The City Energy Project Assessment Methodology for Energy Code Compliance in Medium to Large Cities

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CONTENTS

Abstract

The CEP Assessment Methodology is designed to assist medium to large cities in identifying residential and commercial energy code compliance issues and developing solutions to such issues to ultimately increase compliance rates with the energy code. This methodology will provide an *informal* energy code compliance rate that is not intended to be statistically valid or supersede compliance methodology recommended by the U.S. Department of Energy. Compliance information collected as part of the study can feed into larger statewide compliance studies. Strategies to increase compliance are contained in the ***Establishing a Plan to Achieve Energy Code Compliance in Cities*** document.

Introduction

Ensuring compliance with building energy codes is a simple, ready-made way for cities to realize energy and carbon savings without the passage of any new policies. In fact, according to a fact sheet produced by the Institute for Market Transformation (IMT) in partnership with 16 other leading energy efficiency organizations, every dollar spent on energy code enforcement yields $6 in energy savings: A 600 percent return on investment.

Building energy codes are legal requirements—adopted at the state and local levels—for the design and construction of buildings. They establish the minimum level of energy efficiency for new residential and commercial buildings and for alterations and additions to those buildings. They improve efficiency by mandating performance through careful construction and proper systems design.[1]

From 2006 to 2012, national model energy codes increased energy savings potential by nearly 30 percent. However, these savings are only realized when a building is designed and constructed to meet the provisions of the adopted energy code. Enforcement of energy codes is almost always done by building permit office staff at the local (city or county) level who typically review plans to ensure they are compliant and then conduct field inspections to verify that the plans are followed during construction. Non-compliance can be a result of several factors, including department budget, priorities, training, and accountability. Design and construction professionals are most likely to comply when given adequate education and training; similarly, city building department staff are most likely to spot non-compliance when they have adequate tools, training, and accountability for reviewing plans for compliance and sufficiently inspecting construction.

[1] Energy Codes 101 provides a comprehensive, non-technical introduction to energy codes, available at https://www.energycodes.gov/sites/default/files/documents/DOE_Building%20Energy%20Codes%20101_February2010_v00.pdf.

1.1. Benefits of Code Compliance

Low compliance rates mean energy savings associated with code compliance are lost and households and businesses incur unnecessary costs for heating and cooling buildings. Residents may spend an additional $300 per year on their energy bills.[2] That is significant to a household's budget, and is also impactful when extrapolated to a city: for example, in a city with 4,000 annual single-family housing starts, that translates to an additional $1.2 million that homeowners and renters would pay for utility bills if compliance rates are low. This figure increases exponentially when new commercial and multifamily buildings are considered. In fact, a recent IMT CEP Compliance Assessment study found that in one Mid-Atlantic city, high-rise multifamily buildings were using $0.50 additional per square foot in energy costs due to non-compliance. That adds up to over $1.5 million in unnecessary annual energy costs for buildings permitted citywide in 2014 alone. The study also found that commercial office buildings were paying an additional $0.25 per square foot in energy costs due to non-compliance with the code, which is nearly $3 million for buildings permitted citywide in 2014 alone.

In addition to the energy-related cost savings associated with code compliance, energy codes provide additional significant benefits[3,4] including:

- Increasing durability of the building envelope, preventing air leaks that could potentially bring contaminants and pollutants that are stored outside of the conditioned space into the building
- Improving fires safety
- Protection from extreme temperatures and storms
- Preventing potential moisture, mold, and rot problems
- Reducing water use via hot water piping insulation
- Increasing the comfort and safety of the building's occupants

1.2. Statewide Code Compliance Assessments

Historically[5], compliance assessment studies have been done at the state and regional level. However, while providing valuable information on state and regional trends, they don't meet the needs of cities for several reasons:

- Cities that participate in the evaluations typically receive little to no feedback on the findings or what actions could be taken to correct compliance issues
- Statewide compliance studies data collection teams, particularly those following U.S. Department of Energy protocol, often have limited interaction with the jurisdictions
- The statewide sample may include only a small number of buildings in any one jurisdiction
- The analysis focuses on statewide trends

[2] http://www.imt.org/uploads/resources/files/PolicymakerFactsheet-EnergyCodeCompliance.pdf
[3] http://www.imt.org/uploads/resources/files/non-energy_benefits_of_energy_codes_report.pdf
[4] http://www.swenergy.org/data/sites/1/media/documents/codes/Energy-Codes-are-Life-Safety-Codes.pdf
[5] A background on the development of statewide compliance methodology is provided in Appendix A.

Re-focusing compliance assessment from a state to a city allows the evaluation to look more specifically at the jurisdiction. The CEP Assessment Methodology looks specifically for barriers and solutions to compliance within the city, uses a larger and more proportional population of buildings in a city, and directly involves staff to provide an interactive learning opportunity.

2. An Overview of the CEP Assessment Methodology

To assist medium and large cities in assessing code compliance, the City Energy Project created *The CEP Assessment Methodology for Energy Code Compliance in Medium to Large Cities*, a plug-and-play methodology for cities to assess code compliance. This peer-reviewed methodology collects data on building systems, conducts interviews, and evaluates processes to provide both qualitative and quantitative feedback, including an estimated percentage compliance rate, and cumulative increased energy use due to non-compliance.

The CEP began conducting citywide compliance assessments in 2013. In 2014, the CEP Assessment Methodology was drafted based on lessons learned in the first 10 cities participating in the project, and the methodology transitioned from looking at whole buildings to systems. Overall, initial compliance rates in the CEP cities have ranged from 64 percent to 75 percent, as illustrated in Figure 1. Originally published in 2016, the CEP Assessment Methodology has since been updated based on additional lessons learned and current best practices to further assist the cities in compliance assessment. Cumulative increased energy use due to non-compliance is calculated based on data collected in the field and building starts in the city, reflecting the true cost of non-compliance and providing a tangible objective for improved compliance[6].

[6] Appendix B provides an overview to the changes in the 2017 release of the CEP Assessment Methodology.

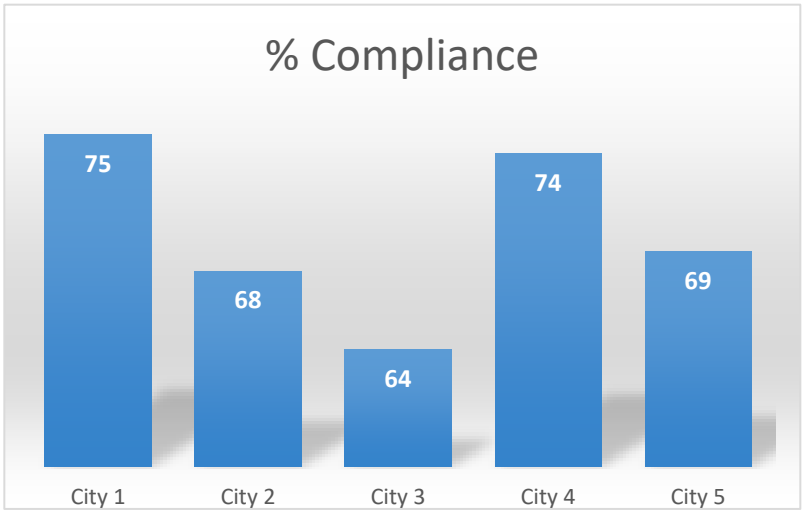

Figure 1. Initial Compliance Rates

2.1. Four Phase Protocol

The CEP Assessment Methodology provides a four-phase protocol to comprehensibly assess a city's energy code compliance, and develop a compliance improvement plan. Briefly described below, the phases are more fully detailed in Table 1, and in the respective sections of the document.

