

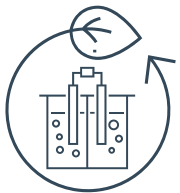
## Connecting Innovation with Market Implementation

Ass.Prof. Dr. **Alexander Trattner**, CEO and Research Director

Hydrogen Summit, Athens, 18.11.2025

# At a glance

- **Austria's leading research center for hydrogen technologies** since 2005
- **120+ Researchers at HyCentA** & multi-disciplinary team
- **3000+ Researchers at TUG** campus
- **600+ Projects** successfully completed
- **State-of-the-art infrastructure** for applied hydrogen research & technology development
- **4 Research areas** along the hydrogen value chain
- **COMET K1 Center**



Electrolysis  
& Power-to-X



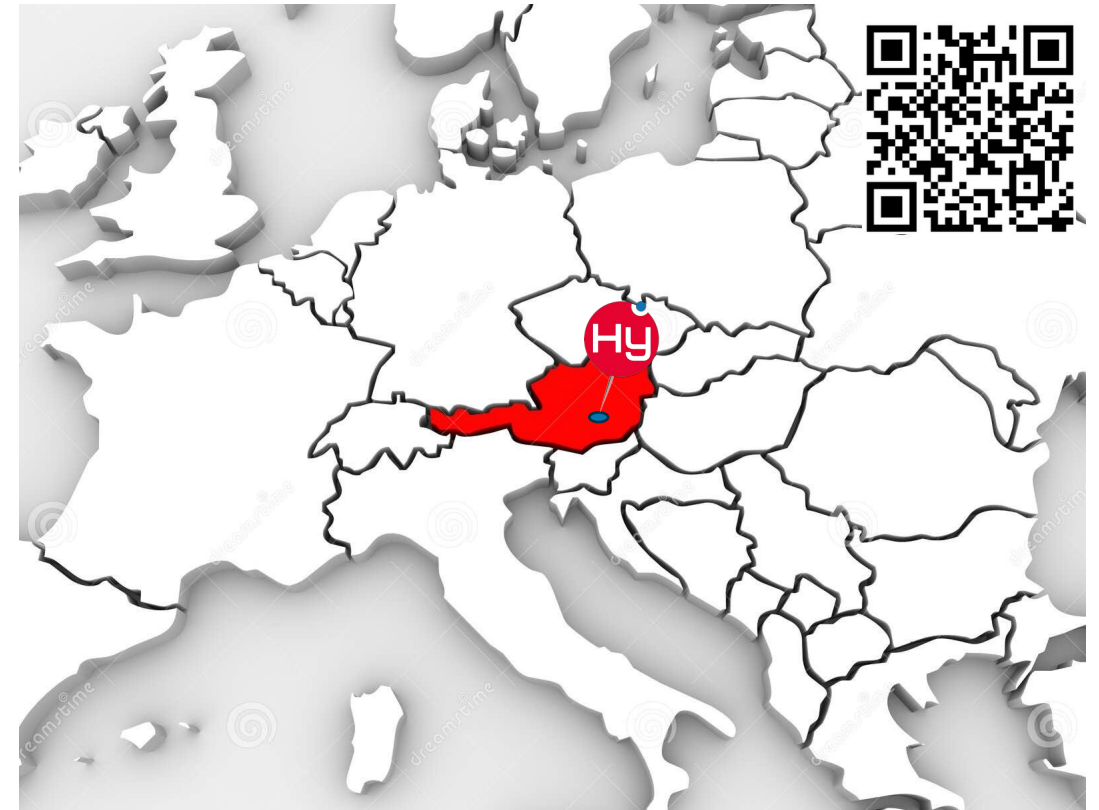
Green Energy  
& Industry



Green  
Mobility



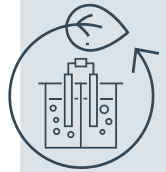
Circularity  
& System Opt.



Shareholders:



# Research Areas along the Entire Value Chain



Area 1 – ECT  
**Electrolysis and  
Power-to-X**



Material research, new **electrolysis technologies**, alternative processes (from materials to industrial applications)



Area 2 – INT  
**Green Energy  
and Industry**



Research on **generation, purification, compression, storage, distribution and delivery** technologies for the industry and the energy Sector



Area 3 – MOT  
**Green Mobility**



**Fuel cell** research on materials, cell, stack and system; optimisation of entire **powertrain** system including **hydrogen storage**



Area 4 – MET  
**Circularity and  
Sys. Optimization**



Measurement and **testing** technologies, **controls**, diagnostics, **modelling** and simulation “digital twin”



# I. Electrolysis and Power-to-X

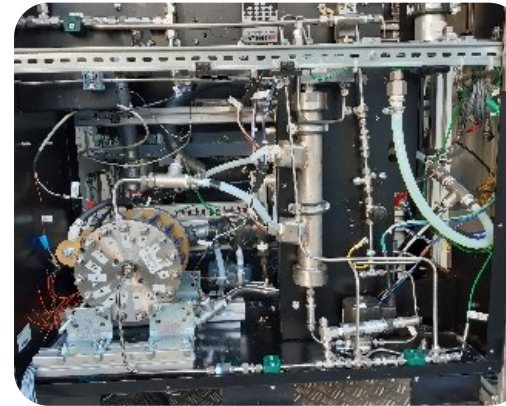
## One-stop-shop Electrolyser Development at HyCentA Research



