Energy and Renewables

Thomas Fend, German Aerospace Center, Institute of Solar Research

EWACC Building Bridges
Young Scholars’ Forum (YSF), Nicosia, Cyprus, June 7 to 17, 2015
Outline

- Why is Renewable Energy (RE) interesting for young people?
- Which RE technologies are useful?
- What can Concentrating Solar Power (CSP) do?
- Why are RE important for MENA and EU?
- How can we support RE in MENA and Europe?
Why is RE interesting for young people?
climate change by greenhouse gas emissions

source: IPCC report 2014
Why is RE interesting for young people?
climate change by greenhouse gas emissions
Why is RE interesting for young people?
poor countries are suffering from climate change

Source: Press release University of Wisconsin-Madison, November 16, 2005
Why is RE interesting for young people?
rich countries are responsible for CO2 emissions
Why is RE interesting for young people?

rising prices for fossil energy carriers
Why is RE interesting for young people?
increasing energy demand in MENA
Why is RE interesting for young people?
PV electricity costs vs. customer costs

“We believe the trend is clear: grid parity without subsidies is already here, increasing parity will occur, and solar penetration rates are set to ramp worldwide,” Vishal Shah, Deutsche Bank.
Why is RE interesting for young people?
job creation

Renewable Energy and Jobs – Annual Review presents the status of renewable energy employment, both by technology and in selected countries, over the past year. In this second edition, IRENA estimates that renewable energy employed 7.7 million people, directly or indirectly, around the world in 2014 (excluding large hydropower). This is an 18% increase from the number reported the previous year. In addition, IRENA conducted the first-ever global estimate of large hydropower employment, showing approximately 1.5 million direct jobs in the sector.

The 10 countries with the largest renewable energy employment were China, Brazil, the United States, India, Germany, Indonesia, Japan, France, Bangladesh and Colombia.

The solar PV industry is the largest renewable energy employer worldwide with 2.5 million jobs, followed by liquid biofuels with 1.8 million jobs, and wind power, which surpassed 1 million jobs for the first time. The employment increase extends across the renewable energy spectrum with solar, wind, biofuels, biomass, biogas and small hydropower all seeing increases in employment.
Why is RE interesting for young people?

....because you can make money with it!
Which RE Technologies are useful?

- Biomass
- Solar Architecture
- Hydropower
- Wind
- Solar thermal
- Solar PV
- Solar CSP
Which RE Technologies are useful?

Biomass
Solar Architecture
Hydropower
Wind
Solar thermal
Solar PV
Solar CSP

+ easy, small units, storable
- high land use, no building integration
Which RE Technologies are useful?

- Biomass
- Solar Architecture
- Hydropower
- Wind
- Solar thermal
- Solar PV
- Solar CSP

source: Prof. Bombeck, University of Rostock
Combined air conditioning
Alhambra / Sevillia

- vegetation
- water surfaces
- exposition

source: Prof. Bombeck, University of Rostock
passive use
of solar energy

summer
winter

Principles:
- irradiation
- storage
- shading

source: Prof. Bombeck, University of Rostock
Which RE Technologies are useful?

Biomass
Solar Architecture
Hydropower
Wind
Solar thermal
Solar PV
Solar CSP

Lake Aswan 2100 MW
Which RE Technologies are useful?

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Which RE Technologies are useful?

Biomass
Solar Architecture
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Solar CSP

+ storable, energy on demand
- high land use,
- environmental impact, resettlements
- restricted to humid mountain countries
Which RE Technologies are useful?

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Which RE Technologies are useful?

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*Figure 4. Representative turbine architectures from 1980 to 2010*
*Source: NREL*
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http://www.cityofcalabasas.com/solar.html
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http://forum.xcitefun.net/worlds-first-commercial-solar-power-tower-t87804.html
Which RE Technologies are useful?

...all of them, we need a proper mixture!
What can CSP do?

- Gas
- Oil
- Coal
- Nuclear
- Biomass
- Waste

Fuel

Superheater

Turbine

Generator

Cooling Tower

Evaporator

Condensor

Preheater

Feed water pump

Grid
What can CSP do?
What can CSP do?

- Solar tower (SNL)
- Dish-Stirling (SBP)
- Parabolic trough (PSA)
- Linear Fresnel (MAN/SPG)

Up to 1000 °C Gas turbines, Motors
Up to 550 °C steam turbines
What can CSP do?

- optional thermal storage or hybrid operation
- heat extraction for process heat, cooling, seawater desalination
Current CSP Projects
Status Quo Worldwide

Total 7.000 - 8.500 MW

Source: for current information see: www.solarpaces.org


Worldwide
in operation: 4.2 GW
forecast 2020: 15.5 GW
forecast 2050: 1070 GW

Sources: ESTELA and Protherm, solar, July 2014
What can CSP do?

Current project in MENA: Ain Beni Matar (Morocco)

- Combined Cycle + Solar field (ISCCS)
- Owner: ONE
- EPC conventional CC-plant: Abener
- EPC solar field + 2 year O&M: Abener
- Groundbreaking: 2008
- Commissioning: 5/2011
- Solar field size: 180,000 m²
- Solar share (yearly): 4%

An overview on CSP-projects in the world is given by

www.solarpaces.org
social.csptoday.com/
www.cspworld.org
What can CSP do?

