

## 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 11<sup>st</sup>-12<sup>nd</sup>, 2007

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Managing Director  
kernenergien - the solar power company

## solar water projects

### Structure

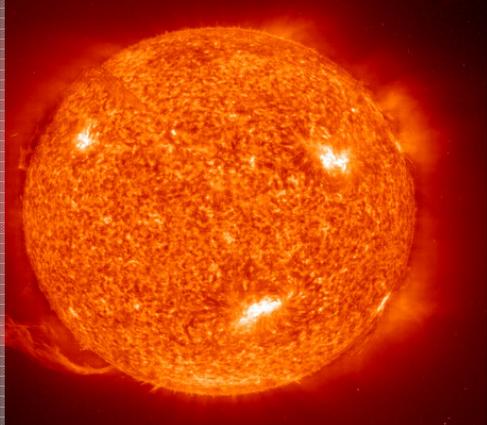
structure  
kernenergien  
solar power  
desalination  
pro. heat/cool  
integration  
potentials  
projects  
conclusions  
action

- 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

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- 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



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- Electricity  
Renewable
- Diversified supply
  - Domestic production
  - Low cost
  - Low hazardous
  - Low risk of corruption
  - Requires public investment
  - Trend to lower cost
  - Power on demand
  - Based on proven technology

## Egyptian Mail

- dominated by fossil fuels and Nuclear Power
- limited resources
- high electricity prices
- large scale investment
- nuclear waste and CO<sub>2</sub> emissions
- proliferation and accidents
- continuous subsidisation
- pollution
- and high price volatility (e.g. 6000 €/kW h, NDA 2002)
- ideally stored energy
- technical breakthroughs: fusion, breeder technology, advanced reactor, etc.
- and sequestration.



# Solar Power Technologies

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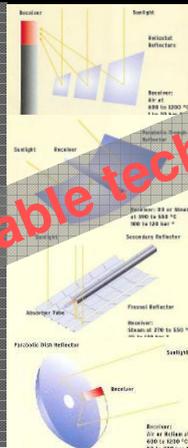


# Concentrating Solar Thermal Power CSP

- structure
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## Technologies

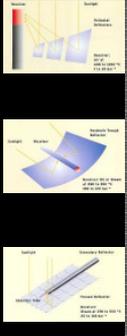
- Tower / Heliostats
  - Medium Air
  - 600-1200 °C
- Parabol Troughs
  - Medium Oil/Steam
  - 390-550 °C
- Fresnel
  - Medium Steam
  - 270-550 °C
- Parabolic Dish
  - small units < 50 kW remote
  - Helium/Hydrogen
  - 600-1200 °C



# Status of CSP Projects

(March 2007)

structure  
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solar power  
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conclusions  
action



- 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)

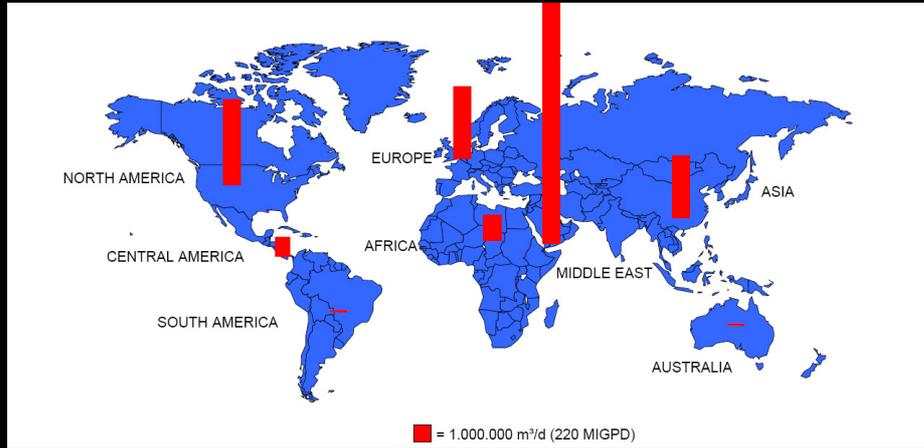
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Solucar PS10	10MW
→ Tower	
→ 50.000 m <sup>2</sup>	
→ pre-commercial	
→ operation >2006	
Nevada Solar One	64MW
→ Trough SEGS	
→ 200.000 m <sup>2</sup>	
→ commercial	
→ on grid 2007	
AndaSol I & II	50MW
→ Trough SKAL-ET	
→ 500.000 m <sup>2</sup>	
→ commercial	
→ on grid 2008	



