Solar Energy for Science

SOLAR ENERGY FOR SCIENCE

A new energy/science partnership between Europe and MENA

an initiative by DESY
co-organized by DLR

DLR

in cooperation with
SESAME and Academy of
Scientific Research & Technology, Egypt

SESAME

ASRT

Wissenschaftlicher Ausschuss
DESY, 12 April 2011
Frank Lehner

HELMHOLTZ ASSOCIATION

DESY

Motivation

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- 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?

    RI Examples: ESS-S, SKA

  - =>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
- Part of the DESY sustainability concept

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Renewable Energy from the Deserts

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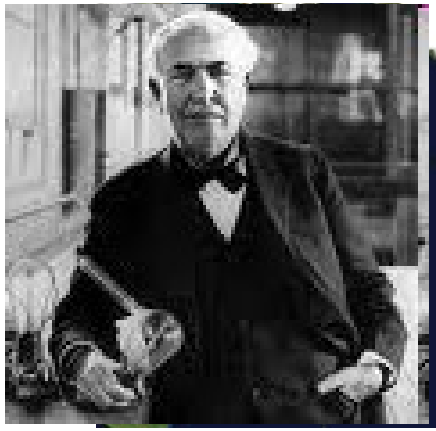
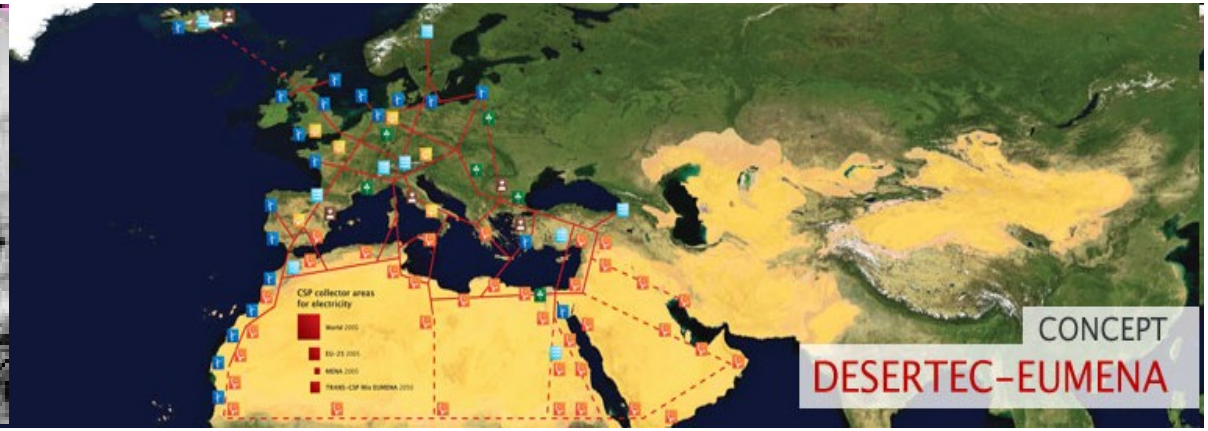
- Renewable energy from the desert regions of the Middle East and Northern Africa (MENA)
  - Reduce carbon, provide reliable energy supply
  - reduce „energy poverty“ in MENA, drinking water supply
  - Economic and sustainable growth, peace, stability („from a shatterbelt to a Gateway“)
  - Support reform 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

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Energizing the MENA Deserts

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- 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

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Concept of a joint energy/science partnership

