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

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 Lebanon **more than 23 Billion Euro** in 20 years

* assuming an average lifetime of EE measures 20 years

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Contents

Introduction

- What are co-benefits of energy efficiency?
- Why assess co-benefits on a macro-economic level?

Analysis

- Boundary conditions and assumptions for the assessment
- Selection of co-benefits to be quantified
- Methodological approach of scaling the macro-economic level based on stock data and reference buildings

Results

- Savings potential for energy consumption, future emissions and energy costs
- The overall cost savings of EE buildings in Lebanon due to its co-benefits

Conclusion

- Main take aways
- 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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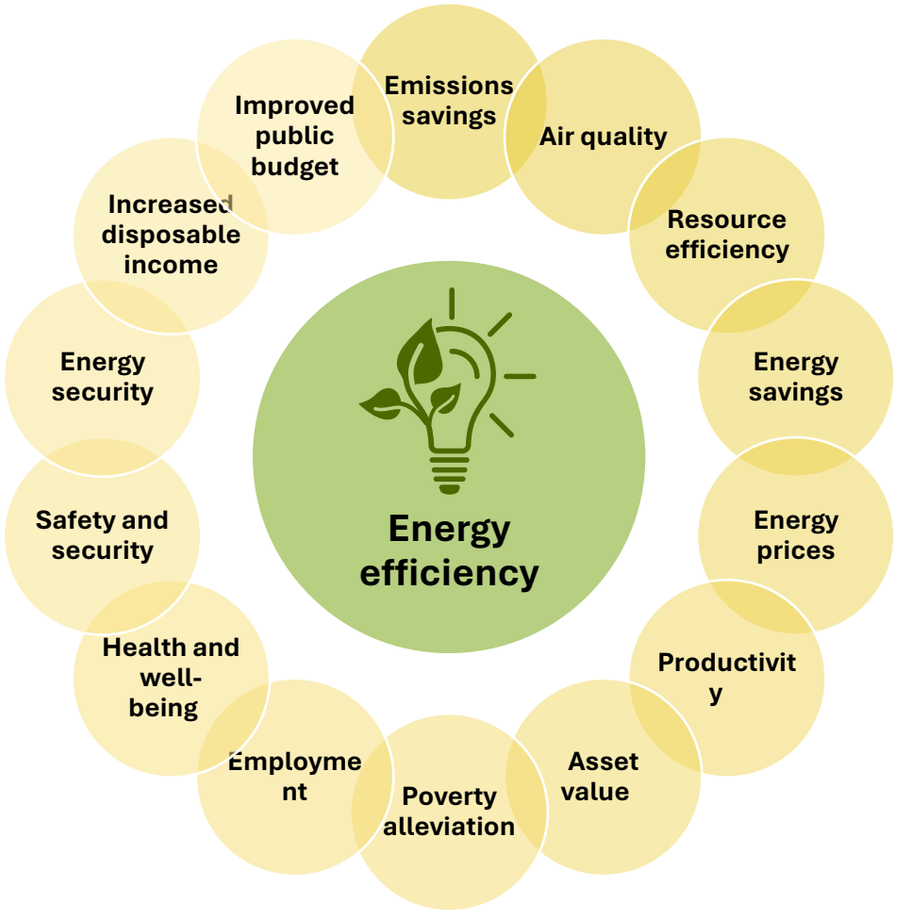
Our scope: Multiple benefits at the macroeconomic level

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 Lebanon.

