HGF, FZJ, PoF and HI ERN
General overview

30.06.2025 ||| Jens Hauch und Karl Mayrhofer

The non-university academic institutions in Germany

Max-Planck Society

- 84 Institutes, ca. 3 billion€ federal funding, extension of university research
- Focus: natural, social and human sciences; 31 Nobel Prizes
- Predominantely non-permanent research staff; important role of the director

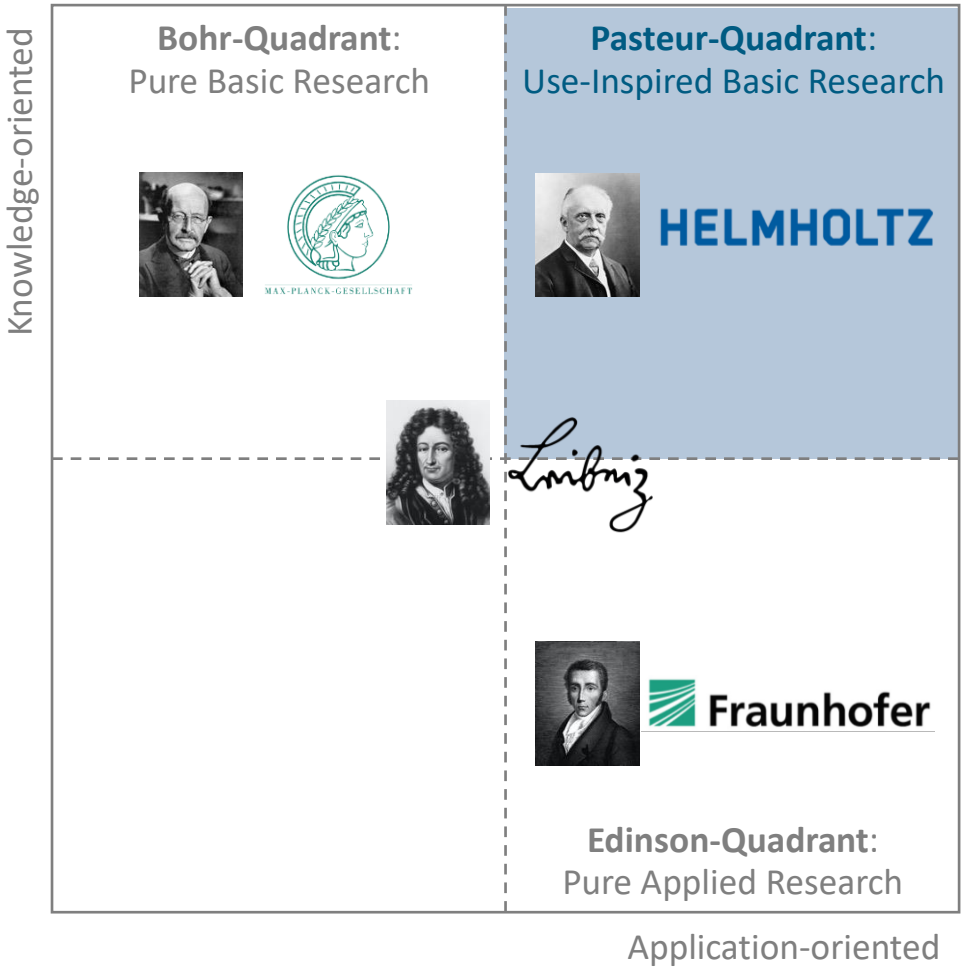
Helmholtz Society

- 20 centers, ca. 4billion€ federal funding, societal relevant research
- Focus: matter, health, information, aeronautics, earth&environment, energy
- Operation of large-scale german research infrastructure, many permanent positions

Fraunhofer Society

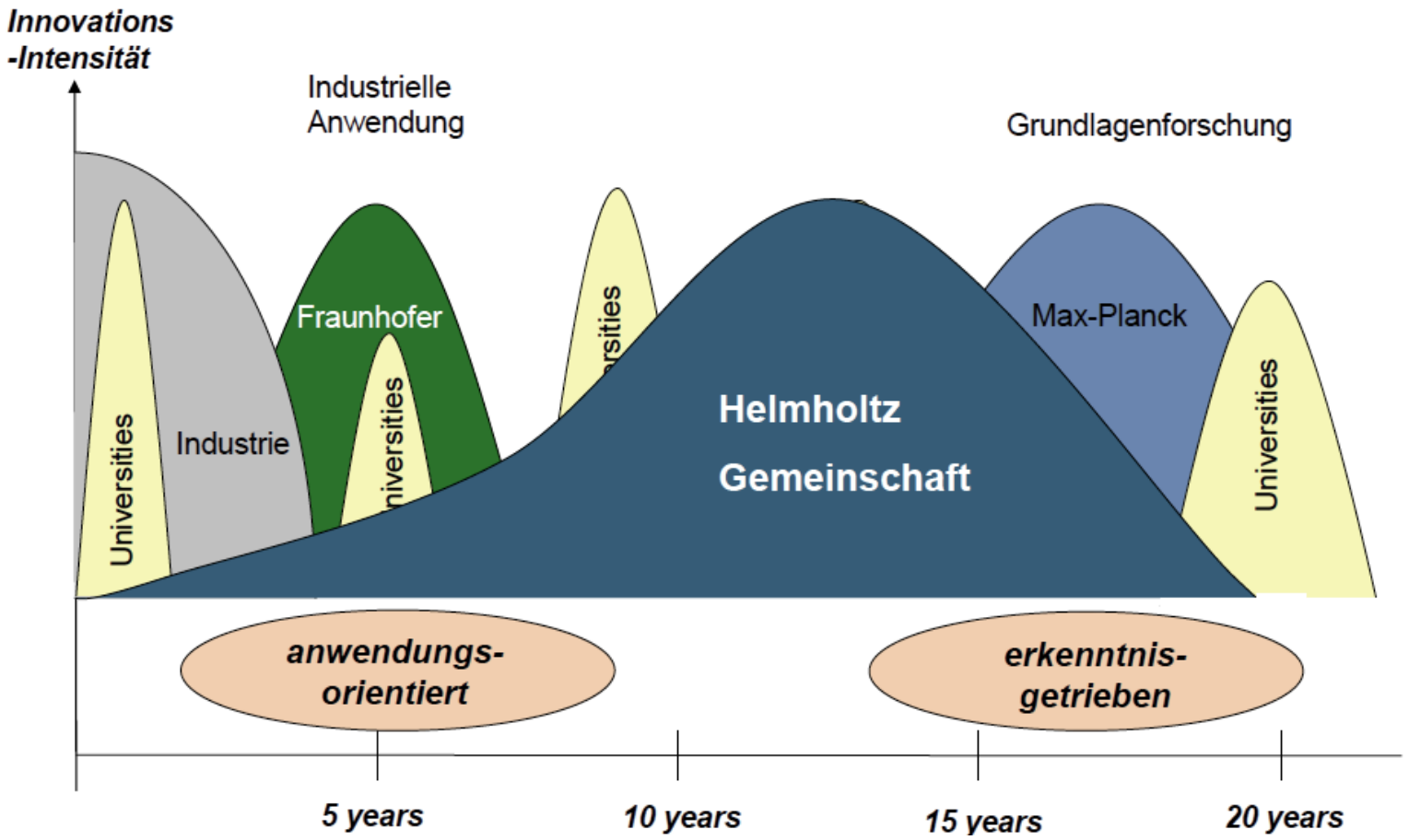
- 80 institutes, ca. 1.5billion€ federal base funding, applied research and development
- Focus: natural and technical sciences; >70% funding from industry
- Mainly project-based type of work; industry funding and networking is essential

Helmholtz-Society (HGF)



- The Helmholtz Association pursues the **long-term research goals** of the state and society
- To do this, the Helmholtz Association conducts top-level research to identify and explore the **major challenges facing society**, science and the economy

