Macroeconomic benefits of building energy efficiency Assessing the co-benefits of EE buildings in Egypt

IKI Project: Accelerating 0-emission building sector ambitions in the MENA region (BUILD_ME)

February 2025

Guidehouse

What if we told you green buildings built till 2030 could save Egypt

more than 18 Billion Euro

in 20 years

* assuming an average lifetime of EE measures 20 years

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- Economic, environmental, and social dimension of co-benefits

Introduction

Why assess the co-benefits of EE buildings?

Why assess the co-benefits of EE buildings?

The objective is to capture the full value of EE buildings

- EE buildings are not only designed to reduce energy, but they also provide healthier, safer, and more productive indoor environments for occupants, reduce pollution, and reduce operating and maintenance costs.
- Communicating the co-benefits is essential in supporting stakeholders to understand the role of EE in achieving ESG objectives in the building sector.
- Assessing and quantifying ensures that the full value of EE in buildings is captured and recognized, facilitating buy-in, informing policy decisions, and providing a more robust business case for EE projects

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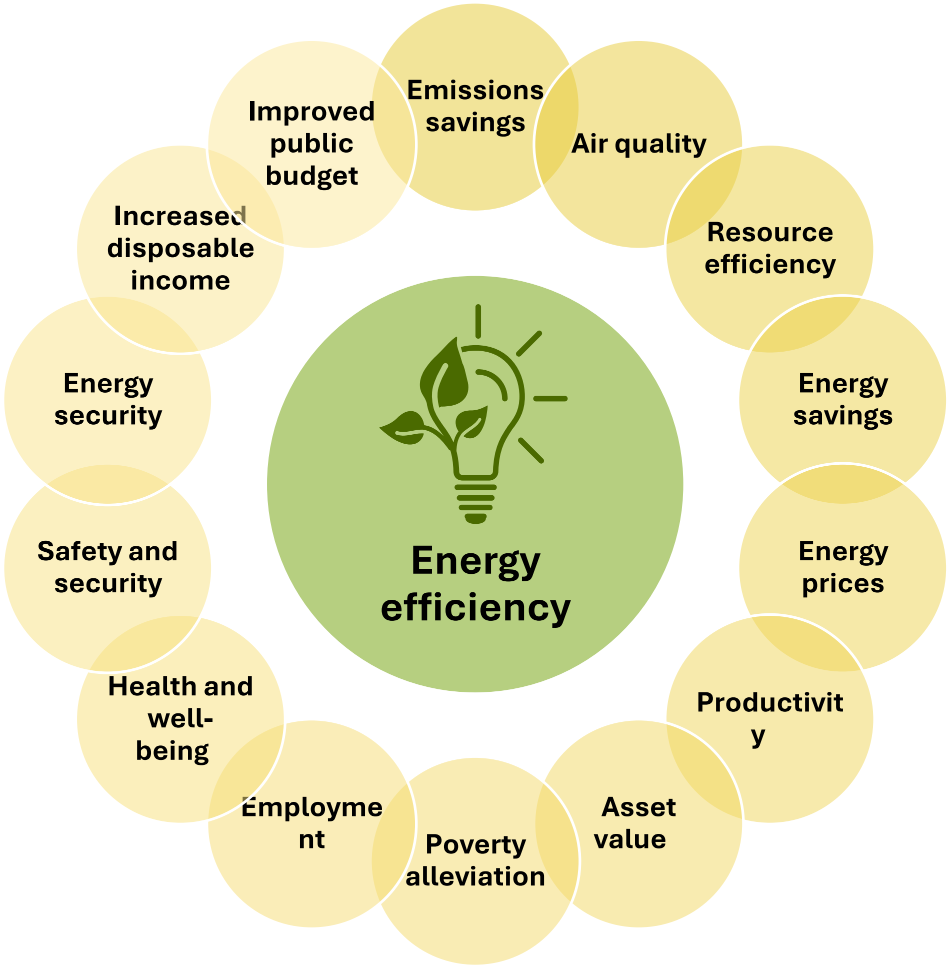
Our scope: Multiple benefits at the macroeconomic level

14 “classical” co-benefits of EE buildings

Beyond primary goal of reducing energy consumption, this study the results can bring positive outcomes such as environmental, social and economic benefits, increasing the value of EE, and the multifaceted impact aligns with several of the UN Sustainable Development Goals (SDGs):

- SDG 1: No poverty
- SDG 3: Good Health and Well-being
- SDG 7: Affordable and Clean Energy
- SDG 8: Decent Work and Economic Growth
- SDG 9: Industry, Innovation, and Infrastructure
- SDG 10: Reduced Inequalities
- SDG 11: Sustainable Cities and Communities
- SDG 12: Responsible Consumption and Production
- SDG 13: Climate Action
- SDG 17: Partnerships for the Goals



Approach to quantifying co-benefits

Our applied **methodology** allows is a based on local contextualization

1 Identifying multiple benefits

Identifying the most relevant multiple benefits (top 5) for MENA with input from local experts from Egypt.