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

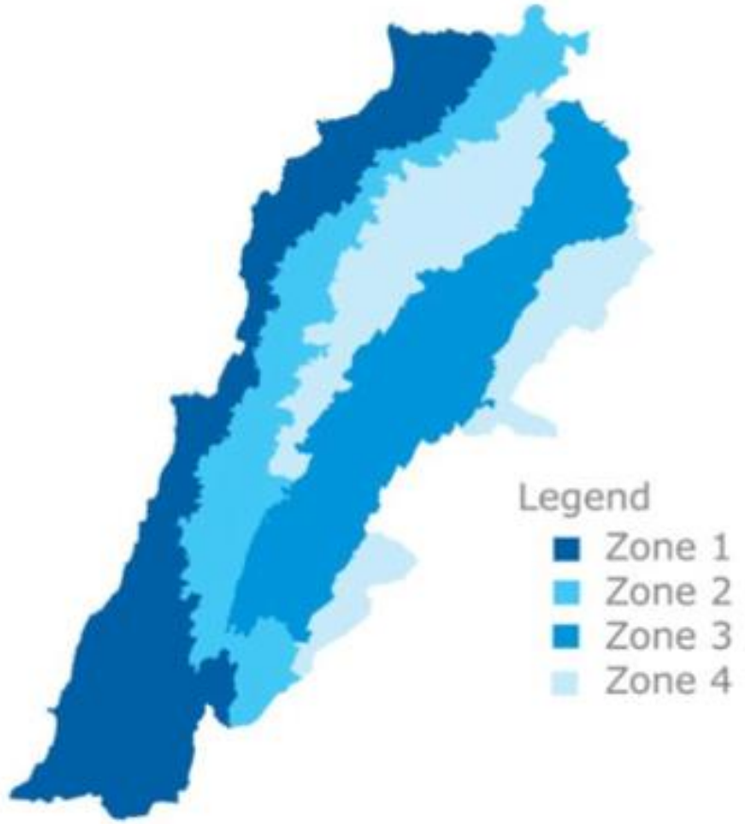
Quantify and, where possible, monetise economic effects.

Boundary conditions

Local conditions in Lebanon

Climate zones in Lebanon

Instrument	Approximate Altitude Range	Approximate HDD(18) Inland CDD(21) Thresholds
Zone 1: Coastal	0 – 700m	300 < HDD < 1200 120 < CDD < 1050
Zone 2: Western Mid-Mountain	700-1400m	1200 < HDD < 2000 0 < CDD < 120
Zone 3: Inland Plateau	700-1150	1200 < HDD < 1800 120 < CDD < 600
Zone 4: High Mountain	Littoral Side +1400m Inland Side +1150m	HDD > 2000 | CDD = 0 HDD > 1800 | 0 < CDD < 120



Source: https://www.researchgate.net/figure/Climatic-Zones-of-Lebanon_fig28_268408852
https://nanopdf.com/download/climatic-zonic-for-buildings-in-lebanon_pdf

Assumptions: CO2 price

- Challenge: No CO2 price has been set in representative country of the MENA region.
- EU ETS value in 2025 for 1tonne CO2 = 55€
- A **very conservative** number of 1€ / tonne CO2 is used to monetise this co-benefit.

Assumptions: Employment

- 1 million of € investment in green buildings equals 34 full time employees
- Average wage for green jobs in Lebanon is assumed at 4,800 € 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 Lebanese context
- According to Greenpeace, Lebanon has the highest estimated premature deaths due to fossil fuel air pollution (about 0.39 premature deaths per 1,000 people), with air pollution costing the country approximately 1.4 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 34.9 % of total emissions, of which 60% 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 Lebanon

