Renewable Energies in the MENA Region: Potential for Sustainable Energy Provision and Export to Europe

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Nokraschy Engineering GmbH (Germany)
Deutsche Gesellschaft Club of Rome (Germany)
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New Energy Algeria (Algeria)
New and Renewable Energy Authority (Egypt)
Hamburg Institute of International Economics (Germany)
Honorat Satoguina
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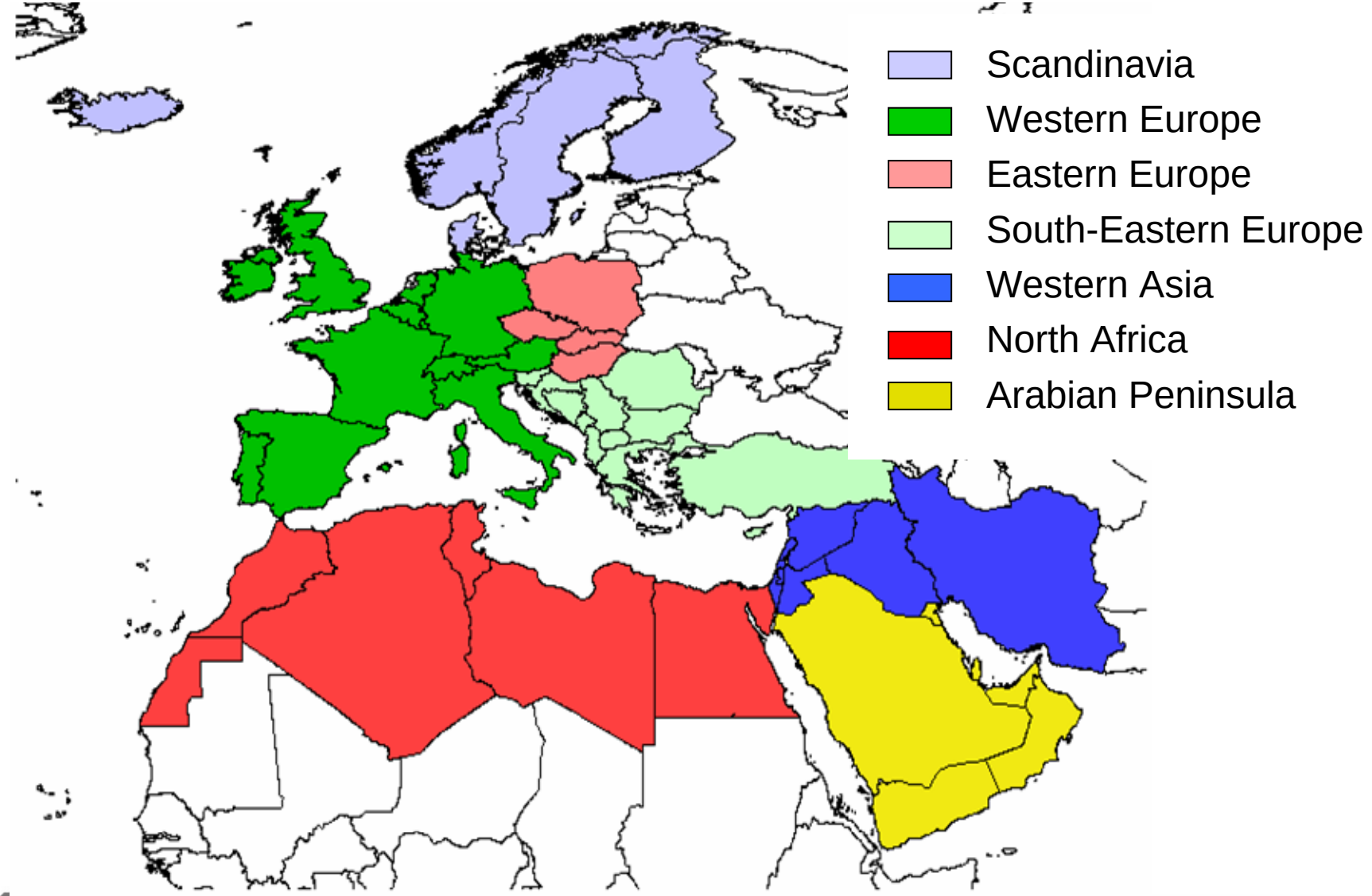
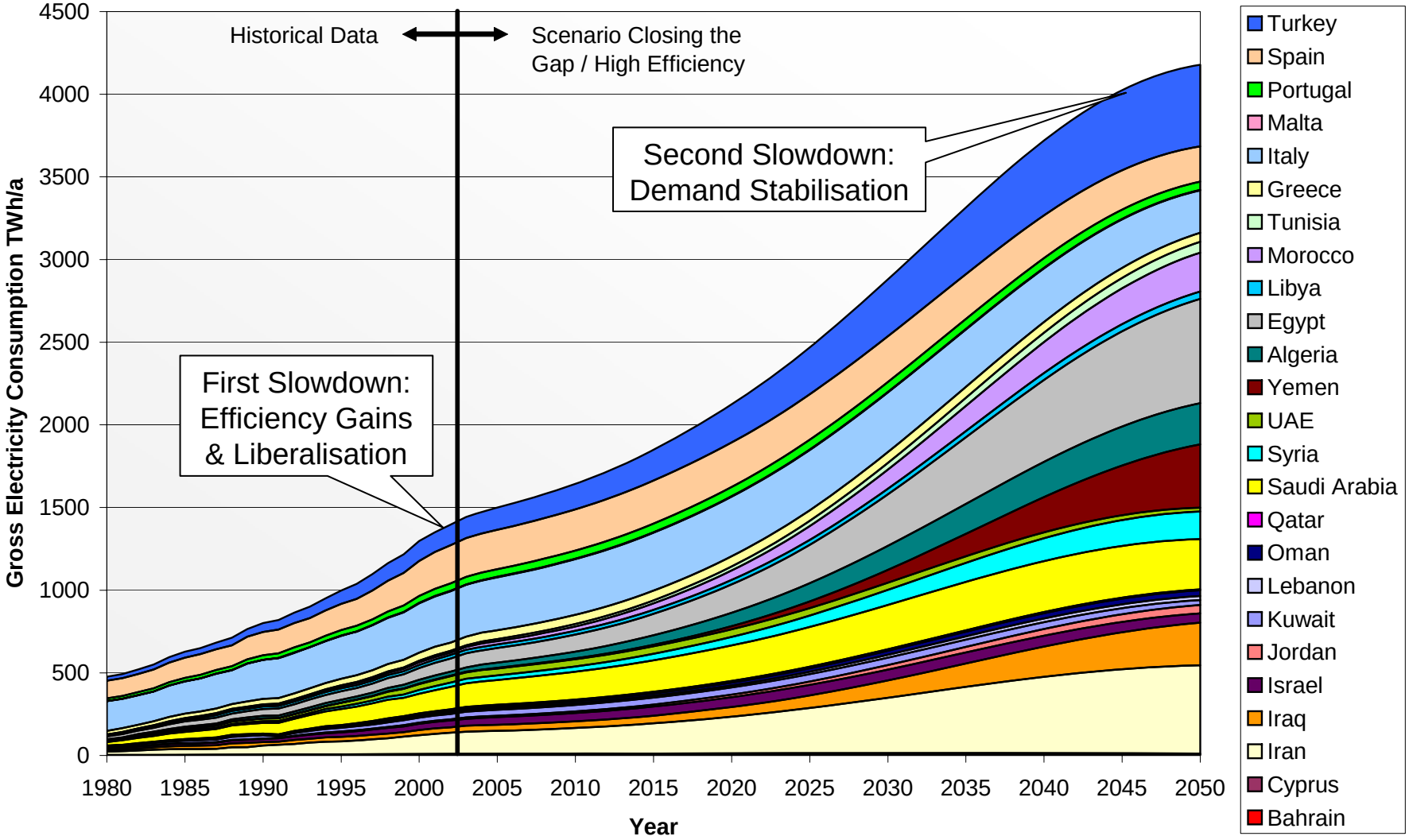
50 countries analysed within the MED-CSP and TRANS-CSP Studies



