What are the steps?

Building energy codes and standards

Buildings: Session 6

Buildings energy efficiency sessions in partnership with:

BEEP

INDO-SWISS BUILDING ENERGY EFFICIENCY PROJECT

UCL ENERGY INSTITUTE

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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: Schneider Electric
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 Pierre Jaboyedoff

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Scenario: A respected industry association claims that the building energy codes out of date.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

Building energy code types (1 of 2)

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.

Building energy code types (2 of 2)

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

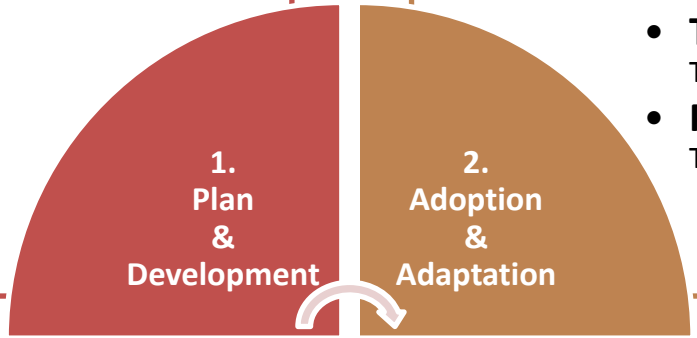
4 part governance

Roadmaps and pathways

Building energy codes: 4-part governance

ASSESS, DEVELOP & IMPROVE

- **Technical Lead**: TBD
- **Policy Lead:** TBD
- **Support**: Stakeholders



- **Lead**: Implementing jurisdiction
- **Technical Support**: TBD
- **Policy Support:** TBD

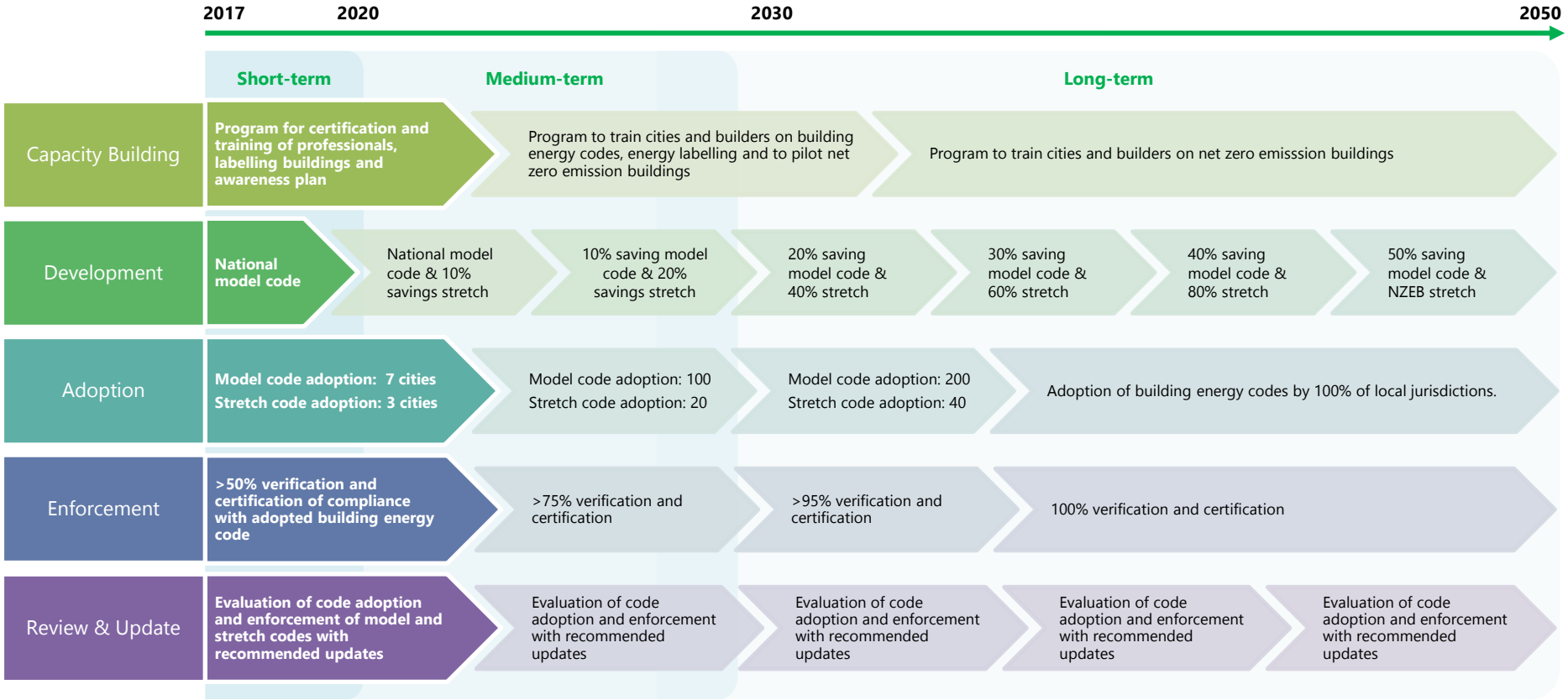
- **Lead**: TBD
- **Support**: Stakeholders