2 Establish reference buildings

Establish reference buildings as a baseline. Carried out within the scope of the BUILD_ME project.

3 Quantify Energy reductions

Quantify expected reductions in energy demand at the building level for new, small and large multi-family residential buildings using the BEP tool 2.0.

4 Calculate the changes

Calculate the changes in co-benefit indicators at the building level.

5 Estimate reductions

Estimate changes from reductions of energy demand at the macro level by upscaling from micro (building) level to macro (country level) for projected number of SMFH and LMFH to be built until 2030 (i.e. compare projected number of buildings built at EPC level C to if x % were built to EPC level A)

- **10% of new buildings up to 2030**
- **30% of new buildings up to 2030**
- **50% of new buildings up to 2030**

6 Quantify The impact

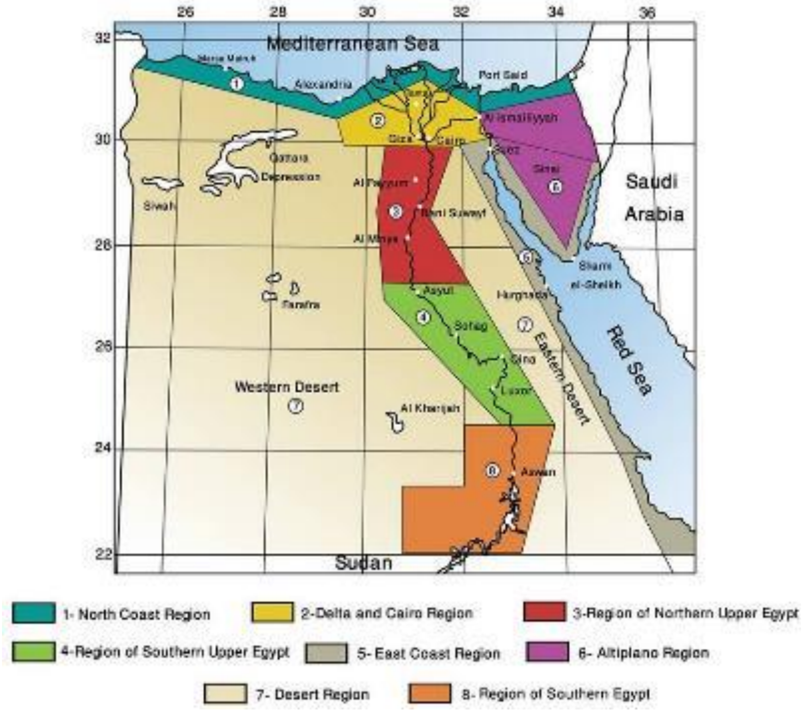
Quantify and, where possible, monetise economic effects.

Boundary conditions

Local conditions in Egypt

Climate zones in Egypt

Instrument	Approximate HDD and CDD Thresholds	Instrument	Approximate HDD and CDD Thresholds
Zone 1: North Coast Region	Σ HDD: 387 Σ CDD: 1,367	**Zone 5: East Coast Region**	Σ HDD: 132 Σ CDD: 2,630
Zone 2: Delta and Cairo Region	Σ HDD: 374 Σ CDD: 1,367	**Zone 6: Altiplano Region**	Σ HDD: 1,612 Σ CDD: 909
Zone 3: Region of Northern Upper Egypt	HDD: 402 Σ CDD: 1,800	**Zone 7: Desert Region**	Σ HDD: 362 Σ CDD: 2,609
Zone 4: Region of Southern Upper Egypt	Σ HDD: 502 Σ CDD: 2,172	**Zone 8: Region of Southern Egypt**	Σ HDD: 169 Σ CDD: 2,172



Source: https://www.researchgate.net/publication/264419622_An_Analysis_of_Thermal_Comfort_and_Energy_Consumption_within_Public_Primary_Schools_in_Egypt#pf3

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Assumptions: CO_2 price

- Challenge: No CO_2 price has been set in representative country of the MENA region.
- EU ETS value in 2025 for 1tonne CO_2 = 55€
- A **very conservative** number of 1€ / tonne CO_2 is used to monetise this co-benefit.

Assumptions: Employment

- 1 million of € investment in green buildings equals 15 full time employees
- Average wage for green jobs in Egypt is assumed at 3,000 € annually.
- A conservative number of 10% tax is assumed to be collected by government.

Assumptions: Health & Air quality

- Health data is not easily accessed in the Egyptian context
- According to Greenpeace, Egypt has the highest estimated number of premature deaths from fossil fuel air pollution, (about 0.33 premature deaths per 1,000 people) with air pollution costing the country approximately 6.9 billion USD per year.
- While sources of air pollution can vary from transport and manufacturing to energy production, emissions in the housing sector account for about 22 % of total emissions, of which 85% of floor space is in multifamily home.
- It is assumed that “air pollution costs” consist predominantly of healthcare costs (e.g. treatment expenses for respiratory and cardiovascular diseases caused by air pollution, hospital admissions and emergency room visits due to pollution-related health issues, and costs of medication and long-term care for chronic conditions exacerbated by poor air quality), productivity costs from illness, absenteeism and premature death, and to a lesser extent property maintenance and damage, environmental damage, and public health programmes.

