

Energy Efficiency Impacts on Building Envelope;

Application of Energy Performance Certificates as “A way forward to Accelerate net zero emissions in building and construction sectors”

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PRACTICAL RESEARCH IMPACTS
ON BUILDINGS & URBAN
DEVELOPMENT

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Contents

1. Objectives and Background
2. Applications on NCCS and NDC's
3. Energy Efficiency Impacts on Building Envelope
4. Q&A



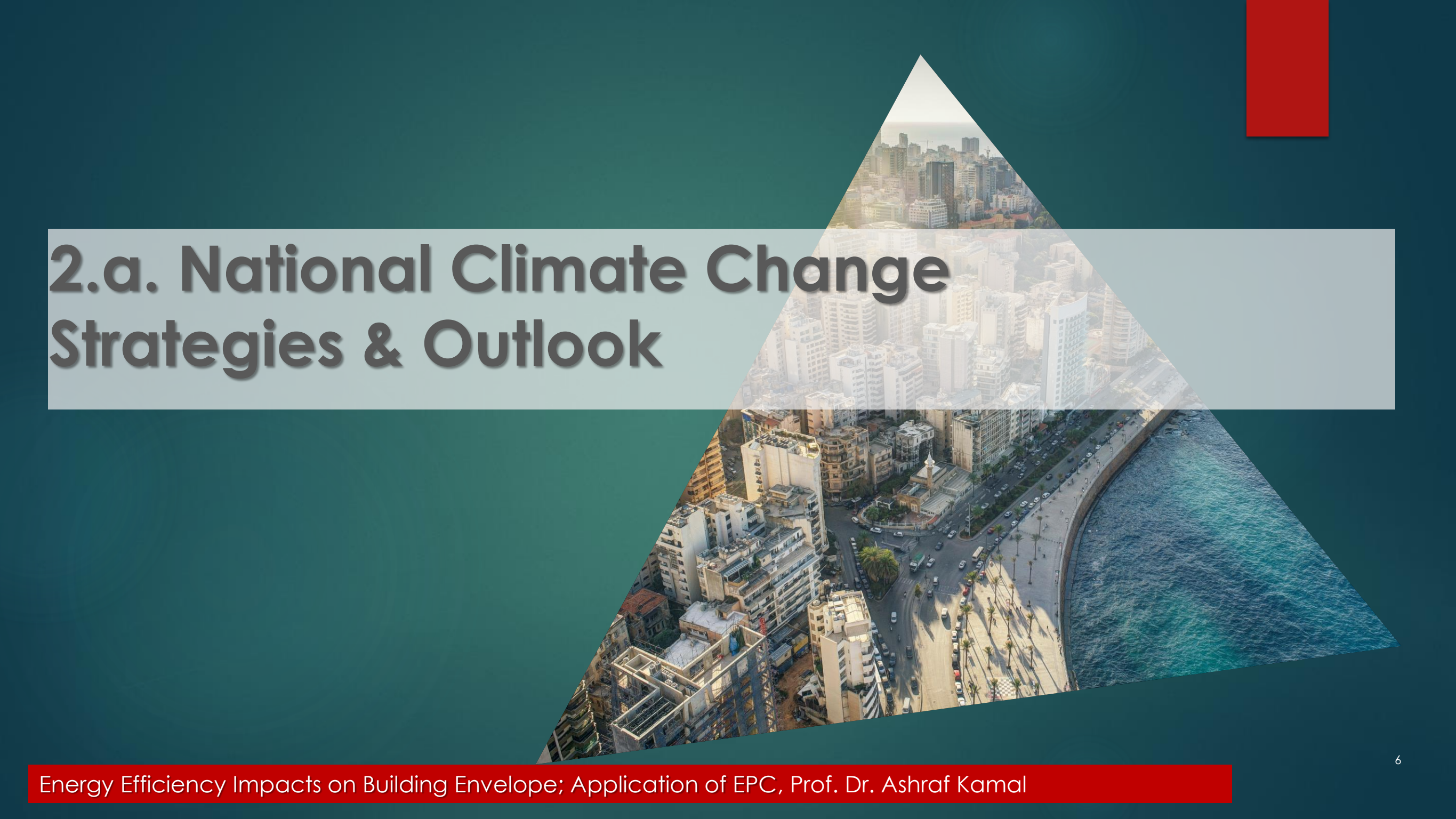
1. Objectives & Background

1. Objectives & Background

- Paris Agreement (2015 @ COP21) highlights **commitment to align financial flows with low-carbon and climate resilient development.**
- Developing a **Regulatory framework** that **defines sustainability**, including Environmental (**E**), Social (**S**) and Governance considerations (**G**).
- Integrating **ESG** criteria into **developments of Real Estate** sector, and to **integrate financial feasibility with sustainability.**
- Importance of interdisciplinary **sustainability training of Urban Development and RE**, with specific highlights on **Climate Change guidelines and anticipated consequences.**



2. Application on NCCCS and NDC's

An aerial photograph of a coastal city, likely Beirut, Lebanon, showing a dense urban area with numerous high-rise buildings and a prominent waterfront promenade. A large, semi-transparent white triangle is superimposed on the image, pointing downwards. The text '2.a. National Climate Change Strategies & Outlook' is centered within this triangle. A solid red vertical bar is located in the top right corner of the slide.

2.a. National Climate Change Strategies & Outlook

Egyptian Perspective

National Climate Change Strategy (NCCS)

- ▶ NCC strategy includes: **adaptation and mitigation** programs in all sectors until 2050.
- ▶ The most important of which are: **Energy, Transportation, Agriculture and Water Resources.**
- ▶ The total cost of **mitigation** programs is estimated at about \$211 billion, while **adaptation** programs will cost \$113 billion.
- ▶ NCCS aims to **aid economic growth** while **reducing emissions** in several sectors, as well as **improving adaptation capabilities** to protect the economy and climate governance.
- ▶ NCCS is also designed to **improve climate finance and infrastructure**, **enhance research in green technology** and **raise awareness** to confront climate change.

