



# Potential of Concentrating Solar Power for the Combined Production of Water and Electricity in MENA Countries

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# The MENA Water Outlook Project

- Project supported by the World Bank
- In collaboration with Governments in the MENA Countries
- Objectives:
  - review of desalination potential in combination with CSP
  - development of a water supply scenario for MENA



**FICHTNER**

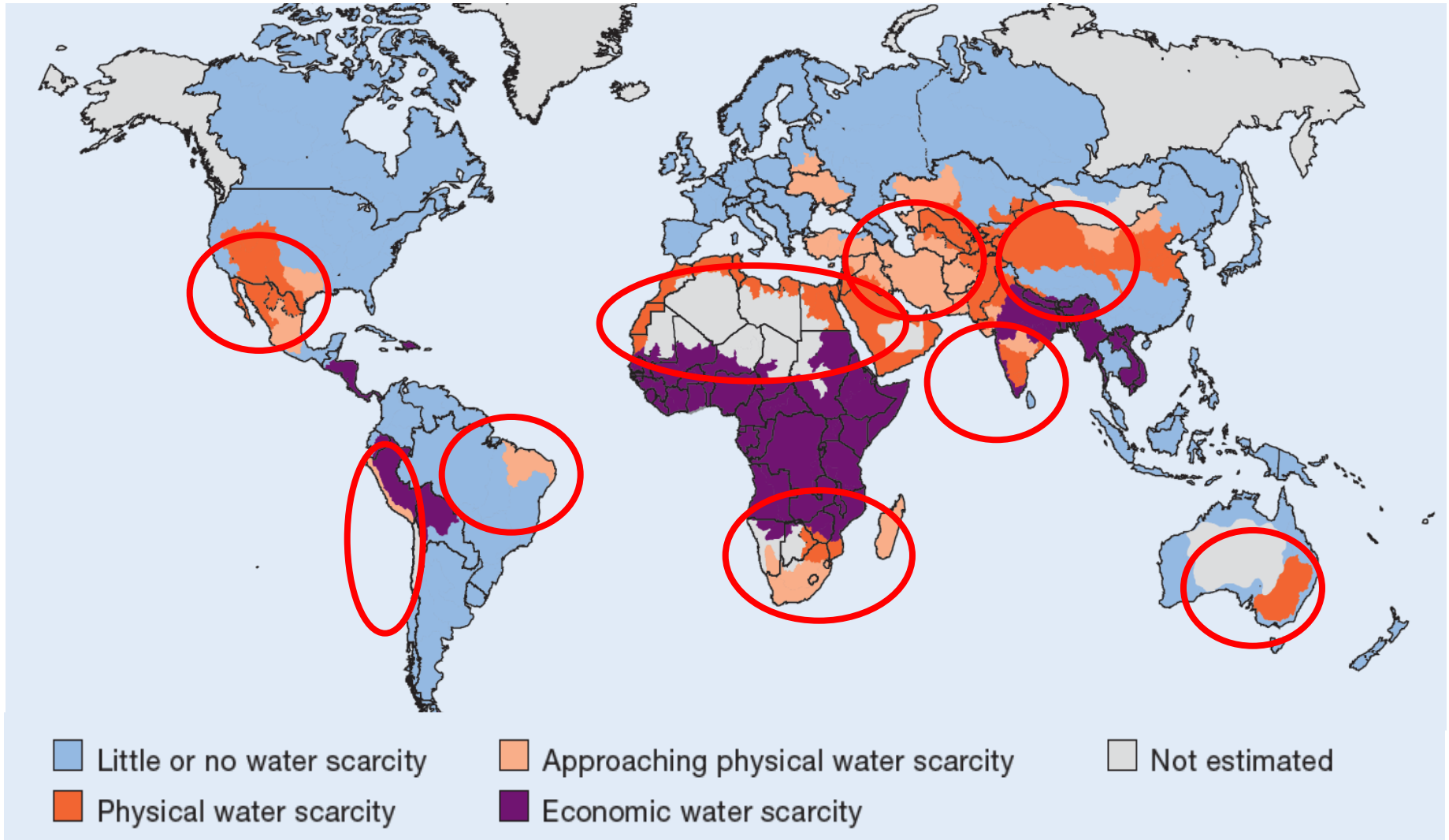


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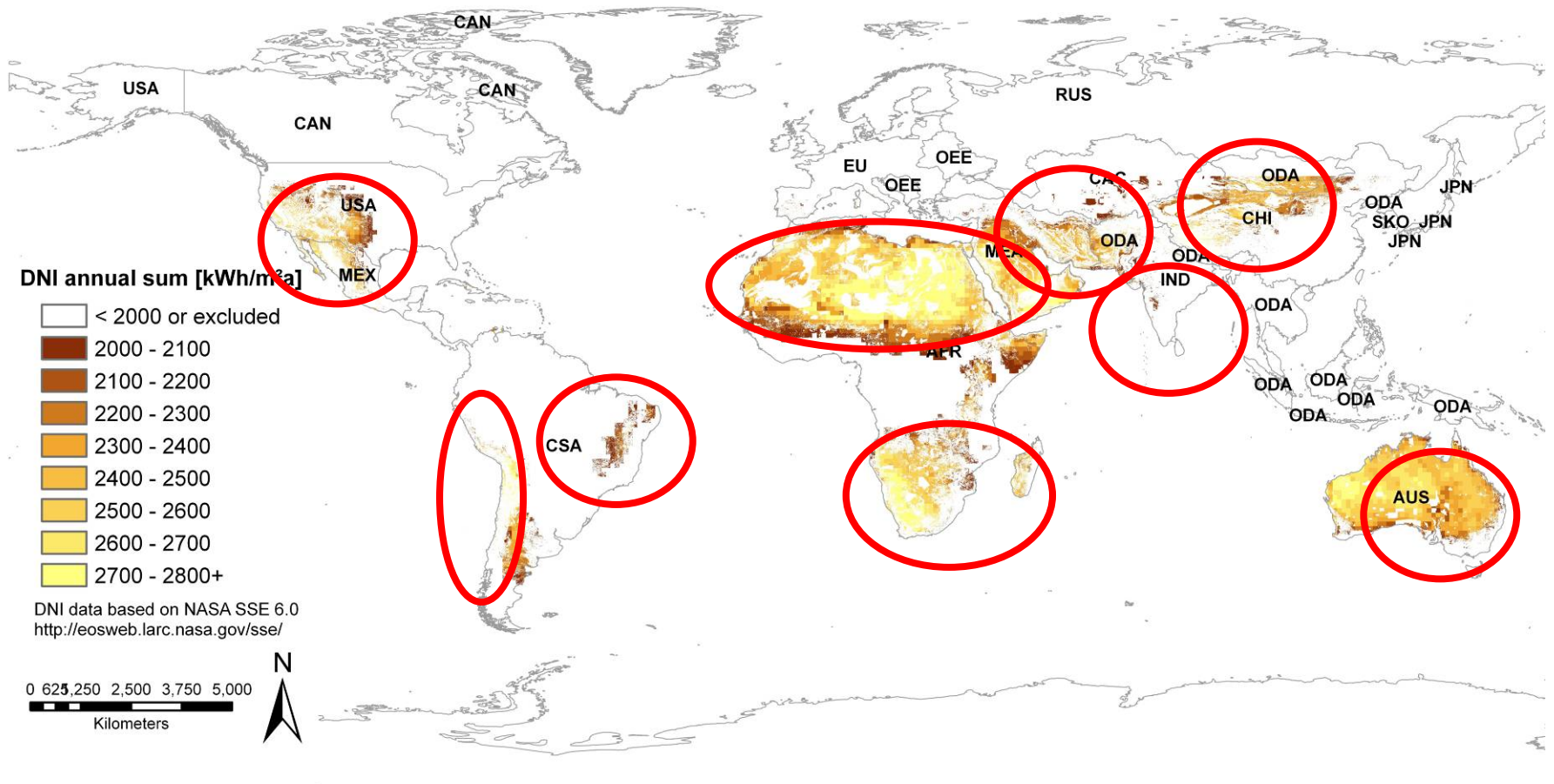