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

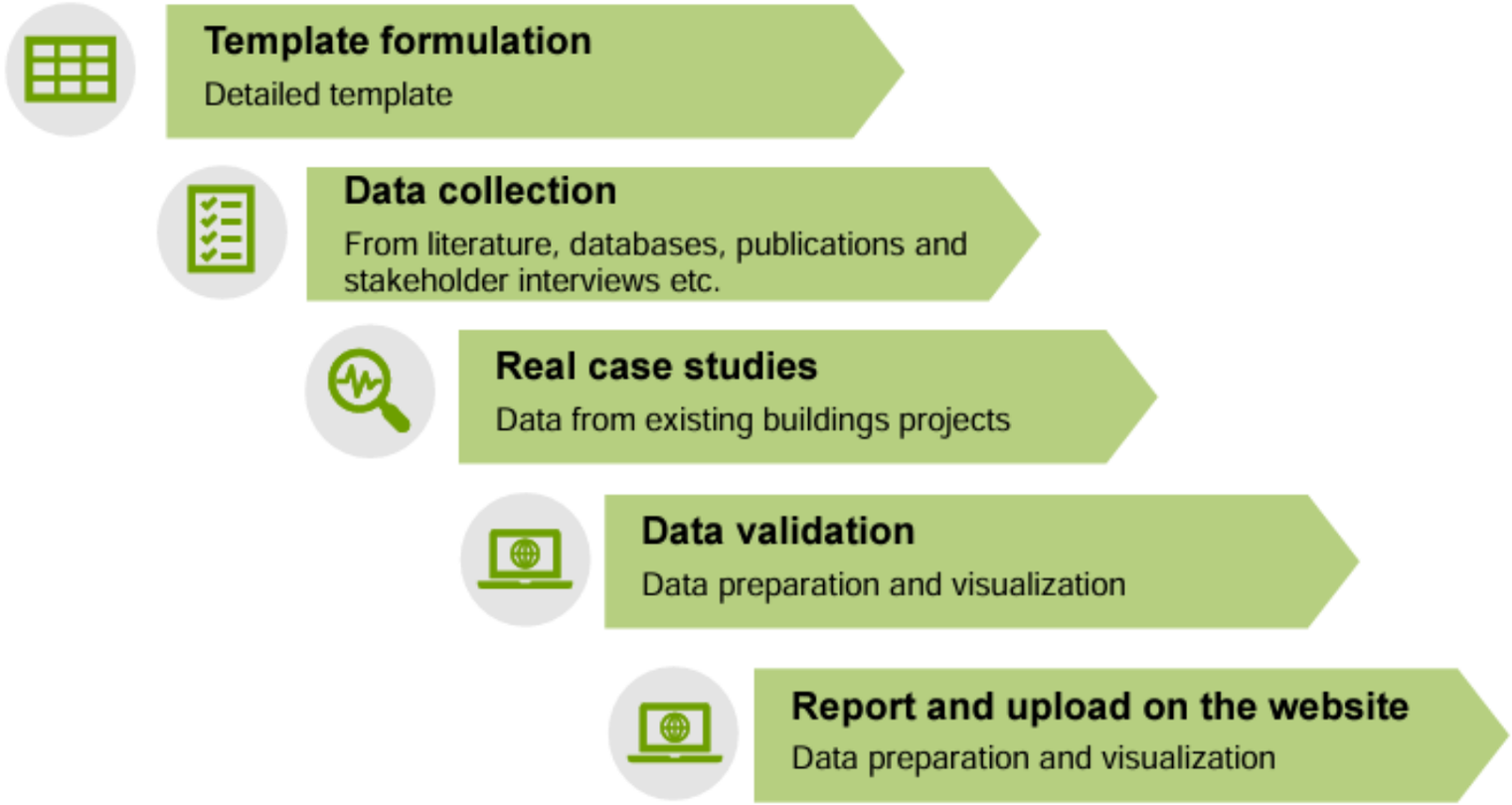
No	Co-benefit	Calculation methodology	Data availability	Country relevance	Relevance for public sector	Relevance for private sector	Relevance for building stock
1	**Emissions savings**	+++	++	++	++	-	+++
2	Air quality	--	-	++	++	++	++
3	Resource efficiency	--	-	++	++	+	+
4	**Energy savings**	+++	+++	+++	+++	++	++
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