The objectives of the National Climate Change Strategy

Five distinctive goals to promote climate change in Egypt



Achieving sustainable economic growth with low emissions through different sectors



Building resilience and ability to adapt with climate change while reducing negative effects of climate change



Improving governance and operation related to climate change



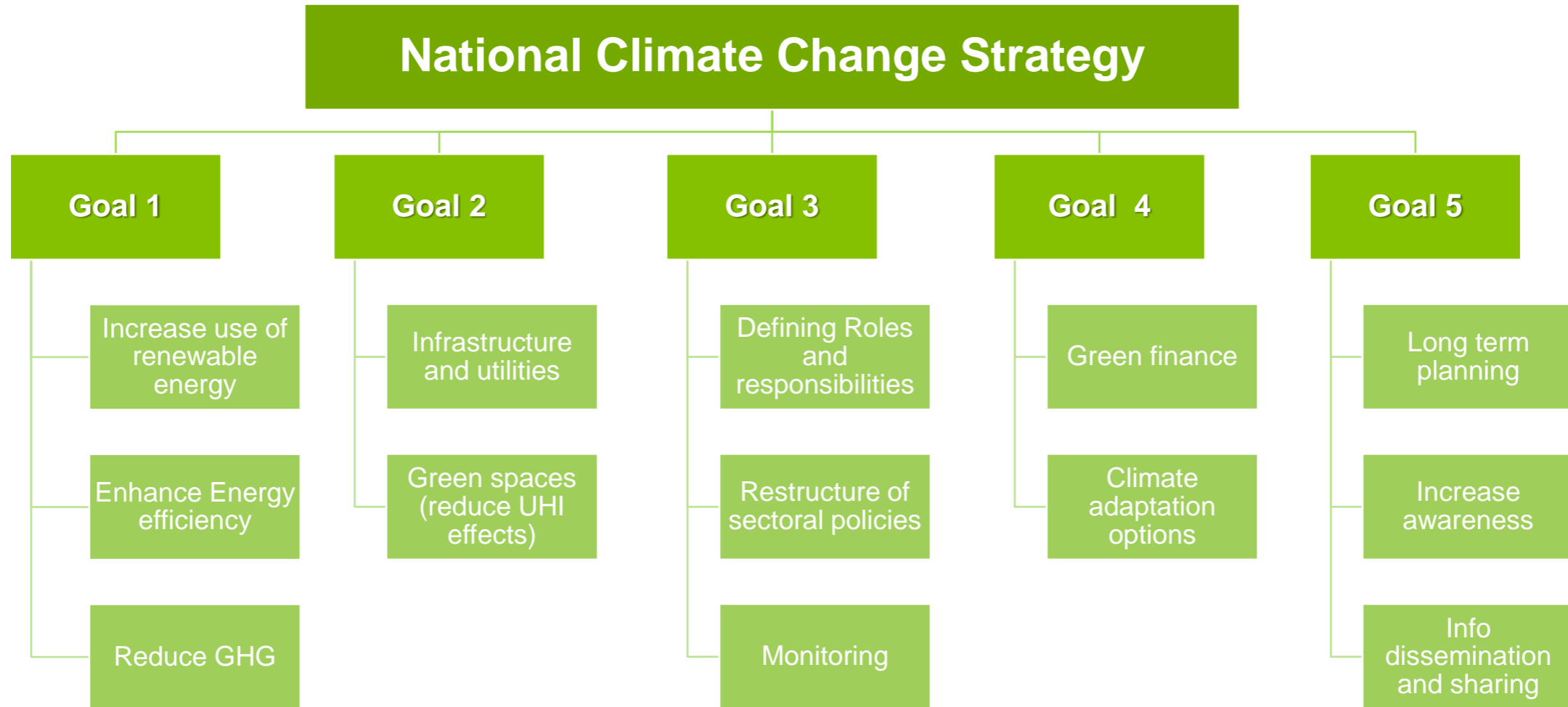
Enhancing infrastructure and finance mechanisms for climate-related activities



Strengthening of scientific research and transfer of technology & knowledge management, as well as raising awareness to reduce impacts of climate change

The building sector captured in the strategy

Exemplary zooming into the National Climate Change Strategy







2.b. NDC's in Egypt

Impacts on Building & Construction sector

NDC's Criteria Overview

PREFACE

EGYPT'S Update on NDC's; (1st issue on June 2017, update on 8th June 2022)

- ▶ was update is aligned with **Egypt's developmental and National Climate Change Policies**,
- ▶ As well as the **Sectoral Strategies**;



Integrated **Sustainable Energy Strategy 2035**

National Energy Efficiency Action Plan **NEEAP II**

National **Water Resources Plan (2017- 2037)**

Integrated **Solid Waste Management Strategy**

Sustainable **Agricultural Development Strategy (SADS 2030)**



Sustainable Development Strategy (SDS)

Egypt's **Vision 2030**

Long Term Low Emission Development Strategy 2050 (**LT-LEDS**)

National **Climate Change Strategy 2050 (NCCS)**

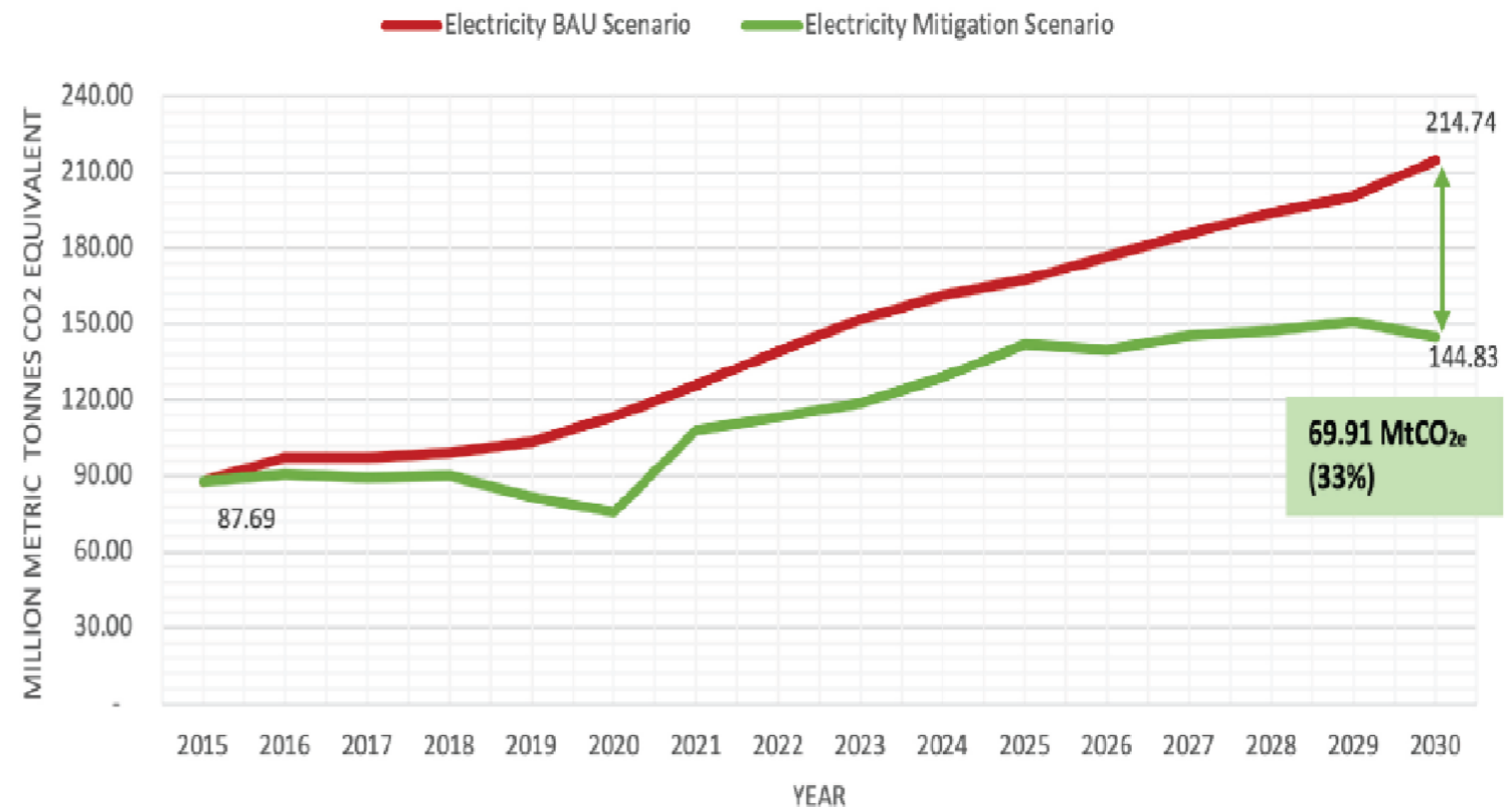
Nat. Strategy for **Disaster Risk Reduction 2030**