Catalyst ink preparation



PEM Single Cell Test Bench



PEM Stack Test Bench



System Test Bench



Component Manufacturing

Single Cell Testing

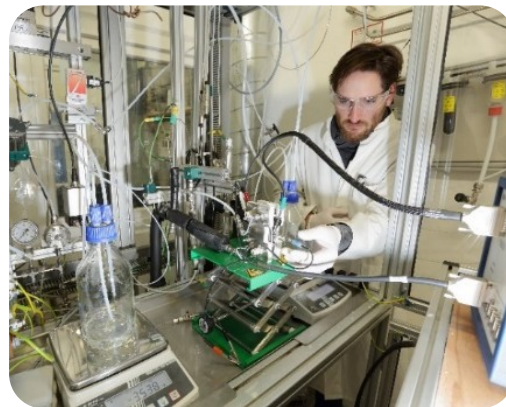
Stack Testing

System Testing

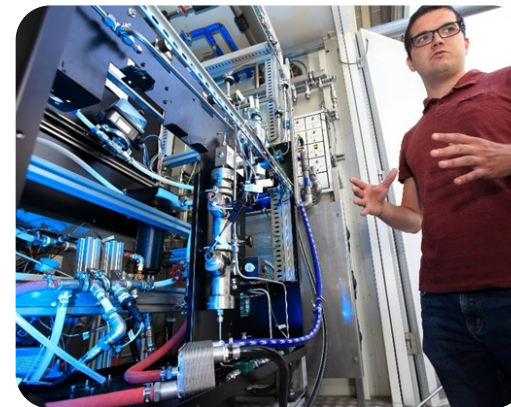
Electrode Manufacturing



AEM Single Cell Test Bench



AEM Stack Test Bench



Gas Analysis





# I. Electrolysis and Power-to-X

2005

**HyCentA was founded**  
Test facilities at TU campus are opened



2019 – 2022

**Project HyTechBasis4WIVA**  
PEM stack and system development



2020

**Stack test bench (15 kW)**  
PEMWE and AEMWE



2021

**PEM & AEM Single cell test bench**



2022 – 2024

**Project AEM Neo**  
Electrode manufacturing



2025

**Electrolyser test field**  
2.5 MW System test bench



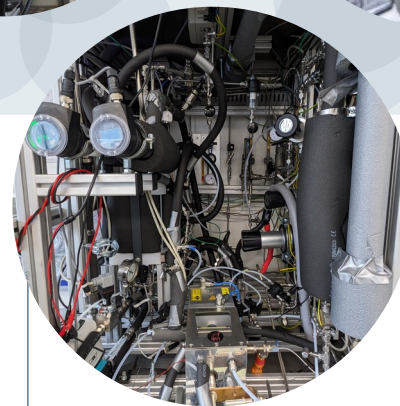
2014 – 2016

**Project wind2hydrogen**  
100 kW PEM electrolysis pilot plant



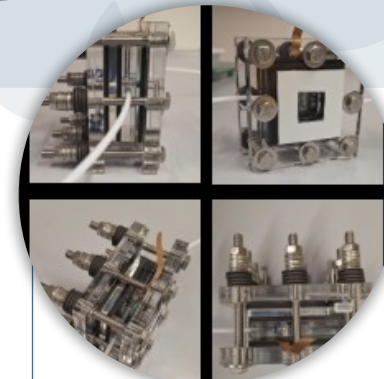
2020 – 2023

**Project Recycalyse**  
14 cells PEMWE and recycling strategies



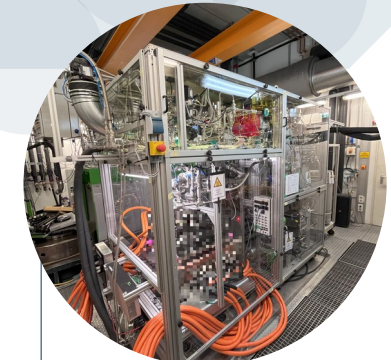
2021 – 2025

**Project HyGen**  
(HyTechnomy)



2023-2026

**COMET projects**  
PEM, AEM, EHC, SOEC, PEC and alternative H<sub>2</sub> production



2024

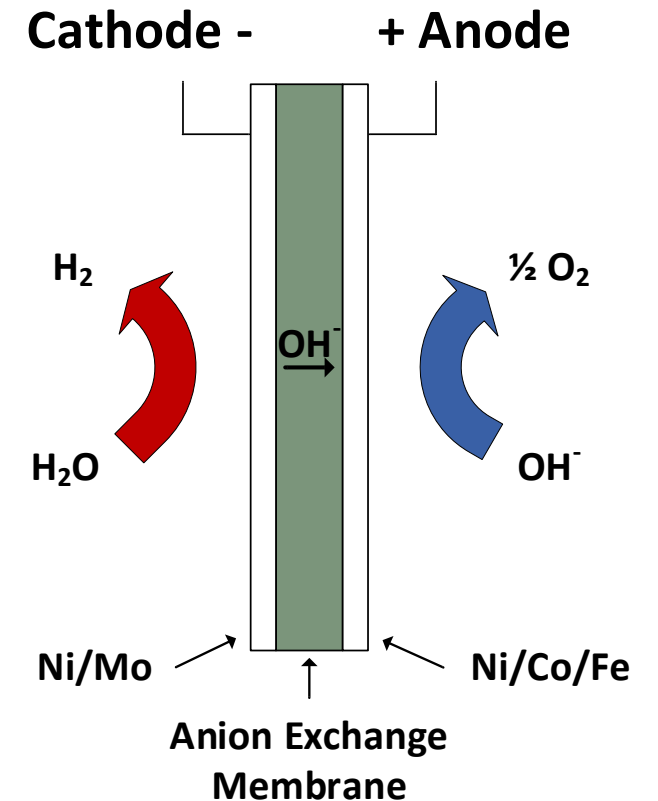
**Full-size stack test bench**  
160 kW PEM & AEM



