high RES penetration scenarios – case studies for Germany and Europe - Middle East/North Africa

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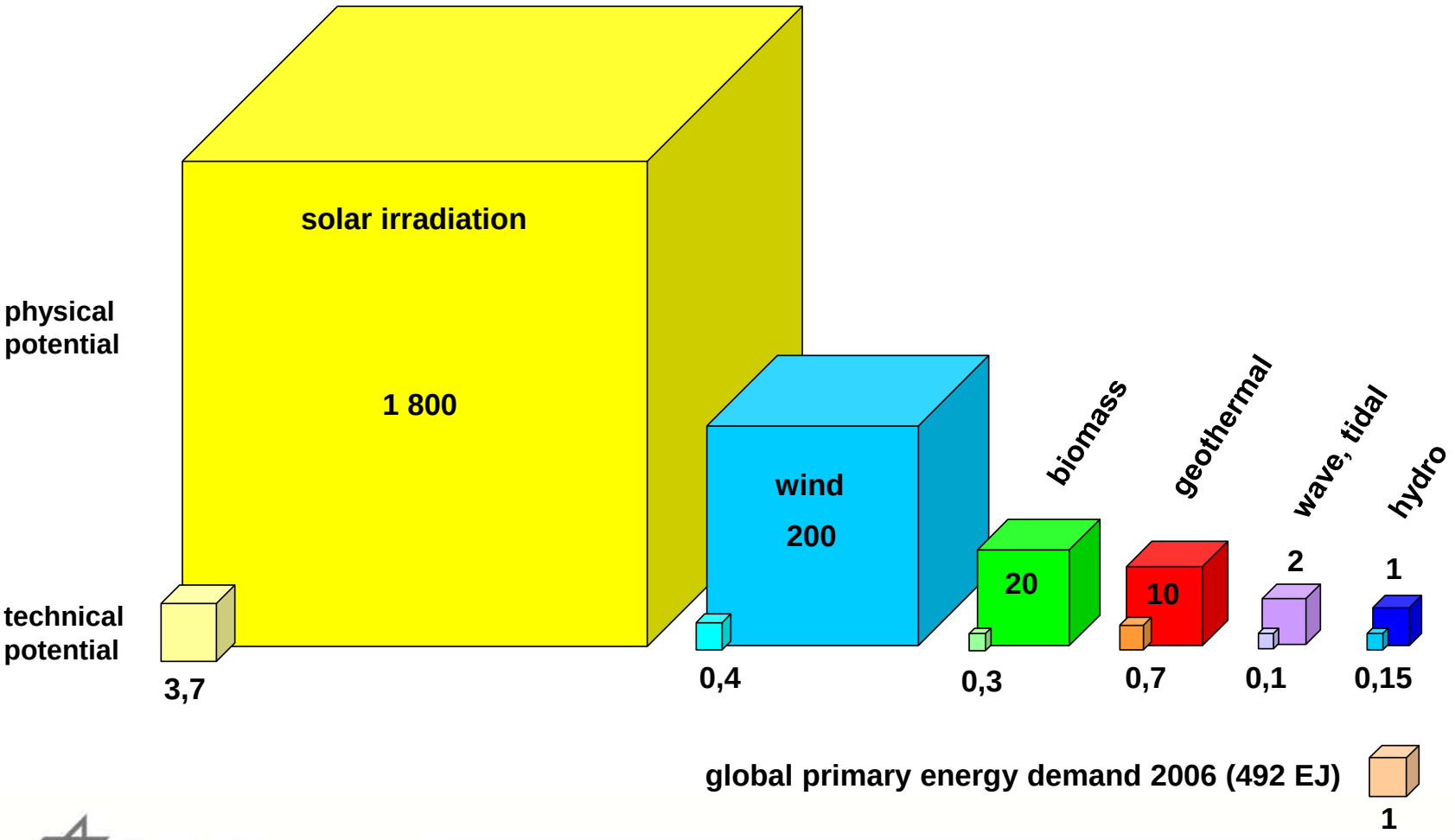
EMF Workshop
Modeling Renewable Energy Technologies in IAMs
August 5, 2009

global renewable energy potential >> energy demand



critical issues related to high RES shares

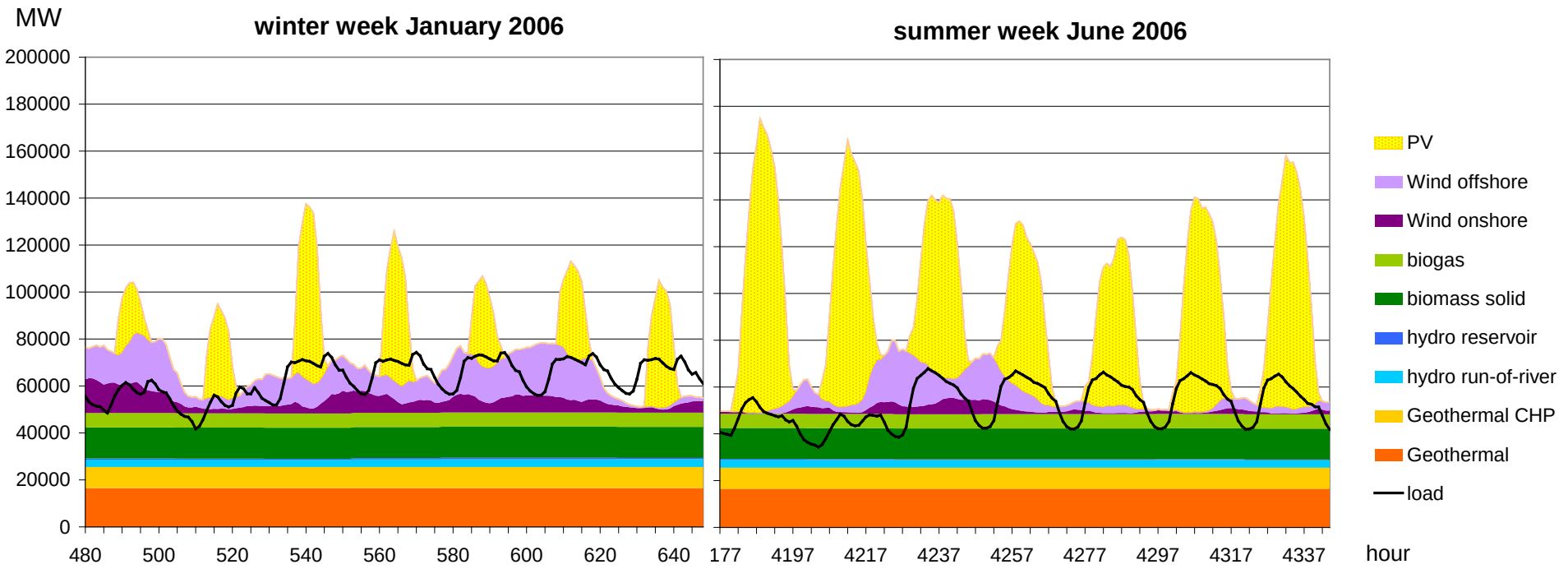
- availability of renewable energy resources
- match load and supply
- compliance with nature conservation and sustainability criteria

case study I: the German ‘Lead Study 2008’ – Strategy to increase the use of renewables in Germany’

Policy targets:

- CO_2 reduction: 40% by 2020, 80% by 2050 (compared to 1990)
- increase energy productivity by 3% per year until 2020
- renewable energies:
  - electricity: 30% by 2020
  - heat: 14% by 2020
  - primary energy demand: 50% by 2050
- phase out of nuclear electricity generation by 2022

