Bundesministerium Innovation, Mobilität und Infrastruktur

Bundesministerium Wirtschaft, Energie und Tourismus

FFG Forschung wirkt.

Das Land Steiermark – Wirtschaft, Arbeit, Finanzen, Wissenschaft und Forschung

SFG – Neues denken. Neues fördern.

Tirol

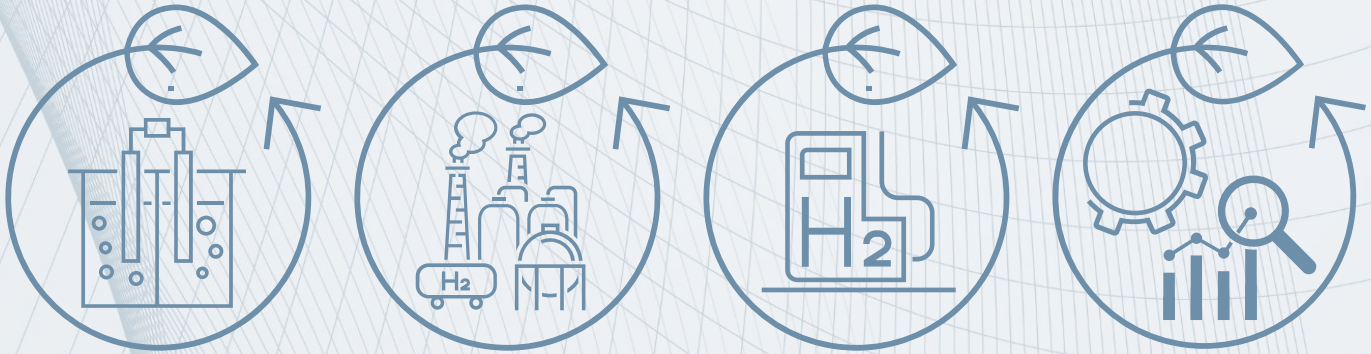
UAR Innovation Network

wirtschaftsagentur wien

ober österreich

HyCentA Research GmbH

The Hydrogen Technology Research Center



HyCentA

HYDROGEN CENTER AUSTRIA

Austria's Research Center for Hydrogen Technologies

HyCentA
HYDROGEN CENTER AUSTRIA

HyCentA Research – Leading Hydrogen Innovation

- **120+ researchers** mechanical engineering, physics, chemistry, process engineering, electrical engineering
- **600+ projects** successfully completed
- **20+ years of R&D expertise**
- **State-of-the-art research**, testing and refueling infrastructure
- **International Cooperations**

Extra-university research organization at Graz University of Technology (TUG)

SYSTEMCERT ISO 9001 certified Reg.No. Q14220825

TU Graz

FVT MAGNA OMV

Research Areas along the Entire Value Chain

HyCentA
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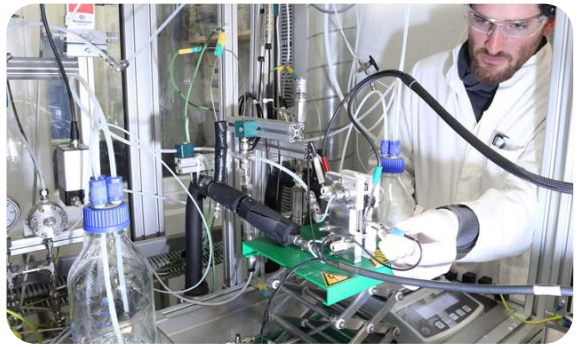
Area 1
Electrolysis and Power-to-X



Area 2
Green Energy and Industry

Area 3
Green Mobility

Area 4
Circularity and Sys. Optimization

R&D Activities at HyCentA

HyCentA
HYDROGEN CENTER AUSTRIA

Cutting-edge R&D activities across the hydrogen value chain.

- **Electrolysis** from R&D to certification
- **H_2 Infrastructures, Storage and Distribution of Hydrogen**
  - Design and testing of compressor and storage systems
- **Fuel Cells** from R&D to certification
- **Measurement and Testing Systems**
  - Measurement techniques, test rigs and development

