Solar Chemicals and Materials Part II

Prof. Dr. Christian Sattler
Christian.sattler@dlr.de

Overview

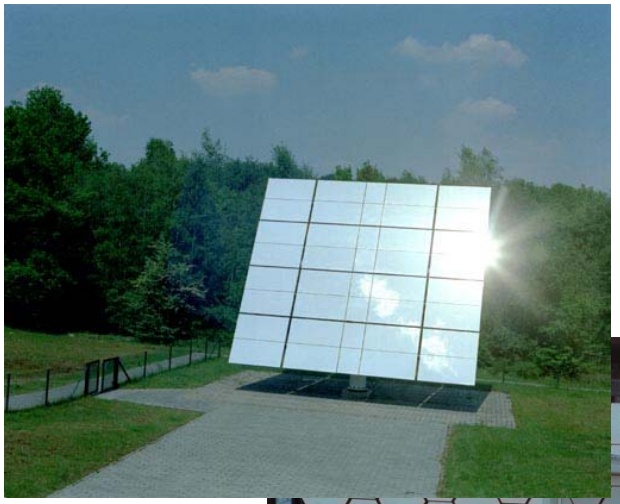
- Main work performed on
  - Limestone (see Dr. Meiers presentation)
    - New projects are expected in EU HORIZON 2020 as industrial processes is a special topic
    - SOLPART will start January 1st, 2016
  - Sulfuric acid
    - Ongoing projects like the FCH-JU SOL2HY2, a further development is expected as well
  - Aluminum
    - South African – German project SOLAM

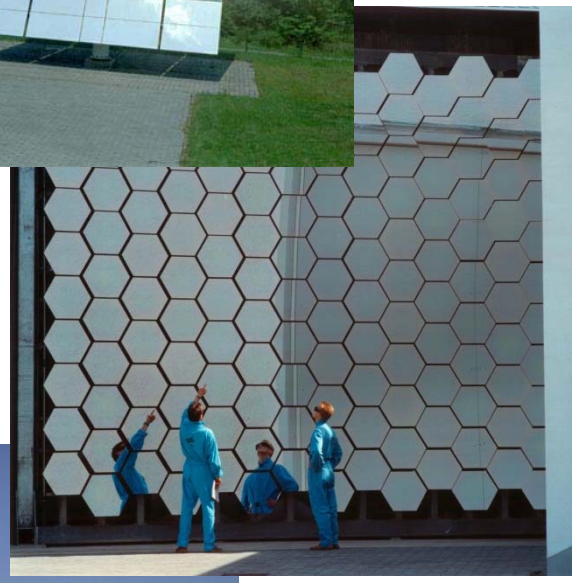
Solar Aluminium Recycling – Work performed in a National German Project

- Partner was VAW, now HYDRO
- Development of a rotary kiln
  - Batch reactor to be operated in DLR‘s solar furnace
  - Kiln made from SiSiC to be able to handle different materials
  - Up to 10 kW_{th} heat input
  - Up to 3 kg of UBC (Used Bevarage Cans)
- Development of startegies for solar aluminium scrap (UBC) recycling
- Control of the materials quality
  - Solar Aluminium is about 0.2% „cleaner“ than industrial recycled aluminium
- Technology is able to deal with even more difficult scrap like Mg

