



الجمعية العلمية الملكية
Royal Scientific Society



Energy Efficiency; Current Trends and Future Perspectives in Jordan

International Workshop
“Cooperation between EU and Mediterranean Partner Countries in Energy Sector”
Athens: 22-23/2/2016

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Content

1. Introduction to Jordan's Energy Situation
2. Buildings Energy Consumption & Current trends
3. Buildings Codes
4. Potential of EE in Buildings & Benchmarks
5. Implementation Capacity In Jordan

Amman

An aerial photograph of Amman, Jordan, showing a dense urban landscape with numerous high-rise buildings and a prominent blue dome structure. The city is built on a hillside, and the background shows a vast expanse of residential and commercial buildings under a clear blue sky.

Jordan

- **Area: 90,000 km²**
- **Population > 9 million (2015)**
- **Climate: semi-arid**
- **Average of rainfall falling per year: 8,300 MCM**
- **Sea Port: Aqaba**
- **GDP: around 30 bn € (2014)**



ENERGY IN JORDAN

IMPORTANT FIGURES, 2014

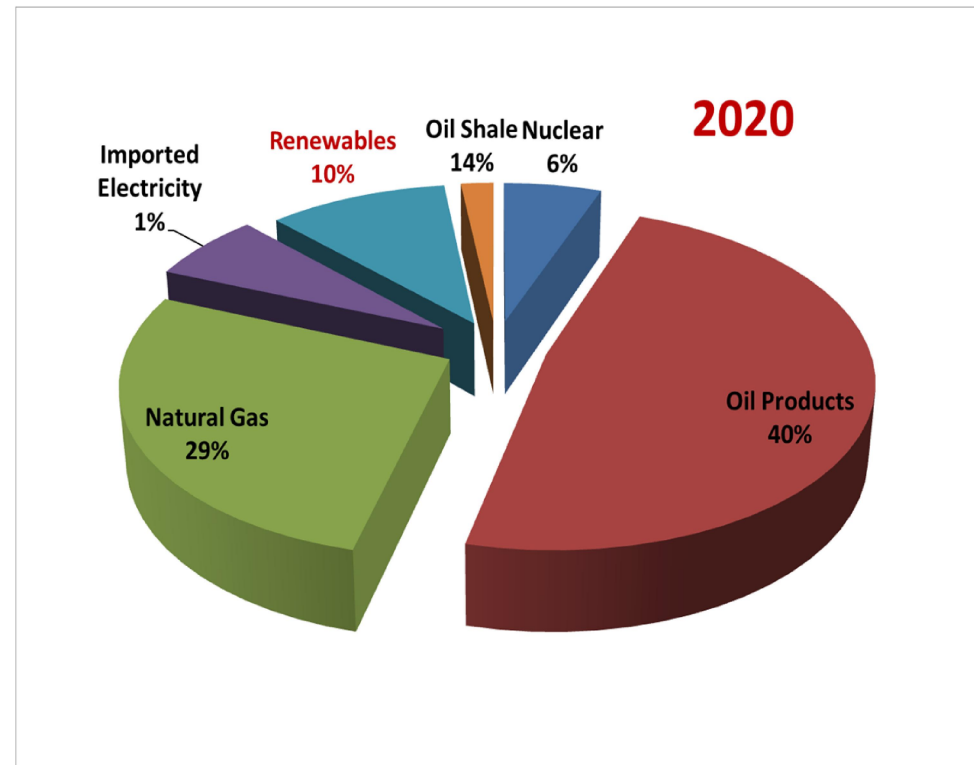
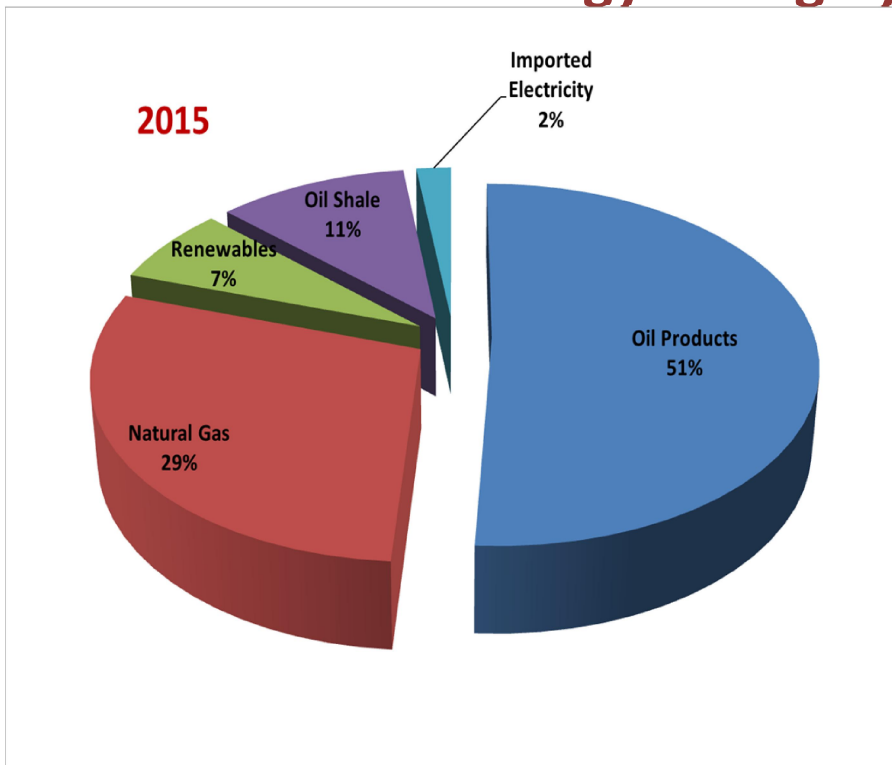
➤ Primary Energy Consumption	8.2 Mtoe
➤ Imported Crude Oil	7.1 Mtons
➤ Imported Natural Gas	867.5 mcm
➤ Generated Electricity	17287 GWh
➤ Consumed Electricity	14564 GWh
➤ Imported Electricity	380 GWh
➤ Peak Demand	3100 MW
➤ Cost of Imported Energy	around 5 bn €
➤ Imported Energy Bill	17% of GDP
➤ Per Capita Primary Energy Consumption	1249 kgoe
➤ Per Capita Electricity Consumption	2235 KWh
➤ Energy Intensity (kgoe/1000 JD)	208