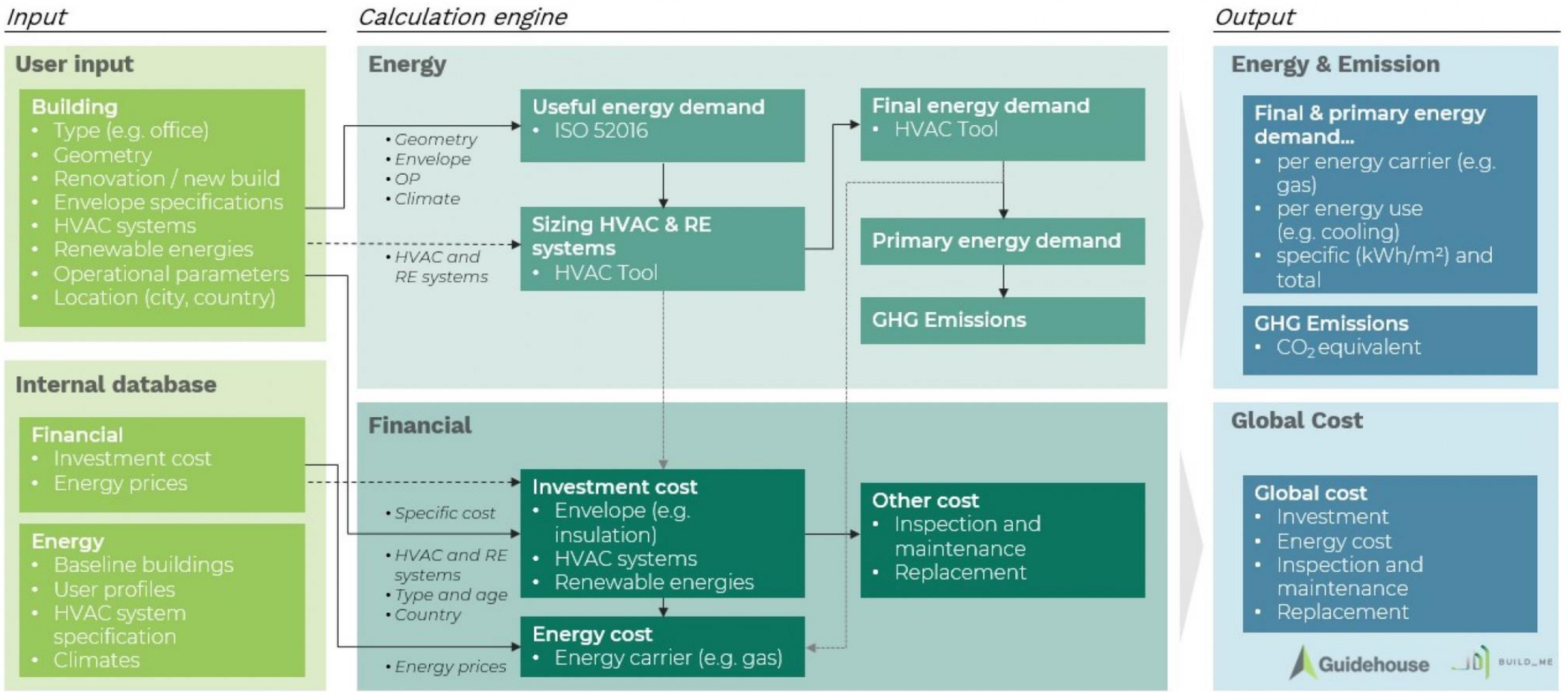
Carried out within the scope of the BUILD_ME project

BUILD_ME developed the typology database which depicts representative reference buildings in Lebanon. 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**	**Beirut**	**Qartaba**	**Bayssour**	**Haoch El Oumaraa**	**Bcharre**	**Lebanon**
Total expected number of new MFH buildings until 2030		2651	5723	2858	1221	1716	14169
Share of new SMFH buildings until 2030	%	10%	10%	70%	90%	100%	40%
Share of new LMFH buildings until 2030	%	90%	90%	30%	10%	0%	60%
Net floor area per SMFH	m^2	693	693	693	693	693	693
Net floor area per LMFH	m^2	7200	7200	7200	7200	7200	7200
Total floor area of MFH in the buildings stock	m^2						241,886,437