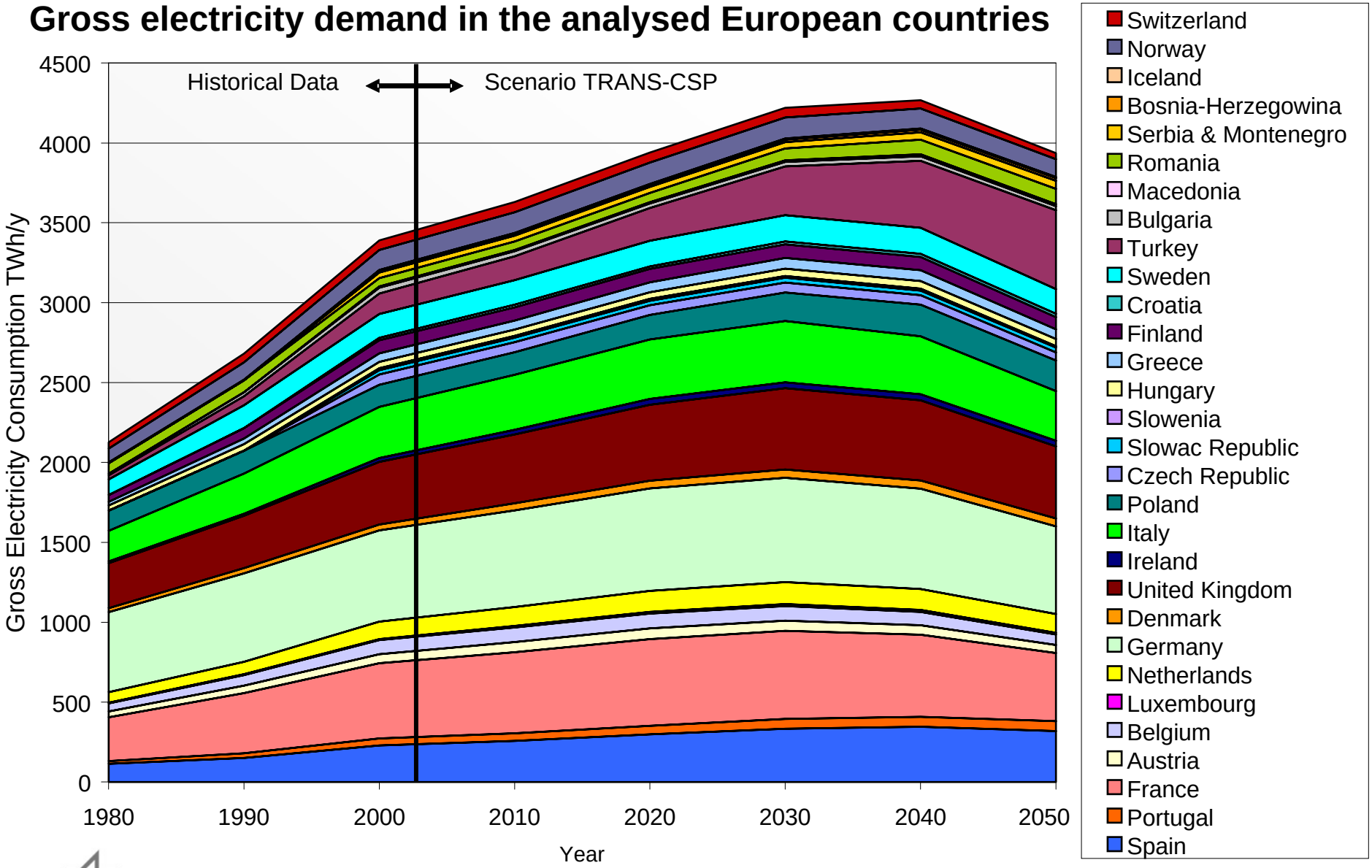
Parameters considered in the analyses

- Annual electricity demand
- Annual load curve
- Available fossile and renewable resources
- Existing power plants in 2000 and their expected lifetime
- Cost of fossil fuels (oriented at IEA Scenario)
- Maximum production growth rates of RE industries
- Existing grid infrastructure
- 100% power availability
- Peaking power demand and 25 % reserve capacity
- Sustainability criteria
- Opportunities of financing
- Policies and energy economic boundary conditions

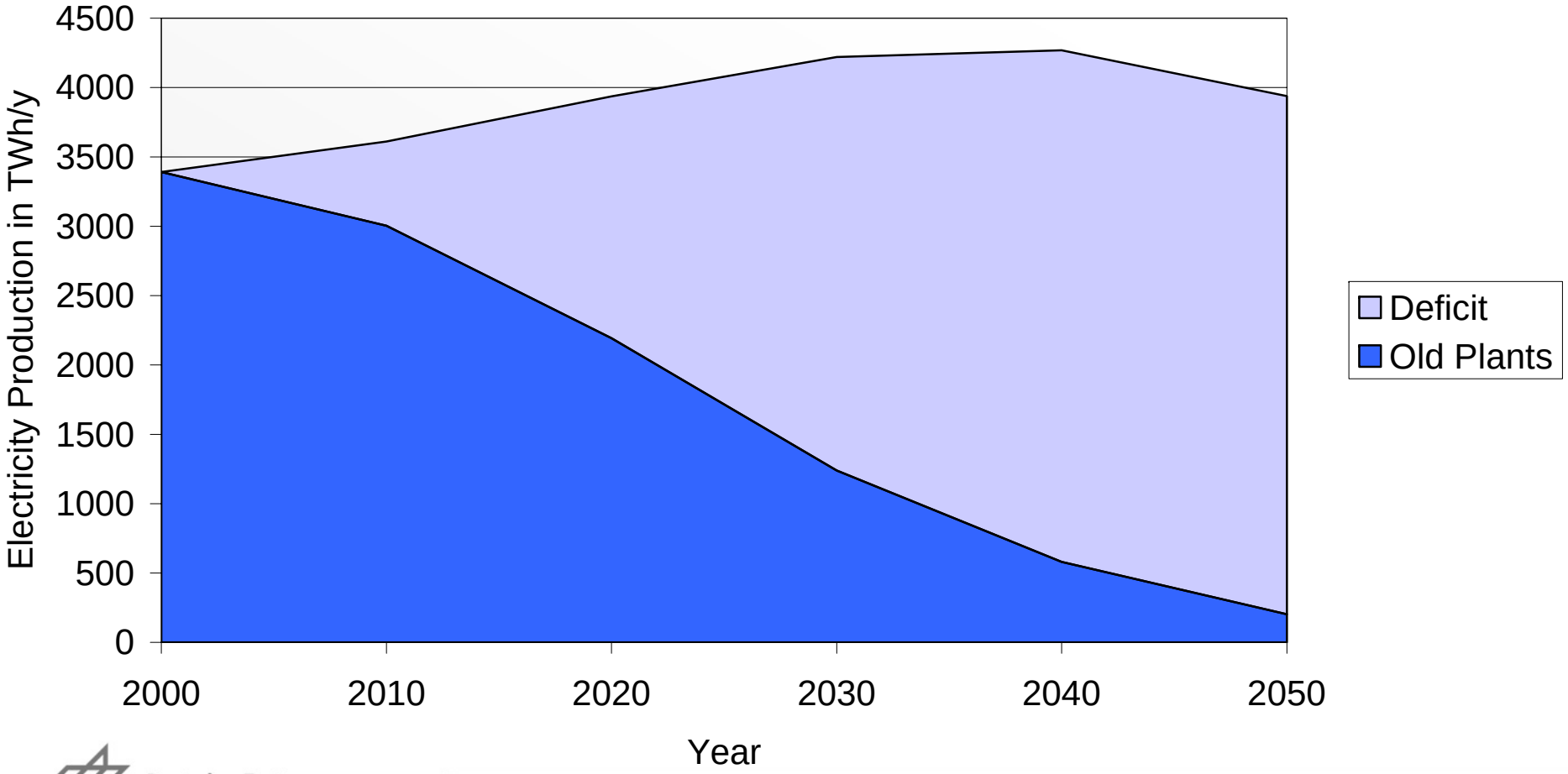
Gross electricity demand in the analysed MENA countries



