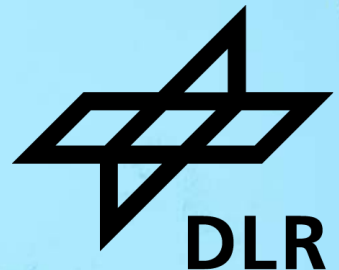


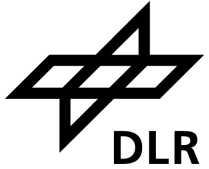
IDEA TO GERMAN-MONGOLIAN COOPERATION: THERMOCHEMICAL STORAGE, GREEN AMMONIA, SYNTHETIC FUELS

Institute of Future Fuels, German Aerospace Center, DLR

ScD. Dr. Enkhtsetseg Dashjav, Dr. Mathias Pein, Dr. Martin Roeb

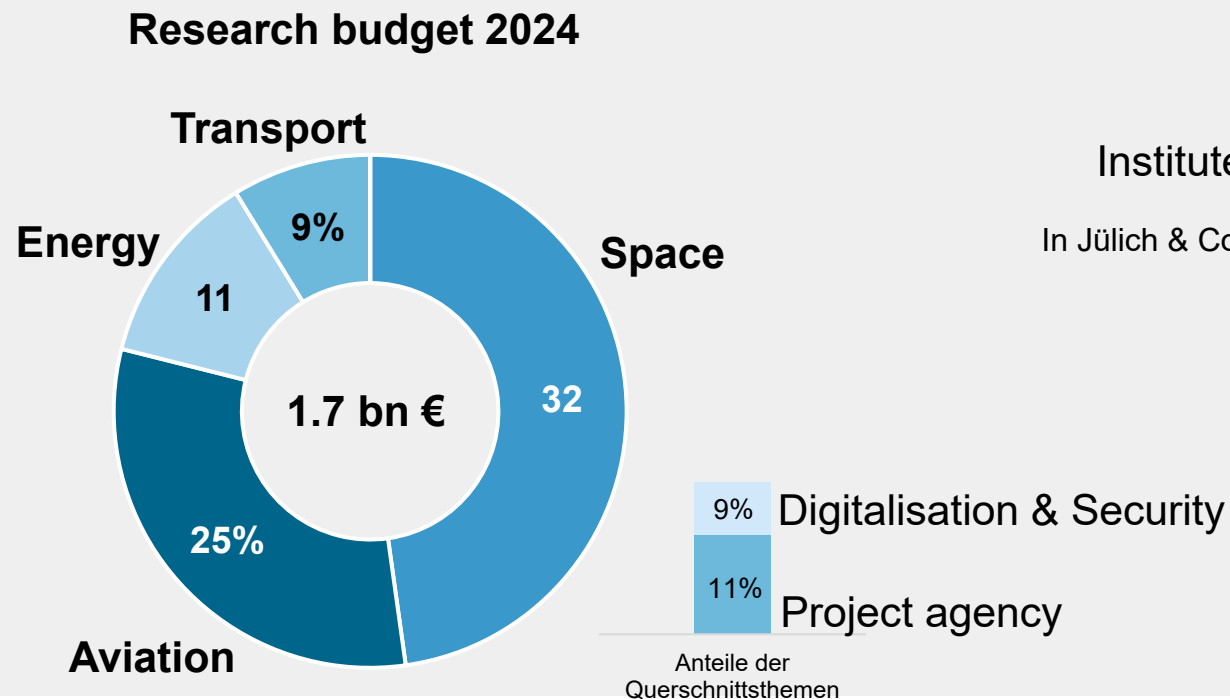


German Aerospace Center, DLR:

