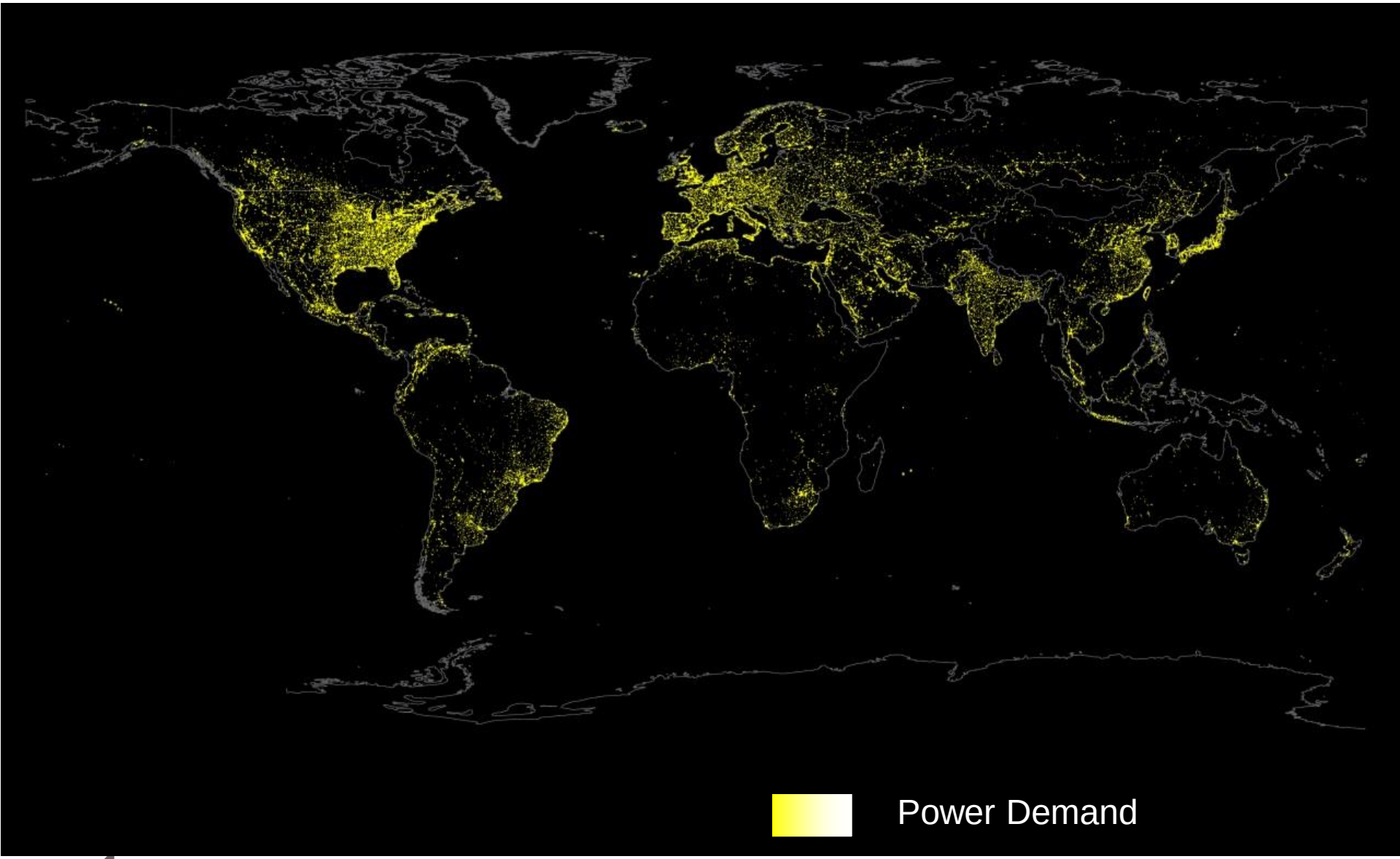
A Virtual Journey to Deserts

Dipl.-Ing. Denis Hess

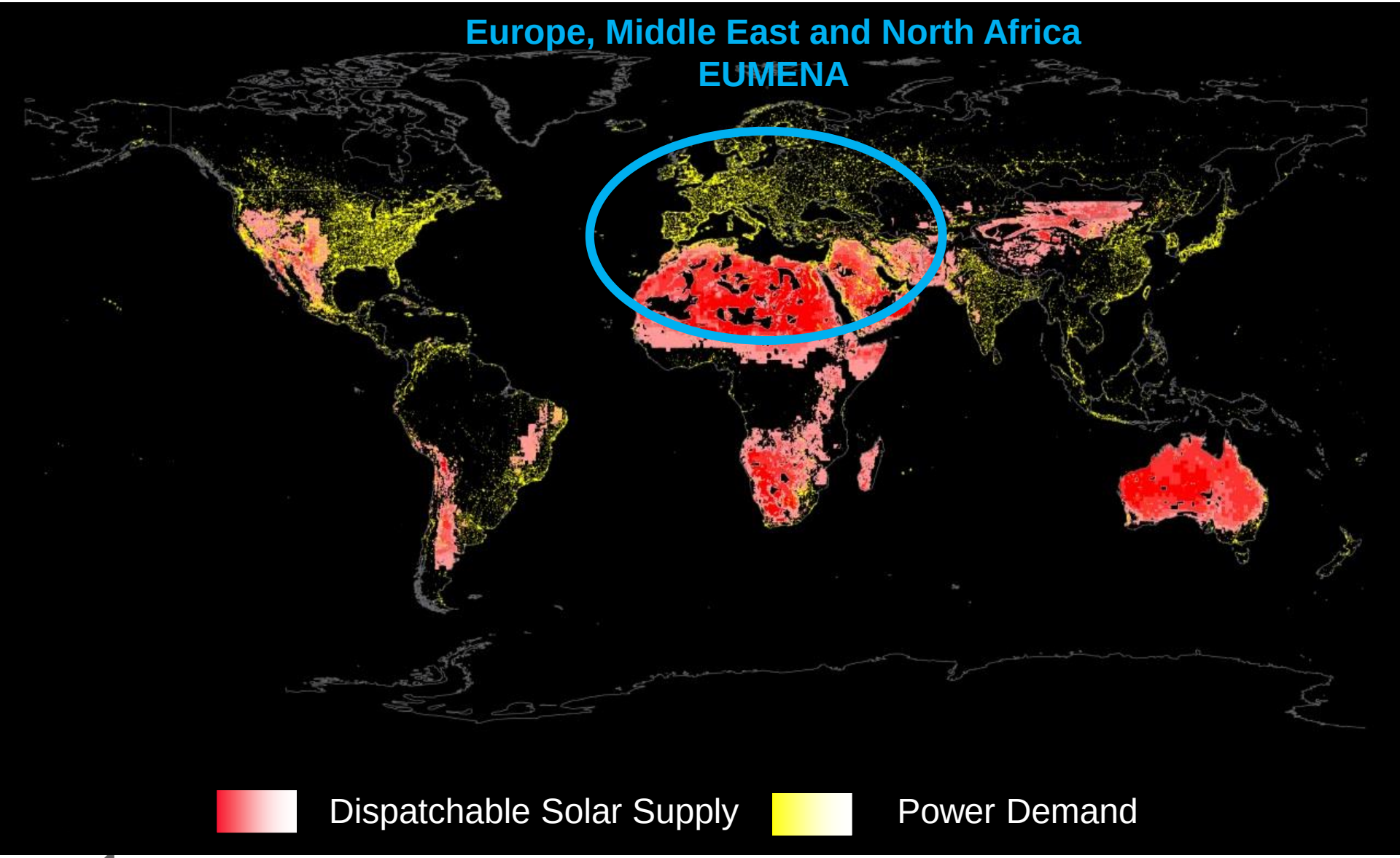
Conference of Youth (COY13)