Nat. Strategy for **Adaptation to Climate Change**

Quantification of mitigation potential

Pathway to Egypt's 2030 mitigation targets (NDC)

- **GHG reduction % compared to BAU in 2030= 33%**
- **Maximize Energy Production from local resources** and diversify supply, *reduce intensity of energy consumption*, and transition to low carbon pathway in electricity sector, primarily through:
 - Installing additional **Renewable Energy (RE) capacities** to reach RE contribution target of 42%
 - Improve **Energy Efficiency of Electricity Generation** by maintenance, upgrade, and replacement programs for obsolete plants



CHALLENGES

FOR BUILDINGS, RE AND URBAN CITIES

Promote Sustainability in existing & new buildings towards **Adopting Low Carbon Standards**,
Through:

- ▶ Promoting use of **Renewable Energy and Energy Efficiency**
- ▶ Expanding **Energy Efficiency Labels and Specifications**,
- ▶ **Promote Green Buildings** by activating Energy Efficiency Codes for New Buildings,
- ▶ and **adopting** procedures to **renovate** existing buildings to meet energy performance standards,
- ▶ **Increase Green Spaces and Sustainable Parks** (irrigated with treated wastewater)
- ▶ Adopt National Active **Mobility** Strategy to **encourage use of bicycles and walking** in designated paths
- ▶ **Shift gradually to electric vehicles and using clean energy sources**
- ▶ Installing **energy efficient and/or solar-operated street lighting and advertisements**

ANTICIPATED CHALLENGES & MEANS TO IMPLEMENT

- Policy **Mechanisms and Institutional** Arrangements
- International **Agreements**
- **Capacity Building and Technology Transfer**
- **Financial** Support (Estimated conditional cost for Mitigation 196 BUSD + Adaptation 50 BUSD)

However; the Main Challenges for implementation are:

- Finance **availability and mechanisms**
- Setting Policy **Mechanisms and Institutional** requirements
- Handling the **Capacity Building and Technology Transfer** (including scientific research and dissemination of Data and Info)
- **Simplification of Energy Efficiency Codes and Enforcement**



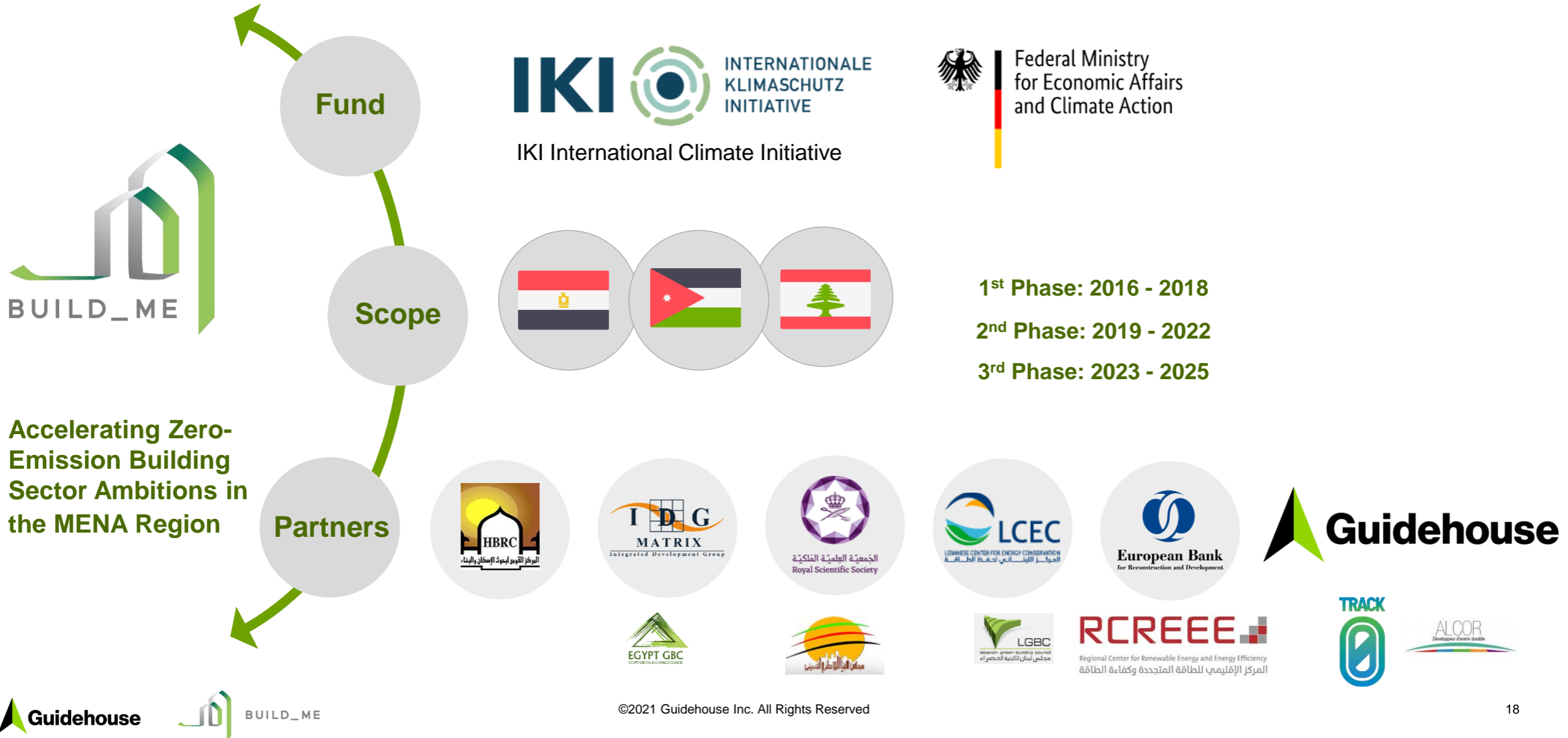
3. Energy Efficiency Impacts on Building Envelope