Research and Development

Modeling and Simulation

Measurement and Testing

Training and Teaching

High pressure test bench

Components & system test beds

Fuel cell system test bench

Electrolysis test bench

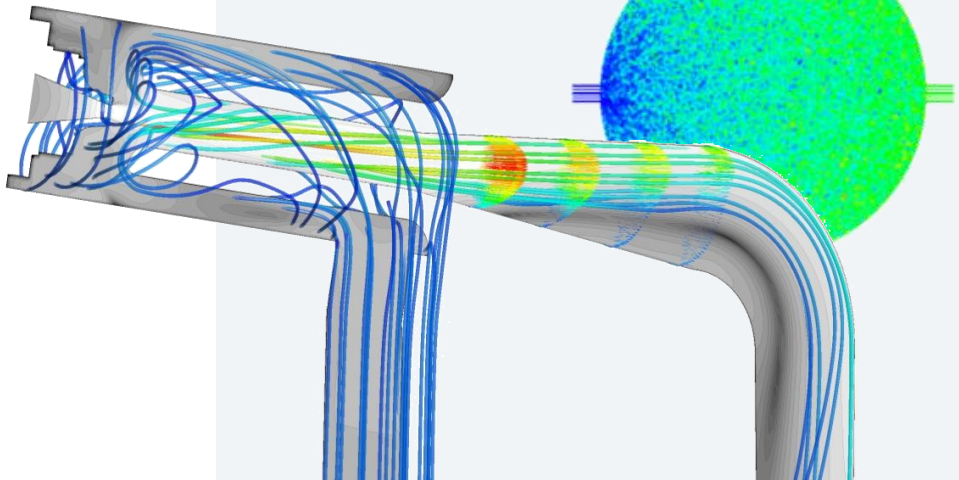
Gas analysis laboratory

Simulation Activities at HyCentA

HYDROGEN CENTER AUSTRIA

Accelerate the transition to a hydrogen-based economy!

- **HYDRA -** Hydrogen Infrastructure Simulation and Optimization Tool – Techno-economic optimization
- **CAD Design and FEM Simulation**
  Stacks, components, systems …
- **Multi-Phase Flow Simulation**
  Stack layout, hydrogen storage system, injector/ejector,…
- **Real Time Fuel Cell System Simulation and Control Design** Automotive PEM system …
- **Vehicle Simulation and HiL**
  Passenger cars, busses, trucks, trains, snowmobiles …

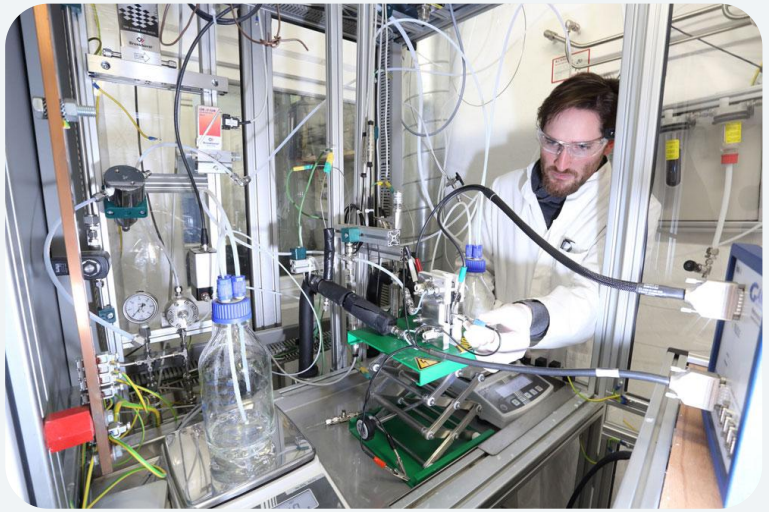


Testing Activities at HyCentA

HyCentA
HYDROGEN CENTER AUSTRIA

Lead the charge in hydrogen technology testing and validation!

- PEM & AEM **electrolyser cell & stack testing**
- Highly Dynamic **Fuel Cell System Test Bench** up to 160 kW
- **High pressure test stand** up to 1000 bar
- **H_2-Refueling** for 350 and 700 bar with **cold fill**
- Test cells for **component and subsystem testing**
- **Hydrogen gas quality laboratory**
- **Lots more … contact us**



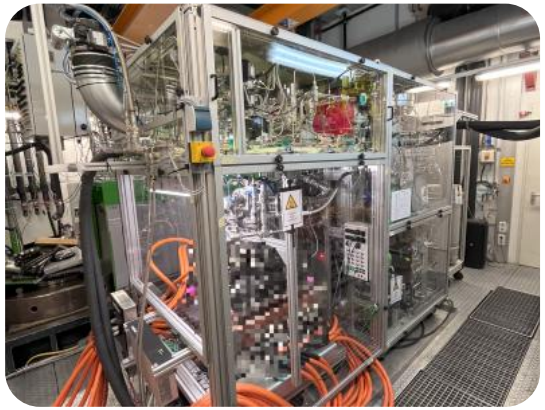
I. Electrolysis and Power-to-X

One-stop-shop Electrolyser Development at HyCentA Research

Catalyst ink preparation

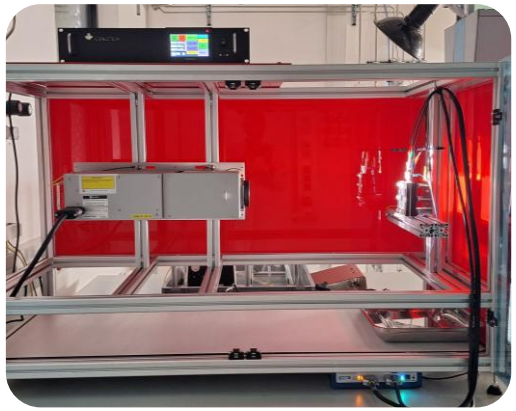
PEM Single Cell Test Bench

20 kW Stack Test Bench



150 kW Stack Test Bench

Component Manufacturing	Single Cell Testing	Stack Testing	System Testing
Electrode Manufacturing	PEC Single Cell Test Bench	AEM Single Cell Test Bench	Gas Analysis



