

# Status of energy efficiency in the building sector in the Arab region and potential prospects

ESCWA UNDA Closing Webinar:  
Presentation of the outcomes of the UN Development Account Project on  
“Up-scaling Energy Efficiency in the residential and services sectors in the Arab Region”

Online, via Zoom, 20 & 21 December 2021



MINISTRY OF ENERGY AND MINERAL RESOURCES  
THE HASHEMITE KINGDOM OF JORDAN



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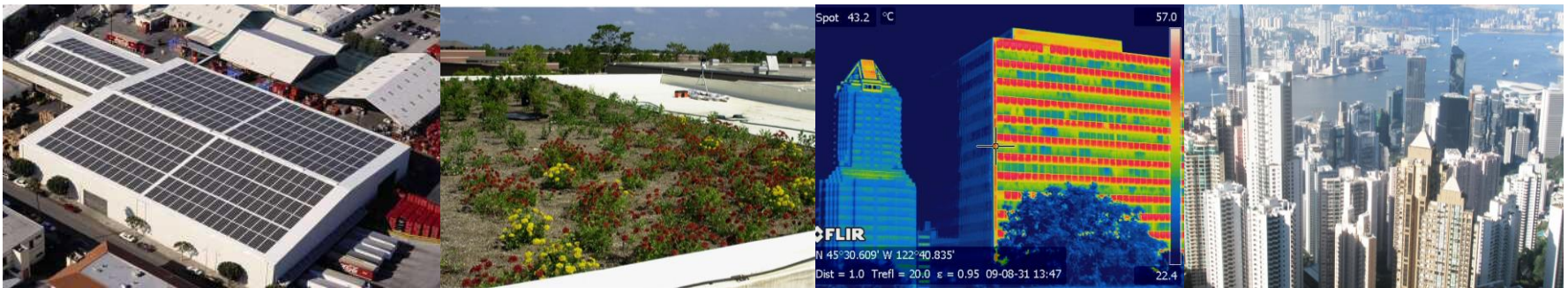
Shared Prosperity Dignified Life



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# OUTLINE

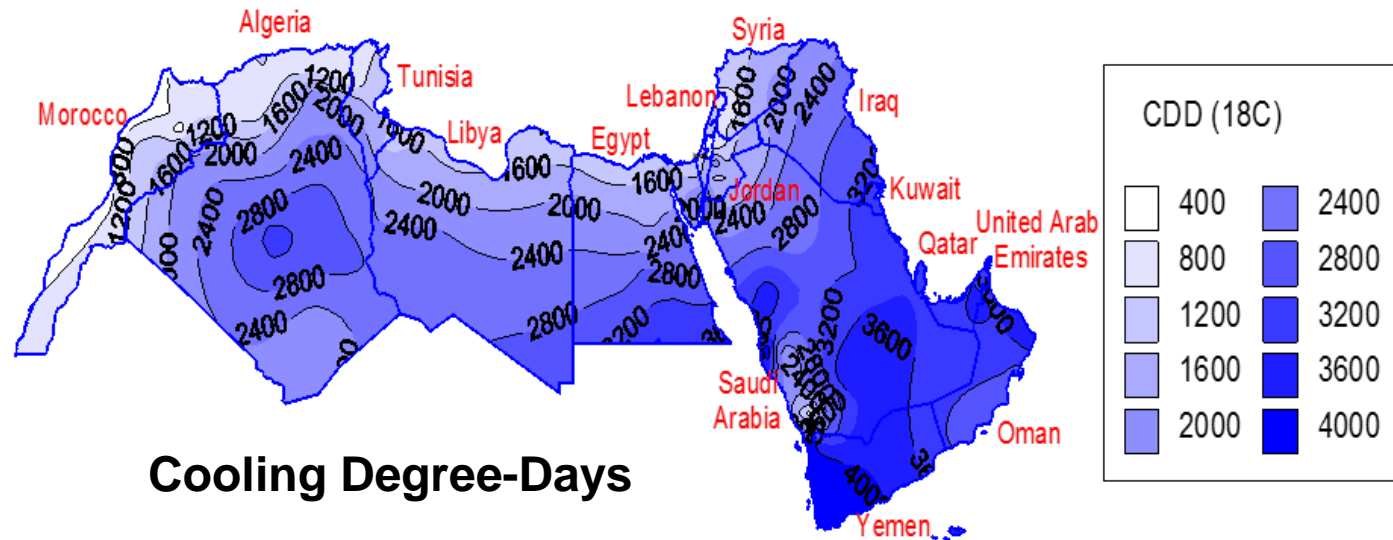
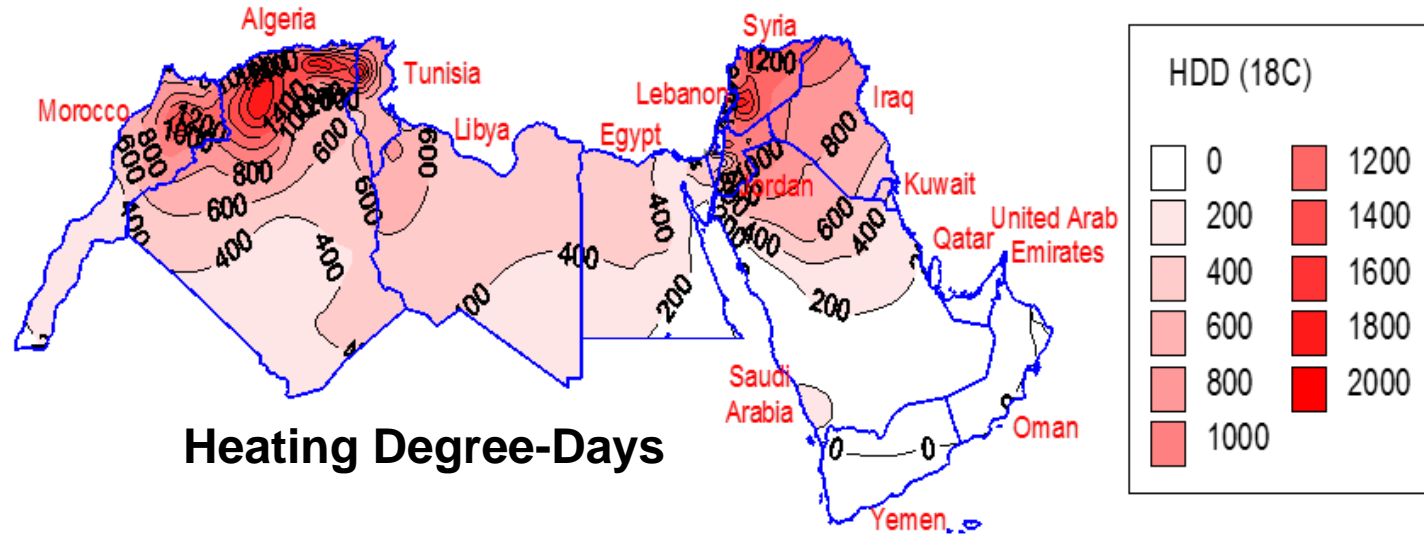
- **Current Energy Efficiency Status in the Arab Region**
- **Potential Energy Efficiency for the Region**
- **Examples of Energy Efficiency Projects**
- **Challenges and Opportunities**
- **Concluding Remarks**



# CURRENT STATUS OF ENERGY EFFICIENCY

*Reference:* M. Krarti, Evaluation of Large-Scale Energy Efficiency Potential for the Building Sector in the Arab Region, *Energies*, 12(22) (2019), Article 4279. [doi.org/10.3390/en12224279](https://doi.org/10.3390/en12224279) (with updated data from IEA, 2021).

