Validation of Results of Mapping of Energy Efficiency Standards in Buildings in the UNECE Region

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CONTENTS

• Need to undertake this new study
• Objectives of the study
• Proposed methodology for data collection
• Survey results
• Gap analysis results
• Conclusions and recommendations
• Questions and discussion
NEED TO UNDERTAKE THIS STUDY

• Countries of the UNECE region differ greatly in the area of building standards
• Lack of information and knowledge with regards to building standards
• Difficult to harmonize data and standards
• Building codes require specific technical expertise – can be difficult to monitor from the political level
• Continues monitoring and evaluation
• Outcomes of the UNECE survey of 2015 on buildings standards and building regulations identified “Mapping of existing energy-efficiency standards in buildings” as one of the main activities
OBJECTIVES OF THE STUDY

1. To examine the current status of the energy efficiency standards in buildings in the UNECE region
2. To form a basis to improve knowledge of UNECE member States of existing energy efficiency standards in buildings
3. To collect best practices related to existing standards
4. To provide a gap analysis and harmonization of data and standards
5. To prepare an initial assessment of energy efficiency technologies in buildings in relation to the existing standards (currently is being prepared)
Approach to mapping of Energy Efficiency Standards in Buildings in the UNECE Region

1. Conduct data collection on energy efficiency standards in buildings (using questionnaire survey, desktop study, consultation with stakeholders)
2. Prepare countries summary profiles on existing energy efficiency standards (Countries Information Sheet, Annex III)
3. Comparative analysis of the building energy codes (gap analysis in the tabular form)
4. Identify best practices in sub-regions of the UNECE region
5. Draw conclusions and provide recommendations
6. Prepare a draft Analytical Report
PROPOSED METHODOLOGY FOR DATA COLLECTION

**Questionnaire**
Collecting information from 56 member States on the current status of the energy efficiency requirements and technologies in building codes

**Desktop Study**
Review of relevant policy documents, previously published studies, technological developments and best practices related to existing standards across countries of the UNECE region

**Consultation with the members of the Joint Task Force on EEB**
Collection of feedback and comments from the members of the Joint Task Force on Energy Efficiency in Buildings
QUESTIONNAIRE SURVEY
STRUCTURE

• Questionnaire consisted of 40 questions and aimed to collect data on:
  Part 1. General information
  Part 2. Building Energy Codes
     ▪ Performance-based requirements and values
     ▪ Prescriptive requirements and values
       a) Building envelop
       b) Requirements on Heating, Ventilation and Air-conditioning systems
       c) Other
  Part 3. Energy Performance Certificates (EPC)
  Part 4. Building materials requirements
  Part 5. Enforcement and compliance
QUESTIONNAIRE SURVEY TIMELINE

• First draft of the questionnaire was presented at the first Meeting of the Joint Task Force on Energy Efficiency Standards in Buildings on 30-31 October 2017 in Geneva.

• The questionnaire was available on the UNECE website for the period from 26 January to 12 February 2018 in English and Russian, with deadline further being extended to 28 February 2018.

• Around 300 questionnaires were sent out to CHLM and CSE focal points in 56 member States and Members of the UNECE Group of Experts on Energy Efficiency, international experts, representing international intergovernmental and non-governmental organizations, the private sector and academia.

• The full version of the questionnaire can be found in Annex I.
ANALYSIS OF THE SURVEY RESULTS

Results were presented by sub-regions as follows:

• **A.** European Union (EU) Member States prior to 2004 (EU15) Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

• **B.** EU enlargement - the 13 countries that joined the EU after 2004 10 (EU13) Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia

• **C.** Russian Federation, South-Eastern Europe, the Caucasus and Central Asia

• **D.** United States and Canada; and

• **E.** Israel and Turkey (not included in the survey results analysis and gap analysis, although a country information sheet was compiled for Turkey using previously published online data)
A total of 62 responses were given from 28 countries, of which 34 fully completed the questionnaire.

Approximately one-quarter of the respondents were female.

