



## Measuring State Energy Code Compliance

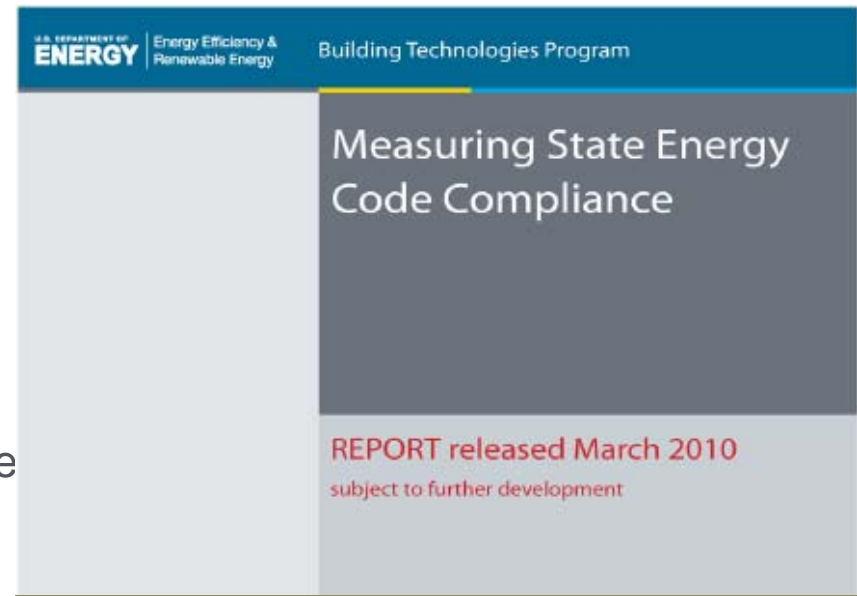
April 2011

### **BUILDING TECHNOLOGIES PROGRAM**

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Building Energy Codes Program  
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# Measuring State Energy Code Compliance

- 74 pages
- Contents
  - Code Adoption and Equivalency
  - Annual Measurement
  - Planning for Compliance Evaluation
  - Onsite Compliance Evaluation Processes)
  - Evaluation Checklists



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

- 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

# State Sample Generator

**State Sample Generator**

Generate a random construction sample

Click a state

WY

WYOMING

Choose a construction category and time period

Construction Category: All Categories

Time Period:
 

- Average of 3 Most Recently Available Years
- Average of 2 Most Recently Available Years
- Most Recently Available Year

