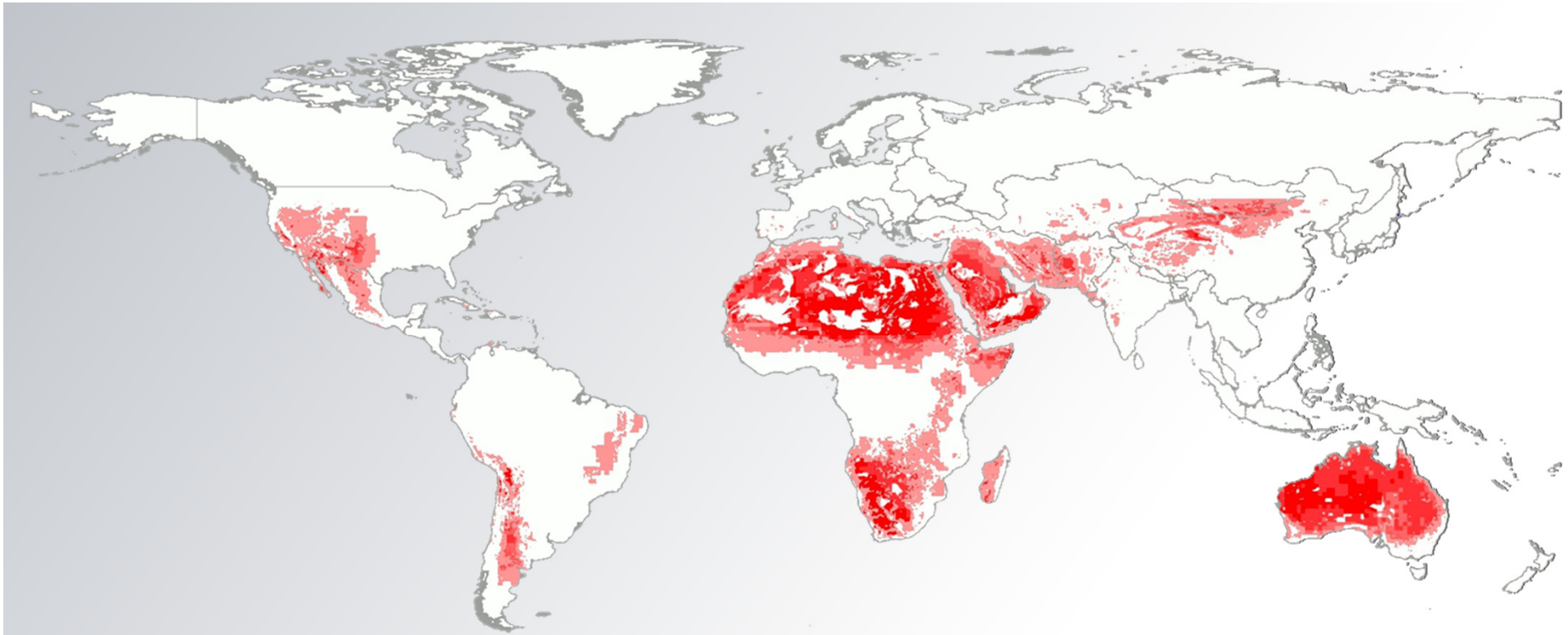

DESERTEC - Clean Power from Deserts

A concept for energy security and climate protection for a world with 10 billion people in 2050

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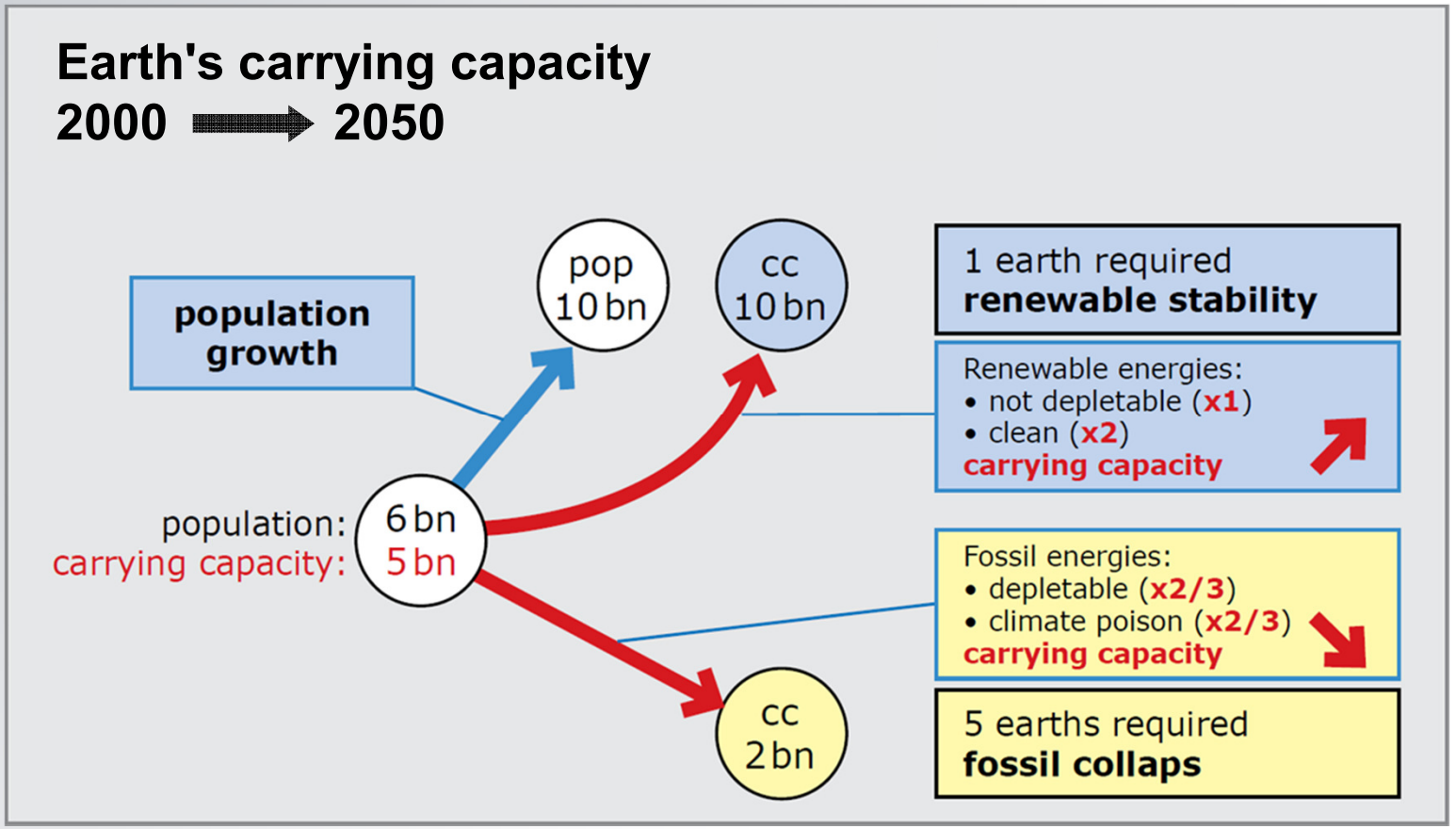
Why DESERTEC?