Gross electricity demand in the analysed European countries

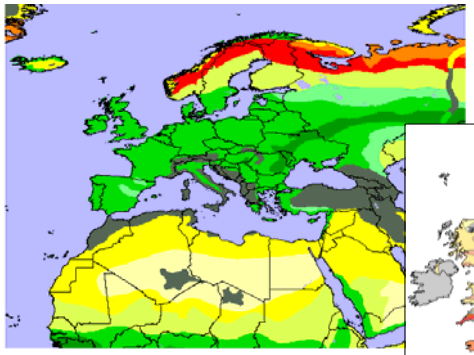


Electricity production of power plants already existing in 2000 and deficit to be covered by new plants until 2050, in the European countries analysed within TRANS-CSP

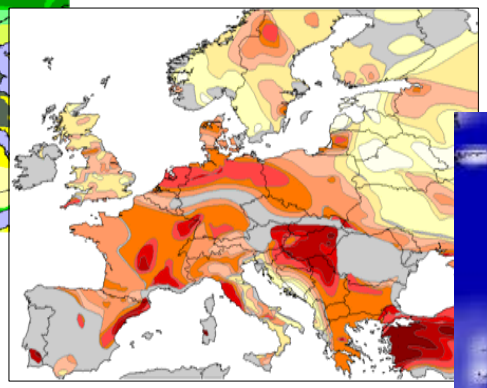


Renewable energy resources in Europe and MENA

Biomass (1)

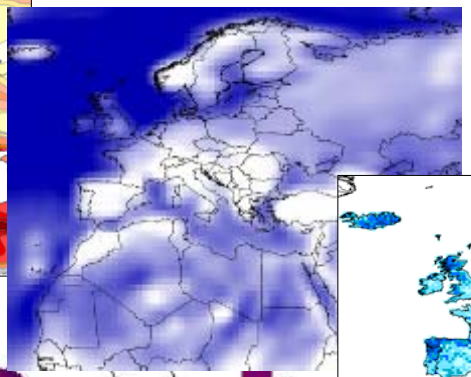


Geothermal (1)

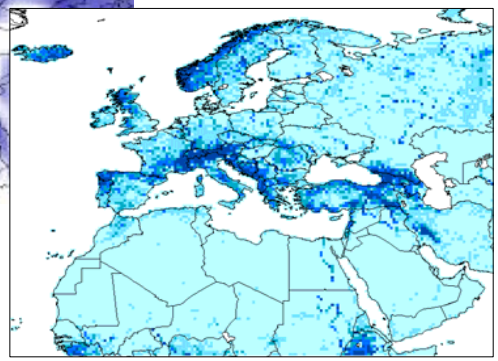


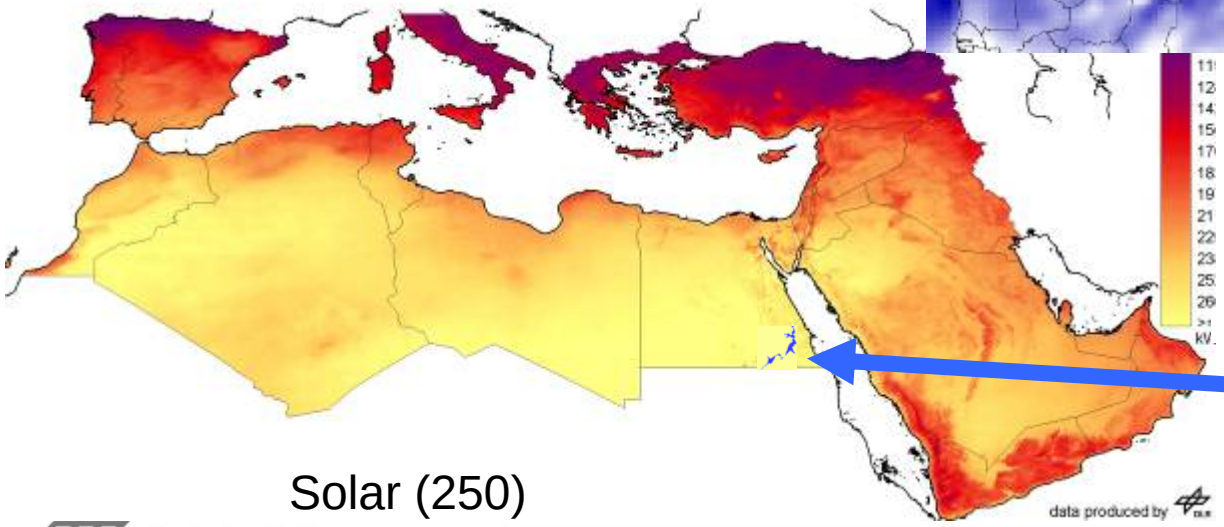
In brackets: (max. yield in GWh_{el} / km² /y)

Wind (50)



Hydropower (50)

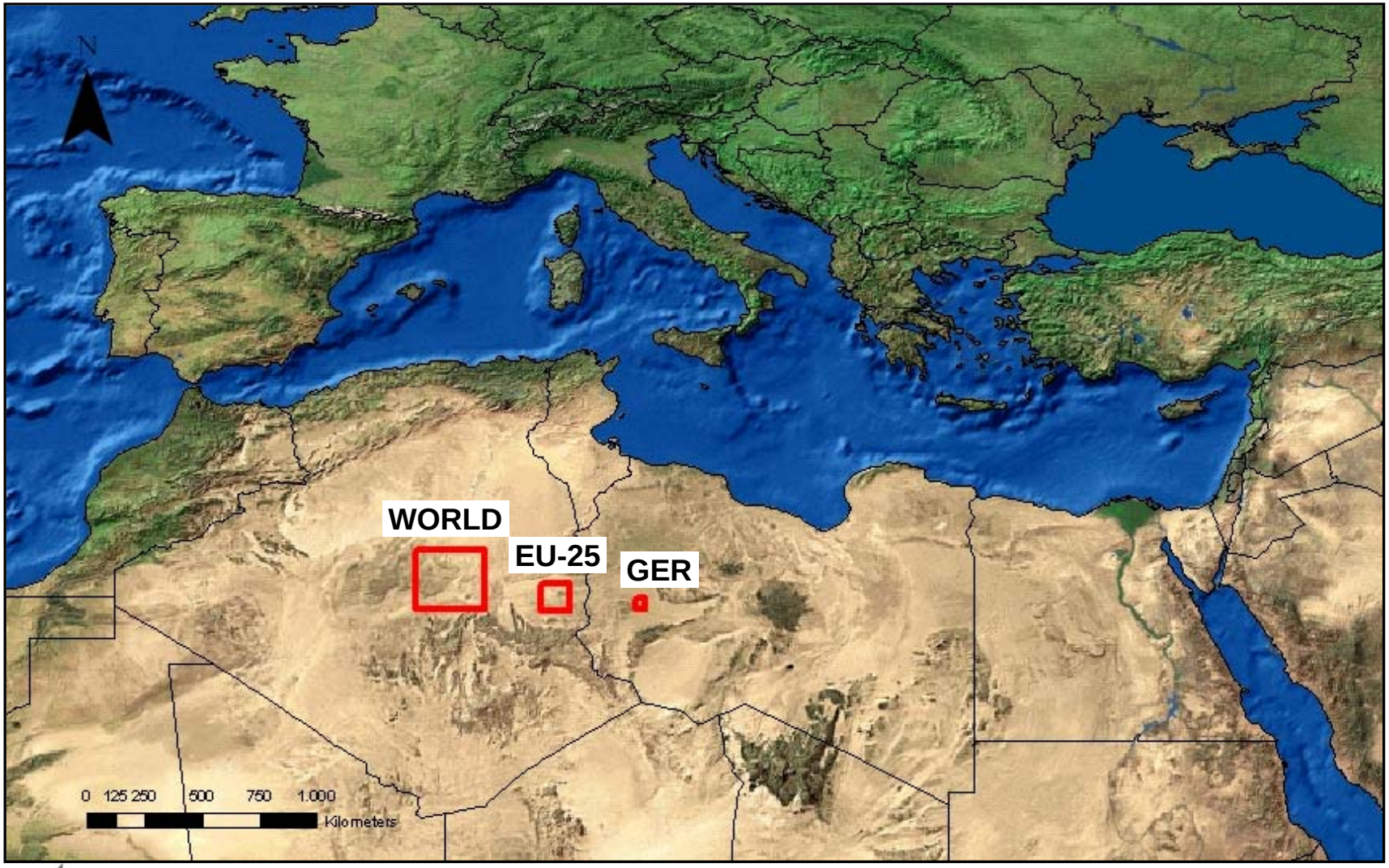




Solar (250)

