Expertise in
Sorption and Catalysis

The Importance of Sorption Technologies for the Energy Transition

Dr. Marcus Lange

This is us – the INC Leipzig

- Founded in 1997 as an *affiliate institute* at Leipzig University
- **Legally independent, non-profit research organization**
- Currently 17 employees and several graduate students
- R&D Service Provider (application-oriented)

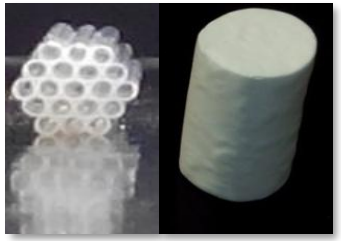
  → own projects (third-party funded)

  → collaborative projects together with industrial partners
- Cooperation with companies, universities and research institutions

SIG Sächsische Industrieforschungsgemeinschaft e.V.

ZUSE-GEMEINSCHAFT

contact us:
E-Mail: info@inc-leipzig.de





Main challenges for the Energy Transition & Circular Economy

Decarbonization of Energy Production

→ Expansion of renewable energies (wind, solar, hydropower, biomass, geothermal)

→ Gradual phase-out of coal, oil and natural gas

→ Development of CO_2-neutral alternatives (green hydrogen, synthetic fuels)

Storage Technologies and Enhanced Flexibility

→ Expansion of battery storage, pumped-storage power plants, power-to-X (hydrogen, methane)

