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

- 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
- Planta Solar 10 MW, Sevilla, 2007
- Nevada Solar I, 64 MW, 2007
- Andasol 2 x 50 MW, Guadix, 2007
- Novatec
  - Murcia, 2007
- MAN/SPG
  - Almeria, 2007
<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Potential (GWh/km²)</th>
<th>Electricity Yield (TWh/y)</th>
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</thead>
<tbody>
<tr>
<td>Biomass (0-1)</td>
<td>Max: 1350</td>
<td>1350 TWh/y</td>
</tr>
<tr>
<td></td>
<td>Min: 630000</td>
<td>1100 TWh/y</td>
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<tr>
<td>Geothermal (0-1)</td>
<td>Max: 1100</td>
<td>1950 TWh/y</td>
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<tr>
<td></td>
<td>Min: 1350</td>
<td>1350 TWh/y</td>
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<tr>
<td>Solar (10-250)</td>
<td>Max: 630000</td>
<td>630000 TWh/y</td>
</tr>
<tr>
<td>Wind Energy (5-50)</td>
<td>Max: 1950</td>
<td>1950 TWh/y</td>
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<tr>
<td></td>
<td>Min: 1350</td>
<td>1350 TWh/y</td>
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<tr>
<td>Hydropower (0-50)</td>
<td>Max: 630000</td>
<td>630000 TWh/y</td>
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<tr>
<td></td>
<td>Min: 1350</td>
<td>1350 TWh/y</td>
</tr>
</tbody>
</table>
Economic Renewable Electricity Potentials vs. Demand in EUMENA

How Does a Sustainable Mix Look Like?

- Solar
- Geothermal
- Hydro
- Wind
- Biomass
- Wave/Tide
- Desalination
- MENA
- Europe
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.
Electricity Cost (Example Spain)

- TRANS-CSP Mix
- Mix 2000
- CSP Import
- CSP Spain
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
Concentrating Solar Power for the Mediterranean Region

Trans-Mediterranean Interconnection for Concentrating Solar Power

Concentrating Solar Power for Sea Water Desalination

MENAREC 2
Amman, Jordan
May 2005

MENAREC 3
Cairo, Egypt
June 2006

MENAREC 4
Damascus, Syria
June 2007

www.menarec.org