

# Berlin Seminar on Energy and Climate

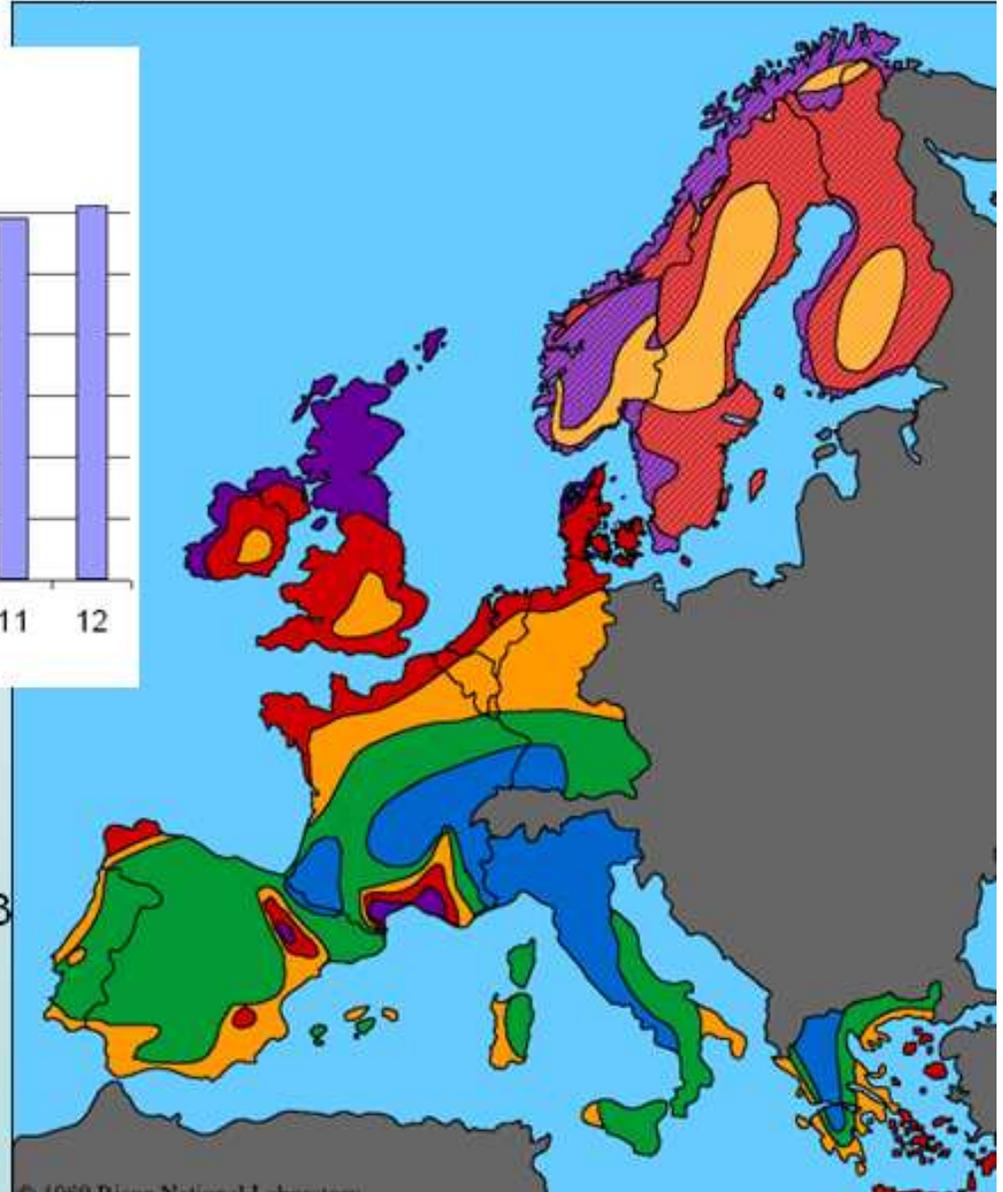
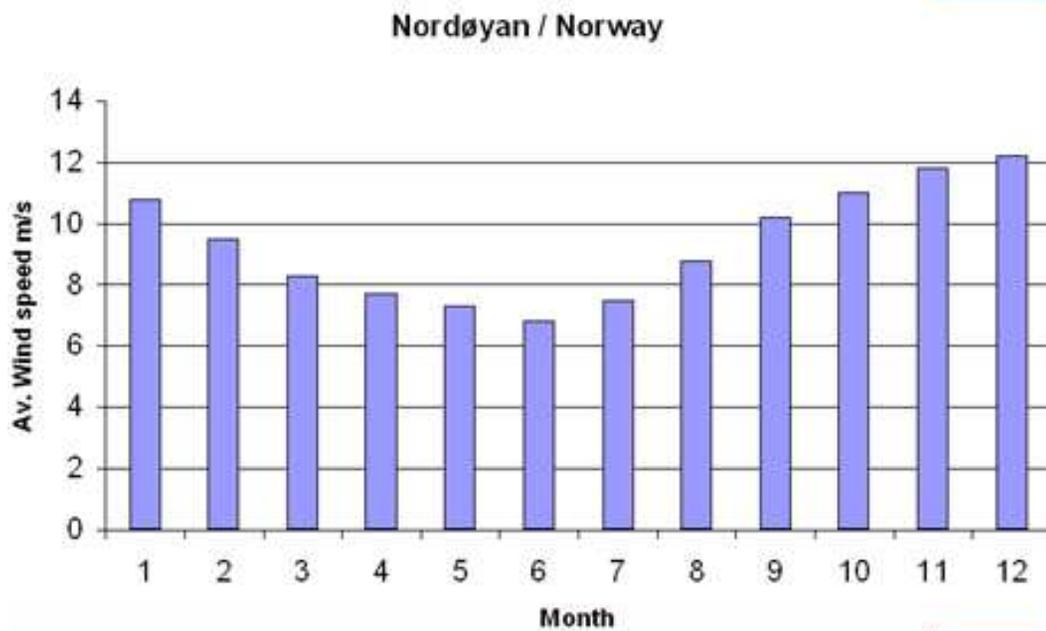
## The Deserts as Everlasting Power Houses for Security of Electricity and Water

Dr.-Ing. Hani El Nokraschy

DESERTEC Foundation

[www.DESERTEC.org](http://www.DESERTEC.org)

# Wind in Northern Europe



Strong in Winter ...  
... weak in Summer

Electricity yield  $\sim$  (Wind speed)<sup>3</sup>

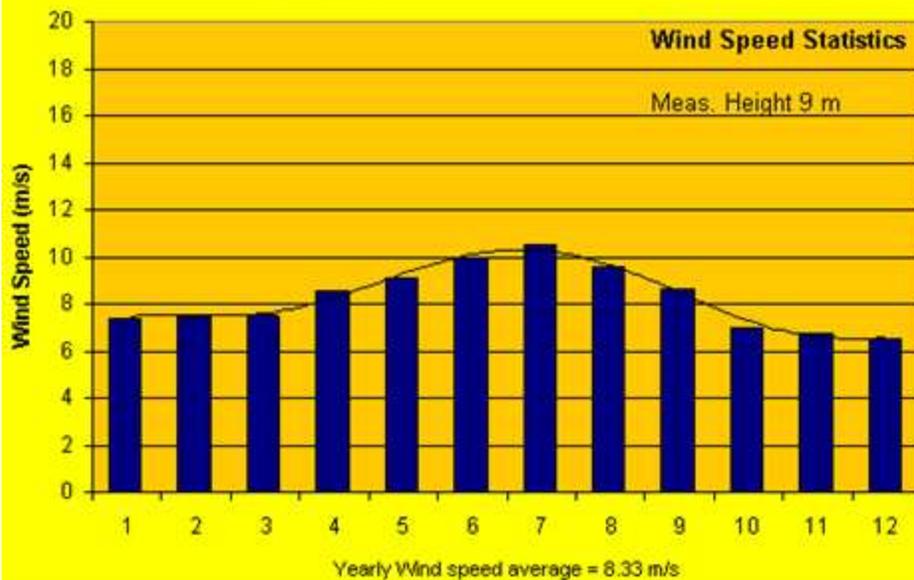
Winter electricity  $\approx$  1/8  
of Summer electricity

# Wind at the Atlantic Coast of Morokko

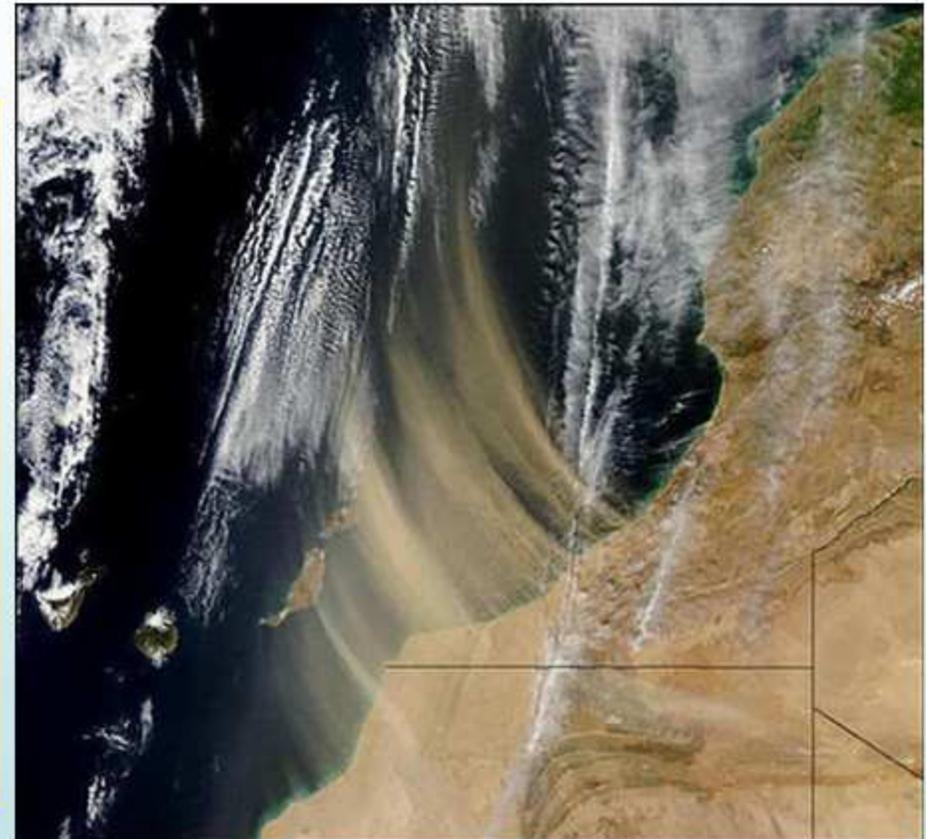
TINIGUIR / DAKHLA (23°38' N, 5°50' W)

Average of Monthly Wind Speed

Recorded from: Oct. 93 - Feb. 2001



Source: [Saharawind.com](http://Saharawind.com)

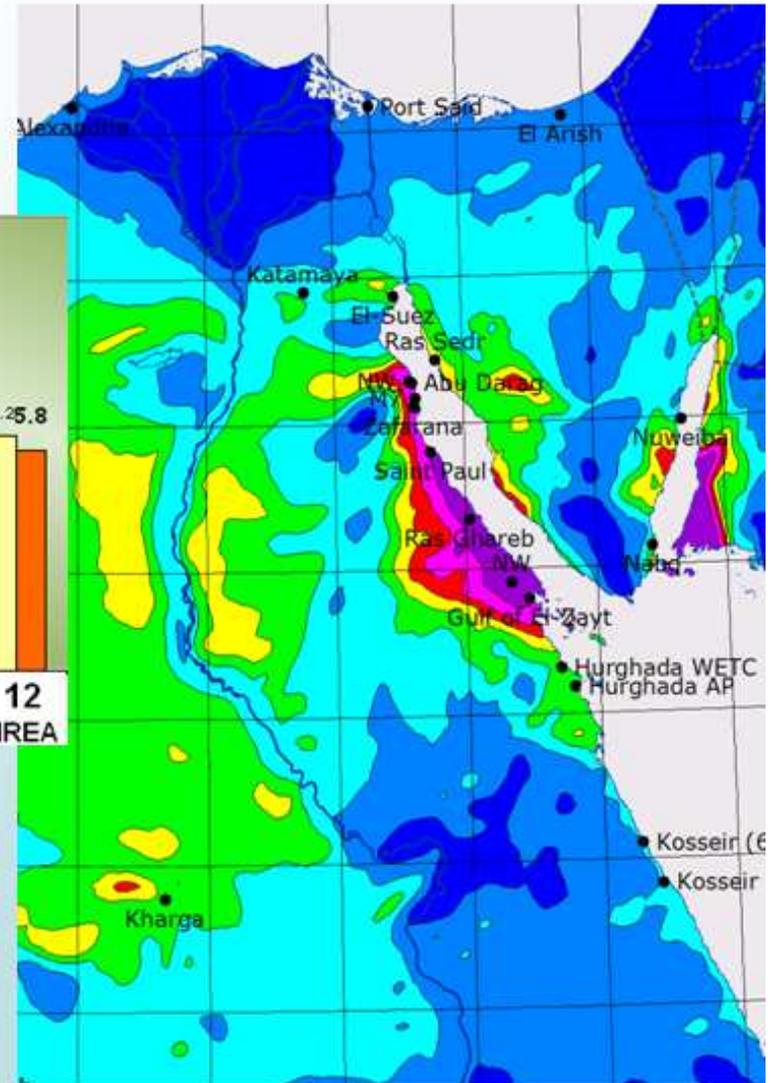
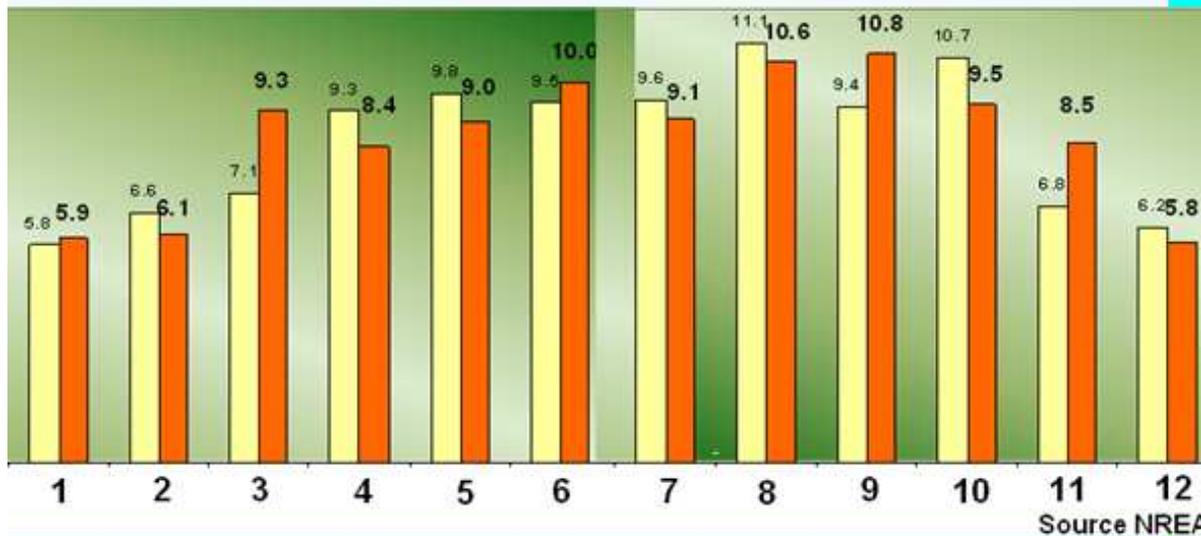


**Storm in North Africa**

.. is exactly in opposite phase to Northern Europe

... also the excellent Wind Site at the coast of the Gulf of Suez, Egypt ....