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# Global Water Scarcity



# Global Potential for Concentrating Solar Power

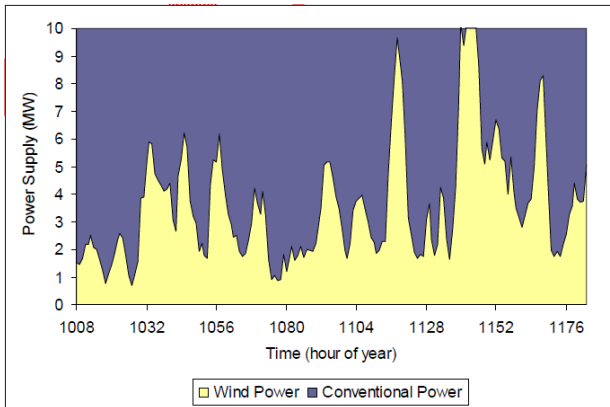


Data provided by  (2008) for EU-project REACCESS

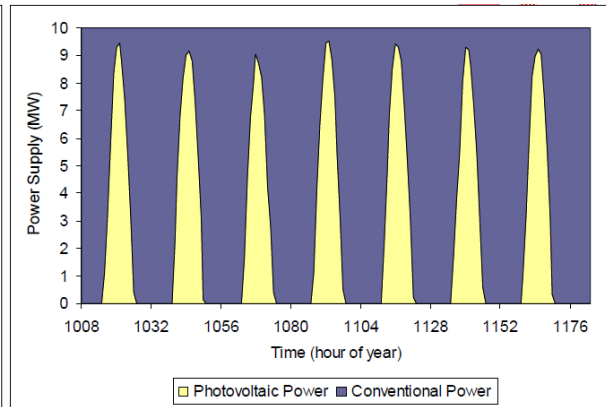
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**Source: REACCESS 2009**

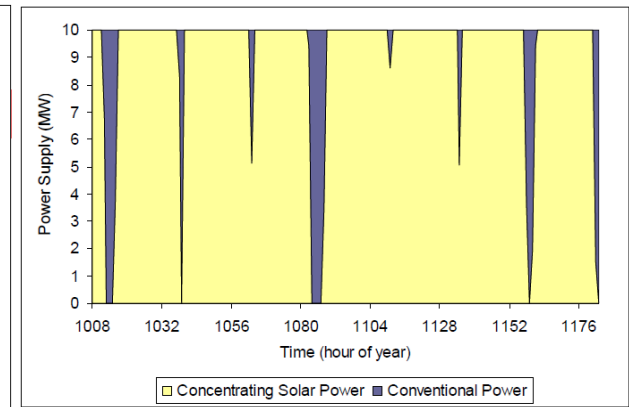
# Renewable energies for desalination: why CSP?