03th of November 2017 in Bonn



DLR

http://nasa.gov


Europe, Middle East and North Africa
EUMENA
Dispatchable Solar Supply
Power Demand

DLR

- Energy?
- Water?
- Food?
- Labor?
- Income?

for further
300 Million
People
in Middle East
and North Africa?

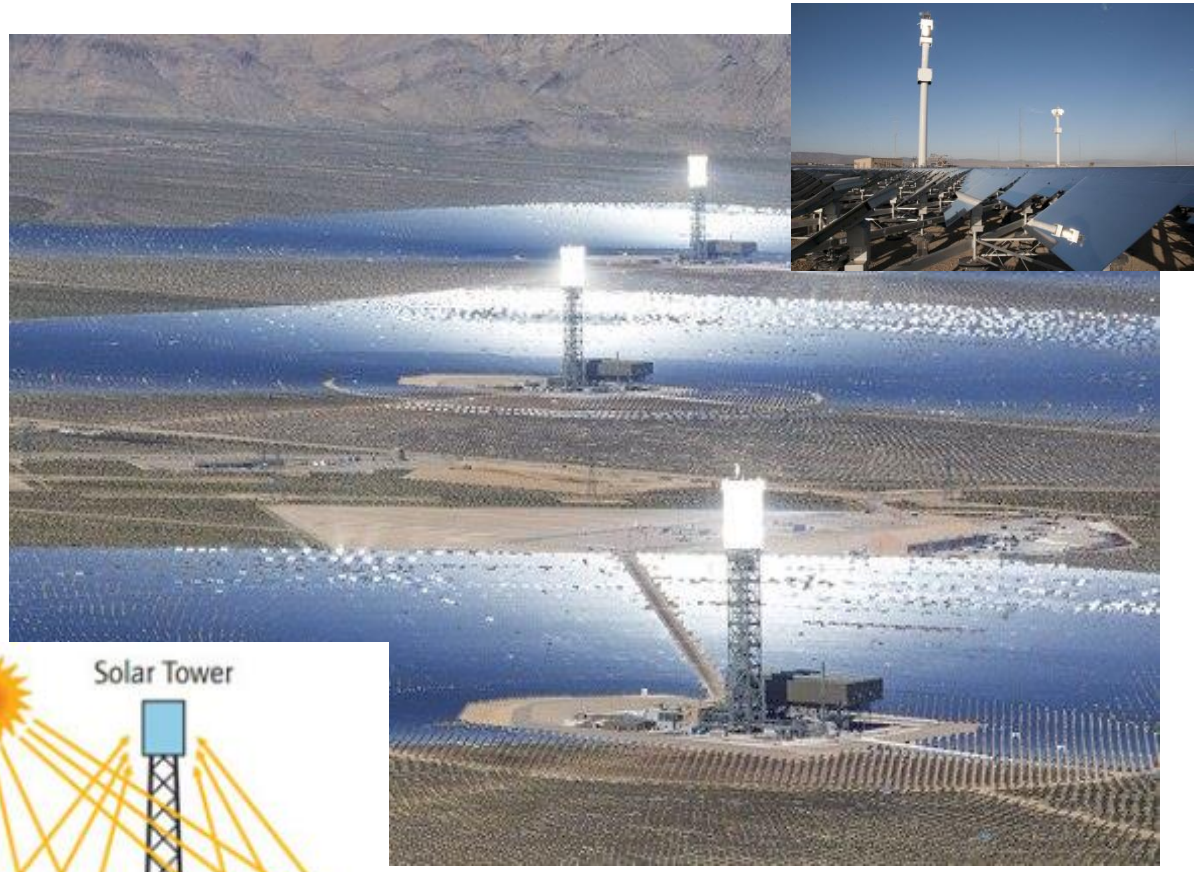
Solar Power & Desalination Plants

- Energy!
- Water!
- Food!
- Labor!
- Income!

for further
300 Million
People
in Middle East
and North Africa!

(artist view created from Franz Trieb with Google Earth)

Concentrating solar power



Ivanpah 392 MW - Solar Tower

Location of Ivanpah Solar Power Facility

○ Show map of California
◉ Show map of the US
○ Show all

Country	United States
Location	near Ivanpah, San Bernardino County, California
Coordinates	35.57°N 115.47°W
Status	Operational
Construction began	27 October 2010[1]
Commission date	13 February 2014[2][3][1]
Construction cost	$2.2 billion
Owner(s)	NRG Energy BrightSource Energy Google
Solar field	
Type	CSP
CSP technology	Solar power tower
Collectors	173,500
Site area	3,500 acres (1,420 ha)[4]
Site resource	2,717 kW·h/m²/yr

