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# EBC Building Energy Codes WG Survey

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Philadelphia in Legos, Photo credit: Center City Team, https://centercityteam.com/2016/11/11/lego-philadelphia-look-like/

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# Overview

- Background and Objectives
- Methodology
- Survey Categories
- Next Steps and Discussion

# Background & Objectives

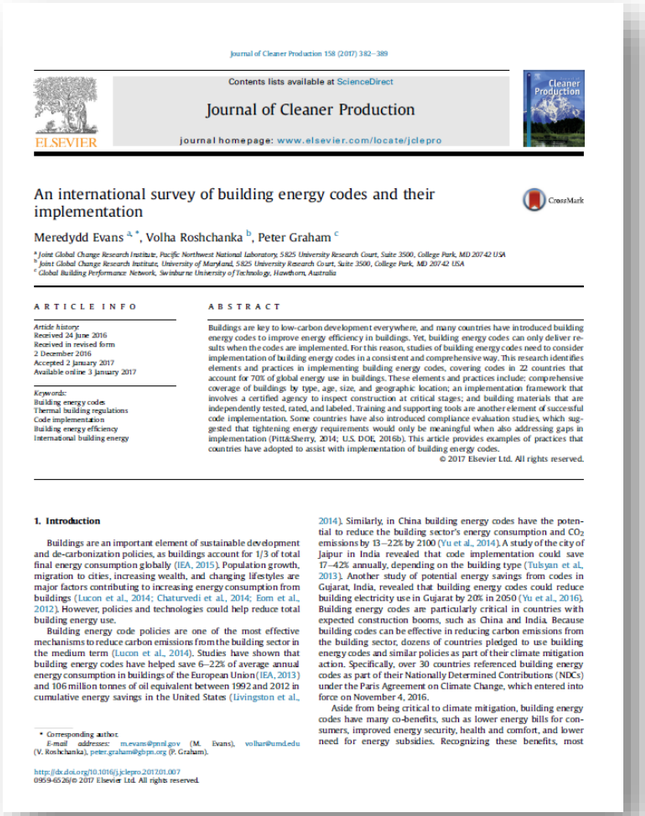
- Why is this important?
  - A WG goal: *Enhance our understanding of impactful options and practices regarding building energy codes across different countries*
  - However, codes comparison can be challenging given inherent differences across countries in the types of housing, styles of living, and governance structures, to name a few examples.
- The country survey, and accompanying glossary list, will help to:
  - Provide a common basis/descriptive context for cross-national comparison that can lead to meaningful information-sharing
  - Broadly characterize the status of energy codes/standards for buildings in the EBC countries and enhance our understanding of the range of practices
  - Better analyze and distill methods/metrics for assessing the full benefits of energy-efficient buildings

# Methodology and Approach to Survey

- Build on past, road-tested surveys such as IPEEC survey
- Update based on feedback of BECWG members
- Include a glossary to find or clarify common terminology to improve quality
- Countries will fill out survey, drawing on previous survey results if they want
- BECWG members will schedule interviews with country representatives to confirm and cross check results

# 2017 building energy codes survey

- Focused on implementation of building energy codes in 22 countries
- Identified 6 key categories for analysis:
  1. Code coverage
  2. Institutional approaches
  3. Building checks
  4. Incentive structure
  5. Training and tools
  6. Building materials
- The study did not compare the stringency of requirements
  - Stricter code requirements are only meaningful if implementation systems are in place
  - Stringency of requirements varies between countries and can be challenging to compare directly as a result of differences in climate, construction techniques, and how codes are written



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An international survey of building energy codes and their implementation

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ABSTRACT

Buildings are key to low-carbon development everywhere, and many countries have introduced building energy codes to improve energy efficiency in buildings. Yet, building energy codes can only deliver results when the codes are implemented. For this reason, studies of building energy codes need to consider implementation of building energy codes in a consistent and comprehensive way. This research identifies elements and practices in implementing building energy codes, covering codes in 22 countries that account for 70% of global energy use in buildings. These elements and practices include: comprehensive coverage of buildings by type, age, size, and geographic location; an implementation framework that involves a certified agency to inspect construction at critical stages; and building materials that are independently tested, rated, and labeled. Training and supporting tools are another element of successful code implementation. Some countries have also introduced compliance evaluation studies, which suggested that tightening energy requirements would only be meaningful when also addressing gaps in implementation (Pitt&Sherry, 2014; U.S. DOE, 2016b). This article provides examples of practices that countries have adopted to assist with implementation of building energy codes.