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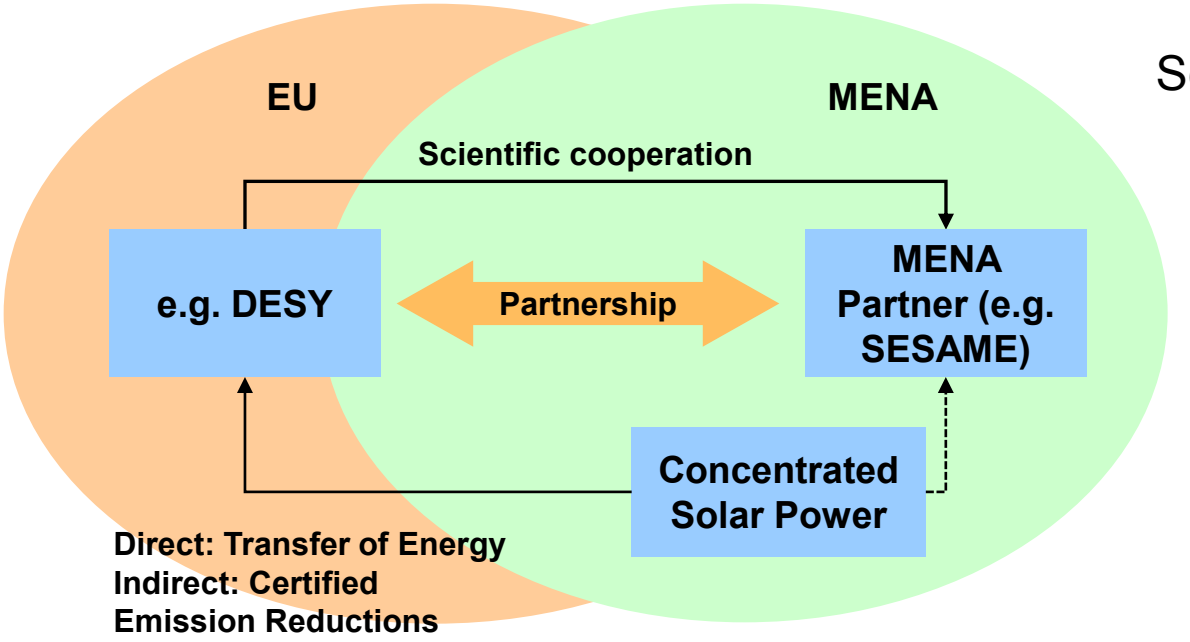
Science can build bridges



- 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)

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SESAME

- 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 Flourescence Spectroscopy
  - IR Beamline

“a quintessential science for peace project” (UNESCO)

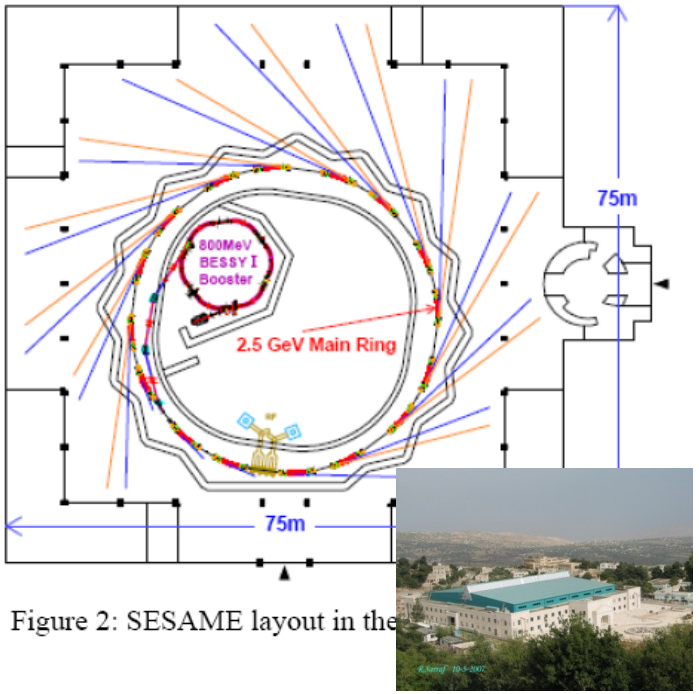


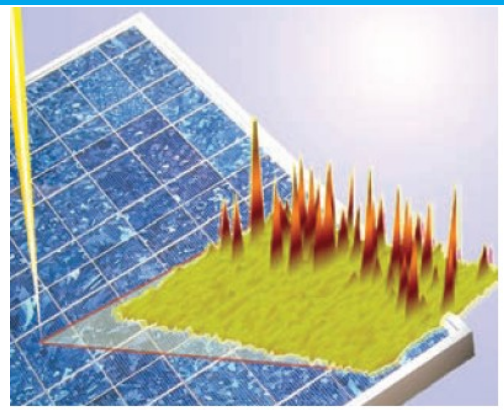
Figure 2: SESAME layout in the

Table 1: SESAME design parameters.

