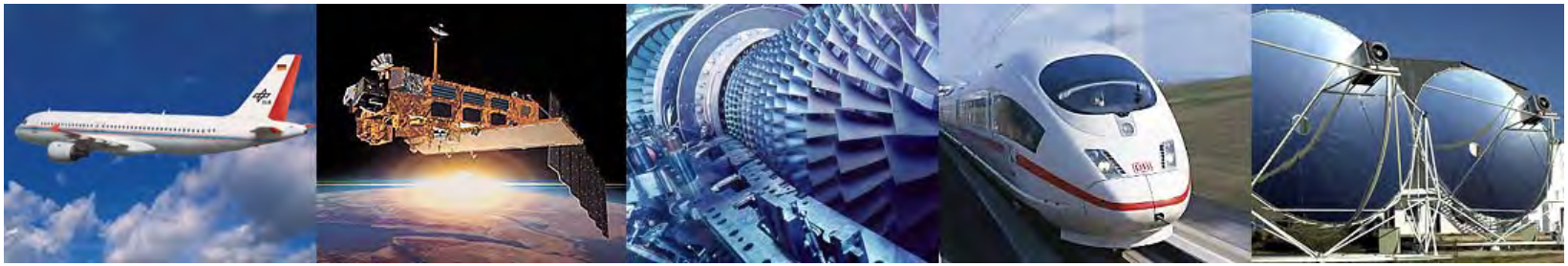
FFF and SolarPACES Workshop

Johannesburg, September 20-21, 2014

Overview DLR, International Initiatives, Research Programmes

Dr. Christian Sattler
christian.sattler@dlr.de

DLR
German Aerospace Center



- Research Institution
- Space Agency
- Project Management Agency

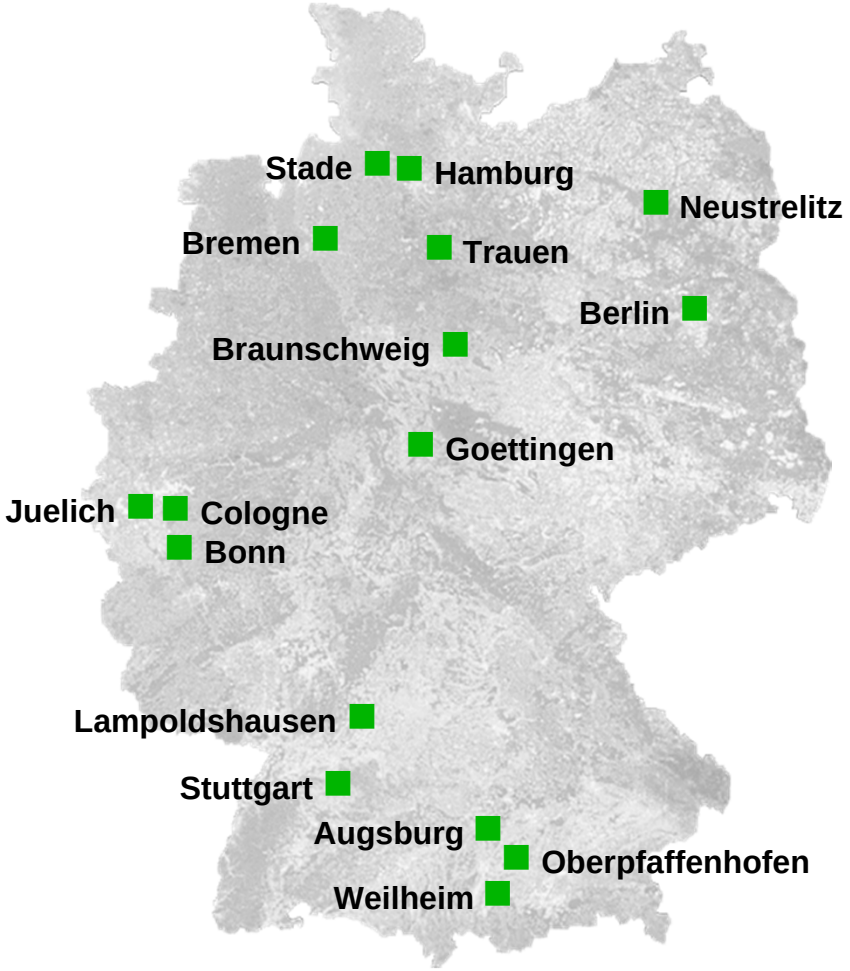
- Aeronautics
- Space Research and Technology
- Transport
- Energy
- Defence and Security
- Space Administration
- Project Management Agency

Locations and employees

7700 employees across
32 institutes and facilities at
16 sites.

