Solar Water Projects

Integrated Solar Production of Power, Water and Cooling Energy

Egyptian-German Symposium,
"Solar Thermal Power and Desalination"
German Egyptian Year of Science and Technology (2007)
Cairo November 11st-12nd, 2007

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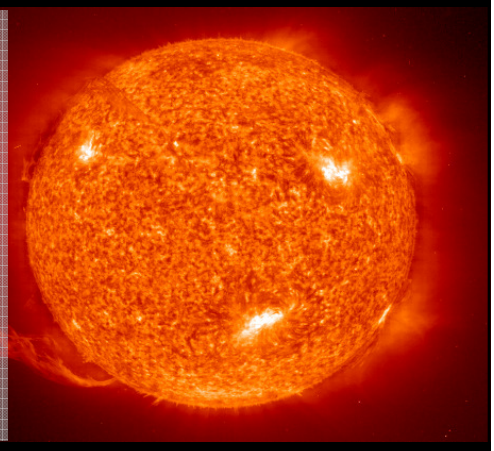
Managing Director
kernenergien - the solar power company

Structure

- kernenergien – the solar power company
- solar technologies: concentrating solar power CSP
- sea-water desalination and solar desalination
- solar process heat and solar cooling
- integrated technologies
- solar resources and potentials
- the 'solar water' projects
- benefits
- conclusions and action

kernenergien
the solar power company

- kernenergien – the solar power company ?
  - ¬ [dict] kernenergien [de] – nuclear energy [en]
  - ¬ antagonism to solar energy?
  - ¬ using the largest nuclear fusion reactor
  - ¬ in the safest and most effective way
  - ¬ the sun



Electrici
Renewable

- ¬ Diversified sup
- ¬ Do estic co
- ¬ Lo
- ¬ Low hazardou
- ¬ Low risk of co
- ¬ Re ires publi
- ¬ Lo
- ¬ Trend to lower

Lo

Lo

- ¬ Power on dem
- ¬ Based on prov

Egyptian Mail

HSBC
The world's local bank

Mubarak announces nuclear power plant launch

Abbas here for peace talks

Rypt eyes fresh vistas in Japan ties

NEW HORIZONS IN MEDICAL EDUCATION
WEILL CORNELL MEDICAL COLLEGE IN QATAR

- Two-Year Pre-medical Program
- Four-Year Medical Program
- Cornell University curriculum, standards & faculty
- Coeducational, internationally diverse community

Weill Cornell Medical College in Qatar

x dominated by
d Nuclear Power

and limited resources
nate ectricity
arge
nuclear waste and CO_2
iferation and accidents
contin subsidisation
boll on
and high price volatility
ngmt. 6000 €/kW ! /NDA 2002/)
y ideally stored energy
echnical breakthroughs:
breeder technology.
ion reactor.
and sequestration.

Risk

Cost

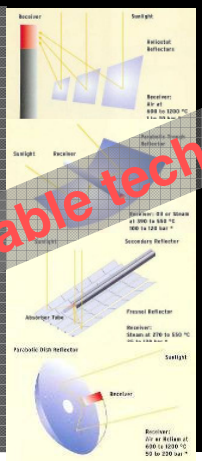
Solar Power Technologies

Source: Sandia National Laboratories Applied Energy Photo Database

Concentrating Solar Thermal Power CSP

Technologies

- Tower / Heliostats
  - ¬ Medium Air
  - ¬ 600-1200 °C
- Parabol Troughs
  - ¬ Medium Oil/Steam
  - ¬ 390-550 °C
- Fresnel
  - ¬ Medium Steam
  - ¬ 270-550 °C
- *Parabol Dish*
  - ¬ *small units < 50 kW remote*
  - ¬ *Helium/Hydrogen*
  - ¬ *600-1200 °C*

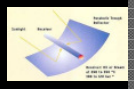


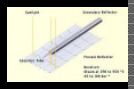
Market available technology

Source: BMU

Source: Sandia National Laboratories Applied Energy Photo Database

Status of CSP Projects
(March 2007)





- Tower
  - ¬ PS10 10 MWel in operation
- Trough
  - ¬ Nevada SolarOne 64 MWel in operation
  - ¬ AndaSol I & II 50 MWel in construction
- Fresnel
  - ¬ Novatec Biosol Fresnel first steam
  - ¬ MAN / SPG Fresnel Demo first steam

