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

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

https://wildjordancenter.com/news/wild-jordan-center-is-mentioned-as-one-of-the-favorite-exposed-concrete-buildings-in-amman/

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BUILD_ME

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

more than 2.5 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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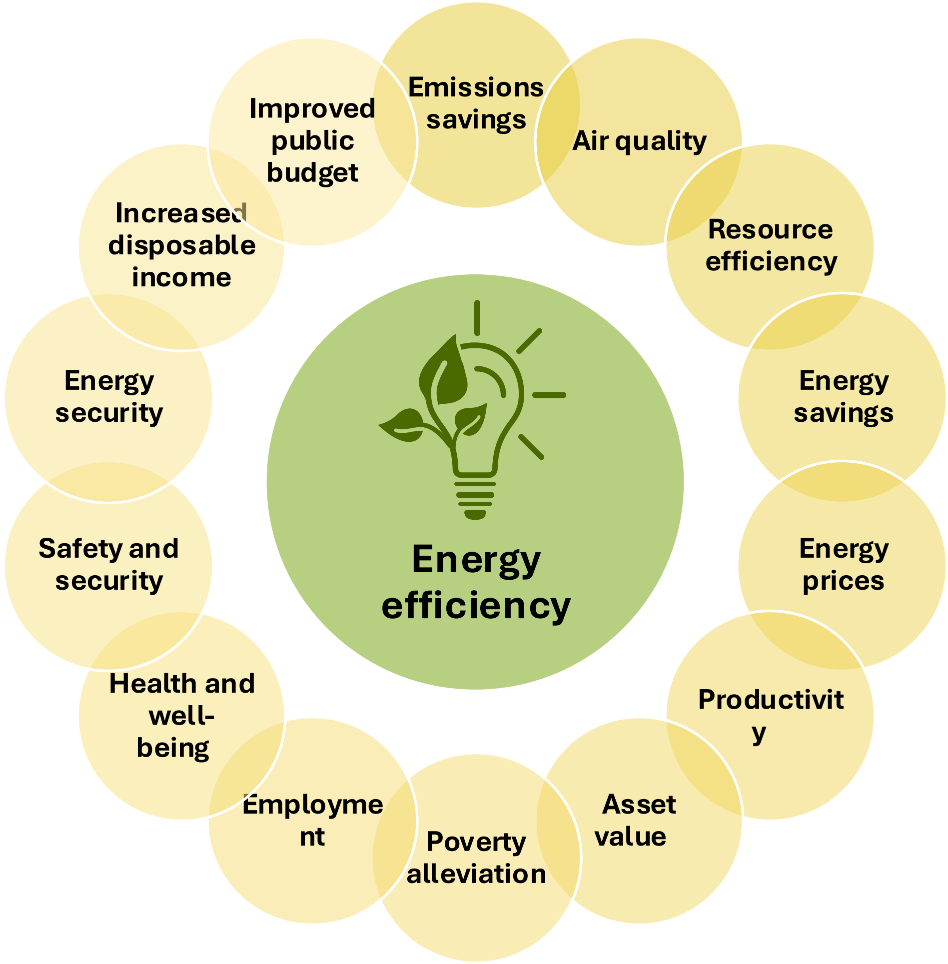
Our scope: Multiple benefits at the macroeconomic level

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 Jordan.

