

HyP 3D

Hydrogen Production in Pressurized 3D-Printed Solid Oxide Electrolysis Stacks

Project Coordinator: **A. Tarancón**
WPs leader: **A.G. Sabato**



Webinar “Solid Oxide Cells: from materials to systems” 19 February 2025



ID Card

Title: Hydrogen Production in Pressurized 3D-Printed Solid Oxide Electrolysis Stacks (**HyP3D**)

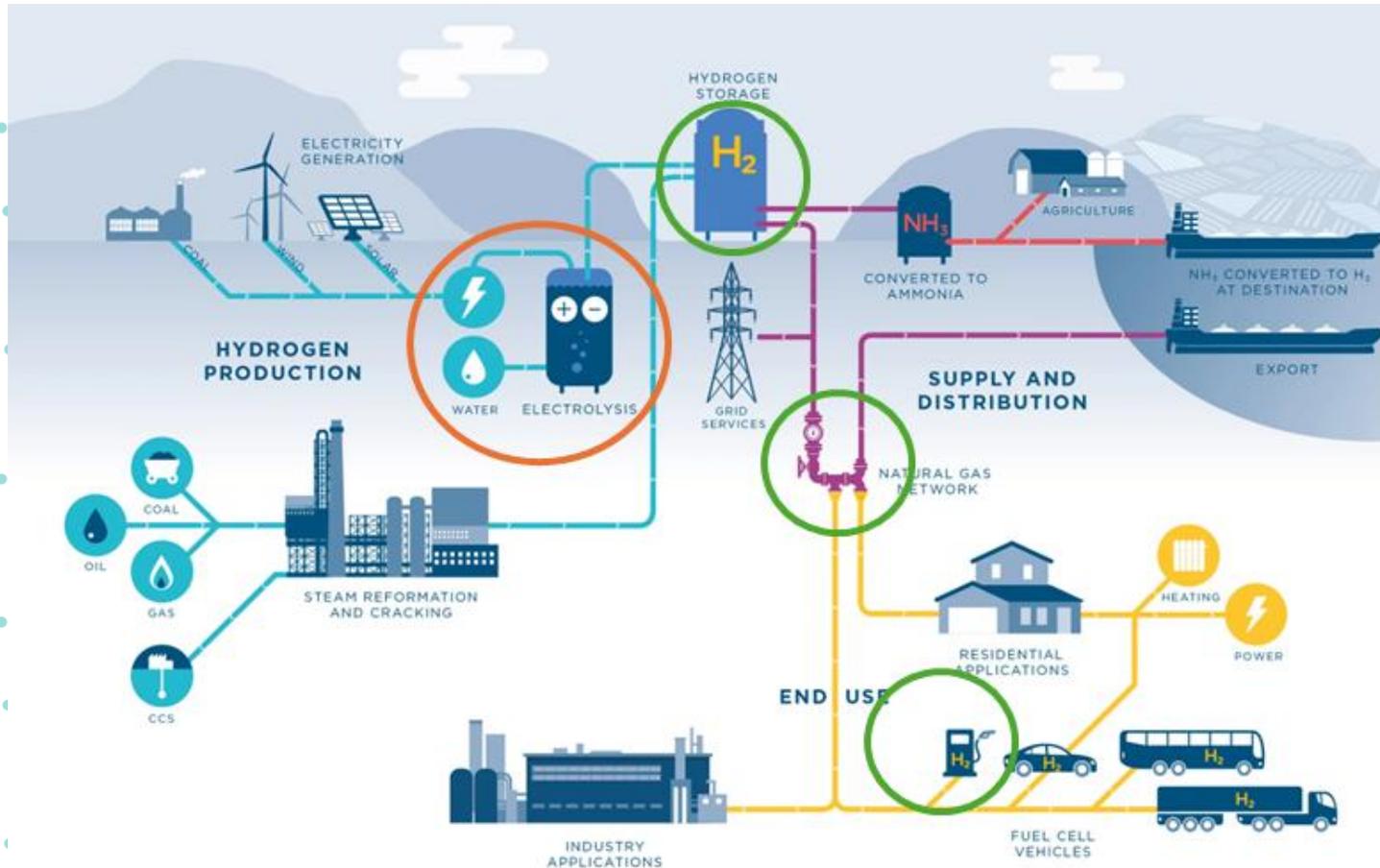
Call: It's a project funded by HORIZON-JU-CLEANH2-2022. We are **8 partners**, and the duration is **48 months**. Budget: 2.5 M€.