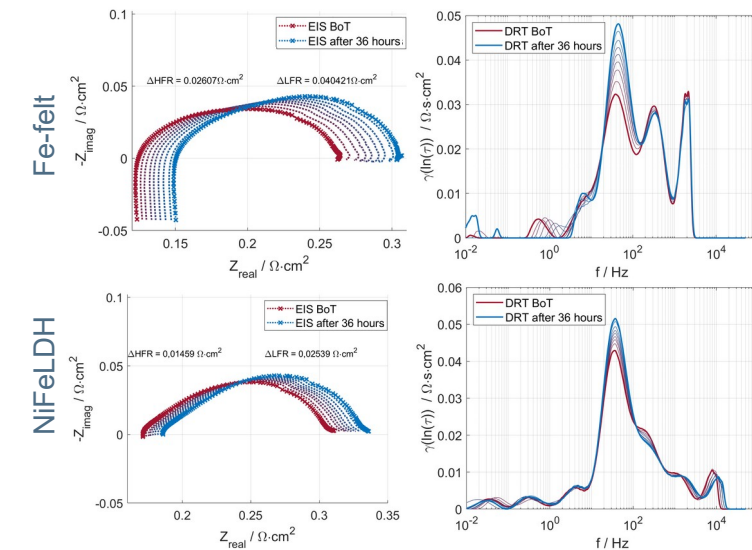
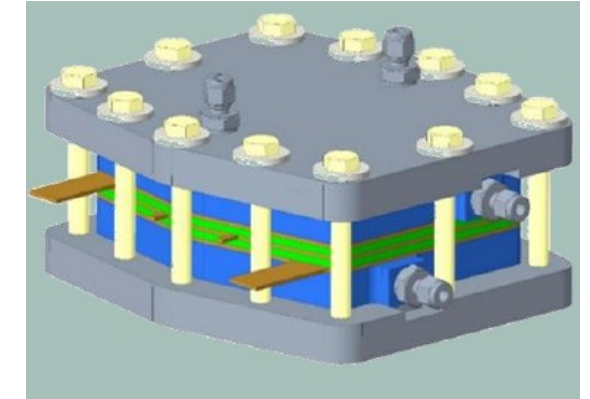
- + Capable of partial load operation
- + Compact design
- + Differential pressure
- + Low CAPEX
- + non-PGM catalysts
- + High recyclability of Ni based catalyst → no shortage
- + No PFAS membrane required

Spec. energy consumption: < 55 kWh/kg @ 100 % power

- Far from MW scale
- Lifetime of membrane



- Design and component development:
  - **4 single cells** and **3 stacks** developed in 4 years
  - More than **100 electrodes** (CCS and CCM) prepared via spraycoating
  - **>10 different catalyst** and **>5 membrane materials** tested
- Stability and performance:
  - **>500 h of operation** for single setup (degradation  $<0.01$  V/100 h)
  - High performance cell  **$>2$  A/cm<sup>2</sup> @  $<2$  V**
- Innovation:
  - **1 patent** granted / **1 patent** on **stack design** pending
- Testing experience:
  - Single cell: **~12 000 h of operation** in 4 years
  - Stacks: **~1 000 h** (up to 10 kW) in 2.5 years (4 stacks)
  - First institute applying **DRT analysis** on AEM single cell and stack



Dynamics of anion exchange membrane electrolysis: Unravelling loss mechanisms with electrochemical impedance spectroscopy, reference electrodes and distribution of relaxation times; M. Ranz, B. Grabner, B. Schweighofer, H. Wegleiter, A. Trattner; Journal of Power Sources, 2024, 605



Degradation in Anion Exchange Membrane Water Electrolysis: Insights from a Distribution of Relaxation Times Approach; M. Ranz, B. Grabner, B. Schweighofer, H. Wegleiter, A. Trattner; 2025.

## Austria's largest green hydrogen electrolyzer: 10MW PEM now live



Foto: OMV Media Center

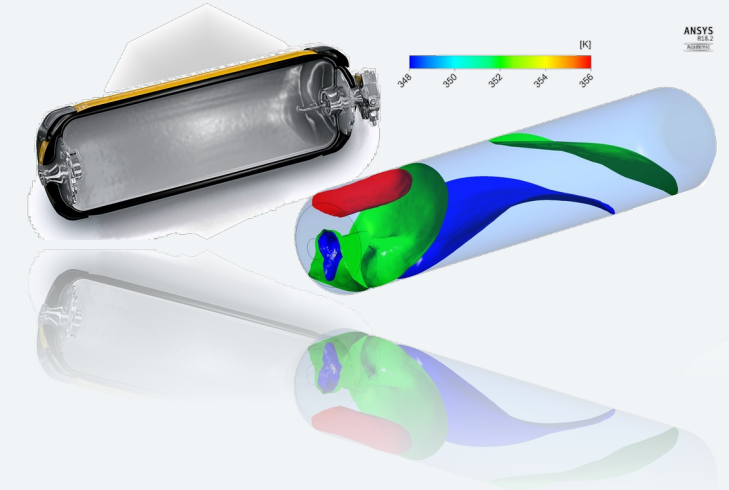
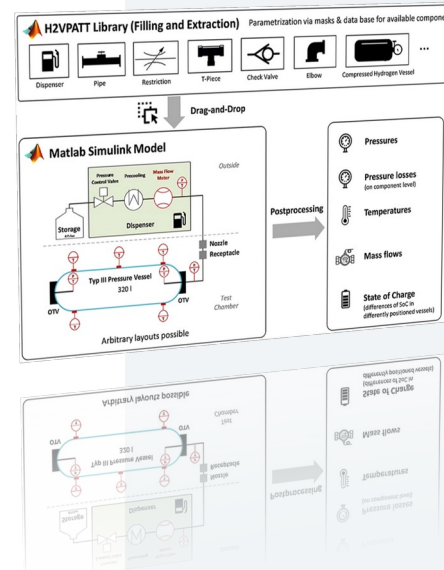
- 1,500 tons of green hydrogen per year
- Direct integration into **OMV Schwechat refinery** for real-time use
- Based on PEM electrolysis, powered **exclusively by renewables**
- Exceeds EU safety standards and achieves **ISCC-certified RFNBO status**
- From pilot to industrial scale: **140 MW coming next**