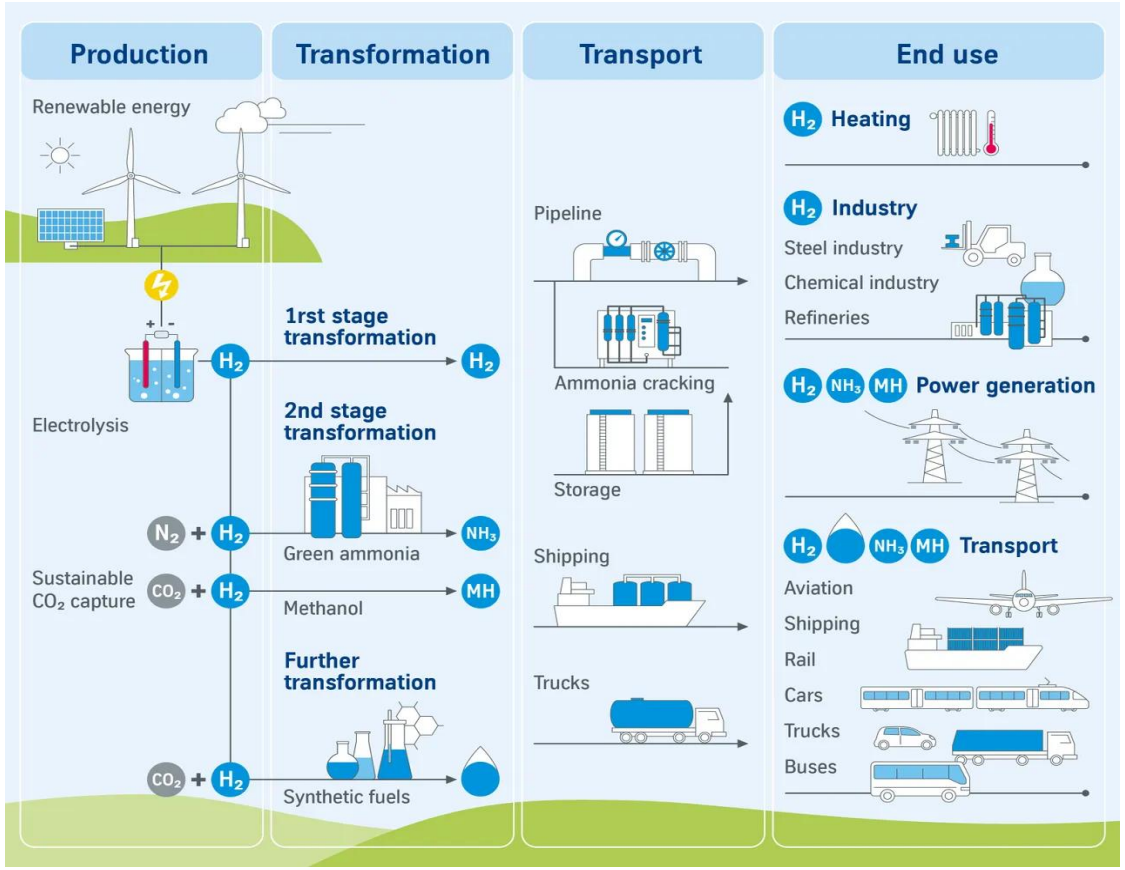
Grid Expansion & Modernization

Sector Coupling

→ Electrification of heating (heat pumps) and transport

→ Use of electricity surpluses in industrial processes or for hydrogen production

Increase Energy Efficiency



Taken from: https://www.thyssenkrupp.com/de/stories/nachhaltigkeit-und-klimaschutz/gruenes-ammoniak-und-sein-beitrag-zur-bewaeltigung-des-klimawandels.

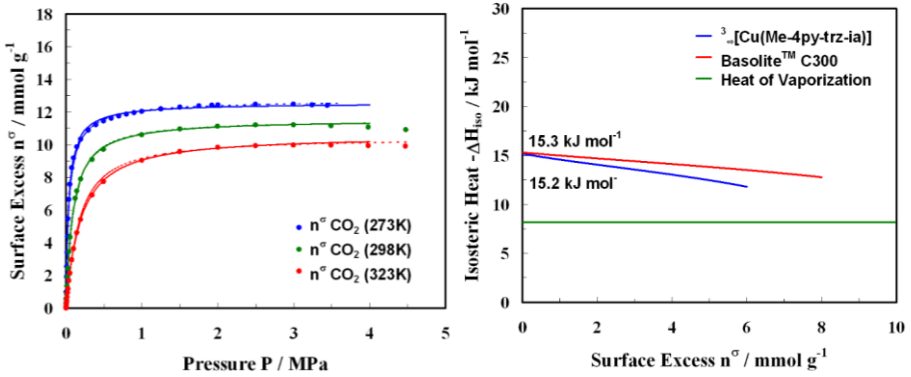
Potential Applications using Sorption Technology

Field of Application	Advantages
CO_2 Capture (CCS & DAC) Flue gas treatment, direct air capture with adsorbents (zeolites, MOFs, activated carbon)	High selectivity for CO_2, reusable sorbents, enables negative emissions
Hydrogen & Gas Storage Adsorptive H_2 or CH_4 storage in porous materials (MOFs, zeolites)	Lower pressure requirements, safer storage, scalable for Power-to-Gas
Gas Separation & Purification Biogas upgrading (CH_4/CO_2), removal of H_2S, SO_2, NO_x from industrial gases	High efficiency, targeted contaminant removal, improves fuel quality
Thermochemical Energy Storage Adsorption heat pumps, sorption-based cooling/heating systems using waste heat or solar heat	Efficient heat storage, low energy demand, enables sector coupling (power ↔ heat)
Environmental Protection Gas treatment, Solvent recovery	Reduces pollution, supports circular economy, resource recovery possible

Sorption studies – What we can provide

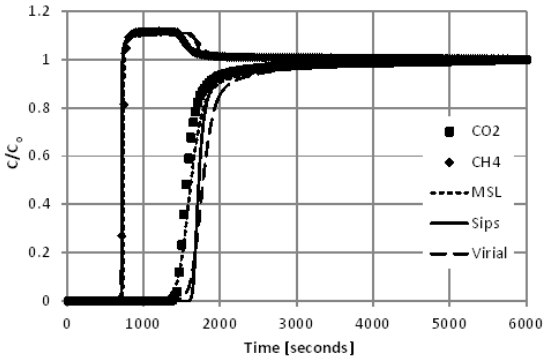
Material Characterization

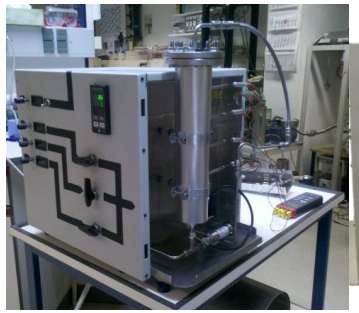
Equilibrium data (e.g. isotherms), Kinetic data



