Asia-Pacific
Economic Cooperation

# APEC Green Building Code Infrastructure Guide

**APEC Sub-Committee on Standards and Conformance**

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Asia-Pacific Economic Cooperation

USAID FROM THE AMERICAN PEOPLE

# GREEN BUILDING CODE INFRASTRUCTURE GUIDE

## *FRAMEWORK DOCUMENT*

**U.S.-APEC Technical Assistance to Advance Regional Integration (US-ATAARI)**

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# Acknowledgements

The author of this report is Ms. Aleisha Khan, ICF International. The report was prepared for the Asia-Pacific Economic Cooperation (APEC) organization as part of the US – APEC Technical Assistance to Advance Regional Integration (US-ATAARI) Project. For further information, please contact Ms. Victoria Waite, Chief of Party, vwaite@nathaninc.com.

# Contents

# Acronyms

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|---|---|
| APLAC | Asia Pacific Laboratory Accreditation Cooperation |
| APEC | Asia-Pacific Economic Cooperation |
| ASEAN | Association of Southeast Asian Nations |
| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| BCA Green Mark | Building and Construction Authority Green Building Rating System in Singapore |
| BREEAM | Building Research Establishment Environmental Assessment Methodology |
| BSN | National Standardization Agency of the Republic of Indonesia |
| CASBEE | Comprehensive Assessment System for Built Environment Efficiency |
| CDD | Cooling degree days |
| Estidama Pearl | Building rating system in Abu Dhabi |
| GHG | Greenhouse gases |
| GIZ | Deutsche Gesellschaft fur Internationale Zusammenarbeit |
| GPMCS | Green Plumbing Mechanical Code Supplement (see IAPMO) |
| Green Star | Building rating system in Australia |
| HDD | Heating degree days |
| IAF | International Accreditation Forum |
| IAPMO | International Association of Plumbing and Mechanical Officials |
| ICC | International Code Council |
| IEA | International Energy Agency |
| IgCC | International Green Construction Code |
| IFC | International Finance Corporation |
| ILAC | International Laboratory Accreditation Cooperation |
| ISO | International Organization for Standardization |
| LEED | Leadership in Efficient and Environmental Design (green building rating system in the United States) |
| PAC | Pacific Accreditation Cooperation |
| TBT | Technical Barriers to Trade |
| UPC | Uniform Plumbing Code (see IAMPO) |
| USAID | United States Agency for International Development |
| WTO | World Trade Organization |

# Introduction

Increasing energy efficiency, a key component of green buildings, is crucial to ensuring the sustainability of growth for Asia-Pacific Economic Cooperation (APEC) members, particularly for developing economies experiencing rapid urbanization. Buildings consume 40 percent of global energy, according to the United Nations Environment Program.[1] In the context of increased urbanization, improving the efficiency of buildings will make a significant contribution to Greenhouse Gas (GHG) emissions reductions.

In 2011, APEC Leaders expressed an aspiration to "reduce APEC's aggregate energy intensity by 45 percent by 2035" and to "promote energy efficiency by taking specific steps related to transport, buildings, power grids, jobs, knowledge sharing and education in support of energy-smart low-carbon communities."[2] This commitment was reinforced by the May 2014 Meeting of APEC Ministers Responsible for Trade in Qingdao, China. The ministers cited APEC's ongoing work with ASEAN on green buildings as an important element of APEC's efforts to promote the aforementioned goal.

The Asia-Pacific region has experienced significant growth in its green building market. APEC members have supported a number of related activities over recent years to advance building rating systems, promote life-cycle analysis for products and materials, and document policies regulating building design and construction. The common goal of these efforts is to work toward a sustainable built environment supported by the free flow of trade in products and technologies.

Around the world, the proliferation of green buildings has been primarily driven through voluntary programs which use rating systems, such as BREEAM, CASBEE, Estidama Pearl, Green Star, Green Mark, and LEED[3], to incentivize the market. However, as acceptance of green building practices expands,

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[1] *International Energy Agency (IEA);* http://www.iea.org/aboutus/faqs/energyefficiency/. Accessed 18, November 2014.

[2] "The Honolulu Declaration - Toward a Seamless Regional Economy" 2011 Leader's Declaration, Asia-Pacific Economic Cooperation (APEC), Honolulu, Hawaii, United States 12-13 November 2011. http://www.apec.org/Meeting-Papers/Leaders-Declarations/2011/2011_aelm.aspx

[3] CASBEE (add info), LEED (Leadership in Energy and Environmental Design) was launched in the United States, BREEM (Building Research Establishment Environmental Assessment Methodology) was established in the United Kingdom, Green Star was first developed in Australia, Green Mark was created in Singapore, and Estidama Pearls was developed in United Arab Emirates.

codes present a growing opportunity to raise the bar on fundamental mandatory requirements. By incorporating some of the measures typically seen in rating programs, codes can mandate a more sustainable level of basic construction. Codes are successfully tested mechanisms to improve the quality and safety of buildings. When formalized into policies, they set building requirements that drive product and technology demand, job creation, and new service offerings in the local marketplace. When strongly enforced, they also provide a stable and attractive market for manufacturers and product investors. When technically current and appropriate international standards are incorporated, and supported by certifications, codes can facilitate broad, uniform, and affordable access to the products and materials needed for green construction. However, these market forces rely on strong and reliable mechanisms and processes that enable the code to be applied, successfully implemented, and improved over time. A strong infrastructure provides a support-system for technical measures and is essential to the evolving the building sector.