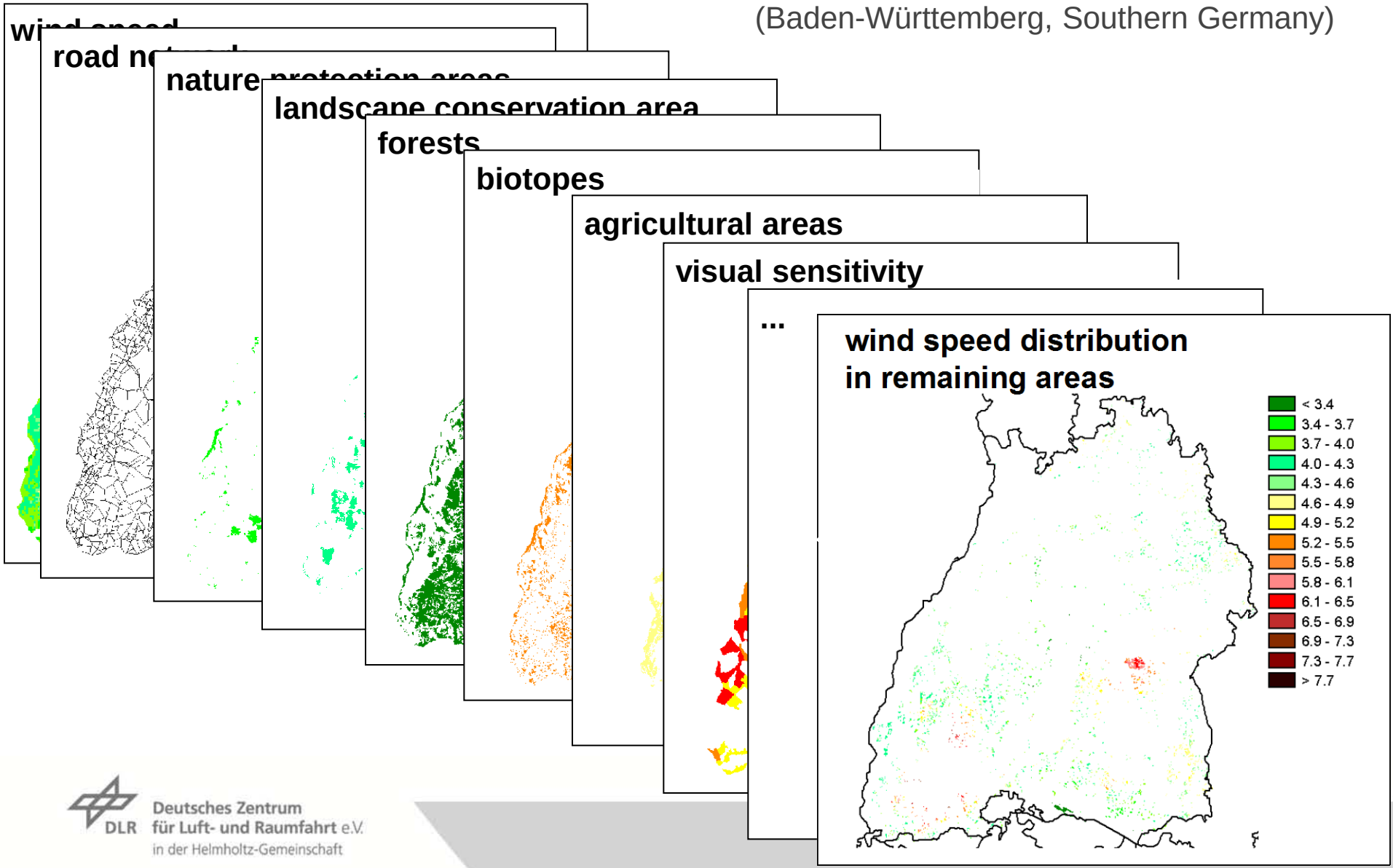
renewable electricity potential in Germany



Source: REMix Model, DLR

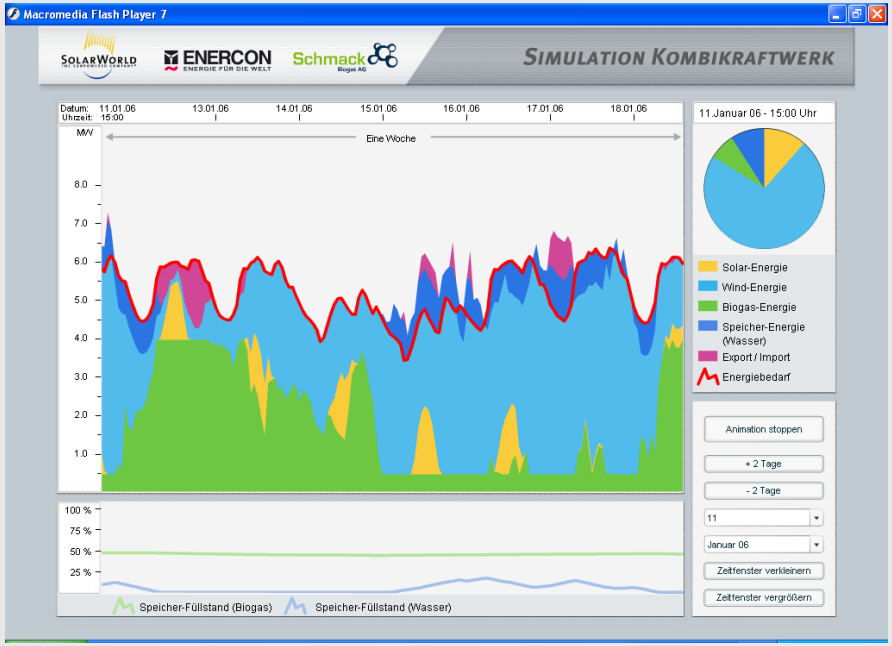
wind energy potential under nature conservation constraints

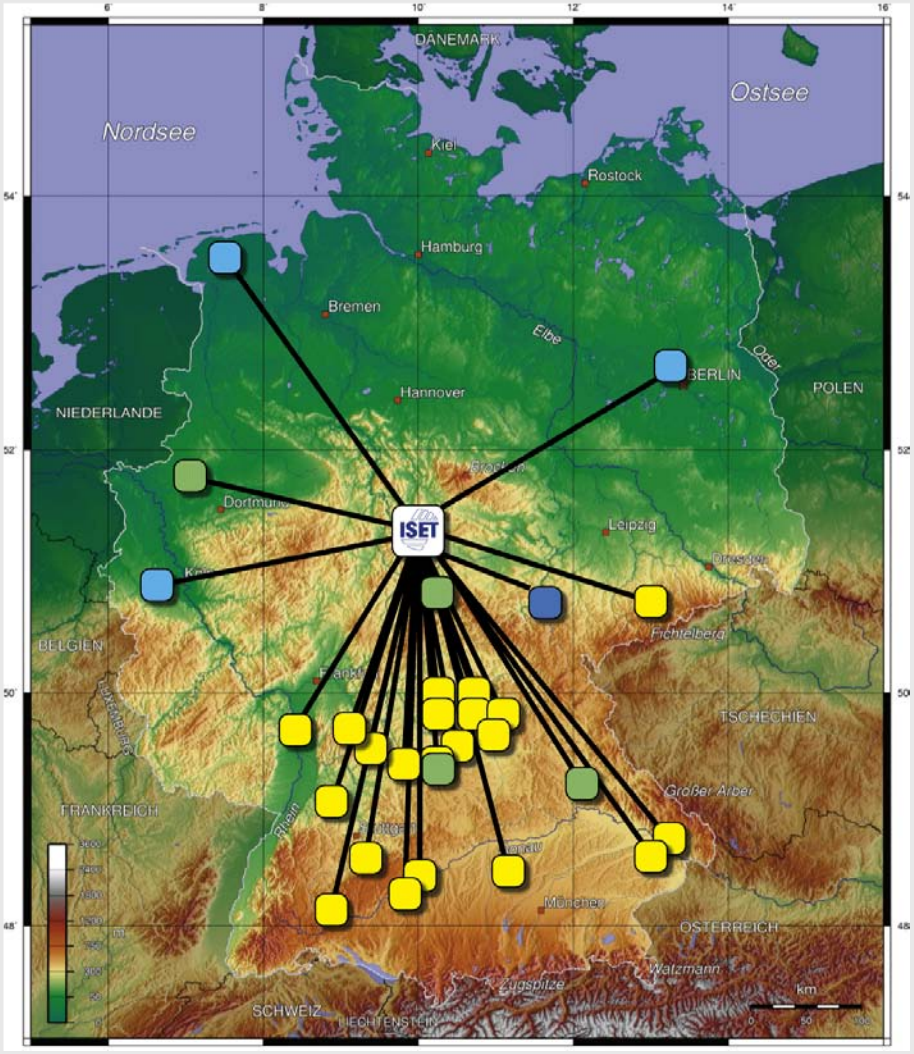
(Baden-Württemberg, Southern Germany)



