NEEST

NEW ENERGY & ENVIRONMENTAL SOLUTIONS AND TECHNOLOGIES

TETHYS WEBINAR – GREEN HYDROGEN PRODUCTION

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HYDROGEN REFUELLING STATIONS (HRS)

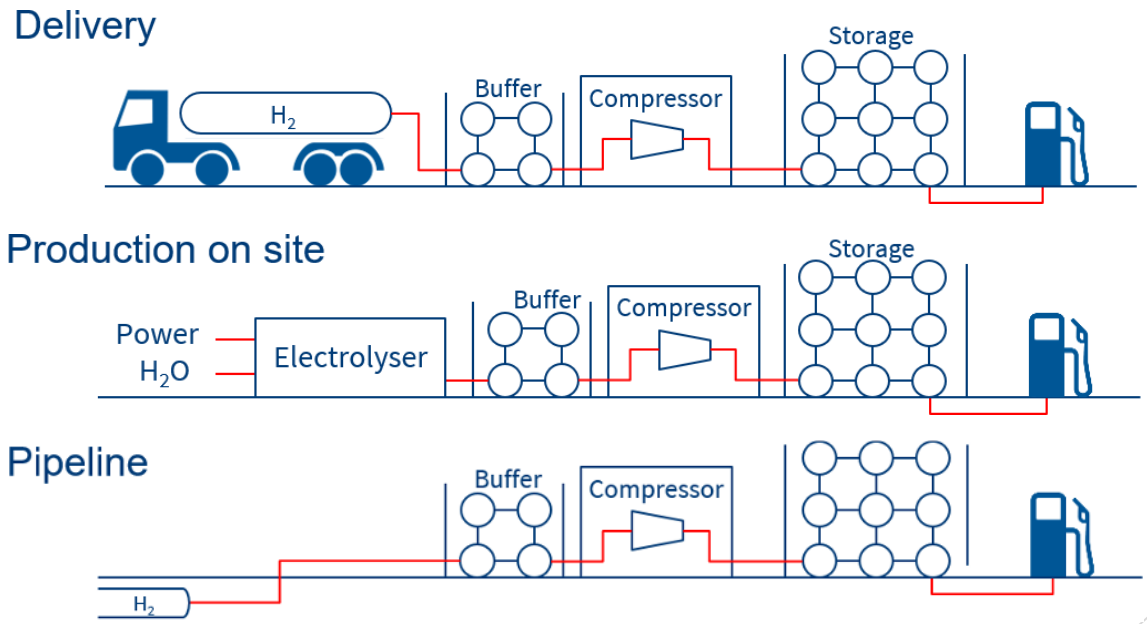
Hydrogen Refueling Stations (HRS) – EU

Typical Sub-systems HRS

Pilot Integrated Station H2 – NCSRD

Hydrogen Refueling Stations

Hydrogen supply for refueling stations



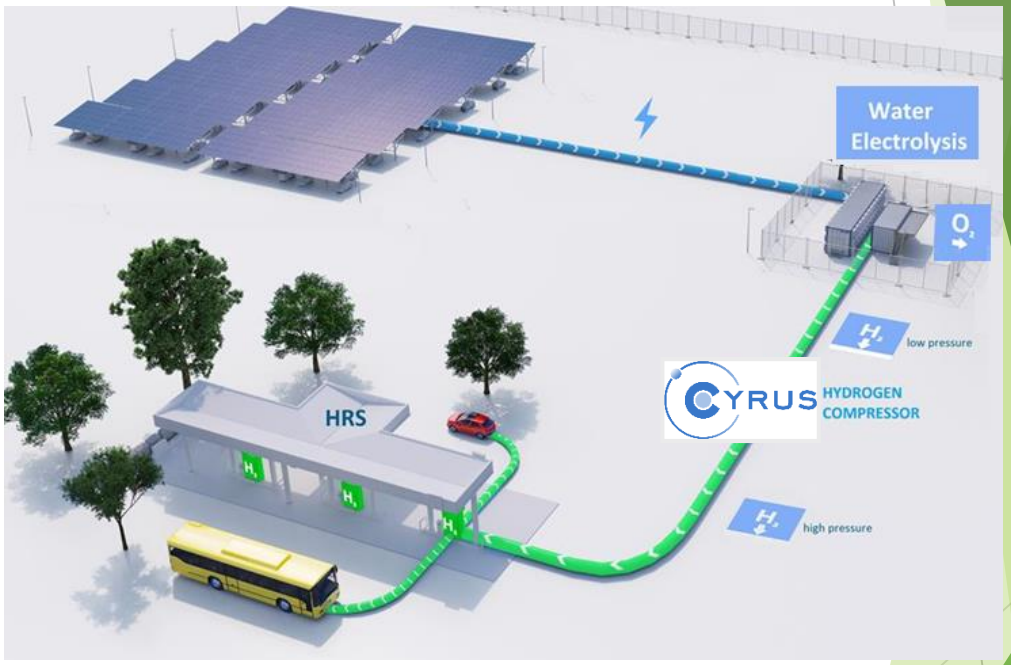
THE H2TRANS PROJECT

H2TRANS main goal

Developing the first hydrogen refueling station in Greece and demonstrating hydrogen-powered vehicles