In 2050, the world´s population will need 3 planets

to cover it´s demand for resources



growth in demand for energy, natural resources and more emissions

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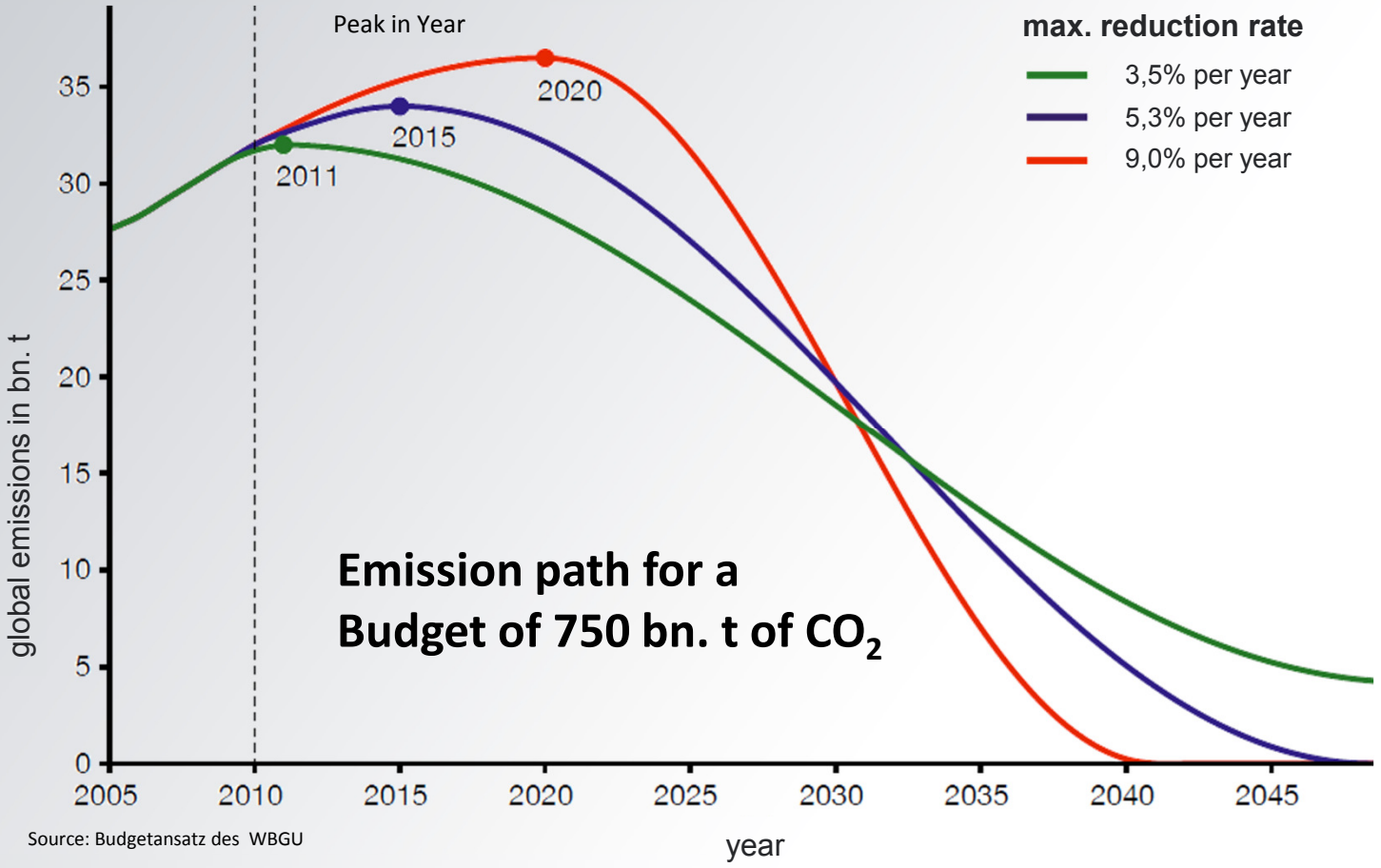
The later our emissions peak,

the more drastic the necessary reductions in CO_2



Source: Budgetansatz des WBGU

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Challenges of a global energy supply

growing energy demand and the threat of climate change

1. **By 2050, the global demand for electricity will more than double**

   - The world population will grow from 7 to between 9 & 10 billion people
   - Developing countries will catch up with industrialized states