I. Electrolysis and Power-to-X

HyCentA
HYDROGEN CENTER AUSTRIA

2005
HyCentA was founded
Test facilities at TU campus are opened

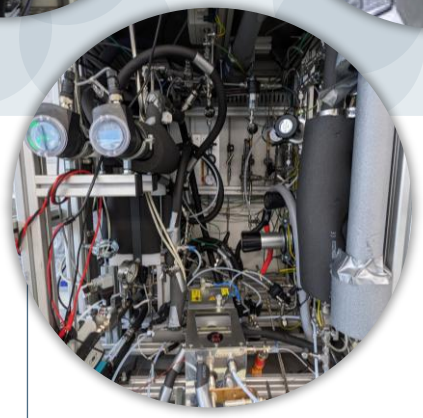
2014 – 2016
Project wind2hydrogen
100 kW PEM electrolysis pilot plant

2019 – 2022
Project HyTechBasis4WIVA
PEM stack and system development

2020 – 2023
Project Recycalyse
14 cells PEMWE and recycling strategies

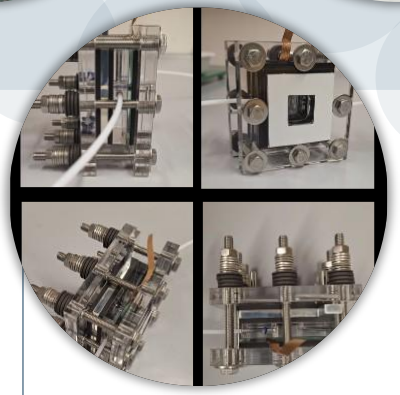
2020
Stack test bench (15 kW)
PEMWE and AEMWE

2021 – 2025
Project HyGen
(HyTechnonomy)