BUILD_ME

IKI Project: Accelerating 0-emission building sector ambitions in the MENA Region

Overview



Overarching storyline of BUILD_ME phases

Phase 1

2016 - 2018



Analysis & Recommendations

- Analysis of boundary conditions and stakeholder perspectives
- Formulating recommendations for implementation

Phase 2

2019 - 2022



Prepare the Implementation

- Developing tools for implementation
- Connecting with stakeholders to initiate the implementation

Phase 3

2023-2025



Support the Roll-Out

- Piloting the roll-out to reach implementation
- Scaling up activities to enlarge the impact

How to develop a **baseline** to assess **climate friendly buildings**



BUILD_ME 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

Unit	XXX	Baseline	Delta
Space heating	4.51	6.45	-1.94
DHW	5.95	7.02	-1.07
Space cooling	18.98	24.60	-5.62
Lighting	7.95	7.95	0.00
Auxiliary energy	0.42	1.92	-1.50
Total	37.80	47.90	-10.10
Total incl. PV	37.81	47.94	-10.13

	Current	Baseline	Delta
Investment	50 €/m ²	41 €/m ²	9 €/m ²
Replacement	7 €/m ²	7 €/m ²	0 €/m ²
Residual	-9 €/m ²	-7 €/m ²	-1 €/m ²
Energy	31 €/m ²	40 €/m ²	-8 €/m ²
Inspection & Maintenance	1 €/m ²	1 €/m ²	0 €/m ²
Global cost (total)	80 €/m²	81 €/m²	-1 €/m²

Building Typology in Egypt Results



Building type

- Multi-family house
- Single-family house
- Education
- Retail/Trade
- Office
- Mixed-use
- Hospital
- Hotels

1950
-
1980
-
2000

Age group

- New and recent constructions (after 2015)
- Existing building: 1980- 2015
- Existing building: before 1980



Regions

- National
- Cairo
- Alexandria
- Aswan

[Link to the typology on BUILD_ME website](https://www.buildings-mena.com/)

<https://www.buildings-mena.com/>

Typology	Construction period		
	New and recent constructions (after 2015)	Existing building: 1980-2015	Existing building: before 1980
Multi Family House (MFH) - Small (< 1000m ²) - detached			
Single Family House (SFH) - detached			
Retail / Trade			
Office			
Multi Family House / Apartment block - Large (> 1000m ²) - detached			
Single Family House (SFH) - attached (row houses / townhouses)			

Logic of the **BEP** Building Energy Performance tool

Customisable, transparent, adapted to the MENA region



**Performance of
energy efficiency
measures & RE**



**Calculation of
monetary savings**



Free web application



Proven methodology
“Recognized by
international entities”

Online Web App – Results detail

25

1 Quick overview

The main facts.

2 Output selection

4 tabs to select the energy performance indicator.

3 Overview chart

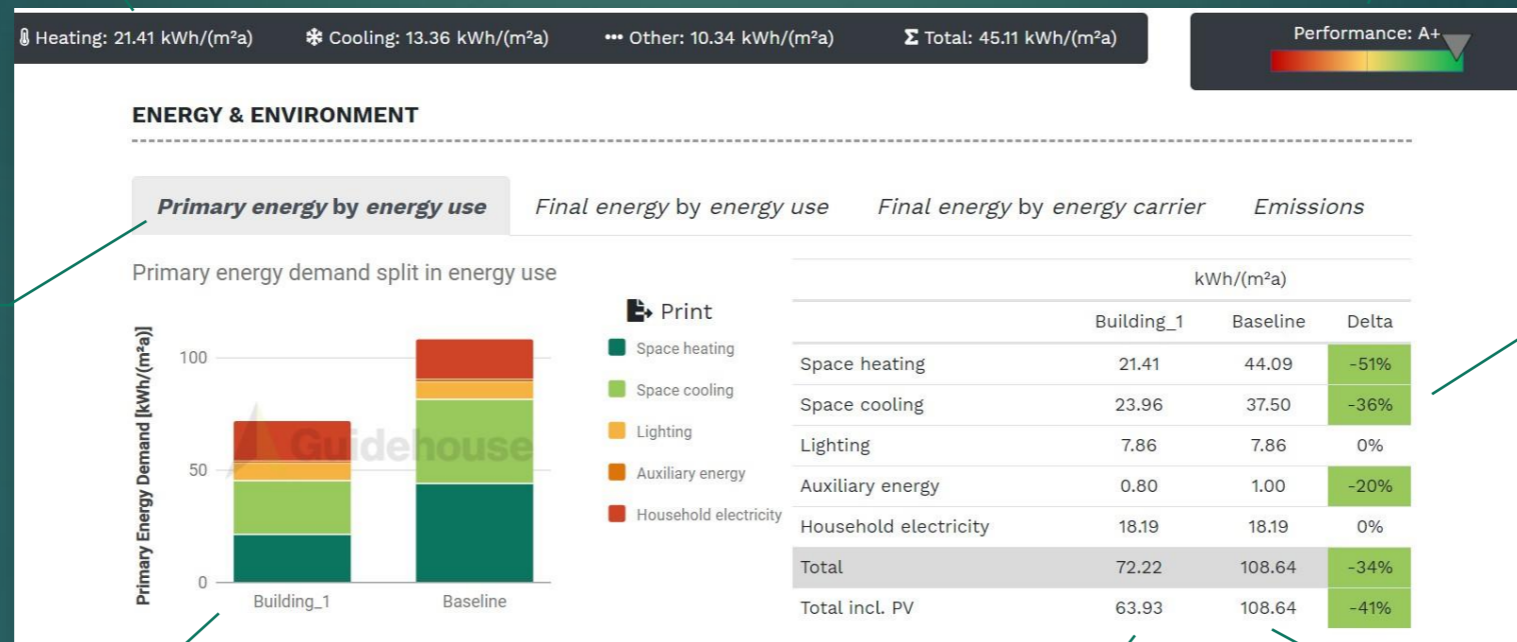
Comparison to the baseline building.

