VSB TECHNICAL UNIVERSITY OF OSTRAVA | ENERGY AND ENVIRONMENTAL TECHNOLOGY CENTRE | ENERGY RESEARCH CENTRE

VŠB TECHNICKÁ UNIVERZITA OSTRAVA

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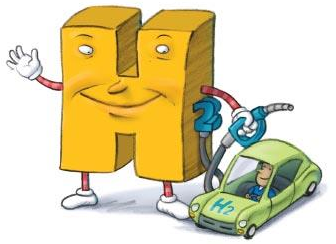
12.12.2023

Energy Research Centre

Hydrogen region?? Together!!! UNITY & UNIQUENESS!!



Hydrogen activities - hydrogen valley - Moravian-Silesian Region

- Change of busses – CNG to H2 buses
  - Minus 800 000 000,- CZK per year
  - We don’t have station for H2
  - We don’t have stable production of H2
  - Future – Optimistic version 120 H2 big buses, 150 H2 small buses, 8 H2 HUB

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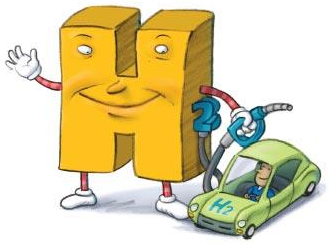

Hydrogen activities at the Energy Research Centre

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Energy Research Centre

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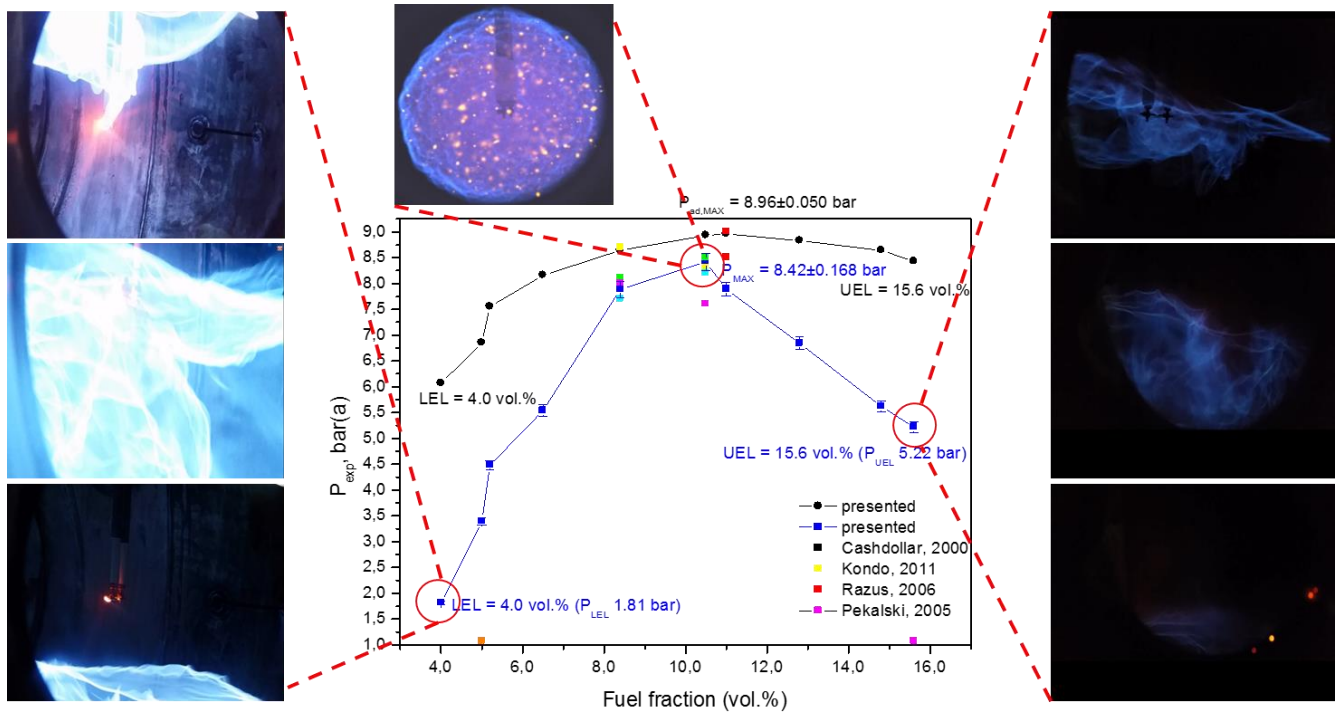
12.12.2023