- **Phase 1.** Review initial submittals of construction plans to the building department, interview plan reviewers, and assess intake and plan review processes. (Refer to Section 3.1 Phase 1)
- **Phase 2.** Assess plans which have been plan reviewed, necessary corrections made, and have been deemed "Approved" for construction, complete any unfinished interviews and plan review process assessment. (Refer to Section 3.2 Phase 2)
- **Phase 3.** Conduct on-site inspection of buildings under construction, interview inspectors and assess inspection processes. (Refer to Section 3.3 Phase 3)
- **Phase 4.** Analyze findings, develop a compliance improvement plan. (Refer to Section 3.4 Phase 4)

For the qualitative component, interviews with building department staff and an assessment of plan review and inspection processes help reveal challenges to effective energy code compliance, and options to address those challenges through education or operational changes within the city.

For the quantitative analysis, key information is collected on a wide variety of code requirements, from insulation levels in walls to specifications for heating, ventilation, and cooling (HVAC) equipment.

To increase flexibility and use by the cities, the CEP Assessment Methodology includes scoping options which impact time and cost of the assessment to the jurisdiction. These scoping issues are discussed in Section 2.5 Scoping Modifications and Decisions.

Table 1. CEP Methodology Overview

Phase	Task Descriptions – Recommended Staff Responsibilities	Task Descriptions – Recommended Third-Party Responsibilities
Phase 1	**Data Collection and Plan Review of Submittal Quality.** Staff collects data during the initial review of the building plans and documentation to assess the quality of the submittal from a compliance standpoint. Data gathered here will help indicate how compliant the construction plans are when they are initially submitted to the building department, and if there are design trends or problems to address among architects and developers. **This phase focuses on tenant build-outs and additions or alterations anticipated to be permitted and completed within six months.**	**Interview and Evaluate Energy Code Knowledge of Internal Staff.** The third party will interview plan review staff to determine knowledge of the code and identify determine problems and issues they are experiencing. **Assess the Process for Document Submittal, Plan Review**. The third party will review the entire process from initial submittal through inspection and document storage, to identify any issues that impact compliance. Examples include lack of clarity on what information needs to be submitted, storage processes that hamper retrieval of energy code documentation, etc.
Phase 2	**Data Collection and Plan Review of Approved Plans.** Assess the approved plans of the projects reviewed during Phase 1, plus as many additional projects as are selected to complete the sample size, with an emphasis on new construction. Looking at the approved plans provides information on what staff may be missing in their review, and how to educate them.	**Complete Interview and Process Evaluation as Needed** **Train Staff for Data Collection**, provide quality assurance check at halfway (50 percent) point of data collection.
Phase 3	**On-Site Verification.** Assess code compliance for components of the systems evaluated in Phases 1 and 2 based on field inspections of building systems. This information is entered into data collection forms that were initially populated in Phases 1 and/or 2.	**Train Staff for On-Site Verification**, provide quality assurance check at halfway (50 percent) point of data collection. **Interview and Evaluate Energy Code Knowledge of Internal Staff.** The third party will interview field inspection staff to determine knowledge of the code and determine problems and issues they are experiencing. **Assess the Process for Inspections.** The third party will review the field inspection process to determine what tools are currently being used in terms of checklists, computers, etc., to guide the field inspection for the energy code.
Phase 4		**Final Review of Data.** The third party overseeing the evaluation process for the City reviews the complete set of data provided by Phases 1, 2, and 3, and determines the city's estimated rate of compliance. It also assembles quantitative and qualitative information to resulting in a compliance plan for how the city can improve compliance.

2.2. Building Systems

Importantly, the CEP Assessment Methodology applies a "building systems" approach. Data is collected on each of the three systems which comprise a building—building envelopes (roof, walls, and foundation), lighting, and HVAC mechanical systems—as those systems are accessible. Data is collected from building plans for a building that will be at a stage in the construction process that reveals the system to be inspected during the time frame of the assessment. For example, if the mechanical system is going to be inspected, the ducts should not be covered with sheetrock at the time of inspection. Using a systems approach allows greater access to data in a shorter amount of time from several buildings compared to the whole-building approach, which requires multiple visits to a single building over the construction period to collect data on all systems from one building.

2.3. CEP Assessment Methodology Sample Size

The CEP Assessment Methodology recommends a sample size of 35 commercial additions/tenant build-outs or alterations, 20 new commercial new buildings, and 30 residential buildings. The sample is distributed across systems and building type, including new construction and additions and alterations of both commercial and residential structures, for medium and large cities.

The CEP Assessment Methodology includes a total of 85 system samples for both plan review and on-site verification, for a total of 170 samples, as shown in Table 2. The number of building systems selected is not intended to be statistically valid. Instead, the CEP Assessment Methodology is intended to provide sufficient information to the building department to determine an informal compliance rate with the energy code and identify potential energy code compliance issues. The number of building systems selected is also intended to alleviate any undue burden on the building department implementing the methodology.

There are several goals for the sampling strategy of the CEP Assessment Methodology program:

- Ensure that cities collect sufficient information on energy code compliance without over-burdening plan review and field inspection staff
- Design the sample set so that it is reasonably representative of the energy impacts of the mix of projects that occur within cities. Since cities tend to have a high percentage of large commercial buildings, including multifamily buildings taller than three stories, these building types are more highly represented than single-family residential structures. Similarly, since renovation rather than new building construction is more common in cities, the required sampling rate for alterations is comparatively high, and creates a common methodology for city-to-city comparison.

It is also recommended that projects that are unique to the jurisdiction (only one building of its type will be built) should be avoided when selecting the sample. Additions and alteration projects selected for the sample should be complex enough to elicit interest given the scope of the study. Residential buildings are defined as low-rise (three stories or less) projects that include one-, two-, and multifamily homes. Fewer residential than commercial samples are proposed to reflect the typical proportion of residential and commercial buildings in a medium-to-large city. Note that commercial buildings, as defined above, include multifamily residential buildings that are four stories and higher. The buildings should not be participants in an above-code program such as LEED or ENERGY STAR.