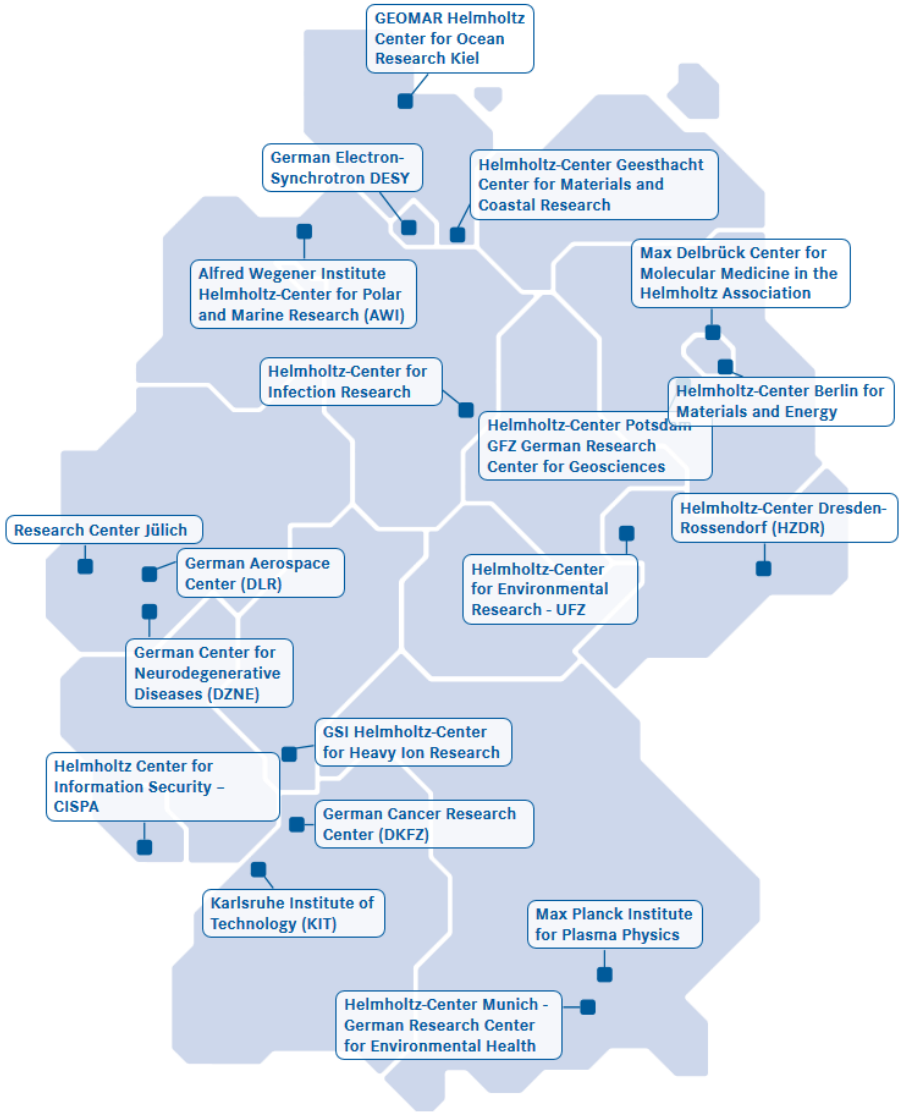
Research @ HGF



- Bridge between basic and applied research
- Knowledge-based technology development

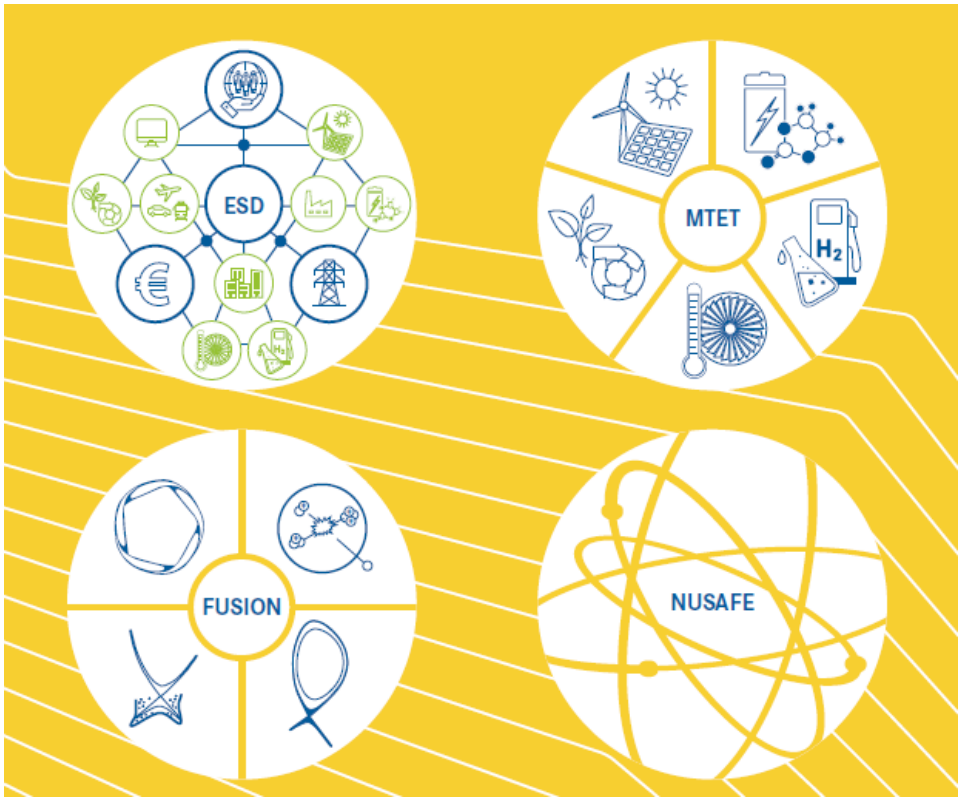
→ **Accelerated technology transfer**

The Helmholtz Society Centers and joint programs



Research Field Energy

- All centers together develop a joint program
- 2 program evaluation every 7 years
- Potential shift in funding priorities by government

