What are the steps?

Building energy codes and standards

Buildings: Session 6
Energy Efficiency Training Week: Buildings Program

1. **Where to start:** Understanding energy use in buildings
2. **Where to start:** Energy efficiency potential in buildings
3. **Toolkit:** Energy efficient building design
4. **Toolkit:** Energy efficient building technologies
   - Where do I get help? IEA’s Technology Collaboration Programmes
5. **Toolkit:** Enabling investment with energy efficiency policies
6. **What are the steps:** Building energy codes and standards
   - Site Visit: Ministry of Public Works and Housing
7. **What are the steps:** Set targets and develop policies
8. **Did it work:** Evaluating the multiple benefits of energy efficiency
9. **Did it work:** Tracking progress with energy efficiency indicators
   - Where do I get help? International and regional energy efficiency initiatives
10. **Energy Efficiency Quiz:** Understanding energy efficiency in buildings
6. What are the steps: Building energy codes and standards

Trainers: Brian Dean and Autif Sayyed

Session: 1 hour

Purpose: To teach the fundamentals of building energy codes and standards. This course will include discussions of regulation types (e.g. mandatory, voluntary and stretch codes) and compliance paths (e.g. prescriptive, performance and outcome-based).

Scenario: A respected industry association claims that the building energy codes out of date. How do you go about testing this claim, and what do you do if this information is correct?
Building energy code types

- Prescriptive
- Simple trade-off
- Performance
- Outcome-based
1. **Prescriptive Codes:**
   - Specify requirements for key elements such as wall and ceiling insulation, window and doors, roofs, foundations, heating, ventilation air-conditioning, equipment efficiency, water heating, lighting fixtures, and controls.
   - Compliance with these codes is commonly assessed by checking project designs and specifications against the list of prescribed requirements.

2. **Simple Trade-Off Codes:**
   - Typically allow for trade-offs between similar building components. For example, less efficient insulation for more efficient windows in the building envelope.
3. **Performance Codes:**
   - Specify a minimum required level of energy consumption or intensity for the whole building. They require energy modelling to be conducted at design stage.
   - Compliance is commonly checked by comparing the modelled energy performance of the design with a reference building of the same type.

4. **Outcome-based Codes:**
   - Requires demonstration of buildings achieving code required performance in operation.
   - Compliance is typically possible through energy performance certificates or with energy disclosure policies.
Building energy code process

4 part governance

Roadmaps and pathways
Building energy codes: 4-part governance

1. Plan & Development
   - **Lead:** TBD
   - **Policy Lead:** TBD
   - **Support:** Stakeholders

2. Adoption & Adaptation
   - **Lead:** Implementing jurisdiction
   - **Technical Support:** TBD
   - **Policy Support:** TBD

3. Enforcement & Certification
   - **Lead:** Implementing jurisdiction
   - **Support:** TBD

4. Review & Update
   - **Lead:** TBD
   - **Support:** Stakeholders

Source: Mexico and IEA
Building energy codes: 4-part governance roadmap

Source: Mexico and IEA

© OECD/IEA 2018
Building energy codes: policy pathway

POLICY PATHWAY
Modernising Building Energy Codes

1. Define and adopt the objectives, scope and norms
2. Define modalities to support implementation and enforcement
3. Set a supportive policy context
4. Organise awareness campaigns
5. Develop training materials and provide training
6. Develop necessary tools for compliance checking and tracking
7. Analyse compliance trends at local level
8. Communicate compliance results and enforcement actions openly
9. Generate different metrics and evaluate implementation gaps at national level
10. Update building energy codes regularly based on lessons learned from the evaluation

www.iea.org/publications/policypathwayseries/
Building energy codes: policy pathway

Items to consider in the plan and development stages:

1. **Energy sufficiency**
   - Reduce energy needs
   - Land-use policies
   - Bioclimatic design principles
   - Use of passive solutions

2. **Energy efficiency**
   - Reduce energy consumption
   - Building energy codes
   - Mandatory S&L for:
     - overall building energy performance
     - building elements and equipment

3. **Renewable energy**
   - Reduce CO₂ emissions by using renewable energy
   - Land-use policies
   - Building energy codes
   - S&L policies for equipment
   - Mandatory share of supply from renewable energy sources
   - Mandatory S&L for equipment
Building energy codes: policy pathway

Items to consider in the implementation stages:

Before issuing construction permit:
- review plans;
- review test reports of construction materials;
- review calculation assumptions;
- review thermal calculation results.

Check compliance at the design stage

At the construction stage:
- at least one to two random on-site checks;
- review list of materials substituted in the field;
- review test reports indicating the approval of the changes;
- ensure insulation is well installed.