This ***Green Code Infrastructure Guide*** proposes a framework to support code requirements in the marketplace to achieve desired outcomes[4]. While specific goals and drivers for green buildings will vary among economies, the basic concepts of infrastructure are "driver-neutral" and, at the same time, heavily economy-specific in practice. The proposed framework is flexible and can be customized to leverage the strengths and accommodate the realities of individual economies. The guide provides

- Details on components necessary to support effective green building code policy formulation and implementation, and

- A framework that will help policymakers, regulators, the private sector, and green building advocates identify and begin to close gaps in local code infrastructure.

Based on best practices, the guide includes examples of strategies used to strengthen infrastructure in the region. . Regardless of the level of progress already achieved by a particular economy, this framework can be used to move towards a stronger implementation of codes and greener buildings.

This guide is divided into two sections: (1) *Infrastructure Components*, and (2) *Next Steps*. The first section describes the four components of a green building code infrastructure:

1. **Development**. This section summarizes the varied elements and actors typically required for effective green code development.

[4] Benefits and current practices for green codes are summarized in *APEC Guidelines on Standards Infrastructure* [http://publications.apec.org/publication-detail.php?pub_id=1522], *APEC Building Codes, Regulations and Standards: Minimum Mandatory and Green* [http://publications.apec.org/publication-detail.php?pub_id=1442], and *Survey on Sharing Experiences in the Design and Implementation of Green Building Codes in the APEC Economies* [http://mddb.apec.org/Documents/2013/SCSC/WKSP1/13_scsc_wksp1_009.pdf].

2. **Implementation**. This section outlines the three phases of code implementation, which include (1) New/Updated code release, (2) Mid-code cycle, and (3) Code revisions.
3. **Enforcement**. This section summarizes resources and activities that encourage and discourage code enforcement.
4. **Evolution**. This section describes how green codes can be updated and improved over time.

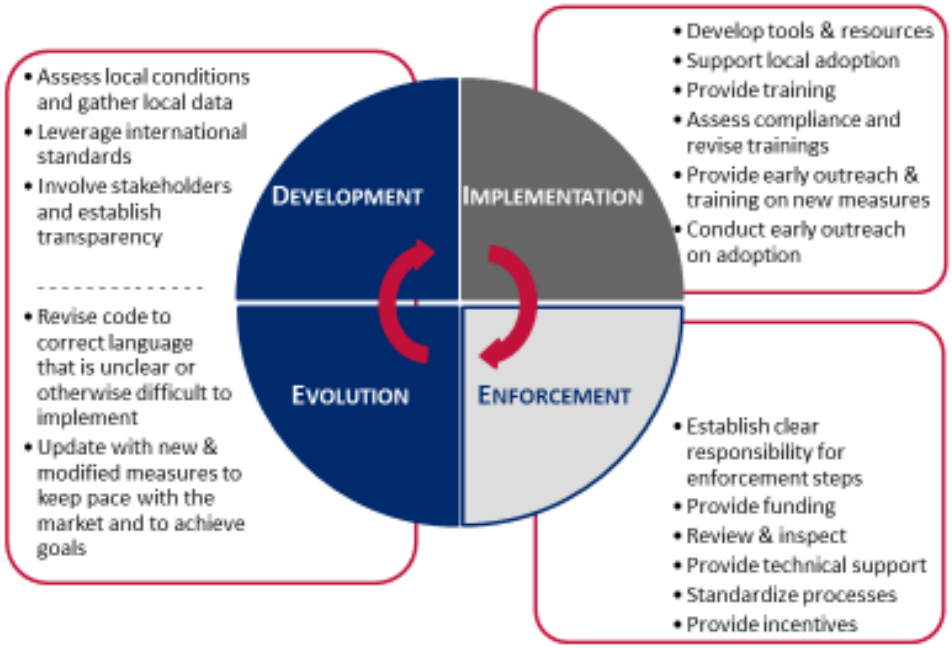
The final section, *Next Steps*, provides a template to help users identify gaps in their current code infrastructure, and identifies best practices and references that can be considered in developing specific actions to lead to improvements.

# 1. Infrastructure Components

Code infrastructure has four components: development, implementation, enforcement, and evolution. The approach to building this infrastructure can be unique to an economy and each component can be improved independently of the others to take advantage of changes in markets, policies, funding, and other factors. Improving code infrastructure is an ongoing process that, by its nature, continues over time. A strong code infrastructure will not only help achieve greener buildings, but can contribute to overall improvement of buildings and implementation of many health and safety building requirements.

**Figure 1**
***Code Development, Implementation, Enforcement, and Evolution***

*Green codes succeed through activities that build lasting local infrastructure for all aspects of development, implementation, enforcement, and continued development/evolution*



# COMPONENT 1: DEVELOPMENT

Code development is a major focus area to achieve energy and other resource savings in the building sector. The main objective is to produce a set of green building measures that will support economy goals, for example, improved air quality, decreased fuel imports, or economic and job growth. Measures should be cost-effective, utilize commercially available technology, and account for regional climate conditions and local building traditions. These individual code measures are important and will benefit from infrastructure put in place to support the process. Once a code is established, development continues through Component 4: *Evolution*. Activity in the following areas should be assessed and, if not in place, considered as opportunities to improve development:

Figure 2
***Green Building Code Development***

*A supportive development infrastructure involves a diverse group of stakeholders, which vary from economy to economy, builds off of international standards and codes which have been successfully used by peer economies, and adapts requirements to meet the conditions and needs of the local market.*

## Local Conditions

Local Conditions must be understood and incorporated to set technical requirements that result in the desired building performance. Gathering data on heating and cooling-degree days (HDD and CDD) and humidity, for example, will provide the basis for specifying climate-appropriate insulating properties and technology. Other types of data are also essential to building an effective code from the ground up:

- Market activity includes the availability and cost of materials and technology, as well as the presence of consumer information on their green attributes. Are green products readily available in local markets? What construction practices are entrenched? How do occupants use buildings in terms of times of day, comfort temperature settings, and outdoor air (open windows)? How well trained is the construction workforce? Answers to questions like these can point to opportunities and market barriers, and should be considered when developing code language.
- Voluntary programs operate on the leading edge of the market, pulling it towards innovation. Participants follow these programs not because they are required, as is the case with codes, but because they see a welfare or cost benefit. These programs provide a testing ground for new technologies and approaches which become better understood with time, and cost-effective through greater use. Voluntary programs can provide valuable insight into which green building measures have market acceptance. Coordination of the technical content between voluntary programs and codes helps avoid duplication of effort and offers a harmonized pathway to beyond-code performance (see textbox[5]).