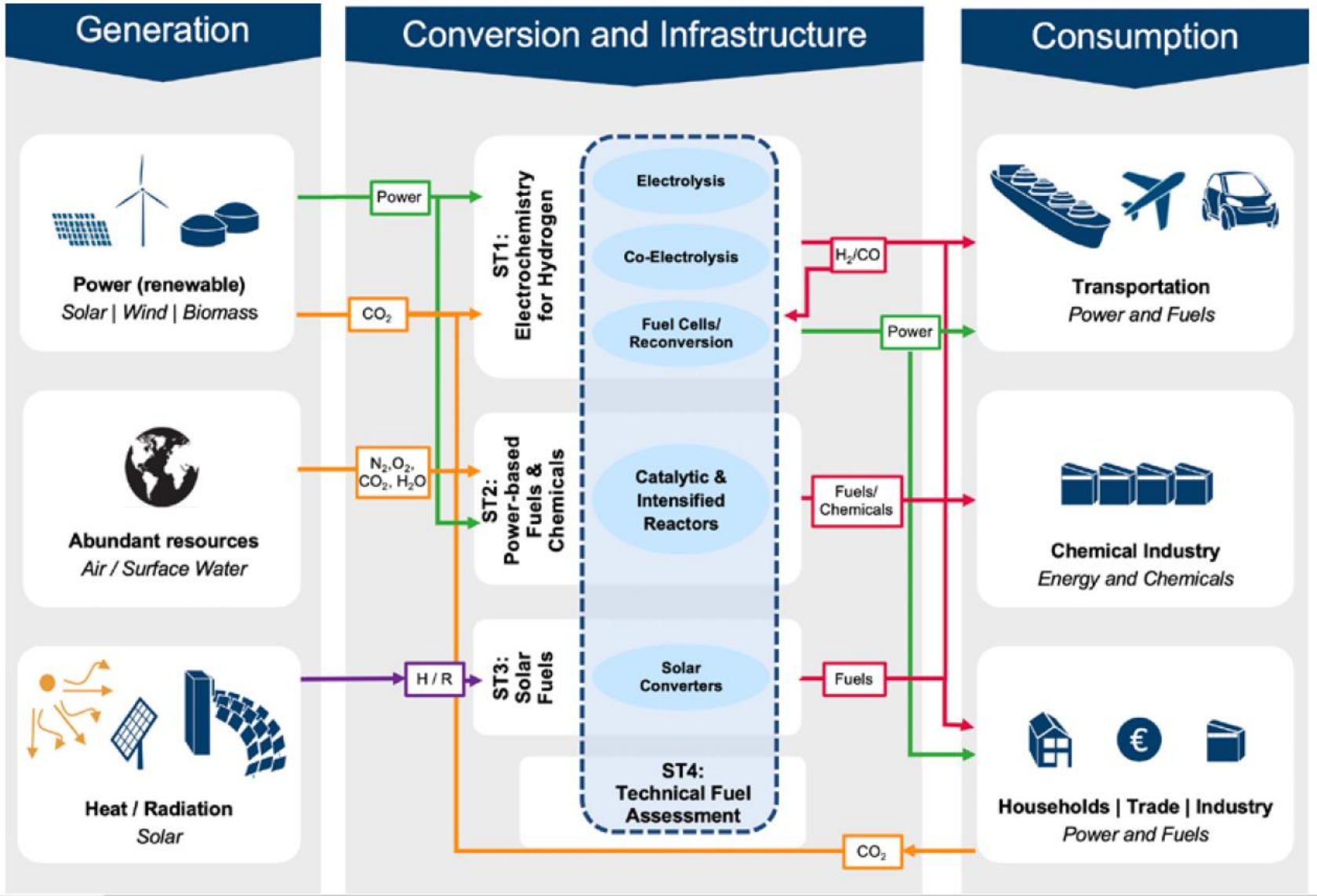


The structure of the MTET program

Materials and Technologies for the Energy Transition (MTET)

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5
Photovoltaics and Wind Energy	Electrochemical Energy Storage	Chemical Energy Carriers	High-Temperature Thermal Technologies	Resource and Energy Efficiency
181 FTE, 14 %	227 FTE, 17 %	375 FTE, 29 %	264 FTE, 20 %	258 FTE, 20 %
HZB, FZJ, KIT, DLR	KIT, FZJ, HZB, DLR, HZDR	FZJ, KIT, DLR, HZB, IPP	DLR, KIT, FZJ	KIT, HZDR

The topic of Chemical Energy Carriers in MTET

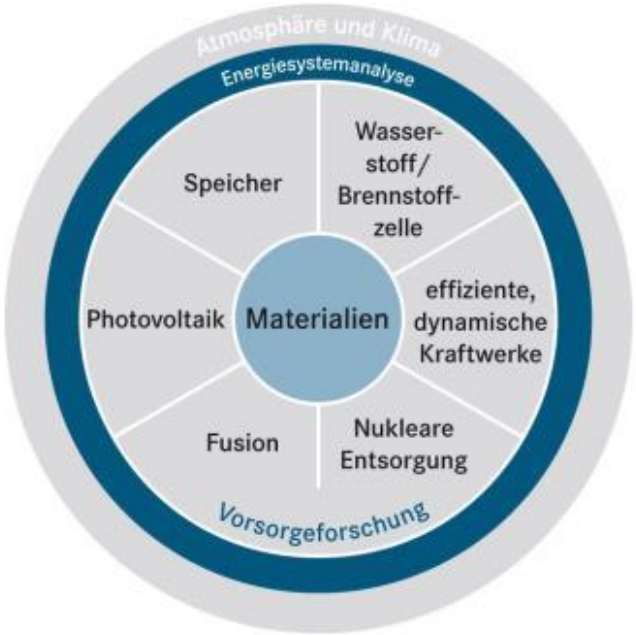


Forschungszentrum Jülich (FZJ) is one center

Foundation	11. Dezember 1956
Shareholders	Bundesrepublik Deutschland (90 %) Nordrhein-Westfalen (10 %)
Budget	ca. 600 Mio. Euro (40 % third party funding)
Structure	9 Institutes

- Institute for Advanced Simulation (IAS)
- Institute of Bio- and Geosciences (IBG)
- Institute of Complex Systems (ICS)
- Institute of Energy and Climate Research (IEK)
- Institute of Neuroscience and Medicine (INM)
- Jülich Centre for Neutron Science (JCNS)
- Nuclear Physics Institute (IKP)
- Peter Grünberg Institute (PGI)
- Central Institute of Engineering, Electronics and Analytics (ZEA)

Employees	ca. 6.000 (in total)



14 Institutes for Energy and Climate Research,
plus 4 new Institutes for Sustainable Hydrogen Research
(Directors e.g. Olivier Guillon, Martin Winter, Peter Wasserscheid, Rüdiger Eichel, Michael Eikerling, Detlef Stolten, Christoph Brabec,…)

Helmholtz-Institute Erlangen-Nürnberg (HI ERN)

HI ERN has been established in close cooperation with

- Helmholtz Zentrum Berlin (HZB) of the HGF
- Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)

HI ERN Mission: Develop material- and process-based solutions for a climate-neutral, sustainable and cost effective utilization of renewable energies

Research focus:

- Structural and functional characterization, modelling and processing of materials relevant to hydrogen and solar technologies

HI ERN – the build-up of a new institute

8/2013:
Gründung HI ERN

7/2017:
Spatenstich

12/2018:
Richtfest

09/2021
Einzugstermin
HI ERN Neubau

4/2014:
Peter Wasserscheid

Chemical hydrogen storage

9/2015:
Jens Harting

Dynamics of complex fluids

12/2015:
Karl Mayrhofer
(Direktor)

Electrocatalysis

1/2018:
Simon Thiele

Electrocatalytic interface engineering

7/2018:
Christoph Brabec

High-Throughput material research

11/2018:
Marcus Bär
(HZB)

X-ray synchrotron spectroscopy

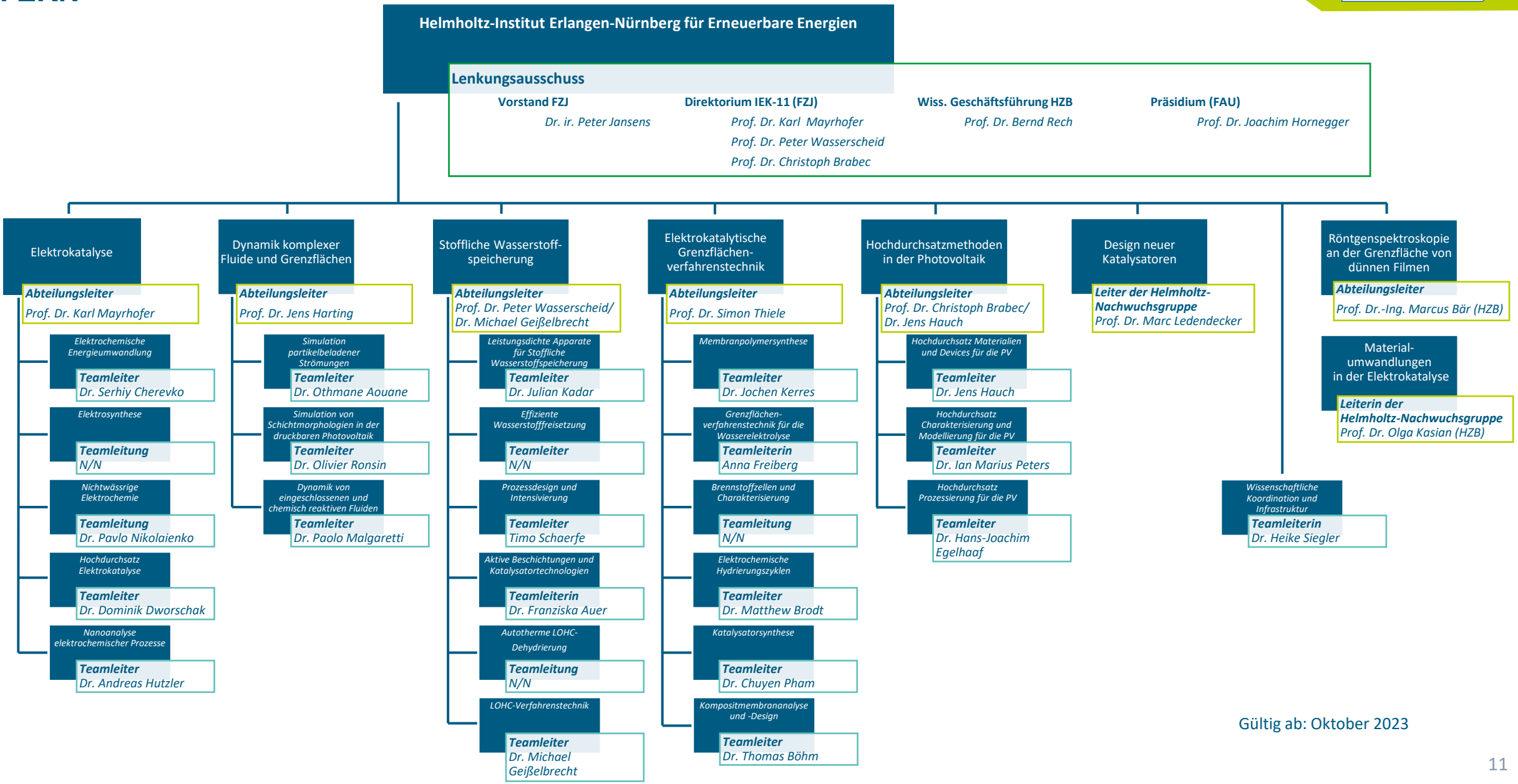
05/2019:
Olga Kasian
(HZB)