Figure 1. Respondents by sub-region

- EU15: 47%
- EU13: 27%
- United States and Canada: 19%
- Russian Federation, South-Eastern Europe, the Caucasus and Central Asia: 7%
ANALYSIS OF THE SURVEY RESULTS

Figure 2. Type of organization represented by respondents

- National Government: 46%
- Business (private company/ state-owned company): 15%
- International/intergovernmental organisation: 14%
- Non-profit/non-governmental (NGO): 14%
- Educational/research institution: 14%
- Independent expert: 4%
- Other: 3%
ANALYSIS OF THE SURVEY RESULTS

Part Two – Building Energy Codes

Figure 3. Existing specific standards

- Climate zones: 41%
- Sub-regions: 21%
- None of the above: 21%
- Other: 17%

None of the above
Other
ANALYSIS OF THE SURVEY RESULTS

Figure 4. Type of buildings covered by building energy codes in all countries of the UNECE region

- **Existing Non-Residential (e.g. after substantial refurbishment):** 83%
- **Existing Residential (e.g. after substantial refurbishment):** 91%
- **New Residential:** 96%
- **New Non-Residential:** 91%
ANALYSIS OF THE SURVEY RESULTS

- **Public Buildings**: 96%
- **Commercial**: 91%
- **Apartment Blocks**: 96%
- **Single Family Houses**: 96%
ANALYSIS OF THE SURVEY RESULTS

Figure 5. Type of buildings covered by building energy codes in sub-region C

- **Existing Non-Residential (E.G. After Substantial Refurbishment)**: 81%
- **Existing Residential (E.G. After Substantial Refurbishment)**: 93%
- **New Residential**: 93%
- **New Non-Residential**: 87%

The percentages range from 74% to 94%.
ANALYSIS OF THE SURVEY RESULTS

- Public Buildings: 94%
- Commercial: 81%
- Apartment Blocks: 94%
- Single Family Houses: 88%
ANALYSIS OF THE SURVEY RESULTS

Figure 6. Stringency of building energy codes in the UNECE region

- 52% Mandatory
- 38% Voluntary
- 10% Mixed (both voluntary and mandatory)
ANALYSIS OF THE SURVEY RESULTS

Performance-based requirements in building energy codes

Figure 7. Energy levels considered when defining energy performance of a building
ANALYSIS OF THE SURVEY RESULTS

Figure 8. Elements taken into account for energy performance calculation

- Other: 24%
- Thermal bridge: 81%
- Indoor and outdoor climatic conditions: 76%
- Passive solar systems and solar protection: 71%
- Design position and orientation of buildings: 76%
- Built-in lighting system: 71%
- Mechanical and natural ventilation: 86%
- Air-conditioning system(s): 76%
- Space heating system and hot water supply units: 90%
- Air-tightness: 62%
- Thermal characteristics of the building: 95%
ANALYSIS OF THE SURVEY RESULTS

Energy performance gap

Figure 9. Energy performance accuracy in buildings
ANALYSIS OF THE SURVEY RESULTS

Prescriptive technical requirements in building energy codes

Figure 10. Prescriptive technical requirements in building energy codes
ANALYSIS OF THE SURVEY RESULTS

Figure 11. Requirements for regular inspection of heating and A/C systems in all countries of the UNECE region

- Yes, for both heating and A/C systems
- Yes, for heating systems only
- Yes, for A/C systems only
- No
ANALYSIS OF THE SURVEY RESULTS

Figure 12. Requirements for regular inspection of heating and A/C systems in sub-region C
ANALYSIS OF THE SURVEY RESULTS

Part Three – Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Figure 13. Type of buildings covered by EPC in countries of the UNECE regions

- None: 24%
- Existing non-residential (e.g. after substantial refurbishment): 12%
- Existing residential (e.g. after substantial refurbishment): 6%
- New residential: 18%
- New non-residential: 41%
ANALYSIS OF THE SURVEY RESULTS

- NONE: 12%
- PUBLIC BUILDINGS: 88%
- COMMERCIAL BUILDINGS: 82%
- APARTMENT BLOCKS: 76%
- SINGLE FAMILY HOUSES: 82%
ANALYSIS OF THE SURVEY RESULTS

Figure 14. Policy requirement level for EPC

- Mandatory: 56%
- Voluntary: 11%
- Mixed (both mandatory and voluntary): 33%
ANALYSIS OF THE SURVEY RESULTS

Figure 15. National registry database for EPC

- 50% Yes
- 39% No
- 11% I don't know
ANALYSIS OF THE SURVEY RESULTS

Part Four – Building Materials and Products

Figure 16. Requirements to have building materials certified

- Yes: 72%
- No: 28%
ANALYSIS OF THE SURVEY RESULTS

Figure 17. Requirements to test building materials and products by certified test laboratories.
ANALYSIS OF THE SURVEY RESULTS