[5] http://www.usgbc.org/articles/leading-building-industry-groups-agree-streamline-green-building-tool-coordination-and-deve

## International Standards

International standards are fully developed requirements that can be adapted to local conditions. A core component of codes, standards provide authoritative technical documents that deliver fundamental information on specifying, testing, installing and maintaining materials and systems. Codes reference standards extensively because it is a practical, economical and efficient way to incorporate in-depth, innovative and current technical details.

International standards are developed in a cooperative process involving all stakeholders to produce market-driven and market-relevant solutions. [6]However, there is a great variance between the needs and circumstances of various market sectors. For many products, processes, and services, the marketplace will demand one globally accepted standard. In other areas, long-standing national infrastructures (such as electrical) may make it economically or technically infeasible for one globally accepted standard. While in other sectors, the best approach may be to develop competing standards and let the marketplace decide on implementation. Standards developers, code developers, governments, and industry partners work together to identify workable solutions through cooperation and coherence.

**VOLUNTARY PROGRAMS**
**United States**

In August 2014, a significant step forward to align the existing green code, green standard, and green voluntary program was announced. These three options for green, developed independently of each other, represent strong efforts to promote green buildings but set up potential problems for the market. Individual U.S. jurisdictions, including states, counties, and cities, are responsible for developing, managing, and enforcing their own building codes. While this results in an uneven set of building requirements across the country, they are generally all based on the same set of nationally-developed model codes. The agreement, by their respective development bodies, to combine Standard 189.1 and the International Green Construction Code (IgCC) into one regulatory tool, and align it with above-code guidance under LEED, will avoid the adoption of conflicting green codes and create a streamlined framework to advance green buildings in the U.S. Local policymakers, as well as the design, construction, and manufacturing industries, will be able to meet code requirements where adopted, and clearly understand what additional measures they can voluntarily implement to achieve a higher level of green design and construction.

The World Trade Organization (WTO) Technical Barriers to Trade (TBT) Committee Decision on what constitutes an international standard (G/TBT/9, 13 November 2000, para. 20 and Annex 4) outlines seven principles for development of standards to facilitate trade which include transparency,

[6] http://www.ansi.org/standards_activities/nss/faq_usss.aspx?menuid=3

openness, impartiality and consensus, effectiveness and relevance, coherence and development dimension.[7]

**INTERNATIONAL CODE COLLABORATION**
**Indonesia**

International standards provide a valuable starting place for APEC economies that want to develop or revise local standards and codes. The process can be aided significantly through collaboration with the appropriate standard setting organization. This approach is demonstrated by Indonesia's partnership with IAPMO, the International Association of Plumbing and Mechanical Officials, in developing, and implementing, a national standard (SNI) on plumbing system based on IAPMO's Uniform Plumbing Code. Through an open consensus process involving stakeholders, the National Standardization Agency of the Republic of Indonesia (BSN), the Ministry of Public Works, and the Ministry of Industry worked with IAPMO on specific goals for development and adoption. A series of technical coordination meetings aided the process to incorporate local industry and stakeholder input, reflect Indonesian construction norms, and be respectful of all cultural practices. They also developed a 3rd party testing laboratory and certification body for plumbing products in the local market, and a personnel certification program for installers and enforcement officials.

## International Codes

As more economies develop and implement green and energy efficiency code requirements, more resources and best practices will become available. Standards like ASHRAE 90.1, 62.1, and 189.1, and codes from the International Code Council (ICC) and the International Association of Plumbing and Mechanical Officials (IAPMO) in the U.S.[8], are examples of requirements developed for one economy which can be modified for use in another. While determination of specific measures requires field testing and analysis and evaluation against local conditions, use of existing, relevant international standards provide a common language and facilitate trade in building products.

[7] http://www.wto.org/english/tratop_e/tbt_e/tbt_e

[8] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) develops a series of linked standards including 90.1 (*Energy Standard for Buildings Except Low-Rise Residential Buildings*), 62.1 (*Ventilation for Acceptable Indoor Air Quality*), and 189.1 (*Standard for the Design of High-Performance Green Buildings*). The ICC produces model codes including the IECC (*International Energy Conservation Code*) and the IgCC (*International Green Construction Code*). IAPMO produces model codes including the UPC (Uniform Plumbing Code) and the GPMCS (Green Plumbing and Mechanical Code Supplement).

## Conformity Assessment and Accreditation

Conformity assessment and accreditation support the specification of green products and technologies. Conformity assessment is the process of verifying that products, materials, services, systems or people measure up to the specifications of a relevant standard. This has become an important component of world trade and is most often carried out by specialist organizations, such as inspection and certification bodies and testing laboratories. Accreditation is a procedure by which an independent authoritative body (accreditation body) gives formal recognition that a (conformity assessment) body or a person is competent to carry out specific tasks. Accreditation involves the onsite peer assessment of conformity assessment bodies for their competence to carry out specified calibrations, tests, inspections and/or certifications of product or personnel, to determine if they meet a required standard. These conformity assessment activities are critical to the quality and accuracy of the many products and services upon which all economies rely for, among other things, the health and safety of its citizens, and for trade.