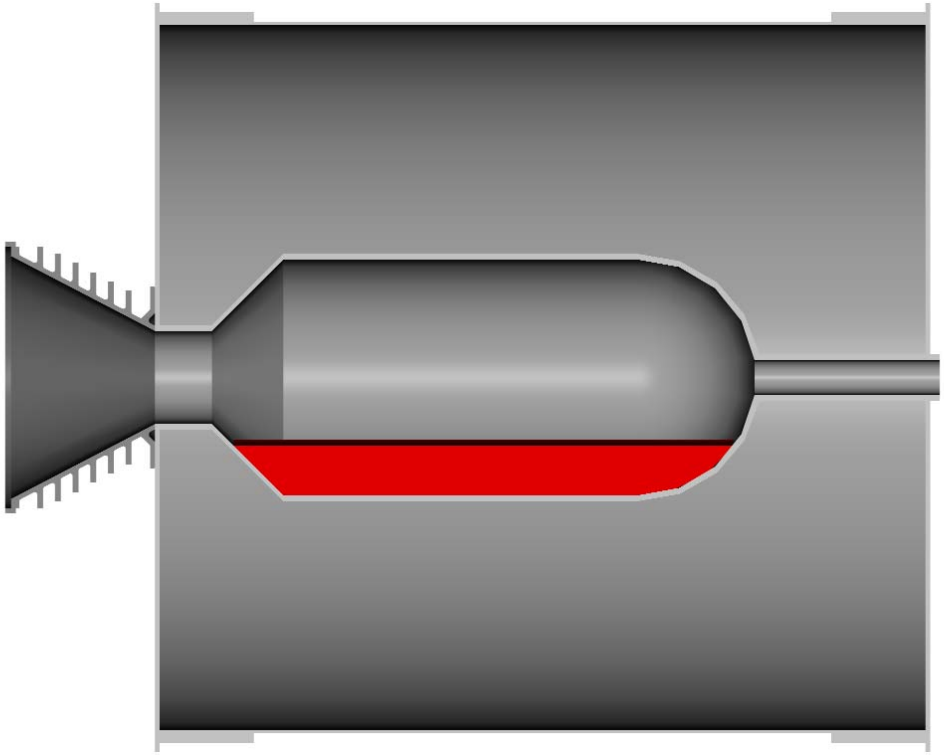
DLR‘s Solar Furnace

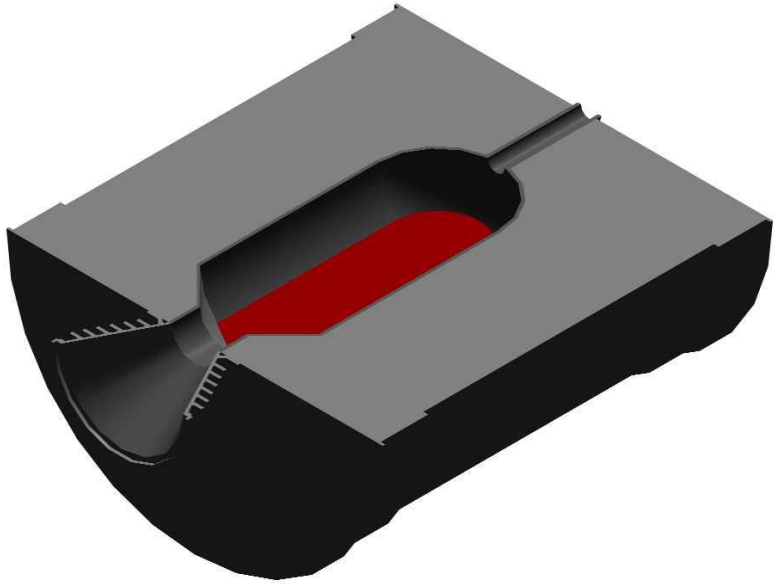
- Off-axis design
- 160 hexagonal facettes
- Concentration factor up to 5500 = 5 MW/m^2
- 25 kW_{th} maximum power
- Up to 2700°C
- In operation since 1994
- Over 200 experiments since then



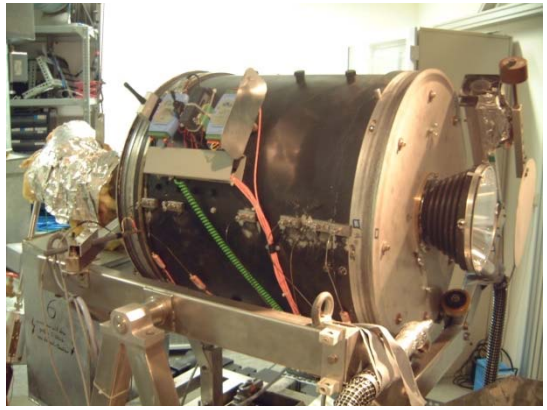
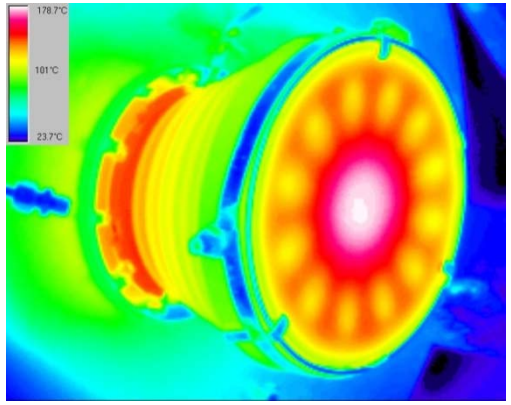


