What are the steps?
Implementing building energy codes and standards

Buildings energy efficiency sessions in partnership with:

Buildings

IEA #energyefficientworld
Energy Efficiency Training Week: Buildings programme

1. **Where to start:** 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
   - *Special session.* Technology demonstration
5. **Toolkit:** Energy efficiency policies and target setting
6. **What are the steps?** Enabling investment with energy efficiency policies
7. **What are the steps?** Implementing building energy codes and standards
8. **What are the steps?** Building operations and procurement
   - *Special session.* The multiple benefits of energy efficiency
9. **Did it work?** Evaluation and energy efficiency indicators
   - Where do I get help? International and regional energy efficiency initiatives
10. **Energy efficiency quiz:** Understanding energy efficiency in buildings
Energy Efficiency Training Week: Buildings

7. What are the steps?: Implementing codes and standards

Trainers: Brian Dean and Pierre Jaboyedoff

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Scenario: A respected industry association claims that the building energy codes are out of date. How do you advance building energy codes in your jurisdiction?
Building energy code vision

Review IEA’s Policy Pathway

Set a strategy
Online resource: IEA’s Policy Pathway series

www.iea.org/publications/policypathwaysseries/
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

EVALUATE

PLAN

IMPLEMENT

www.iea.org/publications/policypathwaysseries/
## Building energy codes: set a strategy

<table>
<thead>
<tr>
<th>Energy strategy</th>
<th>Policy instrument</th>
<th>Policy measure</th>
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<tbody>
<tr>
<td><strong>1 Energy sufficiency</strong></td>
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<td>Reduce energy needs</td>
<td>Land-use policies</td>
<td>Bioclimatic design principles</td>
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<td>Building energy codes</td>
<td>Use of passive solutions</td>
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<td><strong>2 Energy efficiency</strong></td>
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<td>Reduce energy consumption</td>
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<td><strong>3 Renewable energy</strong></td>
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<td>Reduce CO₂ emissions by using renewable energy</td>
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Building energy code types

Code type
• Prescriptive
• Simple trade-off
• Performance
• Outcome-based

Document type
• Model code
• Stretch code
Building energy code types

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 the list of prescribed requirements.

2. **Simple trade-off codes:**
   - 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:**
   - Demonstration of performance during the operation of buildings.
   - Compliance is typically possible through energy performance certificates or with energy disclosure policies.
Code document type: Model code vs. regulation

- **Model code:** a code document that is designed to be copied and adopted for implementation by multiple jurisdictions.
  - To enable increased consistency across multiple jurisdictions
  - To simplify the code adoption and implementation process

- **Regulation:** a code becomes a regulation when it is legally adopted for implementation by a jurisdiction.
  - A legal regulation that has been notified or adopted by a government
  - Binding requirements that are able to be enforced by the government
Model code examples: United States, Mexico and India

- **International Energy Conservation Code**
  - Available for use across multiple countries
  - Currently used in Mexico and the United States as a model code

- **ASHRAE (90.1 and 90.2)**
  - Available for use across multiple countries
  - Commonly used for state and city commercial building codes in the United States

- **Energy Conservation Building Code**
  - Developed for local adoption by states in India
  - Originally based on ASHRAE 90.1
Code achievement type: Stretch codes vs. base code

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

• **Base code:** the minimum code with a set of requirements that are typically directly from the model code.
  - Commonly used by the majority of jurisdictions
Stretch code examples: United States and India

• Massachusetts
  - First stretch code in the United States
  - Originally 20 percent energy savings beyond the 2009 IECC, and then updated to be more efficient than the 2015 IECC / 2013 ASHRAE
  - Jurisdictions covering 66% of the Massachusetts state population have adopted the stretch code in their city/town
  - California, Oregon and Vermont have also started using stretch codes

• India
  - 2017 Energy Conservation Building Code includes multiple tiers in the code, ranging from the base code and two stretch levels that are more efficient (called ECBC+ and SuperECBC)
  - This is an example of a single code document that can be adopted by local jurisdictions with both base and stretch code requirements available to builders
India’s Energy Conservation Building Code 2017

Code update process:

• 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: 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: Estimated impact

<table>
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<tr>
<th>Climate</th>
<th>Typical Building</th>
<th>ECBC</th>
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India’s Energy Conservation Building Code 2017: Compliance

Buildings applying for ECBC Compliance

Meet Mandatory Provisions

Prescriptive Method

All building components need to comply the code individually

Envelope Trade-off Method

Allows trade-off among envelope components (Wall, Roof & Fenestration) based on total Envelope Performance Factor $EPF_{proposed} \leq EPF_{prescriptive}$

Other building components need to comply the code individually

Whole Building Performance Method

Annual Energy Simulation of Whole Building

$kWh_{proposed} \leq kWh_{prescriptive}$
India’s Energy Conservation Building Code - Residential

ECBC-R development & consultations

- The approach, the development and the code draft has been reviewed by the Steering Committee, the Technical Committee, by a consultation on the website of India Bureau of Energy Efficiency (BEE) and by consultations in cities like Chennai, Delhi, Calcutta, Mumbai.

- All comments have been taken into account and included in the draft code in consultation with BEE.

- Final draft submitted to BEE.

- Applicable to all residential buildings built on a plot area of ≥500 m².
**ECBC-R: a simplified two tier process**

- **Development:** Review experience in the region Singapore, Hong Kong, others...
  - Buildings survey, representative buildings, > 20,000 Energy Plus simulations across climates

- **Adoption and enforcement:** Model bye-laws developed at the national level can be adopted by the states to implement the building code.