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%

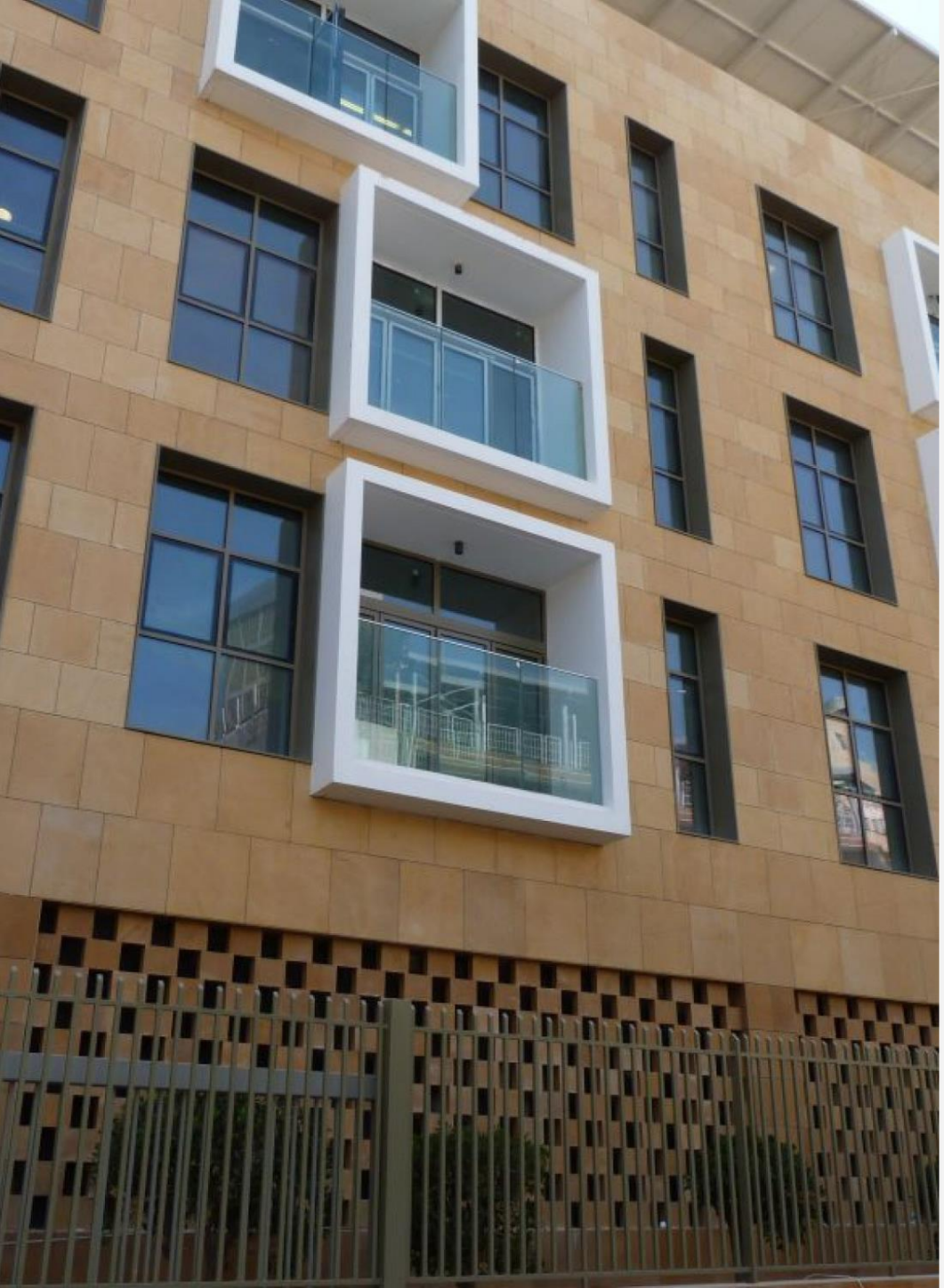
Scenario 2

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 Lebanon **more than 23 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

