Concentrating Solar Power for Sea Water Desalination

AQUA-CSP

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Criteria for Sustainable Water:

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

✓ **Secure**
- diversified and redundant supply
- based on inexhaustible resources
- available or at least visible technology
- capacity expandable in due time

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

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Portfolio of Energy Sources for Power & Desalination:

✓ Coal, Lignite ✓ Oil, Gas ✓ Nuclear Fission, Fusion	ideally stored primary energy
✓ Concentrating Solar Power (CSP) ✓ Geothermal Power (Hot Dry Rock) ✓ Biomass ✓ Hydropower	storable primary energy
✓ Wind Power ✓ Photovoltaic ✓ Wave / Tidal	fluctuating primary energy

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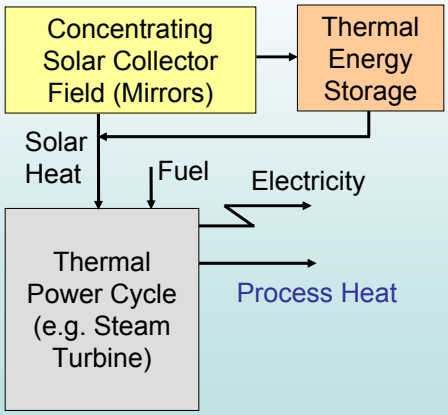
Principle of a Concentrating Solar Thermal Power Plant



- concentrated, easily storable solar thermal energy as fuel saver
- firm capacity, power on demand
- combined generation of process heat for desalination

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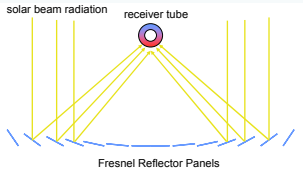
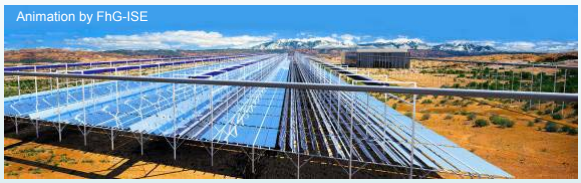
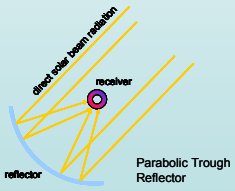
Linear Fresnel Concentrating Solar Thermal Collector





Parabolic Trough Concentrating Solar Thermal Collector



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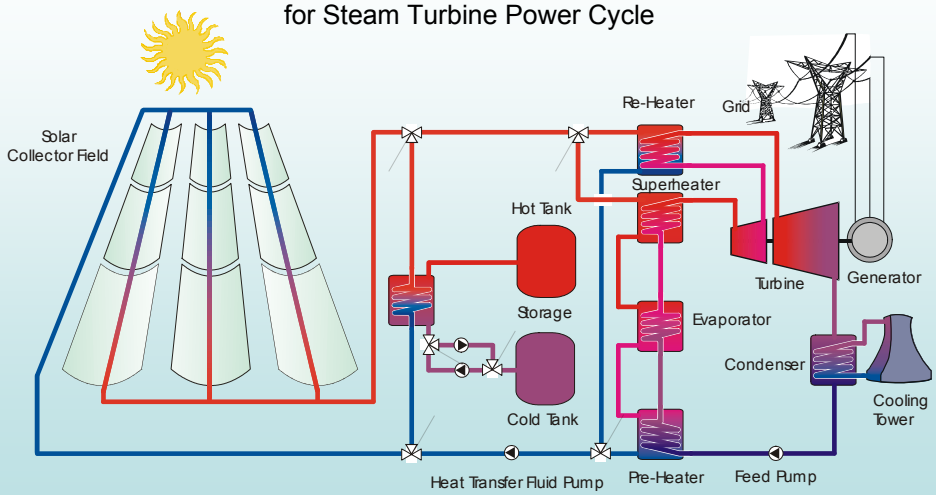
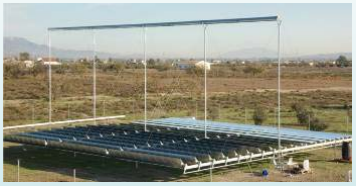
Configuration of Solar Trough Plant with Thermal Storage for Steam Turbine Power Cycle




