Berlin Seminar on Energy and Climate

The Deserts as Everlasting Power Houses for Security of Electricity and Water

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Wind in Northern Europe

Strong in Winter ...
... week in Summer

Electricity yield $\sim (\text{Wind speed})^3$

Winter electricity $\approx 1/8$ of Summer electricity
Wind at the Atlantic Coast of Morokko

TINIGUIR / DAKHLA (23°38’ N, 5°50’ W)
Average of Monthly Wind Speed
Recorded from: Oct. 93 - Feb. 2001

Wind Speed Statistics

- Meas. Height 9 m
- Yearly Wind speed average = 8.33 m/s

Source: SaharaWind.com

Storm in North Africa

.. is exactly in opposit phase to Northern Europe
... also the excellent Wind Site at the coast of the Gulf of Suez, Egypt ....

... has the same cycle

Let us imagine connecting these 3 Sites

Source: Wind Atlas Egypt
... this is a Possible Solution ...
... is it sufficient?
Countries analysed within the MED-CSP and TRANS-CSP Studies
Renewable Energies around the Mediterranean

A study commissioned by the Federal Ministry of Environment and conducted by the German Aerospace Center DLR
Growing Electricity Demand around the Mediterranean

This is a second Europe
How can it be achieved?

~4000 TWh/yr
Concentrating Solar Power Technologies (CSP) relevant for Power Stations are 5 MW to 1000 MW

- Parabolic Trough 5-600 MW
- Solar Tower 5-100 MW
- Linear Fresnel 5-600 MW
- Not relevant
- Parabolic Dish 0.5-50 kW

Source: DLR
CONCENTRATING SOLAR POWER TECHNOLOGIES for >5 MW

Linear Fresnel

Parabolic Trough

Central Receiver
Parabolic trough Technology
Parabolic trough Technology
Solar Hybrid Power Station with Desalination

Desalination (MED) with Waste Heat
Solar Hybrid Power Station with Desalination

Step 1:
Solar field in Hybrid operation for day and night service. Solar share ~30%

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Step 2:
Solar field with Heat Storage for Night operation + fossil boiler as reserve. Solar share up ~99%

Desalination (MED) with Waste Heat
ANDASOL 1

50 MW CSP power plant in Spain using molten salt as storage for 7 h full load operation
Alternative Design: Flat Mirrors

Best collection of the Sunrays. Simple, cost effective and usage of area underneath mirrors is possible.
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Automated Cleaning = less cleaning water & it is not wasted

In the shadow plants need less irrigation water
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In the shadow plants need less irrigation water
Linear Fresnel Solar Steam Power Plant 1.5 MW in Spain, March 2009

System: NOVAREC BIOSOL

- No water consumption
- Dry cooling
- Dry cleaning

Air cooled condenser
A View on Europe's Electricity Demand
Analysed countries within TRANS-CSP
Vision for 2050

3 Samples out of 20 EU-MENA HVDC interconnections each line transmitting 5 Giga Watt

Transmission cost 1 ct/kWh

5 ct/kWh

4 ct/kWh
Electricity Consumption in Europe

- Historical Data
- Scenario TRANS-CSP

- Switzerland
- Norway
- Iceland
- Bosnia-Herzegovina
- Serbia & Montenegro
- Romania
- Macedonia
- Bulgaria
- Turkey
- Sweden
- Croatia
- Finland
- Greece
- Hungary
- Slovenia
- Slovakia
- Czech Republic
- Poland
- Italy
- Ireland
- United Kingdom
- Denmark
- Germany
- Netherlands
- Luxembourg
- Belgium
- Austria
- France
- Portugal
- Spain

- Biomass (620)
- Geothermal (380)
- Wind Energy (1520)
- Hydropower (910)
- Solar Energy (1730)

Available 145% however mainly fluctuating. Firm Portion is 80%
Installed Capacity in Europe

- **Power Capacity [GW]**
  - 1400
  - 1200
  - 1000
  - 800
  - 600
  - 400
  - 200
  - 0

- **Year**
  - 2000
  - 2010
  - 2020
  - 2030
  - 2040
  - 2050

- **Categories**
  - Import Solar
  - Photovoltaics
  - Wind
  - Geothermal
  - Hydropower
  - Biomass
  - Wave / Tidal
  - CSP Plants
  - Oil
  - Gas
  - Coal
  - Nuclear
  - Nuclear
  - Peak Load
Effect on Electricity Costs in Germany

Average Electricity Cost [€/kWh]

Year

2000  2010  2020  2030  2040  2050

TRANS-CSP Mix  Mix 2000  No Nuclear  Solar Import
Power demand, and supply scenario (TWh/y) in MENA and EU
Resulting decarbonization in EUMENA, compatible with climate goal $\Delta T < 2^\circ$
The Requirements in MENA are different than those of Europe...

- Not only Electricity is needed...
  ... 6-8% increase yearly

- Water is also needed...
  ... more than two Niles by 2050
Why Should the MENA Adopt Concentrating Solar Power?
Why Should the MENA Adopt Concentrating Solar Power?

Water Demand in the Arab Countries

Freshwater Demand [billion m³/y]

Year

Natural Renewable Water

Countries:
- Bahrain
- Yemen
- UAE
- Saudi Arabia
- Qatar
- Kuwait
- Oman
- Iran
- Iraq
- Syria
- Lebanon
- Jordan
- Israel
- Palestine
- Egypt
- Libya
- Tunisia
- Algeria
- Morocco
Signing Memo of Understanding
Munich, 13 July 2009

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E-on
HSB NORDBANK
MAN Solar Millennium
Munchner Volksbank
mvw Zander GmbH
VORWEG GEHEN
SCHOTT solar
SIEMENS
Unsubsidised cost of electricity of CSP versus natural gas CC

This difference is used to support water desalination

Reducing cost of water from CSP/MED plants
Steps for EU-MENA Partnership

• Shift subsidies from oil/gas for electricity production to electricity sold to the end user, privileging RE.

• Agree to couple electricity exports to a reasonable amount of desalted seawater: 20-40 m³ for each MWh dispatched electricity.

• Found an EU-MENA Company that constructs the HVDC transmission lines and operates them.

• Found another Company that buys the electricity from the South and sells it to the EU-Grid.
What are the „Win-Win-objectives“?

• **MENA wins:**
  - Water + Water + Water
  - Sells electricity at a reasonable price.
  - Social and economic development through local production of components.

• **Europe wins:**
  - Clean and cheaper electricity.
  - **Employment** due to investment instead of burning oil.
  - Diversification of energy sources.

• **Environment wins:**
  - Less CO₂ emissions.
The deserts of the world receive within 6 hours more energy from the sun than humankind consumes within a year.

Gerhard Knies
Chairman of the Supervisory Board of the DESERTEC Foundation.