Table 2. CEP Recommended Sample Size

COMMERCIAL ADDITIONS/TENANT BUILD-OUTS/ALTERATIONS (PROJECTS ≤ 6 MONTHS TIME FRAME)				
Building System	Sample Size			
Envelope	5 Prescriptive Approach	5 COMCheck/ Performance Approach		Total # of Envelope Systems: **10**
Lighting	5 Retail	5 Office	5 Other Building Types	Total # of Lighting Systems: **15**
HVAC/Service Water	5 Single Zone Systems	5 Complex Systems		Total # of HVAC Systems: **10**
				Total # of System Samples: **35**
Commercial New Construction/Alterations/Additions (Projects>6 Months' Time Frame)				
Envelope	5 envelope systems			Total # of Envelope Systems: **5**
Lighting	5 systems that represent alterations and additions that are tenant build-outs and 5 that represent new construction			Total # of Lighting Systems: **10**
HVAC/Service Water	5 new systems added to the building			Total # of HVAC systems: **5**
				Total # of System Samples: **20**
Residential New Construction/Additions				
Envelope	5 Prescriptive Approach	5 REScheck/ Performance Approach		Total # of Envelope Systems: **10**
Lighting	10 lighting systems			Total # of Lighting Systems: **10**
HVAC/Service Water	10 HVAC systems/Service Water			Total # of HVAC/Service Water Systems: **10**
				Total # of System Samples: **30**

2.4. CEP Assessment Time Frame

The CEP Assessment Methodology is designed for a six- to nine-month period, as illustrated in Table 3. Phase 1 and Phase 2 can start concurrently based on the type of projects selected. Phase 3 can start within two weeks of the start of Phase 2, as the process may already be in progress for projects selected during Phase 2. Phase 3 should be completed by the end of month seven. Final data collected during Phase 3 will be compiled and evaluated in Phase 4, which should be completed by the end of nine months.

Table 3. CEP Assessment Time Frame

Month:		1	2	3	4	5	6	7	8	9
Full Assessment										

Legend:		Phase 1	Phase 2	Phase 3	Phase 4

2.5. Scoping Modifications and Decisions

The CEP Assessment Methodology can be varied in the following three dimensions, depending on how expansive the city wishes to make its scope, the volume of building permits and construction trends, and how much time and budget available to invest in the study:

- Integration of Phase 1 with Phases 2 and 3
- Data collection sample size
- The degree of building department staff involvement

2.5.1 Modified Phase 1 Integration

The jurisdiction may follow the Phases as they are scoped, or choose to modify Phase 1. As recommended, plan review staff conduct initial review of plans at intake in Phase 1, and these same plans are then reviewed by a third party in Phase 2. An onsite inspection is conducted on that same system in Phase 3.

Issue: Data collection at three construction stages (initial submittal, final plan review, and construction) of a building system necessitates a time span of six to nine months, even when Phase 1 is limited to tenant build-outs and additions or alterations anticipated to be permitted and completed within six months. If a study of six to nine months is not feasible for a jurisdiction, or the jurisdiction has different needs, the CEP Methodology offers a Modified Approach to Phase 1 as illustrated in Table 4, in which changes to Phase 1 are italicized. The modified approach can significantly reduce the time frame of the study, depending on construction activity, however it does eliminate the opportunity to compare findings across three stages of construction, and the opportunity to identify and assess common design issues.

Solution: Conduct Phase 1 data collection discretely from Phases 2 and 3, using an additional sampling equal to 1/3–1/2 of the overall designated sample.

Table 4. Modified Phase 1 Integration

	Full Assessment	Modified Phase 1 Approach
Phase 1	**Interview and Evaluate Energy Code Knowledge of Internal Staff.** The third party will interview plan review staff to determine knowledge of the code and determine problems and issues they are experiencing. **Assess the Process for Document Submittal, Plan Review**. The third party will review the entire process from initial submittal through inspection and document storage, to identify any issues that impact compliance. Examples include lack of clarity on what information needs to be submitted, storage processes that hamper retrieval of energy code documentation, etc. **Data Collection and Plan Review of Submittal Quality.** Staff collects data during the initial review of the building plans and documentation to assess the quality of the submittal from a compliance stand point. Data gathered here will help indicate how compliant the construction plans are when they are initially submitted to the building department, and if there are design trends or problems to address among architects and developers. **This phase focuses on tenant build-outs and additions or alterations anticipated to be permitted and completed within six months.**	**Interview and Evaluate Energy Code Knowledge of Internal Staff.** The third party will interview plan review staff to determine knowledge of the code and determine problems and issues they are experiencing. **Assess the Process for Document Submittal, Plan Review**. The third party will review the entire process from initial submittal through inspection and document storage, to identify any issues that impact compliance. Examples include lack of clarity on what information needs to be submitted, storage processes that hamper retrieval of energy code documentation, etc. **Data Collection and Plan Review of Submittal Quality.** Staff collects data during the initial review of the building plans and documentation to assess the quality of the submittal from a compliance stand point. Data gathered here will help indicate how compliant the construction plans are when they are initially submitted to the building department, and if there are design trends or problems to address among architects and developers. ***This sample will not be included in Phase 2 or Phase 3. The additional sample should be approximately 1/3–1/2 that of the designated sample size.***

Phase 2	**Complete Interview and Process Evaluation as Needed** **Data Collection and Plan Review of Approved Plans.** The third party or building department staff assess the approved plans of the projects reviewed during Phase 1, plus as many additional projects as are selected to complete the sample size, with an emphasis on new construction. Looking at the approved plans provides information on what staff may be missing in their review, and how to educate them.	**Complete Interview and Process Evaluation as Needed** **Data Collection and Plan Review of Approved Plans.** The third party or building department staff assess the approved plans *as designated in the sample size. If conducting a modified Phase 1 assessment, this phase will include a sample of tenant build-outs, additions and alterations, and new construction per the CEP Assessment Methodology*. Looking at the approved plans provides information on what staff may be missing in their review, and how to educate them.
Phase 3	**Interview and Evaluate Energy Code Knowledge of Internal Staff.** The third party will interview field inspection staff to determine knowledge of the code and determine problems and issues they are experiencing. **Assess the Process for Inspections.** The third party will review the field inspection process to determine what tools are currently being used in terms of checklists, computers, etc., to guide the field inspection for the energy code. **On-Site Verification.** The third party or staff assess code compliance for components of the systems evaluated in Phases 1 and 2 based on field inspections of building systems. This information is entered into data collection forms that were initially populated in Phases 1 and/or 2.	**Interview and Evaluate Energy Code Knowledge of Internal Staff.** The third party will interview field inspection staff to determine knowledge of the code and determine problems and issues they are experiencing. **Assess the Process for Inspections.** The third party will review the field inspection process to determine what tools are currently being used in terms of checklists, computers, etc., to guide the field inspection for the energy code. **On-Site Verification.** The third party or staff assess code compliance for components of the systems evaluated in Phase 2 based on field inspections of building systems. This information is entered into data collection forms that were initially populated in Phase 2.
Phase 4	**Final Review of Data.** The third party overseeing the evaluation process for the City reviews the complete set of data provided by Phases 1, 2, and 3, and determines the city's estimated rate of compliance, and cumulative energy savings lost due to non-compliance. It also assembles quantitative and qualitative information to resulting in a compliance plan for how the city can improve compliance.	

2.5.2 Modified Sample Size

The sample size can be adjusted based on the number of construction starts, the budget available for the assessment, staff availability, and internal decisions on what is appropriate for the city.

Issue: Constructions starts, staff time, or other issue that may conflict with assessing the recommended sample size.

Solution: Conduct the assessment with a minimum sample size is 15 sets of commercial building plans and 10 sets of residential plans. The data collection for a sample of this size can typically be conducted in two weeks, with assessment completion in three to five months. This sample size is similar to that in the CEP compliance assessments in several cities. Occupancy types (e.g., lighting sample) can also be adjusted based on typical occupancy types being permitted in the city, but the number of total occupancy types should be limited to no more than five.