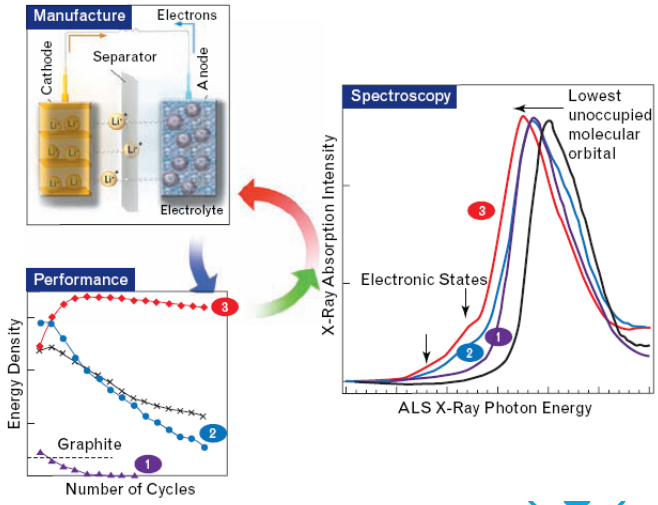
Energy (GeV)	2.5
Circumference (m)	133.12
N. of Periods	8
Dipole field (T)	1.455
Dipole field index	11
Q_x - Q_z	7.23 – 6.19
Mom. Compaction	0.00829
N. Emitt.(nm.rad)	26.0
U_0 (keV/turn)	589.7
τ_ε, τ_x, τ_z (ms)	2.80, 2.28, 3.77
RF freq. (MHz)	499.564
Harmonic Number	222
Peak Voltage(MV)	2.4
Synch. Freq. (kHz)	37.18
σ_L (cm)	1.15
Current (mA)	400
N. of bunches	200
1/e Lifetime(hrs)	16.9

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 flourescence 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

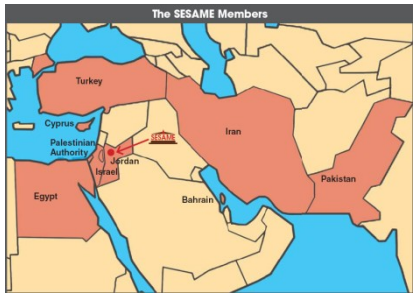


Artist's depiction of an intense beam of synchrotron light striking a solar cell and the resulting fluorescence image of the distribution of iron impurities. Courtesy of T. Buonassisi (MIT). [Buonassisi et al., *Nat. Mater.* **4**, 676 (2005) ; Buonassisi et al., *Appl. Phys. Lett.* **89**, 042102 (2006); Buonassisi et al., *Acta Mater.* **55**, 6119 (2007).]



SESAME could be an anchor point

- 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



Symposium Solar Energy for Science – 19/20 May 2011 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

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SESAME ASRT

BUILDING BRIDGES

SYMPOSIUM
19/20 MAY 2011
DESY HAMBURG
GERMANY
www.solar4science.de

United Nations Educational, Scientific and Cultural Organization
With the support of Natural Sciences Sector