Part Five – Requirements for enforcement and compliance

Figure 18. Existence of specific incentives for compliance
ANALYSIS OF THE SURVEY RESULTS

Figure 19. Penalties for non-compliance

- Fines for non-compliance: 35%
- Refusal for occupancy or construction permit: 41%
- Other: 6%
- None: 18%
ANALYSIS OF THE SURVEY RESULTS

Monitoring of energy performance in building energy codes

Figure 20. Requirements for energy performance monitoring

Yes: 50%  
No: 50%
ANALYSIS OF THE SURVEY RESULTS

Figure 21. Level of compliance with monitoring

- 5 - Fully compliant: 9%
- 4 - High level of compliance: 36%
- 3 - Medium level of compliance: 36%
- 2 - Low level of compliance: 0%
- 1 - Non-compliant: 18%
ANALYSIS OF THE SURVEY RESULTS

Part Six – Energy Efficiency Technologies

Figure 22. Energy efficiency technologies deployment

- **Condensing boilers**: 95%
- **Biomass boilers (wood chip and pellet)**: 95%
- **Pellet stoves**: 89%
- **Heat pumps**: 100%
- **Solar thermal systems**: 95%
- **Photovoltaic systems**: 95%
- **Other**: 16%
COUNTRIES SUMMARY PROFILES

- Brief summary of a country
- Main regulatory documents;
- Building Energy Codes stringency and coverage;
- Performance-based requirements in Building Energy Codes;
- Prescriptive requirements in Building Energy Codes;
- Energy Performance Certificates;
- Requirements for enforcement and compliance; and
- Requirements for building materials and products.
### Examples of Countries Information Sheets

#### Poland
- **Main regulatory documents related to building energy codes**
  - The Building Code of 2008, which entered into force on 1 January 2009

- **Building Energy Code Strategy and Coverage**
  - Single family houses
  - Commercial
  - Industrial buildings

- **Performance-based requirements in building energy codes**
  - Thermal comfort and energy efficiency
  - Lighting and ventilation
  - Water management
  - Renewable energy

#### Slovakia
- **Main regulatory documents related to building energy codes**
  - Building Energy Code of 2011
  - Building Energy Code of 2012

- **Building Energy Code Strategy and Coverage**
  - Single family houses
  - Commercial
  - Industrial buildings

- **Performance-based requirements in building energy codes**
  - Thermal comfort and energy efficiency
  - Lighting and ventilation
  - Water management
  - Renewable energy

#### Armenia
- **Main regulatory documents related to building energy codes**
  - Building Energy Code of 2015

- **Building Energy Code Strategy and Coverage**
  - Single family houses
  - Commercial

- **Performance-based requirements in building energy codes**
  - Thermal comfort and energy efficiency
  - Lighting and ventilation
  - Water management
  - Renewable energy

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**Building Energy Code Strategy and Coverage**

- **Thermal comfort and energy efficiency**
- **Lighting and ventilation**
- **Water management**
- **Renewable energy**

**Performance-based requirements in building energy codes**

- **Thermal comfort and energy efficiency**
- **Lighting and ventilation**
- **Water management**
- **Renewable energy**
GAP ANALYSIS OF THE STATUS OF ENERGY EFFICIENCY STANDARDS IN BUILDINGS IN THE UNECE REGION
The objective of gap analysis is to evaluate the most effective policies and identify best practices to help Member States learn from one another and achieve greater savings. Specific metrics used to evaluate building energy codes in individual countries have been presented to demonstrate which countries are performing at the highest level in each category with some examples of best practice.
GAP ANALYSIS OF THE STATUS OF ENERGY EFFICIENCY STANDARDS IN BUILDINGS

1. Comprehensiveness and stringency of the building energy codes;
2. Technical requirements of the building energy codes;
3. Comprehensiveness and stringency of the EPC;
4. Enforcement mechanisms, including incentive packages and penalties; and
5. Energy efficiency materials and products requirements in building energy codes.
ASSUMPTIONS AND LIMITATIONS

- Data inconsistencies and data gaps still exist
- The gap analysis has been presented in a tabular form and based mainly on information gathered through the questionnaire responses received from the UNECE Member States
- Many countries have a federal form of governance in which only subnational jurisdictions can adopt and enforce building energy codes
- In some countries, a building energy code may be nominally mandatory, but enforcement may be dependent on self-certification.
- This has presented some difficulty in assigning the scoring for some metrics
# Analysis of Comprehensiveness and Stringency of the Building Energy Codes

