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

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

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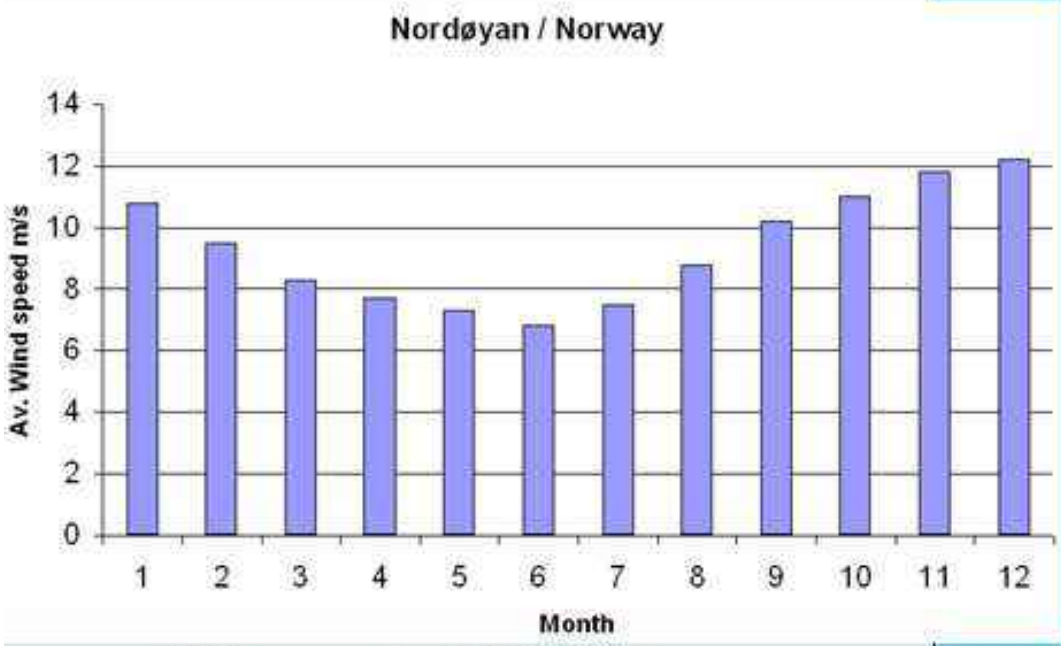
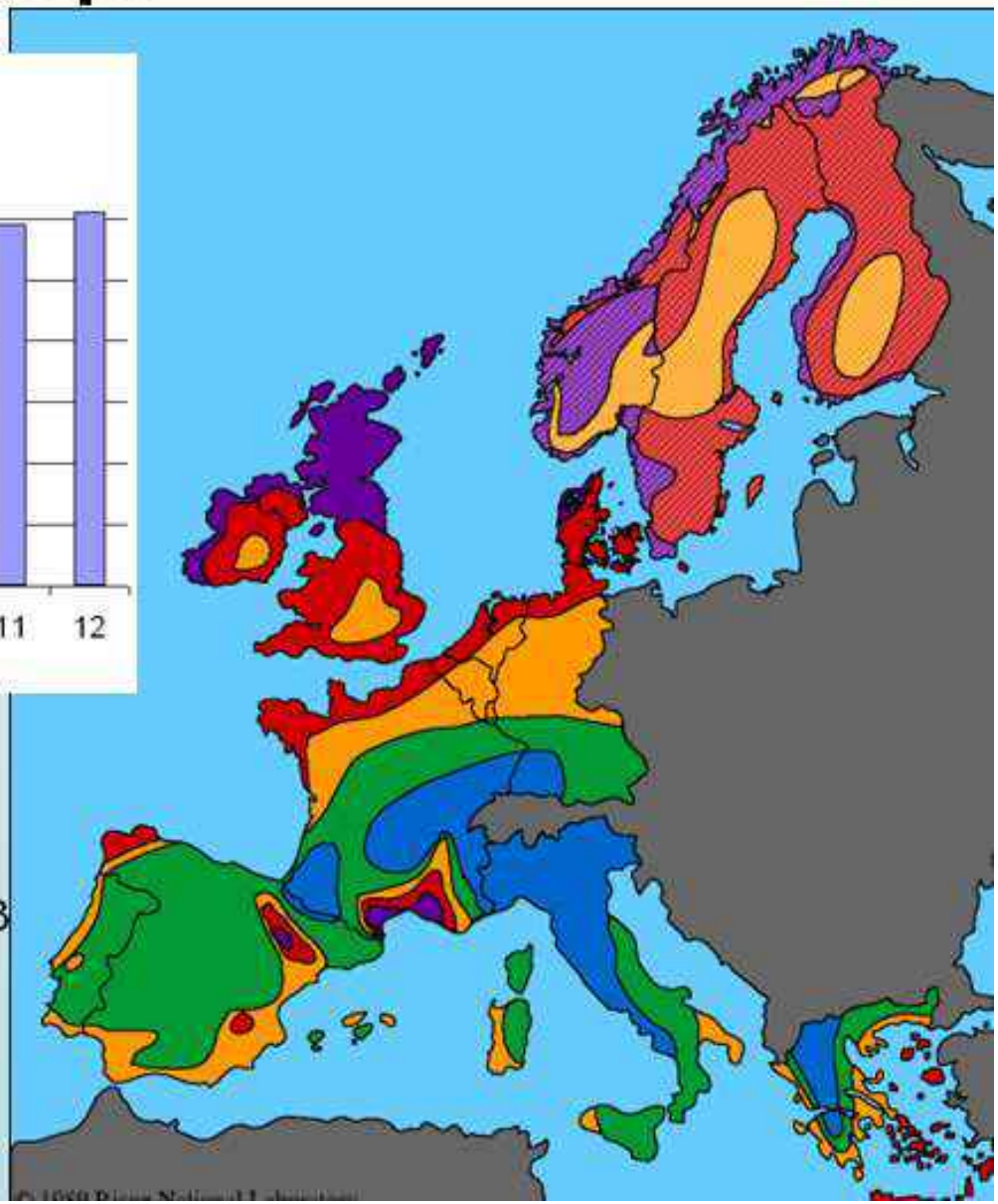
Wind in Northern Europe



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

Electricity yield ~ (Wind speed)^3

Winter electricity ≈ 1/8
of Summer electricty



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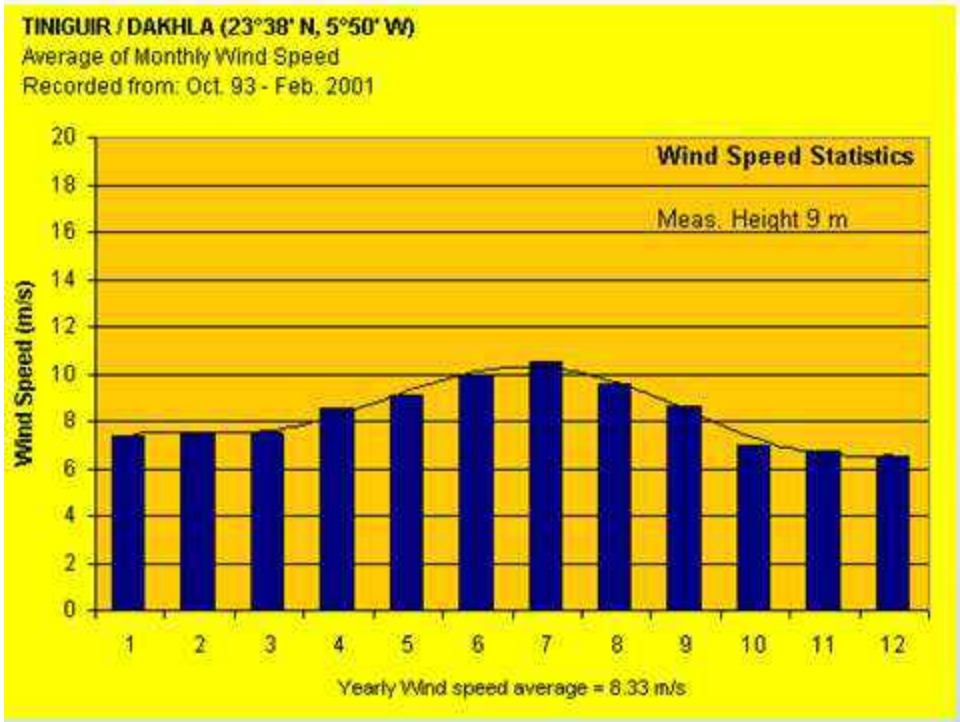
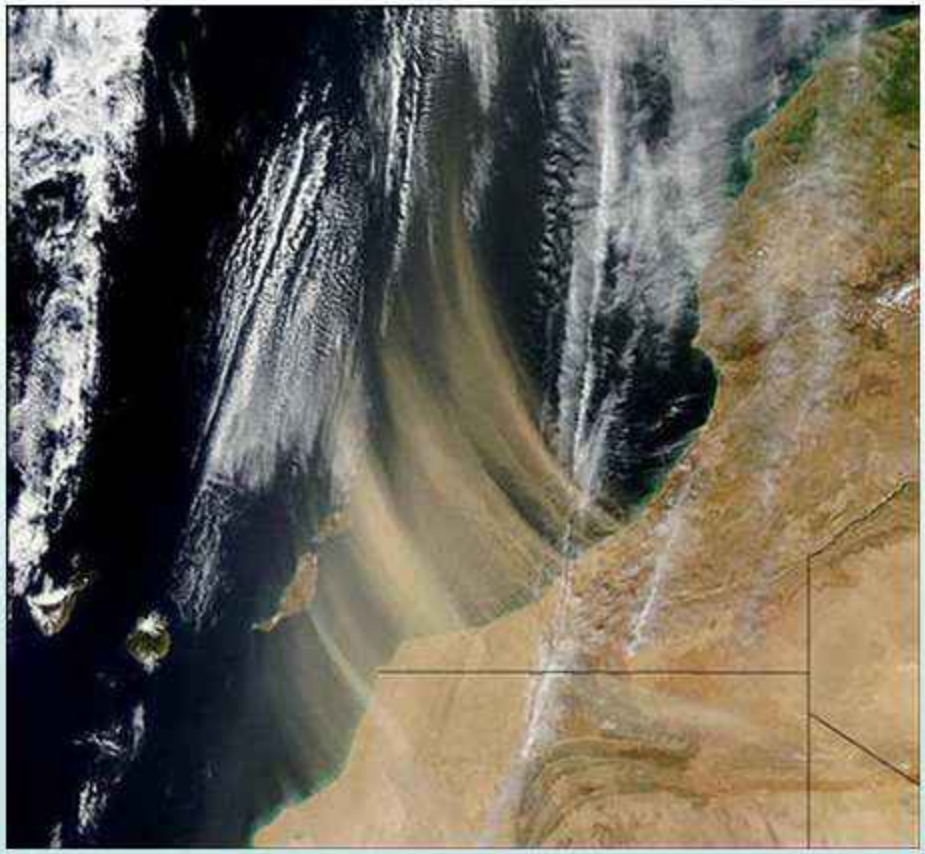
Wind at the Atlantic Coast of Morokko



Source: Saharawind.com



Storm in North Africa

.. is exactly in opposit phase to Northern Europe

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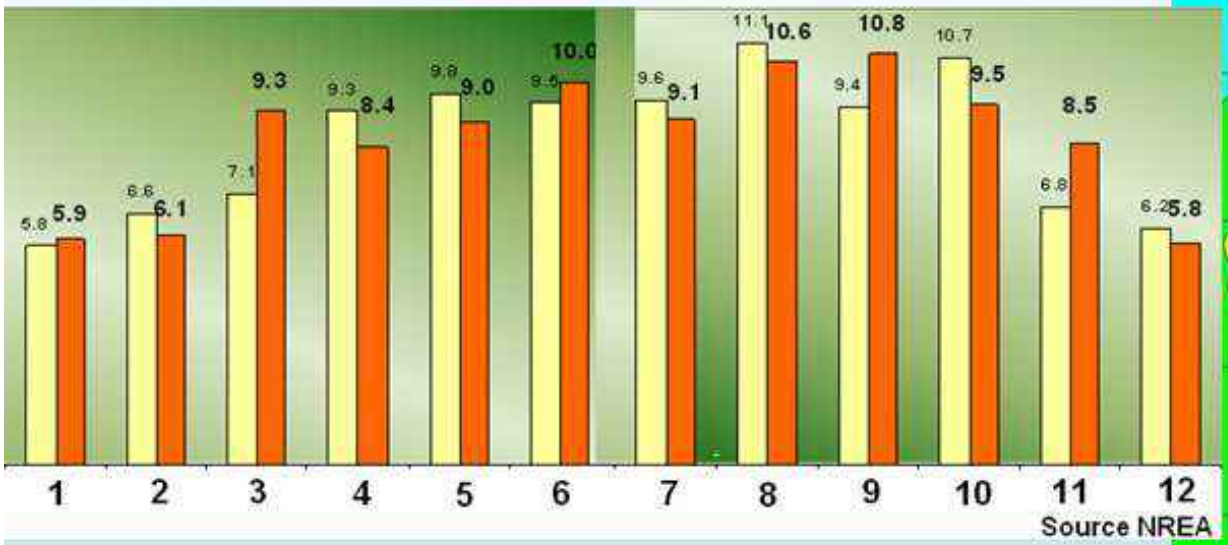
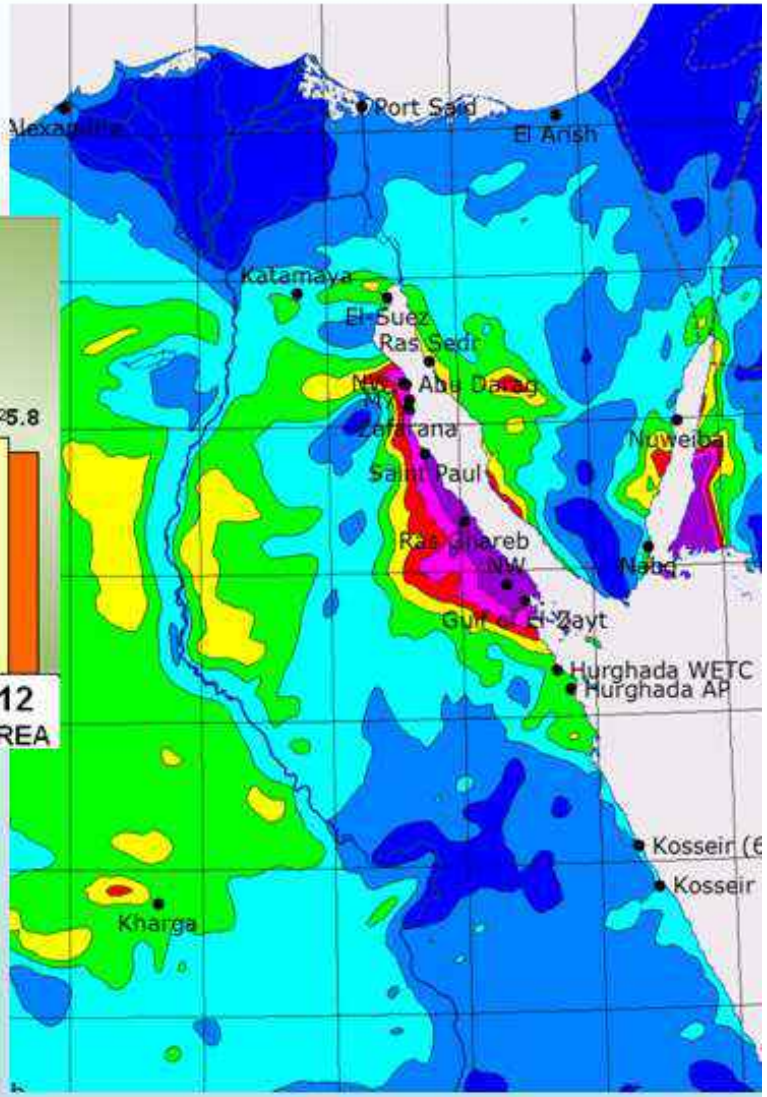
... also the excellent Wind Site at the coast of the Gulf of Suez, Egypt ....