renewable combi-plant

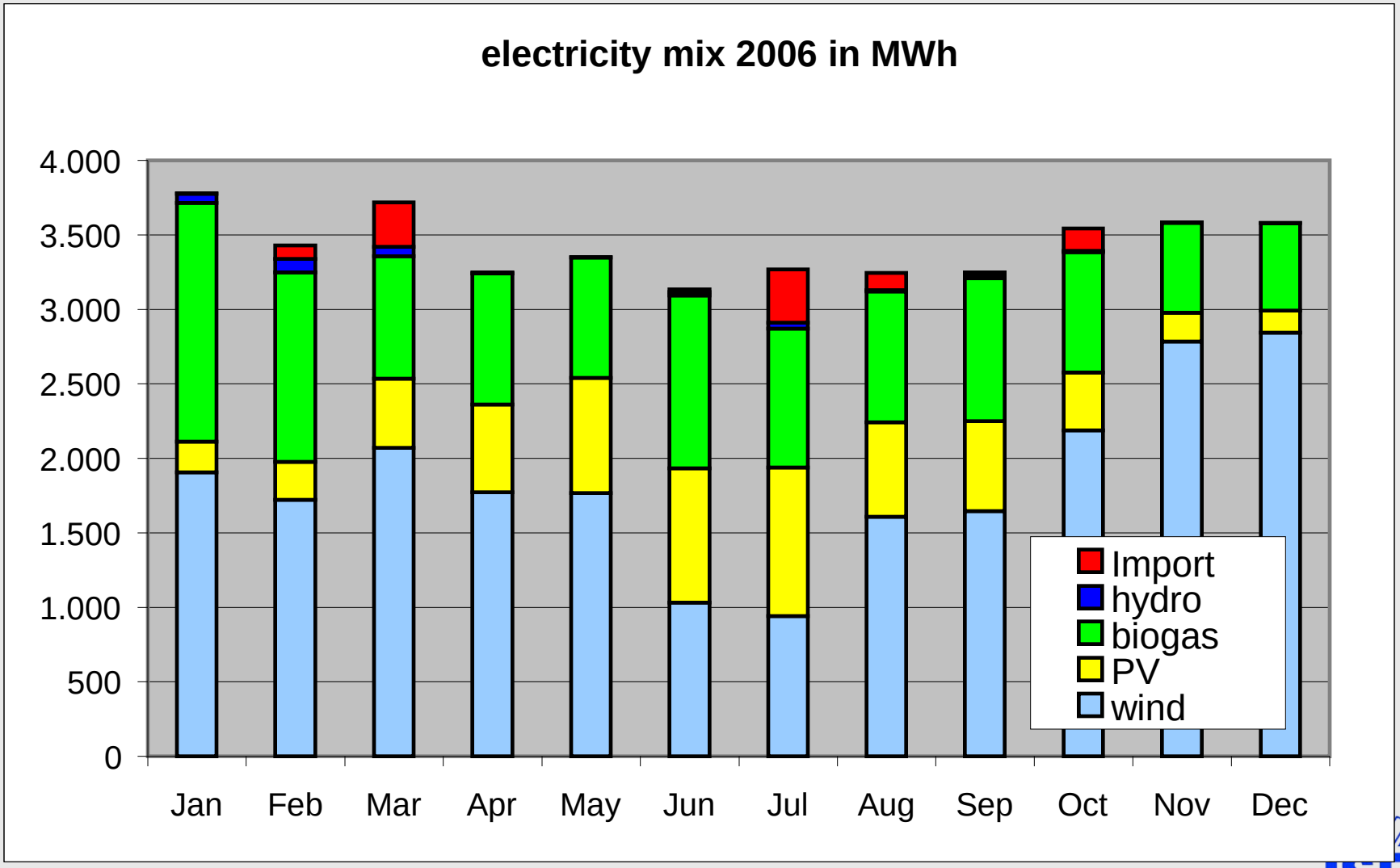
- German load curve scaled down by 1:10,000
- full supply by wind, PV, biogas and pump storage