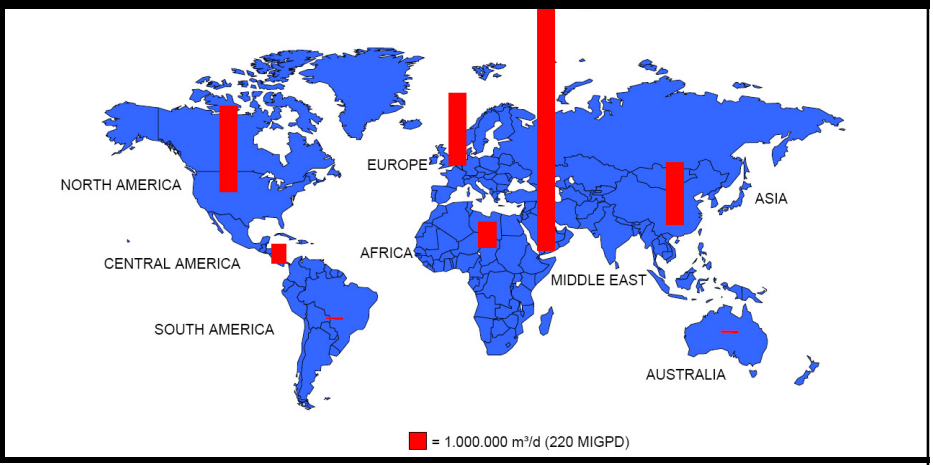
Status of CSP Projects
(March 2007)

Solucar PS10 10MW
- ¬ Tower
- ¬ 50.000 m²
- ¬ pre-commercial
- ¬ operation >2006

Nevada Solar One 64MW
- ¬ Trough SEGS
- ¬ 200.000 m²
- ¬ commercial
- ¬ on grid 2007

AndaSol I & II 50MW
- ¬ Trough SKAL-ET
- ¬ 500.000 m²
- ¬ commercial
- ¬ on grid 2008

Seawater Desalination



Solar Desalination: Fresh water production

Solar Collectors

PV / Wind

Infrastructure not developed
¬ Small villages in rural areas
¬ Decentralised settlements
¬ Small islands

small niche for desalination
ments for
m³ per day

Electricity
- RO
- VC
- EDR*

Heat
- Still
- MED
- MEH
- MD

Solar Desalination: Fresh water production

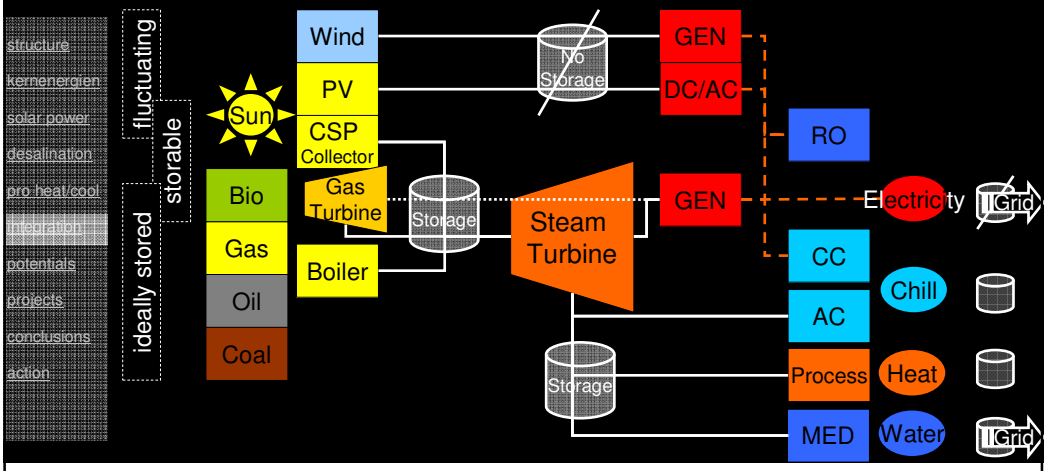
Infrastructure developed
¬ Large settlements
¬ Cities
¬ Hotels, Resorts

