Concentrated Solar Power In Egypt

CTF : Concentrated Solar Power Scale-Up Program for MENA Region
Workshop June 28, 2012, Tunisia

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Institutional framework: Establishing NREA (1986)
The national focal point to develop and introduce renewable energy technologies to Egypt on a commercial scale together with implementation of related energy conservation programs.
The Energy Sector Policy

It Depends on 3 Main Pillars:
- Diversifying Energy Resources.
- Improving Energy Efficiency and Energy Conservation Programs.
- Maximizing the share of Renewable Energy (RE) in the energy mix.

New Electricity Act

- A new electricity act has been developed by the Ministry of Electricity & Energy and it is subject to the constitutional approvals.
- The act has been designed to reflect the ongoing market reform as well as to strengthen the regulatory agency.
- It includes articles supporting REs, through encouraging private investments in renewable.
Egypt’s Vision

Focuses on

- Increasing the contribution of RE in the electric energy mix to meet the growing demand (before the rev. 7 – 8 % annually).
- Saving the fossil fuels (Oil & NG) for export and for future generations needs.
- Exporting clean energy generated from Wind and Solar to Europe via regional interconnection links.
- Trading the emission reductions.
- Enhancing the local industrial capabilities through technology transfer.
- Creating national and regional market for RE equipment.
- Creating new job opportunities
Egypt’s Plan

Targets to:

Satisfying 20% of the generated electricity from RE by 2020, including:
- 12% Wind energy
- 5.8% Hydro
- 2.2% Solar

(National plan will be issue to install 3500 MW from solar energy (CSP – PV) by year 2027)

Achievements

Projects in Operation
- 140 MW CSP Project in Kuraymat in cooperation with WB/JICA

Projects Under Preparation
- 100 MW CSP Kom Ombo Project, in cooperation with WB, AFDB, EIB. FDA, GG, CTF
- 20 MW PV Hurghada Project, in cooperation with JICA
- 20 MW PV Kom Ombo Project, in cooperation with FDA
Point of View for CSP Deployment in Egypt

**Encouraged by:**
- High intensity of solar irradiation.
- Uninhabited large flat desert available.
- Expanded national power grid, as well as the gas pipeline network.
- Cheap labor and intensive skills, in addition to local industrial capabilities.

**We are looking to:**
- Be one of the players, not an audience.
- Tapping the natural solar potentials based on win-win situation.
- Enhancing the cooperation with all involved parties.
- Be the hub for CSP market in the region.

**Barriers need to be tackled**
- High investment cost compared with wind energy.
- Incentives to attract investments are required.
- Strengthening programs for know-how and technology transfer.
- Lack of relevant R & D activities
- Despite the current incentives of the international institutions, but are not enough
The Plan of Financing the RE Projects in Egypt

The Renewable Energy Fund

- AT 16th Jan 2012 establishing a renewable energy fund will help through:

1. Bridging the gap between cost of electricity from conventional and renewable energies.
2. Addressing the risk of the Foreign currency exchange
3. Contributing in financing RE pilot projects.
4. Supporting R & D activities in renewable energy field.
5. Enhancing Local manufacturing of RE equipment.

- Forming a ministerial committee composed of ministers of electricity, petroleum, environment and Deputy Prime Minister to find how to finance it.
Positive trends and on-going steps taken by NREA

Projects

Project: Kuraymat Solar Thermal Power plant

- 1st governmental CSP project. (Under Operation 7/2011)
- 140 MW ISCC configuration (120 MW CC & 20 MW Solar)
- Finance (340 Million $)
  - GEF (Global Environment Facility – World Bank) grant 50 M$
  - JICA (Japanese International cooperation Agency) Soft loan 190 M$
  - NREA for local currency portion (100 M$).
- National private sector contractor for solar island (Orascom).
- 50% of the solar field is locally manufactured.
Positive trends and on-going steps taken by NREA

Research

ENEA – ASRT Agreement

**MATS Project**

**Multipurpose Applications by Thermodynamic Solar**
- FP7-ENERGY (under negotiation)
- 11 Partners (4 from Egypt)
  (ASRT, NREA, Orascom and Delft Environment)

*Multi Combined Heat and Power plants*
- Electricity Generation (1,0 MW el)
- District heating & cooling
- Water desalination unit (250 m³ per day)
- Integration by biomass
- Integration by fossil fuels
- Single thermal stratifying storage tank
- Molten salts backup auxiliary heater

Science & Technology Development Fund

- STDF announces its first targeted call for Scientific Research and Technology Development in the area of “Renewable Energy” including CSP
- Fund allocated for the Manufacturing Egyptian Parabolic Trough.