ZEIT-Stiftung Ebelin und Gerd Bucerius

http://www.solar4science.de

DESY

Objectives of Symposium

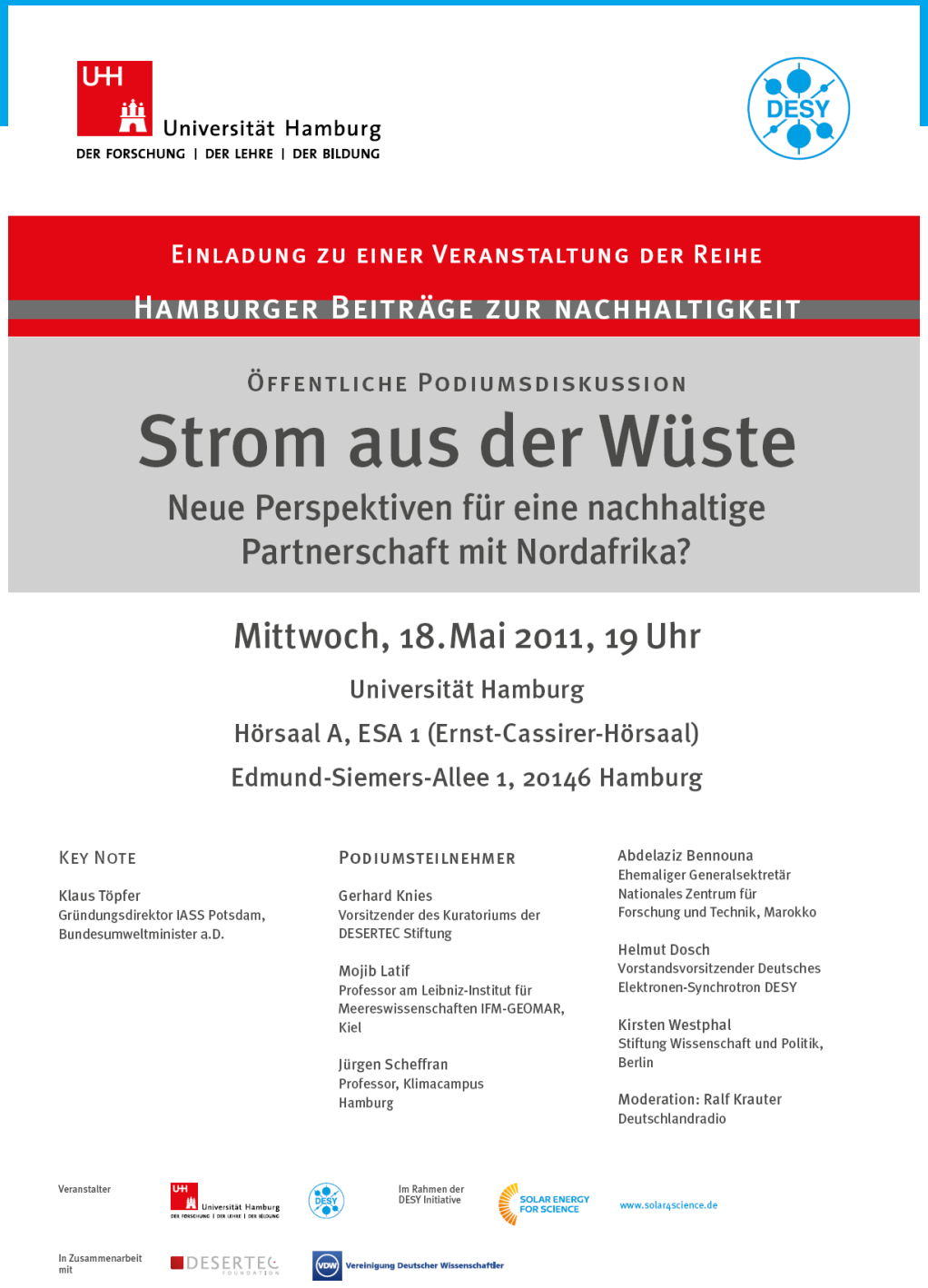
- raising awareness of the importance of renewable energies in in view of global challenges
- emphasizing science and scientific cooperation between Europe and MENA as crucial driver for capacity building and as facilitator for a sustainable development
- developing a process to shape a future energy/science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

Speakers:

- Carlo Rubbia, Herwig Schopper, Chris Llewellyn-Smith
- Claudia Kemfert, Ottmar Edenhöfer
- Mojib Latif, Hartmut Grassl
- Gretchen Kalonji (UNESCO-Direktorin), Klaus Töpfer, E. Weizsäcker
- Maged Al-Sherbiny, Khaled Toukan, Mouldi Miled, Suhail Kiwan, …

Öffentliche Podiumsdiskussion

- Im Rahmen der Nachhaltigkeitsreihe der UHH
- Teilnehmer
  - Klaus Töpfer
  - Gerhard Knies
  - Mojib Latif
  - Jürgen Scheffran, UHH
  - Abdelaziz Bennouna
  - Helmut Dosch
  - Kirsten Westphal
  - Moderation: Ralf Krauter
- 18. Mai 2011 um 19h Hörsaal ESA 1, UHH



Next Steps

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- Further development/sharpening/widening of Initiative
  - Integrate and widen concept within Helmholtz Association and other research organizations
  - promote initiative with other research laboratories in Germany/Europe, engage European RIs
  - Seek active support from politics in Germany, Europe, MENA
- Scientific Cooperation
  - consolidate Cooperation with SESAME, participate with other European Synchrotron labs in EC call to support SESAME and prepare integration into ERA, MoU signing with SESAME at Symposium
  - identify further science partners in Europe/MENA and areas of overlap/cooperation
  - exploit potential of renewable energy R&D at SESAME synchrotron, stimulate networking of relevant MENA partners
- Technological Cooperation
  - Together with DLR prepare a technical workshop towards a feasibility study for a solar demonstration plant
- European Research Infrastructure Facilities (synchrotrons, neutrons, ions, computing, …)
  - Explore energy-efficient ways to operate research facilities, develop sustainability concepts
  - Workshop at DESY 13/14 October 2011