Conformity assessment can assure that products perform as specified in green requirements. As public awareness grows, false advertising of low-quality products, materials, and services can damage support for green buildings. International standards exist to assess conformity of products worldwide. Global accreditation networks, International Accreditation Cooperation (ILAC) and the International Accreditation Forum (IAF), support harmonization of conformity assessment practices and offer easy access to accredited facilities on their websites. The Pacific Accreditation Cooperation (PAC) works to create a global system that grants international recognition of certification or registration of management systems, products, services, personnel, and other conformity assessment programs.

## Stakeholders and Transparency

Involving stakeholders and requiring transparency in the development of standards and codes helps ensure buy-in and market-level support and compliance. The composition of potential stakeholders will vary widely across economies, but can provide valuable contributions. For example, as part of the process, global and regional manufacturers can provide input on product ratings and accommodate new efficiency and green requirements into their product development processes. Local architects and developers can contribute information on ease-of-use, and common practice. Policymakers can provide input on needed timeframes and resources. International donors, including organizations such as USAID, GIZ, and others can coordinate demonstration projects and other support programs. Regardless of the particular mix of stakeholders, transparency will build public- and private-sector confidence in the process and resulting requirements.

# COMPONENT 2: IMPLEMENTATION

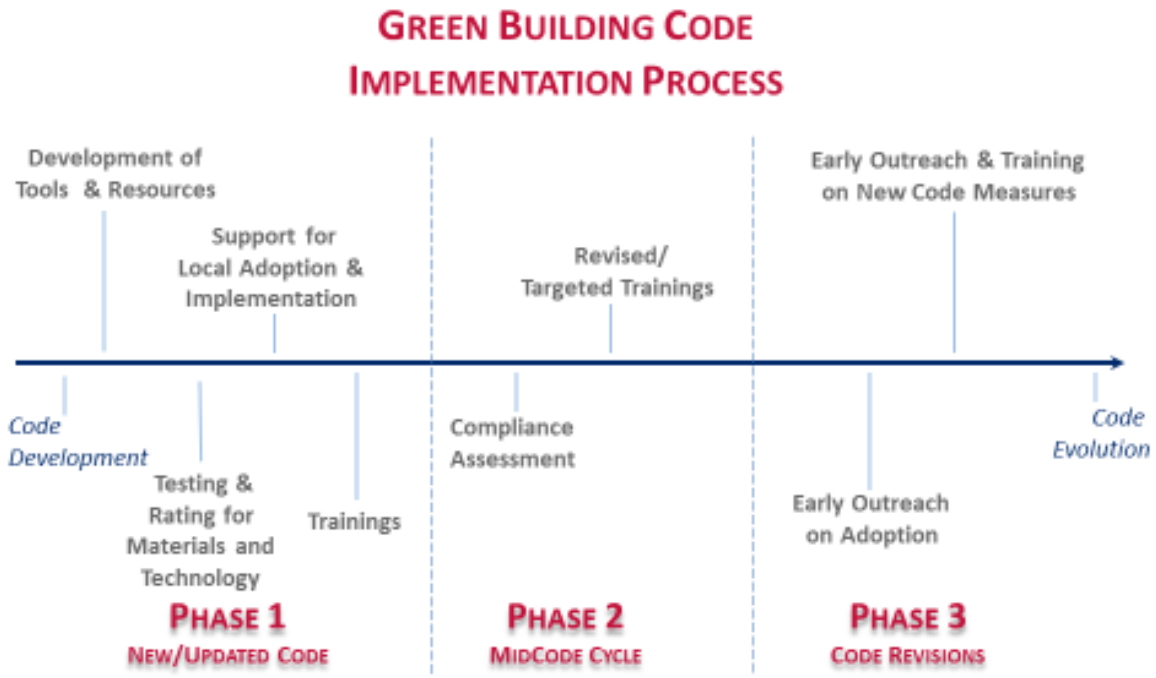
Information, tools, resources, and training are all critical elements of a code implementation infrastructure, and can be carried out by a number of stakeholders. Successful application of a code requires a diverse workforce (ranging from government officials to architects to brick-layers) to understand and implement specific requirements. Each of these groups needs easy-to-use resources that

support design, construction, demonstration of code compliance, and explanation of green benefits to customers. These can be developed at the domestic level and across disciplines. A domestic engineering association, for example, may be the most appropriate group to create tools for its membership.

**Figure 3**

***Green Building Code Implementation***

*The timing of implementation can vary but funding and staffing resource limitations typically mean focusing on one activity at a time. Once all Phase activities are operational, they can be improved during Phase 2, and should continue through Phase 3, while new activities start up in anticipation of revised code requirements.*




It is often difficult to assess the necessary support required for new green requirements at the time of a code launch. For this reason, approaching implementation infrastructure as a repeating cycle that starts with the release of a code, and ends and restarts with an updated code, will develop effective support in all phases of code application.

## Phase 1: New/Updated Code

The objective of phase I is to engage the market by addressing needs important to implementers.

