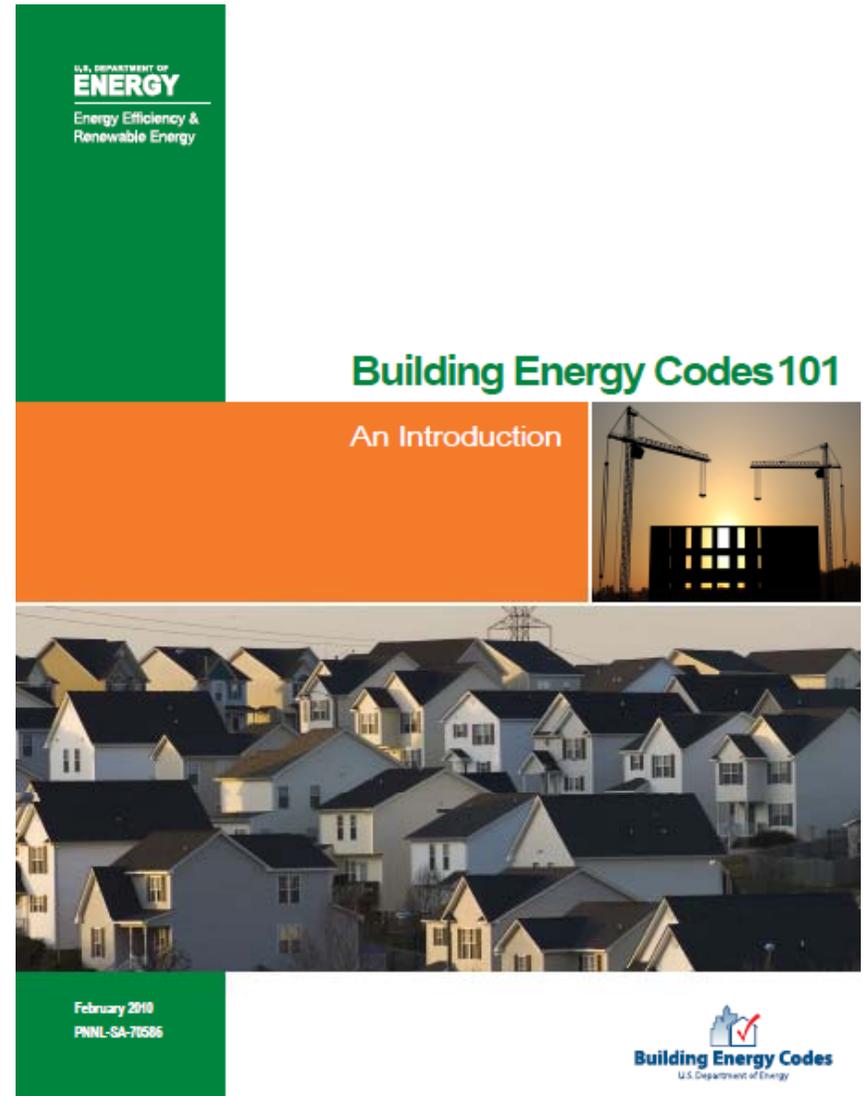
- BECP evaluator training to be offered in four states
  - Will include Train-the-Trainer
  - Anticipate an online video of training (sans practicum)

- Building Energy Codes 101
- IECC 2009 (Residential)
- 90.1-2007
- IECC 2009 (Commercial)
  - Envelope
  - Lighting
  - Mechanical

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

[www.iccsafe.org](http://www.iccsafe.org)

[www.ashrae.org](http://www.ashrae.org)



# At the Jurisdiction

- The evaluator team represents the SEO and other partners participating in the study.
- Jurisdictions may not want participate in this study
- Focus on establishing long term relationships between the jurisdiction and the project partners
  - You may need to return for more information
- Take advantage of the visit to collect as much information as possible

- Meet with building official and those interested in study
  - Use time to review the purpose of the study, protocol and the building types to be reviewed
  - Administer survey
  - Answer questions concerning the evaluation
  - Answer energy code related questions
- Work with the building official to pull the plans and energy code documentation based on the criteria for the study
  - Information for sample size
    - Building type (residential, commercial, renovation, etc)
    - Number of buildings
    - Stage of construction
    - Method of data collection (e.g., whole building or portions of building)

- Building permit requirements and available information will vary with each jurisdiction
  - For residential buildings, plan requirements range from
    - Full architectural, structural, mechanical, plumbing and electrical drawings, to
    - Plot plan showing house in relation to the well and septic
  - For commercial, plans may vary from
    - Full architectural, mechanical and electrical, to
    - Design build drawings, to
    - Shell building with either tenant build out as a separate permit