# II. Green Energy and Industry

## Benefit from 20 years of R&D in hydrogen technologies

- **R&D Hydrogen Conditioning & Storage**
  - **Storage:** Focus on CH<sub>2</sub>, LH<sub>2</sub>, metal hydride, alternative liquid hydrogen carriers
  - **Transport:** Trailer, train, pipelines
  - **Compression:** Electrochemical & piston compressors
  - **Purification:** Electrochemical purification
- **Safety & Legal Framework**
- **Concept Development and Systemic Analysis**



**ZUKUNFT GRÜNES GAS** **OVGW**

HyTool by HyCenta

08 - Results View

Results Overview

Results Overview

Distribution

Overview

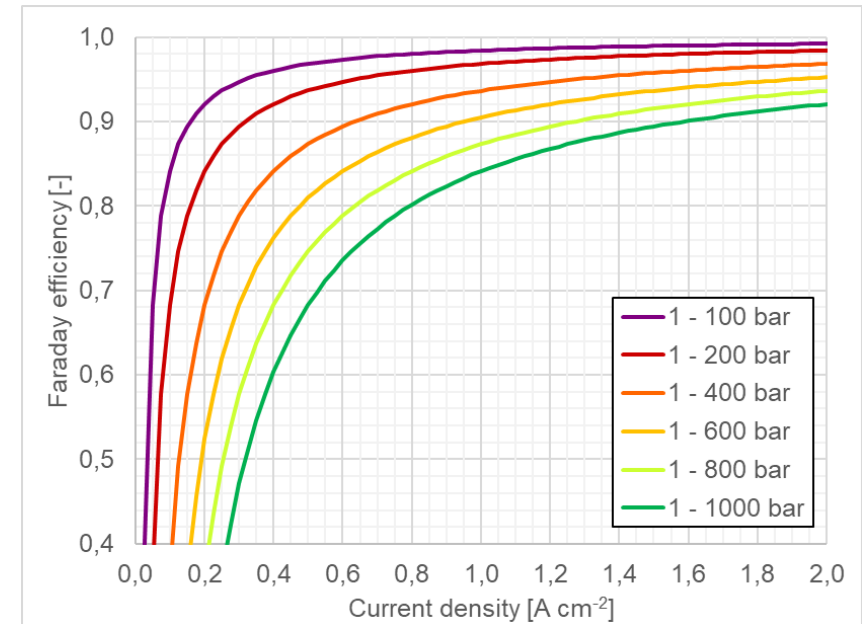
System Config Diagram

Efficient Design

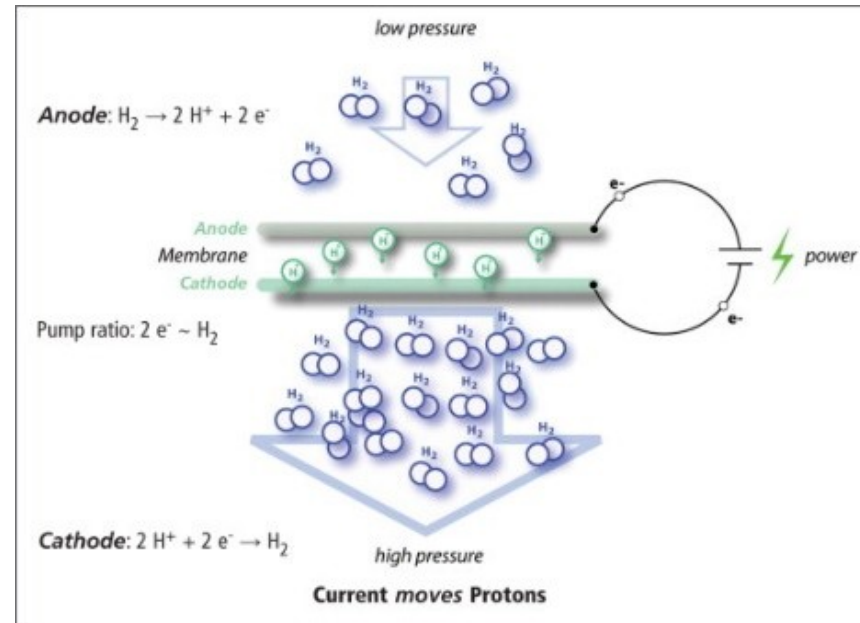
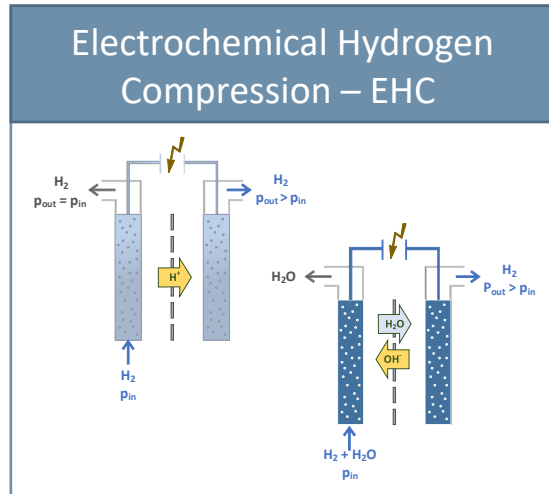