Outline for today's presentation

- Determination of technical safety parameters
- Process safety and methodology
- Separation of hydrogen from proces gases
- Hydrogen battery system for households
- Greeen innovation in industry/hydrogen mobility
- H_2 station concept in Ostrava
- Purity H2 and metalhydride

Hydrogen safety properties

- Explosion range (upper and lower explosion limits)
- Limiting oxygen concentration
- Minimum ignition energy



Process safety and methodology

The goals of safety planning are to:

- identify hazards
- evaluate risks by considering the likelihood and severity/consequence of an incident associated with the hazards
- minimize the risks associated with a project/facility

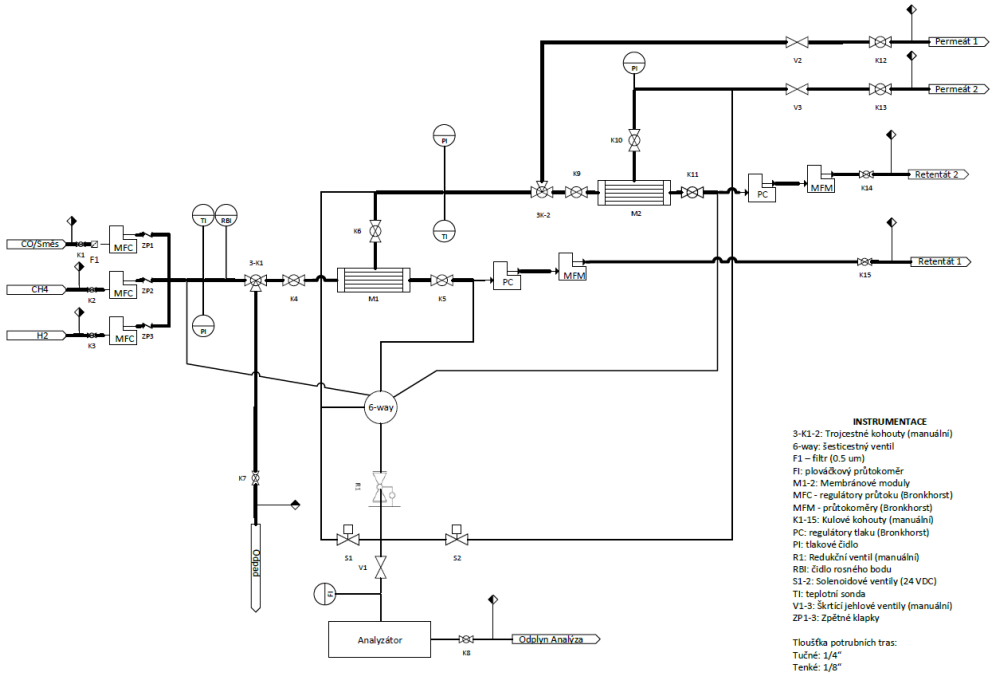
To achieve these goals, various hazard analysis and risk assessment techniques are used, in conjunction with safety reviews.

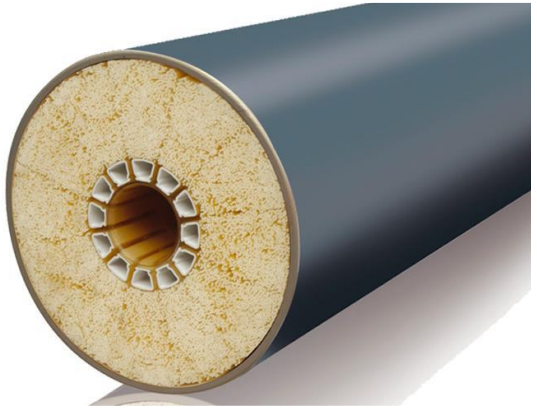
Common methods employed by those involved in systems safety today include:

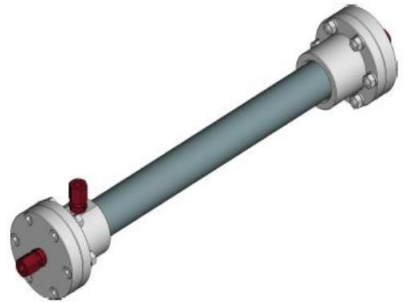
- Hazard and operability studies (HAZOPs)
- Failure modes effects and criticality analysis (FMECA)
- Preliminary hazards analysis (PHA)
- Fault tree analysis (FTA)
- Event tree analysis (ETA)

Separation of hydrogen from process gases

- Development of innovative hydrogen purification technology based on membrane systems
- Verification the separation properties of membrane modules on prepared mixtures
- Testing hydrogen admixture for gas applications
- Development of technology to separate hydrogen from low-concentration hydrogen streams





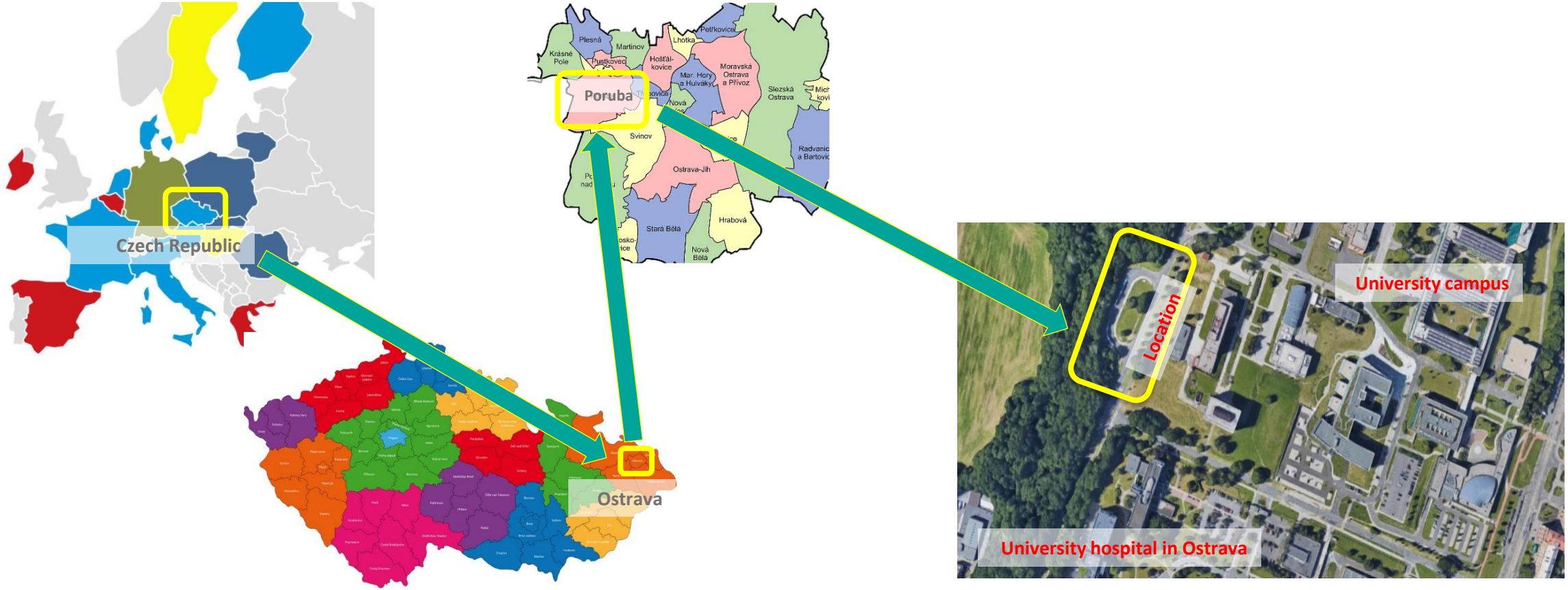


Hydrogen battery system for households

Autonomus system for green home

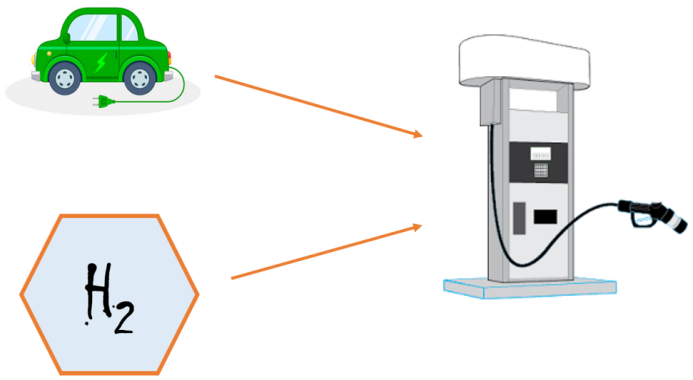