- Enforcement will range from
  - Full plan review and inspection
    - Optimal with high probability that the plan review and inspection portion of the evaluation can be successfully conducted
  - Issuance of building permit with no plan review or inspection
    - Medium to low probability of success
    - May or may not have plans to review and will need to rely on verifying information on the building site
  - No building permit required
    - Low to no probability of success
      - Try to contact the builder
      - Choose another jurisdiction within the same county, but document the non-response
      - Choose another jurisdiction for the study, but document the non-response

# At the Jurisdiction

- Complete the Plan Review portion of the survey while at the building department
  - Review energy code documentation if provided
  - Complete portions of the checklist that require “proposed levels of efficiency” to be recorded
  - Record special features about the building that will need to be reviewed onsite
  - Verify compliance of certain features if no energy code documentation is available

**Residential Data Collection Checklist**  
2009 International Energy Conservation Code  
Climate Zone 5 and Marine 4

Date: \_\_\_\_\_ Name of Evaluator(s): \_\_\_\_\_

Building Name & Address: \_\_\_\_\_ Conditioned Floor Area: \_\_\_\_\_ ft<sup>2</sup>

Building Contact: Name: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Compliance Approach:  Prescriptive (402.1.2 or 402.1.3)  UA Trade-Off (402.1.4)  Building Performance (405)

State: \_\_\_\_\_ Jurisdiction: \_\_\_\_\_

Building Type: 1- and 2-Family, Detached:  Single Family  Modular  Townhouse  
Multifamily:  Apartment  Condominium

Project Type:  New Construction  Addition to existing building  Existing building renovation<sup>1</sup>

Item Number <sup>1</sup>	Pre-Inspection/Plan Review	Code Value	Verified Value	Complies			Comments/Notes/Findings
				Y	N	N/A	
PR1 [103.2] <sup>1</sup>	Construction drawings and documentation submitted and available. Documentation sufficiently demonstrates energy code compliance.			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
PR2 [403.6] <sup>2</sup>	HVAC loads calculations: Heating system size(s): Cooling system size(s):		kBtu: _____ kBtu: _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Additional Comments: \_\_\_\_\_

- Access to the building sites
  - Will require permission from someone
    - Builder
    - General contractor
    - Building owner
    - Building department
  - Issues that can arise
    - Liability
      - Solution: Ensure that the evaluation team is properly insured
    - Availability of builder/developer
      - Solution: Perseverance or select another sample and document the non-response
    - Selecting not to participate in the study
      - Solution: Select another sample, and document the non-response

# Scoring the Results



# Analyze the Data

- New construction scored differently than renovations
  - Individual buildings for new construction receive individual building scores
  - Renovations are scored at state level only
- Checklist items are ranked and scored according to impact
  - Tiers 1-2 for residential
  - Tiers 1-3 for commercial
- State scores for new commercial construction are weighted by building size

General building information only required if different than above

Date: \_\_\_\_\_ Name of Evaluator(s): \_\_\_\_\_  
 Building Name & Address: \_\_\_\_\_ Conditioned Floor Area: \_\_\_\_\_ ft<sup>2</sup>  
 Building Contact: Name: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_  
 Compliance Approach:  Prescriptive  Trade-Off (Section 5.6)  Performance (ECB Section 11)

Item Number	Framing / Rough-In Inspection	Verified Value	Complies			Comments/Notes/Findings
			Y	N	N/A	
FR1 [5.8.2.2] <sup>1</sup>	Fenestration products are certified as to performance labels or certificates provided.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR2 [5.5.3.1, 5.8.1.2] <sup>1</sup>	Roof insulation R-value provided. Installed per manufacturer's instructions.	R-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR3 [5.5.4.2.1, 5.5.4.2.2] <sup>1</sup>	Performance compliance approach submitted for vertical fenestration area >40% or skylight area >5%.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR4 [5.5.4.3a] <sup>1</sup>	Vertical fenestration U-Factor.	U-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR5 [5.5.4.3b] <sup>1</sup>	Skylight fenestration U-Factor.	U-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR6 [5.5.4.4.1] <sup>1</sup>	Vertical fenestration SHGC value.	SHGC -	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR7 [5.5.4.4.2] <sup>1</sup>	Skylight SHGC value.	SHGC -	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR8 [5.8.2.1] <sup>2</sup>	Fenestration products rated in accordance with NFRC.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR10 [5.4.3.2] <sup>3</sup>	Fenestration and doors meet maximum air leakage requirements.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR12 [5.4.3.4] <sup>3</sup>	Vestibules installed per approved plans.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Additional Comments: \_\_\_\_\_

- Checklist Store and Score online tool available for recording, storing, and scoring the checklists
- Checklist data can be:
  - Transferred from paper checklists (BECF services provided)
  - Imported from Word forms
  - Entered directly into online tool
- Password protected
- State access will provide excel export of all state data and scores
- Central database to allow reporting of state, regional, and national results
- Individual building, jurisdiction, and county scores protected

- What is your state compliance rate?
- Which building systems have the lowest compliance rates?
- Which building use types have the highest rate of compliance? The lowest?
- Which energy code requirements most often fail? By how much and what is the impact?
- Which energy code requirements almost always comply?
- What percentage of building compliance is demonstrated under each of the compliance approaches (prescriptive, trade-off, performance)?