2021
PEM & AEM Single cell test bench

2023-2026
COMET projects
PEM, AEM, EHC, SOEC, PEC and alternative H_2 production



2022 – 2024
Project AEM Neo
Electrode manufacturing

2024
Full-size stack test bench
160 kW PEM & AEM

2025
Electrolyser test field
2.5 MW System test bench

UpHy Projects: Green H_2 Production

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

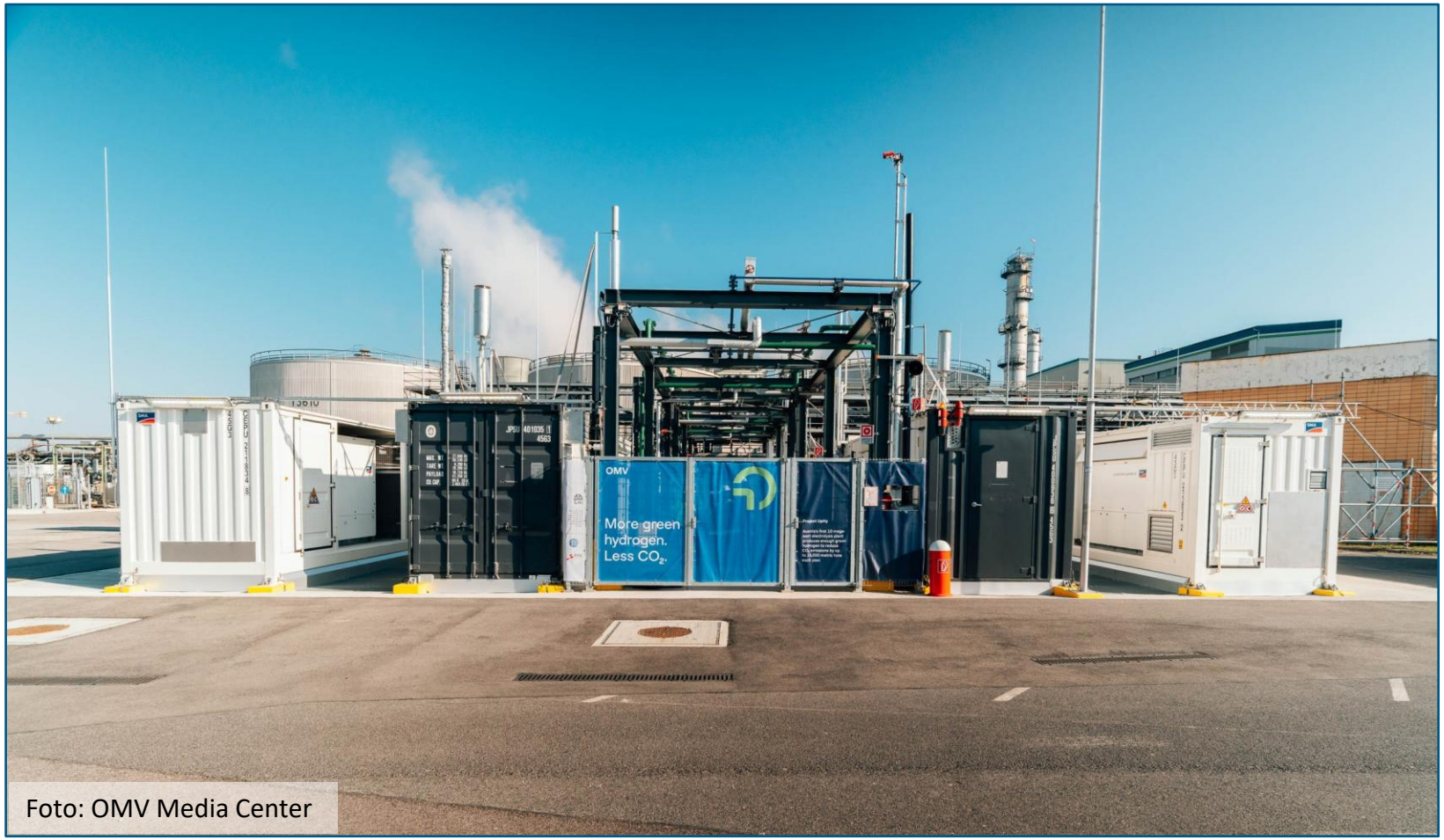


Foto: OMV Media Center

- **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**

UpHy Projects: H_2 Quality Monitoring

Boltzmann Gas- and Materialanalysis Laboratory@HyCentA

- **Austria´s most advanced H_2 analysis lab**
- Mobile ultra pure **gas sampling** up to **1000bar**
- H_2-Quality Analysis according to **ISO14687 Grade D** and beyond
- Mass- and quality certification for hydrogen industry
- Research and innovation hub for hydrogen metrology

I. Electrolysis and Power-to-X

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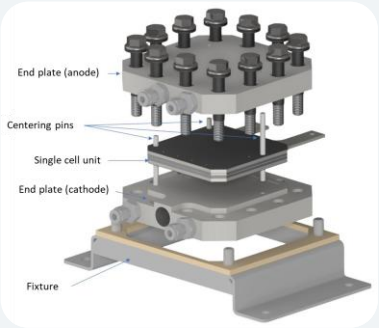
Cell components
- Optimization of **catalyst ink recipes** for spray coated electrodes
- Characterization of **catalyst materials** (e.g. RDE)
- Design and optimization of **flow fields** and distributer meshes
- **Compression characterization, Material stability** under operation conditions

Single cell
- **Inter-correlation** of selected cell components
- Allocation of losses to **reaction and transport mechanisms**
- Effects of **operation parameters** (T, p, conc) on performance
- Accelerated stress tests (AST) and **degradation**

Cell stack
- Investigation of **stacking effects** (thermal, mechanical, etc.)
- Development and optimization of **activation and operation strategy**
- Monitoring of product **gas quality and safety** (internal and external leakage)
- Investigation of **degradation** mechanism

System
- Concepts for **MW system** implementation
- R&D on **balance of plant** components
- Safety and **regulations**
- **State of health** monitoring



Electrolysis Technologies @HyC:
AEM, PEM, AEL, EHC, EPC, SOEC

I. Electrolysis and Power-to-X

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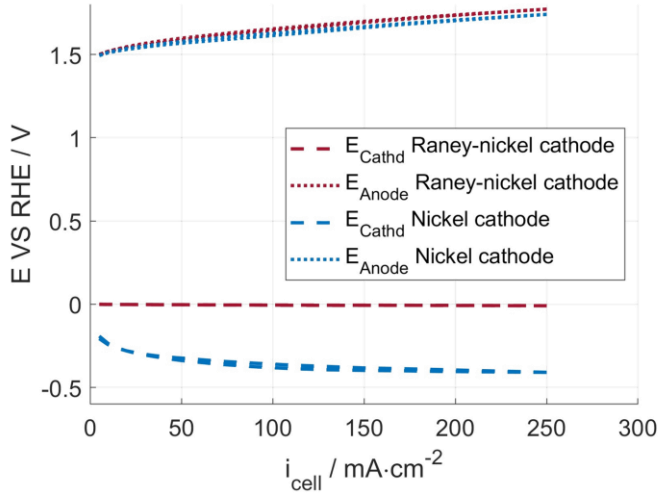
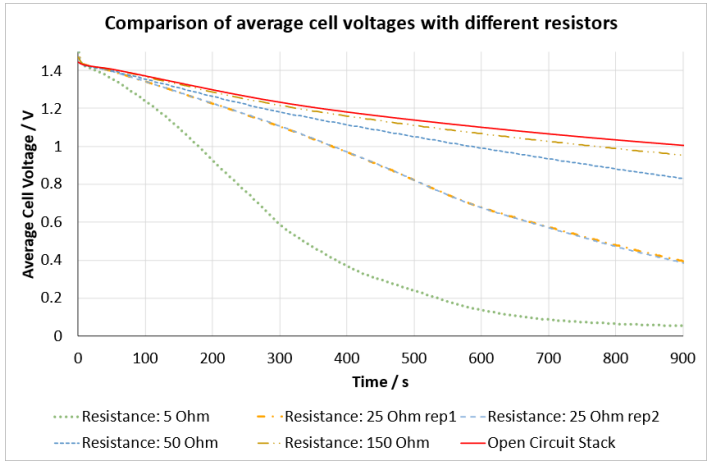
Characterization methods

