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_A Guide to the Building Energy Performance Tool for the MENA Region

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_A Guide to the Building Energy Performance Tool for the MENA Region

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TOWARD A CLIMATE-FRIENDLY BUILDING SECTOR

_Role of buildings in the decarbonization of the MENA region

Continuous population and economic growth and accelerated urbanization have increased the demand for residential areas in urban centers in the Middle East and North Africa (MENA) region. At the same time, global average temperatures are rising, caused by anthropogenic climate change. These factors lead to increased energy demand, especially for cooling, which is primarily covered by the use of fossil fuels, increasing greenhouse gas (GHG) emissions.

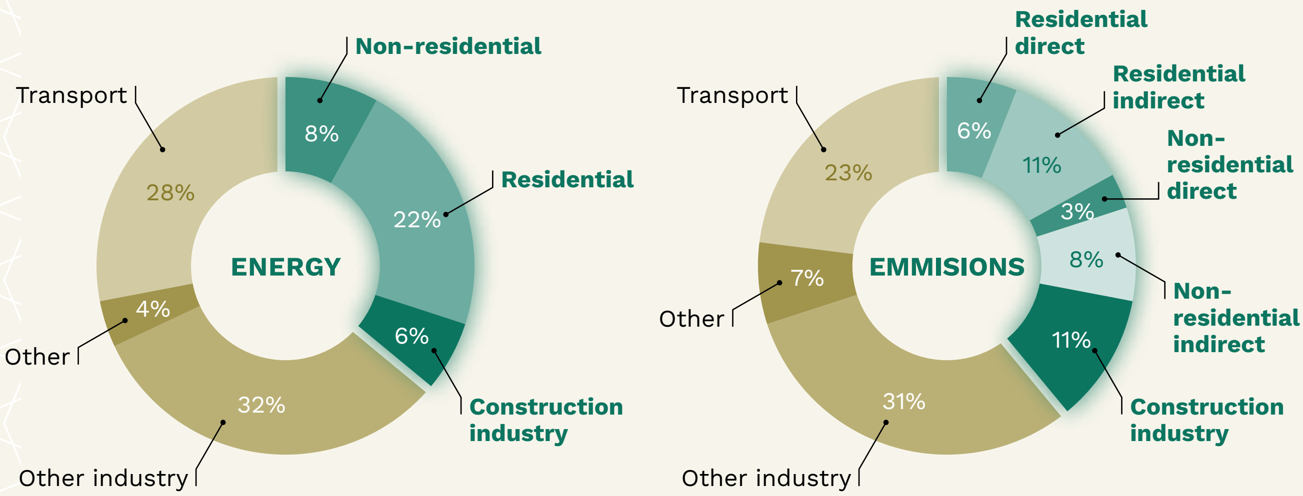

Figure 1 _Global share of buildings and construction in final energy and emissions, 2018 (Adapted from [IEA, 2019a] and [IEA, 2019b])

Internationally, the building sector's relevance to emission reductions is gaining attention. Building codes play an important role in setting energy efficiency standards for new buildings while investment programs are ramped up for energy refurbishments. The following trends can be observed in the building sector:[1]

- The global buildings and construction sector is responsible for 39% of global GHG emissions. Floor area and population expansions are key reasons the sector's emissions will continue to increase.
- Many countries are developing and enhancing strategies, policies, and measures to improve energy efficiency and emissions reductions in buildings. Updates to nationally determined contributions accelerate this process.
- International donors and financial institutions backed with recovery fund money are looking for markets and mechanisms to invest into sustainable and low-carbon building projects.

To reach the global objectives of the Paris Agreement on climate change, building sector GHG emissions need to be reduced by at least 80% by 2050. This reduction requires a massive transformation of the building sector toward an efficient use of energy and switching to renewable sources of energy.


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Picture 1 _High-rise buildings in Beirut, Lebanon

