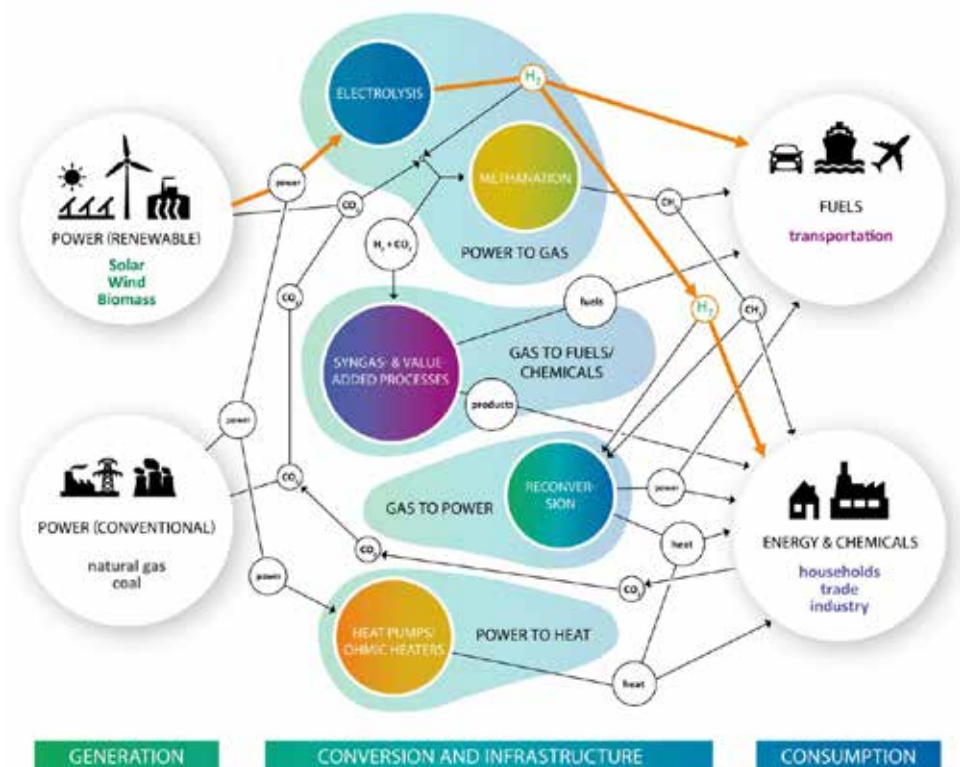




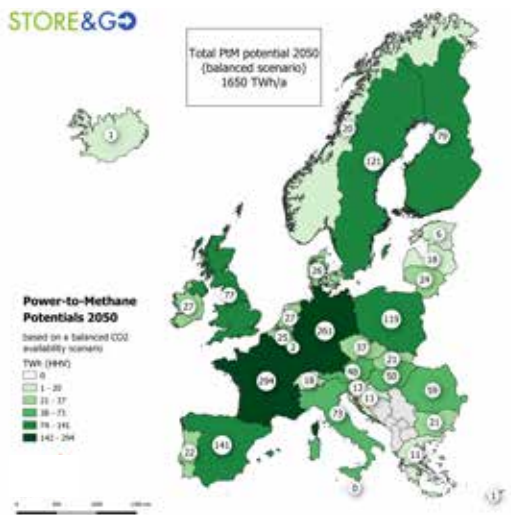
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## Hydrogen (H<sub>2</sub>)

is a key element of sector coupling and offers a fundamental opportunity to contribute to greenhouse gas neutrality across all sectors. Particularly in cases where electricity from renewable energies (RE) cannot be used directly due to existing limitations, hydrogen enables access to the mitigation of greenhouse gas emissions. However, the integration of hydrogen into a climate-neutral energy system is challenging and is currently being intensively investigated by GWI in various research projects.

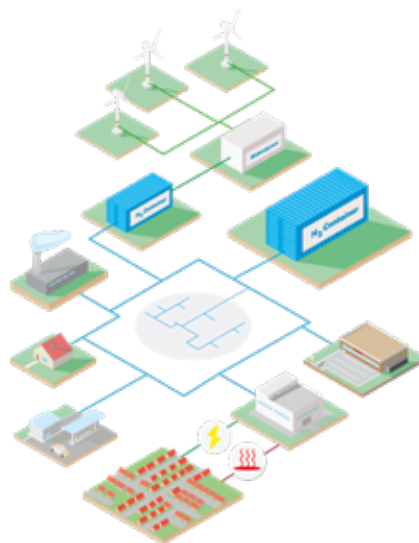


PATH ANALYSIS ALONG THE ENTIRE VALUE CHAIN | [VIRTUAL INSTITUTE - POWER TO GAS AND HEAT](#)