12.4%

Additional CapEx for SMFH

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

8.0%

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

92 €/m²

SMFH

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

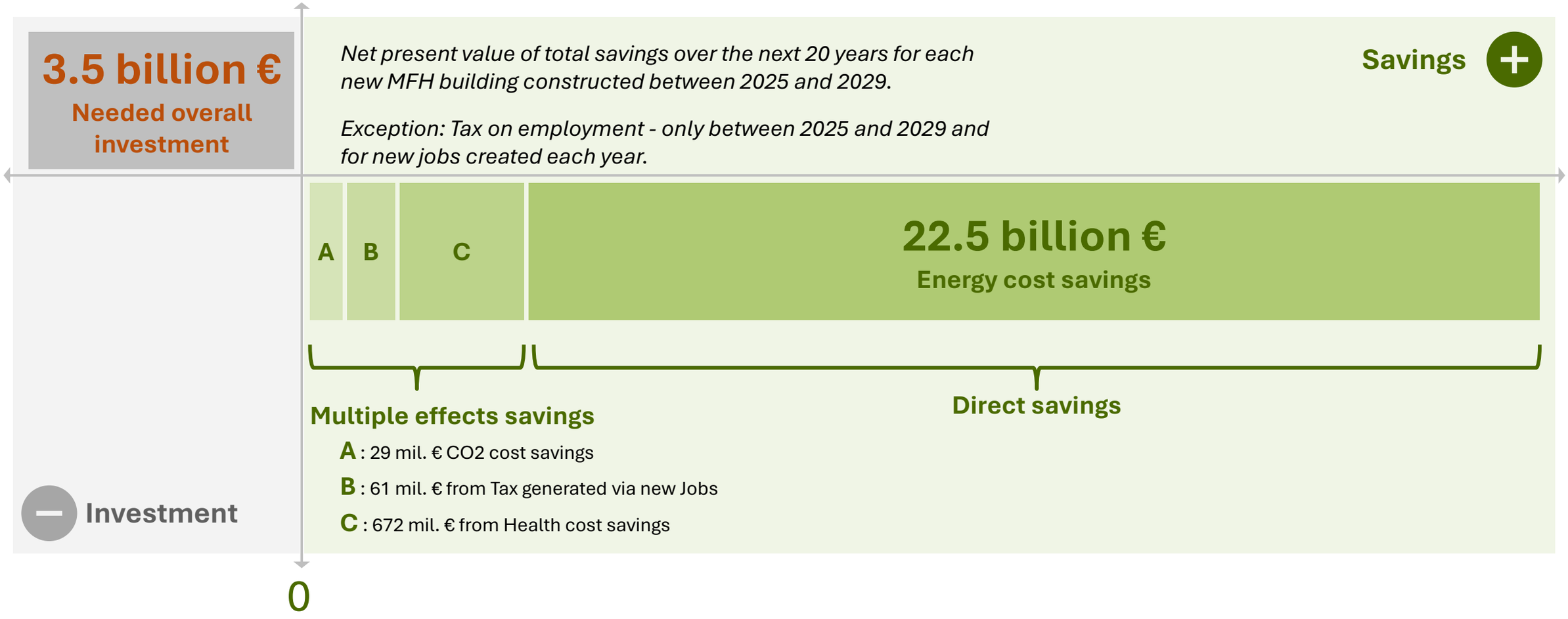
59 €/m²

LMFH

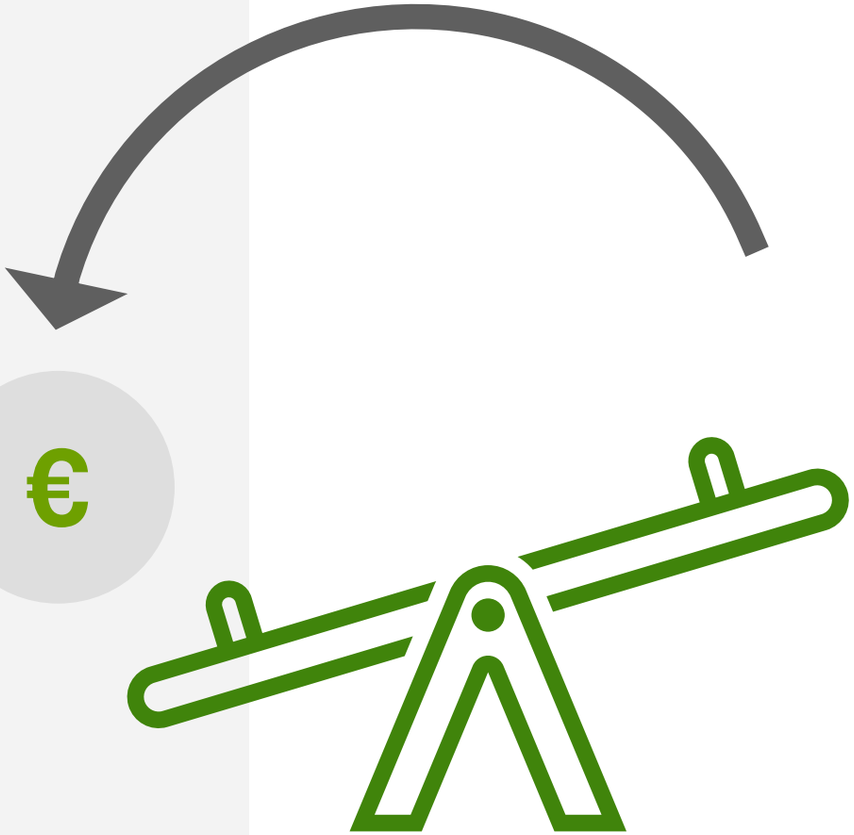
Additional investment per building for Large multi-family house LMFH, per square meters.