Check compliance at the construction stage

When the building is occupied:
- meter energy consumption at least during the first two years of occupancy;
- adjust heating, cooling, ventilation and lighting systems;
- implement energy management system;
- work with end-users on their behaviour.

Check compliance when the building is occupied

Check compliance prior to the occupancy of the building

Before issuing occupancy permit:
- conduct blower-door test;
- fix the leaks;
- check each building system;
- conduct comprehensive commissioning.
Building energy codes: Germany
Germany has used increasing regulation and increasing technology R&D to achieve a 75% reduction in heating energy use from 1975-2015.

Source: IEA Energy Efficiency Market Report
Building energy codes: United States
United States: Target setting for building energy codes

- In 2007, US Congress directed US DOE to support efforts to reduce energy use in new buildings by at least 30% by 2010.

- In October 2010, final voting confirmed code improvements that resulted in 32% energy savings.

2007 Target: resulted in 32% improvement. More energy savings than any period since 1975.

Source: US DOE and IEA Energy Efficiency Market Report
United States: Building code jurisdictions are complicated

• National body accountable to Congress:
  - US Department of Energy

• Non-government bodies that develop “model” codes:
  - International Code Council
  - ASHRAE

• Jurisdictions that adopt codes:
  - States
  - Cities/towns

• Stakeholders that influence the development and adoption of codes:
  - Manufacturers, code officials, builders, developers, lobbyists, consultants, etc.
United States: Adoption of the code by states

- American Recovery and Reinvestment Act of 2009 Section 410 linked $3.1 billion in state energy program funding to the adoption of and compliance with the latest residential and commercial codes. Section 410 required states to:
  - implement codes that met or exceeded the 2009 International Energy Conservation Code and the 2007 ASHRAE 90.1 standard
  - achieve compliance in at least 90 percent of new and renovated buildings

- “Home rule” states (like Arizona and Colorado) do not have a state code, but major cities are responsible for adopting and enforcing building energy codes
United States: Stretch codes

• **Stretch code**: a code that has higher energy efficiency requirements than the base model code.
  - To allow local jurisdictions to adoption higher energy efficiency requirements
  - To enable incentive programs tied to higher efficiency levels

• **Massachusetts stretch code**
  - First stretch code in the US
  - Originally 20 percent energy savings beyond the 2009 IECC
  - Updated to be more efficient than the 2015 IECC / 2013 ASHRAE
  - Jurisdictions covering 66% of the population have adopted the stretch code

• California, Oregon and Vermont have also started using stretch codes
Building energy codes: 
India’s Energy Conservation Building Code
India’s Energy Conservation Building Code 2017 & Draft Residential
India’s Energy Conservation Building Code 2017: Objective

- Systematic implementation and enforcement
- Strong push towards energy efficiency
- Net Zero Energy Building Vision by matching both energy efficiency and renewable energy
- Response to recent technological advancements
- Applicable to various categories of buildings and passive design strategies
- Technology neutral
India’s Energy Conservation Building Code 2017: Update steps

- **Working Groups:**
  - Market Assessment
  - Technical Analysis
  - International Best Practice
  - Expert Comments

- **Technical Committee:**
  - Regional and National Workshops
  - Public Consultation

- **Steering Committee:**
  - Overall Review and Guidance
India’s Energy Conservation Building Code 2017: Estimated impact

![Energy Performance Index (kWh/m²-yr)](chart)

- **Cold**
  - Typical Building: 201 kWh/m²-yr
  - ECBC: 213 kWh/m²-yr
  - ECBC+: 217 kWh/m²-yr
  - SuperECBC: 217 kWh/m²-yr

- **Composite**
  - Typical Building: 224 kWh/m²-yr
  - ECBC: 224 kWh/m²-yr
  - ECBC+: 224 kWh/m²-yr
  - SuperECBC: 224 kWh/m²-yr

- **Hot Dry**
  - Typical Building: 196 kWh/m²-yr
  - ECBC: 196 kWh/m²-yr
  - ECBC+: 196 kWh/m²-yr
  - SuperECBC: 196 kWh/m²-yr

- **Moderate**
  - Typical Building: 196 kWh/m²-yr
  - ECBC: 196 kWh/m²-yr
  - ECBC+: 196 kWh/m²-yr
  - SuperECBC: 196 kWh/m²-yr

- **Warm Humid**
  - Typical Building: 201 kWh/m²-yr
  - ECBC: 201 kWh/m²-yr
  - ECBC+: 201 kWh/m²-yr
  - SuperECBC: 201 kWh/m²-yr

© OECD/IEA 2018
India’s Energy Conservation Building Code for Residential 2018

Process for developing new code:

- **Review experience in South East Asia**
  - Singapore
  - Hong Kong
  - Others ...