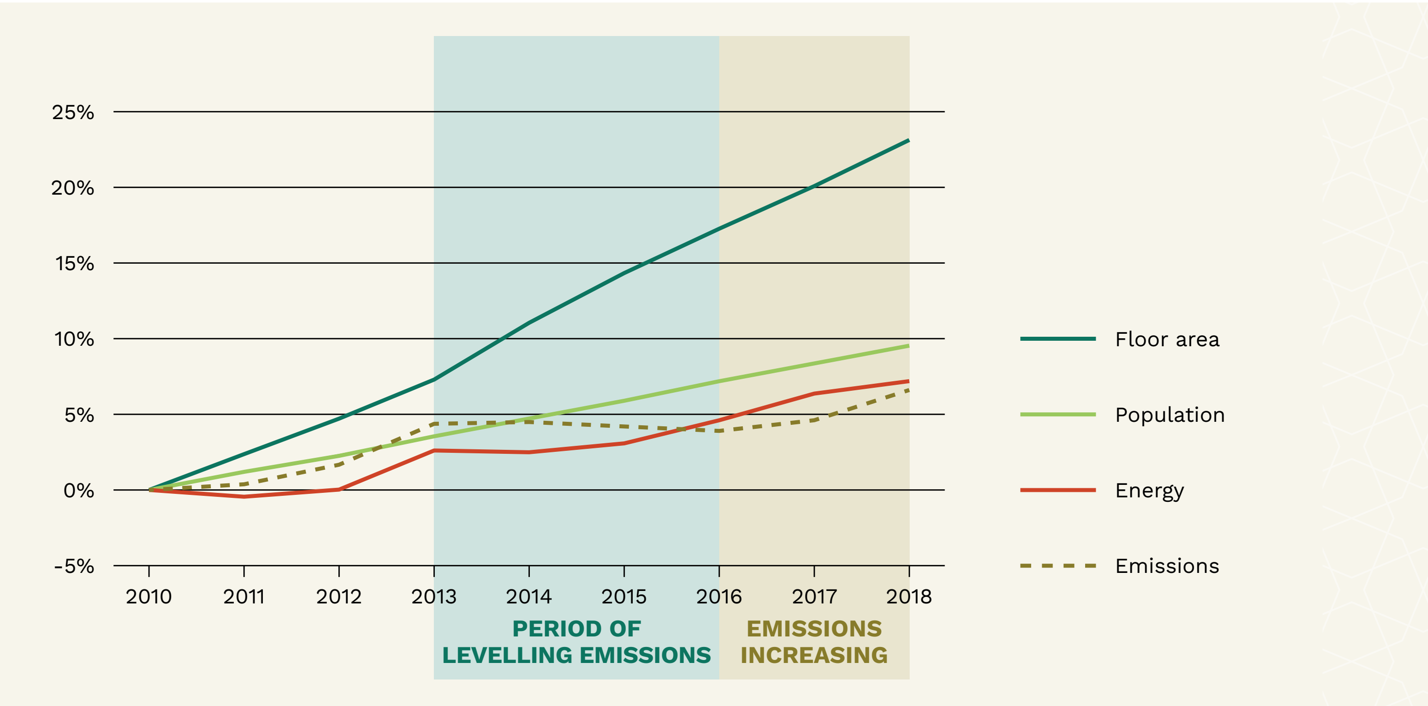


Figure 2 _Global changes in floor area, population, building sector energy use, and energy-related emissions [Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme, 2019]

1 Findings from the BUILD_ME project and Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme, 2019.

Many MENA region countries can be characterised by three main energy challenges:

- Insufficient electricity generation capacities are lagging demand growth due to a growing population, rising living standards, and a lack of adequate forecasting and planning.
- High dependence on fossil fuels exposes economies to the price volatility of fossil fuels, be it as an exporter or importer.
- High GHG emissions are caused by electricity production despite considerable renewable resource potential.

The MENA region's building sector accounts for an energy demand of about 50 million tonnes of oil equivalent (Mtoe), roughly one-third of the region's total annual energy consumption, and it is expected to continue to grow. If the current trend holds, lock-in effects will compromise the region's transition toward a low-carbon economy due to the long life and renovation cycles of buildings. Energy efficiency and the use of renewable energies can reduce the dependency on energy imports, improve energy security, and grant new economic opportunities while elevating living standards.

_Measures for zero-emission buildings

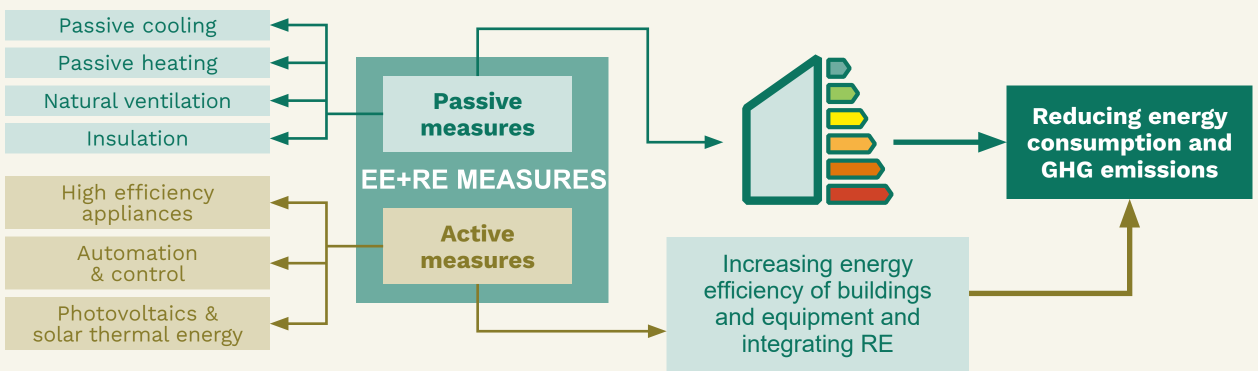


Figure 3 _Measures of zero-emission buildings

Future buildings need to be climate-proof. This means their energy demand needs to be reduced to a minimum amount. The remaining demand needs to be covered by renewable energy sources that are ideally produced onsite.

A holistic view is needed to develop green and sustainable buildings, using the full set of active and passive measures:

- **Passive** energy-saving measures are incorporated into the building design in the early stages and includes elements such as shading or insulation.
- **Active** measures include fitting the building with energy efficient systems that reduce the electricity consumption and cooling load and use renewable energies.

Passive and active energy efficiency measures coupled with the use of alternative or natural refrigerants with low global warming potential in space cooling and refrigeration systems guarantee optimum results in terms of climate change mitigation and GHG emissions reduction.

