Welcome back!

• Review: What we learned yesterday and questions
• Polls:
  - **Question 1:** Which features of a building code should be performance based rather than prescriptive?
    
    | Option                                    |
    |-------------------------------------------|
    | Area of glazing allowed                   |
    | Insulation                                |
    | Type of shading device to be installed    |
    | Colour of surface finishes               |
    | Use of commissioning                      |
    | Air tightness                             |
    | Daylight                                  |
    | Area of ventilation openings              |
    | Other                                     |
Results

Which features of a building code should be performance based rather than prescriptive?

- Area of glazing allowed: 12%
- Insulation: 26%
- Type of shading device to be installed: 12%
- Colour of surface finishes: 12%
- Use of commissioning: 4%
- Air tightness: 11%
- Daylight: 7%
- Area of ventilation openings: 14%
- Other: 2%
What are the steps? Implementing codes and standards

Buildings: Maxine Jordan, IEA and Ian Hamilton, UCL Energy Institute
Pretoria, Wednesday 16\textsuperscript{th} October 2019
Energy Efficiency Training Week: Buildings programme

1. Where to start: Energy use in buildings
2. Where to start: Energy efficiency potential in buildings
   - Special session: GlobalABC Regional Roadmaps
3. Toolkit: Energy efficient building design technologies
4. Toolkit: Energy efficient building system technologies
   - Special session: Green Building in Africa – *Elizabeth Chege, KGBS*
   - Special session: The GlobalABC Africa Roadmap for buildings and construction
5. What are the steps? Determining the current status of policies
6. Toolkit: Energy efficiency policies and target setting *with guest speaker: Hlompho Vivian, GBC SA*
7. **What are the steps? Implementing codes and standards**
8. What are the steps? Building operations and procurement *with guest speaker: Christelle Van Vuuren, Carbon Trust*
   - Special session: The multiple benefits of energy efficiency
9. Did it work? Evaluation and energy efficiency indicators
   - Special session: Financing energy efficiency in buildings
10. Buildings quiz
Energy Efficiency Training Week: Buildings

7. What are the steps?: Implementing codes and standards
Trainers: Ian Hamilton, UCL Energy Institute

**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.

*Discussion question: How do you advance building energy codes in your jurisdiction?*
Why codes?
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
Building code activity in Africa

Group discussion on local examples
Stretch code examples: India

• 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>
<thead>
<tr>
<th>Region</th>
<th>Typical Building</th>
<th>ECBC</th>
<th>ECBC+</th>
<th>SuperECBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold</td>
<td>201</td>
<td>213</td>
<td>224</td>
<td>196</td>
</tr>
<tr>
<td>Composite</td>
<td>213</td>
<td>217</td>
<td>224</td>
<td>217</td>
</tr>
<tr>
<td>Hot Dry</td>
<td>224</td>
<td>196</td>
<td>196</td>
<td>217</td>
</tr>
<tr>
<td>Moderate</td>
<td>196</td>
<td>217</td>
<td>217</td>
<td>217</td>
</tr>
<tr>
<td>Warm Humid</td>
<td>217</td>
<td>196</td>
<td>196</td>
<td>217</td>
</tr>
</tbody>
</table>

Energy Performance Index (kWh/m²·yr)
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 $\text{EPF}_{\text{proposed}} \leq \text{EPF}_{\text{prescriptive}}$

Other building components need to comply the code individually

Whole Building Performance Method

Annual Energy Simulation of Whole Building

$kWh_{\text{proposed}} \leq kWh_{\text{prescriptive}}$
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 web site 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 $\geq 500$ m$^2$
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.
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
   - Technical 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
   - 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

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

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

Before issuing occupancy permit:
- conduct blower-door test;
- fix the leaks;
- check each building system;
- conduct comprehensive commissioning.

Check compliance prior to the occupancy of the building
### Who: Stakeholders influence action across building lifecycle

<table>
<thead>
<tr>
<th>NEW BUILDINGS</th>
<th>EXISTING BUILDINGS</th>
<th>RETROFIT</th>
<th>DEMOLITION &amp; DECONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land Use/Planning</strong></td>
<td><strong>Design</strong></td>
<td><strong>Construction</strong></td>
<td><strong>Sale or Lease</strong></td>
</tr>
<tr>
<td>Local governments</td>
<td>Design &amp; construction professionals</td>
<td>Design &amp; construction professionals</td>
<td>Buildings owners and managers</td>
</tr>
<tr>
<td>Developers and self-help builders</td>
<td>National and provincial governments</td>
<td>Building investors</td>
<td>Developers and self-help builders</td>
</tr>
<tr>
<td>Local governments</td>
<td>Suppliers &amp; manufacturers</td>
<td>Building occupants</td>
<td>Design &amp; construction professionals</td>
</tr>
</tbody>
</table>

*Source: WRI, 2016, Accelerating Building Efficiency: Eight Actions for Urban Leaders*
Stakeholder engagement tools

- **Responsibility matrix**: also known as the RACI (Responsible, Accountable, Consulted, Informed) matrix. This tool can be used with stakeholders to clearly identify which roles are appropriate for each stakeholder throughout the roadmap development and implementation process.

- **Gap analysis**: can be used to identify where there is potential for improvement to move from the current situation to the desired market for energy efficiency.

- **SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis**: building on the gap analysis, a SWOT analysis can be done in a collaborative setting with stakeholders to better understand what opportunities can drive energy efficiency and what weaknesses can be addressed with further capacity building.

- **PIE (Progress, Impact, Effort) multi-matrix**: such as the Building Efficiency Policy Assessment Sheets developed by the Building Efficiency Initiative at Johnson Controls, can be used to enable stakeholder discussion on the current level of progress with a policy, technology or programme approach and then to identify how important the impact can be for each approach and the level of effort needed to make the approach successful. This information can then be used to recommend targets and timelines.
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Scenario:

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

*What stakeholders need to be consulted for improving the building code and what capacities need to be put in place to support that?*