... has the same cycle



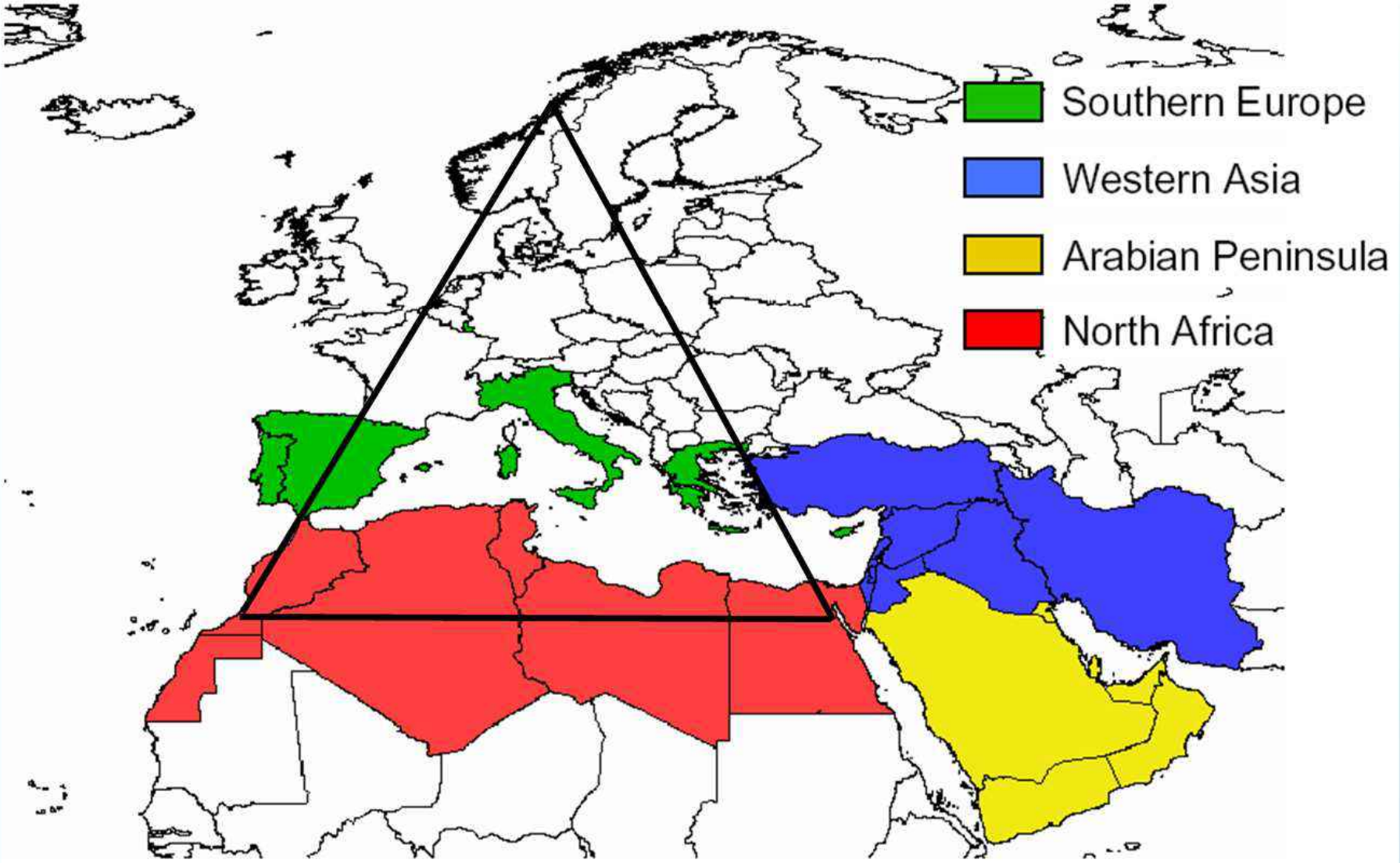
Source NREA



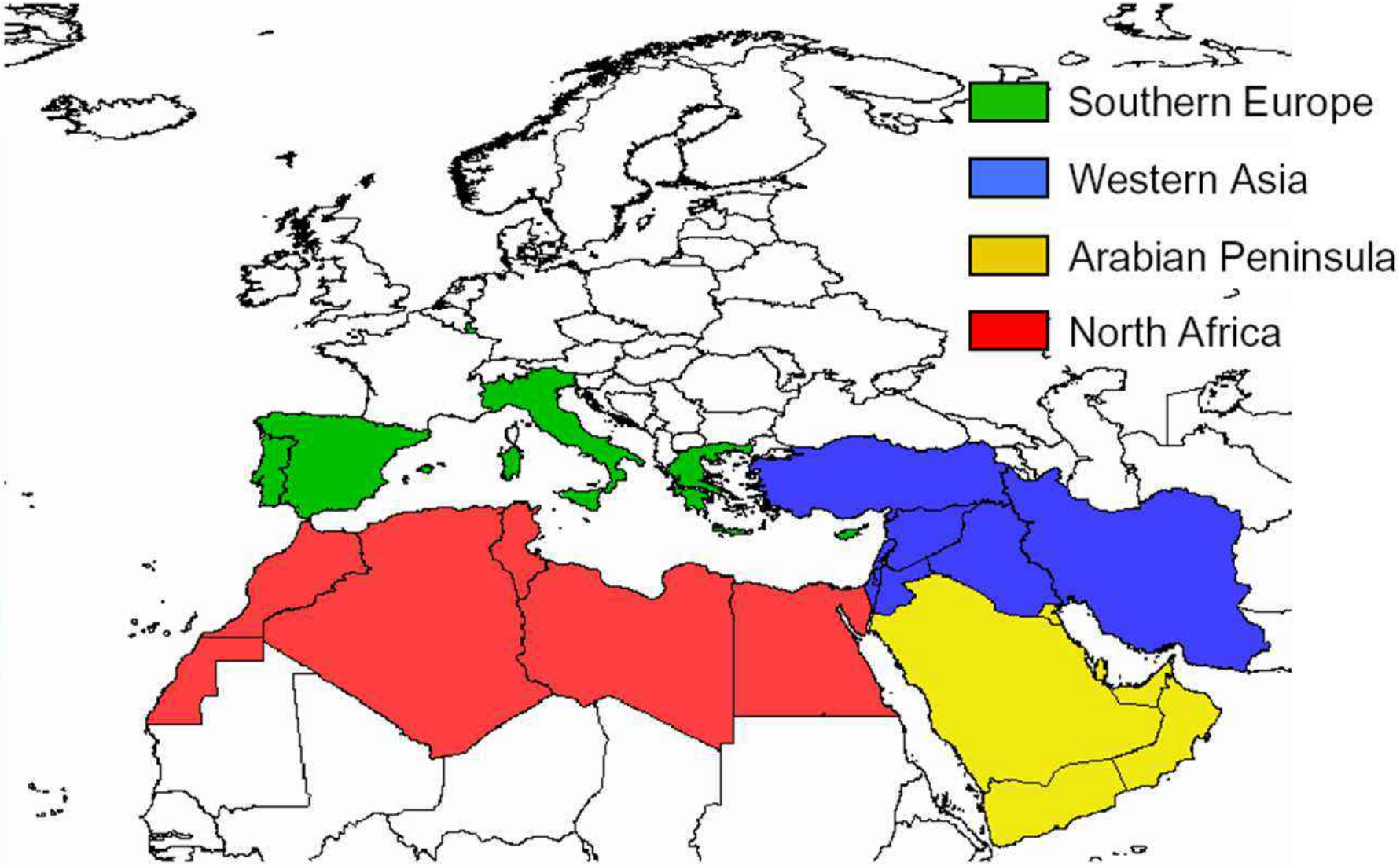
Let us imagine connecting these 3 Sites

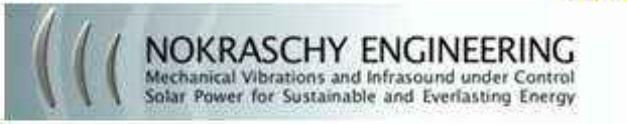
Source: Wind Atlas Egypt

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



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





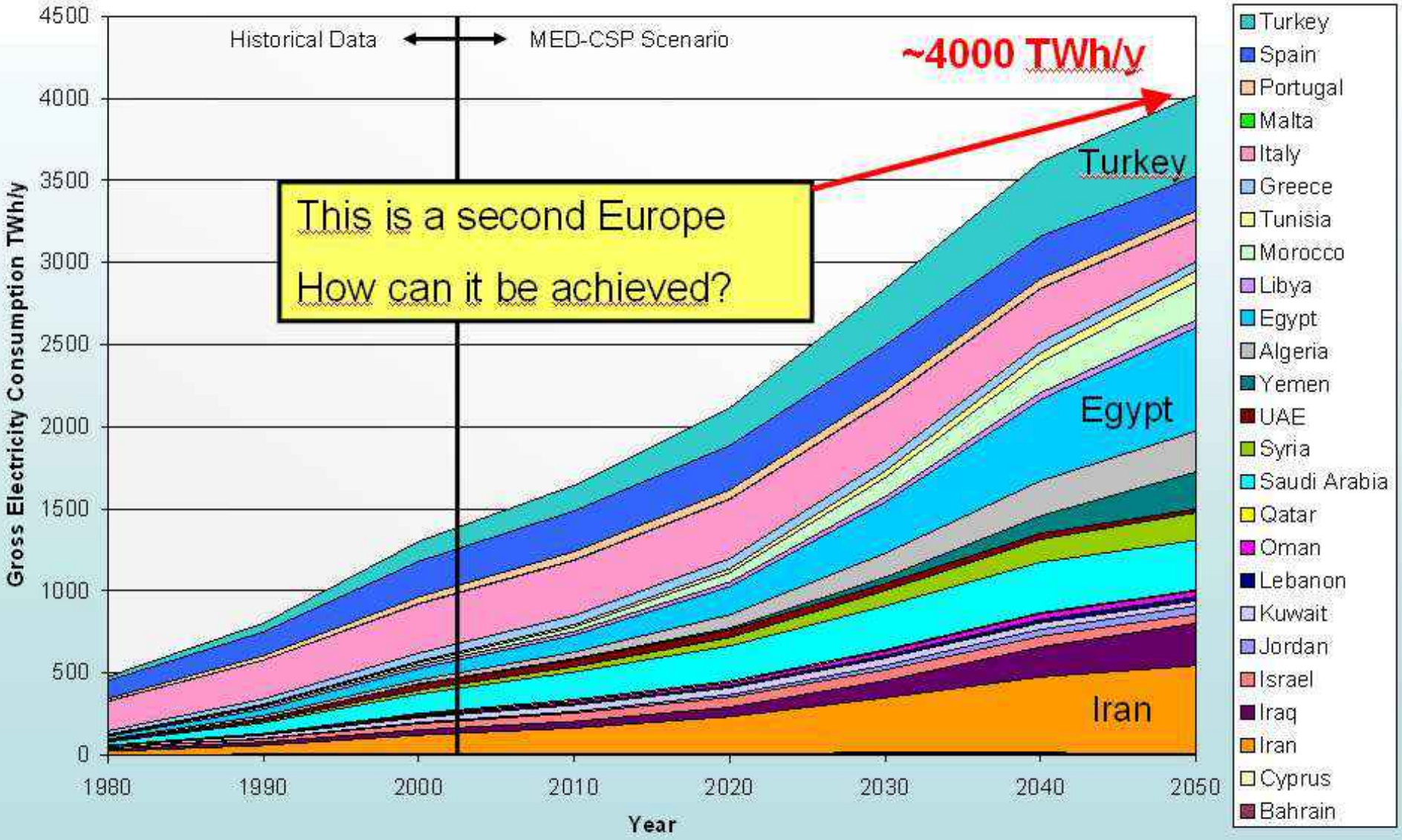
NREA

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

Renewable Energies around the Mediterranean

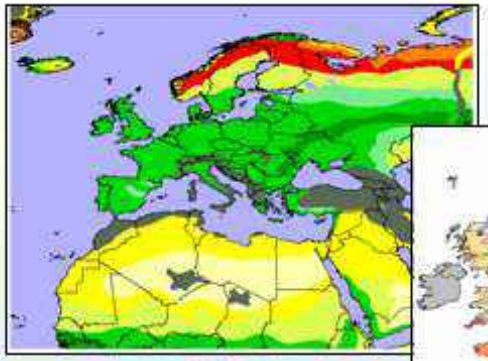
A study commissioned by the Federal Ministry of Environment
and conducted by the German Aerospace Center DLR

Growing Electricity Demand around the Mediterranean



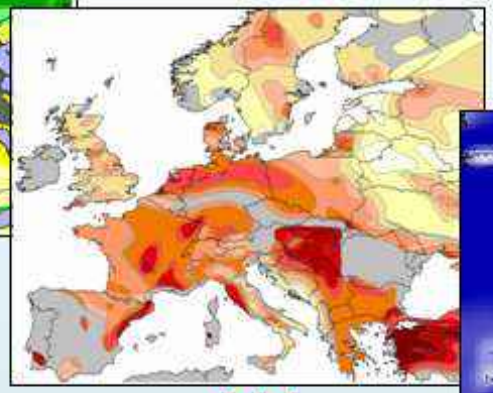
Renewable Energy Resource Mapping

Biomass



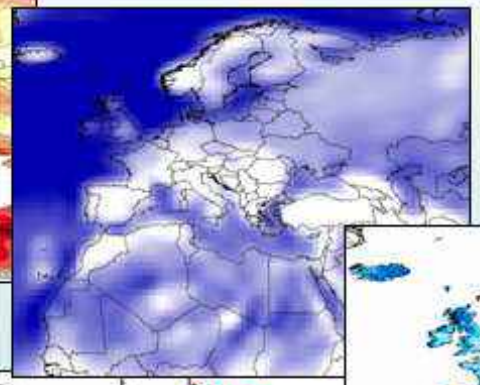
402

Geothermal Energy



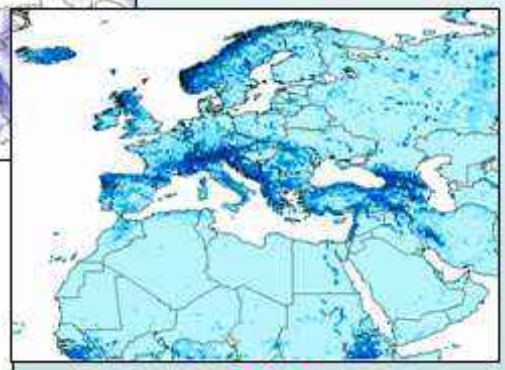
414

Wind Energy



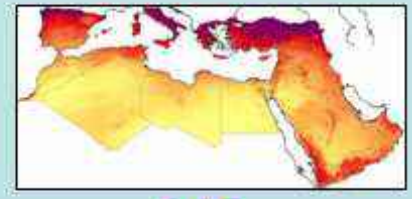
447

Hydropower



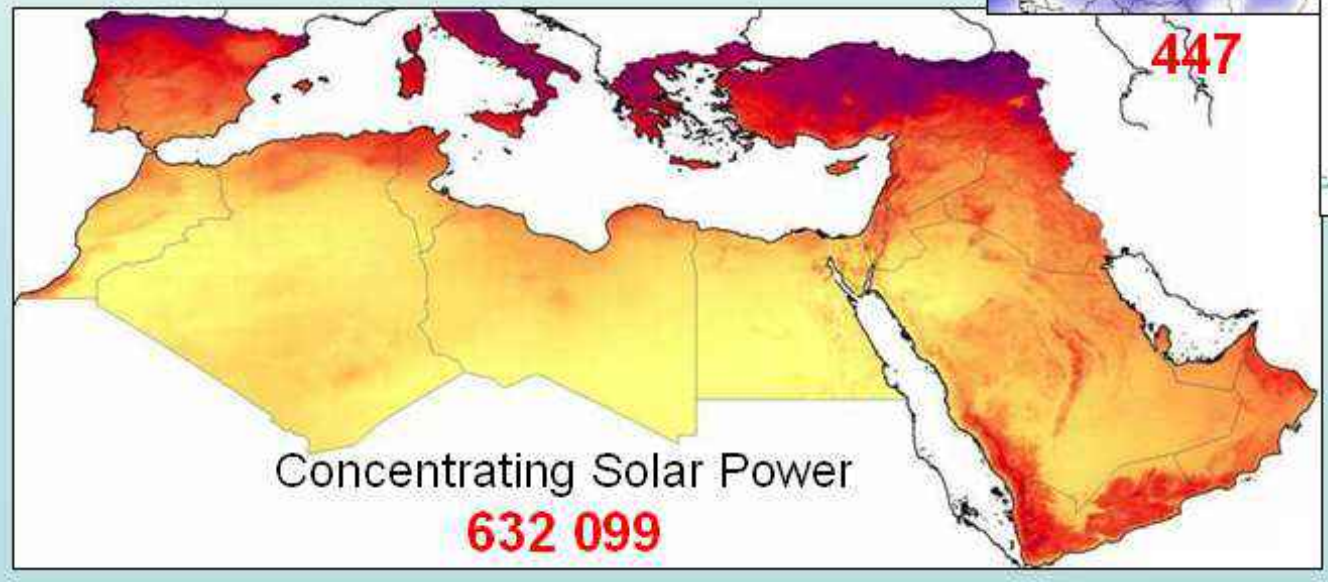
432

PV



218

Concentrating Solar Power



632 099

Economic Potential TWh/y

(Demand 2050 ≈ 4000 TWh/y)

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Concentrating Solar Power Technologies (CSP)