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**Sub-region C - Russian Federation, South-Eastern Europe, the Caucasus and Central Asia**

**Turkmenistan**
- Residential
- Non-Residential
- Single Family; Apartments
- Commercial; Public Buildings
- Mandatory
- 4.5

**Azerbaijan**
- Residential; Non-Residential
- Residential; Non-Residential
- Apartments
- Commercial; Public Buildings
- Voluntary
- 3.5

**Uzbekistan**
- Residential; Non-Residential
- Residential; Non-Residential
- Single Family; Apartments
- Commercial; Public Buildings
- Mandatory
- 5

**Kazakhstan**
- Residential; Non-Residential
- Residential; Non-Residential
- Apartments
- Commercial; Public Buildings
- Mandatory
- 4.5

**Armenia**
- Residential; Non-Residential
- Residential; Non-Residential
- Single Family; Apartments
- Commercial; Public Buildings
- Mixed
- 4.5
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ANALYSIS OF THE TECHNICAL REQUIREMENTS IN BUILDING ENERGY CODES

• Thermal insulation;
• Heating and hot water;
• Air conditioning systems;
• Natural and mechanical ventilation;
• Solar gains (G-values);
• Lighting efficiency;
• Design, position and orientation;
• Air-tightness;
• Thermal bridging;
• Renewables;
• Indoor and outdoor climatic conditions; and
• Passive solar systems and solar protection.
## ANALYSIS OF THE TECHNICAL REQUIREMENTS IN BUILDING ENERGY CODES

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### Analysis of the Technical Requirements in Building Energy Codes

#### Sub-region C - Russian Federation, South-Eastern Europe, the Caucasus and Central Asia

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</tr>
<tr>
<td>Belarus</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>2.8</td>
<td></td>
</tr>
</tbody>
</table>
## Analysis of the Technical Requirements in Building Energy Codes

### Selected countries

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Thermal insulation</th>
<th>Heating and hot water</th>
<th>Air conditioning systems</th>
<th>Natural and mechanical ventilation</th>
<th>Solar gains (G-values)</th>
<th>Lighting efficiency</th>
<th>Design, position and orientation</th>
<th>Air-tightness</th>
<th>Thermal bridging</th>
<th>Renewables</th>
<th>Indoor and outdoor climatic conditions</th>
<th>Passive solar systems</th>
<th>Solar protection</th>
<th>Points (Max 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.3</td>
</tr>
<tr>
<td>Canada</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Sub-region D - North America
# Analysis of the Comprehensiveness and Stringency of the EPC

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Coverage</th>
<th>Stringency</th>
<th>National registry database for EPC</th>
<th>Points (Max 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>New build</td>
<td>Existing</td>
<td>Residential</td>
<td>Commercial</td>
</tr>
<tr>
<td><strong>Sub-region A - European Union (EU15)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>Residential</td>
<td></td>
<td>Single Family; Apartments</td>
<td>Commercial; Public Buildings</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Residential; Non-Residential</td>
<td>Residential; Non-Residential</td>
<td>Single Family; Apartments</td>
<td>Commercial; Public Buildings</td>
</tr>
<tr>
<td>France</td>
<td>Residential; Non-Residential</td>
<td>Residential; Non-Residential</td>
<td>Single Family; Apartments</td>
<td>Commercial; Public Buildings</td>
</tr>
</tbody>
</table>
# Analysis of the Comprehensiveness and Stringency of the EPC

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Coverage</th>
<th>Stringency</th>
<th>National registry database for EPC</th>
<th>Points (Max 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-region B - European Union enlargement (EU12)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slovakia</td>
<td>Residential; Non-Residential</td>
<td>Residential; Non-Residential</td>
<td>Single Family; Apartments</td>
<td>Commercial; Public Buildings</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Residential; Non-Residential</td>
<td>Residential; Non-Residential</td>
<td>Single Family; Apartments</td>
<td>Commercial; Public Buildings</td>
</tr>
<tr>
<td>Croatia</td>
<td></td>
<td></td>
<td>Single Family; Apartments</td>
<td>Commercial; Public Buildings</td>
</tr>
</tbody>
</table>
## ANALYSIS OF THE COMPREHENSIVENESS AND STRINGENCY OF THE EPC