Analysis

1. Assessment of multiple benefits
2. Establish reference buildings
3. Quantify expected reductions

1. Assessment of multiple benefits considered for Egypt

Identifying the most relevant multiple benefits (top five in green rows)

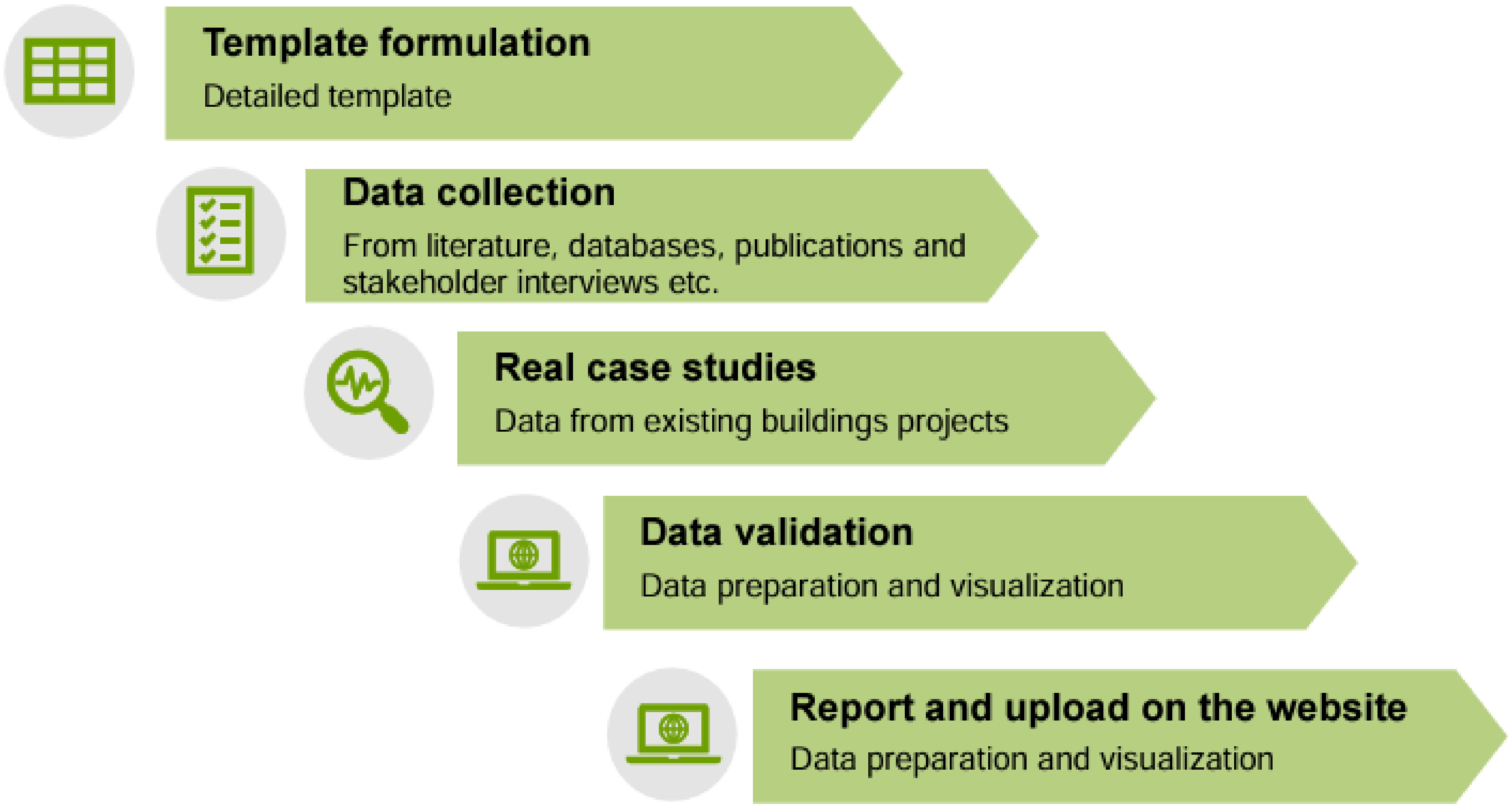
No	Co-benefit	Calculation methodology	Data availability	Country relevance	Relevance for public sector	Relevance for private sector	Relevance for building stock
1	**Emissions savings**	+++	++	++	++	-	+++
2	Air quality	--	-	++	++	++	++
3	Resource efficiency	--	-	++	++	+	+
4	**Energy savings**	+++	+++	+++	+++	++	++
5	**Energy cost savings**	+++	+++	+++	+++	+++	++
6	Productivity	-	-	++	+	+	++
7	Asset value	++	++	++	-	+	+
8	Poverty alleviation / affordable housing	+	-	++	++	-	++
9	**Employment**	+++	++	++	+	++	++
10	**Health**	--	++	++	+	+	++
11	Safety and security	---	---	---	---	---	---
12	Energy security / peak loads	++	+++	+++	++	++	+
13	Increased disposable income	+++	+++	+++	+++	+++	++
14	Improved public budget impacts	+++	---	+++	+++	++	+