DESY

European Research Infrastructures - ERF

ERF European Association of National Research Facilities

- organizes every year topical workshop
- previous topics: open access, human mobility

Now: ERF Workshop on Energy Management at large RIs

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

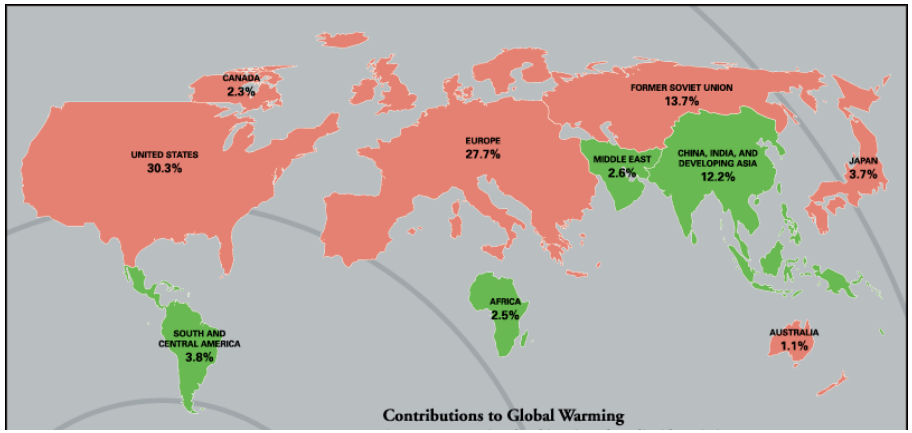
13/14 October 2011 – DESY, Hamburg

European Research Infrastructures

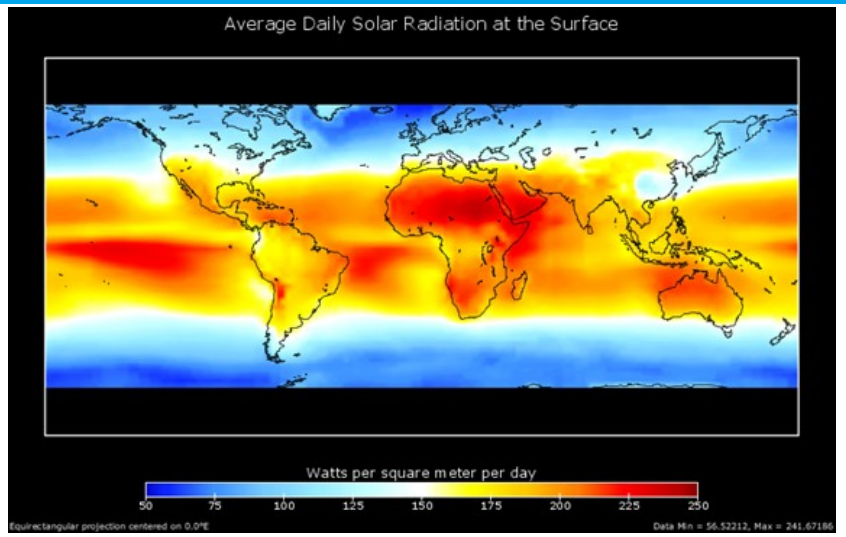
Conclusions:

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.

The global picture – north-south asymmetry

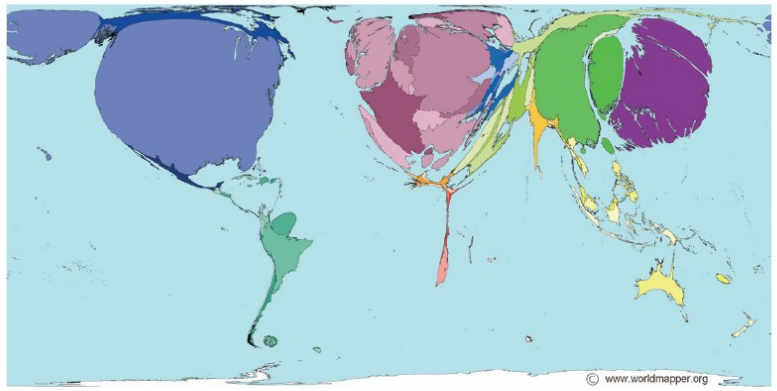


Historic CO2-emissions



Solar potential

Energy consumption



Die Territorium … en für Forschung/
Kopf wieder. (C

Knowledge production

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

Winter 2011 in Egypt or Jordan