7 Performance rating

C = equal to baseline

6 Comparison

Difference to the baseline buildings.



4 Results table

Detailed results in numbers.

5 Baseline building

Detailed results of the baseline building.

- Adapted (from EU tool) to cope with local and regional conditions

Online Tool – Two new features

Built-in U-Value calculator

User-friendly CAPEX / OPEX overview

3

Get U-Value

1

Select building materials

2

Enter thickness of each material

1,16 W/(m²K)

Calculate U-Value

Lime plaster | 0.7 ✓ ▾ -

0,01 ✓ m

Aearated concrete (light, 600 kg/m³) ✓ ▾ -

0,2 ✓ m

Lime plaster | 0.7 ✓ ▾ -

0,01 ✓ m

FINANCIAL - CAPEX / OPEX - OPERATIONAL

	Current	Baseline	Delta
Heating system	10.761	9.384	-1.377
DHW system	128	128	0
Cooling system	326	326	0
Lighting	2.700	2.700	0
PV system	-	-	-
Ventilation system	-	-	-
Shading system	12.070	12.070	0
Envelope	14.904	20.389	5.485
Energy cost	18.884	16.810	-2.074

Get cost delta of all systems and elements separately

BEP tool and EPC Certification

Purpose of the BEP tool and Certification

Easier access to financing for energy efficient buildings

How to design and finance an energy efficient project?



BEP Tool shows:

- ✓ [25]% energy saving in comparison with **baseline**
- ✓ Financing available at local bank



Intermediating **bank grants credit** based on trusted/reliable classification scheme



Project is realized as energy efficient building

Update cost related inputs

Data from 2020 have been updated in 2023

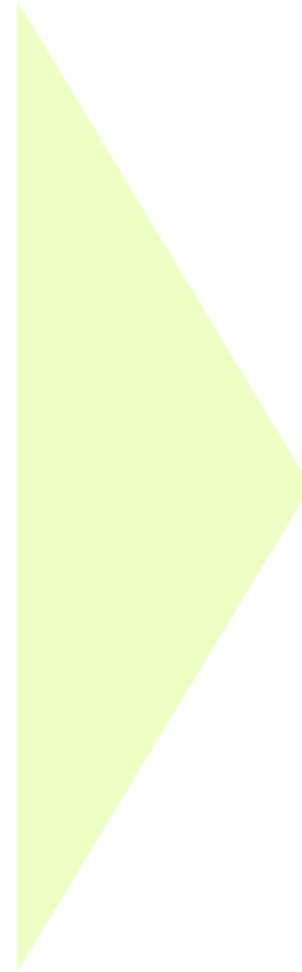
2020 - Input data

Opex

- Energy costs (electricity, gas, diesel, etc.)

Capex

- Building envelope (thermal insulation, windows, shading elements)
- HVAC (heating systems, ventilation, air conditioning, hot water)
- Renewables (Solar, thermal Systems, Photovoltaics)



2023 - Input data

Opex

- Energy costs (electricity, gas, diesel, etc.)

Capex

- Building envelope (thermal insulation, windows, shading elements)
- HVAC (heating systems, ventilation, air conditioning, hot water)
- Renewables (Solar, thermal Systems, Photovoltaics)

Illustration of useful energy demand in results

🔌 Heating: 45.47 kWh/(m²a)

❄️ Cooling: 26.98 kWh/(m²a)

⋮ Other: 36.29 kWh/(m²a)

Σ Total: 108.74 kWh/(m²a)

Performance: C



ENERGY & ENVIRONMENT

Primary energy by energy use

Final energy by energy use

Final energy by energy carrier

Useful specific demand

Emissions

Useful specific demand



	kWh/(m ² *a)		
	test	Own Baseline	Delta
Space heating	41.5	41.5	0%
DHW	7.9	7.9	0%
Space cooling	68.5	68.5	0%
Total	117.9	117.9	0%

- Special request from national stakeholders
- The effect of building shell improvements are more visible
- Differentiate between building shell and HVAC system influences in the efficiency improvement

Define own baseline to calculate existing buildings

1| Baseline selection

User can select from predefined baselines or define own baseline

2| New baseline input tab

Only activated if the user select own baseline in the “Specify baseline” section

The screenshot shows the 'Specify baseline' section of the BUILD_ME web application. The 'Specify baseline' dropdown menu is highlighted in green and contains the option 'Define my own (start with National) on the next tab'. Other fields include 'Project Name' (test), 'Country' (Jordan), and 'Reference city' (Amman).

Section	Field	Value	Status
PROJECT	Project Name	test	✓
	Specify baseline	Define my own (start with National) on the next tab	✓
LOCATION	Country	Jordan	✓
	Reference city (representative climate for the selected climate region)	Amman	✓
	Country	Jordan	✓