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Coverage</th>
<th>Stringency</th>
<th>National registry database for EPC</th>
<th>Points (Max 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New build</strong></td>
<td>Existing</td>
<td>Residential</td>
<td>Commercial</td>
<td></td>
</tr>
<tr>
<td><strong>Existing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Residential</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Commercial</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sub-region C - Russian Federation, South-Eastern Europe, the Caucasus and Central Asia

<table>
<thead>
<tr>
<th>Country</th>
<th>Coverage</th>
<th>Stringency</th>
<th>National registry database for EPC</th>
<th>Points (Max 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkmenistan</td>
<td>Residential; Non-Residential</td>
<td>Mandatory</td>
<td>No</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Residential; Non-Residential</td>
<td>Commercial; Public Buildings</td>
<td>No</td>
<td>2.5</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>Residential; Non-Residential</td>
<td>Commercial; Public Buildings</td>
<td>Yes</td>
<td>6.0</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>Currently not in use</td>
<td>No</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Armenia</td>
<td>Currently not in use</td>
<td>Voluntary</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Ukraine</td>
<td>Currently not in use</td>
<td>Mixed</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Republic of Moldova</td>
<td>Non-Residential</td>
<td>Commercial; Public Buildings</td>
<td>Mixed</td>
<td>3.0</td>
</tr>
</tbody>
</table>
ANALYSIS OF THE COMPREHENSIVENESS AND STRINGENCY OF THE EPC

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Coverage</th>
<th>Stringency</th>
<th>National registry database for EPC</th>
<th>Points (Max 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States (IN SOME STATES)</td>
<td>New build</td>
<td>Existing</td>
<td>Residential</td>
<td>Commercial</td>
</tr>
<tr>
<td>Residential</td>
<td>Residential</td>
<td>Single Family; Apartments</td>
<td>Mixed</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>Currently EPC is not in use (coming soon)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sub-region D - North America
We examine three ways that codes are enforced:

• The country has specific policy packages and incentives that complement or motivate compliance with building codes. Such mechanisms can include green loan programs, financial schemes and incentives, and public incentives including tax credits, and some countries will even give owners incentives such as relaxed building height and size restrictions;

• If the building does not comply with the code, then they are refused permission for occupancy or construction; and

• Enforcement of building codes includes fines and fees for noncompliance.
## Analysis of Enforcement Mechanisms, Including Incentive Packages and Penalties

### Sub-region A - European Union (EU15)

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Specific incentive</th>
<th>Refusal for occupancy or construction permit</th>
<th>Fines for non-compliance</th>
<th>Requirements for energy performance monitoring</th>
<th>Stringency of monitoring</th>
<th>Points (Max 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portugal</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>Germany</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>3.0</td>
</tr>
<tr>
<td>Italy</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>3.0</td>
</tr>
<tr>
<td>Switzerland</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>3.0</td>
</tr>
<tr>
<td>Spain</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>3.0</td>
</tr>
<tr>
<td>France</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>4.0</td>
</tr>
</tbody>
</table>
ANALYSIS OF ENFORCEMENT MECHANISMS, INCLUDING INCENTIVE PACKAGES AND PENALTIES

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Specific incentive</th>
<th>Refusal for occupancy or construction permit</th>
<th>Fines for non-compliance</th>
<th>Requirements for energy performance monitoring</th>
<th>Stringency of monitoring</th>
<th>Points (Max 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkmenistan</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>Mandatory</td>
<td>4.0</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Armenia</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Ukraine</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>-</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>Mandatory</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Sub-region C - Russian Federation, South-Eastern Europe, the Caucasus and Central Asia
Analysis of energy efficiency materials and products requirements in Building Energy Codes

Three criteria were selected to be included in this metric:

• Existence of requirements to have building materials certified;

• Harmonization of building materials with CE Marking or ISO; and

• Existence of requirements to test building materials by certified test laboratories

Out of the 3 possible points, countries were awarded 1 point for each of the above criteria.
## Analysis of energy efficiency materials and products requirements in Building Energy Codes

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Requirements to have building materials certified</th>
<th>Building materials a harmonized with CE Marking or ISO</th>
<th>Requirements to test building materials by certified test laboratories</th>
<th>Points (Max 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-region A - European Union (EU15)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td>Germany</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>Italy</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>0</td>
</tr>
<tr>
<td>Switzerland</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td>Spain</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td>France</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Sub-region B - European Union enlargement (EU13)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slovakia</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td>Croatia</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
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</tbody>
</table>
## Analysis of energy efficiency materials and products requirements in Building Energy Codes