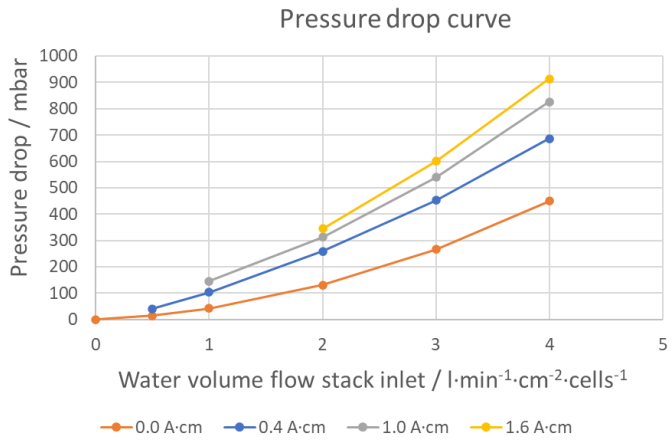
IV-characteristics



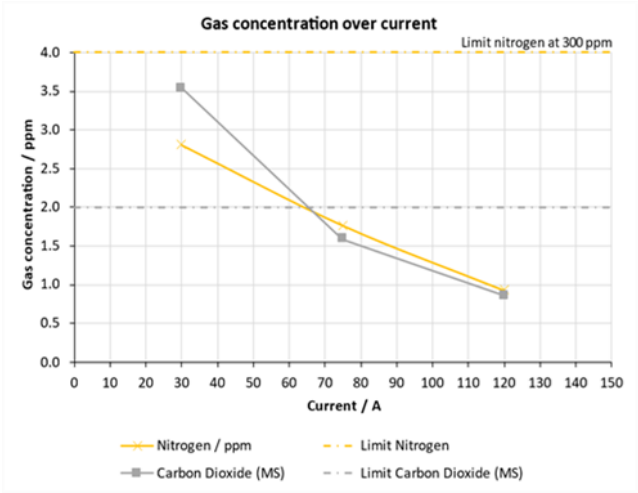
Discharge curve



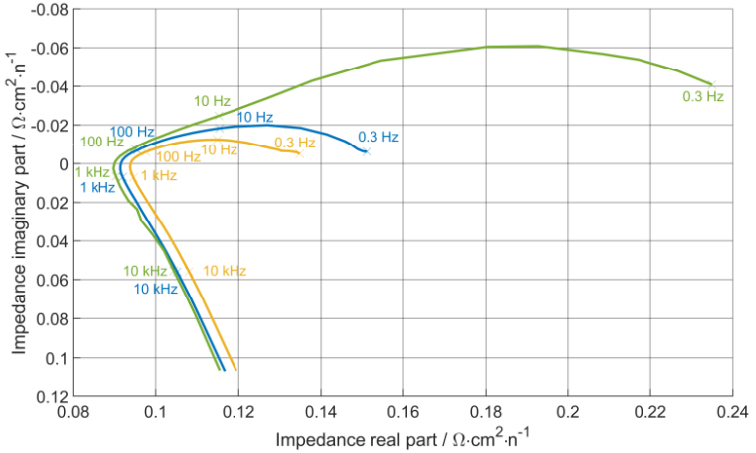
Hydraulic response



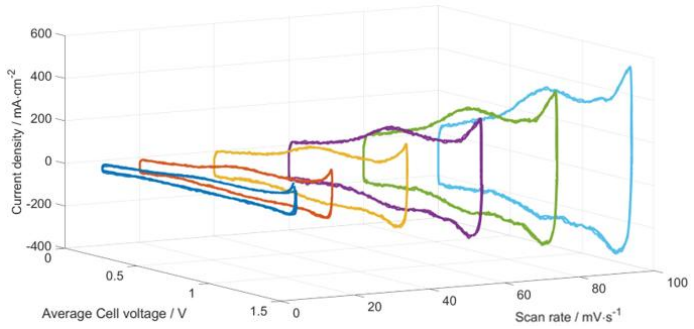
Gas analysis



EIS analysis



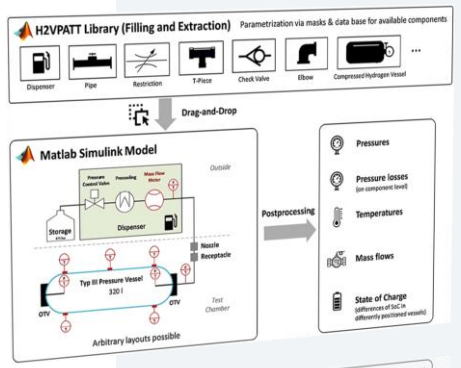
CV measurement

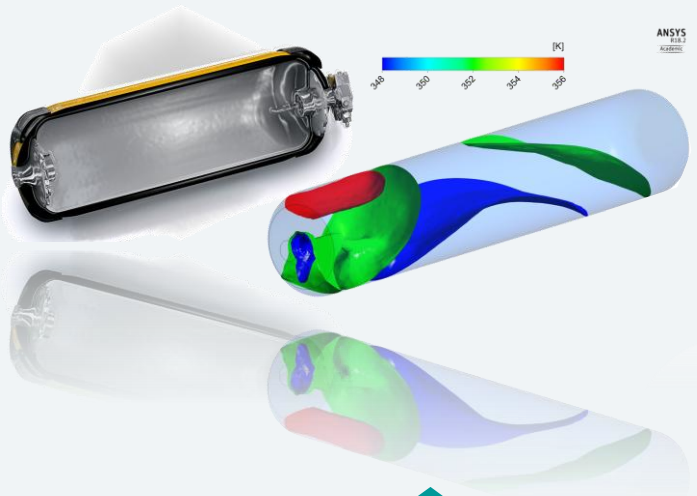


II. Green Energy and Industry

Benefit from 20 years of R&D in hydrogen technologies

- **R&D Hydrogen Conditioning & Storage**
  - **Storage**: Focus on CH_2, LH_2, 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**

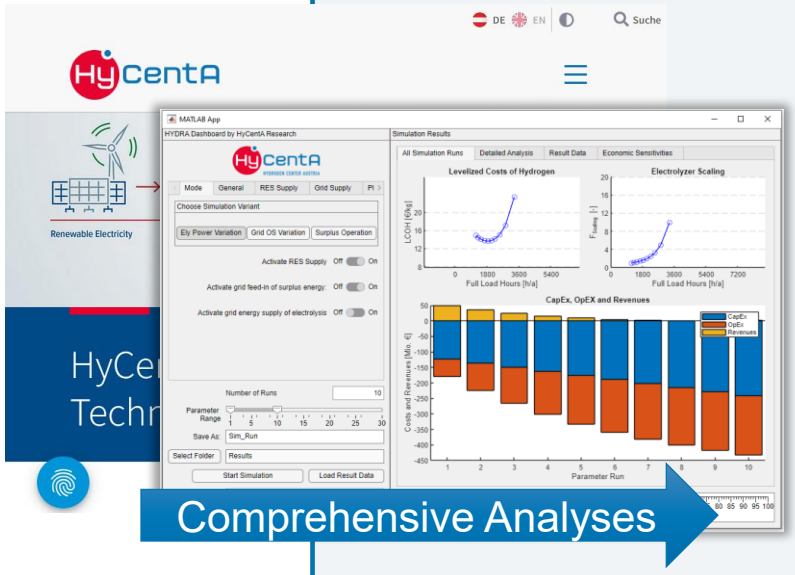




II. Green Hydrogen Production – Techno-Economics

Accelerate innovation with customized design tools!