2. **Simultaneously, a fast and drastic reduction of CO2 is necessary, in order to prevent catastrophic climate change**

   - At the current rate of growth, CO_2-emissions will breach the suggested limit of 750 metric tonnes of additional CO_2 in 20-25 years
   - At that point it becomes likely that earth warms by more than 2˚C, reaching possible tipping points, leading to runaway climate change

Ethanol Production vs. Rainforest

Reduced CO_2 absorption & increased Ethanol Production

Soybean production in Brazil

1. **CO_2 absorption**

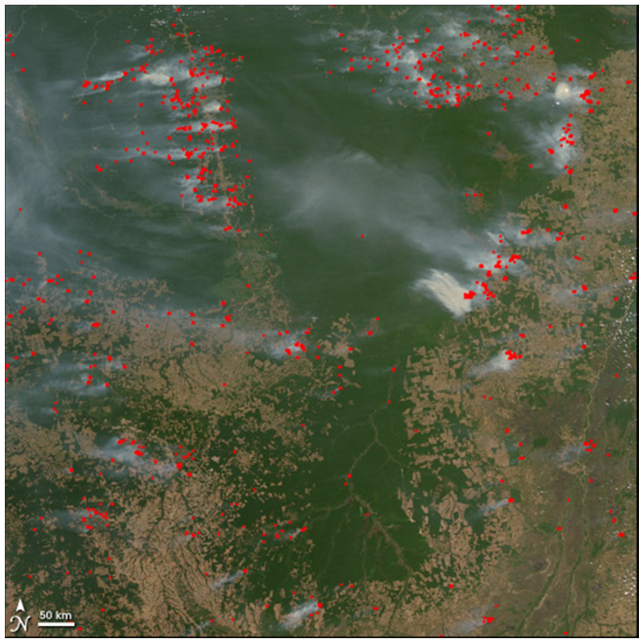
   - ‘Rainforests are responsible for 28% of the world's oxygen turnover’

2. **Deforestation**

   - 2000-2004 increased deforestation
   - Since 2004 slowed down, still a big problem

3. **Population growth, a future risk**

   - Population growth
   - Increased energy consumption per capita



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Electricity production by source in Brazil

conventional vs. renewable

Production électrique par source/*Electricity production by source*

TWh	2000	2007	2008	2009	2010	TCAM/*AAGR* 00/10	TC/*GR* 09/10
Géothermie/*Geothermal*	–	–	–	–	–	–	–
Éolien/*Wind*	0,038	0,559	0,541	0,815	1,4	43,2 %	68,8 %
Biomasse/*Biomass*	7,6	17,9	19,8	23,1	24,7	12,5 %	6,8 %
dont biomasse solide/*solid biomass share*	*7,6*	*17,9*	*19,8*	*23,1*	*24,7*	*12,5 %*	*6,8 %*
dont biogaz/*biogas share*	–	–	–	–	–	–	–
dont biomasse liquide/*liquid biomass share*	–	–	–	–	–	–	–
dont déchets municipaux/*municipal waste share*	–	–	–	–	–	–	–
Déchets non renouvelables/ *Non-renewable waste*	–	–	–	–	–	–	–
dont déchets industriels/*industrial waste share*	–	–	–	–	–	–	–
dont déchets municipaux/*municipal waste share*	–	–	–	–	–	–	–
Solaire/*Solar*	0,014	0,023	0,026	0,031	0,033	9,1 %	6,5 %
dont photovoltaïque /*photovoltaic share*	*0,014*	*0,023*	*0,026*	*0,031*	*0,033*	*9,1 %*	*6,5 %*
dont thermodynamique/*CSP share*	–	–	–	–	–	–	–
Hydraulique/*Hydraulic*	304,7	374,0	369,6	391,0	396,0	2,7 %	1,3 %
dont turbinage-pompage/*pumped-storage share*	–	–	–	–	–	–	–
Énergies marines/*Marine energies*	–	–	–	–	–	–	–
Nucléaire/*Nuclear*	6,0	12,4	14,0	13,0	14,5	9,2 %	12,0 %
Fossile/*Fossil*	30,8	41,0	59,4	38,7	58,7	6,6 %	51,5 %
Tot. renouvelable/*renewable*	**312,3**	**392,5**	**389,9**	**414,9**	**422,1**	**3,1 %**	**1,7 %**
Tot. conventionnelle/*conventional*	**36,9**	**53,4**	**73,3**	**51,7**	**73,2**	**7,1 %**	**41,6 %**
Total production	**349,2**	**445,8**	**463,3**	**466,6**	**495,2**	**3,6 %**	**6,1 %**
Part renouvelable/*Renewable share*	***89,4 %***	***88,0 %***	***84,2 %***	***88,9 %***	***85,2 %***		