Source: Ivanpah, IEA and Wikipedia

Concentrating solar power

Andasol 150 MW – Parbolic Trough

Location of Andasol Solar Power Station within Spain

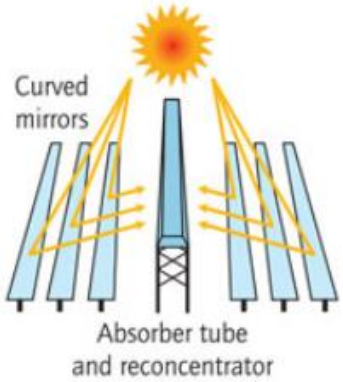
Country	Spain
Location	near Guadix, Granada
Coordinates	37°13'42.70"N 3°4'6.73"W
Status	Operational
Commission date	2009
Owner(s)	ACS Group (Andasol 1&2) Stadtwerke München MAN Ferrostaal Innogy
Solar field	
Type	CSP
CSP technology	Parabolic trough
Site area	600 hectares (1,483 acres)
Site resource	2,136 kWh/m^2/yr[1]
Power generation	
Nameplate capacity	150 MW
Capacity factor	0.41[2]
Storage capacity	7.5 hours
Annual output	495 GWh[3]

Source: Andasol, IEA and Wikipedia

Concentrating solar power

India
Rajasthan Sun
Technique Energy

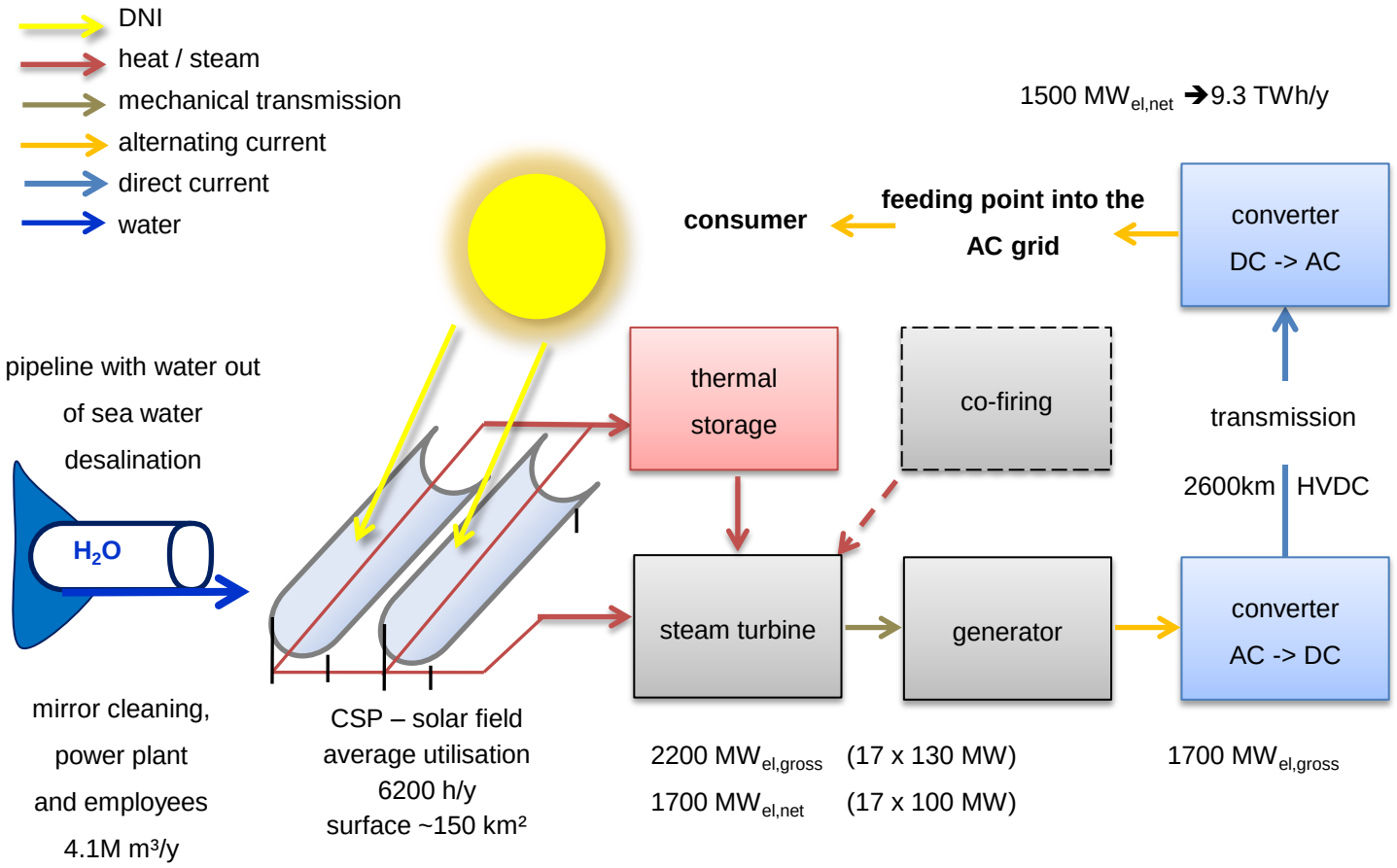
Start of operation: 2014



Dhursar 125 MW – Linear Fresnel

Source: Reliance Power, IEA and Google Earth

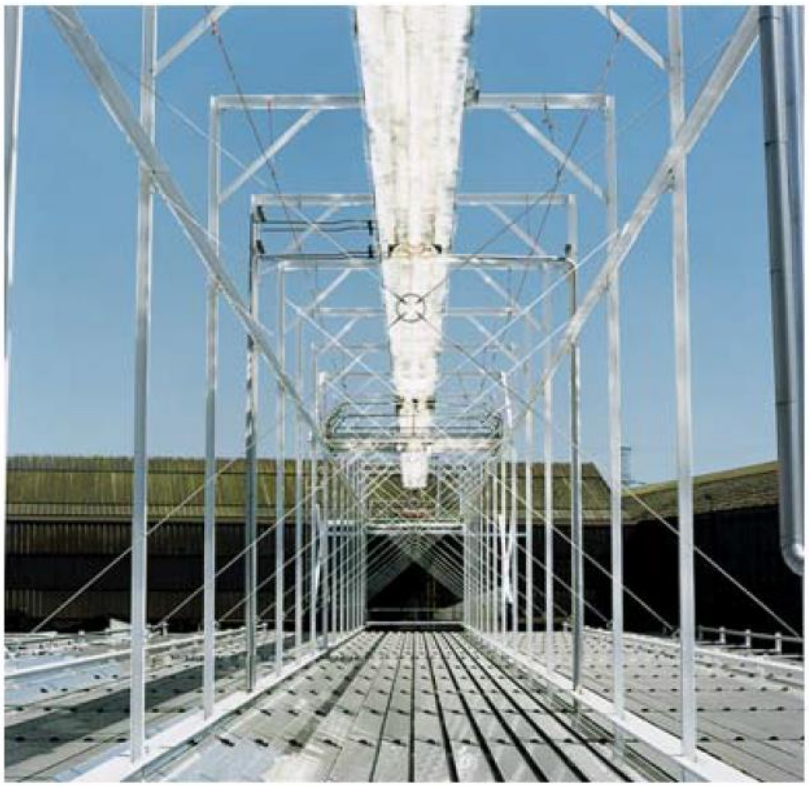
Functioning of concentrating solar power (CSP)