Scale: --- (difficult to calculate/obtain/low relevance) to +++ (easy to calculate/obtain/high relevance)

2. Establish reference buildings as a baseline

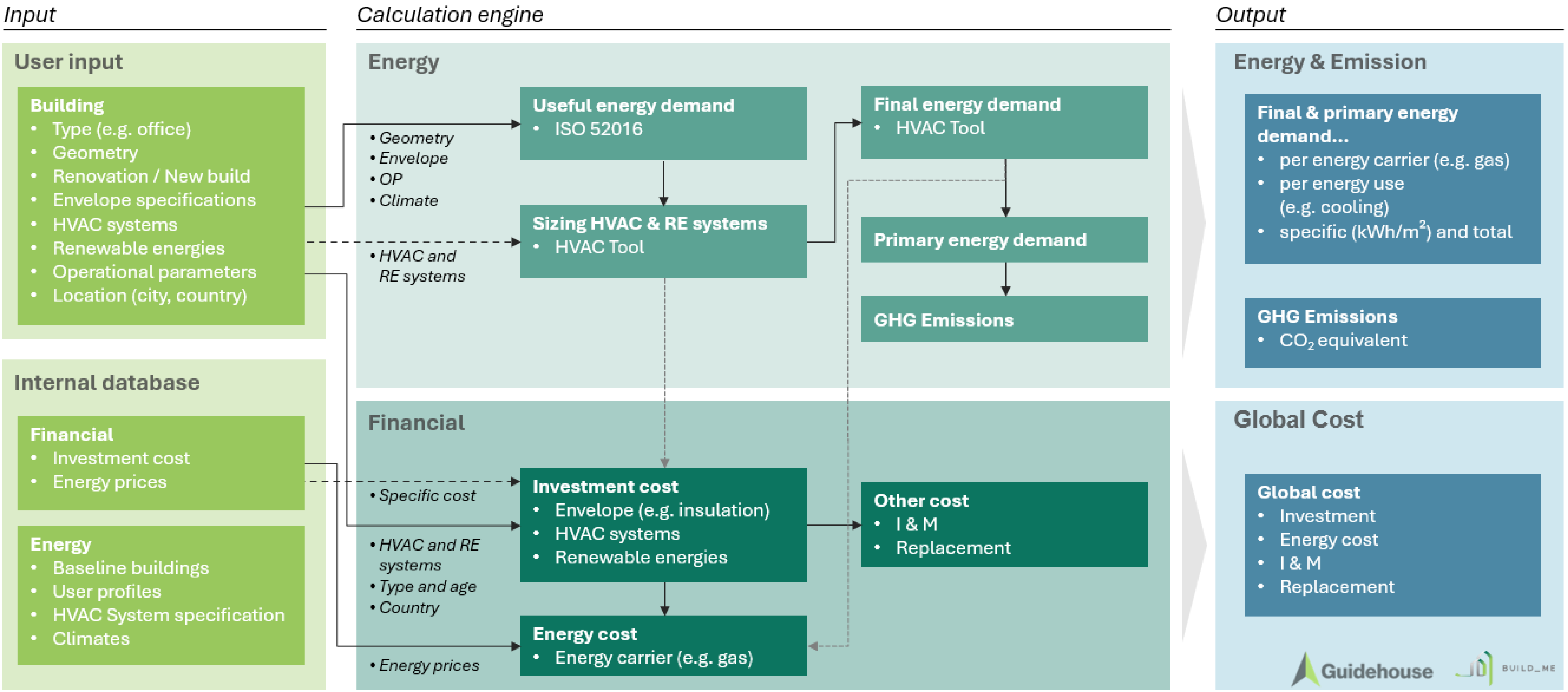
Carried out within the scope of the BUILD_ME project

BUILD_ME developed the typology database which depicts representative reference buildings in Egypt. These are buildings in the building stock (new and existing buildings) that represent a specific building type (e.g., free-standing single-family house) and reflect the region's typical architecture and technical building systems.



3. Quantify expected reductions in energy demand

NEW Multi-family buildings using the BEP Tool 2.0



4. Co-benefit indicators quantified and monetised at building level

Besides the energy cost saving the following co-benefits have been quantified

CO_2 savings

Job creation

Health

5. Values are scaled to the macroeconomic level

from individual buildings to the regional level and then to the national level

Buildings stock												
Particulars	**Unit**	**Alexandria**	**Aswan**	**Asyut**	**Cairo**	**Dakhla**	**Hurghada**	**Port Said**	**Qalyubia**	**St Catherine**	**Tanta**	**Egypt**
Total expected number of new MFH buildings until 2030		31021	3700	65458	24191	285	2846	2561	2988	9392	14941	157383
Share of new SMFH buildings until 2030	%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%
Share of new LMFH buildings until 2030	%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%	29%
Net floor area per SMFH	m^2	984	984	984	984	984	984	984	984	984	984	984
Net floor area per LMFH	m^2	2604	2604	2604	2604	2604	2604	2604	2604	2604	2604	2604
Total floor area of MFH in the buildings stock	m^2											2.9 million

Building stock data

The two representative buildings

Six-story multi-family house with one attached wall as often constructed in the urban centres of the MENA region.

