RENWABLE ENERGY IN OMAN OUTLOOK

Water & Energy
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SQU

Dr. Ali Hamed Al Ghafri
Chairman Assistant for IR&C
Public Authority for Electricity and Water
Sultanate of Oman

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PRESENTATION OVERVIEW

• ELECTRICAL SECTOR OVERVIEW
• RENEWABLE ENERGY
• FUTURE ENERGY RESOURCES
ELECTRICAL SECTOR OVERVIEW
Power System Components

- What are the main component of a power system?

  - Generation plants
  - Transmission Lines
  - Distribution systems
  - Loads
The Main Electric Power systems in Oman (2013)

MIS Network (90%)
- MIS (4634 MW)
- Dhofar Network (DPC) (≈385 MW)
- Rural Networks (RAECo) (≈90 MW)
- Middle Network (PDO) (≈ 660 MW)

Net system peak MW:

MIS
Dhofar Network (DPC)
Rural Networks (RAECo)
Middle Network (PDO)
The Current Main Arrangements of Generation, Transmission & Distribution Electric Power System

- **Generation**
  - 11/220kv
  - 11/132kv

- **Transmission**
  - 220/132kv
  - 132/33kv
  - 33/11kv

- **Distribution**
  - 11/0.415kv
  - Over Head line
  - Over Head line
  - Over Head line or Cable

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## Power Plants Connected to the MIS (2013)

### STATION

<table>
<thead>
<tr>
<th>STATION</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rusail</td>
<td>623</td>
</tr>
<tr>
<td>Ghubrah</td>
<td>356</td>
</tr>
<tr>
<td>Manah</td>
<td>288</td>
</tr>
<tr>
<td>Wadi Jizzi</td>
<td>254</td>
</tr>
<tr>
<td>Al Kamil</td>
<td>283</td>
</tr>
<tr>
<td>Barka (ACWA)</td>
<td>464</td>
</tr>
<tr>
<td>Barka SMN</td>
<td>712</td>
</tr>
<tr>
<td>Barka 3</td>
<td>0</td>
</tr>
<tr>
<td>Sohar 1</td>
<td>595</td>
</tr>
<tr>
<td>Sohar 2</td>
<td>346</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>3921</strong></td>
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### SOURCE

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>Import</th>
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<tbody>
<tr>
<td>OCC</td>
<td>0</td>
</tr>
<tr>
<td>OMCO (IBTX)</td>
<td>0</td>
</tr>
<tr>
<td>PDO</td>
<td>52</td>
</tr>
<tr>
<td>Sohar Aluminium</td>
<td>305</td>
</tr>
<tr>
<td>OMIFCO</td>
<td>0</td>
</tr>
<tr>
<td>SRC</td>
<td>15</td>
</tr>
<tr>
<td>UAE</td>
<td>18</td>
</tr>
<tr>
<td>DIESEL GENSETS</td>
<td>137</td>
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</tbody>
</table>
MIS System Peak load
(2000 to 2013)
The Current Sector Framework

Public Authority for Electricity & Water

Electricity Holding Company
- Rusail
- Wadi Jizzi
- Manah
- Al Kamil
- Ghubrah
- Barka-1,2
- Barka-3
- Sohar-1
- Sohar-2
- Sur

Authority for Electricity Regulation
- Oman Power & Water Procurement Company
- Oman Electricity Transmission Company
- Muscat Electricity Distribution Co.
- Mazoon Distribution Co.
- Majan Distribution Co.
- Dhofar Power Co.
- Other Direct Connected Customers.

Rural Area Electricity Company
- Generation & Desalination
- Distribution
- Supply

Customers

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RENEWABLE ENERGY
Study on Renewable Energy Resources

Objectives:
• To provide an overview of renewable sources of energy in Oman & the potential use of renewable energy for electricity production
• To provide a platform for developing renewable energy policies for Oman

Findings:
• Significant potential from: Solar & Wind
• Limited potential from: Biogas, Geothermal & Wave
PAEW Renewable Energy Strategies

Policy & Strategy
1. Developing Policy for R.E development
2. Regulatory review

Project Implementation
1. Pilot Projects (RAECO)
2. 100 – 200 MW Solar Plant (Grid Connected)
3. Wind Monitoring Program then Wind farm
4. Energy Conservation
5. R.E Database

Regulatory review

Capacity Building
R & D
1. R.E Desalination
2. Hybrid Solutions
3. Solar Cooling
4. Focused research on specific technologies

Industrial
1. Row material extractions
2. Manufacturing
3. Added value services

Human Resources
1. University Programs
2. Engineering and O & M Skills
3. Research & Development
4. Utilities experience

Benchmark/ Monitoring / Feedback
Renewable Energy completed studies

1- Pilot Projects.