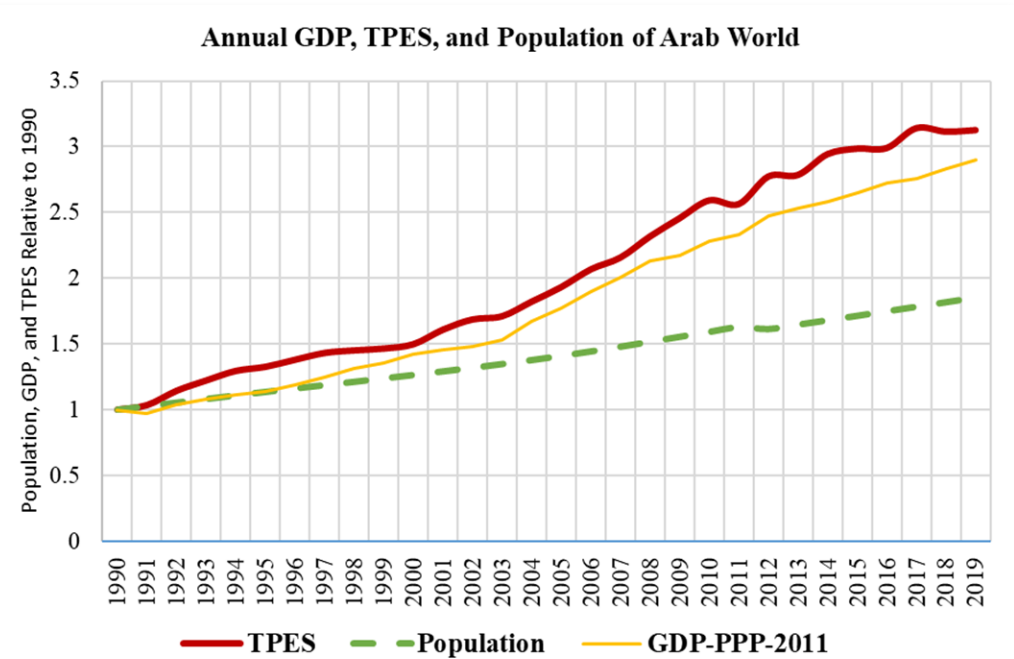
# Climate Zones Arab Region



# Primary Energy Use Trends

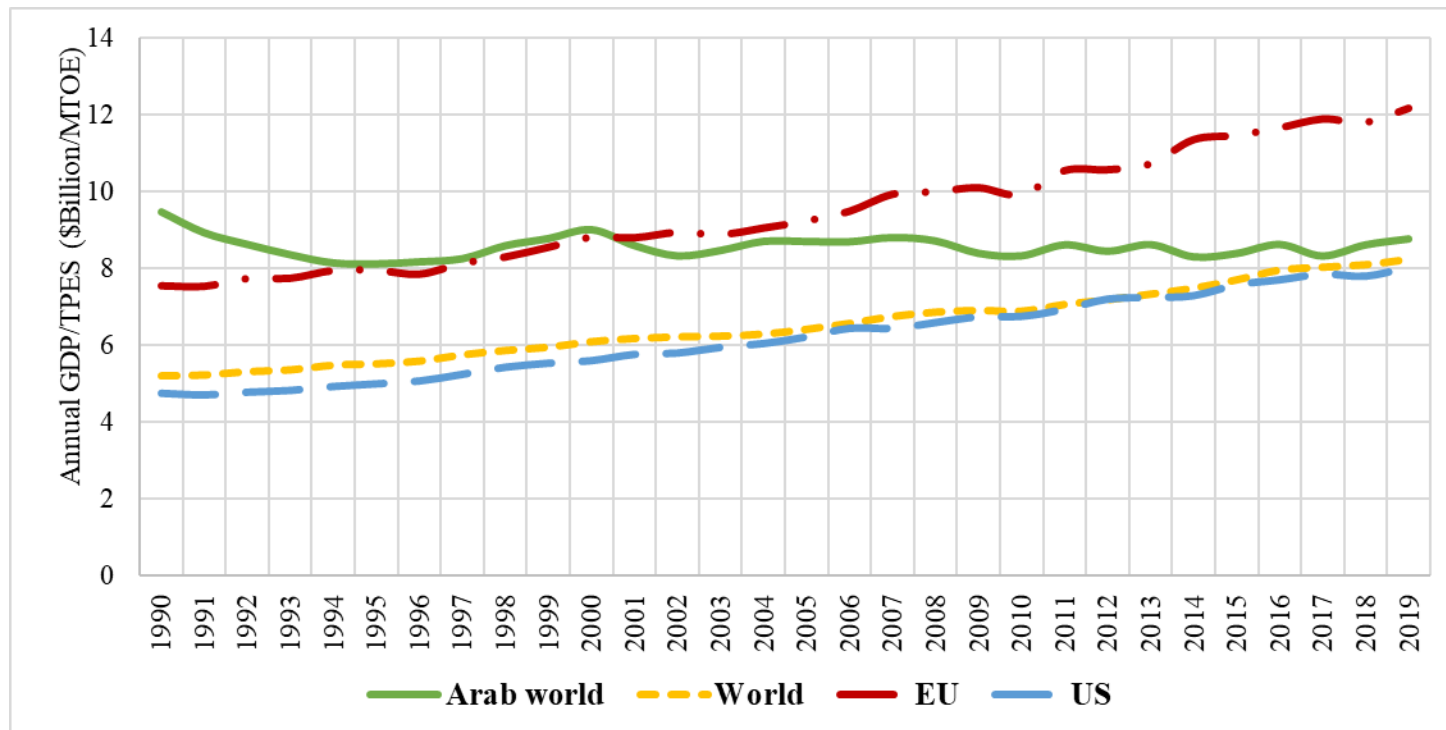
Between 1990 and 2019, the Arab region has increased:

- its primary energy consumption by 300%,
- its GDP by 250%, and
- its population by 60%.



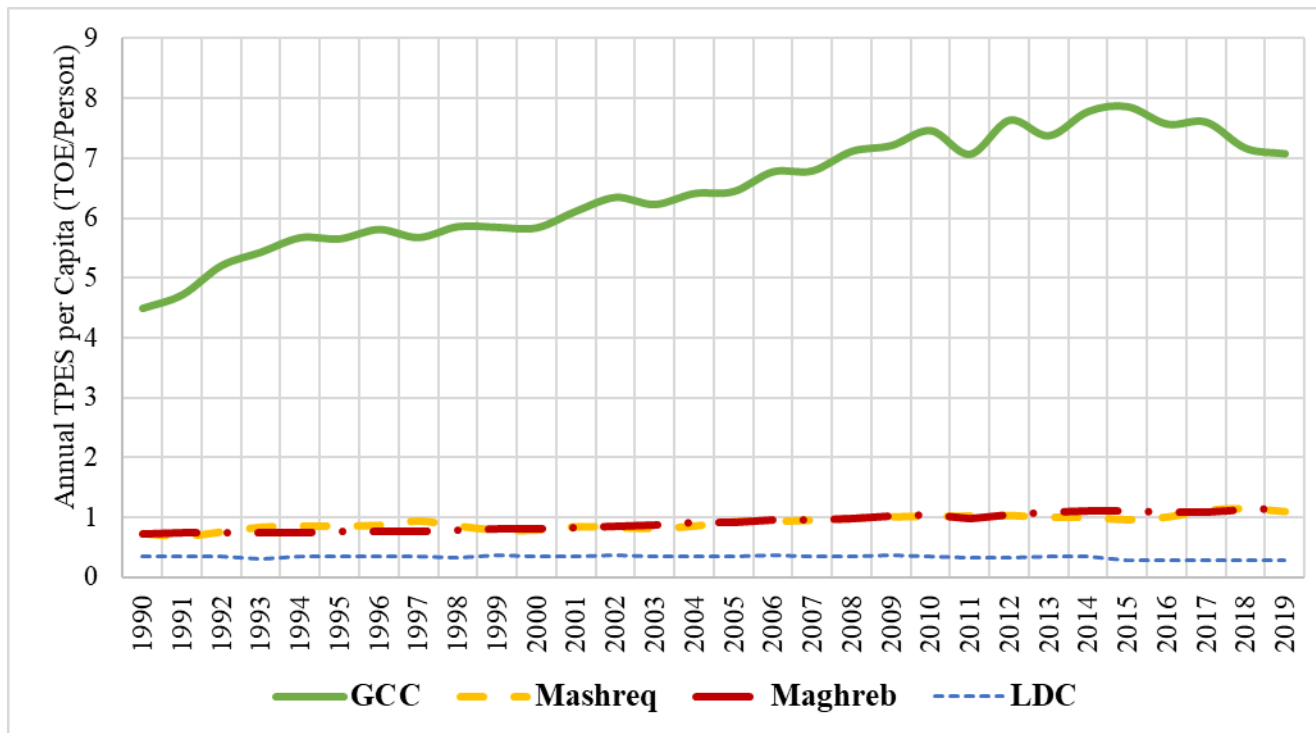
# Primary Energy Use Trends

Between 1990 and 2019, the Arab region has decreased its energy productivity (inverse of energy intensity).



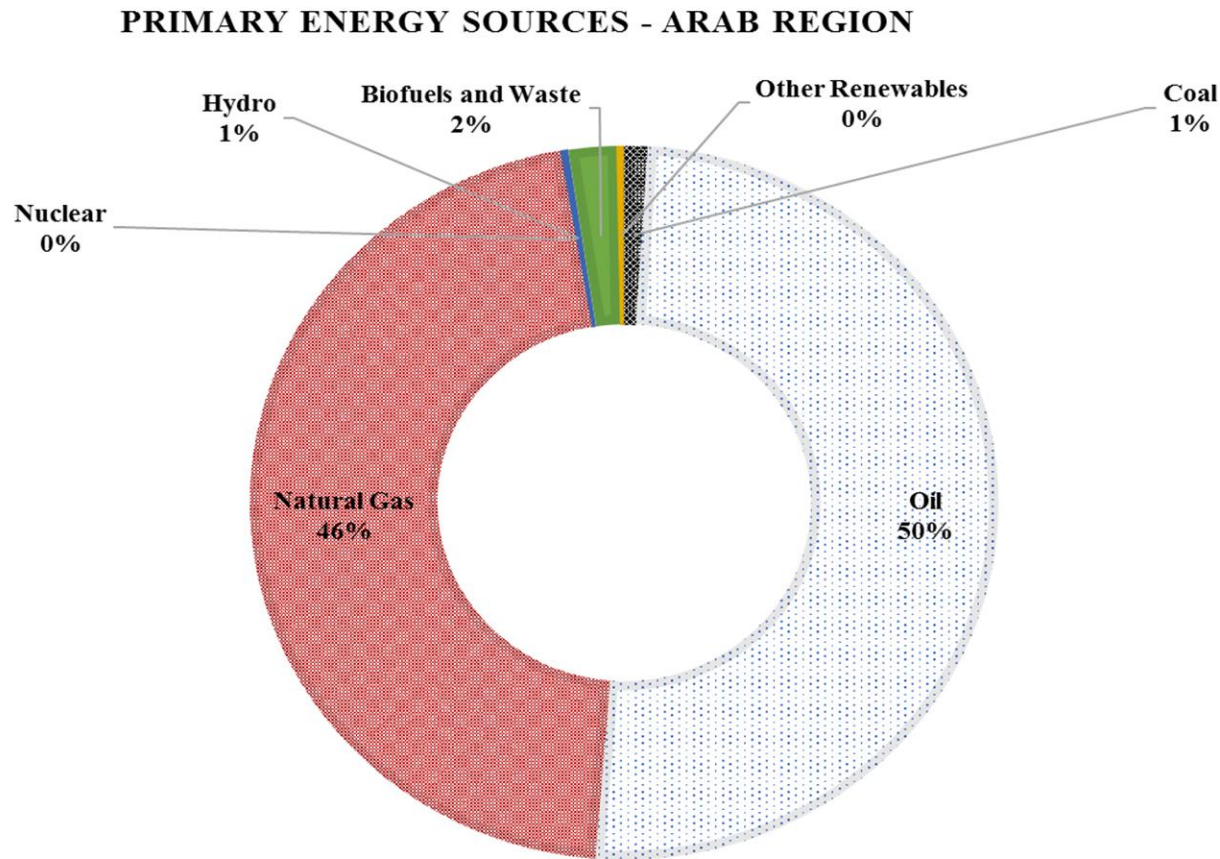
# Primary Energy Use Trends

Per capita energy consumption within the Arab region varies significantly between countries and sub-regions