POWER-TO-METHANE POTENTIAL 2050 – [STORE&GO](#)

## Distribution

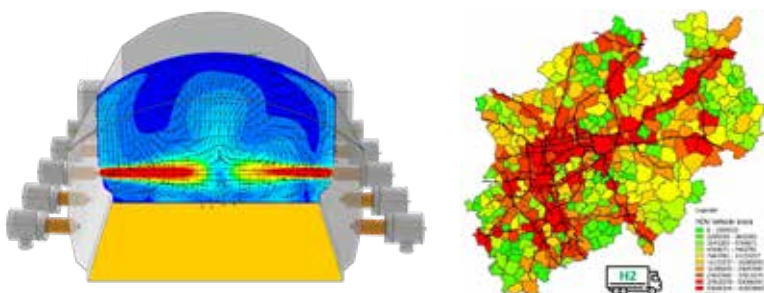
- Overall system analysis including pipeline and non-pipeline transport of H<sub>2</sub> and derived products
- H<sub>2</sub>-pipeline transport: dynamic modelling and simulation of energy grids and their coupling
- Development of monitoring concepts for determining H<sub>2</sub> concentrations in the gas grid
- Investigations regarding H<sub>2</sub> compatibility of gas installation components
- Legal framework and techno-economic analysis of H<sub>2</sub> grids and blending into the natural gas grid

H<sub>2</sub> TEST SERIES AT A SEMI-INDUSTRIAL PLANT

GEOREFERENCED EUROPEAN GAS TRANSMISSION NETWORK



INVESTIGATIONS ON THE SEMI-INDUSTRIAL PLANT WITH A CAPACITY OF 1.3 MW



CFD SIMULATION: FLOW FIELD OF A GLASS MELTING TANK

ANALYSIS OF HEAVY-DUTY VEHICLES (MILEAGE, ROUTES, EMISSIONS)

## H<sub>2</sub> value chain

### Production

- Feasibility and site analysis considering RE sources as well as the infrastructures of power, gas and district heating networks
- Techno-economical and ecological path analysis and classification according to the regulatory framework
- Analysis of H<sub>2</sub>-generation paths (electrolysis, pyrolysis) and downstream products such as CH<sub>4</sub> or NH<sub>3</sub> (PtX)

### End-use

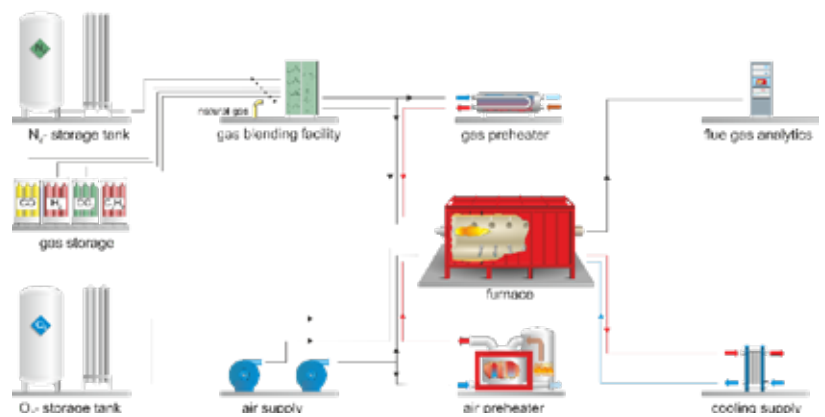
- Investigations of H<sub>2</sub> utilisation in the heating sector (space and process heat) by means of:
  - Test rigs offering capacities from less than 1 kW up to 1.3 MW
  - Simulation tools: ANSYS (FLUENT®; CFD-Simulation), ChemCAD®, Cosilab®, GasCalc®
- Techno-economic and ecological analysis for heating, mobility and industry sector
- Analysis of the H<sub>2</sub> utilisation potentials in the thermal process industry
- H<sub>2</sub> utilisation potential in the mobility sector: identification and evaluation of potential sites for refueling stations based on traffic analysis