Parties involved:

- NSCR Demokritos
- NEEST
- ELFON
- XANTHIS
- CITIPOST



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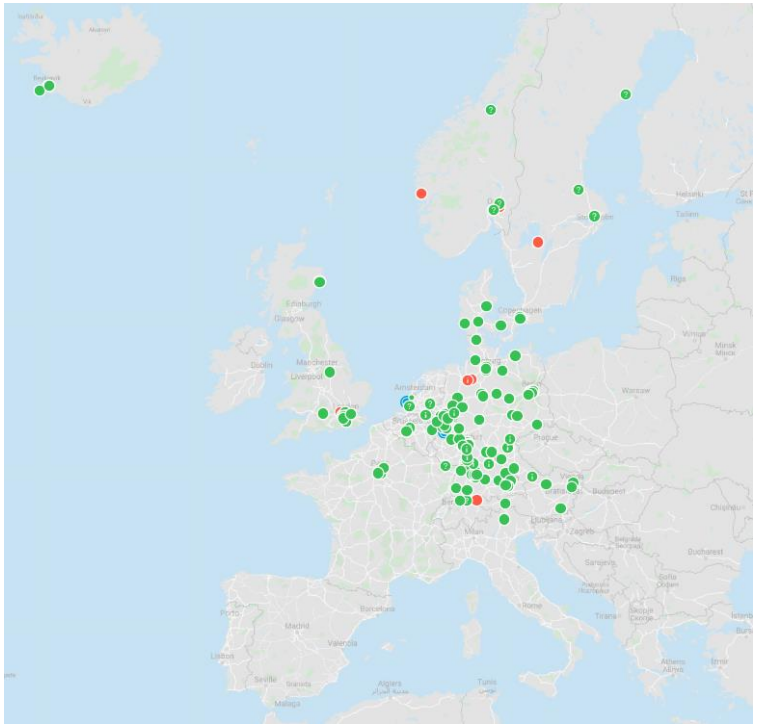
H2 stations in operation

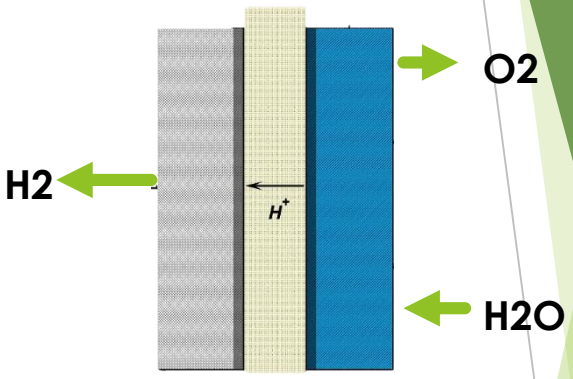


H2 stations in operation in Europe

- **432 stations in operation worldwide and another 226 are being planned.**
- **177 stations in Europe with the majority in Germany, and the rest distributed throughout central Europe.**
- **Most notable manufacturers include Shell, Total and Air Liquide**
- **Different layouts are being tried**