- **H2Cost** - Quick and easy estimation of the economic viability of hydrogen infrastructures
- **HyTool** - Efficient, comprehensible and practice-orientated tool for the rapid initial design of PtG systems
  - **Give it a try:** grünes-gas.at/Hytool
- **HYDRA** - Techno-economic PtX plant design and green hydrogen value chain optimization
  - **Available** via Web-Platform **soon**!
  - RED II conform H_2 production scenarios



II. Green Hydrogen Production - Renewable Gasfield

Location: Gabersdorf/Styria

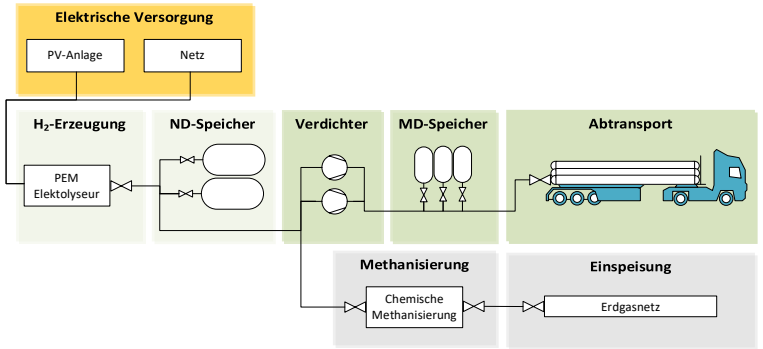
Project Volume: 4.2 million EUR

Funding Program: Flagship Region Energy, 2nd Call

Duration: 12/2018–05/2023

Project Lead:

Project Partners:



- **HyCentA Activities:**
- **Conceptual design and dimensioning of the H_2 system path**
- **Support during the tendering process**
  - Market research
  - Preparation of tender documents
  - Technical support during technical discussions
- **Support during permitting phase**
  - Submission
  - Additional documentation
  - Meetings with authorities
  - On-site inspections
- **Verification of gas quality**
  - According to ISO 14687:2019

III. HyCentA mobility journey up to today

HyCentA
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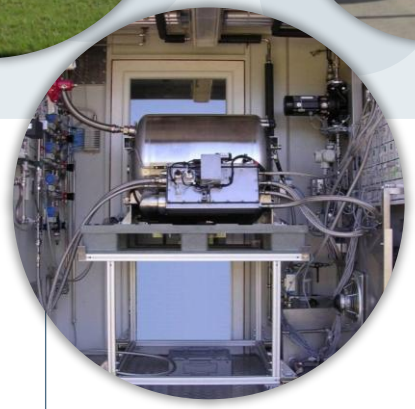
2005
HyCentA was founded
Test facilities at TU campus are opened

2006 – 2008
Test runs of an LH2 – liquid hydrogen tank (produced by MAGNA) for a BMW Hydrogen 7



2008 – 2010
Project HyCart

2009 - 2012
Project HyCar-1
First ever H_2 vehicle with public road approval in Austria

2010 – 2016
E LOG Bio Fleet

2015 – 2018
Project HIFAI RSA
FCS climatic testbench up to 160 kW

2017 – 2020
Project KEYTEC4EV

2017 – 2021
Project HySnow
Decarbonisation of Winter Tourism by Hydrogen Powered FC Snowmobiles

2021 – 2023
Project FC4HD

2023 – 2027
Project Hy.COMM
Clean Hydrogen Construction and Mining Machines

2024 – 2027
Project ZEAS
Zero Emission Adriatic Ship

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

HyCentA HYDROGEN CENTER AUSTRIA

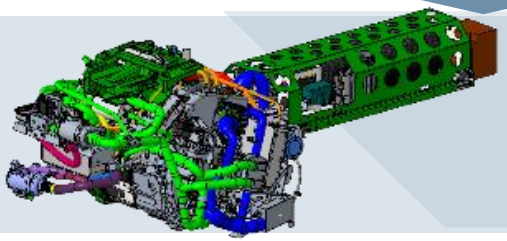
Requirements | Concept | Physical design | Test and validation | Application

Application

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

- Calibration
- Validation
- Certification
- Drive Cycle Emissions

System

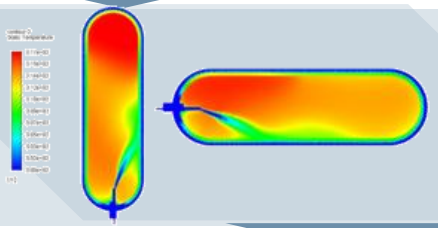


- Advanced Real-time PEM System Simulation & Control Design
- Thermal & Energy Management Simulation
- Optimized Operation Strategies
- CAD system packaging and integration

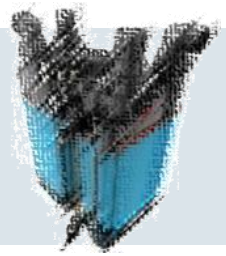
- DoE & Automated Calibration
- Durability & Robustness (cold, hot & transient)
- Transient Operation / Start-Up and Shutdown Time
- Performance Characterization & Acceptance Testing
- Accelerated Stress, Freeze & Cold Start Testing

Subsystem

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

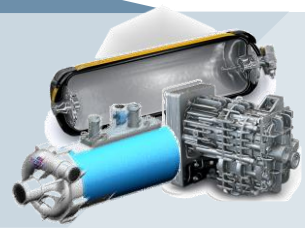


- Rapid prototyping
- Diagnostics & Characterization
- Stack Ageing & Degradation
- Stack Water Management
- Accelerated Stress Tests



Components

- 3D CAD, CFD & FEM simulation
- Reliability & Durability Testing
- Leakage & Functionality Tests (H_2 & N_2)
- HSS Fast Filling Tests



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

Simulation | **Testing**

IV. Circularity and Systems Optimization

HyCentA HYDROGEN CENTER AUSTRIA

Measurement and Testing Systems for Fuel Cells and Electrolysis:

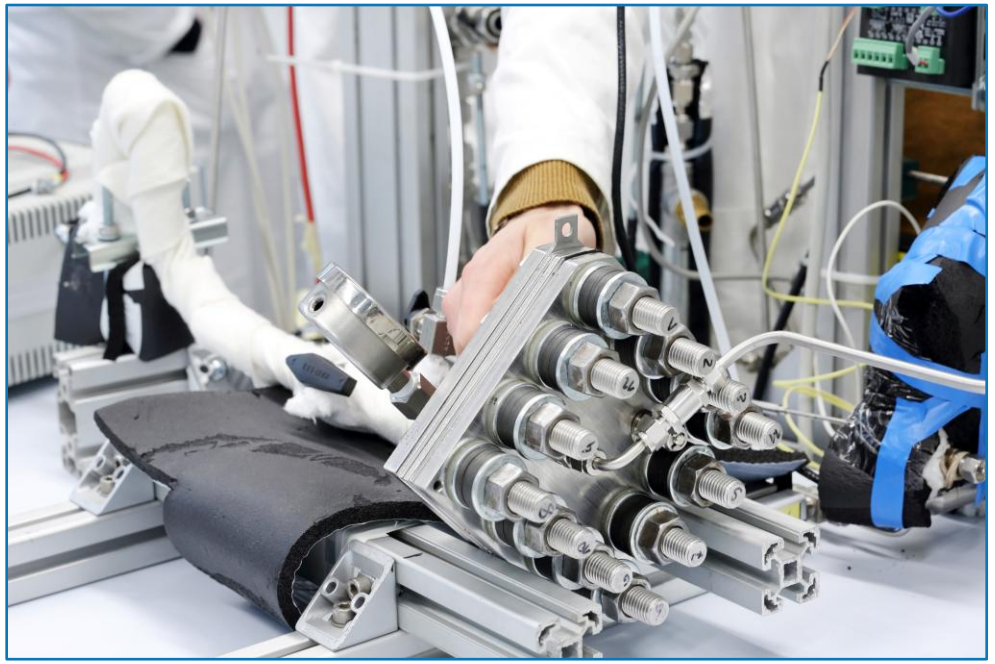
- Seamless degradation tool chain on single cell, stack, system level
- Advanced diagnostic tools based on multi-physics measurements

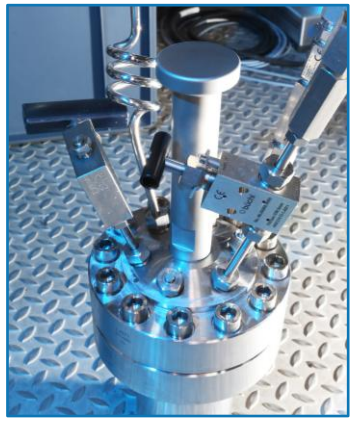
Materials suitability testing technology:

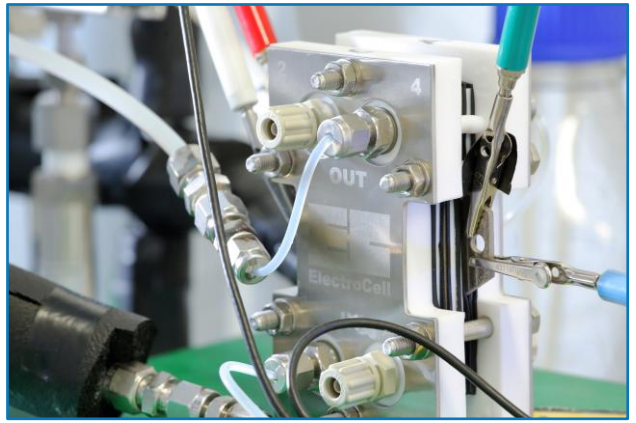
Enhancing high pressure applications with new testing methods

Hydrogen dispersion analysis, hazard potentials and safety evaluation tools:

Accelerating H_2-Applications with effective and accurate safety concepts







Testing Tool Chain

Permeation Test Chamber

1000bar Component Testing

Fuel Cell System

Hydrogen Quality Analysis

Material Testing | **Component Testing** | **System Testing** | **Metrology & Diagnostics**

High Pressure Autoclave

Refueling Infrastructure

Fuel Cell Stack

Sampling and Certification

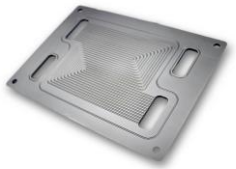
IV. Circularity and Systems Optimization

HyCentA HYDROGEN CENTER AUSTRIA

PEM and AEM electrolyser components

(examples)

Porous transport layers
Bipolar plates



www.elconprecision.com

End-of-Life

2nd life

- 2nd life scenarios
- Regeneration, repair
- Fit-for-2nd-life tests

Recycling

- Systemic recycling pathways
- Technological and economical best recycling chains
- Novel recycling technologies

- Eco-Design

Assessment of

Environmental impact
- Life cycle analysis

Economic viability

Sustainability
- Assessment Tool Development

Other use case for sustainability assessment tool:
H_2 prod./transport/ storage combinations

HyCentA
HYDROGEN CENTER AUSTRIA

Join us in shaping the future of hydrogen technology!

HyCentA Research GmbH

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- www.hycenta.at

Bundesministerium Innovation, Mobilität und Infrastruktur

Bundesministerium Wirtschaft, Energie und Tourismus

FFG Promoting Innovation.

Das Land Steiermark
Wirtschaft, Arbeit, Finanzen, Wissenschaft und Forschung

SFG
NEUES DENKEN. NEUES FÖRDERN.

wirtschaftsagentur wien

Tirol

Partner of UAR INNOVATION NETWORK

ober österreich