In combination with a thermal energy storage and a co-firing option, CSP can provide energy according to demand! ➔ dispatchable energy

Source: PhD Hess 2017

Agricultural applications in combination with CSP



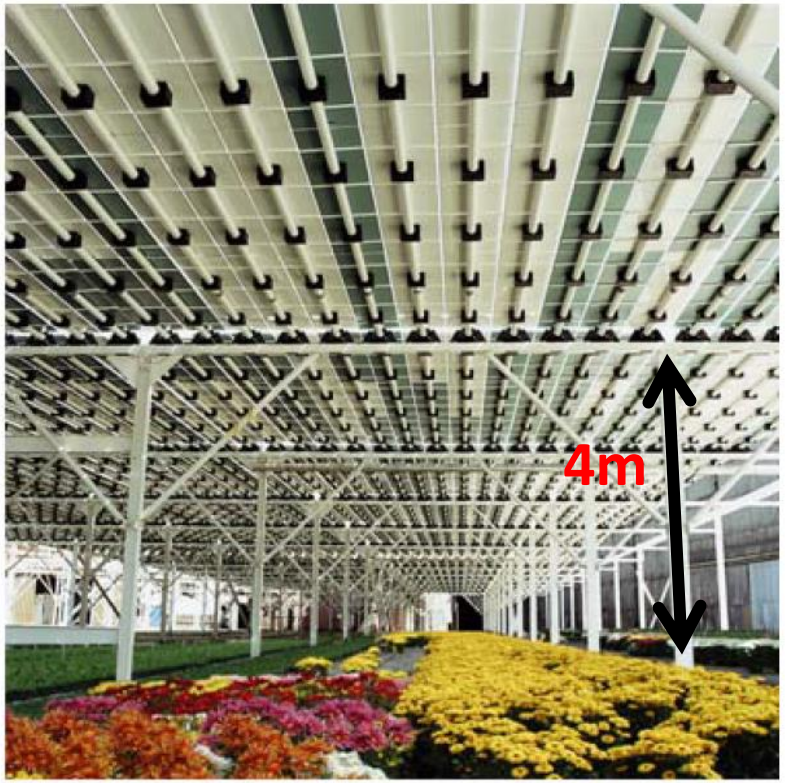
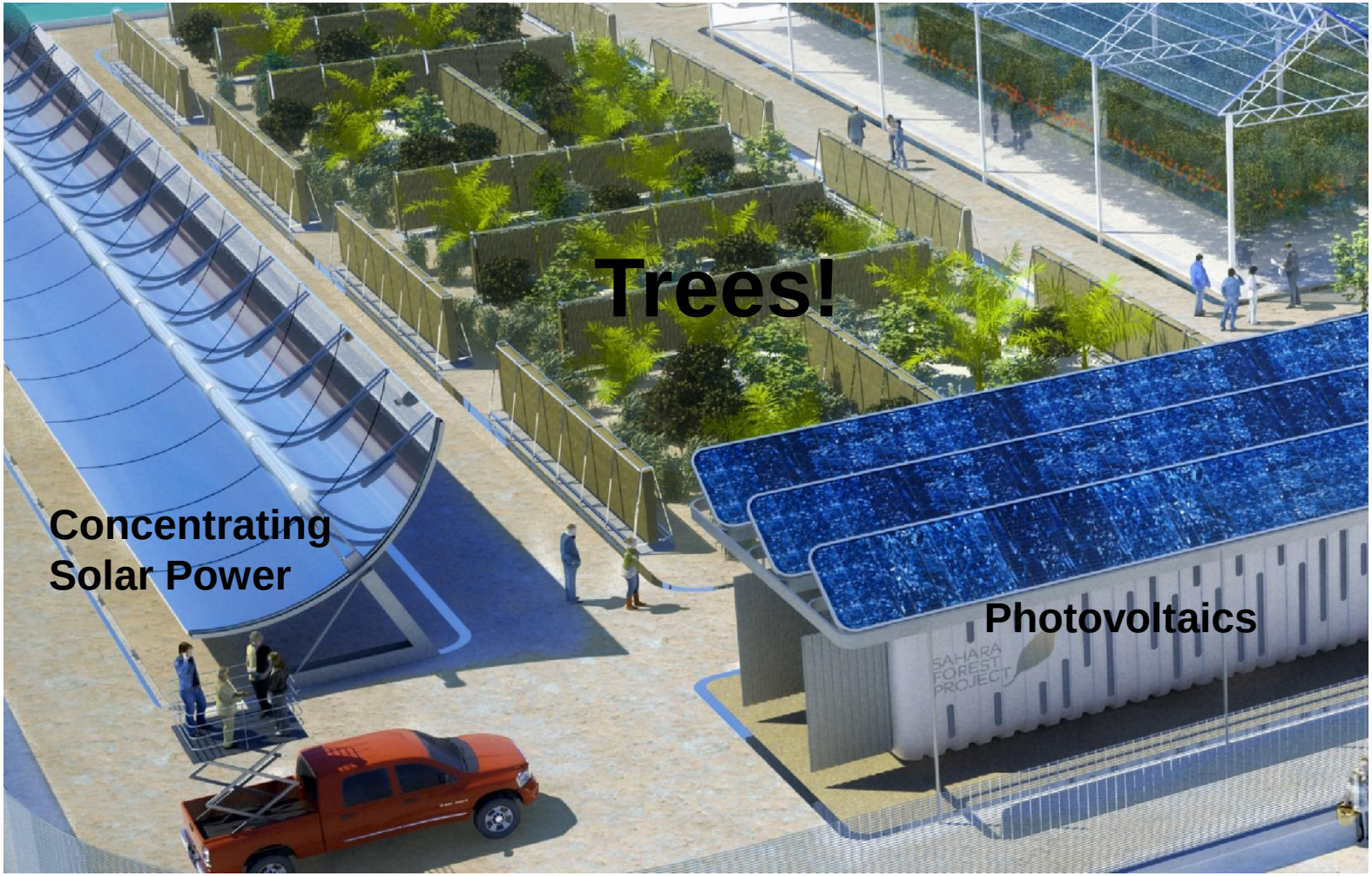


