IEA EBC Annex 72:

Assessing life cycle related environmental impacts caused by buildings

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Operating agent, Switzerland

Webseminar:
The Science and Communication of Energy-Efficient Indoor Environments
10 November 2020
Net zero CO₂ emissions by 2050

Global total net CO₂ emissions
Billion tonnes of CO₂/yr

In pathways limiting global warming to 1.5°C with no or limited overshoot as well as in pathways with a high overshoot, CO₂ emissions are reduced to net zero globally around 2050.

IPCC (2019) Global Warming of 1.5°C; International Panel on Climate Change, Geneva, Switzerland.

Non-CO₂ emissions relative to 2010
Emissions of non-CO₂ forcers are also reduced or limited in pathways limiting global warming to 1.5°C with no or limited overshoot, but they do not reach zero globally.

Methane emissions

Black carbon emissions

Nitrous oxide emissions
Buildings – an important source of CO$_2$-Emissions


39%
IEA EBC Annex 72: Full scope environmental assessments of buildings

whole building life cycle

Net Zero
Subtasks

- **Subtask 1**: Harmonised methodology guidelines:
  - developing and extending the methodology guidelines

- **Subtask 2**: Building assessment workflows and tools:
  - description and development of national or regional building assessment tools, in particular embedding of life cycle assessment approach into BIM (Building Information Modelling)

- **Subtask 3**: Case studies:
  - analyzing building case studies using the methodology agreed in Subtask 1

- **Subtask 4**: Building sector LCA databases:
  - development and supply of life cycle assessment databases targeted to the building sector
  - India as a case study: developing buildings sector database

- **Subtask 5**: Dissemination:
  - communication and dissemination of the results
Embodied Greenhouse gas emissions of buildings: a meta analysis

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Embodied Greenhouse gas emissions of buildings: a meta analysis

a) Net global GHG emission pathways (acc. IPCC SR 1.5)

Target: Net zero life cycle GHG emissions, i.e. embodied and operational, by:
   i) year 2040 for ‘1.5°C pathway’
   ii) year 2055 for ‘well below 2°C’ scenario

b) Average ‘New standard’ building

c) Average ‘New advanced’ building

# Typology of (net-)zero building approaches

<table>
<thead>
<tr>
<th>Net Zero emission approaches</th>
<th>Zero emission a.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net balance</strong></td>
<td><strong>Net balance</strong></td>
</tr>
<tr>
<td>potentially avoided emissions</td>
<td>allocation</td>
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</tbody>
</table>

- **Net balance**
  - Accounting for the potential benefits caused by exported energy produced on-site
  - Attributes the prorata share of GHG emissions caused by on-site energy production to the exported energy

- **Economic compensation**
  - Purchase of CO₂ certificates covering life-cycle GHG emissions caused by the building

- **Technical Reduction**
  - Investment in technical-reduction measures to reduce life-cycle-based GHG emissions caused by the building

- **Use of construction materials/operational energy with zero GHG emissions (including supply chain emissions)**

**Level of ambition**

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Typology of (net-)zero building approaches

Direct emissions

Direct emissions plus energy supply chains

Full life cycle emissions

## Results: Mapping of national definitions, milestones

<table>
<thead>
<tr>
<th>Design stages definition</th>
<th>Strategic definition</th>
<th>Preliminary studies</th>
<th>Concept Design</th>
<th>Developed Design</th>
<th>Technical Design</th>
<th>Manufacturing and Construction</th>
<th>Handover and close out</th>
<th>Operation and management</th>
<th>End of use, re-cycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Objectives</td>
<td>Requirement setting, project risks &amp; alternatives, site appraisal, client brief</td>
<td>Feasibility studies, call for design competition</td>
<td>Concept, sketches, competition design</td>
<td>Elaboration of design, building permit application</td>
<td>Detailed technical design, procurement of construction works</td>
<td>(Pre) Fabrication of construction products, Construction and supervision</td>
<td>As-built documentation, hand over, commissioning and testing</td>
<td>Facilities Management and Asset Management, Evaluation and improvement of building performance</td>
<td>Decommissioning of the building, deconstruction, reuse and testing</td>
</tr>
</tbody>
</table>

- **AT**
  - 0: PE0-PE3
  - 1: PE4-PE7 & LPH1
  - 2: LPH2
  - 3: LPH3
  - 4: LPH4
  - 5: LPH5
  - 6: LPH6
  - 7: LPH7, LPH8
  - 8: LPH9

- **CA**
  - 1: 1
  - 2: 2
  - 3: 3
  - 4: 4
  - 5: 5
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- **CN**
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- **CZ**
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- **FR**
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- **DE**
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- **HU**
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- **SLO**
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- **ES**
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- **SE**
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- **CH**
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- **UK**
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- **US**
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**Environmental performance target definition & assessment**

**Competition design**

**Building permit**

**Procurement of construction works**

**Handover**

**Decommissioning, Deconstruction**

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**Technology Collaboration Programme**

by [IEA](#)
Building LCA databases survey: Asian countries

- 1 National database is closed. (Taiwan)
- 11 generic database
- 0 sector specific databases
- 2 building LCA database: Evah OzLCI2019 Free Database (Australia), BRANZ CO 2 NSTRUCT (New Zealand)
The package for national buildings LCA

- Life cycle stages
- building elements
- operational energy
- allocation

Method

- Design tools based on designated method and background data
- Successfully verified

Accredited tools

- One defined LCI background database
- Defined version #

Background data

- Different building types
  - New and refurbished buildings

Benchmark values
Synthesis

- Embodied environmental impacts gain importance and need (more) attention
- Paris Agreement calls for high ambition “net zero emission” buildings
- Guidelines, data and tools are ready for application in many countries: time for life cycle based policy measures
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http://annex72.iea-ebc.org/
LinkedIn; ResearchGate
Latest developments in the assessment of GHG emissions of buildings: biogenic carbon

**Option 1**
Assessment of biogenic carbon: the 0/0 approach

**Option 2**
Assessment of biogenic carbon: the -1/+1 approach

**Option 3a**
Assessment of biogenic carbon – the dynamic approach
Tree growth before before harvest

**Option 3b**
Assessment of biogenic carbon – the dynamic approach
Tree growth after harvest

Design steps

Relationship between the typical project and design steps for a new building and the building’s physical life cycle
An intact natural environment is not only vital for humankind but also provides the basis for further social and economic development. For more than 30 years, the international scientific community has provided a strong body of evidence on the increasingly high atmospheric concentrations of man-made greenhouse gases (GHG) and the need to reduce these in order to limit the damages and risks caused by global warming. The UNFCCC has endorsed this and has started international processes for collectively reducing these.

https://www.tugraz.at/en/events/sbe19/graz-declaration/graz-declaration/