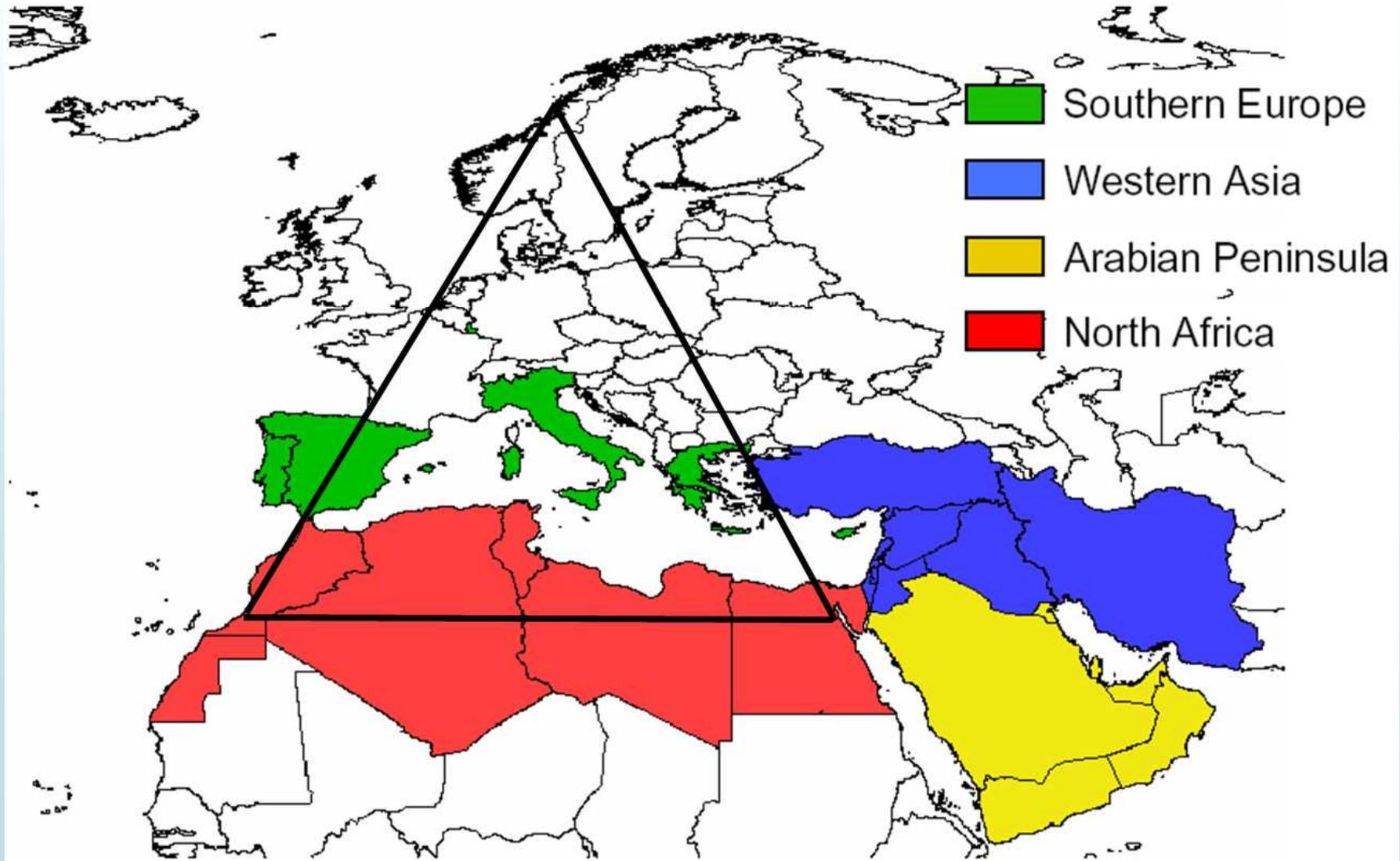
... has the same cycle



Let us imagine connecting these 3 Sites

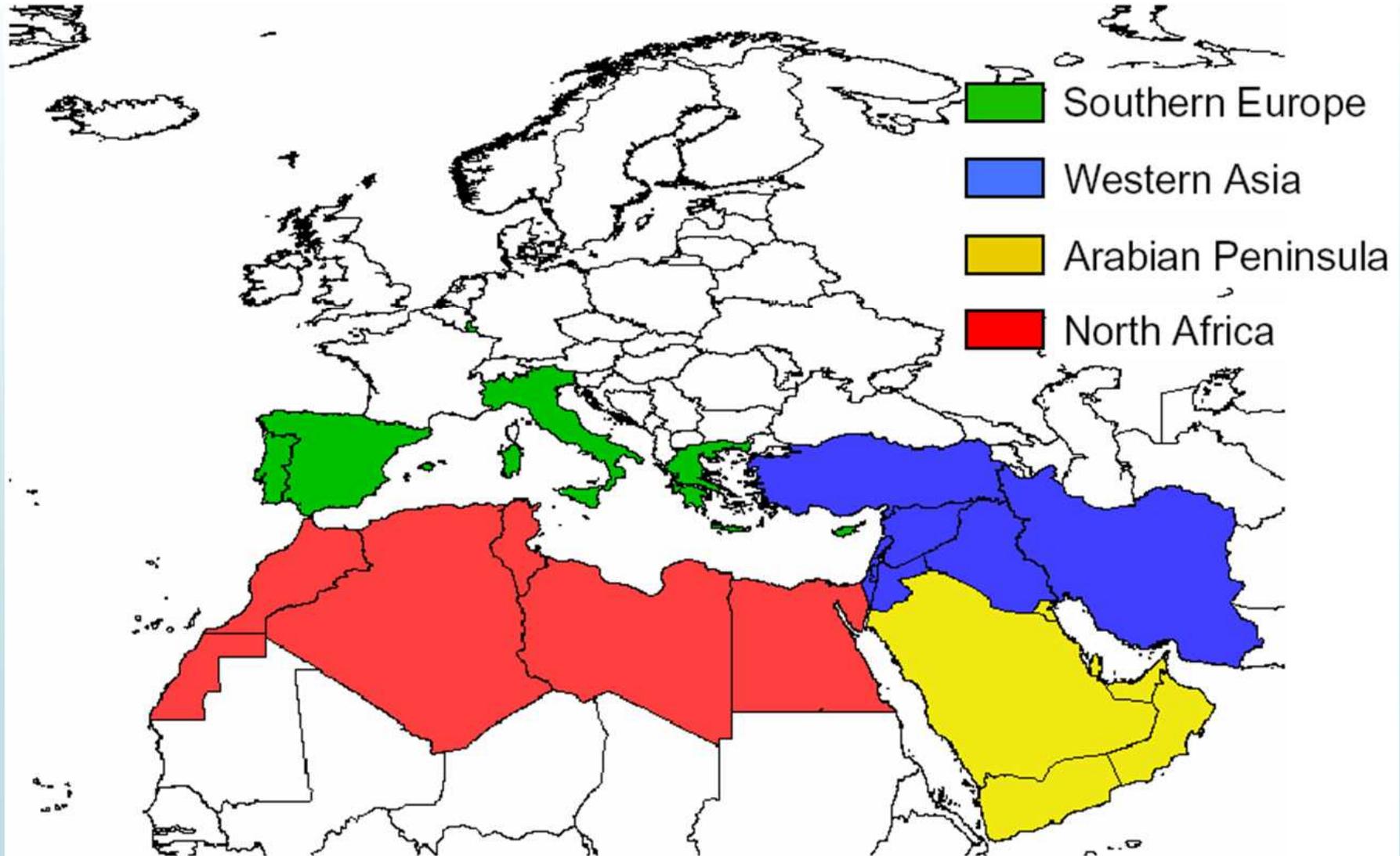
Source: Wind Atlas Egypt

... this is a Possible Solution ...  
... is it sufficient ?