# Electrochemical Compressor (EHC)

Compact, modular and efficient compression with high efficiencies and no moving parts (noise) & purification



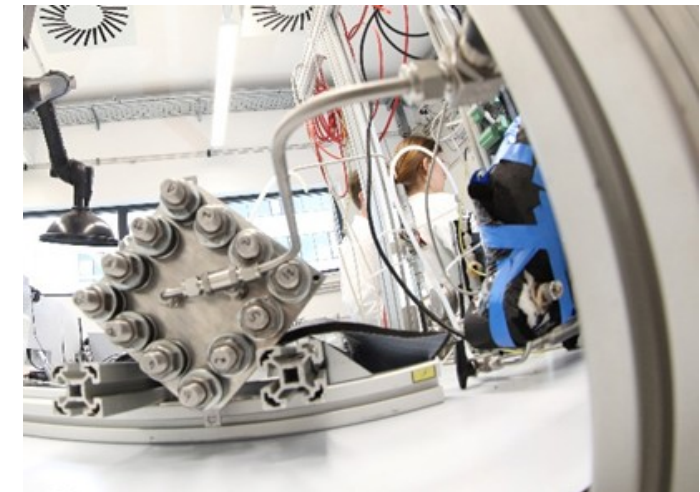
Source: HyCentA, on-going PhD Michael Richter



Source: HyET

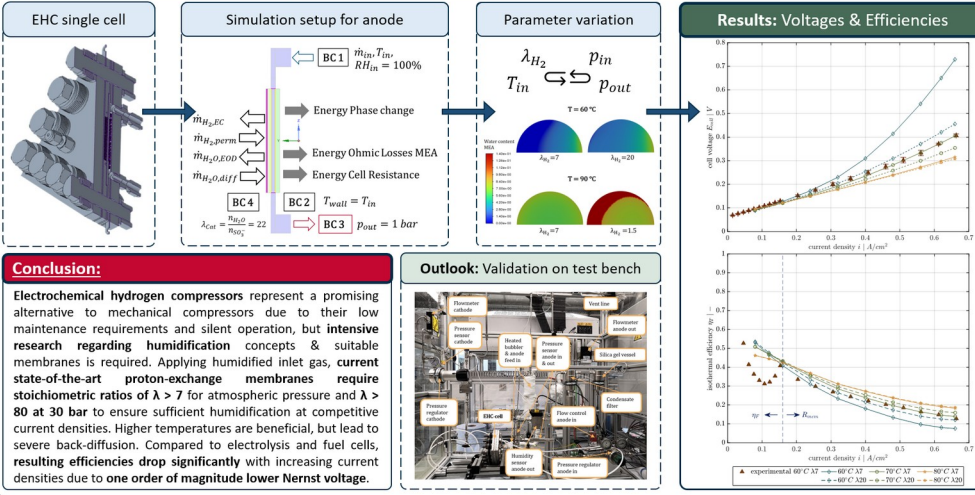
- H<sub>2</sub> supply at atmospheric or low pressure p<sub>in</sub>
- Δp across membrane
- H<sub>2</sub> at p<sub>out</sub> > p<sub>in</sub>
- Possible with PEM or AEM

- Humidification of supplied hydrogen
- Optimised stacking
- Durable seal concepts
- Integration in H<sub>2</sub> systems and infrastructure

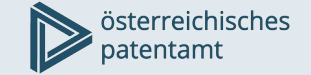


## Publication to IJHE

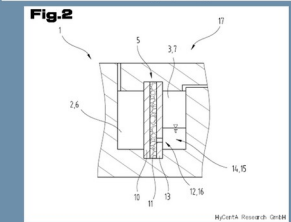
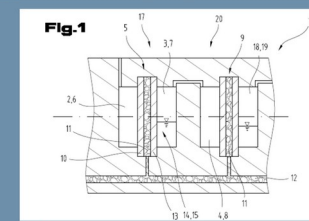
Investigation of favourable operating conditions of electrochemical hydrogen compressors by 3D CFD simulation and single cell tests



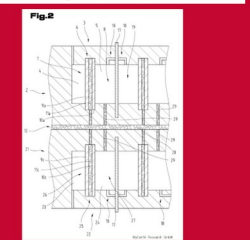
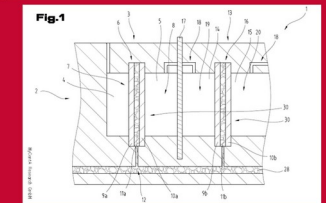
## 2 patents accepted by