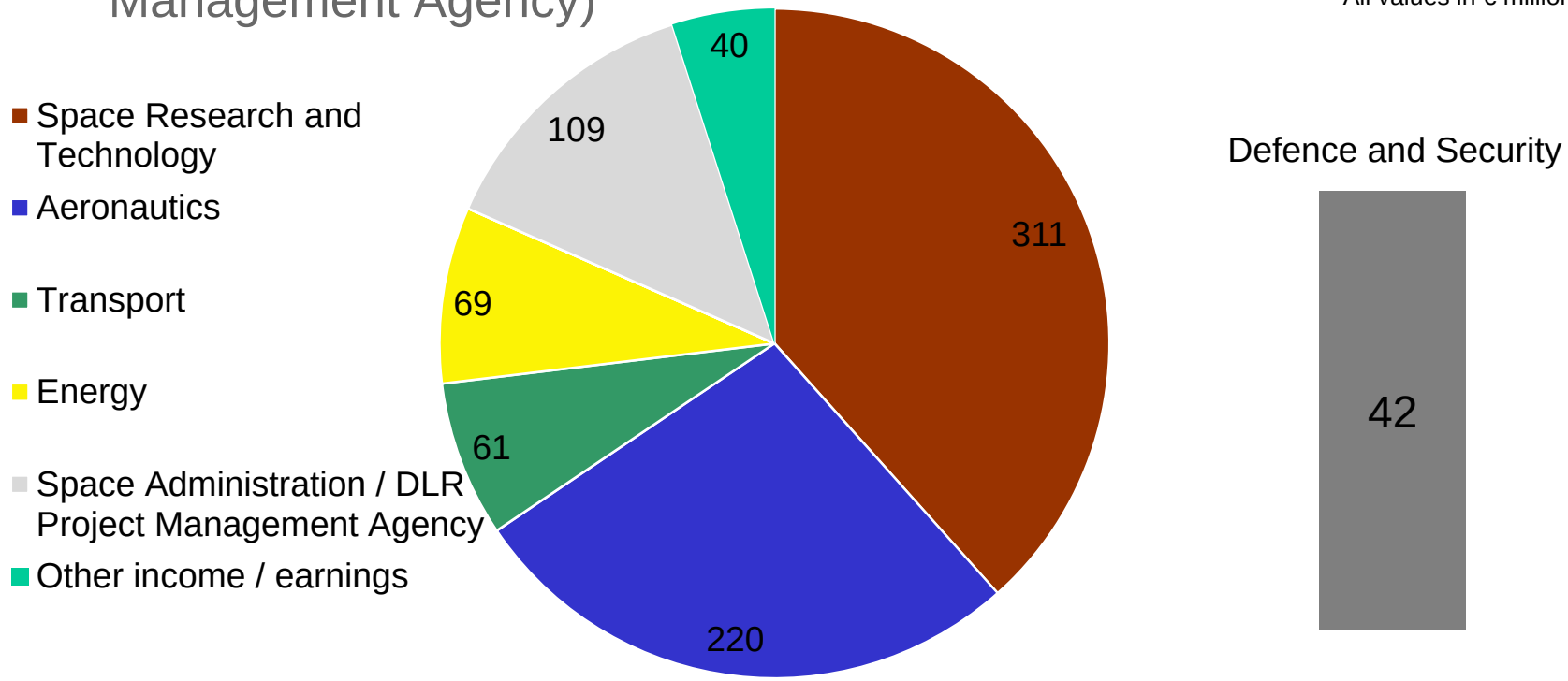
Offices in Brussels, Paris,
Tokyo, Washington and Almería.