Wind



PV



CSP

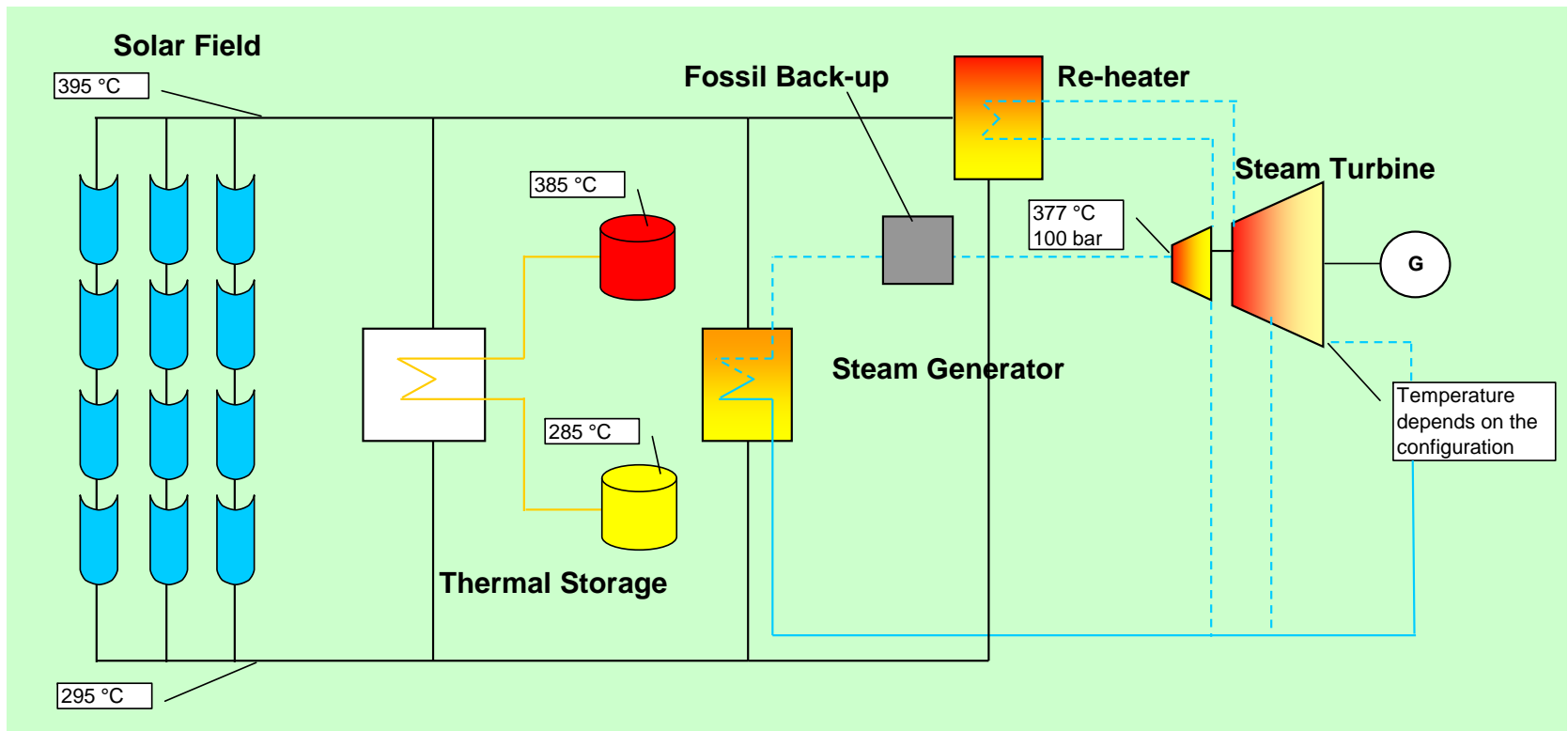
Desalination plants require continuous operation

- Conflict with the intermittent nature of renewable energies
- CSP offers the option of thermal energy storage
- Hybrid operation is possible in the same power block (no “shadow power plant” required)

# CSP Technology Overview



# CSP Scheme



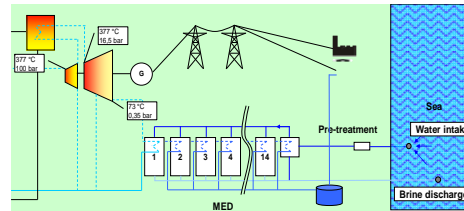
# Project structure

## Water Demand Model



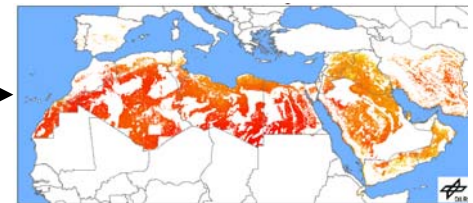
- Climate change models
- Monthly approach for water scarcity calculation
- Result: water deficit per country/sector in the period 2000 - 2050