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1. Introduction

Buildings are an important element of sustainable development and de-carbonization policies, as buildings account for 1/3 of total final energy consumption globally (IEA, 2015). Population growth, migration to cities, increasing wealth, and changing lifestyles are major factors contributing to increasing energy consumption from buildings (Lucon et al., 2014; Chaturvedi et al., 2014; Eom et al., 2012). However, policies and technologies could help reduce total building energy use.

Building energy code policies are one of the most effective mechanisms to reduce carbon emissions from the building sector in the medium term (Lucon et al., 2014). Studies have shown that building energy codes have helped save 6–22% of average annual energy consumption in buildings of the European Union (IEA, 2013) and 106 million tonnes of oil equivalent between 1992 and 2012 in cumulative energy savings in the United States (Livingston et al., 2014). Similarly, in China building energy codes have the potential to reduce the building sector's energy consumption and $CO_2$ emissions by 13–22% by 2100 (Yu et al., 2014). A study of the city of Jaipur in India revealed that code implementation could save 17–42% annually, depending on the building type (Tubsyan et al., 2013). Another study of potential energy savings from codes in Gujarat, India, revealed that building energy codes could reduce building electricity use in Gujarat by 20% in 2050 (Yu et al., 2016). Building energy codes are particularly critical in countries with expected construction booms, such as China and India. Because building codes can be effective in reducing carbon emissions from the building sector, dozens of countries pledged to use building energy codes and similar policies as part of their climate mitigation action. Specifically, over 30 countries referenced building energy codes as part of their Nationally Determined Contributions (NDCs) under the Paris Agreement on Climate Change, which entered into force on November 4, 2016.

Aside from being critical to climate mitigation, building energy codes have many co-benefits, such as lower energy bills for consumers, improved energy security, health and comfort, and lower need for energy subsidies. Recognizing these benefits, most

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# Survey Coverage

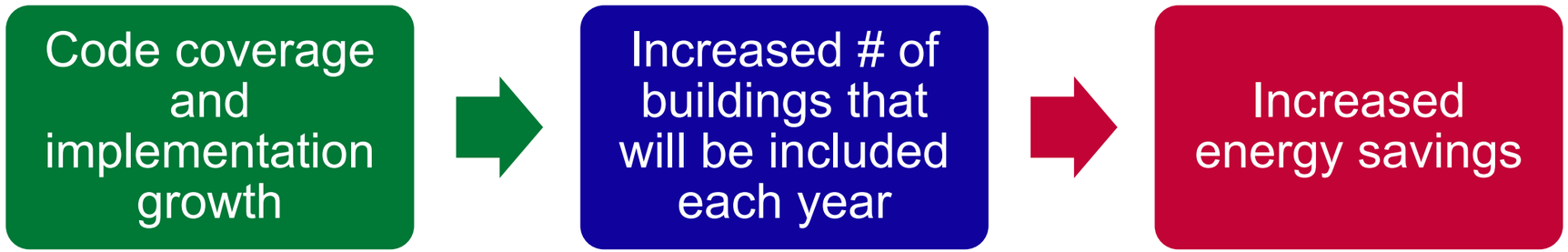
# Code history and background

- This section covers basic information such as year of first code adoption and year of adoption of the current code(s).
- Defining terminology is important – for example, we refer to building energy codes as *codes/standards that limit energy consumption in buildings directly* (e.g., through mandating thermal insulation or setting an energy consumption limit).
- Governance structure: differences in jurisdiction impact how governments design their implementation agencies

1. *Does the central government adopt the code or do local/regional governments have the jurisdiction to adopt a building energy code?*
2. *Does the country participate in any regional (pan-national) union that influences the evolution of its national building energy code?*

# Code coverage

- A country may have one or more national/model codes
- Code coverage
  - First step in ensuring that building energy efficiency requirements apply to a significant portion of buildings and have an impact on energy-intensive buildings
  - One way to consider the extent of implementation (limited coverage and lack of a clear implementation system present missed energy saving opportunities)