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

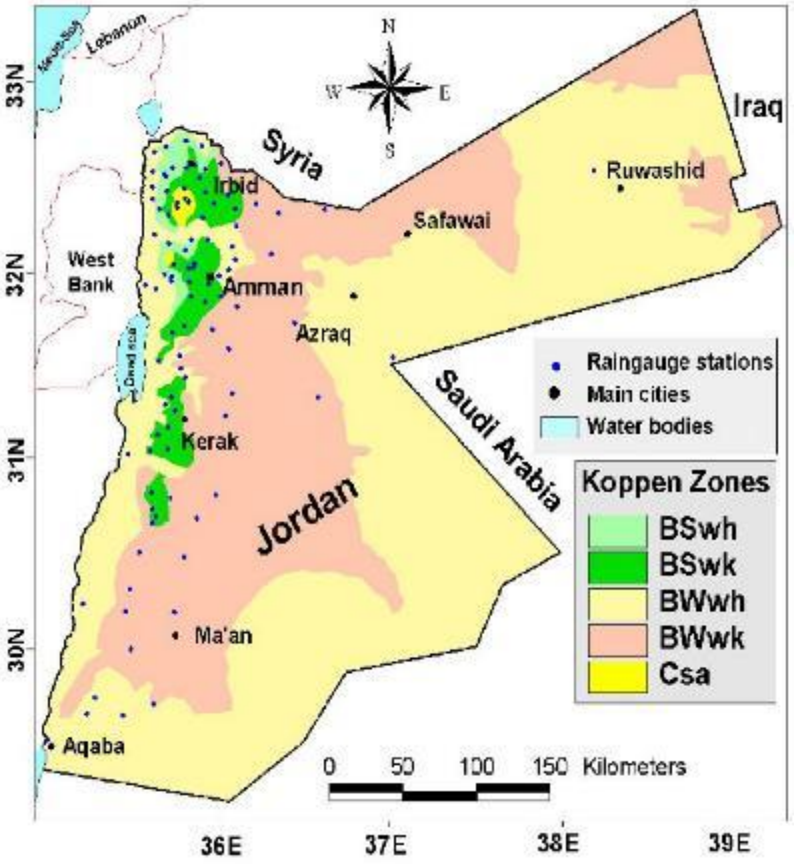
Quantify and, where possible, monetize economic effects.

Boundary conditions

Local conditions in Jordan

Climate zones in Jordan

Instrument	Approximate HDD and CDD Thresholds
Zone 1: Arid, desert, hot/cold	Σ HDD: 1,039 Σ CDD: 1,726
Zone 2: Arid, steppe, hot/cold	Σ HDD: 1,184 Σ CDD: 1,113
Zone 3: Temperate, dry summer, hot summer/warm summer	Σ HDD: 1,100 Σ CDD: 1,019



Source: https://www.researchgate.net/publication/367555423_Energy-passive_residential_building_design_in_Amman_Jordan#pf5
Albadaineh, Renad. (2023). Energy-passive residential building design in Amman, Jordan. Energetika. 68. 10.6001/energetika.v68i1.4857.

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 monetize this co-benefit.

Assumptions: Employment

- 1 million of € investment in green buildings equals 11.9 full time employees
- Average wage for green jobs in Jordan is assumed at 12,000 € annually.
- A conservative number of 5% tax is assumed to be collected by government.

Assumptions: Health & Air quality

- Health data is not easily accessed in the Jordanian context
- According to Greenpeace, Jordan has a premature death rate of about 0.13 premature deaths per 1,000 people due to fossil fuel air pollution, with air pollution costing the country approximately 490 million 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 27 % of total emissions, of which 34% 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.

Assumptions: Public subsidies

- Energy consumption subsidy: The first 300 kWh of consumption per month are subsidized by the government with 0.065 €/kWh
  - The first 300 kWh of energy consumption will cost 0.065 EUR/kWh.
  - Energy consumption between 300 kWh and 600 kWh will cost 0.13 EUR/kWh.
  - Energy consumption above 600 kWh will cost 0.26 EUR/kWh.
- Number of dwellings in SMFH (Single-Multi Family Homes): 10 dwellings
- Number of dwellings in LMFH (Large Multi-Family Homes): 16 dwellings
- Percentage of MFH (Multi-Family Homes) that consume less than 1000 kWh: 75% of the total MFH

https://jordantimes.com/news/local/emrc-announce-mechanism-household-electricity-subsidy

