Jordan
Renewable Energy (Solar PV)
Market – Opportunities – Complexity
Contents

- Kawar Energy Profile
- Jordan Energy Situation
- Developing Solar PV Project
- Shams Ma’an
- Shamsi
Kawar Group

www.kawar.com

Kawar Energy Parent Company

• A leading privately-owned business group, with headquarters in Jordan and operating in the Middle East and North Africa

• Today the Group represents a large entrepreneurial enterprise with multiple business interests in the following sectors:
  - Shipping and Logistics
  - Travel and Tourism
  - Information and Communication Technologies
  - Multimedia
  - International Trade and Project Development
  - Healthcare
  - Investments
  - Energy
  - Real Estate
Core Activities

Projects – Services – Investments

- **Renewable**: Solar, Wind, Synthetic Diesel
- **Gas**: LNG, Natural Gas
- **Mining**: Oil Shale, Uranium
- **Water treatment and recycling**: 
- **Consultancy**: Energy efficiency, CDM
- **Investments**
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Jordan’s Electricity landscape

POLICIES MAKERS AND REGULATORY BODIES

- Ministry of Energy and Mineral Resources
- Electricity Regulatory Commission (ERC)

GENERATION SECTOR

- Central Electricity Generation Co (CEGCO)
- Samra Electric Power Generation Company (SEPGCO)
- Independent Power Producer IPP’s
- Large Industries

TRANSMISSION SECTOR

- National Electric Power Company (NEPCO)
- Interconnections

DISTRIBUTION SECTOR

- Jordan Electric Power Company
- Irbid District Electric Company
- Electricity Distribution Company (EDCO)
Jordan is highly dependent on imported energy and the cost of energy imports has been a major burden to the economy.

In 2012, the cost of imported energy amounted to 20% of the GDP. Total imported energy amounted to 97% of Jordan's total energy needs.

High growth of primary energy demand is forecasted to cope with sustainable development.

In 2020, the expected demand for primary energy amounts to 15 million tons of oil equivalent as compared to 7.6 million tons of oil equivalent in 2007.

Rapid increase in demand.
Jordan’s Energy Strategy

Electricity Generated to Meet Future Demand

- The anticipated electricity demand in 2020 is 5,770 MW compared with 2,100 MW in 2007, an average increase of 300 MW per year.

- To meet the energy demand and the challenges of the energy sector, a comprehensive energy strategy was approved by the Cabinet in December 2004, revised in 2007, to provide a vision for development of the energy sector over the next ten years.

- The strategy studied all options and alternatives for securing all types of energy from the following points of view:
  - The optimal options to cope with the energy demands and its investment cost.
  - Reforming and restructuring the energy sector to open the market for competition.
  - Expanding on renewable energy projects and implementing energy conservation programs.

The Main Variables

- The anticipated electricity demand in 2020 is 5,770 MW compared with 2,100 MW in 2007, an average increase of 300 MW per year.

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  - The optimal options to cope with the energy demands and its investment cost.
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  - Expanding on renewable energy projects and implementing energy conservation programs.
Domestic Resources 4%, Imported 96%
Expected Future Energy Mix

**Targeted Energy Mix in 2015**

- **Oil Products**: 51%
- **Natural Gas**: 29%
- **Oil Shale**: 11%
- **Imported Electricity**: 2%
- **Renewable Energy**: 7%

**Targeted Energy Mix in 2020**

- **Oil Products**: 40%
- **Natural Gas**: 29%
- **Oil Shale**: 14%
- **Imported Electricity**: 1%
- **Renewable Energy**: 10%
- **Nuclear**: 6%

**Future Goals**

- Reduce the dependence on foreign energy sources (energy independence)
- Security of supply with energy production based on a variety of sources
- The target for 2015 is for domestic resources to cover 25% of demand reducing imports to 75%
- The target for 2020 is for domestic resources to cover 39% of demand reducing imports to 61% and achieving energy production from additional energy sources
- Renewable energy target set at 10% of the energy mix by 2020
According to the **Energy Strategy** the required **investment** in the energy sector is around **$14-18 billion** over the period (2008-2020)