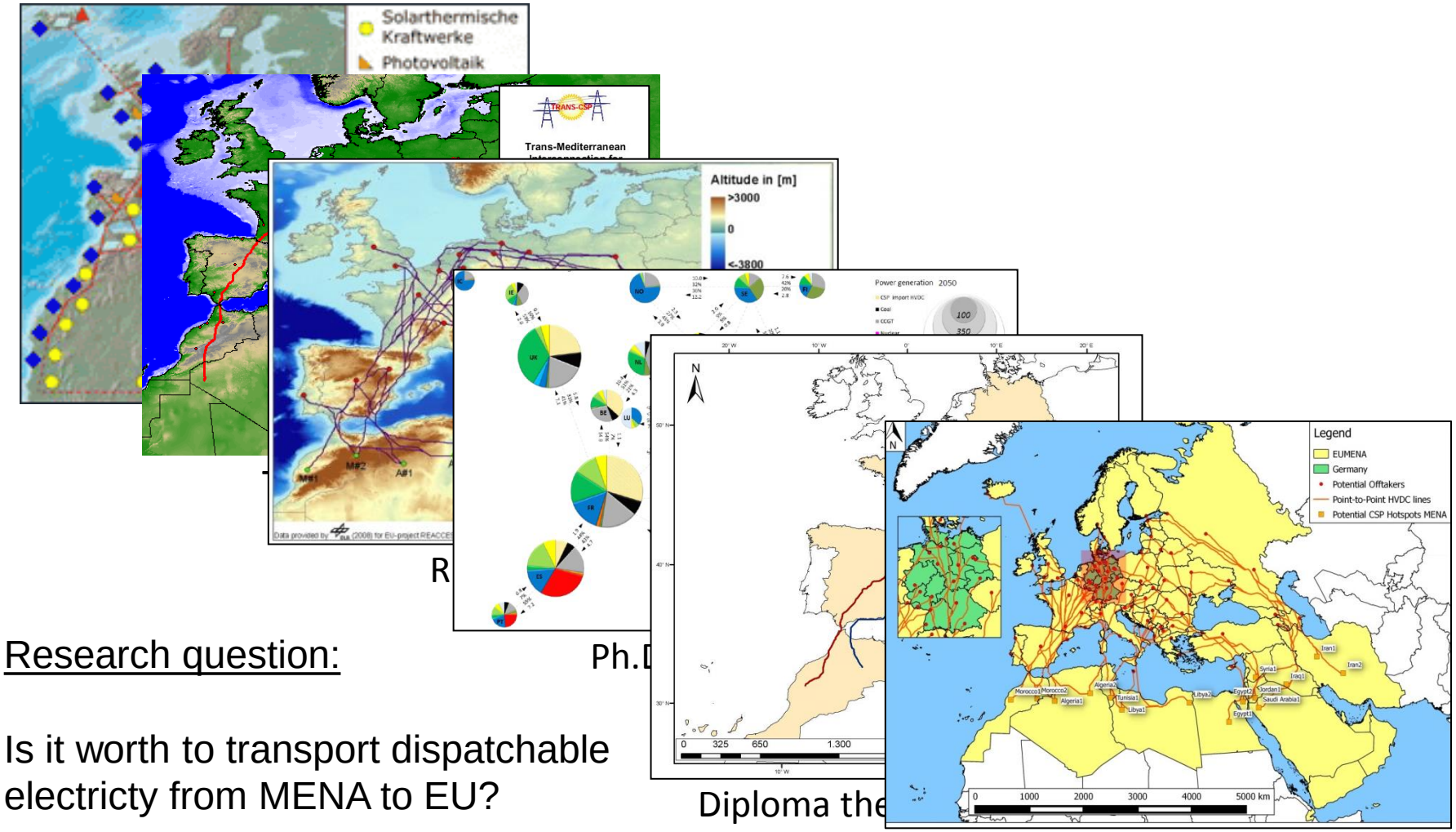
Figure A-45: Energy production above and horticulture underneath a linear Fresnel collector field in a multipurpose concentrating solar thermal power plant. Photos of the collector field by Solarmundo, greenhouse visualisation by DLR.

Need for a agricultural studies using renewable power plants and new living area



https://www.saharaforestproject.com/

Ongoing research in the field of CSP integration, EUMENA



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Ph.D

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Research question:

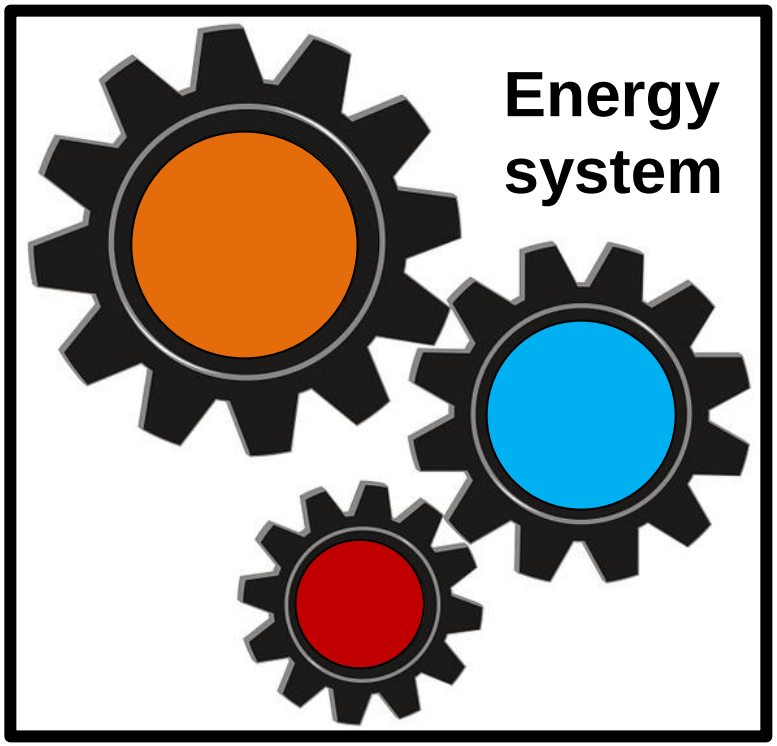
Is it worth to transport dispatchable electricty from MENA to EU?