A solar power plant of the size of Lake Nasser equals the total Middle East oil production

Area Required to Provide the Electricity Demand of the World, EU-25 and Germany

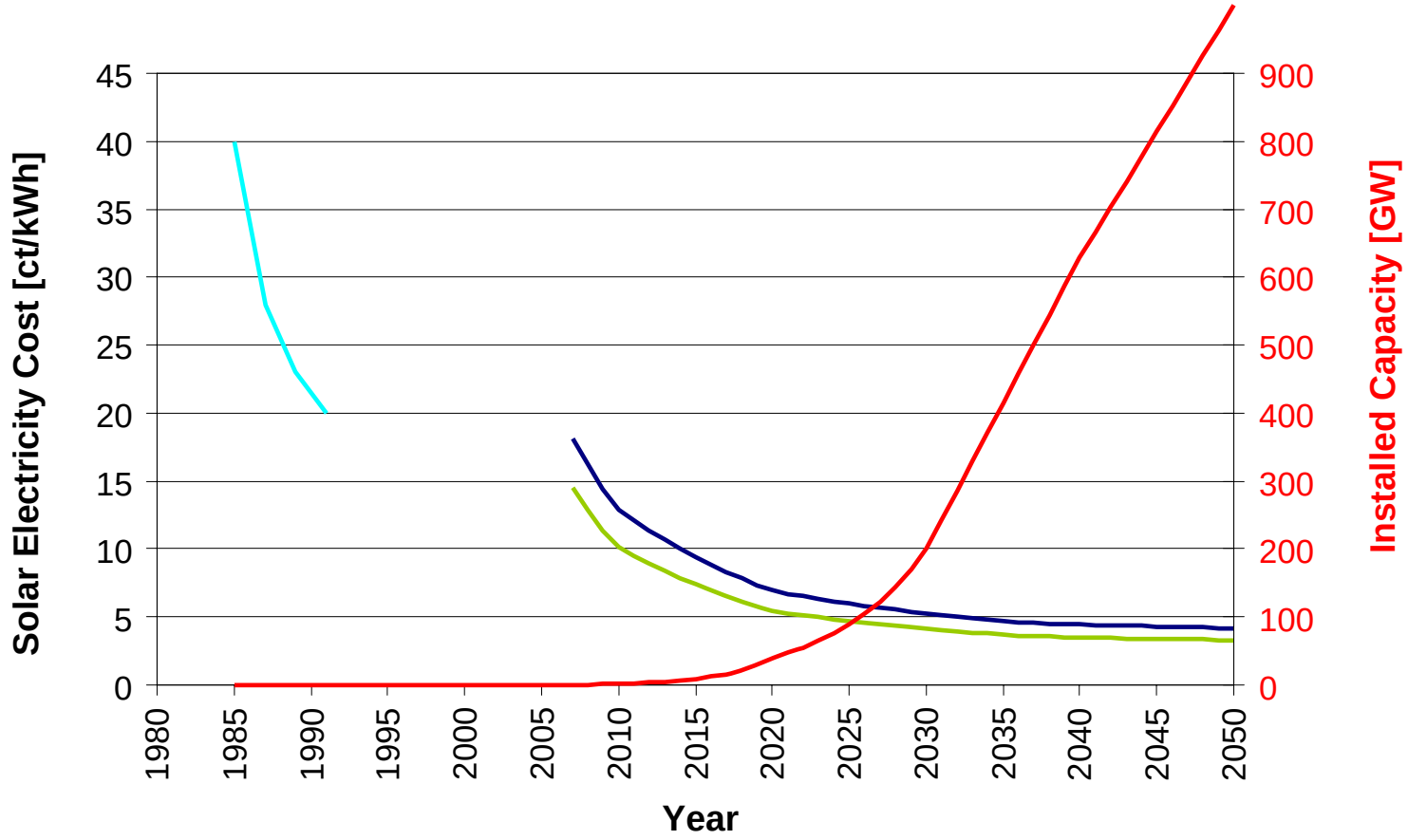


Solar Thermal Power Plants

Novatec
Lorca

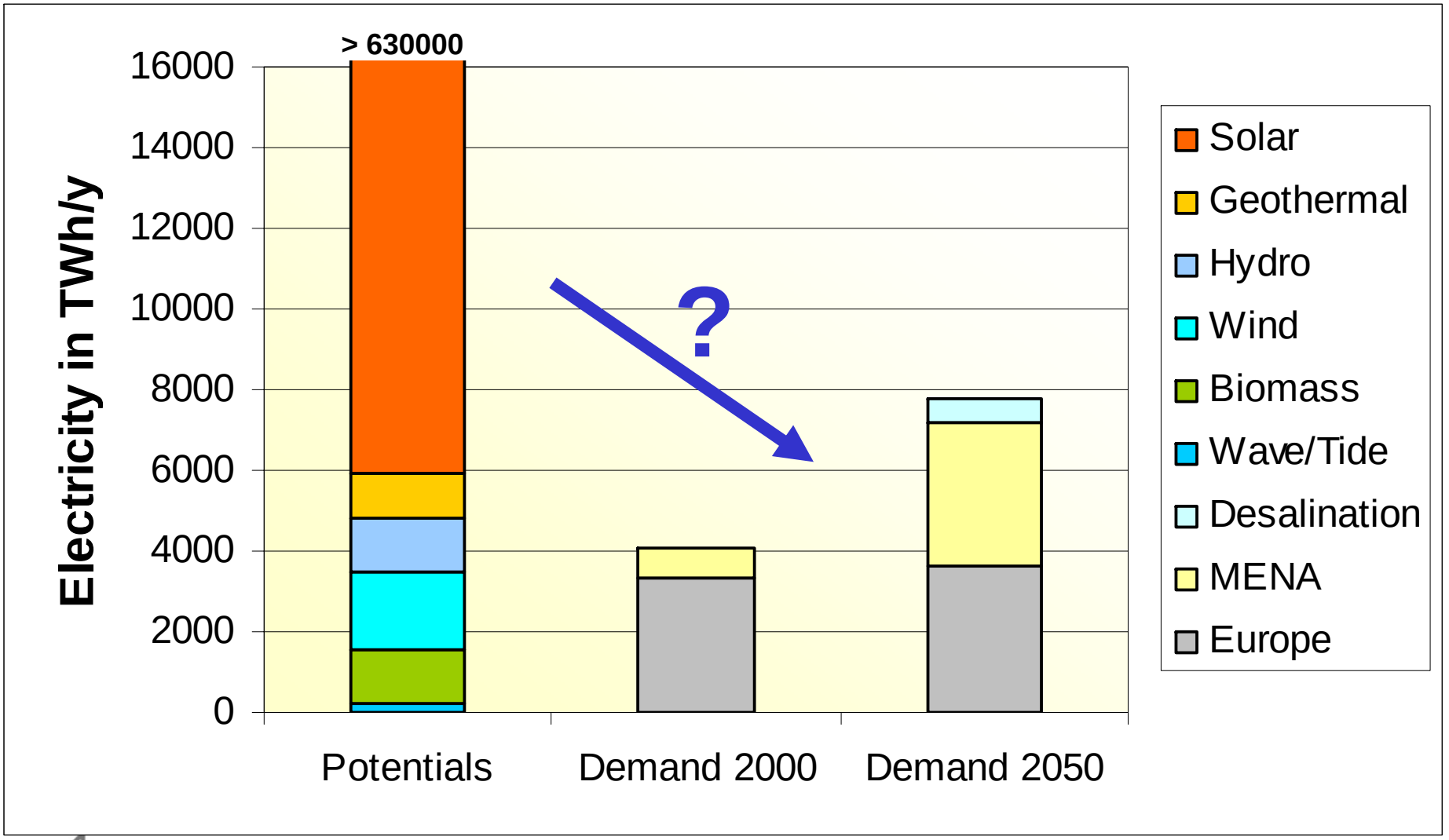
MAN/SPG
Almeria

Solar Electricity Cost of Concentrating Solar Power Plants



Source: EU-IP NEEDS (New Energy Externalities Developments for Sustainability

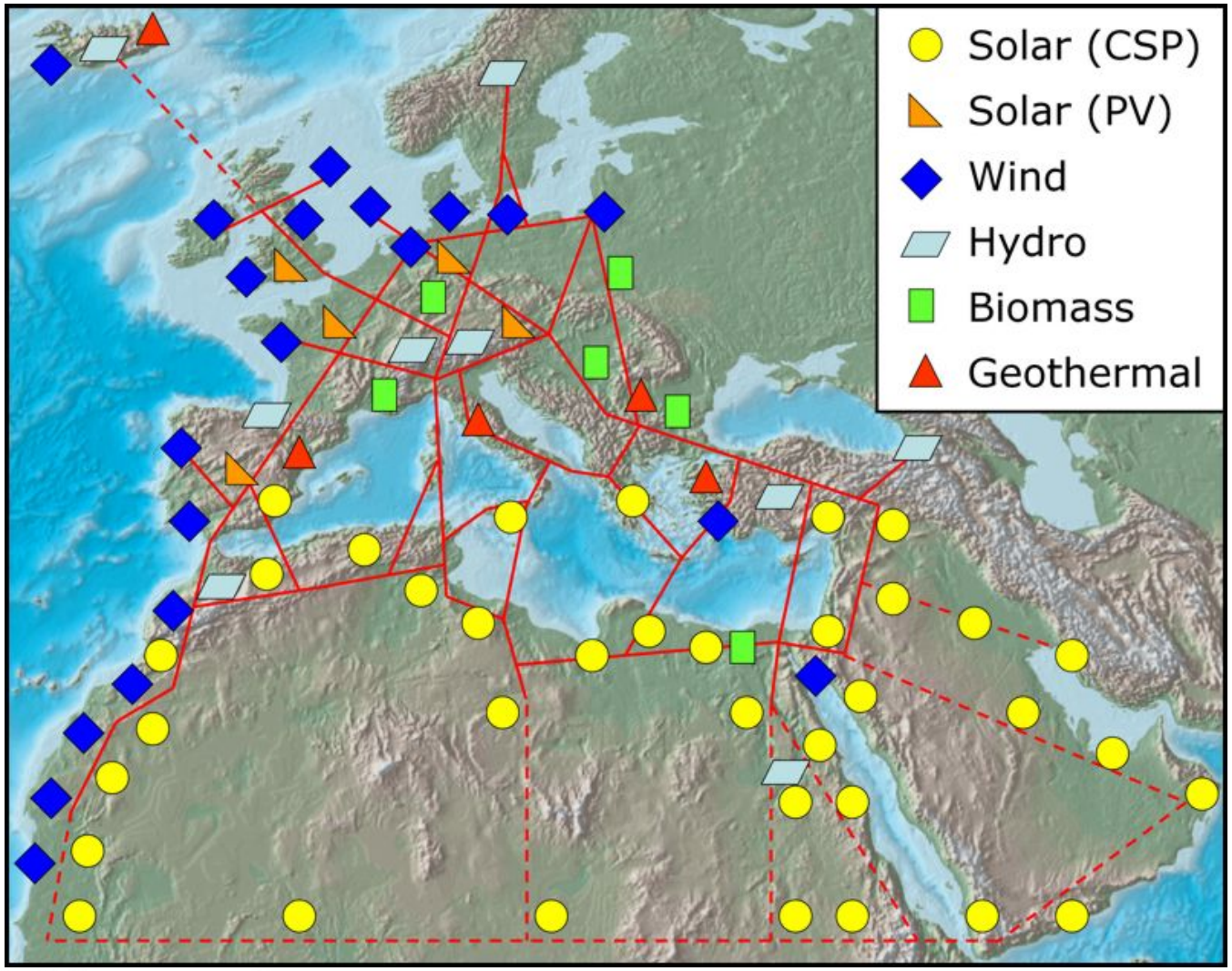
Economic renewable electricity potentials vs. demand in Europe and MENA



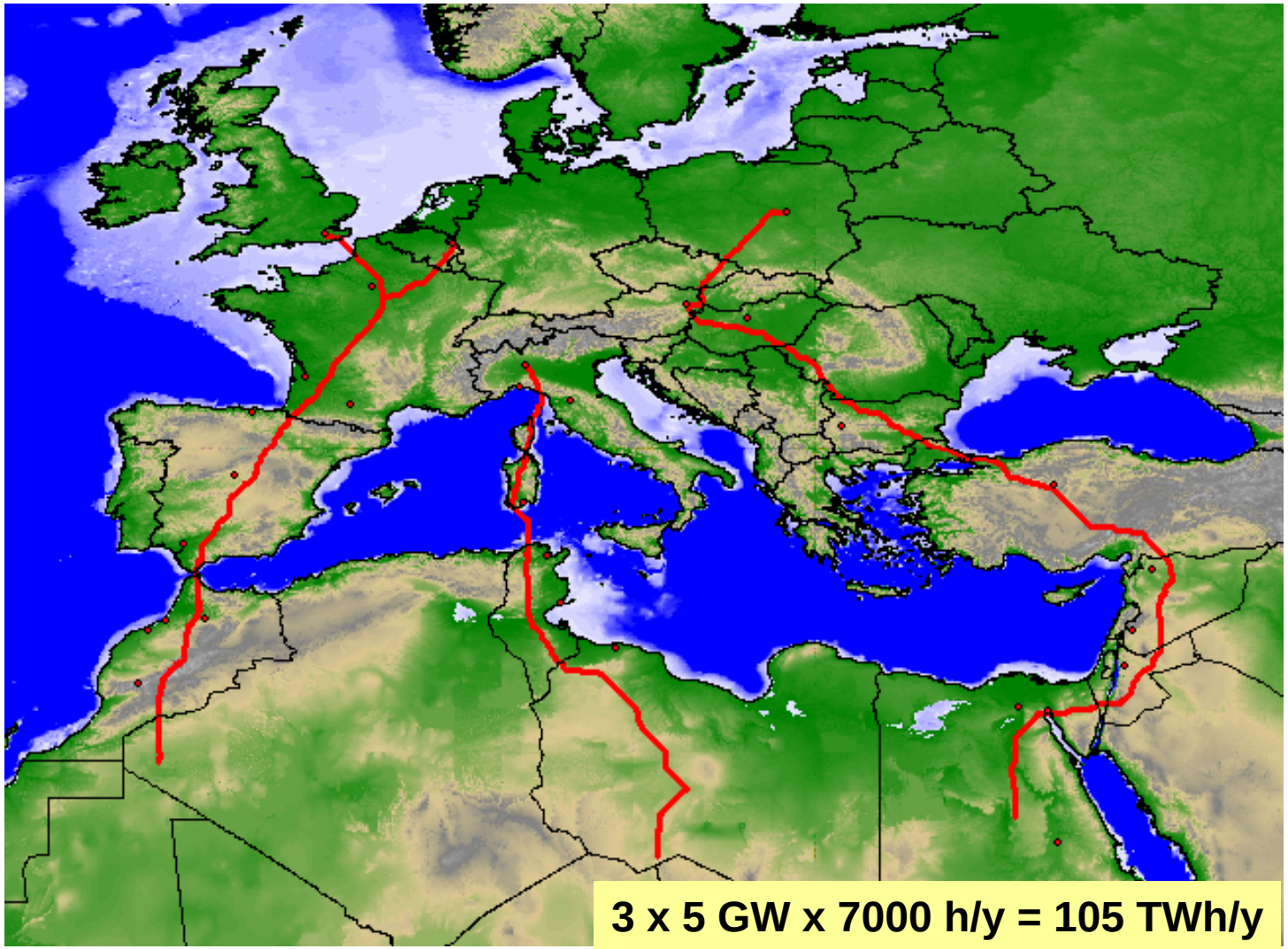
Options for solar electricity transfer over 3000 km distance

Solar Power Transfer by:	**Hydrogen**	**AC / HVAC**	**HVDC Line**
Losses	75 %	45 % / 25 %	10 %
Cost	very high	high	low
Adaptation to Consumers (Transformer)	has to be transformed to AC first	directly transformable	has to be transformed to AC first
Over Sea Transport	by tankers or pipelines	not over 30 km	standard solution
Visibility Impact	very low	high	low
Materials and Emissions	moderate	moderate	low
Preferred Application	eventually fuel for transport	regional and local power	long distance power transfer