2.5.3 Level of Staff Involvement/Third Party Support

In preparing to conduct a compliance assessment, jurisdictions will need to make decisions on the level of staff involvement and the role staff play in data collection, as well as the use of outside consultants.

The CEP Assessment Methodology encourages collaboration with building department staff starting in the data collection process. This provides an opportunity for staff to identify solutions to compliance issues, and to gain further education on the energy code and how it affects energy consumption in their jurisdiction. The CEP Assessment Methodology recommends using an outside consultant to interview staff and assess processes, train staff in data collection, provide oversight and quality assurance, and provide the final analysis and compliance improvement recommendations. How these responsibilities align with the phases is illustrated in Table 1. This approach has the potential to reduce the costs of data collection while providing hands-on education for the building department staff.

A jurisdiction has several different options for conducting an energy code compliance assessment including:

- CEP Recommended Third-Party Staff Team Evaluation
- Staff Self-Evaluation
- Third-Party Evaluation

Each approach uses a slightly different strategy for conducting the assessment with varying advantages and disadvantages, as discussed on the following pages. In practice, many cities have preferred to have an outside consultant conduct the entire assessment, due to time and resource constraints.

Tables 5 and 6 provide estimates of staff time involved in an assessment, considering variables of staff or third party collecting the data, and whether the data collection is integrated into the regularly scheduled plan reviews and inspections or whether it is conducted separately.

	Staff Collect Data		
	Phases 1 and 3 **Integrated** into Plan Review and Inspection Process	Phases 1 and 3 **Separated** from Plan Review and Inspection Process	Third Party Collects Data
Training	8 hrs. each	8 hrs. each	
Qualitative Interviews	1 hr. each	1 hr. each	1 hr. each
Phase 1	0.5 hr. per sample (max/min)	1 hr. per sample	----
Phase 2	1 hr. per sample	1 hr. per sample	0.5 hr. per sample
Phase 3	0.5 hr. per sample	2 hrs. per sample	2 hrs. per sample
Phase 4	-----	-----	----

Table 5. Staff Time for Assessment per Sample

Thus, in addition to a day of training and hour in interview, staff time works out to the following:

Table 6. Staff Time for Assessment, Recommended and Minimum Sample Size

	Staff Collect Data				Third Party Collects Data	
	Phases 1 and 3 **Integrated** into Plan Review and Inspection Process		Phases 1 and 3 **Separated** from Plan Review and Inspection Process			
	Recommended Sample Size: 55 Commercial, 20 Residential	Minimum Sample Size: 15 Commercial, 10 Residential	Recommended Sample Size: 55 Commercial, 20 Residential	Minimum Sample Size: 15 Commercial, 10 Residential	Recommended Sample Size: 55 Commercial, 20 Residential	Minimum Sample Size: 15 Commercial, 10 Residential
Phase 1	37.5	12.5	75	25	----	----
Phase 2	75	25	75	25	37.5	12.5
Phase 3	37.5	12.5	150	50	150	50
Phase 4	----	----	----	----	----	----

2.5.3.1 CEP-Recommended Third-Party and Staff Team Approach

The CEP Assessment Methodology recommends a Third-Party and Staff Team model where a third party provides initial oversight and training to the building department during the evaluation process. The in-house staff then collects data from the building plans and on-site inspections. Finally, the third-party and completes Phase 4, conducting analysis and developing a compliance improvement plan. The Third-Party and Staff Team Approach is recommended as an alternative to pure third-party evaluation as it can reduce the cost of that evaluation by using the consultant in more targeted ways. During a CEP assessment, the third party monitors the evaluation process and provides assistance when needed while the building department staff receives training on the evaluation process and the energy code. As with self-evaluation, staff will have direct access to the building plans and all stages of construction so fewer assumptions are necessary during the data collection process. In-house staff can either assess the results of the evaluation process or provide the data to the third party for assessment. The Third-Party Staff Team approach has the advantages of both the third party and self-evaluation assessment strategies, while minimizing the disadvantages associated with each.

Advantages

The third party can provide oversight into the evaluation process and reduce the bias typically associated with self-evaluation. Additionally, the overall cost is significantly less for the Third-Party and Staff Team approach, as opposed to for pure third-party evaluation. Evaluators have direct access to the building plans and construction projects, which enables them to collect compliance data as the project progresses, reducing the number of assumptions that typically enter the collection process. Compliance issues and problems can be identified and reported immediately. Staff will increase their knowledge on the energy code over time as they evaluate their own work. The third party can be used to validate compliance barriers that may exist outside of the building department and even engage City leadership on developing solutions.

Disadvantages

The cost of a Third-Party and Staff Team evaluation is greater than self-evaluation by the building department, as a qualified third-party will need to be contracted to assist with the evaluation. This cost, however, is significantly less than a full third-party review. There may also be some residual bias since plan review and inspection will be performed by in-house staff, although the third-party oversight should reduce that problem.

2.5.3.2 Self-Evaluation

Self-evaluation, sometimes considered "first-party" evaluation, involves in-house plan review and inspection staff performing an energy code compliance assessment on their department. Self-evaluation can lead to biased results. For example, those conducting the evaluation may not accurately report compliance issues due to lack of training, or to protect the jurisdiction or staff member involved in the plan review or inspection of a project. As such, self-evaluation should not be used as a formal evaluation process. However, because the evaluator has direct access to building plans and the construction site, the quantity of "real" data collected can be significantly greater than third-party evaluation. The self-evaluation process allows plan review and inspection staff to collect on-site data as the building is being constructed versus visiting the site just once during the evaluation process.

Advantages

A self-evaluation can be conducted in-house with a minimal budget, as evaluators (plan review and inspection staff) have direct access to the building plans and construction projects.

Disadvantages

Self-evaluation can lead to subjective, biased results that may not accurately reflect issues within a jurisdiction. A common problem is the evaluator may not have training or experience in evaluating energy code compliance and therefore may lack the expertise necessary to determine compliance with the energy code—this can lead to inaccurate results.

A self-assessment may also make it difficult to address energy code compliance challenges that are caused by policies outside of the building department. For example, if the city council has set a policy to fast-track development to the detriment of energy code compliance, it may be difficult for building department staff to bring attention to such a policy. Finally, there may be reluctance on the part of code officials to expose low compliance rates which might reflect badly on the department.

2.5.3.3 Third-Party Evaluation

Third-party evaluation involves the use of an independent evaluator with no conflict of interest with the City, designers, or builders assessed as part of the project. Third-party evaluations eliminate bias in the evaluation process and produce objective results. The evaluator or evaluation team conducts the evaluation over a period of days, weeks, or months based on the depth of the evaluation. Evaluators complete data collection forms for both quantitative and qualitative data and evaluate and summarize the data prior to reporting to the City.

Advantages

The advantage of third-party evaluation is that it minimizes potential bias in producing an objective evaluation of the building department's processes. This type of evaluation also typically involves companies with expertise in the assessment of energy code compliance and requires less commitment by building department staff.