In-situ X-ray spectroscopy

Prof. Marc Ledendecker (TUM)
Start YIG: Mai 2023

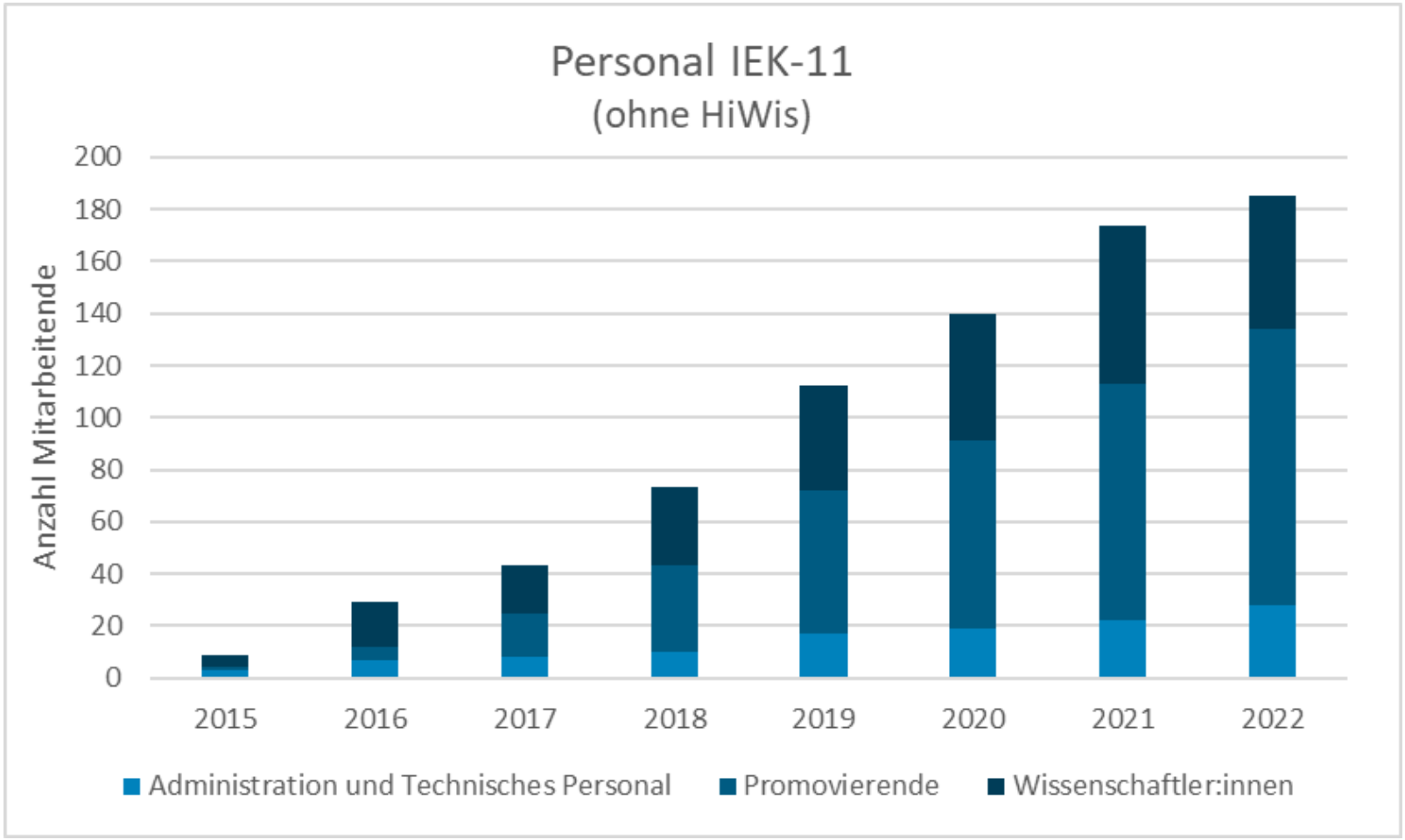
Dr. Ian Marius Peters
Start ERC: 2023

HI ERN



Gültig ab: Oktober 2023

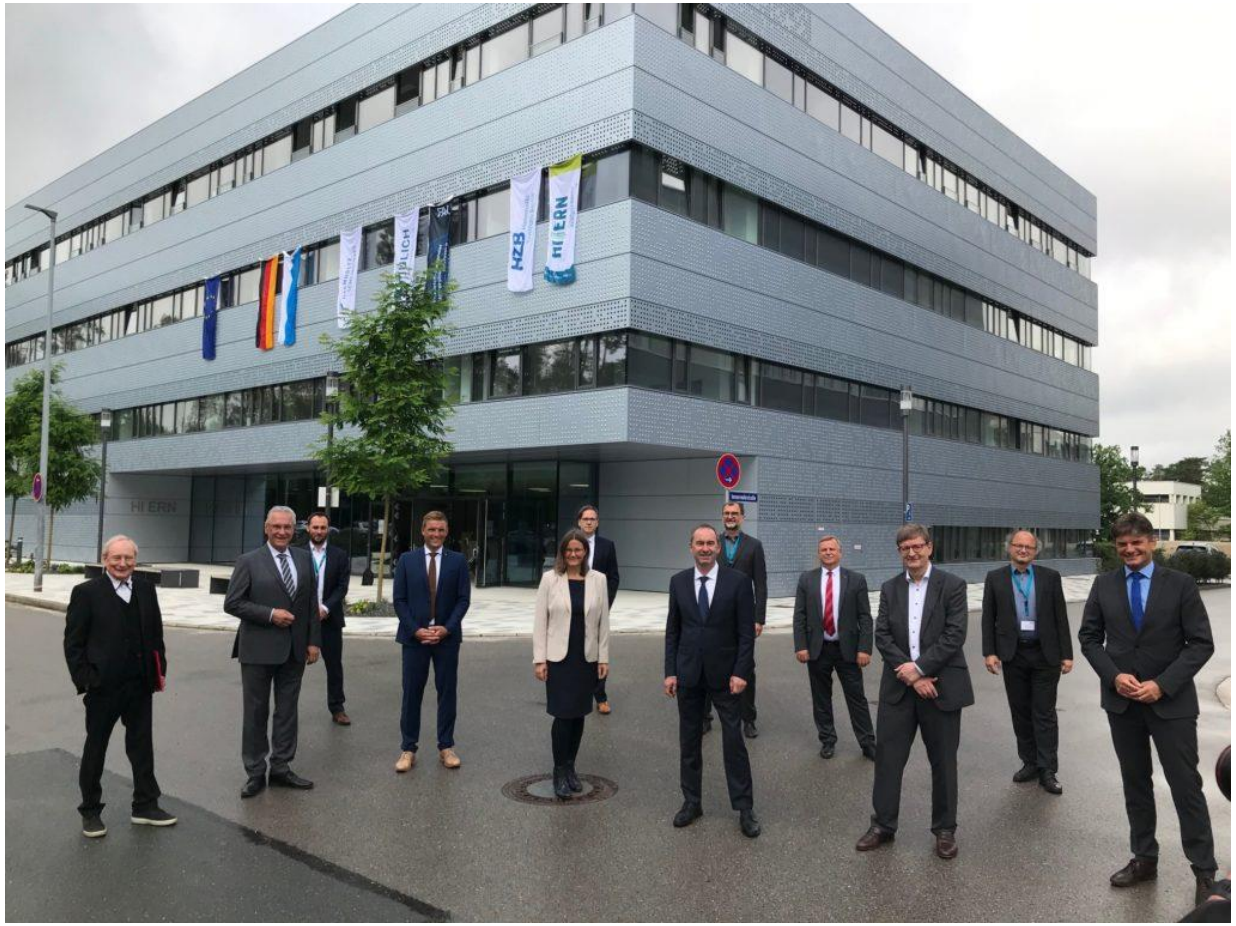
HR-development

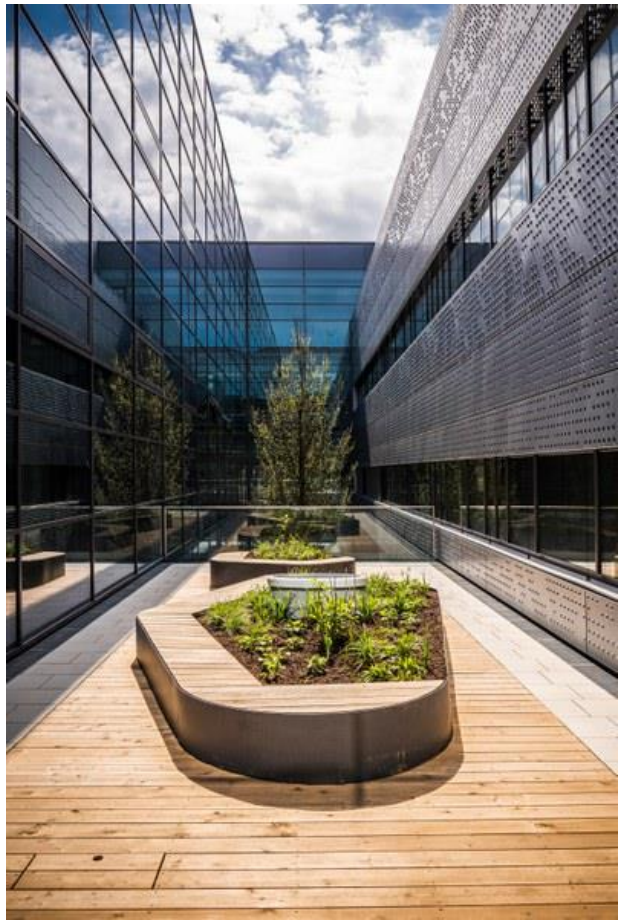


Employees HIERN, without HZB, without Master/Bachlor students