Dynamic Sorption

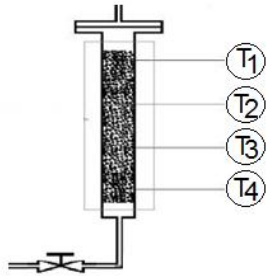
Tests under application-oriented conditions





Regeneration/ Desorption studies

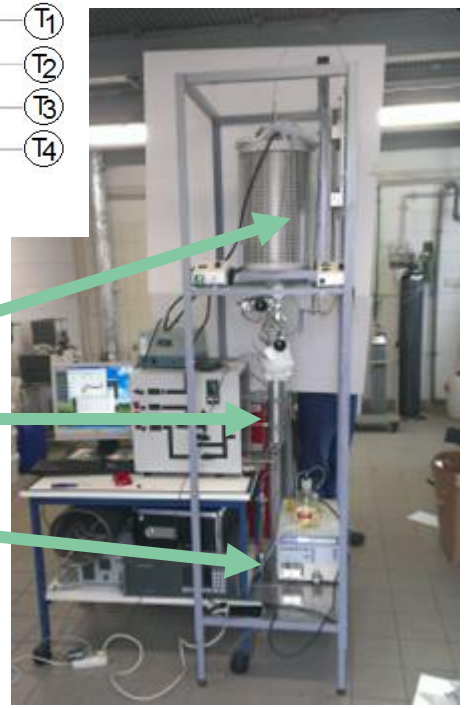
PSA, TSA, Steam regeneration and other



evaporator

adsorber

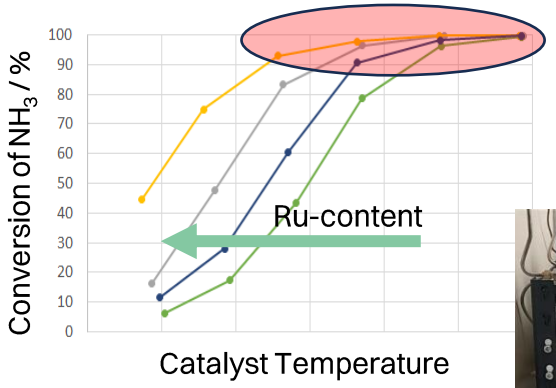
HPLC-pump



Hydrogen Purification – What we can provide

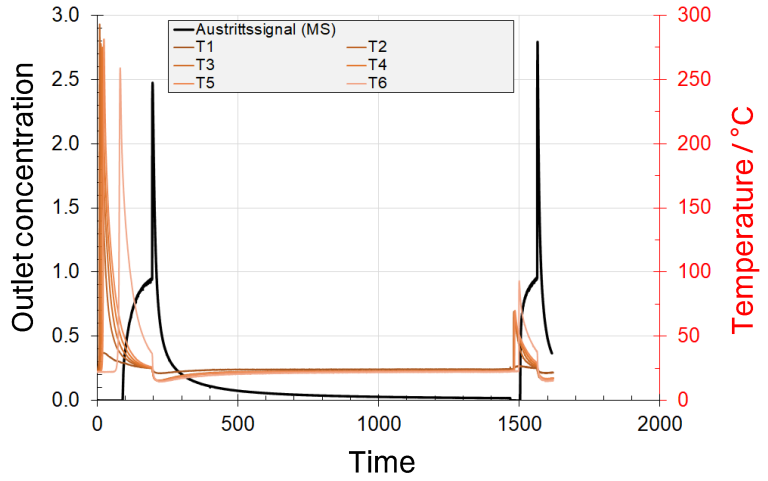
Impurities depending on the source (NH_3, electrolysis) and process conditions