- **Lead**: Implementing jurisdiction
- **Support**: TBD

IMPLEMENT

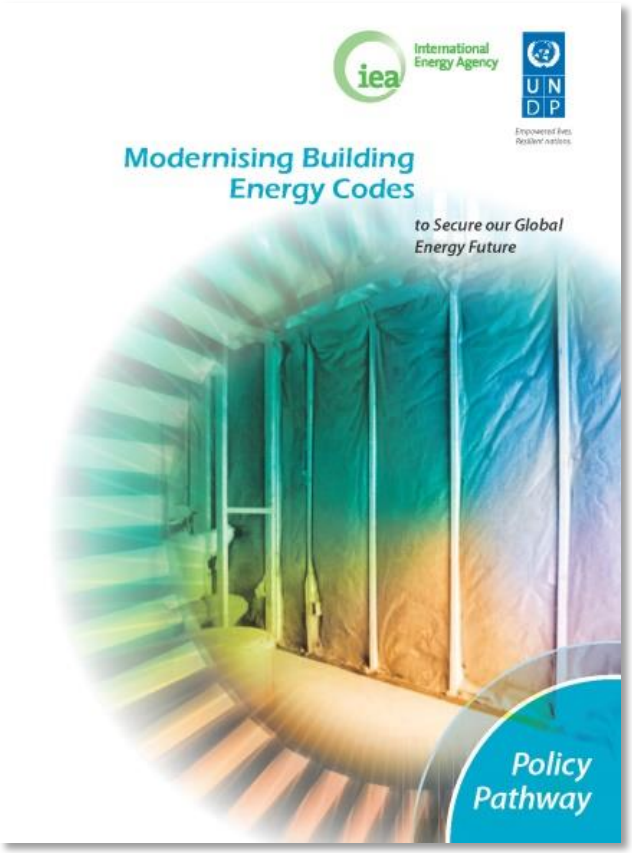
Source: Mexico and IEA

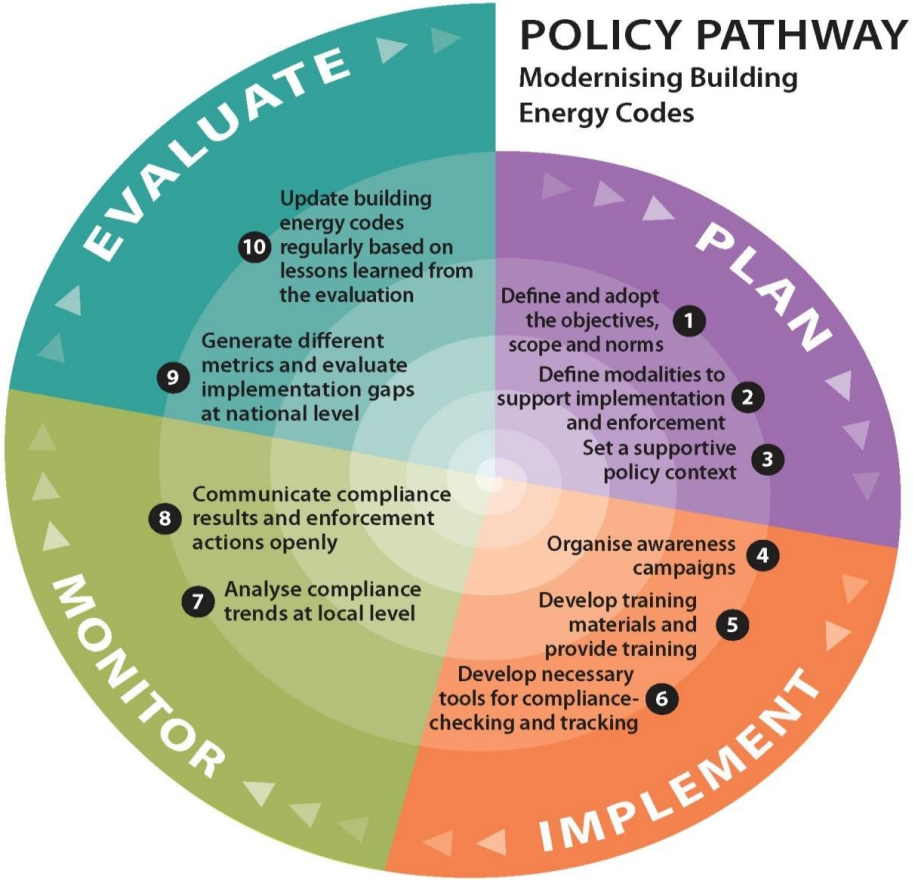
Building energy codes: 4-part governance roadmap



