Transmission of dispatchable solar energy from North Africa to Central Europe

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Transmission of dispatchable solar energy from North Africa to Central Europe

~ 100% RE

Source: Hess, D., 2013, Fernübertragung regelbarer Solarenergie

Source: (http://de.wikipedia.org/wiki/Baden-W%C3%BCrttemberg)
Paradigm change in the load range

in the year 2012 in BW

- Peak load
- Mid-load
- Base load

until the year 2050

- Feeding of fluctuating RE
- Residual load with dispatchable RE

100% RE

Quelle: Hess, D., 2013, Fernübertragung regelbarer Solarenergie
Renewable energies for Baden-Württemberg

The decision for scenario 2 is already TODAY necessary!

Source: Hess, D., 2013, Fernübertragung regelbarer Solarenergie
Time series of power production by type of power plant

Source: Hess, D., Trieb, F., 2013, Fernübertragung regelbarer Solarenergie
System problems in Baden-Württemberg in the year 2050 with 95% renewable energy (RE) in electricity supply

Two scenarios for the year 2050, each with 95% renewable energies for the electricity supply in Baden-Württemberg

Today, the decision must be made specifically for the choice of one way!

Source: Hess, D., Trieb, F., 2013, Fernübertragung regelbarer Solarenergie
Transmission of dispatchable solar energy: CSP-HVDC site

- CSP - collectors
  - average utilization: 6200 h/y
  - land area: ~ 150 km²

- Heat storage

- Turbine

- Generator

- Converter

- Transmission: 2600 km HVDC

- Feeding point into the AC grid

- 1500 MW_{el,net} → 9.3 TWh/y

- Drought Normal Irradiance (DNI)
- Concentrating Solar Power (CSP)
- High Voltage Direct Current (HVDC)

Source: Hess, D., 2013, Fernübertragung regelbarer Solarenergie
The economic **CSP potential** in the northern part of Morocco is at about **8450 TWh/y** with **18500 km²** CSP gross land demand

-> one site with 150 km² needs **only 0.8% of this potential**
First design of the CSP-HVDC site, cost and land requirements

MOR-E-F-D

HVDC 2600 km
1.7 GW / 1.5 GW_{net}
3 billion €
150 km²

CSP 2.2 GW
CSP 12 - 18 billion €
150 km²

O&M:
4-5 €Cent/kWh

LCOE:
12-15 €Cent/kWh

MOR-E-F-D

HVDC 2300 km
1.7 GW / 1.5 GW_{net}
5.1 - 6 billion €
75km²

CSP 2.2 GW
CSP 12 - 18 billion €
150 km²

-> 9.32 TWh/a
16-24 billion € (real 2010)
feasible until 2024

Source: Hess, D., 2013, Fernübertragung regelbarer Solarenergie
Adequate permanent payment for the required land

Overhead line
- 70 m
- Restriction of agriculture through the mast base (blue)
- Protective strip
- Mast base (grey)
- Covered area
- Safety conductor

Underground cable
- 4 m
- Cheaper overhead line and more expensive underground cable can reach through this compensation payment
- Cost neutrality within their lifetime!

Cheaper overhead line and more expensive underground cable can reach through this compensation payment

Cost neutrality within their lifetime!

Free choice of technology is made possible --> increased acceptance

Source: Hess, D., 2013, Fernübertragung regelbarer Solarenergie
Annual income for the concerned nations, their municipalities and landowners (riparians) – each time with 4 routes

Today only the blue value is paid for the construction of transmission lines in Germany END!
Decision ways

Representative democracy

Petitions, citizens' decision

Participatory democracy

Participation of concerned citizens

Formal procedures including implementation options

Legal certainty

Permit

Project implementation

The traffic light model

Project idea and political intention

Information for citizens

Political framework decision

Participation of concerned citizens

Formal procedures including implementation options

Permit

Project implementation

Active information

Implementation: yes or no?

Active information

Discourse and deliberation

Implementation: yes, but how?

Evaluative information

Source: Hess, D., 2013, Fernübertragung regelbarer Solarenergie
Time limit for a decision

- Optimistic scenario:
  - 1 year for political decision
  - 1 year for construction
  - 4 years for operating time

- Realistic scenario:
  - 1 year for planning
  - 2 years for approval procedures
  - 6 years for construction
  - 1 year for operating time

- Additional delay X years after construction

Source: Drees&Sommer, Dr. Uwe Knauer 2013
Tariff of the CSP-HVDC site Mis-Eic with underground cable - How can 16 billion € be paid that low interests incurred and thus the capital costs remain low?

Source: Hess, D., 2013, Fernübertragung regelbarer Solarenergie
How can 16 billion € be paid that low interests incurred and thus the capital costs remain low?

Apportionment of the costs on all electricity customers

Savings (black) and additional costs (red) accumulated in 40 years versus dispatchable fossil fuels (coal / gas)

interests = 9.9%
discount rate = 1.3%

Source: Hess, D., 2013, Fernübertragung regelbarer Solarenergie
„Ways connect people“

Thank you for your attention!

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Source: http://www.ribapylondesign.com/
Further steps

- preparation of a handbook for public participation
- publication of further scientific studies on the necessity of dispatchable solar electricity imports to Baden-Wuerttemberg on a multilingual website
- questioning of citizens in case studies in exemplary communities
- detailed cost-benefit analysis with risk assessment
- cooperation with ENTSO, TransnetBW, RTE, REE, ONEE in preparation for the inclusion in the "Union List" of a project with common interests (EU Regulation 347/2013)
- support of the necessary application documents and the required measures
- search for suitable project responsible
Communication platform for online public participation
Declaration of intent on state level

exemplary scientific model

green: in favour
red: refusal
white: not yet decided
Declaration of intent on regional level

exemplary scientific model

green: in favour
red: refusal
white: not yet decided
Declaration of intent on municipal level

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- green: in favour
- red: refusal
- white: not yet decided

exemplary scientific model
Declaration of intent on owner level
On the interactive website can also appear:

- Image video about this potential project (animation of the power plant function, need in the energy system of a Central European control area, data and interviews with affected people of the power station, the transmission line and electricity customers)
- All current activities with citizens, in politics, science and economy
- Schedule of citizen participation and overall schedule
- All data in the field of economy, ecology, technology, social and institutional
- Already achieved progress and critique