Concept of a EU-MENA Renewable Energy Link Using HVDC Power Transmission Technology



Analysed Examples for EU-MENA HVDC Interconnection

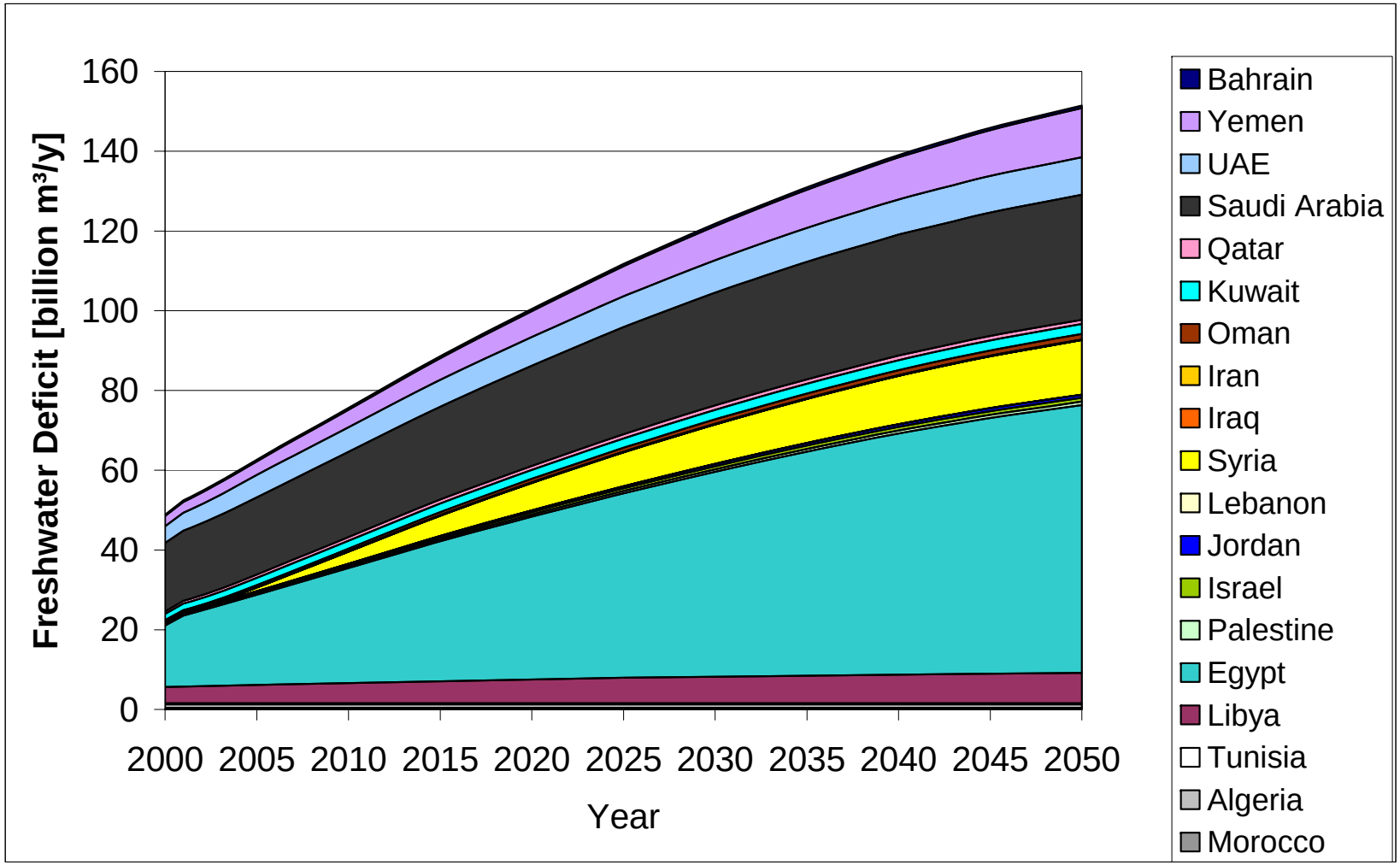


Scenario for total EU-MENA HVDC interconnection 2020 – 2050 *

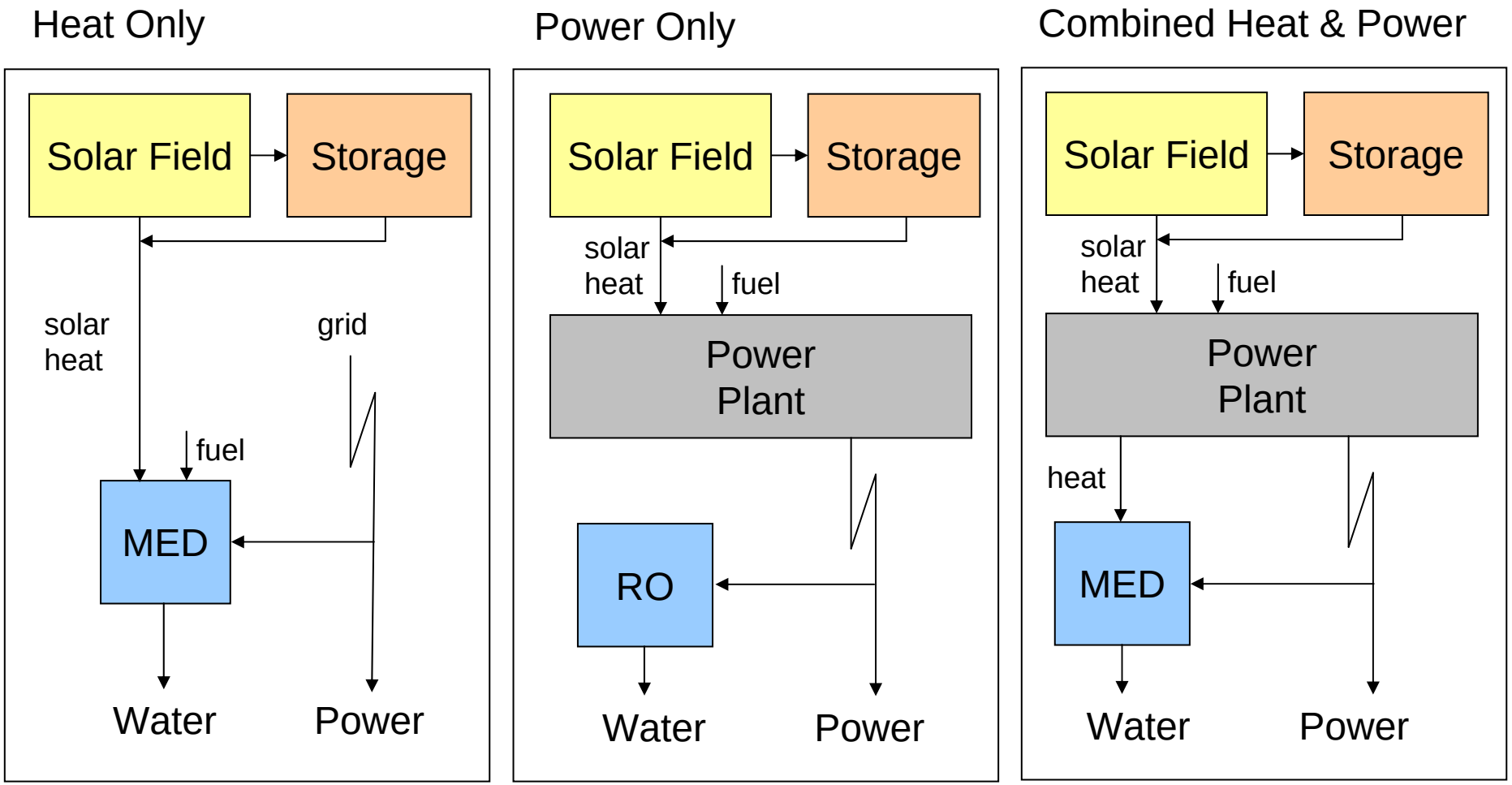
Year		2020	2030	2040	2050
Capacity GW		2 x 5	8 x 5	14 x 5	20 x 5
Transfer TWh/y		60	230	470	700
Capacity Factor		0.60	0.67	0.75	0.80
Land Area km x km	CSP HVDC	15 x 15 3100 x 0.1	30 x 30 3600 x 0.4	40 x 40 3600 x 0.7	50 x 50 3600 x 1.0
Investment Billion €	CSP HVDC	42 5	134 16	245 31	350 45