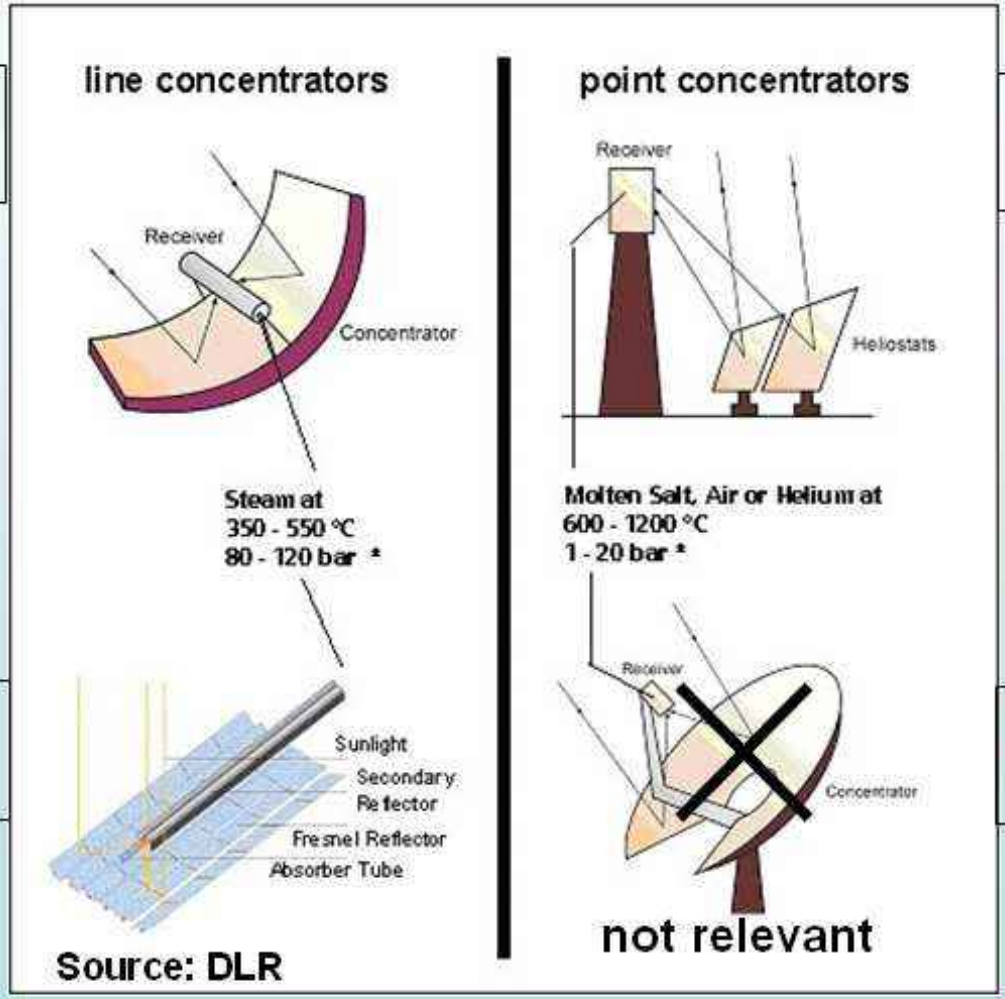
relevant for Power Stations are 5 MW to 1000 MW

Parabolic Trough
5-600 MW

Solar Tower
5-100 MW

Linear Fresnel
5-600 MW

Parabolic Dish
0,5-50 kW



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CONCENTRATING SOLAR POWER TECHNOLOGIES for >5 MW

Linear Fresnel

Parabolic Trough

Central Receiver

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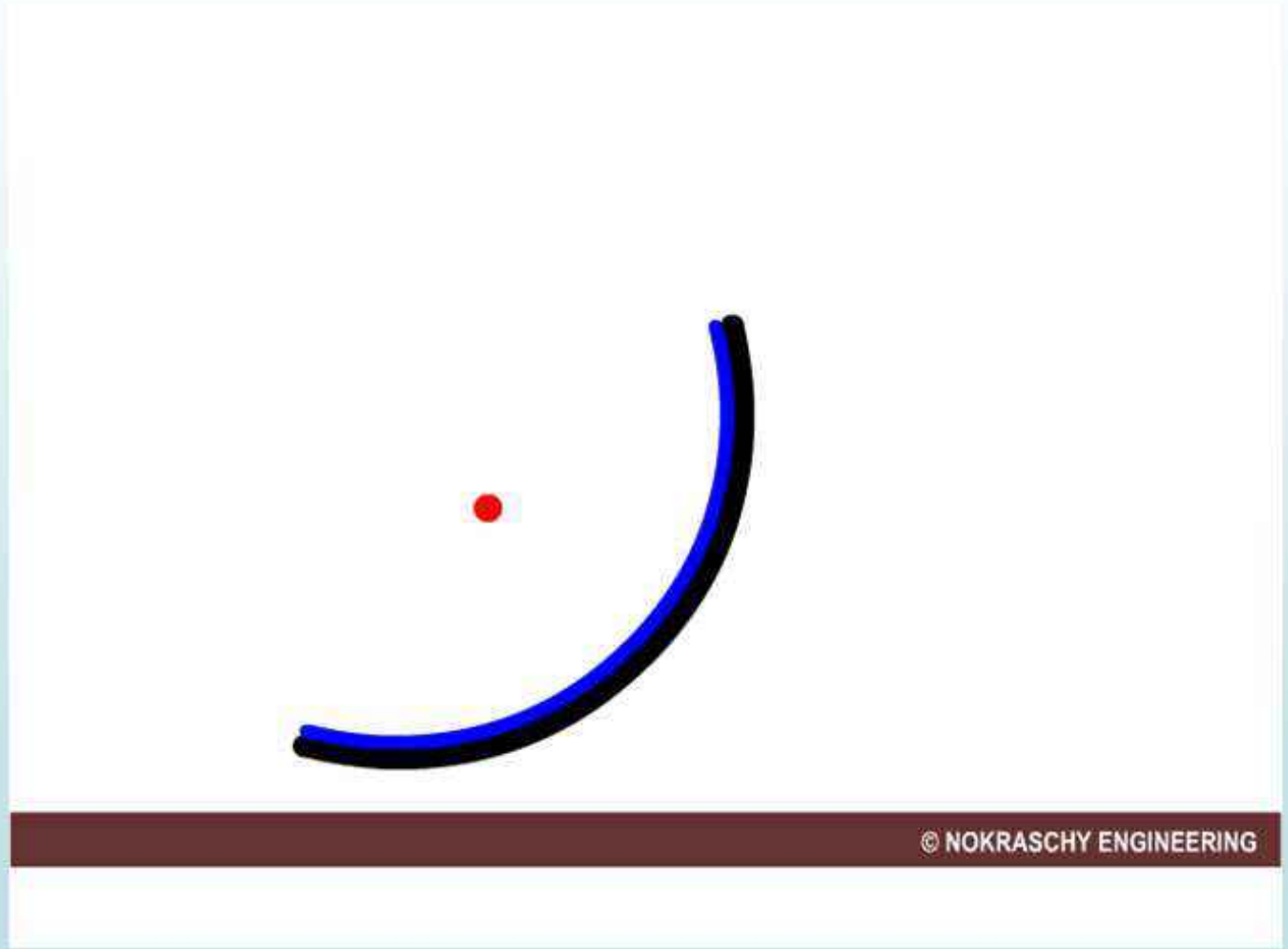
Parabolic trough Technology



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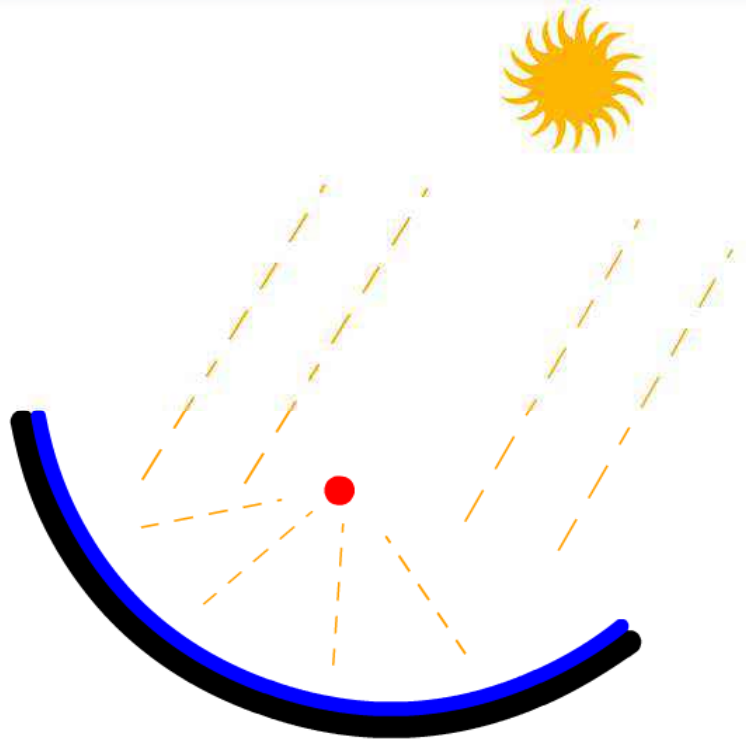
Parabolic trough Technology



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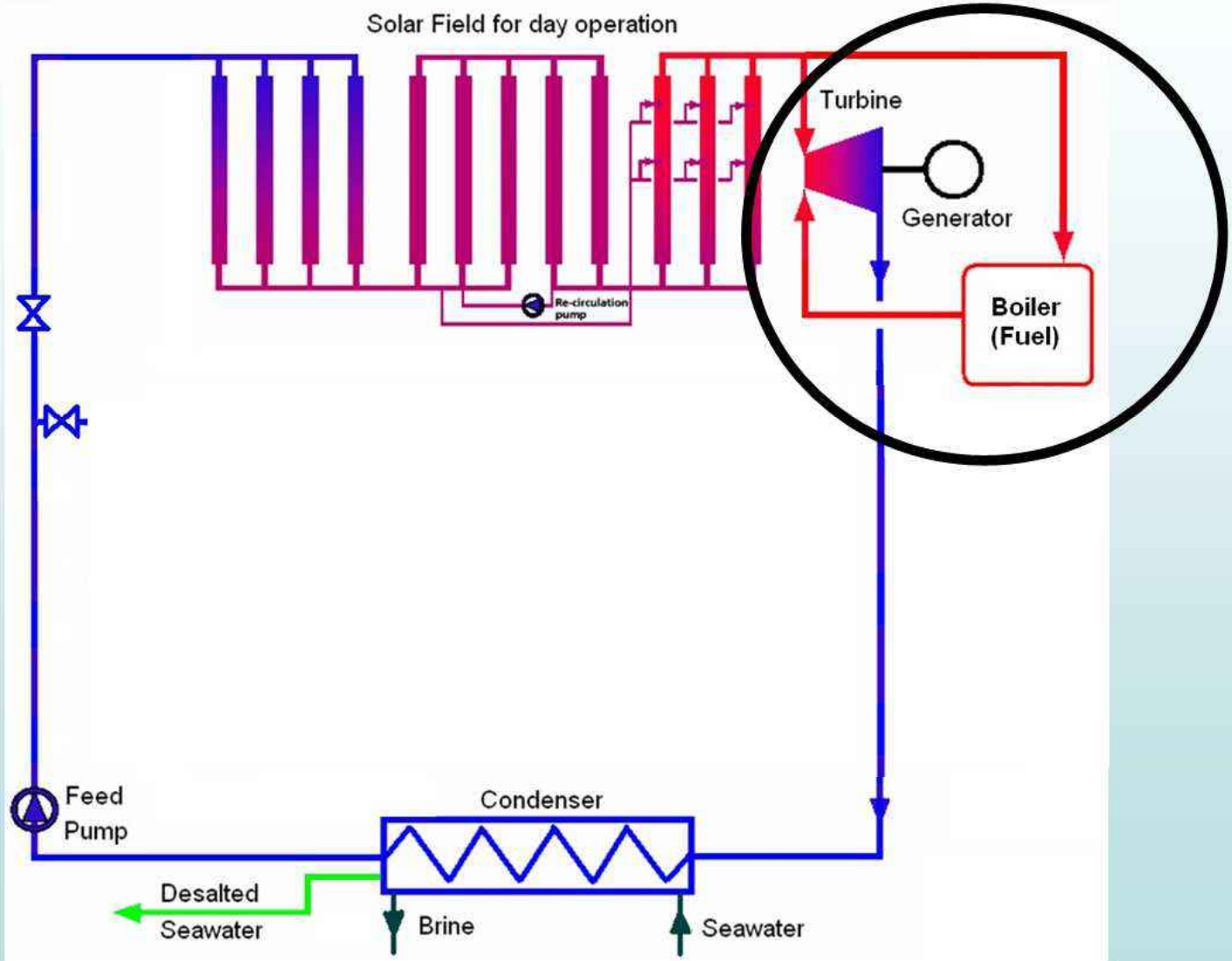
Solar Hybrid Power Station with Desalination



Conventional Steam Power Station

Desalination (MED) with Waste Heat

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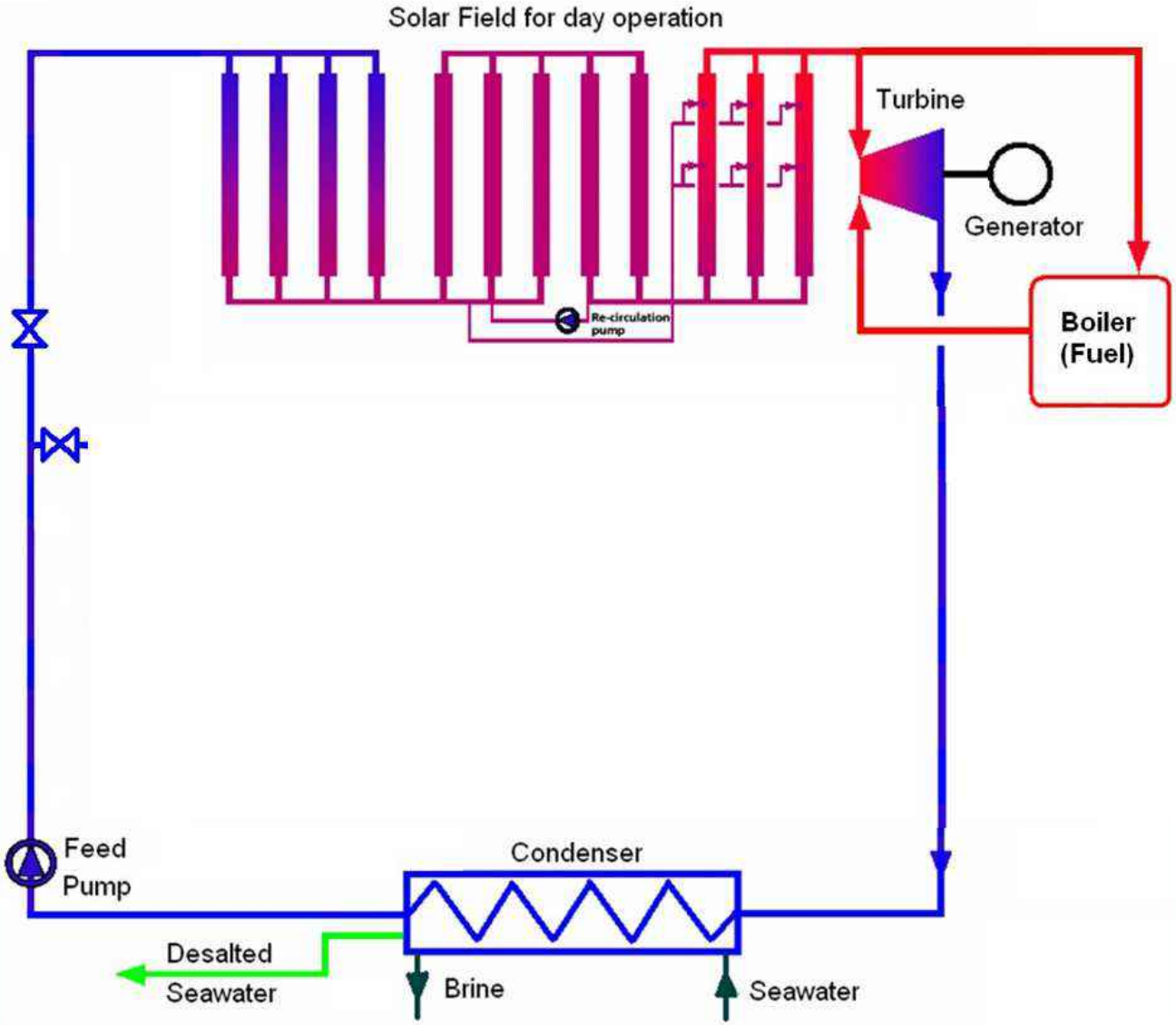
Solar Hybrid Power Station with Desalination