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The DESERTEC Concept

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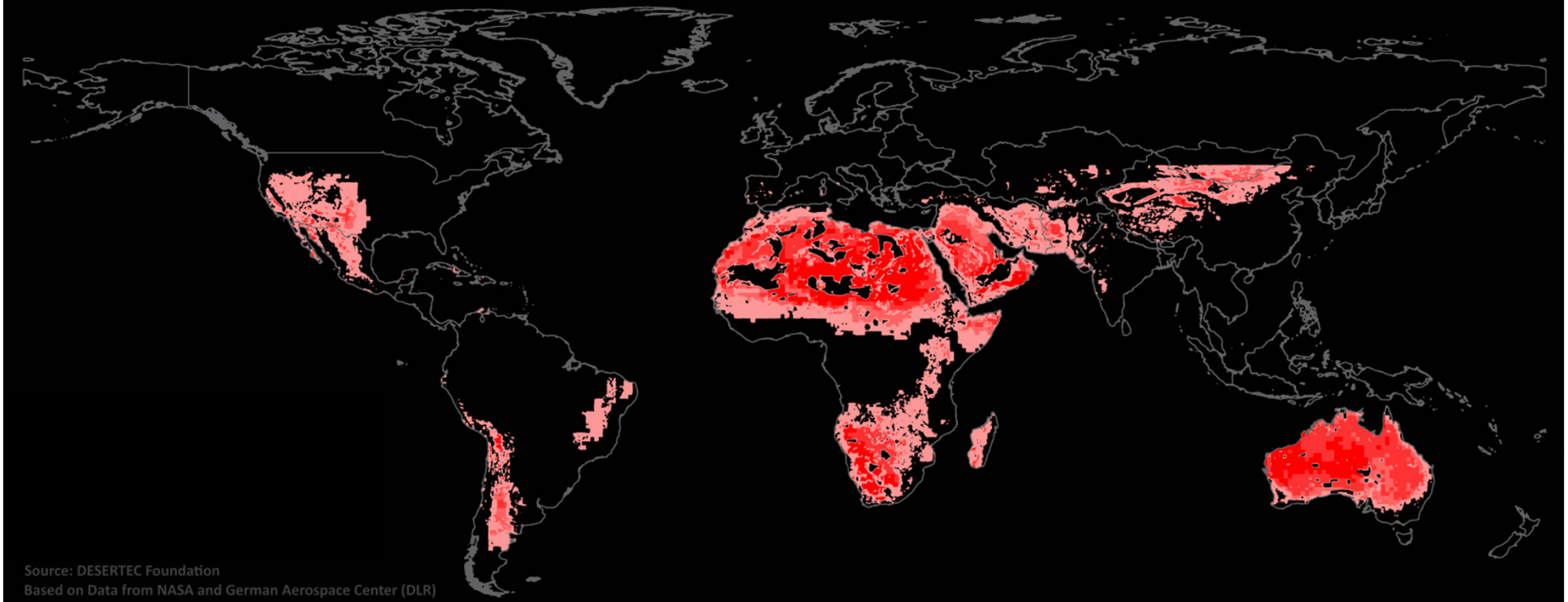
In six hours the worlds deserts receive more energy from the sun than humankind consumes within a year.



Source: DESERTEC Foundation
Based on Data from NASA and German Aerospace Center (DLR)

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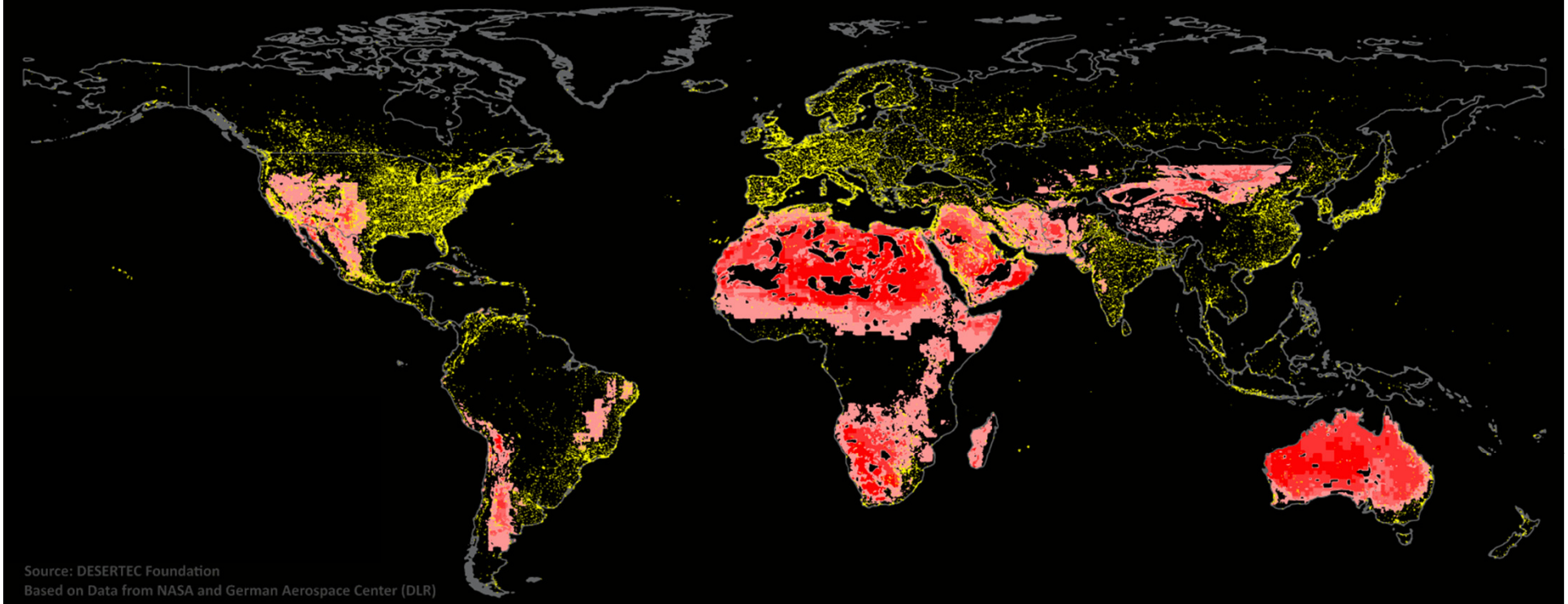
90% of the world's population lives within 3,000km of its deserts