- Mainly PhDs and post-docs
- >80% non-permanent
- 70% on third-party projects
- 40 different nationalities

HI ERN building – completion 09/2021



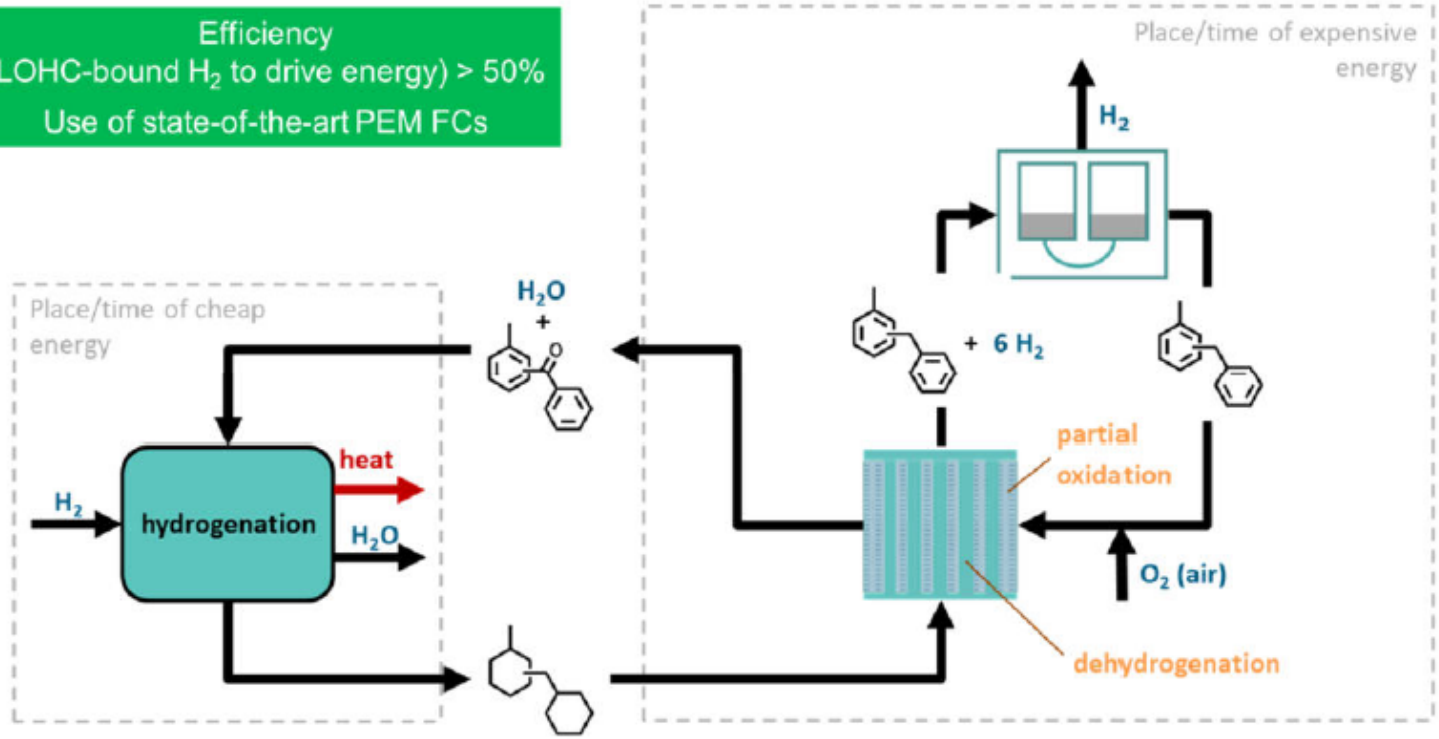


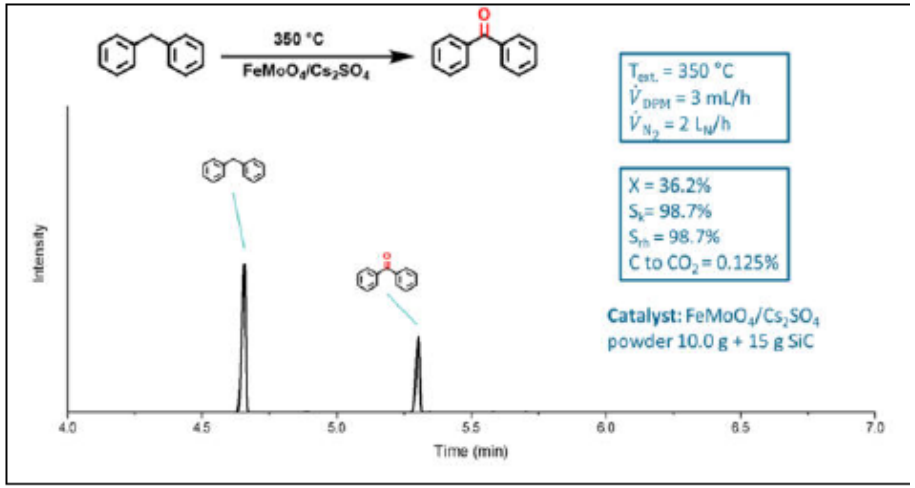
(1) Gebäude Gerber Architekten; Kunst „Synergie“ von Philipp Dreber