- **Oil Sector**: $3400 m
- **Power Sector**: $4800- $5800m
- **Natural Gas**: $2400 m
- **Renewable Energy**: $1400- $2100 m
- **Energy Efficiency**: $80-150 m
- **Oil Shale Exploration**: $1400- $3800 m
Promoting RE Sources to share 7% in the primary energy mix in 2015, and 10% in 2020

- 600 - 1000 MW Wind Energy.
- 300 - 600 MW Solar Energy.
- 30 - 50 MW Waste to Energy.
EDAMA Association

- Jordan’s Blueprint for Green Economy
- Promote mature energy-water-environment sector
- Work towards Jordan energy independence
- Provides export opportunities in the form of marketable energy-water-environment and technical expertise
- Have a tangible impact on the country’s environment and socioeconomics
- EDAMA Association is Jordan’s focal point of support and reference for the EWE sector to elevate its capabilities, capacity, and positive economic and environmental impacts.
Role of Renewable Energy

- Renewable energy can **contribute to Jordan’s security of supply** and reduction of energy imports by capitalizing on the country’s natural resources.
  - **High solar index**, which in many areas can achieve more than 2,500 KWh/sqm annually.
  - **Extensive desert land** areas that can be used for large solar energy at small or no cost.

- To develop renewable energy production, Jordan needs to **attract investment by providing an attractive and stable regulatory framework**.
  - RE currently requires financial incentives and state support.
  - However, the cost of the **RE technologies is constantly decreasing**.
  - **Tax breaks, subsidies and feed-in tariffs** are usually the range of incentives deployed by governments.
Global PV cumulative installed Capacity 2000 – 2012 (MW)

Global PV annual installations 2000 – 2012 (MW)

Source: EPIA Global Market Outlook for Photovoltaic 2013 2017
PV Future prospects for market development

PV opportunity mapping of Sunbelt countries

* Following countries are not shown on the mapping due to poor availability of data: Chad, Côte d'Ivoire, Congo Democratic Republic, Cuba, Iraq, Madagascar, Mali, Myanmar, Somalia, Sudan, Uganda.

Source: EPIA, Unlocking the Sunbelt Potential of Photovoltaics, 2010
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Project Milestone

Political will

Off Taker

Legal Framework

Bankable feasibility

EPC

Commissioning

May 2013
Politics: Egyptian Gas Dilemma

16 X

Increase budget deficient

Fuel switching cost $ 4.25 million/ day

Energy Bill 20% GDP year 2011

This is a 2 MW PV plant per day!
**Legal Framework**

**Goals**
- Provide a legal mandate for the government and a regulatory framework for RE and EE development.
- Encourage private-sector investment in RE.
- Diversify energy sources in Jordan.
- Reduce greenhouse gases.
- Develop in-country expertise related to RE and EE.

**Main Articles**
- Creates a registry of renewable energy sites
- Tendering of RE Projects
- Direct proposals by the private sector
- Obligation to purchase renewable energy
- Interconnection and Licensing Incentive
- Develop “Net Metering”
- Establishing a Renewable Energy & Energy Efficiency Fund
- Allows for Bylaws to be issued for EE measures in different sectors.