Analysis

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

1. Assessment of multiple benefits considered for Jordan

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

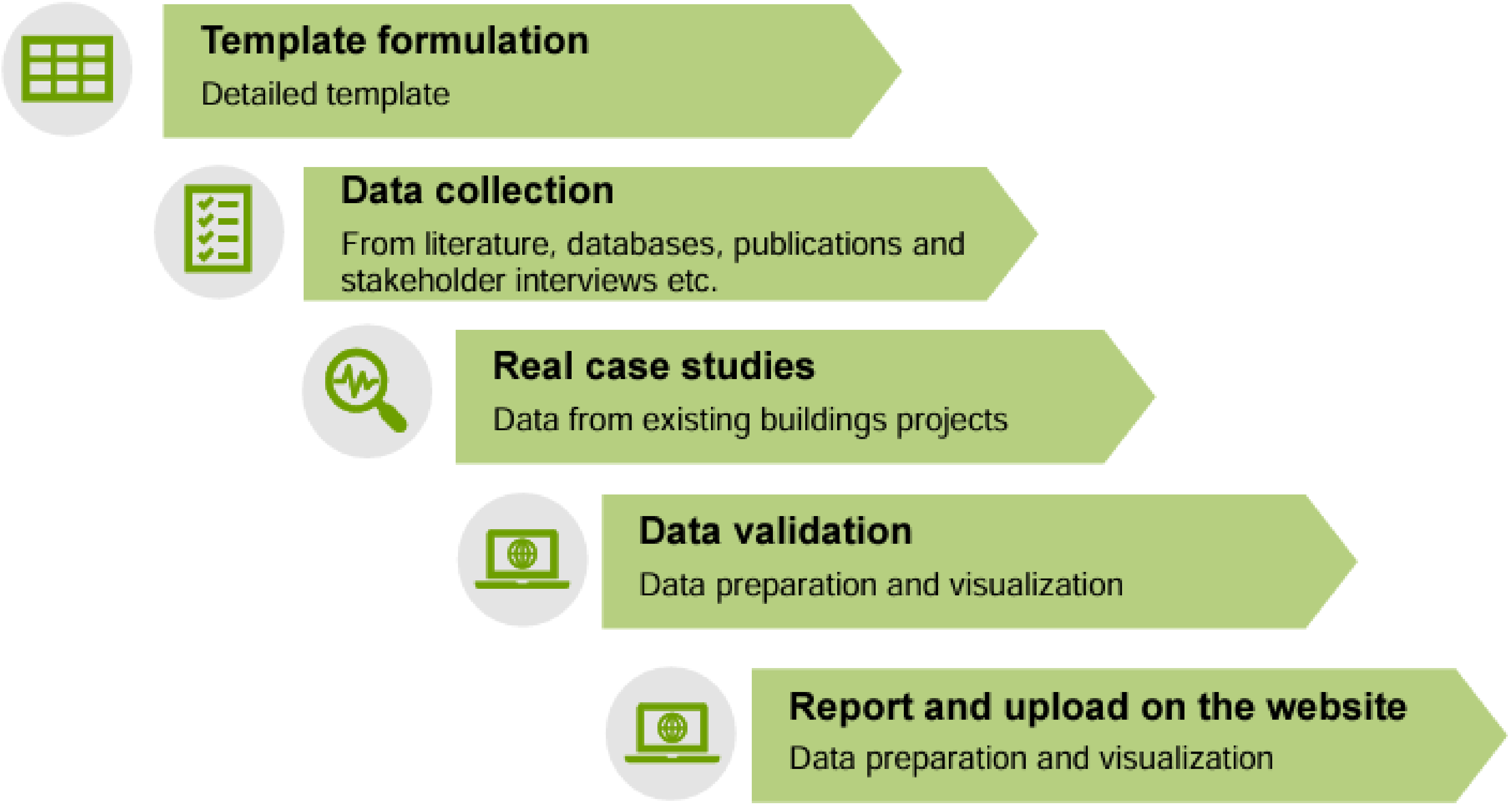
No	Co-benefit	Calculation methodology	Data availability	Country relevance	Relevance for public sector	Relevance for private sector	Relevance for building stock
1	Emissions savings	+++	+++	+++	++	--	+++
2	Air quality	++	+	++	++	+	++
3	Resource efficiency	++	+++	+++	++	-	++
4	Energy savings	+++	+++	+++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