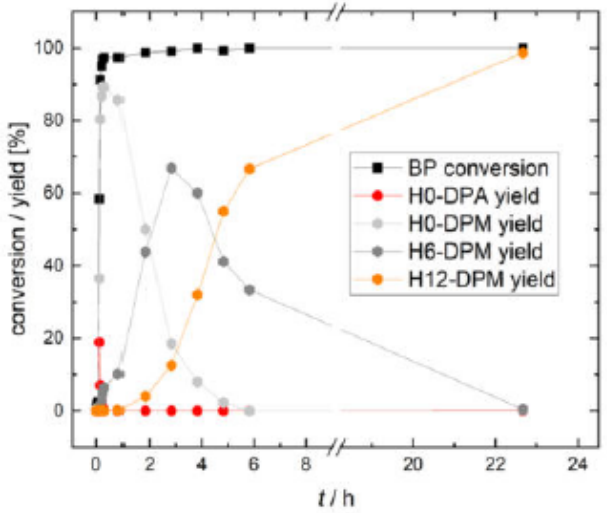
HIERN selected highlights

LOHC technology

Efficiency
(LOHC-bound H_2 to drive energy) > 50%
Use of state-of-the-art PEM FCs





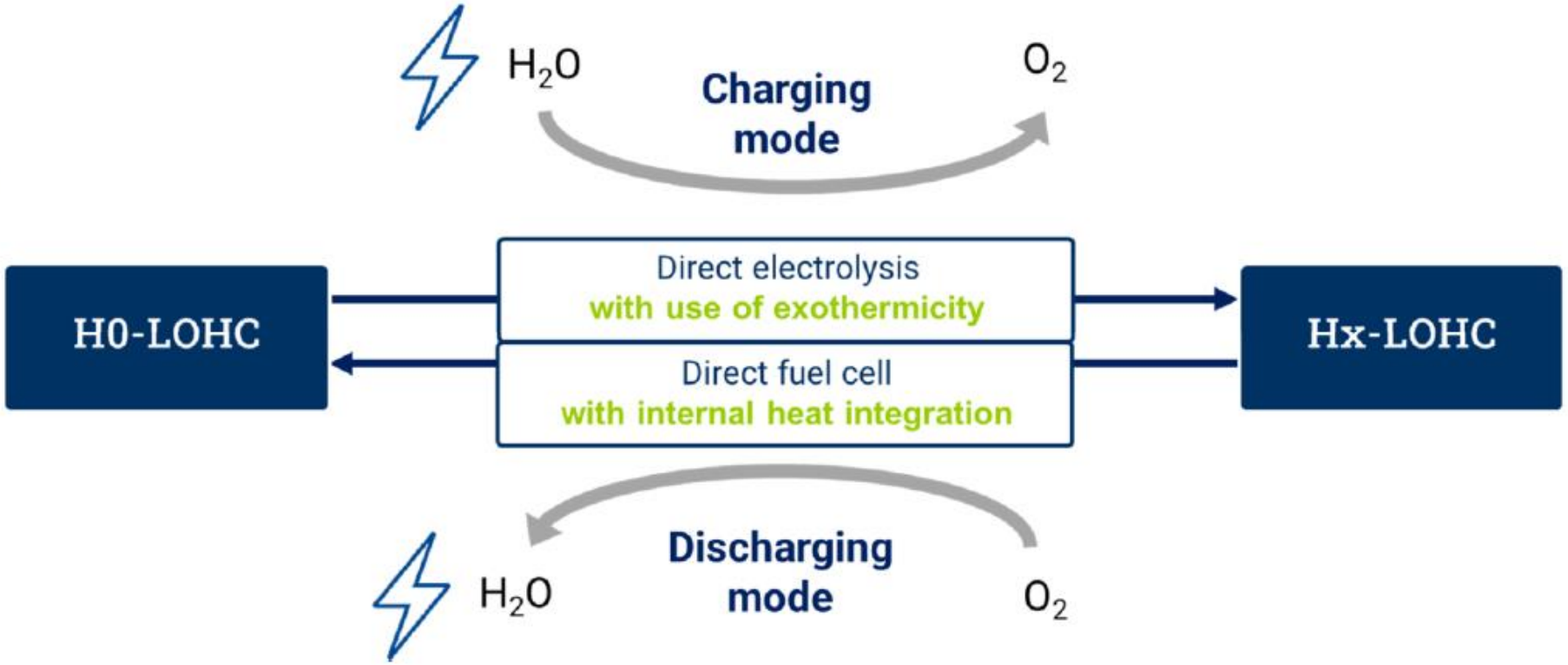


Benzophenon hydrogenation; 180°C, 30 bar H_2; 0.1 mol% Pd/C.

M. Distel, P. Preuster, P. Wasserscheid, M. Gundermann, J. Ascherl, M. Wolf, *Process and system for providing hydrogen gas*, WO2022223444 A1; 2022-10-27 [Chem. Abstr, **2022**:2709965]

One long term LOHC research goal – direct LOHC

Nwe concept
(patented, lab proven,
funding proposal
submitted to StMWi)



Power-to-power Effizienz: $\eta_{PtP}^{DIWE,DIFC} = 40 - 55\%$

compared to $\eta_{PtP}^{EC,cH_2,FC} = 30 - 40\%$

(electrolysis - H_2 pressure storage – fuel cell)

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Competence fields electrochemical energy conversion