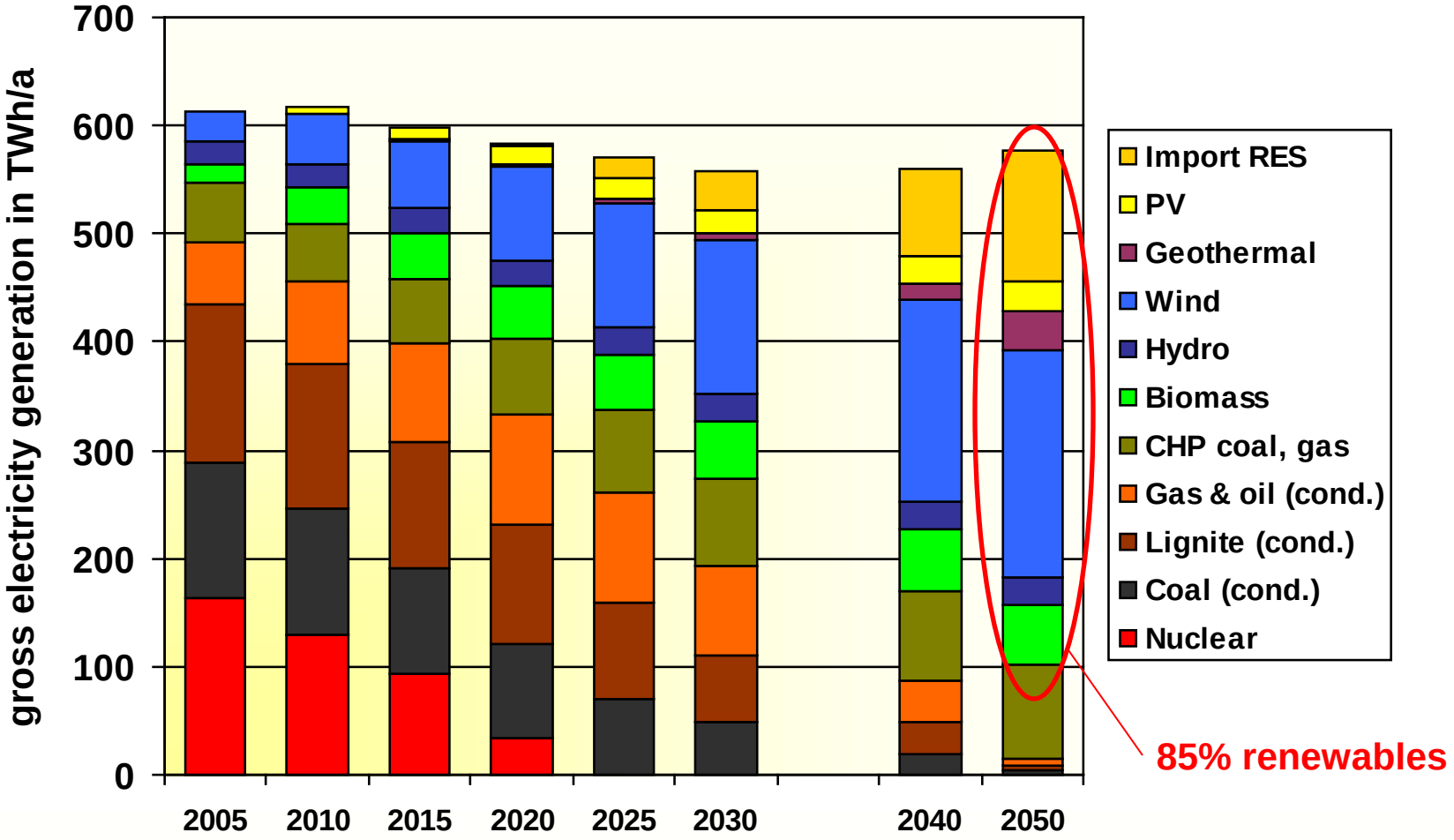


ISET

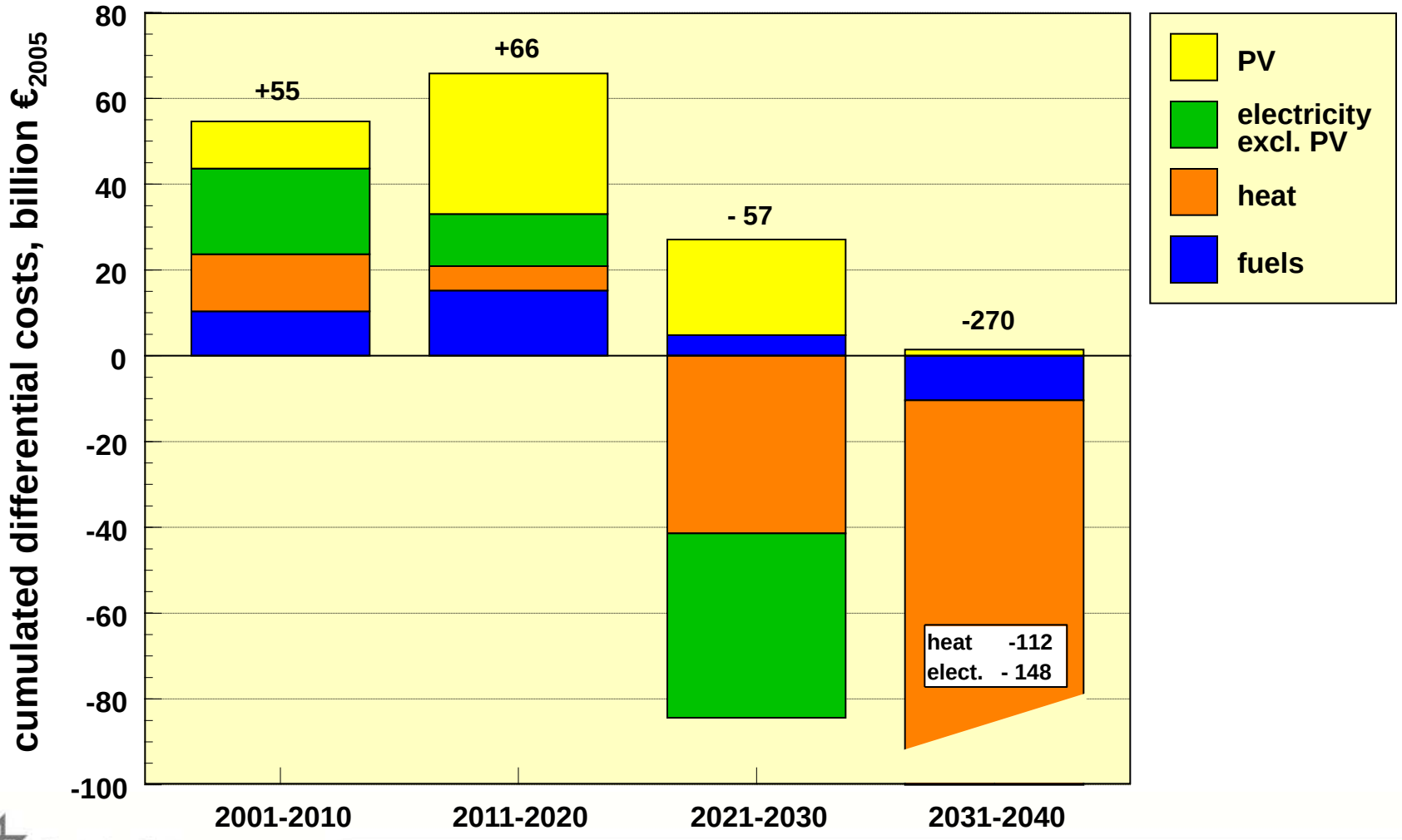
renewable combi-plant



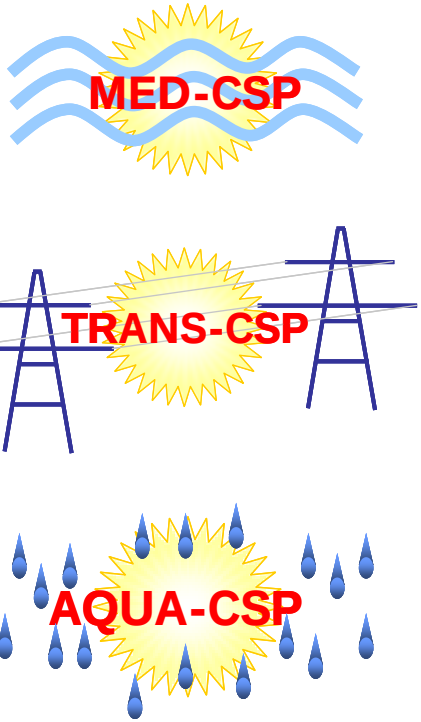
electricity generation in the German ‘Lead Study’

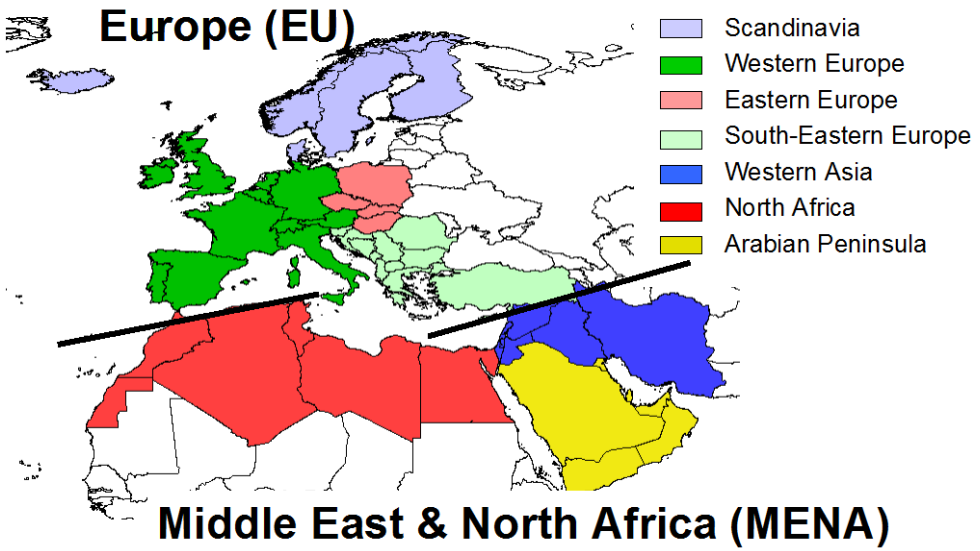


German ‘Lead Study 2008’ – differential costs of RES exploitation



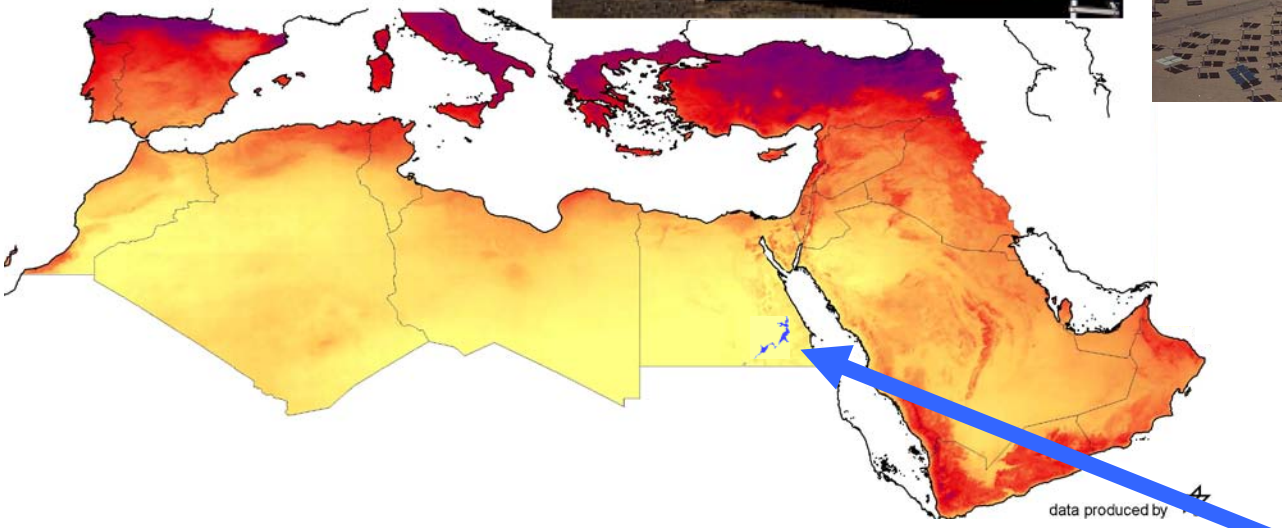
case study II: Sustainable Electricity and Water for Europe, Middle East and North Africa





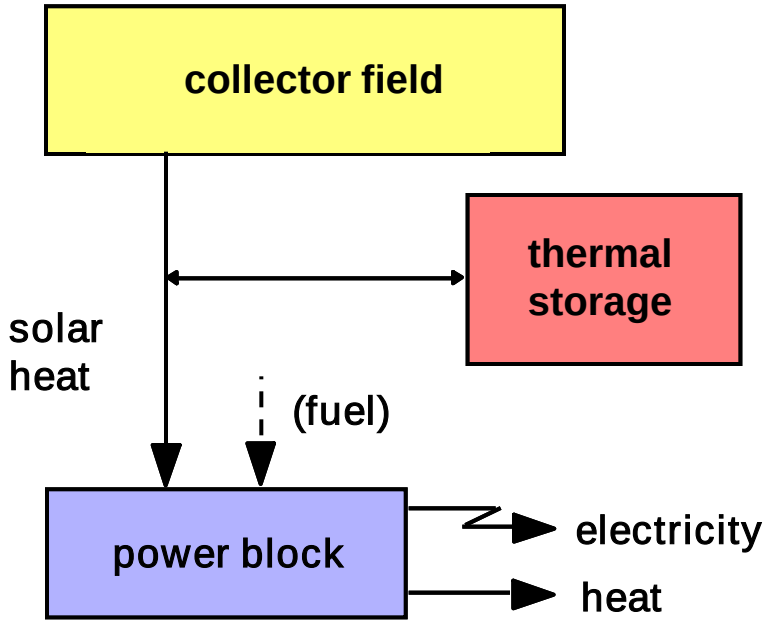
source: Trieb et al.
www.dlr.de/tt/med-csp
www.dlr.de/tt/trans-csp
www.dlr.de/tt/aqua-csp