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

2. Establish reference buildings as a baseline

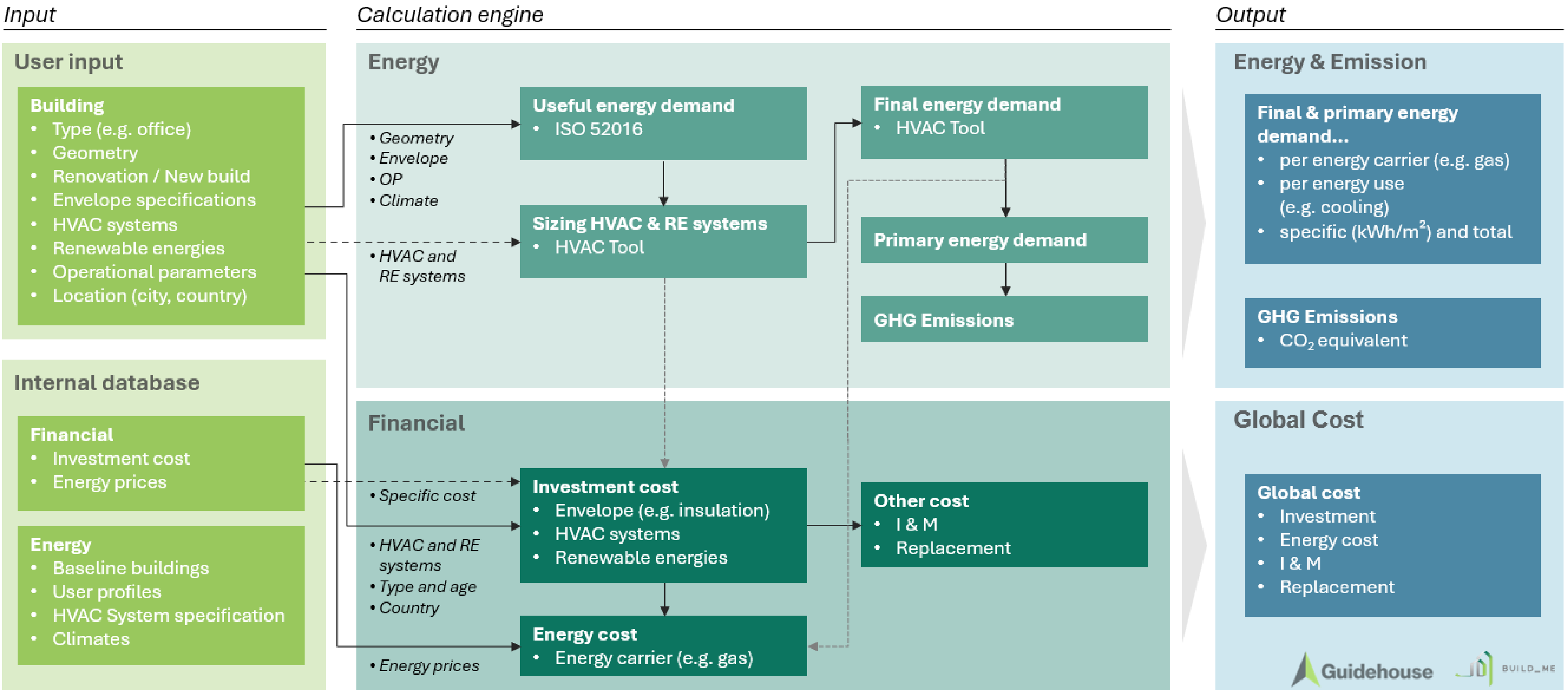
Carried out within the scope of the BUILD_ME project

BUILD_ME developed the typology database which depicts representative reference buildings in Jordan. 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

Public subsidies

5. Values are scaled to the macroeconomic level

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

Building stock										
Particulars	**Unit**	**Ajloun**	**Amman**	**Aqaba**	**Dead sea**	**Irbid**	**Ma'an**	**Ruwaished**	**Zarqa**	**Jordan**
Total expected number of new MFH buildings, 2025-2030	-	260	5918	278	279	2614	234	812	2016	12411
Share of new SMFH buildings until 2030	%	75%	75%	75%	75%	75%	75%	75%	75%	75%
Share of new LMFH buildings until 2030	%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Net floor area per SMFH	m^2	1485	1485	1485	1485	1485	1485	1485	1485	1485
Net floor area per LMFH	m^2	2629	2629	2629	2629	2629	2629	2629	2629	2629
Total floor area of MFH in the buildings stock	m^2									90,978,432

