How to develop a baseline to assess climate friendly buildings

in Egypt, Jordan and Lebanon

June 21, 2022
Outline

1. Problem statement
2. Solution approach & Results
3. Conclusion
Introduction & Problem statement
Introduction to the BUILD_ME Project

Fund

IKI International Climate Initiative, German Federal Ministry of Environment

MENA Region

EGY  JOR  LEB

Team

ALG  MOR  TUN

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag
Problem statement
The lack of a baseline hindering the assessment of low energy buildings in the BUILD_ME countries

1. Problem
   - Lack of enforcement and/or availability of EEBCs
   - Lack of data about “Business as Usual” BaU constructions
   - No benchmarking of buildings’ energy performance

NO
energy consumption baseline

Bottleneck
To finance energy efficient buildings
Solution approach
Our Integrated Solution
Define own baselines and develop tailored energy labelling scheme for new buildings

- Data from real constructions not older than 3 years
- At least 5 cases per building type covered in each country building typology
- Data from subsidy programs, literature, interviews with relevant stakeholders, permits documents etc.

- BEP tool based on ISO 52016, fed with local data used as calculation engine.
- Researched buildings in building typology represents baseline, which is shown in the BEP Tool as default value.

Reference Buildings and Building Typology

BUILD_ME Building Energy Performance Calculation tool

Classification of buildings compared to baseline
Building typology
Development approach of the building typology

Four main working steps

1. **Template formulation**
   - Prepared by Guidehouse

2. **Data collection**
   - National partners collect data from site visits, stakeholder interviews, literature and databases

3. **Data validation**
   - By Guidehouse and national partners

4. **Reporting > upload on the website**
Results and main sections of the template

### A: General information

<table>
<thead>
<tr>
<th>Country</th>
<th>Project Name</th>
<th>Building type</th>
<th>Region (specify)</th>
<th>Construction Period</th>
<th>ID</th>
<th>Reference ID</th>
</tr>
</thead>
</table>

### B: Geometries

<table>
<thead>
<tr>
<th>Number of stories</th>
<th>Number of dwelling</th>
<th>Typical number of occupants</th>
<th>Net floor area (users)</th>
<th>Clear room height</th>
<th>Volume</th>
<th>Roof type</th>
<th>Area floor slab (ground plate)</th>
<th>Roof area opaque</th>
<th>Façade area opaque</th>
<th>Share of façade oriented north</th>
<th>Share of façade oriented east</th>
<th>Share of façade oriented south</th>
<th>Window area</th>
<th>Share of windows oriented north</th>
<th>Share of windows oriented east</th>
<th>Share of windows oriented south</th>
<th>Share of windows oriented horizontal</th>
<th>Opaque doors</th>
<th>Ratio Floor / Ground</th>
<th>Ratio Floor / Roof</th>
<th>Ratio Floor / Façade (excluding windows)</th>
<th>Ratio Floor / Facade (including windows)</th>
<th>A/V</th>
</tr>
</thead>
</table>

### C: Technical specifications building envelope

<table>
<thead>
<tr>
<th>Thermal heat bridge - Slab</th>
<th>U-value - Roof</th>
<th>Thermal heat bridge - Roof</th>
<th>U-value - Wall</th>
<th>Thermal heat bridge - Wall</th>
<th>Type of window</th>
<th>U-value - Window</th>
<th>Thermal heat bridge - Window</th>
<th>G-value Windows</th>
<th>Average shading factor of windows (0-1)</th>
<th>A/V</th>
</tr>
</thead>
</table>

### D: Specifications of technical building systems

<table>
<thead>
<tr>
<th>Primary space heating system</th>
<th>Secondary space heating system</th>
<th>Primary hot water generator</th>
<th>Secondary hot water generator</th>
<th>Primary space cooling system</th>
<th>Secondary space cooling system</th>
<th>Ventilation</th>
<th>Photovoltaics</th>
<th>Lighting</th>
<th>Temperature set-points</th>
</tr>
</thead>
</table>

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Building Typology | Egypt

Results

<table>
<thead>
<tr>
<th>Building type</th>
<th>Age group</th>
<th>Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-family house</td>
<td>New and recent constructions (after 2015)</td>
<td>National</td>
</tr>
<tr>
<td>Single-family house</td>
<td>Existing building: 1980-2015</td>
<td>Cairo</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>Alexandria</td>
</tr>
<tr>
<td>Retail/Trade</td>
<td></td>
<td>Aswan</td>
</tr>
<tr>
<td>Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed-use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotels</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


1. Problem
2. Solution
3. Conclusion

Link to the typology on BUILD_ME website
Building Energy Performance (BEP) tool
Logic of the BEP tool
Customisable, transparent, adapted to the MENA region

Performance of energy efficiency measures & RE

Calculation of monetary savings

Free web application

Proven methodology
BEP calculation methodology

**Input**

**User input**
- Building: Type (e.g. office), Geometry, Renovation/new build, Envelope specifications, HVAC systems, Renewable energies, Operational parameters, Location (city, country)

**Internal database**
- Financial: Investment cost, Energy prices
- Energy: Baseline buildings, User profiles, HVAC system specification, Climates

**Calculation engine**

**Energy**
- Useful energy demand: ISO 52016
  - Geometry
  - Envelope
  - OP
  - Climate
- Sizing HVAC & RE systems: HVAC Tool
  - HVAC and RE systems
- Final energy demand: HVAC Tool
  - Primary energy demand
  - GHG Emissions

**Financial**
- Investment cost: Envelope (e.g. insulation), HVAC systems, Renewable energies
  - Specific cost
  - Energy carrier (e.g. gas)
- Energy cost: Energy prices
  - Energy carrier (e.g. gas)
- Other cost: Inspection and maintenance, Replacement