Permanent delegation at the European Solar Test Centre Plataforma Solar de Almería, Spain

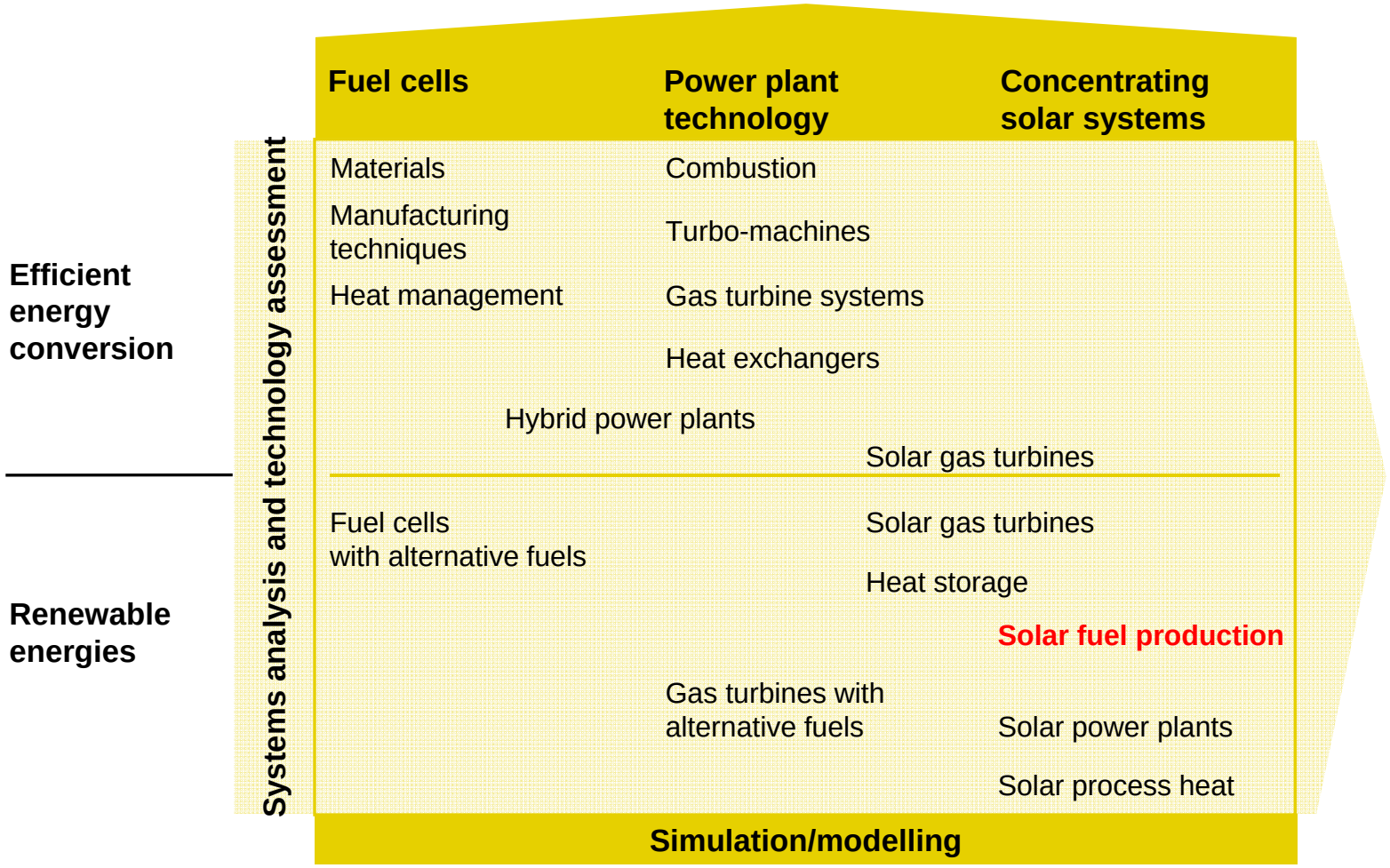


Total income 2013 – Research, operations and management tasks: €810 Mio. (excluding trustee funding from the Space Administration / DLR Project Management Agency)

All values in € million



Portfolio of Competences – Energy



DLR Institute of Solar Research

Main Topic:

Solar Thermal Power Plants

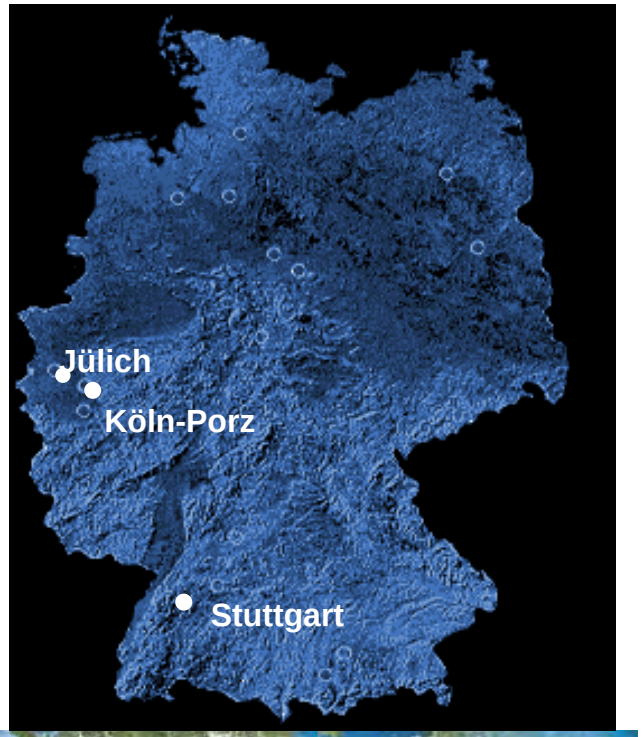
140 Persons

5 Departments, 4 Sites

Köln-Porz, Jülich

Stuttgart

Plataforma Solar de Almería (Permanent Delegation) and Office in Almería, Spain



Department of Solar Chemical Engineering

Head
Organisation
Strategy
Representation in boards

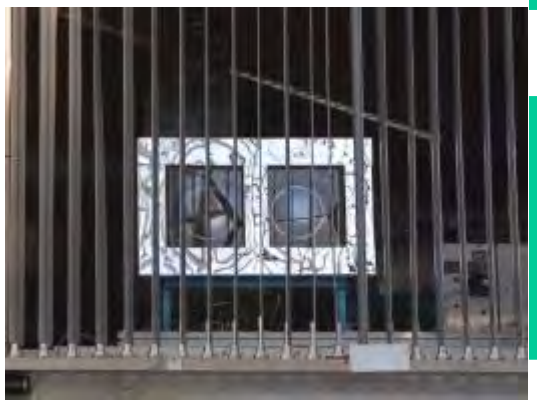
Group
High temperature CE
Solar tower >500° C