**Renewable Energy and Energy Efficiency Law, Feb 2012**
Lenders Requirements

- Project is financially and economically viable
- Can support senior debt obligations
- Project contracts and agreements are financeable
- Acceptable financing plan relative to capital and operating cash flow
- Bankable technology
- Solar data and proof of yield assessment
- Grid availability and capacity
- Adequate Site security measures
- Adequate insurance coverage
- Appropriate project land use rights
- Acceptable legal structure including loan collateral, security management and international arbitration
- Satisfactory regulatory environment
- Project meets lenders eligibility requirements
- Meets Social and environmental guidelines
- And many more.................................
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<th>Engineering</th>
<th>Procurement</th>
<th>Construction</th>
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<td>• Civil Design</td>
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<td>• Execution Design</td>
<td>• Structural</td>
<td>• Module Mounting</td>
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<tr>
<td>• Maintenance and monitoring design</td>
<td>• Manufacturing and Procurement of BoS Components and PV Modules</td>
<td>• Cabling</td>
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<td>• Performance Optimization</td>
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<td>• Inverter</td>
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<td>• Cost Reduction</td>
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<td>• Installation</td>
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<td>• Grid Connection</td>
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<td>• Commissioning</td>
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# Project Risk Identification

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<th>Political Risks</th>
<th>Technical Risks</th>
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<tr>
<td>• Energy law and policy (changes, instructions, legal)</td>
<td>• Plant location (climate, terrain, solar radiation, floods)</td>
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<tr>
<td>• Land ownership (private, public, permits, construction and local community)</td>
<td>• Technology (selection, new technology, inverters, trackers, grid)</td>
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<tr>
<th>Economic Risks</th>
<th>Time Delay Risks</th>
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<tr>
<td>• Technology (cost of equipments PV/ CPV, inverters, trackers)</td>
<td>• PPA</td>
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<tr>
<td>• Plant location (weather, solar radiation, floods, earthwork)</td>
<td>• Construction (EPC)</td>
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<tr>
<td>• Plant start-up permits (cost of grids connection, cost of land)</td>
<td>• Connection to Electric grid</td>
</tr>
<tr>
<td>• Plant operation (cost, maintenance, performance losses)</td>
<td>• Changes in energy bylaws, legislations and instructions</td>
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<tr>
<td>• Bank financing</td>
<td>• Changes to Land and urban planning legislations</td>
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<tr>
<td>• Energy demand due to economical activities</td>
<td>• Connection to Electric grid</td>
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<td>• Currency fluctuation</td>
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<td>• Changes in energy prices</td>
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<th>Legal Risks</th>
<th>Social Risks</th>
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<tr>
<td>• Changes in energy bylaws, legislations and instructions</td>
<td>• Plant Exploitation (vandalism, thefts)</td>
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<td>• Changes to Land and urban planning legislations</td>
<td>• Land issues and ownership</td>
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<td>• Connection to Electric grid</td>
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Key Benefits

- Shams Ma’an plant will provide supply of clean peak energy allowing:
  - optimization of investments in new generation capacity (today Jordan imports 96% of its energy)
  - exploitation of MA’AN Industrial Area capabilities
  - Saving 160,000 tons/year of CO₂ emissions in atmosphere, (the same as planting and growing for 25 years 960,000 pine trees)**

- Extensive technology transfer into the MA’AN Industrial Area and into Jordan overall

- Strong employment impact:
  - > 500 people during construction
  - 100 - 120 people during operating*

- Efficient usage of water:
  - very limited usage of water for operations (v/s CSP)

- Shams Ma’an a step forward towards Jordan’s Energy Independence:
  - Utilizing Jordan’s own renewable resources

- Puts Jordan on the world’s Renewable Energy Map
  - Attracting investments
  - Technology hub

- A Nucleus for DESERTEC/ MSP
  - Clean Power from Deserts
  - $ 300 million investment

* It includes local people indirectly employed by O&M operator, for monitoring and maintenance (electrical, modules cleaning … etc.)