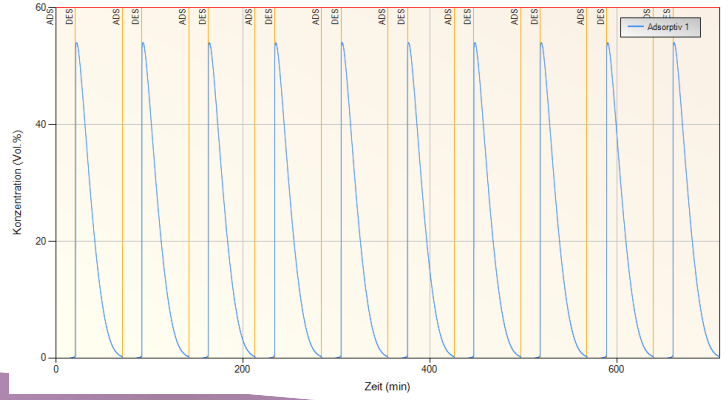
NH_3 Splitting leads to impurities of NH_3 and N_2 in H_2

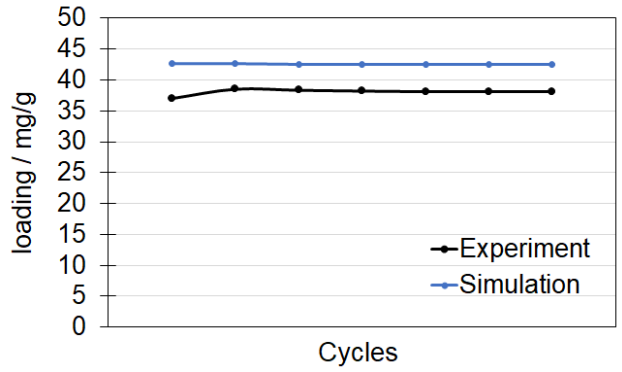


H_2 Purification via Pressure Swing Adsorption

Experiment and Simulation of NH_3 Removal





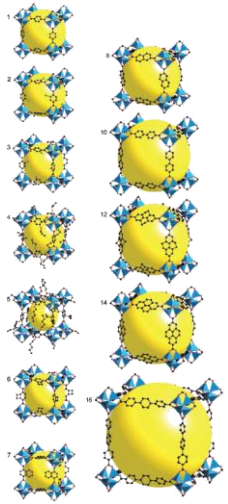


Hydrogen Storage – What we can provide

Characterization of solid materials

Physisorption

MOFs



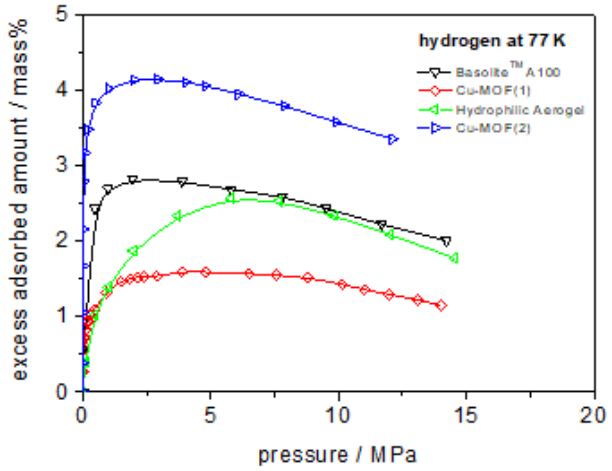
Aerogel

Activated Carbons

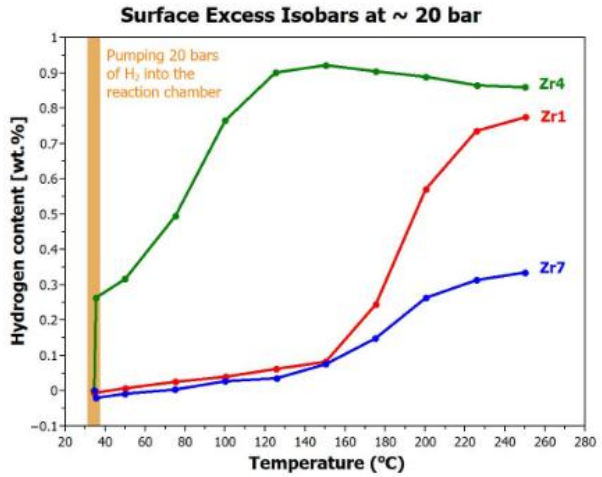
Alloys

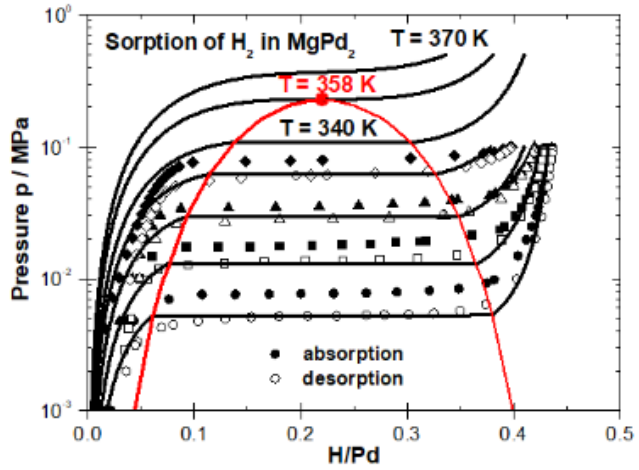
Chemisorption

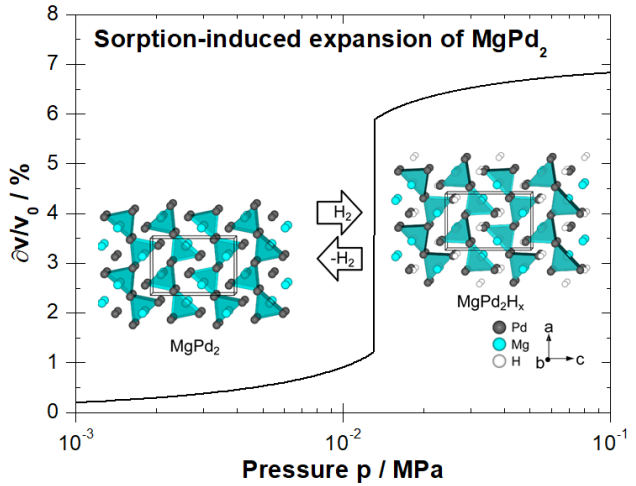
Isotherms/PCT curves



Isobars



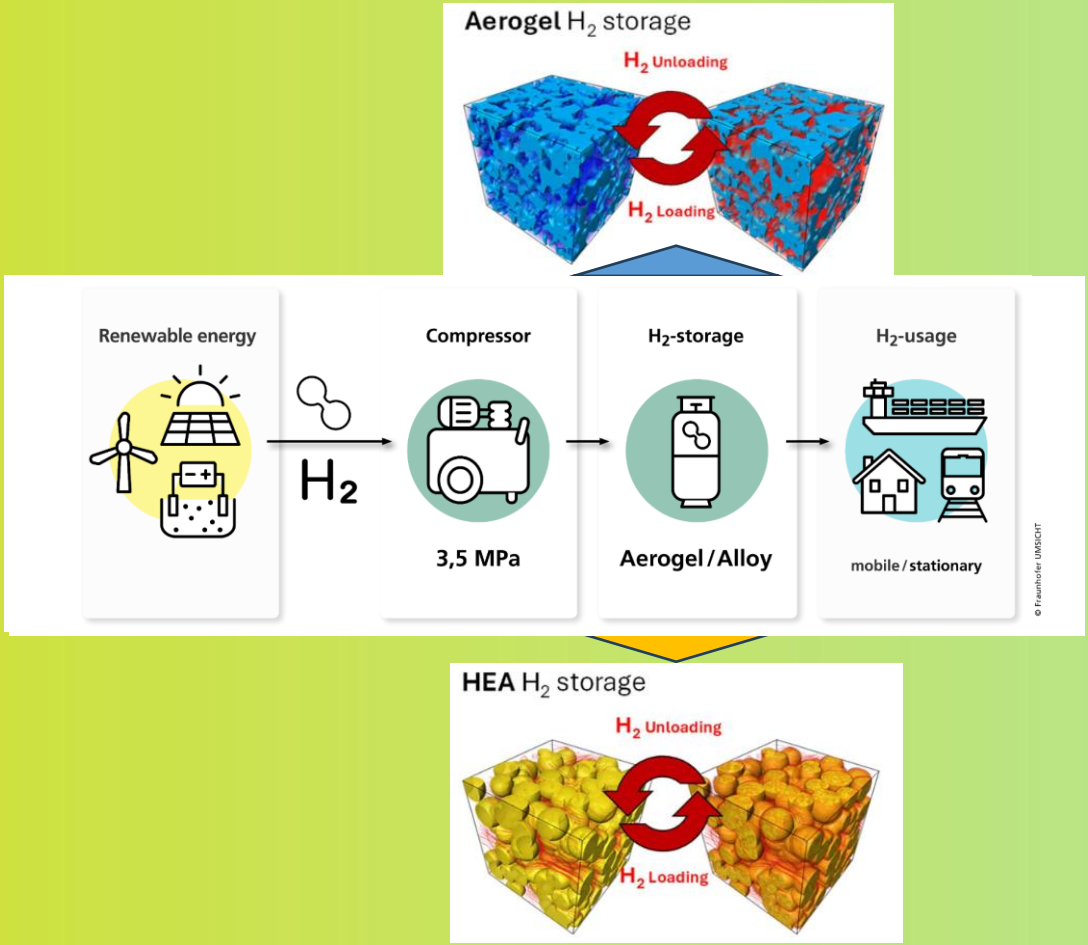