Source: DESERTEC Foundation
Based on Data from NASA and German Aerospace Center (DLR)

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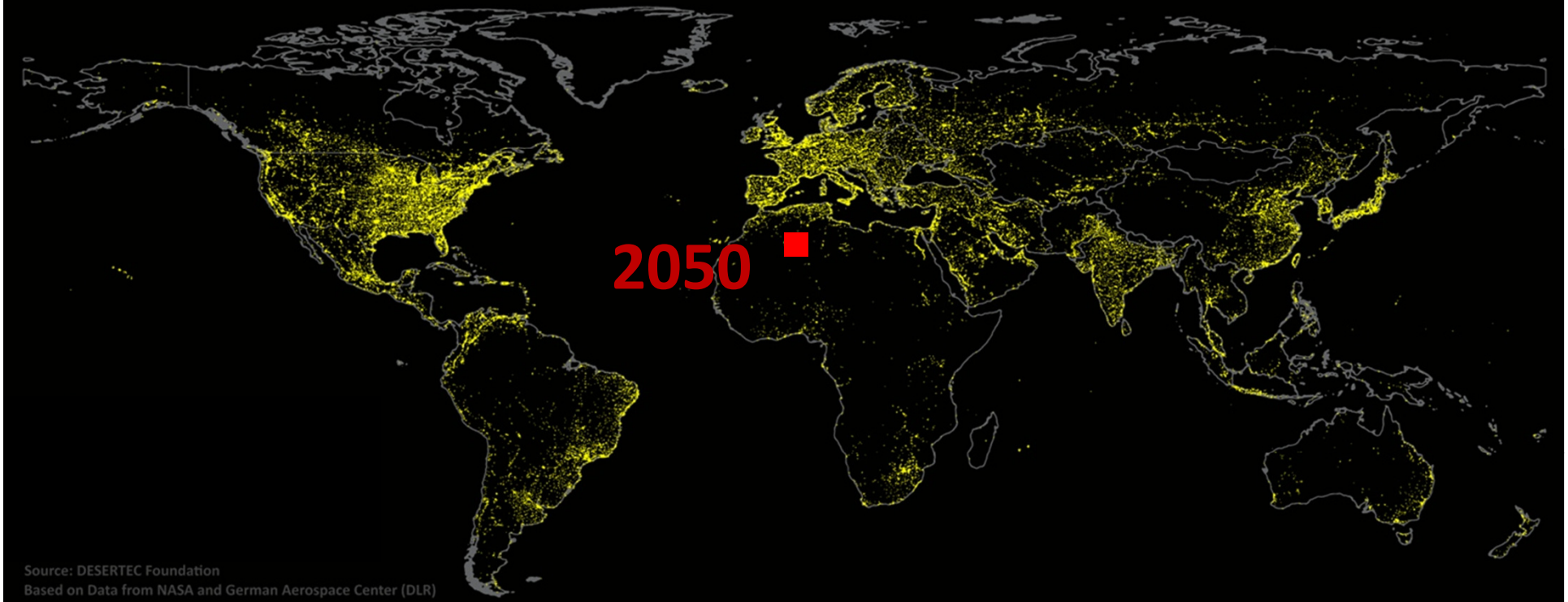
A fraction of the deserts surface spread across the world would be enough to supply humankind's energy needs with clean energy.



Source: DESERTEC Foundation
Based on Data from NASA and German Aerospace Center (DLR)