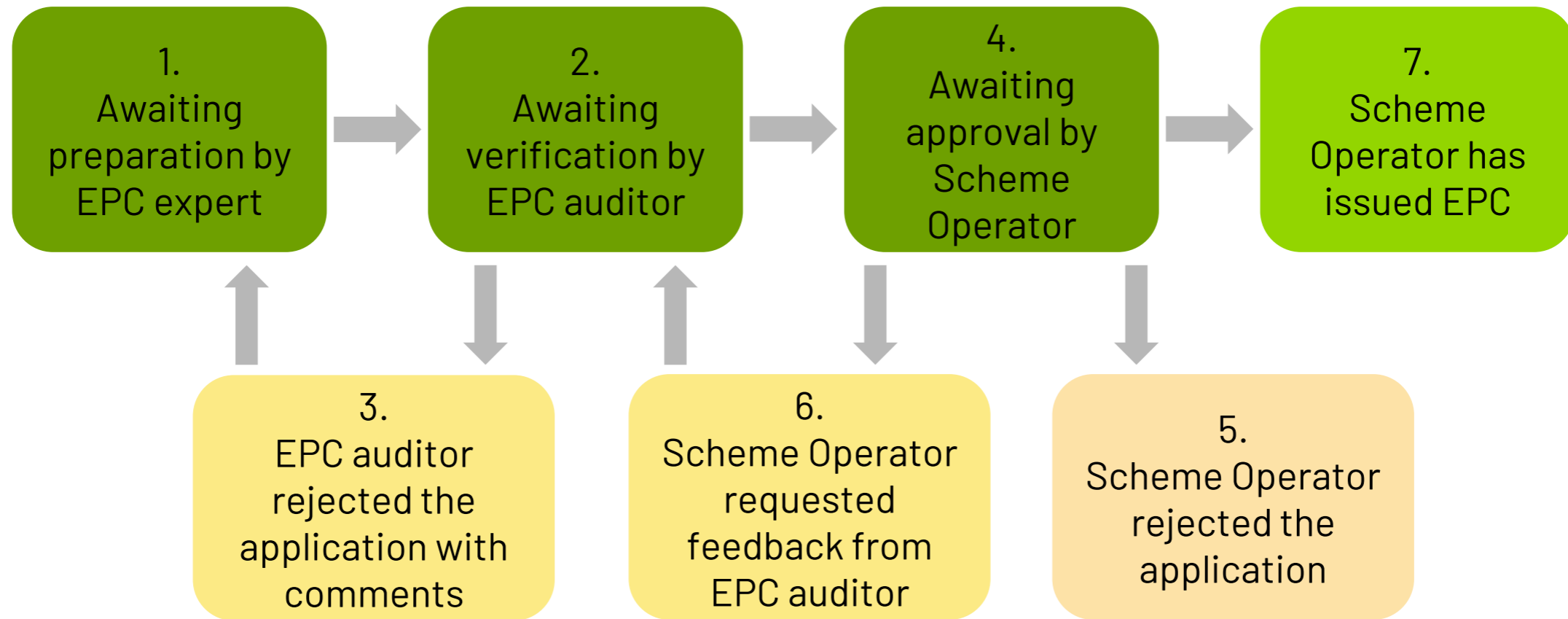
The screenshot shows the 'Geometry-related parameters' section of the BUILD_ME web application. The 'Input' tab is highlighted in green and contains the 'Own baseline' dropdown menu. The 'Retrofit' dropdown menu is also highlighted in green. The 'Geometry-related parameters' section contains a table of input fields for building geometry.

Parameter	Value	Unit	Status
Building levels (floors)	4	-	✓
Number of dwellings	10	-	✓
Net floor height (Floor to ceiling)	3.10	m	✓
Net floor area (i.e. living area)	1,245.60	m ²	✓
Roof area opaque	346.00	m ²	✓
Façade area opaque (excluding windows)	998.88	m ²	✓
Window area (Total = transparent + frame)	229.92	m ²	✓

Easy comparison of renovation projects with existing situation and national baseline (EPC)

Integration of EPC

Workflow on the website



Output of new BEP tool

Energy Performance Certificate (Preliminary)

General building info

PRELIMINARY ENERGY PERFORMANCE CERTIFICATE_for Single Family House

VALID UNTILL 20.03.2029
CERTIFICATION NO. PRE_LEB202400002
CLIMATE ZONE Beirut

_GENERAL BUILDING INFORMATION

BUILDING TYPE: Single Family House

ADDRESS: Musterstraße xx, XXXX Musterstadt, Musterland

PLANNED YEAR OF CONSTRUCTION: 2024

AMOUNT OF APARTMENTS (BY M²): 16

NET FLOOR AREA: 2800 [m²]

SPECIFIC BASELINE (NATION/CITY/TOWN/Village): National

_BUILDING ENVELOPE

WALL: 0,57 [W/m²K]

ROOF: 0,28 [W/m²K]

FLOOR: 1,20 [W/m²K]

WINDOW: 1,20 [W/m²K] / 0,85 [-]

_HVAC SYSTEM

AIR CONDITIONING: Single-split

HEATING: Portable LPG (gas) heater

VENTILATION: Mech. vent. w/o HR

HOT WATER: Portable LPG (gas) heater

_RENEWABLES

PHOTOVOLTAIC: 10 [kWp]

SOLAR THERMAL: 5 [m²]

OTHERS: [-]

_EPC EXPERT

NAME: Muster Name

EPC EXPERT CERTIFICATE NO.: JOR0A00028

DATE: 03.04.2024

_EPC AUDITOR

NAME: Muster Name

EPC AUDITOR CERTIFICATE NO.: JOR0A00028

DATE: 15.04.2024

_CERT. AUTHORITY

NAME: Muster Name

UNIT: Musterabteilung

DATE: 05.04.2024

KPIs

PRELIMINARY ENERGY PERFORMANCE CERTIFICATE_for Single Family House

VALID UNTILL 20.03.2029
CERTIFICATION NO. PRE_LEB202400002
CLIMATE ZONE Beirut

_FINAL ENERGY DEMAND

56,78 [kWh/m²a]
0,48 [-]

_CO₂ EQUIVALENT

18,06 [kgCO₂/m²a]
0,48 [-]

_ENERGY CONSUMERS

Final energy split in energy use

56,78 [kWh/m²a]

Baseline: 120,88 [kWh/m²a]

Space Heating, Ventilation, DHW, Auxiliary energy, Space Cooling

_ECONOMIC INDICATOR

Very economical

Incremental costs 10 [%]

Pay 7 [years]

Global cost savings 82 [%]

Recommendations

PRELIMINARY ENERGY PERFORMANCE CERTIFICATE_for Single Family House

VALID UNTILL 20.03.2029
CERTIFICATION NO. PRE_LEB202400002
CLIMATE ZONE Beirut

_RECOMMENDATIONS TO REACH ZERO ENERGY BUILDING STANDARD [A+]

No.	Category	Measures
1	Building Envelope	Foramti omnimittas mllab inuipar Busam cullabore, tempore oreus utlabo. Ita volorae cum quibus apidipiant pro cum est. Acepelicia verum vellistius denuarium volupta dolore nobit utasimo loresta voluptatim ea solore ea sequa seris doluptatis mo berumet aut mod quae vidella aut eplignit isenit de sed quam nhib, si dolupta velecto magnatint ea enim erum qui sequataquae.
2	HVAC	Ita volorae cum quibus apidipiant pro cum est. Acepelicia verum vellistius denuarium volupta dolore nobit utasimo loresta voluptatim ea solore ea sequa seris doluptatis mo berumet aut mod quae vidella aut eplignit isenit de sed quam nhib, si dolupta velecto magnatint ea enim erum qui sequataquae.
3	Renewables	Equis esequi tur saute comine niderum, com muller aut quibus pos excepematem doluptae nuptas lum quo doluptatiani.
4	Behavior	Hieniant empore erserum eate aliberit pei elur? Ciplatis aut fuga. Peri archiit upata dolorem re molaregudi nonatus doluptit as simpore nienhi temporum fugiat unahendebit velignam nari quam ipsam non none pla vives doloris lunt. Igender litore velenihit occusam, ulparh ellabor epudit doluptat assequi stibus, eleceit nolon moluptatut.