Patent 1: Humidification of EHC with capillary layer



Patent 2: Combination of PEM/AEM for EHC/EHP



## A new H – short video for EHP



Green Utopia 2025

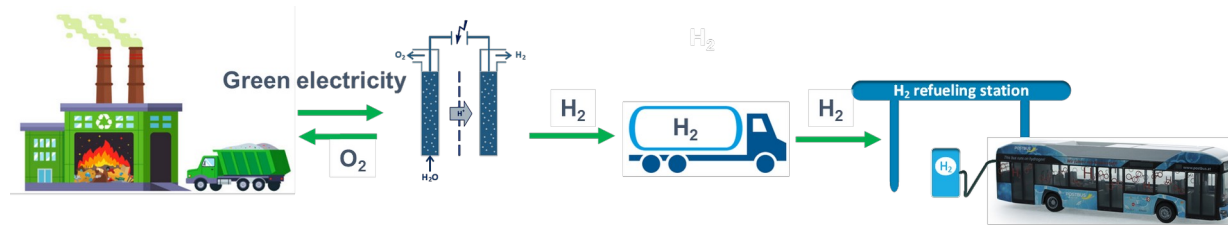


## EFCE 1st-4th July 2025



# DeCarb – 35 Fuel Cells Buses

**Location:** Arnoldstein/Carinthia  
(Electrolysis)  
Villach/Carinthia  
(HRS for bus-fleet)



**Projekt Lead:**

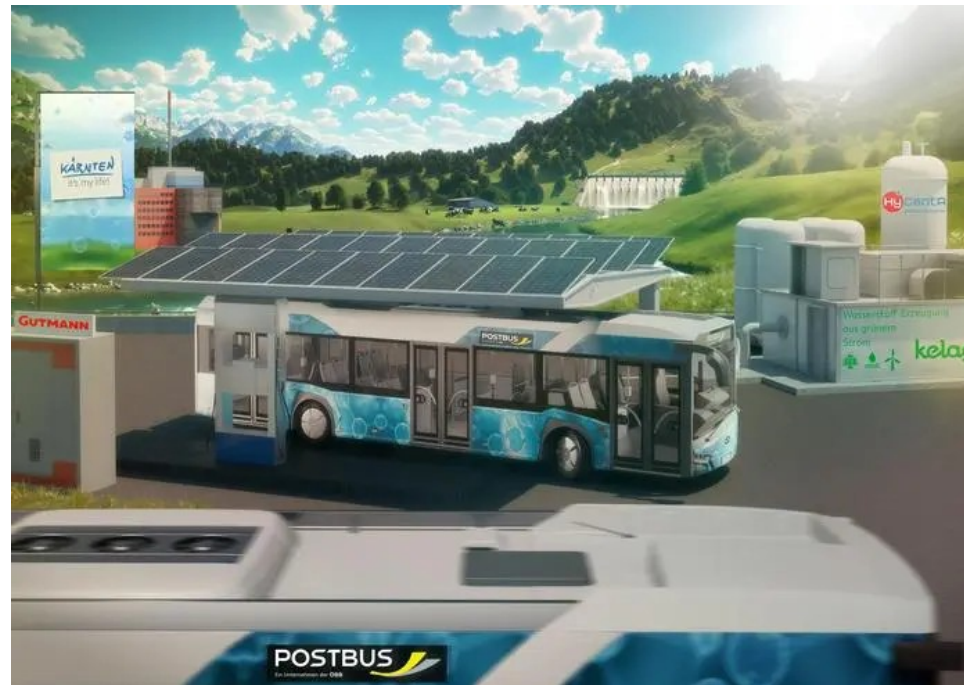


**Project Partners:**



**Duration:**

2024– ongoing  
Commissioning of plant: Q1-2026  
Full operation of 35 busses:  
Q2-2026



**Source:** <https://www.kleinezeitung.at/wirtschaft/19098425/neustart-fuer-36-wasserstoffbusse-in-kaernten>

**HyCentA Activities:**

- **Conceptual design and dimensioning of the H<sub>2</sub> system path**
  - Simulation of refueling schedule
  - Simulation of operation schemes + trailer logistics
- **Support Basic and Detail Engineering**
  - P&ID
  - Control strategy
  - Layout Plan
  - Redesign due to project changes
- **Support during the tendering process**
  - Market research
  - Specification sheets
  - Technical support during technical discussions
- **Scientific monitoring of implementation phase**
- **Scheduled:** Verification of gas quality once in operation
  - According to ISO 14687:2019



# III. One-Stop-Shop for Fuel Cell R&D



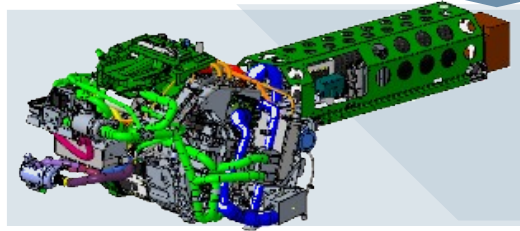
- Longitudinal Dynamics Simulation
- Model Based Functional Development
- HARA, Safety development & Certification
- Techno-Economic Analysis
- Market Research



## Application



- Calibration
- Validation
- Certification
- Drive Cycle Emissions



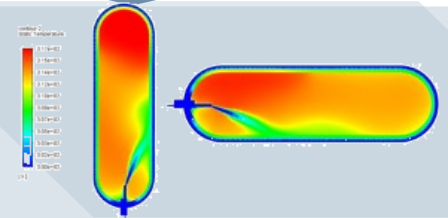
- Advanced Real-time PEM System Simulation & Control Design
- Thermal & Energy Management Simulation
- Optimized Operation Strategies
- CAD system packaging and integration

## System



- DoE & Automated Calibration
- Durability & Robustness (cold, hot & transient)
- Transient Operation / Start-Up and Shutdown Time
- Performance Characterization & Acceptance Testing
- Accelerated Stress, Freeze & Cold Start Testing

- PEM FC Stack Simulation
- THD & Electrochemical Analyses
- Loss Analysis
- Degradation & State of Health Analysis



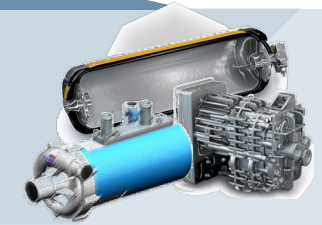
## Subsystem

- Rapid prototyping
- Diagnostics & Characterization
- Stack Ageing & Degradation
- Stack Water Management
- Accelerated Stress Tests



- 3D CAD, CFD & FEM simulation
- Reliability & Durability Testing
- Leakage & Functionality Tests (H<sub>2</sub> & N<sub>2</sub>)
- HSS Fast Filling Tests

## Components



- Component Stability & Durability
- Freeze Start Ability
- Safety & Materials
- Validation & Certification