PASSIVE

Energy efficient measures in buildings

Category	Measure
Passive cooling and heating	• Orientation • Building shape • Window to wall ratio • Shading elements • Zoning • Thermal massing • Natural ventilation • Passive evaporative cooling
Daylighting	• Open space planning • Sky view factor • Window formats
Thermal insulation and windows	• Roof (floor) • External walls • Windows

ACTIVE

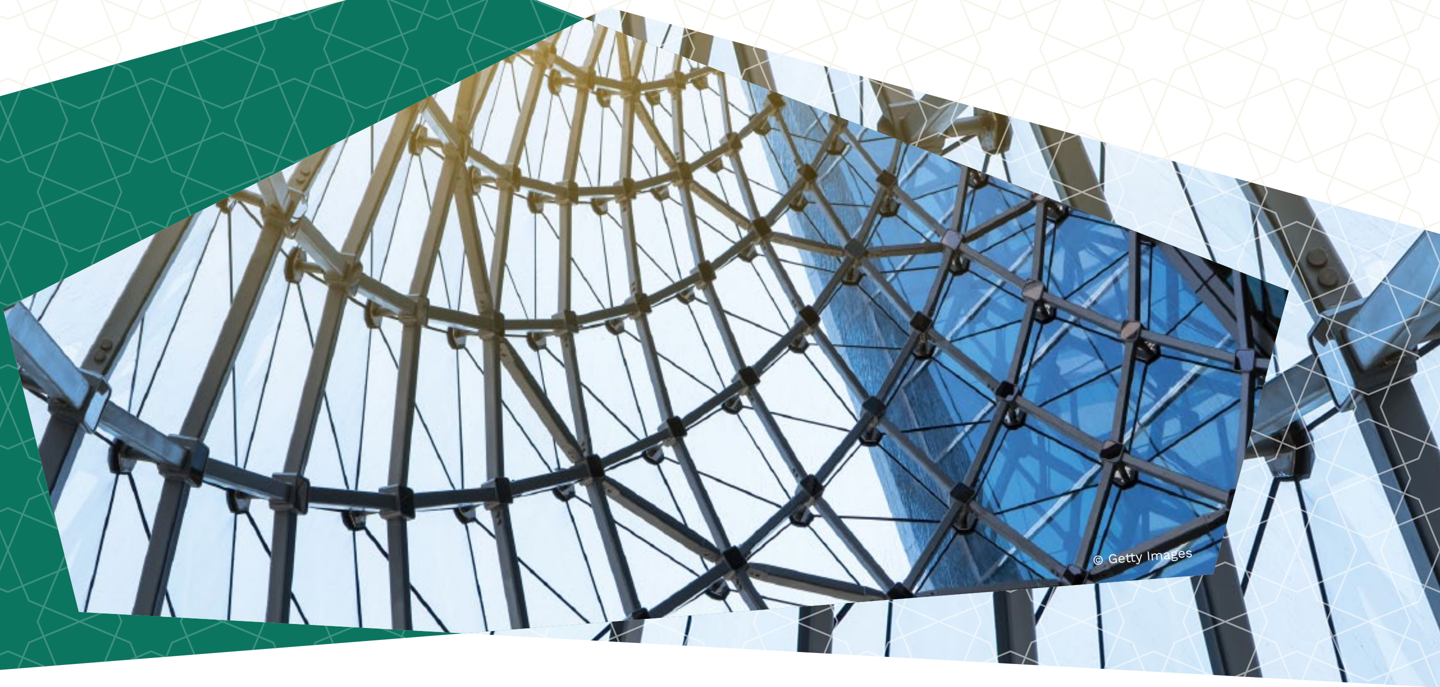
EE and RE systems in buildings

Category	Measure
High efficient appliances	• Energy efficient heating appliance • Energy efficient cooling appliance
Automation & control	• Time controls • Occupancy controls • Conditions controls (temperature, humidity, and carbon dioxide levels) • Building managements systems
Renewable energy systems	• Photovoltaics • Solar thermal systems

Figure 4 _Energy efficient measures and EE+RE systems in buildings

To find out how much energy, GHG emissions, and costs a building can potentially save with energy efficiency measures and the use of renewable energies, use the **Building Energy Performance (BEP) Tool** to learn the answer. Tailored to the MENA region, the BEP Tool is a free software tool to calculate the overall energy performance of buildings and the cost-effectiveness of building energy efficiency measures.

Picture 2 _Cairo on the Nile river, Egypt



THE BUILDING ENERGY PERFORMANCE TOOL – MOBILIZING FINANCE IN GREEN BUILDINGS

International building certification schemes are scarcely applied in the MENA region—either because they are too expensive, they focus on sustainable construction as opposed to energy performance, or they do not respond well to the market conditions. To apply for financial support from banks and international donors, project developers need evidence that their building project sufficiently reduces the energy demand below standards. To close this gap, the BUILD_ME project, funded by the International Climate Initiative (IKI), developed the BEP Tool.

The BEP Tool is a free browser application tailored to MENA region countries that provides a wealth of information about a building's energy performance and the cost-effectiveness of renewable energy or energy efficiency measures. In the tool's lending banks, project developers or other interested persons can find answers to questions like:

- How much energy can my building save with energy efficiency measures or the use of renewable energies?
- How much money would that save me?
- How does my building project compare to similar buildings in my country?

From the building envelope to the use of renewable energies, the tool covers all relevant aspects that influence the energy performance of buildings and the lifecycle costs of energy efficiency measures. Using the BEP Tool, project developers can develop buildings that demand less energy than business-as-usual (BAU) buildings on the market. Banks can design funding lines that provide financial support to projects that achieve a certain threshold below BAU projects based on the results of the BEP Tool.

The BEP Tool is based on a proven Guidehouse model that has been applied in many international projects, delivering realistic results based on a solid, internationally applicable methodology. The model's calculation core is based on the international standard ISO 52016 – *Energy efficiency of buildings – energy requirements for heating and cooling, indoor temperatures and sensitive and latent heat loads*. ISO 52016 is the most up-to-date standard for calculating building energy requirements.