SEGS 350 MW, California, since 1985

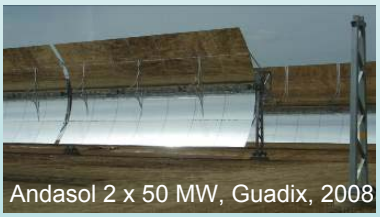

Planta Solar 10 MW, Sevilla, 2007

Achievements

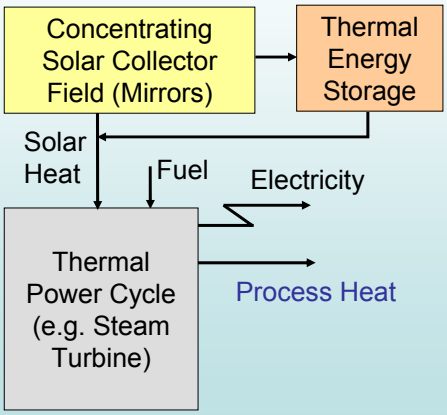

Novatec
Murcia,
2007


MAN/SPG
Almeria
2007


Nevada Solar I, 64 MW, 2007

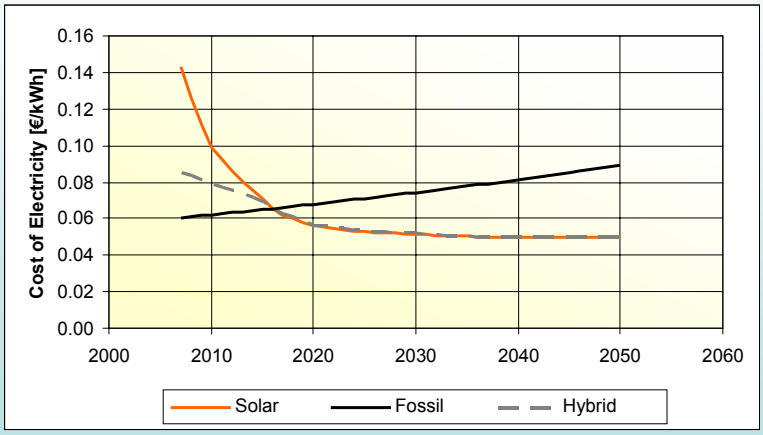

Andasol 2 x 50 MW, Guadix, 2008

Cost of Heat from Concentrating Solar Collectors



Year	Solar Share on Base Load	Cost of Solar Heat equivalent to Crude Oil at:
1985	20 %	200 $/barrel
today	20 %	50-60 $/barrel
2010	40 %	40 $/barrel ± 5
2015	60 %	25 $/barrel ± 5
2020	80 %	20 $/barrel ± 5
2030+	90+ %	15 $/barrel ± 5

Unsubsidised cost of electricity of CSP versus natural gas CC



Discount rate 5%, economic life 25 years, fuel cost 25 €/MWh, fuel cost escalation 1 %/y, irradiance 2400 kWh/m²/y, real €2007, €/$=1

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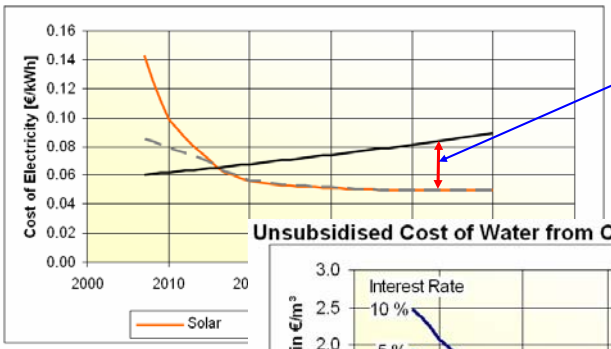
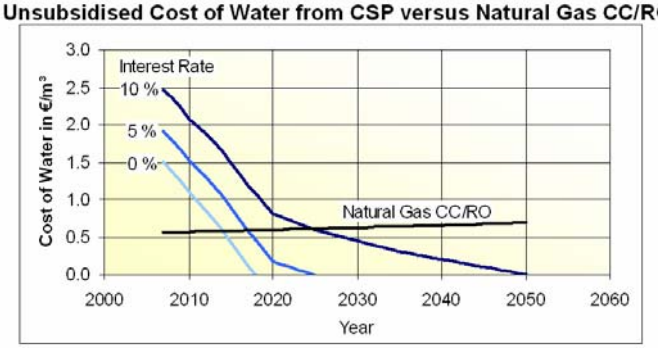
Unsubsidised cost of electricity of CSP versus natural gas CC



This diffirence is used to support water desalination

Unsubsidised Cost of Water from CSP versus Natural Gas CC/RO



Cost of water from CSP/MED plants. Please note that before 2020 water could be produced as bye-product without cost