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).


https://architizer.com/blog/inspiration/collections/7-public-buildings-redefining-the-architectural-identity-of-amman-jordan/

Results

Summary of estimated costs and savings

What if we told you green buildings built till 2030 could save Jordan **more than 2.5 Billion Euro** in 20 years

* assuming an average lifetime of EE measures 20 years

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https://architizer.com/blog/inspiration/collections/7-public-buildings-redefining-the-architectural-identity-of-amman-jordan/

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

9.8%

Additional CapEx for SMFH

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

7%

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

$55\ €/m^2$

SMFH

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

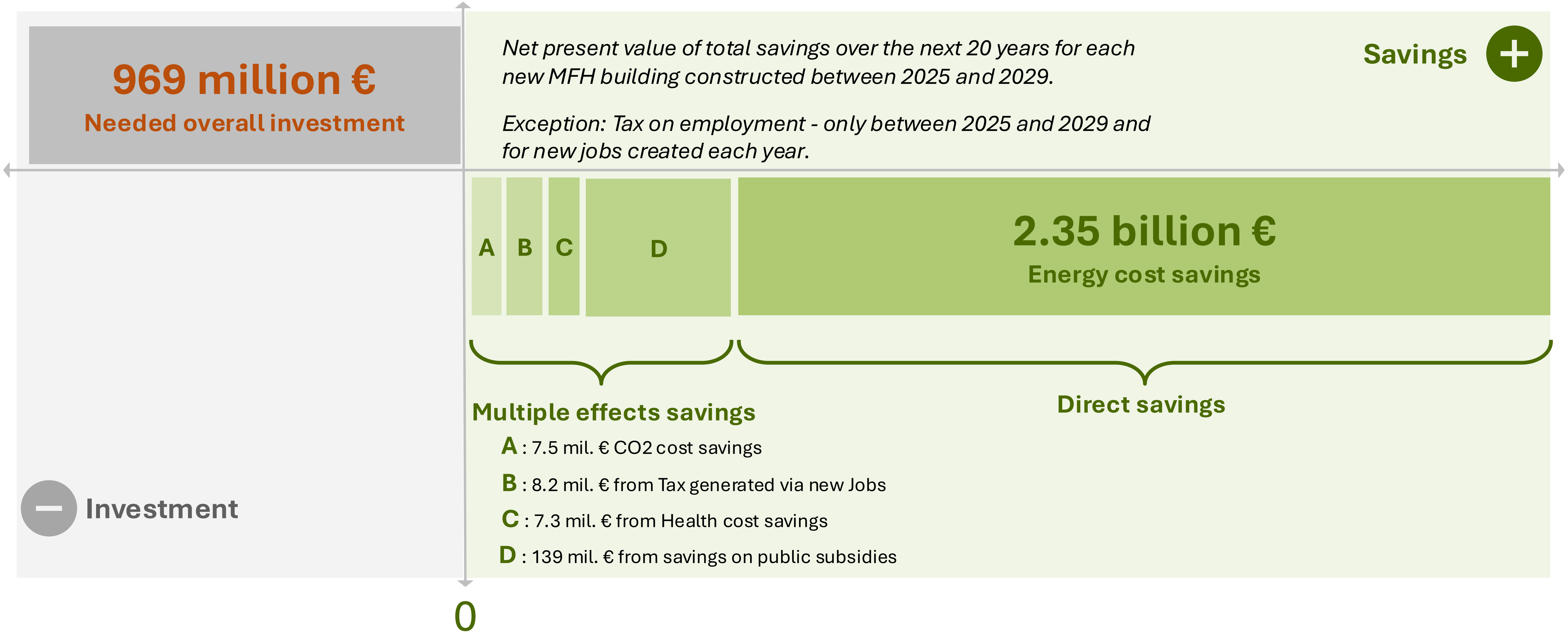
$40\ €/m^2$

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

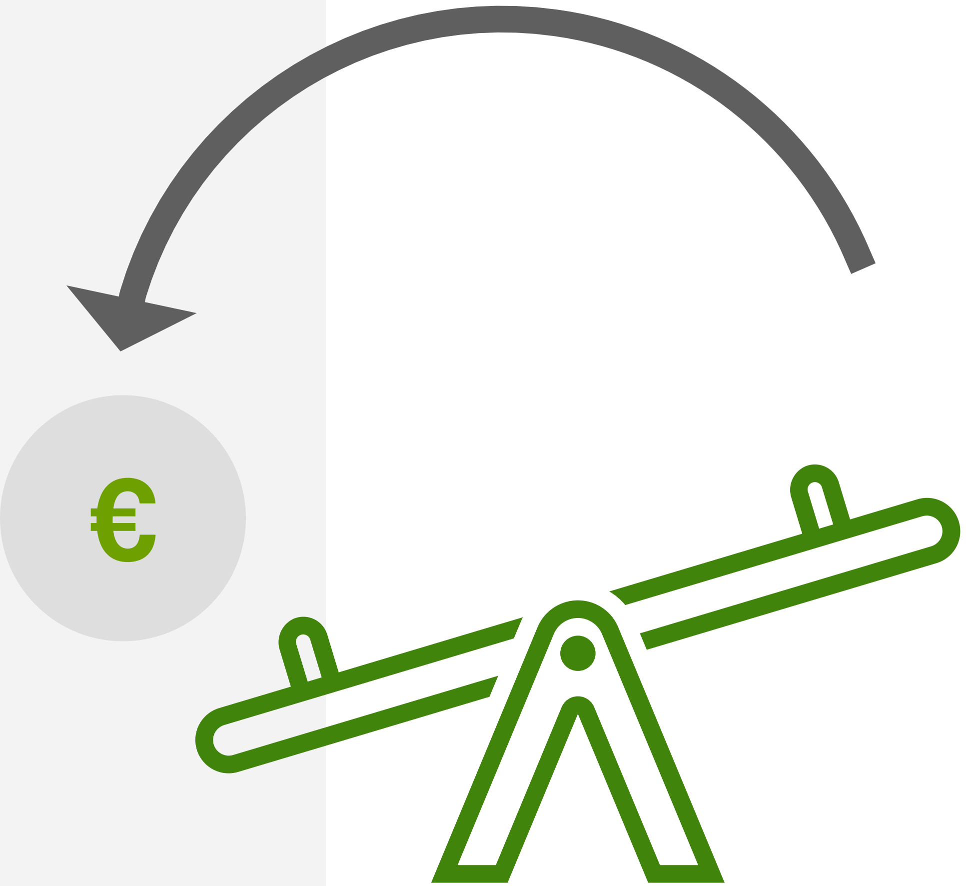


Generated savings vs needed investments

