Industrial integration of CSP technologies in Morocco

Chances and potential for Moroccan and international partners

ESMAP 2011 Knowledge Exchange Forum
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1. The Moroccan Solar Plan

2. Industrial integration - ESMAP study

3. Actions to support the industry
Current situation of energy supplies and demand

- 95% of Morocco’s energy demand is covered by imports
- 20 MW of CSP are already installed

**Structure of energy supplies**

Year 2008

- Coal: 34%
- Solar energy: 24%
- Gas: 7%
- Wind energy: 24%
- Hydraulic: 2%

**Annual energy demand**

- Average increase rate: 6.5%

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy demand in GWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>13265</td>
</tr>
<tr>
<td>2000</td>
<td>13942</td>
</tr>
<tr>
<td>2001</td>
<td>14804</td>
</tr>
<tr>
<td>2002</td>
<td>15440</td>
</tr>
<tr>
<td>2003</td>
<td>16779</td>
</tr>
<tr>
<td>2004</td>
<td>17946</td>
</tr>
<tr>
<td>2005</td>
<td>18518</td>
</tr>
<tr>
<td>2006</td>
<td>21105</td>
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<tr>
<td>2007</td>
<td>22608</td>
</tr>
<tr>
<td>2008</td>
<td>24004</td>
</tr>
<tr>
<td>2009</td>
<td>25009</td>
</tr>
</tbody>
</table>

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National energy strategy

In the year 2020:
- Share of renewable energies 42 %
- 14 % solar energy

- Secured energy supply
- Positioning in the long-term development

- Diversification of resources

- Furtherance of renewable energies

Chances for social and economical development
R&D, local industries, competition, ...

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## The Moroccan Solar Project

### Power creation

Installation of solar power plants with an overall performance at least 2000 MW until 2020

### Industrial integration

- Identification of the potential of Moroccan industries to manufacture components for solar power plants
- Subsidy and furtherance
- Acquisition of expertise in the field of development

### Research and development

- Identification of R&D subjects
- Financing R&D projects
- Creation of infrastructure for R&D

### Education

- Definition of the required educational profiles
- Partnerships
- Support of the establishment of new educational programs

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Industrial integration

**Objectives**
- Establishment of industries along the entire value chain for components and plants in the field of solar energy including the required services
- Qualification of the Moroccan industry in the fields of R&D, manufacturing and services up to the ability of innovation

**Approach / strategy**
Creation of the necessary conditions in the three pillars of industrial integration

- Infrastructure
- Industrial offer
- Human resources
Industrial integration along with the first plant project

- Information based on a very usable study initiated by the World Bank with the title “MENA Assessment of the Local Manufacturing Potential For Concentrated Solar Power Projects

### Output of the World Bank - ESMAP Study

<table>
<thead>
<tr>
<th>CSP value chains</th>
<th>Required manufacturing processes</th>
<th>Potential to cover certain steps of the value chain in Morocco</th>
<th>Cost structure along the value chains</th>
</tr>
</thead>
</table>

### Advantages of the study for Morocco

- Overview of required manufacturing processes and of the current manufacturing capabilities in Morocco
- Local value addition opportunities for the first solar power plant project
  - Maximum utilization of investment due to high value addition
- Abstract of the potential value addition in each value addition step based on the cost structures

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Data from the ESMAP Study

- The value chain of CSP plants
Data from the ESMAP Study

Cost structure of a parabolic trough plant with a capacity of 50 MW and 7 h thermal energy storage

![Graph showing cost structure]

**Data:**
- Parabolic Trough technology from Spanish market
- 50 MW with storage for 7 hours
- Total investment 364 Mio US$ in 2010

