THE GERMAN HYDROGEN STRATEGY

The European research project ELEGANCY – Webinar | 18 June 2020

PROF. DR.-ING. WOLFGANG MARQUARDT

Requirements:

- No net emissions of greenhouse gases in 2050
- Reliable and cost-effective energy supply
- Growth of national economy

Embedded in:

- National economic Corona stimulus plan
- Germany’s 2020 EU Council presidency
- Energy transition plan

GOALS AND AMBITIONS

- use green H_2
- take global responsibility for reducing green house gases
- make H_2 competitive
- develop a national market
- prepare reliable paths for H_2 imports
- establish H_2 as alternative fuel
- promote research and innovation
- accelerate transition processes
- establish high safety standards for broad acceptance
- become No. 1 in H_2 technology

FINANCIAL VOLUME

So far already:

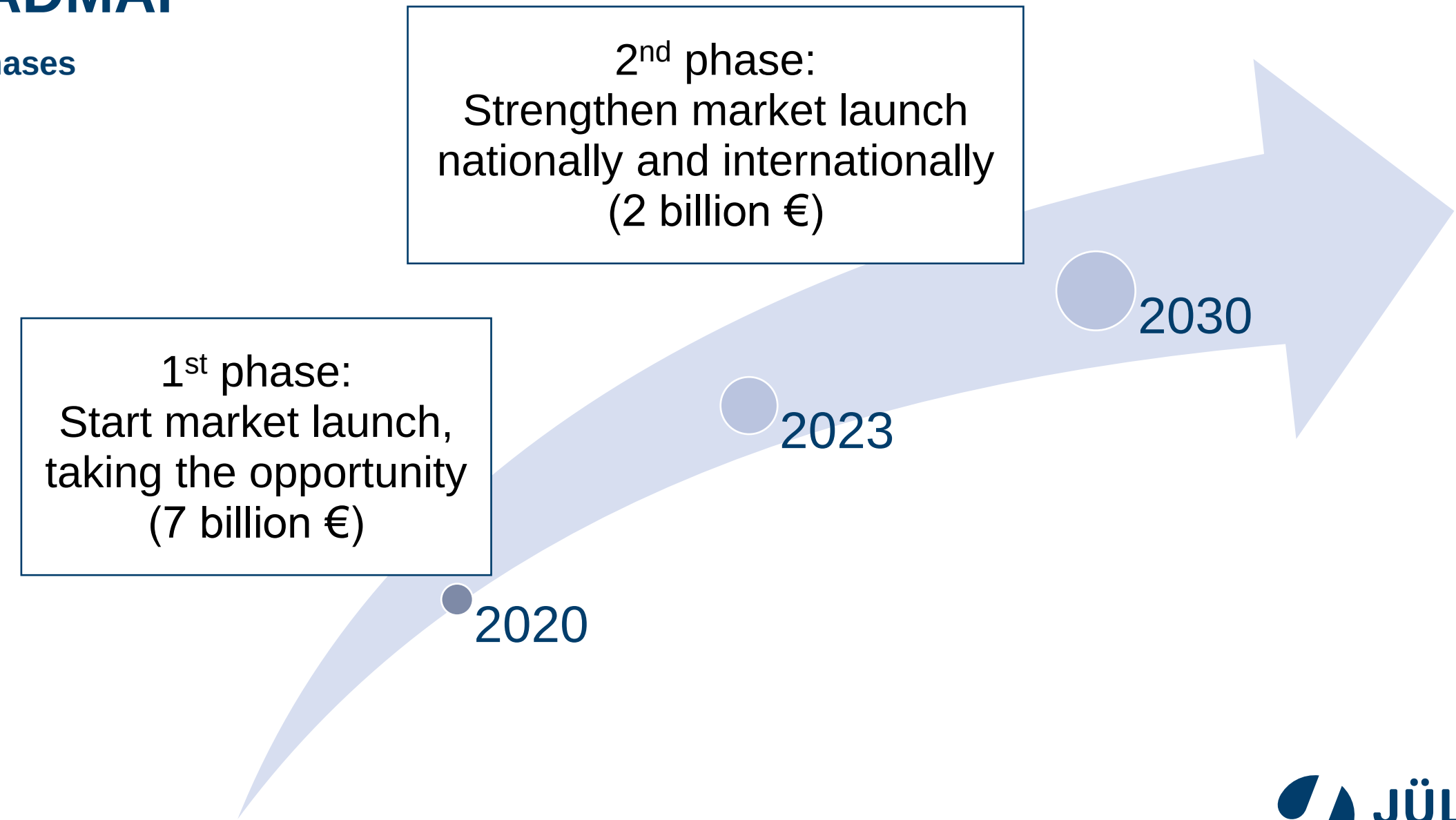
- **2.1 billion €** : National innovation program for H_2 and fuel cell technology (2006-2026)
- **0.3 billion €** : Energy and climate fond (2020-2023)
- **0.2 billion €** : Application oriented fundamental research (2020-2023)
- **0.6 billion €** : Reality labs for energy transition (2020-2023)
- **1.0 billion €** : National decarbonisation program (2020-2023)

