GREEN BUILDING COUNCIL
FRIEDRICH EBERT STIFTUNG

NetZero Buildings in Jordan

JORDAN GBC
Jordan Green Building Council

FRIEDRICH EBERT STIFTUNG

Climate and Energy Project
مشروع الطاقة والمناخ

Established in 2009, Jordan Green Building Council is a member based, civil society and cross-sector non-profit, non-Governmental organization registered at the Ministry of Social Development. Its Mission is to: Promote and advocate for adoption of the Green Build environment, leading towards making the Green Build environment a widespread reality in Jordan.

Our Council is part of a global network of more than 74 GBCs worldwide and holds the authority to represent the World Green Building Council (WGBC) in the Hashemite Kingdom of Jordan. The Jordan Green Building Council is serving as the Vice Chair of MENA (Middle East and North Africa) Regional Network. Jordan GBC has evloved to be global leader in this field and will continue to serve and make the Kingdom proud.

The awareness process happens through four major processes: Firstly, and most importantly the membership and networking; where we seek potential members in the green sector of Jordan in order to shed the light on the most important services, products or internal processes that are Eco friendly though sharing their own experiences using our green promotion and networking platforms.

Secondly, the Green Academy which is meant to enhance the public's awareness and education by being committed to proving high quality education in green practices and processes in order to train professionals to develop, manage and successfully execute green projects. Jordan GBC builds these capacities through professional workshops and trainings realted to Green Buildings.

Thirdly; Outreach activities and events where customized to serve different target groups to suit their awareness needs in order to send the message of Eco friendly buildings and build environment. The outreach events can target School student, universities, engineers of different fields.

Lastly, Reserach and Innovation; we constantly work on developing the council through researching potential for projects and engaging different stakeholders from multiple sectors.

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Jordan Green Building Council | NetZero Buildings in Jordan

Wind and solar PV will provide the majority of the electricity generation [19].

Figure 6: Power Generation Capacity by Source 2000-2040 [19].

Primary Energy Sources in Jordan

of its primary energy sources from Arab countries just like Egypt, some Gulf countries and Syria

However, the Syrian market has been stalled since 2012 [20]. The need to reduce the Jordanian dependency on imported resources was a major reason to encourage decision-makers to announce the National Energy Strategy of 2007 – 2020. The strategy has set a target of generating 10% of its energy demand from renewable energy sources by 2020 and the target is achieved [20]. The national energy strategy 2020 - 2030 sets a target of increasing the renewable energy share to 14% by 2030.

In 2019, Jordan was depending on crude oil and natural gas as the main sources for energy.

Figure 7: Shares of Primary Energy Sources in Jordan [21].

Furthermore, nuclear energy has been under study since 2007 as a source of alternative energy, and the target is to provide 30% of Jordan's electricity using nuclear power by 2030 [21].

Consequently, the first Jordan Research and Training Reactor (JRTR) was built in 2016 with a capacity of 5 MW in consortium with the Korean Atomic Energy Research Institute (KAERI). In addition, it was announced in 2018 that the second commercial nuclear power plant is scheduled for completion in 2025 in cooperation with many other countries [21].

Energy costs are subsidized by the government. Moreover, the Jordan Renewable Energy and Energy Efficiency Fund (JREEEF) - which is an independent entity under the umbrella of the Ministry of Energy and Mineral Resources; provides energy efficiency and renewable energy programs with subsidized costs for the public.

The challenge of increasing primary energy sources to meet the demands can be mitigated by energy efficiency practices. The residential sector plays a key role in this challenge which makes NetZero Energy Buildings gain higher interest as a crucial solution in this challenge.

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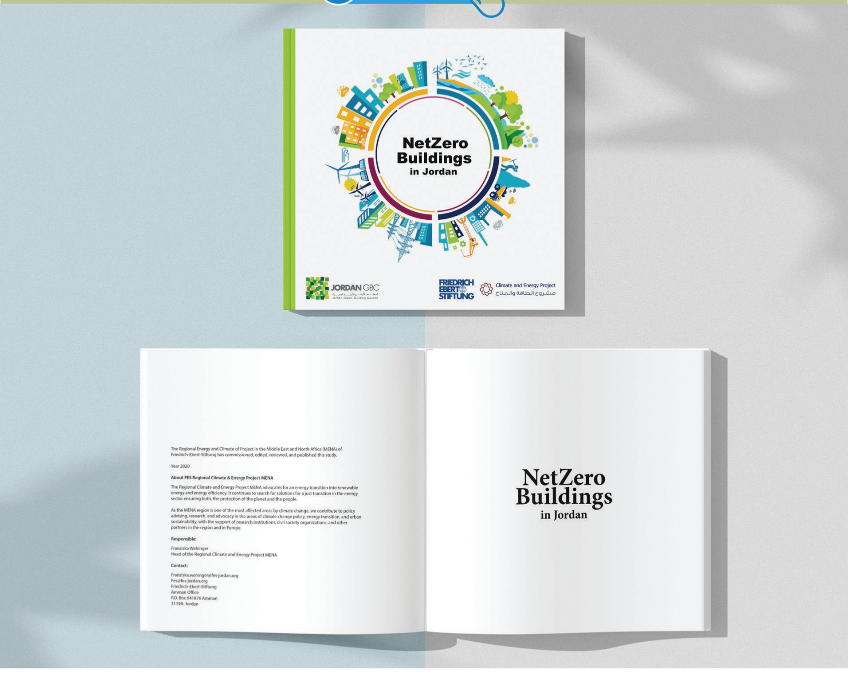

NetZero Buildings in Jordan

The Regional Energy and Climate of Project in the Middle East and North Africa (MENA) of Friedrich-Ebert-Stiftung has commissioned, edited, reviewed, and published this study.