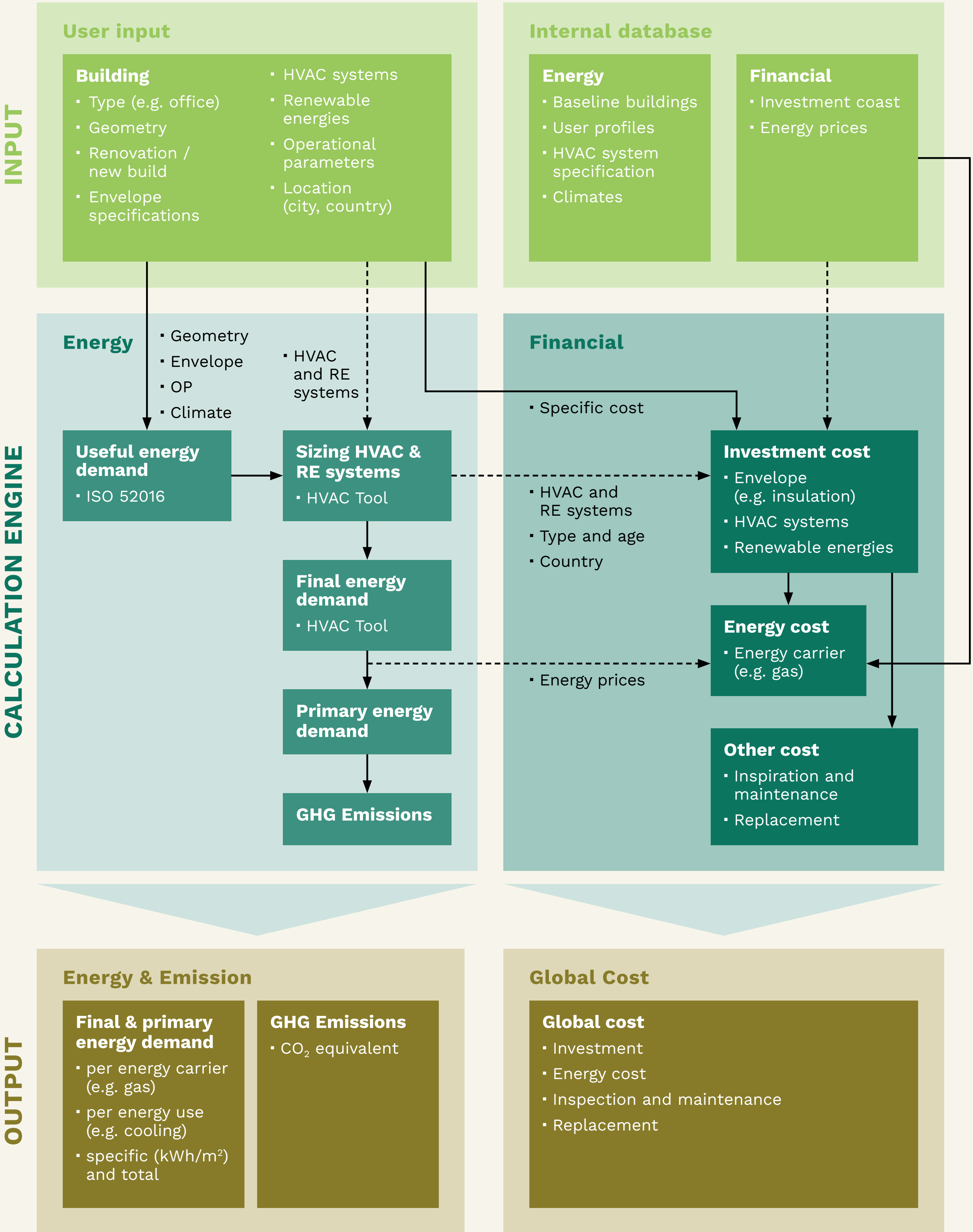


Figure 5 _Input, calculation engine, and output of the BEP Tool

The BEP Tool is powerful for a wide range of actors, particularly actors from the MENA region, including:

- Project developers seeking to exploit energy-saving potentials, identify the cost-optimal or economic efficiency measures, and appropriately size renewable energies to their building.
- Financial institutions to verify climate-proof building projects in the local market and support them with green funding.
- Architects to pre-assess potential measures in the concept phase with an easy-to-use and free tool, supporting the design of nearly zero-energy buildings.
- Researchers to generate energy consumption data for either representative reference buildings or individually designed use cases.
- Policymakers to understand the impact of energy efficiency measures on a building's energy performance and possible CO_2 emission reductions.

_Why use the BEP Tool?

Figure 6 _Strengths of the BEP Tool

The integrated solution of the BEP Tool makes it possible for banks to compare their own projects with a national energy consumption baseline by building type and to classify their building following an energy labeling scheme for new buildings. The BEP Tool offers a customizable and transparent approach, which is currently exclusively adapted to the three target countries of the BUILD_ME project: Egypt, Jordan, and Lebanon.

Performance of energy efficiency measures and renewable energies

The BEP Tool calculates the overall energy performance of buildings and analyses the cost-effectiveness of energy efficiency measures and the integration of renewable energies.

Free web application

The BEP Tool can be used by everyone without any extra costs and is available as a free web application under. It provides default input values and an advanced mode for experienced users.

Calculation of monetary savings

The BEP Tool calculates the potential monetary savings that can be achieved with energy efficiency measures and the integration of renewable energies in buildings.

Proven methodology

The BEP Tool, based on the international energy calculation methodology provided in ISO 52016, has been successfully applied in various projects. It is fed with local market data from existing construction no more than 3 years old.

_How to use the BEP Tool to finance energy efficient buildings?