New:

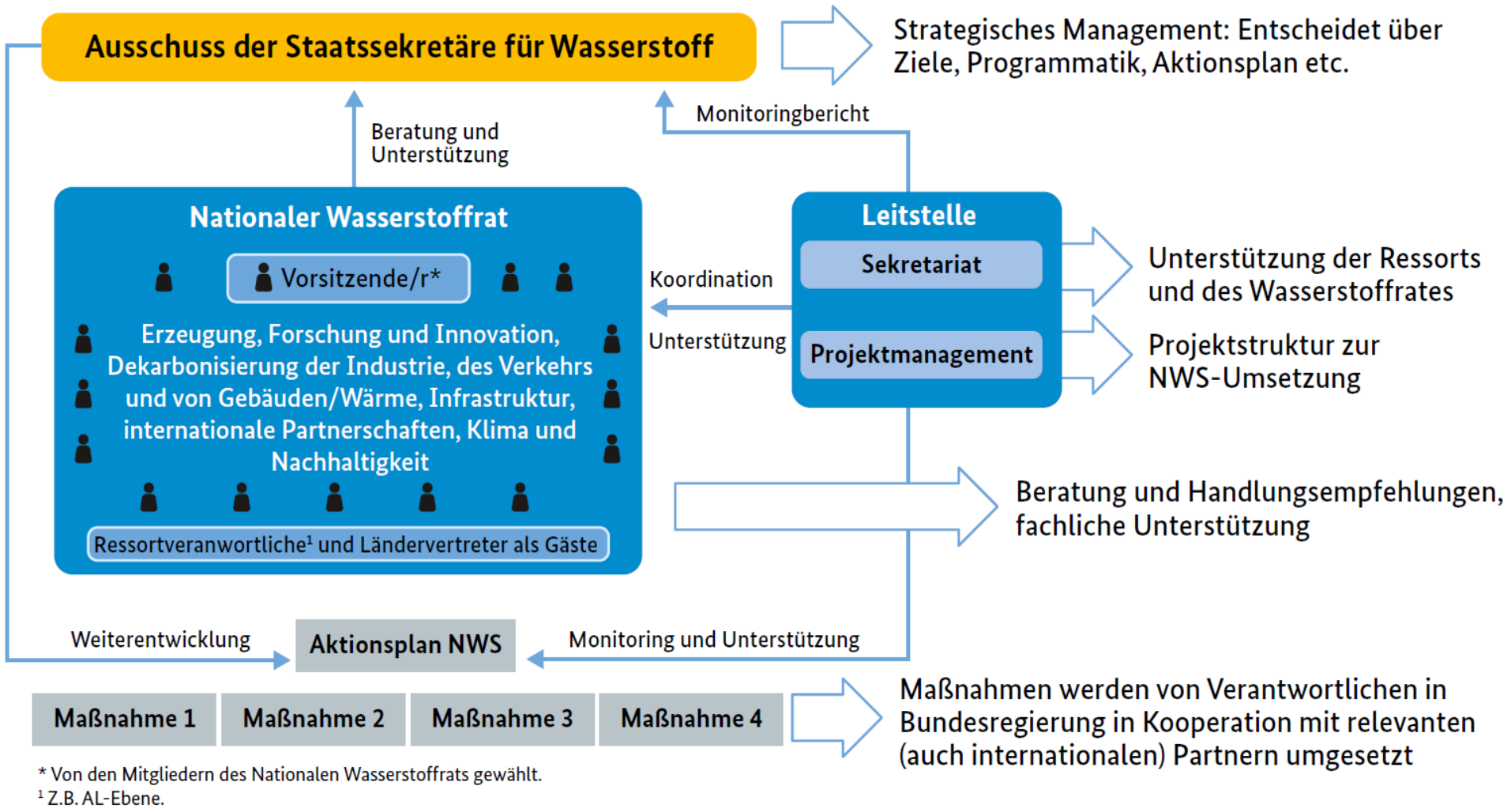
- **9.0 billion €** : as part of the national economic stimulus program

ROADMAP

Two phases



GOVERNANCE STRUCTURE



* Von den Mitgliedern des Nationalen Wasserstoffrats gewählt.
[1] Z.B. AL-Ebene.