- Electrolysis system
- Hydrogen storage
- Fuel cell power system

The smart fuelling station from solar energy



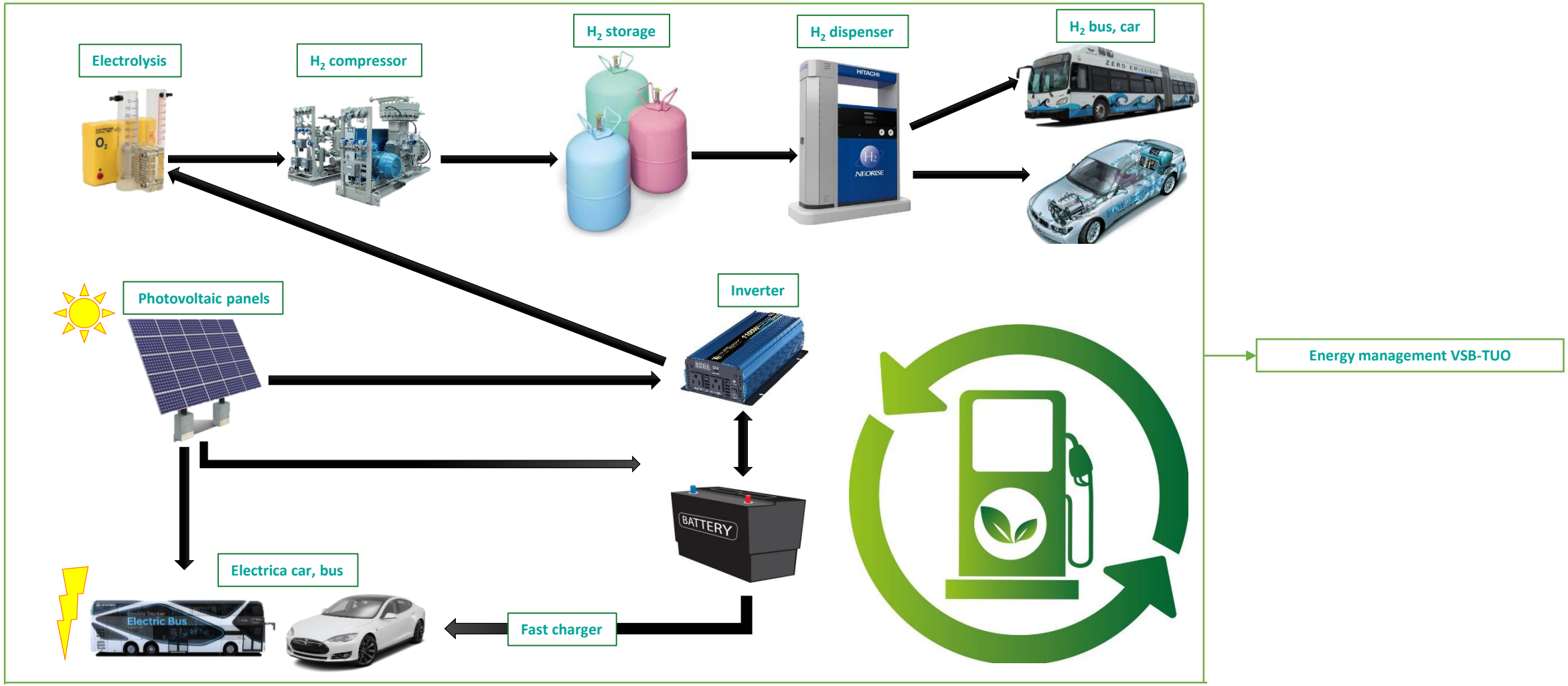
Location: Along the border of University campus opposite the biggest hospital in Ostrava

The fuelling station concept description



- The Fuelling Station will be connected to the University Solar Power Station which is operated on the roofs of the university campus (approx. 800 kWp).
- Hydrogen for cars and buses.
- Fast Combined Charging Stations for Electric Vehicles (with batteries accumulation).
- Pilot Fuelling Station application will be connected to university energy management for operating optimisation.
- Real operation-open for public, R&D applications.

