Solar Energy for Science

A new energy/science partnership between Europe and MENA

Workshop on „Renewable Energy Concepts for Mega-Science Projects demonstrated at the SKA and its Pathfinders“

Berlin, 07 April 2011

Frank Lehner
DESY
Member of Helmholtz Association

Mission:
Development, construction, operation and scientific exploitation of accelerators
Provide (open) access and services for national and international users

• Accelerators
• Photon Science
• Particle and Astroparticle Physics

Research Collaboration with leading labs worldwide

Budget ~ 180 Mio €/a
Employees ~ 1900

Research Infrastructures: DORIS, FLASH (-II), PETRA-III, XFEL, TIER-2

External Users: ~ 3000/year from 45 countries
Our science policy mandate: construction, operation and exploitation of large research infrastructures

large research infrastructures are energy intensive
  - synchrotron radiation sources, neutron sources, X-Ray lasers, high magnetic field facilities, high performance computing, …
  - DESY (w/o XFEL): 20 MW Power, 210 GWh/year, about 110 kt CO2/year
  - future development of energy prices, volatility?
  - how climate neutral/sustainable should research centers be?
  - => Question of energy supply is of strategic relevance

Goal: have on a long-term a reliable, sustainable and economic energy supply for large research infrastructures
DESY engaged in CTA

remote Research Infrastructure for high energy gamma astronomy
The global picture – asymmetric/complementary

Historic CO2-emissions

Solar potential

Energy consumption

Knowledge production
Renewable energy from the desert regions of the Middle East and Northern Africa (MENA)

- Reduce carbon, provide reliable energy supply
- Reduce „energy poverty“ in MENA, drinking water supply
- Economic and sustainable growth, peace, stability („from a shatterbelt to a Gateway“)
- Support reform and modernization process in MENA !!!!
- Sustainable development of geopolitical interest in Europe (Neighborhood politics)

*I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait till oil and coal run out before we tackle that.*

*Thomas Alva Edison, 1847-1931*
Fascinating prospects for a win-win situation – however, it requires

- favorable political regulations and conditions (in export-/import countries)
- incentives for private investments, e.g. feed-in tariffs
- upgrade of power grid infrastructure
- Communication/advocacy in MENA region
- Visible added value and benefits in MENA, e.g. increased security of energy supplies, jobs, economic wealth, infrastructure, value chain in MENA, ...

Proposal: embark on Energy/Science Partnership between EU and MENA (Solar Energy for Science)

- Understand EU-MENA as one area of common interest in energy supply, water, climate protection and science & technology exchange
- coupling of sustainable energy supply MENA-EU to scientific, technology, education transfer/collaboration
- partnership could give long-term perspectives to MENA now, Science can contribute to build bridges
- Such a mechanism can be additional incentive to intensify post-Kyoto climate politics
Concept of a joint energy/science partnership

Enhance S&T cooperation with MENA partners as stimulus for governments to promote renewable energies in MENA

- coupling of sustainable energy supply MENA-EU to scientific, technology, education transfer/collaboration
- partnership can help to overcome obstacles, remove regulatory hurdles

Prospect/Vision for EU-MENA: direct physical transfer of solar energy (via high voltage DC transmission lines) – swap knowledge, education and S&T versus energy (“in-kind contribution”)
> SESAME – “Synchrotron-Light for Experimental Science and Applications in the Middle East” in Jordan

> developed under UNESCO auspices and modeled after CERN governance, nine member states

> state-of-the-art third generation synchrotron source - to be operational in 2015

> BESSY I – as donation from Germany - serves as 800 MeV Booster

> it will significantly strengthen fundamental research in the region with application in physics, material science, chemistry, life sciences, ...

> first three planned beamlines

  - protein crystallography
  - X-Ray absorption Fine Structure / X-Ray Fluorescence Spectroscopy
  - IR Beamline

“a quintessential science for peace project” (UNESCO)