## Configuration of typical CSP+DES plants



- Different configurations considered
- Result: typical land use

## CSP Potential in MENA

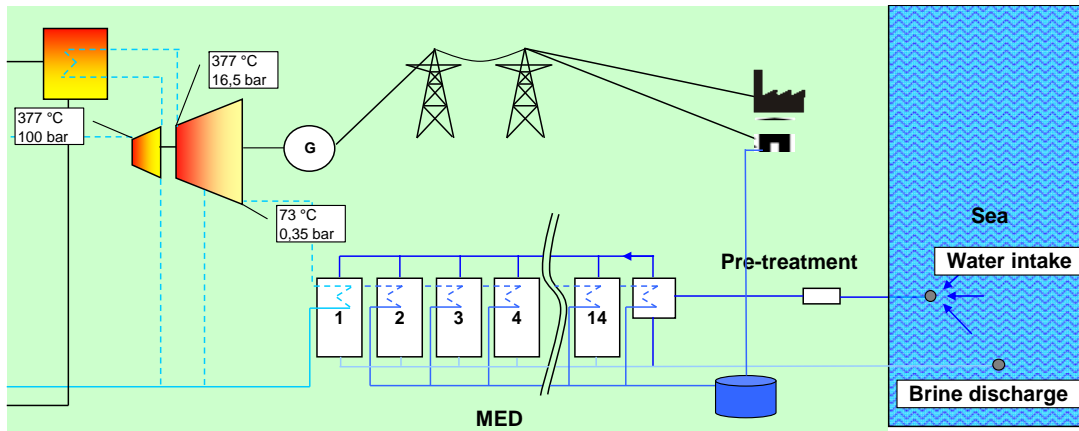


- GIS analysis
- Exclusion map overlay
- Result: Area of suitable areas for CSP+DES plants

## Water Supply Scenario for MENA



# Analyzed configurations



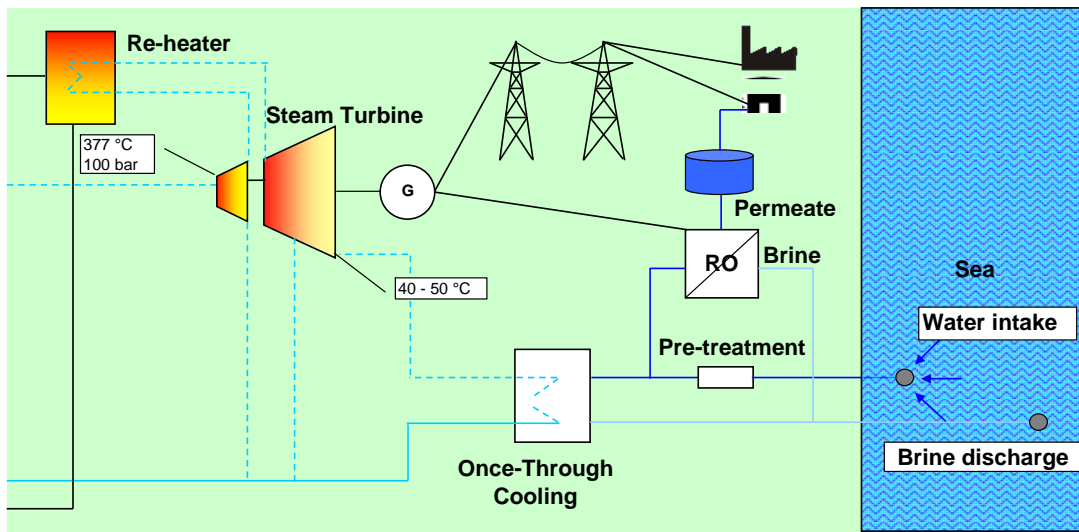
- 2 desalination technologies:  
MED: Multiple-Effect-Distillation  
RO: Reverse Osmosis