Development of an Egyptian Prototype CSP
- Cost-Effective mechanical design of CSP module
- Cost-Effective thermal design of CSP module
- Manufacturing & assembling of 1st. Egyptian CSP
- Testing & Performance evaluation
- Integration by fossil fuels
- Single thermal stratifying storage tank
- Molten salts backup auxiliary heater

ASRT ➔ Egyptian Academy of Scientific Research and Technology.
Positive trends and on-going steps taken by NREA

Renewable Energy Master Plan (Priority for Wind & CSP)

NREA in cooperation with KFW and European Union has conducted a contract with an international consultant to conduct “The Master Plan of Renewable Energy in EGYPT”.

**Phase 1:** Preparation a Master Plan for Electricity Generation from Renewable Energy (Wind – CSP – PV).

**Phase 2:** Master Plan for the remaining RE resources (Biomass – Biofuels – Geothermal .....).
Positive trends and on-going steps taken by NREA On CSP KOM OMBO Project

- 14 Sites initially selected by NREA
- 11 sites visited by Lahmeyer International (Oct. 2009)
- 2700 Km traveled
Positive trends and on-going steps taken by NREA On CSP KOM OMBO Project

EMPower Program (Pre-feasibility study by June. 2010)

United Nations Environment Program (UNEP)
German Ministry of Economic Cooperation and Development (BMZ)
Represented by KfW
EMPower Program, Phase II

Pre-Feasibility Study Report: CSP Plant Kom Ombo
First Draft

June 2010
Lahneyer International GmbH
Positive trends and on-going steps taken by NREA on CSP KOM OMBO Project

Feasibility study for CSP for Kom Ombo plant (Technical report Feb. 2012)

- Meeting in Cairo at Dec. 2011 (NREA - IBRD – AFBD – KFW - … ) for review and Comments on Technical report
Visiting of the Kom Ombo site (NREA - LAHMEYER)

- Collecting data for all issues as:
  - Water supply
Visiting of the Kom Ombo site (NREA - LAHMEYER)

- Collecting data for all issues as:
  - Gas feeding
Positive trends and on-going steps taken by NREA On CSP KOM OMBO Project

Visiting of the Kom Ombo site (NREA – LAHMEYER)

- Collecting data for all issues as:
  - Earthquake
  - Topography of land
Visiting of the Kom Ombo site (NREA – LAHMEYER)

- Collecting data for all issues as:
  - Grid connection

Positive trends and on-going steps taken by NREA On CSP KOM OMBO Project
Projects proposed (Site Location)

Obtaining approvals from all relevant government departments
### Positive trends and on-going steps taken by NREA On CSP KOM OMBO Project

<table>
<thead>
<tr>
<th>Options for Kom Ombo Solar Power Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>X1</strong></td>
</tr>
<tr>
<td><strong>X2</strong></td>
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<td><strong>X3</strong></td>
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<td><strong>X8</strong></td>
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<td><strong>X9</strong></td>
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## Positive trends and on-going steps taken by NREA
### On CSP KOM OMBO Project

<table>
<thead>
<tr>
<th></th>
<th>X1</th>
<th>X2</th>
<th>X4</th>
<th>X5</th>
<th>X6</th>
<th>X8</th>
<th>X9</th>
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<tbody>
<tr>
<td>CSP m²</td>
<td>60,495</td>
<td>90,579</td>
<td>90,579</td>
<td>120,663</td>
<td>120,663</td>
<td>60,495</td>
<td>90,579</td>
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<tr>
<td>Loops</td>
<td>185</td>
<td>277</td>
<td>277</td>
<td>369</td>
<td>369</td>
<td>185</td>
<td>277</td>
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<tr>
<td>Storage Hours</td>
<td>Without</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>Without</td>
<td>4</td>
</tr>
<tr>
<td>Cooling</td>
<td>WCT</td>
<td>WCT</td>
<td>WCT</td>
<td>WCT</td>
<td>ACC</td>
<td>ACC</td>
<td>ACC</td>
</tr>
<tr>
<td>Extra Heating</td>
<td>-</td>
<td>-</td>
<td>10 – 15%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Total Energy GWH/Y</td>
<td>294.3</td>
<td>444.8</td>
<td>506</td>
<td>585.3</td>
<td>573</td>
<td>288.3</td>
<td>434.6</td>
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<tr>
<td>Net energy GWH/Y</td>
<td>261</td>
<td>395.6</td>
<td>450.5</td>
<td>520.5</td>
<td>506</td>
<td>253.3</td>
<td>383.7</td>
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<tr>
<td>Water Consumption m³/Y</td>
<td>967,899</td>
<td>1,434,370</td>
<td>1,612,510</td>
<td>1,867,350</td>
<td>106,271</td>
<td>53,934</td>
<td>80,643</td>
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<tr>
<td>Coast (1000€)</td>
<td>338,552</td>
<td>542,572</td>
<td>556,418</td>
<td>731,830</td>
<td>740,820</td>
<td>347,611</td>
<td>551,588</td>
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<tr>
<td>Options</td>
<td>X1</td>
<td>X2</td>
<td>X3</td>
<td>X4</td>
<td>X5</td>
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<td></td>
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</tr>
<tr>
<td>Levelised Electricity Costs LEC</td>
<td>150.6</td>
<td>151</td>
<td>135.8</td>
<td>150</td>
<td>155.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic rate of return (EIRR)</td>
<td>9.2%</td>
<td>10.4%</td>
<td>12.4%</td>
<td>11.2%</td>
<td>10.8%</td>
<td></td>
<td></td>
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<tr>
<td>Total Cost (1000 £)</td>
<td>435,152</td>
<td>661,126</td>
<td>677,087</td>
<td>864,097</td>
<td>869,275</td>
<td></td>
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<tr>
<td>Total Benefit (1000 €)</td>
<td>474,532</td>
<td>789,566</td>
<td>932,576</td>
<td>1,099,421</td>
<td>1,076,891</td>
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<tr>
<td>B/C Ratio</td>
<td>1.09</td>
<td>1.19</td>
<td>1.38</td>
<td>1.27</td>
<td>1.24</td>
<td></td>
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Positive trends and on-going steps taken by NREA On CSP KOM OMBO Project
The CTF grant agreement (USD 995,500) for Kom Ombo project has now been fully signed at 17th May 2012.