- Development of resources and tools can range from energy modeling software to simple job-site cards depicting the proper installation of a rainwater recovery system. They also include case studies and building owner/marketing materials, which are important to help designers and contractors communicate with their clients on the benefits of green building requirements and how the code affects them.
- Trainings on referenced standards, code requirements, benefits, resources and tools, and enforcement procedures are essential. Customized training for different users of the code, i.e., for design, engineering, construction, inspection, etc., will boost awareness and understanding.
- Support for local adoption & implementation can smooth the roll-out process of new code requirements. Some local governments will need to adopt the code according to national law, and can benefit from sample policy language they can modify. Often a number of new stakeholders are engaged in codes at the municipal and local levels. Support can be provided to governments on communicating the location-specific benefits of green buildings to their constituents.
- Testing and rating for materials and technology is important in order to verify that such products conform to safety, environmental, and other relevant standards. In some cases, development of a recognized label may be an effective way of communicating quality to the market

## Phase 2: Mid-Code Cycle

- Compliance assessments are strategic mid-cycle checks designed to identify which measures are not being followed, and why. Compliance failure may be due to any number of factors, such as not understanding the code language, problems communicating the required actions down the construction chain, and competing priorities.
- Revised/Targeted trainings provide an opportunity to address the issues leading to compliance failures, in most cases. Trainings may need to focus on a particular implementing group, or revisions to curriculum used to explain specific requirements. If code language is confusing, it may need to be revised during the *Evolution* stage.

## Phase 3: Code Revisions

- Early outreach & training on new code measures to stakeholders and code users will enable a greater set of support activities. Engineers, for example, typically provide training for their

sector and can integrate upcoming changes to meet code release dates. Early feedback and input can also be received which may benefit the process of finalizing requirements.

- Early outreach on adoption facilitates support from local governments and adoption, when required. Where there is flexibility, implementation of green elements may be rolled out most effectively through a short voluntary phase, or partial phase (e.g., "10 greenest requirements"), before all requirements become mandatory.

# COMPONENT 3: ENFORCEMENT

Effective enforcement requires enabling policies and available funding for permits, plan reviews, inspections, and related training and certifications. Many economies also require some collaboration and adoption at the local level, creating the added need for streamlined but flexible enforcement practices to ease the burden on local governments. Clear responsibilities across domestic government agencies for each step in the enforcement process are essential to achieving code compliance in a streamlined and cost-effective manner. There are many enforcement models in use and an assessment of the most appropriate and functional structure for a particular economy is wise. However, regardless of the specific approach followed, there are some basic elements that can be put in place to encourage strong enforcement. Alternatively, the presence of other elements can discourage enforcement and lead to poor levels of code compliance.

**THE CHALLENGES OF GREEN CODE EDUCATION AND TRAINING**
**Singapore**

"The main challenge is to obtain buy-in. Through our joint studies with the local university and industry partners, we demonstrate to the stakeholders that going green for their buildings make strong business sense. Our research shows that retrofitting inefficient existing buildings can enhance the market valuation of the building by more than 2 percent.
The big challenge is to convince small and medium enterprises to green their buildings, especially their existing buildings. Another set of challenges is to green buildings under multi-strata management where individual owners/operators own/operate their own shop units within a building."

- -- Representative, Singapore Building and Construction Authority—

**Figure 4**
***Actions and Resources Affecting Green Code Enforcement***

*Activities that encourage enforcement will be economy-specific; however, many types of actions and resources have been consistent across economies in their ability to support or dissuade code compliance.*


Policies at various levels of government are of critical importance in putting actions in place to support enforcement. For example, domestic policy can clearly specify responsibility for permit approvals, construction document reviews, and site inspections. When the process is clearly laid out, there is less confusion and entities can cooperate smoothly. When policy is used to identify codes as a strategy for achieving specific domestic or local goals, funding for all areas of infrastructure, especially enforcement, is easier to secure. Policy can also require standardization of forms, tools, testing reports, and other means of demonstrating compliance. This supports local entities with resources while providing for flexibility to accommodate local conditions. The penalties for non-compliance with the code need to be clearly articulated and readily accessible for review by all stakeholders. On the other hand, incentives may be best suited to local policy and can include streamlining the enforcement processes for developers in good code-compliance standing, for example, through reduced or expedited site-inspections.

**CODE ENFORCEMENT AND INCENTIVE MEASURES**
**Chinese Taipei**

***Enforcement Measures***

Architects or professional technicians, or both, sign a document by which they take responsibility for implementing the certification system.

To tie in with spot check regulations on the amended certification items of construction licenses and miscellaneous licenses, the Ministry of Interior (MOI) stipulates that a green building be listed as a necessary spot check item and that inspections be strengthened.

If any person has difficulty complying with the Building Code when adopting novel green building design approaches, applying new engineering methods, or use unique materials, they may file an application with the MOI for compliance approval through the use of a performance evaluation model.

The green materials labeling system established in 2004 is complemented by a review, inspection, and test certification system of materials.

***Incentive Measures***

The government subsidizes review expenses incurred for public buildings applying for a green building label. They also reward architects who produce outstanding green building designs.

If an owner/operator is willing to adopt standards higher than those required for green building design, a reward is considered, such as increasing the building capacity allowance.

# COMPONENT 4: EVOLUTION

A policy requirement and a process for revisions and updates, allows a code to reflect experience and enables a contemporary set of green measures. The process of periodic review, refinement, and improvement of the code over time follows many of the same elements present in the *Development* component and occurs in tandem with continued activity under the *Implementation* and *Enforcement* components. There are two types of actions in evolution—revision and updating. **Revision:** unclear, confusing, or otherwise hard-to-implement requirements should be revised in the regular code cycle. Establishing a feedback loop, during *Implementation*, through code training to identify these measures can be very effective.