ACTION PLAN

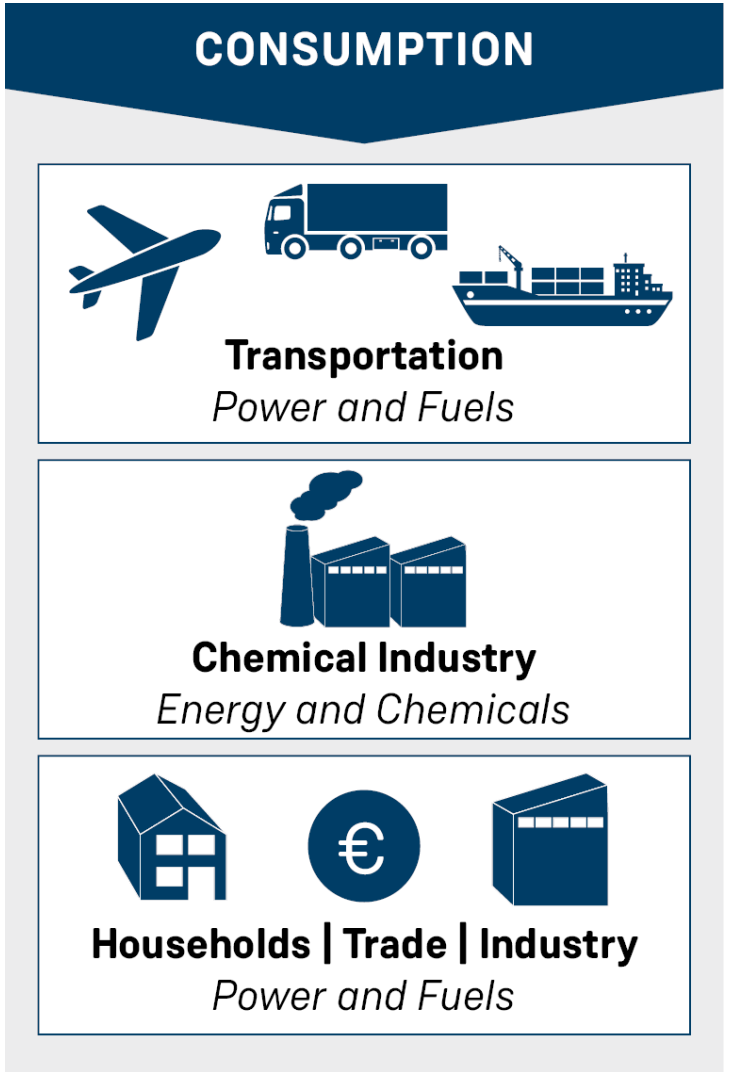
Generation of H2:

- improve boundary conditions
- test new business plans
- funding of electrolyzers
- off-shore wind energy

Applications:

- green H_2 for fuel production
- mobility sector
- kerosene, bio-fuels
- H_2 filling stations
- international standardization

ACTION PLAN



Industry:

- CO_2-free technologies
- electrolysis plants
- dialogue platforms for decarbonisation strategies
- fuel cell based heating systems in buildings

Infrastructure/Supply:

- interconnect electricity, heat, and gas infrastructures

Research, education, innovation:

- roadmap
- demonstrator projects
- research campaigns and programs
- education and training of experts

H2 RESEARCH IN JÜLICH

IEK-1
- Membranes
- SOEC (H_2)

IEK-9
- electro-chemical processes (e.g. SOC)
- CO_2 → base chemicals

IEK-13
Modelling:
- Electrolysis
- Fuel cell

IEK-14
- Hydrogen: Electrolysis & BZ
- Thermal-catalytic processes

IEK-5
Photo-electro-chemical water splitting

IEK-6
H_2 safety

IEK-11
- LOHC incl. process engineering
- materials design (Exp.)

IEK-2
Degradation processes (materials)

