

Establishing a Plan to Achieve Energy Code Compliance in Cities

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BACKGROUND AND OVERVIEW

This document was developed as a resource for the City Energy Project, a joint initiative of the Institute for Market Transformation and the Natural Resources Defense Council, which is assisting 20 major U.S. cities to launch integrated energy efficiency policies and programs. The purpose of this document is to guide city leadership and their building departments in working together to implement an effective strategy to achieve high levels of energy code compliance for new and renovated buildings.

First, this document will introduce the factors responsible for low compliance rates, followed by the process for implementing an improvement plan, and finally the details of the challenges and effective strategies for addressing each challenge. In an effort to provide solutions for varying administrative structures, a wide range of strategies and recommendations are presented.

1. WHY IMPROVE ENERGY CODE COMPLIANCE?

A strong building energy code is one of the most affordable and effective mechanisms for advancing energy efficiency in buildings. The national model building energy codes have increased energy saving potential by nearly 30 percent from 2006 to 2012. However, energy savings are only achieved when the code is enforced. While there has been a push to adopt the latest model energy codes in many jurisdictions in recent years, resources for training and enforcement have been lacking, and code compliance rates in many jurisdictions are low. Ensuring compliance with building energy codes is a simple, ready-made way for cities to realize energy savings without the passage of any new policies.

Low compliance rates mean the consumer benefits of the energy code are not being realized. The very direct result for building owners is higher utility bills. However, compliance with the energy code has many non-energy related benefits that often are overlooked. These benefits include improved occupant comfort, better indoor air quality, and a more resilient building stock.

In the realm of building, fire, and life safety codes, the energy code is a relative newcomer. Deadly building fires lead to the first organized fire prevention and life safety codes in the late 1800's. In comparison, it wasn't until the energy crisis of the 1970's that the U.S. began developing energy codes. As with any new code, it takes time to gain widespread adoption and subsequent enforcement. Since the 1970's, building energy codes have made their way into Federal legislation and have been slowly adopted in all 50 states. Over the past decade, the national model energy codes have advanced and gained more attention due to their role in mitigating the negative impact of building energy use on our environment, and their role in helping achieve energy security. After a significant increase in the stringency of the energy code from 2006 through 2012, even more attention has turned to ensuring those savings are realized through enforcement.

1.1 Challenges Facing Building Departments

Low compliance rates are not simply caused by building departments not doing their jobs, but are the result of numerous different challenges. Some of these challenges can be overcome by the building department and some are outside of its control. The most common challenges are:

- **Limited resources:** Building departments are typically funded by permit fees and often these fees are not sufficient to ensure the department can do a thorough job. At departments where the budget comes from a general fund, there typically isn't enough funding to ensure appropriate energy code compliance.
- **Low priority:** The energy code is seen as recently risen in profile and importance, and not having a direct impact on health and life safety that building codes historically addressed. Therefore they are given a lower priority when resources are stretched thin.
- **Inadequate training:** Building department staff do not always receive enough training on energy code compliance. In order to stay up to speed on changes to energy codes, technology, and other helpful innovations in the industry, it is critical for department staff to have regular trainings.
- **Lack of awareness:** Departments typically do not know what compliance issues exist when it comes to the enforcement of the energy code and therefore cannot address them.

This report addresses how cities can develop a plan to overcome these challenges and implement an effective energy code compliance program.

2. GETTING STARTED: UNDERSTANDING THE PROCESS

When developing a strategy to improve energy code compliance it is important to follow a process that will lead to the greatest opportunity for success. The suggested process is outlined in Figure 1 below. The remainder of this section explains each step.

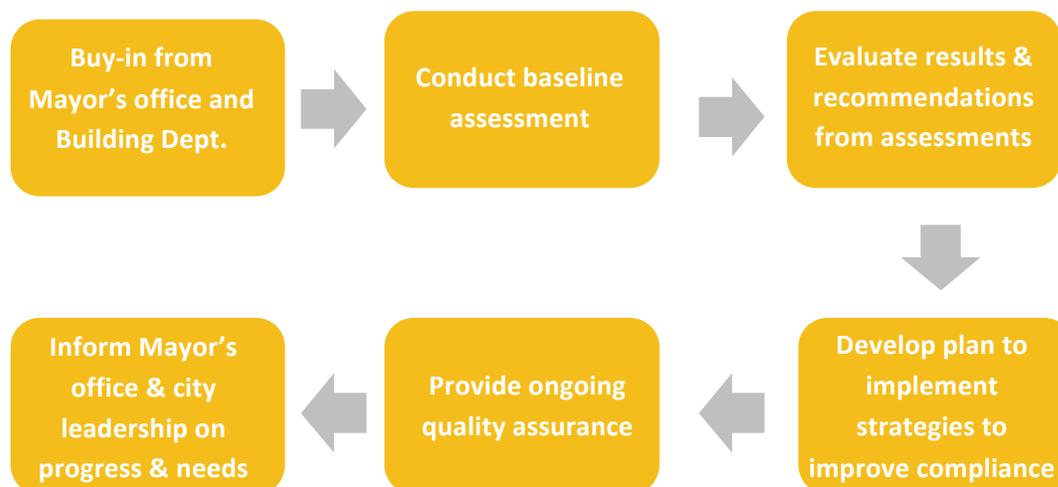


Figure 1: Developing a strategy to improve energy code compliance

2.1 Buy-in from the Mayor's Office and Building Department

A city's building department is the agency responsible for the enforcement of codes and standards related to the construction and renovation of buildings. The building department is ultimately responsible for implementing a plan to improve energy code compliance, but the mayor's office and potentially the city council play a crucial role in supporting high-level buy-in. Of the challenges listed above, low priority is often due to a lack of political will. If the mayor and other city leadership do not support a solid energy code compliance program, one is not likely to succeed.

The desired support includes the mayor's office establishing a goal for improving compliance. The recommended goal should be between 90–100 percent compliance within a specific timeframe (recommended to be no longer than five years), and ensuring accountability for achieving that goal. In support of this goal, the mayor's office should also assist with securing additional funding, staffing, coordination with other agencies, or other resources to support the building department in implementing a compliance plan. In some instances the mayor's office may even develop the specific strategies for the building department to implement.