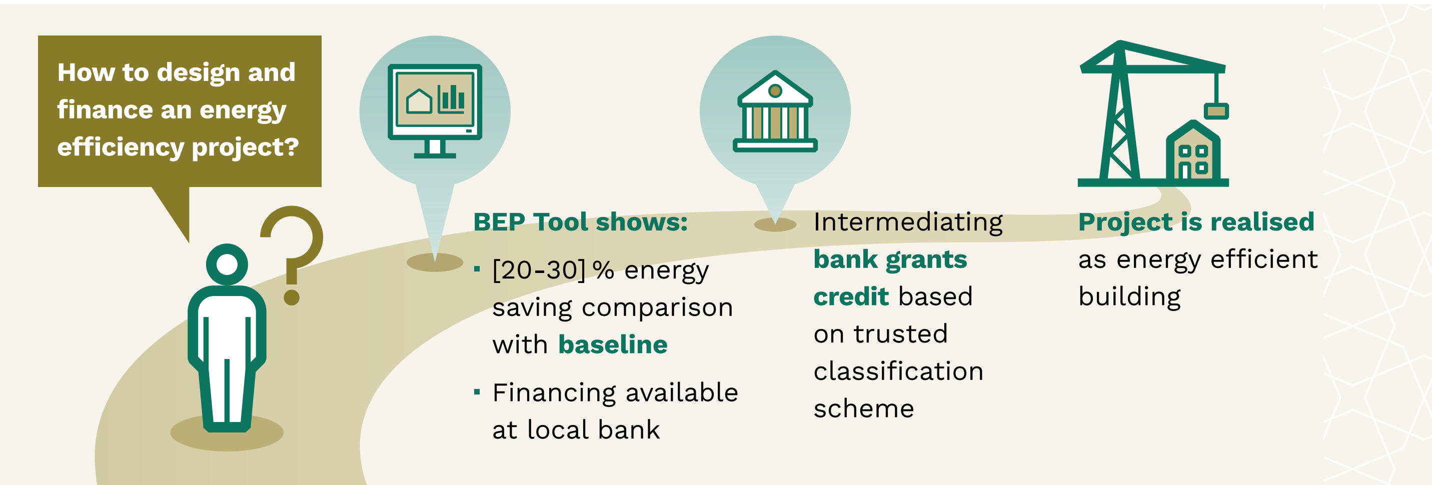


Figure 7 _Simplified way of financing energy efficient building projects with the BEP Tool

The BEP Tool contains modules covering all relevant aspects that influence the energy performance of buildings and the lifecycle costs of energy efficiency measures. The tool calculates the energy demand for space heating and space cooling on an hourly basis for each hour of the year, leading to 8,760 individual calculations using hourly climate data. The BEP Tool considers local climatic conditions and exact building specifications such as the geometry and orientation of surfaces before applying the complex calculations of the standard. Per ISO 52016, the energy demand calculation is supplemented by a calculation module for technical building systems to calculate the final energy demand for space heating, space cooling, and hot water generation. Taking into account national primary energy and emissions factors, the tool converts the final energy demand into primary energy demand and GHG emissions.

In three simple steps, you can gain access to a wealth of information.

1 **Enter general information** about your project, including a project name and building type. At the bottom of the *"General information" tab* several special input modes can be selected to tailor your experience.

2 **Enter more specific data** in the *"Input" tab* on the building geometry, walls, windows, and your building's systems. To make it easier for you, these fields are populated with baseline data from your selected building type. Simply make sure that you update these fields according to your project.

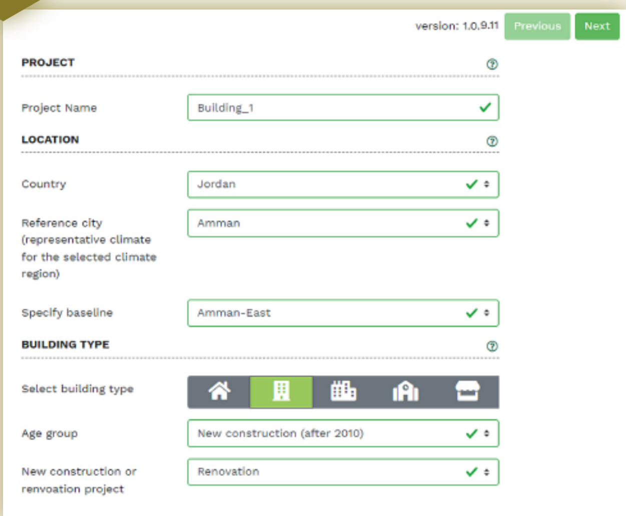
3 **Explore the results.** This includes graphs displaying energy consumption, carbon emissions, and costs. The *"Results" tab* also contains an energy performance rating scale in the upper right-hand corner; this scale provides an indication of where your project stands compared to the corresponding baseline building in your country.

The following images show the types of information that can be found through the three steps.

_Step 1

The user enters general information including the name for the current project, the building type, and the location where project is taking place.

