

Evaluating Energy Code Compliance in Cities

November 2017



© Institute for Market Transformation and Natural Resources Defense Council

TABLE OF CONTENTS

WHAT ARE ENERGY CODES AND WHY DOES COMPLIANCE MATTER? 3

BENEFITS OF CODE COMPLIANCE 4

HOW A CITY CAN ASSESS CODE COMPLIANCE 5

HOW THE CEP ASSESSMENT METHODOLOGY WORKS..... 5

1. Building Systems 8

2. CEP Assessment Methodology Sample Size 8

3. CEP Assessment Time Frame 8

4. Scoping Modifications and Decisions..... 9

CONCLUSION11

WHAT ARE ENERGY CODES AND WHY DOES COMPLIANCE MATTER?

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 level—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 design of systems.¹

Enforcement of energy codes is almost always done by building permit office staff at the local (city) level who typically review plans first to ensure they are compliant and then conduct field inspections to verify that the plans are followed during construction. Noncompliance can be a result of several factors. 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 noncompliance when they are properly trained and are held accountable for reviewing plans for compliance and sufficiently inspecting construction.

If the City fails to identify noncompliance with code—either in the plans or during the construction phase itself—the building will most likely be less efficient and use more energy than were it compliant with code.

Conducting an energy code compliance assessment—internally or in partnership with a consultant—allows a City to acquire the information and data needed to drive improvements in its code enforcement efforts. Benefits of conducting an assessment include:

- An assessment 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.
- A compliance assessment identifies current issues with energy code compliance practices, determines a compliance rate that provides the city with a benchmark that can be used to measure progress.

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

- An assessment results in a compliance plan with solutions to improve compliance and realize energy savings.

For a city government that wants to determine whether opportunities exist to capture additional energy and carbon savings through better enforcement, assessing compliance can be extremely difficult. To overcome this, the City Energy Project—a joint initiative of the Institute for Market Transformation and the Natural Resource Defense Council that is focused on improving energy efficiency in large buildings—developed a public methodology that enables any city to conduct a code compliance assessment.

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, it 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 more 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 fire 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

² "Policy Maker Fact Sheet," October 2010, accessed at <http://www.imt.org/uploads/resources/files/PolycymakerFactsheet-EnergyCodeCompliance.pdf>

³ Ryan Meres and Eric Makela. "Building Energy Codes: Creating Safe, Resilient, and Energy-Efficient Homes," IMT and Britt/Makela Group, Inc., July 2013. Accessed at http://www.imt.org/uploads/resources/files/non-energy_benefits_of_energy_codes_report.pdf

⁴ Christine Hurley Brinker. "Energy Codes are Life-Safety Codes," reprinted from Builder Magazine by Southwest Energy Efficiency Project. Accessed at <http://www.swenergy.org/data/sites/1/media/documents/codes/Energy-Codes-are-Life-Safety-Codes.pdf>

HOW A CITY CAN ASSESS CODE COMPLIANCE

To assist medium and large cities in assessing code compliance, the City Energy Project created [*The City Energy Project Assessment Methodology for Energy Code Compliance in Medium to Large Cities*](#) (CEP Assessment Methodology), 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. The 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 compliance⁵.

HOW THE CEP ASSESSMENT METHODOLOGY WORKS

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 the CEP Assessment Methodology.

- **Phase 1:** Review initial submittals of construction plans to the building department, interview plan reviewers, and assess intake and plan review processes.
- **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.
- **Phase 3:** Conduct on-site inspection of buildings under construction, interview inspectors and assess inspection processes.
- **Phase 4:** Analyze findings, develop a compliance improvement plan.

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.

⁵ Appendix B provides an overview to the changes in the 2017 release of the CEP Assessment Methodology.

Table 1. CEP Methodology Overview⁶

Phase	Task Descriptions – Recommended Staff Responsibilities	Task Descriptions – Recommended Third-Party Responsibilities
Phase 1	<p>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.</p>	<p>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.</p> <p>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.</p>
Phase 2	<p>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.</p>	<p>Complete Interview and Process Evaluation as Needed</p> <p>Train Staff for Data Collection, provide quality assurance check at halfway (50 percent) point of data collection.</p>

⁶ The allocation Task Descriptions in Table 1 assumes a Third-Party and Staff Team approach, as described in Section 2.5.3.

Phase 3	<p>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.</p>	<p>Train Staff for On-Site Verification, provide quality assurance check at halfway (50 percent) point of data collection.</p> <p>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.</p> <p>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.</p>
Phase 4		<p>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.</p>

1. 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. 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.

3. CEP Assessment Time Frame

The CEP Assessment Methodology is designed for a six- to nine-month period, as illustrated in Table 2. 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 2. 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
--	---------	---------	---------	---------

4. 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

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. This protocol inherently takes 6-9 months. Modifying Phase 1 to collect data discretely from Phases 2 and 3, using an additional sampling equal to 1/3–1/2 of the overall designated sample decreases the studies time frame significantly. This approach does however eliminate the opportunity to compare findings across three stages of construction, and the opportunity to identify and assess common design issues.

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. The minimum recommended 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.

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 and 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.

Table 3 provides 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.

Table 2. Staff Time for Assessment per Sample

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

CONCLUSION

Whether using a recommended or minimum sample size, with staff or third party led data collection, an energy code compliance 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.

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 the CEP and the participating cities will support bold solutions that can be replicated by other municipalities nationwide and around the world to advance economic development and reduce pollution.

The 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.

© 2017 The Institute for Market Transformation and Natural Resources Defense Council.