The mayor's office and elected officials also need to realize the important role that energy codes play in relation to other building energy policies, such as energy benchmarking and transparency policies. While benchmarking policies entail a building's energy use to be shared annually, compliance with the energy code during the time of construction can have a large impact on that building's energy use over its lifecycle. For more information on the important links between energy codes and other building energy performance policies, read the report "[Linking Building Energy Codes With Benchmarking and Disclosure Policies.](#)"

2.2 Conduct a Baseline Assessment

To put it simply, if you don't know what's broken, you can't fix it. A thorough baseline assessment consists of both a quantitative and qualitative evaluation of energy code compliance. A quantitative evaluation involves the review of plans and on-site inspections to determine the level of compliance and potential energy savings achievable from improvement. The quantitative assessment typically leads to a compliance rate or "score," while the qualitative assessment identifies the reasons behind the score. The qualitative assessment may uncover issues with documentation, processes, communication, industry knowledge, training, or political priorities. A qualitative assessment should include a review of the building department processes and also engage industry stakeholders to understand what problems they may be facing. The recommendations for improvement from both assessments should be used to develop a phased implementation plan. Refer to Section 3.5.1 of this document for specific guidance on conducting a training needs assessment.

The standard methodology to assess code compliance was created by the U.S. Department of Energy (DOE) to be used by states, but it is not appropriate for cities. A modified methodology needed to be developed for use by cities, with an affordable, appropriately sized sampling rate that better reflects city processes and construction types. Working with a code compliance expert, the City Energy Project has created such a methodology, which has been peer reviewed, and is now available for use by cities. This methodology provides both qualitative and quantitative feedback, including a percentage compliance rate, which can be used to track improvements.

Refer to the document "[The City Energy Project Assessment Methodology for Energy Code Compliance in Medium to Large Cities](#)" for the detailed process of conducting both a qualitative and quantitative assessment.

In addition, several City Energy Project cities have received an abbreviated baseline assessment. These assessments covered more than 20 buildings totaling nearly three million square feet, and found an average compliance rate of 70 percent, which indicates considerable room for improvement.

2.3 Evaluate Results and Recommendations From the Assessment

A thorough baseline assessment should uncover where compliance challenges exist, as well as why they exist, and provide recommended strategies for how to improve compliance. A careful evaluation of the results and recommendations from the assessment should be conducted to inform a compliance improvement strategy. Refer to Section 3 for an analysis of the most common problems that impede effective energy code compliance.

2.4 Develop a Plan to Implement Improvement Strategies

After a careful review of the results and recommendations from the assessment, a plan to implement improvement strategies needs to be developed. The plan should prioritize strategies using a phased approach. Strategies that are quick and easy to implement should be done first, followed by strategies that may take time or require several layers of approval to get started. The plan should be realistic about the time it will take to effectively implement each strategy and not be too aggressive about trying to implement many strategies at once. The plan should be drafted by the building department in consultation with the city leadership. Before the plan is finalized, it should receive buy-in from the mayor's office and city leadership. Once finalized, the plan should be communicated to industry stakeholders to make them aware of any new expectations or requirements for energy code compliance.

2.5 Provide On-Going Quality Assurance

Another critical step in the compliance improvement process is the need to verify progress through on-going quality assurance. This will allow a building department to verify how well a compliance improvement strategy is working and change course if needed. For detailed recommendations of on-going quality assurance, refer to the document "[The City Energy Project Assessment Methodology for Energy Code Compliance in Medium to Large Cities](#)." Also refer to Section 5 for a broader discussion of how on-going quality assurance is a compliance improvement strategy.

2.6 Inform Mayor's Office on Progress and Needs

The building department should keep the mayor's office updated on the progress of compliance improvement. This will help to maintain the mayor's support for the improvement program and allow them to understand and anticipate future needs that may arise in order to maintain high levels of energy code compliance.

3. COMMON COMPLIANCE CHALLENGES AND SOLUTIONS

The purpose of the baseline assessments is to illuminate the areas that need to be addressed in order to improve compliance rates. The following sections cover various elements that may have been identified during the assessments as areas needing improvement, followed by potential improvement strategies.

3.1 Staffing: Challenges and Improvement Strategies

With limited resources being identified as one of the most common challenges facing building departments, it is only logical to consider staffing levels as a means of addressing low compliance rates. Appropriate staffing levels for building departments is a multi-faceted issue, with the following areas being the most common:

- Revenue
- Qualifications of existing staff
- Processes

Revenue is an obvious issue, tied directly to staffing levels. Addressing revenue issues requires an understanding of the building department's funding structure. Most building departments are funded through permit and other fees (enterprise fund), through the city's general fund, or a combination of the two. Raising fees can be a contentious issue, but a city should evaluate its fee schedule against similarly-sized or neighboring jurisdictions. By doing so, a city can determine whether or not its fees are in line with other cities.

Even if a city's permit fees are in line with other cities, it may still make sense to raise fees to cover the cost of enforcing the energy code. One reason for this is that other cities might not be allocating sufficient resources to enforce their energy codes. Also, permit fees will not need to be raised significantly in order to properly enforce the energy codes. (See Section 3.1.1 for specific information on the cost of enforcing the energy code.)

Although permit fees often make up a large source of revenue, some cities will also charge plan review fees as well as re-inspection fees. If it is determined that raising fees is not an option to increase building department resources, the city should consider other funding sources to support energy code compliance efforts, including whether the local utility might be willing to help fund plan review and site inspection activities. Regardless of how a city decides to increase resources for energy code compliance, it should first consider the next two issues before throwing additional staffing behind compliance improvement.

Qualifications of existing staff can also have a very direct impact on staffing needs. If existing staff do not have the certifications or expertise to conduct efficient energy code plan reviews or inspections, it has an immediate negative impact on compliance rates. Not having staff with deep knowledge of the energy code will lead to much slower plan review and inspection times, or it may lead to a complete lack of verification.

Processes that are duplicative, unclear, or inefficient can have the most dramatic impact on building department resources. One area that can lead to inefficiencies is poor internal and external communication. Internal communication involves how efficiently a permit application can move through the review and approval process. Approval of an application often requires coordination with various internal staff as well as with other city departments. External communication involves how well a building department communicates needed information to its customers. For example, if a website doesn't contain basic requirements such as what codes are in effect or what inspections are required, an architect or builder will likely call the department for this information; pulling staff away from their essential duties to answer basic questions.