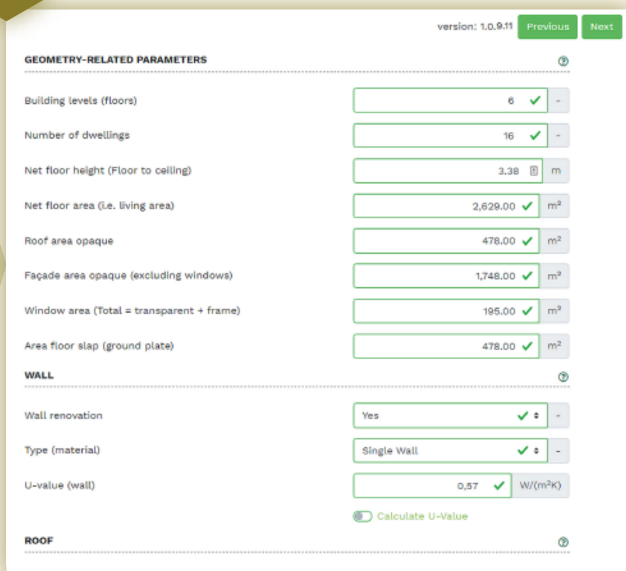
1 GENERAL INFORMATION



_Step 2

The user provides input on parameters for the calculation (e.g., geometry-related parameters).

2 INPUT



A more detailed description of each parameter and a list of the calculation aspects these parameters have a relevant impact on can be found in the documentation file of the BEP Tool.[2]

2 For more information, see: https://www.buildings-mena.com/files/UserManualBEPTool_v101.pdf

Picture 3 _The Boulevard in Amman, Jordan

_Results

The user enters general information including the name for the current project, the building type, and the location where project is taking place.

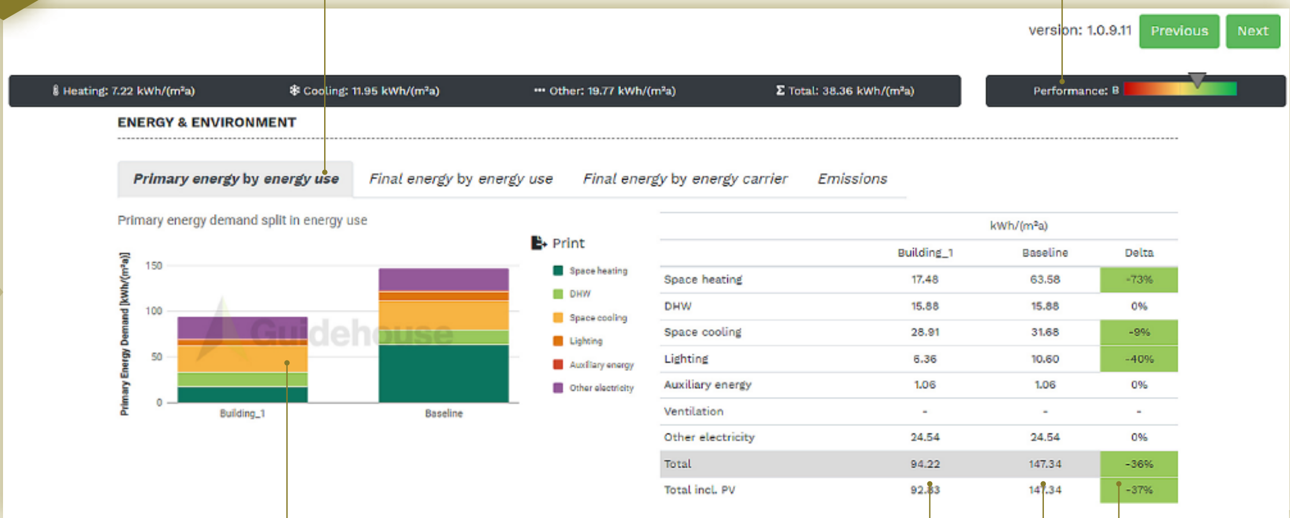
Output selection

4 tabs to select the energy performance indicator.

Performance rating

C = equal to baseline

3 RESULTS



Quick overview

The main facts.

Overview chart

Comparison to the baseline building.

Results table

Detailed results in numbers.

Comparison

Difference to the baseline building.

Baseline building

Detailed results of the baseline building.

_Where has the BEP Tool been used?

Frames, Baasir

Beverly Hills - 229

Dar Al-Oqoud, Amman

The BUILD_ME project tested the BEP Tool in 13 pilot projects in Egypt, Jordan, and Lebanon. Project developers confirmed that the **tool delivers convincing results** and is user-friendly.

KLEOS Achrafieh Apartments

Paim Hills, Alexandria

New Mansoura University

KONN Modular Houses

City Towers Project

College Notre Dame de Nazareth

Kye Beachfront Resort

Misr Alghad

Arcade Suites II

Private Residence

Case Study 1 _Mansoura University (Egypt)

Mansoura City is a new city on the coast of the Mediterranean Sea developed by the New Urban Community Authority of the Ministry of Housing in Egypt. The BEP Tool was used to calculate energy consumption of the central library building of Mansoura University. The library shall provide a working environment to encourage high quality research, teaching, and learning. It has a gross floor area of around 6,000 square meters spread over four floors.