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

Desalination (MED) with Waste Heat

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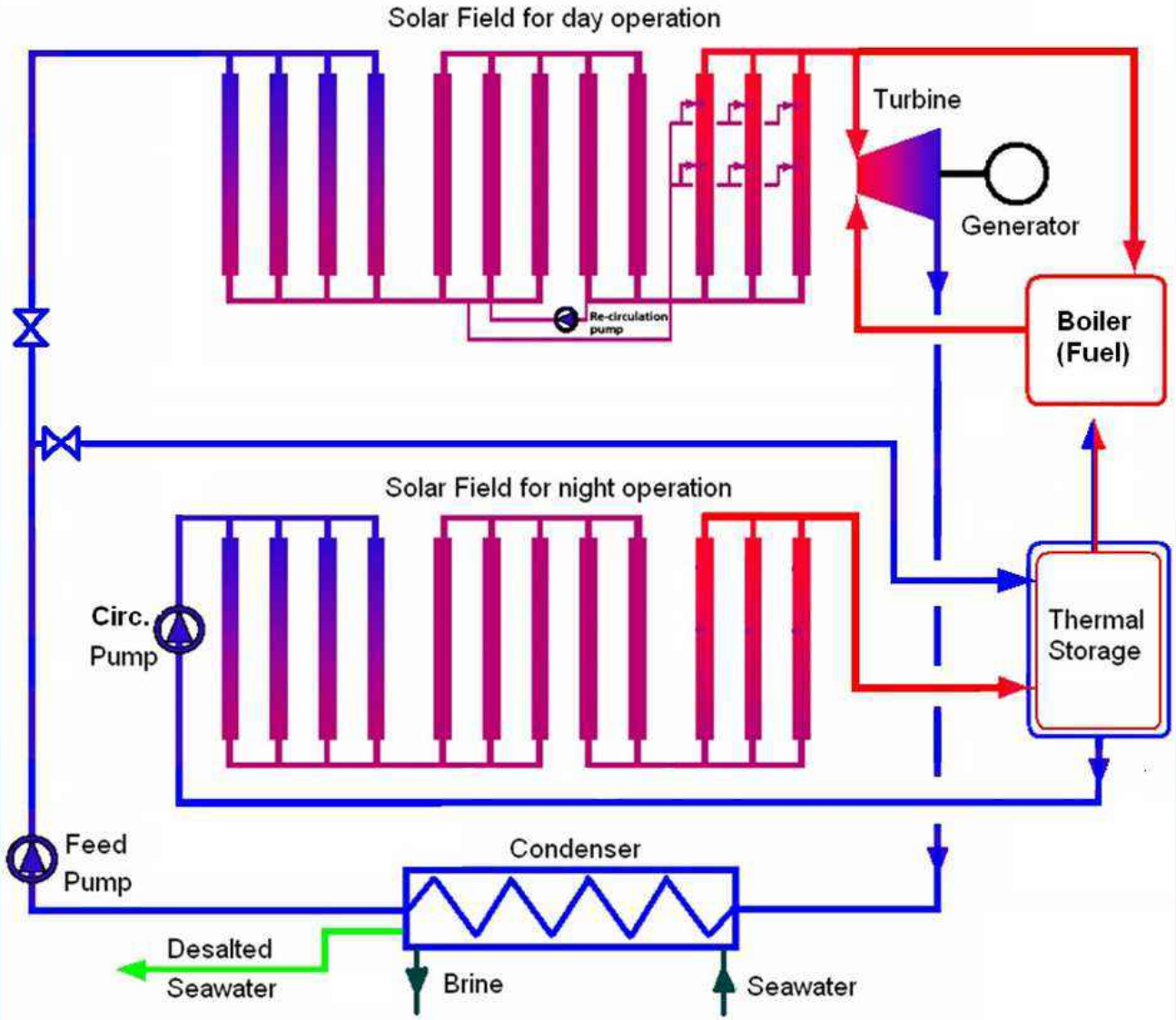
Solar Hybrid Power Station with Desalination



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

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ANDASOL 1

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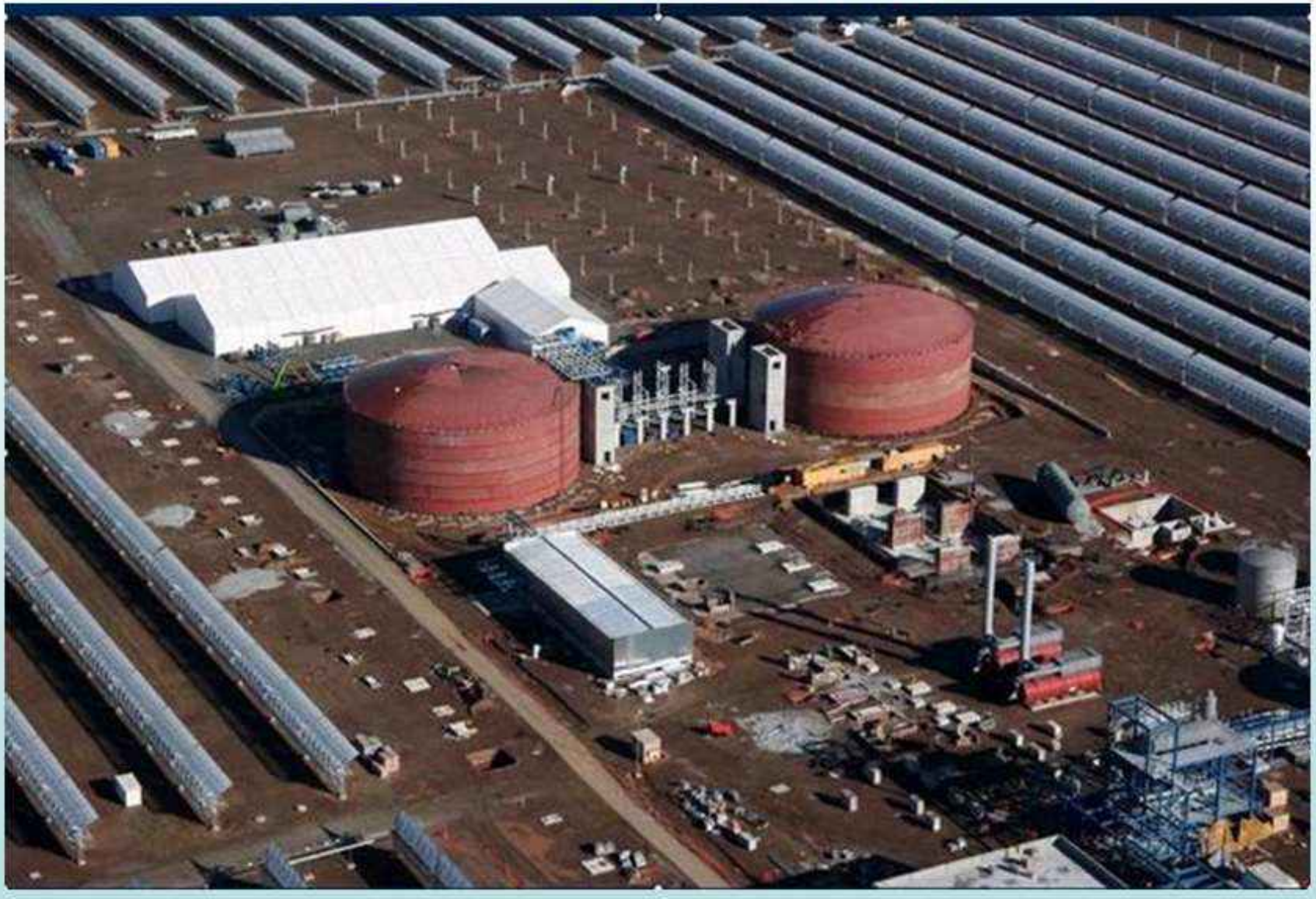
50 MW CSP power plant in Spain using
molten salt as storage for 7 h full load operation



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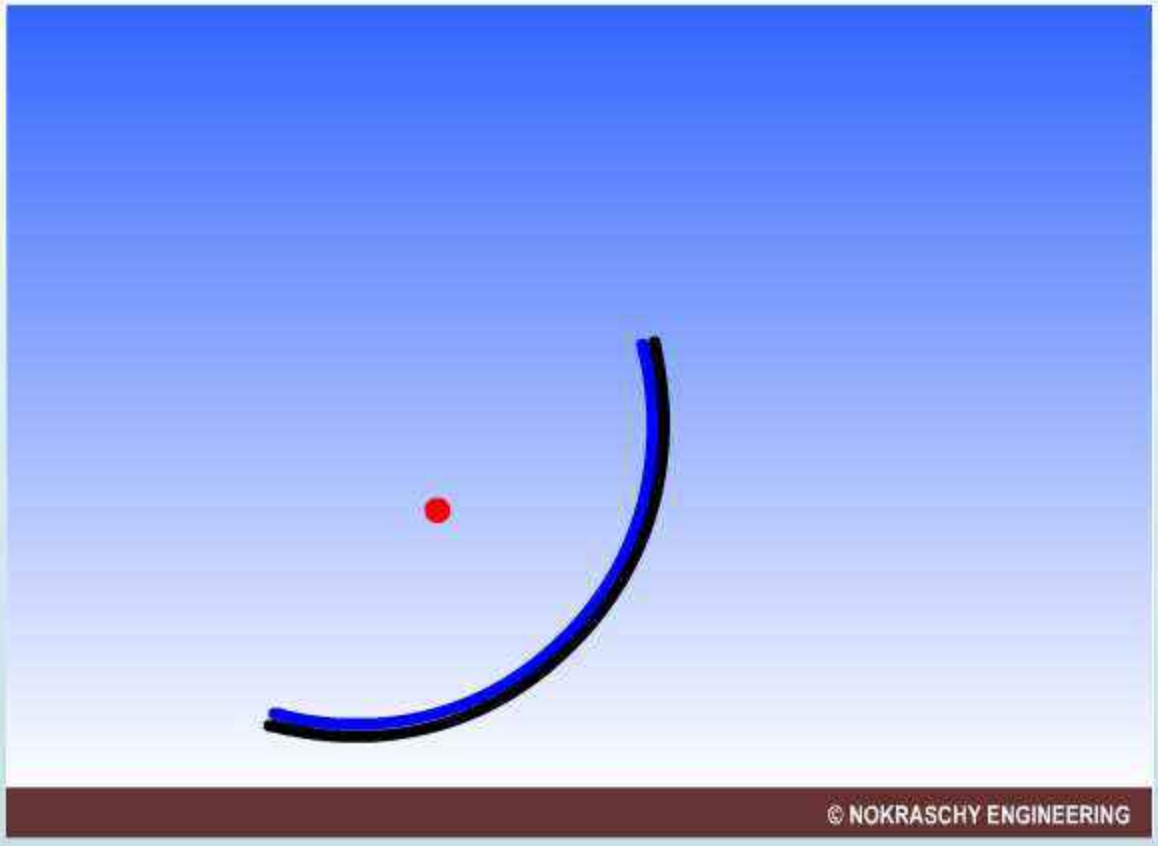
Alternative Design: Flat Mirrors



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

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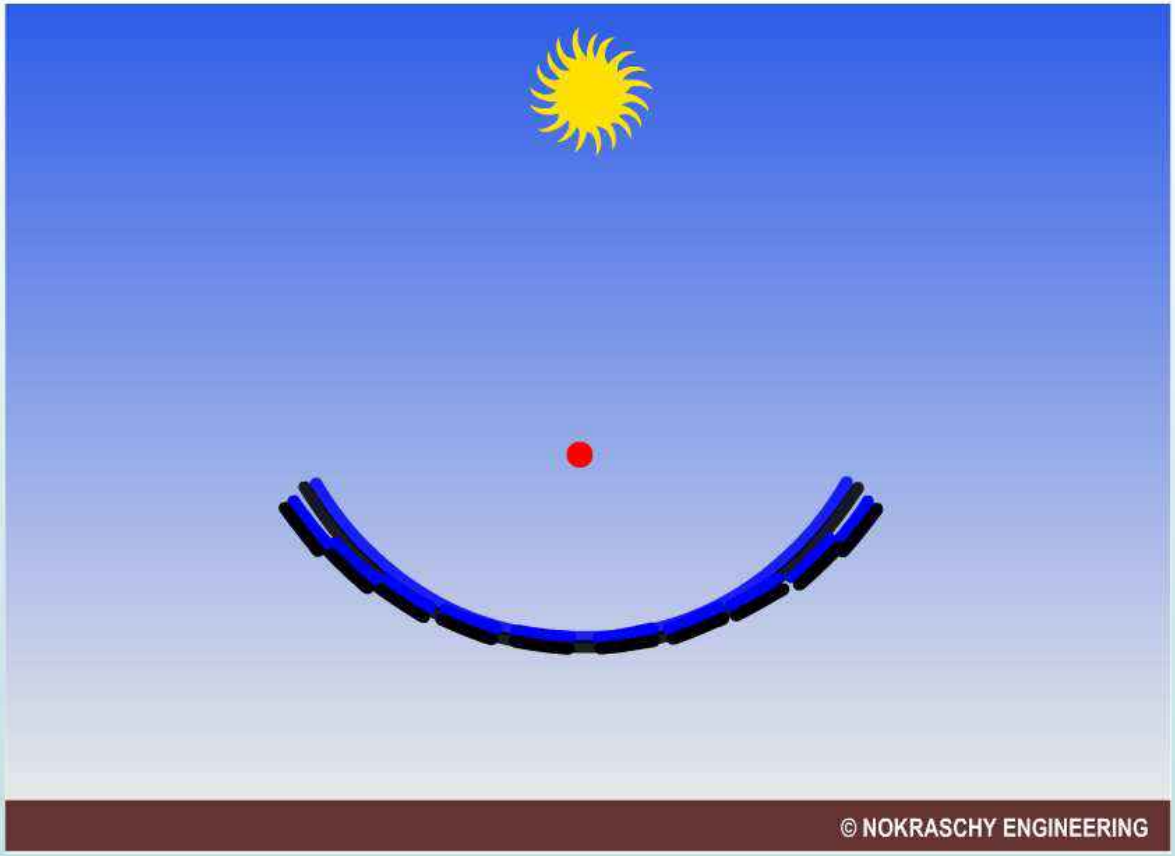
Alternative Design: Flat Mirrors



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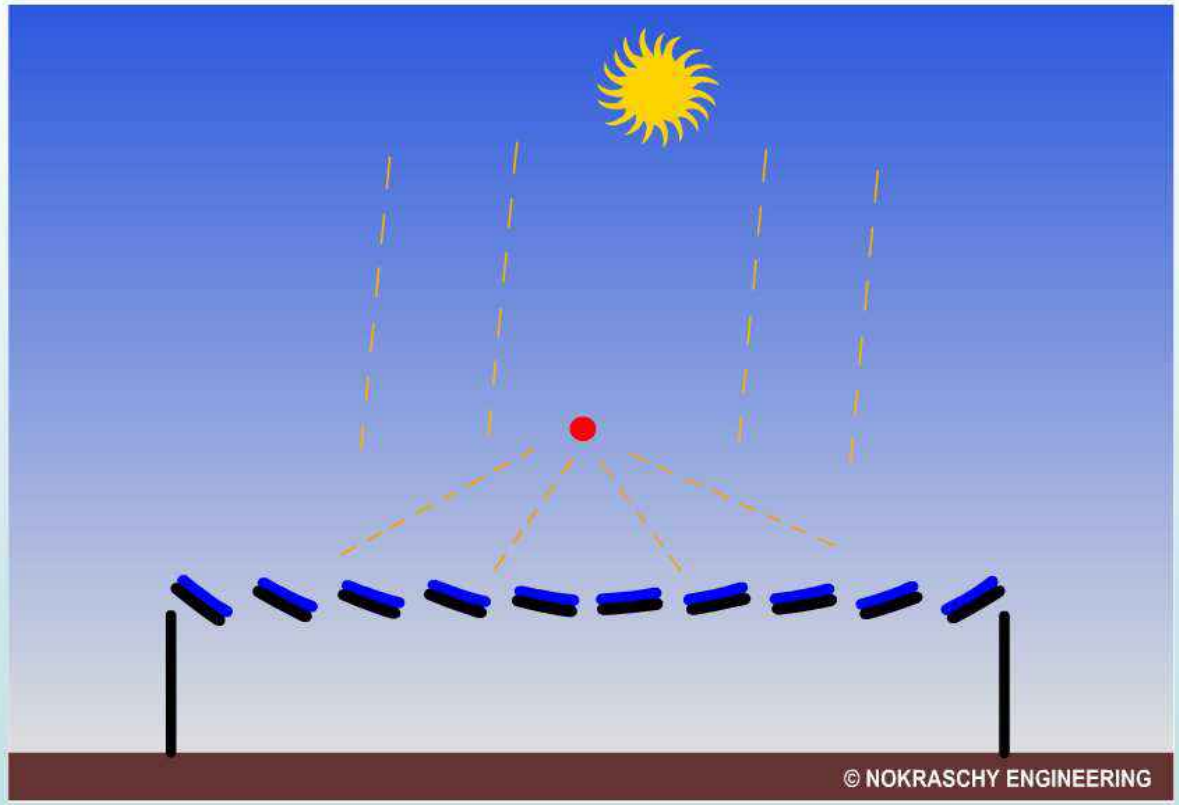