3.1.1 Staffing: Improvement Strategies

Staff Qualifications

When it comes to improving compliance rates related to staffing concerns, the first step should be a review of current staff qualifications. Cities should require their plans examiners and inspectors to obtain International Energy Conservation Code (IECC) certifications, at a minimum; the best practice is to have dedicated staff that reviews for energy code compliance. If the state or city has a higher standard of certification or licensing available, that should be used instead. If current staff does not have a deep knowledge of the energy code, training can be considered as a means of improvement. See Section 3.5 for a discussion on training strategies. For details on how to conduct a qualitative review of staff knowledge, refer to [“The City Energy Project Assessment Methodology for Energy Code Compliance in Medium to Large Cities.”](#)

Streamlined Processes

After staffing qualifications have been considered, cities should explore what opportunities exist to streamline their compliance processes. Streamlining is the practice of improving building regulatory processes to remove overlap and duplication and create more efficient administrative procedures. Streamlining the energy code compliance process should be the first step, and involves the use of forms, checklists, and communication to industry stakeholders (see Section 3.2 below). By communicating clearly what documentation is expected, the building department can ensure a more efficient compliance verification process.

A more thorough streamlining process should also be considered and will often include numerous city departments involved with construction approvals; and therefore must have buy-in from city leadership. The benefit of a more thorough streamlining process is that it often identifies more efficient ways of conducting the construction approval process. A more efficient construction approval process can free-up precious staff time to focus on compliance verification.

Streamlining has impacts that extend far beyond energy code compliance. A 2010 report from the National League of Cities and the International Economic Development Council called [“The Role of Local Elected Officials in Economic Development: 10 Things You Should Know,”](#) identifies the “regulatory environment” as one area to consider in a local economic development strategy. The report states: “For business leaders, time is money; they want to know that the regulatory process provides for timely, reliable and transparent resolution of key issues. If your city’s regulatory policies are riddled with delays, confusing and redundant steps and multiple approval processes, a prospective business may very well choose to locate or expand in another community.”

For more information on streamlining, review this [fact sheet](#), or read the [full case study](#). For ways cities can use technology to improve compliance, read this [fact sheet](#). Additional strategies for addressing staffing issues during plan review and on-site inspections are discussed in Sections 3.2 and 3.3.

Increase Resources

The above strategies can be effective at improving compliance with a relatively small financial investment, but building departments should look for ways to increase revenue in order to provide the best infrastructure for energy code enforcement. Where permit and other fees directly fund building department activities, an increase in those fees should be considered. As a reference point, a [study](#) conducted by the Lawrence Berkley National Lab found the average cost of enforcing the energy code to be \$139 per commercial building and \$49 per single-family home. These figures are based on a survey of 23 local building departments with an average time to conduct plan review and on-site inspections of five hours for commercial projects and 1.9 hours for residential projects. The authors of the study acknowledge that the cost estimates are only representative of personnel time and are exclusive of overhead, benefits, or travel cost (for on-site inspection), which could triple or quadruple the figures.

Since City Energy Project cities are all considered medium to large cities and will typically have higher overhead and labor costs, they should estimate \$400–\$500 per new commercial building and \$150–\$200 per new single-family residential home as the full cost of enforcing the energy code.

To put this in perspective, since the national average cost to construct a 2,400-square-foot single-family home is \$268,000, energy code enforcement would increase costs by 0.06 to 0.075 percent. The relative cost increases in the commercial sector are even less. At construction costs of roughly \$181 per square foot, a 100,000-square-foot office building would cost about \$18 million to build; to cover energy code enforcement, permit fees would need to be raised by \$400–\$500, an increase of 0.0022 percent to 0.0027 percent in the total cost of construction.

Note that the numbers quoted above are rough numbers meant to add perspective. In each city, the buildings department will need to assess their prospective staffing needs and the associated costs.

Cities that have been most successful at enforcing the energy code are those with dedicated staff reviewing plans and conducting on-site inspections for energy code compliance. In cities where building department functions are funded through the general fund, city leadership should look for ways to provide adequate staff for energy code enforcement. Ensuring the proper enforcement of the energy code is one of the most basic ways for cities to achieve their building energy efficiency goals. Where additional city funds are not available, cities should look for other potential funding mechanisms, such as the local utility.

Holding design professionals more accountable for ensuring code compliance is another way to relieve some pressure on staffing constraints. For more information, read the case study: [Design Professional Accountability](#).

3.2 Submittal Documents and Plan Review: Challenges and Improvement Strategies

Submittal documents are those that are required to be submitted to obtain a permit for a construction or renovation project. The submittal documents should contain all the information necessary to verify that the design of the project is in compliance with the city's building energy code. Submittal documents may include building plans, specifications, compliance software reports, and other evidence supporting compliance. The first course of action for ensuring the appropriate documentation is to clearly communicate what is required to be submitted. The required submittal documents should be clearly outlined on the building department's website.

During the plan review process most of the submittal documents are checked to determine compliance with the energy code. A thorough plan review process is critical to ensuring that any compliance issues with the building design are identified and corrected before construction commences. This is the first line of defense for ensuring energy code compliance. However, all of the challenges listed in Section 1 can derail an effective plan review process. In particular, limited resources and inadequate training can have a significant impact. If building department staff members are stretched thin, they often don't have adequate time to do a thorough plan review. Similarly, if they don't have the appropriate training, they may not catch building elements that are non-compliant.

3.2.1 Submittal Documents and Plan Review: Improvement Strategies

Improved and Standardized Documentation

It is recommended that cities conduct a plan review of all new construction and major renovation projects for energy code compliance. This can be done either by city staff or by third parties. The time it takes to review plans for compliance can be greatly reduced by standardizing the way energy code compliance is documented.

The most critical improvements to make for submittal documents and plan review are clearly articulating, on the building department's website, what is required on the building plans and what documents need to be submitted to verify energy code compliance; and creating a documentation strategy that locates all of the essential energy code information in one place, so that the plan reviewer can find it more easily. The lack of such clear documentation requirements has been identified as one of the most significant impediments to documenting or improving energy code compliance rates.

Utilizing Third Parties

Although having dedicated in-house staff to conduct energy code compliance reviews is typically the first option, another alternative strategy that has proven effective at addressing the challenges of a thorough plan review is the use of third parties. Because construction volumes within any city often ebb and flow, third parties can act to relieve building department staff when volumes are high. The strategies for utilizing third parties are as follows:

- The city contracts directly with a third-party provider for all or some energy code plan review, or
- The city simply approves third-party providers that a developer or design professional can contract directly.

Washington, D.C. uses the latter approach. In doing so, they approve third parties to provide plan review services directly to design professionals and developers which relieves the building department from doing a full plan review, thereby expediting the approval process. When using this type of third-party program, the city should ensure that they conduct annual quality assurance audits on plans reviewed by third parties. Additionally, third parties can be utilized for complex plans or for the review of projects using an energy modeling approach to demonstrate compliance because these types of projects often take longer to review and may require specific expertise.