2- Feasibility study for electricity production using wind in Dhofar Governorate.

3- Feasibility study for electricity production using solar energy with capacity of 200 MW in Adam and Mannah.
## 1- Pilot Projects: Summary

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Location</th>
<th>Installed Capacity</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>2*250 Wind turbine</td>
<td>Masirah - Sharqiah</td>
<td>500 kW</td>
<td>wind</td>
</tr>
<tr>
<td>2*2.1 MW turbines</td>
<td>Saih Al Khairat</td>
<td>4,200 kW</td>
<td>wind</td>
</tr>
<tr>
<td>300 kw Solar</td>
<td>Al Mazyonah- Dhofar</td>
<td>292 kW</td>
<td>solar</td>
</tr>
<tr>
<td>1000 Kw Solar</td>
<td>Haima – Al Wusta</td>
<td>1000 kW</td>
<td>Solar (PV-mono crystalline)</td>
</tr>
<tr>
<td>28k W PV and storage system.</td>
<td>Al Mathfa- Dhofar</td>
<td>28 kW</td>
<td>solar</td>
</tr>
</tbody>
</table>
Renewable Energy completed studies (cont.)
1- Pilot Projects (cont.)

Al Mazyunah Solar Project, Summary

• The first utility project to be installed in Oman
• **Capacity: 303 Kwp** to be connected to the Al Mazyunah system
• **Project Structure:** 20 years PPA
• **Technology:** poly-crystalline & Thin Film PV modules
• **Average Annual Output:** 556 MWh.

• **Project Development Partners:**
  - Multitech LLC (BEC Group Company)
  - Astonfield Solar International Ltd.
Renewable Energy completed studies (cont.)
1- Pilot Projects (Almazyunah)
Project Location
Renewable Energy completed studies (cont.)
1- Pilot Projects (Almazyunah)

Project Site

- 8,000m² Area
- Site is located within 180 meters of new RAEC substation under construction; to be connected at 11KV voltage
Renewable Energy completed studies (cont.)

1- Pilot Projects (Almazyunah)

Project Design

- NexPower Thin Film Modules
- Yingli Multi Crystalline Modules
- Main Gate Entrance
- Electrical Room
- Chain Link Fencing
Renewable Energy completed studies (cont.)
1- Pilot Projects (cont.)
Project Benefits (R.O.)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Fuel Savings</td>
<td>653,240</td>
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<tr>
<td>O&amp;M Savings</td>
<td>51,257</td>
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<tr>
<td>Capacity Savings</td>
<td>60,600</td>
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<tr>
<td>Other Savings</td>
<td>59,244</td>
</tr>
<tr>
<td>Total Benefits</td>
<td>824,341</td>
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</tbody>
</table>
2. A feasibility study for power production by wind energy in Dhofar:

- Ensuring that the proper locations for the project are Ayoon, Zeek, Rabkhut and Thumrait west. The location differs in terms of wind speed, geographic and the surrounding environment.
- The best location in terms of technical, environmental and economical is west Thumrait.
- Affected parties from the project are Air Force, Army and residents.
- The project is in the coordination phase between Masdar co. and Rural Areas Electricity Company.
Renewable Energy completed studies (cont.)