Best collection of the Sunrays. Simple, cost effective and usage of area underneath mirrors is possible

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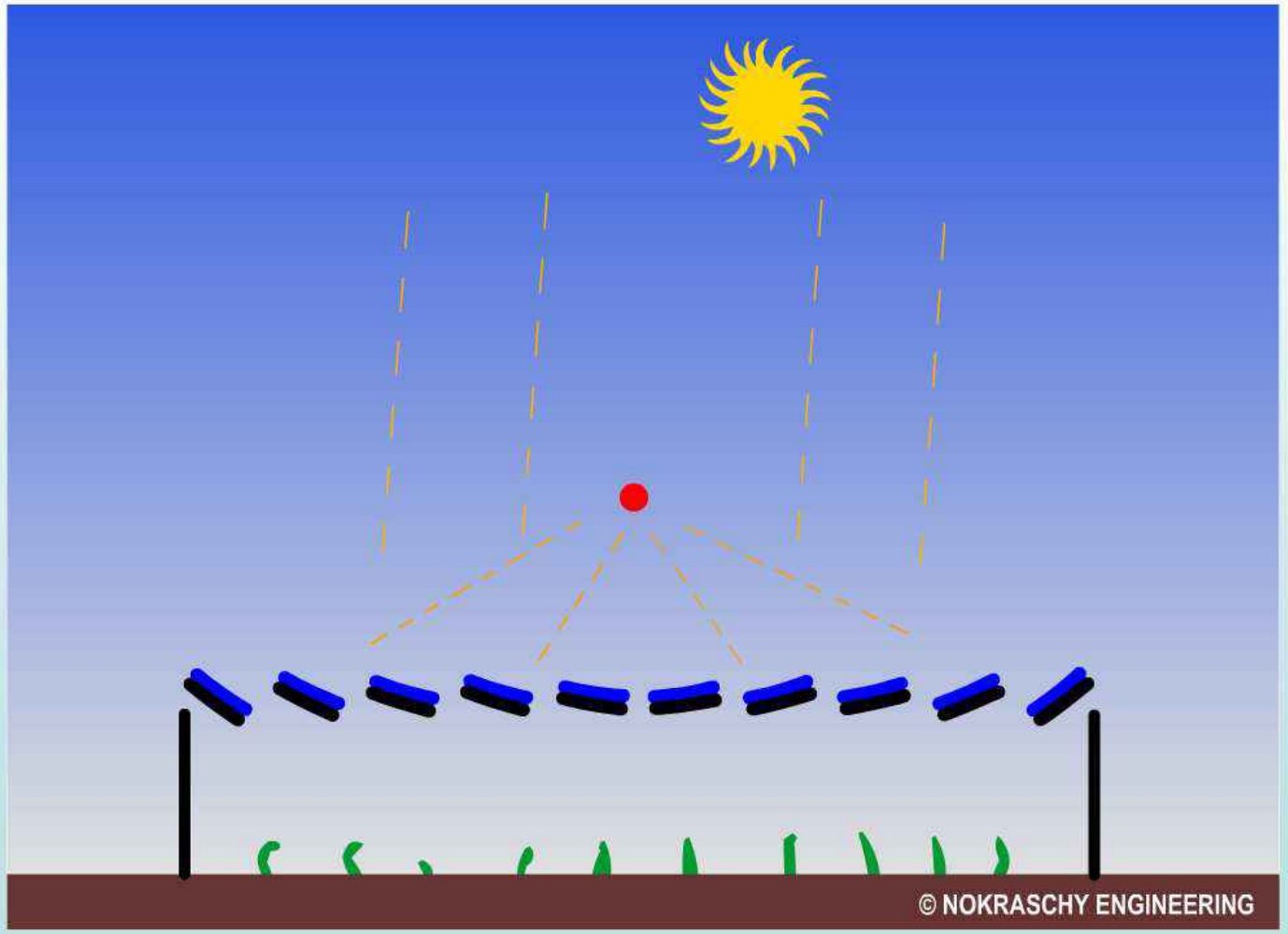
Automated Cleaning =
less cleaning water & it is not wasted



In the shadow plants need less irrigation water

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Automated Cleaning =
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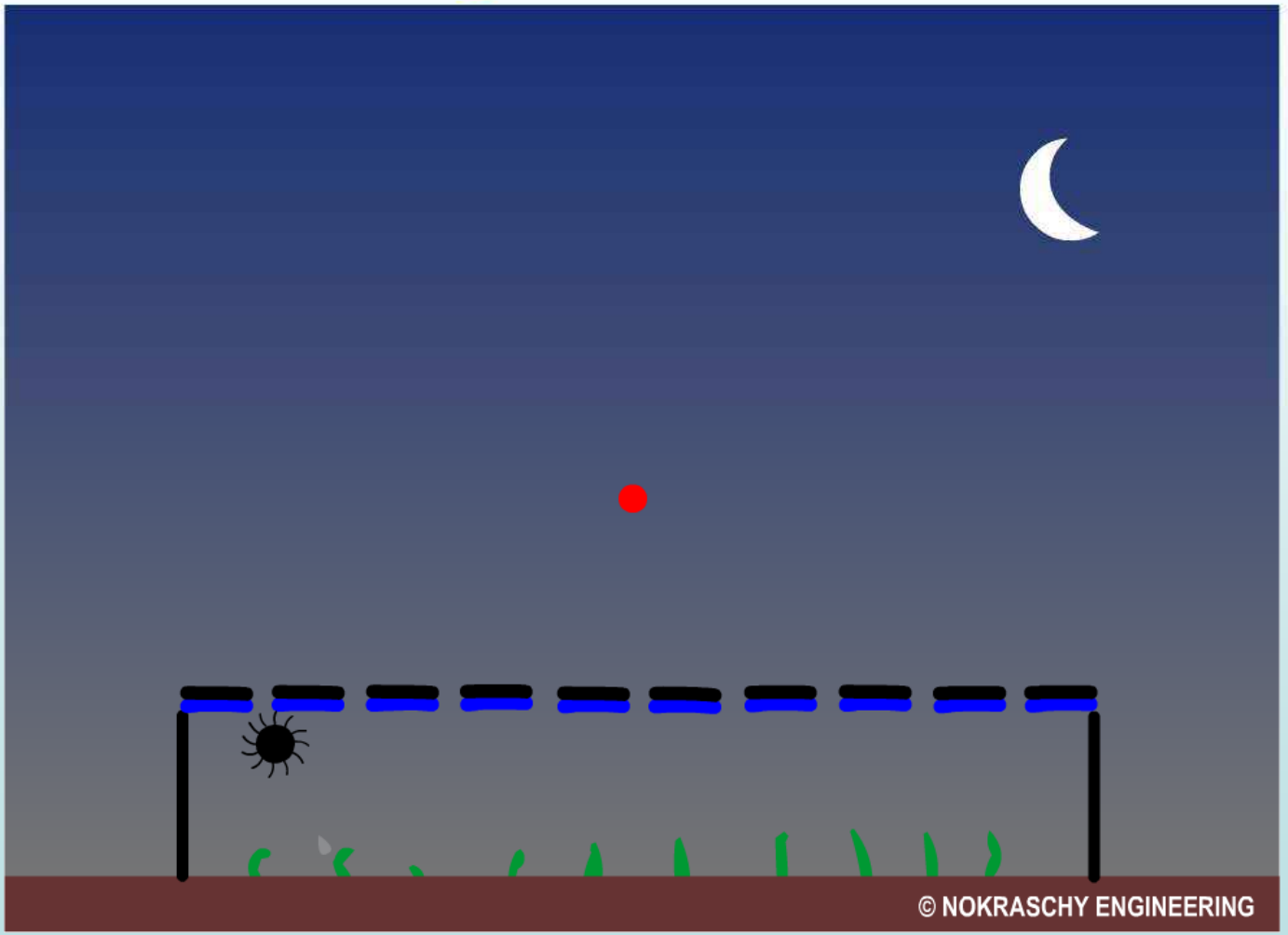

In the shadow plants need less irrigation water

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CSP in action

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

System: NOVAREC BIOSOL

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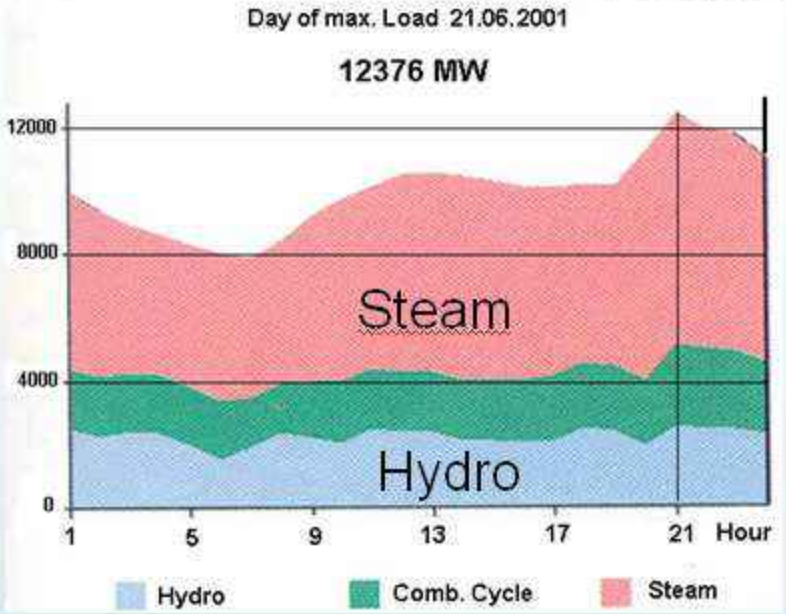
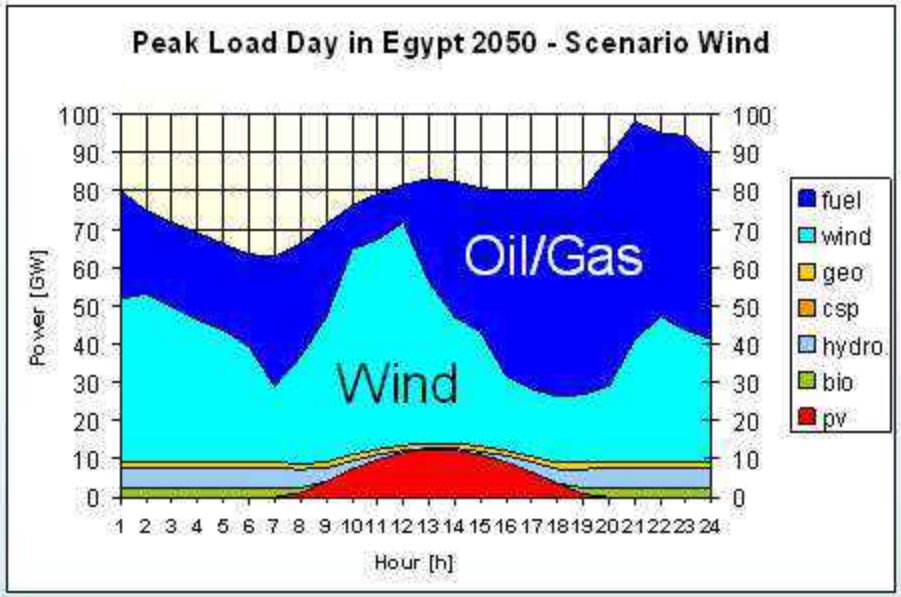
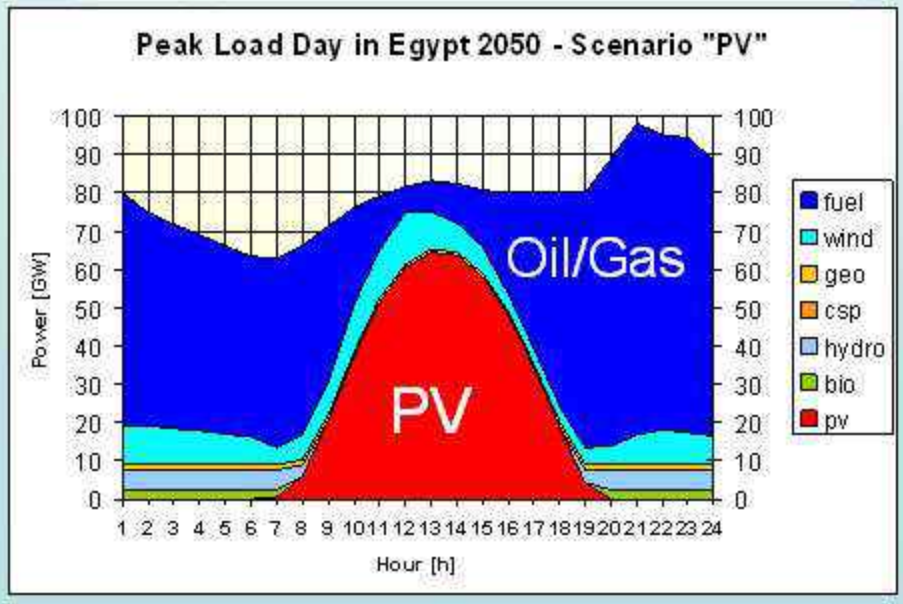
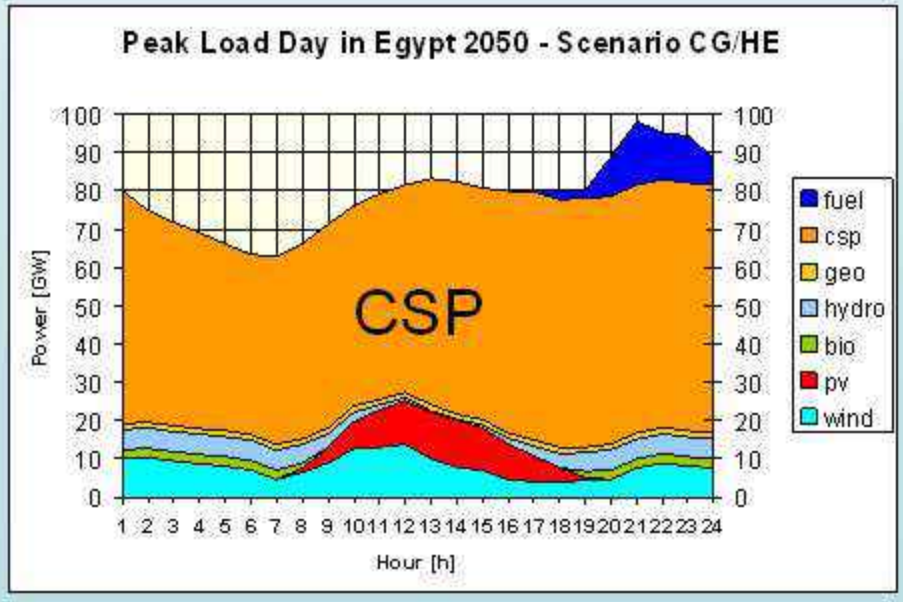
Load Properties