3.3 On-site Inspection: Challenges and Improvement Strategies

On-site inspection occurs at various intervals during the construction project. The purpose of on-site inspection is to verify that what is being constructed is in compliance with the approved design and the city's construction codes. On-site inspections are the second and typically the last line of defense in ensuring compliance with the energy code.

Limited resources and inadequate training often make identifying code violations difficult. Limited resources mean inspectors have less time to conduct inspections and may only verify a limited number of code requirements. Inadequate training often means inspectors are not up to speed on the most recent code requirements and therefore cannot verify compliance. Because on-site inspections require multiple visits to construction sites, often by multiple inspectors, they require careful coordination and planning. Building departments don't typically have an "energy code inspector." but rather the various requirements in the energy code are split among the existing inspector disciplines. (For small scale residential projects it is more common to have multi-discipline inspectors.)

Inspector disciplines typically include mechanical, electrical, plumbing, and structural. Under this type of inspection regime, the structural inspector may be expected to inspect for the air-sealing and insulation provisions in the energy code; while the mechanical inspector would be expected to look for duct insulation; the plumbing inspector for hot water pipe insulation and the electrical inspector for the lighting requirements. This type of single-discipline regime requires careful coordination among different inspectors to make sure it is clear what each is responsible for inspecting. It also requires a targeted training program that is specific to the code requirements of each discipline. (For specific training strategies, see Section 3.5.1)

3.3.1 On-site Inspections: Improvement Strategies

The strategies for improving energy code compliance with on-site inspections are very similar to those for plan review. It is critical to communicate what inspections are required and when in the construction process they are required. As for plan review, it is ideal to have in-house staff conducting on-site inspections, but third parties can take on varying roles.

Clearly Communicate Required Inspections

A critical best practice for improving compliance with on-site inspections is to provide very clear direction on what inspections are required, when in the construction process they are to be conducted, and what energy code provisions will be verified. Clearly communicating this information to builders and trades will make it more likely that the items to be verified are complete and the inspector is called at the right phase of construction. Additionally, listing the most common and frequently cited code violations on the building department website is a great way to save the inspector a second trip to a job site for re-inspection.

Options for Conducting Inspections

There are three common options for cities to conduct on-site inspections of construction projects for energy code compliance. The options are:

- City staff conduct inspections
- Third parties working on behalf of the city conduct inspections
- Third parties working on behalf of the building owner conduct inspection

These third party inspection options are the most common, but cities should be aware that there are many other hybrid variations. One role that third parties are commonly filling during on-site inspection is performance testing and commissioning. Building commissioning as well as air leakage testing of the building envelope and ductwork are time intensive activities that require specialized equipment and knowledge making them an ideal candidate for third-party verification. Where third parties are utilized for all or some energy code inspections, the building department should ensure it provides periodic quality assurance on the third parties. Quality assurance checks are recommended on an annual basis and can be funded by charging third parties a small fee to be registered as a third party provider in the city.

For more information on third-party performance testing, read the [Georgia Case Study](#) on residential performance testing or the third-party performance testing [Case Study on Austin, Texas](#).

3.4 Renovation Projects: Challenges

Nationally, renovations, alterations, and additions to existing buildings contribute 86 percent of building construction expenditures. It is forecasted that 150 billion square feet, approximately half of the current building stock in the United States, will be renovated by 2035.

It's important to note that all of the elements already discussed also pertain to renovation projects. Renovation projects need clear guidance on what submittal documents are required, a thorough plan review, and on-site inspections. However, many compliance issues associated with renovation projects come from a lack of clarity in how the energy code applies. Aside from thorough plan review and inspections, improving compliance of renovation projects should involve the clarification of what the requirements are and when they apply.

3.4.1 Renovation Projects: Improvement Strategies

As mentioned above, clarifying what energy code requirements apply to renovations, and how they apply, is key to improving compliance rates. One of the main issues to be clarified is the compliance trigger for various types of renovations. For discrete components, such as windows, the answer is simple: if you replace a window, the new one has to meet the current energy code. Where things get complex is for continuous systems, such as roofs or HVAC systems. If, for example, you are replacing 100 square feet of roofing on a 10,000-square-foot roof, do you have to insulate that small section to meet the energy code? And if you are replacing half of the roofing or more, is there a point at which you would be required to bring the whole roof up to meet the energy code?

For brochures that explain how the 2006, 2009, and 2012 versions of the IECC apply to renovations, review IMT's [Existing Building Brochures](#). Brochures can be branded with the logo and contact information for a city's building department and address both commercial and residential code provisions. Also review the [Existing Building Factsheet](#) for other ideas for improving compliance with renovations.

One final resource to consider when refining the application of the energy code to renovations is the 2015 IECC. At the 2013 IECC Public Comment Hearings, the ICC governmental voting members approved revisions to the 2012 IECC that help to clarify the provisions for renovations. Those changes are incorporated into the 2015 version of the IECC and can be used to inform how the IECC applies to renovations. See Appendix B on page 30 for an example of the existing building provisions of the 2015 IECC.

3.5 Training and Technical Assistance Challenges

Training is often viewed as the most effective way to achieve higher compliance rates. Inadequate training is listed as one of the challenges in achieving successful compliance rates, but considering the other challenges with improving compliance it should be obvious that training alone cannot solve the problem. The failure of most training programs hinges on their inability to provide appropriate information to a targeted audience. For example, single-discipline inspectors, as discussed above, are typically only interested in the requirements for their specific discipline and should therefore receive training targeted only to their discipline. Training also needs to extend beyond building department staff to cover industry as well.

Targeted training programs help improve compliance, but technical assistance is also a valuable resource. Having an expert energy code resource available to building department staff gives them a place to turn when they have difficult compliance questions.

It's important to note that before embarking on an extensive training program for industry, building department staff should be trained and enforcing the code. Enforcement is much more effective at achieving compliance and having a good enforcement infrastructure in place will drive demand for, and attendance at training events. If the city is not enforcing the code, it often won't matter that the design professionals are trained on the code requirements.

3.5.1 Training and Technical Assistance Improvement Strategies

Training Assessment

During a baseline assessment, the evaluator should be able to gauge the level of energy code knowledge among building department staff and industry. Recommendations from the assessment report should be used in developing a training plan. If the baseline assessment report did not include recommendations for training, the building department should conduct a survey of training needs within the department and among industry stakeholders.

A training assessment should include the traditional groups of builders, designers, plans examiners, inspectors, and trades since these are the professionals that need to have an in-depth technical knowledge of the energy code requirements. However, the training assessment should also involve the often overlooked stakeholders, including city officials (elected and administrative), realtors, building material suppliers, manufacturers, utilities, system benefit providers, and community groups. The assessment should determine where each group needs to be educated, and what methods of delivery would be most effective, (i.e., in-the-field, classroom, or online).