### Selected countries
<table>
<thead>
<tr>
<th>Requirements to have building materials certified</th>
<th>Building materials a harmonized with CE Marking or ISO</th>
<th>Requirements to test building materials by certified test laboratories</th>
<th>Points (Max 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-region C - Russian Federation, South-Eastern Europe, the Caucasus and Central Asia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Armenia</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Ukraine</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Republic of Moldova</td>
<td>-</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Belarus</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
### Analysis of energy efficiency materials and products requirements in Building Energy Codes

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Requirements to have building materials certified</th>
<th>Building materials a harmonized with CE Marking or ISO</th>
<th>Requirements to test building materials by certified test laboratories</th>
<th>Points (Max 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-region C - Russian Federation, South-Eastern Europe, the Caucasus and Central Asia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>2.0</td>
</tr>
<tr>
<td>Uzbekistan</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
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<tr>
<td>Armenia</td>
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<td>X</td>
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<td>3.0</td>
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<tr>
<td>Ukraine</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Republic of Moldova</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>2.0</td>
</tr>
<tr>
<td>Belarus</td>
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<tr>
<td>Russian Federation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>3.0</td>
</tr>
</tbody>
</table>
Analysis of energy efficiency materials and products requirements in Building Energy Codes

<table>
<thead>
<tr>
<th>Selected countries</th>
<th>Requirements to have building materials certified</th>
<th>Building materials a harmonized with CE Marking or ISO</th>
<th>Requirements to test building materials by certified test laboratories</th>
<th>Points (Max 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-region D - North America</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>2.0</td>
</tr>
<tr>
<td>Canada</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>2.0</td>
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</tbody>
</table>
OVERVIEW OF THE RESULTS OF THE GAP ANALYSIS

Figure 23. Comparison of the effectiveness of building energy codes by sub-region

<table>
<thead>
<tr>
<th>Category</th>
<th>EU15</th>
<th>EU13</th>
<th>Russia, South-Eastern Europe, Caucasus and Central Asia</th>
<th>USA and Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Energy Code Coverage and Stringency</td>
<td>96%</td>
<td>84%</td>
<td>86%</td>
<td>100%</td>
</tr>
<tr>
<td>Building Energy Code Technical Requirements</td>
<td>97%</td>
<td>90%</td>
<td>86%</td>
<td>86%</td>
</tr>
<tr>
<td>Energy Performance Certification</td>
<td>80%</td>
<td>83%</td>
<td>47%</td>
<td>22%</td>
</tr>
<tr>
<td>Building Energy Codes Enforcement Standards</td>
<td>63%</td>
<td>64%</td>
<td>32%</td>
<td>60%</td>
</tr>
<tr>
<td>Building Materials Requirements</td>
<td>77%</td>
<td>67%</td>
<td>67%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Legend:
- European Union (EU15)
- European Union enlargement (EU13)
- Russian Federation, South-Eastern Europe, the Caucasus and Central Asia
- USA and Canada
CONCLUSIONS

• The study has showcased status and implementation of building energy codes across sub-regions, highlighting any existing gaps, and includes best practices to increase energy efficiency in buildings.

• Step toward fostering cooperation among countries with building energy standards and those contemplating standards or other policies for increasing energy-efficiency in buildings.

• Basis for further inquiry into the development, structure, and implementation of building energy standards throughout the UNECE region.
RECOMMENDATIONS

• **Recommendation 1:**
  • Member States of the UNECE should continue the process of harmonization of building energy codes by ensuring comprehensive coverage of all types of buildings in their regulations.