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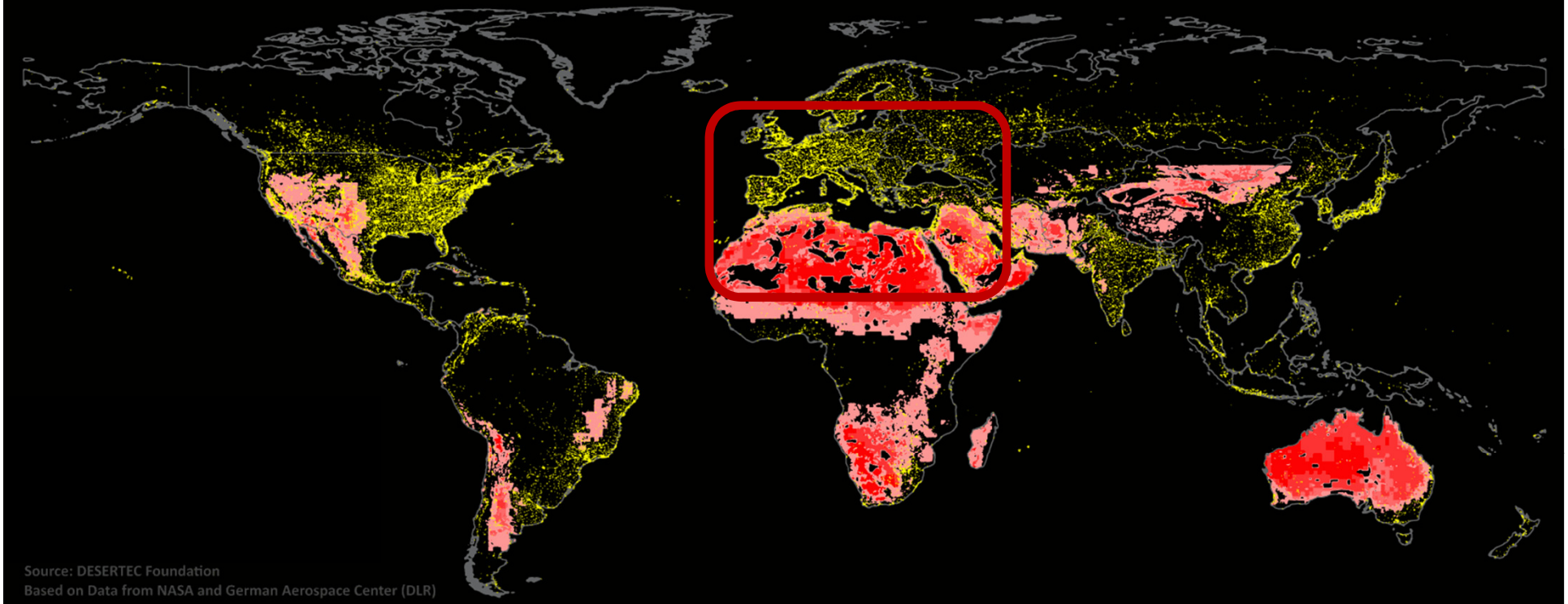
DESERTEC Concept – Focus Region EU-MENA

(Europe, Middle East, Northern Africa)



Source: DESERTEC Foundation
Based on Data from NASA and German Aerospace Center (DLR)

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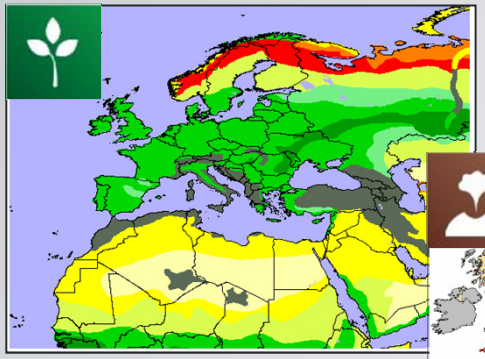
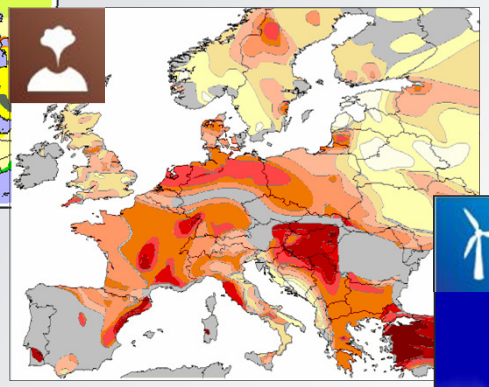
The DESERTEC Concept for EU-MENA

DLR Studies: renewable energy potential in the EU and in MENA

Biomass: 1.350 TWh/y

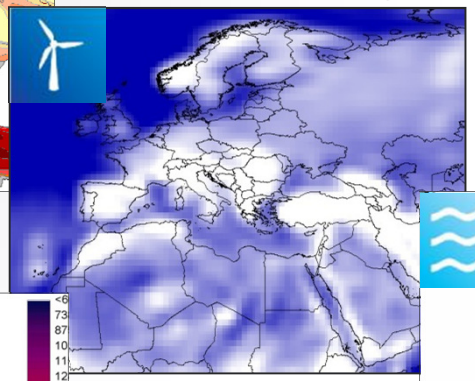


Geothermal: 1.100 TWh/y

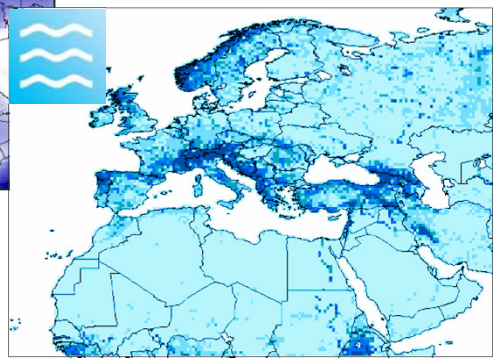


Electricity demand in EU-MENA in the year 2050: 7.500 TWh/y

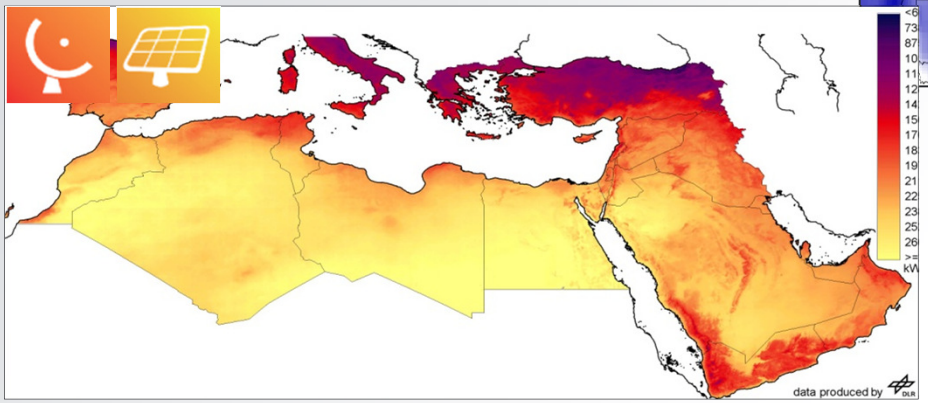
Windpower: 1.950 TWh/y



Hydropower: 1.350 TWh/y



Solar power: 630.000 TWh/y



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The DESERTEC Concept for EU-MENA