## Countries analysed within the MED-CSP and TRANS-CSP Studies





NREA



DLR



The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety



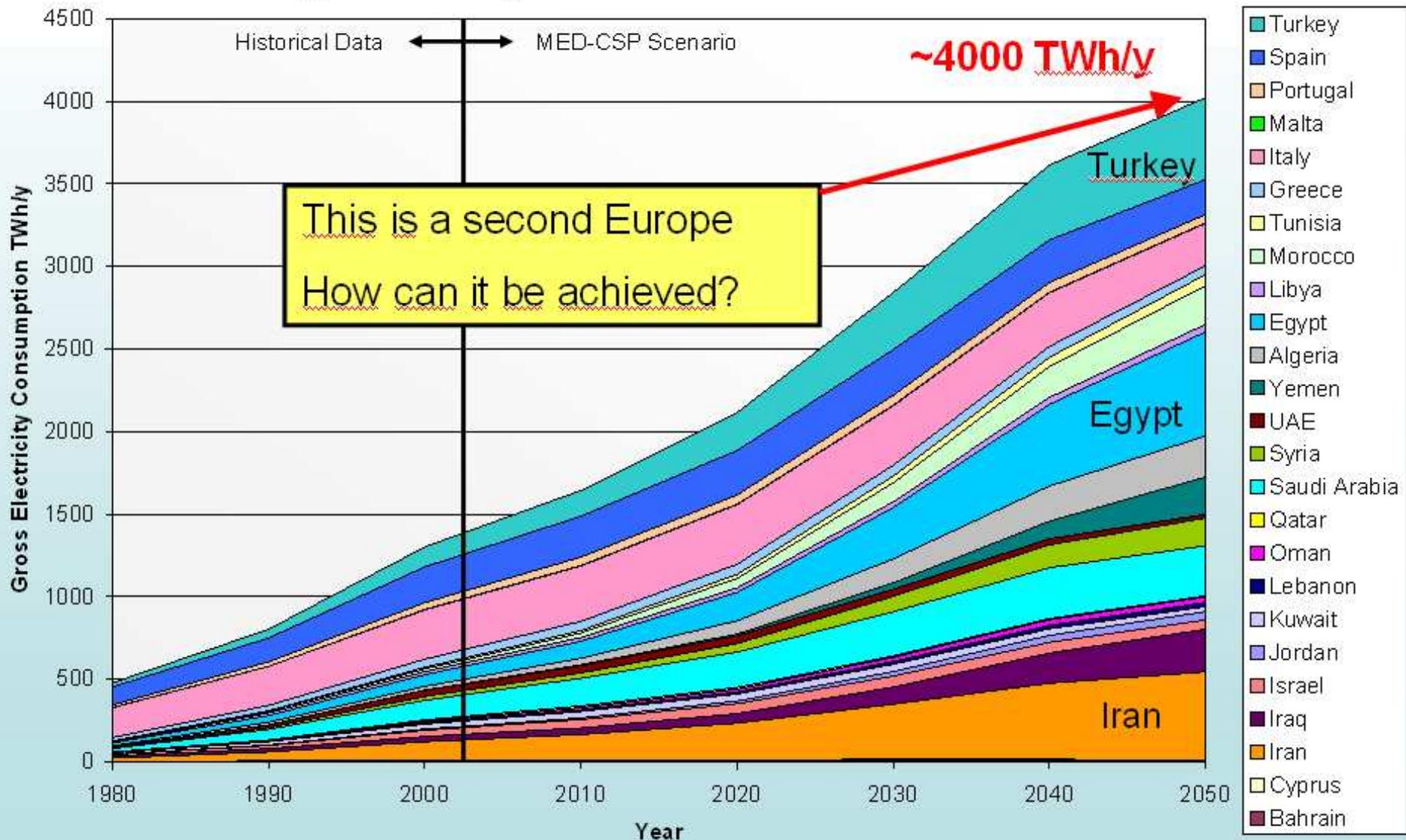
IFEED

## 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



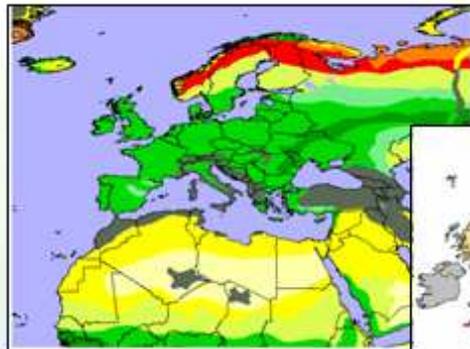


Biomass



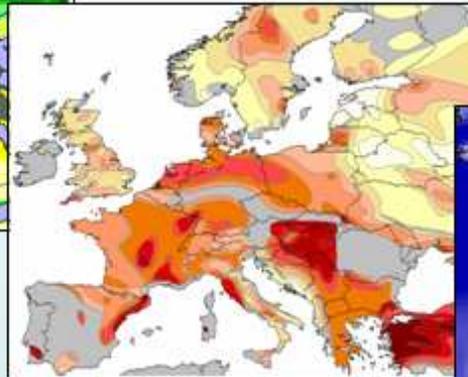
# Renewable Energy Resource Mapping

**Economic Potential TWh/y**  
(Demand 2050  $\approx$  4000 TWh/y)



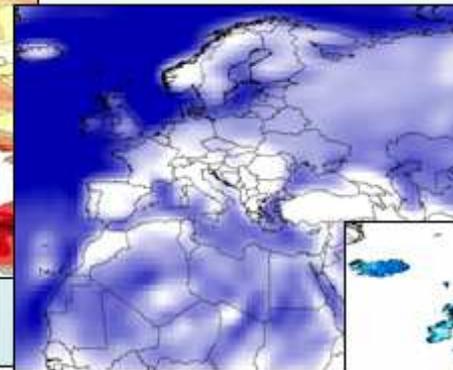
**402**

Geothermal Energy



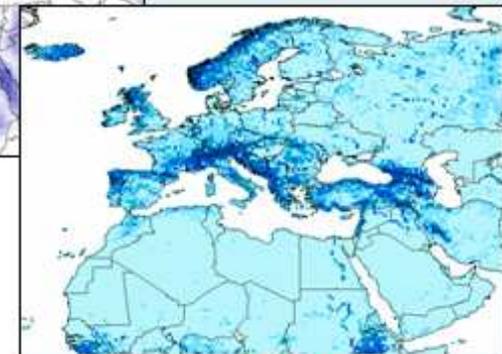
**414**

Wind Energy



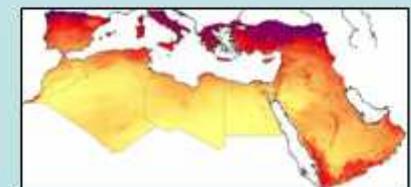
**447**

Hydropower



**432**

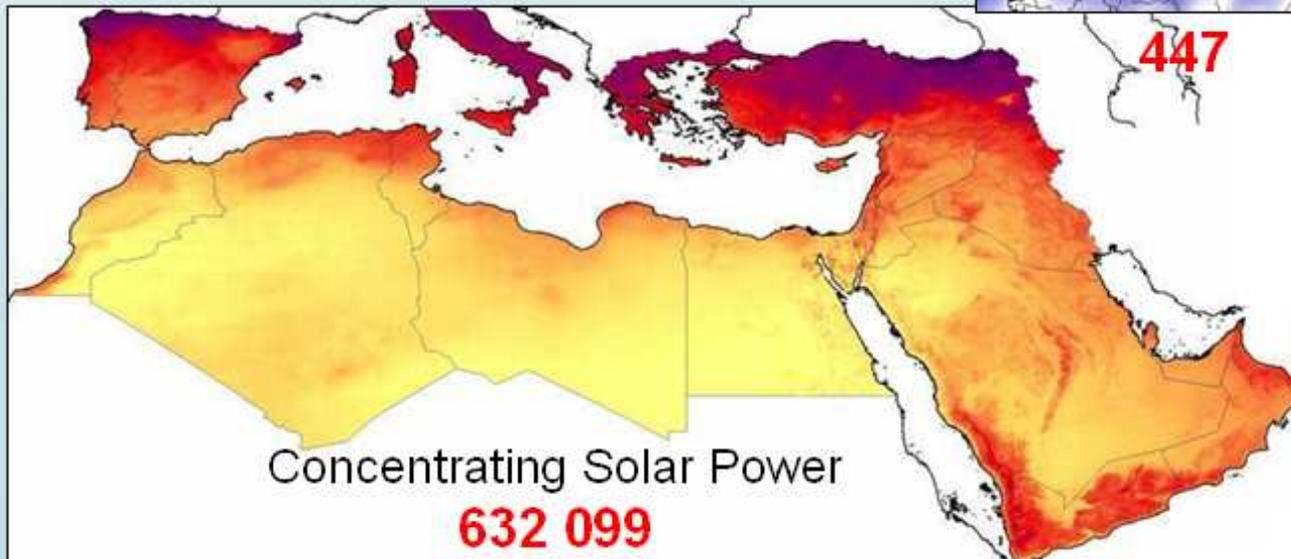
PV



**218**

Concentrating Solar Power

**632 099**

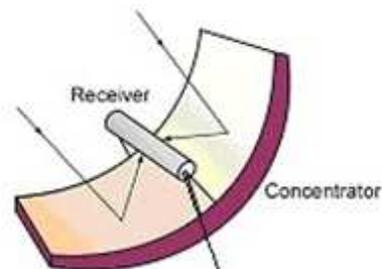


# Concentrating Solar Power Technologies (CSP)

relevant for Power Stations are 5 MW to 1000 MW

**Parabolic Trough**  
 5-600 MW

line concentrators



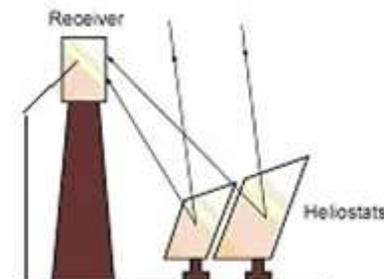
Steam at  
 350 - 550 °C  
 80 - 120 bar \*