Generated savings vs needed investments

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

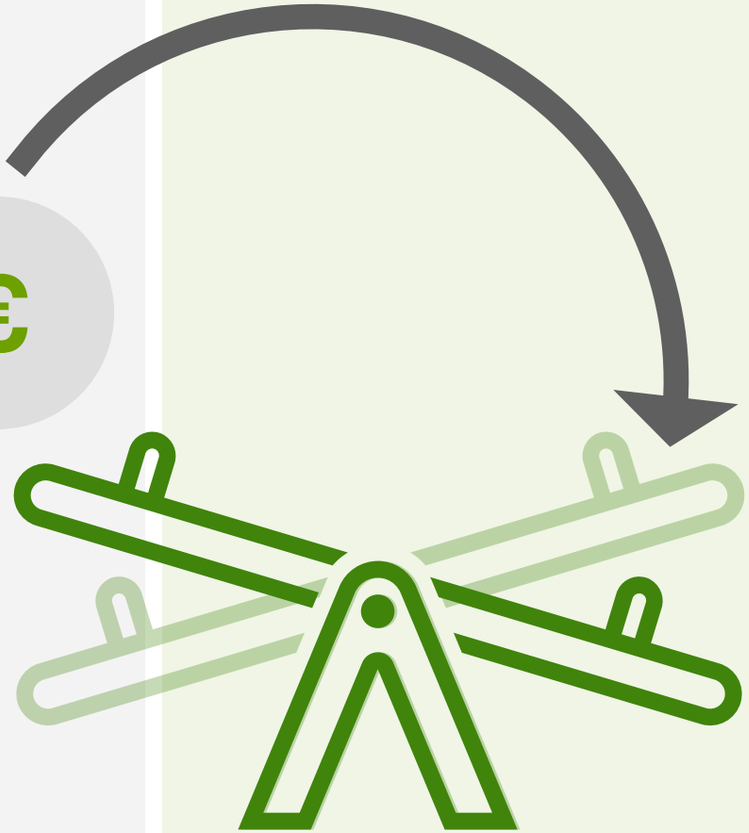


Generated savings vs needed investments



Generated savings vs needed investments

3.5 billion
Investment



23.3 billion
Savings

Every 1€ invested potentially saves ~7€ in the future

6.6 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** (CO_2).

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 CO_2 emissions = 1 €/tonnes CO_2.

2.9 million € **4690 ktCO2**

S1 (10% of new MFH buildings)

8.8 million € **14 069 ktCO2**

S2 (30% of new MFH buildings)

14.8 million € **23 449 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.

2.258 Billion € **10,255 GWh**

S1 (10% of new MFH buildings)

6.775 Billion € **30,765 GWh**

S2 (30% of new MFH buildings)

11.292 Billion € **51,275 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 34 new jobs per 1 Mio € invested and a conservative per capita tax payment of 10%.

6 million € **14 Tsd Jobs**

S1 (10% of new MFH buildings)

---

18 million € **42 Tsd Jobs**

S2 (30% of new MFH buildings)

---

30 million € **71 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 86% air quality improvement through 50% efficiency increases (EPC class C to A)

67 million € **4 690 ktCO2**

S1 (10% of new MFH buildings)

---

201 million € **14 069 ktCO2**

S2 (30% of new MFH buildings)