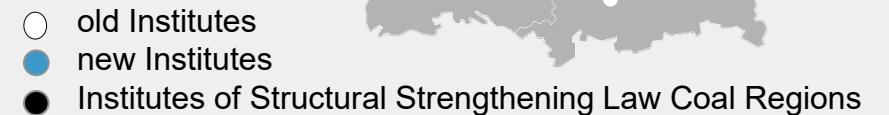


Largest European Research Center for Aviation and Space Research

10.000 Employees, 55 Institutes, 30 Sites



Institute of Future Fuels
In Jülich & Cologne, founded in 2021



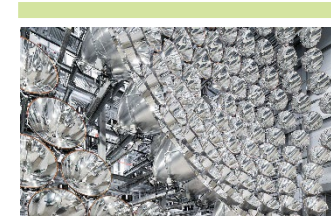
- Research and Innovation for Economy and Society
- Technology Transfer from Science to Industry
- Scientific Advise for Decision Makers

FF: Research in lab scale up to industrial scale

- Solar-chemical processes
- Materials & component design
- Demonstration of scale-up processes
- Transfer of technologies into application
- Techno- and socio-economic evaluation



Solar furnace



Synlight®



Solar tower



Lamps



Lab

Lab scale

Scaling up

Industrial scale

FF: Solar Tower @ Jülich

Heat Generation

Thermochemical Processes:

Solar **Fuels**: Hydrogen, SynGas, Methanol, Kerosene, ...

Solar Chemicals: S, N, Ammonia, ...

Solar Materials: Cement, Phosphate, Metals, ...

High Temperature Thermochemical Storage

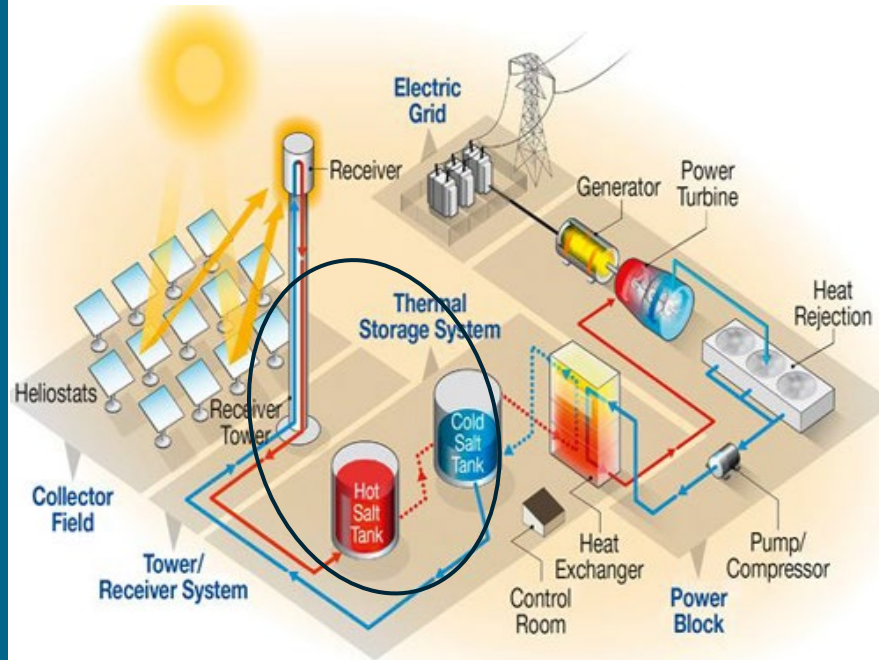
High Temperature Process Heat



FF mission: to develop cost-effective, innovative, resilient, scalable and sustainable processes that integrate solar thermal energy and other renewable sources