Water electrolysis

Investigated Systems:
- AWE
- AEMWE
- PEMWE

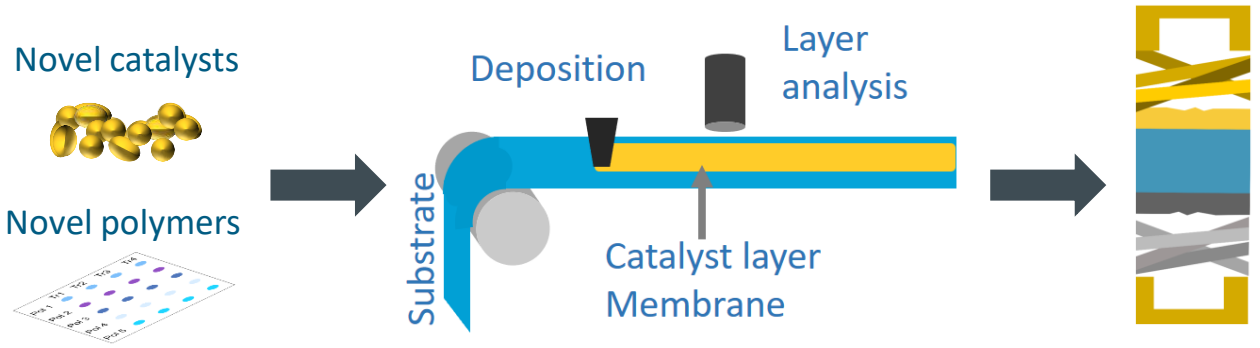
Fuel cells

Investigated Systems:
- LT-PEMFCs
- MT-PEMFCs
- HT-PEMFCs
- DAFCs

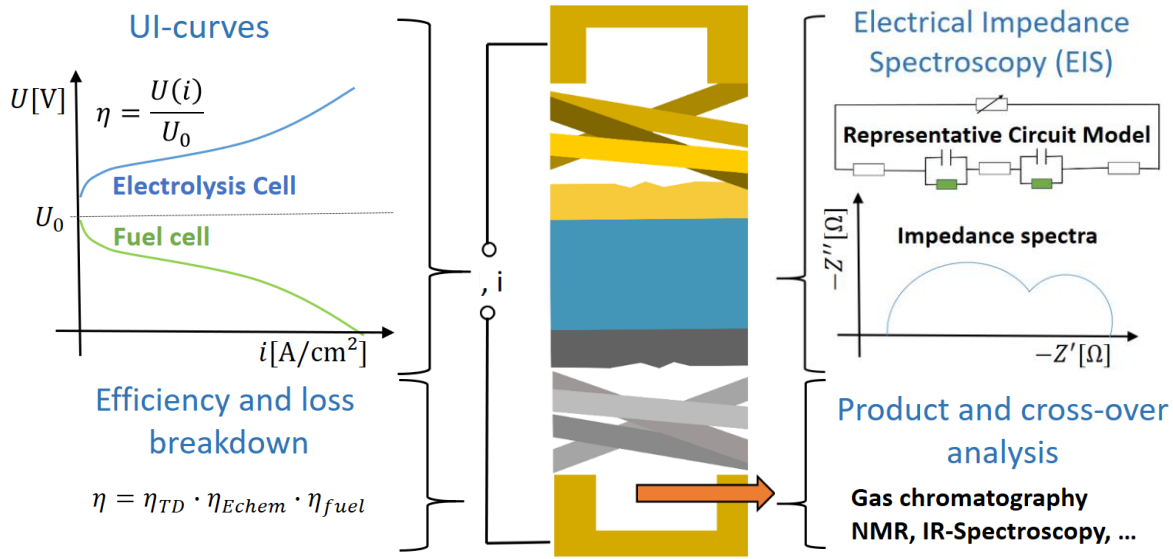
Energy storage by hydrogen

Investigated systems
- Direct LOHC fuel cells
- Direct LOHC hydrogenation

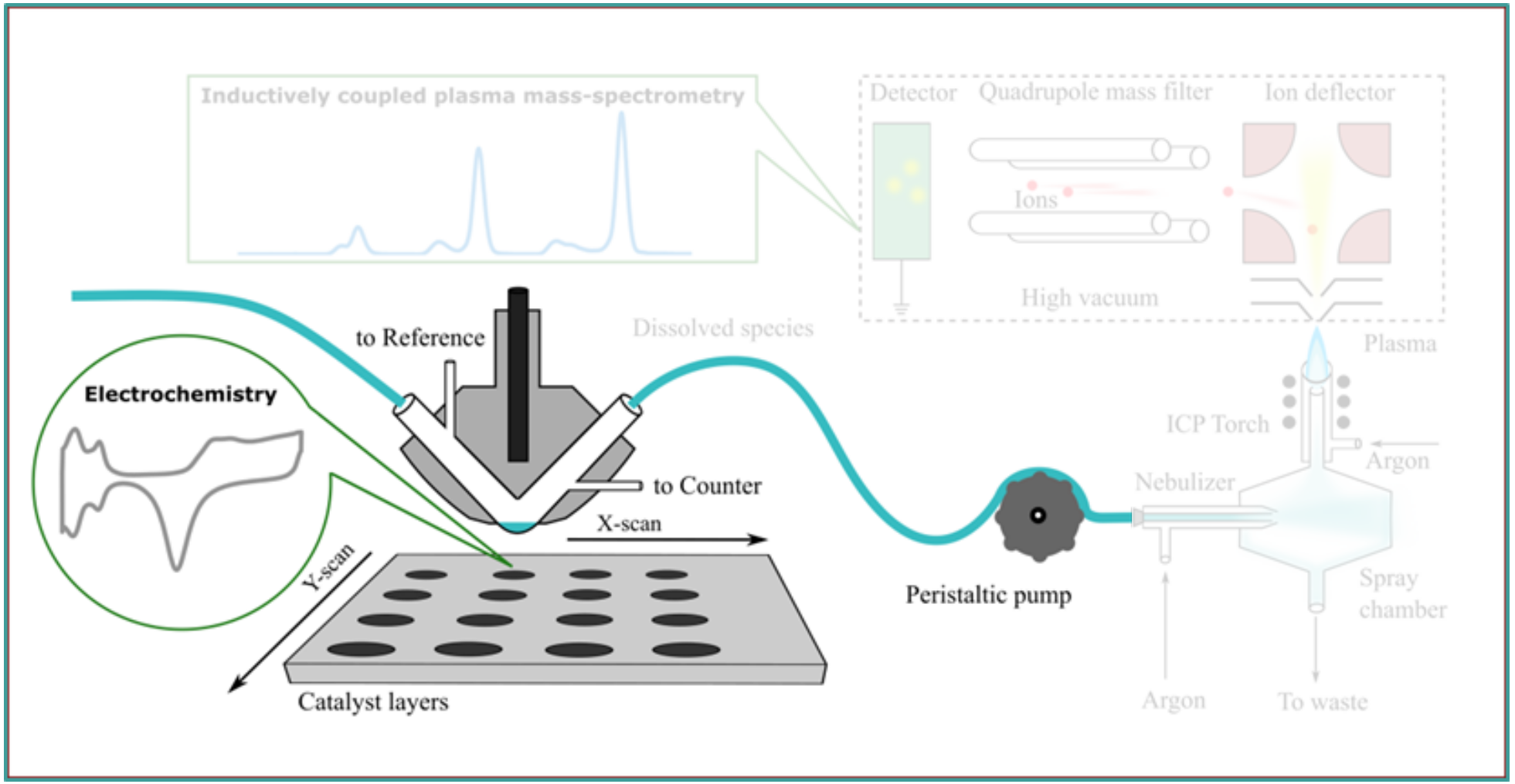
Materials synthesis, MEA processing, technical full cells and stacks



Evaluating cell efficiency and degradation behavior



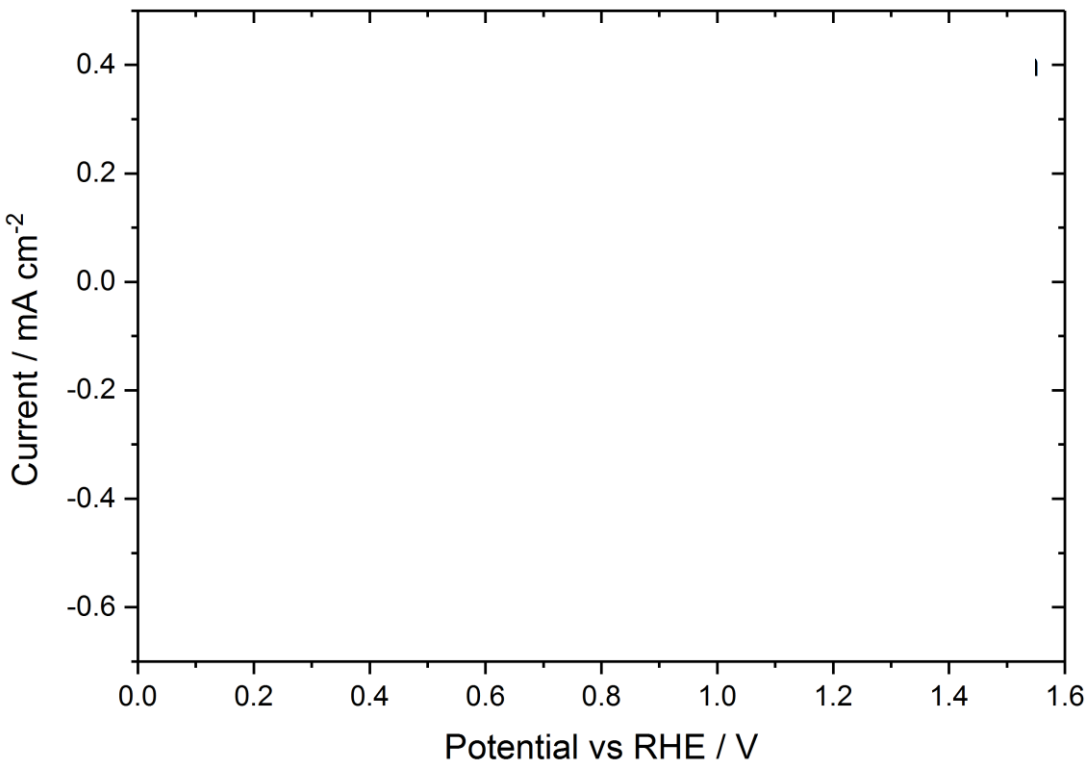
Fast – HT-flow electrochemistry



(1)Cherevko, S.; Mayrhofer, K. J. J.; Encyclopedia of Interfacial Chemistry: Surface Science and Electrochemistry, pp 326–335. (2018)