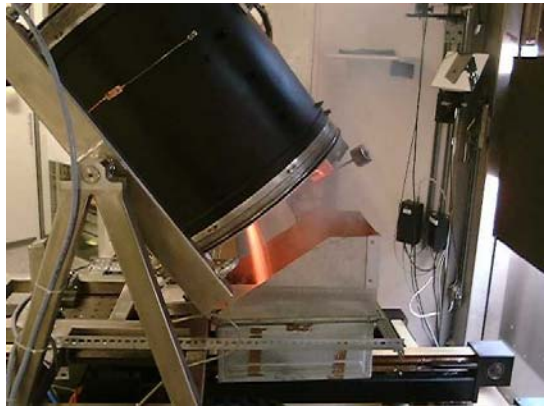
Rotary Kiln Develoment





Recycling of UBC

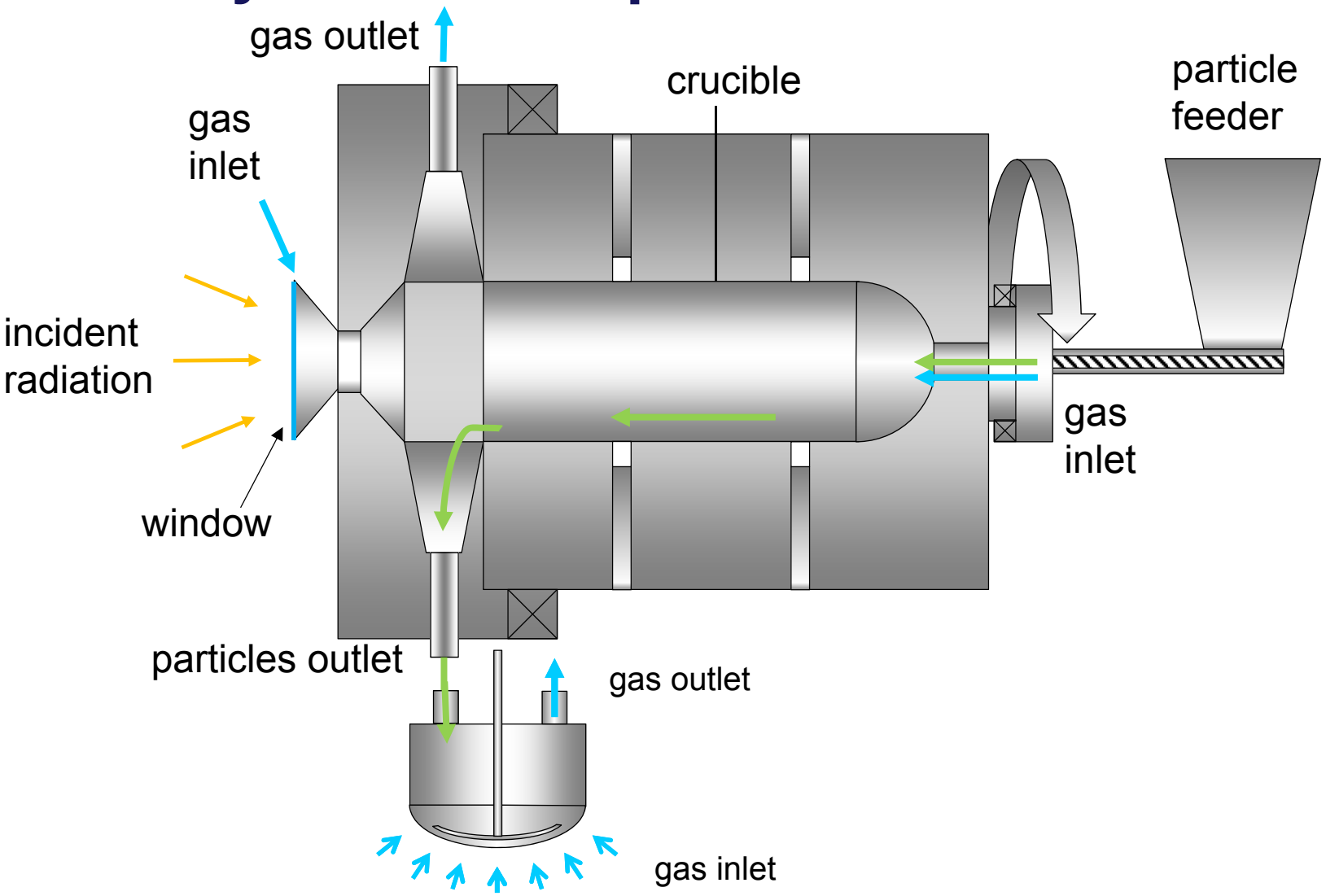





Present Status

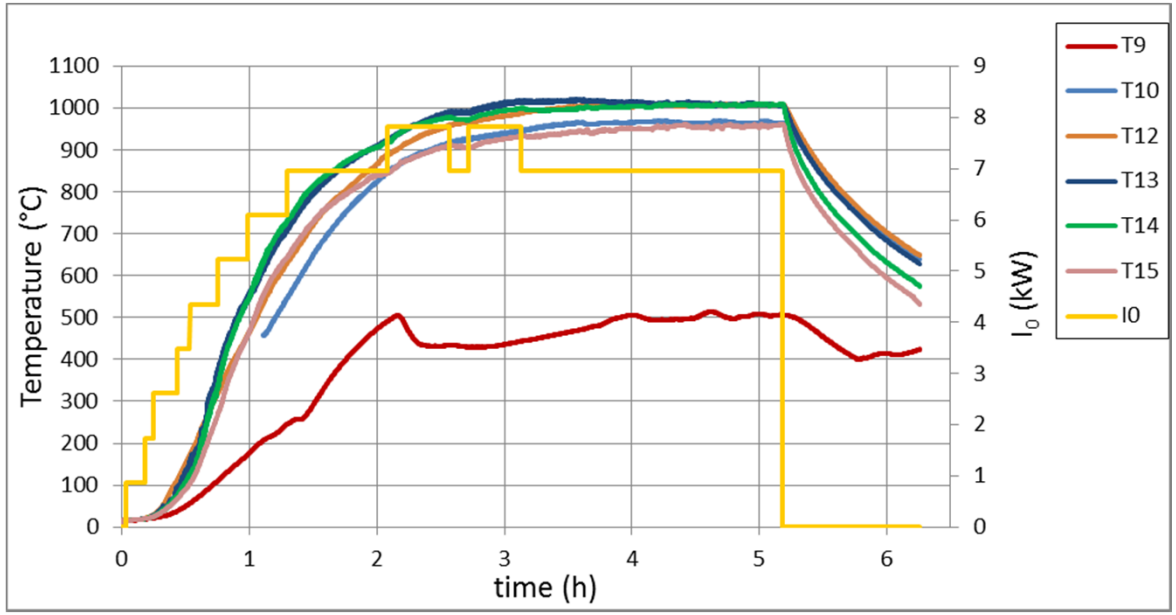
- Design of a new rotary kiln for contineous feeding
- Tests since summer 2013
- More test results will be reported in the forthcoming conferences
- Since 2015 South-African German bilateral project SOLAM

