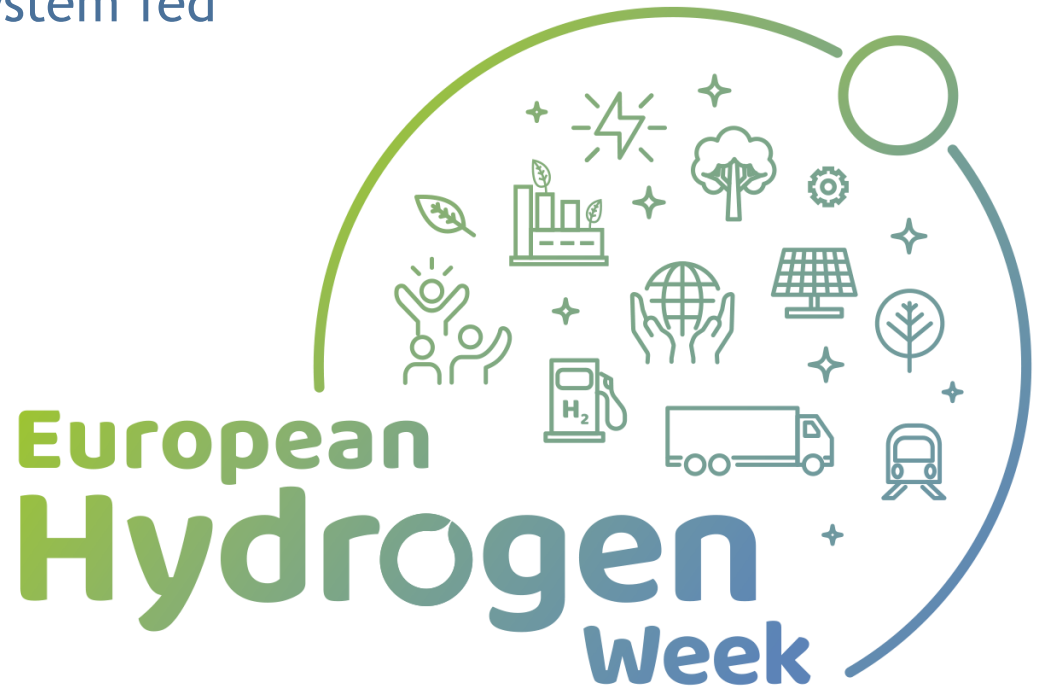
CH2P

Cogeneration of Hydrogen and Power using solid oxide based system fed by methane rich gas



Ilaria Mirabelli

HyGEAR

www.ch2p.eu

ilaria.mirabelli@hygear.com

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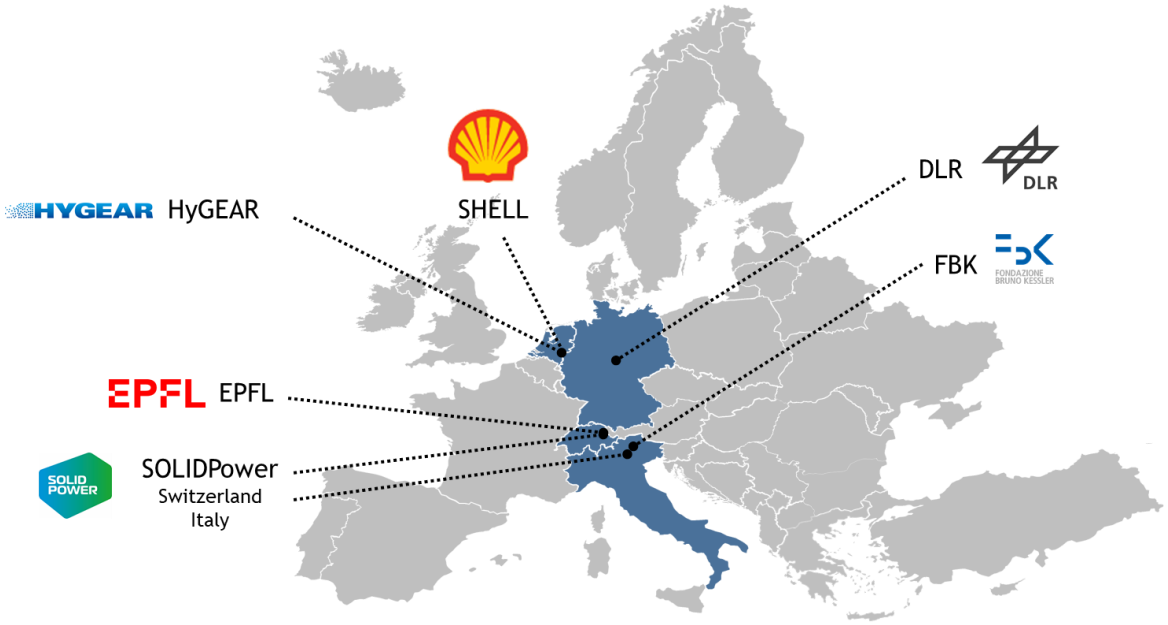
European Commission