15-story multi-family home, as is typical of new constructions for larger developments.

6. Scenarios are applied for different adoption rates

10%

Scenario 1

10% scenario: Compare the projected energy demand and co-benefits if 10% of the new buildings up to 2030 are built to EPC Level A standards instead of EPC Level C (baseline).

30%

Scenario 2

30% scenario: Compare the projected energy demand and co-benefits if 30% of the new buildings up to 2030 are built to EPC Level A standards instead of EPC Level C (baseline).

50%

Scenario 3

50% scenario: Compare the projected energy demand and co-benefits if 50% of the new buildings up to 2030 are built to EPC Level A standards instead of EPC Level C (baseline).

Results

Summary of estimated costs and savings

What if we told you green buildings built till 2030 could save Egypt **more than 18 Billion Euro** in 20 years

* assuming an average lifetime of EE measures 20 years

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Additional costs required to green the buildings to Level A of efficiency of the BUILD_ME Energy Performance Certificates EPC

14.2%

Additional CapEx for SMFH

Additional investment (Capital Expenditure CapEx) per building for Small multi-family house SMFH

12.3%

Additional CapEx for LMFH

Additional investment (Capital Expenditure CapEx) per building for Large multi-family house LMFH

Additional costs required to green the buildings to Level A of efficiency of the BUILD_ME Energy Performance Certificates EPC

57 €/m²

SMFH

Additional investment per building for Small multi-family house SMFH, per square meter.

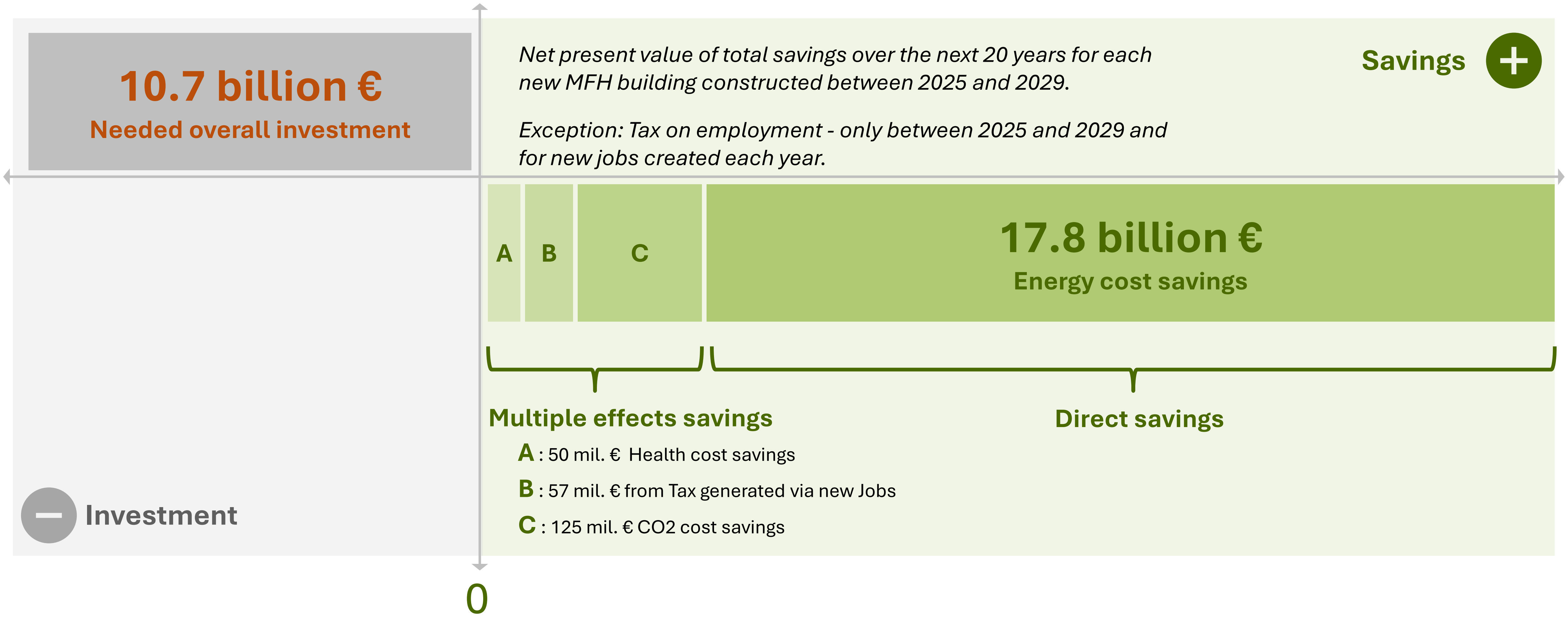
47 €/m²

LMFH

Additional investment per building for Large multi-family house LMFH, per square meters.