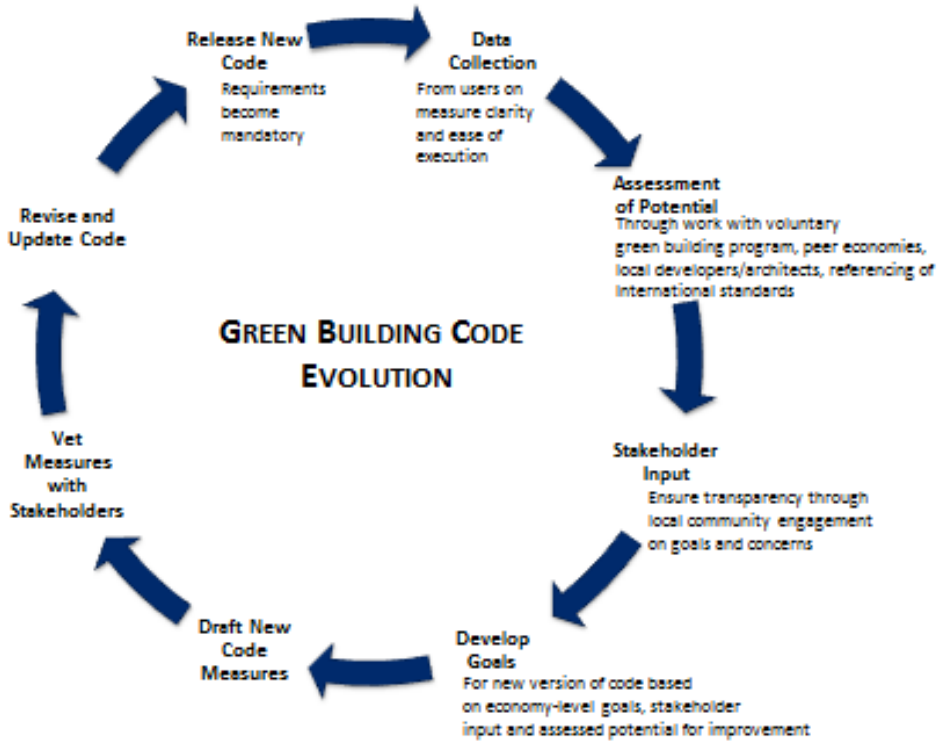
**Updates** provide a mechanism to reach desired outcomes and goals, in both the near- and long-term. Updates are new and modified requirements, routinely incorporated by citation of revised or new standards, which keep the code on pace with market practices, costs, services, and other developments. If the market is able to cost-effectively implement green measures and they are not a part of the code,

these are lost opportunities because they are only being used in a subset of buildings. One important source of updates may be existing voluntary programs. As these programs pull the market forward to accept new technologies and design strategies, individual provisions may become appropriate for broad application through codes. This approach expands the effectiveness of codes using elements that already benefit from acceptance and familiarity by industry. As voluntary programs pull the market toward innovation, codes push the baseline up and establish a minimum acceptable set of requirements. Pushing the baseline to improve the standard of practice followed by the majority of buildings will keep the building sector on track to achieve national goals.

**Figure 5**

***Green Building Code Evolution***

*Evolution continues the code development process so that it can leverage advances in international knowledge and technology related to green buildings, as well as local success in turning green requirements from previous versions into standard practices in the marketplace*




The evolution of green codes should be informed by a continuous process of stakeholder feedback and analysis, as shown in Figure 5. As governments look to revise and update green building codes in support of economy goals, the engagement and buy-in of industry and other stakeholders is crucial. The collection and sharing of data by users can point to potential problematic areas of the code (for revision), as well as new measures (updates) that might enhance the effectiveness of the code in meeting

green goals. Ideally, this data will be collected on the basis of common goals established during the initial code development process, for both local industry and policymakers.

# 2. Next Steps

In learning about each component of code infrastructure as described above, readers may have identified aspects of their own infrastructure that need improvement. The *Green Code Infrastructure Summary Table* provides a quick reference on the elements of each component and associated benefits.

It can be used as a quick reference for the concepts presented in this guide. Following the table is the *Green Code Infrastructure Checklist.* The checklist is provided as a tool for identifying current activity and gaps in a specific economy. It links to resources and provides peer examples that users can utilize to follow up on opportunities as part of their code improvement efforts.

## GREEN CODE INFRASTRUCTURE SUMMARY TABLE

| Key Elements and Actions | Benefits |
|---|---|
| **INFRASTRUCTURE COMPONENT 1: DEVELOPMENT** | |
| Access to economy-specific data on climate, thermal performance of buildings, energy consumption, availability and cost of materials and technology, and construction practices. | This data can be used to effectively adapt international standards and codes from peer economies to the specific conditions and needs of an individual economy. |
| An inclusive and transparent stakeholder process. | Involvement of professionals and technical experts for the design and construction industry will benefit the development process and improve acceptance and use of the code. Non-traditional stakeholders interested in promoting green buildings based on health or climate benefits, including environment ministries and NGOs, can also be beneficial. |
| Leverage international standards to develop green building code requirements. | International standards are a valuable reference when developing local codes that are cost effective and reduce global trade barriers. |

| | |
|---|---|
| A voluntary green building program with requirements coordinated to your green building code. | Green building certification programs encourage the market to try innovative technologies and practices. Providing the building sector with a clear path to advance from mandatory requirements under a code to advanced requirements under a voluntary certification program will improve use and support code evolution activities. |
| Mandatory conformity assessment and accreditation for technology, materials, and services. | Conformity assessment and accreditation can be used to ensure products and services meet a specific standard to support green building quality. |
| **INFRASTRUCTURE COMPONENT 2: IMPLEMENTATION** | |
| Easily available resources and tools to support the code implementation process from design, through construction, to marketing and sales. | Especially when green requirements are new, tools and customized resources can improve understanding and acceptance of unfamiliar practices. |
| Assistance provided to local governments for understanding and adopting new policies for green buildings. | Direct assistance can help ensure that code requirements fit into local policy, and that compliance is enforced by leveraging local processes. |
| A process to verify that materials and technology meet health, safety, and other relevant standards. | A conformity assessment process can give builders and building owners confidence that tested green building products will perform as expected. |
| Easily available resources and tools to support the code implementation process from design, through construction, to marketing and sales. | Especially when green requirements are new, tools and customized resources can improve understanding and acceptance of unfamiliar practices. |
| Trainings provided for all stakeholder groups, and revised based on impact assessments. | Revising trainings and/or targeting trainings to address areas in the code of weak/ineffective compliance, can be a cost-effective strategy to increase overall improvement in building practices. |
| Early outreach to stakeholders on upcoming changes to code requirements. | Conducting outreach before requirements become mandatory allows time for the market to adjust to new practices and for stakeholder organizations to provide educational support, such as through pilot projects, communication materials, and training. |
| **INFRASTRUCTURE COMPONENT 3: ENFORCEMENT** | |
| A clearly defined enforcement process for the green building code, with responsible entities identified for each step. | Avoids confusion and improves compliance by the construction market. |
| Available funding to provide education and training for those enforcing the code. | If inspectors learn about green code requirements, and how to enforce them consistently, they are less likely to |