Solar Fuels
Solar Materials

Group
Low temperature CE
Reactors up to
Parabolic troughs
< 500° C

Heat transfer fluids
Solar fuels
Water treatment

SOWARLA GmbH



25 Persons + 10 Students, 65% external funding

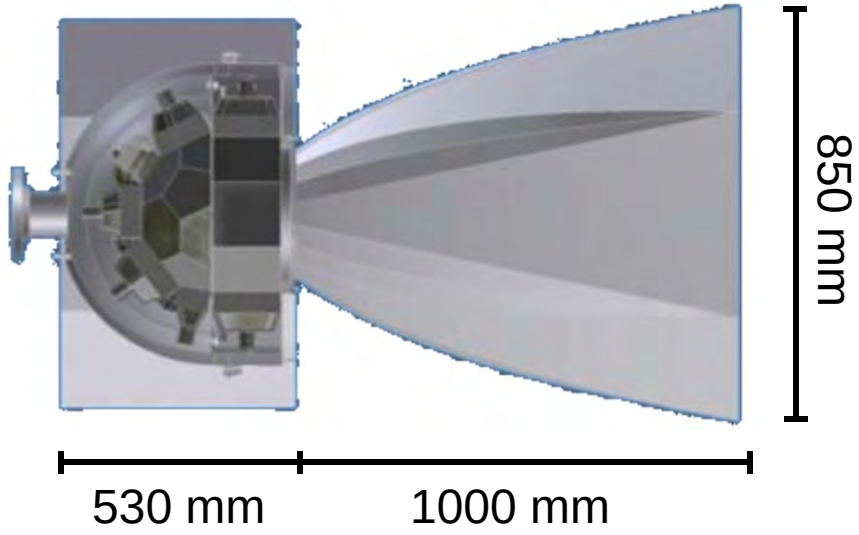
DLR

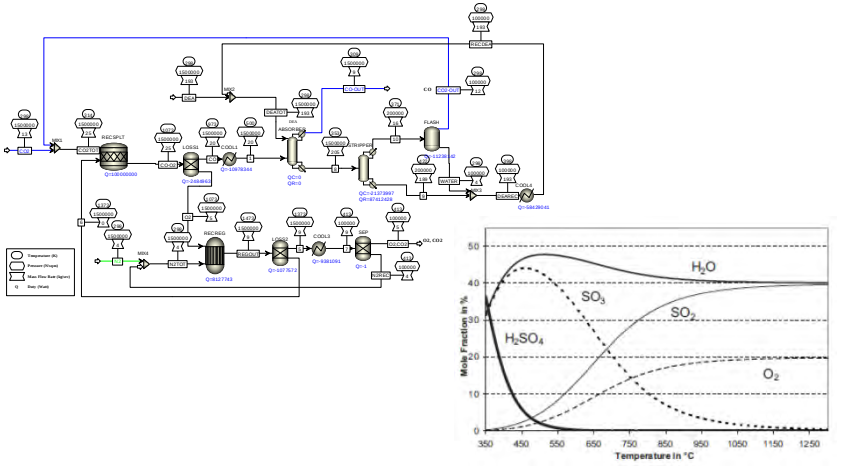
Competences

Development of components and processes

and

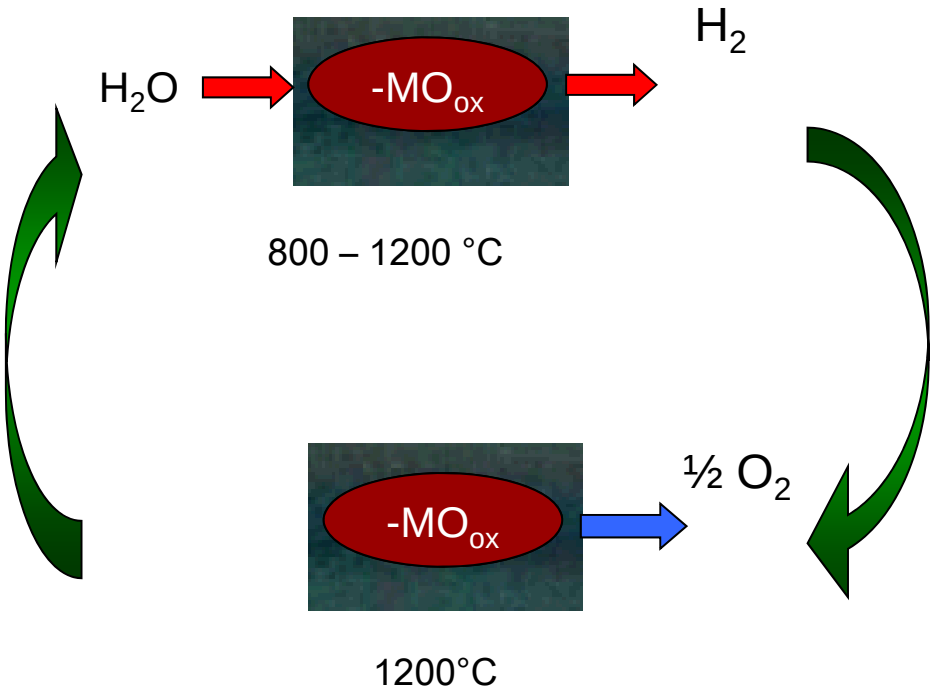
scientific, technologic and economic evaluation





Solar Fuels

- > 20 years experience and international cooperation
- Processes
  - Reforming of NG
  - Thermo-chemical cycles
    - Sulfur
    - metal oxides
  - Solar HT electrolysis
  - Cracking of methane
  - Photo-catalysis
- Products
  - H_2, syn-gas, methanol, FT-Synfuels …