Generated savings vs needed investments

EE measures are one of the most cost-efficient mitigation measures

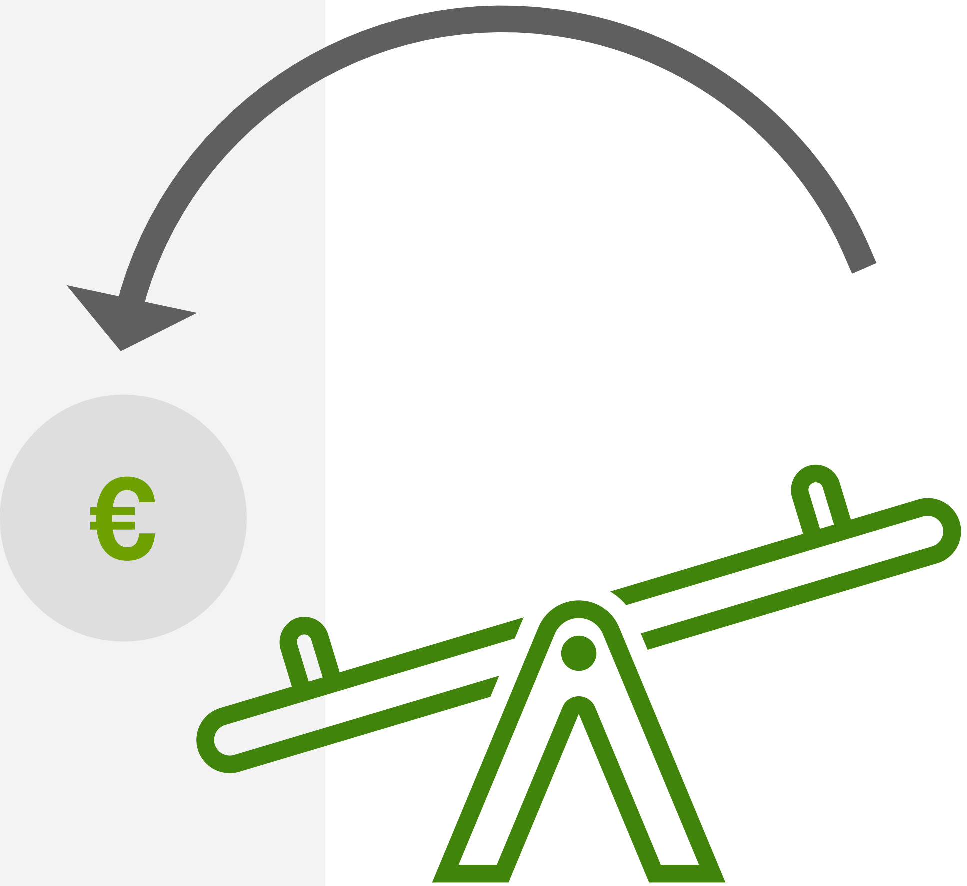


Generated savings vs needed investments

10.7 billion

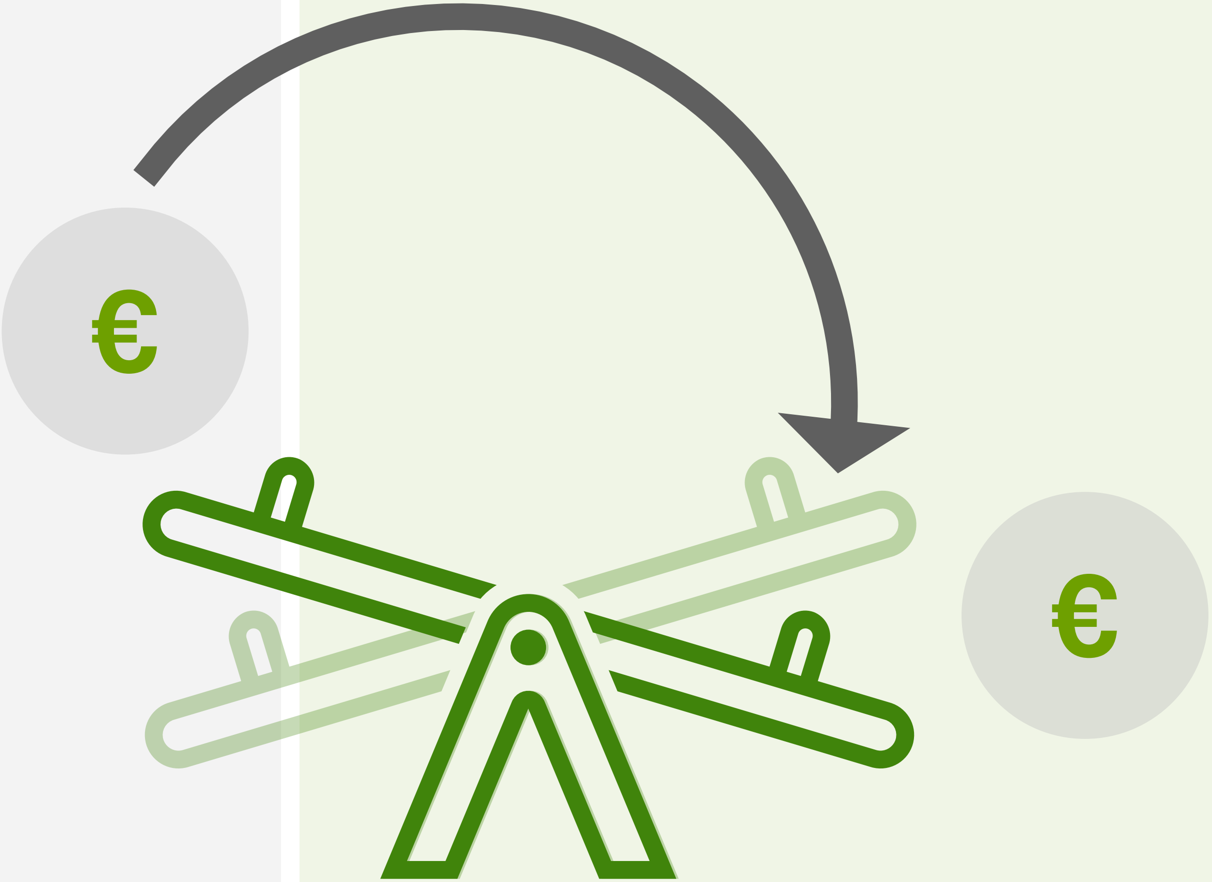
3.5 billion €

Investment



Generated savings vs needed investments

10.7 billion
Investment



Every 1€ invested potentially saves 1.7 € in the future

18 billion
Savings

1.7 Leverage factor

Detailed results per benefit

1. Emissions reductions
2. Energy savings and energy cost savings
3. Employment
4. Health and Air quality

1. Emissions savings

Definition and results

Energy efficiency measures reduce direct energy and electricity consumption, leading to decreased fuel combustion and **lower GHG emissions** (CO2).

Emissions savings play a role in **climate change mitigation**, as well as **improving air quality and public health** (although these benefits are rather prevalent on an international scale).

Very conservative assumption utilised to monetize the CO2 emissions = 1 €/tonnes CO2.

12.5 million € **18 473 ktCO2**

S1 (10% of new MFH buildings)

37.4 million € **55 418 ktCO2**

S2 (30% of new MFH buildings)

62.3 million € **92 363 ktCO2**

S3 (50% of new MFH buildings)

2 + 3. Energy savings and energy cost savings

Energy efficiency measures lead to reduced energy consumption and the associated costs.

They can significantly lower operating costs and decrease impacts of energy use on the environment. Increased spending power from energy cost savings allows individuals to pay bills and other necessities, leading to higher economic activity and GDP, reduced energy poverty, and improved mental well-being.

Conservative energy saving assumptions for relevant efficiency measures have been utilized to calculate energy savings, and conservative price assumptions for relevant energy sources were utilized to calculate the emission cost savings.

1.8 Billion € **44 579 GWh**

S1 (10% of new MFH buildings)

5.3 Billion € **133 738 GWh**

S2 (30% of new MFH buildings)

8.9 Billion € **222 897 GWh**

S3 (50% of new MFH buildings)

4. Employment

Definition and results