# Seawater Desalination

structure  
kernenergien  
solar power  
gasification  
pro-heat/cool  
integration  
potentials  
projects  
conclusions  
action



# Solar Desalination: Fresh water production

structure  
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## Solar Collectors



## Infrastructure not developed

- Small villages in rural areas
- Decentralised settlements
- Small islands

... small niche for desalination  
... components for  
systems ... m<sup>3</sup> per day

## PV / Wind



## Electricity

- RO
- VC
- EDR\*

## Heat

- Still
- MED
- MEH
- MD

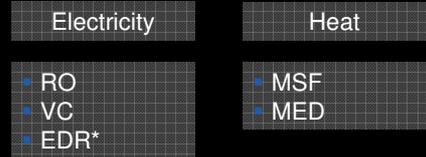
# Solar Desalination: Fresh water production

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## Infrastructure developed

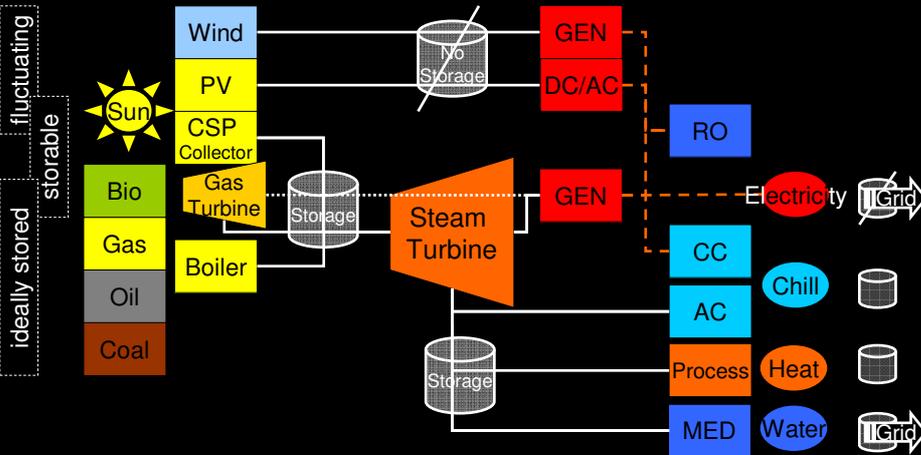
- Large settlements
- Cities
- Hotels, Resorts