Project Overview

- Call year: 2018
- Call topic: FCH-02.4-2016: Co-generation of Hydrogen and Electricity with High-Temperature Fuel Cells (>50kW)
- Project dates: 01 Feb 2017 – 30 Apr 2022
- % stage of implementation 01/11/2021: 75 %
- Total project budget: 6.8 million €
- FCH JU max. contribution: 3.9 million €
- Other financial contribution: -
- Partners: FBK (coordinator), DLR, EPFL, HyGEAR, SHELL, SOLIDPower



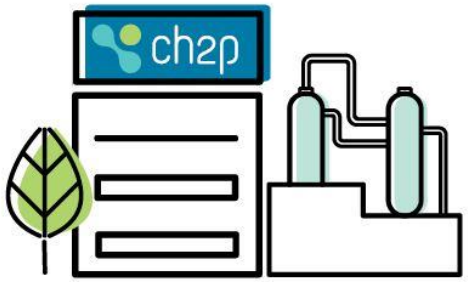
Project Summary

The CH2P project aims to construct and validate a new technology prototype for hydrogen production at high efficiency and low carbon emissions.

The CH2P project has as primary objective to cogenerate hydrogen, heat and power using Solid Oxide Fuel Cell technology fueled by methane-rich gases.

The CH2P prototype is designed for use at hydrogen refueling stations.

Project Summary



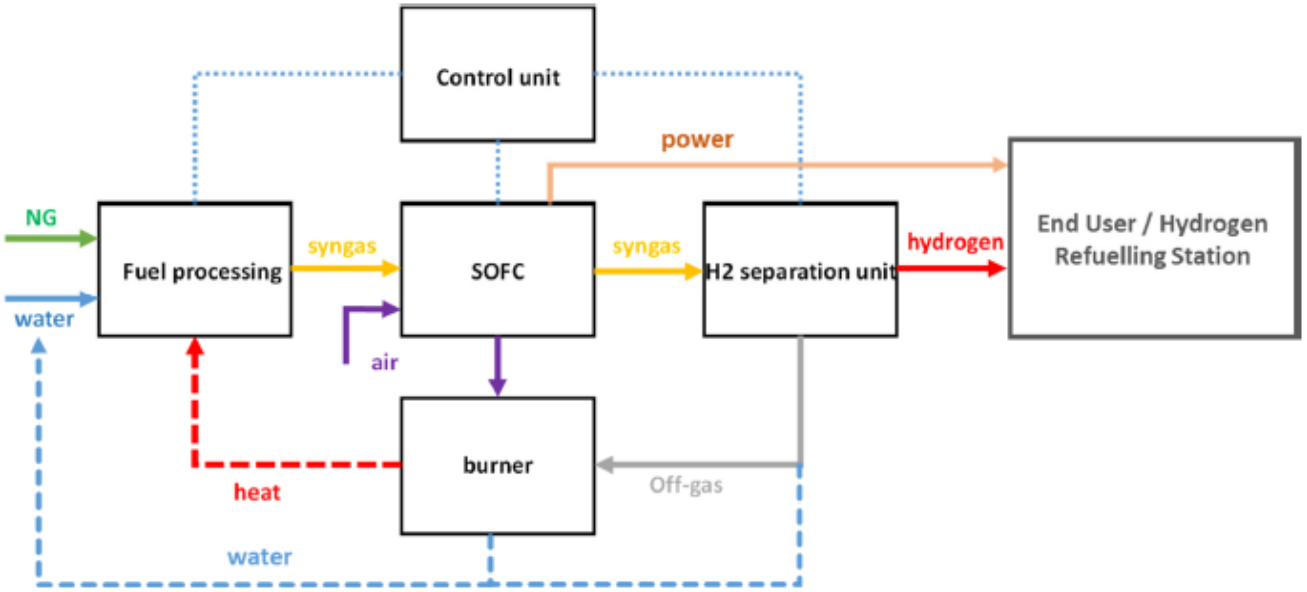
The CH2P main goals are:

- Production of hydrogen and electricity more efficiently than conventional technologies;
- Optimization of decentralized H_2 production from the point of view of an HRS, especially during the ramp-up phase, by flexible hydrogen production capability;
- Purity level of hydrogen for use in the automotive sector;
- Economic hydrogen generation;
- Modularity, to enable a staged deployment of such infrastructure;
- Dynamic hydrogen production capacity adapted to 5 operation modes and a hot stand-by state;
- In future developments, grid stabilization services through flexible power generation and electric energy storage service in the form of H_2

Project Progress – System concept

The CH2P system:

- is designed considering the existing energy infrastructure, the current energy-conversion technologies and the economic conditions for operating an HRS,
- integrates all the sub-processes involved in the H2 production:
  - fuel processing
  - conversion into power and syngas
  - hydrogen purification and compression
  - hydrogen dispensing



Project Progress – System design

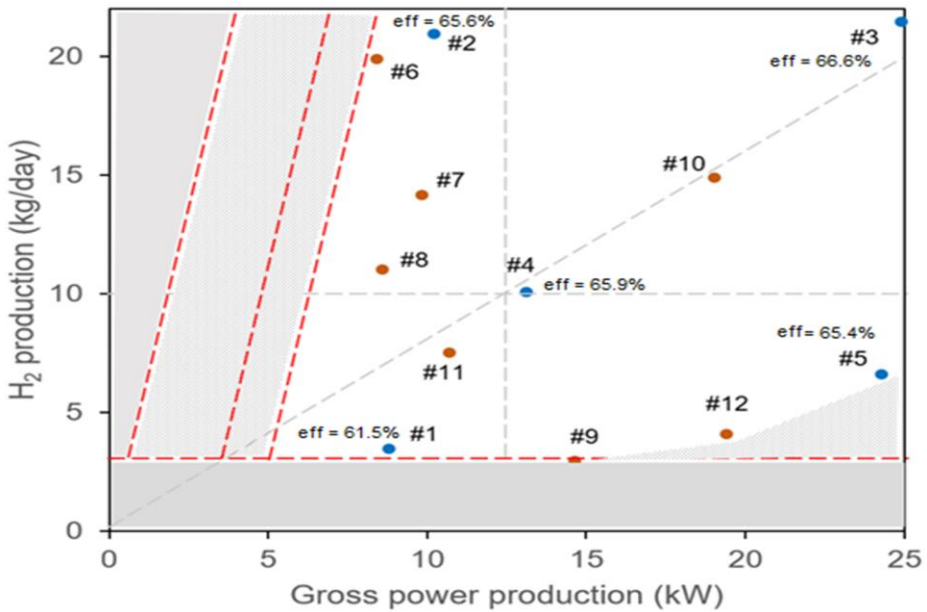
Achievement to-date

System designed for 5 OPERATION MODES

25% 50% 75%

15-100% H_2 AND
33-100% power

- Call topic demands for a SOFC system with power modulation between only electricity produced and 50% electricity and 50% hydrogen produced.
- CH2P system is designed to work in 5 operation modes, adapting to the specific request at the HRS.
- CH2P allows for a wide dynamic range: from 33% electricity and 15% hydrogen up to full load with 100% electricity and 100% hydrogen produced.



Project Progress – System size

Achievement to-date

0 kgH_2/day
0 kW

20 kgH_2/day
25 kW

UNDER CONSTRUCTION

40 kgH_2/day
50 kW

25% 50% 75%

- Call topic demands for a prototype of 20kgH2/day size. CH2P aims at realizing a 40kgH2/day and 50 kW power capacity at full load.
- At the present, the alpha 20kgH2/day module is in assembly and it will be tested in January 2022. The gamma 20kgH2/day module is under construction.
- In a second step, the two modules (alpha and gamma) will be integrated to have the final CH2P system that can operate also in electrolysis mode (gamma system).