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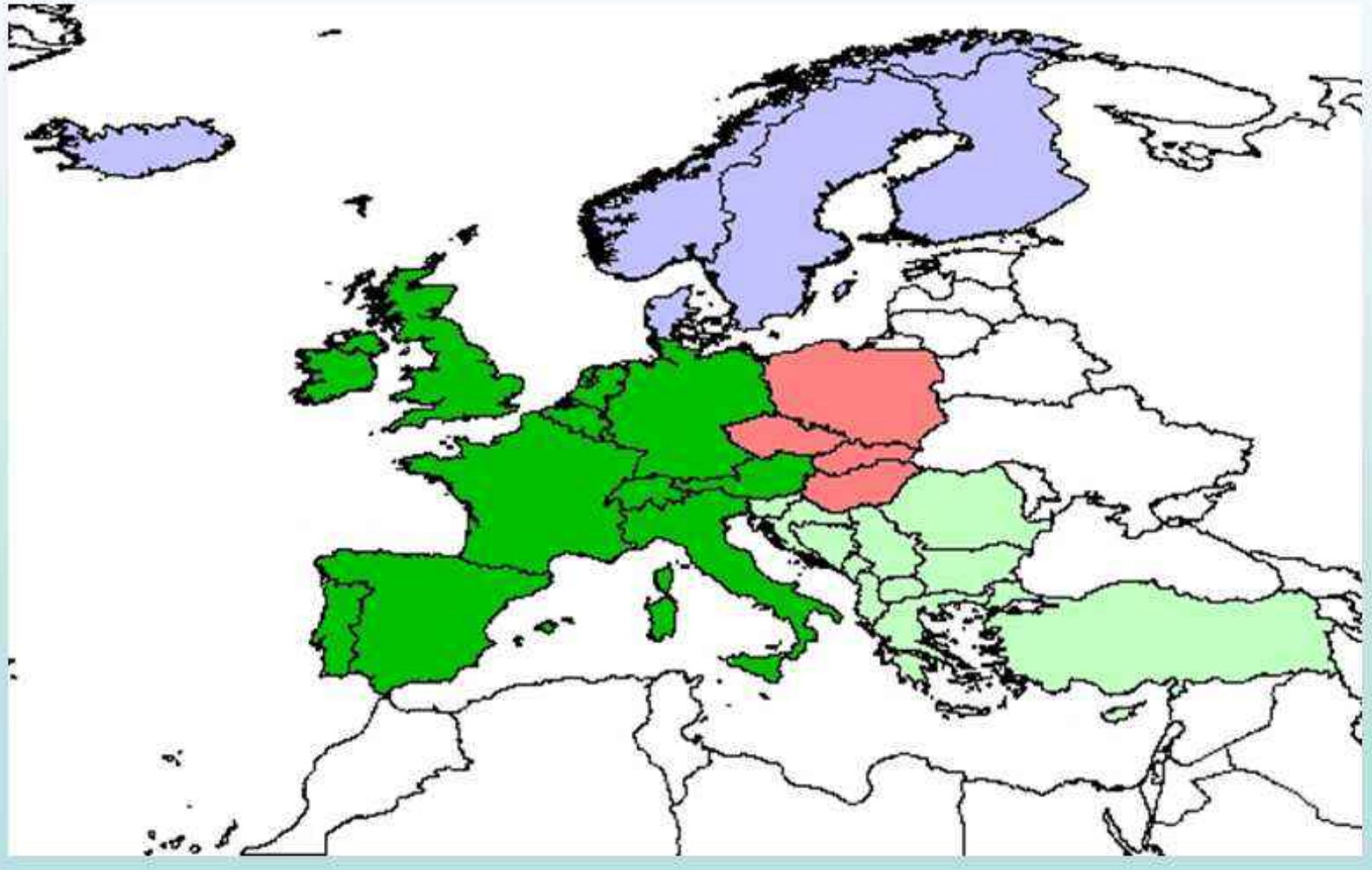
A View on Europe's Electricity Demand

Analysed countries within TRANS-CSP



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Vision for 2050

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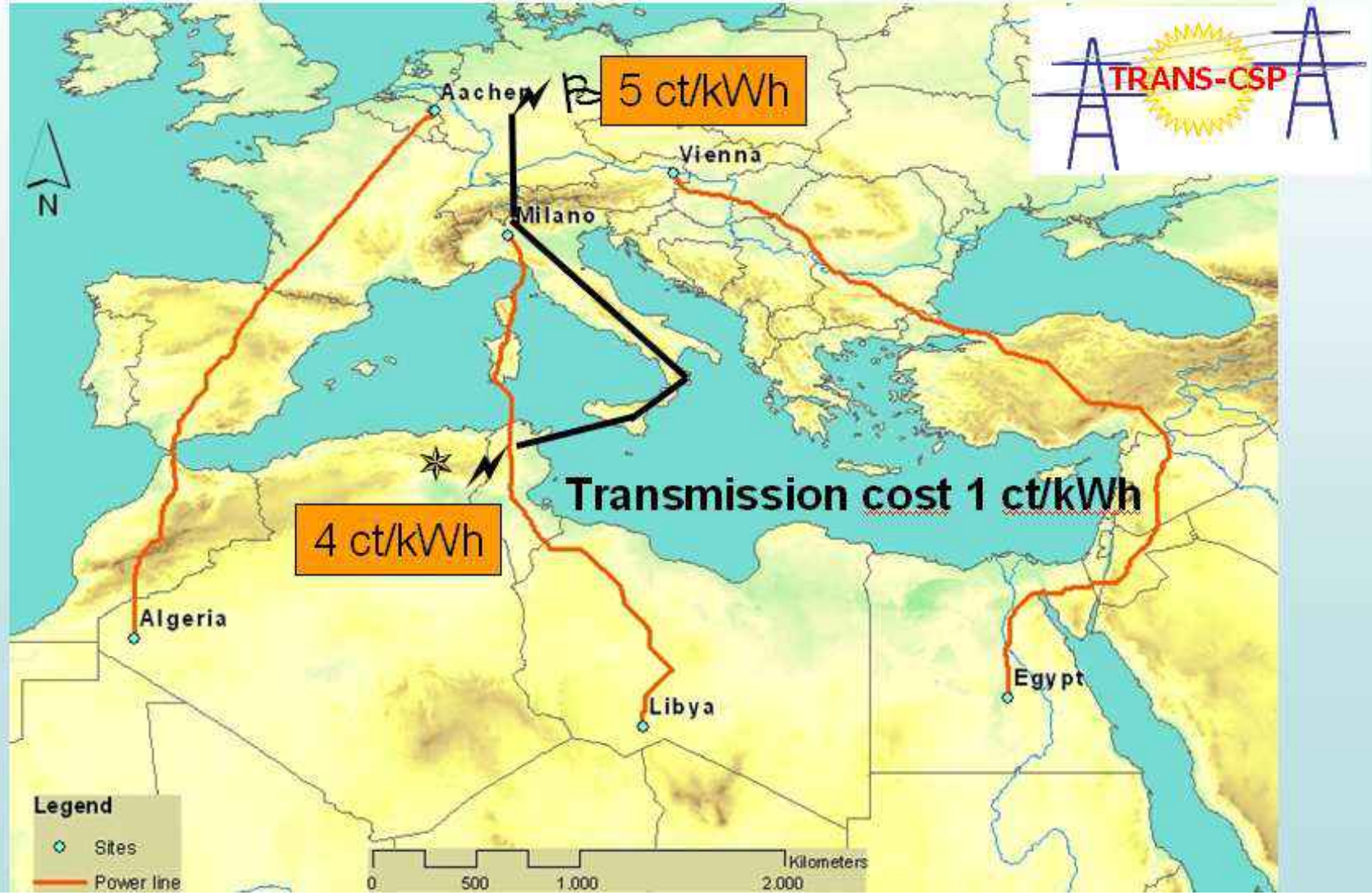
3 Samples out of 20 EU-MENA HVDC interconnections each line transmitting 5 Giga Watt



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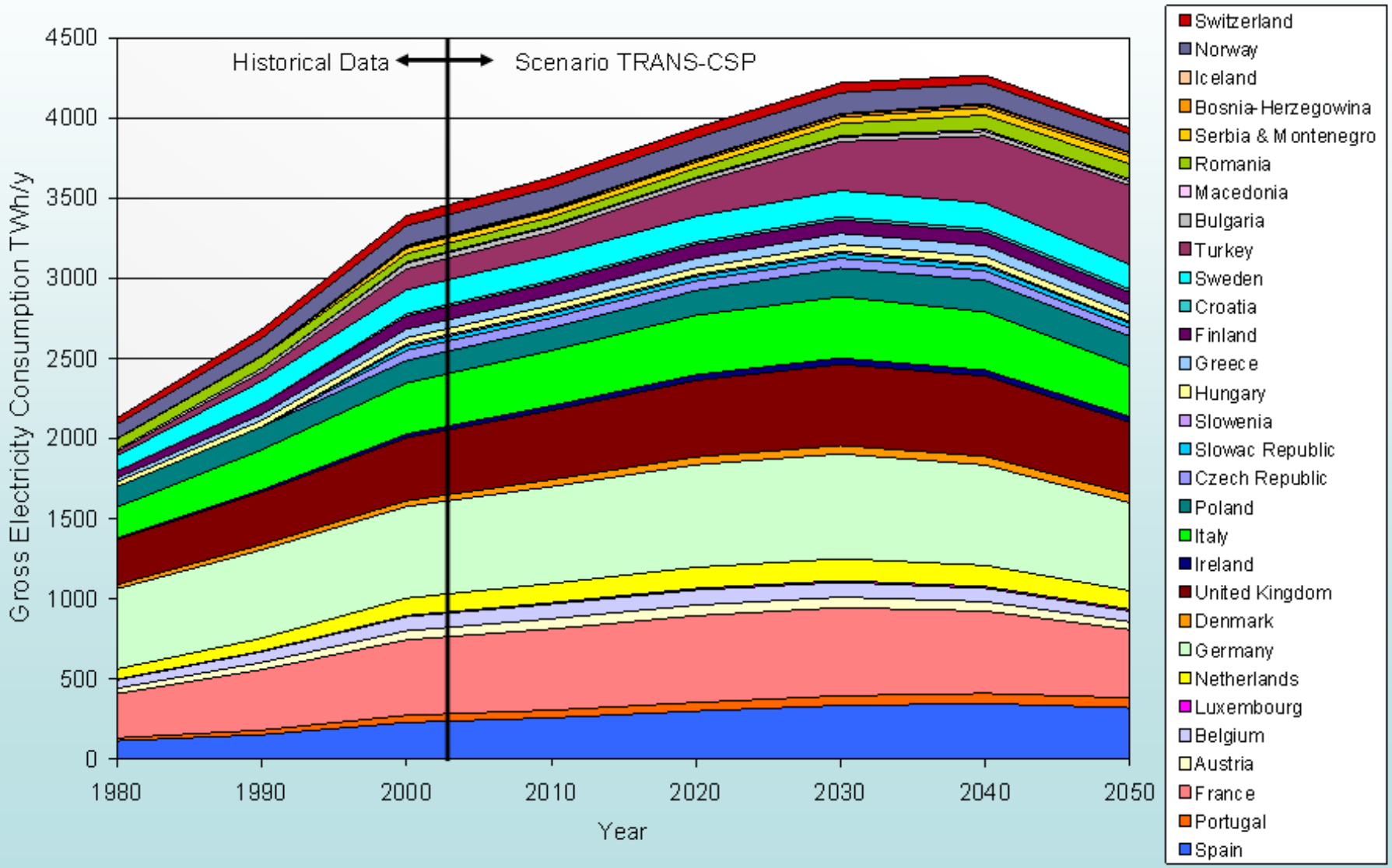
Electricity Consumption in Europe



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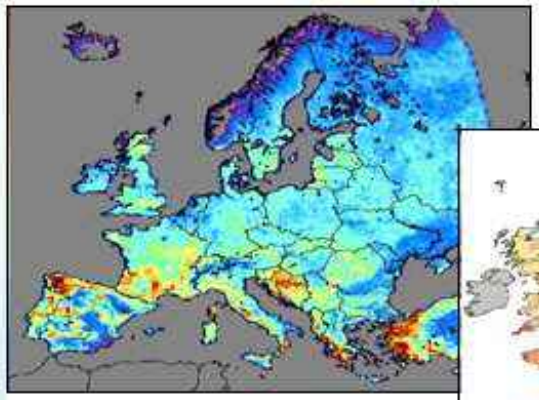
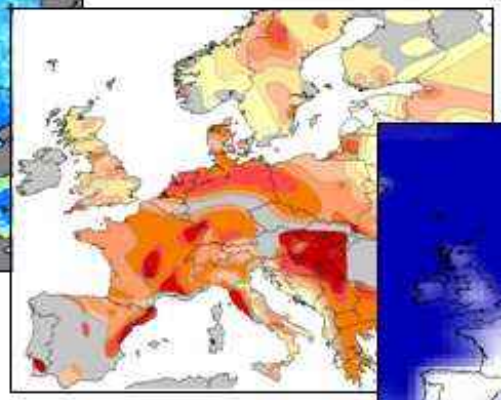
Available Economic Ren. Energy Potential

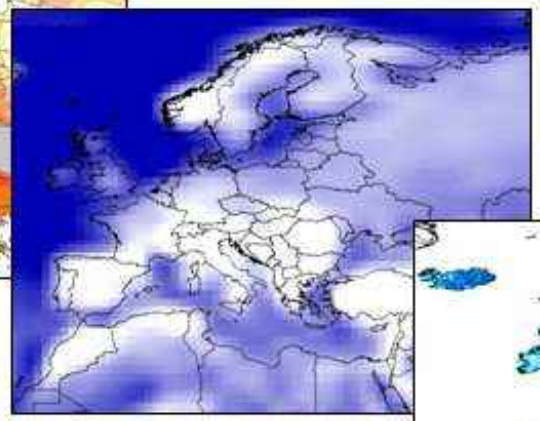
Biomass (620)



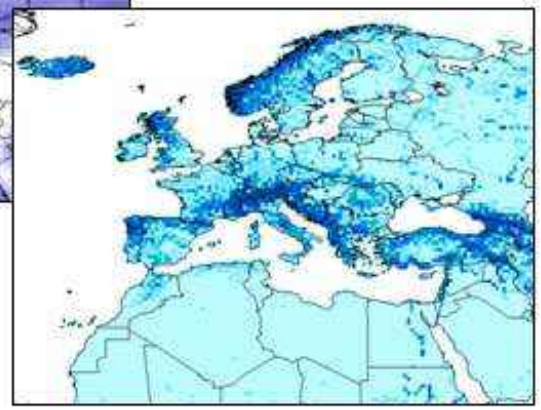
Geothermal (380)

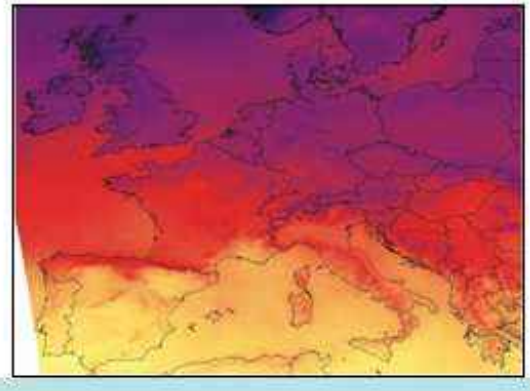


Wind Energy (1520)



Hydropower (910)





Solar Energy
(1730)

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

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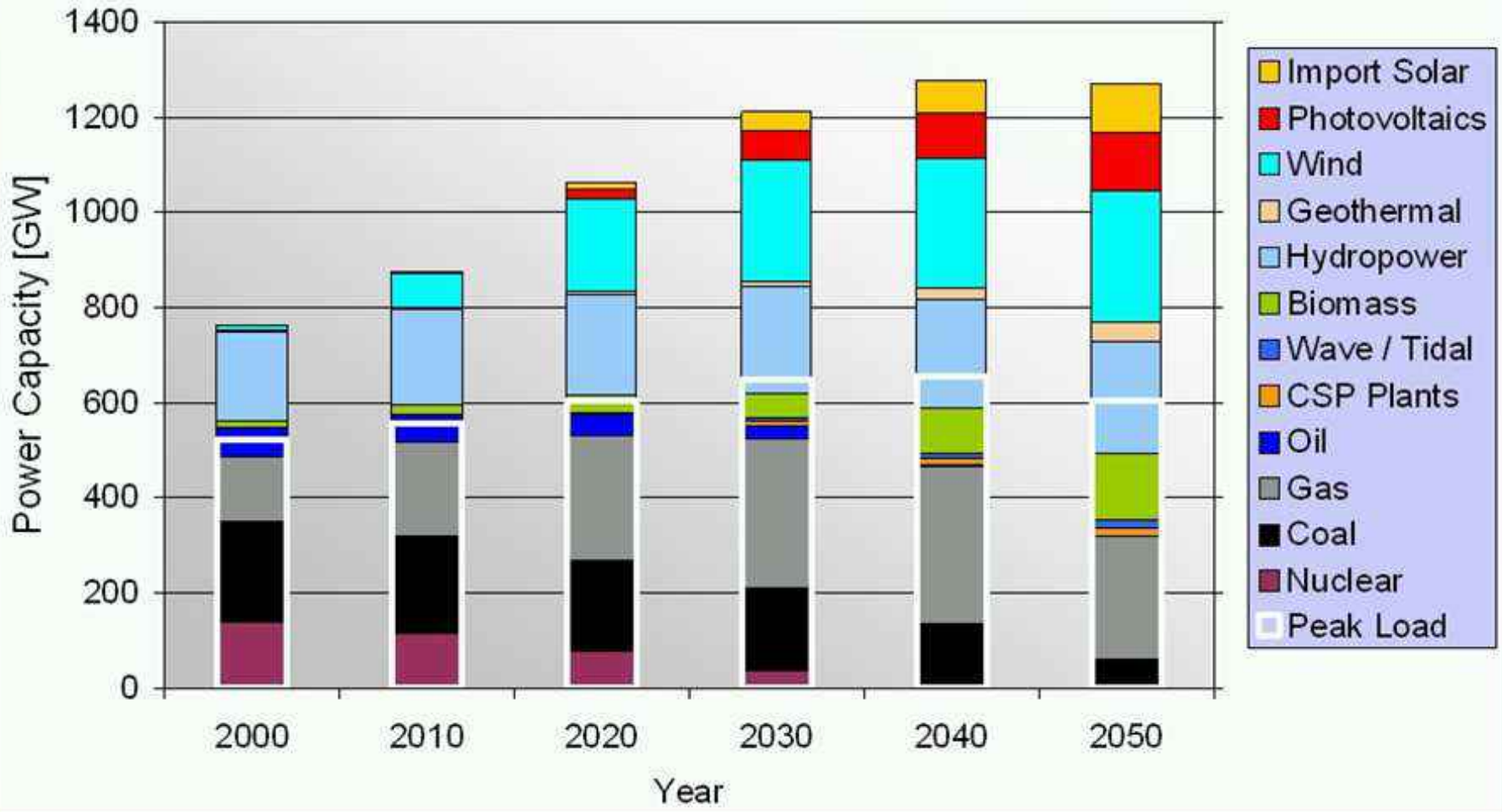
Installed Capacity in Europe