Electricity generation by fluctuating and dispatchable energy

Dispatchable energy

- Gas
- Coal
- Nuclear

- Biomass
- Geothermal
- Hydropower
- **Concentrating Solar Power**



Fluctuating energy

- Photovoltaics
- Wind Onshore
- Wind Offshore

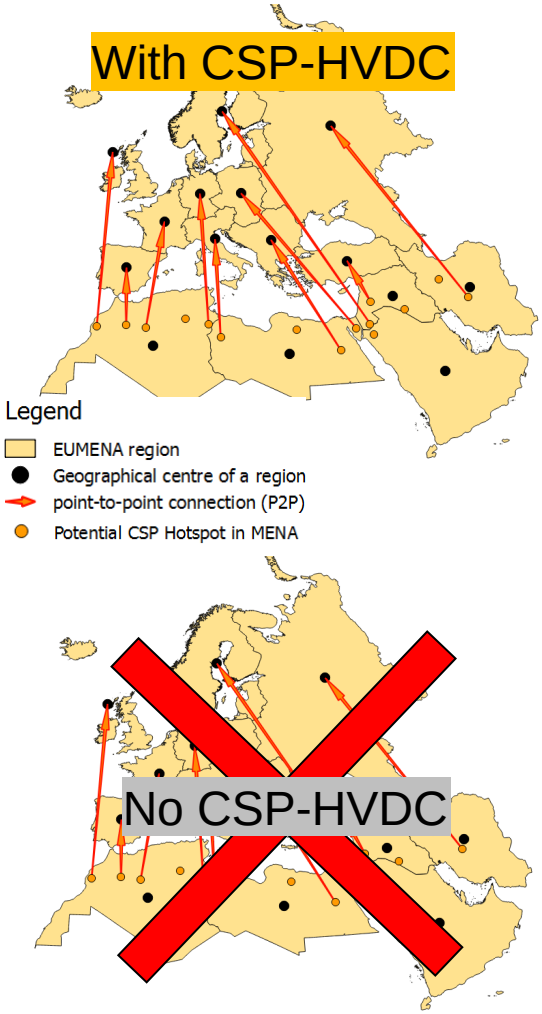
Flexibiltiy options

- Grid Extension
- Storage Technologies
- Demand Side Management

<u>Interplay analysed within an energy system model:</u>

Target function: least cost optimization using linear programming

The Value of Concentrating Solar Power for a Sustainable Electricity Supply in EUMENA in 2050

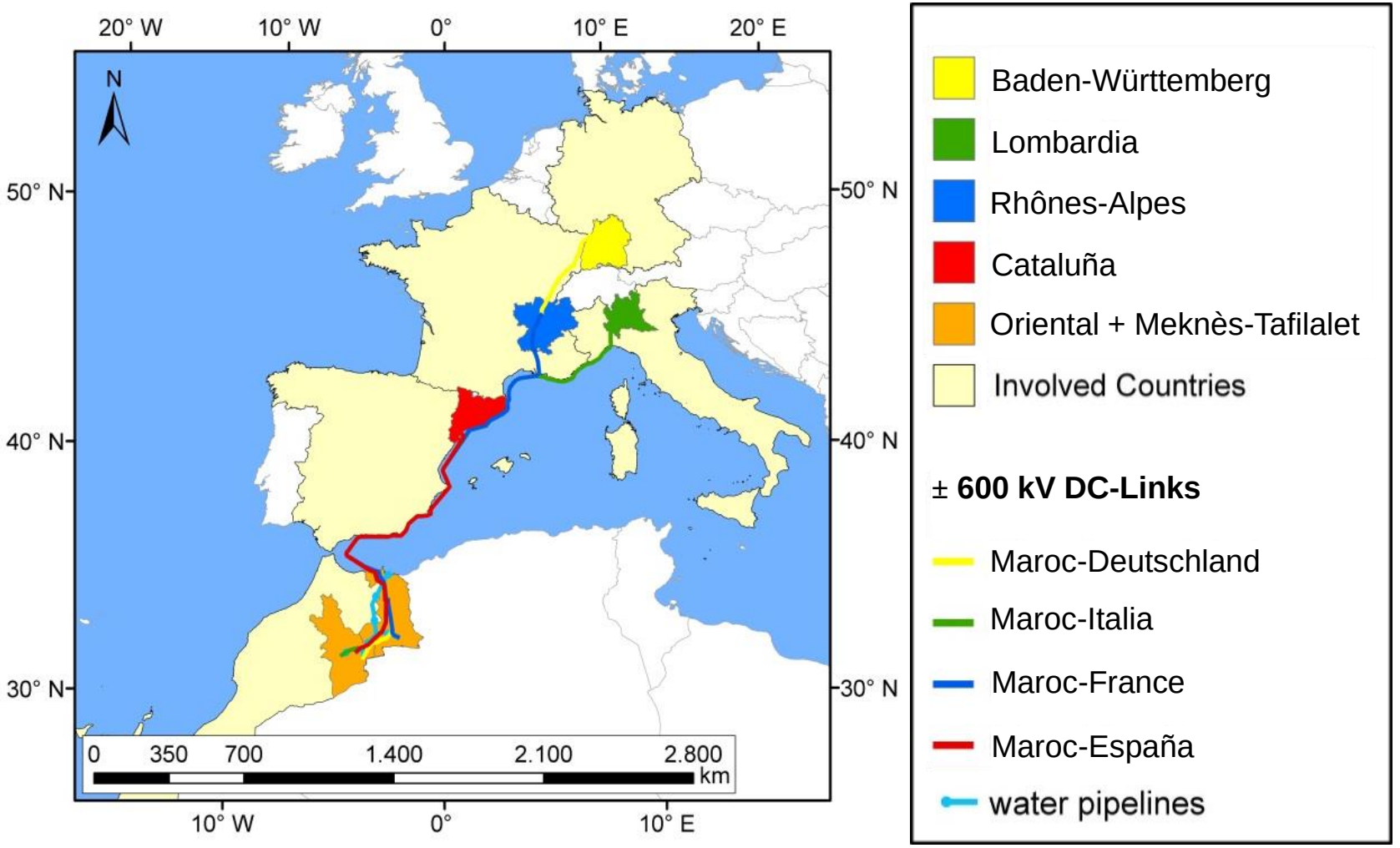


Indicators	With CSP-HVDC	No CSP-HVDC
System cost	0	0
System cost uncertainty	+	-
Power plant capacity	+	-
Electrical storage capacity	+	-
Total power km	+	0
Nodal grid power km	+	-
CSP P2P power km	-	+
Grid stress	+	-
Curtailment	+	-
CO_2 emission	0	0

(higher - / lower + / equal 0)