Disadvantages

Third-party evaluations can be expensive. Due to time and budget constraints for a typical third-party evaluation, most data must be collected from the construction site during one on-site visit per project. Although information is collected from the building plans, it is difficult to determine from the on-site visit if all measures comply with the energy code, or only those that are observed during the site visit under typical time constraints. Assumptions must then be made based on "typical construction practice" in the region to complete the data collection process. In addition, neither industry professionals nor code officials are included in the process, and much of the information gathered may not be effectively communicated between the third-party and code officials.

2.5.3.4 Minimum Building Department Staff Responsibilities

Regardless of the approach selected, building department staff should anticipate at least a minimum level of participation to ensure successful completion of the study. Plan review staff need to provide a predetermined number of sets of commercial and residential building plans representing typical and current construction trends in their jurisdiction. Since each of the projects reviewed during the plan review data collection process will be reviewed in the field in Phase 3, if not conducting data collection themselves, building department staff accompany a third party evaluator onto each project site.

3. Four Phases of CEP Compliance Assessment

Both qualitative and quantitative assessments are important, and work in tandem to comprehensively identify the issues facing the jurisdiction. For example, a quantitative assessment may identify that insulation R-values are non-compliant in many installations. A qualitative assessment may reveal that insulation inspections are not being conducted because of budget cuts and too few staff. Developing a solution that requires the inspector to verify that the installed insulation R-value matches the energy code documentation will not solve the compliance problem if there is no insulation inspection. Effective solutions must be tailored to address the specific barriers faced by the city.

The CEP Assessment Methodology focuses on collecting basic information on the plan review and field inspection processes. This data is collected on checklists (referred to as Data Collection Forms, as discussed in Section 4. Data Collection Tools). The completion of both the qualitative and quantitative assessments results in a compliance plan with solutions to improve compliance and realize energy savings (Refer to Section 3.4 Phase 4).

In addition, information is collected on the political and decision-making processes in the jurisdiction and attitudes toward energy efficiency in general. The qualitative evaluation is initiated by the third-party evaluator to provide an objective viewpoint assessment. A questionnaire (Appendix A. CEP Qualitative Assessment Tool) is used in interviews with plan review and field inspection staff in addition to onsite observations by the third party on how the enforcement process is working. Once complete, the third-party evaluator will review the findings of the qualitative assessment and make recommendations for improvements to the process, if warranted.

3.1. Phase 1: Plan review by building department staff[7]

Phase 1 provides an opportunity for the third party to assess the plan review process and interview plan reviewers, and the building department staff collect data from the initial plan reviews.

3.1.1 Interview and Evaluate Energy Code Knowledge of Internal Staff

Representative plan review and field inspection staff are interviewed to determine their perceived knowledge of the energy code and to determine what problems and issues they are having with the code. The gap in knowledge will be the difference between the perceived knowledge and how well they perform plan review and inspections. An assessment is done on the types of training that staff have attended and reference books that they may use for assisting on the job. Questions are asked concerning the issues and problems that the design and construction communities are having with the energy code.

[7] Within Sections 3.1 through 3.3, the party recommended by CEP Assessment Methodology to conduct each phase is referenced—e.g. Phase 1 as conducted by the building department staff, Phase 2 as conducted by a third party, however Section 2.4.2 Level of Staff Involvement/Third-Party Support addresses options for staffing the assessment.

3.1.2 Assess the Process for Document Submittal and Plan Review

The qualitative evaluation process will also assess the plan review process used in the building department. This will include an assessment that starts with the permit technicians responsible for initial project submittal and ensuring that the plans are complete and ends with those responsible for plan and document storage. Issues to be identified may include a lack of clarity regarding what information needs to be submitted and in what format, receiving a project without all the required energy code documentation, or the storage of plans in such a way that it becomes difficult to retrieve the energy code documentation. Internal processes can impact the ability to access accurate information about a project, which can lead to energy code compliance issues. This evaluation will assess the process used for both new construction and additions and alterations.

3.1.3 Collect Data from Initial Plan Reviews

During this stage, plan reviewers will use the Data Collection Form to record information from the plans and documentation for a select building system and determine if the building system complies with the energy code. Code violations will be recorded on the Data Collection Form with the action taken by the plan reviewer to correct the violation. For example, if window U-factors identified on the plans are less efficient than what is called for in the code, the action taken by the plan reviewer would be that a correction notice was sent to the designer to correct the issue with an additional comment on the form once the code violation has been corrected. This information is used as part of the qualitative assessment to assess process.

The first phase of the data collection process focuses on collecting data during the initial review of the building plans and documentation to assess the quality of the submittal from a compliance standpoint. Phase 1 only applies to tenant build-outs and additions and alterations where the project will be permitted and completed within six months from the start of the evaluation. If modifying Phase 1, this review will include an additional sample of plans, 1/3–1/2 of the designated sample size, which will not be reviewed again in Phases 2 or 3.

3.1.3.1 Plan Review Methodology

The CEP Assessment Methodology uses a basic plan review process for determining compliance with the energy code, which applies to both Phases 1 and 2. The evaluation follows a process common for plan review of energy code submittals:

1. Verify that compliance documentation is complete and accurate. This includes prescriptive compliance submittals, COMcheck or REScheck documentation, or performance approach submittals.
2. Verify that compliance documentation matches the building plans.
3. Verify that the information is contained in the building plans, specifications, and supporting documentation to show compliance with the energy code.

There are typically three types of energy code compliance options for a construction project:

1. Prescriptive
2. Trade-off (for example, COMcheck or REScheck)
3. Performance

Each of the options available to demonstrate compliance requires a slightly different approach when reviewing submittal documents.

3.1.3.1.1 Prescriptive Compliance.

The Data Collection Forms can be used to document compliance using the prescriptive approach. ASHRAE also provides forms for documenting compliance for the prescriptive requirements for commercial buildings. If no code compliance form is present with the building plans, the plans and specifications must be assessed to determine if compliance with the energy code is achieved. The Data Collection Form, included in Appendix B, can be used to guide the plan reviewer through verifying compliance with the code using the steps below:

- **Building envelope:** Use the minimum prescriptive R-values for insulation and maximum fenestration U-factors from the energy code to populate the minimum code requirements on the Data Collection Form. Review the plans to determine both the proposed insulation R-values for each assembly and window U-factors, and determine if the proposed value meets or exceeds the minimum requirements. All deficiencies should be recorded on the Data Collection Form and be listed as part of a correction notice. In addition, verify that the plans and specifications reflect the requirements for the building envelope that are not related to insulation and fenestration. Record all information on the Data Collection Form and identify the deficiencies.
- **Mechanical and Service Water Heating:** Verify that the proposed HVAC and service water heating (SWH) systems comply with the provisions of the energy code. Record all deficiencies on the Data Collection Form.
- **Building lighting system:** Verify that the lighting power density proposed in the building is less than or equal to the allowed lighting power density. Also verify that the lighting controls and other non-lighting power related lighting features comply with the energy code. Record all deficiencies on the Data Collection Form.