solar resources in the Middle East/North Africa region



a solar thermal power plant of the size of Lake Nasser (Aswan) could harvest energy equivalent to the annual oil production of the Middle East

concentrating solar thermal power plant with heat storage

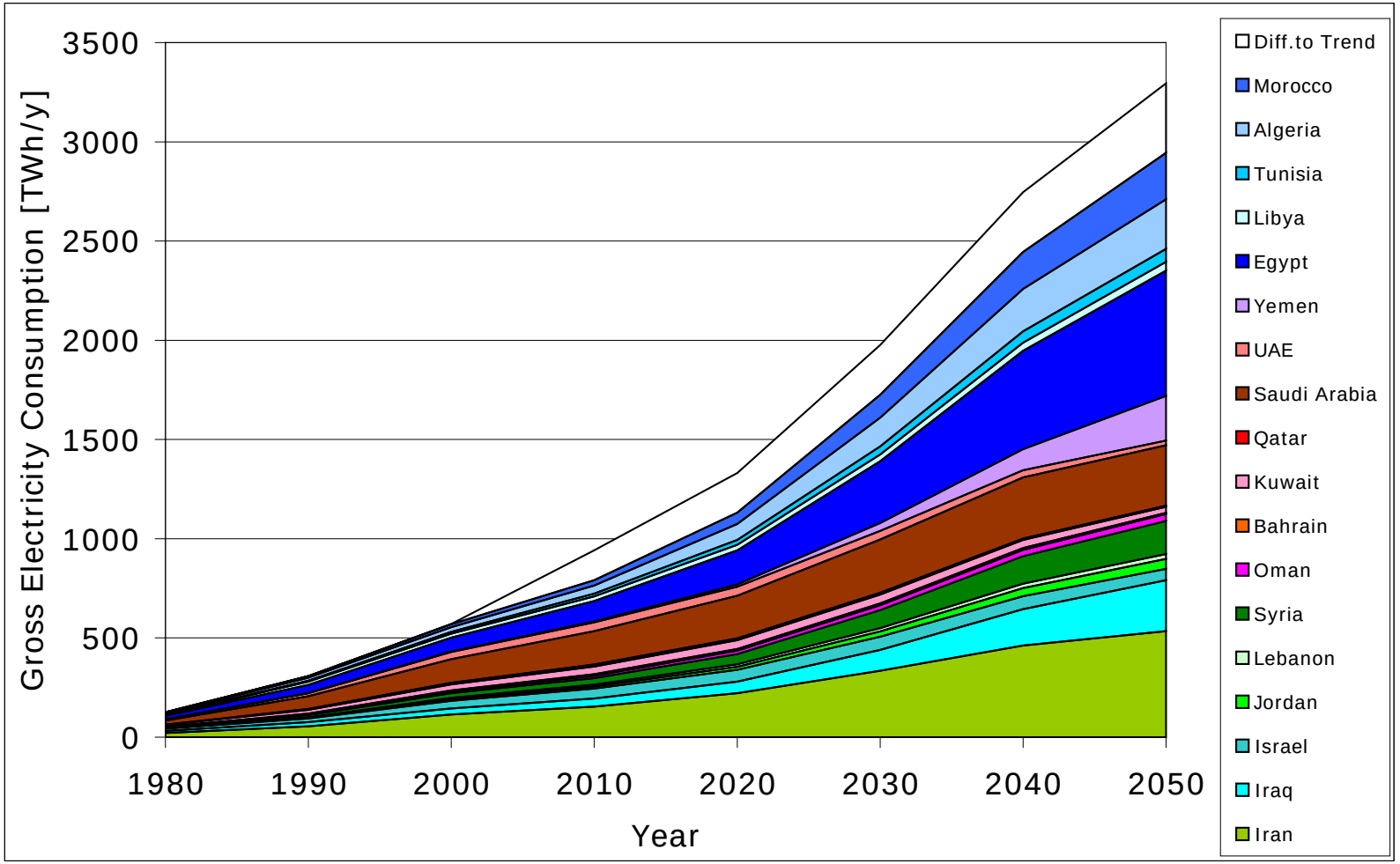


Andasol 1, under construction

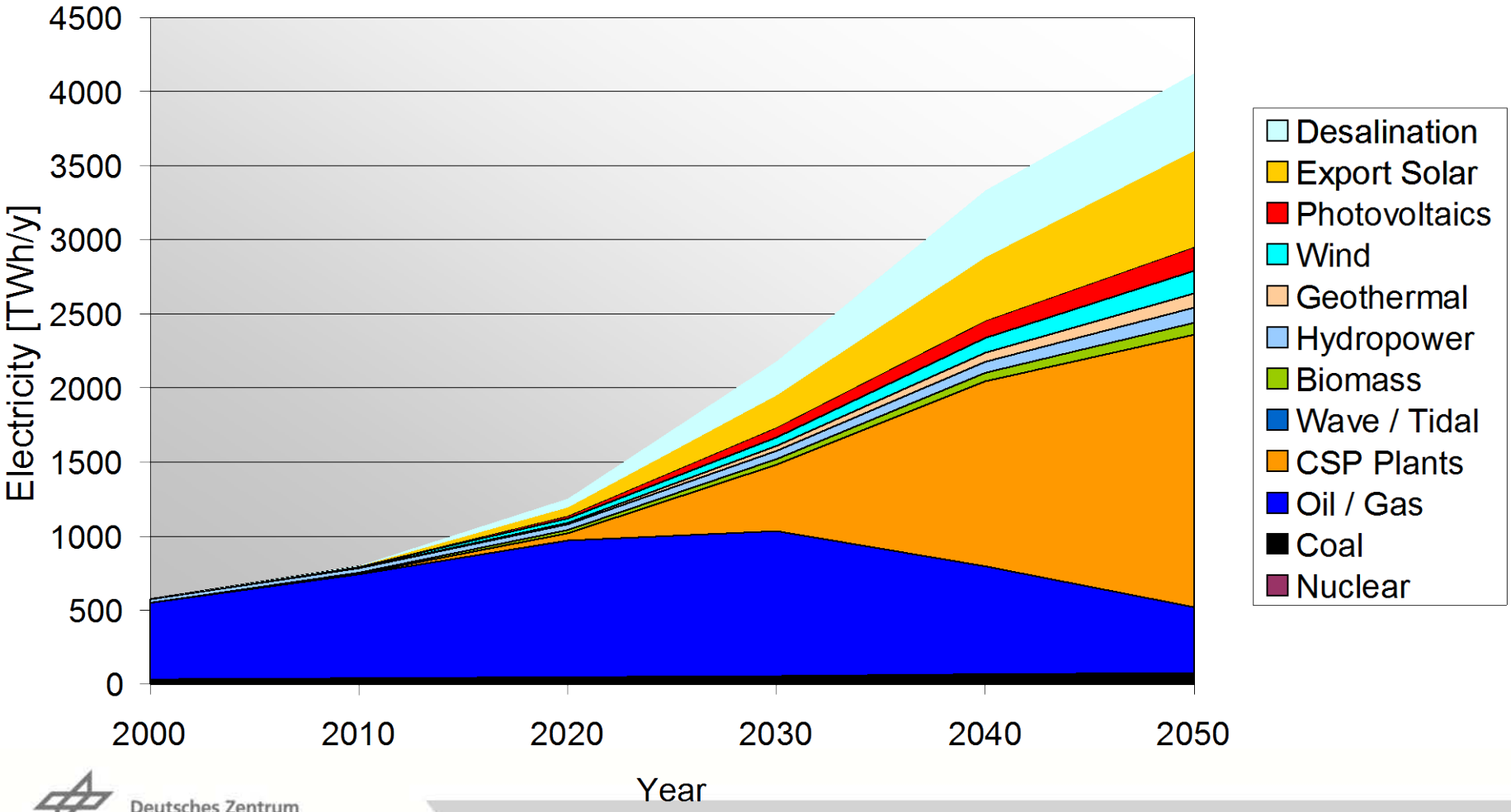
- Andasol 1 (50 MW), Spain: 7 full load hours thermal storage
- dispatchable solar bulk power

Gross Electricity Demand in Middle East and North Africa

(source: DLR MED-CSP)