Generate Samples

**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

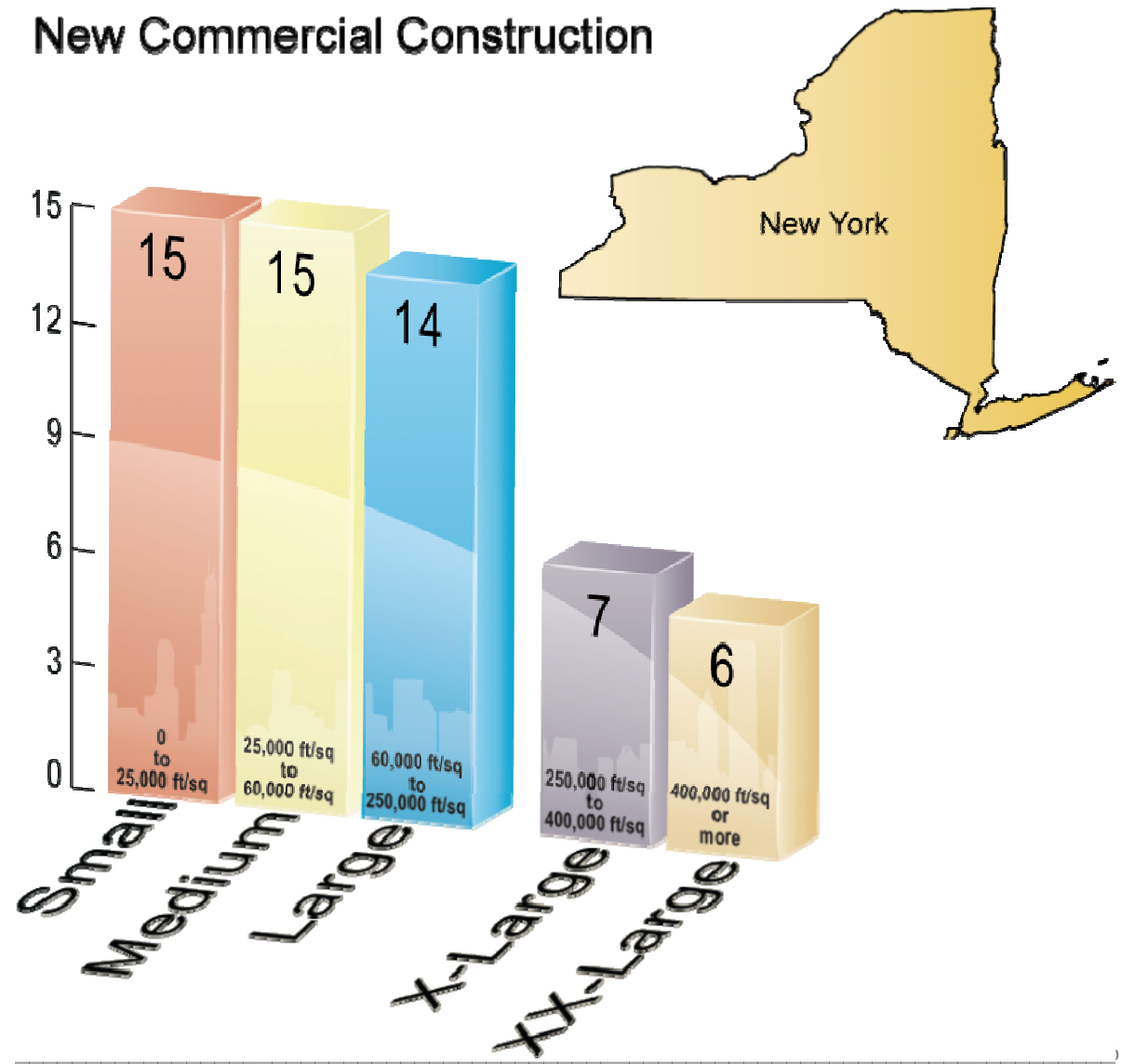
# Generating Samples

- Estimates future construction based on 1-3 years of recent data
  - RS Means FW Dodge building starts data
  - Census permitting information
- Commercial renovation data available for sample generation
- Residential renovation data not available – use new residential sample for both
- Samples distributed by county – states allocate county samples to jurisdictions

# New Commercial Buildings

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

### New Commercial Construction





# Compliance Evaluation Procedures Generating Individual Building Metrics

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Renewable Energy



**Commercial Building Data Collection Checklist**  
ANSI/ASHRAE/IESNA Standard 90.1-2007

Date: \_\_\_\_\_ Name of Evaluator(s): \_\_\_\_\_ Conditioned Floor Area: \_\_\_\_\_ ft<sup>2</sup>

Building Name & Address: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Building Contact: Name: \_\_\_\_\_

Compliance Approach:  Prescriptive  Trade-Off (Section 5.6)  Performance (ECB Section 11)

State: \_\_\_\_\_ Jurisdiction: \_\_\_\_\_  Lodging  Dining  Public  Health  Residential  Other

Building Use:  Office  Retail  Storage  Education  Addition  Renovation Valuation (If Renovation): \$ \_\_\_\_\_

Project Type:  New Construction

	Complies			Comments/Notes/Findings
	Y	N	N/A	
Plan Review	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
provide all information with exceptions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Evaluated buildings are each assigned a compliance rating of 0–100% based on the proportion of code requirements that each has met, and the evaluated buildings' scores within a state are averaged to derive an overall compliance metric with an associated confidence.