** 6 Twenty-Five year old pine trees absorb 1 tone of CO₂
Land Selection

Ma'an, April 2009

• Chert covered surface
• Flat land
• High elevation, 1069 m

+ 

The optimal location for a PV plant

• Average wind 3.4 m/s
• Glob. Irradiation 5.98 KWh/m2/day
• DNI 7.21 KWh/m2/day
• Mean Avg. Temp. H 25º C / L 10º C
• Humidity - Dry
• Annual precipitation 42 mm/year

• Grid Proximity
• Substation Proximity
• Highway Proximity

+ 

p27 (18 May 2013)
Shams Ma’an

Key Parameters

- Location: Ma’an, Jordan
- Surface: 2.00 km²
- Expected Energy*: 1600 to 2200 kWh/kWp/year
- Plant Power: 100 MWp
- Production*: 168 to 220 GWh/year
- Technology: Photovoltaic

*Estimated values

Image of a VLS-PV System in Ma’an Industrial Park
Feasibility Study

- Signing ceremony on May 26, 2010
  - at MENA Power 2010 in Cairo
- Grant of US $617,204.00 for Feasibility study for a 100 PV power plant
  - Technology evaluation PV/CPV
  - Facility and equipment assessment
  - Financial and Technical Analysis
  - Legal and Regulatory issues
  - Environmental and Social Analysis
  - Country Development Impacts
  - Implementation plan

- Started June 2011
- Allocated dedicated, specialized team
  - Technology
  - Engineering
  - Project finance
  - Environmental and socio economics
- Covering 12 tasks
- Expected to finalize end Q1 2012
Technology screening

- Technical Performance
- Commercial - Technical Maturity
- Production Cost

Selected Technology

- PV
- CPV
- CSP
Solar PV Module Market

**Crystalline**

**Advantages**
- Rapid price decrease, approach parity with thin-film (CdTe)
- High efficiency
- Demonstrated operational life

**Challenges**
- Manufacturer consolidation
- Squeeze on margins, manufacturing cost higher than CdTe
- 72 cell module innovation not field tested <5 years – possible solder failures
- New innovations, such as selective emitter, do not have a 30 year demonstrated operational life

**Thin-film**

**Advantages**
- Better performance in warm or hot conditions
- Less complicated form factor (no soldering, no bypass diodes)
- Better response to partial shading/partial soiling (154 active cells without bypass diodes)
- One product form factor focus

**Challenges**
- First Solar warranty claims
- Fewer significant or established players in that domain
- Limited historical lifetime data
- Yearly output degradation 0.7% vs. 0.5%
Technology Evaluation Field – Ma’an

Allocated Land, April 2010

5500 m²

1st CPV in Jordan, May 2010

Soitec

Top tier Participants, May 2013

Project in the making

May 2009
Project Announcement

October 2009
Land Agreement Signed

November 2009
Capacity Building

December 2009
Establishment of Shams Ma'am Power Generation Company PSC

December 2010
Technical Evaluation

January 2011
Evaluation Field agreement with MDC

May 2010
USTDA Grant

May 2010
Project Conference

March 2011
Feasibility Study

May 2011
Carbon Credits Assessment

July 2011
MEMR EOI

September 11, 2012: Received instructions and draft PPA from MEMR

March 11, 2013: Generation proposal submittal

To continue

May 9 2012; MEMR shortlist notification

May 30 2012; MOU signed
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Consumers are Producers

Project

- Residential and Commercial Grid Connected PV systems
- Solar Index: **2100 KWh/m²** per annum, makes PV in Jordan the most desired alternative
- Technology variants used: TFPV and c-Si PV
- Install on rooftops
- **Kawar Energy**: currently leading this initiative delivering a variety of turnkey solutions
Why Shamsi

Facts

• **Electricity prices are rising** with no end in sight. A steep rise for consumers in Jordan

• **Electricity consumptions** are as well **rising** exponentially

• **Homeowners** already **pay $0.16/kWh** for usages above 500 kWh/month. **Commercial consumers** can expect to **pay $0.178/kWh** above 1200KWh/month

• Professionally installed **PV system pricings** have been **falling** sharply the past few years

• **Government legislations** are expected to be put into permanent form soon

• **PV is the most viable option today**, given current market conditions. If a viable FiT is introduced, this forms an added value to the Shamsi initiative
Meeting peak demand

Fig (7)

- Transmission Losses
- Power Station Aux. Consumption
- Distribution Losses
- Total Losses
THANK YOU

Hanna.Zaghloul@Kawar.com