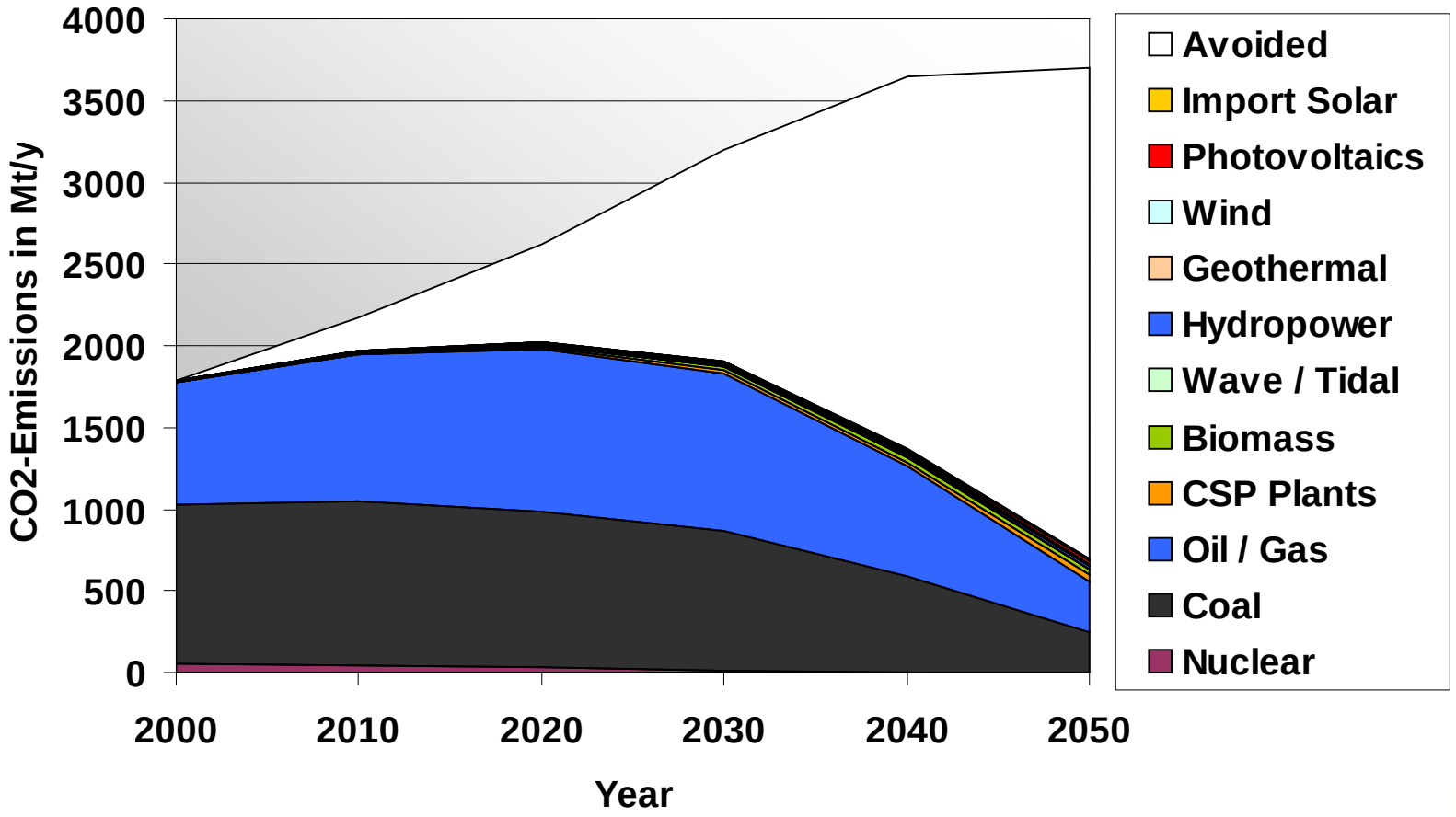


Electricity Supply in the Middle East & North Africa

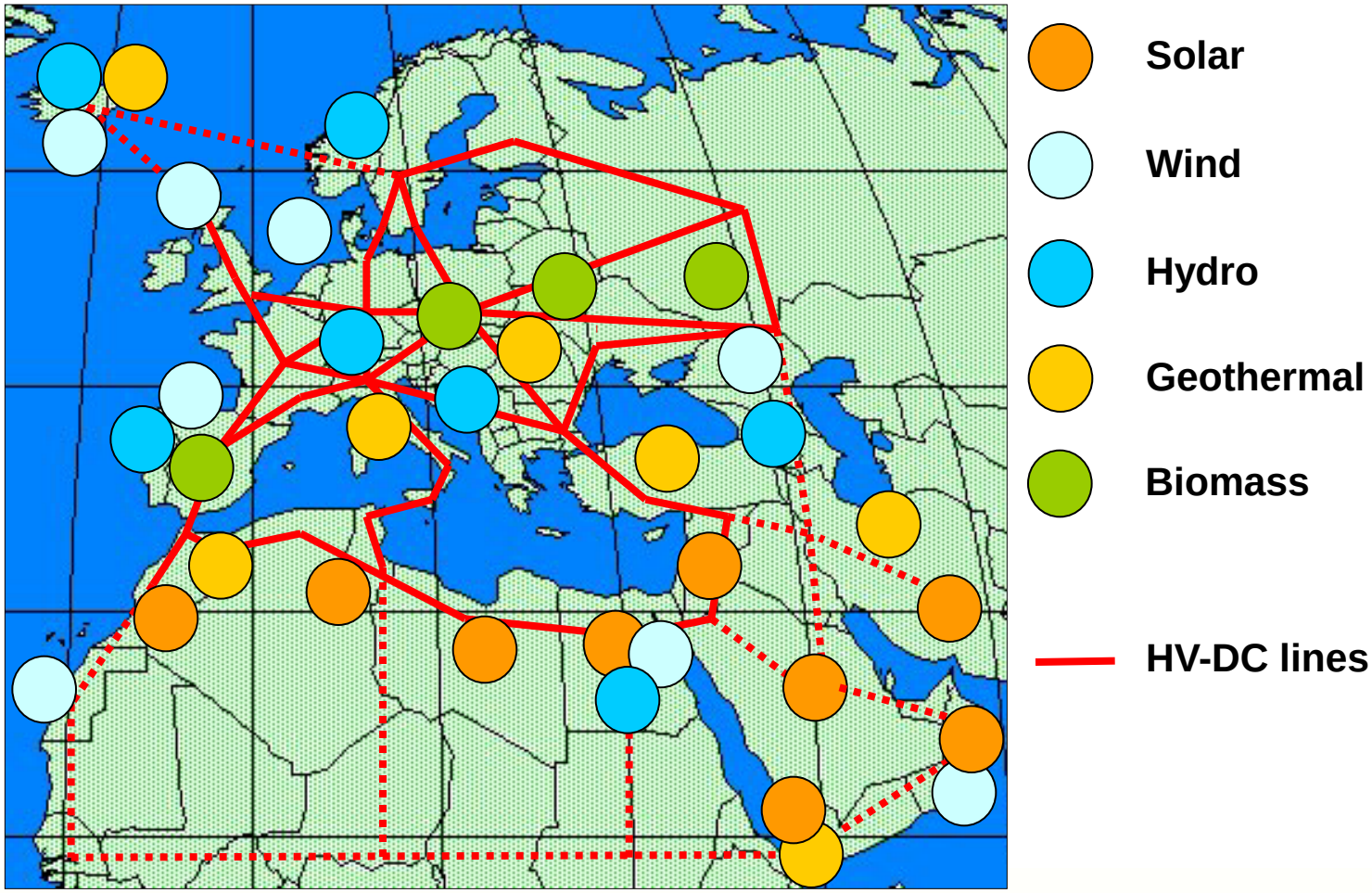


CO_2 emissions from the EUMENA power sector

(source: DLR TRANS-CSP)



Trans-European High Voltage Direct Current Electricity Grid



Munich, July 13, 2009

Assembly of Desertec Industrial Initiative

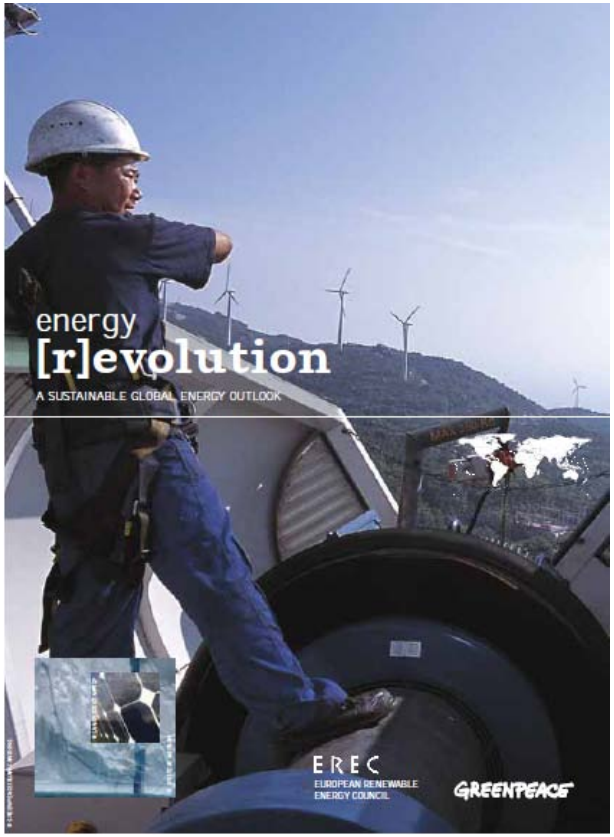
On July, 13 a group of European companies and the DESERTEC Foundation have signed a Memorandum of Understanding with the aim to put the DESERTEC Concept into effect in the EUMENA Region.