- Desalination: 100,000 m<sup>3</sup>/d
- Power: ca. 100 MW<sub>el</sub>
- Storage: 7.5 h (design)

- Plant operation: base load (8,000 h/y) with fossil fuel back-up

- Levelized cost of electricity:  
20 – 24 US\$cent/kWh

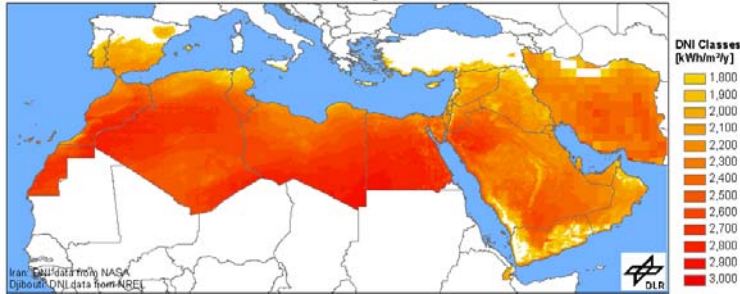
- Levelized water cost:  
1.5 – 1.9 US\$/m<sup>3</sup>



# CSP Potential in MENA

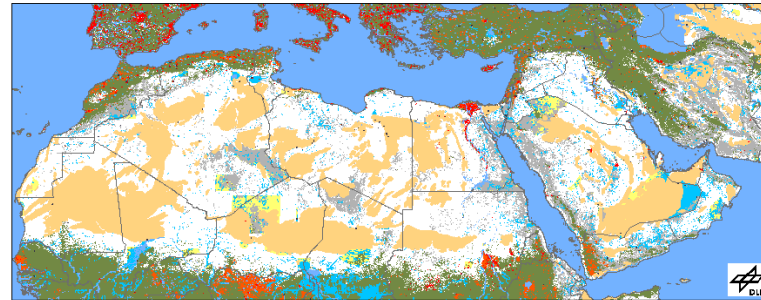
## I. Solar Resource Assessment

Annual Sum of Direct Normal Irradiation [kWh/m<sup>2</sup>/y] in MENA for the year 2002



## II. Land Resource Assessment

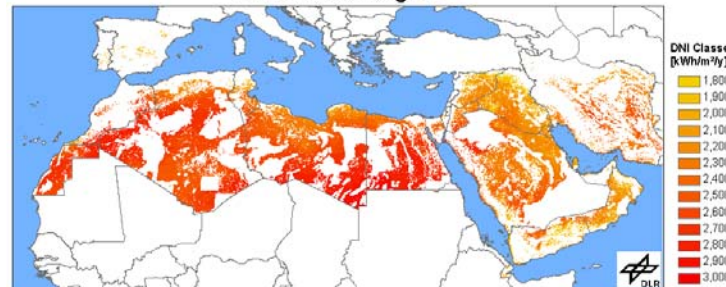
Land Exclusion Map for Concentrating Solar Power in MENA