- **Review and update:** Further improvement could be achieved:
  - 15 W/m² can be lowered to 12 W/m²
ECBC-R: building envelope requirements

Code provisions

I. Heat gain

- Maximum Residential Envelope Transmittance Value (RETV) for envelope (excluding roof)
- Maximum u-value for roof

II. Natural ventilation

- Minimum openable window-to-floor area ratio

III. Daylight

- Minimum visible light transmittance (window-to-wall ratio)
Standards

How is a standard different than a code?

Examples
“What’s the difference between a code and a standard?”

As we saw previously, codes are comprehensive legal documents that enable energy efficiency for buildings as a whole.

Often, building energy codes include requirements from or refer directly to a range of standards, such as specific standards for equipment, products or materials.
OBJECTIVE

Provide a guideline for energy-efficient buildings construction in Mexico, integrating existing and new standards together with recommendations into a single document. Moreover, the codes establish the national baseline for the deployment of energy efficiency programs.

BACKGROUND

Based on the International Energy Conservation Codes developed in the US, the Mexican building code Código de Conservación de Energía para las Edificaciones de México (IECC) was released in 2016. The document is an evolution of the Sustainability chapter of the Código de Edificación de Vivienda from 2009, and contains minimum energy efficiency requirements for energy conservation of commercial and residential new buildings and renovations, including air conditioning and water heating systems, appliances consumption, solar gains and envelope.

While in Federal level, the code is voluntary. However, once adopted by a local government, it becomes mandatory. The code will be updated every three years, addressing developments in technology and the evolution of energy efficiency standards.

México developed its code based on the IECC, from the International Code Council. First version released in 2016, with goal for updates every three years.
OBJECTIVE
Create technical regulation on products, processes, methods, installations, services, systems or activities related to the security, health and protection of consumers and the environment.

BACKGROUND
Mexico has 32 different standards related to energy efficiency (Normas Oficiales Mexicanas – NOM), of which 4 are directly related to buildings (building envelope, insulation, lighting and fenestration included). By the end of 2018, 74 test laboratories, 10 certification institutions and over 200 verification units are part of the structure for developing the standards and putting them to force. These are mandatory standards and are backed by the National Law of Metrology and Normalization.

In addition to the NOMs, there are also Normas Mexicanas (NMX), which contain specifications focused on the quality of products, processes and services, and are also known as normas de calidad or quality standards. NMXs are voluntary standards and are generally recommendations.

The mandatory standards can be found here.

México has mandatory (NOMs) and voluntary (NMX) standards. There are 32 mandatory standards on energy efficiency, of which 15 are buildings-related.
**RESIDENTIAL ENERGY EFFICIENCY STANDARDS**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>NOM-003-ENER-2011</td>
<td>Thermal efficiency of water heaters for residential and commercial use</td>
</tr>
<tr>
<td>NOM-004-ENER-2008</td>
<td>Energy efficiency of centrifugal pumps for water pumping of domestic use with powers from 0.187 kW to 0.746 kW</td>
</tr>
<tr>
<td>NOM-005-ENER-2012</td>
<td>Energy efficiency of residential washing machines</td>
</tr>
<tr>
<td>NOM-015-ENER-2012</td>
<td>Energy efficiency of residential refrigerators and freezers</td>
</tr>
<tr>
<td>NOM-017-ENER-2012</td>
<td>Energy efficiency of Compact Fluorescent Lamps</td>
</tr>
<tr>
<td>NOM-018-ENER-2011</td>
<td>Thermal insulation for buildings</td>
</tr>
<tr>
<td>NOM-020-ENER-2011</td>
<td>Energy efficiency in buildings, envelope of buildings for housing purposes</td>
</tr>
<tr>
<td>NOM-021-ENER/SCFI-2008</td>
<td>Energy efficiency and user safety requirements for air conditioners of room type</td>
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<tr>
<td>NOM-030-ENER-2012</td>
<td>Lighting efficacy of integrated Light-Emitting Diode (LED) lamps for general lighting</td>
</tr>
</tbody>
</table>

**NON-RESIDENTIAL ENERGY EFFICIENCY STANDARDS**

<table>
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<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>NOM-007-ENER-2004</td>
<td>Energy efficiency in lighting systems of non-residential buildings</td>
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<td>NOM-008-ENER-2001</td>
<td>Energy efficiency in buildings, envelope of non-residential buildings</td>
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<td>NOM-011-ENER-2006</td>
<td>Energy efficiency of central, packaged or Split air conditioners</td>
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<td>NOM-023-ENER-2010</td>
<td>Energy efficiency of Split, free discharge and ductless air conditioners</td>
</tr>
<tr>
<td>NOM-024-ENER-2012</td>
<td>Thermal and optical characteristics of glass and glass systems for buildings</td>
</tr>
<tr>
<td>NOM-028-ENER-2010</td>
<td>Energy efficiency of lamps for general use</td>
</tr>
</tbody>
</table>

Mexico has 9 residential and 6 non-residential standards. These standards can then be referred to within the building energy code.
Codes and standards process

Set roles with stakeholders
Create a roadmap timeline with targets
Understand the steps of implementation
Achieve continuous improvement
Building energy codes: 4-step cycle and 4-part governance

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

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

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

4. Review & Update
   - **Lead**: Implementing jurisdiction
   - **Technical Lead**: TBD
   - **Policy Lead**: TBD
   - **Support**: Stakeholders

Source: Mexico and IEA
Building energy codes: implementation

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.
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?