**Linear Fresnel**  
 5-600 MW



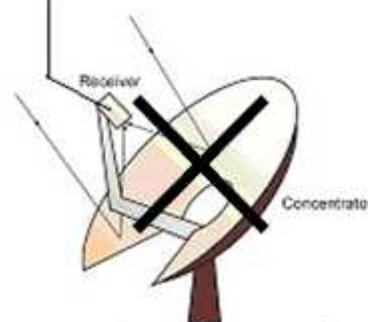
Source: DLR

point concentrators



Molten Salt, Air or Helium at  
 600 - 1200 °C  
 1 - 20 bar \*

**Solar Tower**  
 5-100 MW



not relevant

**Parabolic Dish**  
 0,5-50 kW

## CONCENTRATING SOLAR POWER TECHNOLOGIES for >5 MW

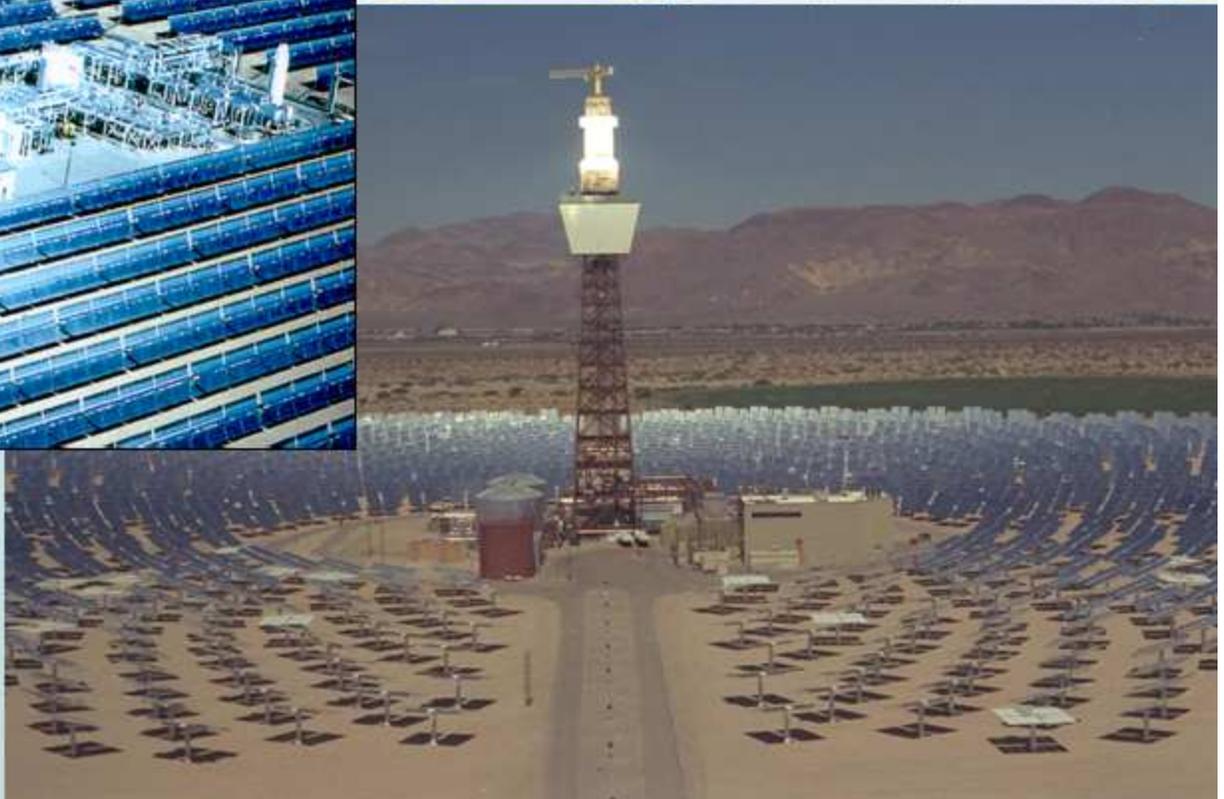
Linear Fresnel



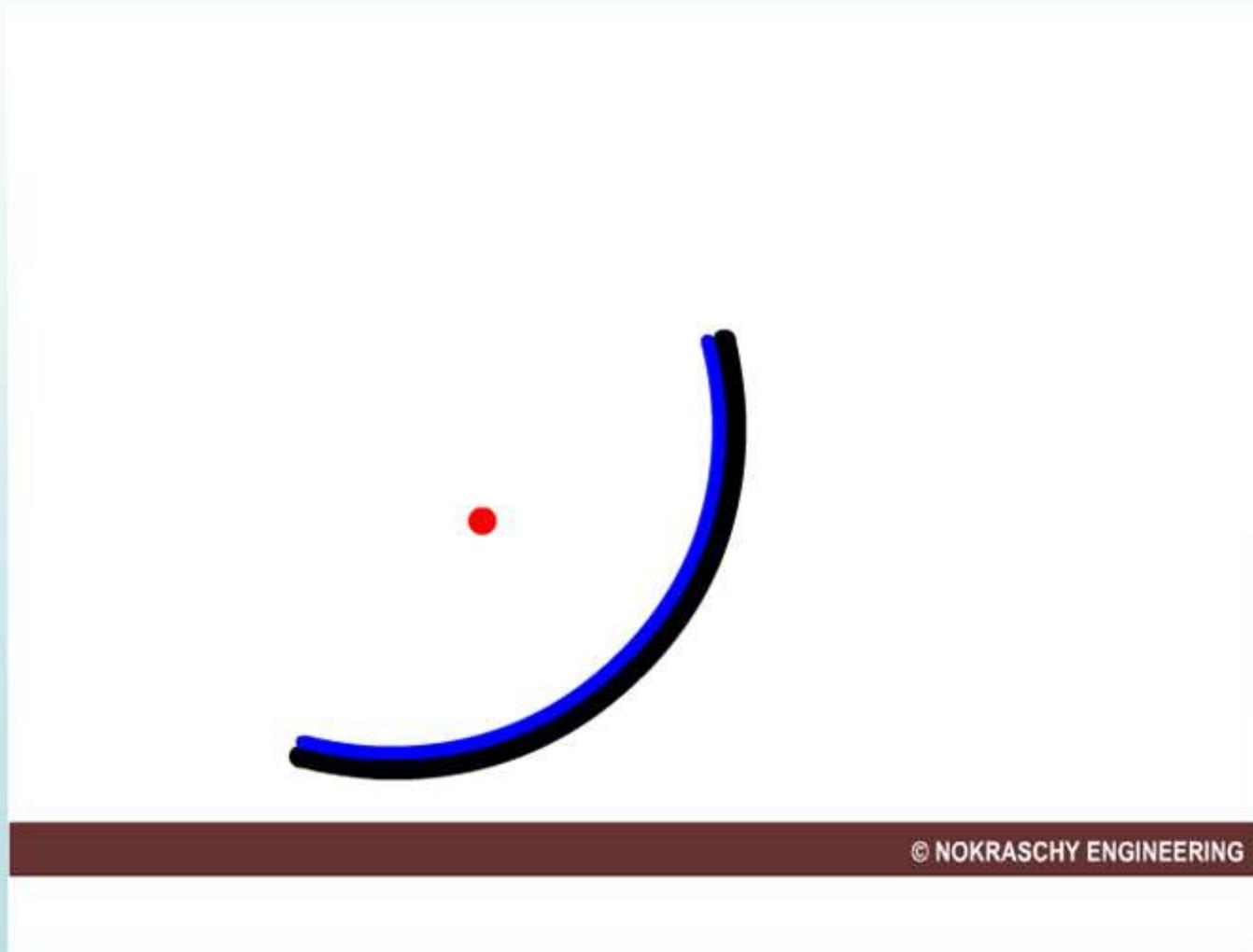
Parabolic Trough



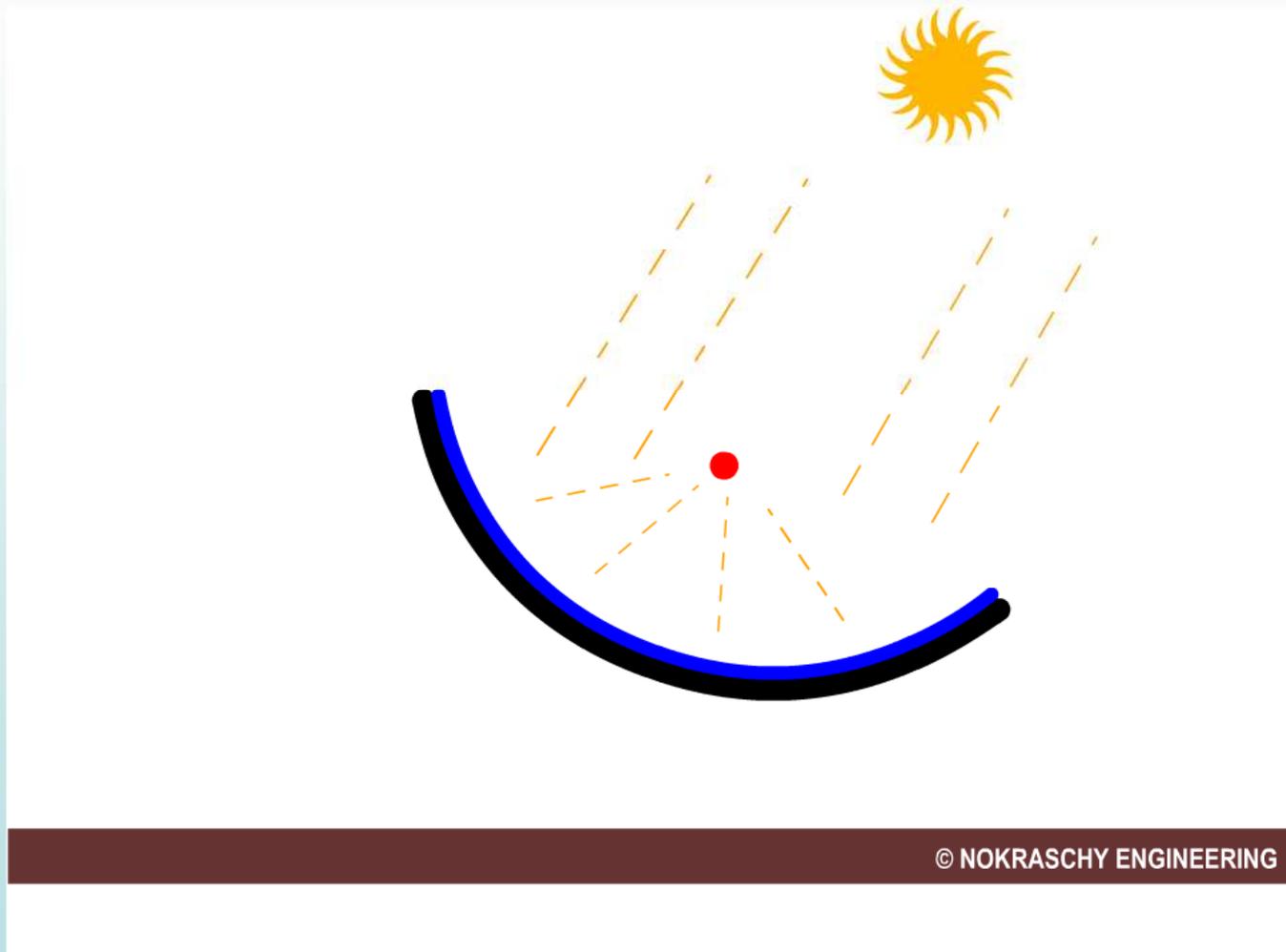
Central Receiver



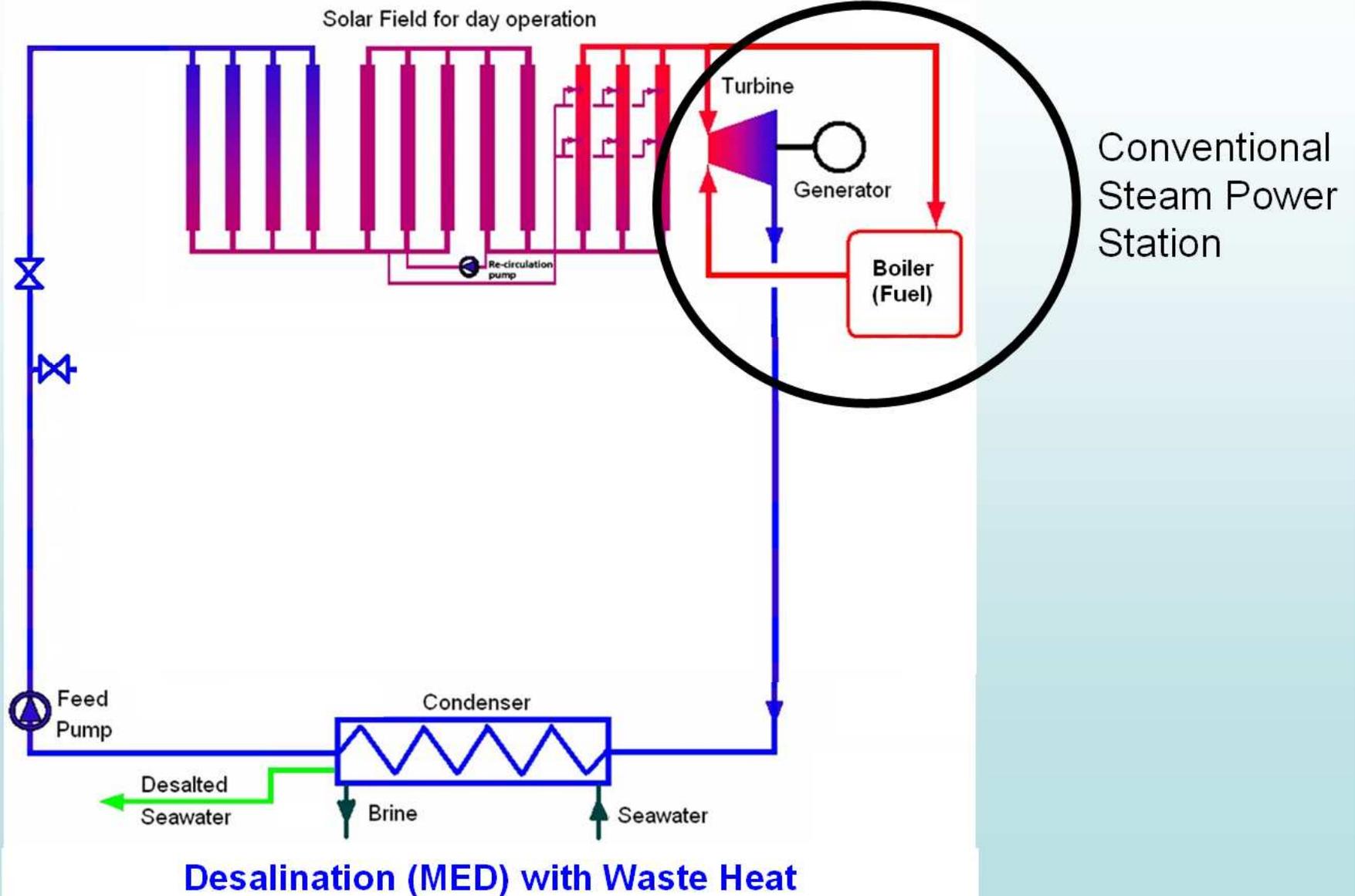
# Parabolic trough Technology



# Parabolic trough Technology

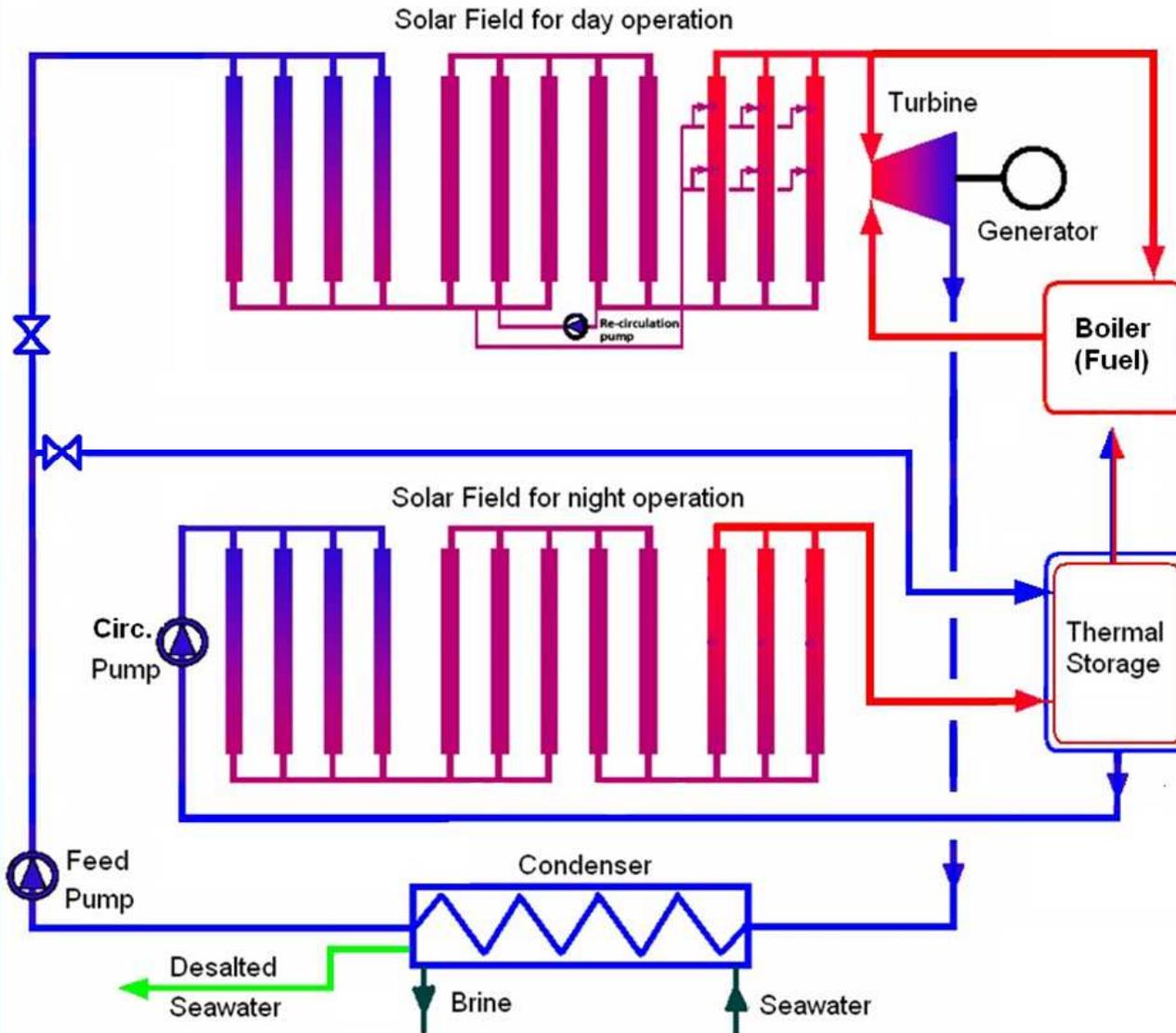


## Solar Hybrid Power Station with Desalination





# Solar Hybrid Power Station with Desalination



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

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

Desalination (MED) with Waste Heat

**DESERTEC**

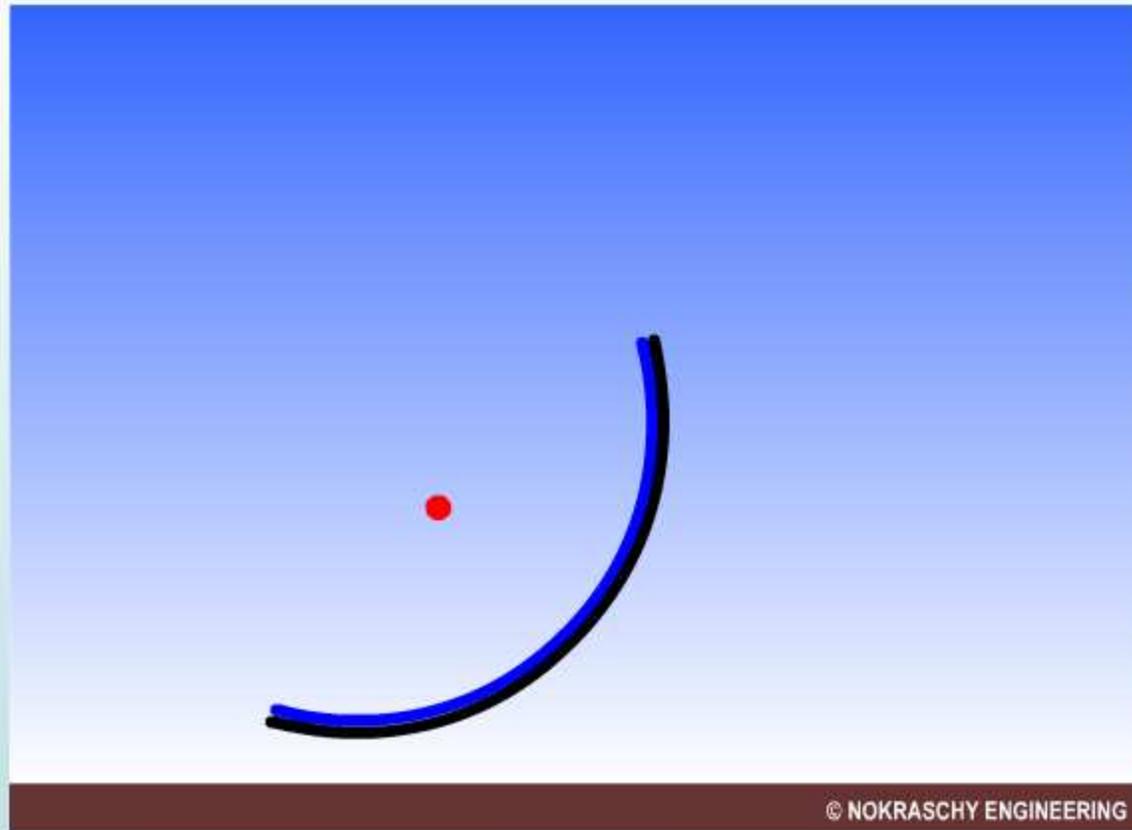
**ANDASOL 1**

**NOKRASCHY ENGINEERING**  
Mechanical Vibrations and Infrasound under Control  
Solar Power for Sustainable and Everlasting Energy

50 MW CSP power plant in Spain using  
molten salt as storage for 7 h full load operation

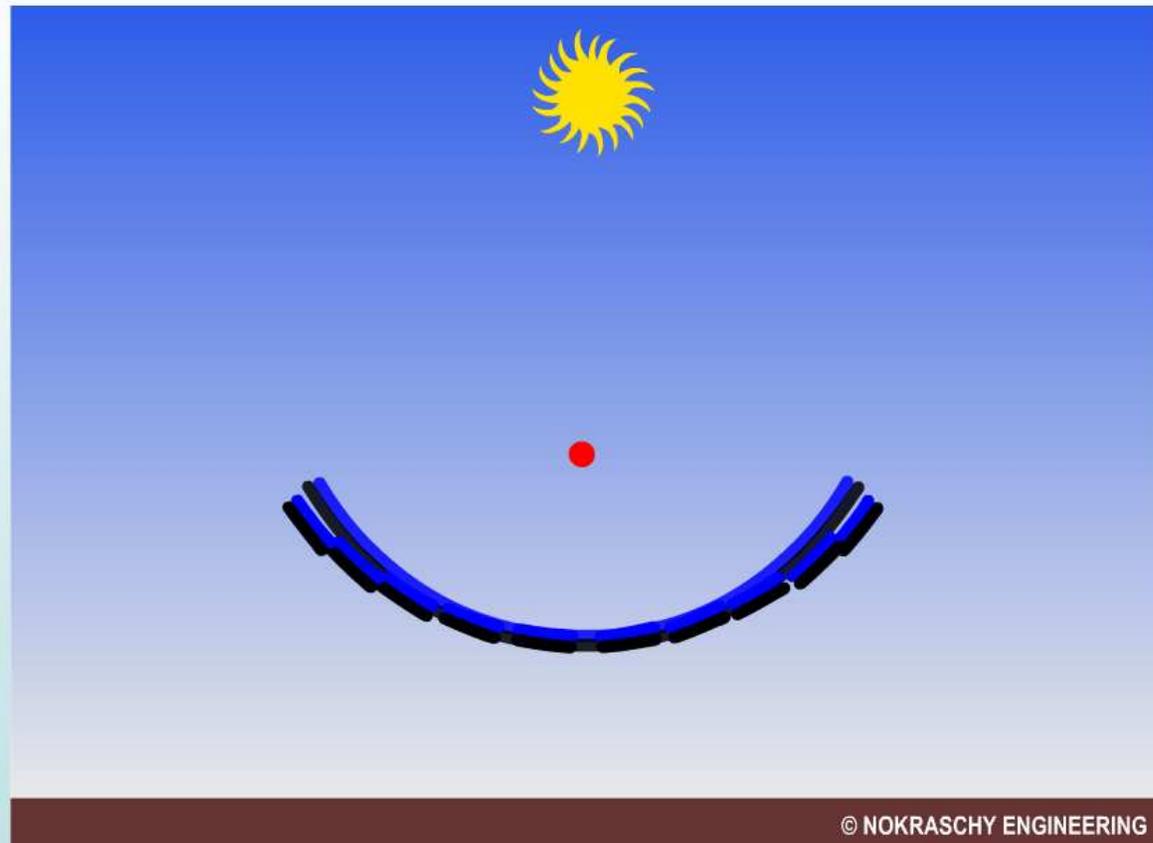


## Alternative Design: Flat Mirrors



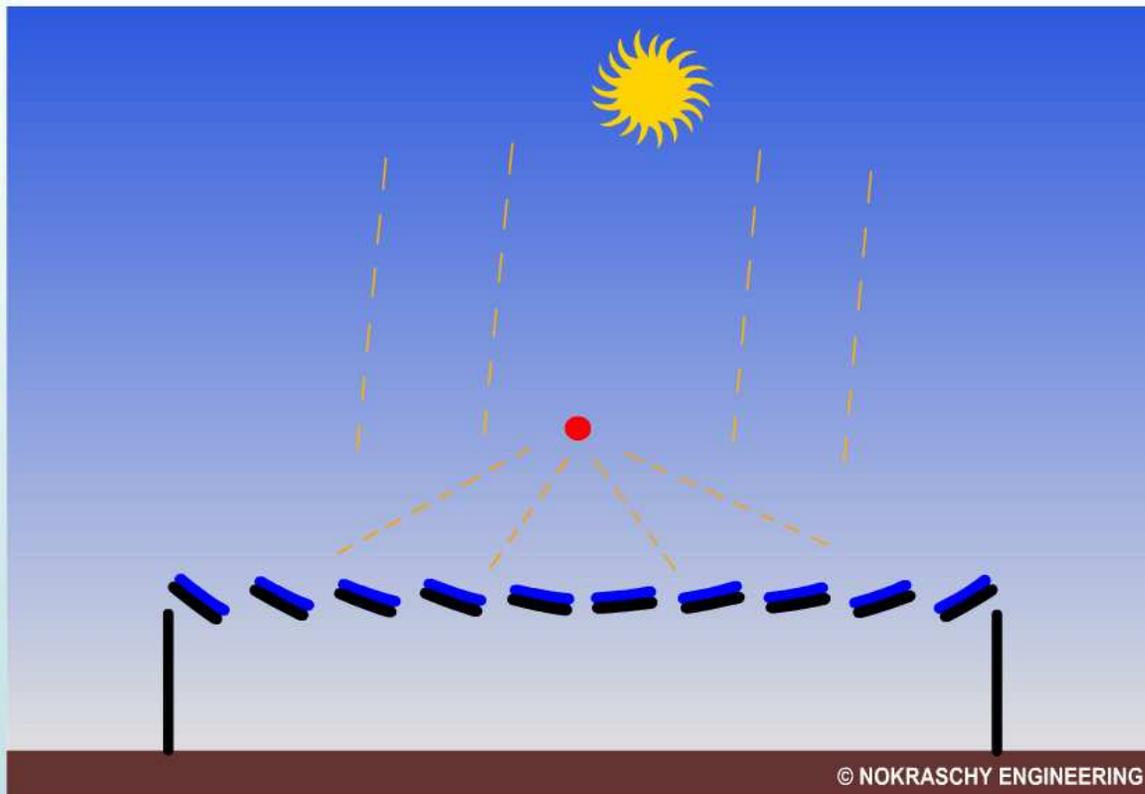
**Best collection of the Sunrays. Simple, cost effective and usage of area underneath mirrors is possible**