3.1.3.1.2 COMcheck and REScheck Compliance.

DOE COMcheck and REScheck software provides forms for documenting compliance with the energy code. If a project complies with the COMcheck or REScheck compliance approach, the levels of efficiency for different measures can be used from the COMcheck or REScheck form to complete the Data Collection Form. When completing the Data Collection Form, use the proposed values in the COMcheck or REScheck documentation to populate the minimum code requirements for the building envelope, HVAC, SWH, and lighting requirements. Use either the COMcheck or REScheck printout or energy code to verify that the plans and specifications provide the information needed to verify compliance with the code.

3.1.3.1.3 Performance Compliance

The energy codes require documentation that provides a summary of the building input file and associated output file when using the performance approach. Documentation from the software varies, but the steps used to evaluate COMcheck documentation can be used to complete the Data Collection Form. As with the COMcheck documentation, the minimum code requirements are the proposed values in the software.

Tool: Data Collection Form

Sample: Phase 1 as recommended—a subset of the overall sample, tenant build-outs and additions and alterations where the project will be permitted and completed within six months from the start of the evaluation. Modified Phase 1—an additional sample of plans, 1/3–1/2 the designated sample size.

Expected outcome: Evaluate the quality of plans and energy code documentation submitted by the applicant, identify training and education opportunities for the design community to improve compliance.

3.2. Phase 2: Plan review by third-party evaluators.

The second phase of the evaluation process will assess the same projects selected during Phase 1, as well as additional projects selected to complete the sample size provided in Table 2. This will allow the evaluators to select projects at random, reducing the bias associated with this methodology. Selected projects will be in a stage of construction that will allow a system to be inspected in the field. For example, if a project is selected for review of the lighting system, it will be important that the building be in a stage of construction where the system components are installed in the field.

If conducting the assessment with a modified Phase 1, this phase of the evaluation will assess a full sampling of projects based on the designated sample size.

The following process will be followed during Phase 2:

- Review the Data Collection Form, plans, and documentation completed for projects selected during Phase 1. A third-party evaluator will review the plans, documentation, and associated Data Collection Form to assess the effectiveness of the energy code plan review. This step is only applicable if conducting the full assessment.
- Review randomly selected plans and energy code documentation for systems that were not selected during Phase 1 and where no Data Collection Form was completed. Sufficient samples should be selected to complete the designated sample size.
- The third-party evaluator will review the plans and documentation, and complete the Data Collection Form to assess the effectiveness of the energy code plan review. The third-party evaluator will also review correction notices that pertain to energy code compliance, determine the action taken to correct the code violation, and record these on the Data Collection Form.

If staff is collecting data in Phase 2 rather than the third-party evaluators, a third party should perform a mid-point assessment when 50 percent of the plan review samples are complete to provide feedback to the jurisdiction on the findings to date. The third party may be an independent entity with in-depth knowledge of the energy code that is not employed by the building department as a plan reviewer or inspector.

Tool: Data Collection Form.

Sample: Plans from Phase 1, plus plans to complete designated sample size. Modified Phase 1—plans for entire designated sample size.

Expected outcome: Evaluate the effectiveness of the department's plan review for energy code compliance.

3.3. Phase 3: On-site Verification

3.3.1 Interview and Evaluate Energy Code Knowledge of Internal Staff

Representative plan review and field inspection staff are interviewed to determine their perceived knowledge of the energy code and to determine what problems and issues they are having with the code. The gap in knowledge will be the difference between the perceived knowledge and how well they perform plan review and inspections. An assessment is done on the types of training that staff have attended and reference books that they may use for assisting on the job. Questions are asked concerning the issues and problems that the design and construction communities are having with the energy code.

3.3.2 Assess the Process for On-site Inspections

The field inspection process will be assessed to determine what tools are currently being used in terms of checklists, computers, etc., to guide the field inspection for the energy code. The third-party evaluator will accompany the field inspector through a typical energy inspection at each stage of construction to assess the inspection process for energy to determine what is reviewed and how. Projects will be selected that represent both new buildings and additions and alterations.

3.3.3 Collect Data from On-site Inspections

The on-site data collection phase of the CEP Assessment will assess code compliance for components of the systems evaluated in prior Phases. The field inspector will perform the on-site data collection during each inspection performed (e.g., foundation, framing, rough-in of mechanical, etc.). The goal is to determine if the installed energy features meet the minimum energy code requirements listed on the Data Collection Form used for the Phase 1 and Phase 2 portions of the CEP evaluation.

The field inspector will record all findings when the job site is first visited for each inspection. An installation will either comply or not comply with the code. The action taken shall be recorded on the Data Collection Form for all features that do not comply with the code. For example, if the foundation insulation is found to be non-compliant with the energy code, the action recorded would be that a correction notice was given to the contractor to correct the violation. Any additional actions for the violation should be recorded on the Data Collection Form until the feature is compliant.

If staff is collecting data in Phase 3 rather than the third-party evaluators, the third party should perform a mid-point assessment when 50 percent of the field inspection samples are complete to provide feedback to the jurisdiction on the findings to date.

Tool: Completed data collection forms from Phase 2

Sample: Full sample, the same as Phase 2

Expected Outcome: Evaluate energy code compliance in the field, prior to corrections, based on the approved plans and documentation. Evaluate the action taken by the field inspector to have the violation corrected.

3.4. Phase 4: Final Review of Data.

All completed Data Collection Forms will then be collected by the third party overseeing the evaluation process for the City. Data and information will be analyzed to determine the informal rate of compliance, potential energy savings due to non-compliance, issues found during the collection process and other helpful feedback. There are several components to the final review and reporting.

3.4.1 Qualitative Analysis

Findings from the interviews and the checklists should be discussed in terms of frequency and impact. Based on findings, consider addressing the following areas:

- Program Staffing
- Use of Third Parties
- Plan Submittals
- Documentation
- Plan Acceptance
- Additions, Alterations, and Repairs Guidance
- Electronic Data Storage and Retrieval
- Site-Built Windows
- Lighting Controls
- Overall Training and Education
- Integration of Energy Code Plan Review and Inspection

3.4.2 Rates of Code Compliance

Compliance rates can be calculated directly in the Data Collection Forms. A rate of compliance provides a measurable point of comparison, but it does not provide an indication of energy savings lost (increased energy spent) due to non-compliance.

3.4.3 Cumulative Increased Energy Use Due to Non-Compliance

Calculating the cumulative increased energy use due to non-compliance provides the jurisdiction with the localized cost of non-compliance, based on energy rates, building types (e.g. residential, commercial-retail, commercial-office, etc.), and construction trends.

Construction permit data is needed to calculate cumulative energy impacts. For example, in a CEP Assessment that was limited to commercial buildings, the project team used the jurisdiction's construction permit data which showed the square footage of construction for each of the building types in the study. Energy lost per square foot of building area was estimated based on cumulative energy lost per occupancy and the floor area of the prototype buildings used in the EnergyPlus analysis.

3.4.3.1 Commercial

Cumulative 20-year potential energy savings for fully compliant commercial buildings can be modeled using DOE'S building prototypes to calculate the differences in energy use for compliant and non-compliant buildings, based on findings from Phase 3—field inspection Using industry standard modeling techniques, the project team can modify the ASHRAE 90.1 based prototypes to reflect the jurisdiction's base code, and local building practices, such as typical glazing area. The models are then again modified to reflect study findings to allow for comparison between code and assessment study findings.