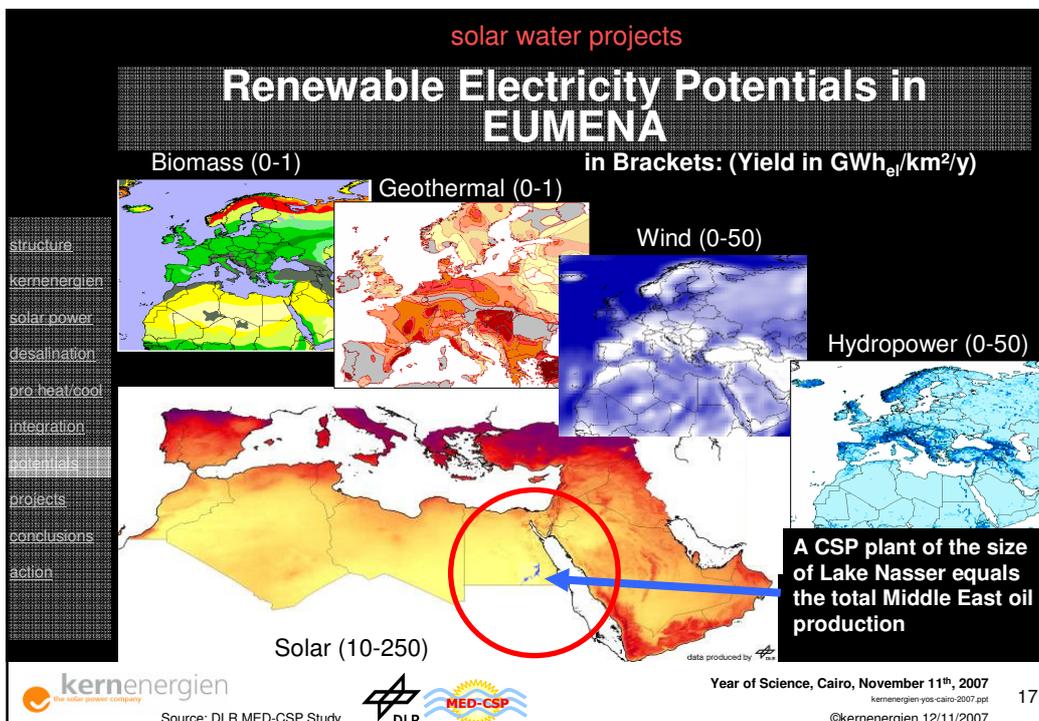
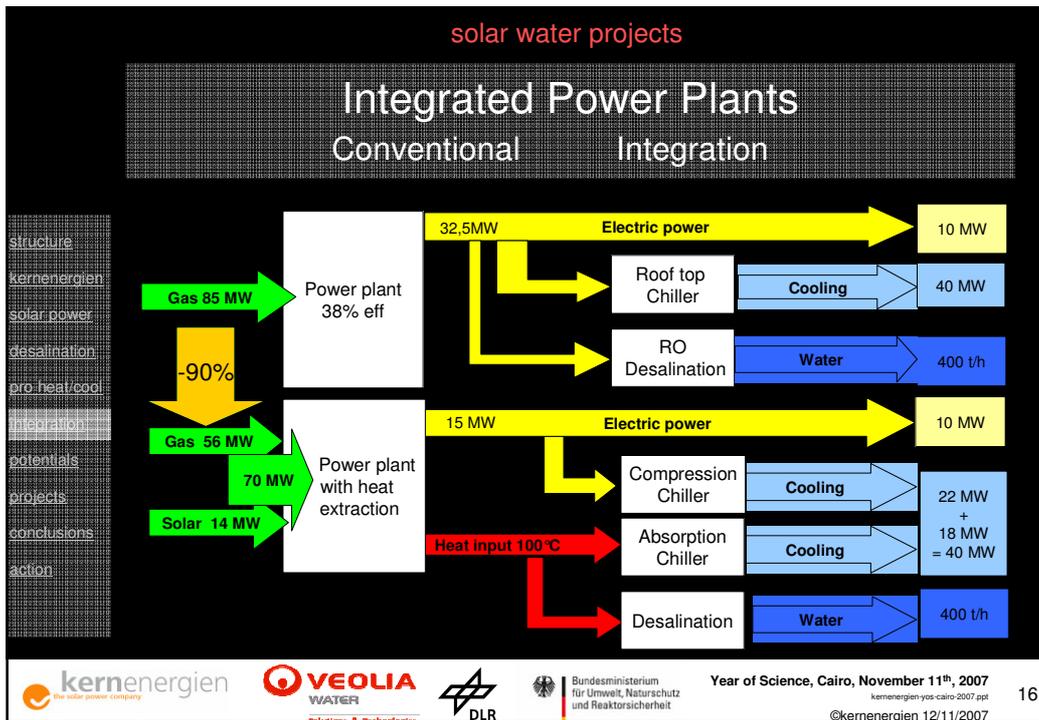
Large scale, well developed desalination systems produce up to 200.000 m<sup>3</sup> per day



# Power Plant Configurations of integrated plants

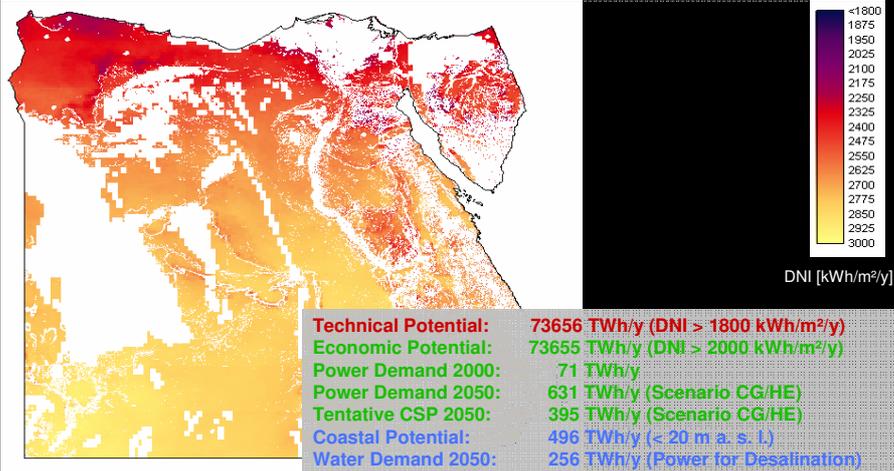
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# Solar Potential of Egypt

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# Jordan Integrated Solar Power & Water