Risks, Challenges and Lessons Learned

The main challenges are related both to the development of innovative single components and their integration into a large and complex system.

The high degree of customization and the validation steps of the integrated system in real operating environment required huge effort and continuous readjustments to meet the targeted performances.

The Consortium is still dealing with the high degree of complexity on multiple levels that demands continuous commitment, learnings and flexibility by all partners.

Lesson learned: technology development requires time that needs to be quantified and respected. Innovation is time-demanding!

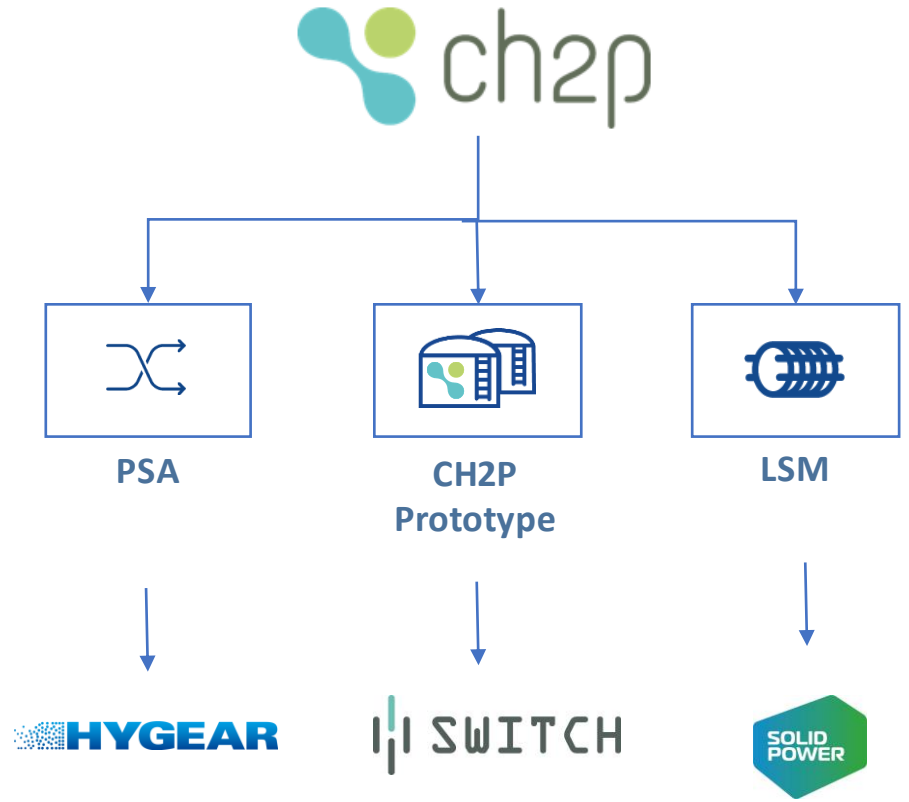
Exploitation Plan/Expected Impact

Exploitation

Three Key Exploitable Results (KERs)

1) **CH2P system prototype:** direct use by HyGear in SWITCH
2) **Flexible PSA:** direct commercialization by HyGear
3) **Large Stack Module:** direct commercialization by SP

The results and knowledge generated in the CH2P project is going to be used in the SWITCH project. The prototype will be upgraded to operate in both fuel cell (SOFC) and electrolysis (SOE) modes.