---

336 million € **23 449 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	2.950 Million EUR	10,255 GWh	2.258 Billion EUR	6.068 Million EUR	67.156 Million EUR
S2: 30% of new MFH buildings) built to CostOpt EPC level A	8.852 Million EUR	30,765 GWh	6.775 Billion EUR	18.20 Million EUR	201.47 Million EUR
S3: 50% of new MFH buildings) built to CostOpt EPC level A	14.754 Million EUR	51,275 GWh	11.292 Billion EUR	30.343 Million EUR	335.784 Million EUR

Conclusions

Benefits for Lebanon

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 **6.7€ saved**

High leverage factor of almost **7** folds of returns

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

Emissions savings

Energy savings

Energy cost savings

Employment

Health & Air quality

More than 23 Billion € of savings can be achieved

Conclusions

sustainable indicators

Economic benefits

Billions of euro can be saved annually in Lebanon

- Significantly reduced energy costs can free up public and private funds have high potential to stimulate Lebanon'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

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IKI INTERNATIONAL CLIMATE INITIATIVE

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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

Lebanon

General information	Baseline Buildings – New Construction (after 2025)										CostOpt Input Parameters – New Construction (after 2015)									
Building type I	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH
Reference city	Beirut	Beirut	Qartaba	Qartaba	Bayssour	Bayssour	Houch El Oumaraa	Houch El Oumaraa	Bcharre	Bcharre	Beirut	Beirut	Qartaba	Qartaba	Bayssour	Bayssour	Houch El Oumaraa	Houch El Oumaraa	Bcharre	Bcharre
Wall																				
U-value W/(m^{2}K)	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Roof																				
U-value W/(m^{2}K)	1	0.7	1	0.7	1	0.7	1	0.7	1	0.7	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Slab (ground plate)																				
U-value W/(m^{2}K)	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Window																				
Window type -	Double glass - air	Double glass - air	Double glass - air	Double glass - air	Double glass - air	Double glass - air	Double glass - air	Double glass - air	Double glass - air	Double glass - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air	Triple glass - solar - lowE - air
G-value	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
U-value W/(m^{2}K)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Space heating																				
Space heating system	Oil non-condensing	Oil non-condensing	Oil non-condensing	Oil non-condensing	Oil non-condensing	Oil non-condensing	Oil non-condensing	Oil non-condensing	Oil non-condensing	Oil non-condensing	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC

CostOpt Building Level A

Lebanon

General information	Baseline Buildings – New Construction (after 1025)										CostOpt Input Parameters – New Construction (after 2015)									
Building type I	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH	SMFH	LMFH
Reference city	Beirut	Beirut	Qartaba	Qartaba	Bayssour	Bayssour	Houch El Oumara a	Houch El Oumara a	Bcharre	Bcharre	Beirut	Beirut	Qartaba	Qartaba	Bayssour	Bayssour	Houch El Oumara a	Houch El Oumara a	Bcharre	Bcharre
Wall																				
Energy carrier	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Oil	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity	Electricity
Resulting efficiency %	90% - 88%	90% - 88%	90% - 88%	90% - 88%	90% - 88%	90% - 88%	90% - 88%	90% - 88%	90% - 88%	90% - 88%	4.6 - 3.9	4.6 - 3.10	4.6 - 3.11	4.6 - 3.12	4.6 - 3.13	4.6 - 3.14	4.6 - 3.17	4.6 - 3.18	4.6 - 3.15	4.6 - 3.16
Space cooling system																				
Efficiency class AC	Min	Min	Min	Min	Min	Min	Min	Min	Min	Min	Best	Best	Best	Best	Best	Best	Best	Best	Best	Best
Resulting efficiency - EER	3.9 - 3.0	4.0 - 2.3	3.9 - 3.0	4.0 - 2.3	3.9 - 3.0	4.0 - 2.3	3.9 - 3.0	4.0 - 2.3	3.9 - 3.0	4.0 - 2.3	> 5.0	> 5.0	> 5.0	> 5.0	> 5.0	> 5.0	> 5.0	> 5.0	> 5.0	> 5.0
Photovoltaics																				
Capacity kWp	0	0	0	0	0	0	0	0	0	0	15	53	15	53	15	53	15	53	15	53
Total module area m^2	0	0	0	0	0	0	0	0	0	0	75	265	75	265	75	265	75	265	75	265