# Using the Evaluation Checklists

## Commercial Building Data Collection Checklist 2009 International Energy Conservation Code

Building ID: \_\_\_\_\_ Climate Zone: \_\_\_\_\_

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

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

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

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

Compliance Approach (check all that apply):  Prescriptive  Trade-Off  Performance

Compliance Software Used: \_\_\_\_\_ Green Building/Above-Code Program?  Yes  No

Building Use:  Office  Retail/Mercantile  Warehouse/Storage  Education/School  Lodging/Hotel/Motel  
 Restaurant/Dining/Fast Food  Public Assembly/Religious  Healthcare  High-Rise Residential  Other

Building Ownership:  State-owned  Locally-owned  National account  Speculative  Other

Project Type:  New Building  Existing Building Addition  Existing Building Renovation Valuation (If Renovation): \$ \_\_\_\_\_

2009 IECC Section #	Plan Review	Complies			Comments/Assumptions
		Y	N	N/A	
103.2 [PR1] <sup>1</sup>	Plans and/or specifications provide all information with which compliance can be determined for the <b>building envelope</b> and delineate and document where exceptions to the standard are claimed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
103.2 [PR2] <sup>1</sup>	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the <b>mechanical systems and equipment</b> and delineate and document where exceptions to the standard are claimed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
103.2 [PR3] <sup>1</sup>	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the <b>service water heating systems and equipment</b> and delineate and document where exceptions to the standard are claimed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
103.2 [PR4] <sup>1</sup>	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the <b>lighting and electrical systems and equipment</b> and delineate and document where exceptions to the standard are claimed. Information provided should include interior and exterior lighting power calculations, wattage of bulbs and ballasts, transformers and control devices.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



# Using the Evaluation Checklists

**Commercial Building Data Collection Checklist**  
2009 International Energy Conservation Code

Building ID: \_\_\_\_\_ Climate Zone: \_\_\_\_\_  
Date: \_\_\_\_\_ Name of Evaluator(s): \_\_\_\_\_  
Building Contact: Name: \_\_\_\_\_ Phone: \_\_\_\_\_ Email: \_\_\_\_\_  
Building Name & Address: \_\_\_\_\_ Conditioned Floor Area: \_\_\_\_\_ ft<sup>2</sup>  
State: \_\_\_\_\_ County: \_\_\_\_\_  
Compliance Approach (check all that apply):  Prescriptive  Trade-Off  Performance  
Compliance Software (if used): \_\_\_\_\_  
Building Use:  Office  Retail/Mercantile  Warehouse/Storage  Education/School  Lodging/Hotel/Motel  
 Restaurant/Dining/Fast Food  Public Assembly/Religious/Entertainment  High-Rise Residential  Other  
Building Ownership:  State-owned  Local government-owned  National account  Speculative  Private  Other  
Project Type:  New Building  Existing Building Addition  Existing Building Renovation  Vibration (If Renovation): \$ \_\_\_\_\_

2009 IECC Section #	Plan Review	Complies			Comments/Assumptions
		Y	N	N/A	
103.2 [PR1]	Plans and/or specifications provide all information with which compliance can be determined for the building envelope and delineate and document where exceptions to the standard are claimed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
103.2 [PR2]	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the mechanical systems and equipment and delineate and document where exceptions to the standard are claimed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
103.2 [PR3]	Plans, specifications, and/or calculations provide all information with which compliance can be determined for the service water heating systems and delineate and document where exceptions to the standard are claimed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