IMPORTING HYDROGEN

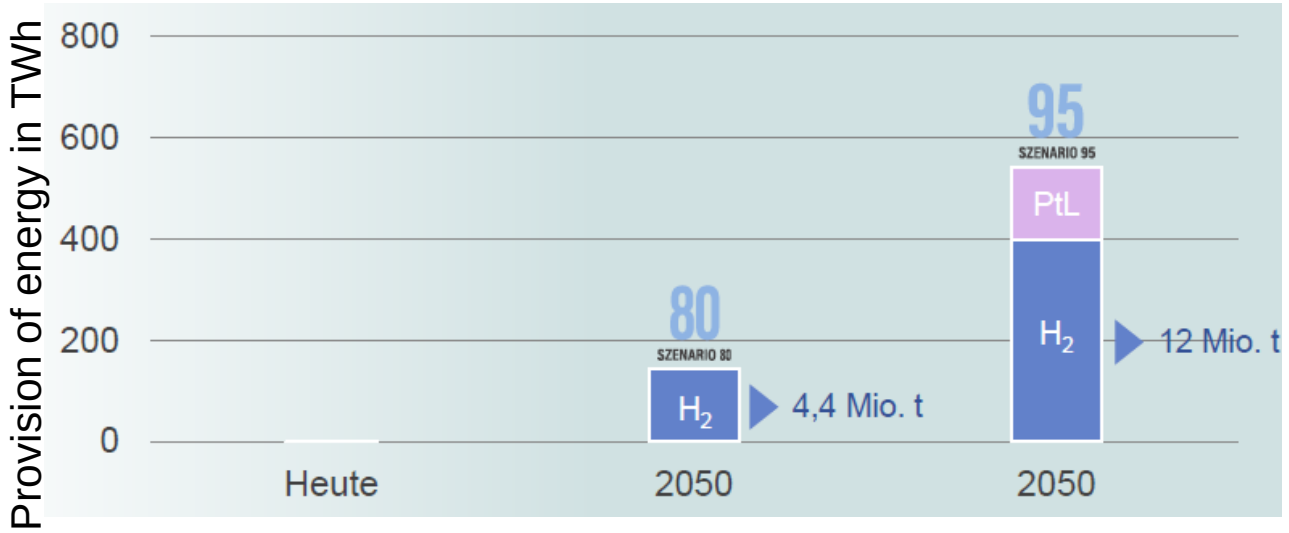
FZ Jülich: Study of transformation strategies 2050

Institut für Energie- und Klimaforschung:
Techno-ökonomische Systemanalyse
https://www.fz-juelich.de/iek/iek-3

Goal:
Identification of the most cost-effective strategy to reduce CO_2 in order to achieve Germany's climate goals by 2050

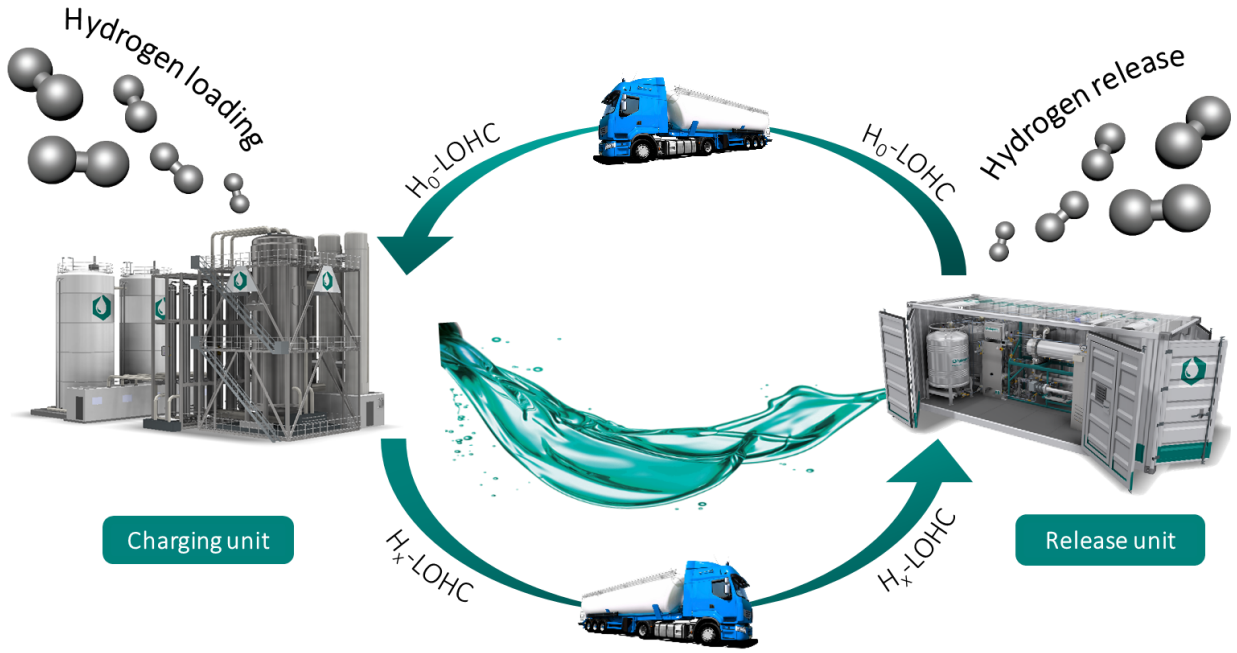
Selected, essential results:

- The transformation is technically and economically feasible
- Reduction strategies differ considerably depending on the target (80/95) for 2050
- Rapid expansion of renewables necessary
- **Sector coupling by Power-to-X processes, increase of H_2 significance**
- **Massive import of H_2 and synfuels necessary**



Infrastructure-compatible hydrogen logistics

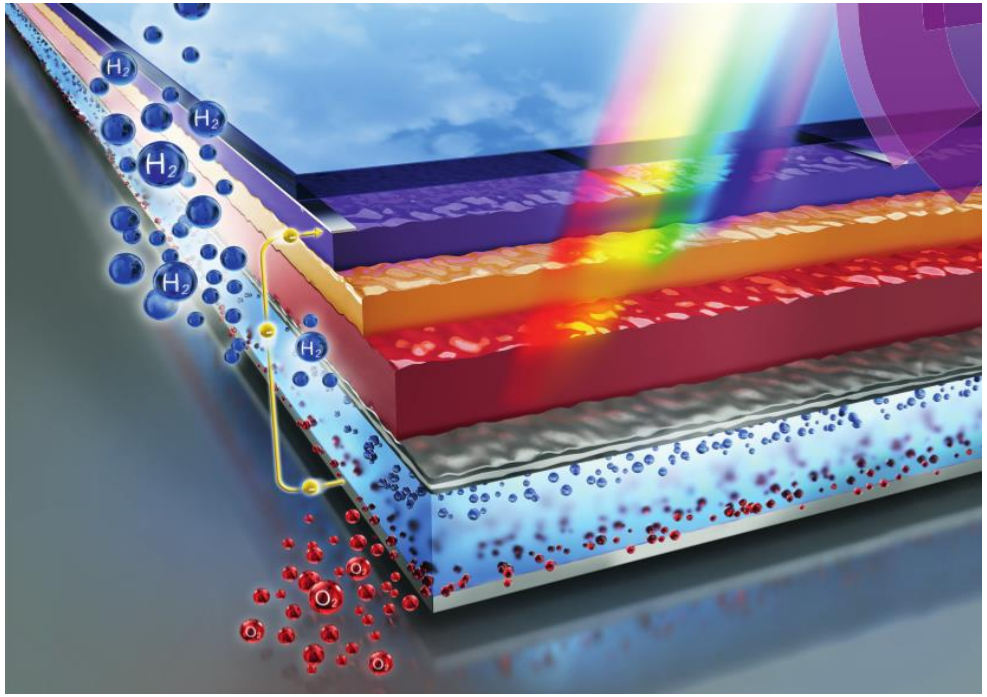
Liquid Organic Hydrogen Carrier (LOHC) systems

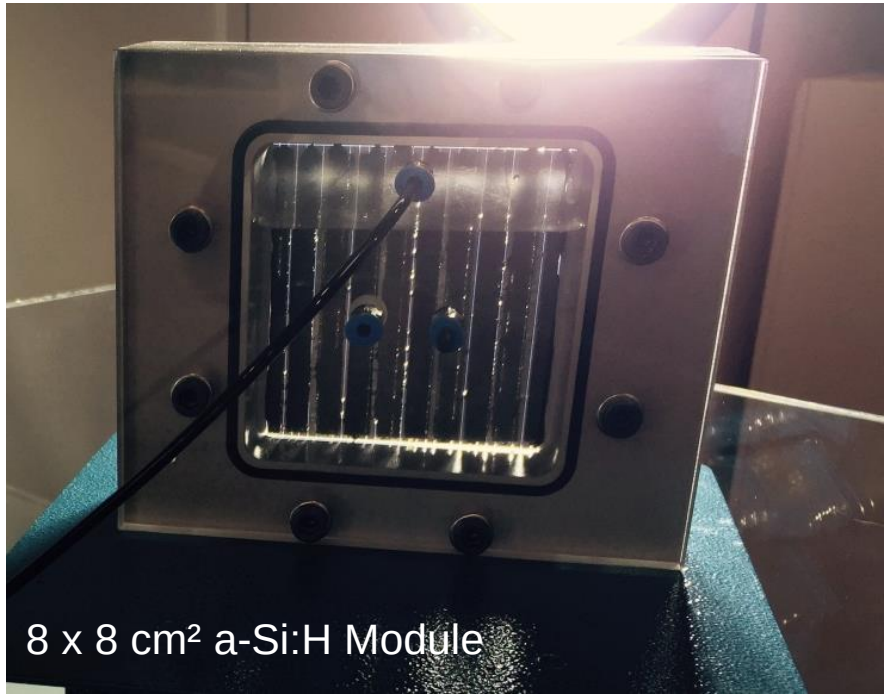


- Reversible binding of H_2 to a liquid carrier compound by catalytic hydrogenation / dehydrogenation
- Fuel-like nature enables use of fuel infrastructure
- Release of pure hydrogen enables local and global zero emission technologies