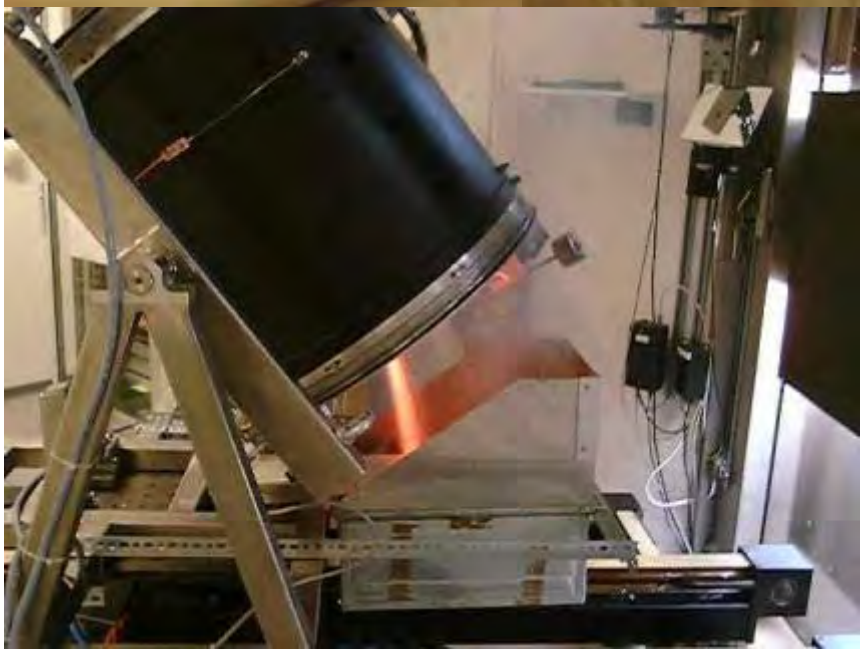


(Roeb, Müller-Steinhagen, Science, Aug. 2010.)

Contact DLR: Dr. Martin Roeb, (martin.roeb@dlr.de Tel.: +49(0)2203 601 2673)

Solar Materials

- High temperature recycling of waste materials (e.g. aluminium, sulfuric acid)
- Development of solar heated reactors – solar heated rotary kilns
- Development and demonstration of production processes



Contact DLR: Dr. Martin Roeb, martin.roeb@dlr.de

Tel.: +49(0)2203 601 2673

Heat Transfer Fluids for CSP

- Accelerated Aging
  - Degradation rates, and kinetics of gas, water, and other degradation products formation
- Physico-chemical parameter at high temperatures
  - Vapor pressure, density, heat capacity, heat conductivity, viscosity, gas soluability
- Interaction with power plant components
  - Hydrogen diffusion, influence of material contacts and impuritieson the aging of the heat transfer fluids
- Field tests
  - Authentic and representative samples of heat transfer fluids during power plant operation, inline- / atline- / offline-analysis

Contact DLR: Dr. Christian Jung (christian.jung@dlr.de; Tel. +49 (0) 2203 601 2940)

DLR

Photocatalytic Synthesis of Solar Fuels

- Qualification of new photo-catalysts for hydrogen production or the reduction of CO_2
  - Determination of spectral quantum yields by special lamp technologies,
  - Determination of the solar efficiency in our solar test fascilities,
  - Evaluation of long term stability, and product quality, optimisation of the produktivity
- Chemical Engineering

  Development of solar receiver-reactors, design of concentrator technologies, scale-up, and economic evaluation

Contact DLR:
Dr. Christian Jung (christian.jung@dlr.de; Tel. +49 (0) 2203 601 2940)

DLR

Photochemical Water Treatment

- Evaluation od solar photochemical processes (VUV to solar)
  Actinometry of light sources, degradation tetst by photolytic and photo-catalytic processes; water analytics
- Development of photo-reactors
  Solar receiver-reactor technology and photo-reactors for nnovative light sources
- Development of photo-chemical plants
  Plants for water treatment with photo-chemical key steps up to demonstration scale, research on the combination of treatment technology, automation, recycling of photo-catalysts, energetic optimisation

Contact DLR:
Dr. Christian Jung (christian.jung@dlr.de; Tel. +49 (0) 2203 601 2940)