The 4 subsystems

PV System



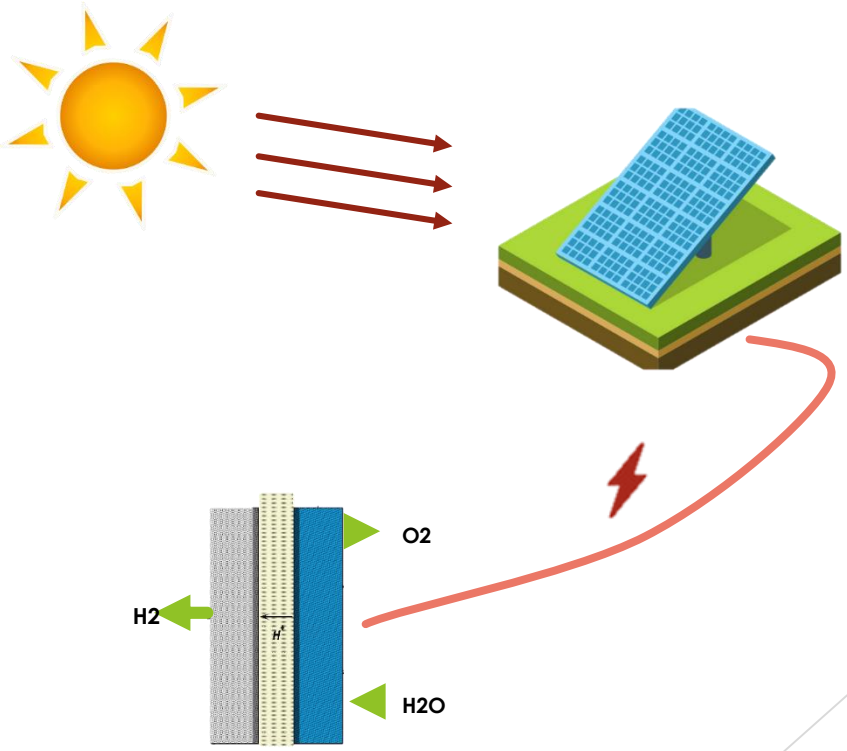
PEM Electrolysis Unit

H2 Vehicles

H2 Storage and compression

Photovoltaic System

- In order to improve the sustainability of the installation , the use of renewable energy sources is inevitable
- This ensures the minimization of CO2 emissions of the system
- For the purposes of the project the installed power will be 20kWp

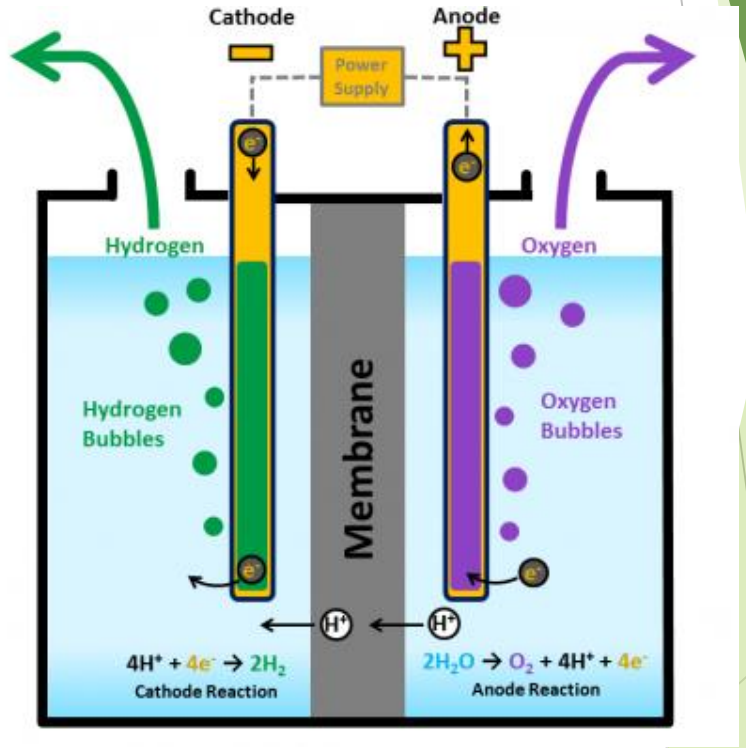


Hydrogen production system

- **Electrolysis unit is powered by DC current produced by solar panels**
- **PEM Electrolyzers use a solid polymer electrolyte for conducting protons from the anode to the cathode**

Working Principle of PEM Electrolysis:

1. Water at the anode reacts to form oxygen and positively charged H2 ions which can pass through the membrane
2. Electrons flow via an external circuit
3. H2 ions combine with electrons of the external circuit to form H2 gas.