Energy efficiency measures imply multiple economic and social benefits including job creation and increased economic activity.

The state benefits from job creation and increased economic activity in form of more employment and more income through increased tax payments. For the calculation of employment benefits it was assumed a ratio of 15 new jobs per 1 Mio € invested and a conservative per capita tax payment of 10%.

5.7 million € **19 Tsd Jobs**

S1 (10% of new MFH buildings)

17.0 million € **57 Tsd Jobs**

S2 (30% of new MFH buildings)

28.3 million € **94 Tsd Jobs**

S3 (50% of new MFH buildings)

5. Health and Air quality

Health and air quality costs consist predominantly of healthcare costs (e.g. treatment expenses for respiratory and cardiovascular diseases caused by air pollution, etc.), productivity costs from illness and premature death, and to a lesser extent property maintenance and damage, environmental damage, and public health programmes.

Through health and air quality improvement, energy efficiency measures thus support increased life expectancy, less healthcare needs, increased productivity, among others. To monetarize health and air quality benefits the assumption of 99% air pollution reduction through 50% efficiency increases (EPC class C to A)

5.0 million € **18 473 ktCO2**

S1 (10% of new MFH buildings)

15.1 million € **55 418 ktCO2**

S2 (30% of new MFH buildings)

25.2 million € **92 363 ktCO2**

S3 (50% of new MFH buildings)

Detailed results

	Emissions savings	Energy savings	Energy cost savings	Employment	Health & Air quality
S1: 10% of new MFH buildings) built to CostOpt EPC level A	12.5 Million EUR	44 579 GWh	1.8 Billion EUR	5.7 Million EUR	5.0 Million EUR
S2: 30% of new MFH buildings) built to CostOpt EPC level A	37.4 Million EUR	133 738 GWh	5.3 Billion EUR	17.0 Million EUR	15.1 Million EUR
S3: 50% of new MFH buildings) built to CostOpt EPC level A	62.3 Million EUR	222 897 GWh	8.9 Billion EUR	28.3 Million EUR	25.2 Million EUR

Conclusions

Benefits for Egypt

Conclusions

The multiple benefit approach analysis shows that increasing Energy Efficiency EE in the building sector can certainly brings several additional returns at the national level.