...provide renewable base load electricity or power on demand!
Why are RE important for MENA and EU?

- The German nuclear power exit strategy
  - All nuclear power stations will be switched off by 2022
- Energy concept 2050: 100% Renewable Energy
- Dependence on weather conditions
- Coverage of *residual load* necessary
Why are RE important for MENA and EU?
Residual load problem from 35% wind and PV
Why are RE important for MENA and EU?
Residual load and price peaks
Why are RE important for MENA and EU?
Price peaks in the electricity market
Why are RE important for EU and MENA

- Solar Thermal power plants with thermal storage
- The DESERTEC Concept
- EU-Mena partnerships
- Improvement of Infrastructure (HVDC lines)
Why are RE important for EU and MENA
Local Manufacturing Potential

Why are RE important for EU and MENA

...because MENA countries and EU may develop electricity exchange in win-win partnerships!
How can we support RE in EU and MENA?

Supporting the Sustainable Implementation of Solar Thermal Power Plants Technology in the MENA Region
How can we support RE in EU and MENA?

enerMENA 2009 – 2014

enerMENA follows the DESERTEC concept

enerMENA supports the Sustainable Implementation of Solar Thermal Power Plants Technology in the MENA

enerMENA is a DLR initiative, supported by the German Federal Foreign Office
How can we support RE in EU and MENA?

enerMENA Budget

Budget Breakdown

- Joint R&D: 41%
- Meteo Network: 18%
- Capacity Building: 26%
- Management: 15%

Budget Timeline (Mio. €)

- 2009-11: 3.4 Mio. €
- 2012: 0.84 Mio. €
- 2013: 0.67 Mio. €
- 2014: 0.33 Mio. €
How can we support RE in EU and MENA?
enerMENA actions: R&D Bypass

**Motivation:**
Increase solar field performance under operation conditions

**Set–Up**
HTF Bypass between header and loop, equipped with different flow meters

**Achievements**
Installed at ISCCS Kuraymat in cooperation with NREA
Joint measurements and capacity building
How can we support RE in EU and MENA?
enerMENA actions: R&D Bypass

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How can we support RE in EU and MENA?
enerMENA actions: Network of Meteo stations

**Motivation:**
- Solar resource assessment for R&D and future CSP projects

**Set – Up**
- 11 Stations in 5 countries
- DNI, GHI
- Optional: soiling, durability, extinction parameters

** Achievements**
- 24.5 data year accumulated
- Data has been used by researchers and project developers
How can we support RE in EU and MENA?
enerMENA actions: Capacity Building

• **Motivation:**
  Establish technical teams to disseminate the CSP know-how and to perform R&D and O&M optimization

• **Implementation**
  Tailor-made courses and teaching materials for each target group (decision makers, project developers, lecturers, engineers and students)

• **Achievements**
  Since 2010 more than 1000 persons have directly participated in enerMENA capacity building
How can we support RE in EU and MENA?
enerMENA network

enerMENA: Network with over 50 Partners from 5 MENA Countries, Germany

International and Regional Organizations
PSA Plataforma Solar de Almeria
SolarPACES
DUN
GIZ
Dii
AUE
AFREC
RCREEE
Protermosolar

Partners in Germany
SIJ
CSP – Services
Fichtner Solar
Flagsol
Lahmeyer
NOVATEC BIOSOL AG
Solarlite

Morocco
MASEN
IRESEN
ONEE
UMP
REUNET
ENIM

Algeria
CDER
UDES
NEAL
SONELGAZ
AHK

Tunisia
CRTEn
Technopark
STEG (ER)
ENIT
AHK

Jordan
UJ
MDA
NERC
JUST

Egypt
CU
NREA
ORASCOM
GUC
How can we support RE in EU and MENA? 
teaching materials: technicians & engineers

Video-Tutorials

<table>
<thead>
<tr>
<th>Material</th>
<th>55 Session, total Time: 15:44:22</th>
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<td># Downloads</td>
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How can we support RE in EU and MENA?

Teaching materials: universities

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<tr>
<td><strong>Scripts</strong></td>
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<td><strong>Universities using the teaching materials</strong></td>
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<tr>
<td><strong>Current Distribution countries</strong></td>
<td>enerMENA Partners + Germany</td>
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<td><strong>Future Distribution countries</strong></td>
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## How can we support RE in EU and MENA?

### Capacity building courses

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<tr>
<th>Year and Place</th>
<th>eM-CB</th>
<th>eM-Project</th>
<th>eM-Expert</th>
<th>eM-University</th>
<th>Student Training Courses</th>
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### Scope

- **Optimization and operation of solar thermal power plants**
- **Project planning of solar thermal power plants**
- **Overview on CSP technologies**
- **Project planning for decision makers**
- **Preparation and implementation of teaching materials**
- **Practical training and experiments**

### Target

- **Engineers technicians**
- **Project developers**
- **Decision makers**
- **Professors**
- **Lecturers**
- **Students**

### Participants

- **54**
- **35**
- **410**
- **237**
- **70**
How can we support RE in EU and MENA?

...by initiating co-operations in education, R&D and project development!
Thank you for your attention!