3. Feasibility study to produce power from solar energy with capacity of 50-200 MW

- The study done by international consultant, contracted by PAEW, includes determining the best locations for the project. The total numbers of locations are 23.
- The study confirms the availability of high resources of solar energy in the Sultanate. Those resources could be used to establish power plant with high capacity.
- Determining the best 4 location to build plants with capacity from 50-200 MW in Adam, Mannah, Ibri and AL Khabourah.
- Adam and Mannah locations have been reserved and environmental approval has been issued.
Current Studies in Renewable Energy

1. A study to prepare general policy for RE in Oman.

2. Wind Atlas study in Oman.

3. Developing researches in RE field:

4. Preparing action plan to establish plant for monitoring data of solar energy in Ibri.
1. **A study to prepare general policy for RE in Oman**

1. Study the current situation.
2. Analyze the available data.
3. Evaluate RE in Oman.
4. Set general framework.
5. Set general policy.
   - Finance:
     - IRENA
   - Consultants:
     - Experts from SQU
2. Wind Atlas study in Oman

- **Objectives:**
  Conducting a comprehensive study of wind level in the Sultanate; it includes the factors affecting the project and the best locations for the project. After that, there will be a program to place wind measure device in the best location. The collected data will determine the project feasibility and finance.

- **Finance:**
  PAEW

- **Consultant:**
  Remal Inter./ Jarad Hassan
3. Developing researches in RE field:

1. Agreement to purchase hybrid unit to produce power using solar and wind energy. Omani Invention
3. Feasibility study to use solar wind in Desalination plants.
4. Feasibility study to use hydraulic turbines in power plants.
Current Studies in Renewable Energy (cont.)

3. Developing researches in RE field:

1. Agreement to purchase hybrid unit to produce power using solar and wind energy. Omani Invention

- Objectives:
  
  RE technologies testing in the Sultanate in order to benefit from the results and to demonstrate the effectiveness of those technologies. Moreover, collect wind and solar energy data for other projects.

- Finance:
  
  PAEW

- Manufacturer:
  
  Acoin Company
3. Developing researches in RE field:

2. Monitoring Plants in Adam and Mannah.

- Objectives:

  Collecting solar energy data, which is fundable. This process will be through samples of solar energy plants. The usage of those devices will help in receiving accurate data, which are important in calculating costs and power produced in the location. It is necessary to provide accurate data for investment in this field.

- Finance:

  PAEW

- Consultant:

  Meteorology & Air Navigation office.
3. Feasibility study to use solar wind in Desalination plants

- Objectives:
  Using solar energy to operate small desalination plants rather than using diesel in the areas which are far from power networks; and using data in other developing researches.

- Finance:
  PAEW

- Consultant:
  PAEW
Current Studies in Renewable Energy (cont.)

3. Developing researches in RE field:

4. Feasibility study to use hydraulic turbines in power plants.
   - Objective:
     Using RE technologies to produce power from pressure in the pipes.
   - Finance:
     PAEW
   - Consultant:
     PAEW
4. Preparing action plan for establishing a station for monitoring solar energy data

- **Objective:**
  Building a plant for monitoring solar energy, in one of the proposed locations, in order to establish a power plant working by solar energy. The purpose of this plant is to collect the fundable data and the feasibility of the project.

- **Finance:**
  PAEWS

- **Consultant:**
  PAEW
FUTURE ENERGY RESOURCES
Energy Form Chain

- Oil around 41%
- Coal 24%
- Natural gas 22%
- Renewable energy 7%
- Nuclear 6%
## Oman National Energy Strategy Study - 2014

<table>
<thead>
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<th>Activity</th>
<th>2014</th>
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<th>Month</th>
<th>2015</th>
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<tr>
<td></td>
<td>Feb</td>
<td>Mar</td>
<td>Apr</td>
<td>May</td>
</tr>
<tr>
<td>Phase 1: Initiation &amp; Scenarios Development</td>
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<tr>
<td>Phase 2: Diagnostics and Strategic Options Development</td>
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<tr>
<td>Phase 3: Energy Strategy Development</td>
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Oman National Energy Strategy Study - 2014

Phase 1 - Initiation and scenario development

• Gather stakeholder views through work groups
• Gather data and develop scenarios which can be used to test strategic option

Phase 2 – Detailed diagnostics and strategic options development

• Review initial model results and key emerging issues
• Clarify future energy needs for Oman

Phase 3 – Energy strategy development

• Test / prioritize options and analyze trade-offs
• Stress test preferred options against scenarios with stakeholders
• Develop road map for implementation
THANK YOU