SOWARLA

DLR

Strategic Basis

International Initiatives

- IEA – International Energy Agency
  - SolarPACES Implementing Agreement
  - HIA – Hydrogen Implementing Agreement
    - Task 1, and Task 25 on high temperature hydrogen production are finished
    - A new task is in preparation. Initiative is lead by the US DoE
- IPHE – International Partnership for Hydrogen in the Economy
  - Initiative of governments to prepare a hydrogen economy – somewhat detached from real developments

Political view: SET-Plan (2007)
European Strategic Plan for Energy Technology

- **Goals of the EU until 2020 (20/20/20)**
  - 20% higher energy efficiency
  - 20% less GHG emission
  - 20% renewable energy
- **Goal of the EU until 2050:**
  - 80% less CO_2 emissions than in 1990
- Actions in the field of energy efficiency, codes and standards, funding mechanisms, and the charging of carbon emissions necessary
- Significant research effort for the development of a new generation of CO_2 emission free energy technologies, like
  - Offshore-Wind
  - **Solar**
  - 2nd generation Biomass

Programs in Europe

- National Energy Research Programs in most of the European Countries (very different levels and aims)
- Joint Programs under the European Framework Programmes for Research and Technical Development (RFP)

- 2014 – 2020 „HORIZON 2020“
    - Wider focus than the previous seven RFPs: It combines all research and innovation funding provided through the RFP, the innovation related activities of the Competitiveness and Innovation Framework Programme (CIP) and the European Institute of Innovation and Technology (EIT).

HORIZON 2020

- Budget € 70 – € 80 billion
- Main Topics
  - Strengthen the EU's position in science. European Research Council (ERC) Person related basic research (33%)
  - Strengthen industrial leadership in innovation (24%)
  - address major concerns shared by all Europeans such as climate change, developing sustainable transport and mobility, making renewable energy more affordable, ensuring food safety and security, or coping with the challenge of an ageing population (43%)
- In the energy sector storage is a major topic
  - Power production
  - Industrial processes

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

European Commission

New Energy World IG
fuel cells & hydrogen for sustainability

N.ERGHY

DLR

Public Awareness, Education

Market Support (SME Promotion, Demand Side Measures, etc.)

Demonstrations

Vehicles & Infrastructure	Low Carbon Supply Chain	System Readiness Manufacturability	Backup/UPS Off-road H2 Vehicles Micro/Portable FC

Technology, Sustainability & Socio-Economic Assessment Framework

Specific PNR & Harmonised RCS

Research and Technological Development

Stack & Subsystems	Processes & Modules	Periphery & Components	Systems & Integration & Testing

Components	New Technologies	Material & Design & Degradation & Durability

Long-term and Breakthrough Orientated Research

Transport & Refuelling Infrastructure	Hydrogen Production & Distribution	Stationary Power Generation & CHP	Early Markets

Studies Published (www.fch-ju.eu)

SOLLAB, SFERA, EERA, STAGE-STE

- SOLLAB - Virtual European Institute of the leading CSP research Institutions
  - Members: CNRS-PROMES (France), DLR (Germany), CIEMAT (Spain), ETH, PSI (Switzerland)
  - Associate members: WIS, Israel, ENEA, Italy
  - Joint work in all fields of CSP, annual Doctoral Student Colloquium, exchange of scientists …
- SFERA, SFERA 2 – EU FP7 Infrastructure projeect
  - Improvement of installations and accessability for people outside the SOLLAB
- EERA CSP – European Energy Research Alliance on CSP
  - Joint programming for European research institutions and industry for the development of CSP – joining national ressources
  - EU political attempt to levelize R&D in Europe
  - First call for projects was launched in 2012
  - Not implemented in the HORIZON 2020 yet
- STAGE-STE – FP7 Project with about 40 partners to prepare the EERA