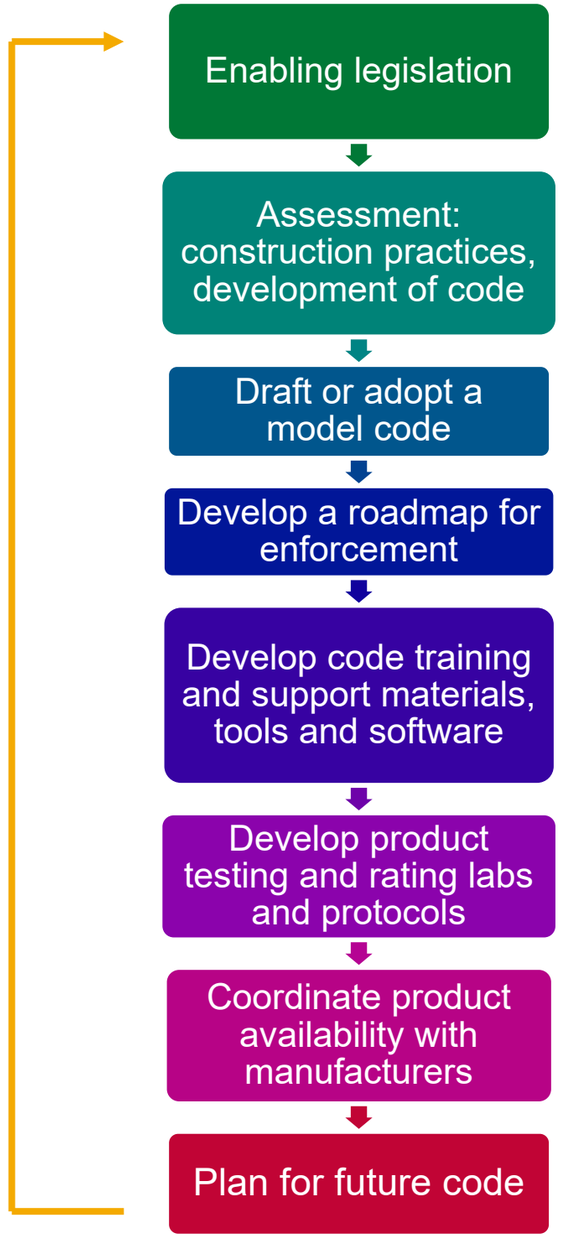


# Code coverage, contd.

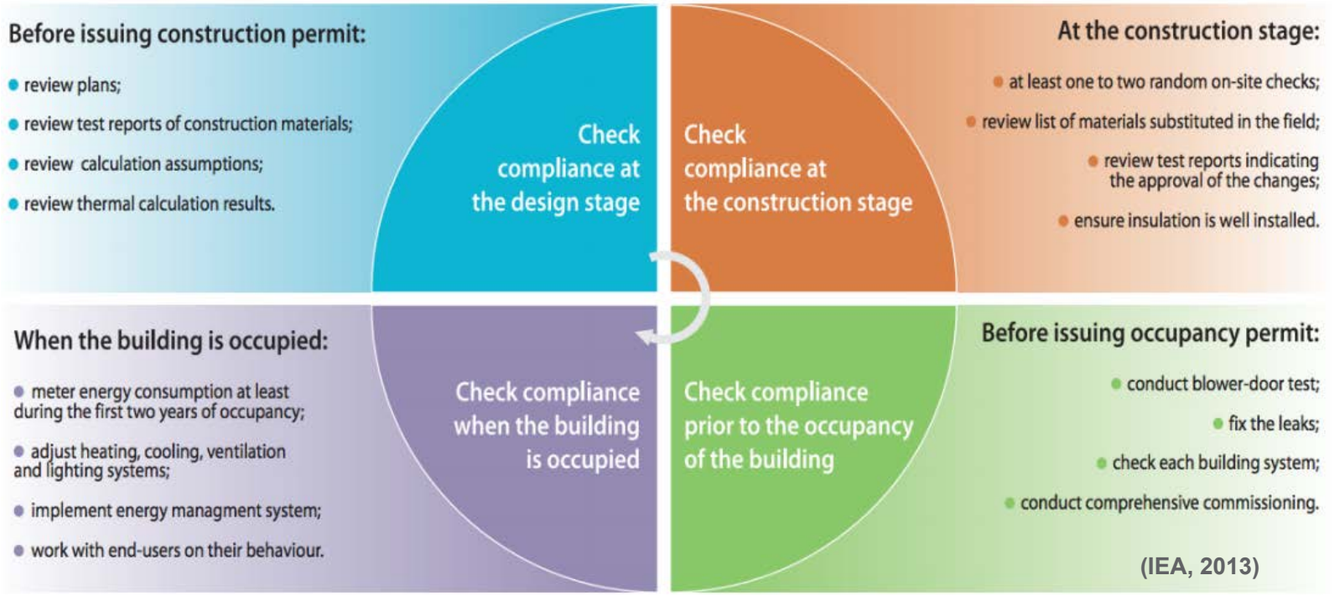
- Types of buildings covered (residential/commercial)
- Measures covered (e.g., envelope, HVAC, service water heating, lighting, electrical power, maintenance, etc.)
- New measures:
  - Integration of renewable energy in the code
  - Grid interconnection and flexibility
- Compliance approach: prescriptive with or without options for trade-offs, performance-based, point system
- Incorporation of international standards (e.g., ASHRAE 140/205)