Example: HI ERN (a part of Forschungszentrum Jülich) runs currently a project to demonstrate an emission-free commuter train based on LOHC-bound hydrogen (on-board release) by 2023 - Sponsor: Bavarian Ministery of economy, 28.7 M€

PHOTO-ELECTROCHEMICAL WATER SPLITTING





Dr. Bugra Turan
(former IEK-5)

Scalable solar water splitting device with integrated coplanar water splitting electrodes. Solar to hydrogen efficiency ~4%.

B. Turan, J. P. Becker, F. Urbain et al., *Nat. Commun.* **7**, 12682 (2016).

GLOBAL: H_2POWER-AFRICA

Atlas of green hydrogen generation potentials in Africa: A technological, environmental and socio-economic feasibility assessment

Funded by BMBF, 2020-2022
Main partners:

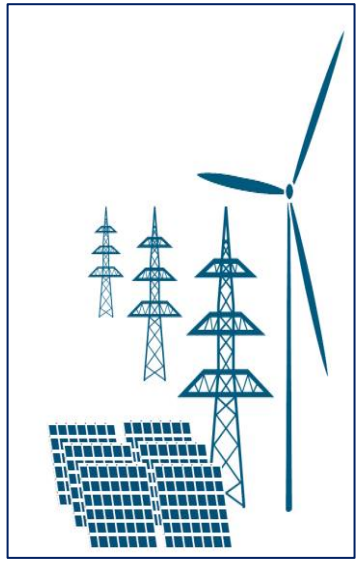
- Forschungszentrum Jülich
- WASCAL
- SASSCAL

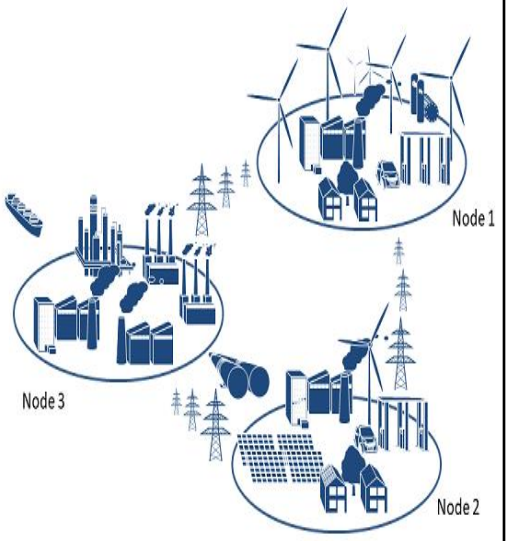
Process Chain

- Wind & Solar energy
- Electrolysis
- Domestic pipeline
- Conversion (LH_2/LOHC)
- Buffer storage
- Shipping

Basic assessment criteria

- **Land eligibility**
- **Renewable energy potential**
- **H_2 infrastructure placement**
- **Local demands**