# Scoring the Checklists

- Unique ID's for each checklist item allows scoring and analysis across both target and current codes
- Building values and comments collected
  - May provide regional building construction trends over time
  - May demonstrate impacts of training and enforcement over time

General building information only required if different than above

Date: \_\_\_\_\_ Name of Evaluator(s): \_\_\_\_\_  
 Building Name & Address: \_\_\_\_\_ Conditioned Floor Area: \_\_\_\_\_ ft<sup>2</sup>  
 Building Contact: Name: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_  
 Compliance Approach:  Prescriptive  Trade-Off (Section 5.6)  Performance (ECB Section 11)

Item Number	Framing / Rough-In Inspection	Verified Value	Complies			Comments/Notes/Findings
			Y	N	N/A	
FR1 [5.8.2.2] <sup>1</sup>	Fenestration products are certified as to performance labels or certificates provided.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR2 [5.5.3.1, 5.8.1.2] <sup>1</sup>	Roof insulation R-value provided. Installed per manufacturer's instructions.	R-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR3 [5.5.4.2.1, [5.5.4.2.2] <sup>1</sup>	Performance compliance approach submitted for vertical fenestration area >40% or skylight area >5%.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR4 [5.5.4.3a] <sup>1</sup>	Vertical fenestration U-Factor.	U-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
FR5 [5.5.4.3b] <sup>1</sup>	Skylight fenestration U-Factor.	U-	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
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FR12 [5.4.3.4] <sup>3</sup>	Vestibules installed per approved plans.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Additional Comments: \_\_\_\_\_

# Annual Measurement

- Spot checks
- Evaluation of 1 of the 4 populations
- Generic jurisdictional survey
  - Survey can be conducted by evaluators at time of visit
- State Energy Code Jurisdictional Survey
  - Paper survey information can be imported (BECP services provided)
- Online and paper survey available as is or with state customization
- Checklist data and survey information associated with state jurisdictions
- Over time, checklist and survey data together can inform correlations between jurisdictional practices and energy code compliance rates

## Online Survey



## State Energy Code Jurisdictional Survey

### Questions about your Jurisdiction

#### Jurisdictional Information

Agency Name:

Jurisdiction Served:

Estimate of the population served:

#### Name, Title, and Contact for person completing the survey:

Name:

Title:

Email Address:

Telephone Number:

#### During the previous year, how many building permits were issued by your agency?

Residential building permits:

Commercial building permits:

# Reporting the Results

- Evaluation checklists
- Feedback on the tools, materials, and training
  - what was good
  - what was not good and why
  - recommendations on how to fix or enhance the materials
  - lessons learned from use of the materials
- Length of time estimates
  - To secure the needed information for the applicable type(s) of evaluations
  - To conduct the jurisdictional survey (if applicable)
- Trends - what stuck out repeatedly as an issue and how might it be addressed
  - (e.g., no load calculations so mechanical contractors need to be given more direction to provide the load calculations)
- What else was needed to do an effective evaluation (to feed into development of new materials and tools)

# Pilot Studies and Other State Activities

- Objective: to measure code compliance based on the procedures and tools developed by BECP
- Process:
  - Statements of interest submitted: April 9
  - Selected pilot states prepared 2-3 page writeups: April 23
  - Pilot study states selected: April 28

- Time to conduct an evaluation for each of 4 building populations
- Some initial metrics for the states
- Recommended modifications to BECP materials and tools
- Compliance data

- Pilot Studies – Selected States
  - MEEA: Iowa, Wisconsin
  - NEEA: Idaho, Montana, Oregon, Washington
  - NEEP: Massachusetts
  - SEEA: Georgia
  - SWEEP: Utah
- Other state compliance measurement activities:
  - New York
  - Indiana
  - New Hampshire

# BECP Support

- Questions about pilot studies:
  - Send an email to: [techsupport@becp.pnl.gov](mailto:techsupport@becp.pnl.gov)
  - Contractual issues: [marly.barrett@pnl.gov](mailto:marly.barrett@pnl.gov)
  - Reporting issues: [rosemarie.bartlett@pnl.gov](mailto:rosemarie.bartlett@pnl.gov)
- Support materials will be posted at [http://www.energycodes.gov/arra/compliance\\_evaluation.stm](http://www.energycodes.gov/arra/compliance_evaluation.stm)
- Interaction with other states and their contractors that may be doing compliance evaluations on their own
  - Interest if we set up an online forum?

# Contact Us



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

BECP Solutions & Help Center:  
[www.energycodes.gov/help/](http://www.energycodes.gov/help/)