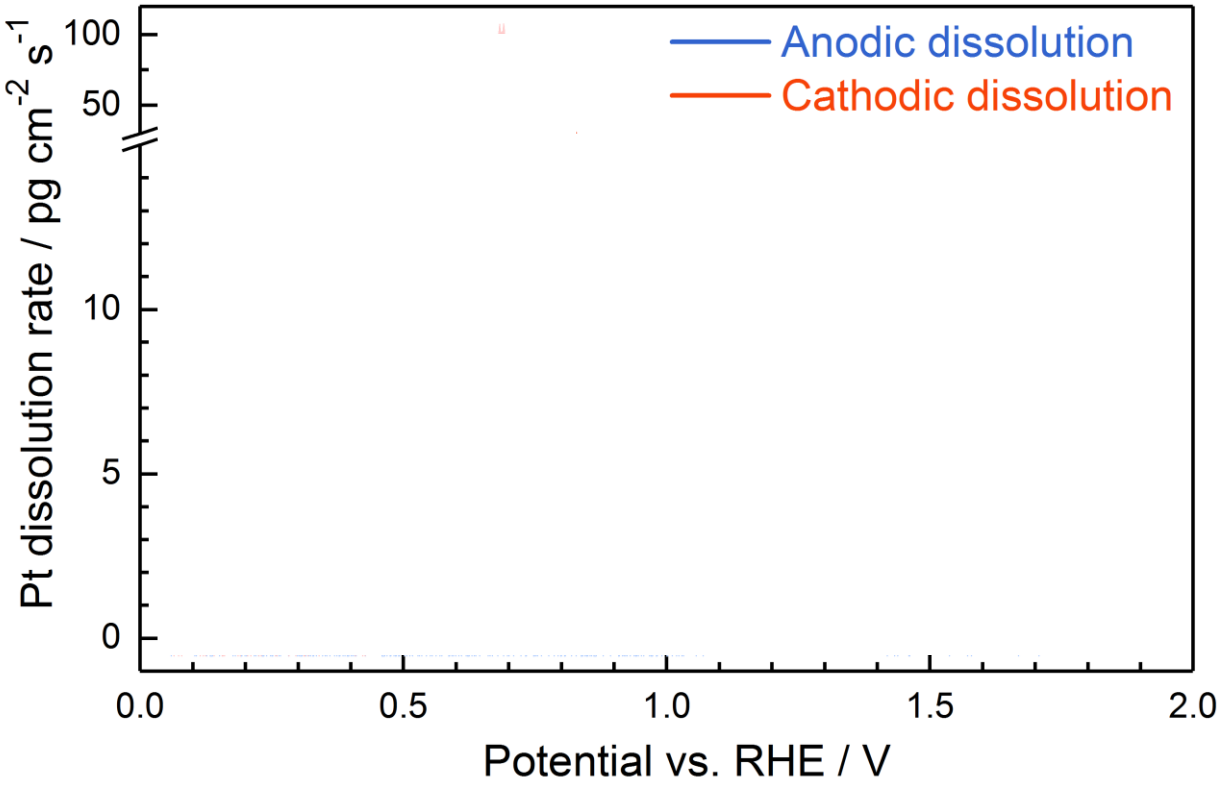
Fast – Real-time dissolution studies

Electrochemistry: *j vs E*



Pt-poly electrode; 0.1 M HClO4; room temp.

On-line ICP-MS: *C vs E*



1 Monolayer 400 ng cm^{-2} . Dissolution selectivity < 0.01%

[1] S. Cherevko et al. Journal of The Electrochemical Society 161 (2014) H822-H830
[2] S. Cherevko et al. Nano Energy 29 (2016) 275-298

YIG Marc Ledendecker (TUM)

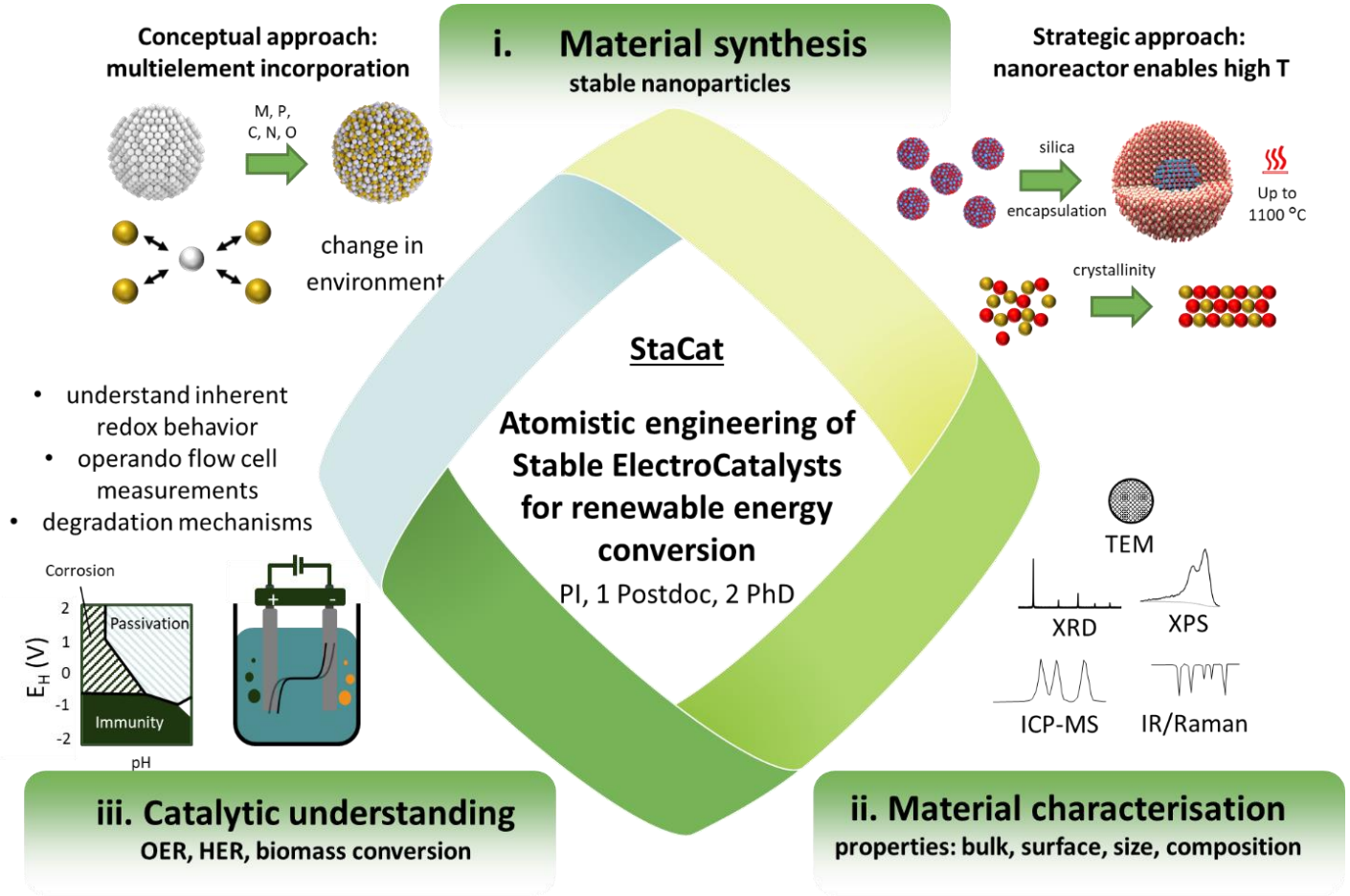


Fig. 1: Proposed approach with three clearly defined research pillars: material synthesis, characterization and catalytic understanding.

Atomistic engineering of Stable ElectroCatalysts for renewable energy conversion (StaCat)

- **Start: May 2023**
- **Professorship @TUM**

HI ERN
Helmholtz Institute
Erlangen-Nürnberg

Thank you for your attention!