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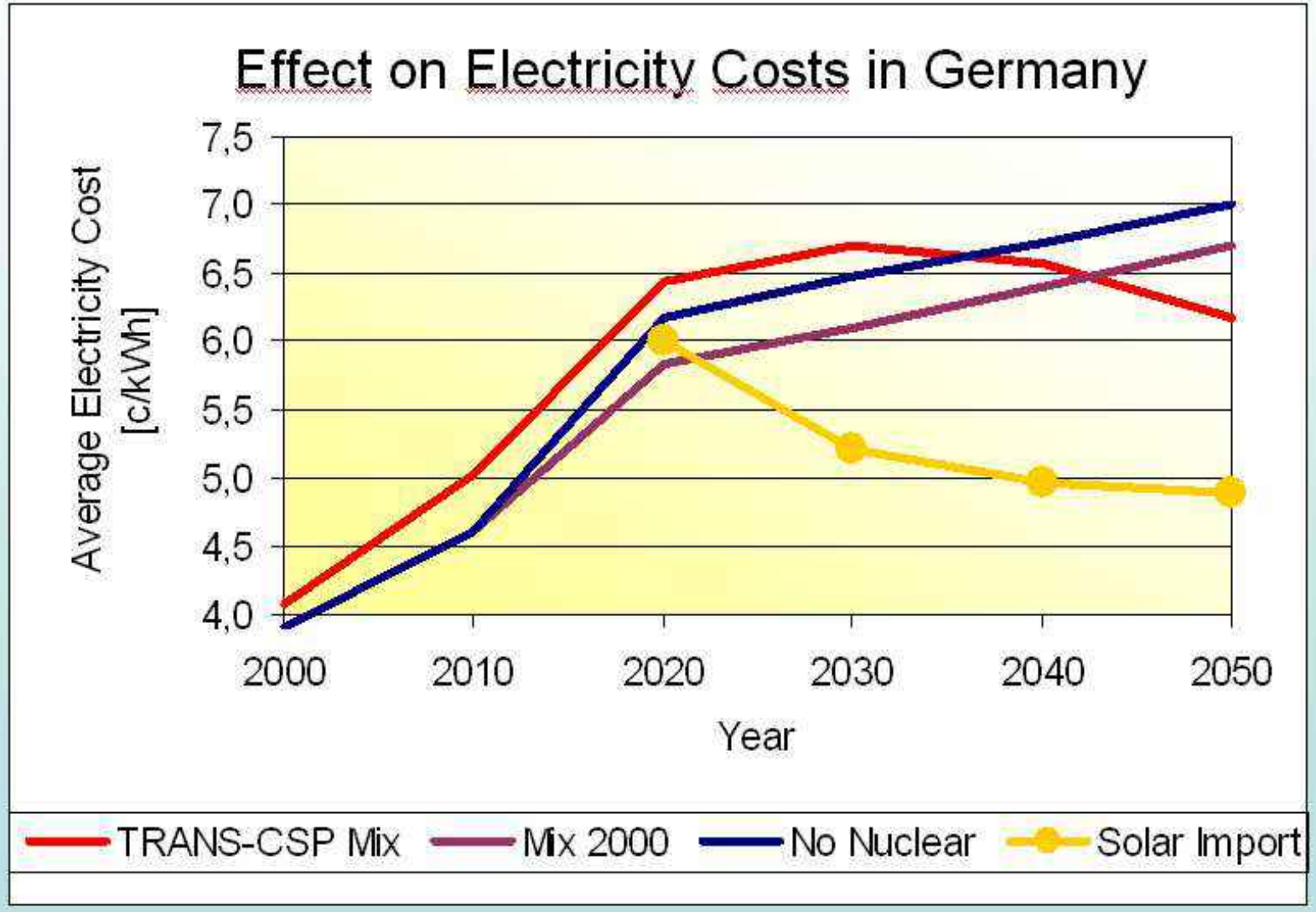

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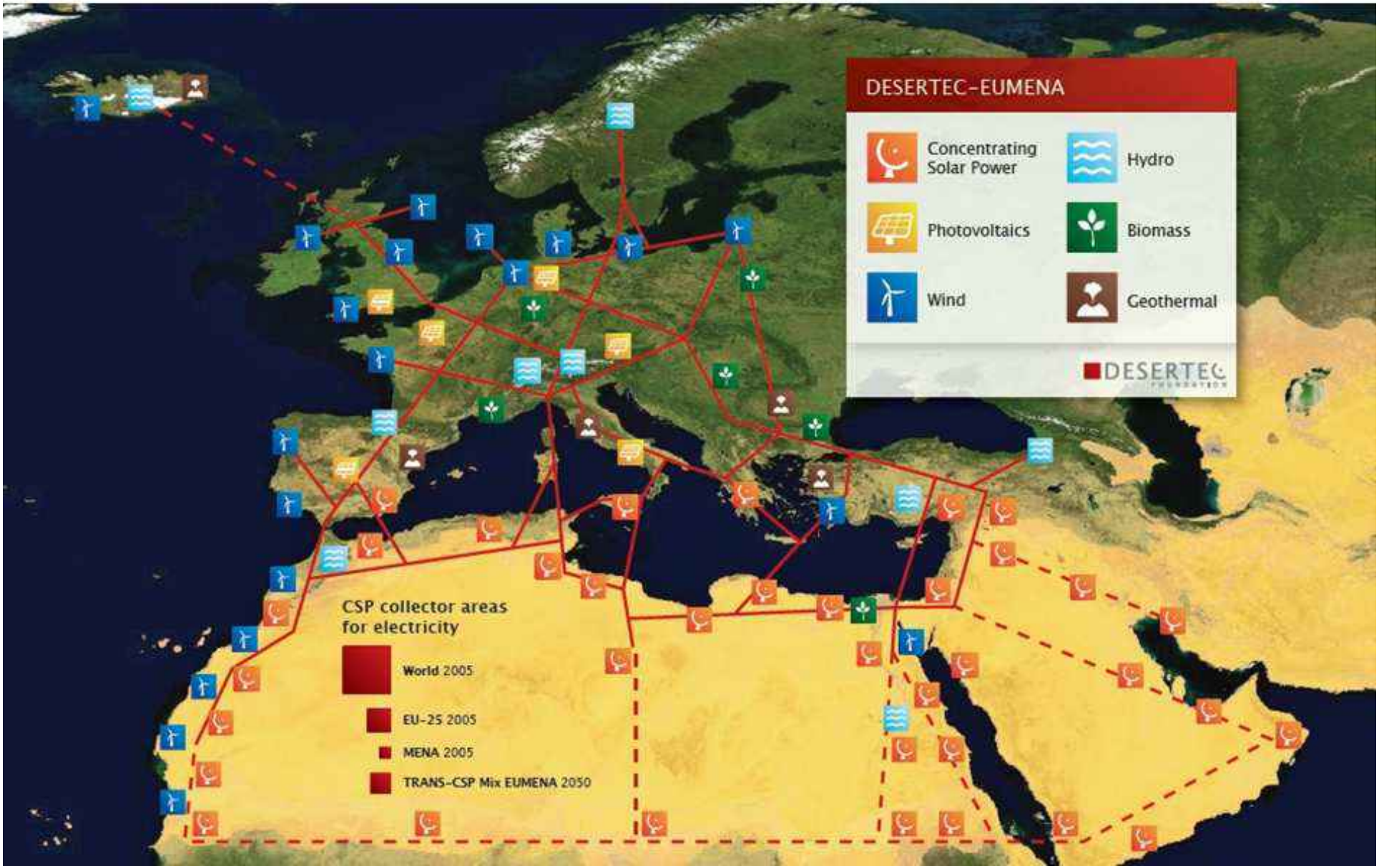

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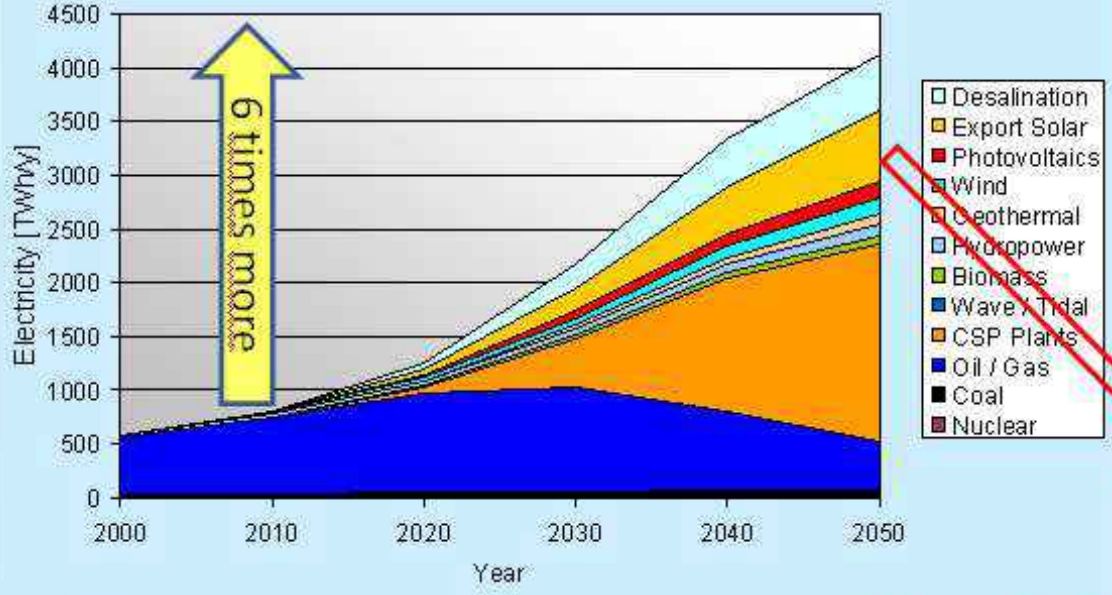

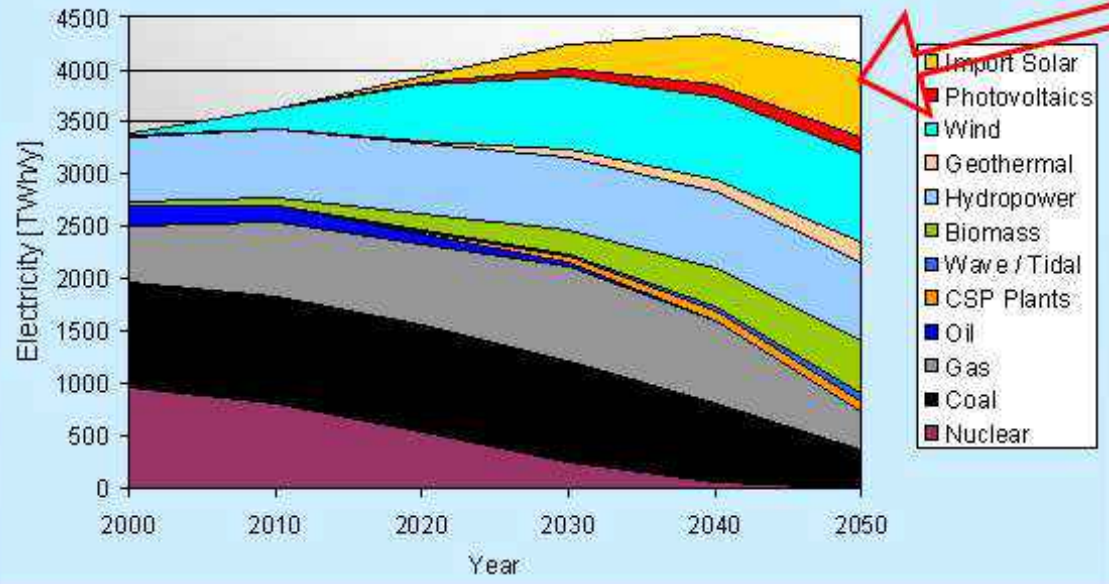

transition mix 2000-2050

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.

Power demand, and supply scenario (TWh/y) in MENA and EU

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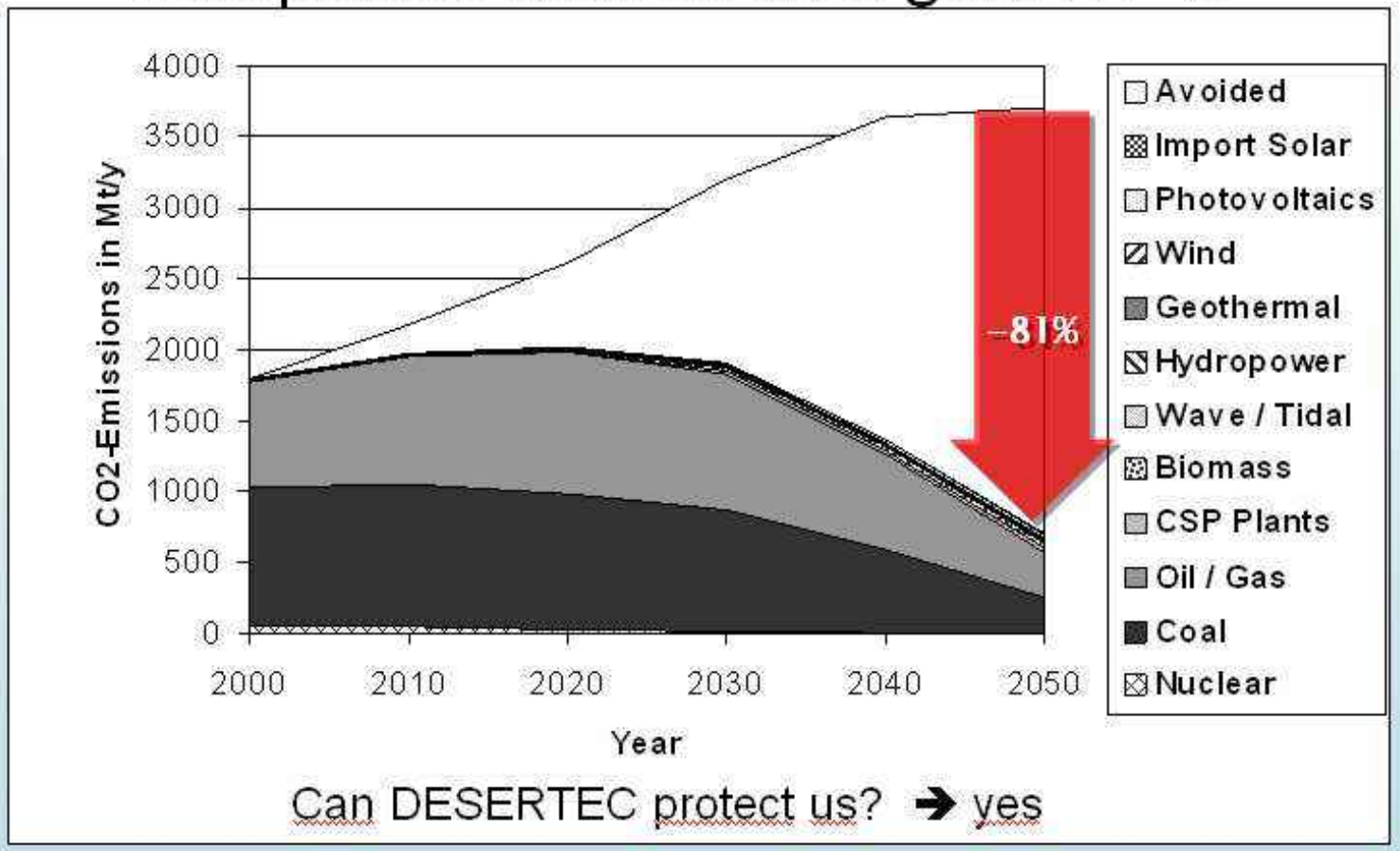
nergy

Resulting decarbonization in EUMENA, compatible with climate goal ΔT<2°



Can DESERTEC protect us? ➔ yes

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The Requirements in MENA are different than those of Europe…

