Sustainable Electricity and Water for Europe, Middle East and North Africa

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Task

Assessment of the renewable energy potential for the sustainable supply of electricity and water in 50 countries of Europe, the Middle East and North Africa taking into consideration the option of Concentrating Solar Power.

50 Countries in EUMENA analysed

Europe (EU)
- Scandinavia
- Western Europe
- Eastern Europe
- South-Eastern Europe
- Western Asia
- North Africa
- Arabian Peninsula

Middle East & North Africa (MENA)
Criteria for Sustainable Electricity Supply:

- **Inexpensive**
  - low electricity cost
  - no long term subsidies

- **Secure**
  - diversified and redundant supply
  - power on demand
  - based on inexhaustible resources
  - available or at least visible technology
  - capacities can be expanded in time

- **Compatible**
  - low pollution
  - climate protection
  - low risks for health and environment
  - fair access

Portfolio of Energy Sources for Electricity:

- Coal, Lignite
- Oil, Gas
- Nuclear Fission, Fusion
- Concentrating Solar Power (CSP)
- Geothermal Power (Hot Dry Rock)
- Biomass
- Hydropower
- Wind Power
- Photovoltaic
- Wave / Tidal

- Ideally stored primary energy
- Storable primary energy
- Fluctuating primary energy
**Principle of a Concentrating Solar Thermal Power Plant**

- Concentrating Solar Collector Field (Mirrors)
- Thermal Energy Storage
- Solar Heat
- Fuel
- Electricity
- Process Heat

- Concentrated, easily storable solar thermal energy as fuel saver
- Firm capacity, power on demand
- Combined generation of process heat for cooling, industry, desalination, etc.

**Achievements**

- SEGS 350 MW, California, since 1985
- Nevada Solar I, 64 MW, 2007
- Andasol 2 x 50 MW, Guadix, 2007
- MAN/SPG Almeria, 2007
- Planta Solar 10 MW, Sevilla, 2007
- Novatec Murcia, 2007
Renewable Electricity Potential in Europe, Middle East & North Africa

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Potential (TWh/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass (0-1)</td>
<td>1350 TWh/y</td>
</tr>
<tr>
<td>Geothermal (0-1)</td>
<td>1100 TWh/y</td>
</tr>
<tr>
<td>Solar (10-250)</td>
<td>630000 TWh/y</td>
</tr>
<tr>
<td>Wind Energy (5-50)</td>
<td>1950 TWh/y</td>
</tr>
<tr>
<td>Hydropower (0-50)</td>
<td>1350 TWh/y</td>
</tr>
</tbody>
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Electricity Yield in GWh/km²

Economic Renewable Electricity Potentials vs. Demand in EUMENA

How Does a Sustainable Mix Look Like?

Economic Renewable Electricity Potentials vs. Demand in EUMENA

- Solar
- Geothermal
- Hydro
- Wind
- Biomass
- Wave/Tide
- Desalination
- MENA
- Europe

Electricity in TWh/y vs. Potentials, Demand 2000, Demand 2050
Installed Capacity vs. Peak Load in EUMENA

- 100 % availability plus 25 % reserve capacity

Carbon emissions of EUMENA power sector are reduced to 38 % until 2050 in spite of a quickly growing demand
One Square Kilometre of Desert Land using Concentrating Solar Thermal Power is enough to harvest up to:

- 250 Million kWh/year of Electricity
- 60 Million m³/year of Desalted Seawater
Trans-Mediterranean High Voltage Direct Current Electricity Grid: Interstate Highways for Renewable Electricity

Strategic Focal Points

- Efficiency Focus
- Renewable Energy Focus
- EU-MENA Cooperation Focus
- EU-MENA Interconnection Focus
- Balancing Power Focus

CSP is the Key