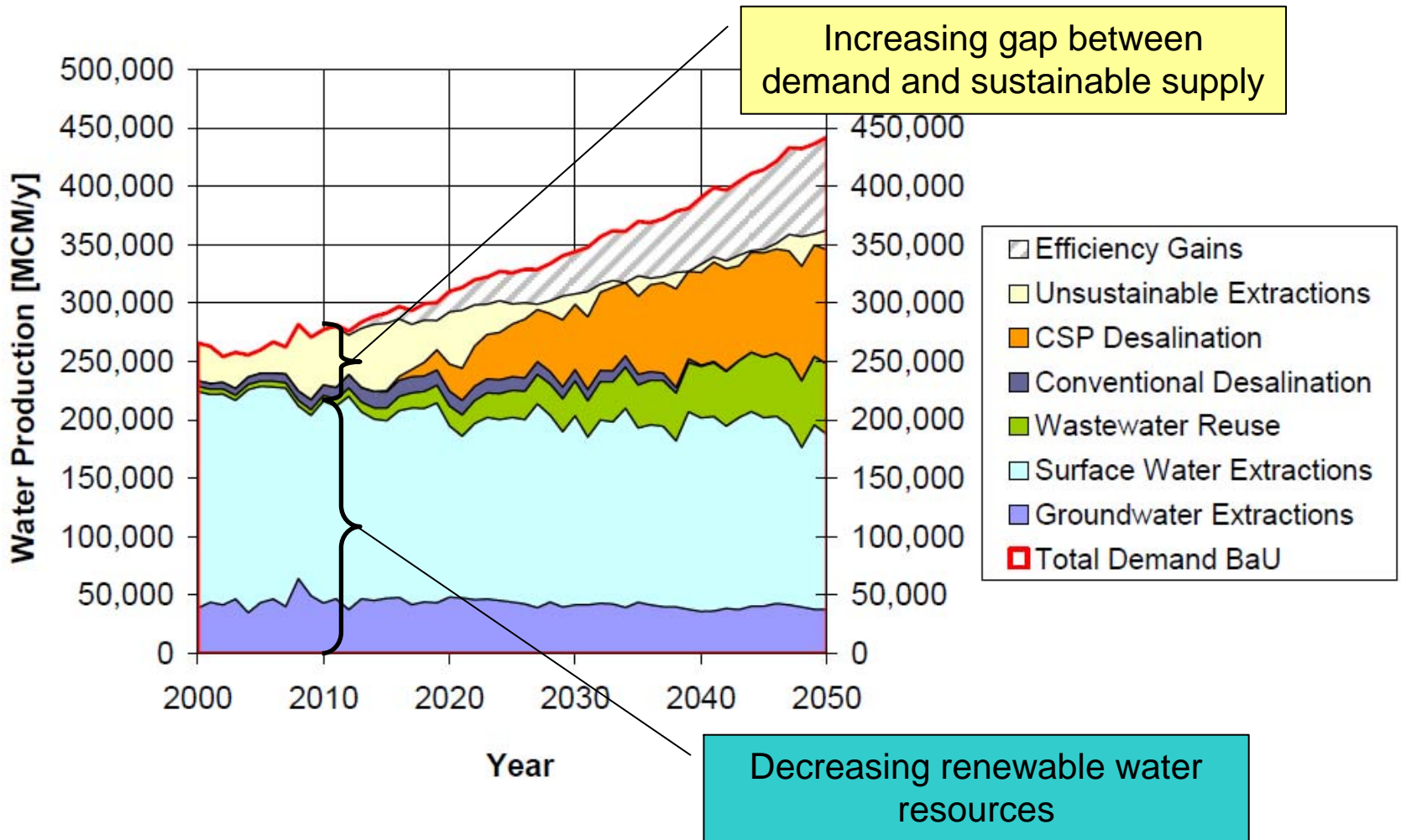
- Exclusion Criteria**
- Not excluded area
  - Water bodies
  - Urban areas
  - Population density
  - Infrastructure
  - Geomorphology
  - Hydrography
  - Land cover
  - Topography
  - Protected area

## III. CSP Potential

Concentrating Solar Power Potential in the MENA Region



# MENA Water Outlook water supply scenario



# Conclusions

- High uncertainty on future water availability! Unmet water demand of MENA in 2050 between 85 km<sup>3</sup> and 283 km<sup>3</sup> (average scenario 199 km<sup>3</sup>)
- Yearly adaptation cost US\$ 103 Billion €<sub>2010</sub>.  
Yemen (11.8%), Iraq (7.5%), Morocco (4.7%), Jordan (4.0%) and Egypt (2.4%) will face the highest cost in relation to the GDP.
- Almost all countries have enough potential to develop CSP also on coastal areas
- Start to act now in order to build-up the required industrial capacities. Political support is required!



# Thank you for your attention!

For more Infos:

[www.dlr.de/tt/menawater](http://www.dlr.de/tt/menawater)

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