Year 2020

About FES Regional Climate & Energy Project MENA

The Regional Climate and Energy Project MENA advocates for an energy transition into renewable energy and energy efficiency. It continues to search for solutions for a just transition in the energy sector ensuring both, the protection of the planet and the people.

As the MENA region is one of the most affected areas by climate change, we contribute to policy advising, research, and advocacy in the areas of climate change policy, energy transition, and urban sustainability, with the support of research institutions, civil society organizations, and other partners in the region and in Europe.

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NetZero Buildings in Jordan

AMBLE

OZONE Depletion

has led to an increase in awareness regarding the implications of climate change in the past few years. This has led emerging nations and countries to take serious actions to mitigate the anthropological impact on the Ozone layer. [1]

In 2015 the United Nations' Climate Change Convention brought together 196 parties for the first time into an effort to combat climate change and mitigate its effects. This convention was called *"The Paris Agreement"* which requires all parties to set goals and targets that reduce greenhouse gas emissions to limit the temperature increase of the earth to 1.5°C or further.

The agreement puts forward all parties' efforts through *Nationally Determined Contributions (NDCs)* [1].

The implementation of NDCs includes - but is not limited to:

- 01 **Switching** to low emission technologies which are charging on CO_2 emissions and other greenhouse gases
- 02 **Limiting** organizations' annual greenhouse gas emissions
- 03 **Providing** grants and subsidies to incentivize the reduction of greenhouse gas emissions.

NetZero Buildings are of a significant interest to nations that contribute to reducing the impacts of the greenhouse gas emissions, as they are major contributors to achieving the goals of the Paris Agreement.

Two goal… support the acc…

- All new buildings … emissions from 203… standard practice to mee…
- 100% of buildings must op… emissions by 2050; existing b… an acceleration of current renova… all buildings are NetZero CO_2 emissi… by 2050.

Globally, buildings contr… 39% of the CO_2 emissions… 28% from operational emission… (energy needed to heat, cool and… power), and 11% from materials and construction [2].

01 INTRODUCTION TO NETZERO BUILDINGS

I. WHAT IS A NETZERO BUILDING?

A NetZero building is a green building which is designed, constructed, operated and deconstructed based on the green building criteria that ensure the building is highly resource efficient and offsets all its associated CO_2 emissions.

According to the World Green Building Council,

A NetZero Building is *"a building that is highly energy efficient with all remaining energy from on-site and, or off-site renewable resources".*

In NetZero buildings, the consumed energy and CO_2 emissions should be equal to or less than the generated renewable energy on an annual basis. The next will introduce the definition of the terminology which are used to describe types of NetZero buildings. It is worth noting that the term "carbon" in NetZero carbon buildings indicates the CO2 emissions and

other greenhouse gas emissions, rather than the carbon element that exists in the planet and all organisms.

Types of NetZero Buildings

- NetZero Energy Building
- nearly NetZero Energy Building
- Net-Zero Operational Carbon Building
- NetZero Carbon Building
- NetZero Water Building

NetZero Energy Building (NZE)

Also known as a Zero Net Energy (ZNE) or a Zero Energy Building (ZE); is an energy-efficient building that **produces as much energy as it consumes over the course of a year,** usually by incorporating renewables on-site. This d… is delivered by the New Building… refers to the operational…


Greenhouse Gas Emissions

Life Cycle Assessment


NetZero Buildings Growth Trends

II.ENERGY

Energy Definition and Measurement Units.

Types of Energy in Buildings:


Two goals have been set to promote and support the acceleration of NetZero Buildings:

The major contributor to CO_2 emissions in buildings is energy use during the operational stage.


Water Resources

Water Resources in Jordan


Scientists divide the carbon emissions from the building life cycle in reference to the stages of the building life cycle:


03
BARRIERS OF NETZERO BUILDINGS

3 Lack of national carbon offset programs. Such programs can sell certificates for building owners whom are looking for offset strategies to achieve a NetZero Building. Renewable Energy Certificates and Carbon Offset Certificates are examples that can guarantee that the offset sources are operated by environmental practices.

A Renewable Energy Certificate (REC) is a proof that energy has been generated from renewable sources such as solar or wind power. Each REC represents the environmental benefits of 1MWh of renewable energy generation. When a resident purchases RECs, renewable energy of the same value is generated. In the same manner, a Carbon Offset Certificate can be defined as a certificate that represents the reduction of one metric ton of carbon dioxide emissions. Figure (46) illustrates the concept of the Carbon Offset Certificates. [59]

Figure 46 : The Concept of the Carbon Offset Certificates.

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TECHNICAL BARRIERS

1 Incorrect construction and operational practices may lead to much higher energy and water consumptions as well as embodied carbon emissions compared to estimates made in the design stage.

2 Inaccurate estimates of energy and water consumptions and materials quantities in the design stage will lead to high deviations between the design calculations and the actual consumptions and/ or quantities.

3 The lack of skills and expertise across the construction sector and workers in the field of NetZero Buildings. This results with increased costs for working compared to traditional buildings.