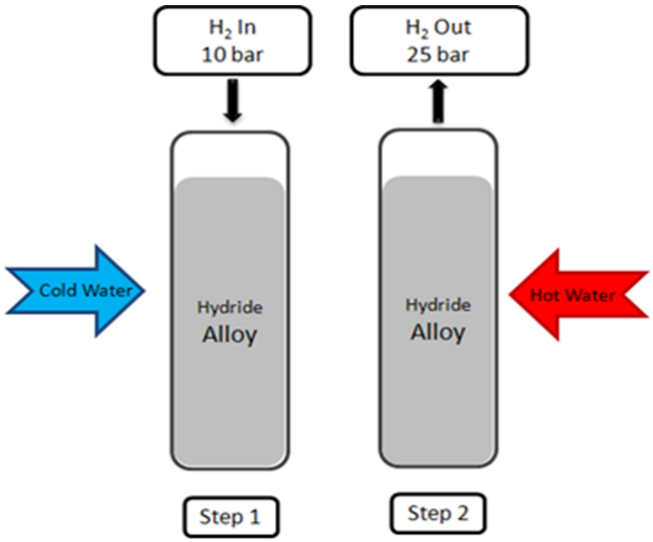
Working of PEM electrolysis

H2 storage system

- Different approaches: Gaseous, Liquid, Chemical storage
- H2TRANS utilizes storage in gaseous form
- Need for compression in order to store larger quantity in given volume
- By compressing H2 :
  - **increased density**
  - **minimized volume**
- Storage at 200 bar in stainless steel tanks
- Total station capacity: 120 Nm³ (12 tanks of 10 Nm³)

Hydrogen in gaseous form storage tanks

Compression system

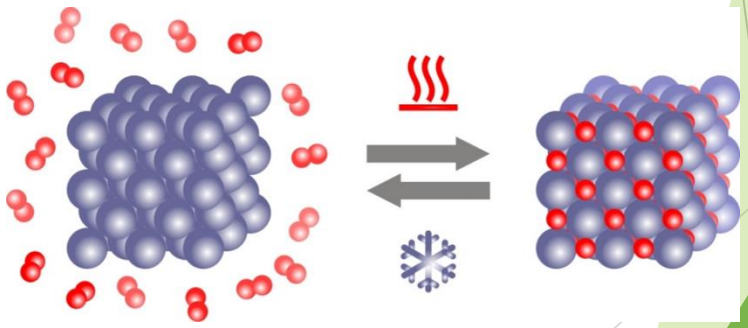


Thermal Compression

- Utilizing metal hydrides (MH) which store hydrogen chemically
- MH store hydrogen at low temperature & pressure
- MH release stored hydrogen when heated
- Energy needs minimized when there is external flux of heat such as waste heat
- Outlet pressure: 200 bar

Metal Hydride Compressor

- No moving parts (low OPEX)
- Low noise
- Ideal for residential areas



Metal Hydride principle of operation

Hydrogen powered Vehicles

- The FCEVs will be implemented by transforming electrical vehicles in a way that they can use fc for powering their electrical motor.
- Transformed vehicles include a scooter and a golf cart
- Compatibility of the fuel cell which will replace the battery, with the electric motor must be ensured
- Vehicles will have on board light weight 200 bar tank
- An ultra capacitor will be installed on board as well ensuring better response of the system
- Vehicles will also have a register and visualization system for monitoring the key performance indicators

Electrical vehicles suitable for fuel cell transformation

Hydrogen Refueling Station

The Hydrogen Refueling Station (HRS) for small vehicles has already been developed at the premises of NCSR DEMOKRITOS (containerized solution)