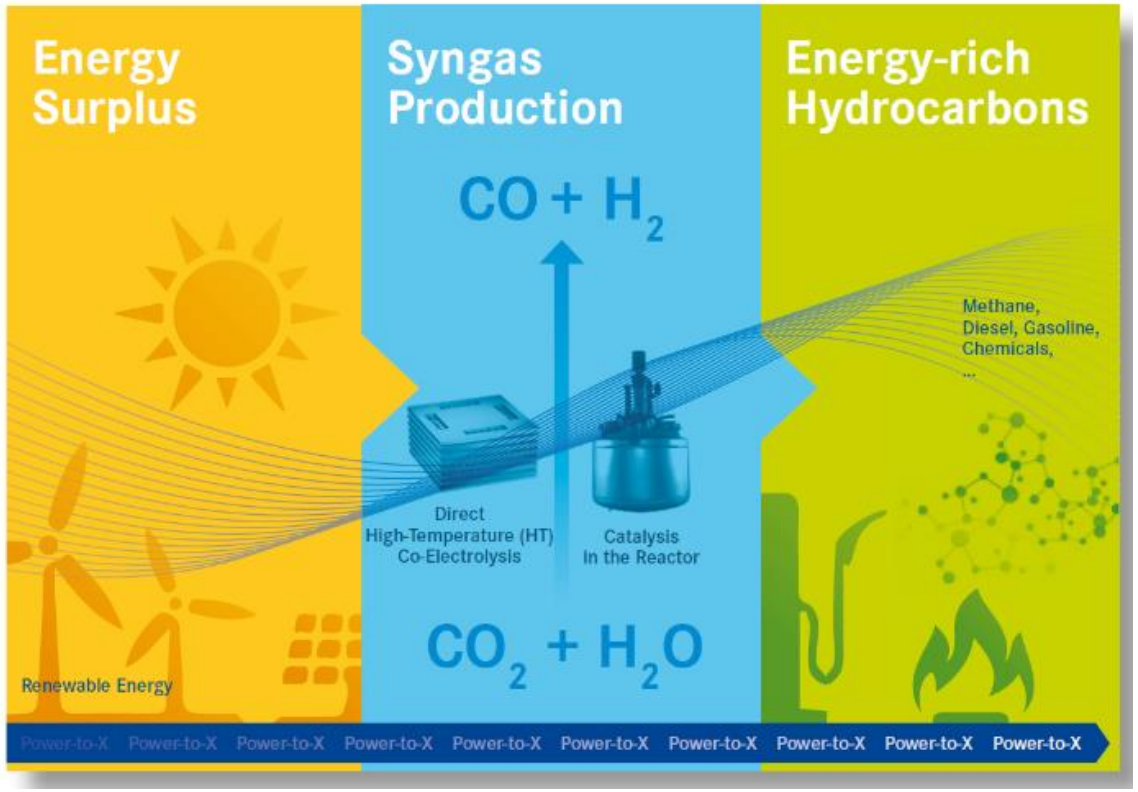
Hydrogen cost

KOPERNIKUS-PROJECT

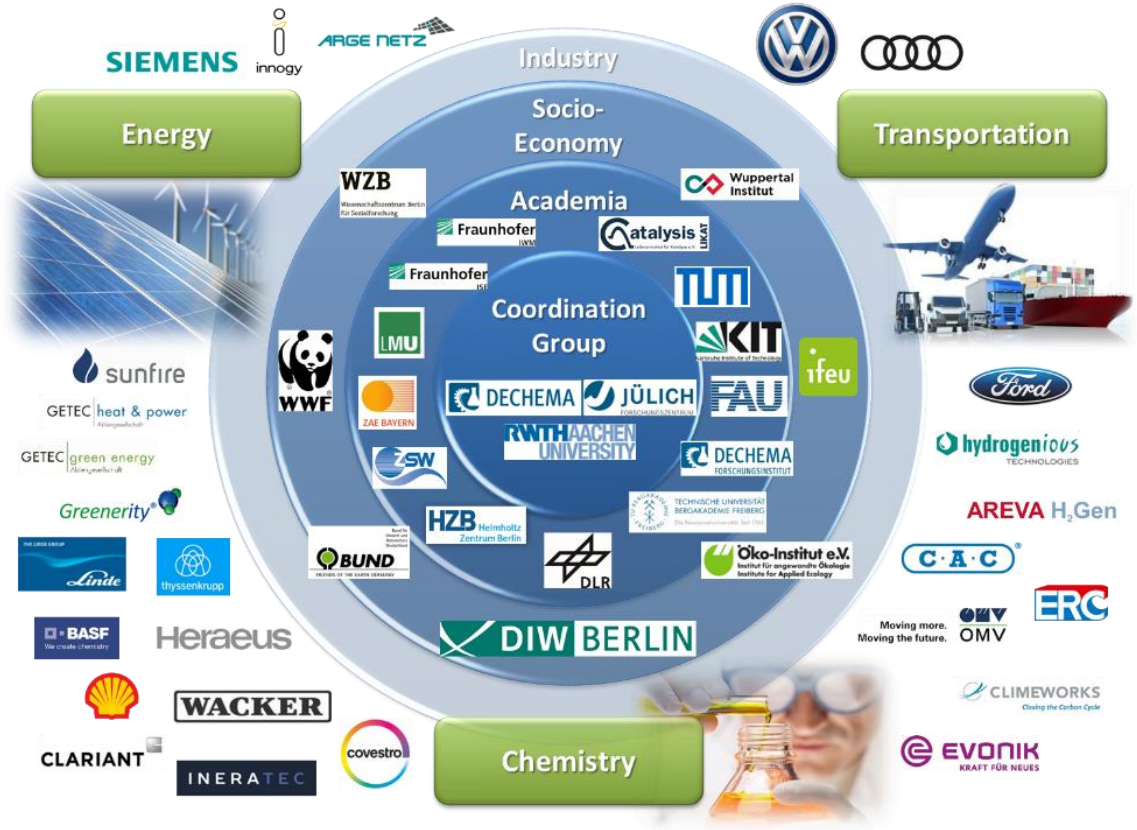
Coordination by FZ Jülich, RWTH Aachen, Dechema