Technical energy code training that covers design and construction requirements will not be appropriate for groups such as city officials, realtors, utilities, and community groups that often are not concerned with detailed technical requirements. The assessment should take into consideration the differences and needs among the technical and non-technical stakeholders and develop strategies accordingly.

Funding, Developing, and Delivering an Effective Training Program

After the assessment of training needs has been completed, the building department should consider strategies for funding the training activities. One of the major barriers to developing effective training programs is the cost involved in developing and delivering the training. Building departments should consider the following strategies for delivering cost-effective training:

- There is no need to develop new energy code trainings from scratch. The U.S. Department of Energy (DOE) has energy code training modules that can be downloaded and modified for local conditions as required. (See link below.)

- Have appropriate department staff develop and deliver training to other staff members.
- Engage manufacturers, building suppliers, or industry associations such as local chapters of the International Code Council, American Institute of Architects, U.S. Green Building Council, ASHRAE, or local non-profits with a focus on energy efficiency in buildings to provide training.
- Engage one or more local utilities to provide the training or funding for training sessions.
- Consider other municipal funding sources such as the Department of Environment or similar city agency with an interest in energy efficiency.
- Contact the state energy office to determine whether the state's energy program funding can be used to provide training within your jurisdiction.

Building departments should ensure that the training provided to staff is targeted to their needs. The same should also be done for industry stakeholders. Building departments should also consider having staff conduct industry trainings. Doing so allows industry stakeholders to see code officials as authorities on a subject and interact with them outside of just issuing code violations.

If a baseline compliance assessment identifies numerous areas in need of training, building departments should consider phasing in the areas that need attention, so staff and industry have time to learn and properly implement just a few new requirements at a time. This successful strategy was used in Parker, Colorado. Parker set delayed enforcement dates for more complex code requirements, which allowed them time to provide training prior to enforcement. Once the enforcement date passed, the building department strictly enforced the requirements.

Visit DOE's [Building Energy Codes Program training catalogue](#) for a full collection of energy code training modules. These modules can be used as a starting point for developing simple energy code training presentations. Since these training modules are based on the national model codes (IECC and ASHRAE 90.1), they can be easily modified to reflect state or city amendments to those codes. To be most effective, it's important for training programs to be as specific as possible to the local construction context and code requirements.

In addition to providing training for staff, building departments should also consider a technical assistance resource. This service can be offered through the organization that conducts the training or through other mechanisms such as the state codes office, state energy office or other organization with expertise in energy codes. DOE's Building Energy Codes Program also has a help desk that can be used to answer energy code questions. Providing a technical assistance resource allows building department staff to call on someone with deep expertise in energy codes to answer code compliance questions.

4. ENFORCEMENT

Cities often question whether enforcement or training and outreach are more effective at driving high compliance rates. Although training is very important to get code officials and industry stakeholders informed on the code requirements, enforcement is much more effective at driving change. Cities need to be prepared to use their enforcement authority to ensure energy code compliance is achieved.

For example, an [article in Crain's](#) on August 18, 2014 states: “[New York City’s] Department of Buildings began auditing thousands of architectural plans for new and renovated office and residential buildings. The results have been staggering: nine of every 10 have failed to meet the energy code, a set of standards that have been on the books for more than 30 years but are only now being enforced in earnest.” This finding comes despite many years of training and outreach on New York City’s energy code requirements.

The strategy of phasing in energy code requirements, discussed above, can be an effective way to implement a comprehensive enforcement program, but enforcement must be taken seriously by the building department to drive higher compliance rates. The building department must reject building plan submittals that do not meet energy code requirements and fail inspections that are not in compliance. When design professionals, builders, and trades know the city is serious about enforcing the energy code, they will get serious about ensuring their designs and construction practices are in compliance.

5. ON-GOING QUALITY ASSURANCE AND IMPROVEMENT

On-going quality assurance is critical to confirming that compliance improvement activities are working. Quality assurance should include regular audits of plans and inspections and be conducted in accordance with the document “[The City Energy Project Assessment Methodology for Energy Code Compliance in Medium to Large Cities](#).” These on-going audits should be used to evaluate the effectiveness of previous training activities and inform future training efforts.

The International Accreditation Service (IAS), a subsidiary of ICC, offers a Building Department Accreditation Program (BDAP) which provides an independent verification that a building department operates under the highest ethical, legal, and technical standards. The IAS BDAP provides several criteria for quality assurance. Section 3.2.10 of the BDAP says the [building] department shall provide evidence of a comprehensive quality assurance program which shall contain, at a minimum, the following components:

- Frequent quality assurance activities
- Annual, or more frequent, internal quality audits
- Management review meetings

Furthermore, the criteria define a quality assurance plan as: “documents which set forth the policies and practices aimed at ensuring the quality of the organization’s services through the observation of work in progress or sampling of completed work.” And a quality assurance program is defined as: “the agency’s system for maintaining minimum quality levels of service through a collection of self-imposed standards through activities such as internal quality audits, document creation and control, management reviews, etc.”

Building departments are encouraged to follow these requirements and should consider accreditation through IAS.

6. CONCLUSION

Improving energy code compliance is a highly cost-effective and practical strategy to improve the energy efficiency of a city’s building stock. Low compliance rates mean the consumer benefits of the adopted energy code are not being realized and building owners are slapped with years of higher utility bills and structures built below standard. Although building departments face many challenges that inhibit better compliance rates; these challenges can be overcome when building department staff and city leadership work together to develop and implement a plan for improvement. City leadership should realize that achieving high energy code compliance is a simple and smart way to improve building energy efficiency and achieve the city’s energy and sustainability goals.

ABOUT CITY ENERGY PROJECT

The City Energy Project (CEP) is a groundbreaking national initiative to improve the energy efficiency of existing buildings in ten major American cities. The partnership between 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. 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 us at www.cityenergyproject.org.

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APPENDIX A: Sample Compliance Assessment Report

Background

The purpose of this study was to evaluate the city's energy code enforcement practices, determine an overall compliance rate and provide suggestions for improvement. This was accomplished by performing energy plan reviews and conducting inspections on a limited number of typically built commercial buildings as well as interviews with building department staff and industry. Compliance rates were based on the energy code that the city has adopted and is currently enforcing. Note that this study was based on a stripped down process that looked at only eight projects, and it should not be viewed as an alternative to the City Energy Project Code Compliance Methodology, which provides more rigor and comparability city-to-city.