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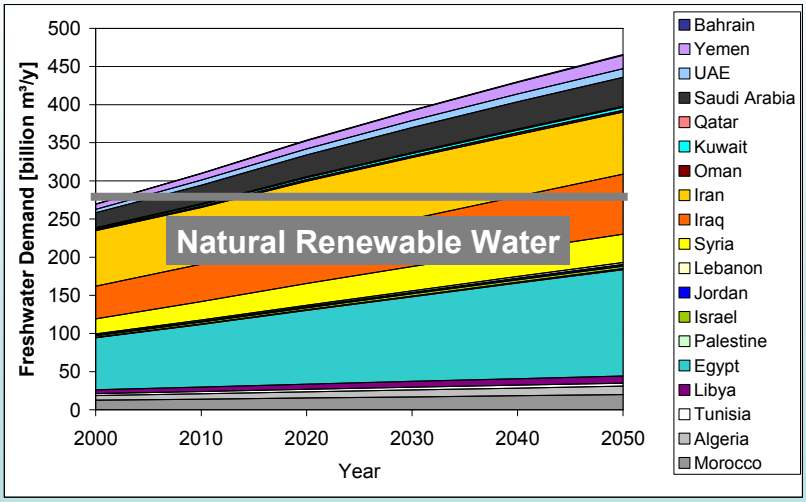
Freshwater Demand Prospects by Country



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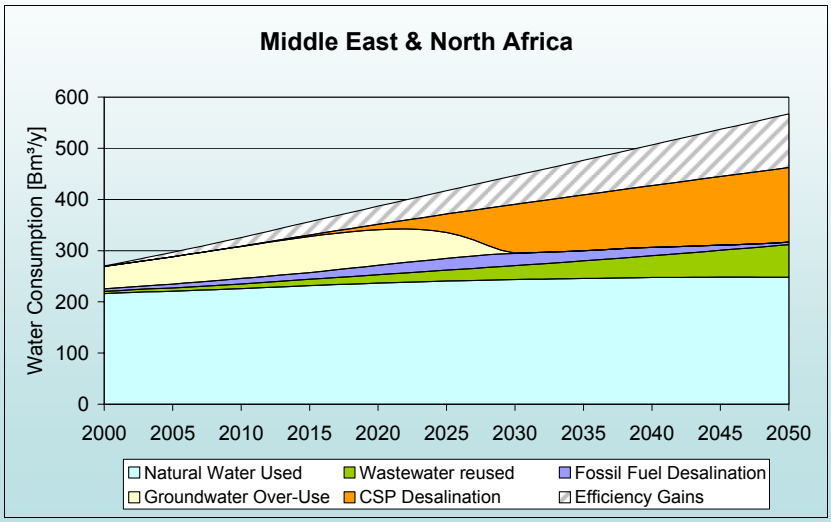
AQUA-CSP Scenario for Sustainable Supply



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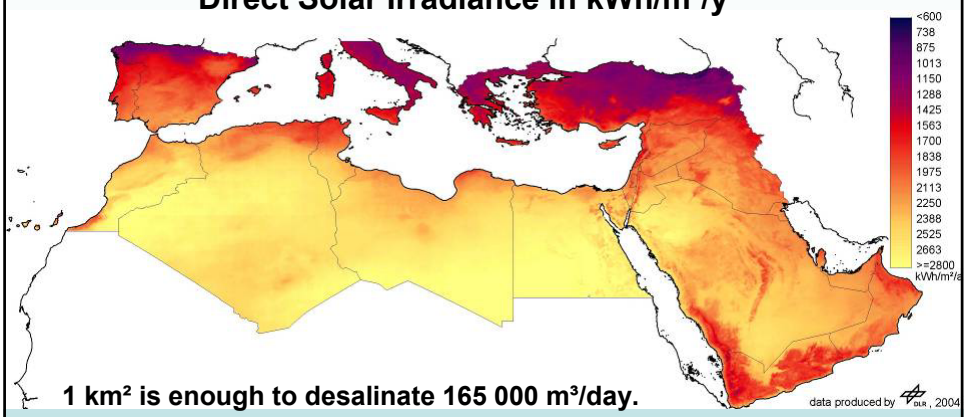
Direct Solar Irradiance in kWh/m²/y



1 km² is enough to desalinate 165 000 m³/day.

50 km x 50 km are needed to avoid the MENA water deficit in 2050.