- Not only Electricity is needed …

  … 6-8% increase yearly

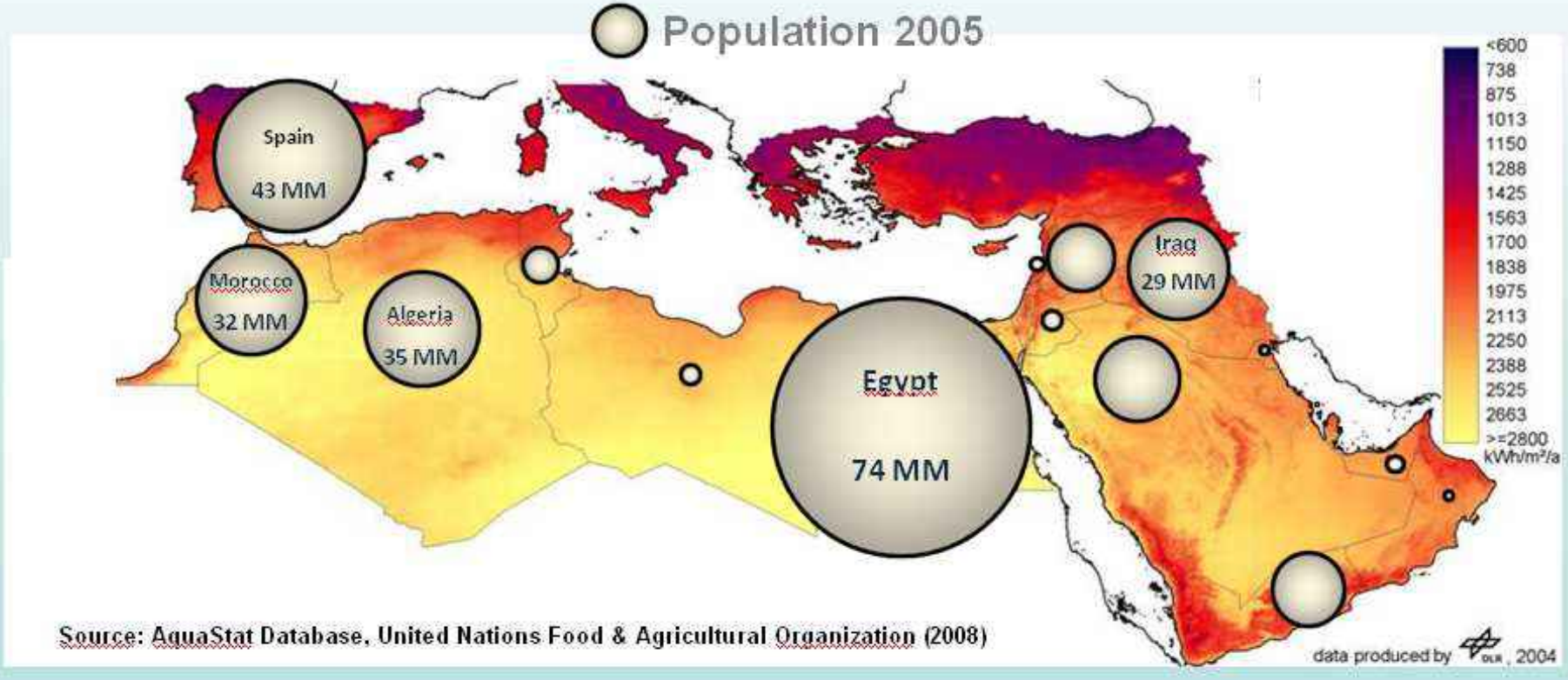
- Water is also needed …

  … more than two Niles by 2050

AQUA-CSP

MENA Cleantech
Samer Zureikat

Why Should the MENA Adopt Concentrating Solar Power?



MENA Cleantech
Samer Zureikat

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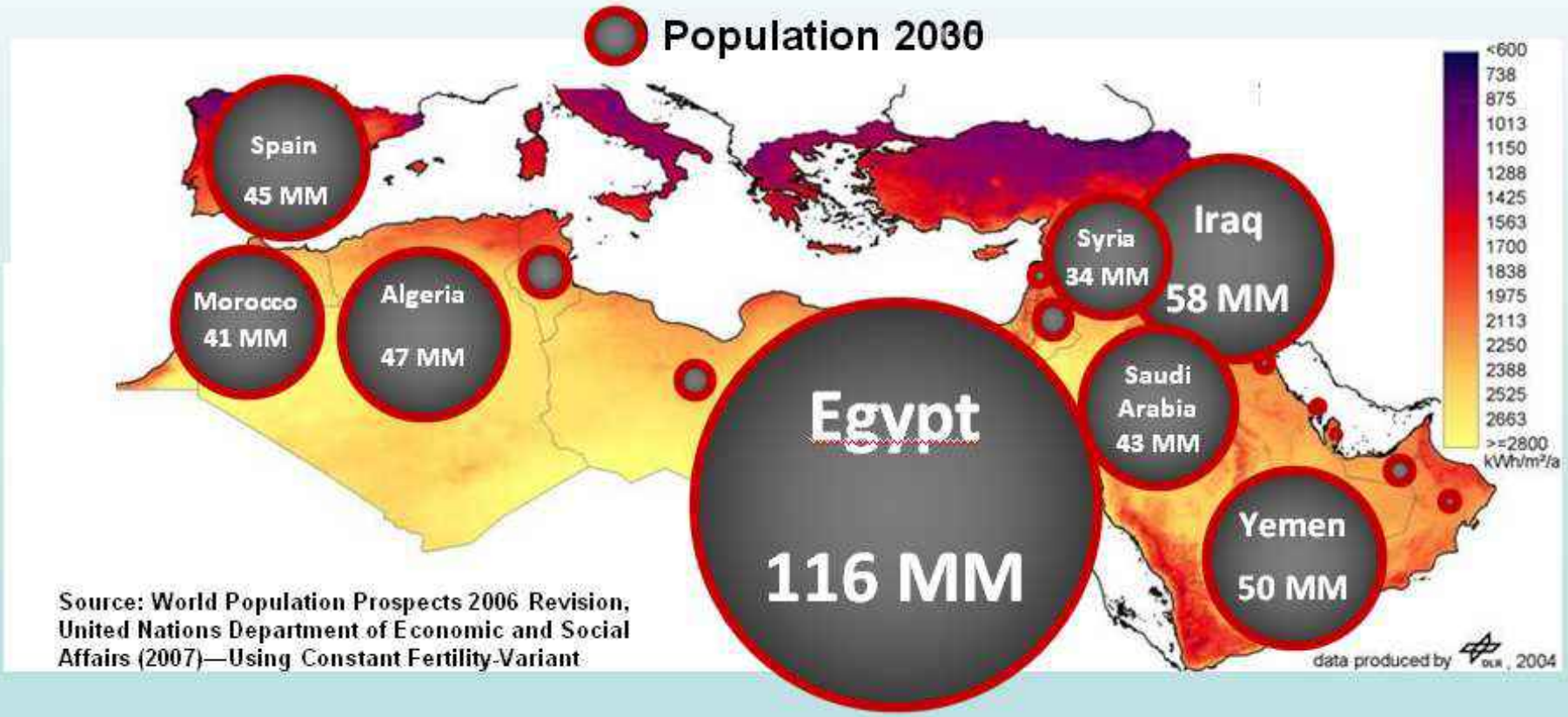

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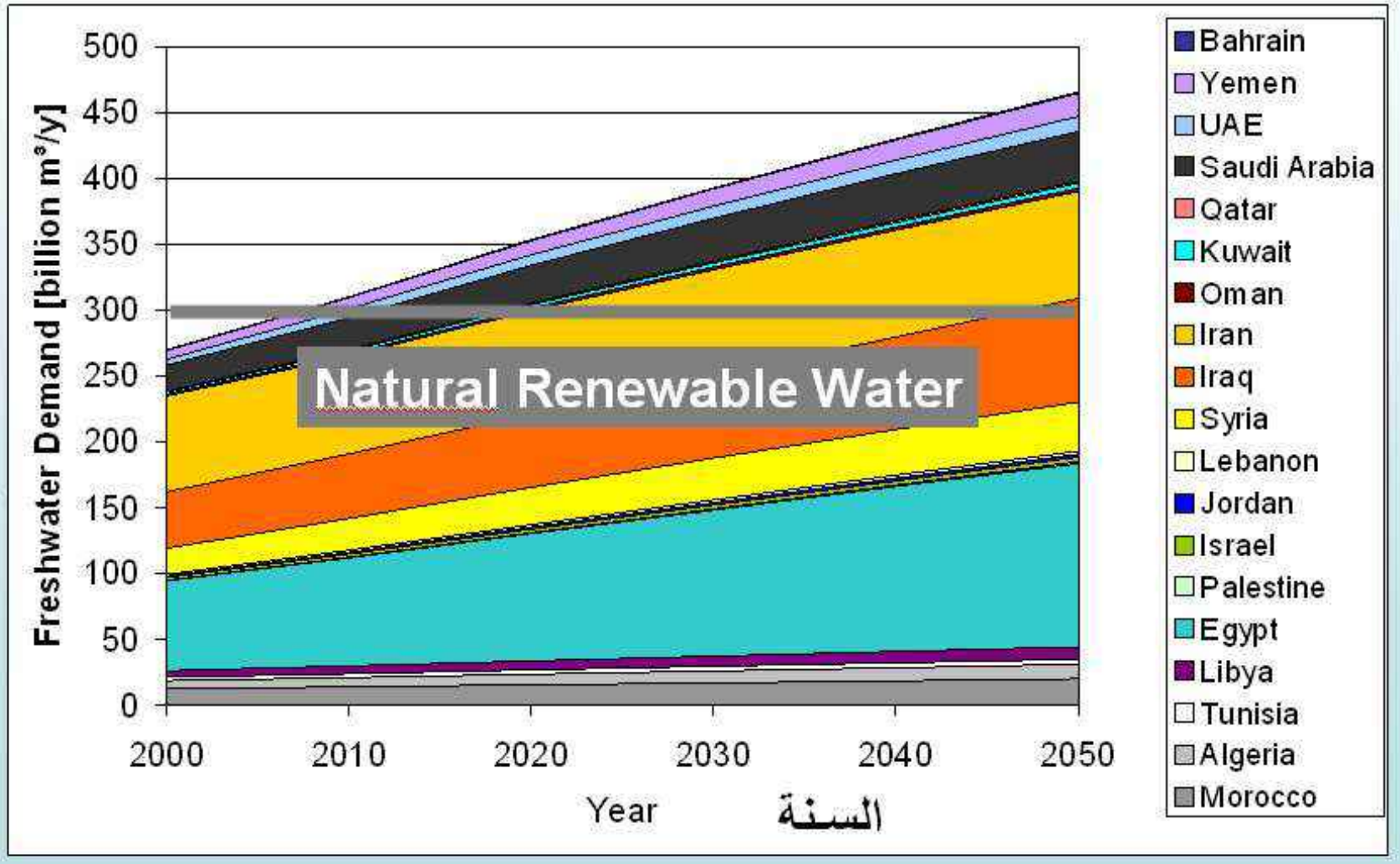
Water Demand in the Arab Countries



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Signing Memo of Understanding

Munich, 13 July 2009

Munich 13th July 2009

ABB — ABB AG

ABENGOA SOLAR — Abengoa Solar S.A.

ceVital — Cevital Spa

DESERTEC — DESERTEC Foundation

Deutsche Bank — Deutsche Bank AG

E.ON — E.ON Climate & Renewables GmbH

HSH NORDBANK — HSH Nordbank AG

MAN Solar Millennium — MAN Solar Millennium GmbH

Münchener Rück Munich Re Group — Münchener Rückversicherungs-Gesellschaft Aktiengesellschaft in München

m+w zander — M+W Zander Group GmbH

VORWEG GEHEN — RWE AG

SCHOTT solar — Schott AG

SIEMENS — Siemens AG

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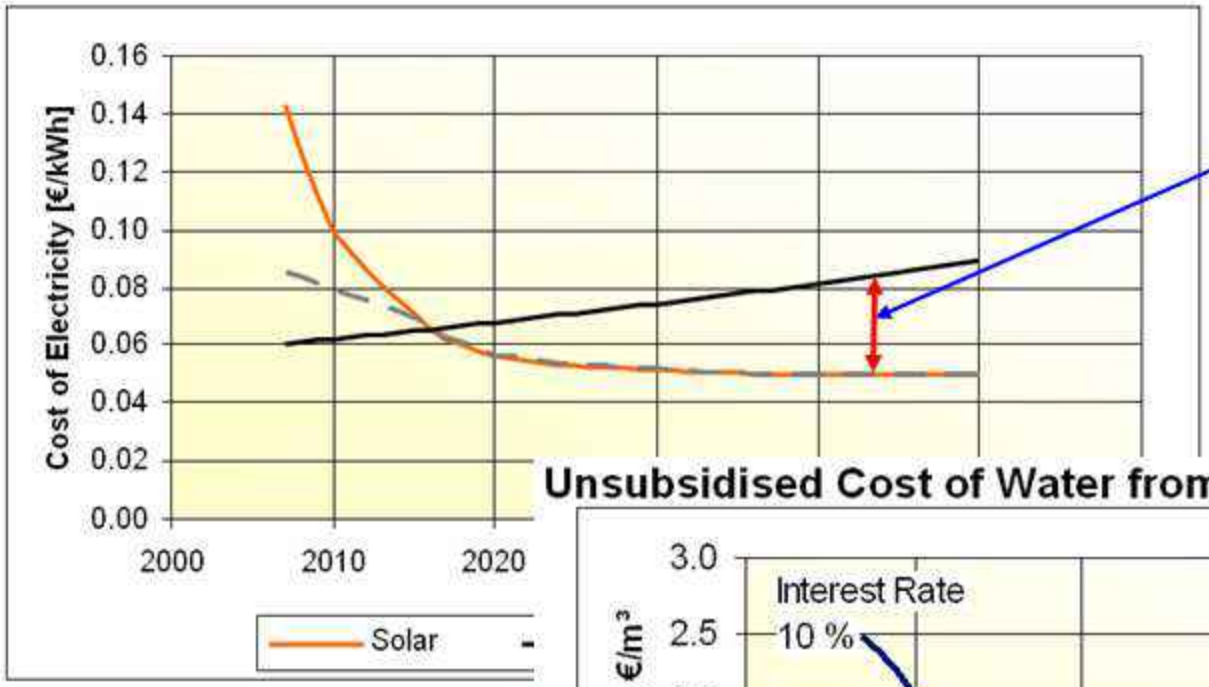
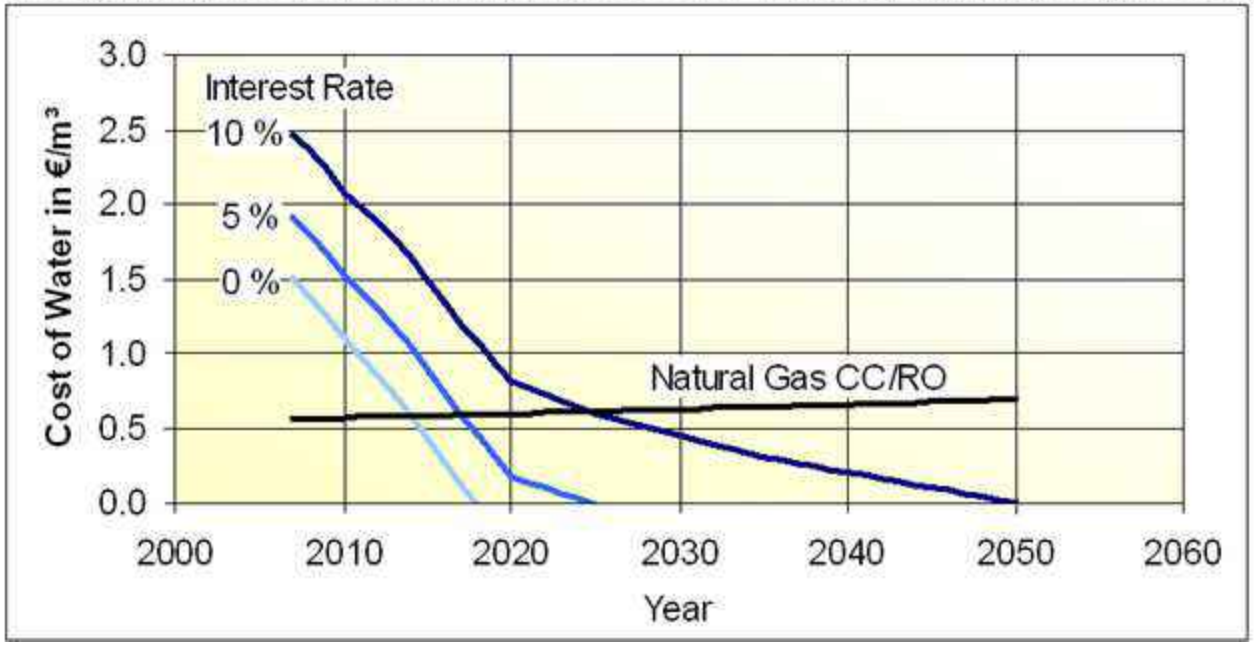
Unsubsidised cost of electricity of CSP versus natural gas CC



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

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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^3 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.

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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_2 emissions.

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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.