Source: PhD Hess 2017, http://elib.dlr.de/114683/

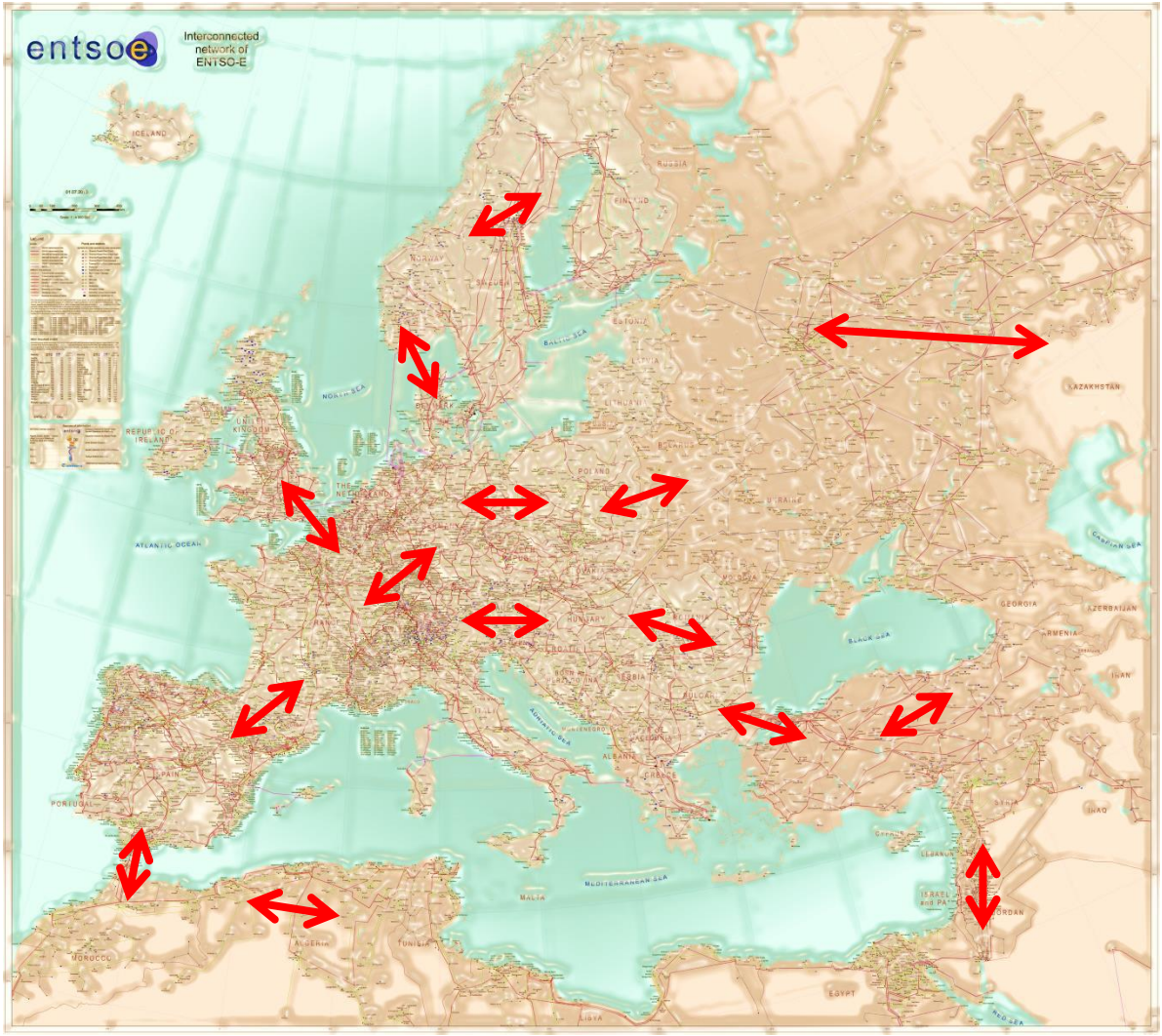
Potential political framework for CSP-HVDC in Europe