Source: Mexico and IEA

Building energy codes: policy pathway

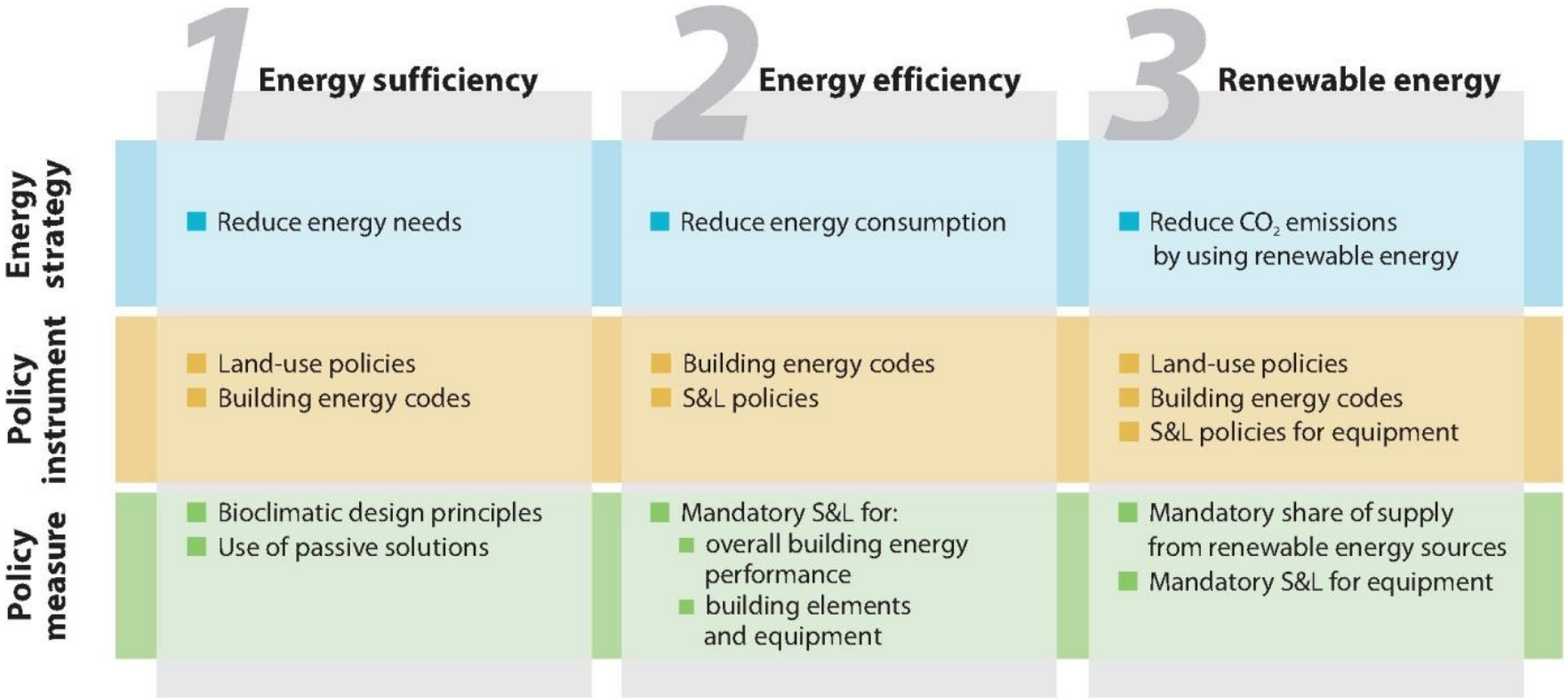




www.iea.org/publications/policypathwaysseries/

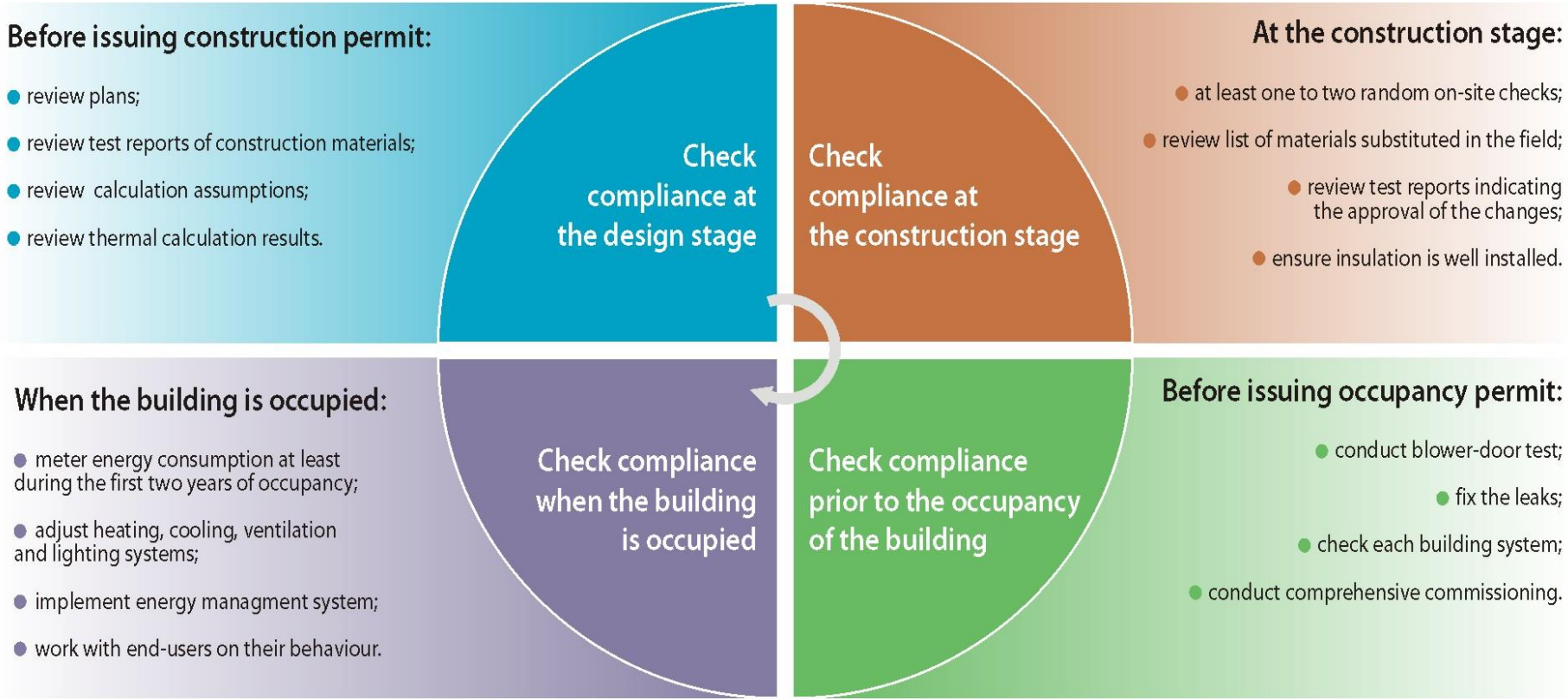
Building energy codes: policy pathway

Items to consider in the plan and development stages:



Building energy codes: policy pathway

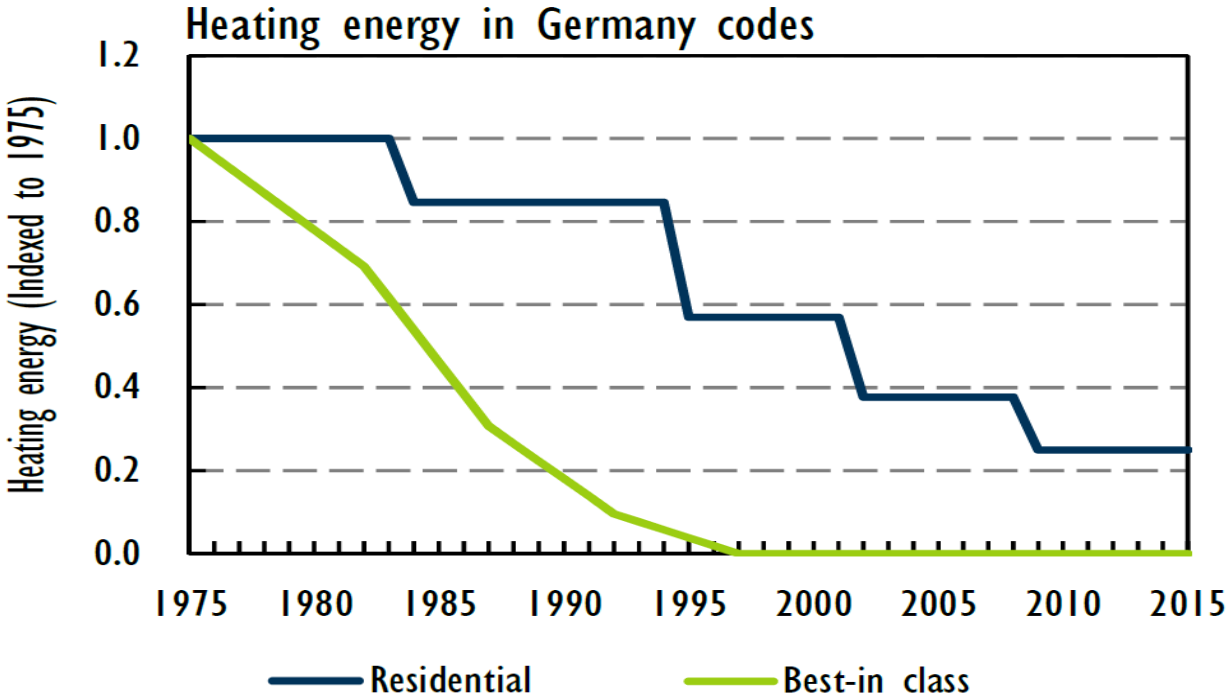
Items to consider in the implementation stages:



Building energy codes:
Germany

Building energy code impact - Germany

Germany has used increasing **regulation** and increasing **technology R&D** to achieve a 75% reduction in heating energy use from 1975-2015