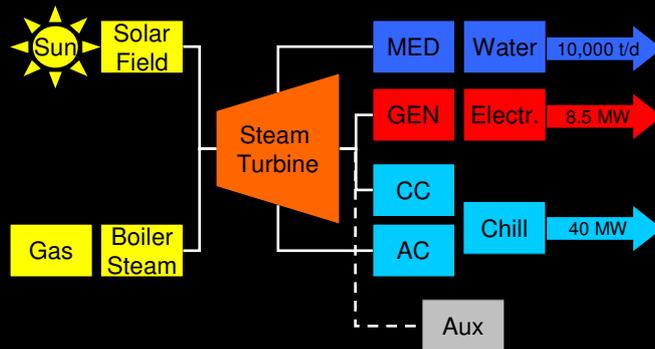
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- Aqaba Hotel & Resort AYLA OASIS
  - ↳ Lagoons (75 hectares)
  - ↳ Hotels (1,540 rooms)
  - ↳ Residential (2,884 Units)
  - ↳ Retail & Commercial (100,000 m²)
  - ↳ Recreational
  - ↳ Golf Course / 27 holes
- Solar thermal power plant with seawater desalination and district cooling
  - ↳ Power (electric) 8.5 MW<sub>el</sub>
  - ↳ Electricity production 72 GWh/year
  - ↳ Power (therm) 40 MW<sub>therm</sub>
  - ↳ 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



## The 'Jordan Solar Water' Project schematic process diagram

structure  
kernenergien  
solar power  
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pro heat/cool  
integration  
potentials  
projects / aqaba  
conclusions  
action



## The Solar Water Projects - Phases

structure  
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- 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

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**The Potential**  
Solar Energy - the most powerful resource

Using a lens into the solar spectrum of Jordan from satellite measurements, the data has revealed potential available for concentrating solar power (CSP) for the entire country. The solar energy potential for the entire area, with the highest in desert areas, is about 40% of the present world electricity demand.

The solar energy coming down on every square metre would reach the level of 1000 kWh of 1000 hours per year. The solar energy that can be converted into electricity is about 10% of the total solar energy that reaches the earth's surface.

**Concentrating Solar Power Plants (CSP)**  
Solar thermal power plants are generating electricity from high temperature solar radiation. In the solar collector field of the power plant, the solar radiation is concentrated on a receiver. The receiver is a tube or a dish that is filled with a heat transfer fluid. The receiver is heated by the concentrated solar radiation and the heat transfer fluid circulates through it. The heat transfer fluid is then used to generate electricity in a power plant.

**Hybrid Technology**  
The combination of CSP and solar photovoltaic (PV) is a promising technology. CSP can provide high temperature heat for PV, which can improve the efficiency of the PV cells. PV can provide electricity for CSP, which can reduce the cost of CSP. Hybrid CSP/PV systems are being developed and tested.

**The Technology**  
Solar Thermal Power Plants  
- Seawater Desalination  
- District Cooling

**Seawater Desalination**  
Seawater desalination is one of the most important water technologies in the world. It is the process of removing salt and other minerals from seawater to produce fresh water. There are two main types of seawater desalination: reverse osmosis (RO) and thermal desalination. Thermal desalination uses heat to evaporate seawater, leaving the salt behind. There are two main types of thermal desalination: multi-stage flash (MSF) and multi-effect distillation (MED). MED is more energy efficient than MSF.

**District Cooling**  
District cooling is a system of providing cooling for multiple buildings in a city or town. It is a more efficient and cost-effective way of providing cooling than individual air conditioning units. District cooling systems use a central plant to produce cooling water, which is then distributed to buildings through a network of pipes. The cooling water is then used to cool the buildings. District cooling systems can be powered by a variety of energy sources, including fossil fuels, nuclear power, and renewable energy.

**Key Performance Indicators (KPIs)**

Parameter	Value
Power Capacity (MW)	10 MW
Desalination Capacity (m <sup>3</sup> /day)	100,000 m <sup>3</sup> /day
District Cooling Capacity (MW)	10 MW
Costing (\$/kWh)	0.05 \$/kWh
Life Cycle (Years)	20-30 Years
Efficiency (%)	30-40 %

# Conclusions

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- A well balanced mix of renewable energy technologies is the least cost option for energy and water security in EU-MENA ✓
  - Solar CSP Technologies are available ✓
  - Desalination is state of the art ✓
    - Supply of industrial process heat offers a big potential for CSP
  - Cooling nets are state of the art ✓
    - 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.

## Action

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

## Links

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

**SOLAR WATER:**

solar powered desalination

water for life

cooling for living

power for development