* All countries analysed in TRANS-CSP

Expected Water Deficits by Country

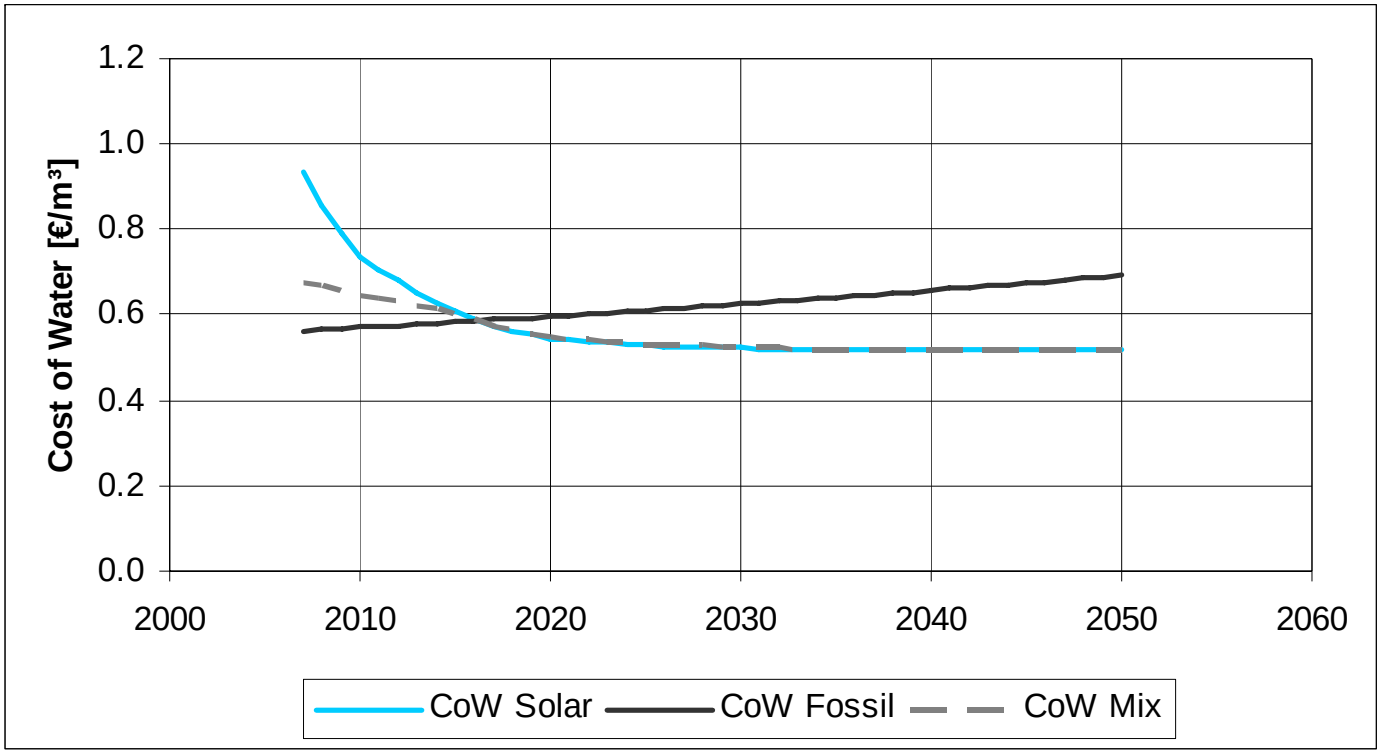


Concentrating Solar Thermal Power for Seawater Desalination (Options)

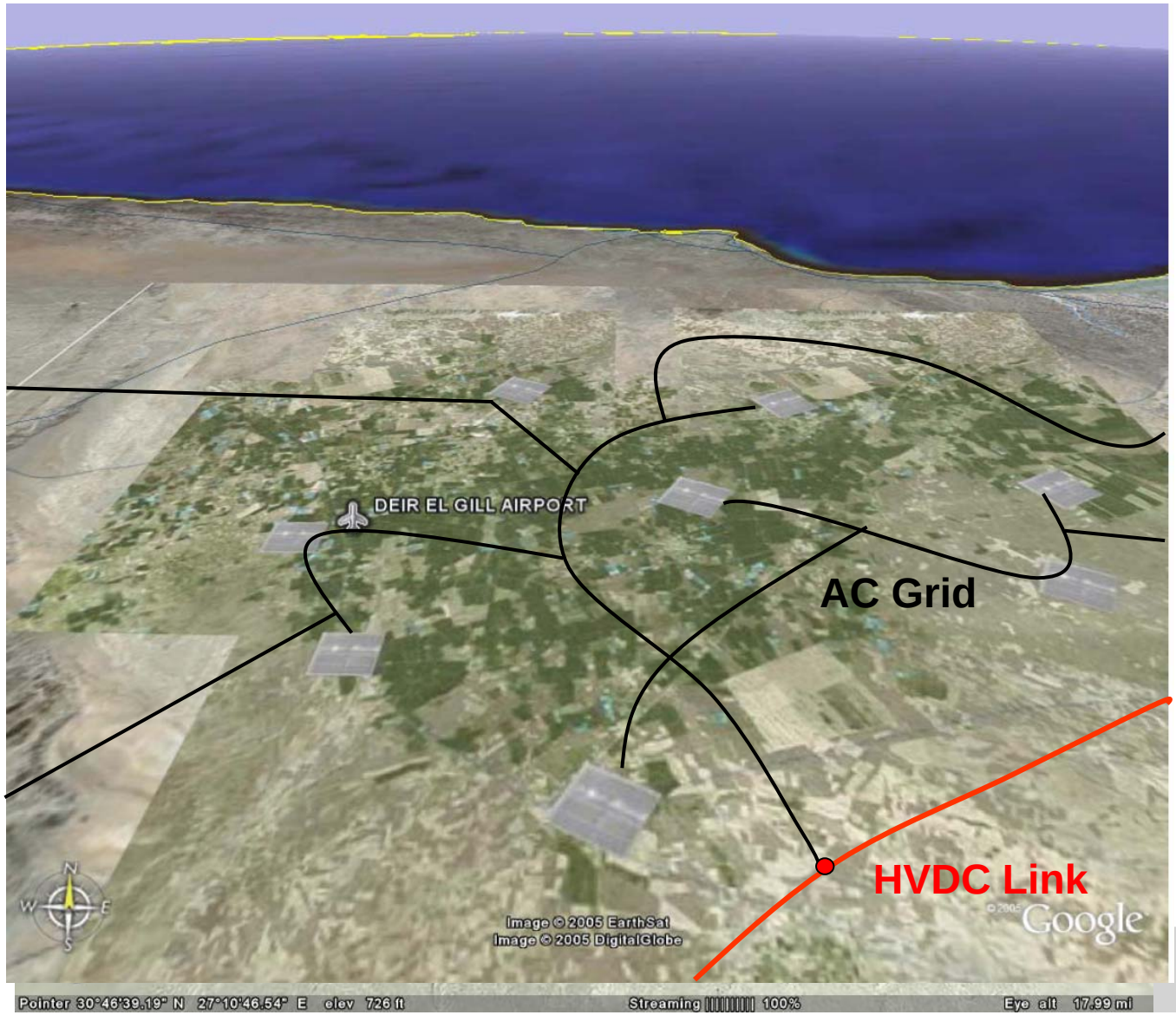


MED: Multi-Effect-Distillation; RO: Reverse Osmosis Membrane Desalination

Projected cost of water (CoW) from reverse osmosis plants using conventionally generated power or solar electricity



Concentrating Solar Thermal Power Plants combined with Sea Water Desalination in Coastal Desert Areas