US Programs

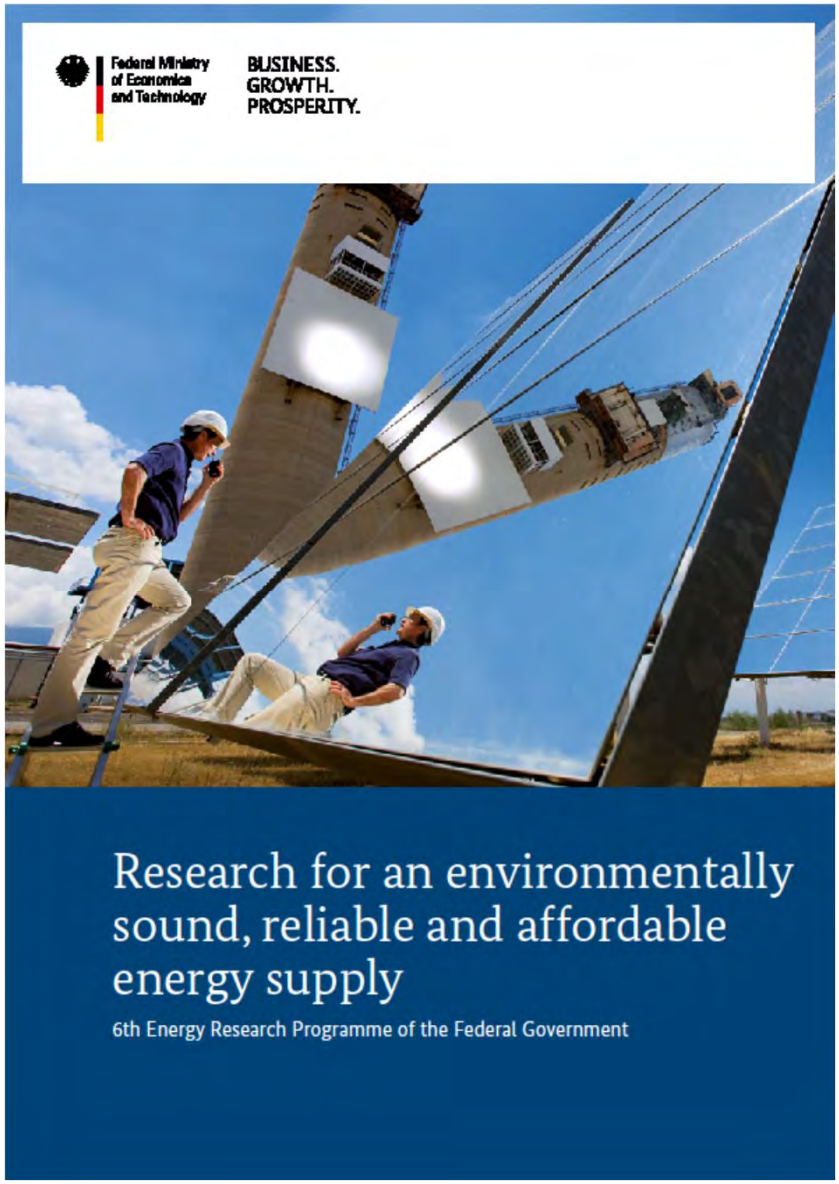
- SunShot
  - CSP Program
  - Special topic – storage
  - Thermochemical storage has a high priority
    - Project on a Sulfur Cycle finished
- Hydrogen
  - There are hydrogen programs as well for nuclear as for solar applications in the past.
  - New solar projects have just started on metaloxide cycles and on hybrid sulfur cycle
- ARPA-E
  - Applied reserch program
  - Projects are running on
    - solar fuels
    - energy reduction in metals extraction
- NSF – National Science foundation
  - Basic research program

Programs in Germany

- 6th Energy Research Program (3.5 billion euros for the period 2011-2014).

- The Program focuses on key topics relating to the restructuring of Germany's energy supply, i.e.
  - renewable energies,
  - energy efficiency,
  - storage and grids.

- Continuation in a succeed program



Programs in Germany

- 6th Energy Research Program
  - BMWi - Energy Storage Program
  - BMU - CSP Program
  - BMVBS - NOW (National Organization for Hydrogen)
  - BMBF - Energy Storage Program
- Basic Funding of the research institutions (e.g. Helmholtz by BMBF and BMWi)
- GIZ – Gesellschaft für Internationale Zusammenarbeit
  - Cooperation RSA - Germany
- BMBF CLIENT Program - Cooperation RSA - Germany
- Programs of the federal states

- Bilateral programs should be available with a number of countries
  e.g. CH-RSA was available until last year (greentech, cleantech)

Thank you very much for your attention!