Review Process

The city's building department was asked to provide nine commercial building projects to complete the compliance study. The buildings represented typical commercial projects being built within the city and were to be at a stage in the construction process where a portion of the efficiency features used for energy code compliance could be evaluated. At the time of the study, only eight building projects fitting the criteria were available. The building type and floor area of each project are listed in Table 1.

BUILDING TYPE	FLOOR AREA
Other (Bakery/Restaurant)	4576
Restaurant/Dining/Fast Food	5967
Healthcare Center	6531
Retail/Mercantile	8568
Retail/Mercantile	15,532
Other (Auto Dealership)	53,648
Lodging/Hotel/Motel	104,885
High-Rise Residential	369,500

Table 1 Building Type and Floor Area (Sq. Ft.)

Buildings were evaluated following the data collection protocol as described in the U.S. Department of Energy (DOE) document, "Measuring State Energy Code Compliance (Compliance Protocol)." Additionally, DOE's 2009 International Energy Conservation Code (IECC) Commercial Data Collection checklist was modified to reflect the city's energy code and was used for on-site data collection for both the plan review and field inspection phases of the project.

Plan Review

The goal of the plan review portion of the compliance study was to determine if the building plans submitted were in compliance with the city's energy code. The data collection checklist described above was used as a guide throughout the review process and whenever feasible, the energy code documentation was used to complete the form. In instances when energy code documentation was not available, it was assumed that the building used the prescriptive approach to comply with the energy code and was therefore compared against the prescriptive requirements. Energy code compliance documentation was then evaluated for each of the projects using either a performance approach or a prescriptive approach.

Field Inspection

Following the completion of the plan review portion of the compliance study, four building projects were selected for field inspections, including the:

- Auto Dealership
- Bakery/Restaurant
- High-rise Residential
- Lodging/Hotel/Motel

The remaining four projects were not visited for various reasons: two of the projects were at framing stage and did not have energy features installed, another project was complete but the building could not be accessed, and the final project consisted of a tenant improvement with minimal modifications that were impacted by the energy code.

Two additional buildings were visited that were not part of the plan review: a medical classroom building and a performing arts building. Information collected from these additional buildings during the field inspections was accounted for in the findings and considered when developing recommendations.

To determine the level of compliance of each building the data collection checklist was used to gather information on the individual efficiency features of the building. For energy code features that had either not been installed or were installed and inaccessible, the "Non-Observable" option was selected. For example, lighting systems were typically deemed "Non-Observable" as the buildings were not at a stage where the final lighting systems had been installed.

Findings

Plan Review

Conducting a plan review on each of the eight commercial buildings provided insight into compliance issues associated with documentation, fenestration, HVAC load calculations and lighting controls. The findings for the plan reviews are included in Table 2 for the building envelope, mechanical, lighting and documentation.

Plan Review Process

Project types in the city range from multi-building hotel complexes with large central cooling plants, to performing arts buildings that use district cooling for space conditioning, to small strip mall shopping centers. The variety of project types requires those reviewing the plans for compliance with the energy code to be well versed in requirements for several different system types and configurations. The plan review staff is subdivided into mechanical, electrical, plumbing, and architectural/structural disciplines with each group reviewing the energy provisions that pertain to their area of expertise. The time spent reviewing for energy code compliance is dependent on the size and complexity of the project.

Documentation

Energy modeling software was commonly used for determining commercial energy code compliance for complete projects (e.g. plans are submitted for architectural, mechanical, water heating and lighting review). The software provides a summary of the levels of efficiency for each of the building's systems and pass/fail documentation of the various features found in the buildings. It also allows users to demonstrate compliance with envelope requirements using the prescriptive method.

All performance-based software documentation (including COMcheck) requires training to understand which parameters are important and which parameters will not affect the energy use of the building. There were some instances where the terms used in the energy modeling software were different from what is used in the energy code. For example, the lighting documentation uses the term "control points" to help document lighting controls in the space. For a person unfamiliar with the documentation, linking the documentation back to the building plans could be difficult.

BUILDING ENVELOPE	
PLAN REVIEW	
Information on Building Plans / Assembly R-values	Often there was not sufficient information shown on the building plans to determine if an assembly complied with the energy code. For example, roof insulation thickness was shown on the plans but a minimum R-value was not indicated. Wall insulation R-value was also not routinely identified on the plans. One project called out an R-29.7 for a wall system (metal stud wall) in the performance documentation which was not represented on the building plans.
Information on Building Plans / Fenestration Efficiency	Often there was not sufficient information shown on the building plans to determine if an assembly complied with the energy code, including information on SHGC and glazing U-factor. For example, the calculations indicated a fenestration U-factor of 0.27 but this information was not included on the plans.
Cool Roof/ Roof Absorptance	Building plans did not typically include maximum roof absorptance for roof systems or cool roof membranes. Cool roof membranes were routinely viewed on-site when available. It is assumed that the membranes meet the intent of the code.
INSPECTION	
Windows	NFRC 100 and 200 certificates were not present for site-built windows to demonstrate the rated U-factor and SHGC for the product
Wall Insulation	When the performance compliance documentation was available, the insulation on the plans matched what was shown on the compliance documentation.
Air Sealing	Air sealing requirements were called out on the plans for two projects. Evidence of air sealing was found onsite for projects that were at the air sealing/insulation stage.
Insulation Installation	Insulation installation quality was good for the type of insulation viewed on site.

MECHANICAL

PLAN REVIEW

Testing & Balance	Testing and balancing requirements were present on plans.
HVAC Efficiency	High efficiency equipment was documented routinely in performance documentation. The efficiencies of the systems shown on the plans were consistent with what was included in the performance documentation.

INSPECTION

Ducts Insulation	Duct insulation R-values were code compliant on site.
Duct Sealing	Duct sealing was compliant for the ducts that were viewed on site.
Piping Insulation	Piping for HVAC systems were insulated to meet the code requirements for all systems viewed on site.
HVAC Controls	HVAC controls that were viewed on site met the intent of the energy code requirements.

LIGHTING	
PLAN REVIEW	
Fixture Wattages	The fixture wattage shown in the performance documentation was not accurate for type of bulb/fixture shown on the plans for one project. However, the proposed lighting on the plans for the building was less than what was shown in the lighting compliance documentation so the building was still in compliance.
Lighting Controls	General lighting controls complied with the code for all projects. Lighting controls for day lit spaces was routinely not accounted for in the lighting projects. Daylighting controls were called out on one project with high glass area.
Automatic Lighting Shut-off	Automatic lighting shut-off was called out on at least one project. Occupancy sensors were used to meet the requirement on another project. Information was insufficient on other projects to determine if automatic lighting shut-off was included.
Task Lighting Controls	Task lighting was routinely controlled separately where required by code.
INSPECTION	
High-Efficacy Lighting	High-efficacy lighting was installed in dwelling units for the high-rise multifamily project per the energy code.