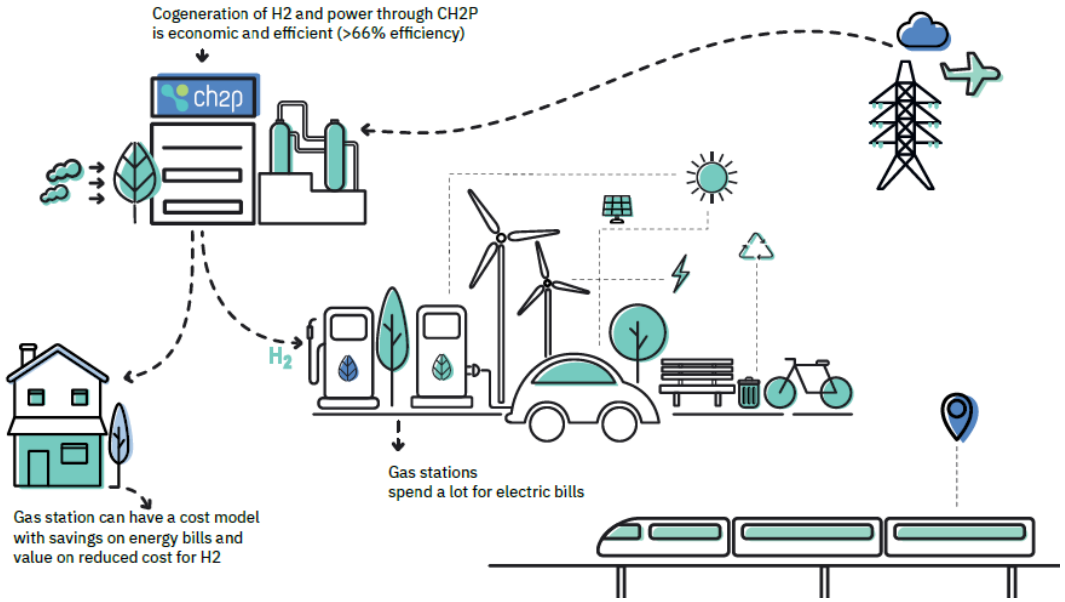


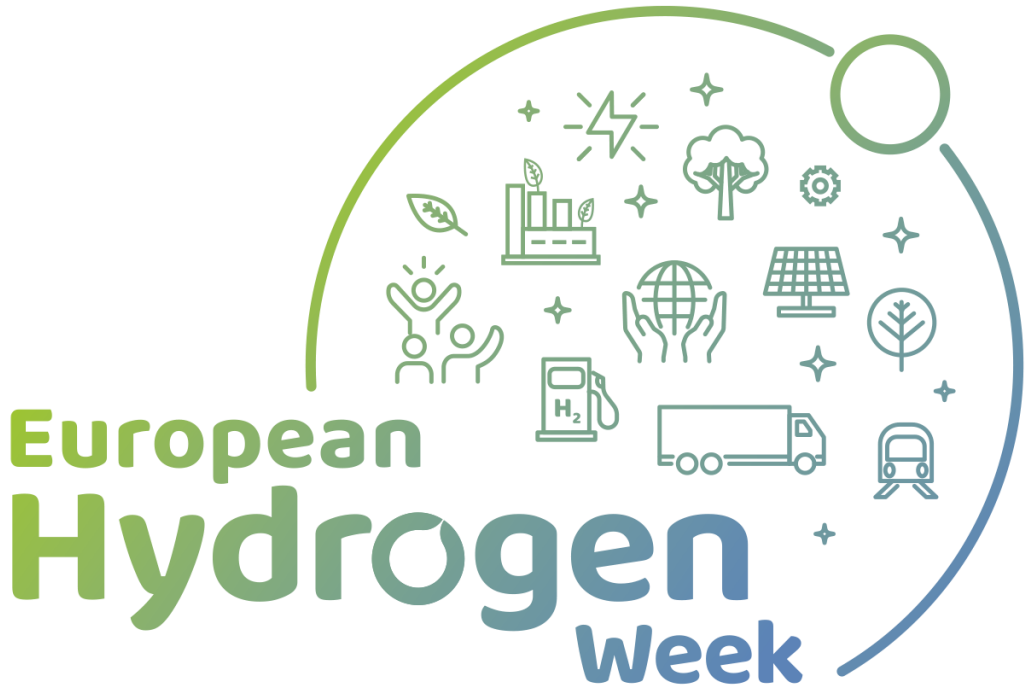
Exploitation Plan/Expected Impact

Impact

Support the transition to Hydrogen Mobility

1) **Flexibility of H_2 production for HRS:** 40kgH_2/day
2) **Reliability of H_2 and power** production to always match demand
3) **Cost competitiveness:** €4.5/kg
4) **Lifetime:** 40.000 hours and 10 years
5) **Sustainability:** under assessment with LCA - LCC





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