# Primary Energy Use Trends

Arab region relies heavily on fossil fuels

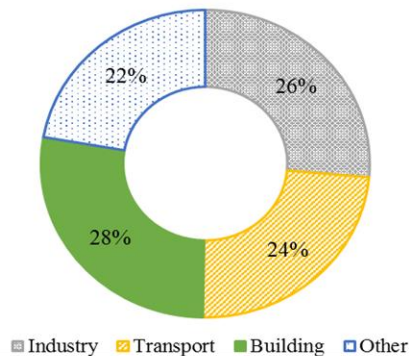




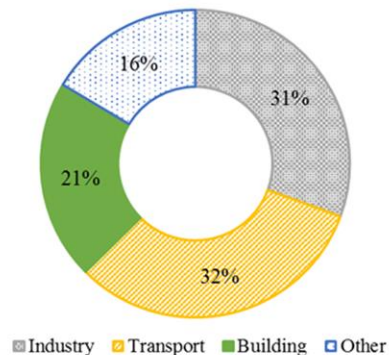
# Building Sector Energy Use

**Buildings consume 28% of the total primary energy supply (TPES) and 21% of the total final energy consumption (TFEC) in the Arab region.**

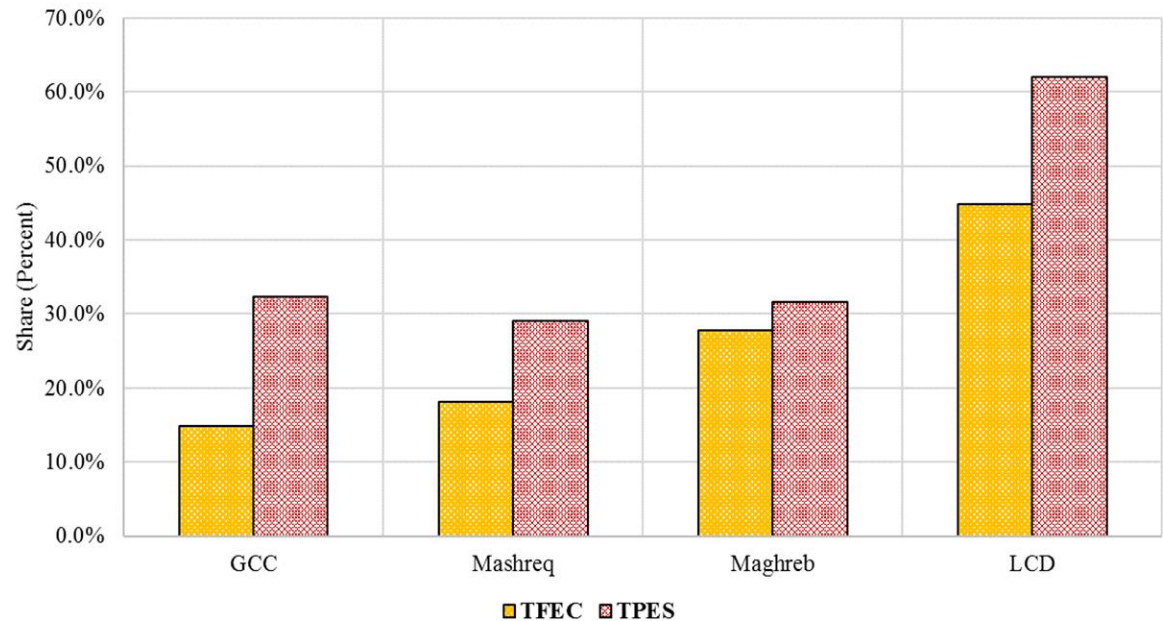
Arab Region (TPES)



Arab Region (TFEC)



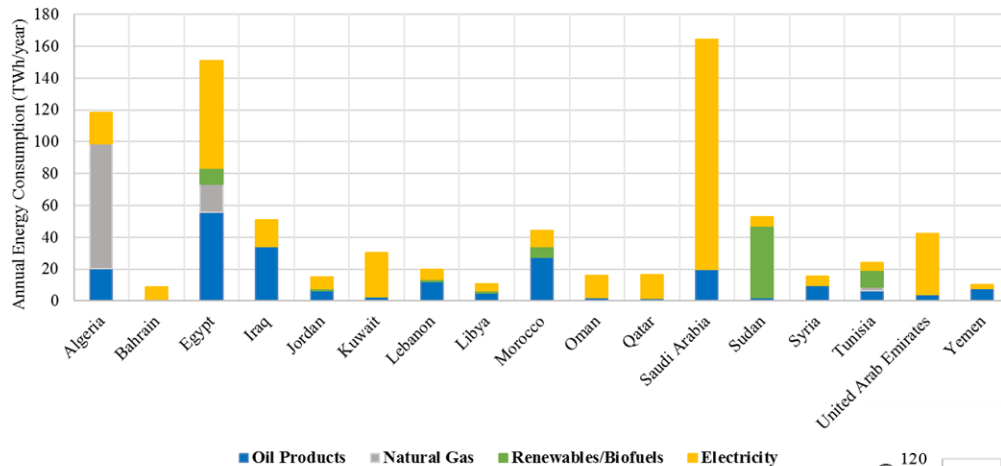
Share of Building Sector in TPES and TFEC - Arab Sub-Regions



# Building Sector Energy Use

**Electricity is the predominant energy source for the building sector in the Arab region**

Energy Consumption by Residential Buildings



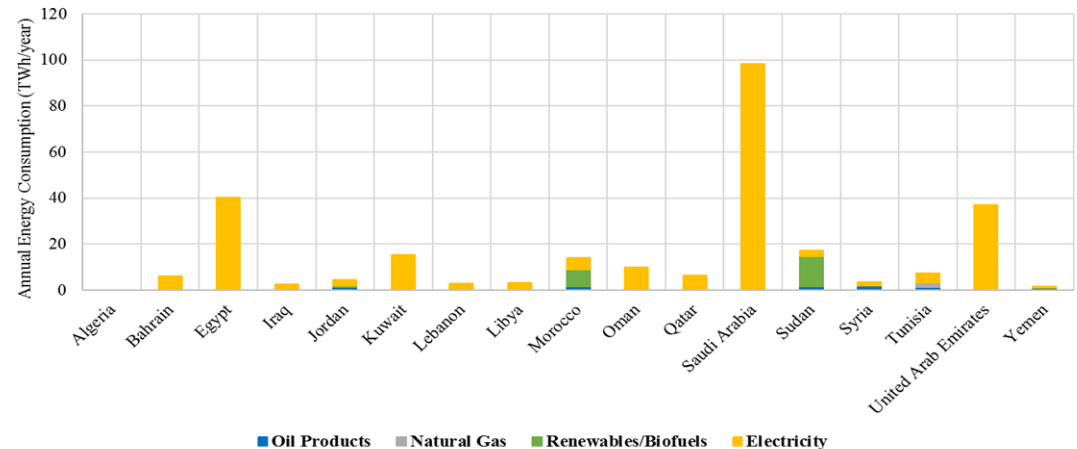
## Residential Buildings:

- All: 790 TWh/year
- Electricity: 397 TWh/year
- Saudi Arabia: 164 TWh/year

## Non-Residential Buildings:

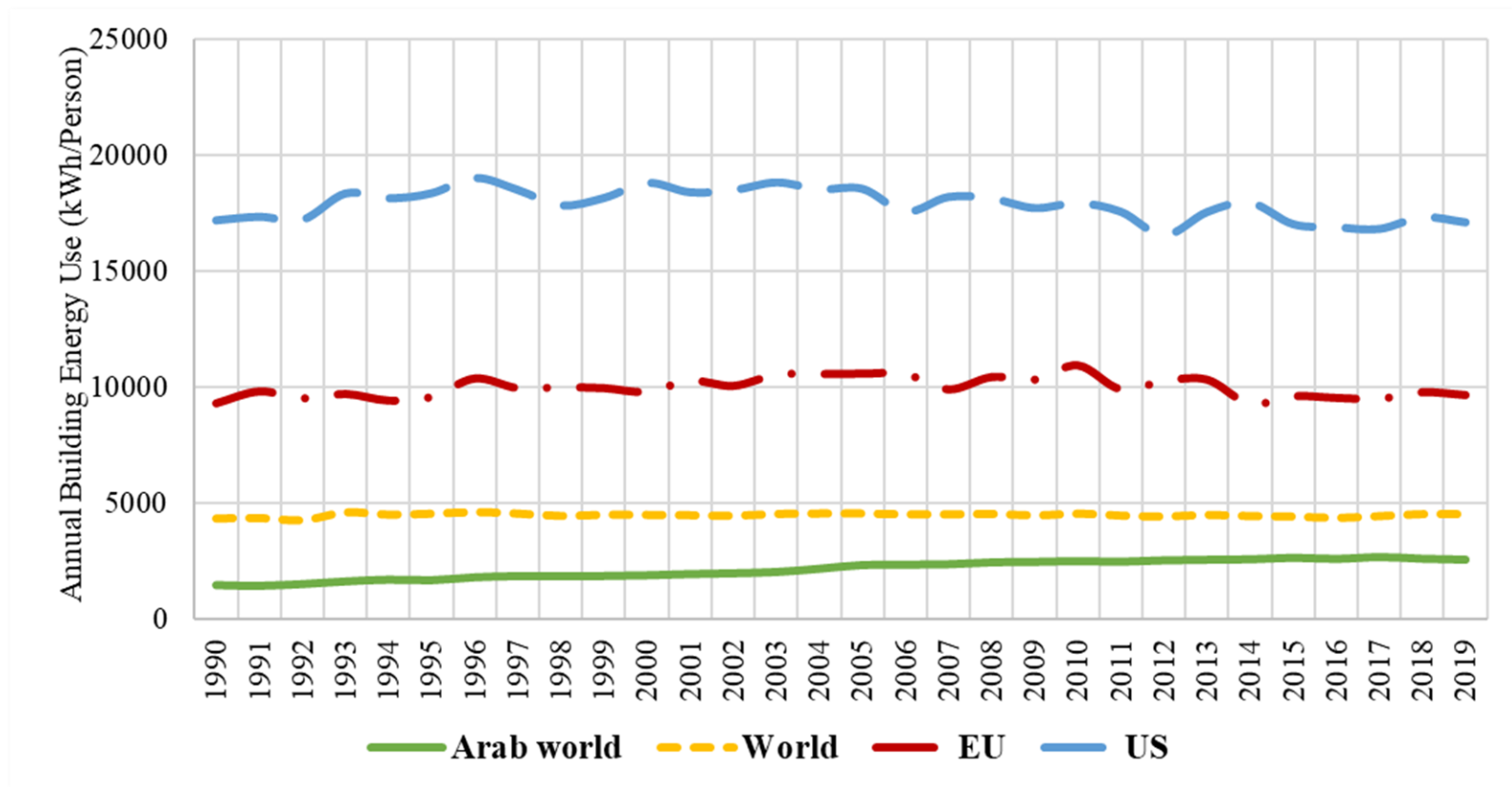
- All: 271 TWh/year
- Electricity: 239 TWh/year
- Saudi Arabia: 98 TWh/year