_EXPECTED RESULTS

ENERGY: A+ 25 [kWh/m²a] 0,2

CO₂: A+ 5 [kg/m²a] 0,2

ECONOMY: Very economical PBP 7 [years] Global costs savings 78%

Explanations

PRELIMINARY ENERGY PERFORMANCE CERTIFICATE_for Single Family House

VALID UNTILL 20.03.2029
CERTIFICATION NO. PRE_LEB202400002
CLIMATE ZONE Beirut

_EXPLANATIONS

Reference Page	Topic
1	Building Types: In building types are available in the BEP tool including single-family house (SH), multi-family house (MFL), office, educational building, shops, and hospitals. This section defines the baseline building used to compare the energy performance of the project building.
1	Net Floor Area: Entire conditioned area of the building. For MFL, building area is used, not apartment area.
1	Building Envelope: The calculation of the envelope considers the insulation of the roof, facade and surface, the windows, and the cost to increase the general air-tightness of the building's envelope.
1	HVAC: Heating, Ventilation, and Air Conditioning. Based on air change rate, space heating, hot water generation, space cooling, and mechanical ventilation.
1	Renewables: Capacity of the photovoltaic (PV) system described by the power output of the entire system at standard conditions.
1	EPC expert: A trained EPC expert must prepare all technical and administrative documents for building energy labels on behalf of end-users, using the BEP tool.
1	EPC auditor: A trained EPC auditor must review all technical and administrative documents for building energy labels.
1	EPC certification authority: certifying body approved to issue the EPC.
2	Baseline: The baseline building data was collected in 2010 and reflects real constructions. By default, every project is compared to its according baseline. In the EPC, the baseline building is represented by level C.
2	Final energy: Total energy consumed by end users.
2	CO ₂ : Carbon dioxide equivalent represents the impact of different greenhouse gases (GHG) and their equivalent global warming impact.
2	Energy consumers: Equipment consuming the most energy in the building.
2	Economic indicators: Incremental costs represent the costs in addition to baseline for selected measures. Payback period is the amount of time required for the investment to recover its initial outlay in terms of energy savings. Global cost savings refers to the benefits realized from the energy savings actions.
2	Zero Energy Building Standard (ZEB): A new or renovated net-zero building is highly energy efficient, does not cause any on-site GHG emissions from fossil fuels, and reduces embodied carbon to a significant extent. It uses renewable energy, preferably generated on-site, if technically feasible, and/or off-site to fully cover its remaining, very low energy use.
2	Expected results: Expected energy savings, CO ₂ , and economic indicators calculated from planned energy efficiency measures.

1st Draft of the Certification Energy Performance Certificate

The image displays three stages of an Energy Performance Certificate (EPC) for a building, each with a Guidehouse logo at the top.

Mockup 1: Preliminary Certification - For Building Type

- Header: PRELIMINARY CERTIFICATION - For Building Type
- Metadata: VALID TILL, REGISTRATION NO., CLIMATE ZONE
- Section: **_GENERAL BUILDING INFORMATION**
 - Fields: BUILDING TYPE, ADDRESS, YEAR OF CONSTRUCTION, NUMBER OF APARTMENTS (MFH), NET FLOOR AREA
 - Building Envelope: WALL, ROOF, FLOOR, WINDOW
 - HVAC System: AIR CONDITIONING, HEATING, VENTILATION, HOT WATER
- Section: **_BACKGROUND INFORMATION RELATED TO THE EPC**
- Section: **_EPC EXPERT** (NAME, ADDRESS, DATE, SIGNATURE)
- Section: **_CERTIFICATION AUTHORITY** (NAME, ADDRESS, DATE, SIGNATURE)

Mockup 2: Preliminary Certification - For Building Type

- Header: PRELIMINARY CERTIFICATION - For Building Type
- Metadata: VALID TILL, REGISTRATION NO., CLIMATE ZONE
- Section: **_FINAL ENERGY DEMAND** [kWh/m²a]
 - Score: 0.77 kWh/m²a
 - Energy Rating: C
- Section: **_CO₂ EQUIVALENT** [kg/m²a]
 - Value: 6.90 kg/m²a
- Section: **_EXPLANATIONS** (ENERGY, ENVIRONMENTAL, ECONOMIC)
- Section: **_ECONOMIC INDICATOR** (Good, Average, Bad)
 - Value: RUNNING COSTS SAVINGS

Mockup 3: EPC Certification - For Building Type

- Header: EPC CERTIFICATION - For Building Type
- Metadata: CERTIFICATE NO., VALID TILL, REGISTRATION NO., CLIMATE ZONE
- Section: **_BUILDING INFORMATION**
 - Fields: BUILDING TYPE, ADDRESS, YEAR OF CONSTRUCTION, NUMBER OF APARTMENTS (MFH), NET FLOOR AREA
- Section: **_BUILDING ACHIEVEMENTS**
 - Energy Savings: 99.99 %
 - CO₂ Emissions: 12.34 %
 - Energy Ratings: C
- Section: **_EPC EXPERT** (NAME, ADDRESS, DATE, SIGNATURE)
- Section: **_CERTIFICATION AUTHORITY** (NAME, ADDRESS, DATE, SIGNATURE)