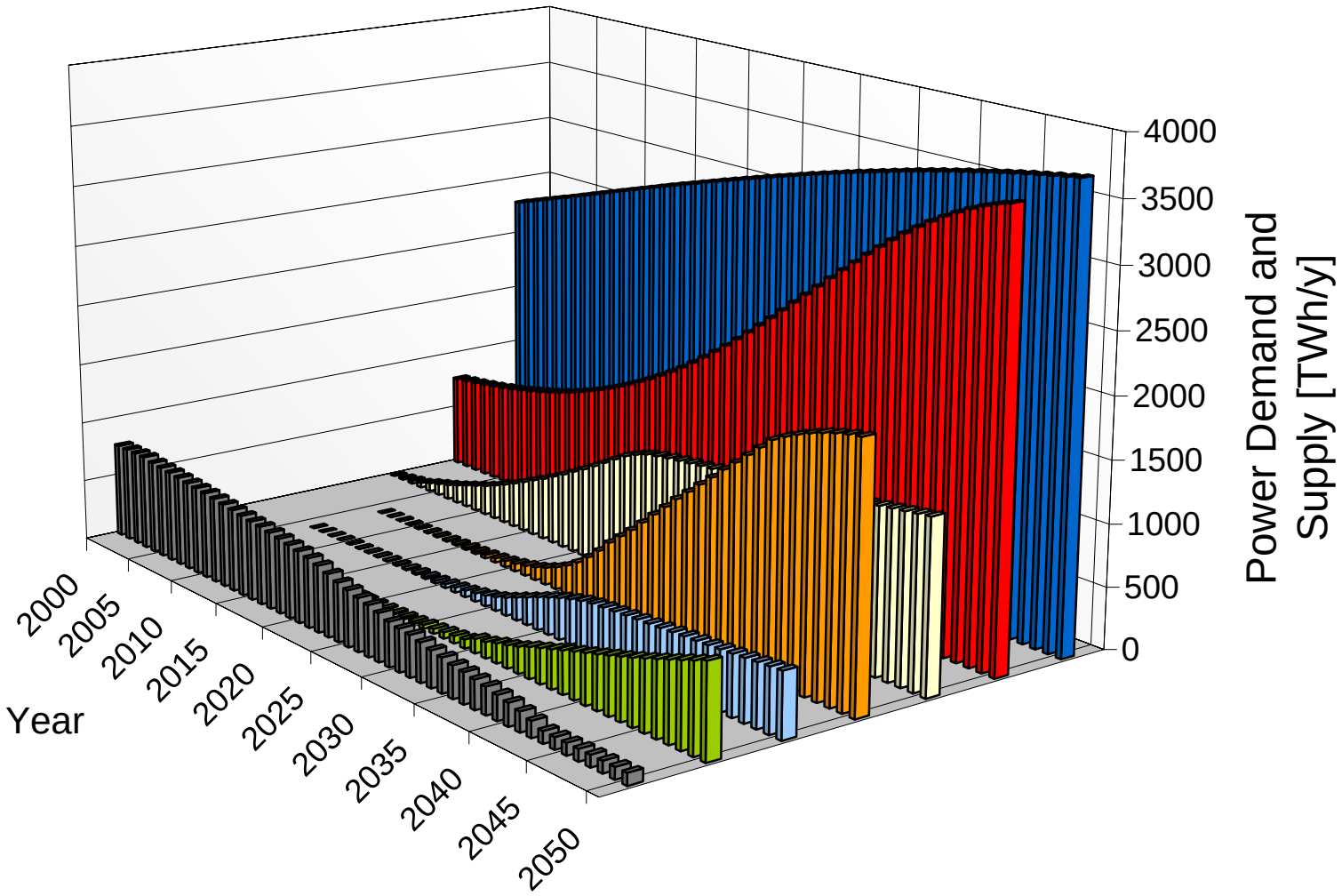
Energy
+
Water
+
Income

=

Sustainable economic development in arid regions

(artist view created with Google Earth) Hans Müller-Steinhagen

Electricity and fresh water provision in MENA

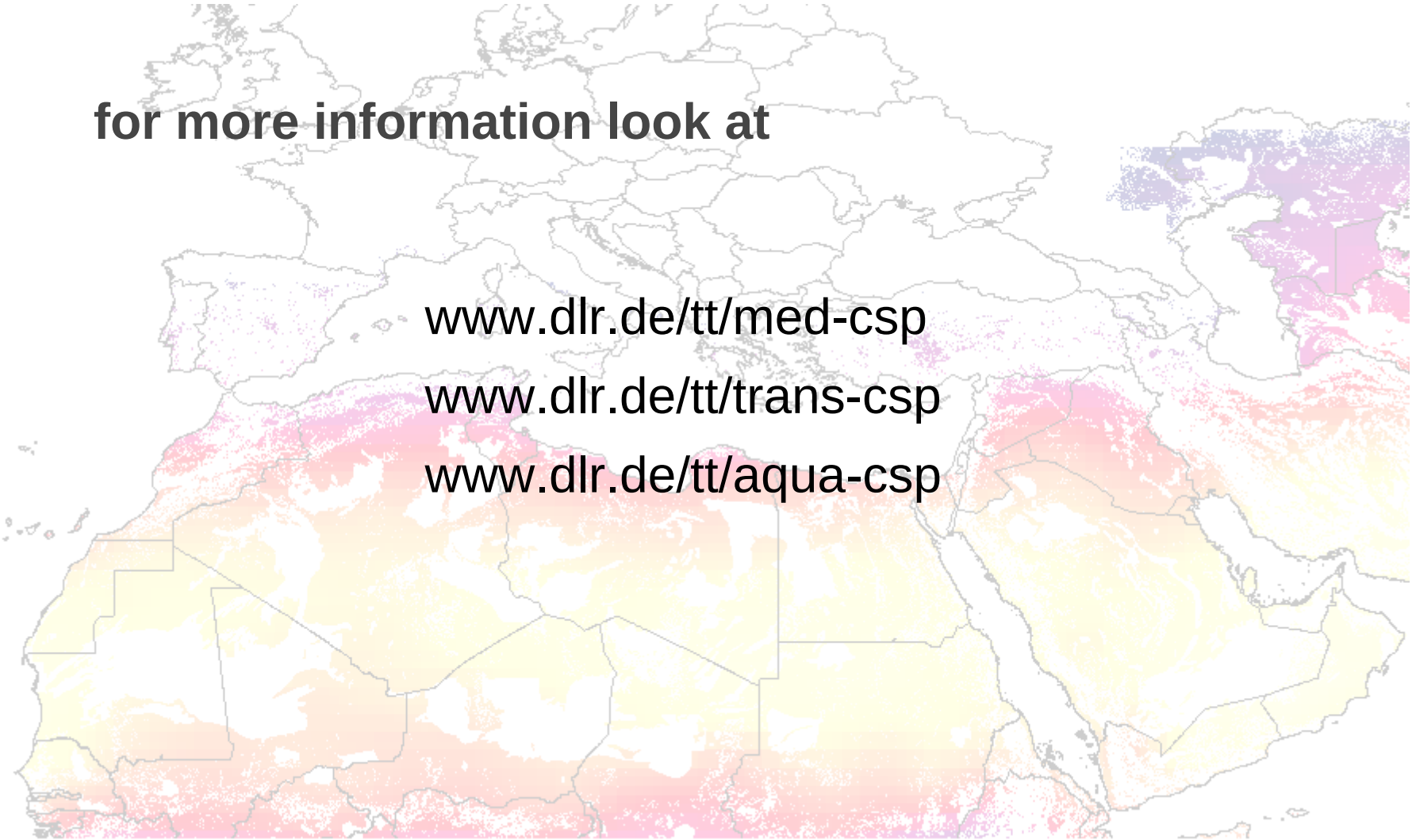


Conclusions

- Within 15 years, a well balanced electricity mix may lead to less expensive electricity than business as usual. Domestic sources reduce the import of fuels.
- Solar electricity from concentrating solar power stations in MENA can provide firm capacity for base load, intermediate and peaking power.
- The most efficient and economic way to transfer electricity from MENA to Europe is via high voltage direct current transmission lines, adding about 1.5-2 cents/kWh to the local generating cost.
- By 2050, 700 TWh/y solar electricity could be imported from 20 locations in MENA at a cost of 5 c/kWh, providing about 15 % of European electricity demand.
- To establish and maintain such a trans-national HVDC electricity grid, strong political support will be required.

for more information look at

www.dlr.de/tt/med-csp

www.dlr.de/tt/trans-csp

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