| | |
|---|---|
| | ignore them or let non-compliant buildings pass inspections. |
| A consistent enforcement process that includes checks before, during, and after construction. | Catching non-compliance during design can save time and money to fix problems after construction. Similarly, much changes during the process of construction so it is important to ensure code measures were implemented as planned. Standardization saves costs in developing individualized processes. |
| **INFRASTRUCTURE COMPONENT 4: EVOLUTION** | |
| Periodic reviews and modifications to the green building code. | Allows for the opportunity to incorporate learning and encourages a contemporary set of green measures. Without updates, code requirements can easily lag behind market opportunities to improve buildings. |
| A process to receive public comments and recommendations to improve clarity in code requirements. | Allows for modifying requirements which have been found to be out-of-date, unclear or otherwise confusing and difficult to implement. |
| Long term targets for the code (i.e. energy savings or emission reductions), and milestones set up to achieve these over time. | Provides a mechanism to reach desired outcomes and goals, in both the near- and long-term. |

# Green Code Infrastructure Checklist

- ✓ **Key Elements and Actions:** This list describes ways to strengthen the infrastructure for green building codes and is consistent with the summary table, above, and the content of the component sections.
- ✓ **Describe Opportunities:** Where an economy may not have activities or processes in place to correspond to a *Key Element* or *Action*, this column provides space to describe ideas for taking action to address that specific opportunity to strengthen green code infrastructure.
- ✓ **Models/Resource Links:** This column provides resource links and specific examples of activities in APEC economies to support the development and implementation of actions across the APEC region. There is no implied endorsement of the examples and links provided.

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
|---|---|---|
| **INFRASTRUCTURE COMPONENT 1: DEVELOPMENT** | | |
| ☐ **In your economy, is there access to economy-specific data on climate, thermal performance of buildings, energy consumption, availability and cost of materials and technology, and construction practices?** | | In **Chile**, mean values of different climate parameters are included in a Chilean Standard Nch1079 (an official non-mandatory standard that defines climatic zoning for the country and establishes general architectural design recommendations). New thermal performance standards for housing, education, and healthcare buildings were studied and proposed in 2013. These were designed to maximize social impact, for example, high air pollution and particulate matter. The government is currently defining the |

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
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| | | agenda to apply these standards in the future Ordenanda General de Urbanismo y Construcciones (OGUC). |
| ☐ **Do you have an inclusive and transparent stakeholder process?** | | Stakeholders in **Singapore** are invited to send representatives to join the Green Mark[9] committees. Their early participation in drafting and revising the Green Mark scheme facilitates valuable input that makes the scheme more implementable and ensures their buy-in. Industry briefings are often done with larger groups of practitioners to share preliminary ideas, gather more feedback, and develop additional buy-in. Workshops and in-depth briefings are also often provided to equip stakeholders with detailed information. |
| ☐ **Does the green building code** | | Commonly referenced international |

[9] BCA Green Mark Scheme (http://www.bca.gov.sg/greenmark/green_mark_buildings.html)

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
|---|---|---|
| **reference international standards?** | | standards include ASTM and ISO. |
| ☐ **Does the green building code leverage widely used codes?** | | Commonly referenced codes used internationally include: (ASHRAE); International Code Council (ICC); International Association of Plumbing and Mechanical Officials (IAPMO).[10] |
| ☐ **Is there a voluntary green building program operating in your economy? If so, are requirements coordinated with the green building code?** | | **China**'s system links minimum requirements (one star) for buildings with progressively greener requirements under additional stars. The single system prevents contradictions between green requirements and other construction code measures, and facilitates achievement of greener buildings by building on a core set of measures. |
| ☐ **Are conformity assessment measures for technology, materials or services needed to validate performance of these elements in the green building** | | Consult conformity assessment tools developed by the International Organization for Standardization's |

[10] ASHRAE (www.ashrae.org); ICC (www.iccsafe.org); IAPMO (www.iapmo.org)

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
|---|---|---|
| **code?** | | Conformity Assessment committee, CASCO (ISO). The Asia Pacific Laboratory Accreditation Cooperation (APLAC)[11] can also provide resources to assess the need for conformity assessment measures. |

## INFRASTRUCTURE COMPONENT 2: IMPLEMENTATION

| | | |
|---|---|---|
| ☐ **Are resources and tools easily available to support the code implementation process from design, through construction, to marketing and sales?** | | In **Hong Kong**, the updated Building Energy Code (BEC) and Energy Audit Code (EAC) are promulgated in their organizations by a Technical Taskforce. The update of BEC and EAC is also publicized on the website of the Buildings Energy Efficiency Ordinance (BEEO), and the latest versions are uploaded to the website for free browsing and download by the general public. In addition, talks and seminars are arranged for the building owners in various local |