**Output**

**Energy & Emission**
- Final & primary energy demand...
  - per energy carrier (e.g. gas)
  - per energy use (e.g. cooling)
  - specific (kWh/m²) and total
- GHG Emissions: CO₂ equivalent

**Global Cost**
- Global cost: Investment, Energy cost, Inspection and maintenance, Replacement

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BEP - Developed for the MENA region
Database from local partners & international calculation methodology

Baseline buildings
Local investment cost & energy prices
Baseline reflects the country-specific building standard
Geographic focus on: Egypt, Jordan and Lebanon

Local PEF and CO₂ emission factors
All data input is collected and verified by local partners and project developers

International calculation methodology: ISO 52016
Methodology is applicable worldwide

Tool was successfully applied in building projects in the MENA region

Internal market data collected from local partners for Egypt, Jordan and Lebanon
International energy calculation methodology
Country-specific climate data, incl. multiple climate zones within each country

Climate data of all countries in the MENA region

All data input is collected and verified by local partners and project developers

The calculation standard is internationally acknowledged.

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Online Tool - Input

1. General Information
   - Project Name: Building_1
   - BUILDING TYPE:
     - Select building type
     - Age group: Renovation
   - LOCATION:
     - Country: Jordan
     - Reference city (representative climate for the selected climate region): Amman
     - Specify region (e.g. urban): East

2. Input
   - GEOMETRY-RELATED PARAMETERS:
     - Building levels (floors): 5
     - Number of dwellings: 5
     - Net floor height (Floor to ceiling): 2.70 m
     - Net floor area (i.e. living area): 770.00 m²
     - Roof area opaque: 154.00 m²
     - Façade area opaque (excluding windows): 734.00 m²
     - Window area (total = transparent + frame): 225.00 m²
     - Area floor slab (ground plate): 154.00 m²
   - WALL:
     - Wall renovation: No
     - Type (material): Single wall
     - U-value (wall): 0.5 W/(m²K)
   - ROOF:

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Online Tool – Results

ENERGY & ENVIRONMENT

Primary energy demand split in energy use

100%
50%
0%

Primary energy demand
Primary energy by energy use

Final energy by energy use
Final energy by energy carrier
Emissions

kWh/m²

Building_1
Baseline
Delta

Space heating
10.66
44.09
-73%

Space cooling
23.09
37.50
-36%

Lighting
7.86
7.86
0%

Auxiliary energy
0.70
1.00
-30%

Household electricity
16.19
16.19
0%

Total
61.29
108.64
-44%

Total incl. PV
61.29
108.64
-44%

FINANCIAL

Specific cost
Total cost
Specific investment cost

Global cost [€/m²]

Building_1
Baseline
Delta

Investment
26
34
-25%

Replacement
8
12
-33%

Residual
-5
-4
-25%

Energy
163
188
-15%

Inspection & maintenance
3

Global cost total
194
334
-41%

Performance: A+
Online Web App – Results detail

1) Quick overview
   The main facts.

2) Output selection
   4 tabs to select the energy performance indicator.

3) Overview chart
   Comparison to the baseline building.

4) Results table
   Detailed results in numbers.

5) Baseline building
   Detailed results of the baseline building.

6) Comparison
   Difference to the baseline buildings.

7) Performance rating
   C = equal to baseline

1. Problem
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Results
Egypt, Cairo [new buildings]
Baseline energy consumption in specific final energy [kWh/m²a]*

*Assumed for a max. conditioned floor area
Jordan, Amman [new buildings]
Baseline energy consumption in specific final energy [kwh/m^2a]*

<table>
<thead>
<tr>
<th></th>
<th>MFH (large)</th>
<th>MFH (small)</th>
<th>Education</th>
<th>SFH</th>
<th>Retail / Mixed Use</th>
<th>Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other electricity</td>
<td>20.3</td>
<td>20.3</td>
<td>10.1</td>
<td>15.2</td>
<td>50.7</td>
<td>25.3</td>
</tr>
<tr>
<td>Ventilation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Auxiliary energy</td>
<td>1.2</td>
<td>1.3</td>
<td>0.0</td>
<td>0.3</td>
<td>1.1</td>
<td>-</td>
</tr>
<tr>
<td>Lighting</td>
<td>4.4</td>
<td>4.4</td>
<td>10.0</td>
<td>4.4</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Space cooling</td>
<td>23.9</td>
<td>27.0</td>
<td>-</td>
<td>36.9</td>
<td>13.4</td>
<td>13.8</td>
</tr>
<tr>
<td>DHW</td>
<td>6.6</td>
<td>20.5</td>
<td>-</td>
<td>6.6</td>
<td>6.6</td>
<td>-</td>
</tr>
<tr>
<td>Space heating</td>
<td>67.1</td>
<td>45.5</td>
<td>45.7</td>
<td>80.9</td>
<td>63.3</td>
<td>8.9</td>
</tr>
</tbody>
</table>

*Assumed for a max. conditioned floor area
Lebanon, Beirut [new buildings]
Baseline energy consumption in specific final energy [kwh/m²a]*

*Assumed for a max. conditioned floor area
Conclusion
Overview of achievements

1. Problem

- BEP tool is ready to use and well perceived by main stakeholders in government, private sector and financial institutions due to several benefits

2. Solution

- More than 150 persons were trained on the BEP tool and are already experienced users
- Proven approach to optimize energy performance of real estate projects as 13 pilot project tested approach
- EBRD interested to use BEP tool, when approach is integrated in national classification schemes, Concepts for national classification schemes in Egypt, Jordan and Lebanon have been prepared

3. Conclusion

- Board of GGF (Green for Growth Fund) approved BEP tool to assess eligibility of projects for financing in AUG 2021
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This project is part of the International Climate Initiative (IKI). The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag.