International Energy Agency

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MINISTRY OF ENERGY AND NATURAL RESOURCES REPUBLIC OF TURKEY

European Bank for Reconstruction and Development

Assessment of Market Penetration of Renewable Energy & Energy efficiency in Jordan

"Supporting deployment of low-carbon technologies in the ETC and SEMED regions"
Istanbul, 15-16 June

Eng. Muhieddin Tawalbeh

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Royal Scientific Society

National Energy Research Center

Jordan

- Area: 90,000 km^2
- Population > 6.1 million
  Population growth rate: 2.8%
- Climate: semi-arid
- Average of rainfall falling per year: 8,300 MCM
- Sea Port: Aqaba
- GDP: 23,121 M Euro (2012)

IMPORTANT FIGURES, 2013

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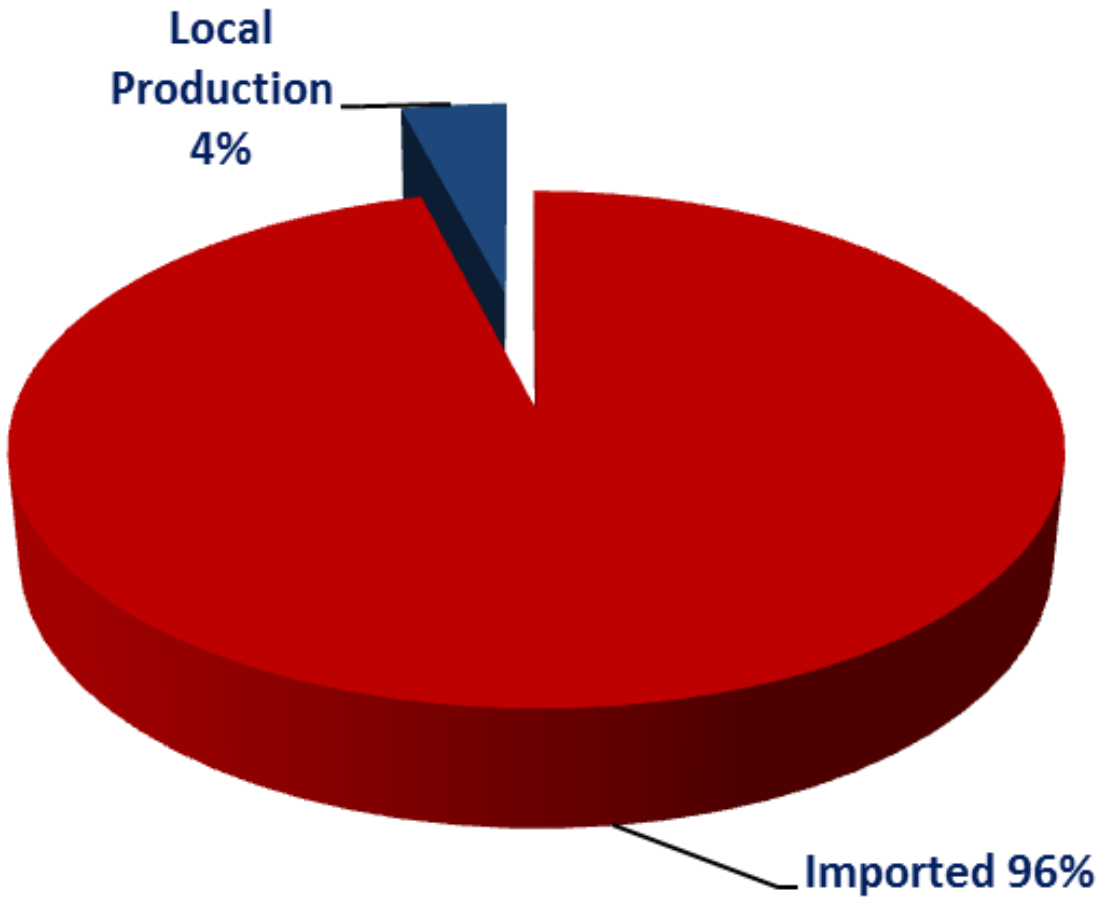
Primary Energy Consumption	8.2 Mtoe
Imported Crude Oil	7.1 Mtons
Imported Natural Gas	867.5 mcm
Generated Electricity	17287 GWh
Consumed Electricity	14564 GWh
Imported Electricity	380 GWh
Peak Demand	3100 MW
Cost of Imported Energy	4.1 bn JD
Imported Energy Bill	17% of GDP
Per Capita Primary Energy Consumption	1249 kgoe
Per Capita Electricity Consumption	2235 KWh
Energy Intensity (kgoe/1000 JD)	208

Source: MEMR

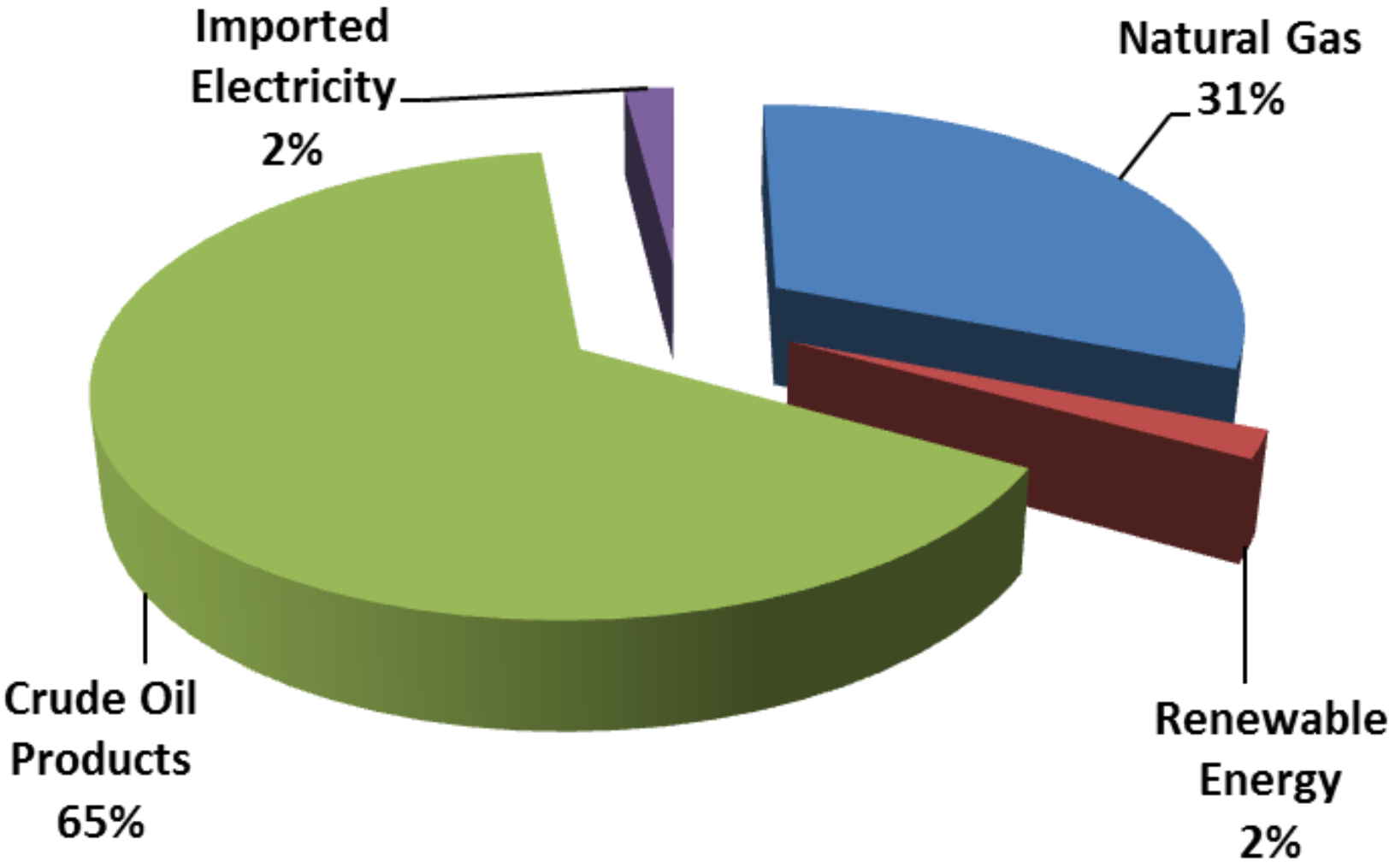
Energy Situation

Energy Mix

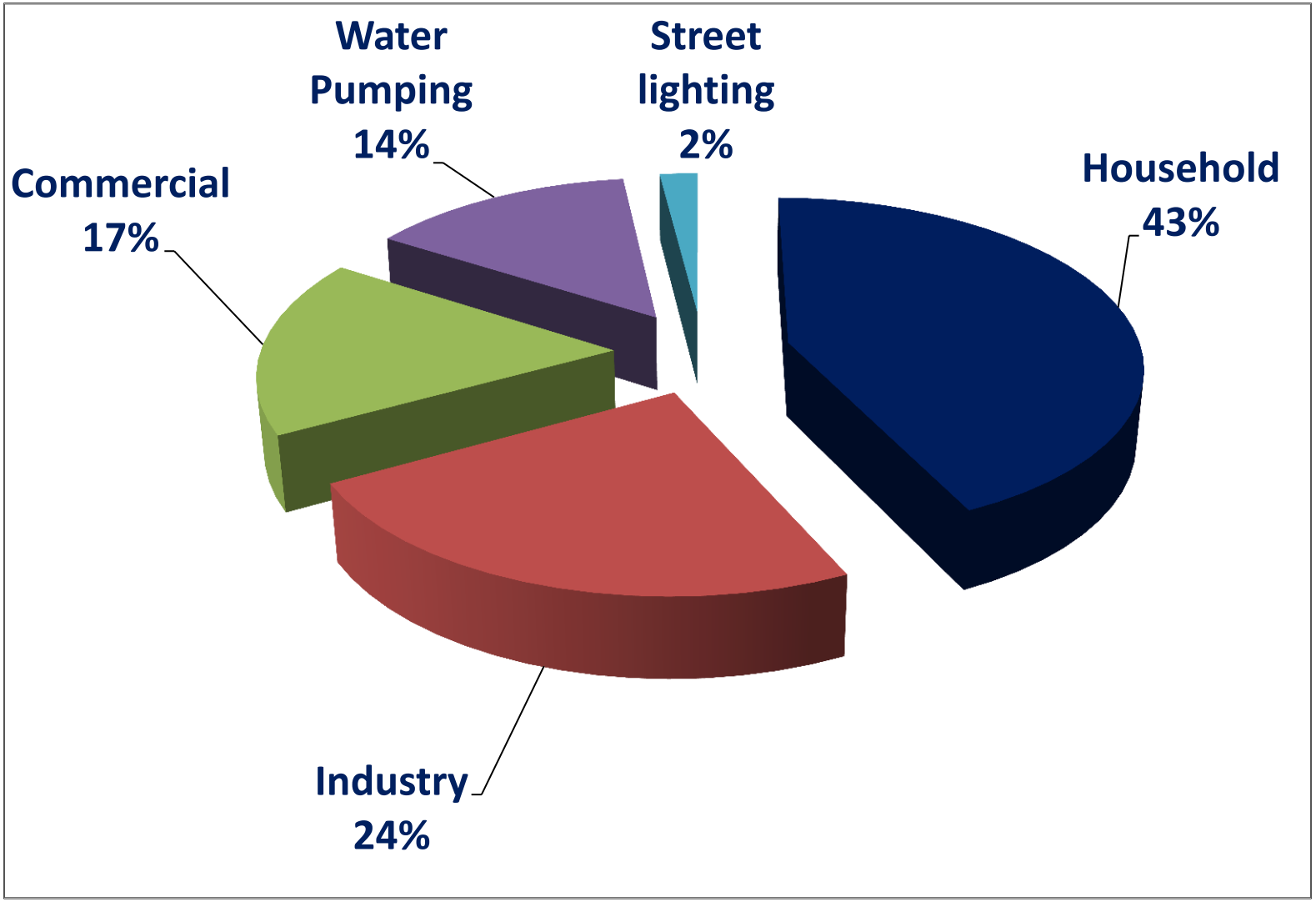


Energy Situation

Primary Energy Consumption



Electrical Energy Consumption



ENERGY STRATEGY

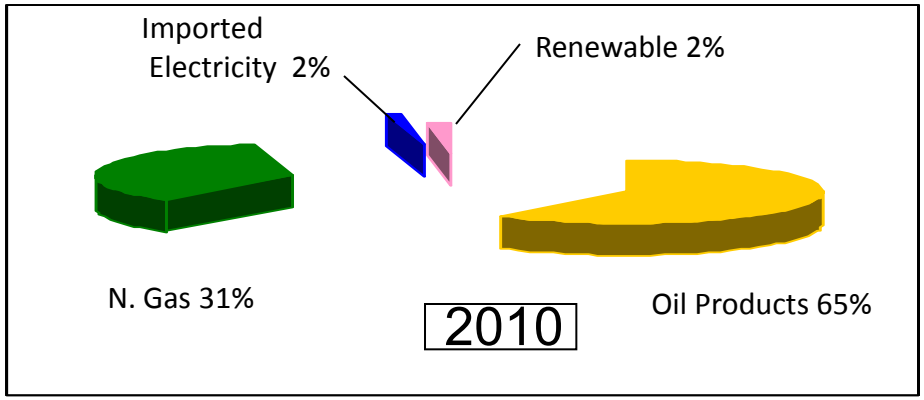
Updated Master Energy Strategy

The Energy Mix in Jordan (2010 – 2020)

10% by Renewables

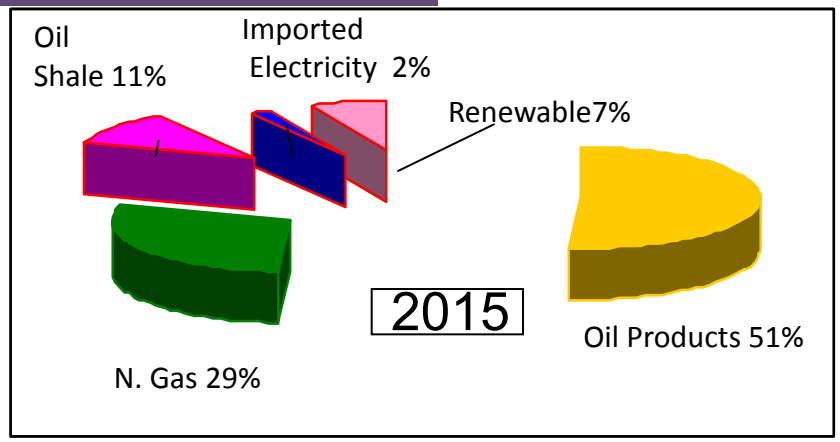
300 - 600 MW Solar Energy.

~ 1000 Wind Energy.

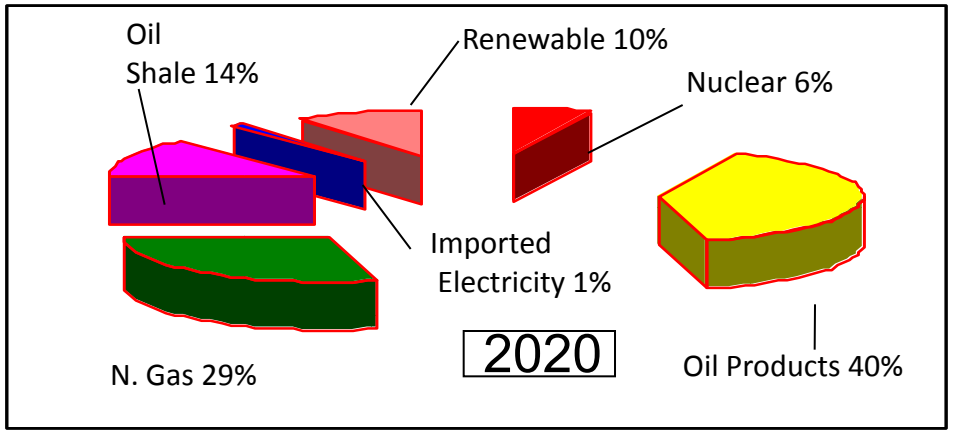


Domestic Resources 4%, Imported 96%

20% Energy Efficiency

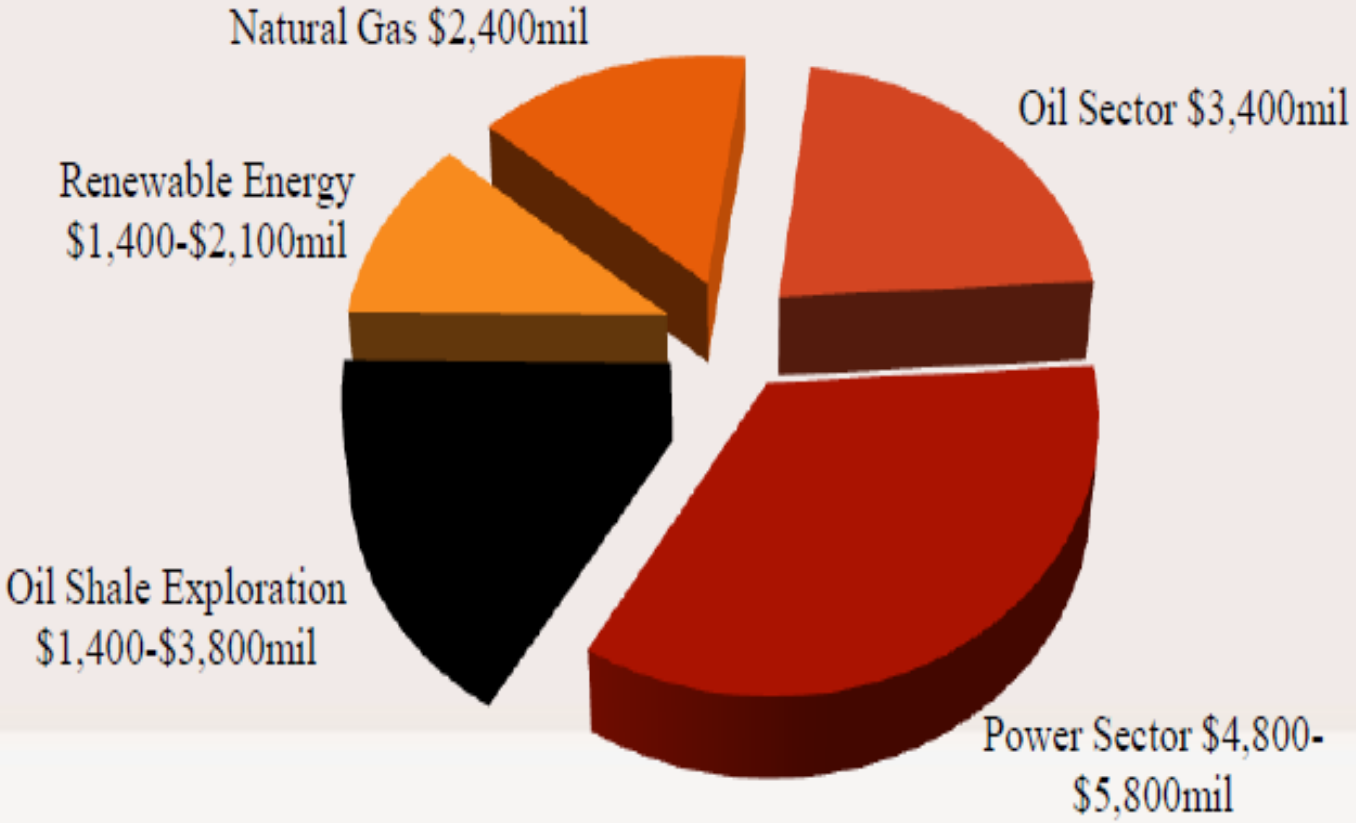


Domestic Resources 25%, Imported 75%



Domestic Resources 39%, Imported 61%

Master Plan Required Investment over Period 2007-2020



Source: Ministry of Energy and Mineral Resources

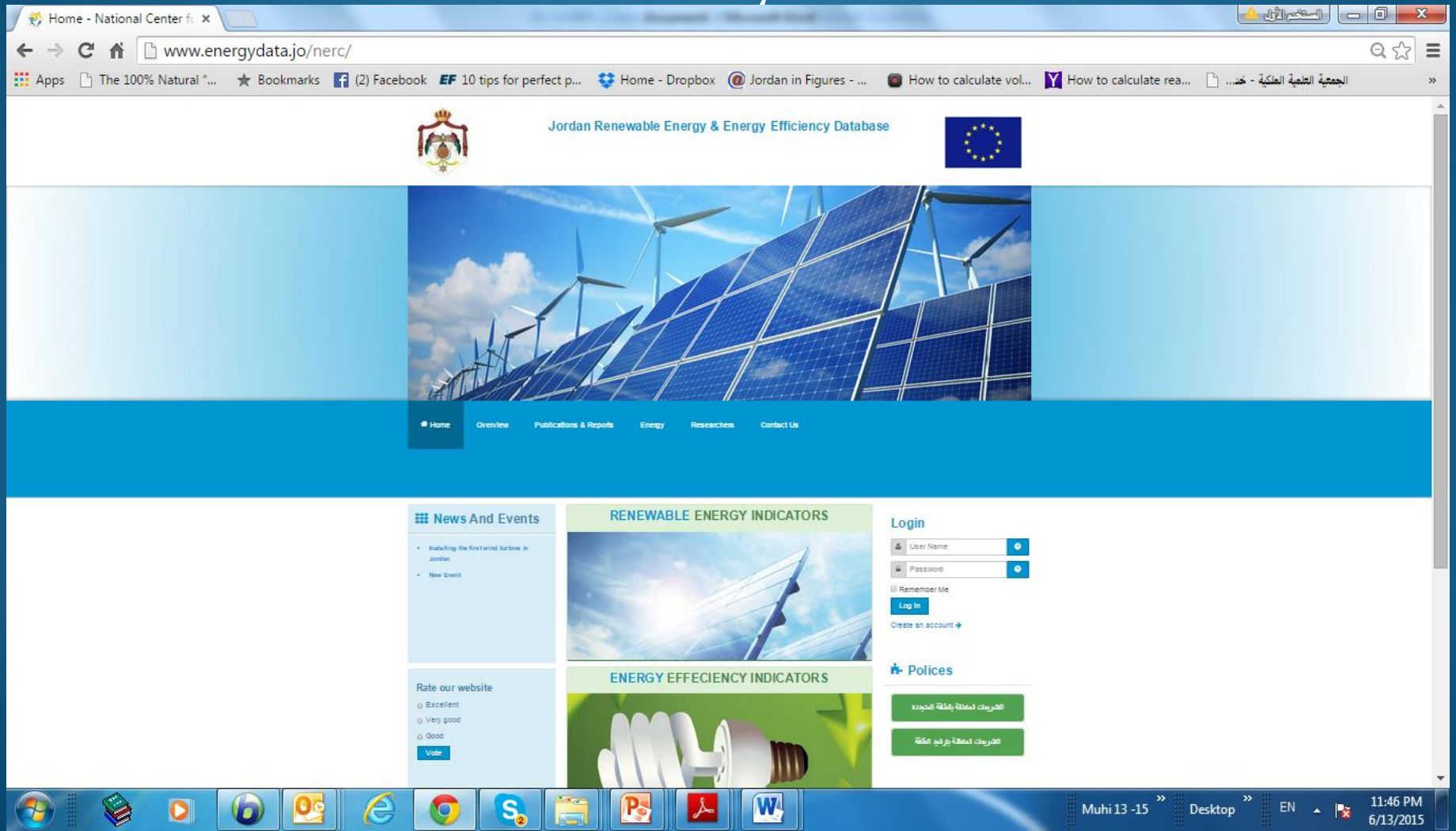
Current and Evolving Policies

- 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
- Insolation Code
- Green Building Manual

Data Collection

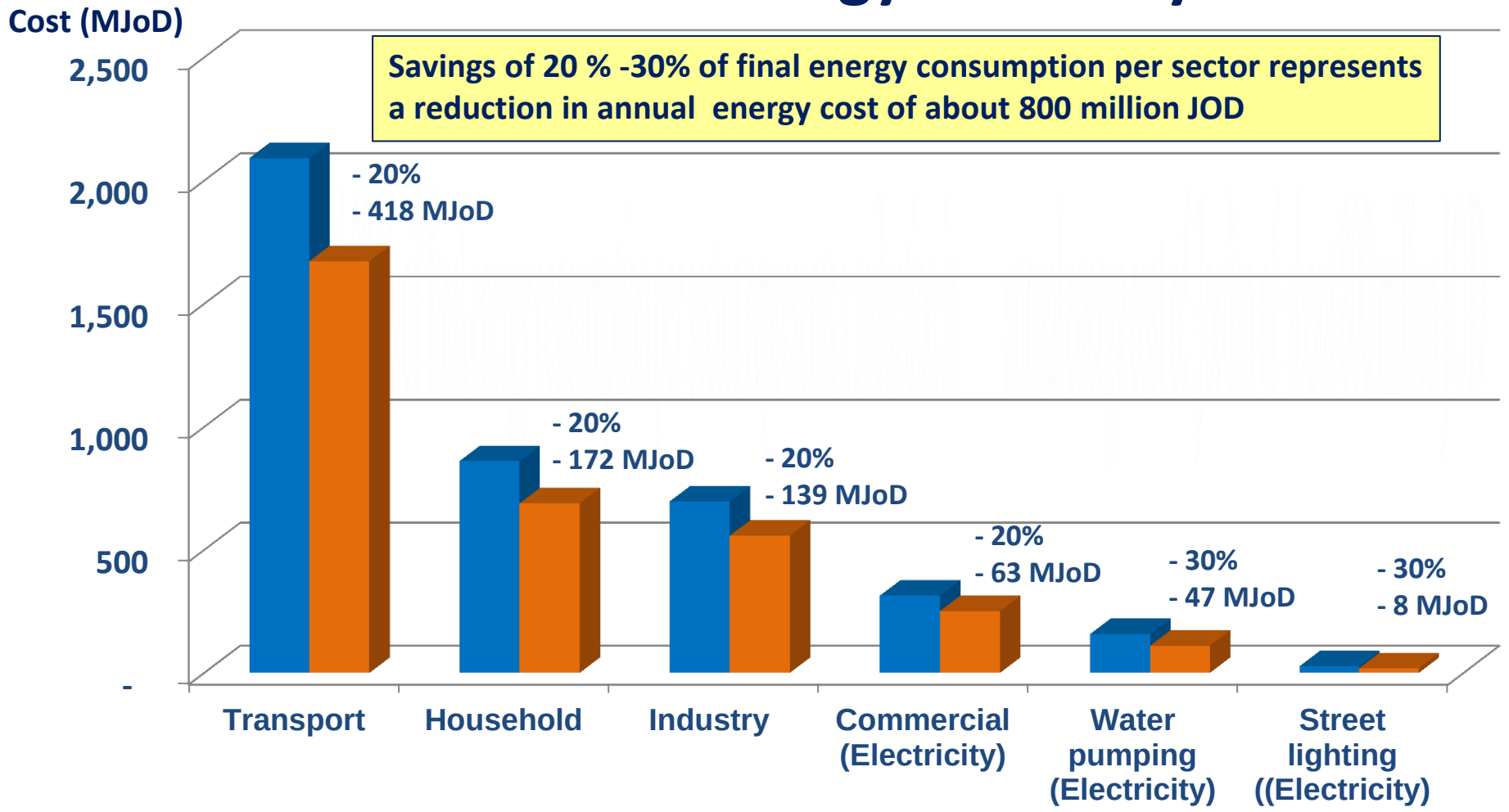
- Data available at the Ministry of Energy and Mineral Resources (MEMR).
- Available data at electricity companies including NEPCO, Generation and Distribution as well as Regulatory Commission (EMRC).
- MEMR is currently in the process of establishing a data base for energy

Data Base for Energy Efficiency and Renewable Energy Indicators
at
National Energy research Center /Royal Scientific Society



Energy Efficiency

Potential of Energy Efficiency



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

NEEAP

Key Indicators

No	Indicator	Unit	Year 2010	Year 2020
1	Electricity intensity	GWh/GDP(US$)	1.13	1.28
2	National end use electricity consumption	GWh/year	14562	29059
3	Projected electricity consumption growth rate	% /year	7.6	
4	Share of electricity in final energy consumption	%	22.7	30.5
5	Share of electricity consumption by sector			
	Sector 1 Residential	%	41	34
	Sector 2 Industrial	%	25	24
	Sector 3 Commercial	%	17	25
	Sector 4 Water Pumping	%	15	15
	Sector 5 Street Lighting	%	2	2
6	Marginal cost of kWh supplied (2011-2013)	USD/kWh	0.0543	

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

Sectorial presentation: Planned and ongoing EE measures for 2012-2013

Residential

No	Title and description of the EE measure	Implementation period	Electricity savings for the first 2 years 2012-2013 GWh
2.1.1	Replacement of incandescent lamps with compact fluorescent lamps (CFL)	2012-2013	123
2.1.2	Energy Label program for four home appliances	2010-2013	68
2.1.3	Installation of Solar water heaters	2012-2013	93
2.1.4	Survey of energy consumption in Residential sector by the end of 2012	2012	N/A

Case Study

Area	Annual Energy Savings			Investment Required (JD)	Pay Back Period (Years)	CO_2 (TON/year)
	KWh/yr		Cost Savings (JD/yr.)			
	Electrical	Thermal				
Steam System						
1. Operating the Synchronous Generator as a Motor	0	12,684,272	379,000	N/A	N/A	2900
1. Blowdown heat recovery: Combination of the Flash Steam Recovery and Blow down Recovery	0	2841384	65190	19,930	0.3	660
1. Insulation of the Uninsulated Valves and surfaces.	0	250852	5683	530	0.09	58
1. Condensate Recovery	0	1224154	28000	1,000	0.04	286
1. Converting the Flash Dryer from working by Diesel to working by LPG	0	00	122938	256,500	2.09	0
Compressed Air System	**0**	**0**	**0**	**0**	**0**	**0**
Reducing the working pressure of the compressed air from 7.5 to 7 bars.	92,667	0	3,940	0		62
Lighting System	**0**	**0**	**0**	**0**	**0**	**0**
Replacing the Conventional ballasts by Electronic Ballasts for Fluorescent Lamps	52486	0	2231	6,773	3	35
Water cooling system	**0**	**0**	**0**	**0**	**0**	**0**
Sea Water pumping system.	377,952	0	16,000	24,000	1.5	250
Cooling water pumping system	186,893	0	7,940	9,000	1.2	125
Total	**709,998**	**17,000,662**	**630,922**	**317,733**	**0.55**	**4376**
% Saving (based on consumption cost)					15%	
% Saving (based on consumption in MWh)					10%	

Potential of Renewable Energy

Solar Energy

Promoting Investment in RE by providing Solar Radiation Data

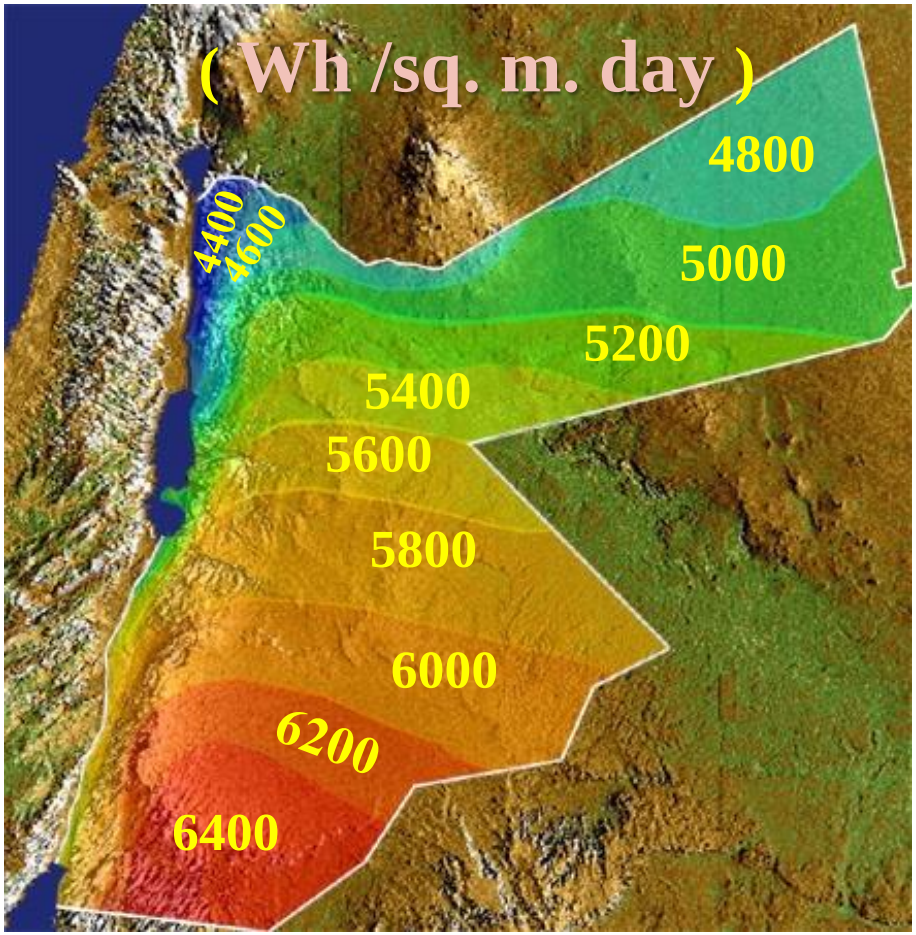
- 15 Measurement Stations in the Country.
- Solar Radiation map for Jordan.
- The readings are recorded on hourly, daily and monthly average.

Potential of Solar Energy in Jordan

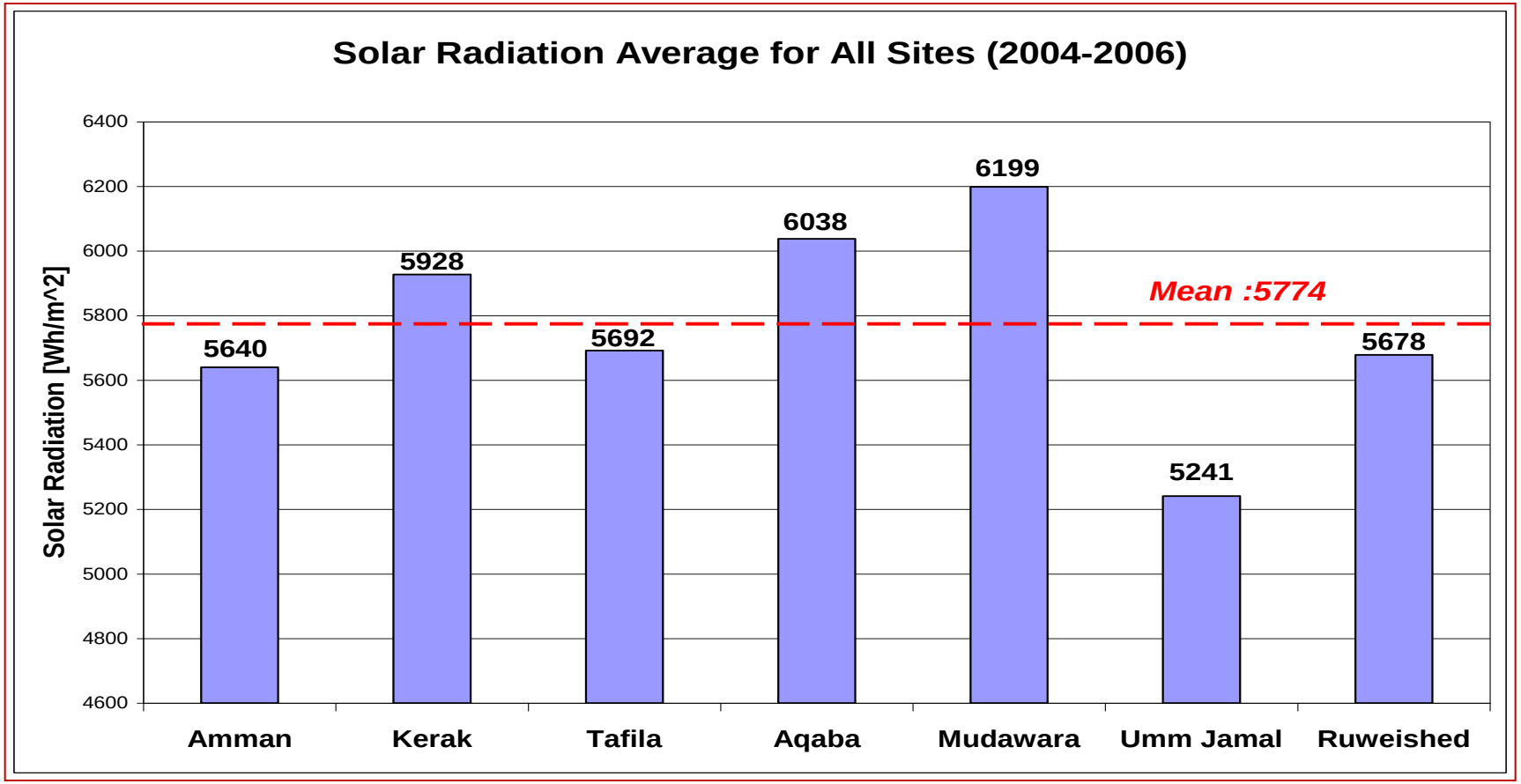
The annual daily average of Global solar irradiance on a horizontal surface

5.6 kWh/m2 day

- The total annual irradiance is 1800-2700 kWh/m^2

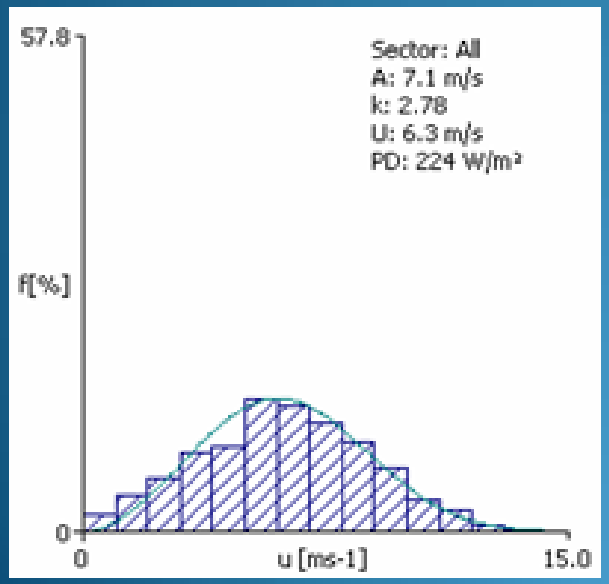


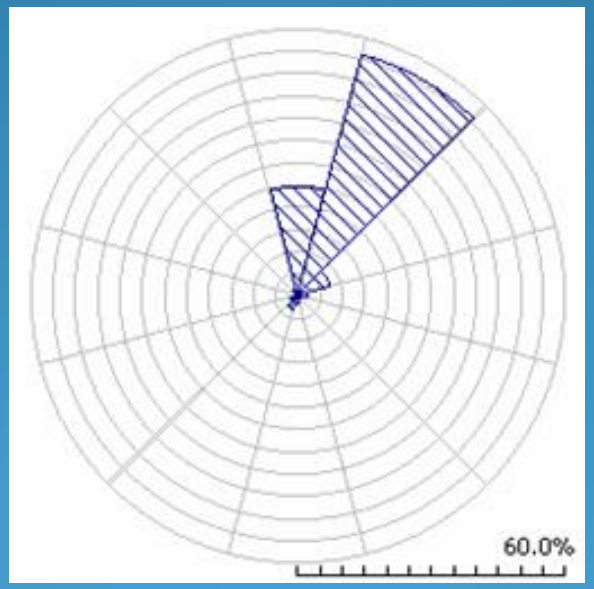
Solar Energy based on GHI

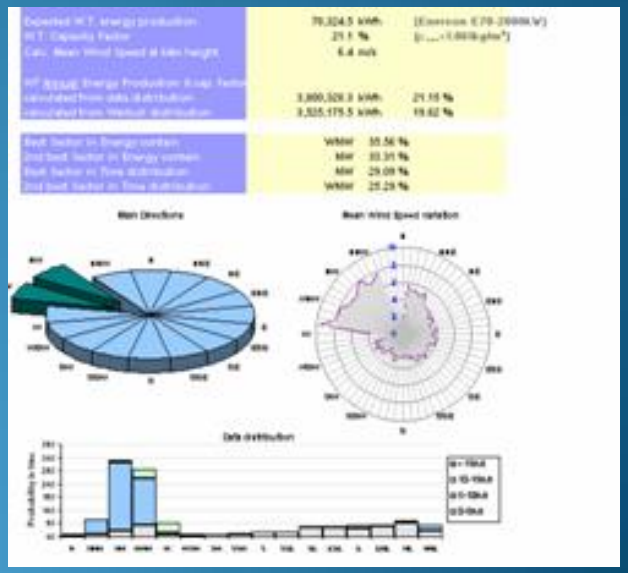


Wind Energy

- Collection Wind Data periodically from around 35 wind measuring systems.
- Average wind speed reaches 10 m/s in some locations







Potential of Renewable Energy in Jordan

Wind Energy

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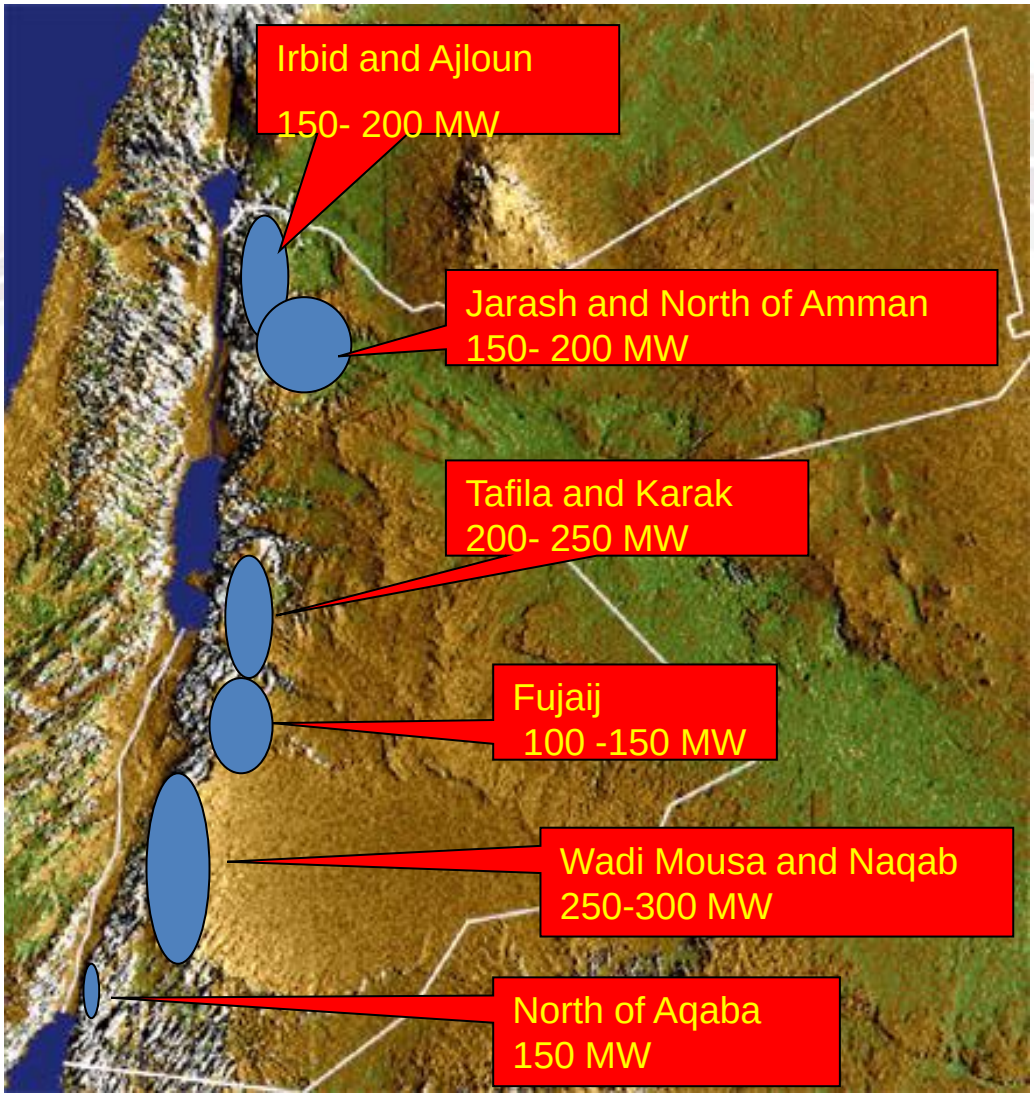
4.1 Expected Wind Potential at the promising sites in Jordan



Renewable Energy Applications

Jordanian first solar house-1981 at RSS

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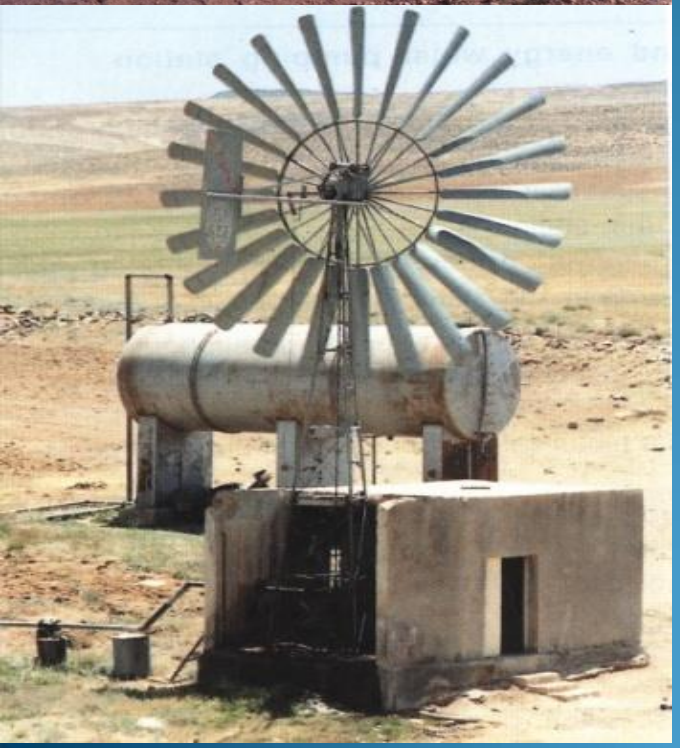
- study the possibilities of solar heating and cooling in buildings,
- Both passive and active design criteria were considered.
- The house faces the south, with large windows insulated walls.
- These collectors are manufactured in Jordan and have a total area of 40 m^2.

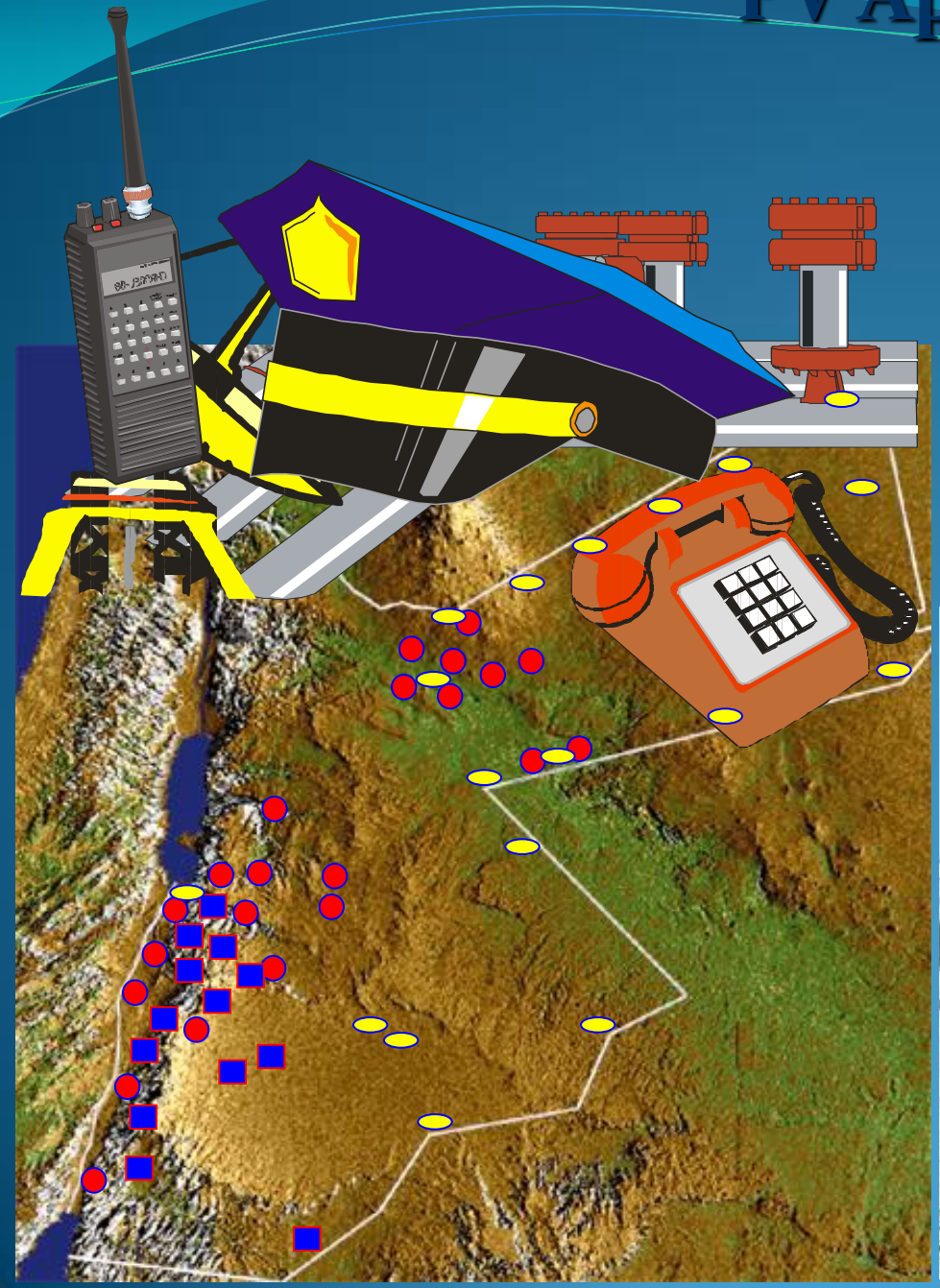


Wind energy

for

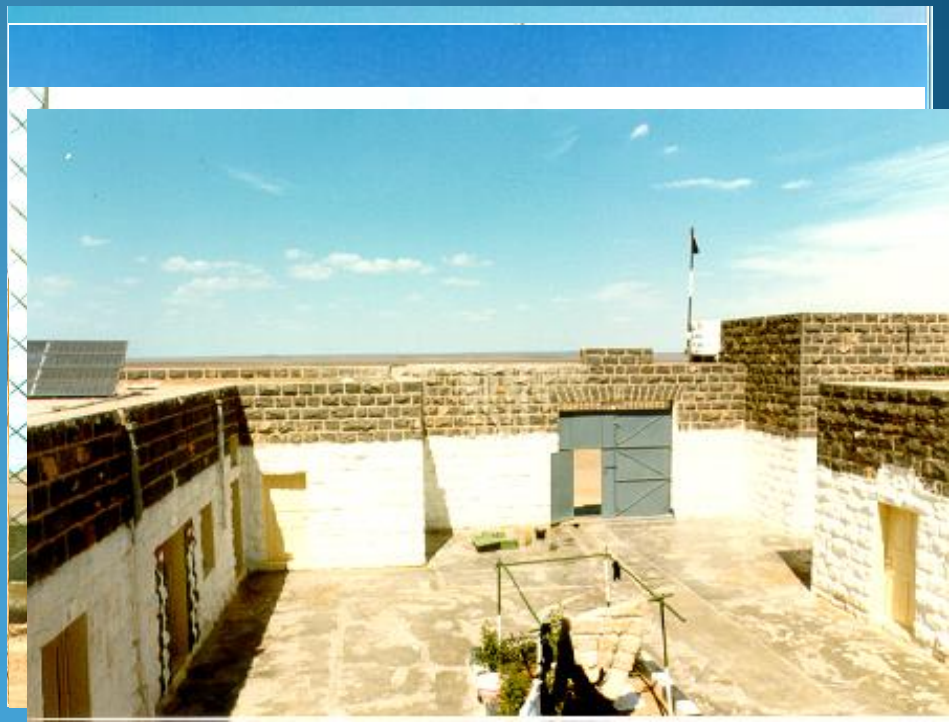
Water Pumping

PV Applications in Jordan

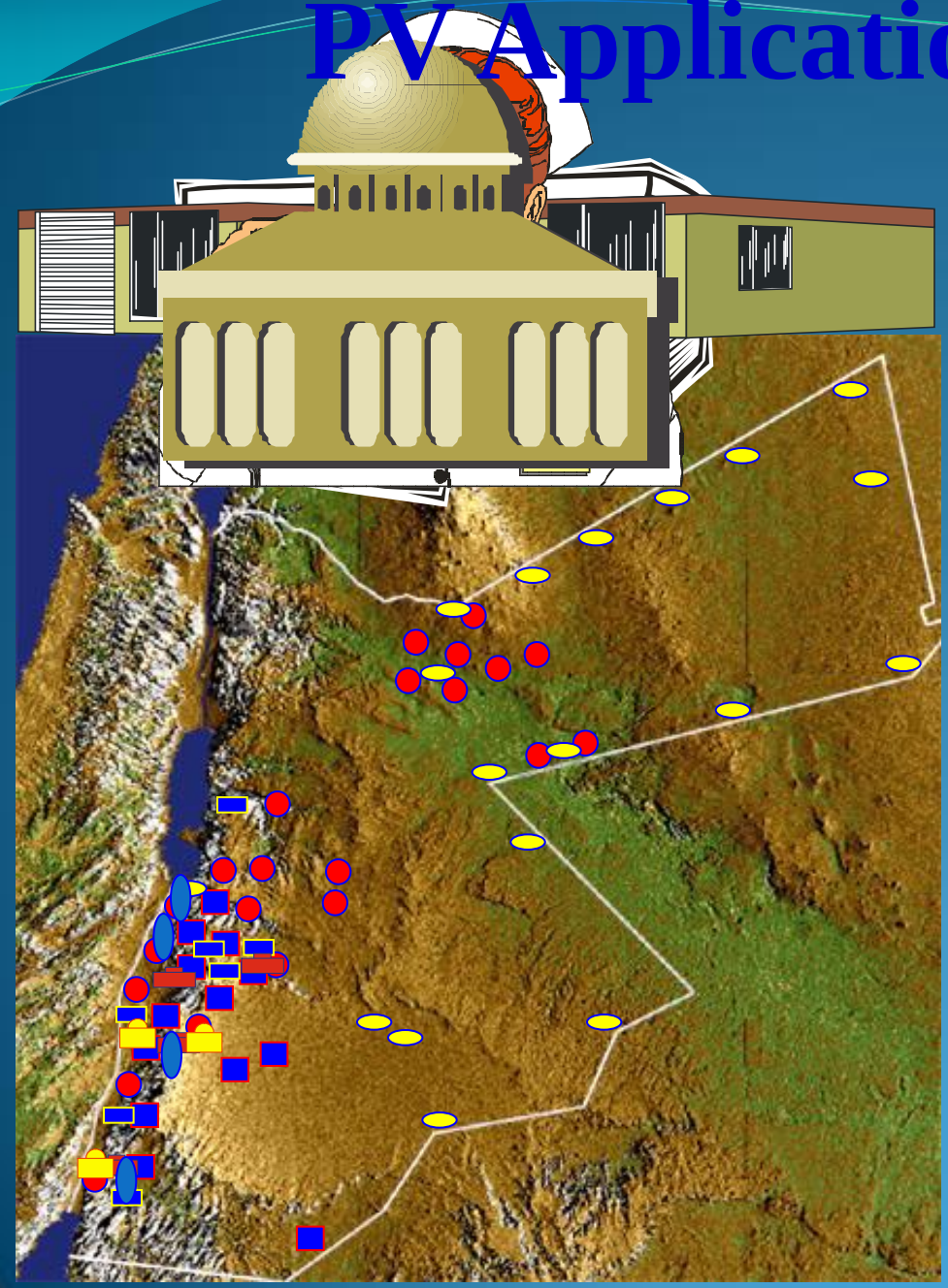


More than 100 PV systems were installed in Jordan since 1985

- Water Pumping
- Communications
- Police Stations



PV Applications in Jordan



More than 100 PV systems were installed in Jordan since 1985

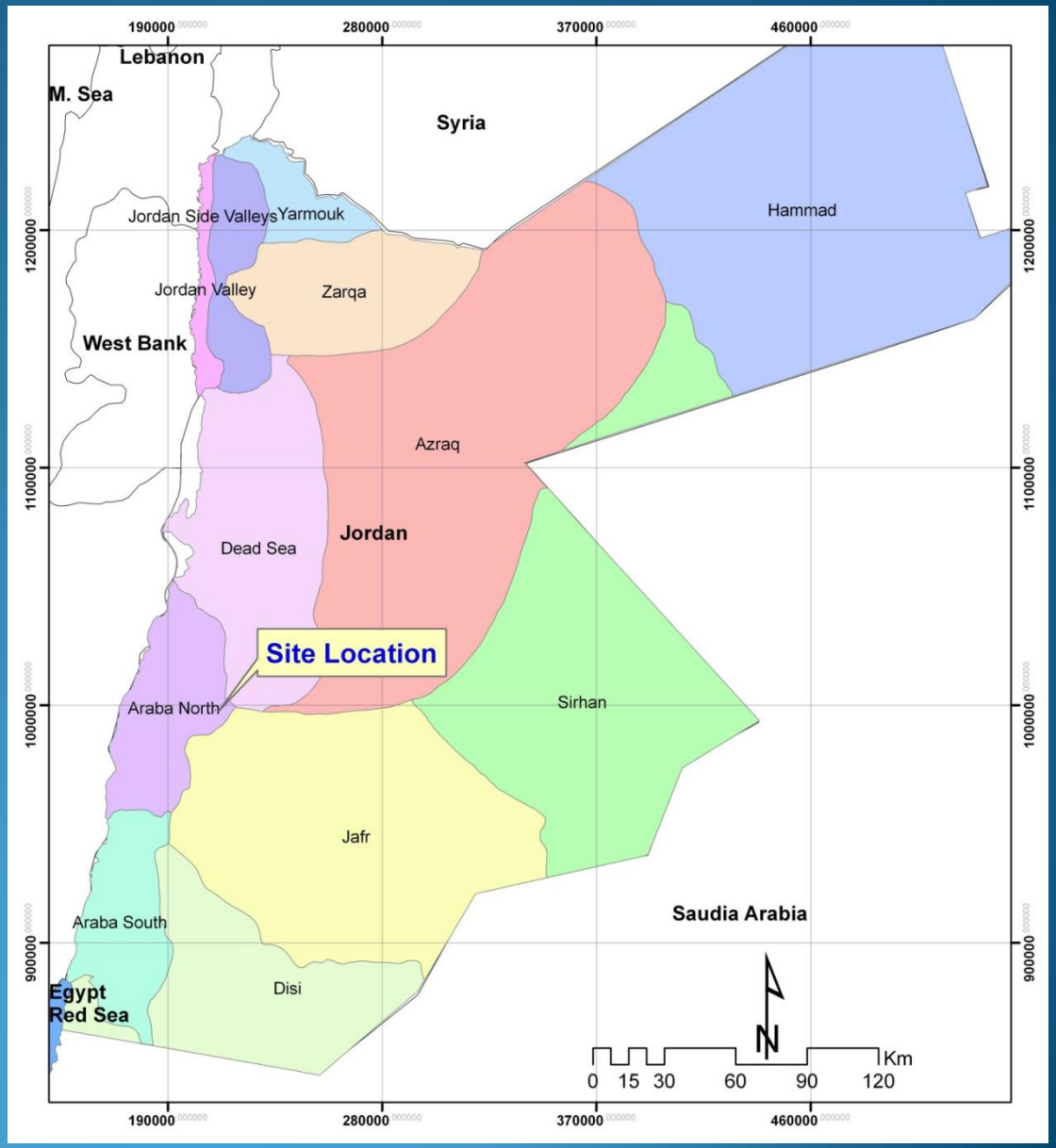
- Water Pumping
- Police Stations
- Communications
- Schools
- Teachers Residences
- Clinics
- Mosques
- Others

Capacity-building In Wind Energy (WE) and Concentrating Solar Power (CSP) in Jordan

Objectives

- The promotion of renewable energy sources through installation of two pilot plants one for ***CSP*** and the other for Wind.
- Establish two "accredited" testing facilities in Jordan for ***CSP*** and Wind.
- Provide training for NERC staff in the construction, installation, operation, maintenance and monitoring of the wind and ***CSP*** pilot plants.

WECSP Site Location



Wind and CSP Power plants at Al- Fujaij /Shoubak

Training Center and Testing Facilities for Wind and CSP

1.Wind Power Pilot Plant 1.65 MW

1.CSP Pilot plant 1 MW

Installation of the First 1.65 MW Wind Turbine in Jordan

Al-fujaij Wind Turbine

Al-fujaij Wind Turbine

Thank You