Energy Consumption by Commercial and Public Services Buildings



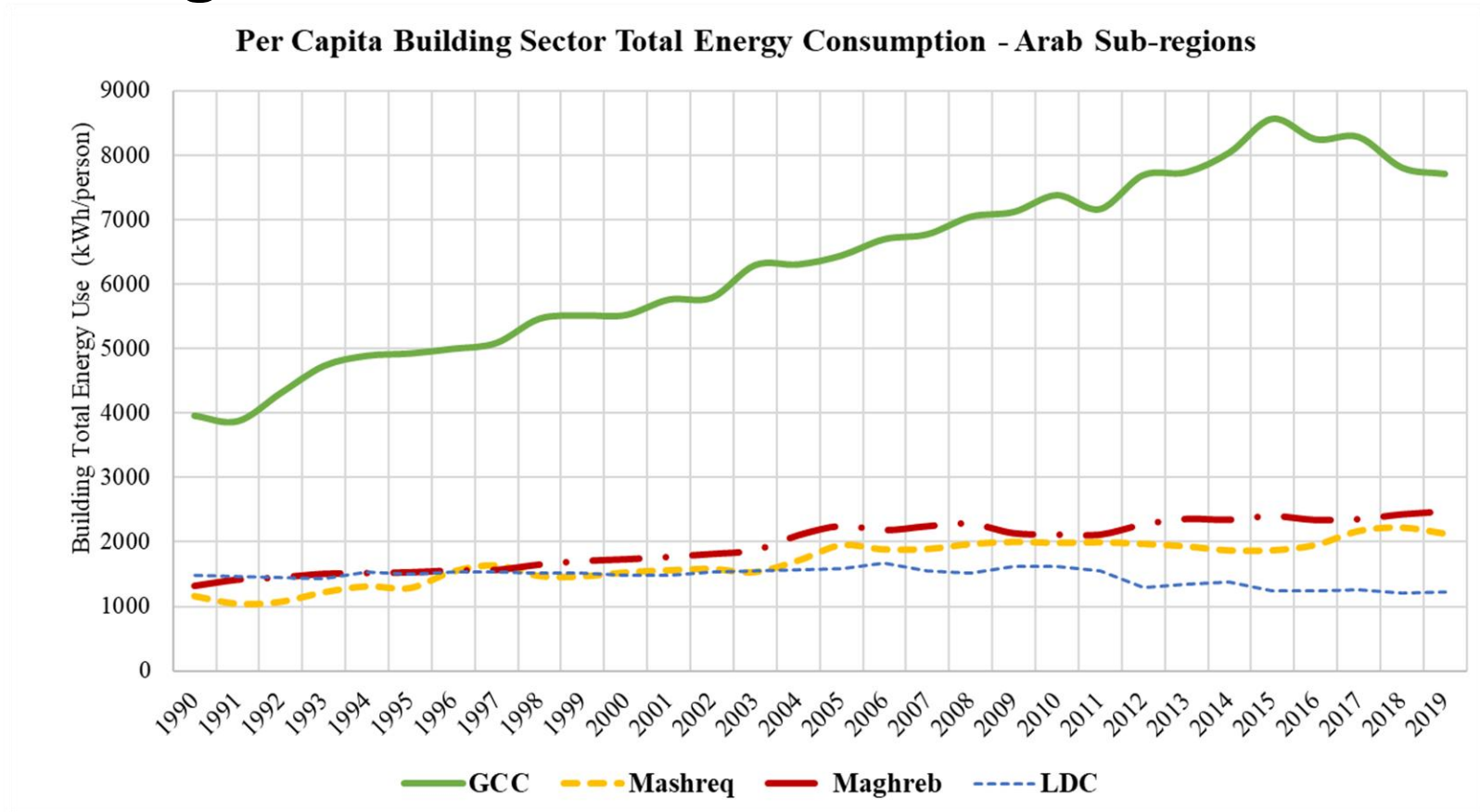
# Building Sector Energy Use

Per capita energy use for the building sector has been increasing for the overall Arab Region but remaining below the World averages



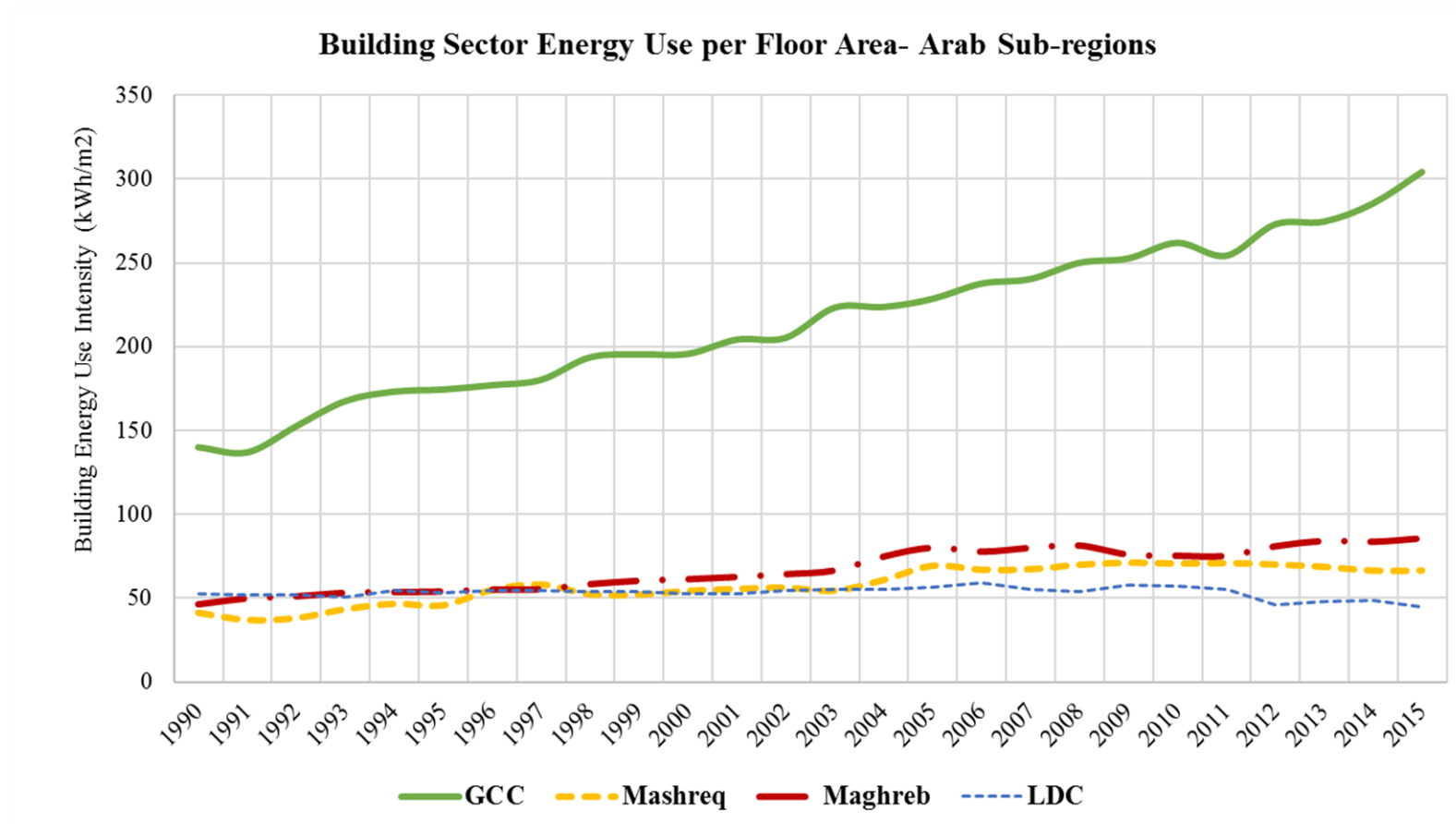
# Building Sector Energy Use

However, the per capita energy use trends vary significantly among the sub-regions within the Arab region



# Building Sector Energy Use

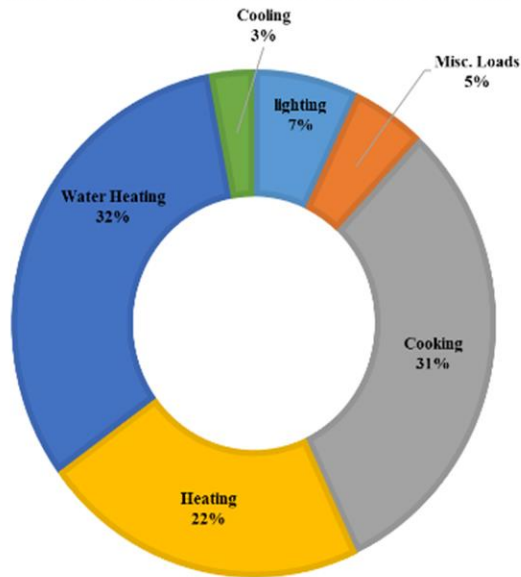
Similarly, the energy use per unit floor area trends vary significantly among the sub-regions within the Arab region.