<table>
<thead>
<tr>
<th>Table 1: SESAME design parameters.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (GeV)</td>
</tr>
<tr>
<td>Circumference (m)</td>
</tr>
<tr>
<td>N. of Periods</td>
</tr>
<tr>
<td>Dipole field (T)</td>
</tr>
<tr>
<td>Dipole field index</td>
</tr>
<tr>
<td>$Q_1 - Q_2$</td>
</tr>
<tr>
<td>Morn. Compaction</td>
</tr>
<tr>
<td>N. Emitt (mm.rad)</td>
</tr>
<tr>
<td>$U_i$ (keV/turn)</td>
</tr>
<tr>
<td>$\tau_1, \tau_2, \tau_3$ (ms)</td>
</tr>
<tr>
<td>RF freq. (MHz)</td>
</tr>
<tr>
<td>Harmonic Number</td>
</tr>
<tr>
<td>Peak Voltage(MV)</td>
</tr>
<tr>
<td>Synch. Freq. (kHz)</td>
</tr>
<tr>
<td>$\sigma_L$ (cm)</td>
</tr>
<tr>
<td>Current (mA)</td>
</tr>
<tr>
<td>N. of bunches</td>
</tr>
<tr>
<td>1/e Lifetime(hrs)</td>
</tr>
</tbody>
</table>
Research Renewable Energy and Synchrotron Sources

> Synchrotron Radiation Sources have unique analytical potential for R&D on renewable energies

> Photovoltaics
  - e.g. Metal impurities in solar cells – X-Ray fluorescence spectroscopy

> Fuel cells
  - In-situ determination of local electro-chemical potentials at electrodes, catalysts

> Energy Storage / Batteries
  - Charge/Discharge Processes in Li-Polymer Batteries

> …

> In general functional structures/materials at nanoscale
Deployment of Solar Energy in MENA and export to Europe requires cross-border collaboration and capacity building.

SESAME serves as a symbol for international collaboration uniting scientists from all over the region, including Middle Eastern nations and Israel. Iran sits next to Israel in Council.

A joint science/energy collaboration with SESAME could be a perfect showcase to foster MENA solar energy R&D, production and exportation:

- Foster renewable energy research at SESAME - collaboration/community and capacity building
- Build a flagship solar energy plant connected to SESAME under international patronage (UNESCO, …)
- As reference, demonstrate all key features of energy production and cross-border transfer that is necessary for the “energy from the desert” concept
DESY - Hamburg

> Organizers:
  - DESY, Prof. Dr. Helmut Dosch
  - German Aerospace Center DLR, Prof. Dr. Robert Pitz-Paal
  - in cooperation with Egyptian Academy of Scientific Research, Prof. Dr. Maged El-Sherbiny and SESAME, Prof. Dr. Khaled Toukan

> Patronage: UNESCO

> Chairman of Advisory Board: Klaus Töpfer

> Topics
  - Climate Change, Renewable Energy and Societal and Developmental Challenges
  - Science, Sustainability and Responsibility
  - Solar Energy Projects in MENA and around the world
  - Bridging Solar Energy from MENA to Europe
  - Scientific & Educational Projects in MENA as Anchor Points for Collaboration and Capacity Building
  - Towards a Science / Energy Partnership

http://www.solar4science.de
Objectives of Symposium

- raising awareness of the importance of renewable energies in MENA in view of global challenges
- emphasizing science and scientific cooperation between Europe and MENA as crucial driver for capacity building and as facilitator for a sustainable development
- developing a process to shape a future energy/science partnership
- promoting and formulating action plans for further activities
- receiving broad support from policy- and decision-makers
Plan for a Technical workshop – winter 2011

> Proposal of a CSP pilot project that acts as showcase for „Solar Energy for Science“
  - 5-10 MW pre-commercial demonstrator solar power plant
  - Attractive for private and public partners from Europe and MENA and for mobilizing investments and funds on national and international levels

> ~50 Experts from research institutions, industry and authorities from Europe and MENA Involvement of private sector is highly desired

> Goal: Kick-Off Feasibility Study by 2012

> Provision of visible regional benefits and added value in terms of technology advancement, sustainability and international cooperation and coordination.

  - **Technology**: Innovative small plants are direly needed and are perceived as a step towards the further development of commercial plants. Demonstration of technology advancements and improvements as compared to existing plants with the goal to increase performance, flexibility, reliability.

  - **Sustainability**: Various sustainable criteria in terms of economic, social and environmental developments considered

  - **Cooperation and Coordination**: Reinforce cross-border cooperation and coordination in MENA and strengthen the scientific links between Europe and MENA to contribute to the Euro-Mediterranean Research and Innovation Area
Conclusions:

4. Likewise, the use of the existing energy-intensive multi-purpose and basic science Research Infrastructures, including e-Infrastructures should be further explored and new energy-efficient ways of operation in performing research should be demonstrated.

ERF Workshop on Energy Management at large RIs

• Energy efficiency and optimization
• Energy procurement, generation and supply strategies

13/14 October 2011 – DESY, Hamburg