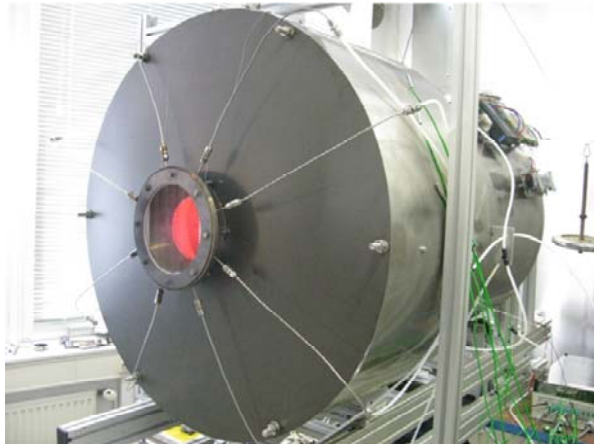
Rotary kiln: concept



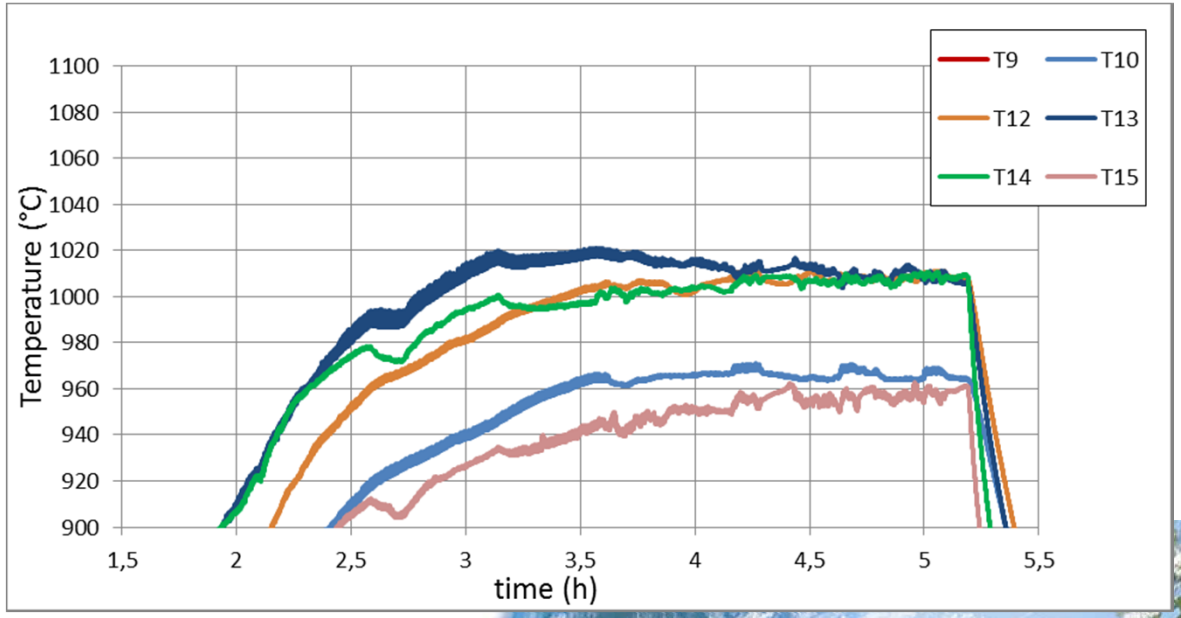
Final reactor

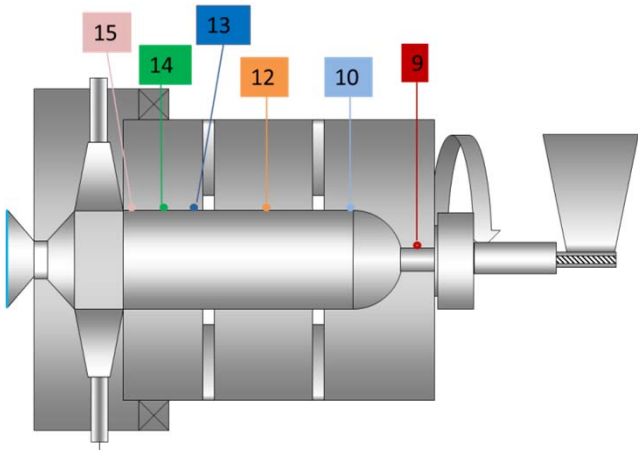
Experiments





I_0 = incident power





RESULTS

A **maximum cavity temperature of 1000°C could be obtained** in less than 3 hours with a maximum temperature difference ΔT_{max}=80°C