## Alternative Design: Flat Mirrors



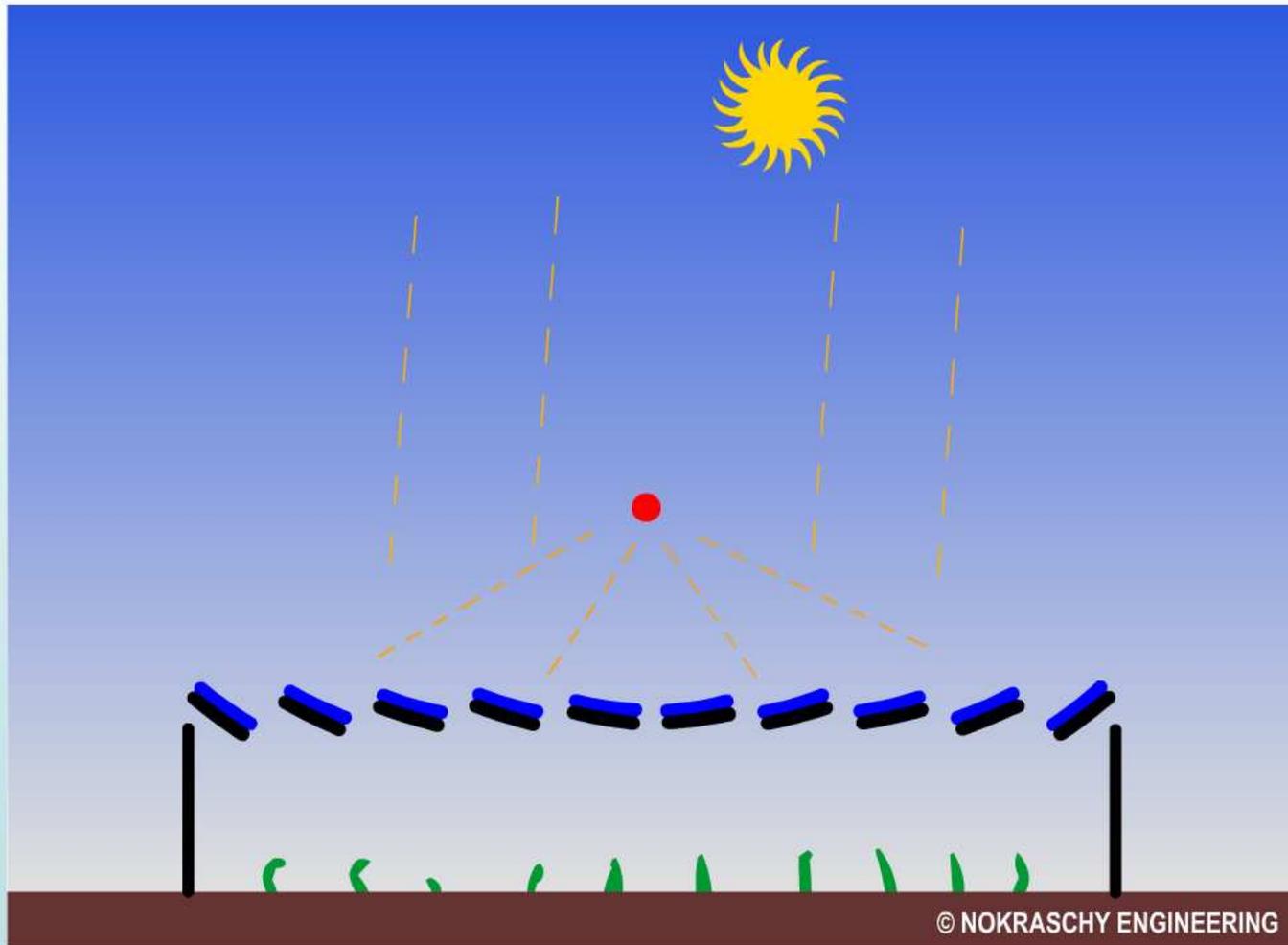
**Best collection of the Sunrays. Simple, cost effective and usage of area underneath mirrors is possible**

## Alternative Design: Flat Mirrors



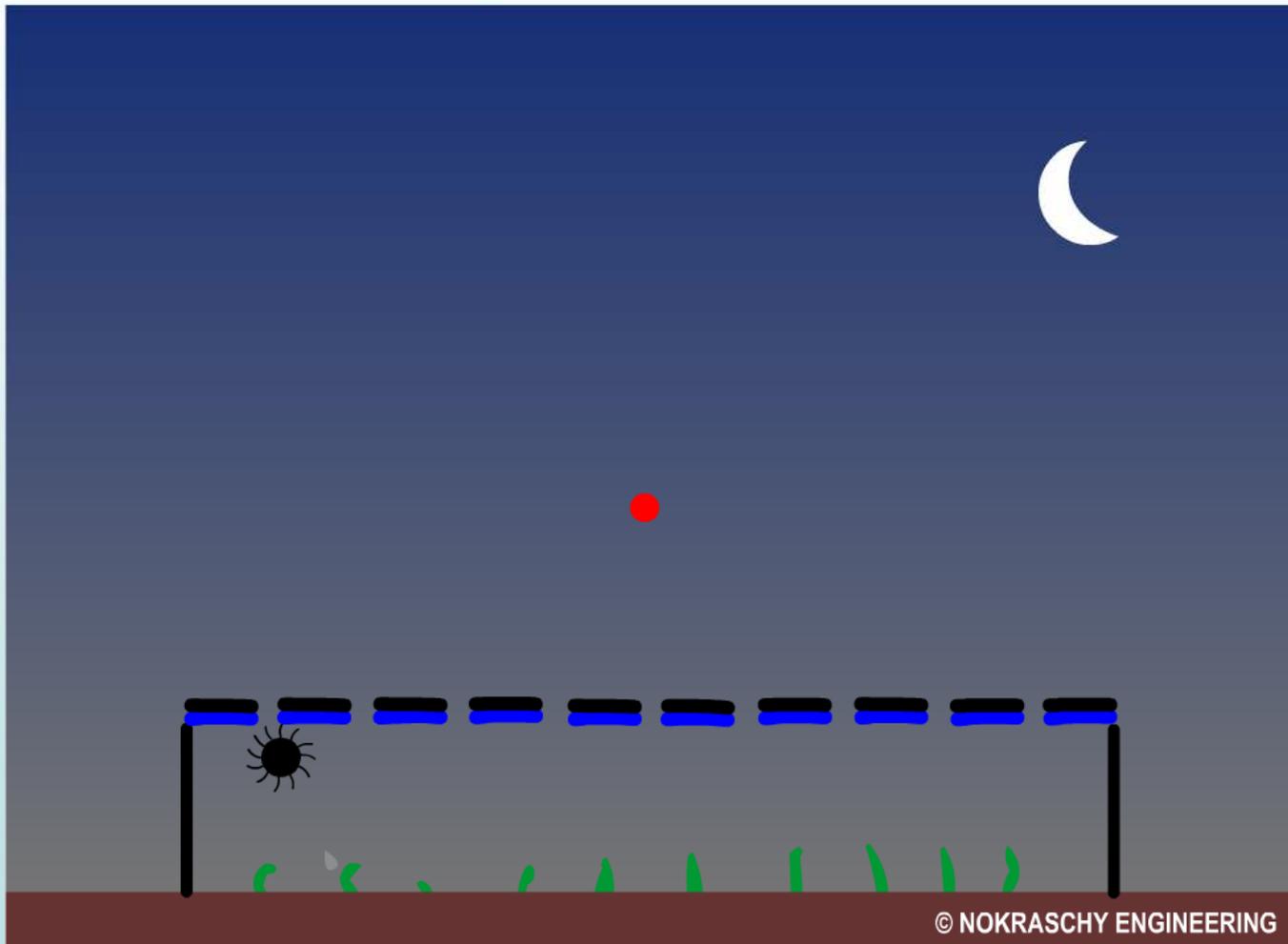
**Best collection of the Sunrays. Simple, cost effective and usage of area underneath mirrors is possible**

## Automated Cleaning = less cleaning water & it is not wasted



In the shadow plants need less irrigation water

## Automated Cleaning = less cleaning water & it is not wasted



**In the shadow plants need less irrigation water**

## CSP in action



Linear Fresnel Solar Steam Power Plant 1.5 MW in Spain, March 2009



**No water  
Consumption**

- **Dry cooling**
- **Dry cleaning**

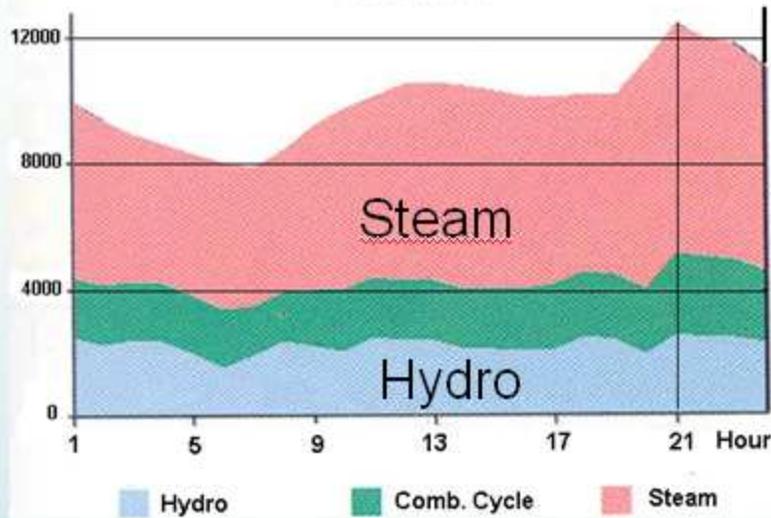
**Air cooled  
condenser**

System: NOVAREC BIOSOL

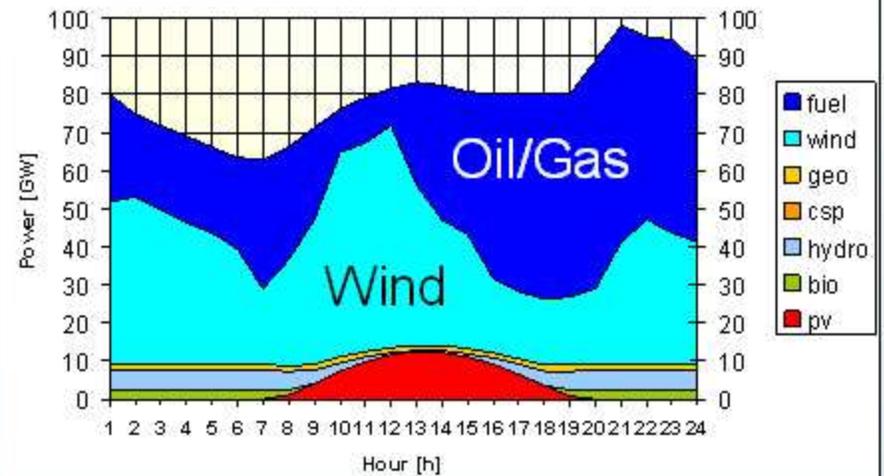
# Load Properties

Day of max. Load 21.06.2001

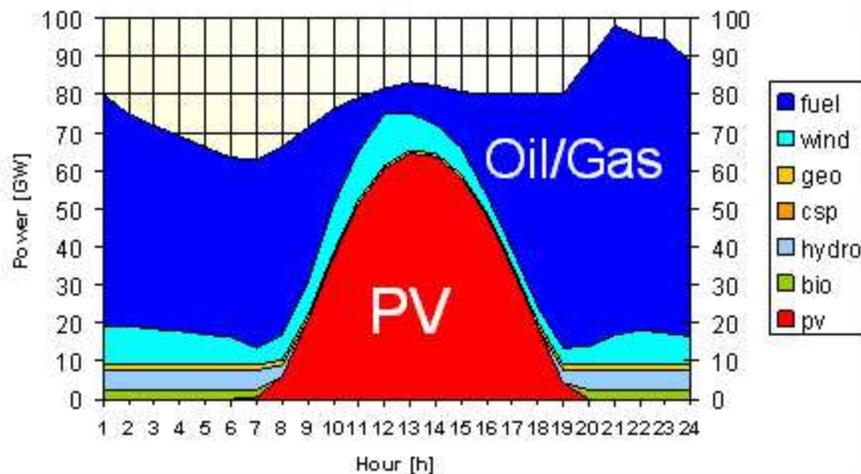
12376 MW



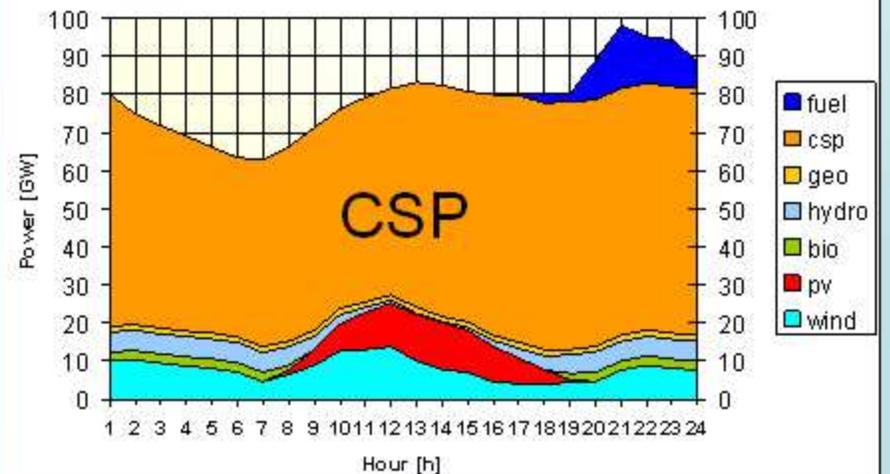
Peak Load Day in Egypt 2050 - Scenario Wind



Peak Load Day in Egypt 2050 - Scenario "PV"