Bastos Neto et al. Energy. Environ. Sci. 2012, 5, 8294
Möllmer et al. J. Alloys & Compd 2021, 859, 157782
Saksl et al. Materials 2024, 17, 1732

Core-H2storage – Cost- and resource-efficient storage of hydrogen at ambient temperature and at a maximum pressure of 3.5 MPa

Core-H2storage



Project Consortium

- Fraunhofer UMSICHT (Germany)
- JA-Gastechnology GmbH (Germany)
- VSB – Technical University of Ostrava (Czech Republic)
- AMAZEMET SP.Z O.O. (Poland)
- Warsaw University of Technology (Poland)
- Higher Institute of Computer Science and Mathematics of Monastir (ISIMM – Tunesia)

Time line:

12/2024 – 11/2027

cet Partnership

ptj Projektträger Jülich Forschungszentrum Jülich

Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages

Thanks to ...

„Core-H2Storage“-Team

Dr. Eva Schieferstein (Fraunhofer UMSICHT, Germany)

Prof. Karel Saksl and Team (TU & SAS Kosice, Slovakia)

Prof. Harald Krautscheid (Leipzig University, Germany)

Prof. Holger Kohlmann (Leipzig University, Germany)

Prof. Bastos-Neto (Universidade Federal do Ceará, Fortaleza, Brazil)

Gefördert durch:

Bundesministerium für Wirtschaft und Klimaschutz

aufgrund eines Beschlusses des Deutschen Bundestages

If Sorption is also part of your research or process, we would be happy to collaborate.