## Infrastructure at GWI:

### H<sub>2</sub> supply

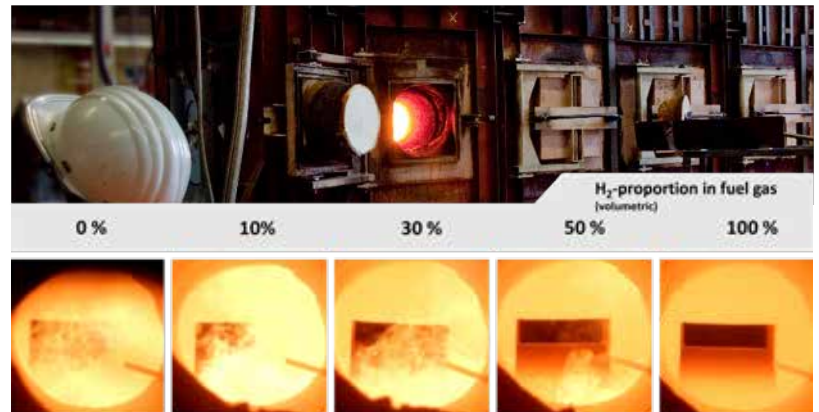
- High precision and controlled supply of gas mixtures by means of specially designed gas mixing systems:
  - i. Power range up to 1 MW: 5-component gas mixing unit; power modulation via modern control technology
  - ii. Semi-industrial application: gas flow rate of 330 m<sup>3</sup>/h H<sub>2</sub>, corresponding to the provision of H<sub>2</sub> fuel gas with a thermal output of more than 1 MW



SCHEMATISCHE DARSTELLUNG DER SEMI-INDUSTRIELLEN VERSUCHSINFRASTRUKTUR IM GWI

### Gas quality measurements:

- High precision measurements using state-of-the-art measuring technology:  
5 Vol.-% H<sub>2</sub>,  
PGC: 50 Vol.-% H<sub>2</sub>,  
gasQS flonic: 40 Vol.-% H<sub>2</sub>



TEST SERIES FOR H<sub>2</sub> ADMIXTURE AT THE SEMI-INDUSTRIAL PLANT FOR H<sub>2</sub> ADMIXTURE LEVELS FROM 0 % TO 100 % IN NATURAL GAS

### End use - test rigs

- Experimental investigations on the H<sub>2</sub> use of residential and commercial units as well as industrial thermal process plants
- Test rigs with modern measurement technology for carrying out investigations for industrial and R&D projects
- The spectrum at GWI ranges from test benches for small fuel cells with outputs of less than 1 kW to semi-industrial high-temperature test rigs with firing rates up to 1.3 MW



POWER-TO-X DEMONSTRATION CENTRE AT GWI

### PtX-Demonstration Centre

- As part of the „Virtual Institute Power to Gas and Heat“, a PtX Demonstration Centre was set up at GWI, consisting of a PEM electrolyser, catalytic methanation, power-to-heat plant and CHP system
- The PtX infrastructure offers the possibility to test and combine different technologies so that flexibility options can be tested under real conditions

## R&D References



## Further References



[www.gwi-essen.de](http://www.gwi-essen.de)

## Overview of our Expertise

Due to the close interaction between research and development, testing laboratories and education GWI is your partner for all issues relating to hydrogen.

### Research and Development

The entire H<sub>2</sub> value chain from production to transport and end-use by us is investigated in overall system analysis. In addition to feasibility and potential studies, experimental investigations on H<sub>2</sub> utilisation for end applications in the heating and industrial sectors are carried out at GWI. The spectrum ranges from test benches for small fuel cells with outputs of less than 1 kW to semi-industrial high-temperature test rigs with firing rates up to 1.3 MW.

### Training and Consulting Centre

Supporting conferences, practical seminars and training sessions on hydrogen applications and associated safety technology.

### Testing Laboratory Department

Inspection and testing of equipment and fittings for natural gas blends with up to 20 % hydrogen admixture (according to ZP3100). We inspect / test components, appliances up to 100 % H<sub>2</sub>.

**Gas- und Wärme-Institut Essen e.V. | Hafenstraße 101 | 45356 Essen | Germany**

**We are looking forward to support you in providing solutions for your challenges - you are welcome to contact us!**

Head of Department  
Industrial Combustion Technology

Dr.-Ing. Anne Giese  
Phone: +49 201 3618-257  
[anne.giese@gwi-essen.de](mailto:anne.giese@gwi-essen.de)

Head of Department  
Fuel and Appliance Technology |  
Testing Laboratory

Dr.-Ing. Frank Burmeister  
Phone: +49 201 3618-245  
[frank.burmeister@gwi-essen.de](mailto:frank.burmeister@gwi-essen.de)

Head of Department  
Training and Consulting Centre

Dr.-Ing. Bernhard Naendorf  
Phone: +49 201 3618-140  
[bernhard.naendorf@gwi-essen.de](mailto:bernhard.naendorf@gwi-essen.de)