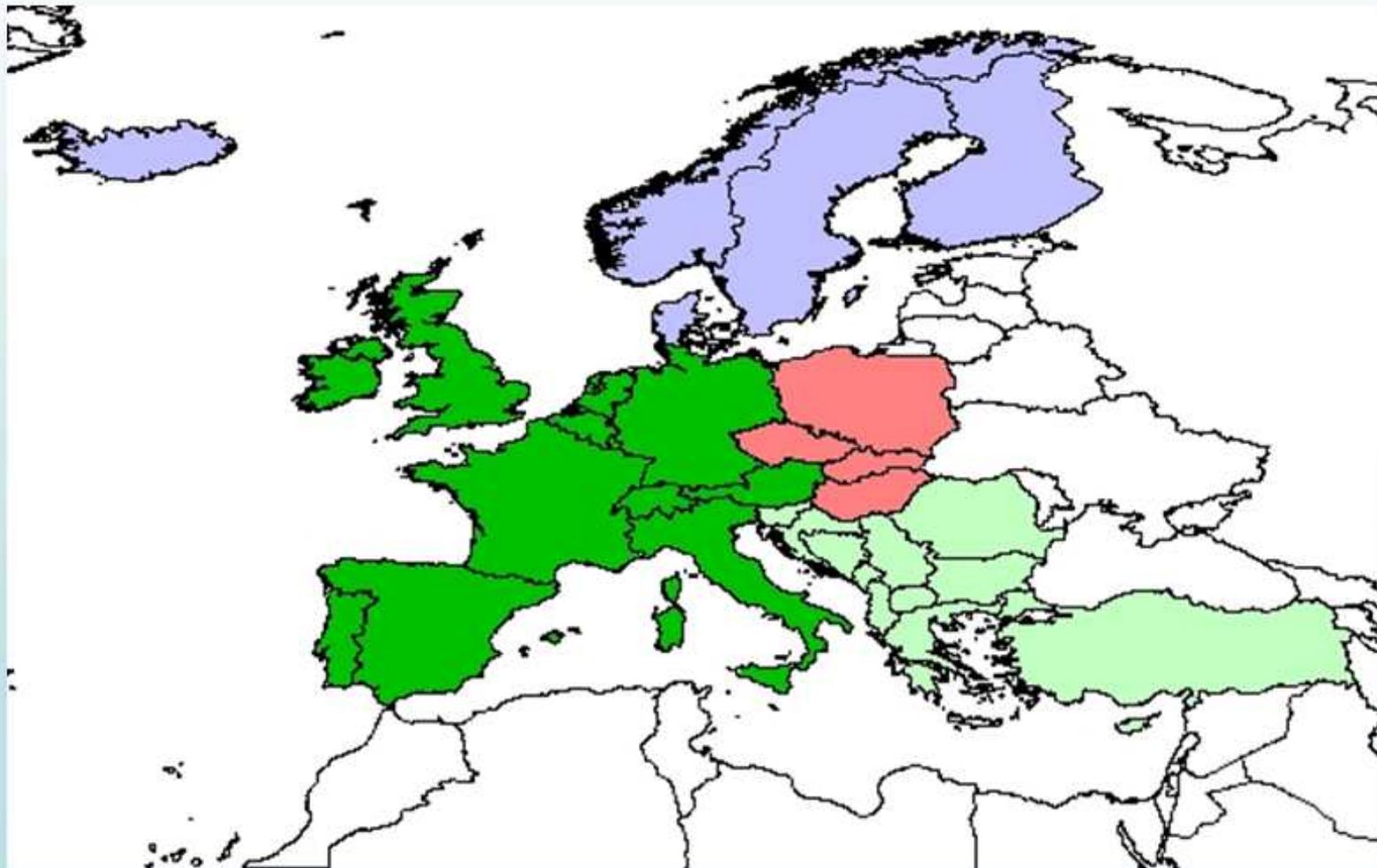


Peak Load Day in Egypt 2050 - Scenario C G/HE

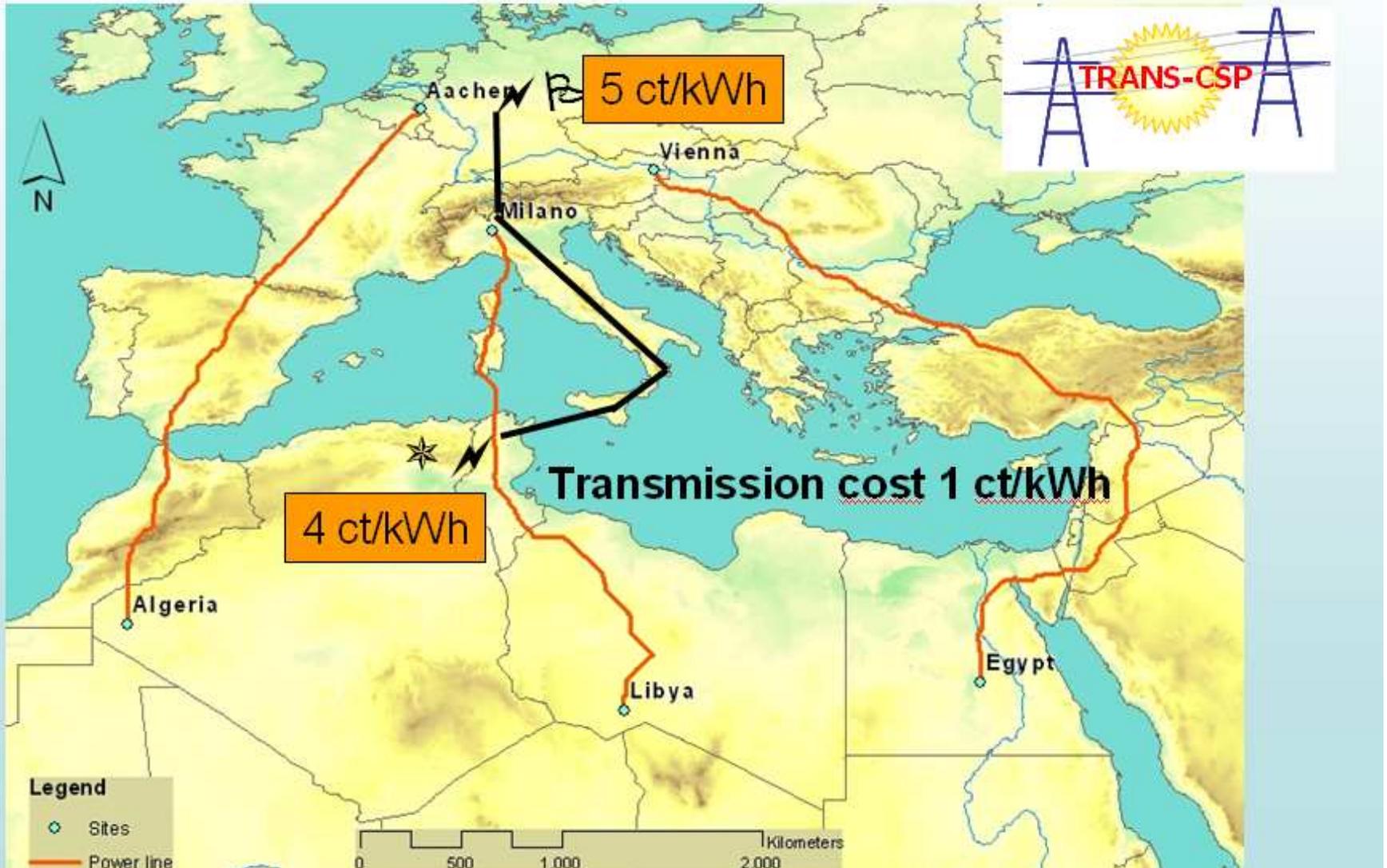


# A View on Europe's Electricity Demand

Analysed countries within TRANS-CSP

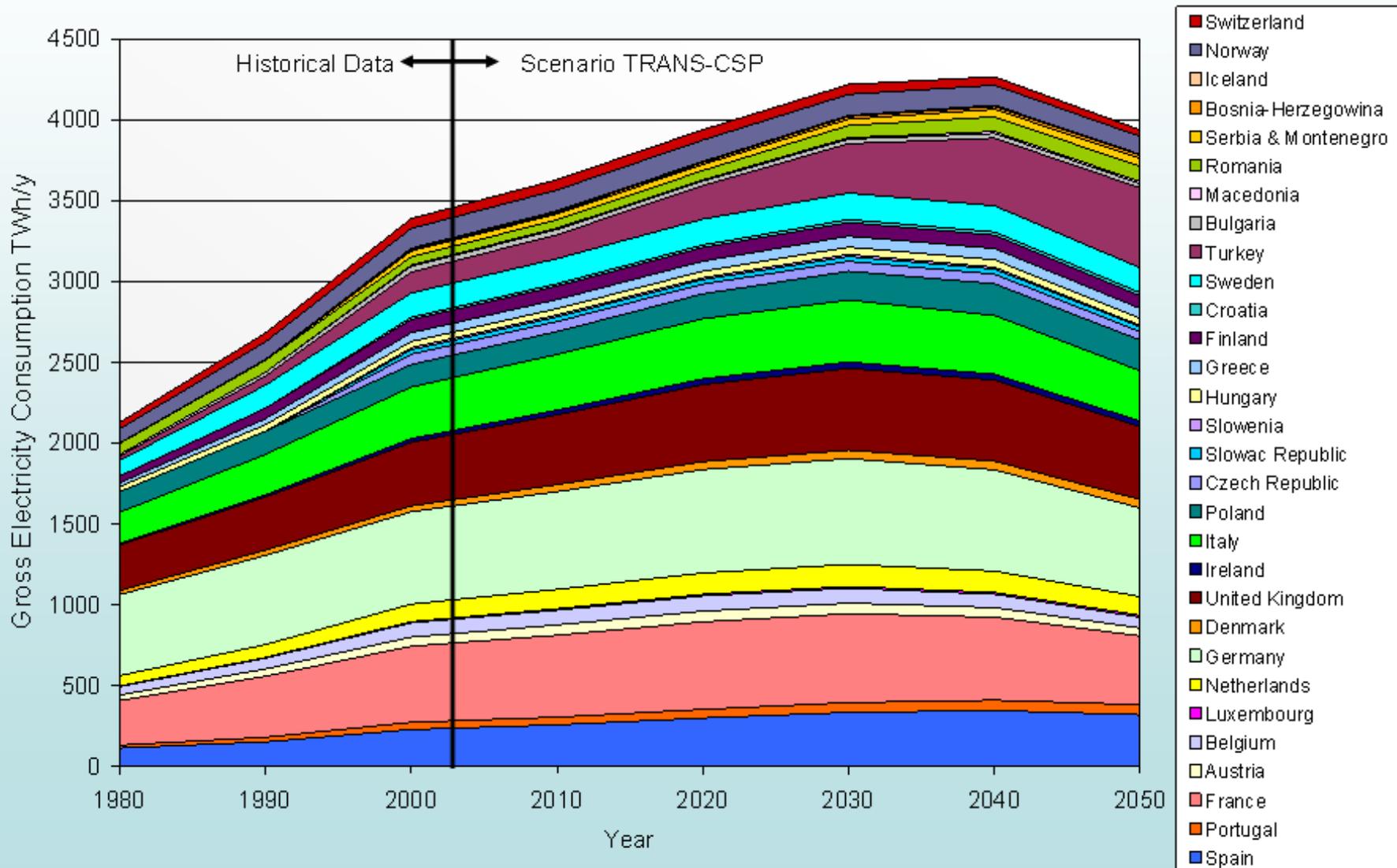


## 3 Samples out of 20 EU-MENA HVDC interconnections each line transmitting 5 Giga Watt



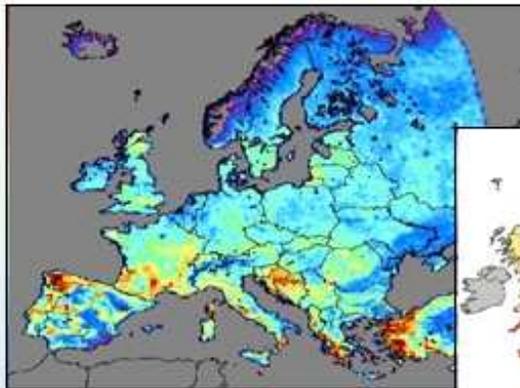


# Electricity Consumption in Europe

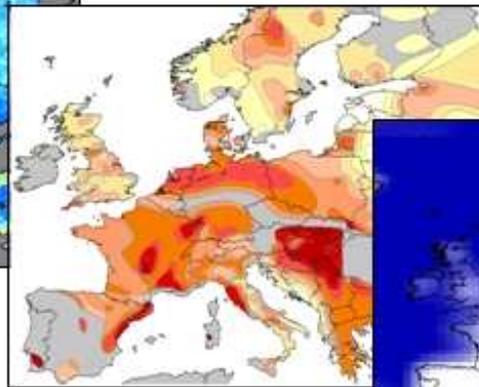


# Available Economic Ren. Energy Potential

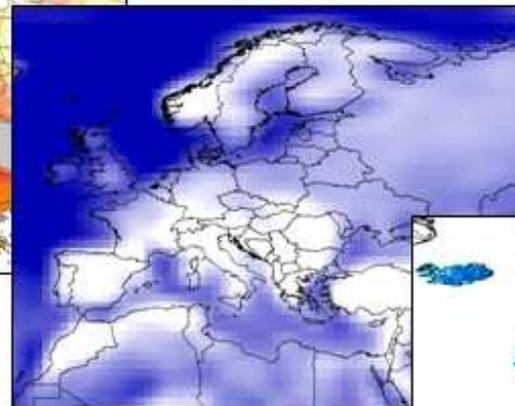
Biomass (620)



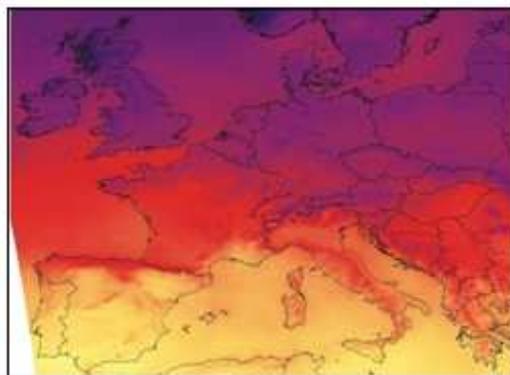
Geothermal (380)



Wind Energy (1520)



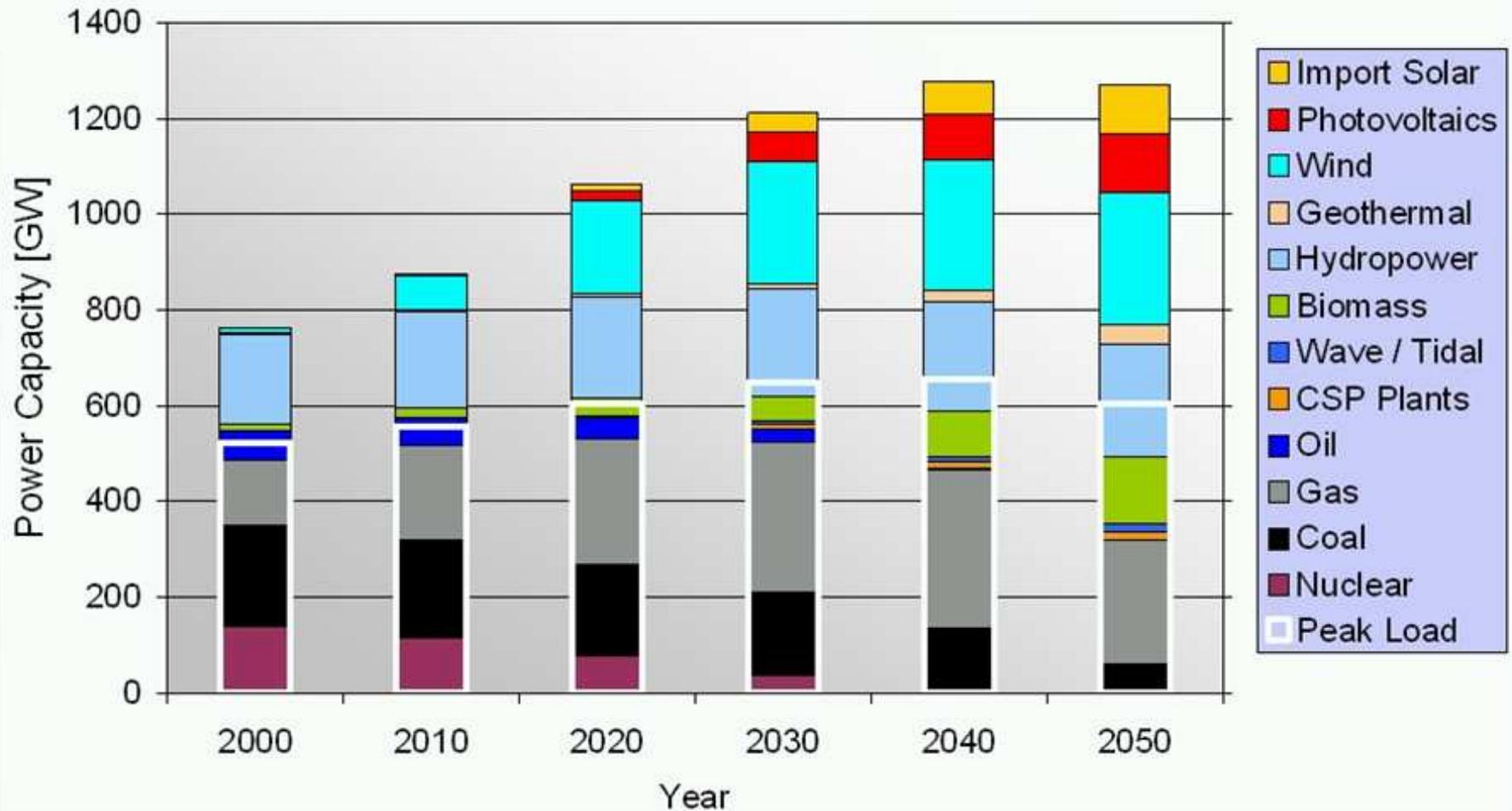
Hydropower (910)