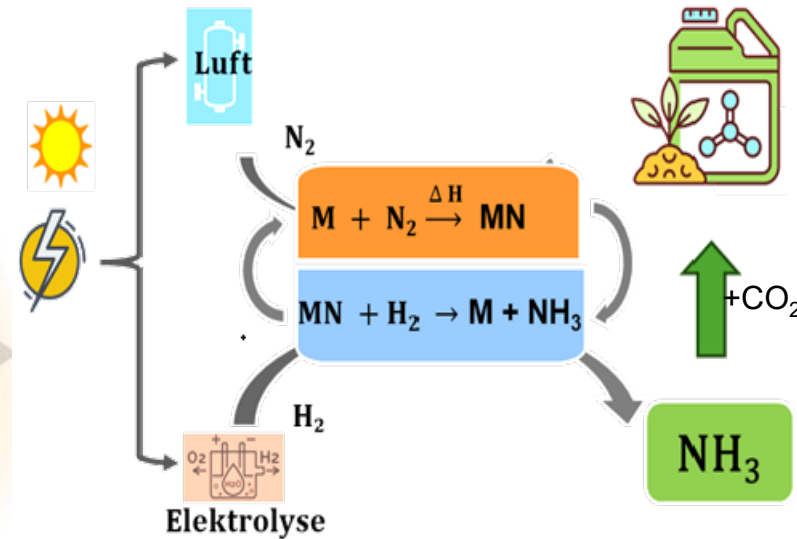
Selected examples @ FF

Thermochemical storage in solar power plants



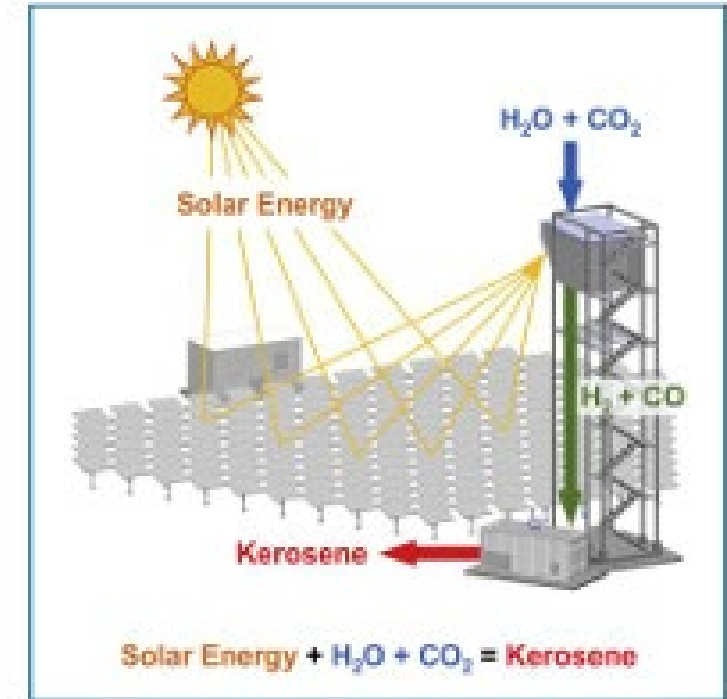
Solar energy is converted into heat for on-demand electricity generation. Heat storage density can be increased by thermochemical process of oxidic porous structures.

Ammonia



How can we produce ammonia using innovative and effective thermochemical looping (N_2 -separation from air, H_2 -water splitting and NH_3 -as fertilizer)