## Commercial Checklist Data Gathering Stages

• Plan Review

• Footing and Foundation

• Framing/Rough-In

• Plumbing Rough-In

• Mechanical Rough-In

• Rough-In Electrical

• Insulation

• Final

# Analyze the Data



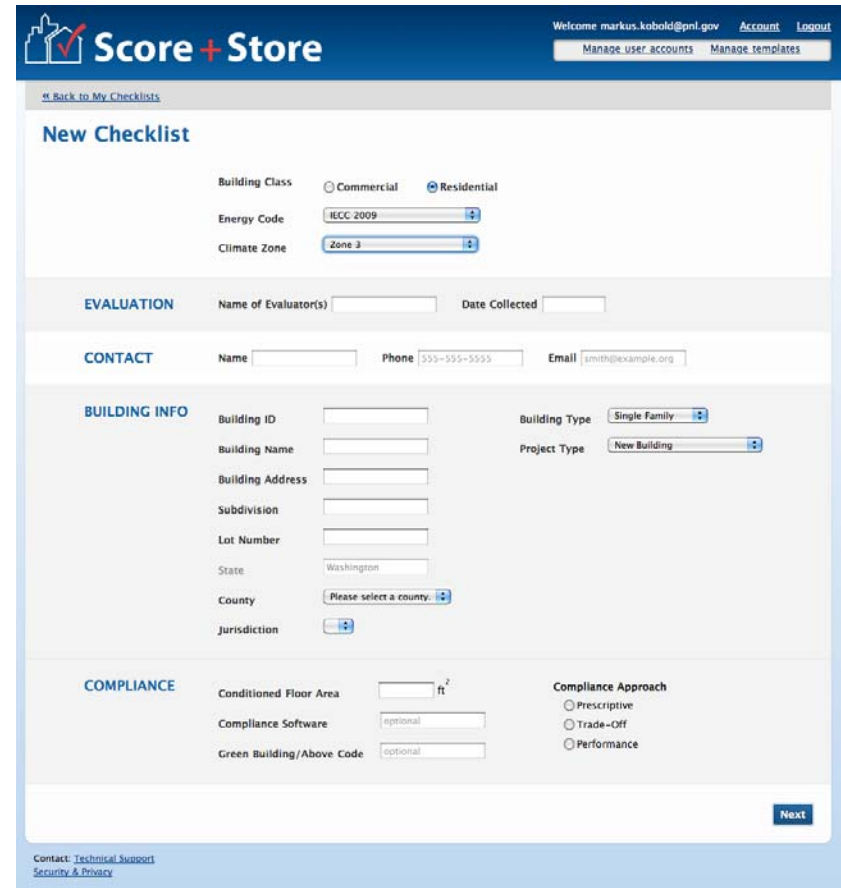
## Score + Store

Score and Store is an application for gathering compliance checklists from states in an effort to gauge the 90% compliance effort.

Log in below to complete checklists for your state. If you don't have an account, you should contact [linda.connell@pnl.gov](mailto:linda.connell@pnl.gov).


<input type="text" value="Name"/>	<input type="text" value="Password"/>	<input type="button" value="Login"/>
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Contact: [Technical Support](#)  
[Security & Privacy](#)



The screenshot shows the 'New Checklist' form in the Score + Store application. The form is organized into several sections: 'EVALUATION', 'CONTACT', 'BUILDING INFO', and 'COMPLIANCE'. At the top right, there is a user welcome message and links for 'Account' and 'Logout'. Below the header, there are links for 'Manage user accounts' and 'Manage templates'. The 'EVALUATION' section includes fields for 'Name of Evaluator(s)' and 'Date Collected'. The 'CONTACT' section includes fields for 'Name', 'Phone', and 'Email'. The 'BUILDING INFO' section includes fields for 'Building ID', 'Building Name', 'Building Address', 'Subdivision', 'Lot Number', 'State', 'County', and 'Jurisdiction'. The 'COMPLIANCE' section includes fields for 'Conditioned Floor Area', 'Compliance Software', and 'Green Building/Above Code', along with radio buttons for 'Compliance Approach' (Prescriptive, Trade-Off, Performance). A 'Next' button is located at the bottom right of the form.