source: DESERTEC Foundation / www.desertec.org

discussion

- significant reduction of energy related CO_2 emissions (~ 80%) in Europe is achievable without relying on nuclear and CCS
- exploitation of renewable energies needs to go along with structural and institutional adaptation of the supply system
- renewable energies are often not well represented in state-of-the-art energy system models:
  - renewable energy potentials are not fully used
  - often implicit and artificial constraints to address problem of integrating fluctuating RES sources
- new model developments are on the way to support better representation of renewables

case study III: Energy [R]evolution – a sustainable global energy outlook



DLR/Ecofys
on behalf of and in cooperation with

Greenpeace International

European Renewable Energy Council

Energy [R]evolution - approach

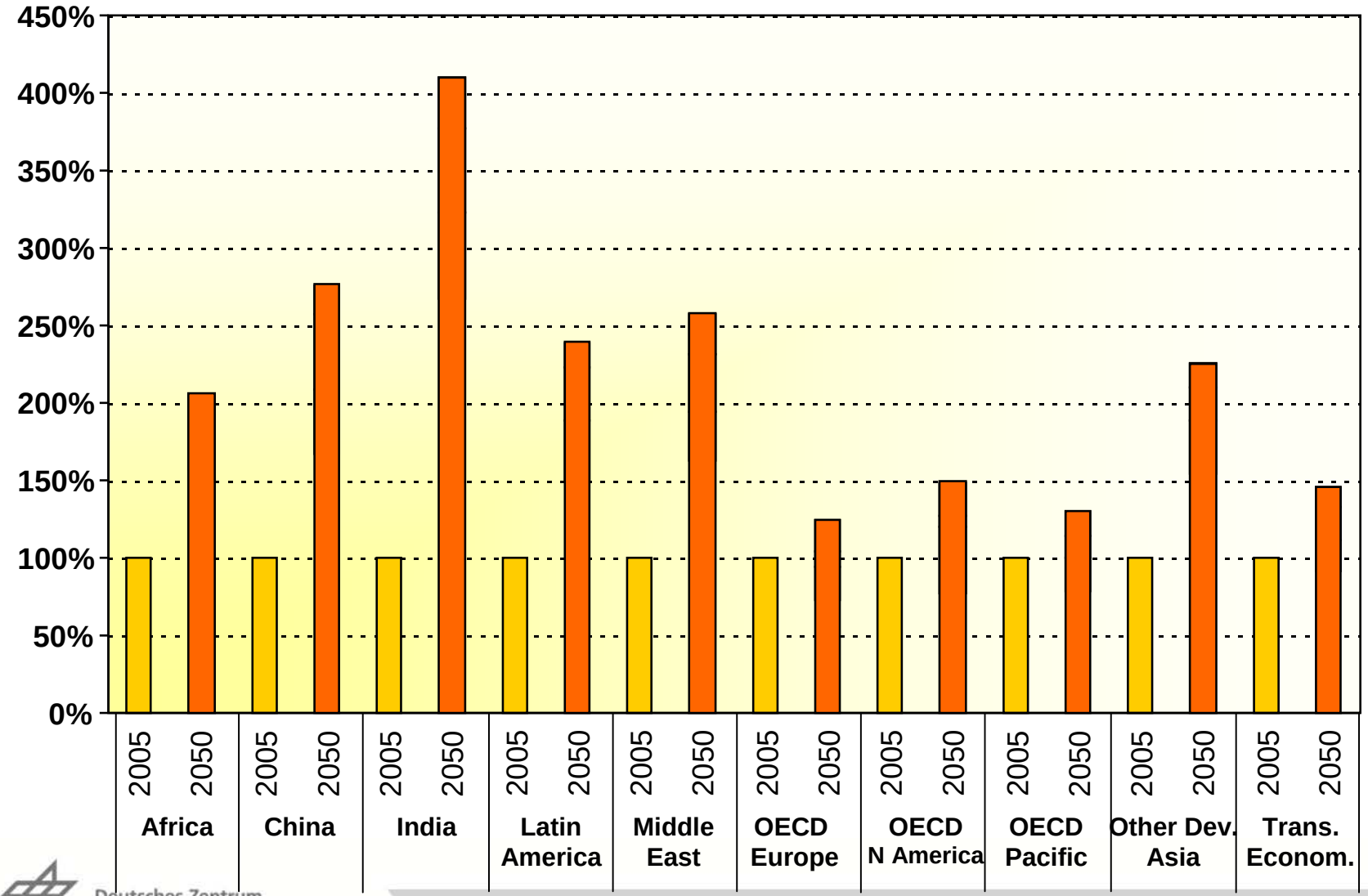
target oriented scenario:

- energy related global CO_2 in 2050: ~ 10 Gt/a
- global phase out of nuclear energy
- economic growth according to IEA assumptions

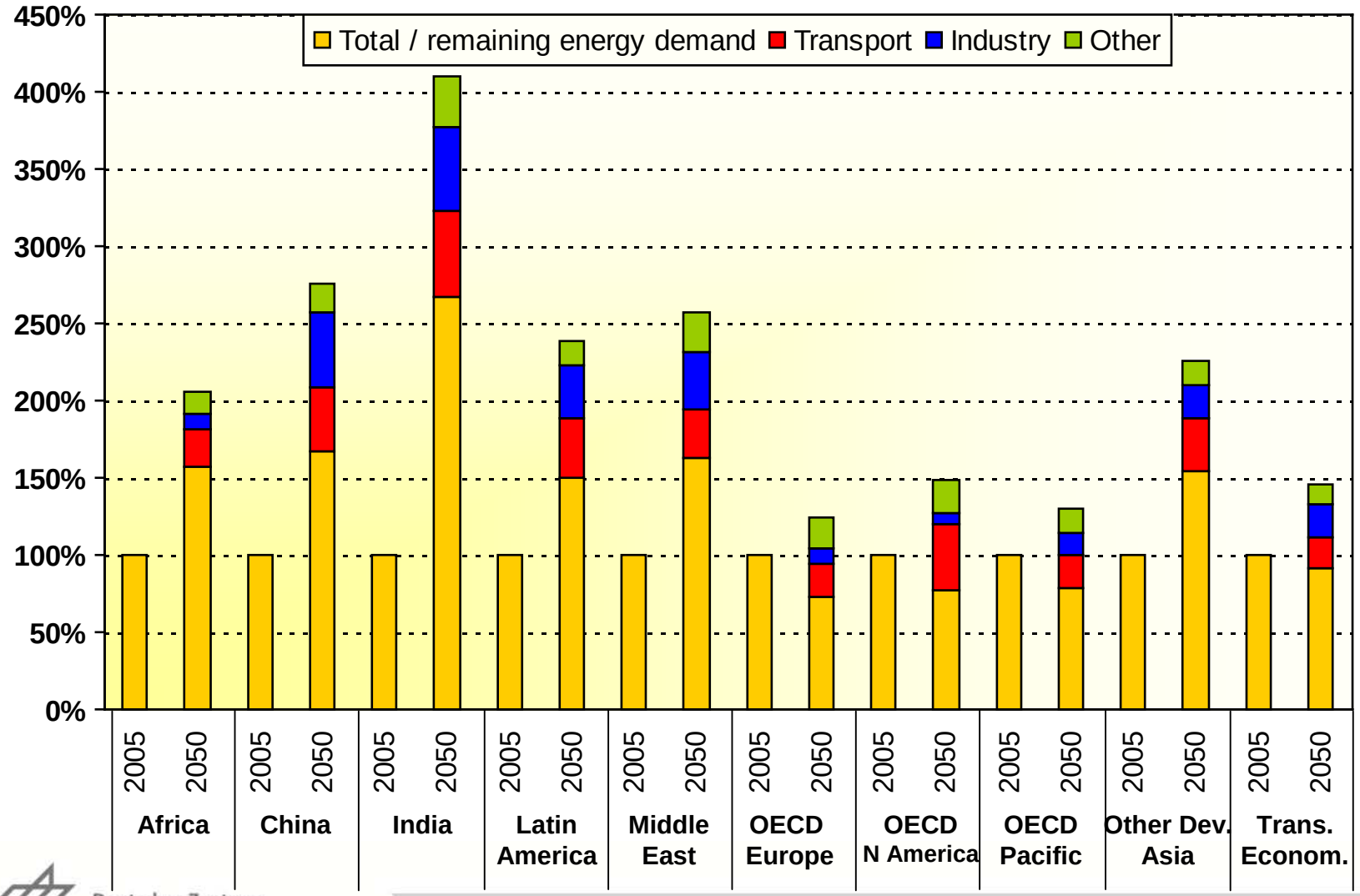
scenario building

- 10 world regions (according to IEA regions) (+ ~ 30 country scenarios)
- review of regional data (demand/supply structure, efficiency potential, RES potential, policy targets, etc.)
- stakeholder workshop with representatives from each world region (industry/academia/NGO)