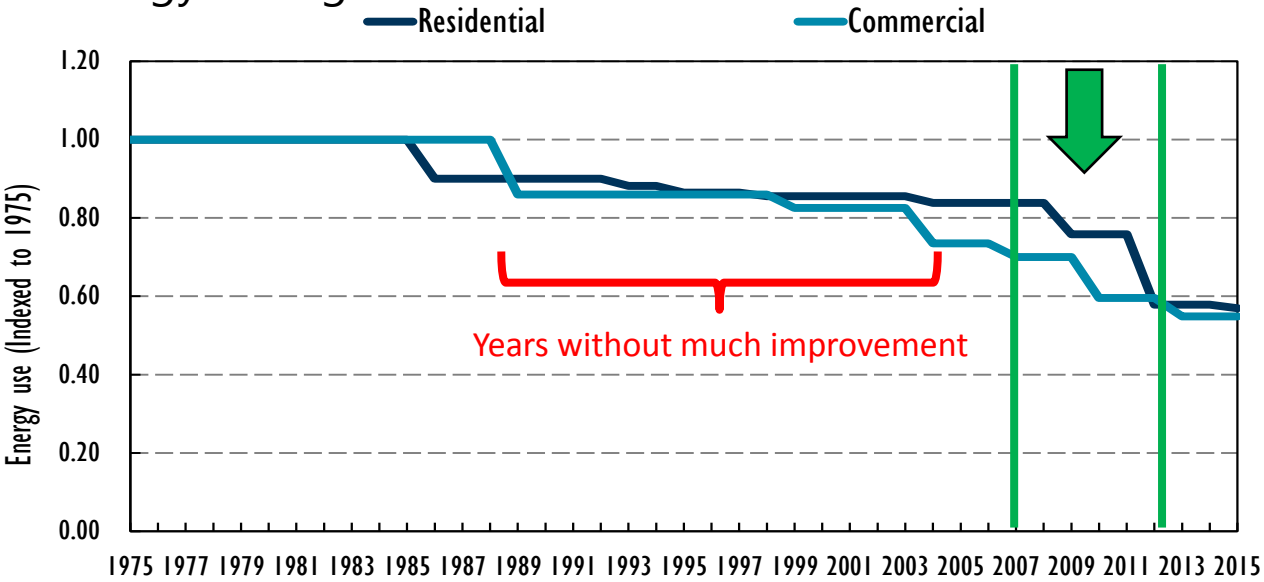


Source: IEA Energy Efficiency Market Report

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

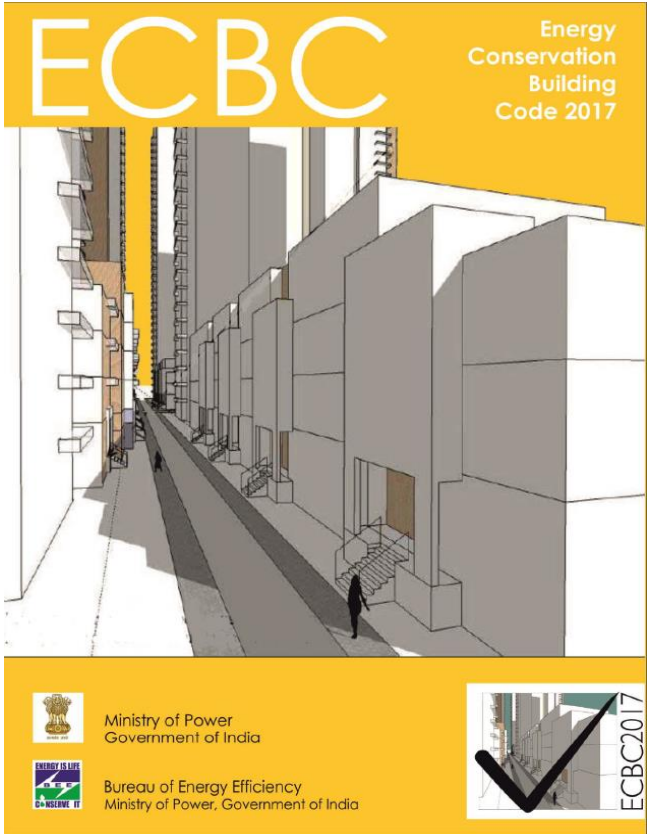
- **Stretch code:** a code that has higher energy efficiency requirements than the base model code.
  - To allow local jurisdictions to adoption higher energy efficiency requirements
  - To enable incentive programs tied to higher efficiency levels

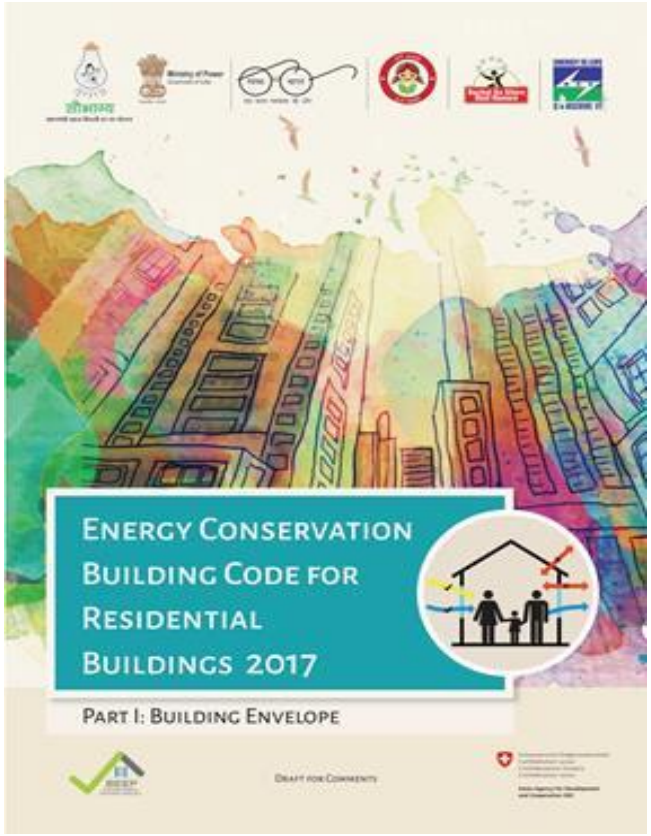
- **Massachusetts stretch code**
  - First stretch code in the US
  - Originally 20 percent energy savings beyond the 2009 IECC
  - Updated to be more efficient than the 2015 IECC / 2013 ASHRAE
  - Jurisdictions covering 66% of the population have adopted the stretch code