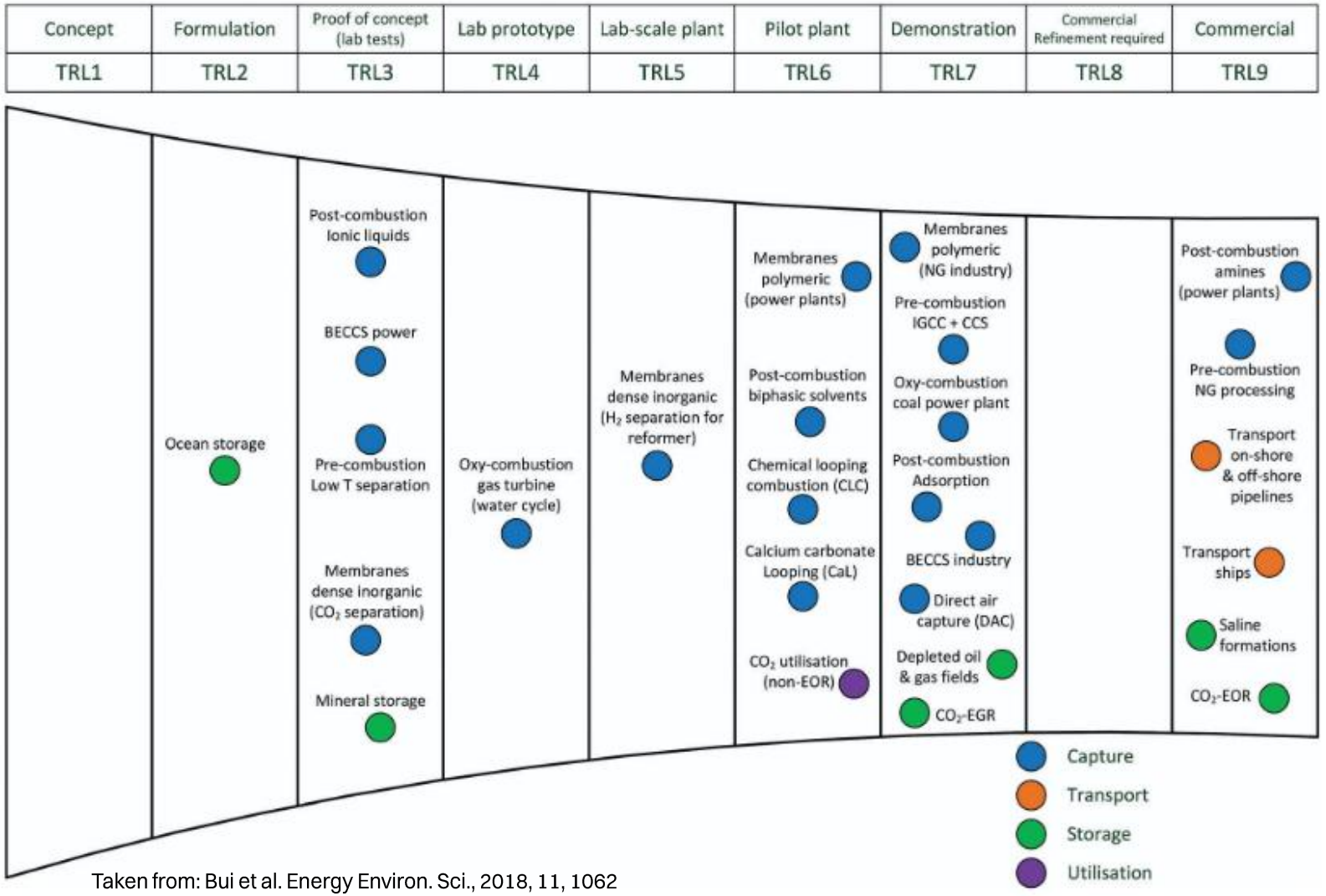
contact us:
E-Mail: info@inc-leipzig.de

Expertise in
Sorption and Catalysis

The Importance of Sorption Technologies for the Energy Transition

Dr. Marcus Lange

Expertise in Decarbonization – Carbon Capture & Storage processes



Taken from: Bui et al. Energy Environ. Sci., 2018, 11, 1062