<table>
<thead>
<tr>
<th>Components</th>
<th>CTF Grant</th>
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<tbody>
<tr>
<td>ESIA study</td>
<td>344,500</td>
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<tr>
<td>Technical Assistance</td>
<td>472,500</td>
</tr>
<tr>
<td>Solar station</td>
<td>88,000</td>
</tr>
<tr>
<td>Operating Costs</td>
<td>90,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>995,500</strong></td>
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</tbody>
</table>
Positive trends and on-going steps taken by NREA On CSP KOM OMBO Project

Environmental and Social Impact Assessment” (ESIA)

- Request of proposals for consulting services “Environmental and Social Impact Assessment” (ESIA) for Kom Ombo Concentrated Solar Power Plant (CSP) Project.
- Issues Letter of Interest for a/m consulting services
- NREA received Pre Qualification Documents from 28 firms.
- Short List from 6 Firms has been selected,
Positive trends and on-going steps taken by NREA on CSP KOM OMBO Project

Environmental and Social Impact Assessment” (ESIA)

- At 20th June 2012, the letter of Invitation has been addressed to the approved short list (6 Firms it’s nationality as shown)

1. Sweden / Egypt
2. France
3. Egypt / Germany
4. UK / Egypt
5. Egypt
6. UK

- At 7th Aug 2012 Proposals will be received.

- At 1st Sep 2012 NREA expected to sign the contract.
Positive trends and on-going steps taken by NREA On CSP KOM OMBO Project

### Brief Time Schedule for CSP Kom Ombo Project

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
<th>Starting Dates</th>
<th>Finished dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility study</td>
<td>8 Months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final FS report</td>
<td></td>
<td>--/--</td>
<td>10 Oct 2012</td>
</tr>
<tr>
<td>ESIA Study</td>
<td>4 Months</td>
<td></td>
<td></td>
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<tr>
<td>Final ESIA report</td>
<td>1 Months</td>
<td>22 Feb 2013</td>
<td>22 Mach 2013</td>
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<tr>
<td>Launch procurement of EPC contract</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFP issued</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>EPC contract signed</td>
<td></td>
<td></td>
<td>12 Aug 2013</td>
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</table>
Project proposals (Preliminary Financial Configuration)

<table>
<thead>
<tr>
<th>Available Financial for Kom Ombo Solar Power Plant</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>100 Million $ CTF (Clean Technology Fund)</td>
<td></td>
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<tr>
<td>170 Million $ WB (World Bank)</td>
<td></td>
</tr>
<tr>
<td>170 Million $ AFDB (African Development Bank)</td>
<td></td>
</tr>
<tr>
<td>50 Million € AFD (French Agency Development)</td>
<td></td>
</tr>
<tr>
<td>50 Million € Government of Germany</td>
<td></td>
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<tr>
<td>50 Million € EIB (European Investment Bank)</td>
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<tr>
<td>KFW will share after the Finish of Feasibility study</td>
<td></td>
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<tr>
<td>local currency portion</td>
<td></td>
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<tr>
<td>Total Investment cost = 750 Million $</td>
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</table>
Thank You