Solar irradiance 2400 kWh/m²/year x 10 % CSP efficiency / 4 kWh/m³ RO power consumption / 365 days/year = 0.165 m³/m²/day

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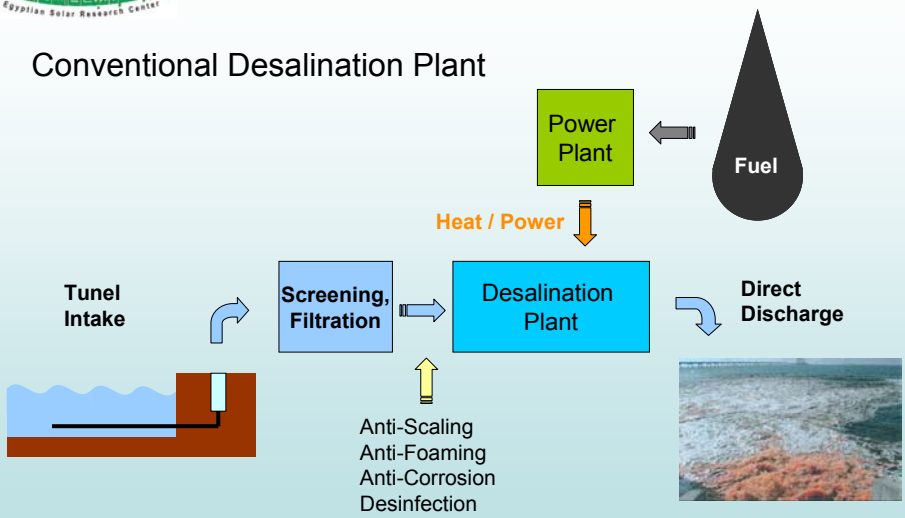
Conventional Desalination Plant



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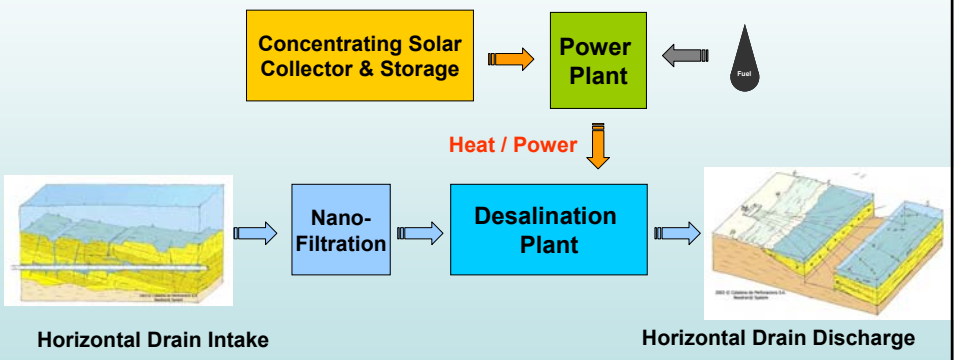
Advanced CSP-Desalination Plant



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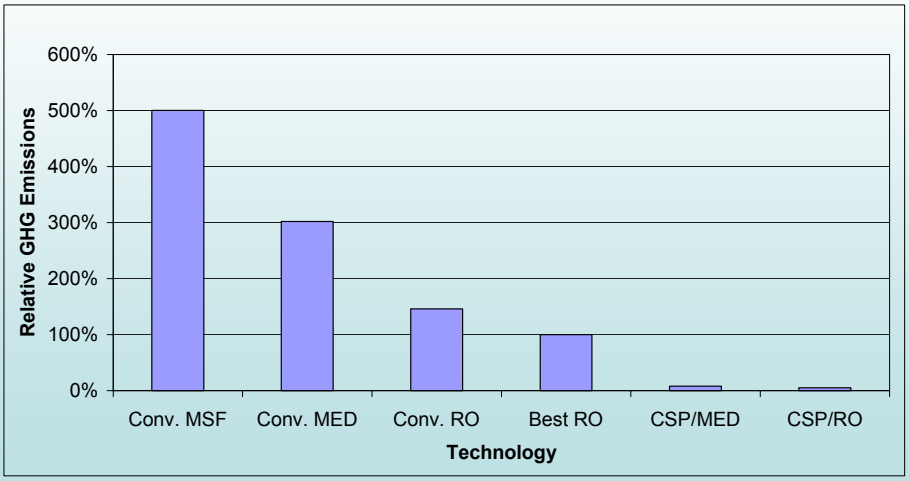
Impact on Global Warming (Life Cycle Assessment)



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Energy Production above and Biomass Production below a Linear Fresnel Collector Field in a CSP Multipurpose Plant