969 million

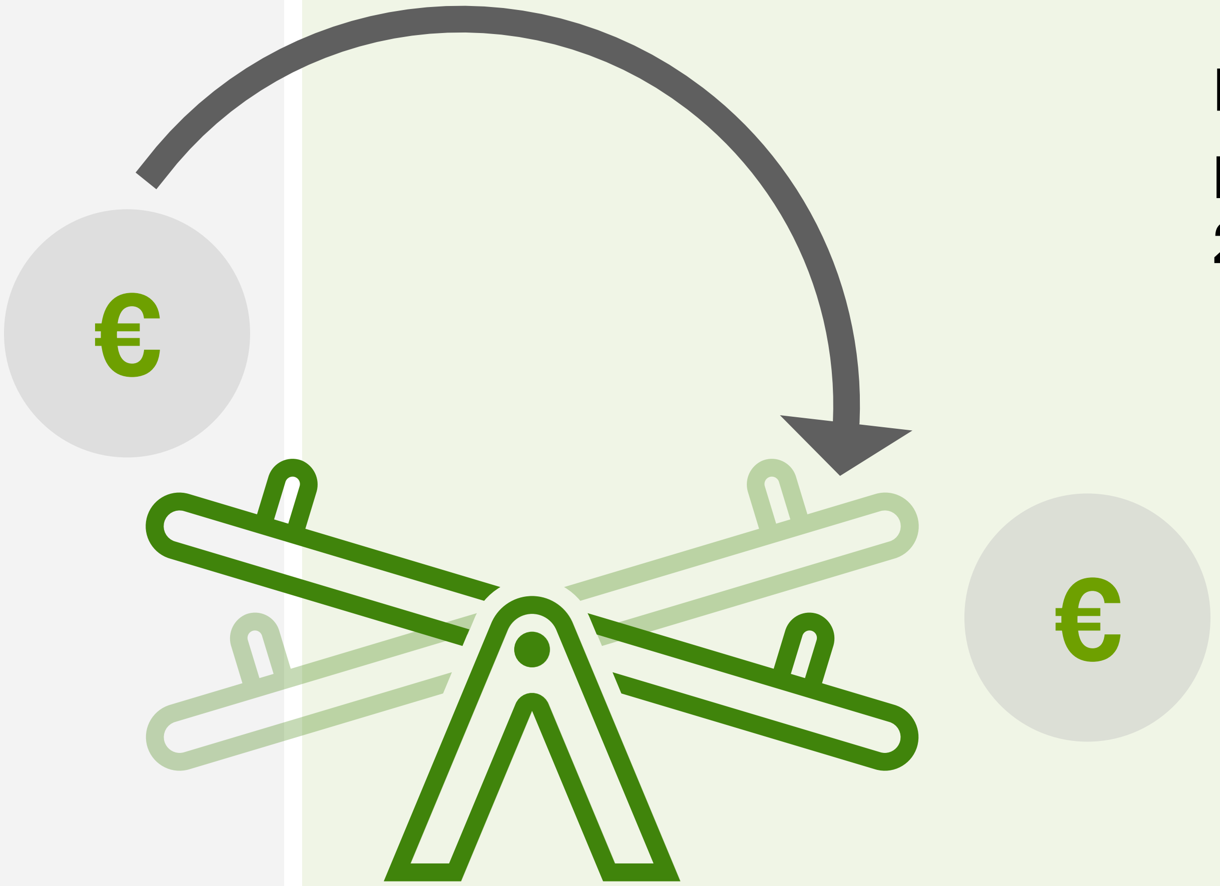
3.5 billion €

Investment



Generated savings vs needed investments

969 million
Investment



Every 1€ invested potentially saves 2.6 € in the future

2.51 billion
Savings

2.6 Leverage factor

Detailed results per benefit

1. Emissions reductions
2. Energy savings
3. energy cost savings
4. Employment
5. Health and air quality
6. Public subsidies

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.

0.7 million € **1 185 ktCO_2**

S1 (10% of new MFH buildings)

2.2 million € **3 556 ktCO_2**

S2 (30% of new MFH buildings)

3.7 million € **5 927 ktCO_2**

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.

235.2 million € **2 442 GWh**

S1 (10% of new MFH buildings)

705.6 million € **7 325 GWh**

S2 (30% of new MFH buildings)

1 175.9 million € **12 208 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 11.9 new jobs per 1 Mio € invested and a conservative per capita tax payment of 5%.

0.8 million € **1350 Jobs**

S1 (10% of new MFH buildings)

2.5 million € **4100 Jobs**

S2 (30% of new MFH buildings)

4.1 million € **6800 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 97% air quality improvement through 50% efficiency increases (EPC class C to A)

0.7 million € **1 185 ktCO2**

S1 (10% of new MFH buildings)

2.2 million € **3 556 ktCO2**

S2 (30% of new MFH buildings)

3.6 million € **5 927 ktCO2**

S3 (50% of new MFH buildings)

6. Public Subsidies

The goal of reducing electricity consumption in residential buildings to less than 300 kWh annually directly contributes to reducing public subsidies. In this context, public subsidies are typically provided by governments to support households in managing their energy bills. By improving energy efficiency in these homes, less electricity is consumed, which leads to lower energy bills. When energy consumption is reduced, households require less financial assistance to cover their electricity costs, thereby decreasing the demand for government subsidies by targeting residential buildings that consume less than 1000 kWh savings in the long term.