The best sites offer the greatest benefit for climate protection

- For the same investment, the best sites can produce more clean electricity and therefore replace more conventional power
- Solar energy especially in the south, wind power in coastal areas, hydropower in the mountains, biomass in fertile central Europe, geothermal as available

Technical implementation

High-Voltage-DC-Transmission (HVDC)

Enables low-loss transmission of electricity over vast distances

- Only around 3% transmission losses per 1,000 km, narrower than HVAC lines and can be placed underground over large distances
- Since 1945, more than 130 HVDC-transmission lines have been built

Source: ABB

Source: Siemens

Example Yunnan-Guangdong in China:

- 5,000 MW hydropower
- 1,400 km distance
- 800 kV voltage

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Solar-Thermal Power Plants

Concentrated sunlight delivers heat for a steam turbine

Parabolic Trough

Source: SkyFuel

Solar Tower

Source: Solar Two, DoE

Linear Fresnel

Source: Novatec Biosol

Parabolic Dish

Source: Eurodish

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Solar-Thermal Power Plants

Through heat storage, solar power day and night according to demand

Heat storage tank with molten salt (50 MW|7,5h)

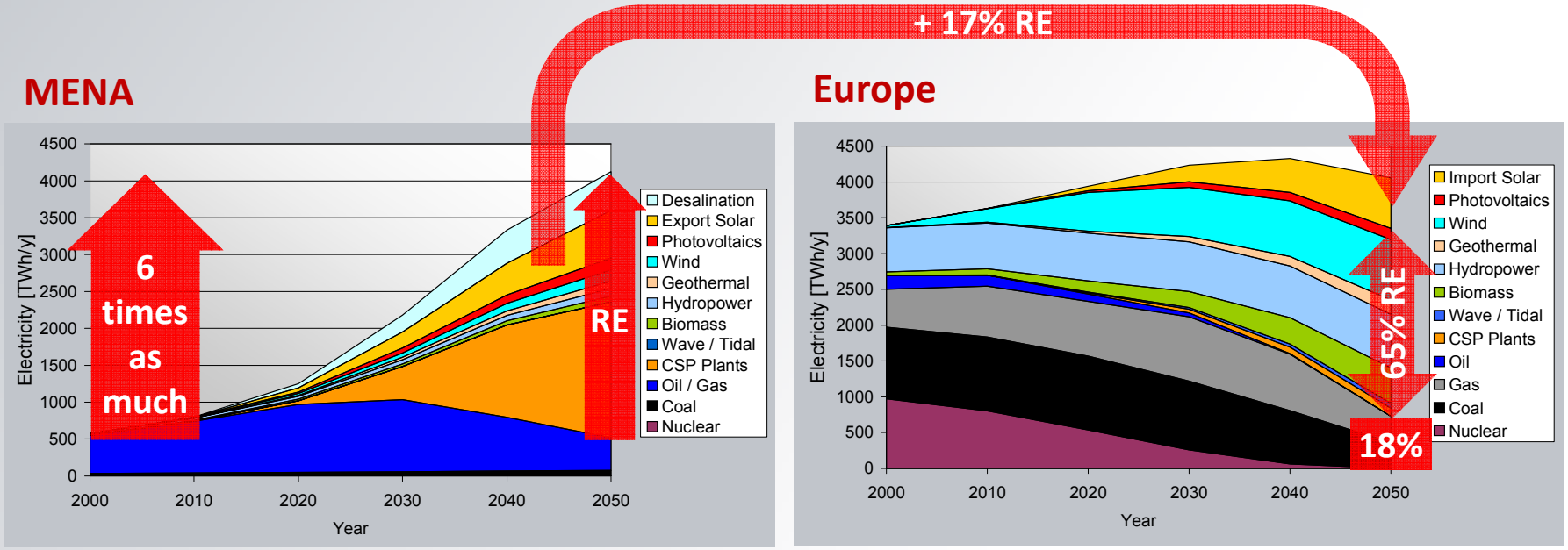
Source: Solar Millennium

- In contrast to electricity, heat energy can be stored cost effectively in large amounts with low losses
- Therefore solar-thermal power plants are baseloadable and dispatchable
- They can balance out the fluctuations of photovoltaics and windpower

Cooperation between Europa and MENA region

Electricity production scenario for EU and MENA

DLR Studies: Clean power from deserts for local demand and export



Source: DLR Studie TRANS-CSP, www.DLR.de/tt/trans-csp

- MENA: Power from deserts mainly for local electricity demand & desalination
- Europe: Expansion of domestic renewable energies
- Dispatchable desert power complements the European electricity mix, enabling a higher proportion of PV & Wind, thus quickening the shift to a renewable energy supply

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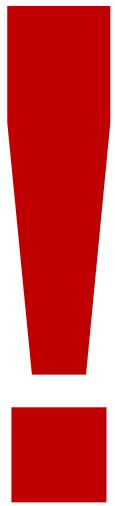
DESERTEC is a Win-Win-Strategy