# Development process & code updates/revisions

- National-subnational coordination is critical to fulfilling clean energy goals
  - Ensures the code reflects local priorities, and helps to link local authorities with capacity building and funding for compliance checking
- Code revision schedule and review process
  - A regular revision schedule can help the market learn to adapt



# Code implementation




- ❑ Enforcement structure
- ❑ Tools for compliance checking
- ❑ Capacity building and education for compliance
- ❑ Penalties, incentives and other mechanisms for improving compliance

- Achieving the potential of building energy codes (as well as other energy efficiency policies) requires effective implementation systems
- Depending on the compliance path, some implementation mechanisms might be more important in one country than others and many countries offer several paths for code compliance
  - E.g., software training is more essential for codes that rely on simulated performance vs. with prescriptive codes

# Compliance assessment

- Evaluating compliance programs can improve enforcement and allow policymakers to make improvements to the code based on hard data
- This is separate from checks of individual buildings
- These studies help identify:
  - Areas of non-compliance and under-compliance
  - Gaps in industry knowledge
  - Deficiencies in enforcement

Examples of building energy code evaluation programs

| Example | Building energy code evaluation |
|---|---|
| Australia | Sampling of a statistically significant number of buildings under construction within a state to assess compliance |
| China | Study of discrepancies between building design and construction, points of non-compliance with the code, and variations across jurisdictions |
| Japan | Annual inspection of selected buildings across the country by a national agency (non-compliant buildings are fixed during the study, so reported compliance rates may not be indicative) |
| United States | Assess code compliance during construction using a statistical, published methodology |

Sources: U.S. DOE, 2016; Pitt and Sherry, 2014; GBPN et al., 2015.

# Building materials & building energy labels

- Countries have varying numbers of products and rigor in their testing, rating, and labeling systems
- Products that are commonly labeled are appliances, lighting, windows, doors, and insulation

Examples of systems in place for building envelope material testing, rating, and labeling (as of 2016)

| Types of building materials available with labeled energy properties | Test protocols exist | Building materials are tested by independent and certified labs | Building materials are clearly labeled with performance characteristics | Example |
|---|---|---|---|---|
| Windows, doors, skylights, insulation, air sealing, roofing | Yes | Yes | Yes | United States |
| Windows, doors, insulation, roofing | Yes | Yes | No, construction companies send samples of materials for testing | China |
| Windows | Yes | In some cases | No, building designer must certify that buildings meet requirements | Australia |
| Windows, insulation, doors | Yes | Yes | No, available upon request | Germany |
| None | Unknown | No | No | Brazil, India, Indonesia |

Source: Evans, Roshchanka & Graham, 2017

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# Next Steps

# Next Steps/Timeline

| Time | Milestones |
|---|---|
| November 27 | Last day to collect feedback on survey and glossary |
| December 16 | Disseminate survey to members |
| January 17 | Countries submit draft surveys |
| January - February 2019 | Individual interviews with WG representatives/survey taker |
| February 28 | Countries submit/comment on updated surveys |
| February - March 2019 | Resolve/clarify any questions on survey |
| March 2020 | Survey completion |
| June 2020 | Overview report comparing building energy codes in WG countries and defining methods and terminology |

Who to ask for help: Please contact Meredydd Evans (m.evans@pnnl.gov) or Alison Delgado (Alison.Delgado@pnnl.gov) for any questions on the survey or to request to fill out the survey earlier.

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# Discussion

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# Thank you