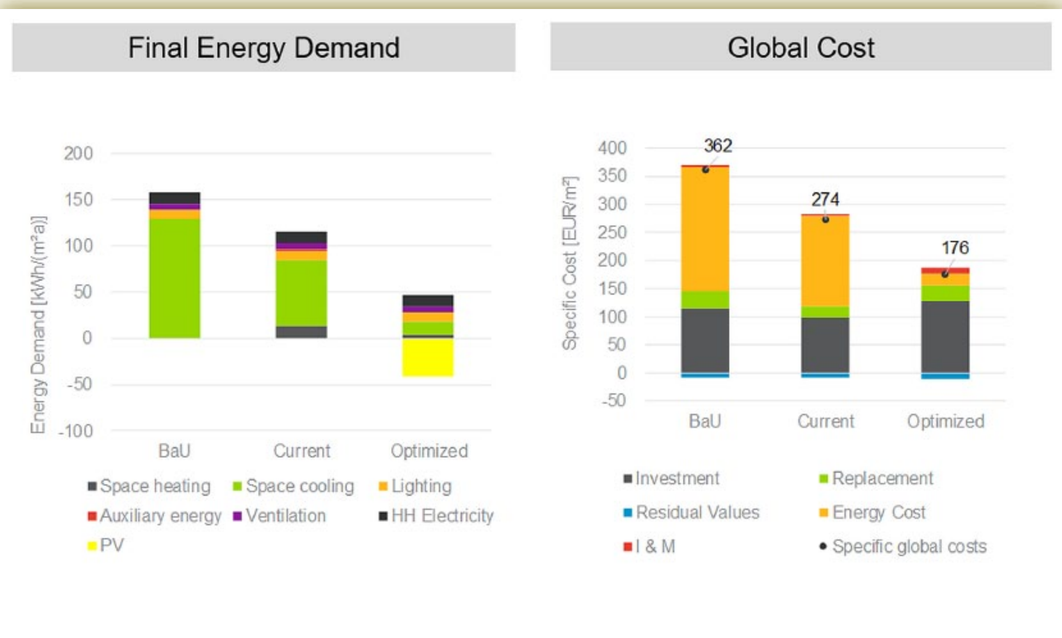
Analysis of the cost-optimal energy efficiency and renewable energy measures with the BEP Tool showed that the following components would be cost-effective and were considered for further planning:

- Improvement of the building envelope
- Solar glazing
- Higher efficiency variable refrigerant flow (VRF) system
- Photovoltaics on the roof

The suggested measures lead to a significant decrease in energy demand and cost savings (see Figure 8). Reduced energy demand ranges between 26% and 90% compared to BAU. Global cost savings reach 24% – 51%.

Picture 4 _Mansoura University in Egypt

Figure 8 _BEP Tool results of the Mansoura project



PV: Photovoltaics

HH Electricity: Household electricity (HH)

I & M: Inspection and Maintenance

Case Study 2 _KONN Modular Houses (Jordan)

The KONN project is designed and developed by Uraiqat Architects. The KONN concept includes several prototypes of residential single-family houses. KONN Homes envisions providing affordable modular housing by using smart modular construction to empower community members and provide them with alternative housing solutions.

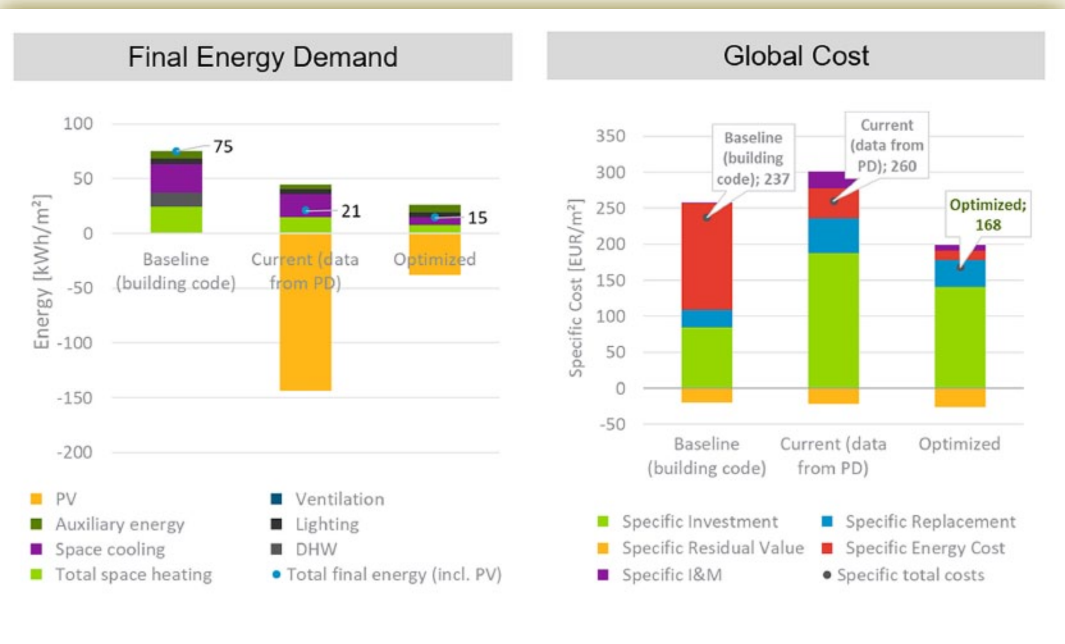
This project provides affordable housing for low-income households and families in rural areas and outskirts of urban centers. The residential single-family houses have a small garden and offer different sizes of 50, 85, and 120 square meters.

Analysis of the cost-optimal energy efficiency and renewable energy measures through the BEP Tool showed that the building envelope is significantly enhanced compared to the BAU and current plan. Special attention is given to the use of renewable energy sources in terms of photovoltaics (for electricity) and solar collectors (for hot water), leading to energy savings and emissions reductions.

The suggested measures of the optimized case led to a significant decrease in energy demand and cost savings (see Figure 9). The energy savings are around 67% compared with the BAU, and global costs savings reach 29% for the optimized solution.