The hottest point on the lateral wall is at 20cm from the cylinder aperture

The coldest points, except the gas outlet pipe (TC9), are the peripheral (both front ad back)

After 2.4h, all the lateral wall is hotter than 900°C.

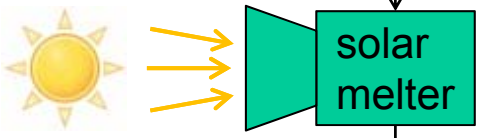
After 4h, the whole lateral wall is hotter than 950°C, the central part is at 1000°C

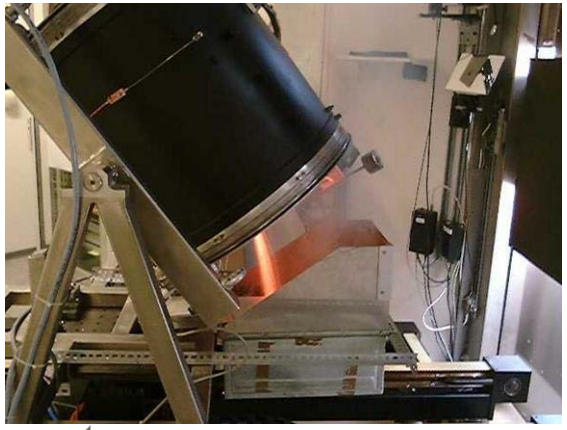
The longer the cavity is heated, the more uniform the temperature becomes: after 5.2h, ΔT_{max} = 50 K

SOLAM - Solar Aluminium Melting in a directly heated Rotary Kiln

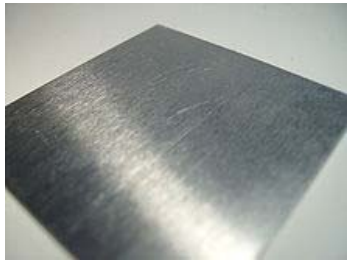
aluminium / aluminium waste

CLIENT 3 – International Partnership for Environmental Technologies
South African – German bilateral Project
CSIR, ESKOM, NFTN, DST, NWU, DLR, AixProcess