Solar Fuels



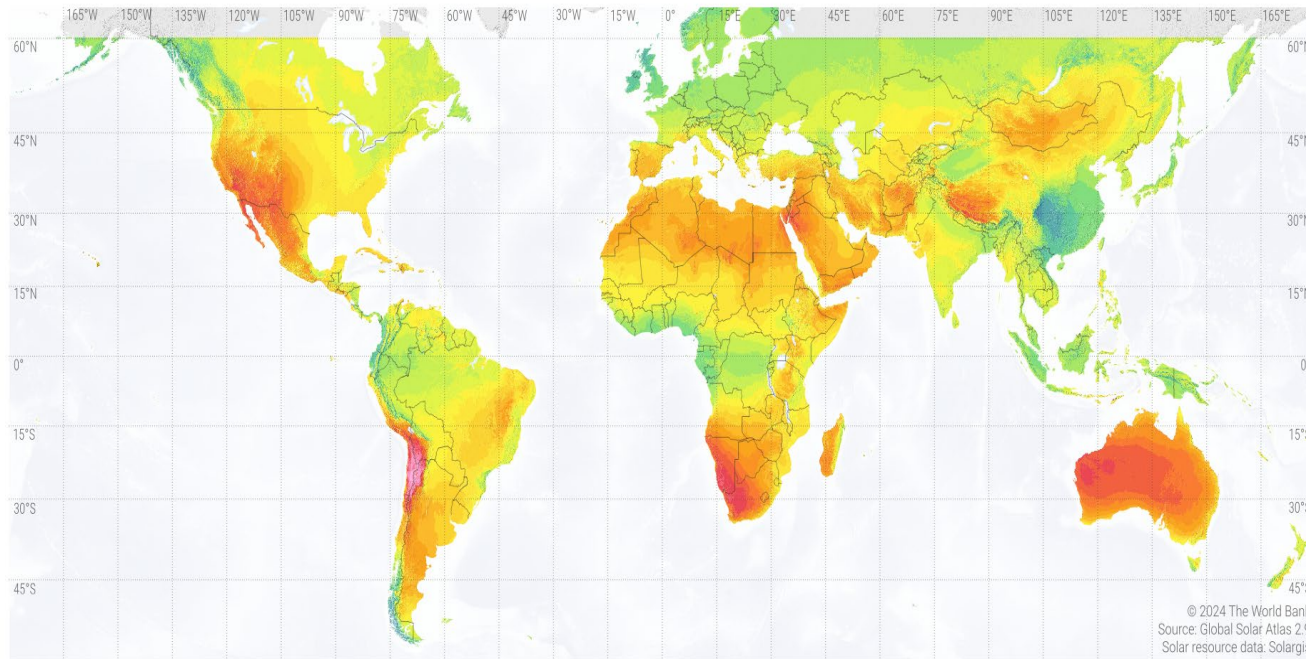
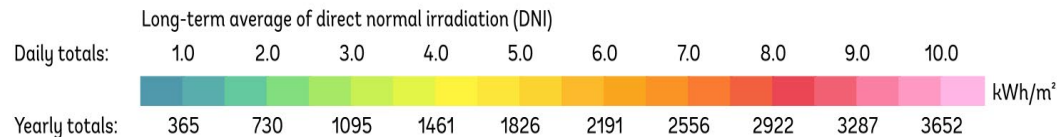
<https://doi.org/10.1016/j.joule.2022.06.012>

How can we produce clean fuels by solar-powered thermochemical processes using abundant resources (CO_2 , H_2O)

Cooperation potential Mongolia with FF

SOLAR RESOURCE MAP

DIRECT NORMAL IRRADIATION



This map is published by the World Bank Group, funded by ESMAP, and prepared by Solargis. For more information and terms of use, please visit <http://globalsolaratlas.info>.

Mongolia is a sunny region, DNI ~ 2300 kWh/m² /year:

- optimal for concentrated solar power and heat
- new opportunities for industrial development

Promising basis for German-Mongolian cooperation

- FF has **expertise & know-how** for resilient, decentral, and sustainable technologies, solar power & heat generation
- **Techno-economic systems analysis** is integrated in the research: How & which technologies can support Mongolia's economic transformation, especially in local industry, clean energy production, and mining.



Potential for Cooperation



Partners in Mongolia:

- German-Mongolian Institute for Resources and Technology
- Department of Chemistry, National University of Mongolia
- Mongolian Engineering Federation

Technical and academic project idea:

- Development of different scenario for resilient decentral production of NH_3 , H_2 , and synthetic fuels using renewable energy sources and storage, including their techno-economically viability and environmental factors in Mongolia
- Establishment of joint research projects and targeted training for Mongolian early-career researchers

Accompanying social science research:

- Analysis and assessment to identify the political framework, social needs, and local acceptance required to implement the selected technological scenarios.
- Socio-economic impact assessment for local communities, employment opportunities, the availability of local resources, and the conditions for attracting investment.

Thank you for your Attention!

<https://www.dlr.de/en/ff>

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