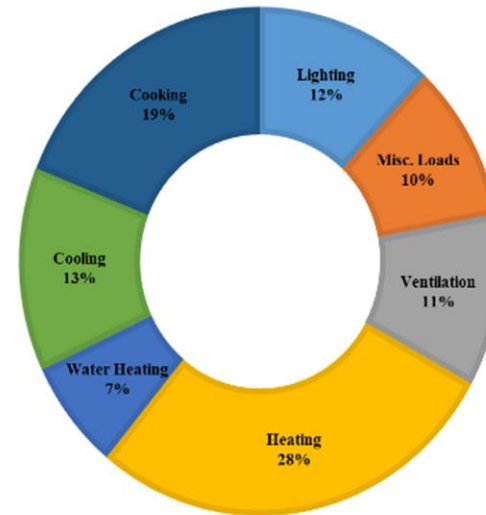
# Building Sector Energy Use

Water heating, space heating and air conditioning, as well as cooking are the main end-uses for residential and non-residential buildings in the Arab region.

ENERGY END-USES FOR RESIDENTIAL BUILDINGS - ARAB REGION



ENERGY END-USES FOR NON-RESIDENTIAL BUILDINGS - ARAB REGION



# Energy Efficiency Standards

- **Building Energy Efficiency Codes (BEECs) for new constructions: Several Arab countries**
- **Minimum Energy Performance Standards (MEPS) for household appliances, air conditioners, and lighting: Some Arab Countries**
- **Energy Efficiency Programs for existing buildings: Very few Arab countries**

# ENERGY EFFICIENCY POTENTIAL FOR BUILDINGS

*References:* Several sources including, M. Krarti, Evaluation of Large-Scale Energy Efficiency Potential for the Building Sector in the Arab Region, *Energies*, 12(22) (2019), Article 4279. [doi.org/10.3390/en12224279](https://doi.org/10.3390/en12224279)



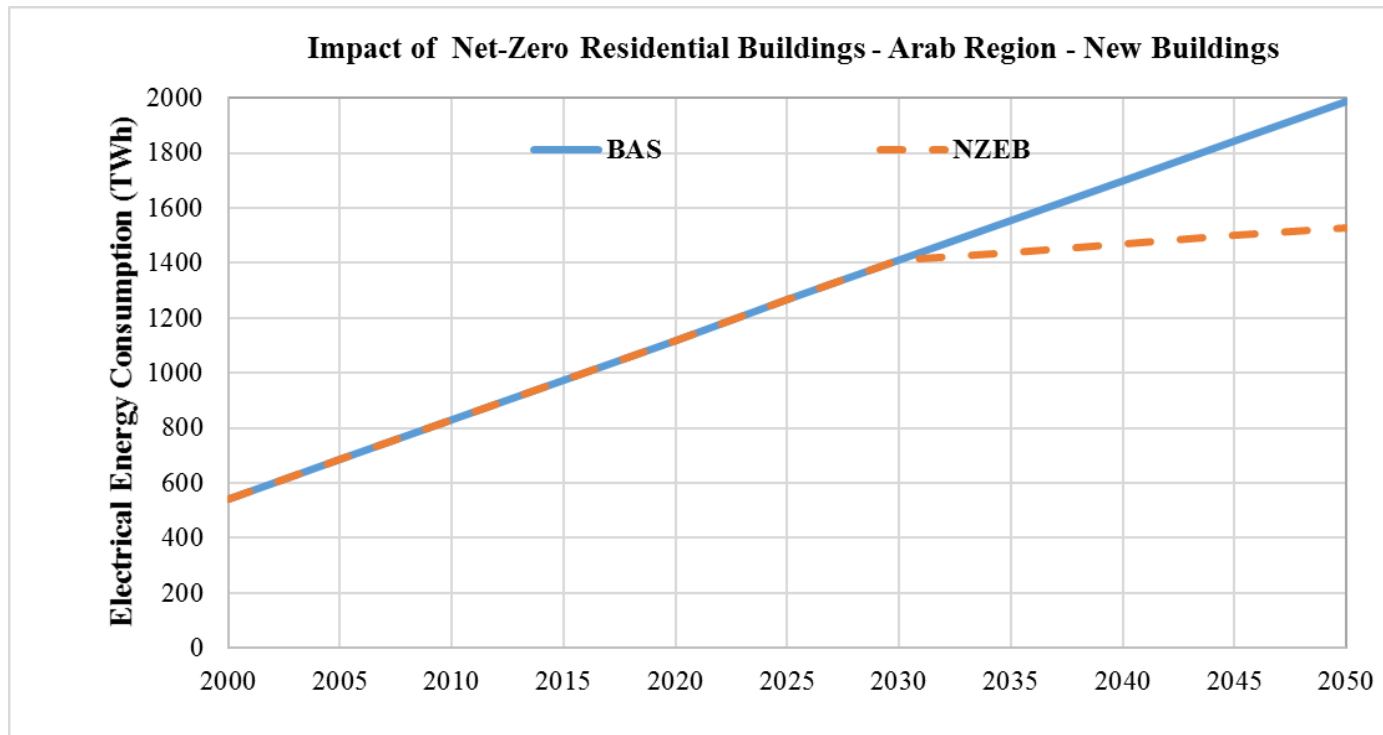
# Enforcement of Building Energy Efficiency Codes

**Deployment and enforcement of a more stringent and integrated BEECs in the Arab region**

<b>Building Type</b>	<b>Annual Energy Use Savings (TWh/yr)</b>	<b>Peak Demand Savings (MW)</b>	<b>Annual CO<sub>2</sub> Emissions Savings (Million Tonnes/yr)</b>
Residential Buildings	9.490	1543	2.960
Commercial and Public Buildings	3.249	528	1.014
<b>Total</b>	<b>12.739</b>	<b>2071</b>	<b>3.974</b>

# Adoption of Net-Zero Energy Buildings

Requiring net-zero energy building (NZEB) for all new residential buildings can substantially lower energy consumption



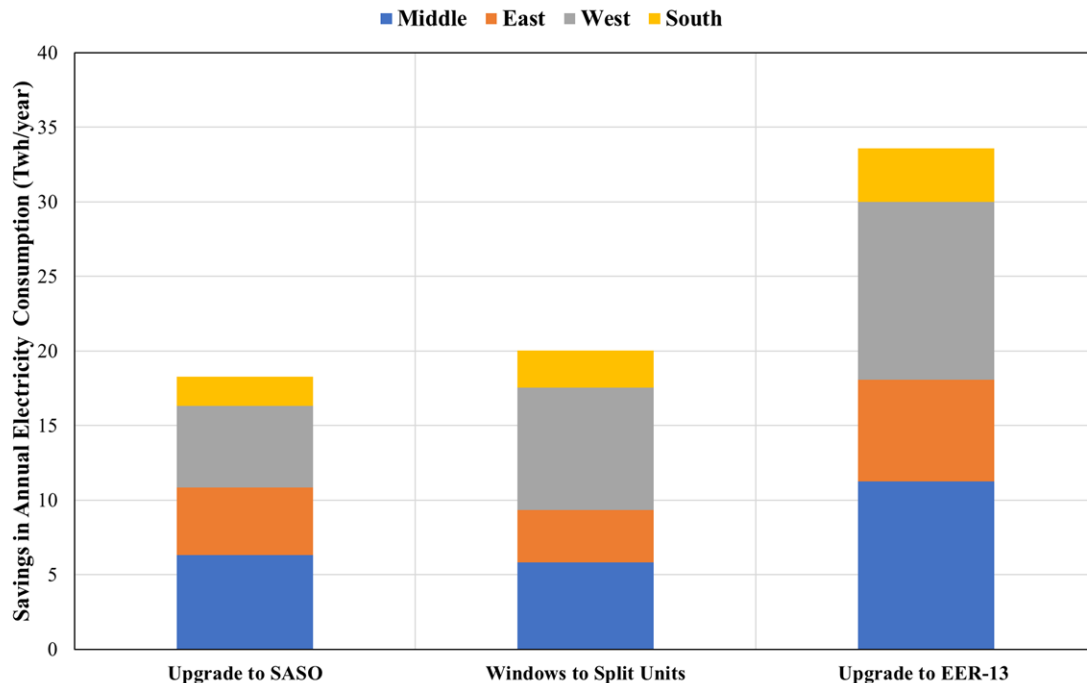
# Adoption of Minimum Energy Performance Standards (MEPS)

## Enforcement of MEPS specific to lighting and household refrigerators

Equipment	Electricity Use (TWh/year)		Energy Cost (USD Million/year)		Carbon Emissions (Million Tonnes/year)	
	2025	2030	2025	2030	2025	2030
Lighting	25.756	26.847	1461.1	1510.7	18.517	19.213
Refrigerators	6.972	13.851	357.5	721.8	4.358	8.756