II. MITIGATION MEASURES

The initial step in implementing NetZero practices is to eliminate and mitigate the challenges to meet the transformation requirement, then spread the practice nationally.

The following mitigation measures can be implemented to overcome the barriers of implementing a NetZero Building:

MITIGATION OF SOCIAL BARRIERS

1 **Developing code-improvement proposals** and voluntary programs that encourage and support the construction of Net Zero Buildings.

2 **Dedicating studies and research efforts** to develop national energy and material references that contain conversion factors for embodied energy and embodied carbon emissions.

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IV. THE COST OF NETZERO BUILDINGS

Few international studies have calculated the incremental cost (the total cost incurred due to the additional expenses) of constructing NetZero Buildings. The cost varies according to multiple factors such as the climatic conditions, building location, building type, community type (rural/urban), and the availability of governmental incentives and rebates. The amount of savings is then compared to a baseline case which is the traditional building that is built according to the minimum building design and construction criteria in the region of study (business as usual case).

STUDY 1

The incremental cost of **NetZero Energy commercial Buildings** compared to the standard construction codes in the United States ranges between:

0-15% with a payback period between 5-10 years **for energy savings between 20-50%.** *[62]*

STUDY 2

A study conducted on single-family homes in four states in America has revealed that:

+$ Incremental cost ranges between **6.7 - 8.1%** compared to the baseline case (building codes in the United States).

The study was carried out in 2018 and shows that the same **multiple energy efficiency factors** **will decrease the incremental cost to become** **3.1 - 5.5%** in 2030. [63]

The future reduction in the incremental cost is expected due to the decline in the renewable systems costs and the higher efficiency gains of the equipment which is a result of the evolving technology.

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STUDY 3

The analysis of a third study carried out in the United Kingdom in 2018 resulted with incremental costs for both residential and non-residential buildings equal to 5%-7%.

Incremental costs for **the residential buildings, in specific** are **7% - 11%** +$ as concluded in the study. [64]

In conclusion, studies are needed to cover initial cost, running cost and ROI of applying NetZero Building as an emerging green building practice in the local market across different territories of Jordan. The vision is to embed the practice in the national standards and legislation to be verified and validated for every building in the future.

V. INTERNATIONAL PROGRAMS TOWARDS ACHIEVING NET ZERO BUILDINGS

International efforts and programs have been dedicated to implementing, advancing and analyzing impacts of NetZero Buildings. There are also Certification Schemes that confirm buildings' compliance with the NetZero goals.

The most widespread programs and certifications are:

World Green Building Council- Advancing NetZero Project

WORLD GREEN BUILDING COUNCIL

Advancing NetZero Project was launched in 2015. It is a global campaign to accelerate uptake of NetZero Carbon buildings to 100% by 2050 through Green Building Councils from 15 countries around the world. The Green Building Councils have been developing mechanisms and initiatives to facilitate mass market transformation, and lead the way, inspiring the business and the government communities to follow. Besides, the Green Building Councils ensure alignment with the four key project principles illustrated in figure (48).

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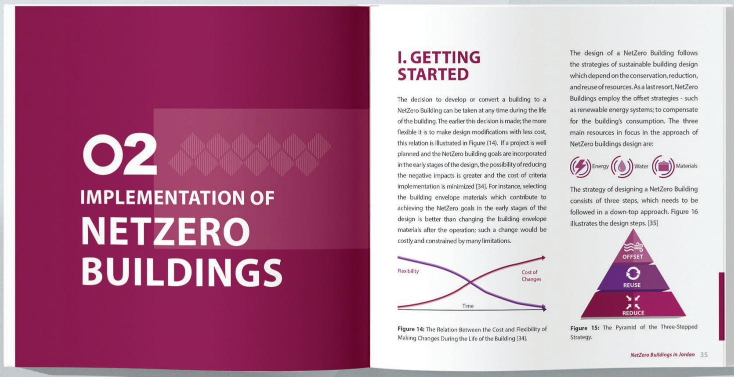

02 IMPLEMENTATION OF NETZERO BUILDINGS

I. GETTING STARTED

The decision to develop or convert a building to a NetZero Building can be taken at any time during the life of the building. The earlier this decision is made; the more flexible it is to make design modifications with less cost, this relation is illustrated in Figure (14). If a project is well planned and the NetZero building goals are incorporated in the early stages of the design, the possibility of reducing the negative impacts is greater and the cost of criteria implementation is minimized [34]. For instance, selecting the building envelope materials which contribute to achieving the NetZero goals in the early stages of the design is better than changing the building envelope materials after the operation; such a change would be costly and constrained by many limitations.

Figure 14: The Relation Between the Cost and Flexibility of Making Changes During the Life of the Building [34].

The design of a NetZero Building follows the strategies of sustainable building design which depend on the conservation, reduction, and reuse of resources. As a last resort, NetZero Buildings employ the offset strategies - such as renewable energy systems; to compensate for the building's consumption. The three main resources in focus in the approach of NetZero buildings design are:

Energy Water Materials

The strategy of designing a NetZero Building consists of three steps, which needs to be followed in a down-top approach. Figure 16 illustrates the design steps. [35]

Figure 15: The Pyramid of the Three-Stepped Strategy.

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As a second option, materials can be recycled either on or off the construction site. A higher percentage of recycled content indicates that fewer raw materials were extracted. The most widely used recycled construction material is reinforced steel bars. The recycled content in steel bars varies between 25% to 90%. Reinforced steel bars are an example of cradle -to- cradle construction material.