Large scale, well developed
desalination systems prod
Up to 200.000 m

Electricity
- RO
- VC
- EDR*

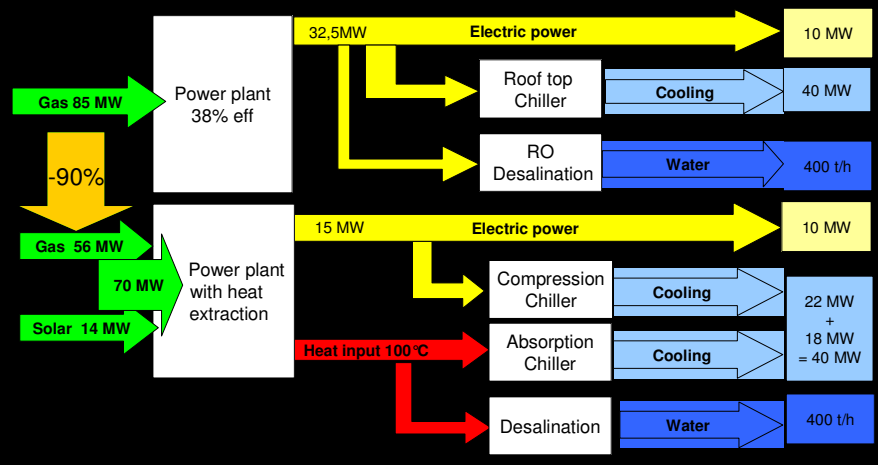
Heat
- MSF
- MED

Power Plant Configurations
of integrated plants



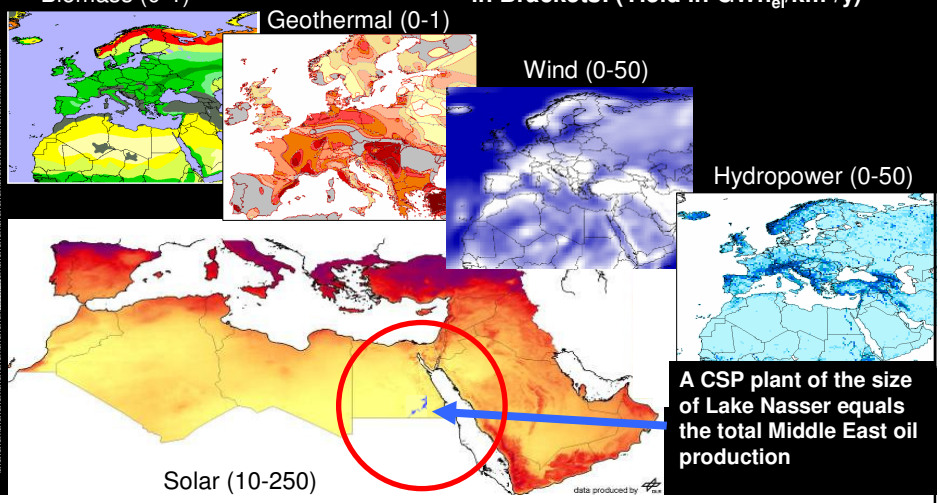
Integrated Power Plants

Conventional Integration

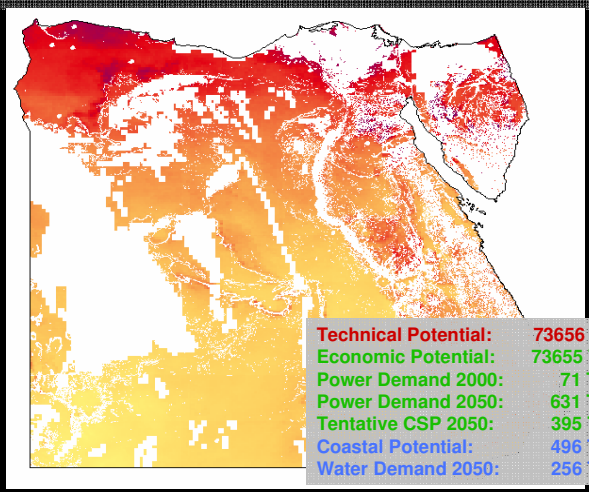


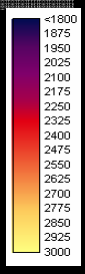
Renewable Electricity Potentials in EUMENA

in Brackets: (Yield in $GWh_{el}/km^2/y$)



Solar Potential of Egypt





DNI [kWh/m²/y]

Technical Potential:	**73656 TWh/y (DNI > 1800 kWh/m²/y)**
Economic Potential:	**73655 TWh/y (DNI > 2000 kWh/m²/y)**
Power Demand 2000:	**71 TWh/y**
Power Demand 2050:	**631 TWh/y (Scenario CG/HE)**
Tentative CSP 2050:	**395 TWh/y (Scenario CG/HE)**
Coastal Potential:	**496 TWh/y (< 20 m a. s. l.)**
Water Demand 2050:	**256 TWh/y (Power for Desalination)**

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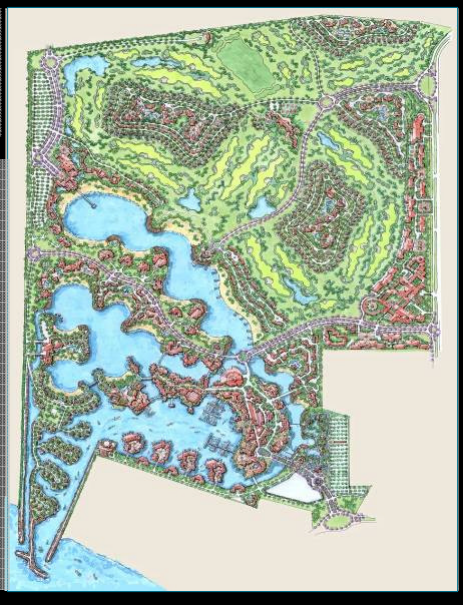
Source: DLR MED-CSP Study