Finally, an estimate for energy use is calculated assuming all buildings under construction had similar compliance issues as were documented in Phase 3. Energy lost can be determined for the total floor area under construction for each occupancy type on an annual basis. The annual energy lost is then extrapolated out 20 years to estimate the cumulative energy savings lost for the current floor area under construction for each occupancy type.

3.4.3.2 Residential

Cumulative, 20-year potential energy savings for fully compliant residential buildings can be calculated using Energy Plus, REMDesign, REMRate, or similar software in which energy use for a building is calculated. Like the analysis described for commercial buildings, findings from Phase 3 are applied to a standard home which reflects typical residential construction in the jurisdiction. An estimate for energy use is calculated assuming all residences under construction had similar compliance issues as were documented in Phase 3. Energy lost can be determined for the total residential floor area under construction on an annual basis. The annual energy lost is then extrapolated out 20 years to estimate the cumulative energy savings lost for the current floor area under construction.

3.4.4 Compliance Improvement Plan

This information will be used to determine an internal course of action to mitigate the compliance issues in concert with the results of the qualitative analysis mitigate the compliance issues identified through quantitative and qualitative analysis. A sample recommendation should be included for each point addressed in Section 3.4.1 Qualitative Analysis. For more information on how to establish an energy code compliance plan, refer to the document "Establishing a Plan to Achieve Energy Code Compliance in Cities."

4. Data Collection Tools

Phases 1–3 of the CEP Assessment Methodology build on data collected using forms based the DOE Data Collection Forms. The CEP Data Collection forms are available at www.imt.org/resources.

The residential data collection forms provided are based on the DOE Data Collection Sheets for the 2009 and 2012 IECC released in 2015; the commercial data collection forms are based on the compliance checklists developed for the 2009 and 2012 IECC released in 2015. The DOE forms have been modified to collect both plan review and field data, as well as to calculate compliance.

The Data Collection Forms are intended for use by evaluators to gather the appropriate information on energy code compliance. These forms generally reflect the energy code provisions that can be reviewed either during the plan review process or in the field and include instructions for proper use and recording results.

The Data Collection Forms collect a variety of information that is crucial to determining whether a building complies with the code. They list the code section number, as well as the building component being inspected, along with a column for the value proposed in the building plans and the observed value of the component installed in the field. This information can be used to inform the magnitude of the compliance issue, and modeling cumulative energy savings due to non-compliance. For example, if the minimum code requirement was R-20 + R-5 wall insulation and all the insulation installed was R-19, installing slightly more efficient insulation would solve the problem at a minimal cost. However, if the installed insulation is R-13, a change in framing to 2”x6” and additional insulation may be needed, resulting in a greater cost.

Based on the data collected from the plan reviews and field inspections, compliance for each component is determined from the compliance options listed in the Data Collection Form. Columns to record assumptions and observations are also included in the forms and can help inform the evaluation results. For example, a project may show continuous insulation for an exterior concrete wall with insulation installed between metal furring strips. The installation would not comply with the code, but the issue could be solved for future projects through training and education. The Data Collection Forms also include areas where the evaluator can record the actions necessary to correct any errors observed in the plan review and field inspection.

5. On-going Quality Assurance

Cities maximize the benefits of undertaking the CEP Assessment Methodology when they undertake periodic quantitative assessments, beginning one year after the completion of the initial assessment and then every two to three years thereafter. The results of the initial qualitative assessment should be reviewed as part of the ongoing evaluation to assess progress in implementing procedural changes. Additionally, an ongoing quantitative assessment will provide continued feedback to the city. Cities should consider using third parties to provide this sort of continuous improvement, but those third parties could be either outside consultants or a plan review or inspection staff member who has participated in the evaluation process. Where the city conducts periodic quantitative assessments, the CEP Assessment Methodology recommends using 50 percent of the sample size from Table 2 based on the building system types and types of projects.

6. CEP Evaluation Budget

Where the city uses an outside consultant, the budget should include both the costs for the contract, as well as building department staff time, which may vary depending on the number of phases of data collection the city undertakes and the sample size it selects. The cost for an outside consultant thus may vary from $30,000 to $80,000, a range which includes conducting qualitative reviews, overseeing the evaluation process, participating in Phase 2 data collection, evaluating the results, and providing a report.

A proposed budget for the one-year follow-up assessment again considers the soft cost of contracting with a third party to oversee the evaluation process, participate in the Phase 2 portion of the review, evaluate the results, review and assess progress in modifying procedures based on the recommendations of the initial qualitative analysis, and provide a report. The estimated cost per evaluation for the third party for the one-year follow-up assessment and the biennial or triennial assessments is $20,000 to $30,000 per city.

Cities may want to determine a long-term funding plan for implementing the initial evaluation, long-term evaluation, and compliance enhancement strategies, based on the evaluation results.

7. Conclusion

The CEP Assessment Methodology provides an effective, low-cost protocol for increasing energy code compliance in cities. Whether Phase 1 plan review provides a basis for subsequent data collection in Phases 2 and 3, or a discrete sampling of intake plan review, the study is done using the recommended or minimum sample size, utilizing staff or third party plan-led data collection, an energy code compliance assessment provides a city with critical information and a plan to drive improvements in its code enforcement efforts. Improved code compliance allows for realized energy savings associated with building energy codes and carbon savings.

The protocol provides a sampling methodology tailored to cities that can be performed quickly to provide actionable feedback. Plan review staff participating in this process will learn how to use the Data Collection Form as a plan review checklist and will increase their overall knowledge of the energy code. Field inspectors will also learn how to use the Data Collection Form to guide them through the energy code inspection process, resulting in greater compliance rates for the energy code. Increased enforcement will result in more complete and accurate plan submittals from designers and engineers; this will ultimately lead to reduced plan review and inspection time for energy codes, resulting in a direct benefit for the building, design and construction industries.

8. Important Resources

ASHRAE, Standard 90.1–2013 User's Manual, available at http://www.techstreet.com/ashrae?ashrae_auth_token=

The Institute for Market Transformation and Natural Resources Defense Council, "City Energy Project Data Collection Forms," updated in November 2017, available at www.cityenergyproject.org/resources

The Institute for Market Transformation and Natural Resources Defense Council, "Establishing a Plan to Achieve Energy Code Compliance in Cities," available at http://www.imt.org/resources/detail/establishing-a-plan-to-achieve-energy-code-compliance-in-cities

International Code Council, 2009 International Energy Conservation Code and ASNI/ASHRAE/IENSNA Standard 90.1– 2007 Energy Standard for Buildings Except Low-Rise Residential Buildings, available at http://shop.iccsafe.org/codes/2009-international-codes/2009-international-energy-conservation-code-1.html

International Code Council, 2012 International Energy Conservation Code and ASNI/ASHRAE/IENSNA Standard 90.1–2010 Energy Standard for Buildings Except Low-Rise Residential Buildings, available at http://shop.iccsafe.org/codes/2012-international-codes/2012-international-energy-conservation-code.html

International Code Council, 2009 IECC Code and Commentary, available athttp://shop.iccsafe.org/catalogsearch/result/?order=relevance&dir=desc&q=IECC+Commentary

International Code Council, 2012 IECC Code and Commentary, available at http://shop.iccsafe.org/catalogsearch/result/?order=relevance&dir=desc&q=IECC+Commentary

Indiana Department of Commerce, Energy and Recycling Division, "Indiana Commercial Energy Code Baseline Study," March 21, 2005, available at https://www.energycodes.gov/sites/default/files/documents/bp_indiana_commercial_energy_code_baseline_study.pdf.