Solar Energy  
(1730)

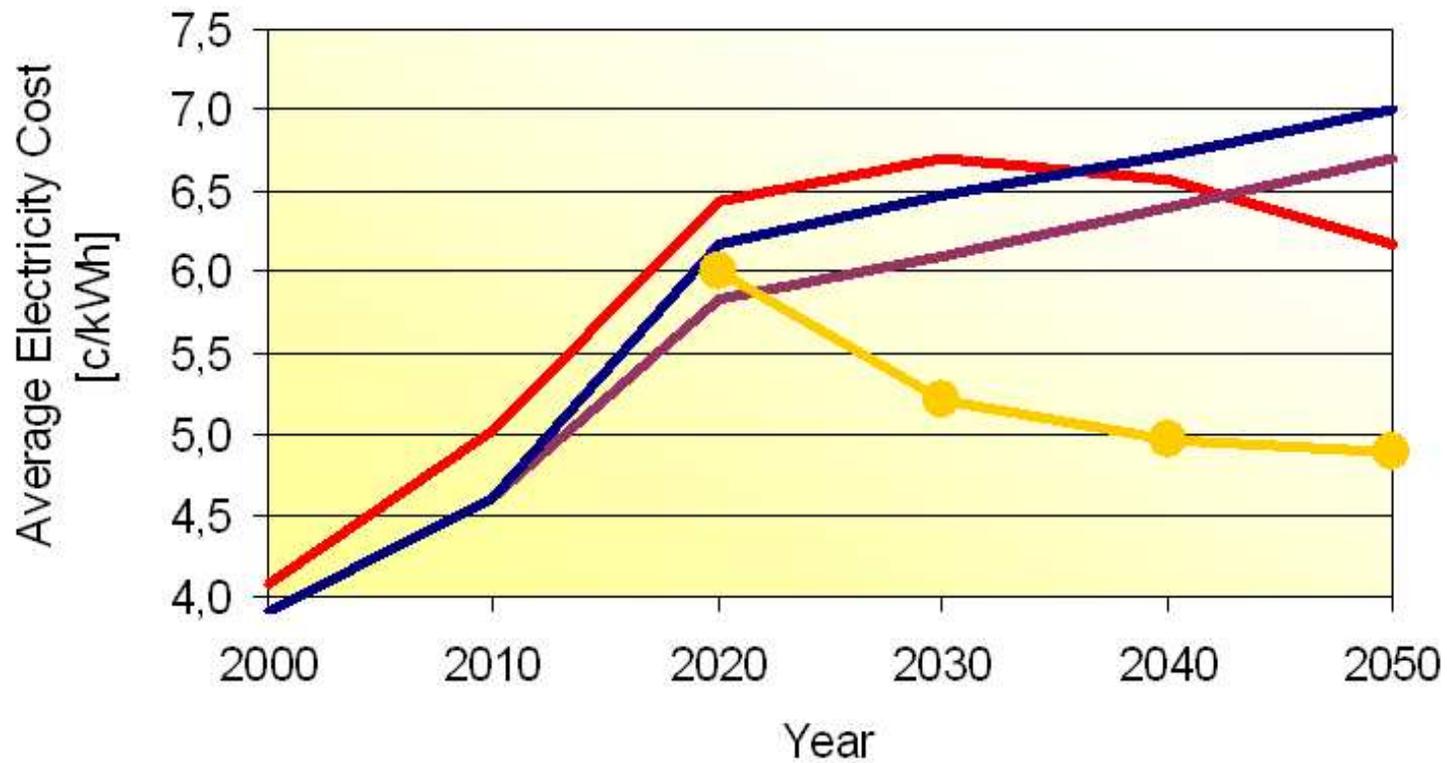
Available 145% however mainly fluctuating. Firm Portion is 80%

# Installed Capacity in Europe



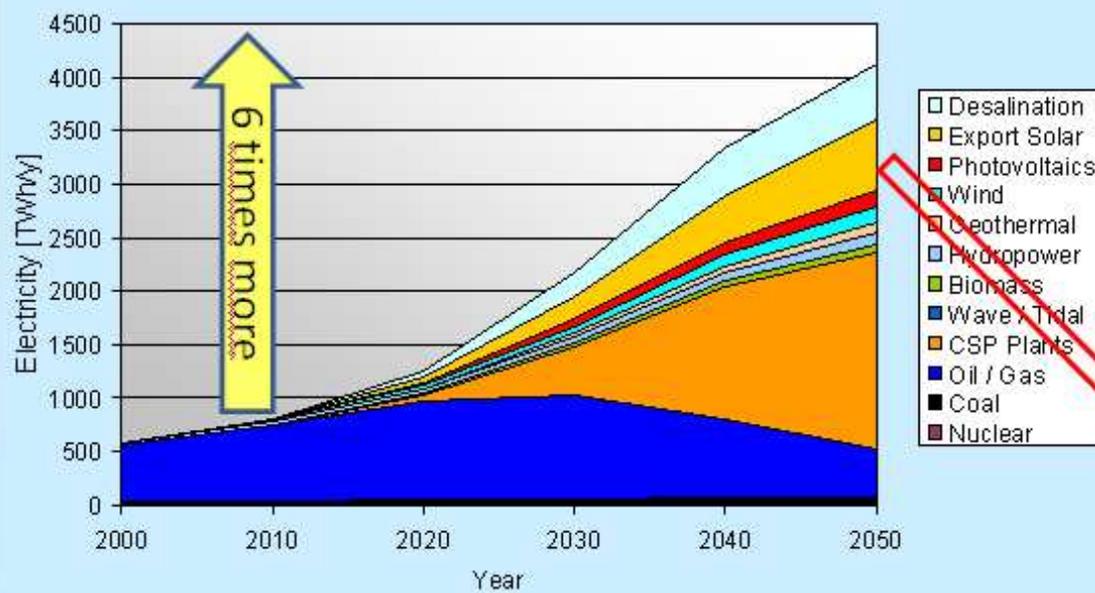


### Effect on Electricity Costs in Germany



— TRANS-CSP Mix    — Mix 2000    — No Nuclear    —●— Solar Import



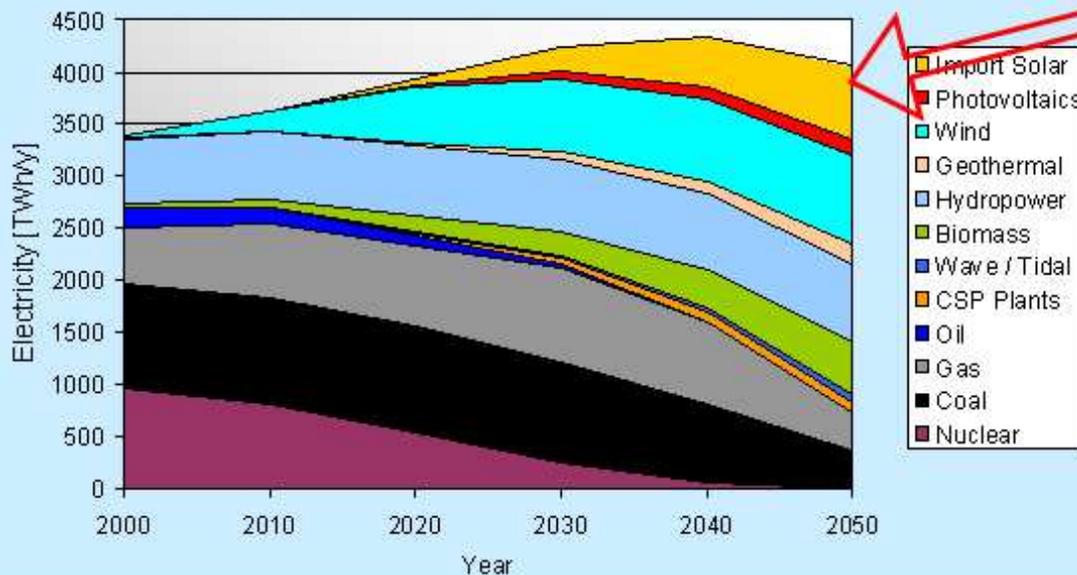


transition mix 2000-2050

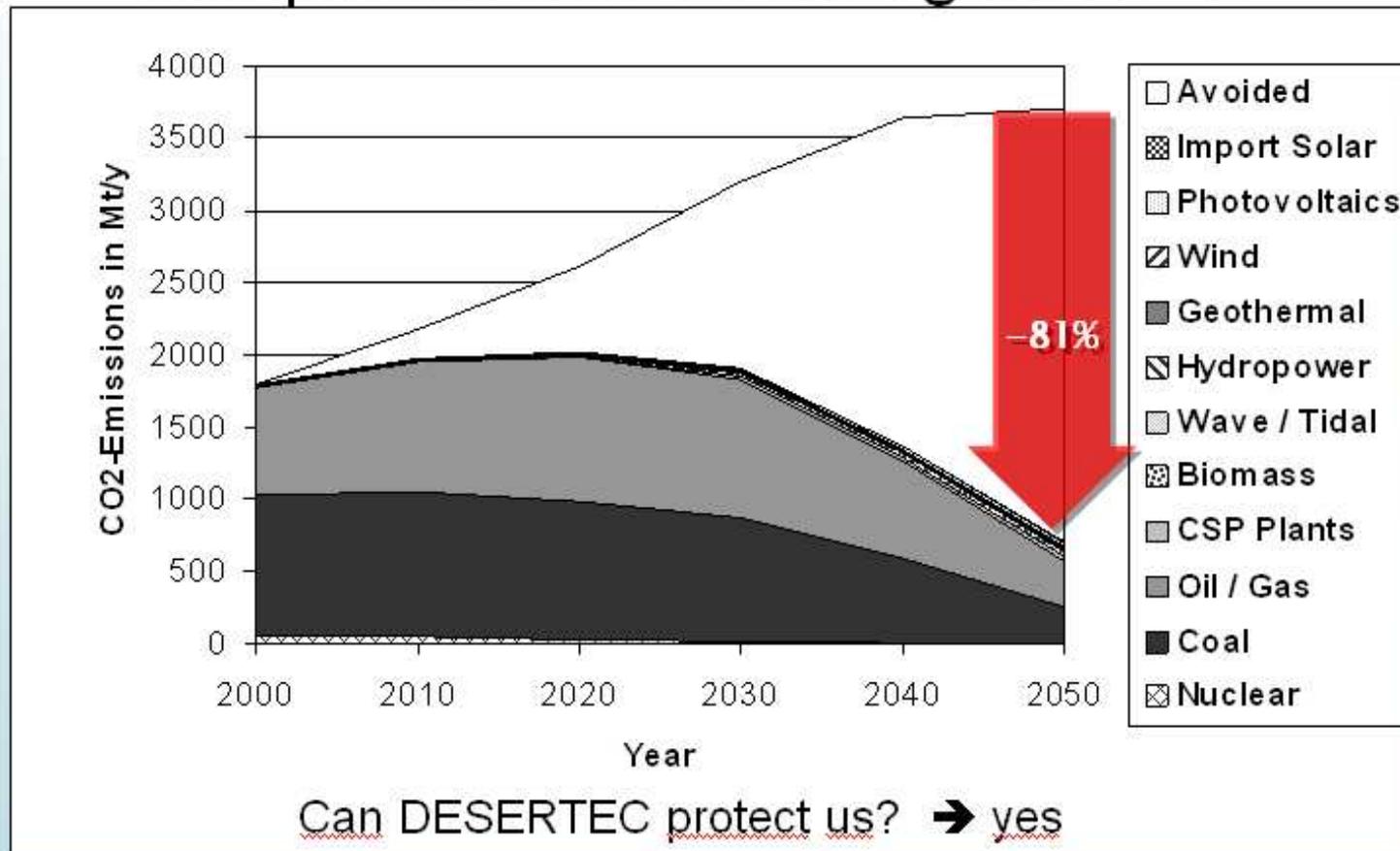
in MENA,  
 including export to  
 Europe and  
 power for desalination

in EU-25, and  
 15% import from MENA

By clean power from  
 deserts **EU gets clean  
 firm capacity and may  
 win 10-15 years** in the  
 fight against climate  
 change.