DOCUMENTATION	
PLAN REVIEW	
HVAC Load Calculations	HVAC load calculations or signed summary sheet were not available for review on all applicable projects and it was unclear if they were submitted with the plans (Section 503.2.1).
Compliance Form A	It is unclear if Compliance Form A is being submitted for projects that are complying prescriptively or for alterations and renovations. Two projects reviewed were alterations and no documentation was present during the review of the plans.

Qualitative Findings

Qualitative information was also collected and used to better understand the city's overall process and potential for increased compliance with the energy code. A brief survey was conducted at the beginning of the site visit and additional questions and observations were made throughout the visit. Qualitative information collected is summarized in Table 3.

Table 3: Qualitative Findings

AREA EVALUATED	DESCRIPTION OF FINDINGS
Number of Commercial Building Permits Issued per Year	Approximately 15,000 to 20,000
Number of Plan Review Staff	Approximately 20. The building department is set up as a "one stop shop." Once the plans are submitted, all reviews are completed simultaneously. The plan review staff is also responsible for review of the fire code.
Division of Disciplines for Plan Review	Separate plan reviews are conducted for each discipline (e.g. structural, mechanical, electrical, and plumbing). Each discipline reviews energy as part of their review.
Number of Inspection Staff	25 to 30 staff members
Division of Disciplines for Inspection	Inspection staff is divided into separate disciplines similar to plan review. Staff is divided into mechanical, plumbing, electrical and structural inspections. Energy is reviewed in the field applicable to each inspection. There are no combination inspectors.
Documentation Type	The majority of documentation submitted is for the performance approach with fewer projects using the prescriptive compliance approach.
Time Devoted to Energy Review During Plan Review	Time is dependent on complexity of project, with more complex projects taking longer time. Times range from 15 minutes to one hour or more.
Time Devoted to Energy Review During Field Inspection	Time is dependent on complexity of project, with more complex projects taking longer time. Times range from 15 minutes to one hour or more.
Greatest Plan Review Issue (Energy)	Moisture related issues are the biggest issues faced by the city. Moisture impacts energy for the building envelope. Termites are another issue that the jurisdiction must overcome. Termites pose a potential problem for the installation of foam insulation at- or below-grade.
Greatest Need	Training on the energy code was the greatest need cited by the Building Official. Specifically, targeted training is needed for building department staff and industry.
Code Interpretations	All formal interpretations are made at the state level, but the building official has the ultimate authority for code interpretations.
Potential for Increasing Efficiency of Code at the Local Level	It is possible for the city to adopt a more stringent or stretch code but this would need to be approved at the state level.

Other Observations

The city has informally designated one inspection staff member as their “energy code person.” This staff member serves on the state advisory committee for the energy code and is looked upon as the in-house resource for the energy code.

One inspector/plan reviewer was assigned to assist in the site visits for this study. The staff person was new to the department. The inspector was very knowledgeable about codes and mechanical and plumbing codes in general. He had a working knowledge of the energy code.

The division manager was responsive to new ideas for the department (e.g. the adoption of a stretch code). He had a working knowledge of the energy code and had performed energy modeling simulations in his architectural practice prior to his position with the city. He is going to be responsible for setting up electronic plan storage for the building department and was very receptive to ideas concerning consistent nomenclature and filing, which was found to be an issue in other compliance studies when it came to locating energy code compliance documentation for the project.

Compliance Rates

Compliance rates were compiled using the DOE Store and Score methodology. Compliance was determined by using both the information found in the field that was observable and, when not observable, the information collected from the building plans.

Overall, the compliance rate was highest for the medical center, which was an alteration. Very little was changed on the overall building other than lighting. Compliance was found to be lowest for the restaurant. There were no calculations with the building plans so prescriptive compliance was assumed, resulting in a lower compliance rate.

The overall compliance rate was 64 percent. However, the compliance rate may have been higher had the energy code documentation been present with the plans.

BUILDING ENERGY CODE COMPLIANCE RATES			
	FLOOR AREA (SQ. FT.)	COMPLIANCE RATE	AREA COMPLIANCE
Retail/Mercantile	8,568	83%	64%
Healthcare Center	6,531	100%	
Restaurant/Dining/Fast Food	5,967	50%	
Other (Auto Dealership)	53,648	71%	
Other (Bakery/Restaurant)	4,576	57%	
High-rise Residential Building	369,500	58%	
Lodging Hotel/Motel	104,885	81%	
Retail/Mercantile	15,532	75%	

Table 4. Energy Code Compliance Rates

Recommendations

Site-Built Windows

NFRC certificates for site-built windows should be required for all installations. Installing fenestration that does not meet the energy code requirements can significantly impact the cooling load of the building. Installing non-compliant fenestration can also result in improperly sized heating and cooling systems in the building if used in the HVAC requirements to size equipment as required by the energy code. The requirements for NFRC certificates can be phased in over time to ensure that the fenestration providers have the time to supply the rated products. This would include training and education for the building, design and enforcement industry. Product information showing window U-factors and SHGC values for all proposed window products should be required at plan review. NFRC certificates should be required at time of inspection for all site built products prior to the installation of the product.

Lighting Controls

Education should be provided to plan review and inspection staff on meeting the lighting controls requirements in the energy code, including specific education on the sections relating to controls for daylight zones and non-daylight zones. The Northwest Energy Efficiency Alliance has developed training specifically for lighting designers and control suppliers that focuses on compliance with the lighting control requirements. Training should also be provided to plan review and inspection staff.

Energy Code Plan Submittals

It is not clear that all of the documentation is being submitted during plan review that is required by the city's energy code. A checklist can be developed for use by the city that provides a list of specific items to be submitted for permit. The city should specify what needs to be included on the plans as well as clearly communicate submittal requirements on its website.

Energy Modeling Software Plan Review Guide

A plan review guide should be developed for use to better understand the energy modeling software reports. A similar guide was developed for the COMcheck reports and is very effective in walking the plan reviewer step-by-step through what to review on the plans.

Overall Training and Education

Energy code training and education is critical for implementation of the energy code. Training for plan review and inspection staff on various energy code issues will increase both the knowledge of the energy code and the energy code compliance rate. Given the types of projects reviewed, suggested training should include sessions on complex mechanical systems. The training should be divided into the following topics:

- Scope and Application
- Architectural
- Mechanical/Plumbing
- Lighting

Field inspection training should also be deployed to ensure that the higher efficiency features called out on the building plans are being installed in the field.