13.9 million €

S1 (10% of new MFH buildings)

41.7 million €

S2 (30% of new MFH buildings)

69.6 million €

S3 (50% of new MFH buildings)

Detailed results

	Emissions savings	Energy savings	Energy cost savings	Employment	Health & Air quality	Public Subsidies
S1: 10% of new MFH buildings) built to CostOpt EPC level A+	746 Tsd EUR	2 442 GWh	235.2 million EUR	818 Tsd EUR	729 Tsd EUR	13.9 million EUR
S2: 30% of new MFH buildings) built to CostOpt EPC level A+	2 238 Tsd EUR	7 325 GWh	705.6 million EUR	2 455 Tsd EUR	2 186 Tsd EUR	41.7 million €
S3: 50% of new MFH buildings) built to CostOpt EPC level A+	3 729 Tsd EUR	12 208 GWh	1 175.9 million EUR	4 092 Tsd EUR	3 643 Tsd EUR	69.6 million €

Conclusions

Benefits for Jordan

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 **2.6 € saved**

High leverage factor with 2.6 folds of returns

Considering **just** 6 of 14 potential co-benefits

Emissions savings | **Energy savings** | **Energy cost savings** | **Employment** | **Health & Air quality** | **Public subsidies**

More than 2.5 Billion € of savings can be achieved

Conclusions

sustainable indicators

Economic benefits Billions of euro can be saved annually in Jordan	▪ Significantly reduced energy costs can free up public and private funds have high potential to stimulate Jordan'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

Jordan - LMFH

General information		Baseline Buildings								National							
Building type I	-	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH	LMFH
Reference city	-	Ajloun	Amman	Aqaba	Dead sea	Irbid	Ma'an	Ruwaished	Zarqa	Ajloun	Amman	Aqaba	Dead sea	Irbid	Ma'an	Ruwaished	Zarqa
Wall																	
U-value (wall)	W/(m²K)	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Roof																	
U-value (roof)	W/(m²K)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Slab (ground plate)																	
U-value (slab)	W/(m²K)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Window																	
Window type	-	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon
G-value	-	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
U-value (window)	W/(m²K)	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	3	3	3	3	3	3	3	3
Space heating																	
Space heating system	-	Portable LPG	Portable LPG	Portable LPG	Portable LPG	Portable LPG	Portable LPG	Portable LPG	Portable LPG	AC	AC	AC	AC	AC	AC	AC	AC
Efficiency clas	-	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT
Energy carrier	-	LPG	LPG	LPG	LPG	LPG	LPG	LPG	LPG	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
Efficiency class	-	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT
Photovoltaics	-																
Capacity	kWp	0	0	0	0	0	0	0	0	47	47	47	47	47	47	47	47
Total module area	m²	0	0	0	0	0	0	0	0	235	235	235	235	235	235	235	235

CostOpt Building Level A

Jordan

General information		Baseline Buildings								National							
Building type I	-	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH	SMFH
Reference city	-	Ajloun	Amman	Aqaba	Dead sea	Irbid	Ma'an	Ruwaished	Zarqa	Ajloun	Amman	Aqaba	Dead sea	Irbid	Ma'an	Ruwaished	Zarqa
Wall																	
U-value (wall)	W/(m²K)	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Roof																	
U-value (roof)	W/(m²K)	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Slab (ground plate)																	
U-value (slab)	W/(m²K)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Window																	
Window type	-	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Single glass	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon	Double glass - lowE - Argon
G-value	-	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
U-value (window)	W/(m²K)	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7	3	3	3	3	3	3	3	3
Space heating																	
Space heating system	-	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC	AC
Efficiency class	-	Good	Good	Good	Good	Good	Good	Good	Good	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
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
Efficiency class	-	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	BAT	BAT	BAT	BAT	BAT	BAT	BAT	BAT
Photovoltaics	-																
Capacity	kWp	0	0	0	0	0	0	0	0	27	27	27	27	27	27	27	27
Total module area	m²	0	0	0	0	0	0	0	0	130	130	130	130	130	130	130	130