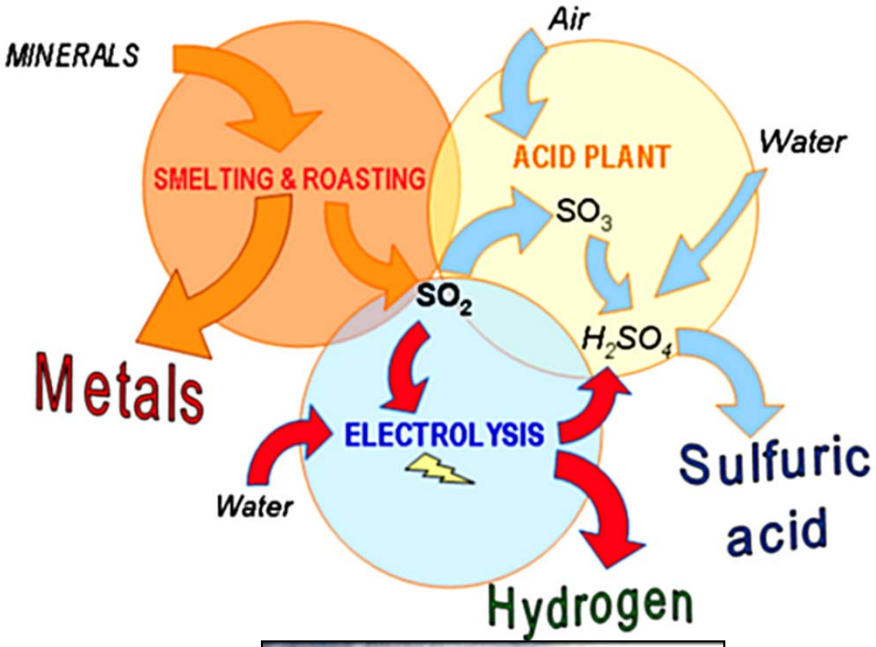


transport to foundry

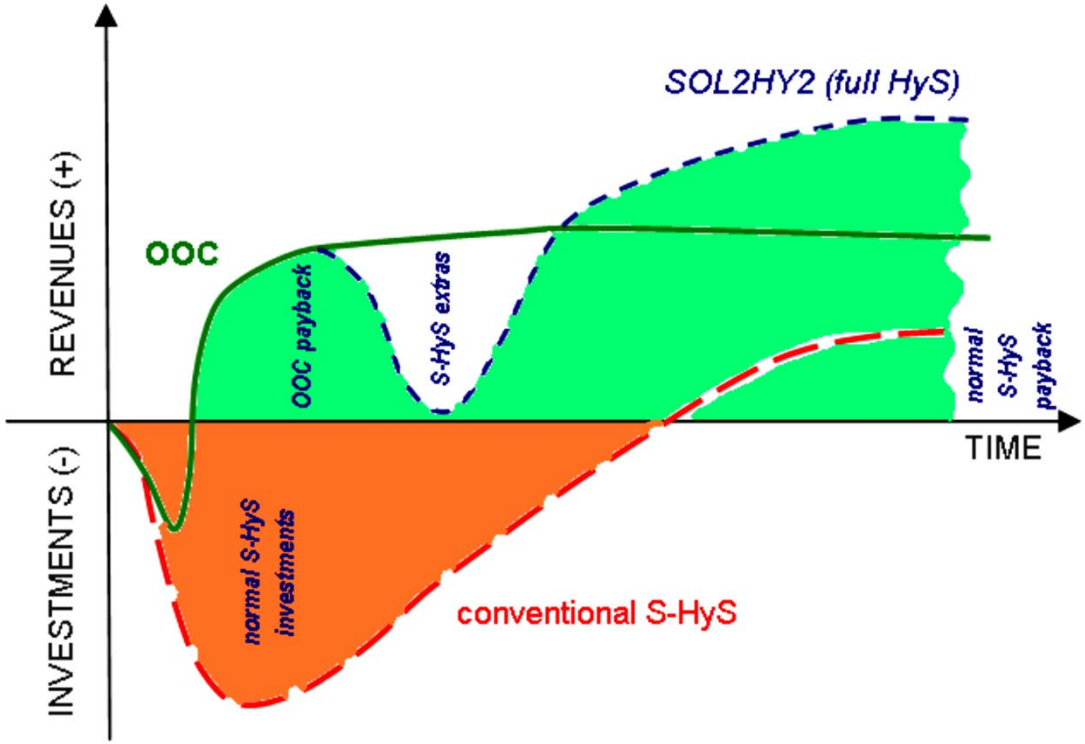


SOL2HY2 – Open TCC

- FCH JU project on the solar driven Utilization of waste SO_2 from fossil sources for co-production of hydrogen and sulphuric acid
- Hybridization by usage of renewable energy for electrolysis
- Partners: EngineSoft (IT), Aalto University (FI), DLR (DE), ENEA (IT), Outotec (FI), Erbicol (CH), Oy Woikoski (FI)
- > 100 kW demonstration plant on the solar tower in Jülich, Germany