Topic: Development and validation of **pressurised** high temperature steam electrolysis stacks (Solid Oxide Electrolysis)

The main goal of the HyP3D project is to deliver a new generation of ultra-compact high-pressure standalone SOEC stacks able to convert electricity into compressed hydrogen for P2G and HRS applications



Motivation: efficient production of pressurized H₂



When using Solid Oxide Electrolysis Cells (SOEC), the hydrogen is typically produced at or near atmospheric pressure. In industrial or transport applications, this gas must then be boosted to pressures ranging from **30 to 200 bar**.

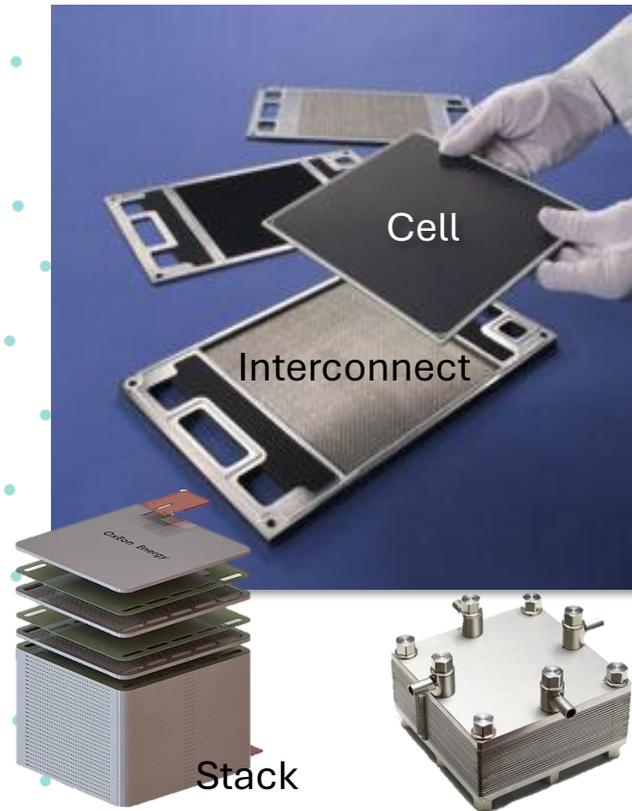
Using a downstream compression is expensive, energy inefficient process that can also compromise the integrity of SOEC upstream.

The compression is particularly complex from 1 to 20 bar.

Challenge: pressurized SOEC technology

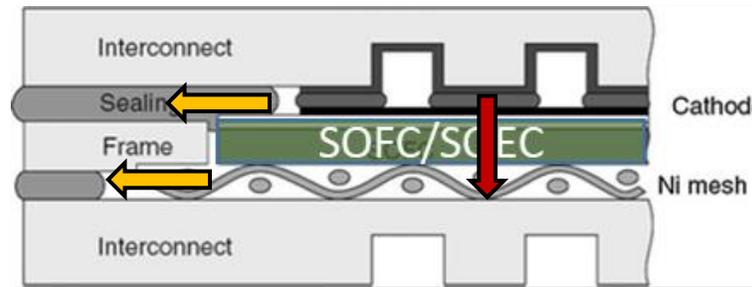
State of the Art in SOEC:

- Flat ceramic cells (ESCs/FESCs)
- Complex metallic interconnects



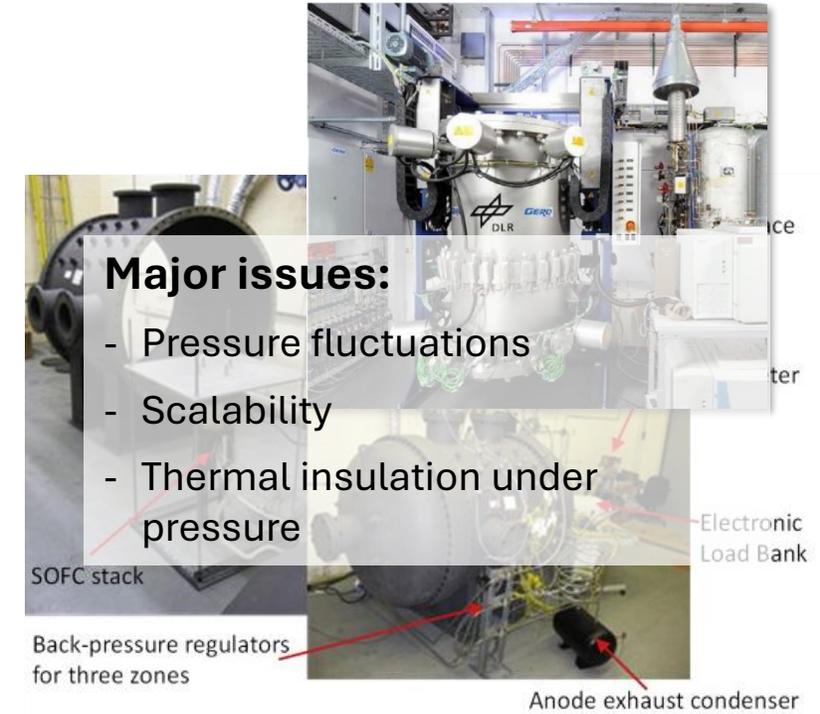
Unbalanced pressure across cells is not allowed (>50 mbar)

Sealing not effective under shear stress



Puig, J., et al.. *J Mater Sci* **51**, 979–988 (2016)

SoA operation under pressure in vessels:

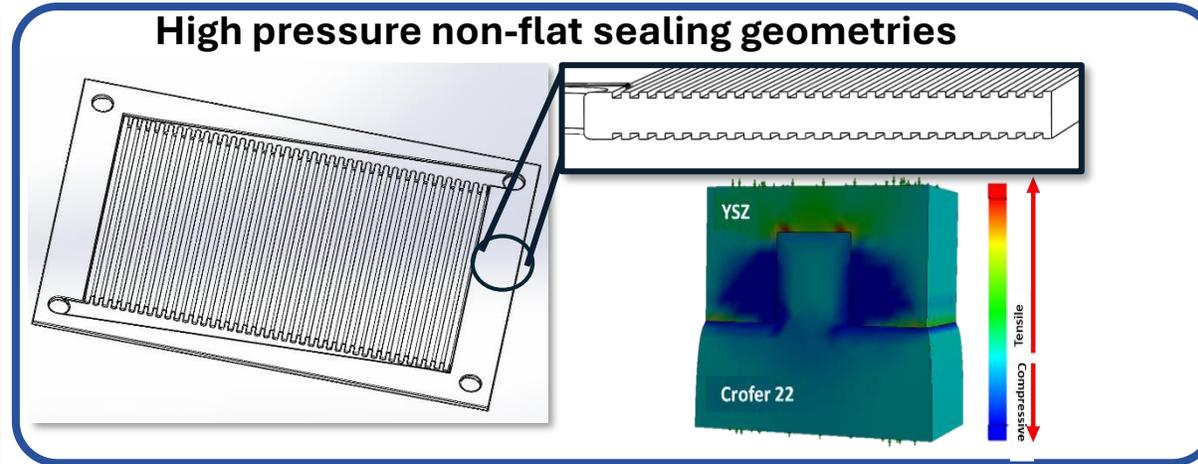


Major issues:

- Pressure fluctuations
- Scalability
- Thermal insulation under pressure

A. Burke et al., *Int. J. Hydrogen Ener.* **38** (2013) 13774
M. Riedel et al., *Int J Hydrog Energy* **44** (2019) 4570

Our solution: HyP3D SOEC stack



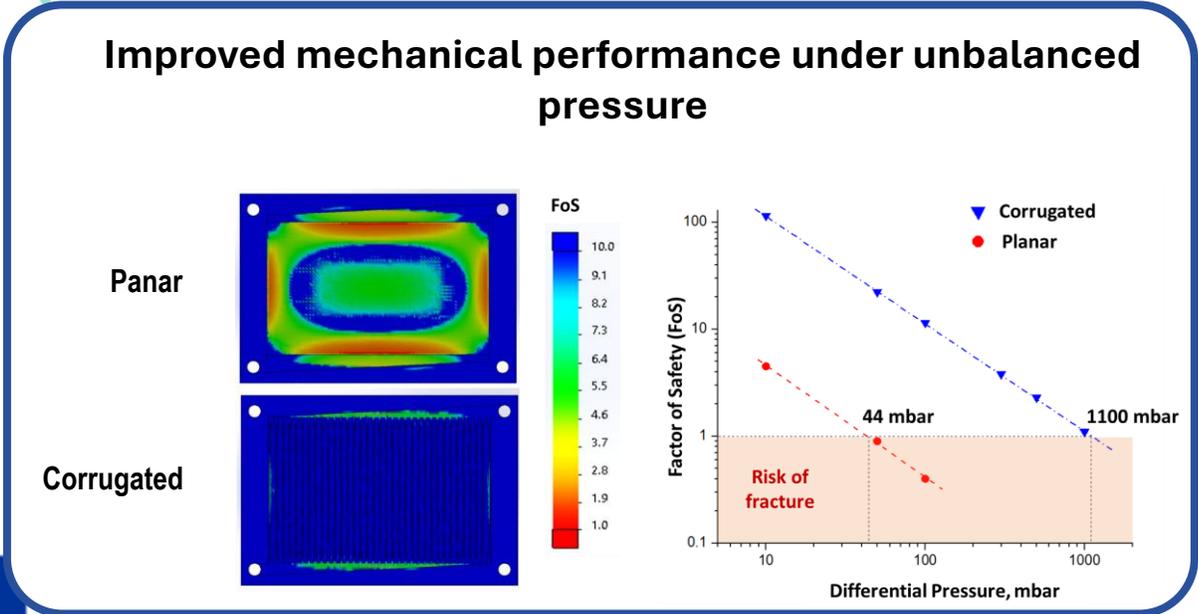
Use of flat and thin metallic interconnects

Conventional

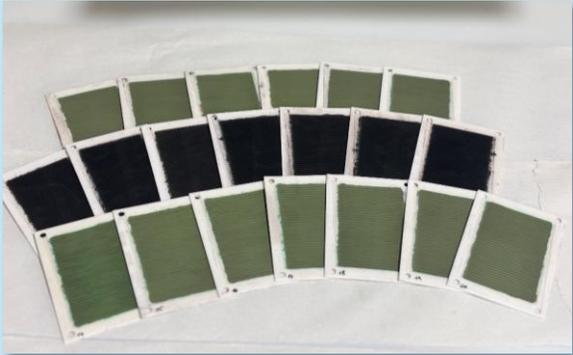
HyP3D

2x-3x volumetric and gravimetric power density respect to SoA

**SOEC
3 kW/L
1 kW/kg**



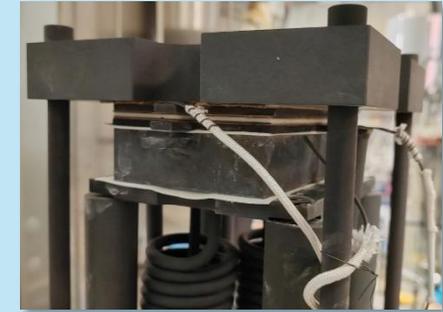
Successful development of large-area cells fabrication incorporating features designed for high-pressure operation.



Validation of cells in SRU and 20 cells stacks at atm pressure



First SRU successfully tested up to 2 bar



Thank you!

www.hyp3d.eu

www.atlab.es

www.irec.cat