U.S. Department of Energy, "Achieving the 30% Goal: Energy and Cost Savings Analysis of ASHRAE Standard 90.1–2010," May 2011, available at https://www.energycodes.gov/sites/default/files/documents/BECP_Energy_Cost_Savings_STD2010_May2011_v00.pdf

U.S. Department of Energy Building Energy Codes Program, Compliance Evaluation Checklists, available at https://www.energycodes.gov/compliance/evaluation/checklists

ABOUT CITY ENERGY PROJECT

The City Energy Project (CEP) is a groundbreaking national initiative to improve the energy efficiency of existing buildings in 20 major American cities. The partnership between CEP and the participating cities supports bold solutions that can be replicated by other municipalities nationwide and around the world to advance economic development and reduce pollution. CEP is a joint project of the Natural Resources Defense Council and the Institute for Market Transformation.

For more information about the City Energy Project, visit www.cityenergyproject.org.

Appendix A:
Statewide Compliance Assessment —A Background

The U.S. Department of Energy's (DOE) Building Energy Codes Program developed an evaluation protocol for determining energy code compliance rates. The document, "Measuring State Energy Code Compliance," was released in 2010 and provided initial national guidance for evaluating compliance rates at the state level. This protocol was based on methodologies used in past energy code compliance studies, including the *Iowa Residential Energy Code Plan Review and Field Inspection Training* and the *Indiana Commercial Energy Code Baseline Study* conducted by Britt/Makela Group. The DOE protocol has been used as a basis for subsequent commercial energy code compliance assessments, including studies in Georgia, Illinois, Iowa New York, Utah, and the Northwest. More recently, residential compliance studies were conducted in Alabama, Georgia, Kentucky, Maryland, North Carolina, Pennsylvania, Texas, and West Virginia and a multi-state study in Idaho, Montana, Oregon, and Washington.

In 2015, the DOE released an updated residential building assessment methodology, "Residential Energy Code Sampling and Data Collection Guidance for Project Teams." The DOE residential building assessment methodology has evolved to collect data on systems instead of whole buildings, calculating potential energy savings due to non-compliance, and the residential checklists have been updated to reflect collection of data on components DOE quantitatively determined as having the largest direct impact on energy use. The commercial building methodology is under development through an ongoing field study.

Appendix B:
Revisions to the 2017 CEP Assessment methodology

The 2017 release of the CEP Assessment Methodology is intended to provide clarity and offer important updates that will increase the value of compliance assessment to the jurisdiction. Technical revisions include:

- The CEP residential data collection forms have been updated based on the 2015 DOE Data Collection Sheets for the 2009 and 2012 IECC and modified to include plan review data collection. The CEP commercial data collection forms may be updated upon conclusion of the current DOE commercial field study.
- The CEP residential data collection forms have been updated to gather data on actuals values, in addition to pass-fail notations. For example, if the code requires R-19 insulation and R-13 observed, in addition to marking "does not comply", the value 13 is recorded.
- A minimum sample size is now identified of 15 commercial and 10 residential buildings.
- Cumulative energy savings lost due to non-compliance is calculated, modeled in EnergyPlus using DOE prototype buildings for commercial buildings and REMRate/REMDesign Energy Plus or software program with similar capability to calculate energy use—modified for findings in the field, Phase 3, and extrapolated for 20 years based on construction data.
- An option to disconnect Phase 1 from Phases 2 and 3 is now included. Currently Phase 1 (plan check at intake) is limited to tenant improvements and additions that can later be field inspected in Phase 3. Regardless of sample size, it tends to push the study time line out to seven to nine months. The option is presented to conduct Phase 1 as a discrete smaller sample simultaneously with Phase 2.

Appendix C: CEP Qualitative Assessment Tool

Agency _____

Jurisdiction served _____

Name of person completing survey _____

Title of person completing survey _____

Email address _____

Telephone number _____

Surveyor _____

Date _____

	QUESTION	RESPONSE
1	**Number of commercial building permits issued per year**	
2	**How is your jurisdiction funded?** **(Check all that apply)**	☐ Permitting Revenue ☐ Jurisdictional Budget ☐ Funding from the State ☐ Other
3	**Does everyone in your department have access to a copy of the energy code?**	
4	**How often do you refer to any energy code?**	
5	**How often do you refer to the other building codes?**	
6	**Who conducts energy code plan reviews? (Check any that apply)**	☐ In-House Staff ☐ Third-party entities ☐ Other jurisdictions or government agencies ☐ Not done ☐ Other
7	**Who conducts field inspections for energy code compliance? (Check any that apply)**	☐ In-House Staff ☐ Third-party entities ☐ Other jurisdictions or government agencies ☐ Not done ☐ Other:

8	**What level of education & training do you and/or your agency staff receive specifically for residential energy codes?**	☐ *High* – Professional certification by ICC or similar credentials. Receives annual training on the energy code. ☐ *Medium* – Receives periodic training on the energy code. ☐ *Low* – Receives on-the-job training on the energy code but seldom receives formal training ☐ *None* – Energy codes training is never provided
9	**What level of education and training do you and/or your agency staff receive specifically for commercial energy codes?**	☐ *High* – Professional certification by ICC or similar credentials. Receives annual training on the energy code. ☐ *Medium* – Receives periodic training on the energy code. ☐ *Low* – Receives on-the-job training on the energy code but seldom receives formal training ☐ *None* – Energy Codes training is never provided
10	**If training is received, how is it delivered? Check all that apply**	☐ Classroom ☐ In the Field ☐ Webinar/Online ☐ Other
11	**How would you prefer to receive your training?**	
12	**If training is received, do you feel the training is worthwhile and you learned what you needed to learn?**	

13	**Is there any specific training you would want to receive that would benefit you in your job?**	
14	**What methods are used as a basis for documenting energy code compliance in commercial buildings and in what percentages?** Note: Include COMcheck submissions for trade-off percentage.	Prescriptive Trade-off Performance
15	**How much time (in hours) is devoted to the average plan review for residential energy codes?**	
16	**How much time (in hours) is devoted to the average plan review for commercial energy codes?**	
17	**How much time (in hours) is devoted to the average field inspection for residential energy codes?**	
18	**How much time (in hours) is devoted to the average field inspection for commercial energy codes?**	
19	**What major issues impede your ability to enforce the energy code for residential buildings?**	
20	**What suggestions would you give to improve the enforcement of the energy codes for residential buildings?**	

21	**What major issues impede your ability to enforce the energy code for commercial buildings?**
22	**What suggestions would you give to improve the enforcement of the energy codes for commercial buildings?**
23	**Describe your process for reviewing plans for energy code compliance.**
24	**How would you improve this process?**
25	**Describe your process for reviewing energy features in the field for compliance with the energy code.**
26	**How would you improve this process?**