## Resulting decarbonization in EUMENA, compatible with climate goal $\Delta T < 2^\circ$

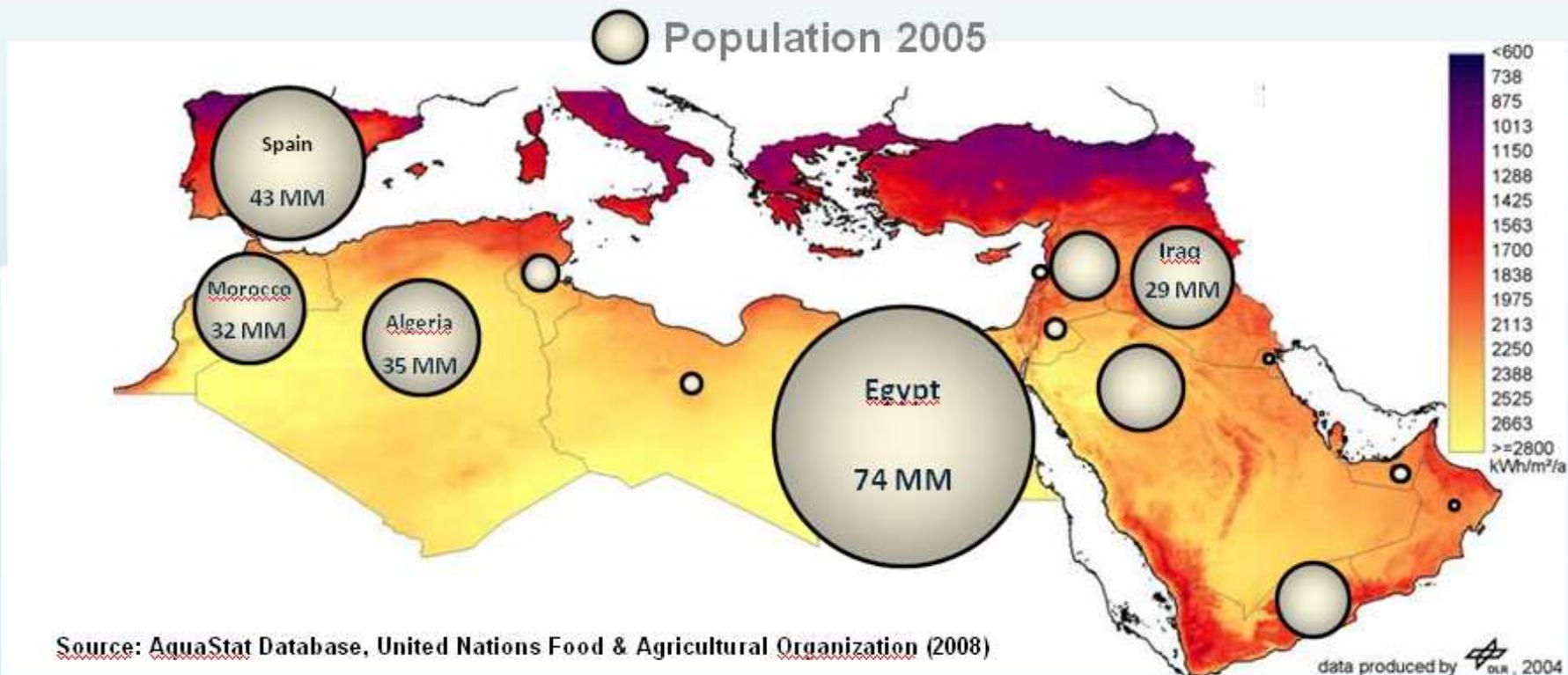


## The Requirements in MENA are different than those of Europe...

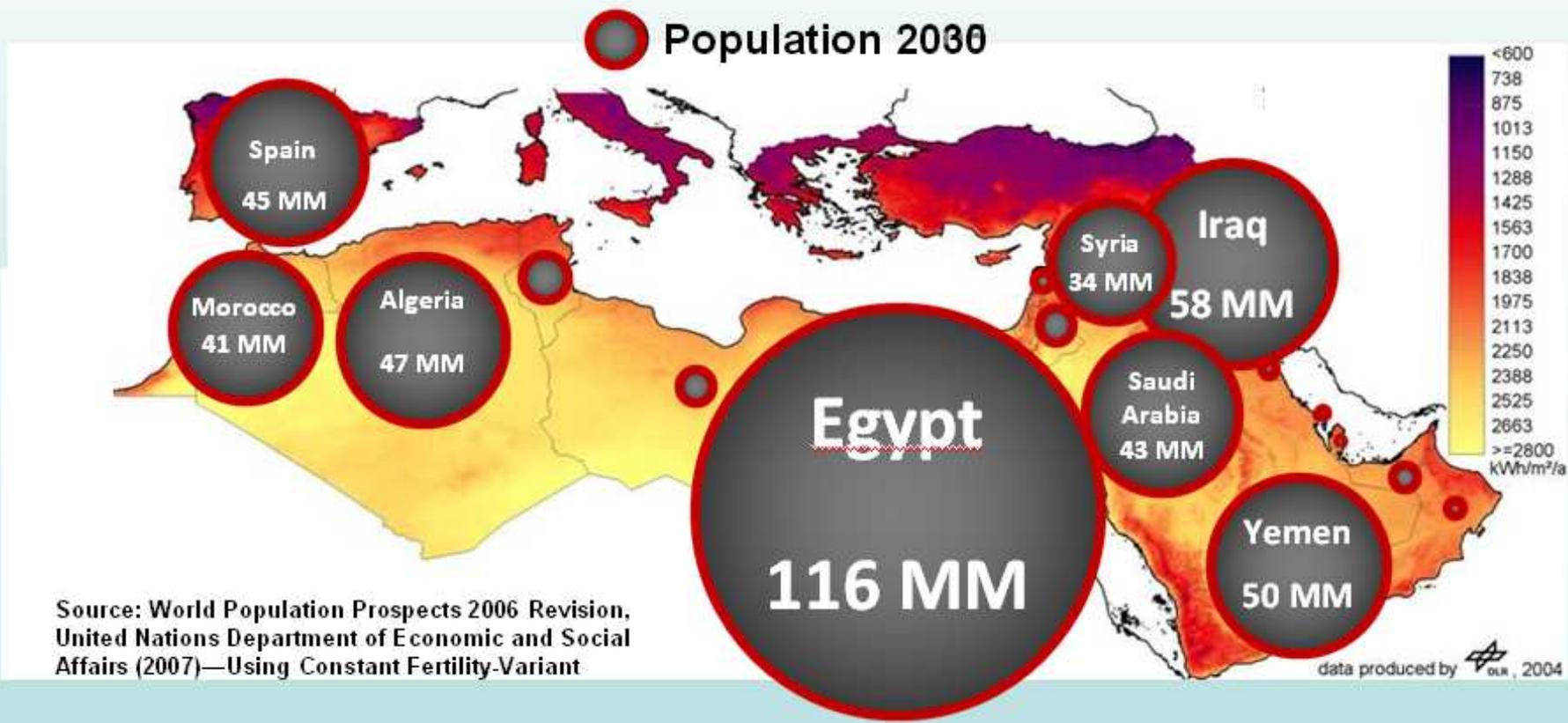
- Not only Electricity is needed ...  
... 6-8% increase yearly
- Water is also needed ...  
... more than two Niles by 2050



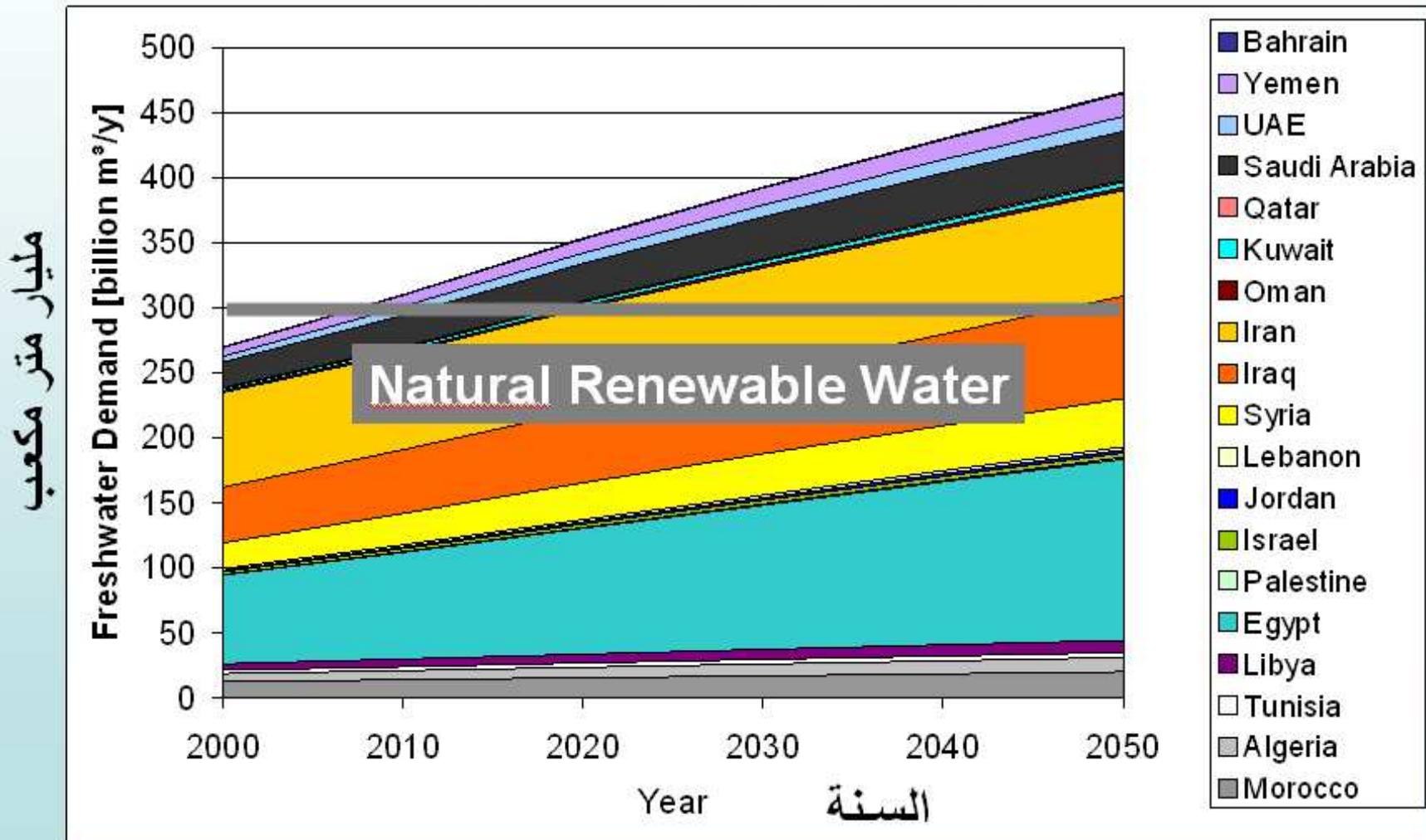
## Why Should the MENA Adopt Concentrating Solar Power?



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## Water Demand in the Arab Countries



# Signing Memo of Understanding

Munich, 13 July 2009

Munich 13<sup>th</sup> July 2009



ABB AG

*[Signature]*



Abengoa Solar S.A.

*[Signature]*



Ceyhal Spa

*[Signature]*



DESERTEC Foundation

*[Signature]*



Deutsche Bank AG

*[Signature]*



E.ON Climate & Renewables GmbH

*[Signature]*



HSH Nordbank AG

*[Signature]*



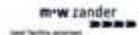
MAN Solar Millennium GmbH

*[Signature]*



Münchener Rückversicherungs-Gesellschaft  
 Aktiengesellschaft in München

*[Signature]*



M+W Zander Group GmbH

*[Signature]*



RWE AG

*[Signature]*



Schott AG

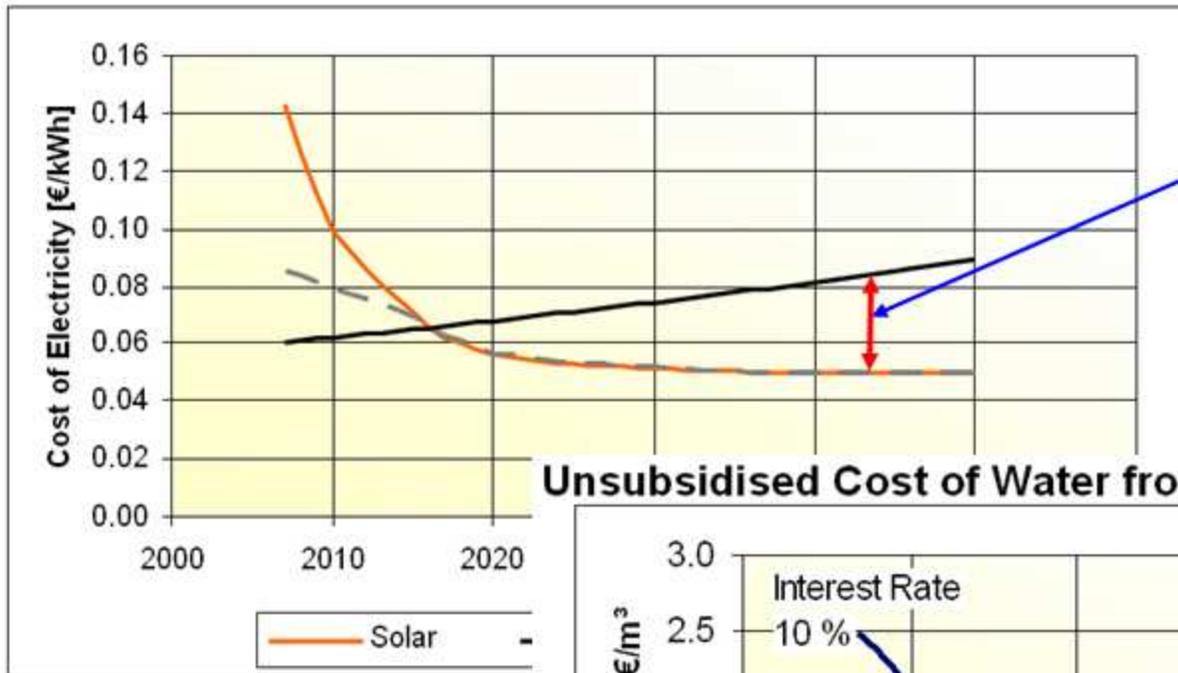
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Siemens AG

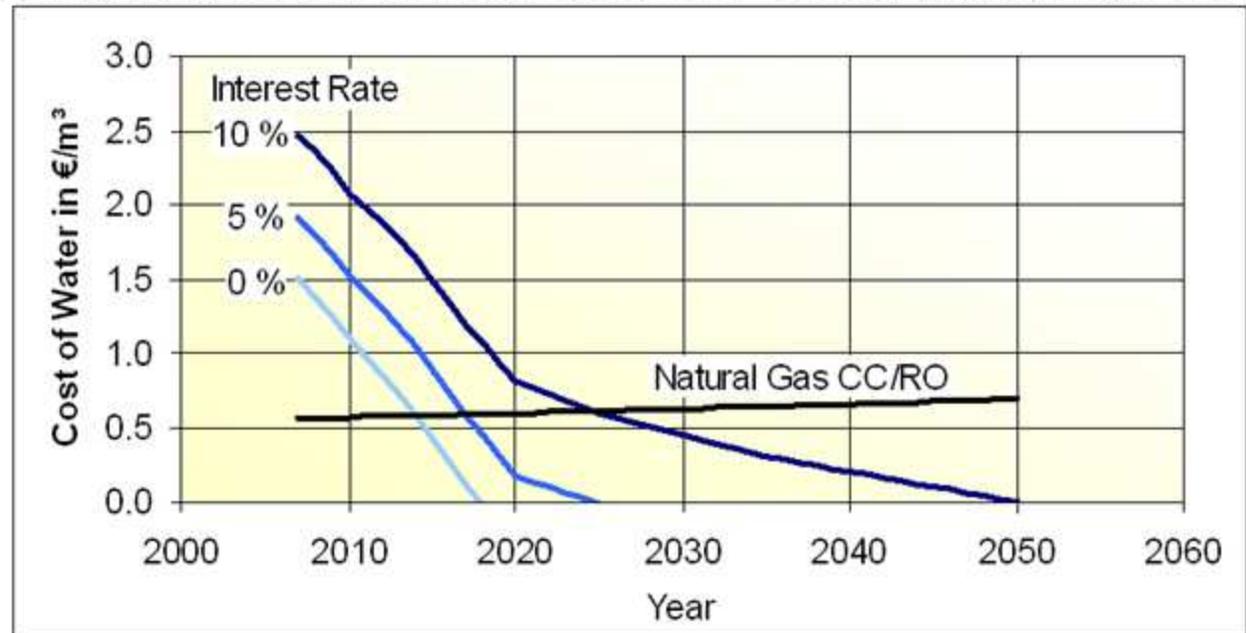


**Unsubsidised cost of electricity of CSP versus natural gas CC**



**This difference is used to support water desalination**

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



**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 m<sup>3</sup> 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 CO<sub>2</sub> 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.