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Use of the ESMAP Study

Sub-costs for in particular fields

<table>
<thead>
<tr>
<th>Cost category and unit</th>
<th>Relative costs (relative value) compared to entire plant in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor costs for site and solar field</td>
<td>17.14</td>
</tr>
<tr>
<td>Solar field</td>
<td>3.11</td>
</tr>
<tr>
<td>Site preparation, infrastructure</td>
<td>5.82</td>
</tr>
<tr>
<td>Steel construction</td>
<td>2.5</td>
</tr>
<tr>
<td>Piping</td>
<td>1.75</td>
</tr>
<tr>
<td>Electrical installations / others</td>
<td>3.96</td>
</tr>
<tr>
<td>Equipment: solar field, HTF system</td>
<td>38.54</td>
</tr>
<tr>
<td>Mirrors</td>
<td>6.36</td>
</tr>
<tr>
<td>Receivers</td>
<td>7.11</td>
</tr>
<tr>
<td>Steel construction</td>
<td>10.71</td>
</tr>
<tr>
<td>Pylons</td>
<td>1.07</td>
</tr>
<tr>
<td>Foundations</td>
<td>2.14</td>
</tr>
<tr>
<td>Trackers</td>
<td>0.43</td>
</tr>
<tr>
<td>Swivel joints</td>
<td>0.71</td>
</tr>
<tr>
<td>HTF System (Piping, pumps, …)</td>
<td>5.36</td>
</tr>
<tr>
<td>Heat transfer fluid</td>
<td>2.14</td>
</tr>
<tr>
<td>Electronics, controls, …</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Potential in Morocco and high value addition

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Some potential Moroccan players

Steel structures

- Tubular cantilever arm
- Tube profiles
- Metal stamping parts

Potential players / references

- Maghreb Steel, menasteel, Leoni, Labinal, Nexans Maroc
- S.n.o.p. Maroc, Ynna Holding, ...

Cables and electrics

- Wide range of cables
- Electrical tower
- Building structure

Sheet metal stamping parts for the automotive industry

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Potential for Moroccan companies to cover parts of the CSP in short term

There is a high potential for Moroccan companies to cover parts of the CSP value chain.

Local value addition possible
- in %
  - min.: 27.78
  - max.: 38.46

Local value addition possible
- in Million USD
  - min.: 101.11
  - max.: 139.99

Based on a reference CSP plant of 50 MW at a total investment of 364 Million USD

- Huge potential for Moroccan companies to participate in the realization of the Moroccan Solar Plan
- Actions to increase the percentage of local value

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Roadmap of the ESMAP Study

Main objectives of the study:

1. Provide an overview of manufacturing processes, costs and cost reduction potential for key CSP components
2. Assess the potential for a CSP manufacturing industry in the MENA region
3. Establish roadmaps and an action plan for the development of local CSP manufacturing in MENA
4. Analyze potential economic benefits of a CSP component manufacturing industry in MENA

Source: The World Bank - ESMAP Study

- Approach in Morocco is to conduct a similar study for all CSP technologies
- Objective of maximizing local value addition on future plant projects
Industrial integration - various CSP technologies

Parabolic Trough

Linear Fresnel

Dish Stirling

Solar Tower
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New study in Morocco for all CSP technologies based on the World Bank Study

Detection of the state of the art

- Identification of the state of the art and skills in Morocco
- Identification of the international state of the art
  - Technologies
  - Components
  - Services
  - Markets

Gap analysis

- Identification of the particular potential for industrial integration

Action plans / Implementation

- Analyze qualification gaps
- Short-term integration
- Action plans
  - Modernisation
  - Spezialisation
  - Qualification

Innovation clusters

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Actions to support the industry

- dedicated offer covering Infrastructure access at low price
- Tax benefits
- Subsidies for training, …

...to be issued in the very short term...
Actions to support the industry

R&D Project: Platform for applied research and development

Moroccan educational institutions

Moroccan industries

Moroccan R&D institutions

Physical

- Demonstrators
- Pilot projects
- Measurement facilities
- Space for industries

Virtual

- Communication network including profiles of actors
- Knowledge database
- Education
- Information and contact point for companies

Platform for applied and pre-operational research in the field of solar technologies

MASEN F&E

International educational institutions

International industries

International R&D institutions

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Thank you for your kind attention