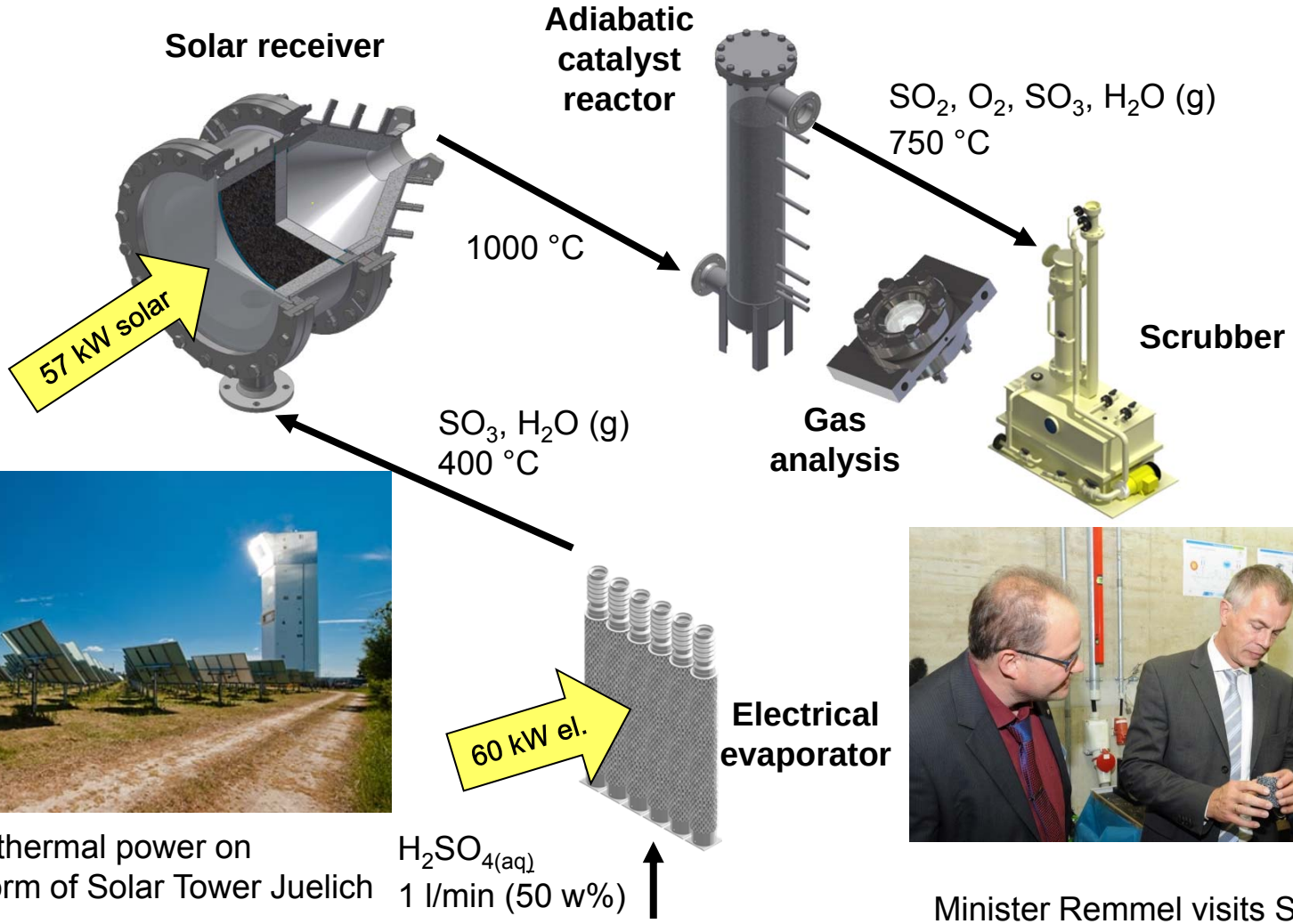


Investments vs. revenues



- Reduction of initial investments
- Financing of HyS development by payback of OOC
- Increase of total revenues

Design of SOL2HY2 pilot plant



~100 kW total thermal power on research platform of Solar Tower Juelich

Minister Remmel visits Sol2Hy2

Acknowledgement:

We thank AG Solar of the Federal State of Northrhine Westphalia for funding of the Solar Fuenace and the Rotary Kiln project, the BMBF for funding SOLAM and the FCH-JU for funding SOL2HY2.

Thank you very much for your attention!

DLR