- **Methodology**
  - Defining representative multi-storey buildings
  - Survey of more than 60 on-going large residential projects
  - Research of typical Window to Wall Ratio for the selected building types
  - Defining user patterns and internal heat gains
  - Performing systematic simulations with Energy Plus (> 20'000) for different climates

- **Using regional experiences**
  - Developing Residential Envelope Transmittance Value (RETV) for representative buildings
Building energy code progress

Policy coverage

Energy savings

Resources
Building energy code coverage

Building energy code coverage, 2015

Source: IEA Energy Technology Perspective 2017

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries, and to the name of any territory, city or area.
Building energy code resources

Online database BEEP
BEEP and other IEA databases are being integrated into IEA’’s Global Exchange Platform
## Online resource: Building energy efficiency policies database

### Policies

#### Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberta Building Code 2011</td>
<td>Alberta</td>
</tr>
<tr>
<td>National Building Code of Canada 2010</td>
<td>Canada</td>
</tr>
<tr>
<td>National Energy Code of Canada for Buildings 2011</td>
<td>Canada</td>
</tr>
<tr>
<td>Ontario Supplementary Standard SB-10 2011</td>
<td>Ontario</td>
</tr>
<tr>
<td>Ontario Supplementary Standard SB-12 2011</td>
<td>Ontario</td>
</tr>
<tr>
<td>Quebec E-1.1 2012</td>
<td>Quebec</td>
</tr>
</tbody>
</table>

### Labels

- BOMA BES7 (Building Environmental Standards) Version 2
- ENERGY STAR Portfolio Manager Benchmarking Tool
- LEED Canada (2009)
- LEED Canada (Existing Building: Operations & Maintenance)

### Incentives

- ecoENERGY Retrofit (2007)

**Source:** www.iea.org/beep
Online resource: Building energy efficiency policies database

<table>
<thead>
<tr>
<th>Prescriptive Compliance path</th>
<th>Prescriptive Compliance Path</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prescriptive requirements apply to building envelope components, heating ventilating and air conditioning equipment, and potable water heating equipment.</td>
</tr>
</tbody>
</table>

**Energy Requirements:**

**Insulation**

<table>
<thead>
<tr>
<th>Building assemblies above ground:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>U-Values (W/m2.K)</td>
<td>Floors</td>
</tr>
<tr>
<td>Climate zone 4</td>
<td>0.214</td>
</tr>
<tr>
<td>Climate zone 5</td>
<td>0.214</td>
</tr>
<tr>
<td>Climate zone 6</td>
<td>0.214</td>
</tr>
<tr>
<td>Climate zone 7A</td>
<td>0.199</td>
</tr>
<tr>
<td>Climate zone 7B</td>
<td>0.199</td>
</tr>
<tr>
<td>Climate zone 8</td>
<td>0.199</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Building assemblies in contact / below the ground:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>U-Values (W/m2.K)</td>
<td>Floors, heated</td>
</tr>
<tr>
<td>Climate zone 4</td>
<td>0.431</td>
</tr>
<tr>
<td>Climate zone 5</td>
<td>0.431</td>
</tr>
</tbody>
</table>

**Performance Compliance path**

**Energy Performance Compliance**

Performance compliance calculations determines the annual energy consumption of a reference house and sets the minimum energy target for the proposed house to that level.

**Energy Requirements:**

**Insulation**

Reduction is limited by health and safety requirements.

**Windows**

Where fenestration and door to gross wall area is less than 17%, the reference house is set to 17%. Where fenestration and door to gross wall area is greater than 22%, the reference house is set to 22%.

**Air Leakage**

An assumed building airtightness of 2.5 air changes per hour (ACH) is applied to the reference house. The proposed can measure airtightness or use an assumed 2.5 ACH in the simulation.

**Space Heating System**

Reference house applies a prescriptive type system for the applicable fuel type

**Space Cooling System**

Reference house applies a prescriptive type system for the applicable fuel type

**Water Heating System**

Reference house applies a prescriptive type system for the applicable fuel type

**Compliance Softwares:**

All energy modelling software used for code compliance calculations must conform to ANSI/ASHRAE 140, “Evaluation of Building Energy Analysis Computer Programs”

**End-uses considered:**

Space cooling, Space heating, Ventilation, Water heating

Source: [www.iea.org/beep](http://www.iea.org/beep)
Group discussion

Scenario:

A respected industry association claims that the building energy codes are out of date.

How do you go about testing this claim, and what do you do if this information is correct?

- What indicators are important in your country?
- What code types?
- How would the process work for you?