Current and Evolving Policies

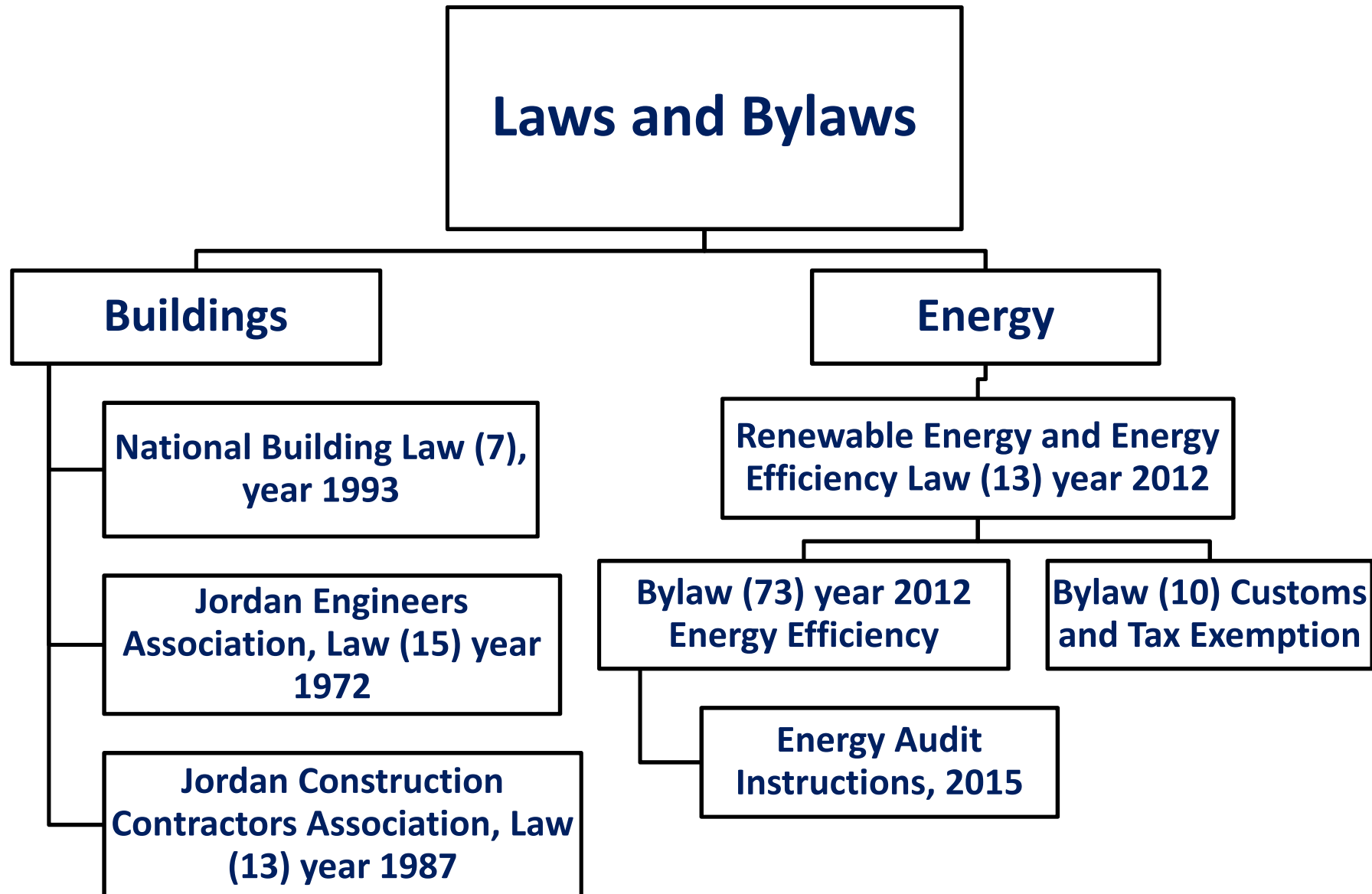
- Tax and customs exemptions granted to RE and EE, 2008
- Renewable Energy & Energy Efficiency Law, 2012
- The Reference Price List which includes the indicative prices for each type of Renewable Source
- Sale of Electrical Energy generated from Small RE Systems (Net Metering – Roof Tops)
- Cost of Connecting RE Facility to Distribution Grid
- Electric Power Wheeling Directives
- Jordan Renewable and Energy Efficiency FUND (JREEEF) designed to mobilize and provide financial and technical support
- Energy Efficiency By-Law
- Energy Efficiency Code
- Solar Energy Code
- Insulation Code
- Green Building Manual

Jordan's Energy Strategy for 2020

- Jordan is committed to increasing the share of Renewable Energies to 10% in 2020
- Major share of RE is to come from Wind Power (1,200 MW) and Solar Power (600 MW), in particular CSP
- **Achieve 20% energy saving by 2020.**



Regulatory Framework (Buildings and Energy)



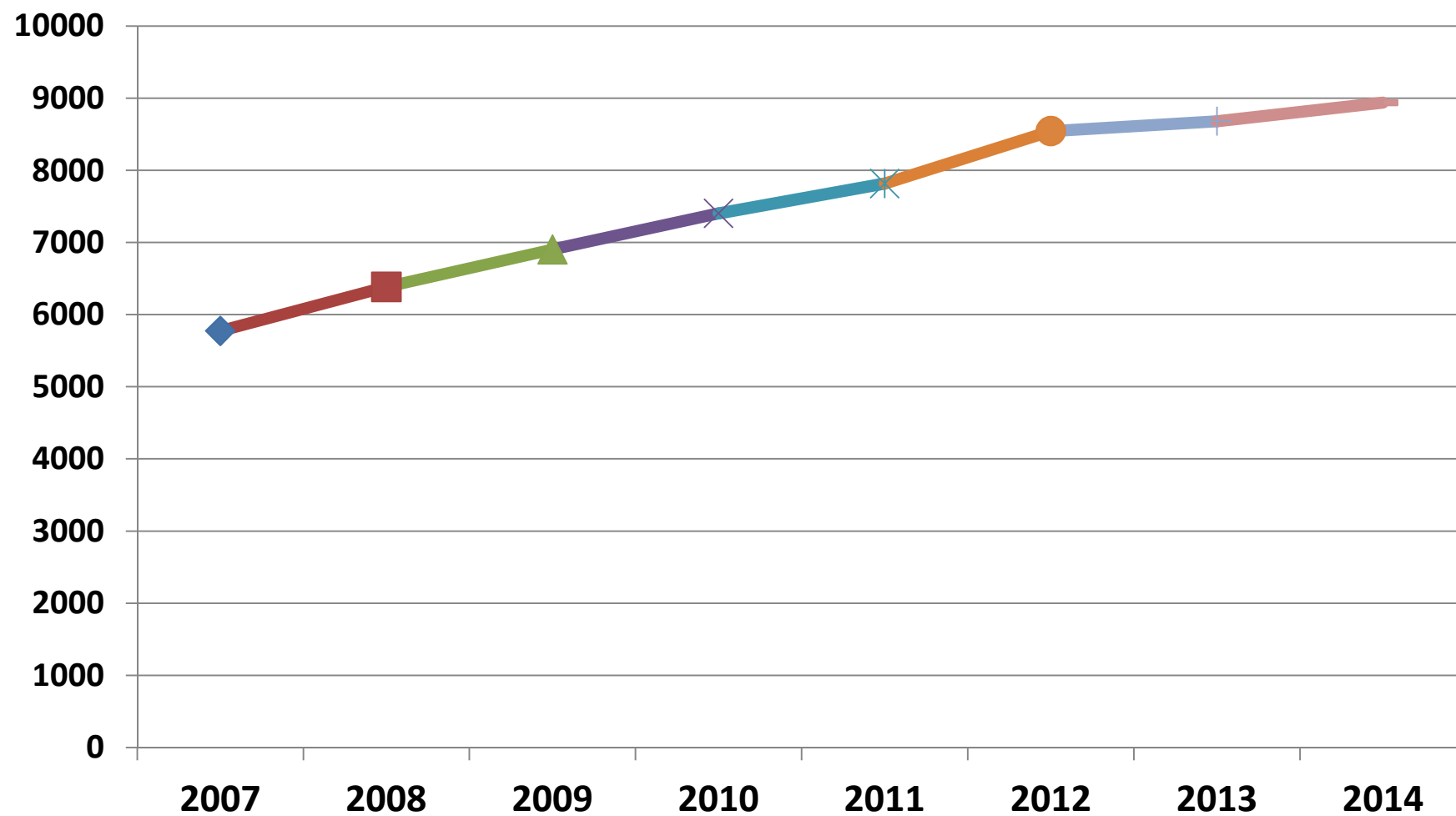
Buildings (Commercial, Public and Residential) consumes more than

60%

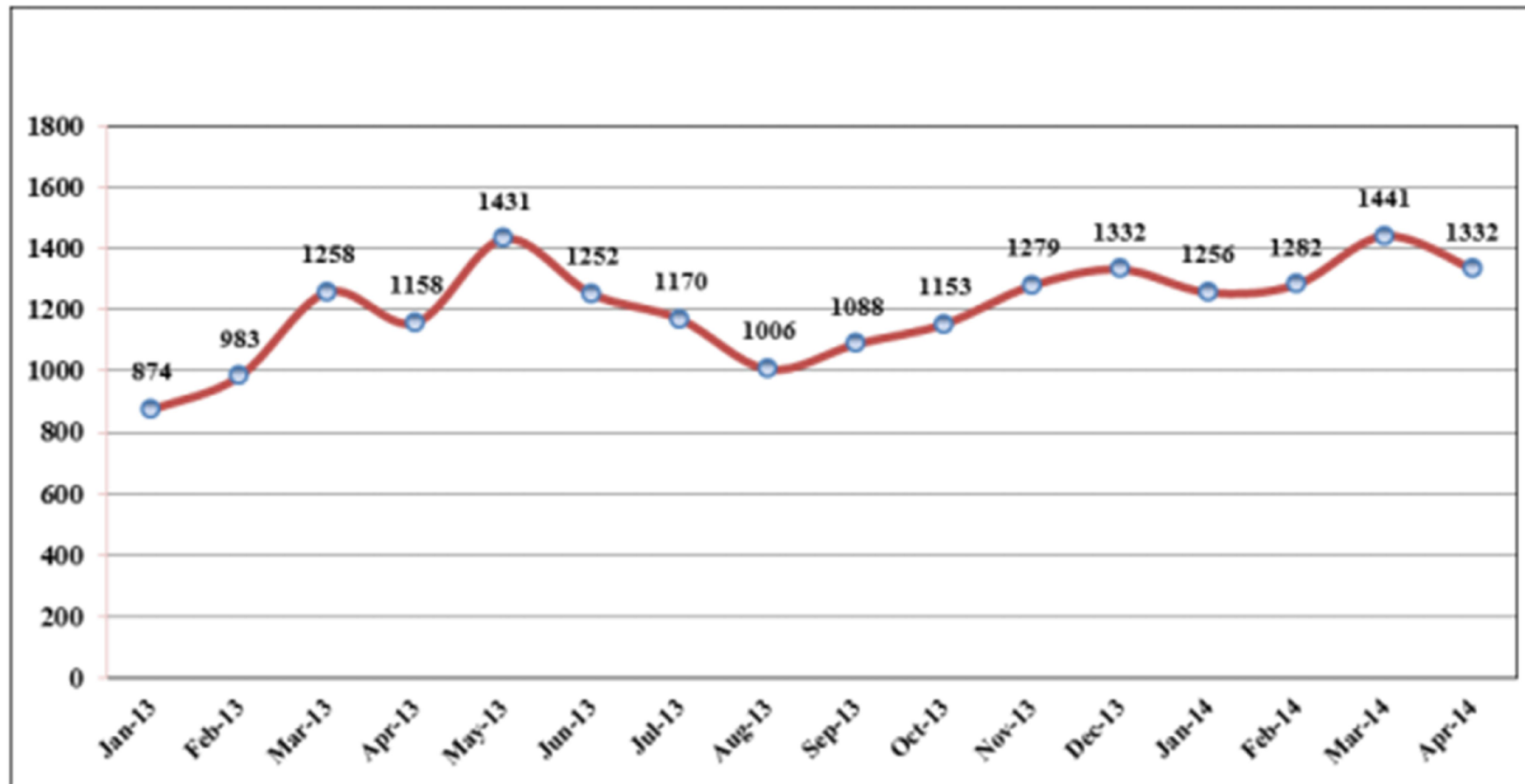
**of the total electricity consumed
in Jordan**

**Every Facility consumes more than 50
toe/ year shall carry out an Energy
Audit**

Buildings' Sector Consumption of Electricity over the last 8 years in Jordan (GWh)



Licensed Buildings 2013-2014 (m²)



http://www.dos.gov.jo/dos_home_a/main/archive/Buildings/2014/Building_may.pdf

Jordanian codes that are related to EE in buildings

- 1. Energy efficiency buildings code**
- 2. Solar energy code**
- 3. Thermal insulation code**
- 4. Green Building Manual**

Energy efficiency Buildings code

- 1. Design with Passive Techniques (Climatic Design)**
 - Utilizing the surrounding environment in optimal way for human comfort.
- 2. Building envelope**
 - Using thermal insulation and double glaze.
- 3. HVAC equipment**
 - Minimum energy efficiency of Air Conditioners was defined in the Code (split unit, heat pump and package unites)
 - Balanced calorimetric AC lab was built in RSS to measure Seasonal Energy Efficiency Ratio (SEER) and to evaluate Energy Efficiency Labels.

Energy efficiency buildings code

4. Water heating systems

- Minimum efficiency for water heaters and boilers was defined for each type.

5. Lighting systems

- Control systems
- Lighting Power Density (LPD)

6. Electrical systems

- Minimum Motors efficiency.
- Power factor

Solar energy code

1. Hot Water storage tank
 - Storage type and selection.
2. plumbing systems
 - Piping net work design
 - fittings
3. Solar collector
 - Type of collector.
 - Orientation and sizing.
4. Solar water heaters types

Thermal insulation code

1. Insulation material

- Material types and properties.

2. Thermal comfort

- Heat storage
- Thermal Conductivity

3. Heat transfer calculation

- Conduction heat transfer for walls and ceiling.
- U- value.

4. Minimum U-value

Jordan's Thermal Insulation U Value for Walls

Mandatory Thermal Insulation Code Table(5-1, 5-2)	Mandatory Energy Saving Buildings Code Table(2-2, 2-3)	Mandatory Green Building Manual	Optional (1point) Green Building Manual	Optional (2 points) Green Building Manual
Solid walls = 0.57	Solid walls = 0.57	Solid walls = 0.57	Solid walls = 0.50-0.4	Solid walls = <0.4
All External walls =1.6	All External walls =1.6	All External walls =1.6	All External walls =1.45	All External walls =1.45

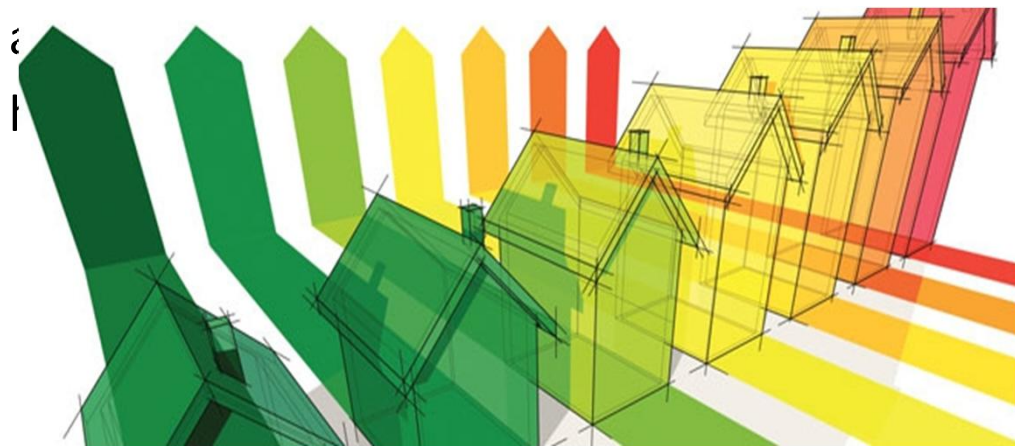
Verification & enforcement of appliance EE labels and standards

1. An international test procedures , standards and label classifications tailored to national conditions have been achieved by JSMO.
 - * Starting from July 2014, all imported appliances to Jordan Shall have the **energy label**
1. Implementation of test laboratories for different appliances products are on going at NERC.

Testing labs for domestic appliances in NERC : Energy efficiency labels

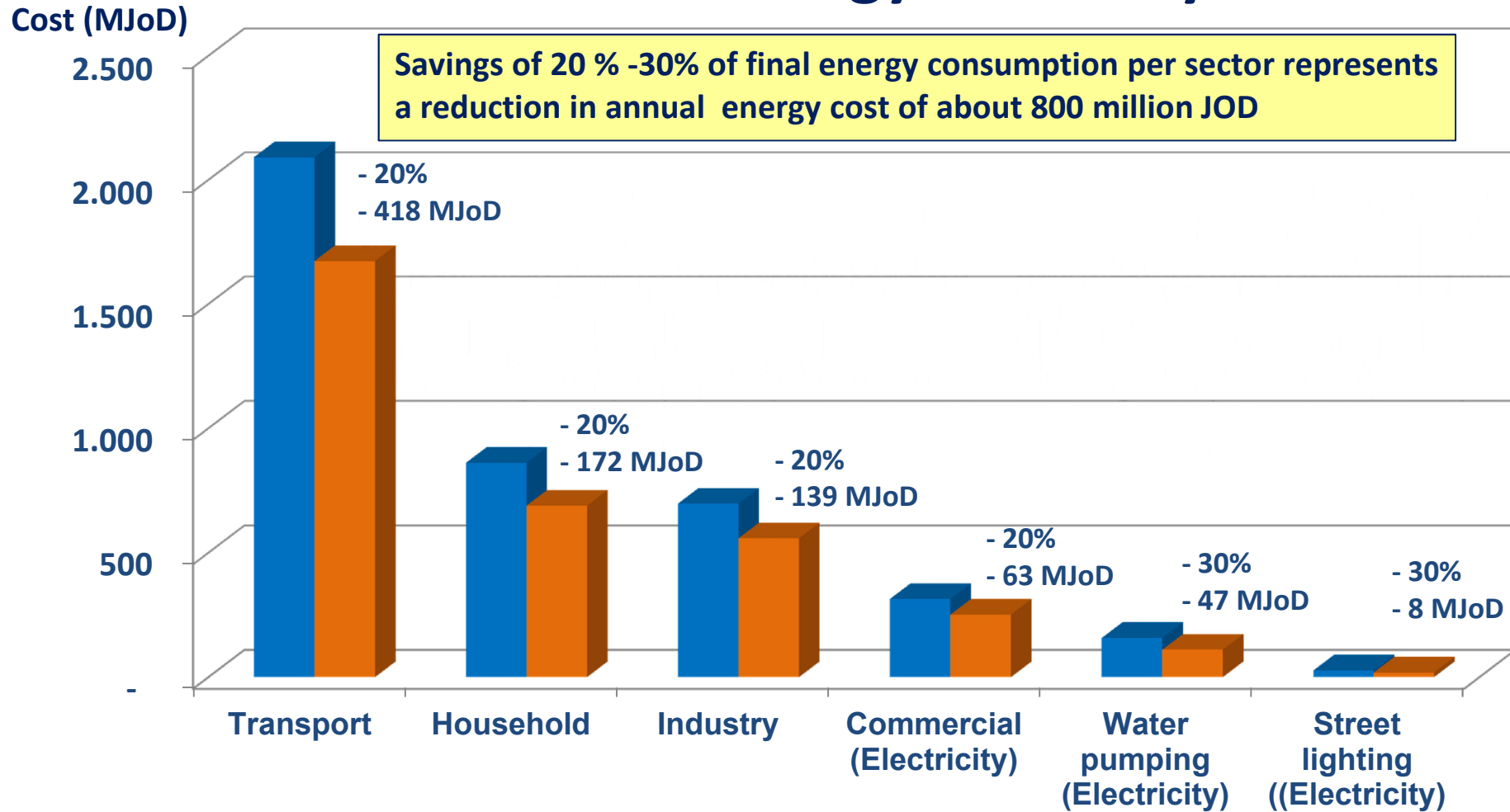
Jordan; represented by the National Energy Research Center (**NERC**)

in cooperation with the European Union (**EU**) has recently ran the EE Standards and Labeling Program which mostly focuses on increasing the penetration rate of energy efficient **home appliances** (air conditioners, washing machines, refrigerators, lighting and freezers)



Potential of EE in Buildings & Benchmarks

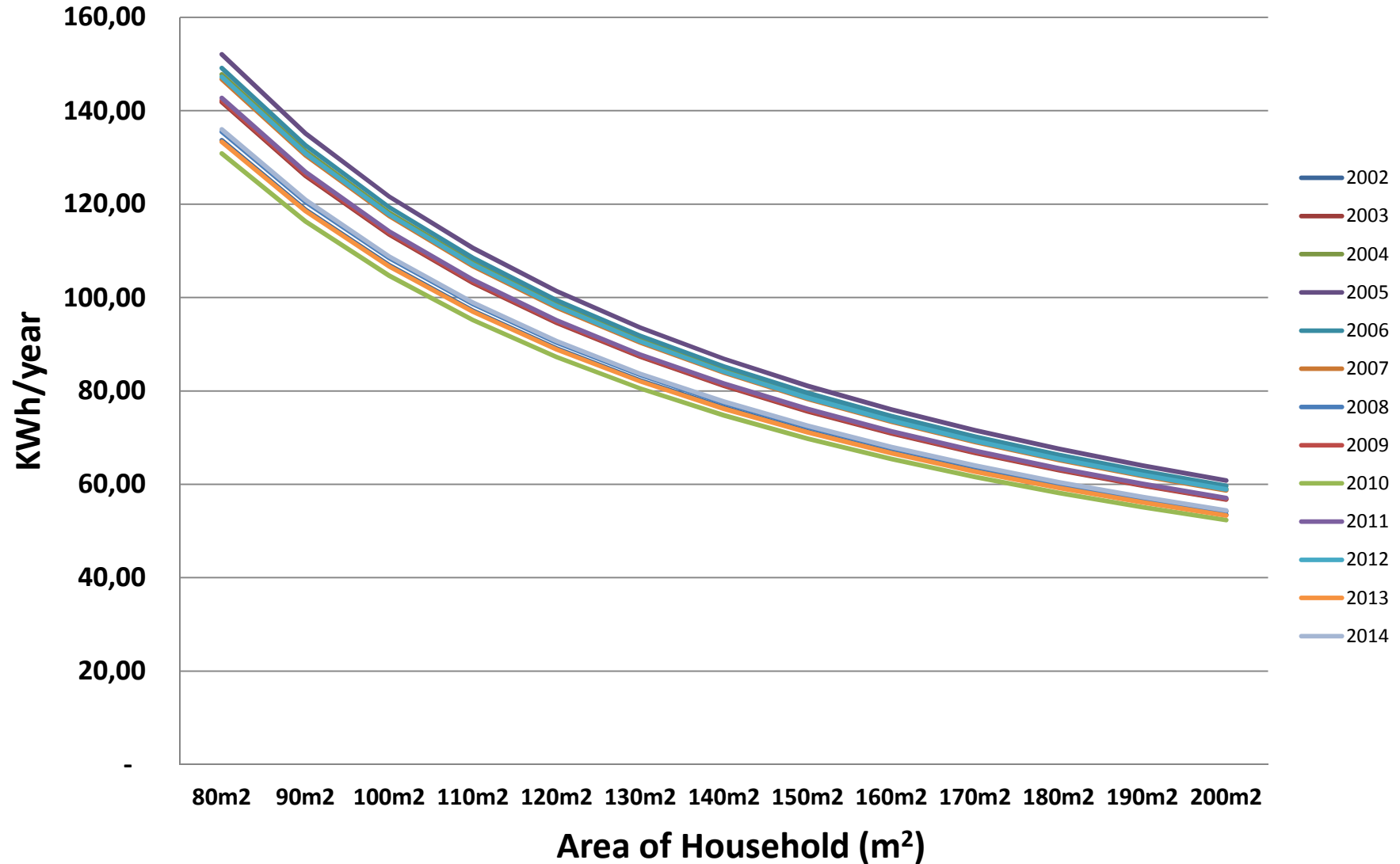
Potential of Energy Efficiency



■ Cost of energy consumed in million JOD

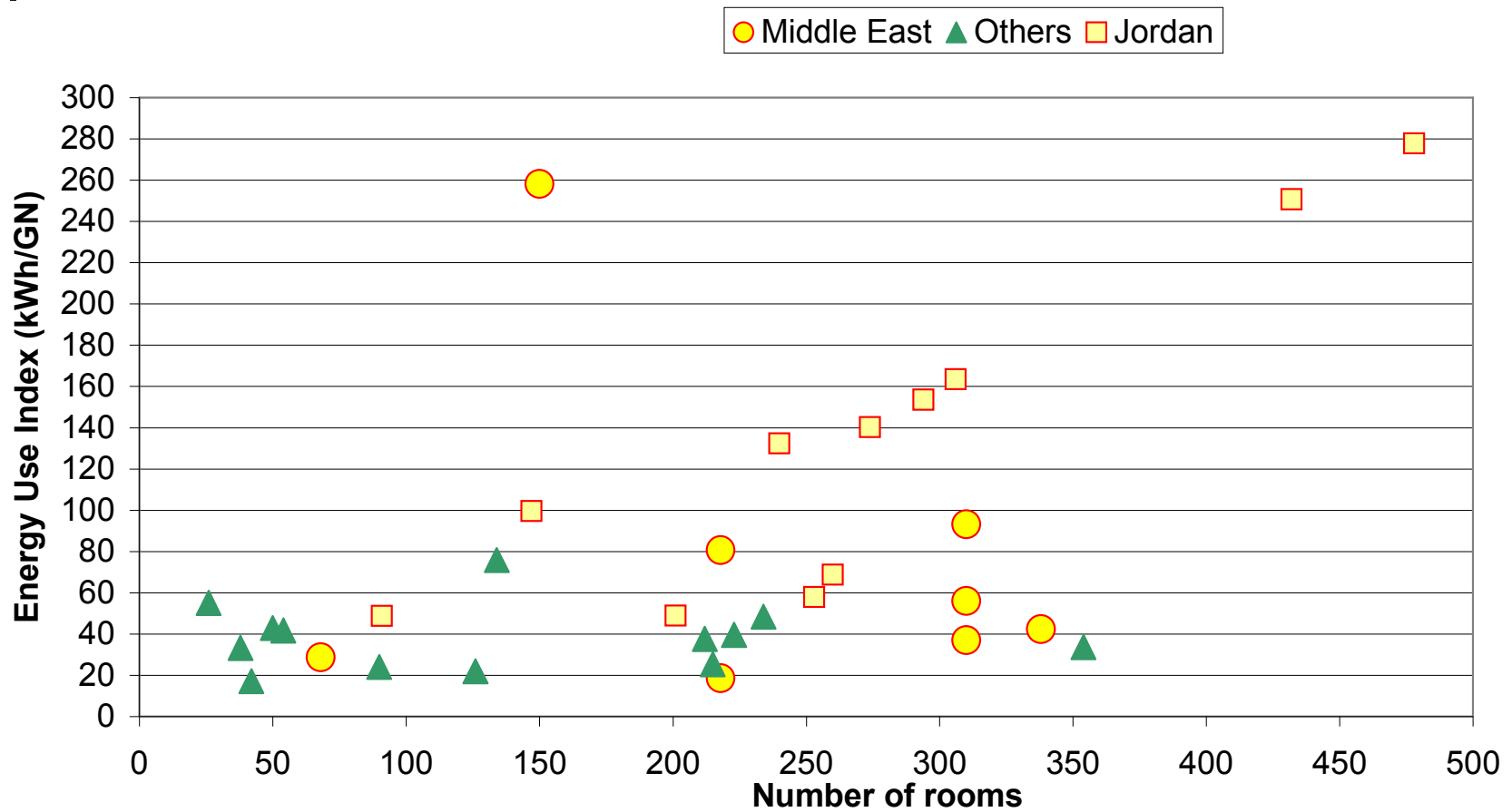
■ Cost of energy consumed in million JOD with energy-efficiency measures

Average Household Electricity Use Intensity (KWh/m²)

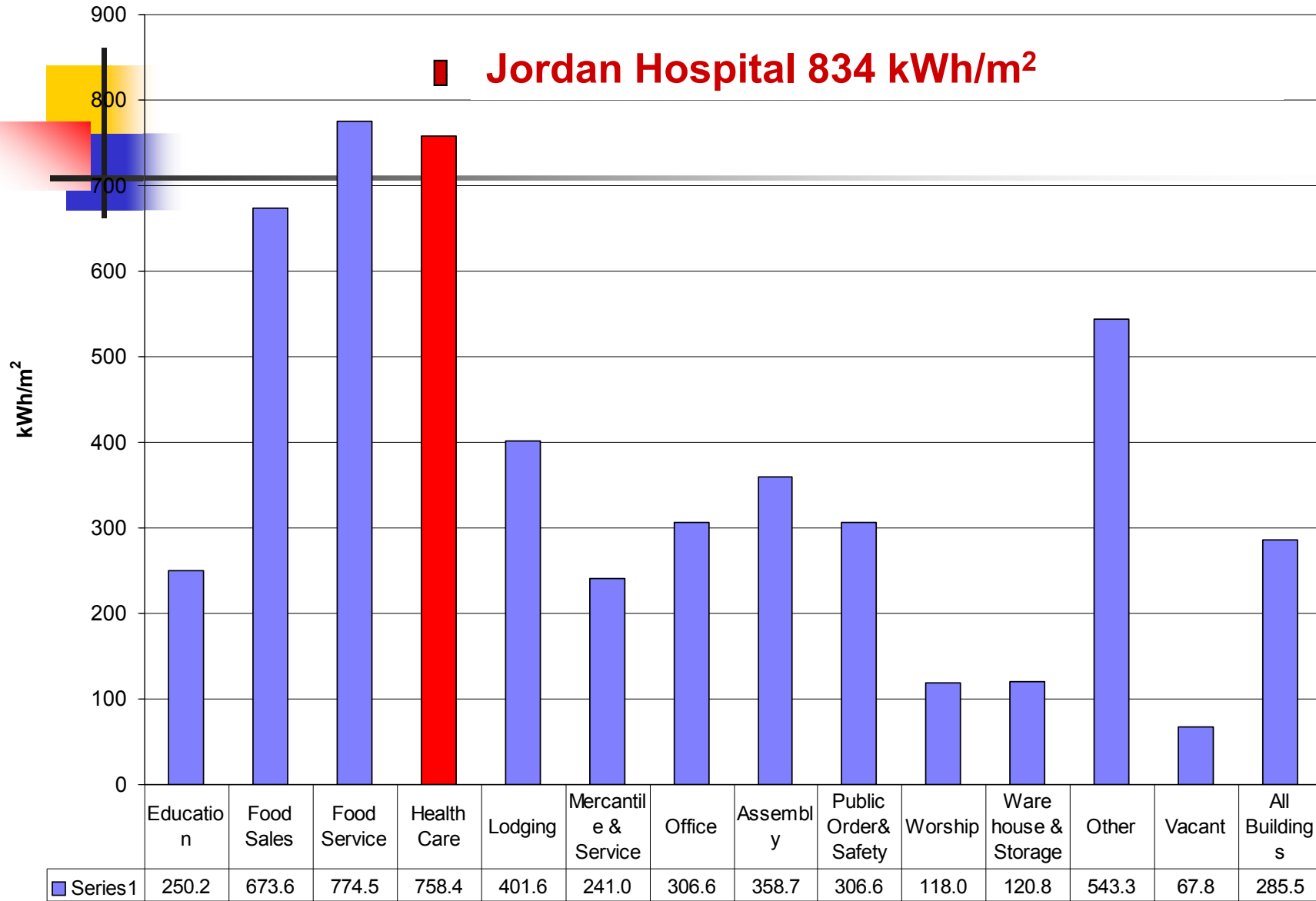


Energy use index vs. Number of rooms

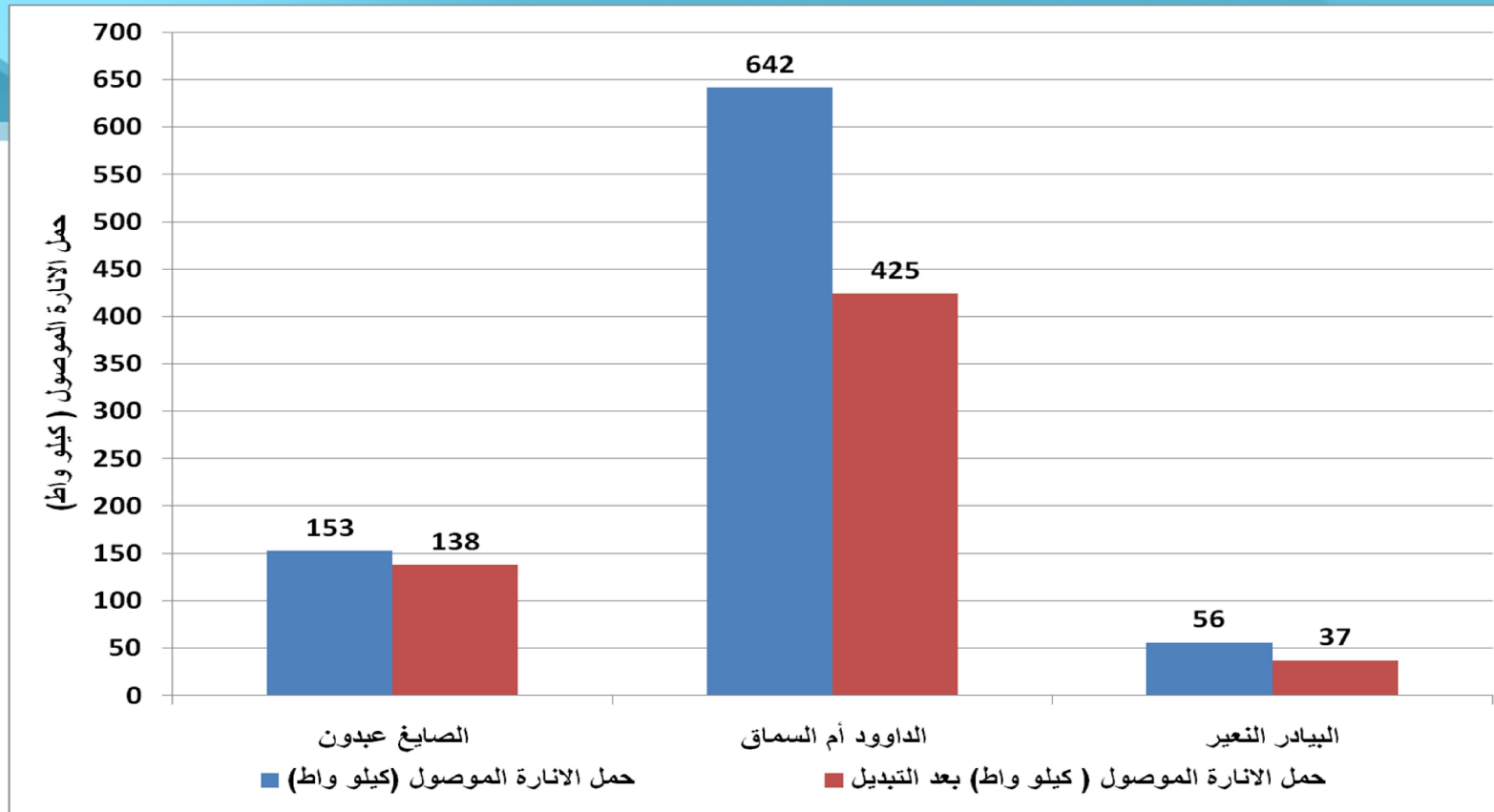
Hotels



Total Energy Use Intensity (Averages)



Residential Lighting Pilot Project



High Consumption Category

Medium Consumption Category

Low Consumption Category

Total Reduction in Lighting Load 215 KW

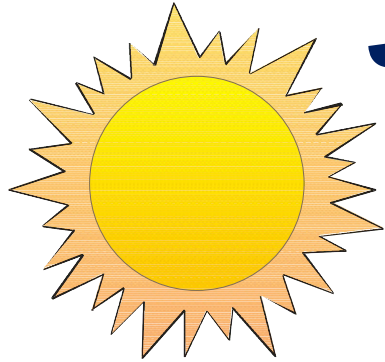
More than 300 MW can be Saved if implemented at the national level

NEEAP

Indicative target

	Baseline consumption GWh/5 years average	National indicative Energy Efficiency target			
		2020		2013 (First NEEAP) 2 years	
		%	GWh	%	GWh
Total	11291	20%	2258	4.4%	502
Sector 1 Residential	4447	25%	1112	5.6%	247
Sector 2 Industrial	3013	15%	452	3.3%	100
Sector 3 Commercial	1875	12%	225	2.7%	50
Sector 4 Water Pumping	1668	23%	384	5.1%	85
Sector 5 Street Lighting	288	30%	86	6.6%	19

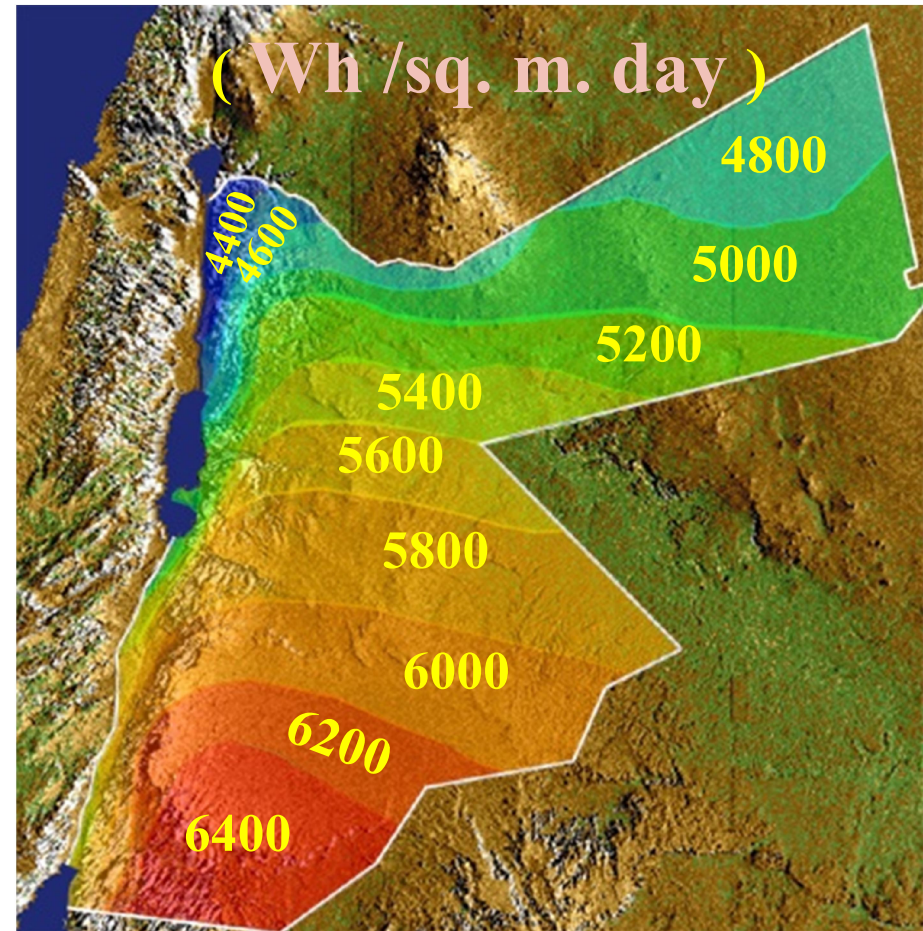
Potential of Solar Energy in Jordan



The annual daily average of Global solar irradiance on a horizontal surface

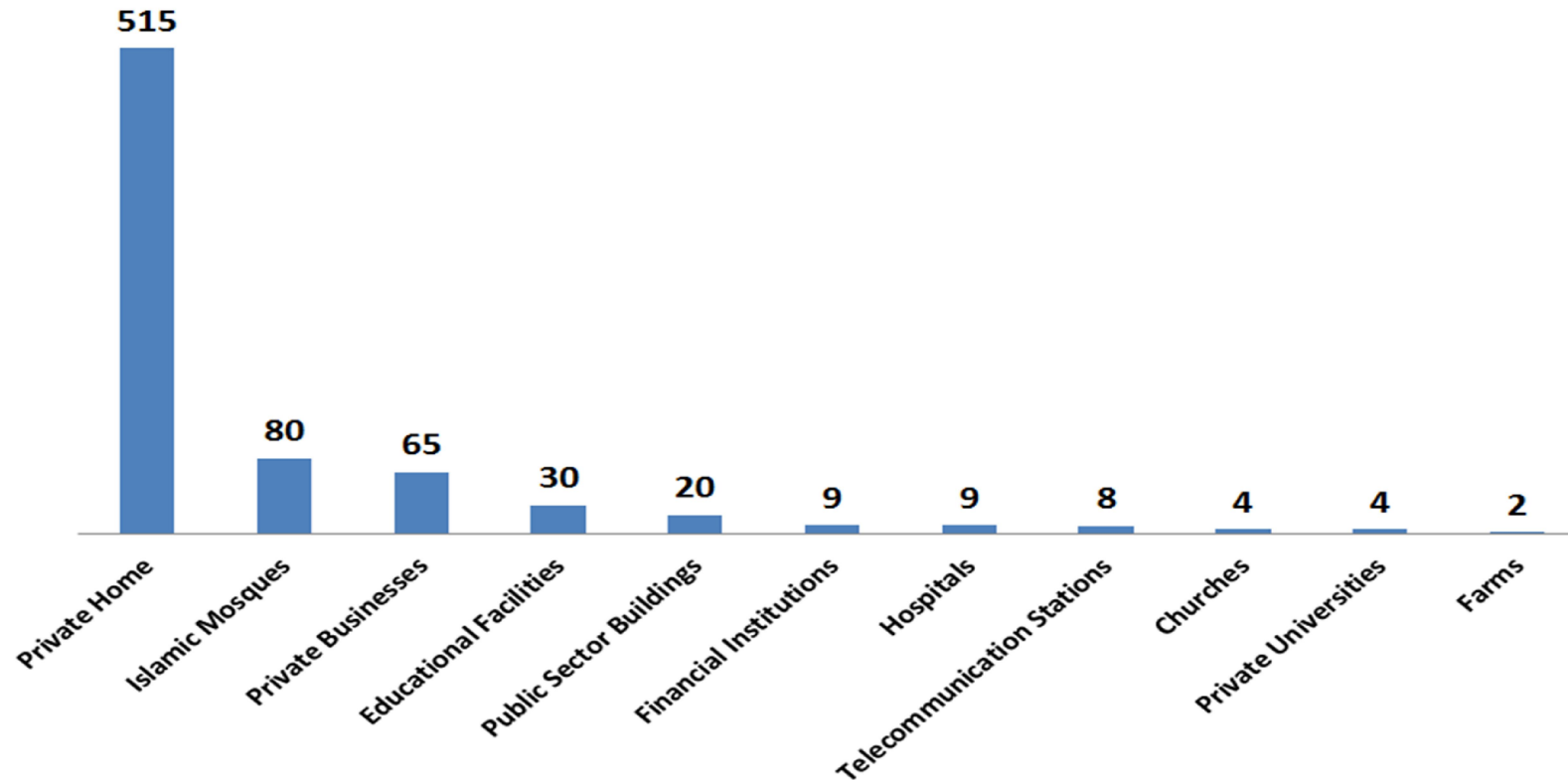
5.6 kWh/m² day

- The total annual irradiance is 1800-2700 kWh/m²



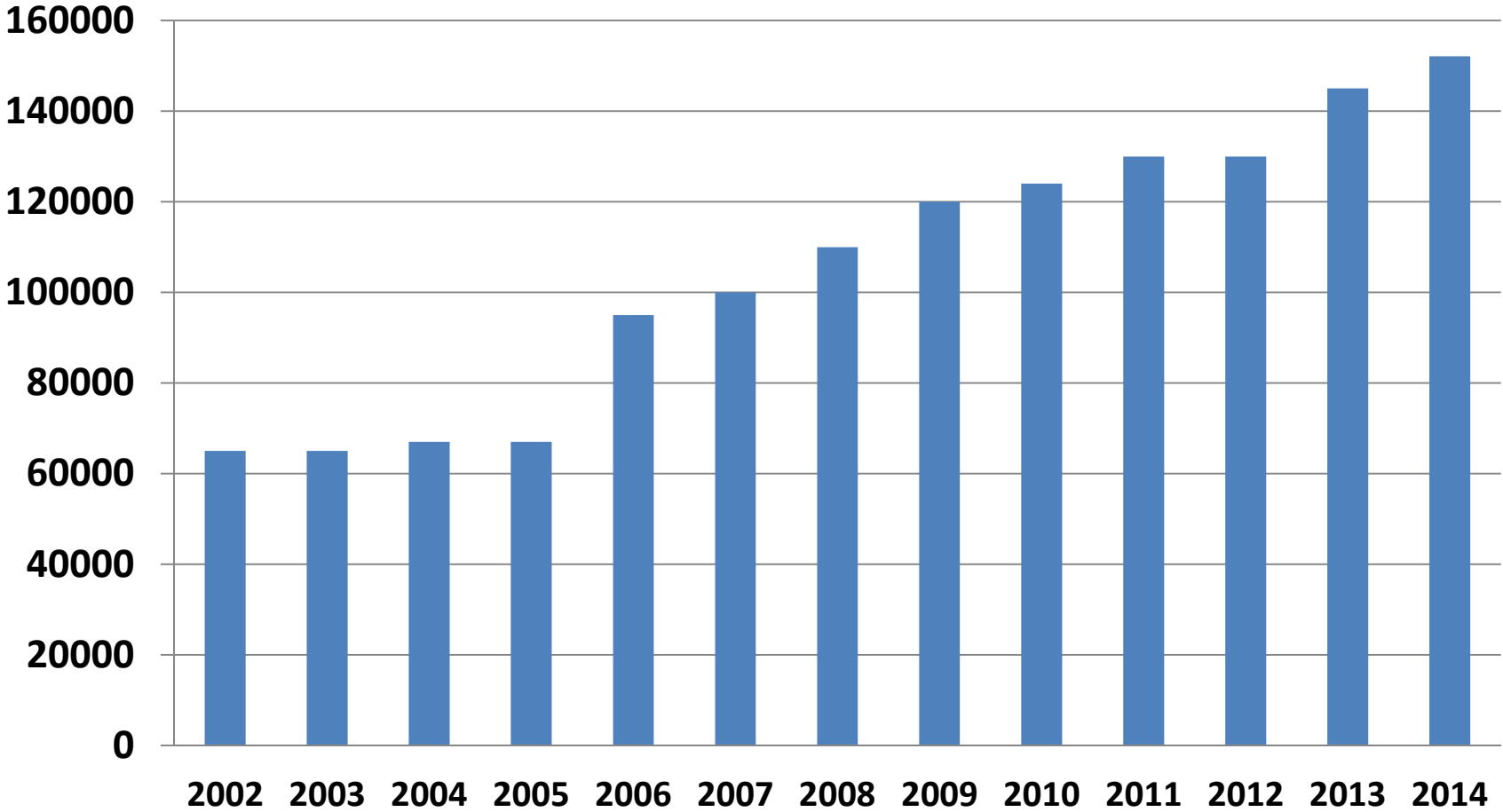
Solar PV Rooftops (Buildings with Net Zero Electricity)

Solar Rooftops in Jordan
February 2015



<http://planetsave.com/2015/02/11/significant-news-jordan-rooftop-solar-sector/>

Solar Thermal Installation (toe)



Implementation Capacity In Jordan

- **By 2012, more than 500,000 m² of Solar Water Heaters are installed.**
- **Very limited buildings have been built in compliance with EE building code!! However several measures mentioned in the EE building code had been applied, especially using insulation materials.**
- **Article (4) of the bylaw No. 73 (2012) regulating procedures and means of conserving energy and improving its efficiency obliges consumers to comply with EE policies and regulations.**
- **More than 11 EE demonstration building projects are constructed.**

Jordanian first solar house-1981 at RSS



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- study the possibilities of solar heating and cooling in buildings,
- Both passive and active design criteria were considered.
- The house faces the south, with large windows insulated walls.
- These collectors are manufactured in Jordan and have a total area of 40 m².



المعرفة
Knowledge



المختبرات
Testing



الجودة
Quality



تنمية المجتمع
Outreach

Aqaba Residents Energy Efficiency pilot Project (AREE)-EU/MED - ENEC Project

- Aqaba Residents Energy Efficiency pilot project.
- Energy saving.
- Grey water.
- PV system
- Local insulating materials



Aqaba Residents Energy Efficiency pilot Project (AREE)-EU/MED - ENEC Project

- Design: avoiding heat gains in summer and heat losses in winter by orientation of the building, reducing the windows surface, natural ventilation and other “passive” features
- Building envelope: insulation of roof and walls, double glazing, thermal mass, etc.
- Energy-efficient lighting (CFL’s, etc.)
- Solar cooling (and as option: generation of electricity by photovoltaic panels)

Aqaba Residents Energy Efficiency pilot Project (AREE)-EU/MED - ENEC Project

Results and potential for dissemination

- The 420 m² house is almost finished and will save over 70% of electricity, with incremental cost of about 38%, compared to a conventional house. The pay-back period for this investment is 8.6 years. The energy savings correspond to a yearly reduction of CO₂ emissions of 21 tons, e.g. 315 tons over the minimum lifetime of the house. If photovoltaic panels will be added, the savings may amount to 93%

Eco-friendly Kamaliyya Residence, which won 2 international prizes



eco-friendly Kamaliyya Residence, which won 2 international prizes - See more at:
<http://www.greenprophet.com/2012/05/ayoub-abu-dayyeh-is-jordans-environmental-champion/#sthash.pSmGZS5I.dpuf>

The Dutch Embassy

Date built: 2010



World Health Organization (WHO) Regional Office Building Date built: 2011



The Middle East Insurance Company

Date built: 2013



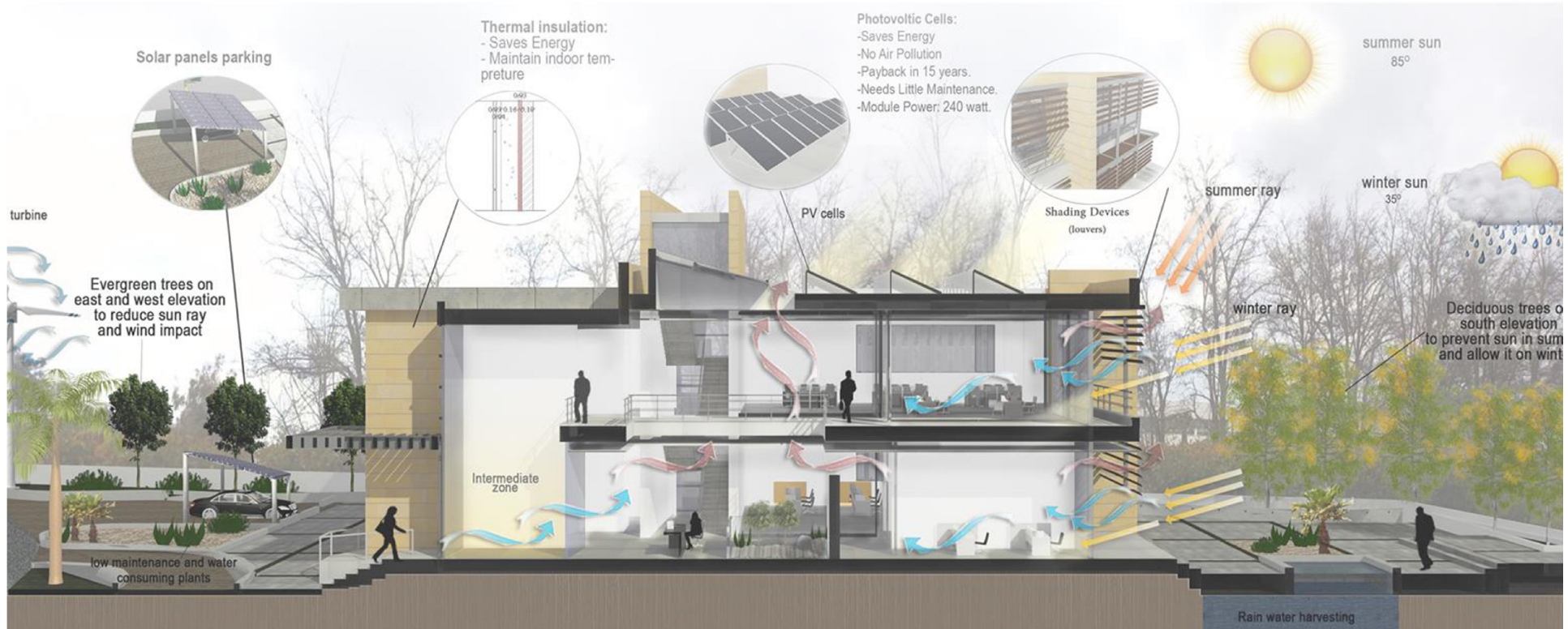
<http://www.venturemagazine.me/2015/10/jordans-greenest-buildings/>



المركز الوطني لبحوث الطاقة National Energy Research Center

DESIGNED BY:

IMAD DABBAS ARCHITECTURAL OFFICE

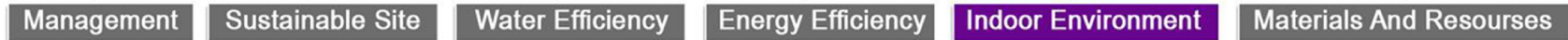


INDOOR ENVIROMENT

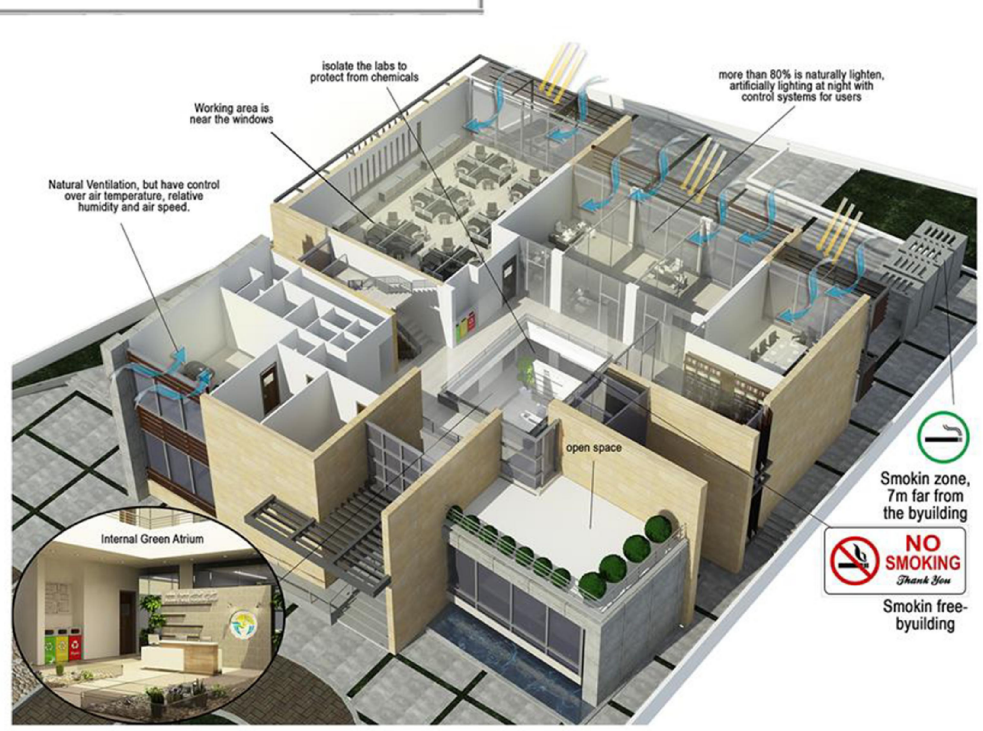
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Meets **Jordan Green Building Guide**

Criteria for Green Building



- **1. Minimum indoor air quality**
- **2. Environmental tobacco some control**
-Smoking is prohibited in the Building
- **3. Pollutants control and their sources**
- Creating intermediate zone, and use special pollution control materials
- Isolate the labs to protect from any chemicals.
- **4. Excess ventilation**
- **5. Day Lighting**
- Approximately 80% of the building is naturally lighted.
- Control the glare.
- **6. Artificial lighting**
Provide control systems for the users
- **7. Thermal Comfort**
Control over air temperature, relative humidity and air speed.
- **8. Thermal comfort control system**
- **9. Ideal acoustic performance**
Provide calm environment for the users, through design.



Designed by:
Dabbas Architectrual Office

 **NERC**

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المركز الوطني لبحوث الطاقة.

RSS 



Thank for your Attention