Photos: Solarmundo

Greenhouse Visualization: DLR

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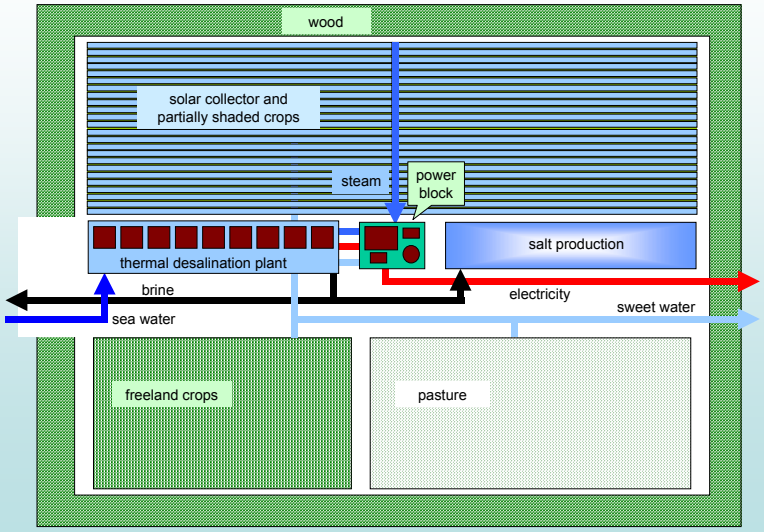
Multipurpose Plant for the Development of Arid Regions



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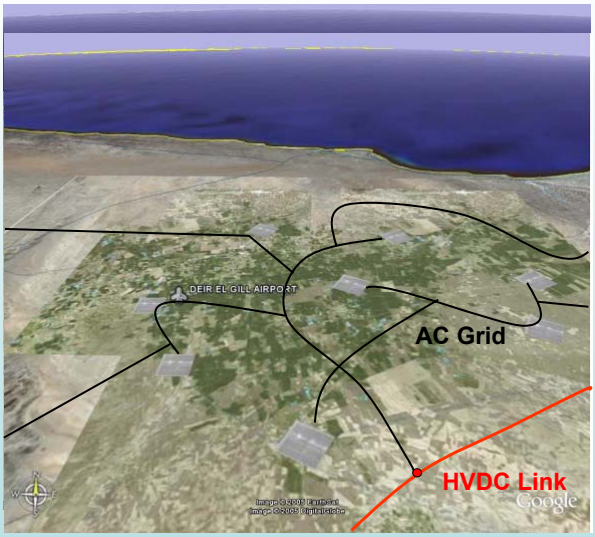
Deserts as Powerhouses and Water Works



(artist view created with Google Earth)

TREC
Clean Power from the Deserts
Trans-Mediterranean
Renewable Energy Cooperation
In conjunction with The Club of Rome

THE CLUB OF ROME

www.desertec.org

One Square Kilometre of Desert Land using Concentrating Solar Thermal Power can produce up to:

- 250 Million kWh/year of Electricity
- 60 Million m³/year of Desalted Seawater

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Considering Sustainability

Why not use …?	Because it does not satisfy the criteria for sustainability, e.g. …
Nuclear	Radioactive waste disposal has not been solved in 50 years of commercial operation Decommissioning cost 8000 €/kW www.nda.gov.uk
Wind, PV, Hydropower, Geothermal, Biomass	Yes, but potential already needed for growing electricity demand in MENA www.dlr.de/tt/med-csp
Coal	No infrastructure, no domestic source, climate change, exhaustible
Oil, Gas	Yes, but expensive and exhaustible

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Concentrating Solar Power for the Mediterranean Region

TRANS-CSP

Trans-Mediterranean Interconnection for Concentrating Solar Power

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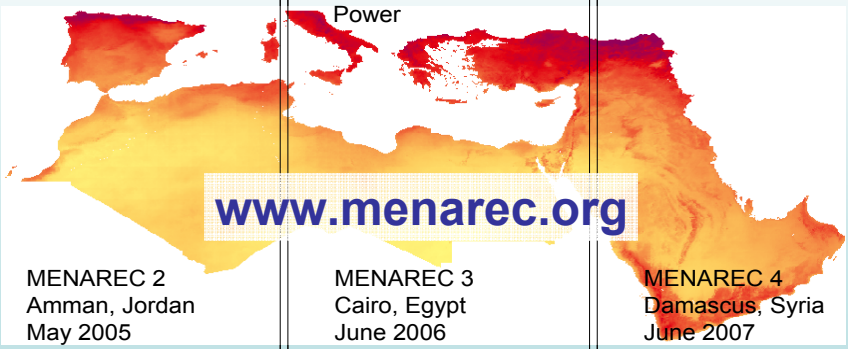

www.menarec.org

MENAREC 2
Amman, Jordan
May 2005

MENAREC 3
Cairo, Egypt
June 2006

MENAREC 4
Damascus, Syria
June 2007

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