Picture 5 _KONN Modular Houses in Jordan

Figure 9 _BEP Tool results of the KONN project



PV: Photovoltaics

HH Electricity: Household electricity (HH)

I & M: Inspection and Maintenance

Case Study 3 _KLEOS Achrafieh Apartments (Lebanon)

The KLEOS Achrafieh Apartments project was developed by the Hayek Group. It is a multi-story building that aims to provide luxurious family residences. It includes apartments of different sizes and other amenities, such as a fitness center and a swimming pool. The building is located near downtown Beirut and consists of 19 floors and a penthouse with total space of 15,000 square meters and 5,000 square meters of underground area. The goal was to make the tower more energy efficient than the standard new construction in Beirut.

Analysis of the cost-optimal energy efficiency and renewable energy measures through the BEP Tool showed that the following components would be cost-effective and were considered in the further planning:

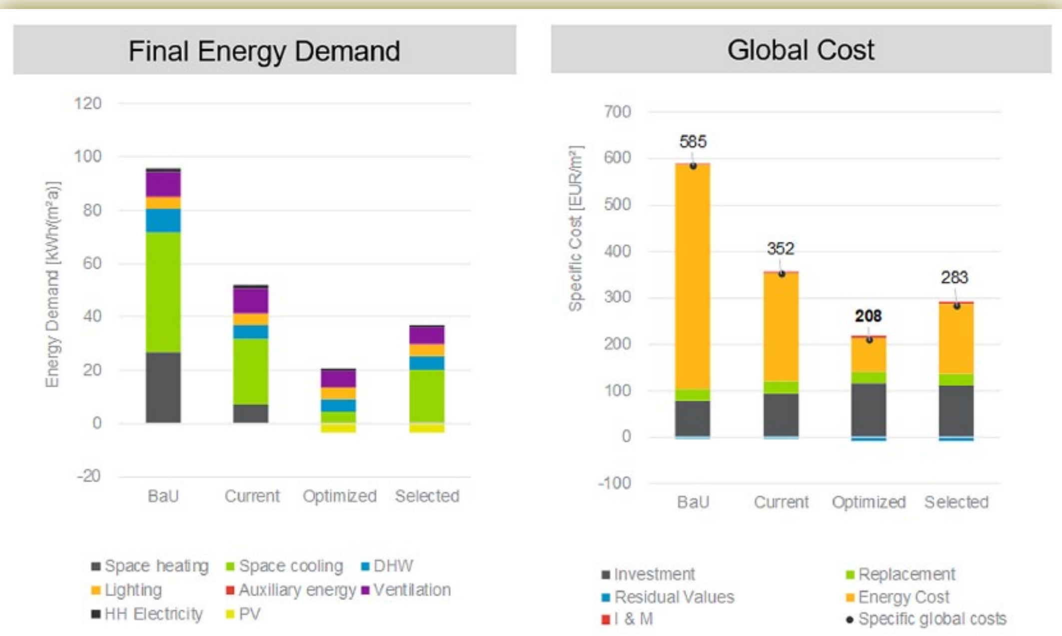
- Improvement of the building envelope
- Solar glazing
- Higher efficiency variable refrigerant flow (VRF) system
- Photovoltaics on the roof

The suggested measures lead to a significant decrease in energy demand and cost savings (see Figure 10).

The energy savings are around 62% compared to BAU; they reach 51% for the selected package and 64% for the optimized solution in terms of global costs savings.

Picture 6 _KLEOS Achrafieh Apartments in Lebanon

Figure 10 _BEP Tool results of the KLEOS project



PV: Photovoltaics

HH Electricity: Household electricity (HH)

I & M: Inspection and Maintenance

FINANCING OPTIONS FOR ENERGY EFFICIENCY PROJECTS IN EGYPT, JORDAN, AND LEBANON

_Egypt

- Green Economy Financing Facility (GEFF)
- Green for Growth Fund (GGF)
- Egypt Renewable Energy Financing Framework
- National Bank of Kuwait-Egypt/ International Finance Corporation
- National Bank of Kuwait Egypt/ European Bank for Reconstruction and Development (EBRD)
- QNB Green Loan
- Solar Loan of the Commercial International Bank (CIB)
- Green Credit Loan of the Commercial International Bank (CIB)
- Green Bond Program of the Commercial International Bank (CIB)

_Lebanon

- National Energy Efficiency and Renewable Energy Action (NEEREA)
- Lebanon Environmental Action (LEA)
- Green Bonds by Fransabank

_Jordan

- Jordan Renewable Energy and Energy Efficiency Fund (JREEEF)
- Jordan Environment Fund (JEF)
- Cities and Villages Development Bank (CVDB) as Direct Access Entity for the Green Climate Fund (GCF) (in process)
- Green Economy Financing Facility (GEFF)

OUTLOOK

We are continuously looking into ways to improve the BEP Tool and how to further advance the transition toward energy efficient and climate-friendly buildings in the MENA region.

The next step is conceiving building classification schemes for Egypt, Jordan, and Lebanon. These schemes will integrate the BEP Tool as a calculation engine and will deploy a classification label (comparable with the EU energy performance certificate) for each country focusing on selected building types.

The development of the classification scheme can be tailored to the country-specific context. For example, a new standalone system focused only on energy can be developed, or the BEP Tool can be integrated into an existing sustainable certification scheme (e.g., Green Pyramid Rating System in Egypt).

The conception will define the following main elements:

- Ownership and management
- Certification scheme concept, design options
- Operational framework
- Testing and rollout
- Evaluation and update of the scheme and related tools
- Action plan for scheme rollout

As a result, each country will have a ready-to-use classification scheme in place, allowing financial institutions to better assess low energy buildings. This will support our aim to make the MENA built environment more sustainable and climate friendly.

Furthermore, we plan to extend the current scope of the BEP Tool by adding new countries and new building types. The open architecture of the BEP Tool allows for flexibility and scalability.

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