Design Phase

Construction Phase

Impact



**1 Technical
Framework**



**2 Financial
Framework**



**3 Dissemination and
Capacity Building**



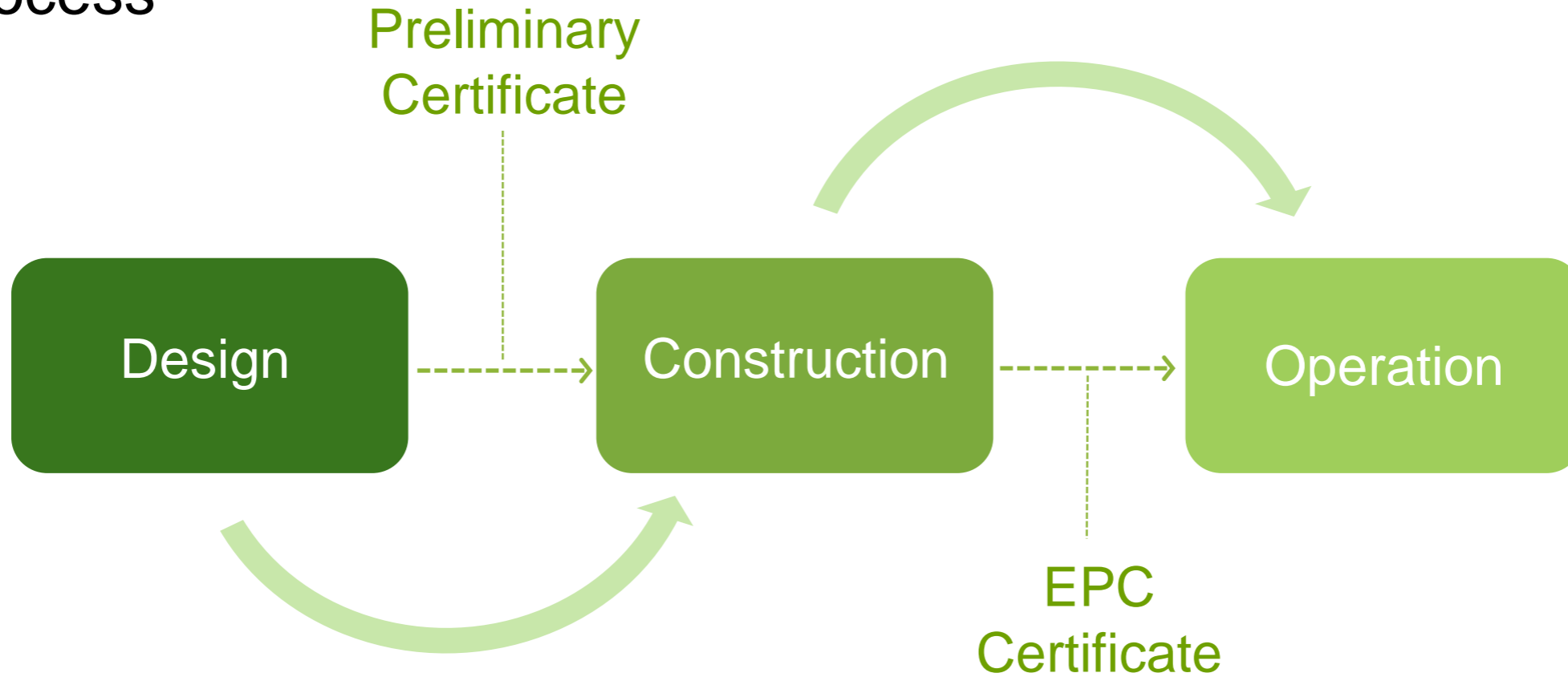
**4 Political and Reg.
Framework**



**Transition towards
zero-emission buildings supported**

Scope

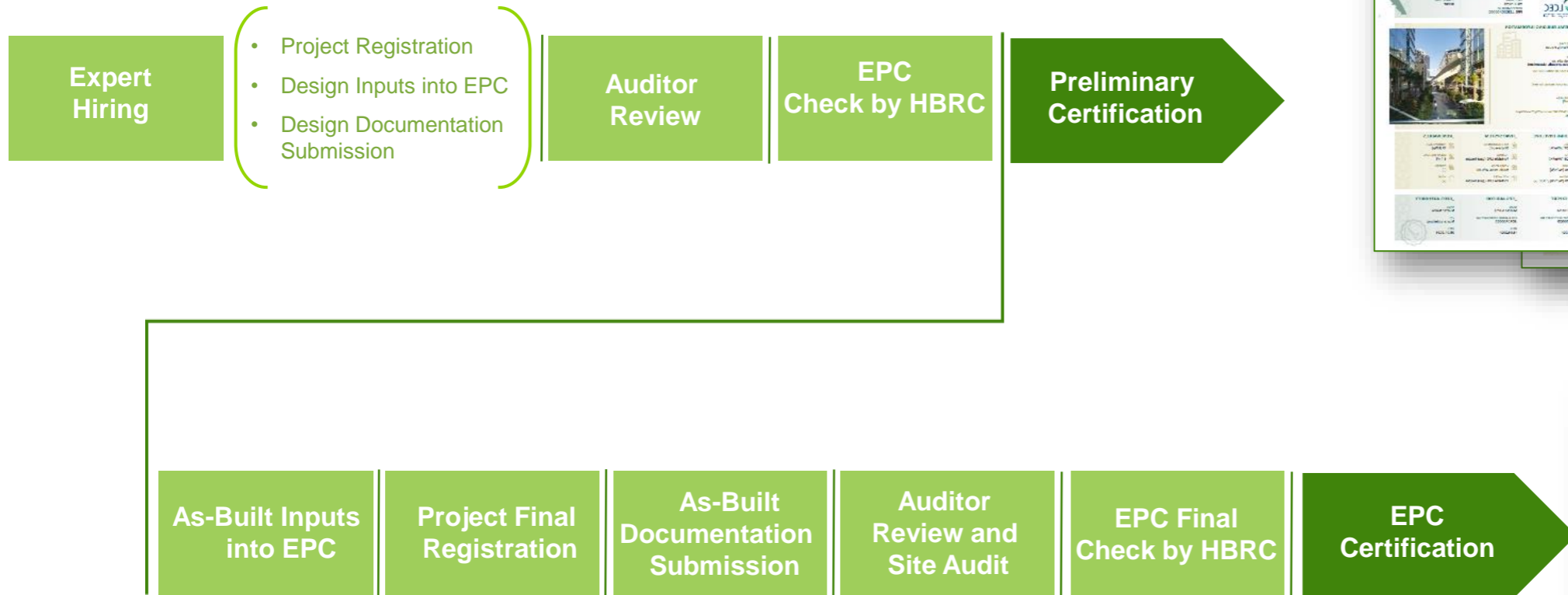
EPC process



Initial **Preliminary Certificate** for design stage and a final **EPC Certificate** after construction stage.

Process in detail

EPC process



Questions



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Thank you