- California, Oregon and Vermont have also started using stretch codes

Building energy codes:
India's Energy Conservation Building Code

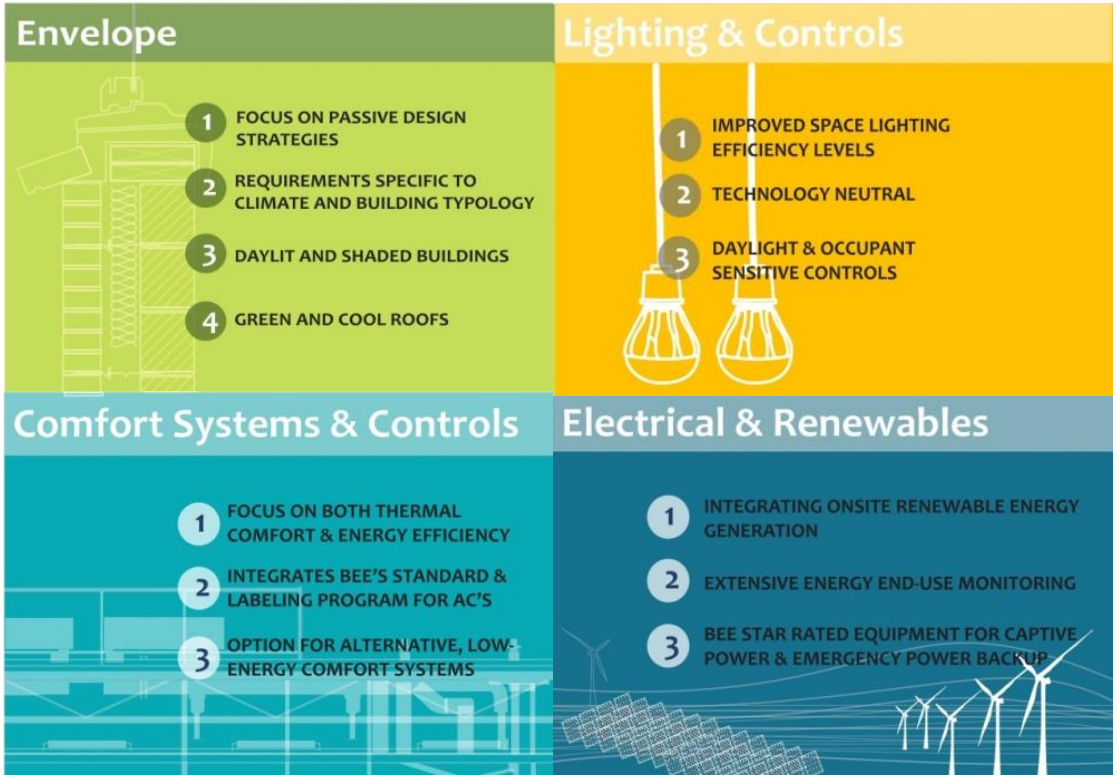
India's Energy Conservation Building Code 2017 & Draft Residential





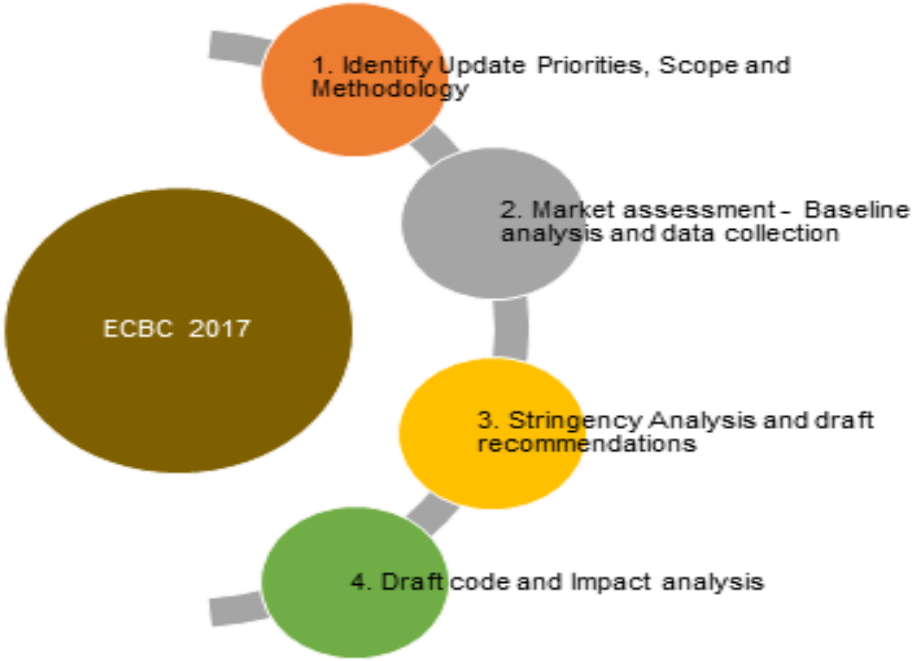
India's Energy Conservation Building Code 2017: Objective