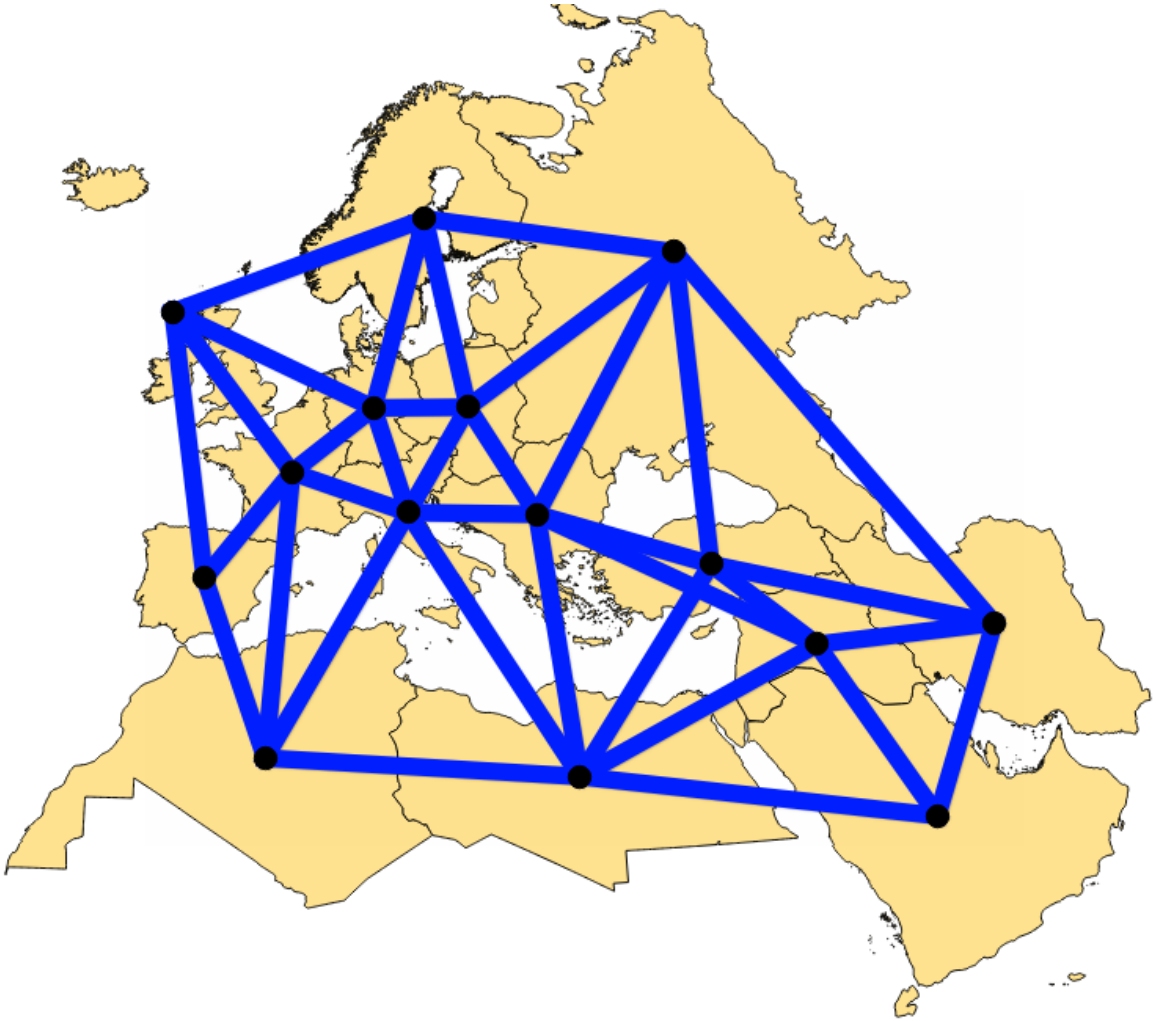
Source: PhD Hess 2017

Experimental Game „SUPERGRID“

Initial situation: Existing transmission grid

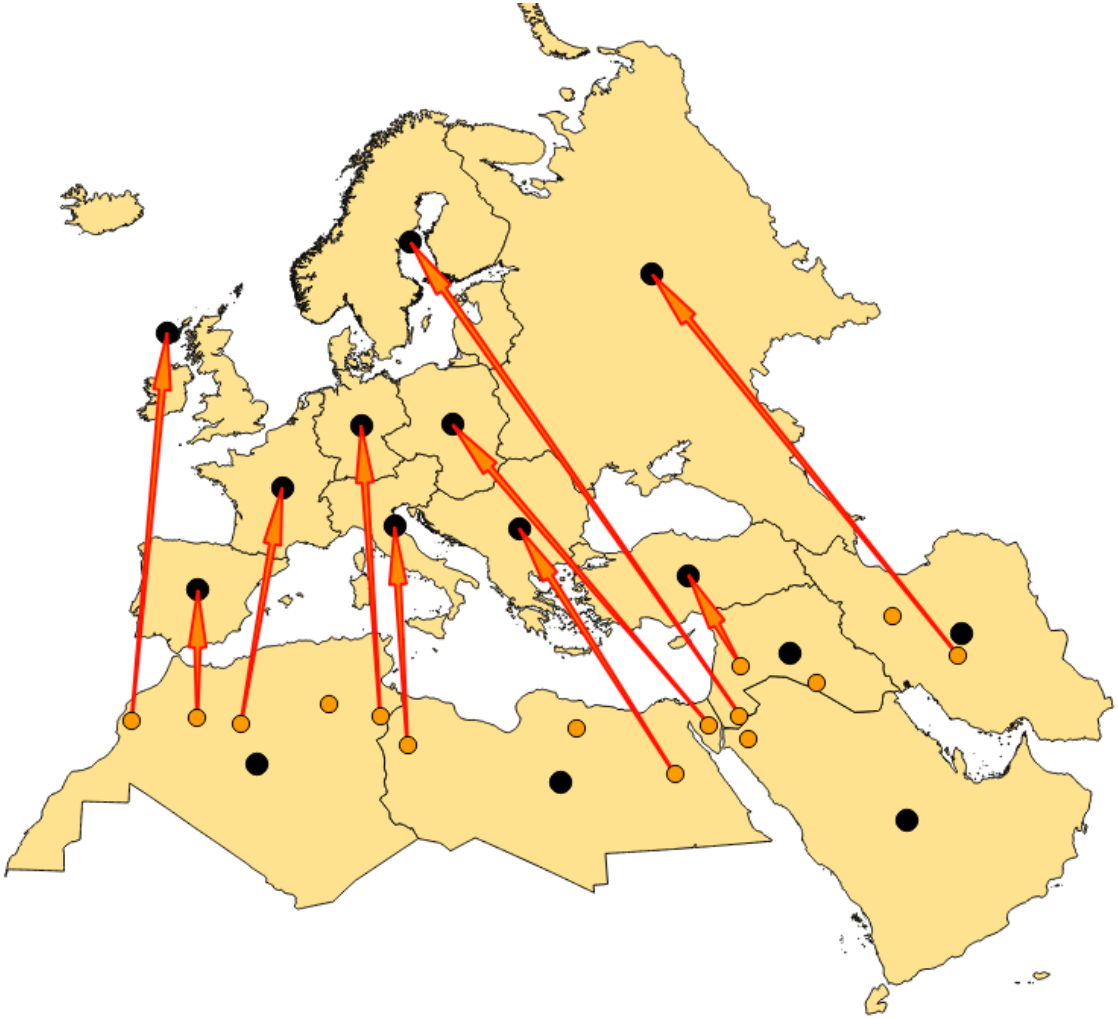


First part: We construct a „Supergrid“



Source: PhD Hess 2017

Second part: We construct a point-to-point conncection



Source: PhD Hess 2017

What can we / I do now?

- Many MENA countries are interested to export dispatchable power of CSP. However, the EU member states are not interested to import renewable energy from MENA because it is today a political No-Go in EU!

  ➔ Talk to your politicians in EU that you **support the idea of a strong and valuable energy cooperation between EU and MENA for using <u>dispatchable</u> power** in EUMENA!

- A pilot study is needed to specify a project to transfer CSP electricity from MENA to EU.

  ➔Need of support from institutions, companies or private persons for **financing the pilot study**!


Thank you
for your
cooperation!
http://www.choishine.com/Giants.html

Literature

- TRANS-CSP www.dlr.de/tt/trans-csp
- AQUA-CSP www.dlr.de/tt/aqua-csp
- MED-CSP www.dlr.de/tt/med-csp
- Fernübertragung regelbarer Solarenergie http://elib.dlr.de/83385/
- Solar Electricity Imports doi:10.1016/j.enpol.2011.11.091
- BETTER project http://www.better-project.net/content/results WP 3
- The Value of Concentrating Solar Power for a Sustainable Electricity Supply in Europe, Middle East and North Africa http://elib.dlr.de/114683/.

„Ways connect people“

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