As illustrated in figure 39, the carbon emissions associated with the production of steel with 97% recycled content is 50% less than carbon emissions from the production of steel with 25% recycled content. Unfortunately, the production of 97% recycled content steel accounts for 29% of the total global steel production compared to 71% for the 25% recycled content steel. [58]

Figure 39: Carbon Impact of Steel with 25% and 97% Recycled Content [58].

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A Matter of Trade-off

In some cases, reducing the carbon footprint of a material may not contribute to reducing the overall life cycle carbon footprint. On the contrary, increasing the embodied carbon associated with the Production Stage may decrease the building life cycle of the embodied carbon.

One example is adding a large thermal mass material, that is high in embodied carbon, thus reducing the building life cycle of embodied carbon by reducing heating and cooling loads.

Third - Offset Carbon Emissions

The offset strategy for carbon emissions from building construction materials is elaborated by calculating the "Embodied Carbon" associated with each material component after applying all possible reduction and reuse strategies.

The calculation methodology can be implemented by listing all construction materials and their quantities, then calculating the amount of CO2e which is associated with each stage of the material life cycle. Finally, carbon offset sources are adopted to compensate for the calculated carbon emissions.

The Calculations of Embodied Carbon

Each material or product in the building has an embodied carbon conversion factor (which is unique for each material). It provides the value of the embodied carbon emissions associated with that material, and depends on multiple considerations during the Material Life Cycle Stages. **These considerations are:**

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In particular, the "Thermal Insulation Code" defines the thermal design principles for buildings in Jordan, such as the types of materials used in thermal insulation, the design requirements and design calculations. Another reference of high importance for the design of NetZero Building is the "Energy Efficiency Building Code" which provides the minimum requirements in architectural and MEP systems' design to lower energy consumption and improve thermal performance. The three stepped-strategy to accomplish a NetZero Energy Building starts by reducing energy consumptions, reusing the residual energy, and offsetting energy by renewables. Figure 17 illustrates the measures of Energy Reduction, Reuse and Offset which will be introduced to achieve a NetZero Building.

Figure 17: Measures of Energy Reduction, Reuse, and Offset to Achieve a NetZero Building [41], [42].

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First - Reduce Energy

The target of NetZero Energy buildings is to lower energy consumption and generate enough energy to match or exceed the remaining energy consumptions. Therefore, the first step is to reduce the demand for energy by implementing energy efficiency measures, thus reducing the generation capacity required by renewables to reach the NetZero Energy.

In Jordan, energy needs are mainly driven by heating loads as illustrated in figure 18 which shows the general energy breakdown of sample of 400 typical residential apartments in Amman.

Figure 18: Energy Breakdown in Residential Apartments in Amman [43].

> *The energy needed for heating and cooling is defined as: "Heat to be delivered to, or extracted from, a conditioned space to maintain the intended temperature". [44].*

A Net-Zero Energy building must be designed to have minimal heating and cooling energy needs. Otherwise it will require plenty of generation to compensate for these loads.

Climatic Analysis

The first step in designing Net Zero and energy efficient buildings is to analyze and understand the climatic characteristics of the area in order to implement design strategies that fit the climate and provide comfortable environments for occupants in the building.

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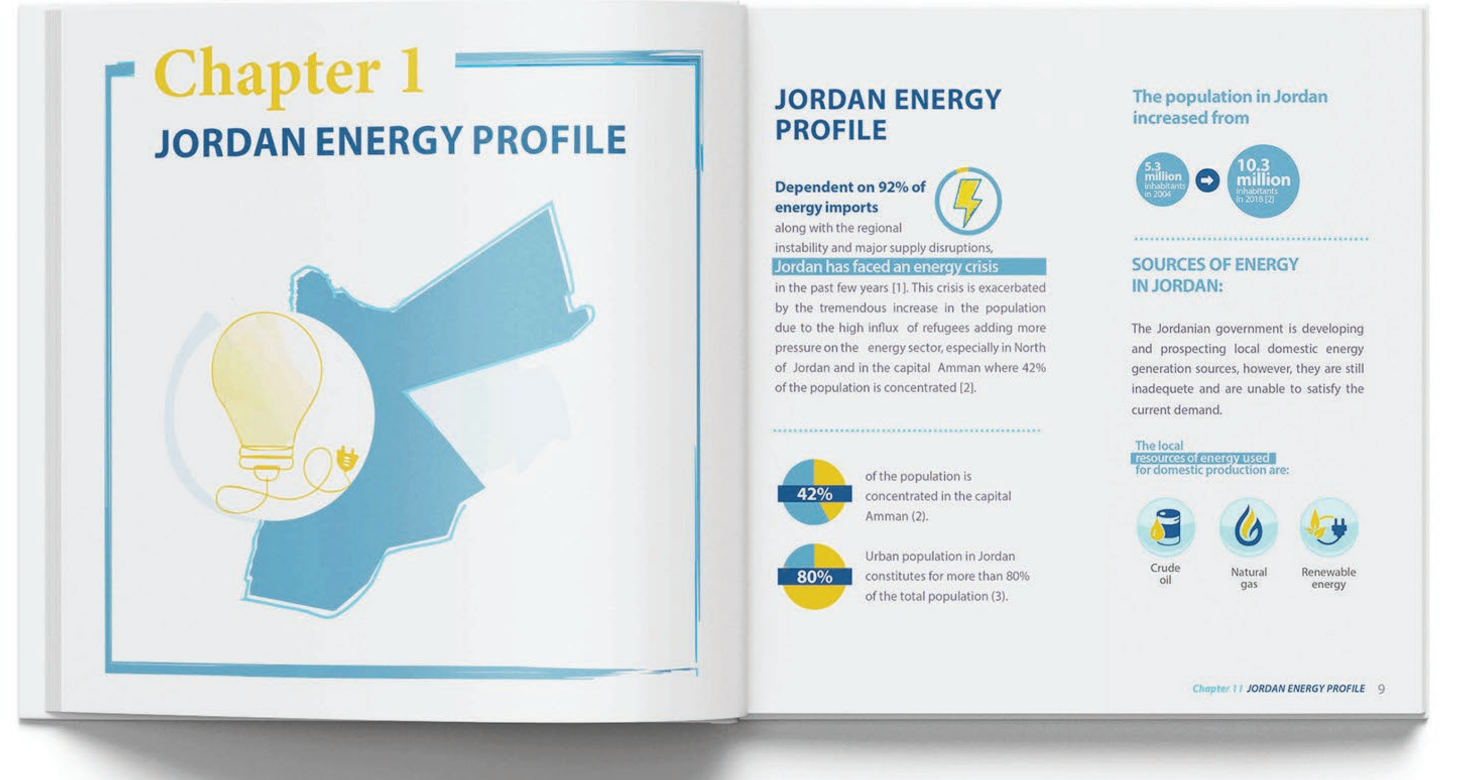