# Adoption of Minimum Energy Performance Standards (MEPS)

Case Study of High Efficiency Air Conditioning (HEAC) Program in Saudi Arabia (a discount of 900 SAR for any AC unit of EER > 13)

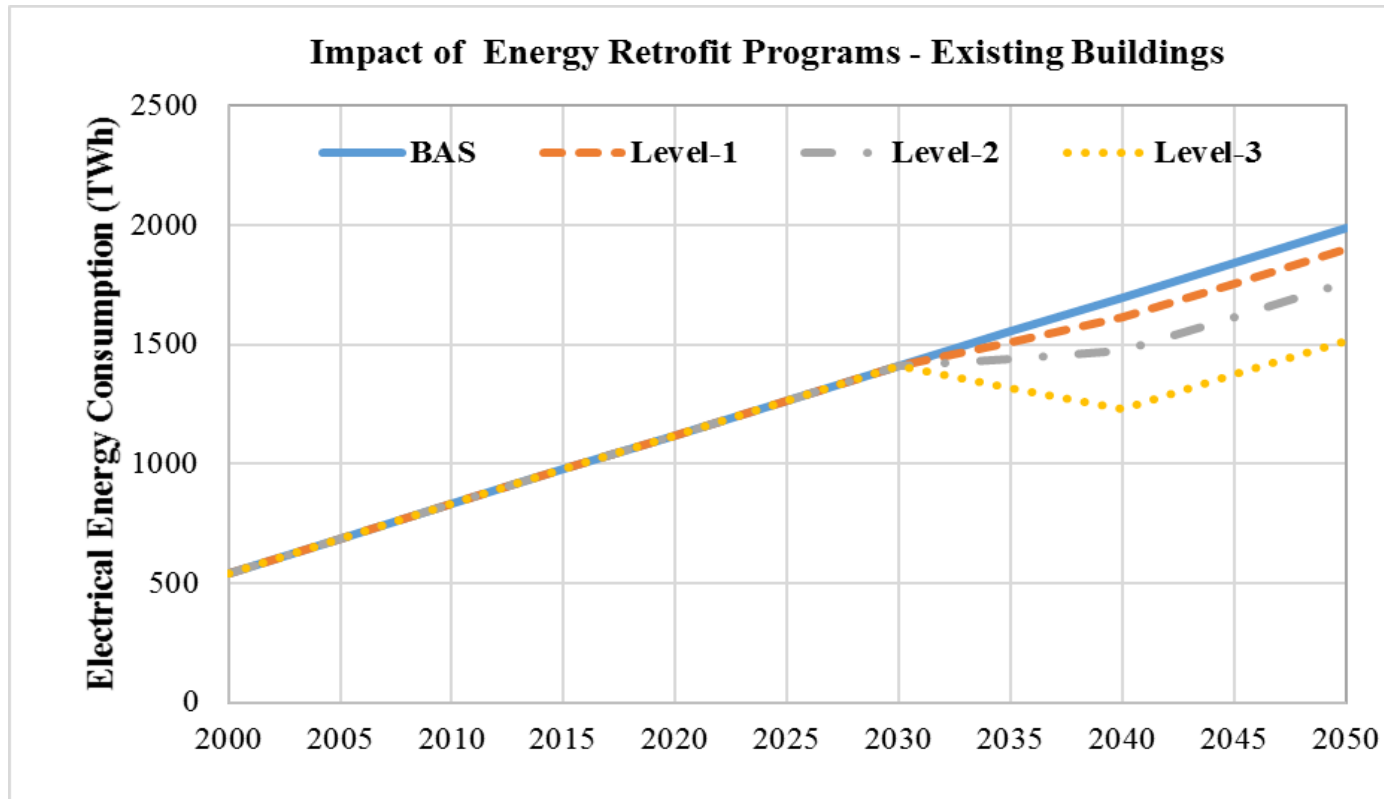


The program can pay for itself in less than 2 years

Action	Saudi Arabia
Cost of the Incentive Program (Billion USD)	5.95
Annual Fuel Savings (Million of BOE/year)	55.49
Annual Income from Fuel Sales (Million USD/year)	3.00
Simple Payback Period (Years)	1.99

# Retrofit of Existing Buildings

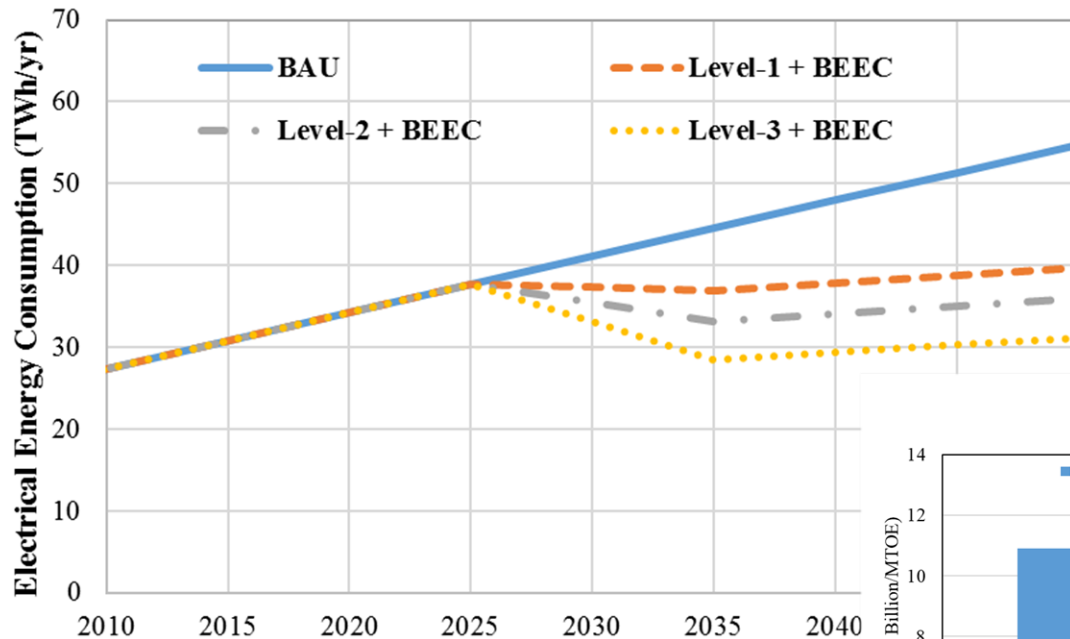
Implementation of large-scale EE retrofit programs for existing building stocks



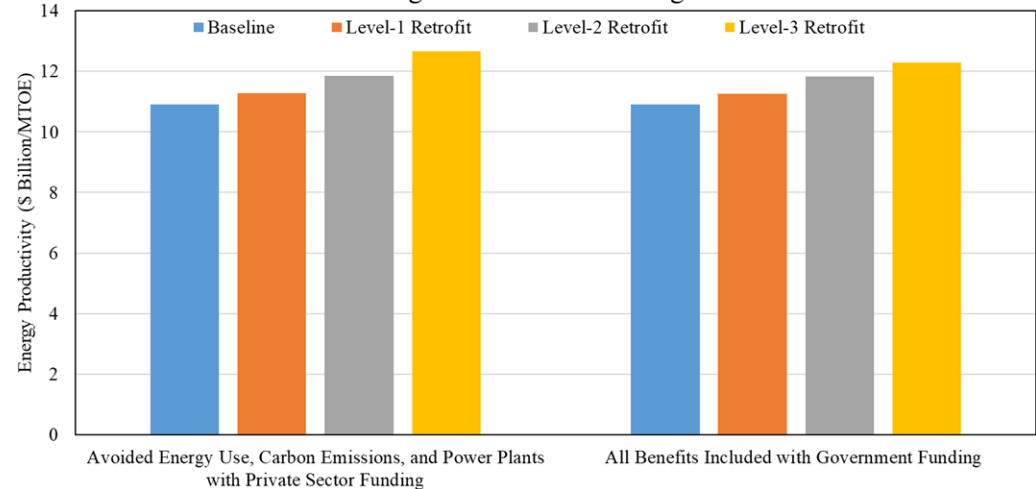
# Retrofit of Existing Buildings

## Case Study of Tunisia – Impact on Energy Productivity

Impact of Energy Retrofit Programs - New and Existing Buildings



Building Sector Energy Productivity for Tunisia  
Retrofit Program for Entire Building Stock