global final energy demand – business-as-usual

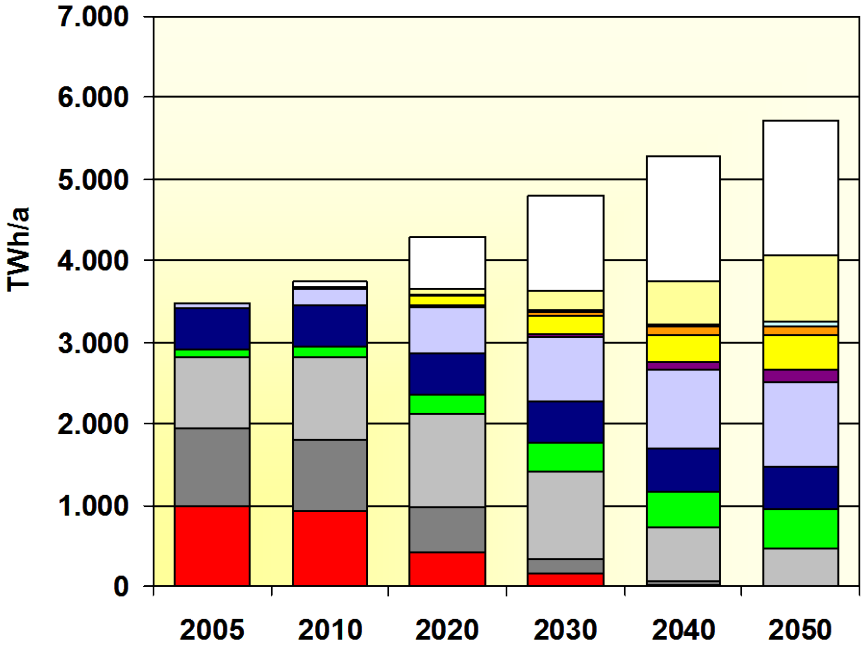


energy efficiency potentials – Energy [R]evolution scenario

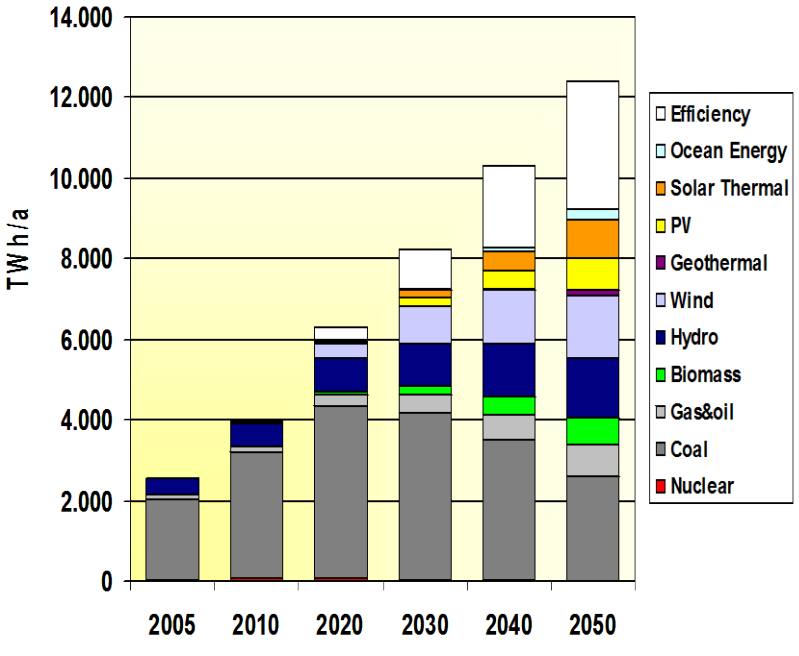


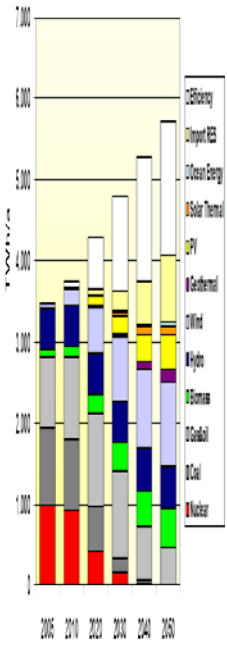
electricity generation - Energy [R]evolution scenario

OECD Europe

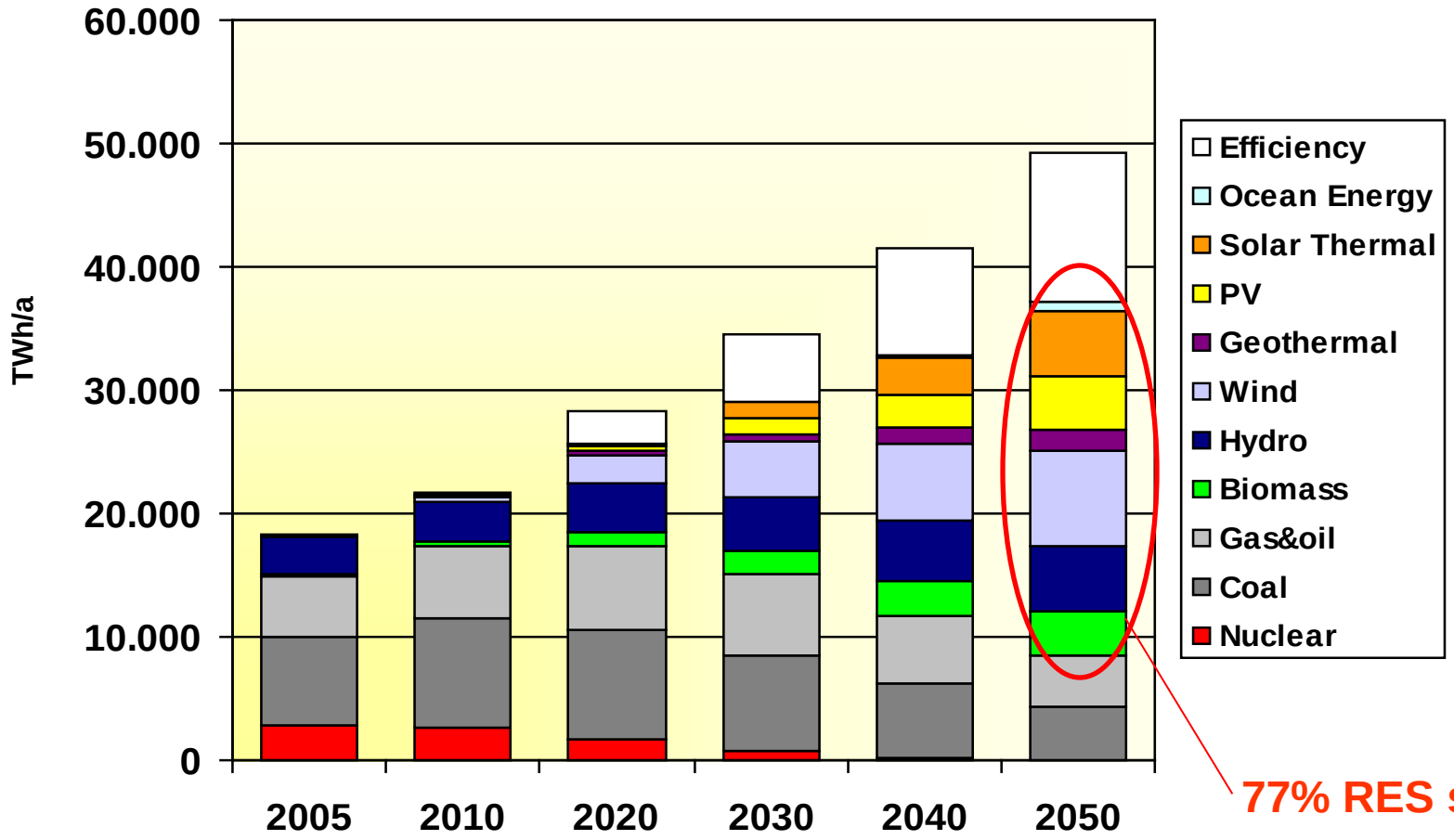


China





global electricity generation – Energy [R]evolution scenario



Energy [R]evolution – 'CO_2 balance' in 2050

(assumption: per capita emission rights of 1 t_{CO2} per year)