Simulation

Testing

# III. HyCentA mobility journey up to today

2005

HyCentA was founded  
Test facilities at TU  
campus are opened



2008 – 2010  
Project HyCart



2010 – 2016  
E LOG Bio Fleet



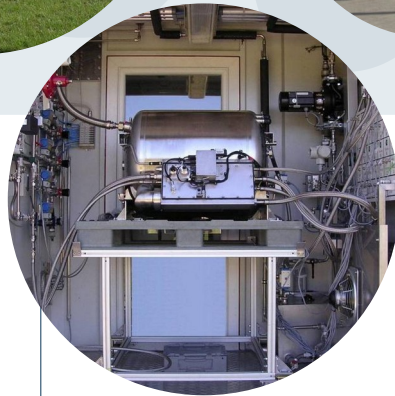
2017 – 2020  
Project KEYTEC4EV



2021 – 2023  
Project FC4HD



2024 – 2027  
Project ZEAS  
Zero Emission  
Adriatic Ship



2006 – 2008

Test runs of an LH2 –  
liquid hydrogen tank  
(produced by MAGNA) for  
a BMW Hydrogen 7



2009 - 2012

Project HyCar-1  
First ever H<sub>2</sub> vehicle with  
public road approval in  
Austria



2015 – 2018

Project HIFAI RSA  
FCS climatic testbench  
up to 160 kW



2017 – 2021

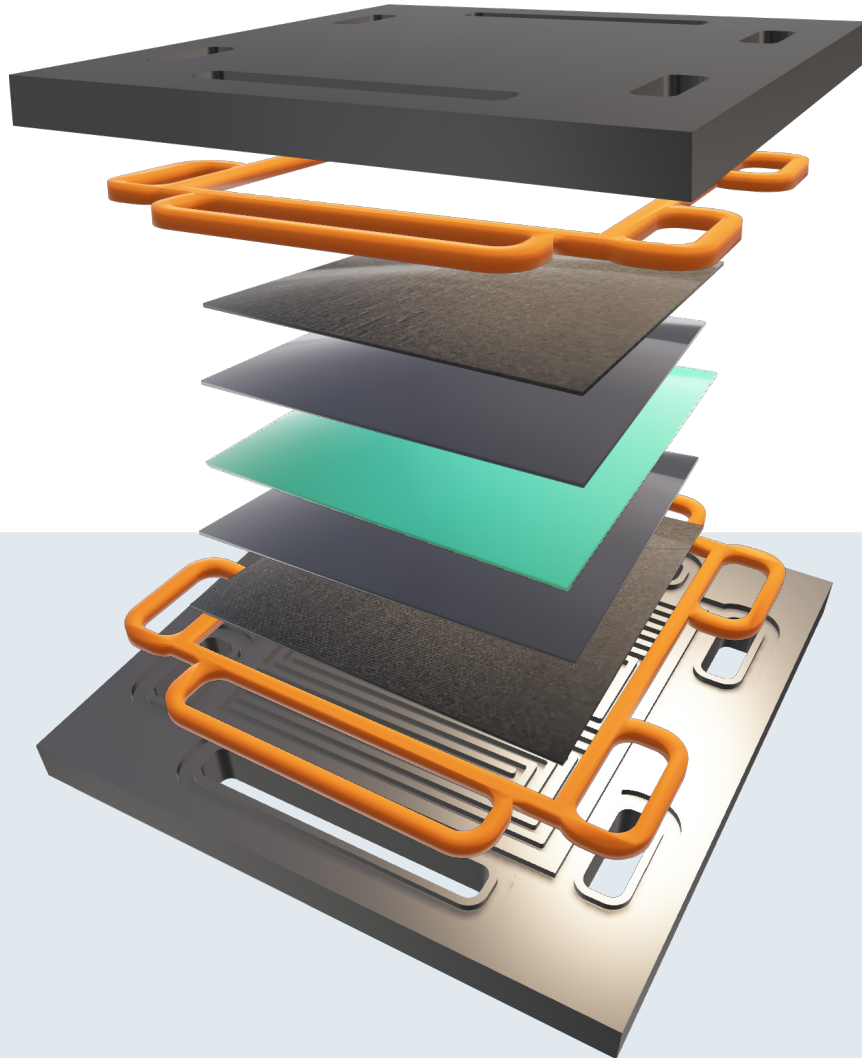
Project HySnow  
Decarbonisation of Winter  
Tourism by Hydrogen  
Powered FC Snowmobiles



2023 – 2027

Project Hy.COMM  
Clean Hydrogen  
Construction and Mining  
Machines





## Advantages

- Use of non-precious metal catalysts
- Cost effectiveness
- high ORR activity in alkaline environment
- wide range of available fuels
- Non PFAS membrane

## Challenges:

- Water management
- Carbonation
- Upscaling

## *COMET Phase 2*

*Further catalysts, stack*



# IV. Circularity and Systems Optimization **HyCentA**

HYDROGEN CENTER AUSTRIA



## Measurement and Testing Systems for Fuel Cells and Electrolysis:

- Seamless degradation tool chain on single cell, stack, system level
- Advanced diagnostic tools based on multi-physics measurements