The overall process scheme of the technology

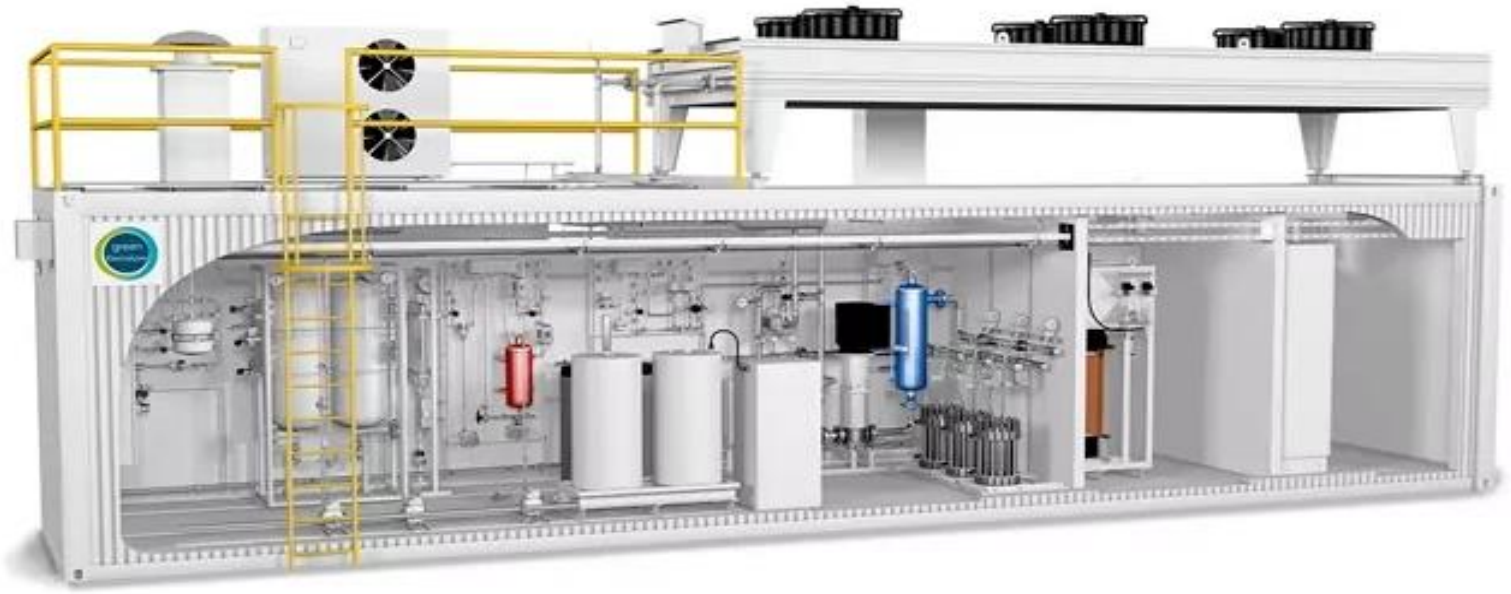


Hydrogen technology

Hydrogen technology

PEM Electrolyser	
Nominal production rate of H2 H2 storage	100-150 kg/24h 200 kg
Production Capacity Dynamic Range	0-100%
Power Consumption by System	5-6 kWh/m³
Purity	99.9998%
Delivery Pressure	30 MPa
Electrolyte	Proton Exchange Membrane (PEM) – Caustic Free

CONTAINER 1: PEM electrolyzer



CONTAINER 2: Compression and storage of H2

Chiller with dispenser

High pressure storage (usually 900-950 bar)