# Analyze the Data

 **Score+Store**
Welcome markus.kobold@pnl.gov [Account](#) [Logout](#)  
[Manage user accounts](#) [Manage templates](#)

« Back to My Checklists 3. Framing / Rough-In Inspection

### Framing / Rough-In Inspection





TOTAL SCORE: 100% Save Checklist

For Building: 123-XT-XT, 123 Main St.  
 Evaluated by Kate Mon on 01/29/2011 Edit

IECC 2009	CODE VALUES	VERIFIED VALUE(S)	COMPLIES	COMMENTS
502.4.1 502.4.2 FR1	Fenestration meets maximum air leakage requirements.	<input type="text"/> cfm/sq ft	<span style="border: 1px solid #ccc; padding: 2px;">Yes</span>	<input style="width: 100%;" type="text"/>
502.4.1 502.4.2 FR2	Doors meet maximum air leakage requirements.	<input type="text"/> cfm/sq ft	<span style="border: 1px solid #ccc; padding: 2px;">No</span>	<input style="width: 100%;" type="text"/>
502.4.1 502.4.2 FR3	Fenestration and doors labeled for air leakage.		<span style="border: 1px solid #ccc; padding: 2px;">Not Observable</span>	<input style="width: 100%;" type="text"/>
502.4.7 FR4	Vestibules installed per approved plans.		<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>
502.2.1 FR5	Roof insulation R-value.	R- <input type="text"/> <input type="checkbox"/> Above deck <input type="checkbox"/> Metal <input type="checkbox"/> Attic	<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>
303.2 FR6	Roof insulation R-value installed per manufacturer's instructions.		<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>
502.3.1 502.1.1 FR7	Performance compliance approach submitted for vertical fenestration area >40% or skylight area >3%.		<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>
502.3.2 FR8	Vertical fenestration U-Factor.	U- <input type="text"/>	<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>
502.3.2 FR9	Skylight fenestration U-Factor.	U- <input type="text"/>	<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>
502.3.2 FR10	Vertical fenestration SHGC value.	SHGC: <input type="text"/>	<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>
502.3.2 FR11	Skylight SHGC value.	SHGC: <input type="text"/>	<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>
303.1.3	Fenestration products rated in accordance with		<span style="border: 1px solid #ccc; padding: 2px;">N/A</span>	<input style="width: 100%;" type="text"/>

# Analyze the Data

The screenshot shows the 'Score + Store' web application interface. At the top left is the logo, and at the top right is the user information: 'Welcome markus.kobold@pnl.gov' with links for 'Account' and 'Logout'. Below this are links for 'Manage user accounts' and 'Manage templates'. The main section is titled 'My Checklists' and includes a '+ New Checklist' button. It displays 'Showing 2 checklists.' followed by a table with the following data:

COUNTY	JURISDICTION	BUILDING CLASS	EVALUATORS	SCORE	
King	Hunts Point Town	Commercial	Kate Mon	100.0%	 
Walla Walla	Walla Walla	Residential	Gary Mod	N/A	 

At the bottom left, there are links for 'Contact: Technical Support' and 'Security & Privacy'.

## Store + Score Sample Results

### Checklist Metrics

#### Code Requirements with Highest Compliance Rate (Top 3)

PR6 - [8.4.1.1] Feeder connectors sized in accordance with approved plans.

PR7 - [8.4.1.2] Branch circuits sized for maximum drop of 3%.

ME8 - [6.4.4.1.2] HVAC ducts and plenums insulated.

#### Code Requirements with Lowest Compliance Rate (Top 3)

PR1 - [4.2.2] Plans and/or specifications provide all information with which compliance can be determined for the building envelope and delineate and document where exceptions to the standard are claimed.

FR3 - [5.4.3.2] Fenestration and doors labeled for air leakage.

FR2 - [5.4.3.2] Doors meet maximum air leakage requirements.