DLR MED-CSP

Jordan Integrated Solar Power & Water

- Aqaba Hotel & Resort AYLA OASIS
  - Lagoons (75 hectares)
  - Hotels (1,540 rooms)
  - Residential (2,884 Units)
  - Retail & Commercial (100,000 m²)
  - Recreational
  - Golf Course / 27 holes
- Solar thermal power plant with seawater desalination and district cooling
  - Power (electric) 8.5 MW_{el}
  - Electricity production 72 GWh/year
  - Power (therm) 40 MW_{therm}
  - Chill production 140 GWh/year
  - Desalinated water 10,000 t/day
  - Water production 2.6 Mill. t/year
- **Ayla: 5 Stars + 1 Green Star + 1 Solar Star**



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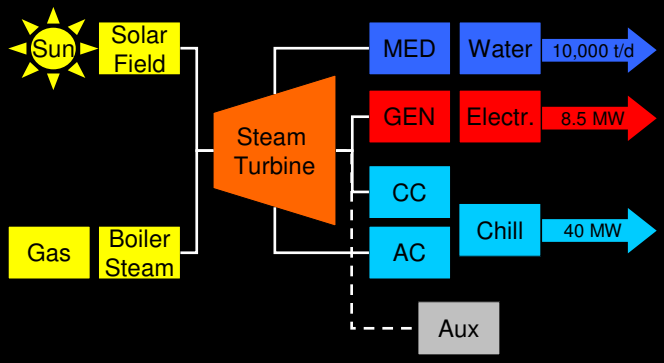
ayla

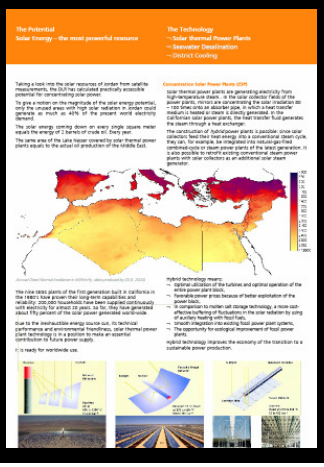
The 'Jordan Solar Water' Project schematic process diagram



The Solar Water Projects - Phases

• Research and Development	2004 -
¬ MED-CSP / AQUA-CSP Studies	2004-2007
¬ BMU SOLWATER Study	2005/2006
¬ EC MED-CSD Study	2008-
• Basic Project Development	2005 - 2007
¬ Aqaba, JOR	2005
¬ Canarias, E	2006
¬ Egypt / Syria	2007
¬ Malta, Oman, Kuwait, ...	
• Project Finance Design	2006 -
• Project Implementation	2008 -
• Construction	2008 - 2009
• Operation	2010

The Solar Water Projects



Conclusions

- A well balanced mix of renewable energy technologies is the least cost option for energy and water security in EU-MENA. ✓
- A wide variety of Technologies of Concentrating Solar Power are well developed and available. ✓
- Seawater desalination & chillers for district chill are state of the art ✓
  - Supply of industrial process heat offers a big potential for CSP
  - Solar cooling with CSP can be a future option for cooling systems ✓
  - Solar desalination is an ideal extension to CSP
- Growing market for water and cooling ✓
- Rising prices for oil & gas will cause a high share of solar ✓
- Solar insurance against rising prices allows reliable energy services on a very competitive and profitable level.

• Well balanced mix of renewable energy
• Solar CSP Technologies are available
• Desalination is state of the art
Cooling nets are state of the art
• Growing market for water and cooling
• Solar insurance against rising prices

Action

- The deployment of renewable energies must be **accelerated** by
- **Policy instruments** that motivate private investment.
- **Feed-in laws** or **Power purchase aggregations** for renewables will
- **Power purchase agreements**
- Build up **portfolios** for development, construction and operation of
- **Investment strategy**
- renewable energy project in the size of commercial power plants as direct **investments** and partnerships with project and technology developers.
- **Pilot projects** to demonstrate the technical and economical power
- **Clients** will wisely invest in '**lighthouse**'-**projects** to **profit early** from
- **Profitable commercial projects**
- – the sun

Links

- kernenergien | the solar power company
  - www.kernenergien.de (DE)
  - www.kernenergien.eu
  - www.kernenergien.com (EN)
  - www.solar-water.com (EN)
- partners:
  - www.dlr.de/tt/
    - www.dlr.de/tt/med-csp
    - www.dlr.de/tt/trans-csp
    - www.dlr.de/tt/aqua-csp
  - www.entropie.com/en
  - www.nerc.gov.jo
  - www.manferrostaal.com
  - www.novatec-biosol.com
  - www.pse.de
- others
  - www.erneuerbare-energien.de (www.bmu.de)
  - www.solar-thermie.org
  - www.trecers.net
  - www.clubofrome.de

SOLAR-WATER:
solar powered desalination

water for life

cooling for living

power for development