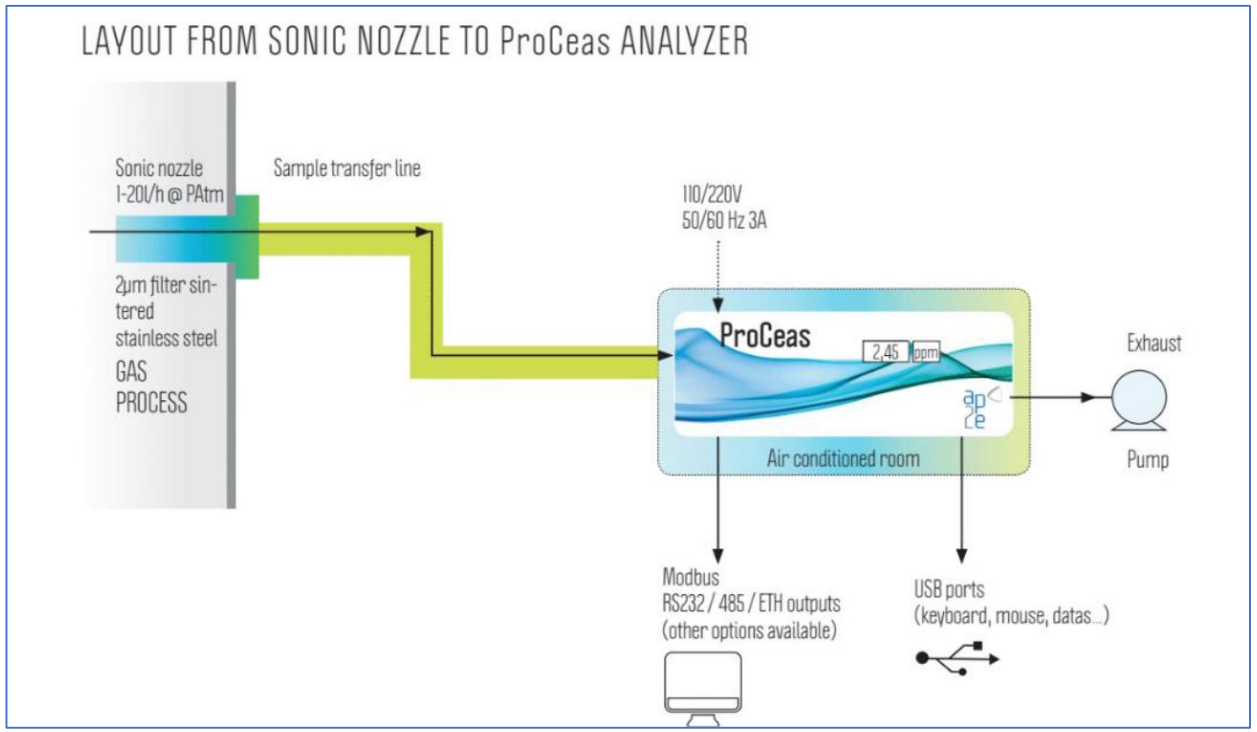
High pressure compressor

Low pressure storage (usually 350 bar)

Low pressure compressor

Hydrogen – analysis technology

System for checking purity of H2



Measured components in H2

COMPONENT	ISO 14687-2 LIMITS (ppm)	LOD ProCeas®A (ppm)
H2O	5	0,01
CH4	2	0,001
O2	5	1
CO2	2	0,2
CO	0,2	0,001
H2S	0,004	0,001
HCHO	0,01	0,001
HCO2H	0,2	0,005
NH3	0,1	0,001
HCl	0,05	0,001

Hydrogen – analysis technology

System for checking purity of H2 – solid particles

Measured components in H2

Adsorption H2 on surface of metalhydride

GAS PRO V2 (ETHERNET RIO)

Sieverts-type gas sorption analyzer, the GASPRO v2 is a fully au-tomated instrument for making Pressure-Composition

Temperature Isotherms with High Accuracy pressure sensors for a variety of gasses : CO2, Hydrogen, Deuterium, Methane, n-Alcanes from C2 to C6, Nitrogen, Argon, Helium and Neon.

Thank you for your attention

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