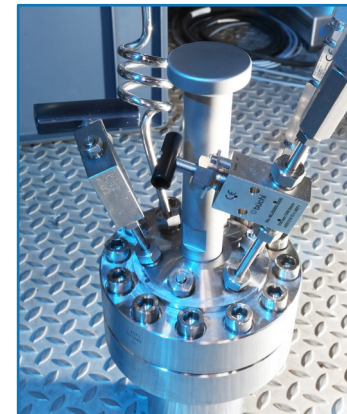
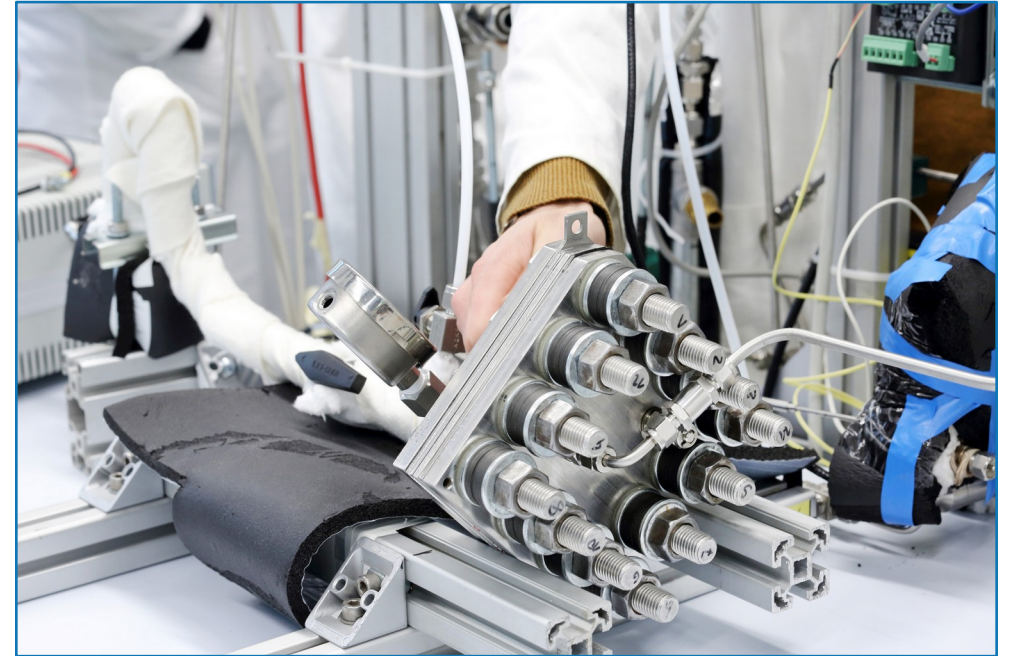


## Materials suitability testing technology:

Enhancing high pressure applications with new testing methods



Hydrogen dispersion analysis, hazard potentials and safety evaluation tools:  
Accelerating H<sub>2</sub>-Applications with effective and accurate safety concepts



## Boltzmann Gas- and Materialanalysis Laboratory@HyCentA



- Austria's most advanced H<sub>2</sub> analysis lab
- Mobile ultra pure gas sampling up to 1000bar
- H<sub>2</sub>-Quality Analysis according to **ISO14687 Grade D** and beyond
- Mass- and quality certification for hydrogen industry
- Research and innovation hub for hydrogen metrology

# H2 Quality in used Pipelines

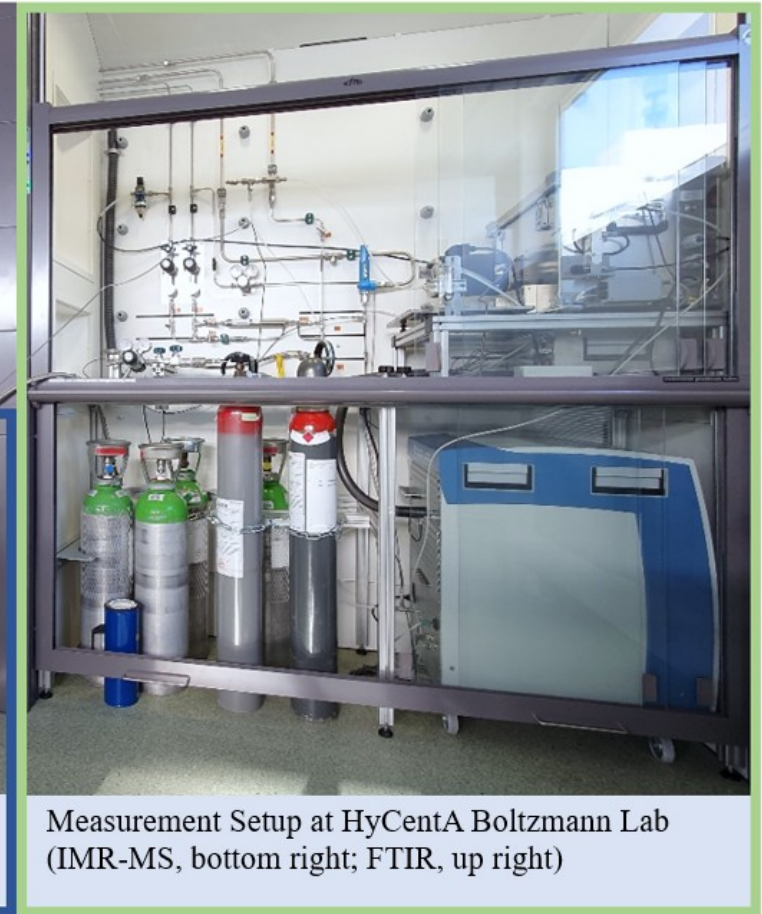
## Experimental determination of H2 quality in the Boltzmann Lab

What H2 quality can be achieved during transport in used high-pressure pipes?

- Strong influence of age, gas history, preparation
- Odorants are visible (ppb level!)
- Natural gas residues
- Higher HCs from solid deposits
- Grade A can easily be achieved



Investigated Pipeline Element No. 5



Measurement Setup at HyCentA Boltzmann Lab (IMR-MS, bottom right; FTIR, up right)



Join us in shaping the future of hydrogen technology!

## HyCentA Research GmbH

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- [office@hycenta.at](mailto:office@hycenta.at)
- [www.hycenta.at](http://www.hycenta.at)



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