- 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

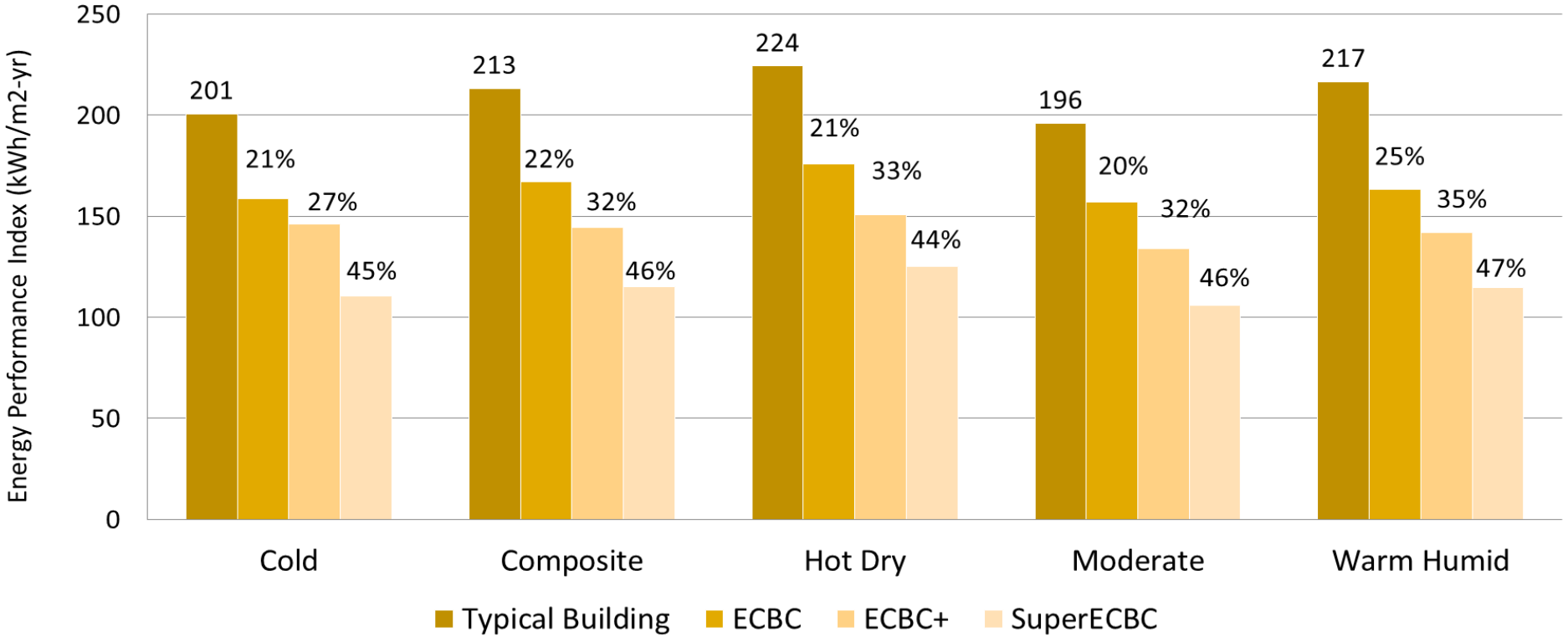


India's Energy Conservation Building Code 2017: Update steps

- **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



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

India's Energy Conservation Building Code for Residential 2018

Developing simple equation for simple trade-off for envelope :

- Envelope heat gain per envelope area obtained by simulation for the main variables
  - Calculated as average for the cooling period, excluding roof
  - Net heat gain rate of building envelope components divided by total exposed envelope area

$$\text{Envelope heat gain}, \frac{W}{m^2} = \frac{Q_{wall.cond}\ (kWh) + Q_{win.cond}\ (kWh) + Q_{win.rad}\ (kWh)}{T_{cooling}\ (h) * A_{envelope}\ (m^2)}$$

- Residential Envelope Transmittance Value (RETV)

$$RETV = A * (1 - WWR) * U_{opaque} * \omega + B * WWR * U_{non-opaque} * \omega + C * WWR * SHGC_{eq} * \omega$$

- WWR: Window to Wall Ratio
- $Uopaque$: thermal transmittance (W/m^2-K)
- $Unon-opaque$: thermal transmittance (W/m^2-K)
- $SHGCeq$: Solar heat gain coefficient
- A,B & C: given coefficients for each climate zone
- ω: orientation factor