• **Recommendation 2:**
  • Member States of the UNECE shall lay down the necessary measures to include a national energy efficiency target, based either on primary or final energy consumption, or on primary or final energy savings, or on energy intensity.
Recommendation 3:

• Member States of the UNECE to continue the process of harmonization through further strengthening the requirements for insulation, ventilation and technical installations:

• Give more attention to the air tightness of the envelope;

• Ensure inclusion of the requirements for air conditioning, lighting, active solar, renewables and natural lighting;

• Make mandatory the requirement for inspection of boilers and air-conditioning systems to improve the quality and precision of Energy Performance Certificates in collective dwelling;
• **Recommendation 4:**
  - Member States of the UNECE to continue introduce quality assurance measures, especially during the early state of the certification process:
  - The requirements for the qualified experts should be harmonised across Member States of the UNECE region;
  - The certifier needs to be physically present onsite;
  - There is a need to further harmonize the quality check of the EPC;
  - Facilitate harmonization of the EPC through integration of ventilation, cooling and lighting into the certificate;
  - Need for guidance in development of the centralised EPCs databases and digitalisation of the EPC process; and
  - Further technical assistance and capacity building activities to the countries where the EPC scheme is not yet in use or not fully developed based on the recognized best practice approaches.
RECOMMENDATIONS

• **Recommendation 5:**
  - Member States of the UNECE should consider making the challenges of the energy performance gap to be a priority area for research.

• **Recommendation 6:**
  - Member States of the UNECE should continue establishing proper (electronic) monitoring systems of compliance, enforcement and quality control processes through a qualified workforce to ensure compliance with building codes and standards.

• **Recommendation 7:**
  - Member States of the UNECE shall lay down the necessary measures to establish a regular inspection of boilers and air-conditioning systems in building energy codes.
RECOMMENDATIONS

• Recommendation 8:
• Member States of the UNECE shall lay down the necessary measures to continuously monitor, analyze and adjust energy usage in building energy codes.

• Recommendation 9:
• Member States of the UNECE, particularly countries with economies in transition, should consider creating incentives for companies for improving energy efficiency through appropriate policies, tax incentives and low-interest loans for energy efficiency projects.
RECOMMENDATIONS

• **Recommendation 10:**

  • Member States of the UNECE shall lay down the necessary measures in building energy codes to facilitate the process of harmonization of energy efficient materials and products testing and certification using best practices employed by other countries of the UNECE region.

  • When developing and harmonizing building energy codes in lower income countries of the UNECE region, regard should be given to the types of construction that these countries can afford to ensure that building energy codes effectively promote research and development for improving local traditional techniques, materials testing and quality control, and do not create dependency on imported building materials that may stifle local innovation.
RECOMMENDATIONS

• **Recommendation 11:**

  Member States of the UNECE shall lay down the necessary measures in building energy codes to ensure that the materials and products used in construction are subject to rigorous quality control processes to meet the requirements for energy efficiency while maintaining robust combustion performance, fire resistance test and seismic resistance, ensuring they do not cause threat to the safety of life and property.

• **Recommendation 12:**

  Member States of the UNECE should consider funding collaborative international research to assist in the establishment of new harmonized building materials test mechanisms and to ensure that independent organizations beyond the manufacturing community can play a key role in developing market-neutral procedures.
RECOMMENDATIONS

• Recommendation 13:

• To consider the matter in relevant UN committees on the feasibility of creating and publishing a printed set of national building energy codes for all 56 countries of the UNECE, followed by the release of the Yearbook. All such printed publications are to be distributed in all countries of the UNECE region and beyond;

• Member States of the UNECE, particularly countries with economies in transition, should consider to post free of charge accessible full-featured versions of their building energy codes with the applicable calculation methods on the relevant websites;

• To consider to set up a new webpage containing free of charge online information with links to the full versions of building energy codes of all Member States of the UNECE, including information on countries’ best practices;
RECOMMENDATIONS

• Member States of the UNECE, especially neighbouring countries who have already developed their building energy codes in detail and are at the stage of their practical implementation with real positive effects, to provide methodological assistance and other types of assistance to countries in need of such development; and

• Member States of the UNECE, particularly countries with economies in transition, to consider developing common approaches to building energy codes reflecting specifics relevant to energy exporting countries and specifics relevant to the countries importing energy and fuel for primary energy generation.
Opportunities for additional studies

• **Recommendation 14:**
  
  To consider carrying out further studies on mapping of national approaches based on more detailed metrics and criteria to provide a more in-depth analysis of the stringency of the EPC across the UNECE region, particularly in developing countries and countries with economies in transition. The future study should focus on the quality, availability and usability of EPC data and provide examples for best practice approaches; and

• To consider carrying out further studies on mapping of national requirements for U-values for wall, roof and floor in new and existing buildings in building energy codes to ensure they are not below the economic optimum and recommend U-values for maximum cost effectiveness, particularly in developing countries and countries with economies in transition.
Thank you for your attention!

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