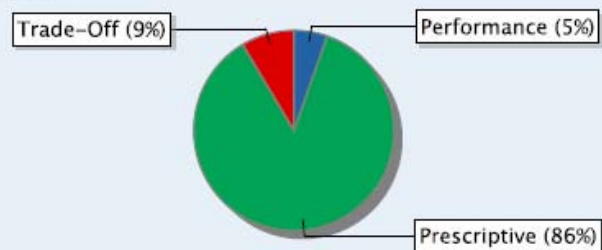
#### Code Requirements Most Frequently Not Observed (Top 3)

FR14 - [5.8.2.3,5.5.3.6] U-factor of opaque doors associated with the building thermal envelope meets requirements.

FR12 - [5.8.2.1] Fenestration products rated in accordance with NFRC.

FR13 - [5.8.2.2] Fenestration products are certified as to performance labels or certificates provided.

#### Compliance Approach Breakdown





# Step-by-Step Companion Guide

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

**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 (BECU) released **Measuring State Energy Code Compliance**, a report that collects BECU's recommended methodologies, which were developed with key input from stakeholders. The full report is available at [www.energycodes.gov/ama/compliance\\_evaluation.htm](http://www.energycodes.gov/ama/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 BECU 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 on” compliance, the first step is to have a proper checklist. BECU 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/ama/compliance\\_evaluation.htm](http://www.energycodes.gov/ama/compliance_evaluation.htm)

**Step 2**  
**GENERATE SAMPLES**

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

- Residential new construction
- Commercial renovations
- Commercial 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—BECU offers State Sample Generator, an automated solution for your state. You can find your state's custom Sample Generator at <http://www.energycodes.gov/SampleGen>

**Step 3**  
**CONDUCT ON-SITE EVALUATIONS**

Do you have data collected, and you know where it is? Do you have the tools? Formal procedures are available to be conducted by third-party evaluators. For on-site evaluations, inspecting new construction and renovation projects according to the energy code is a natural next step, but it can be a challenge—sometimes it's just the way it is. BECU's [www.energycodes.gov/Evaluation](http://www.energycodes.gov/Evaluation) provides a variety of resources to help answer your compliance-related questions. In particular, you'll find Educational and Training Solutions and On-Site and Follow-Up Tools.

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

**Step 4**  
**ANALYZE YOUR STATE'S DATA**

How do you get the most out of compliance data? The question becomes: How should the data be analyzed and used? At this stage, together, it provides answers to state compliance questions. For example, states may send BECU their data to generate a BECU's Checklist Score and Score Tool. (coming soon to [www.energycodes.gov/ama/compliance\\_evaluation.htm](http://www.energycodes.gov/ama/compliance_evaluation.htm)), which can be used to generate building and state-wide metrics.

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

**ALTERNATIVE OR PRACTICE ROUTES**

In some states, Steps 1-4 may not be feasible manually for a variety of reasons. Thus, BECU offers various suggested alternatives to the formal procedures. For example, training and annual measurements can be implemented by coordinating with associations, which will help improve compliance rates after formal procedures are applied. The graphic improvements below of 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 survey mechanisms and spot checks. “Spot checks” are defined as onsite evaluations of a smaller number of buildings than those observed necessary in the more formal evaluation procedures.

**BECP Tool:** Additional surveys are available in online and downloadable formats, for states to distribute electronically or modify and use for their purposes. Visit [www.energycodes.gov/ama/compliance\\_evaluation.htm](http://www.energycodes.gov/ama/compliance_evaluation.htm)

**We Need Your Feedback**

As your state's energy program is established and implemented, BECU wants to know how the process went. Do you have any comments or suggestions? Please contact us at [feedback@leedscenter.org](mailto:feedback@leedscenter.org)

**Thank you!**

The effort that the participating states and larger agencies in compliance information is a significant contribution to the state's energy efficiency. BECU is grateful for the support of building energy codes. The support that you provide is critical to each state's progress in energy efficiency. Thank you for your hard work to achieve energy savings for your constituents.

**Building Energy Codes University**  
A BECU Tool  
www.energycodes.gov

**ENERGY**  
Energy Efficiency &  
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U.S. DEPARTMENT OF ENERGY  
1000 POWER BUILDING  
WASHINGTON, DC 20585



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