# Other Programs and Initiatives

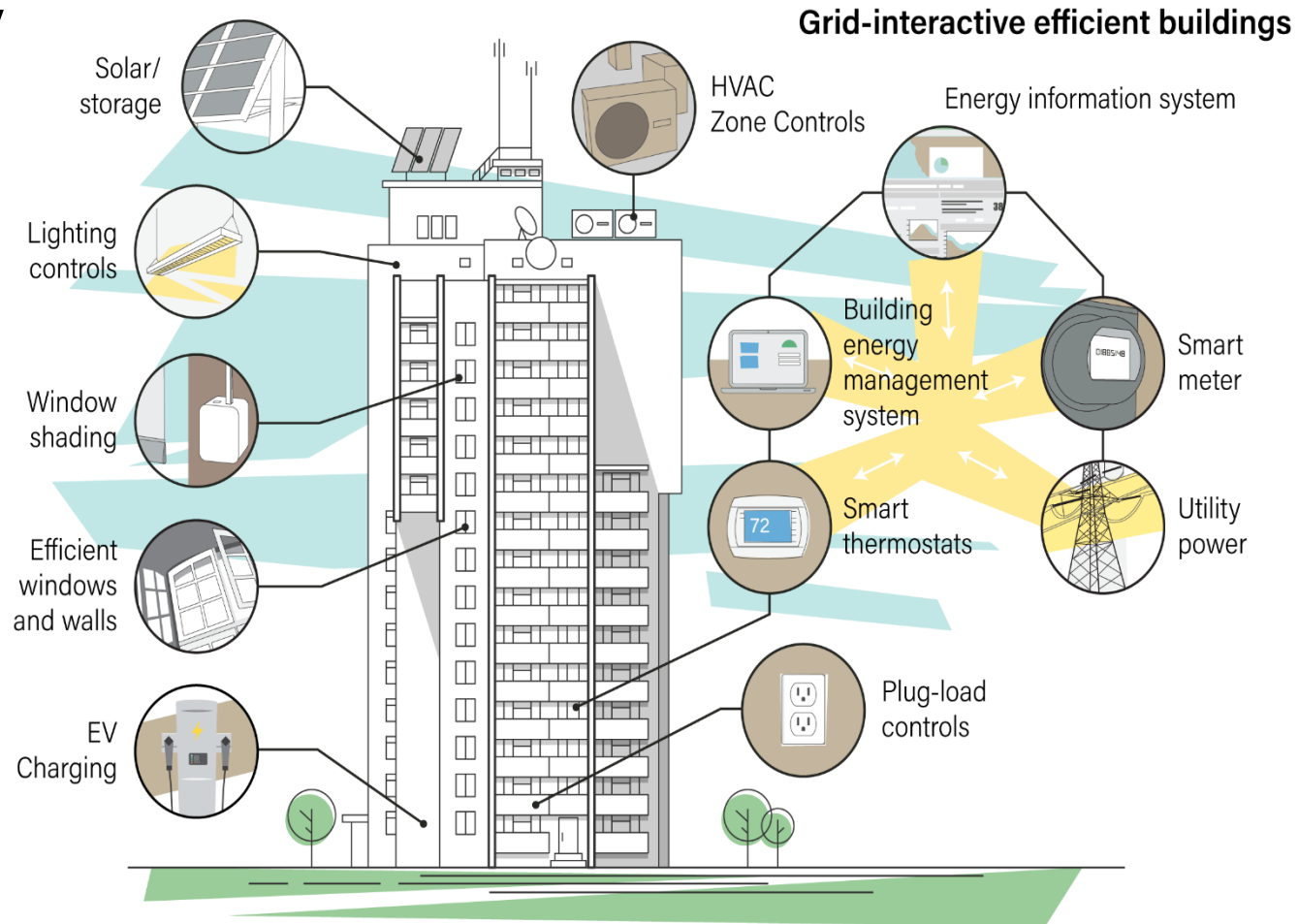
**A wide range of actions and technologies are transforming buildings to be sustainable, residential and smart:**

- ❑ Grid-interactive Efficient Buildings (GEBs)**
- ❑ Grid-Connected Communities (Microgrids)**
- ❑ Electrification of Buildings and Cities**
- ❑ Decarbonization of Buildings**
- ❑ Resilient Buildings and Communities**

# Grid-interactive Efficient Buildings (GEBs)

- ❑ Energy Efficiency
- ❑ Load Shedding
- ❑ Load Shifting
- ❑ Modulation
- ❑ Generation

**GEB Technologies:  
Dynamically Shape  
Building Load**

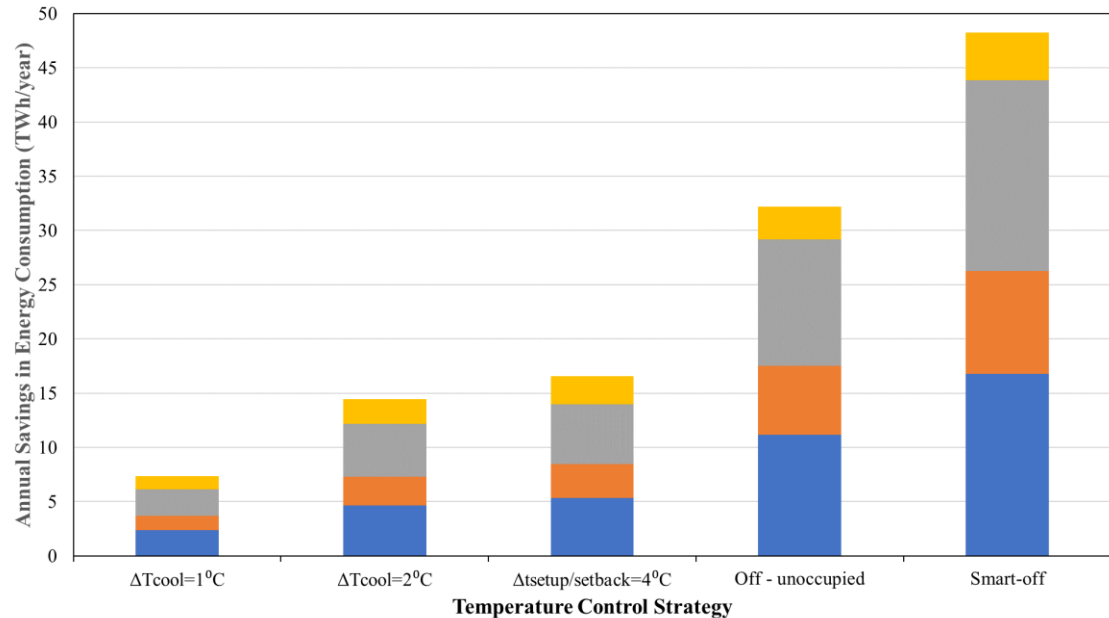
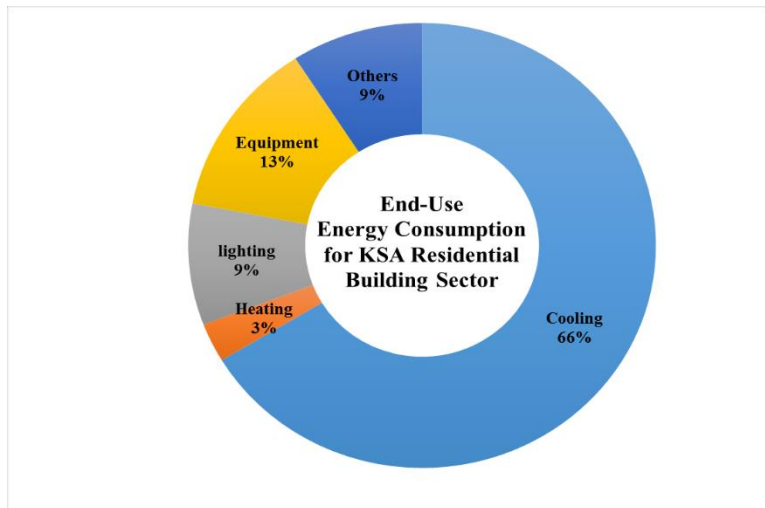
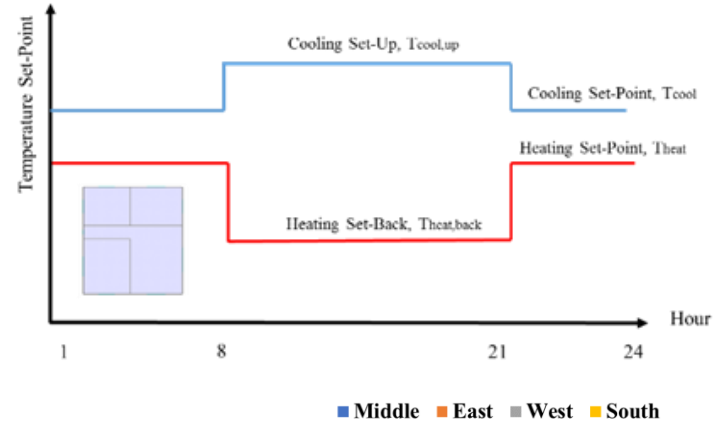
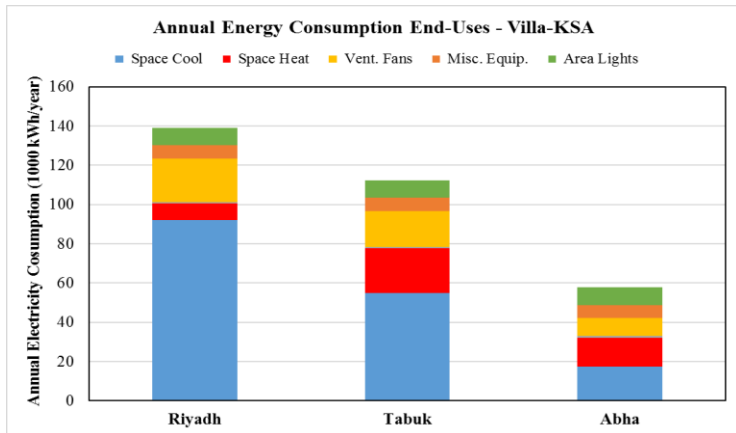