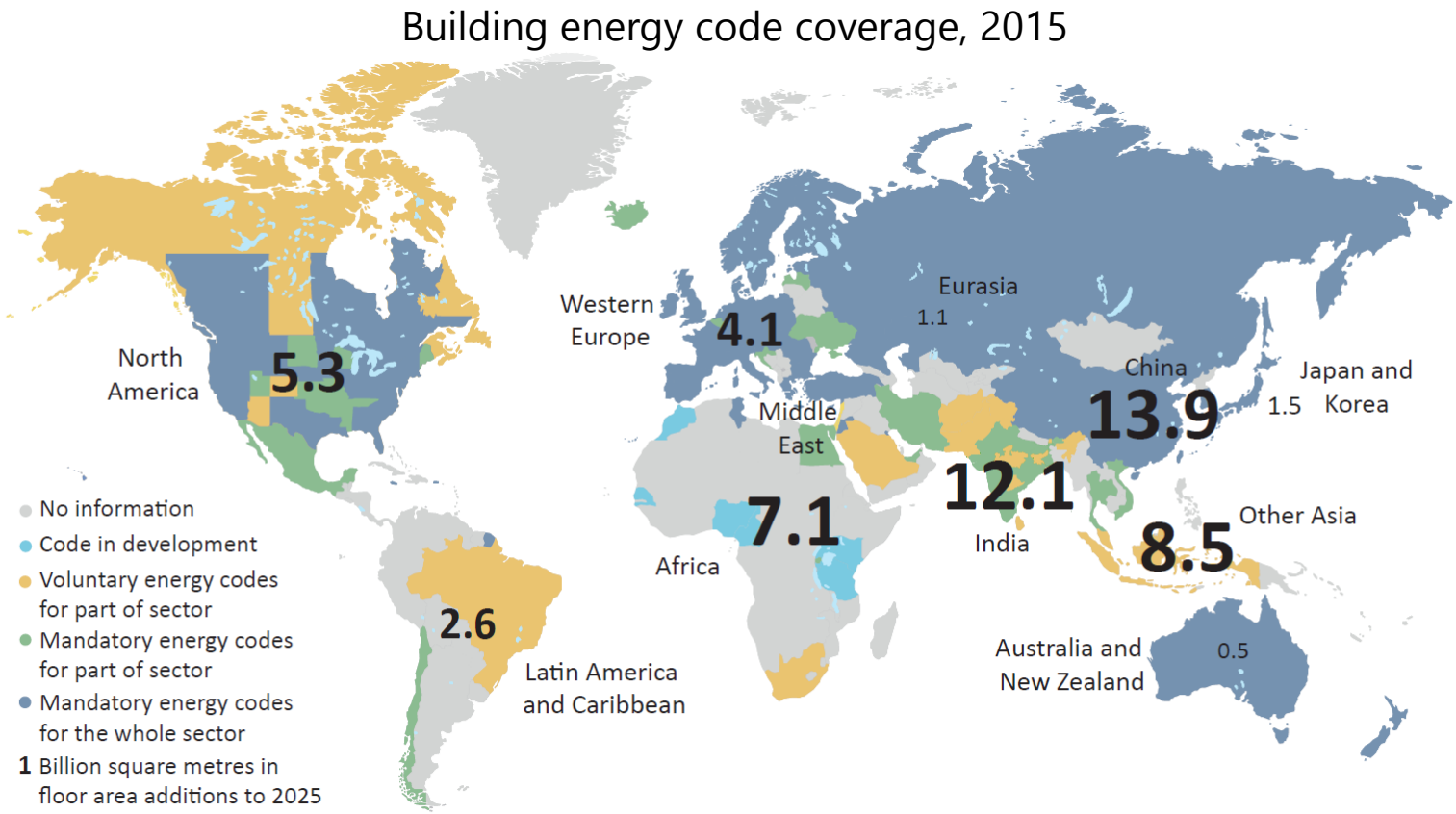
Building energy code progress

Policy coverage

Energy savings

Resources

Building energy code coverage



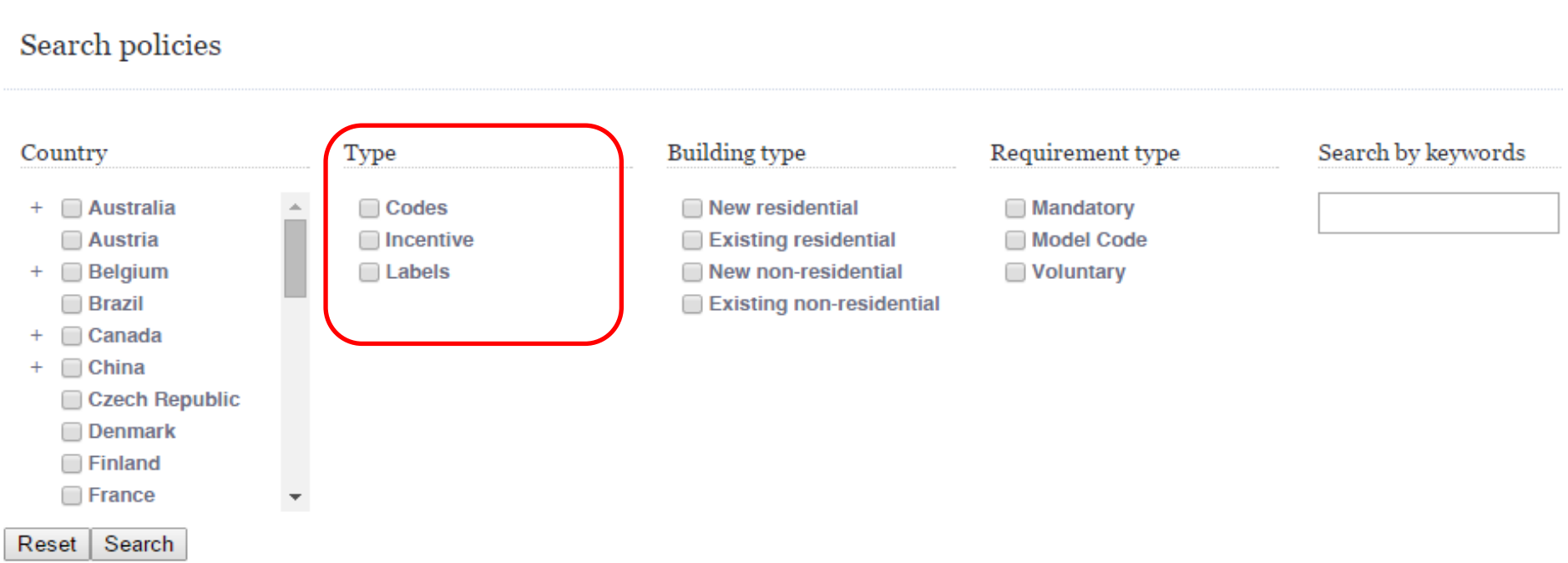
This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boudaries, and to the name of any territory, city or area.

Source: IEA Energy Technology Perspective 2017

Building energy code resources

Online database BEEP

Online: Building energy efficiency policies database



BEEP and other IEA databases are being integrated into IEA"s Global Exchange Platform

Source: www.iea.org/beep

Online resource: Building energy efficiency policies database

Policies

Codes

Alberta Building Code 2011	New residential	Alberta
National Building Code of Canada 2010	New residential, New non-residential, Existing residential, Existing non-residential	Canada
National Energy Code of Canada for Buildings 2011	New residential, New non-residential	Canada
Ontario Supplementary Standard SB-10 2011	Existing non-residential, Existing residential, New non-residential, New residential	Ontario
Ontario Supplementary Standard SB-12 2011	Existing residential, New residential	Ontario
Quebec E-1.1 2012	New residential, Existing residential	Quebec

Labels

BOMA BESt (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

Prescriptive Compliance path

Prescriptive Compliance Path

Prescriptive requirements apply to building envelope components, heating ventilating and air conditioning equipment, and potable water heating equipment.

Energy Requirements:

Insulation

Building assemblies above ground:

U-Values (W/m2.K)	Floors	Roofs, Attic	Roofs, Other	Walls
Climate zone 4	0.214	0.145	0.214	0.360
Climate zone 5	0.214	0.115	0.214	0.325
Climate zone 6	0.214	0.115	0.214	0.325
Climate zone 7A	0.199	0.096	0.199	0.325
Climate zone 7B	0.199	0.096	0.199	0.385
Climate zone 8	0.199	0.096	0.199	0.385

Building assemblies in contact / below the ground:

U-Values (W/m2.K)	Floors, heated	Floors, above the frost lint	Roof	Walls
Climate zone 4	0.431	0.510	0.510	0.503
Climate zone 5	0.431	0.510	0.510	0.336

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

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?***

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