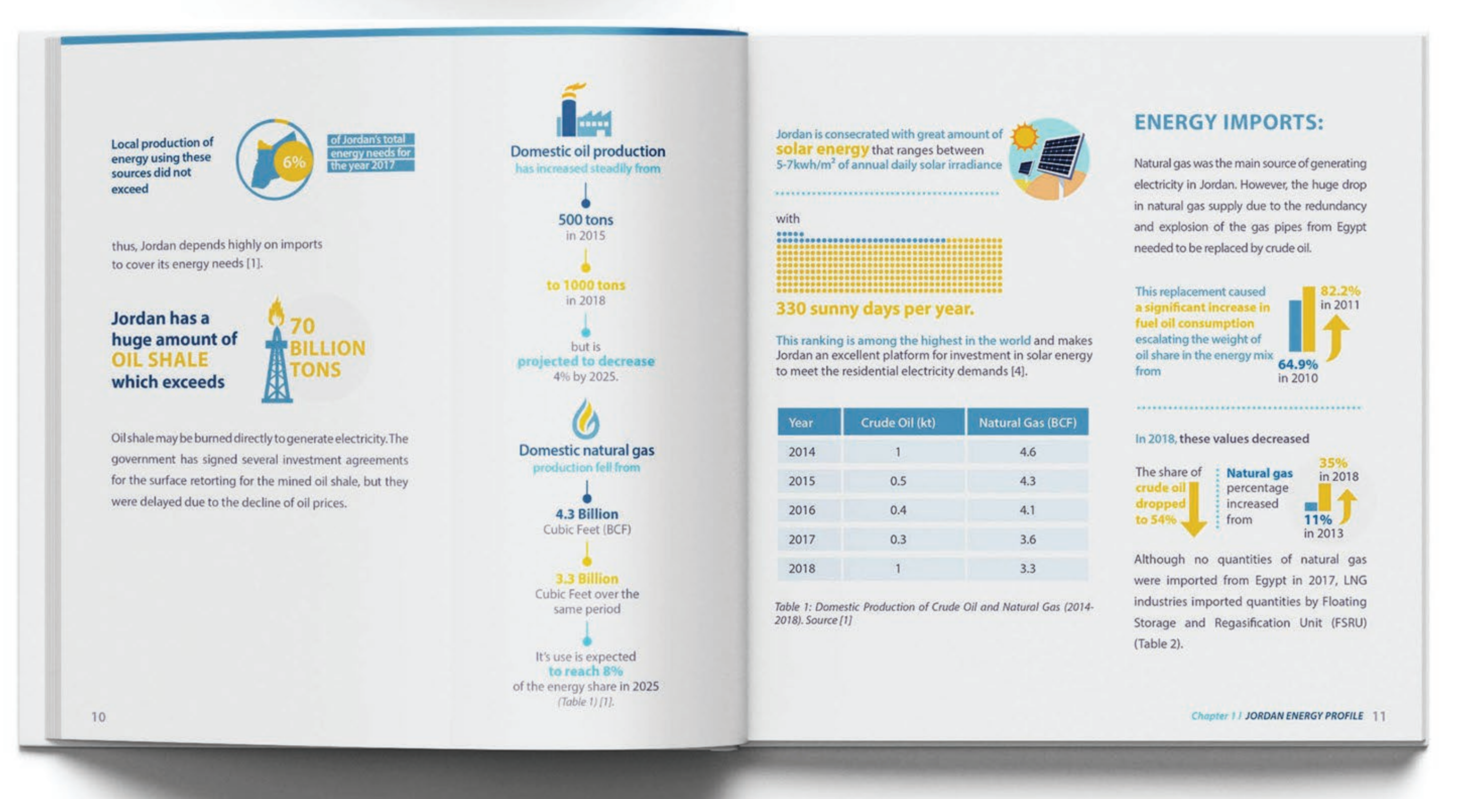

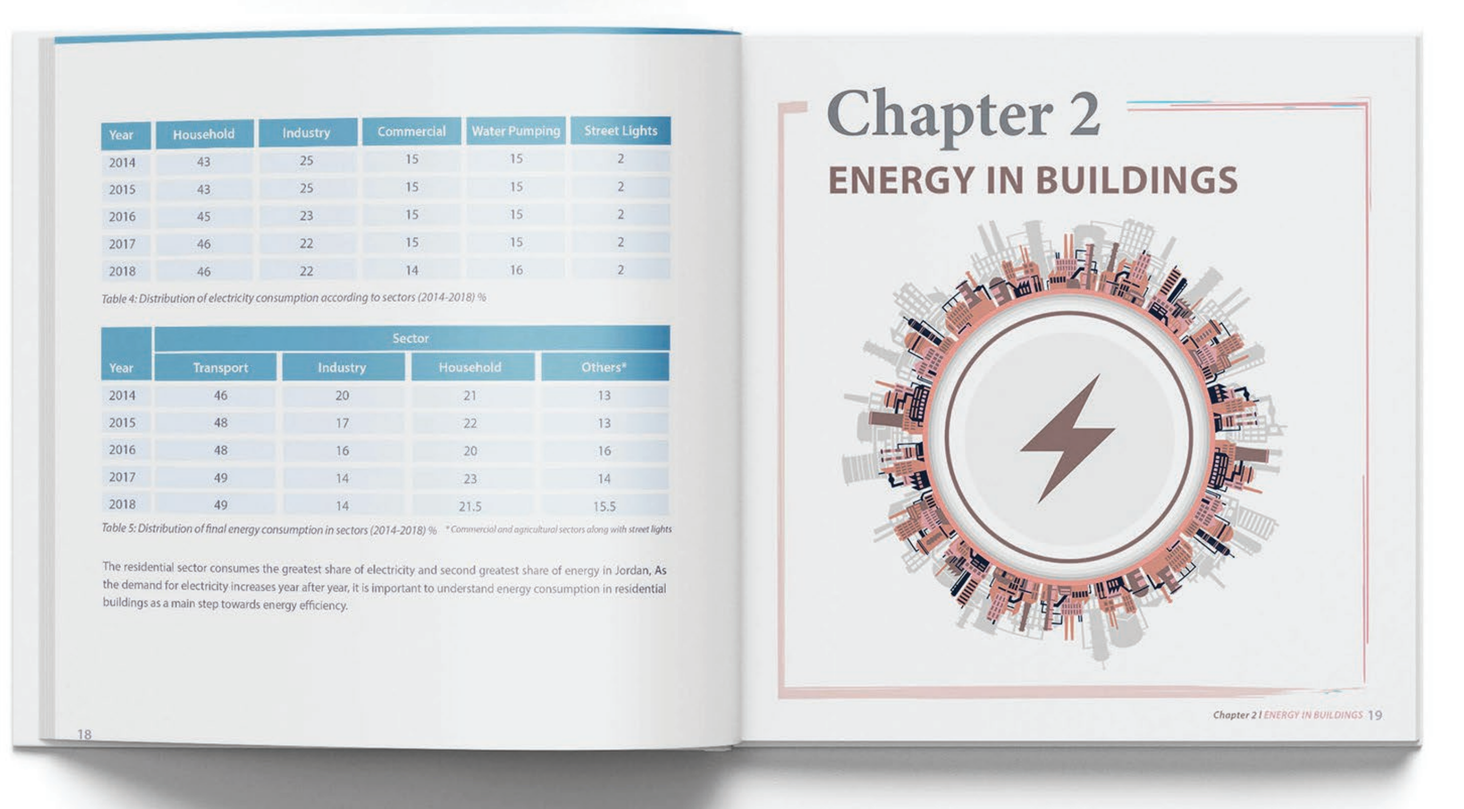

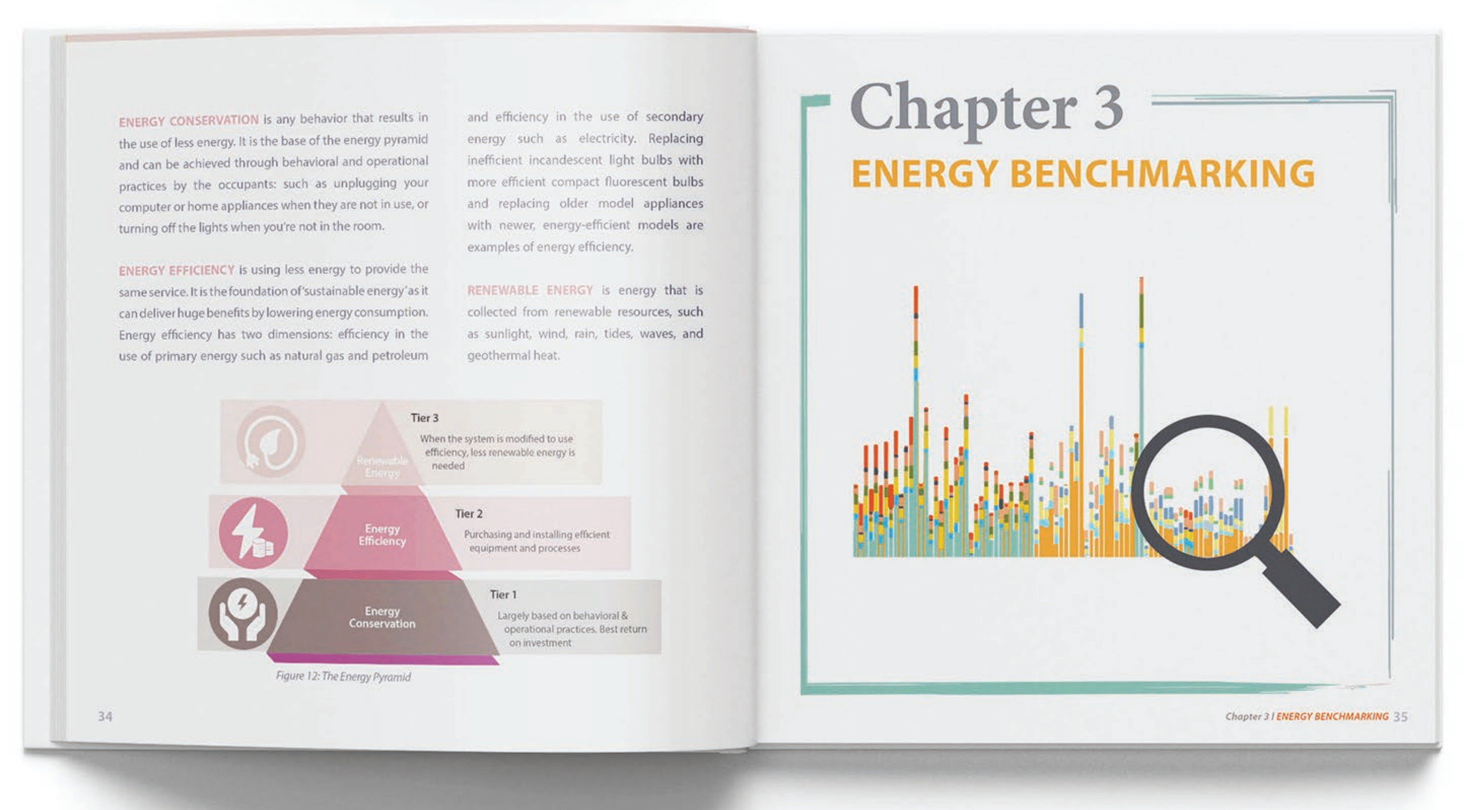

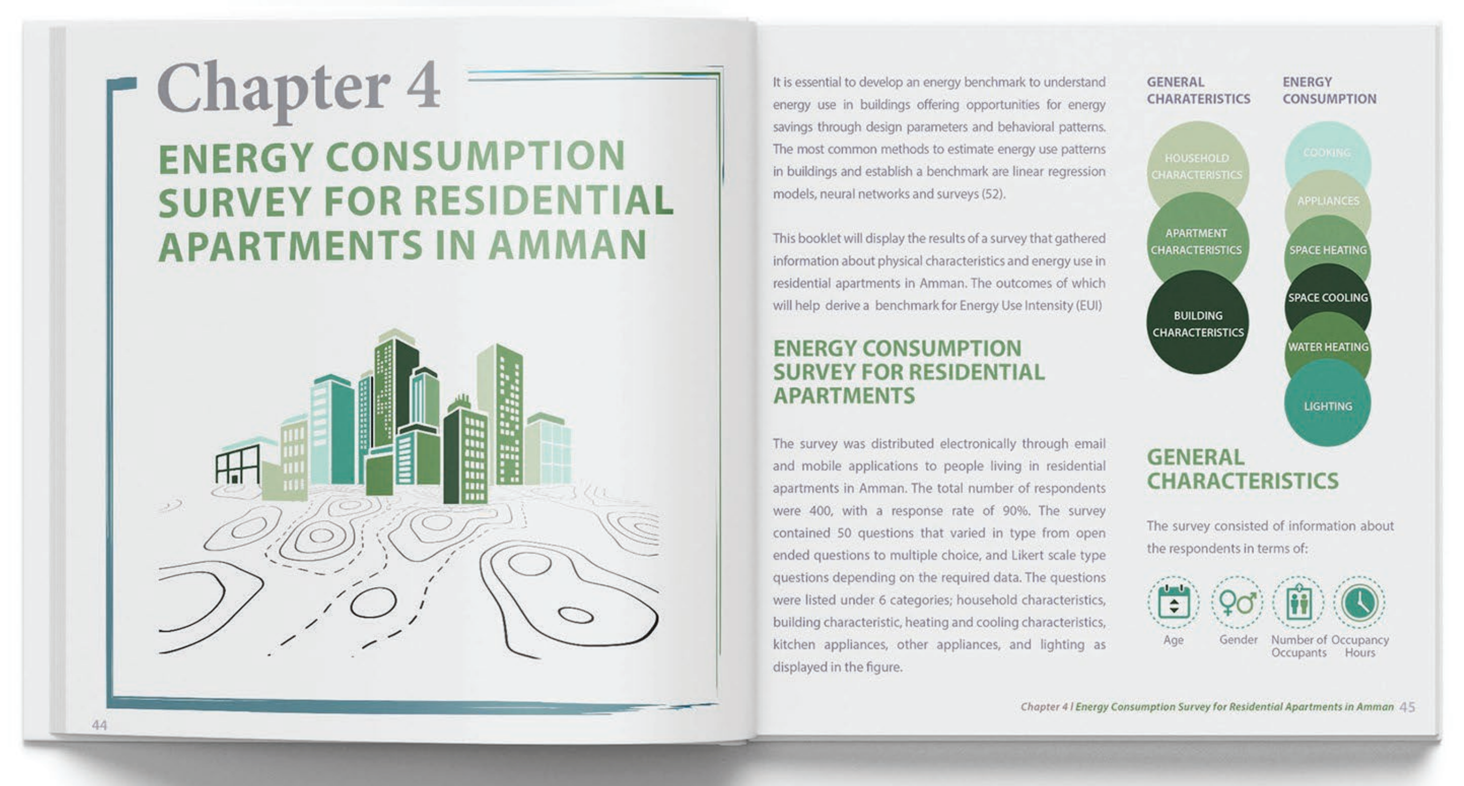

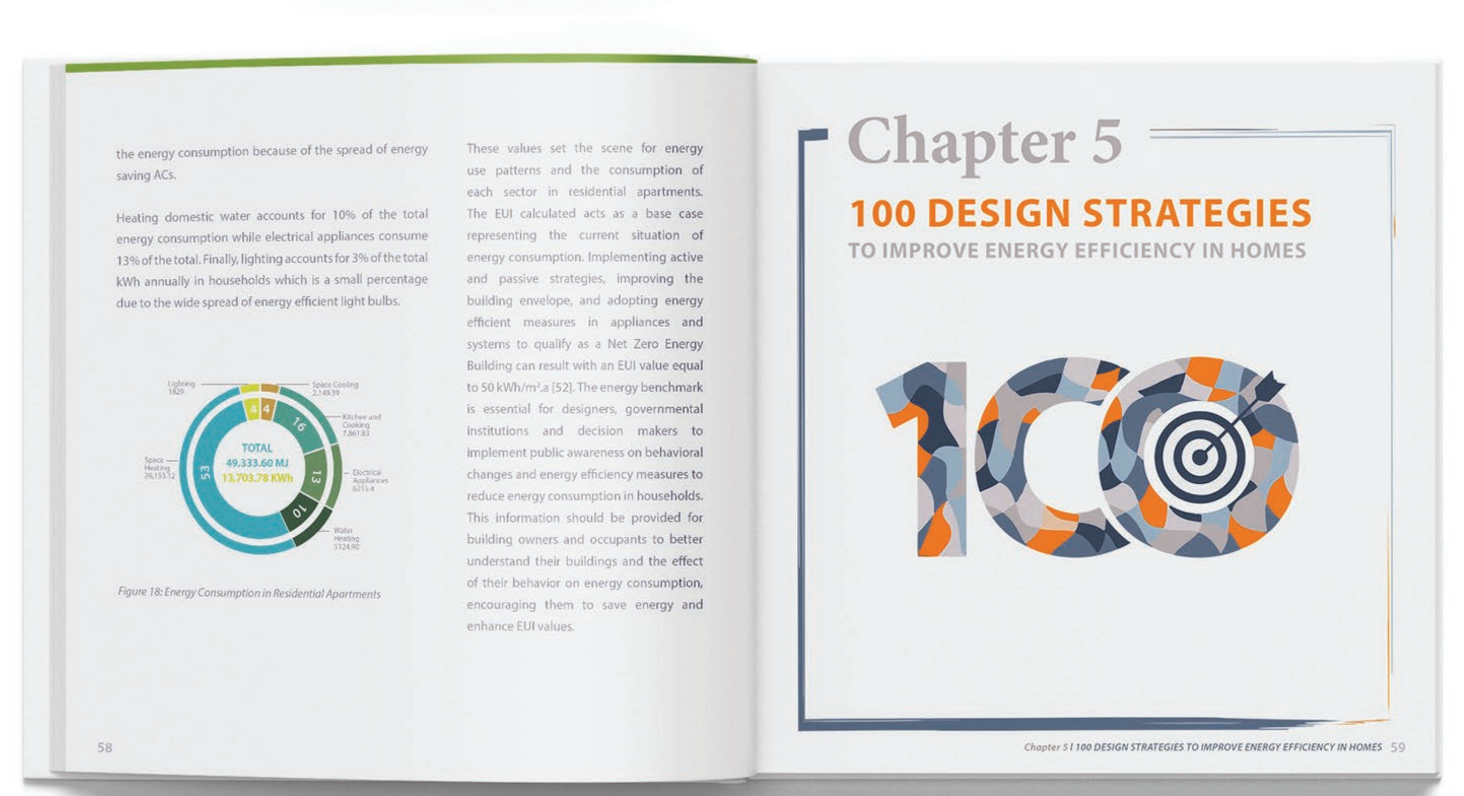

TO VIEW THE FULL BOOKLET

On a 4 continuous years, **Jordan Green Building Council** (GBC) and **Friedrich-Ebert Stiftung** (FES) Launched 4 Booklets, the first of it's kind in the middle east, organised under the patronage of the Ministers of Environment and Energy and Mineral Resources. The guides compiles the best strategies to create a significant step towards a more sustainable built environment by implementing the concept of NetZero Buildings and Green Buildings in the residential sector in Jordan. The challenge was to convert all text and data into attractive visuals that target local practitioners including engineers, contractors, and people working in the governmental and non-governmental organizations, as well as the general public.

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