Cooperation between Europe und MENA offers advantages for both

- ✓ Climate protection, reduced carbon emissions
- ✓ Higher energy security, more diverse and sustainable energy supply, less dependent on oil and gas
- ✓ More drinking water through desalination in desert regions
- ✓ Socio-economic development (MENA):
  - Local set up of new, future-oriented industries
  - International investments and higher export revenue
  - Transfer of knowledge and technology
- ✓ International peacekeeping through cooperation and prevention of resource-related conflicts



The DESERTEC Concept…

- ✓ *Uses all renewable energies where they are most abundant and integrates them into a transnational super grid.*
- ✓ *It is achievable today, because all technologies are available and reliable.*
- ✓ *It is a win-win-strategy for all involved parties and it can be implemented worldwide.*

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About us:
DESERTEC Foundation

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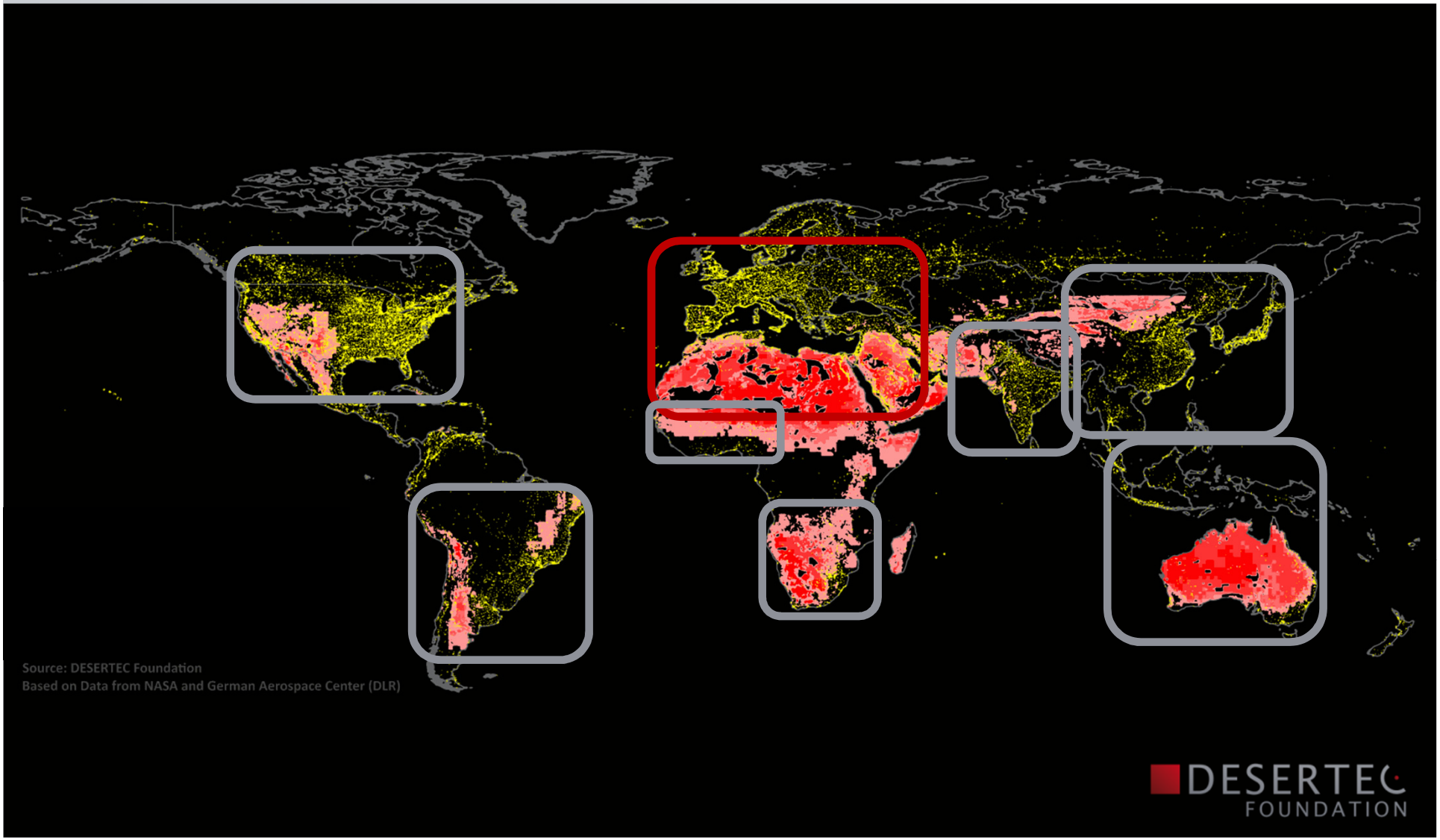
Mission of the DESERTEC Foundation:

World wide implementation of the DESERTEC-Concept



The DESERTEC Foundation

is a non-profit organisation aiming to shape a sustainable future

- Was founded 2009 by the Club of Rome & committed private individuals
- DESERTEC Concept developed together with German Aerospace Center (DLR)

The Mission & Our Projects

Implementation of the DESERTEC concept for energy security and climate protection for a world with 10 billion people in 2050

- In order to reach this goal, we founded the industrial initiative Dii GmbH for the Mediterranean region
- We founded the DESERTEC University Network, a group of 18 universities and research facilities from the EU-MENA region.
- Future focus: further desert regions, Knowledge sharing through DESERTEC University Network and Social-Networks including the DESERTEC Knowledge Platform

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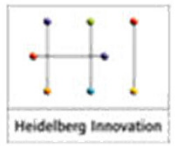
DESERTEC partners:

Supporters of the Foundation



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