Source: ACEEE, 2020



# Examples: Smart Thermostats

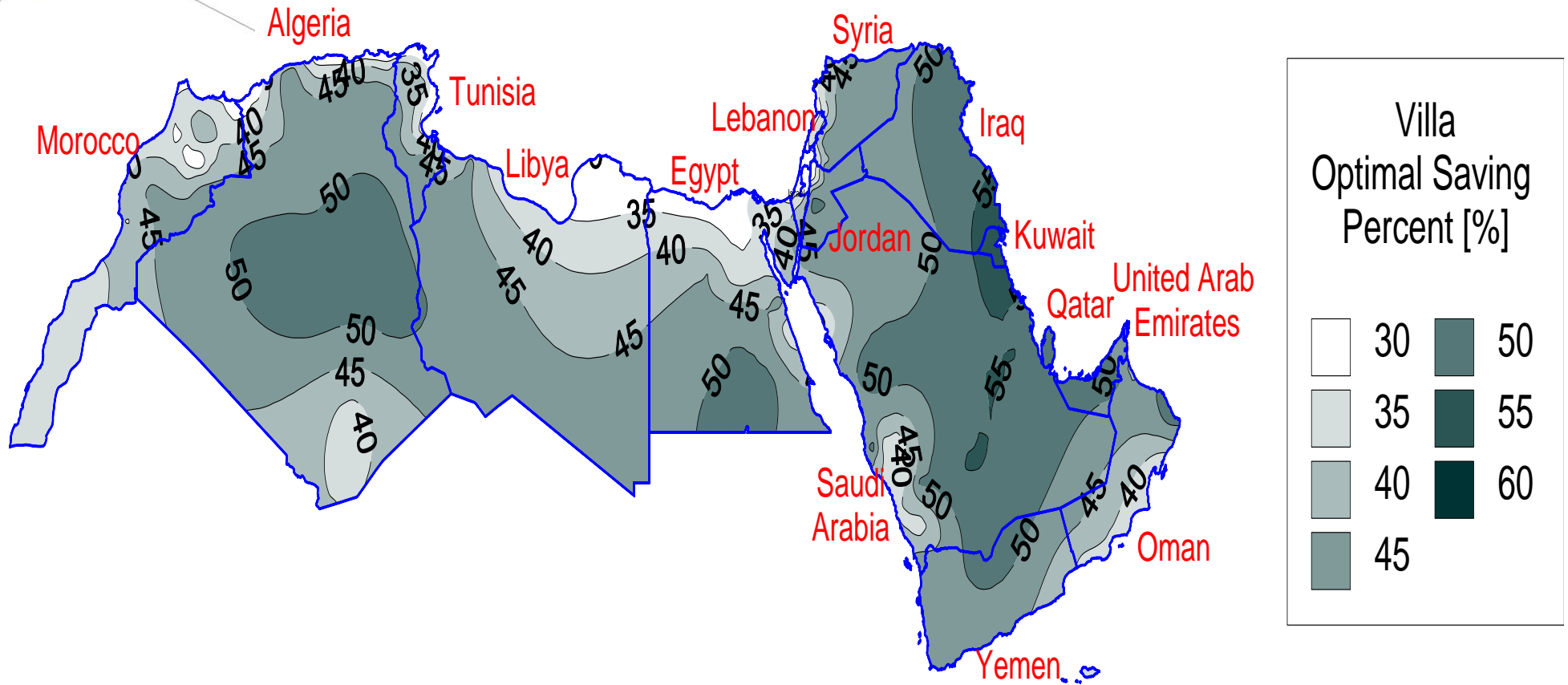
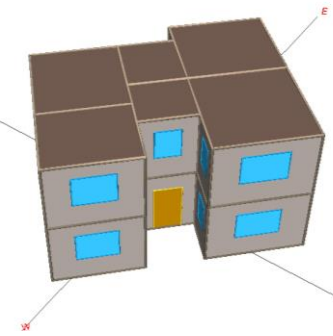
## Use of Smart Controls – Case of KSA



# Examples: Optimal Design of Villas in MENA

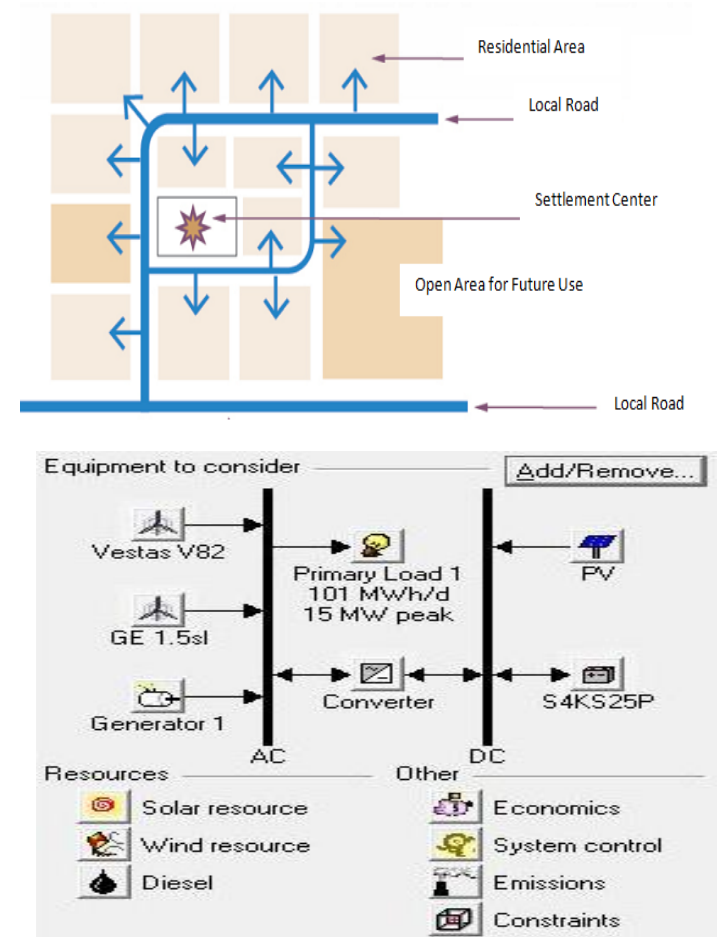
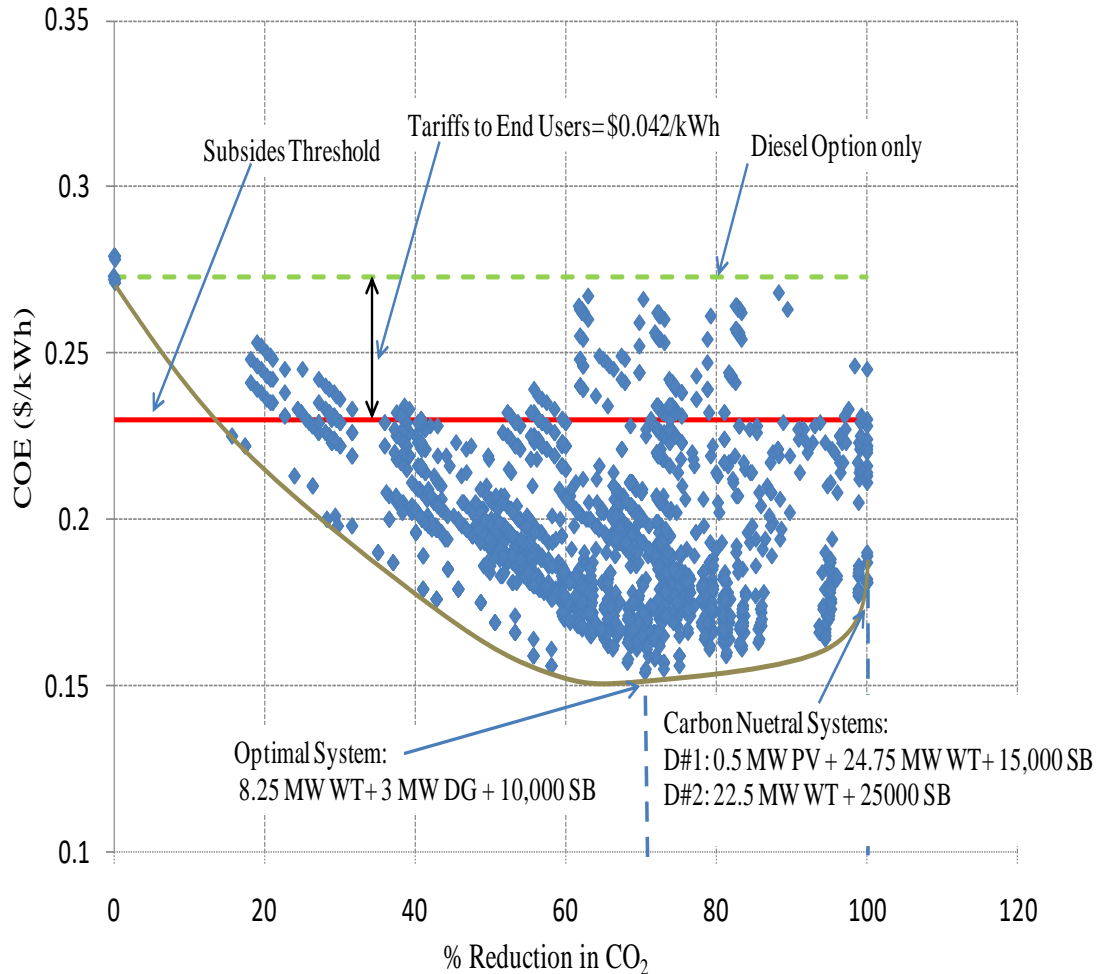
## Potential Annual Energy Use Savings

(Based on Life-Cycle Cost Analysis)



# Examples: Carbon Neutral Islanded Communities

## Residential Community, Masirah Island, Oman



# **CHALLENGES AND OPPORTUNITIES**

# Challenges for Energy Efficiency

- **Financial Challenges** (end-user low energy prices, lack of financial incentives)
- **Energy Policies** (not existing or not ambitious, limited capacity for enforcing adopted regulations)
- **Technical Skills** (lack of R&D support, limited specialized institutions for training the needed skilled workforce)

# Opportunities for Energy Efficiency

- **Global interest in decarbonization due to climate change (buildings are important sources of GHG emissions)**
- **Decreasing cost of renewable energy technologies (buildings can generate energy on-site)**
- **Digitalization of building construction and operation (smart equipment and controls improve efficiency)**
- **Adoption of a product-based construction of buildings (instead of currently inefficient project-based process to construct buildings)**

# CONCLUDING NOTES

- **Significant potential exists in the Arab region to improve the energy efficiency of buildings**
- **With the support of financial and regulatory policies, a significant part of this potential can be realized**
- **Adoption of current market transformations provide an alternative opportunity for the Arab region to improve the energy efficiency of all its sectors including buildings**

# Middle East Solar Decathlon, 2021





# CU Homes, Winners of Solar Decathlon

2021



2005



2002



Shared Prosperity Dignified Life



# Thank you

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