[11] ISO(www.iso.org/iso/home.htm); APLAC (www.aplac.org/home.html)

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
|---|---|---|
| | | districts and the major stakeholders. These enable further dissemination of publicity leaflets/ pamphlets and are effective at enhancing stakeholder awareness of their statutory obligations under the Ordinance. |
| ☐ **Is assistance and outreach provided to local governments for understanding and adopting new policies for green buildings?** | | A 2012 cost-benefit analysis of a new 6-star residential requirement, as compared to the previous 5-Star Plus system, was developed for Western **Australia**. This type of analysis breaks down the impact of regulation into terms that can be easily understood by those outside of the construction industry.[12] |
| ☐ **How will it be verified that materials and technology meet health, safety, and other relevant standards?** | | Can tests already conducted be accepted as evidence of compliance? See ILAC and IAF websites. |
| ☐ **Are trainings provided for all stakeholder groups, and revised based** | | In **Singapore**, members of the |

[12] http://www.commerce.wa.gov.au/sites/default/files/atoms/files/energyefficiencycostbenefit.pdf

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
|---|---|---|
| **on impact assessments?** | | construction industry are educated through a full suite of briefings, workshops, and training programs in green building design, construction and facility management at the Building Construction Authority (BCA) Academy. Within BCA, those involved in the Green Mark assessment process first go through the Green Mark Manager certification program. During the course, attendees work as associate assessors alongside experienced assessors on actual projects to learn on the job. Once the management is comfortable that the new colleagues have the required skills to do Green Mark assessments, they will participate in the assessment team as lead assessors. Green Mark assessments are done on a team basis to maintain impartiality and robustness. |
| ☐ **Is early outreach provided for stakeholders on upcoming changes to code requirements?** | | To prepare the market for implementation of revised energy efficiency building regulations in **Vietnam**, the government is working with international donors including USAID and the IFC, to build a database on energy consumption in |

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
|---|---|---|
| | | cities, disseminate data on green building technologies, and develop pilot demonstration projects and technical tools. |
| **INFRASTRUCTURE COMPONENT 3: ENFORCEMENT** | | |
| ☐ **Is the enforcement process for the green building code clearly defined, and the entities responsible for each step clearly identified?** | | A 2010 advocacy-led project in the **United States** developed detailed descriptions of enforcement processes in 15 states. The primary purpose was to document and analyze the strengths and weaknesses, and provide recommendations for action by various stakeholders to improve compliance. The study uncovered a number of gaps in authority which could then be addressed. Their methodology is available online in a summary paper.[13] |
| ☐ **Is funding available to provide education and training for those enforcing the code?** | | In **Singapore**, those within the Building Construction Authority |

[13] http://energycodesocean.org/resource/white-paper-compliance-planning-assistance-program

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
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| | | (BCA) Academy involved in the Green Mark assessment process first go through the Green Mark Manager certification program. During the course, attendees work as associate assessors alongside experienced assessors on actual projects to learn on the job. Once the management is comfortable that the new colleagues have the required skills to do Green Mark assessments, they will participate in the assessment team as lead assessors. Green Mark assessments are done on a team basis to maintain impartiality and robustness. |
| ☐ **Is code enforcement a consistent process that includes checks before and after construction?** | | **China**'s code enforcement process is supported by its *Code for Acceptance of Energy Efficient Building Construction*. Testing and documentation procedures and construction quality are detailed in this document to inform how and when tests are to be performed, and components are to be inspected. A summary paper of |

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
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| | | China's compliance process in English is available online.[14] |
| **INFRASTRUCTURE COMPONENT 4: EVOLUTION** | | |
| ☐ **Are periodic reviews conducted to identify needed modifications to the green building code?** | | The green building code in **Japan** was developed in 1980, and updated in 1992, 1999, and 2013. A council of technical and academic experts provide their opinion on code updates for the national government to consider. The government also has the opportunity to invite opinions from others in the process.<br><br>**Mexico** building standardization currently has under revision (Anteproyectos): *Edificaciones Comerciales de Alto Desempeño ; Edificaciones de Salud de Alto Desempeño which includes the following standards:* "Normas Mexicanas" –NMX– (standards): NMX – AA – 164 – SCFI 2013 *Edificaciones Sustentables;* NMX – C - 509 ONNCCE *Comisionamiento; and* NMX – J – C – 1489 ANCE – ONNCCE – NYCE |

[14] https://www.aceee.org/files/proceedings/2010/data/papers/2160.pdf

| Key Elements and Actions | Identify Opportunities to Take Action | Examples from APEC Member Economies and Links |
|---|---|---|
| ☐ **Is a process set up to receive public comments and recommendations to improve clarity in code requirements?** | | During the review in **Vietnam** of *Vietnam Building Energy Efficiency Code* (VBEEC), the national government invited the reviews of the university-based Vietnam Association of Civil Engineering Environment (VACEE), the Vietnam Green Building Council (VGBC), international donors IFC and DANIDA, and the Pacific Northwest National Laboratory, among others. The goal was to simplify the code language and processes to improve implementation in the market. |
| ☐ **Are there long term targets for the code (i.e. energy savings or emission reductions), and milestones set up to achieve these over time?** | | In **Chinese Taipei**, an understanding of how intelligent buildings can improve the quality of life for the elderly led to specific targets for green buildings. The *Intelligent Green Building Promotion Program* introduces intelligent equipment systems into green building design techniques to enlarge the green building promotion effects in the industry and achieve a sustainable built environment with safety, health, convenience, comfort, energy efficiency, carbon reduction, and environmental friendliness. The first area of focus (housing) will be |

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| | | followed by buildings, then communities, and lead to development of smart cities. |

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