Develop and Implement a Stretch Code

The development of a stretch code that would increase the efficiency of the city's current commercial code is recommended. Stretch code elements could come from ASHRAE 90.1-2013, the 2015 IECC and the IgCC. Given the complexity of the projects built in the city, the plan review and inspection staff has the expertise to enforce a more advanced code. A proposed stretch code would need to go through state approval but would be worth the investment.

APPENDIX B: 2015 IECC, Chapter 5

CHAPTER 5 (RE)

EXISTING BUILDINGS

SECTION R501

GENERAL

R501.1 Scope. The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing buildings and structures.

R501.1.1 Additions, alterations, or repairs: General. Additions, alterations, or repairs to an existing building, building system or portion thereof shall comply with Section R502, R503 or R504. Unaltered portions of the existing building or building supply system shall not be required to comply with this code.

R501.2 Existing buildings. Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

R501.3 Maintenance. Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices and systems that are required by this code shall be maintained in conformance to the code edition under which installed. The owner or the owner's authorized agent shall be responsible for the maintenance of buildings and structures. The requirements of this chapter shall not provide the basis for removal or abrogation of energy conservation, fire protection, and safety systems and devices in existing structures.

R501.4 Compliance. Alterations, repairs, additions, and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for alterations, repairs, additions, and changes of occupancy or relocation—respectively, in the International Residential Code, International Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, International Plumbing Code, International Property Maintenance Code, International Private Sewage Disposal Code and NFPA 70.

R501.5 New and replacement materials. Except as otherwise required or permitted by this code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs, provided hazards to life, health or property are not created. Hazardous materials shall not be used where the code for new construction would not permit their use in buildings of similar occupancy, purpose and location.

R501.6 Historic buildings. No provision of this code relating to the construction, repair, alteration, restoration, and movement of structures, and change of occupancy shall be mandatory for historic buildings, provided a report has been submitted to the code official and signed by the owner, a registered design professional, or a representative of the State Historic Preservation Office or the historic preservation authority having jurisdiction—demonstrating that compliance with that provision would threaten, degrade, or destroy the historic form, fabric or function of the building.

SECTION R502

ADDITIONS

R502.1 General. Additions to an existing building, building system, or portion thereof shall conform to the provisions of this code as those provisions relate to new construction without requiring the unaltered portion of the existing building or building system to comply with this code. Additions shall not create an unsafe or hazardous condition or overload existing building systems. An addition shall be deemed to comply with this code where the addition alone complies, where the existing building and addition comply with this code as a single building, or where the building with the addition uses no more energy than the existing building. Additions shall be in accordance with Section R502.1.1 or R502.1.2.

R502.1.1 Prescriptive compliance. Additions shall comply with Sections R502.1.1.1 through R502.1.1.4.

R502.1.1.1 Building envelope. New building envelope assemblies that are part of the addition shall comply with Sections R402.1, R402.2, R402.3.1 through R402.3.5, and R402.4.

Exception: Where non-conditioned space is changed to conditioned space, the building envelope of the addition shall comply where the UA, as determined in Section 402.1.4, of the existing building and the addition, and any alterations that are part of the project, is less than or equal to UA generated for the existing building.

R502.1.1.2 Heating and cooling systems. New heating, cooling and duct systems that are part of the addition shall comply with Sections R403.1, R403.2, R403.3, R403.5 and R403.6.

Exception: Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

R502.1.1.3 Service hot water systems. New service hot water systems that are part of the addition shall comply with Section R403.4.

R502.1.1.4 Lighting. New lighting systems that are part of the addition shall comply with Section R404.1.

R502.1.2 Existing plus addition compliance (Simulated Performance Alternative). Where non-conditioned space is changed to conditioned space, the addition shall comply where the annual energy cost or energy use of the addition and the existing building, and any alterations that are part of the project, is less than or equal to the annual energy cost of the existing building when modeled in accordance with Section R405. The addition and any alterations that are part of the project shall comply with Section R405 in its entirety.

SECTION R503

ALTERATIONS

R503.1 General. Alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is no less conforming to the provisions of this code than the existing building or structure was prior to the alteration. Alterations to an existing building, building system or portion thereof shall conform to the provisions of this code as they relate to new construction without requiring the unaltered portions of the existing building or building system to comply with this code. Alterations shall not create an unsafe or hazardous condition or overload existing building systems. Alterations shall be such that the existing building or structure uses no more energy than the existing building or structure prior to the alteration. Alterations to existing buildings shall comply with Sections R503.1.1 through R503.2.

R503.1.1 Building envelope. Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.12, R402.3.1, R402.3.2, R402.4.3 and R402.4.4.

Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall, or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall, or floor cavity is not exposed.
4. Roof recover.
5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during re-roofing shall be insulated either above or below the sheathing.
6. Surface-applied window film installed on existing single pane fenestration assemblies to reduce solar heat gain provided the code does not require the glazing or fenestration assembly to be replaced.

R503.1.1.1 Replacement fenestration. Where some or all of an existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor and SHGC as provided in Table R402.1.4.

R503.1.2 Heating and cooling systems. New heating, cooling and duct systems that are part of the alteration shall comply with Sections R403.1, R403.2, R403.3 and R403.6.

Exception: Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

R503.1.3 Service hot water systems. New service hot water systems that are part of the alteration shall comply with Section R403.4.

R503.1.4 Lighting. New lighting systems that are part of the alteration shall comply with Section 404.1.

Exception: Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

R503.2 Change in space conditioning. Any non-conditioned or low-energy space that is altered to become conditioned space shall be required to be brought into full compliance with this code.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.

SECTION R504

REPAIRS

R504.1 General. Buildings, structures and parts thereof shall be repaired in compliance with Section R501.3 and this section. Work on non-damaged components necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this chapter. Routine maintenance required by Section R501.3, ordinary repairs exempt from permit, and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this section.

R504.2 Application. For the purposes of this code, the following shall be considered repairs:

1. Glass-only replacements in an existing sash and frame.
2. Roof repairs.

3. Repairs where only the bulb and/or ballast within the existing luminaires in a space are replaced provided that the replacement does not increase the installed interior lighting power.

SECTION R505

CHANGE OF OCCUPANCY OR USE

R505.1 General. Spaces undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code.

R505.2 General. Any space that is converted to a dwelling unit or portion thereof from another use or occupancy shall comply with this code.

Exception: Where the simulated performance option in Section R405 is used to comply with this section, the annual energy cost of the proposed design is permitted to be 110 percent of the annual energy cost otherwise allowed by Section R405.3.