Bundesministerium für Bildung und Forschung

Concept: Power-to-X

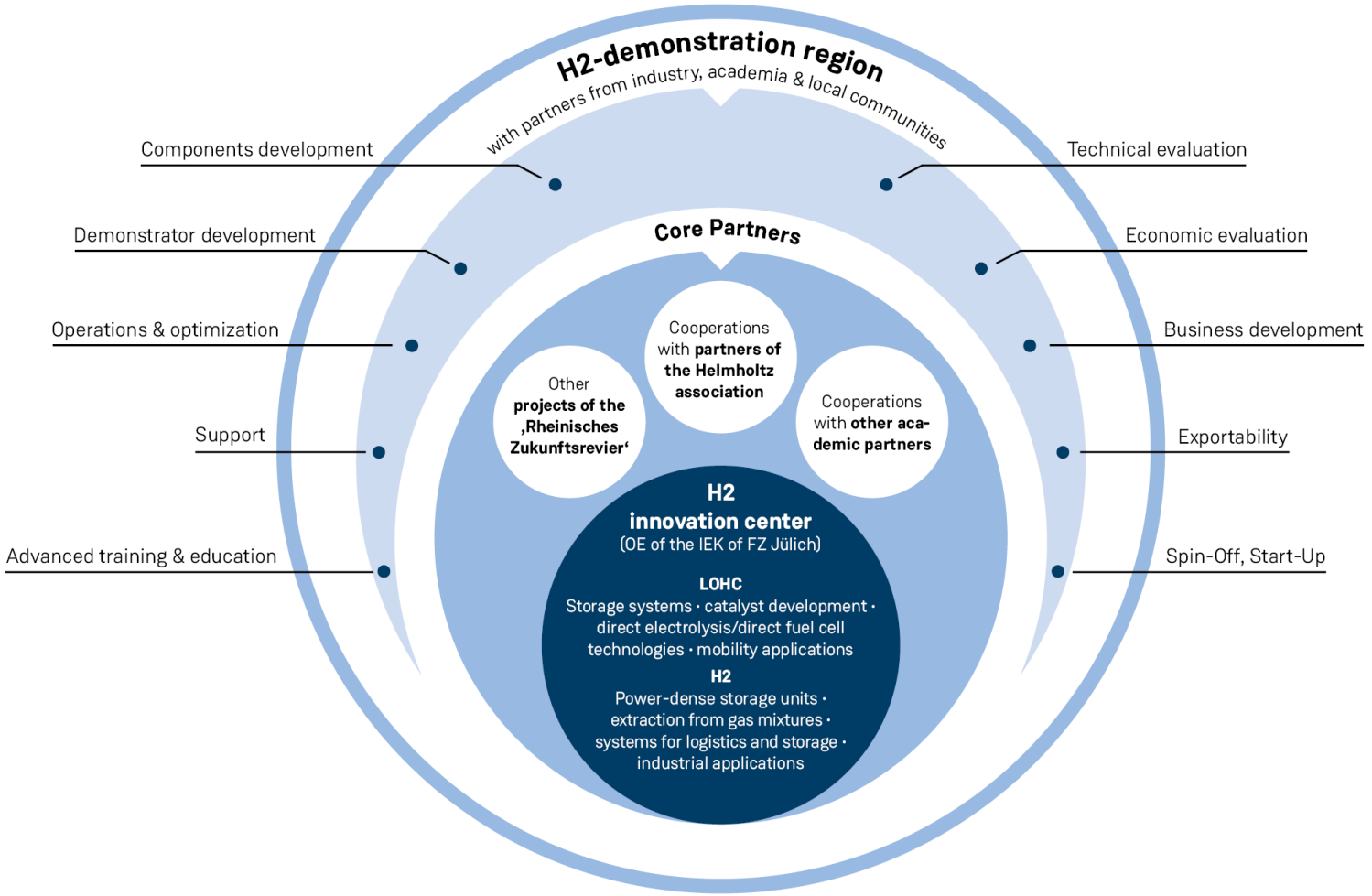


Partner



HELMHOLTZ-CLUSTER FOR H2

Helmholtz-Cluster for sustainable and infrastructure compatible for H_2 economy



Innovation Hub:
Becoming a model region for H_2

FORSCHUNGSZENTRUM JÜLICH

Vielen Dank für Ihre Aufmerksamkeit

Mitglied der Helmholtz-Gemeinschaft

JÜLICH
Forschungszentrum