Reducing energy consumption, lower energy costs for families and businesses, decreased relying on fossil fuels, improving energy security, and improving health and air qualities are among the key multiple benefits that EE can progress.

This approach shows off the clear necessity to include energy efficiency measures in national strategies and plans.

1€ spent 1.7 € saved

High leverage factor of almost **2** folds of returns

Considering **just** 5 of 14 potential co-benefits

Emissions savings

Energy savings

Energy cost savings

Employment

Health & Air quality

More than 18 Billion € of savings can be achieved

Conclusions

sustainable indicators

Economic benefits

Billions of euro can be saved annually in Egypt

- Significantly reduced energy costs can free up public and private funds have high potential to stimulate Egypt's national economy and reduce energy poverty
- Several new employment opportunities and a more resilient labor market
- Increase in property values
- Stable and secure energy supply
- Reduced vulnerability to energy price fluctuations and supply disruptions

Environmental benefits

Reduction in Carbon emissions

- Substantial reductions in GHG emissions and other pollutants
- Reduced impact on natural environment
- Development of sustainable cities and communities
- Long-term environmental sustainability
- Improvement in air quality

Social benefits

Improved health and profit for low-income families.

- Enhancing public health and overall quality of life
- Increased productivity and improved academic performance, reduced absenteeism.
- Affordable energy for low-income households
- Community resilience is enhanced
- Significant saving in public health expenditures

Contact

Dr. Ashraf Kamal

ashraf.kamal@hbrc.edu.eg

Rana Mohamed

rana.mohamed@idg.com.eg

Jessica Weir

jweir@guidehouse.com

Jince John

jjohn@guidehouse.com

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Annex

Methodological conclusions

- Robust methodology for 4 co-benefit calculations
- Challenges due to low data availability & reliance on previous reports
- Challenges were particularly present for health-related benefits
- Very high energy cost savings due to the high energy prices for oil and electricity
- Methodology can be easily adapted to other countries
- A compelling case is made for widespread adoption of EE buildings considering their multiple benefits
- Leverage effect of factor: 7

CostOpt Building Level A

Egypt - SMFH

General information		Baseline Buildings – New Construction (after 2015)										CostOpt Input Parameters – New Construction (after 2015)									
Building type I	-	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH
Reference city	-	Alexandria	Aswan	Asyut	Cairo	Dakhla	Hurghada	Port Said	Qalyubia	St Catherine	Tanta	Alexandria	Aswan	Asyut	Cairo	Dakhla	Hurghada	Port Said	Qalyubia	St Catherine	Tanta
Wall																					
U-value (wall)	W/(m²K)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Roof																					
U-value (roof)	W/(m²K)	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Slab (ground plate)																					
U-value (slab)	W/(m²K)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Window																					
Window type	-	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air
G-value	-	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
U-value (window)	W/(m²K)	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Space heating																					
Space heating system	-	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC
Efficiency class HS	-	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT
Energy carrier	-	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity
Space cooling system	-																				
Space cooling system	-	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split
Efficiency class AC system	-	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best
Photovoltaics	-																				
Capacity	kWp	0	0	0	0	0	0	0	0	0	0	57	57	57	57	57	57	57	57	57	57
Total module area	m²	0	0	0	0	0	0	0	0	0	0	285	285	285	285	285	285	285	285	285	285

CostOpt Building Level A

Egypt - LMFH

General information		Baseline Buildings – New Construction (after 2015)										CostOpt Input Parameters – New Construction (after 2015)									
Building type I	-	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH
Reference city	-	Alexandria	Aswan	Asyut	Cairo	Dakhla	Hurghada	Port Said	Qalyubia	St Catherine	Tanta	Alexandria	Aswan	Asyut	Cairo	Dakhla	Hurghada	Port Said	Qalyubia	St Catherine	Tanta
Wall																					
U-value (wall)	W/(m²K)	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Roof																					
U-value (roof)	W/(m²K)	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Slab (ground plate)																					
U-value (slab)	W/(m²K)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Window																					
Window type	-	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air	Double glass - solar - lowE - air
G-value	-	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
U-value (window)	W/(m²K)	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Space heating																					
Space heating system	-	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC
Efficiency class primary heating system	-	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT
Energy carrier	-	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity
Space cooling system	-																				
Space cooling system	-	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split	Single-Split
Efficiency class primary AC system	-	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best
Photovoltaics	-																				
Capacity	kWp	0	0	0	0	0	0	0	0	0	0	18	18	18	18	18	18	18	18	18	18
Total module area	m²	0	0	0	0	0	0	0	0	0	0	90	90	90	90	90	90	90	90	90	90