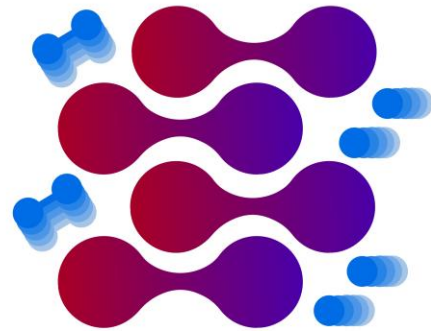


HyCARE

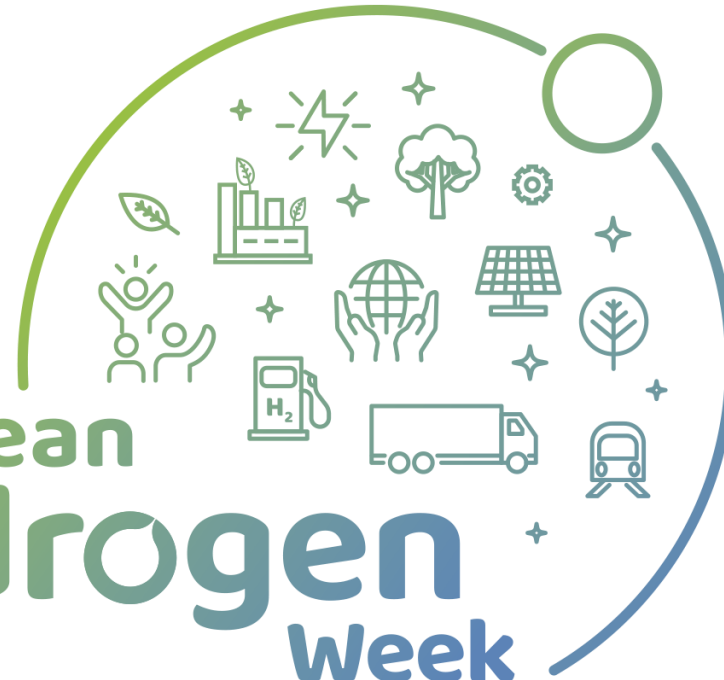
Hydrogen CARRIER for
Renewable Energy

Storage



HyCARE

European
Hydrogen
Week

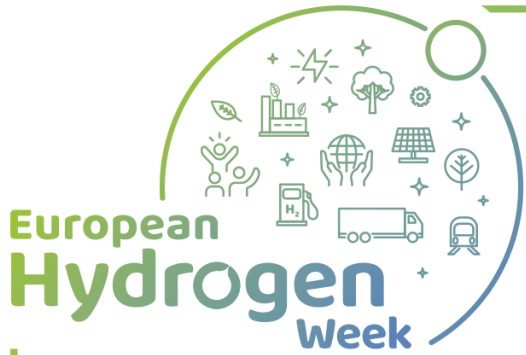


Marcello BARICCO
University of Turin

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marcello.baricco@unito.it

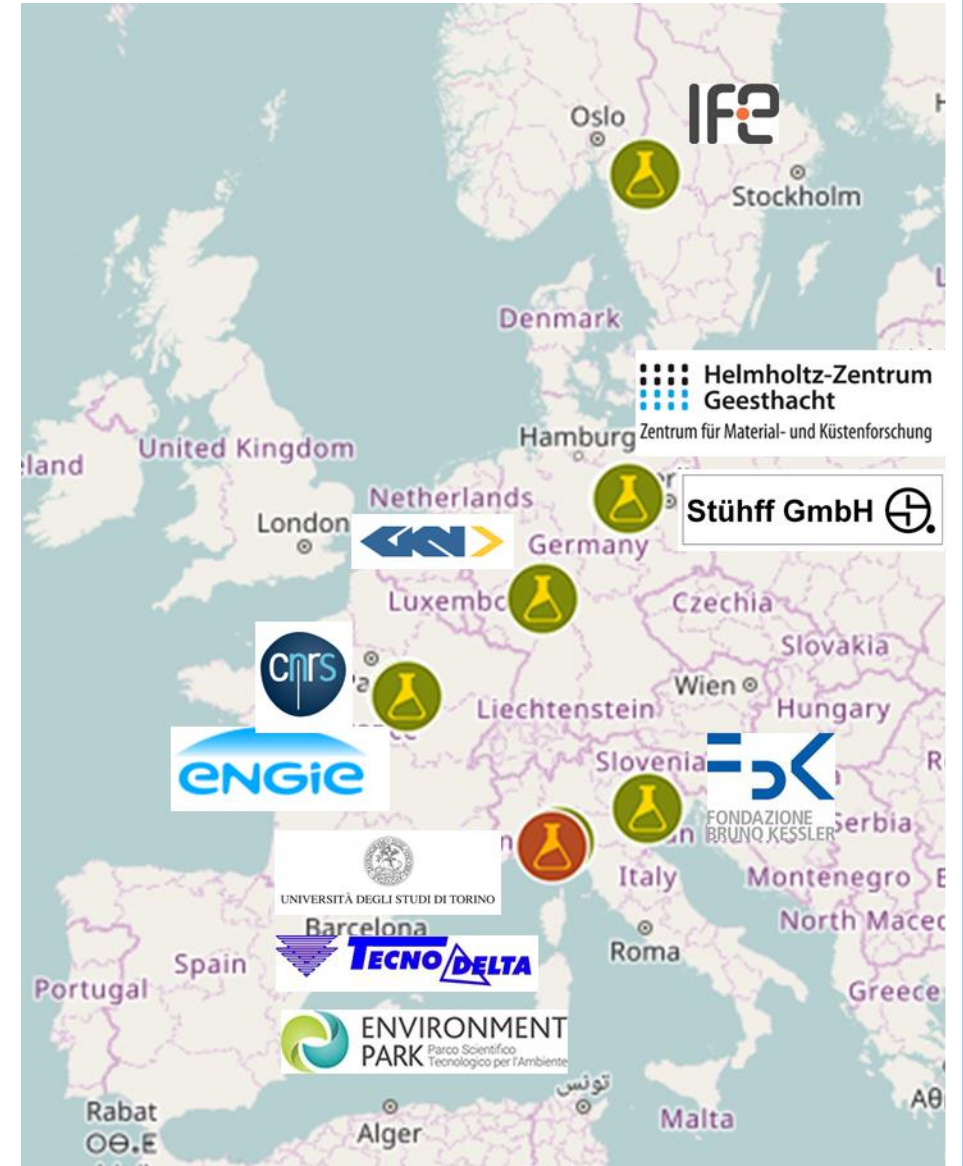
#PRD2020
#CleanHydrogen





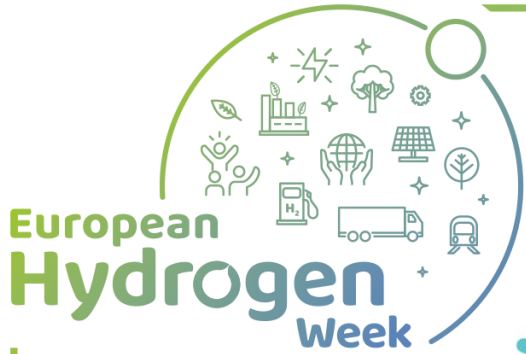
Project Overview

- Call year: 2018
- Call topic: FCH-02-5-2018: Hydrogen carriers for stationary storage of excess renewable energy
- Project dates: 01.01.2019 - 31.12.2021
- % stage of implementation 01/11/2019: 60 %
- Total project budget: 1 999 230 €
- FCH JU max. contribution: 1 999 230 €
- Other financial contribution: 0 €
- Partners: UNIVERSITA DEGLI STUDI DI TORINO (Italy), ENGIE (France), GKN SINTER METALS ENGINEERING GMBH (Germany), TECNODELTA SRL (Italy), STUEHFF GMBH (Germany), FONDAZIONE BRUNO KESSLER (Italy), HELMHOLTZ-ZENTRUM GEESTHACHT ZENTRUM FUR MATERIAL- UND KUSTENFORSCHUNG GMBH (Germany), CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (France), INSTITUTT FOR ENERGITEKNIKK (Norway)



#PRD2020
#CleanHydrogen





Project Goals



- **High quantity of stored hydrogen** ≥ 50 kg
- **Low pressure** < 50 bar and **low temperature** $< 100^{\circ}\text{C}$
- **Low footprint**, comparable to liquid hydrogen storage
- **Innovative design**
- **Hydrogen storage coupled with thermal energy storage**
- Improved **energy efficiency**
- **Integration** with an **electrolyser** (EL) and a **fuel cell** (FC)
- Demonstration in **real application**
- Improved **safety**
- **Techno-economical evaluation** of the innovative solution
- Analysis of the environmental impact via **Life Cycle Analysis** (LCA)
- Exploitation of **possible industrial applications**
- **Dissemination** of results at various levels
- **Engagement** of local people and institution in the demonstration site



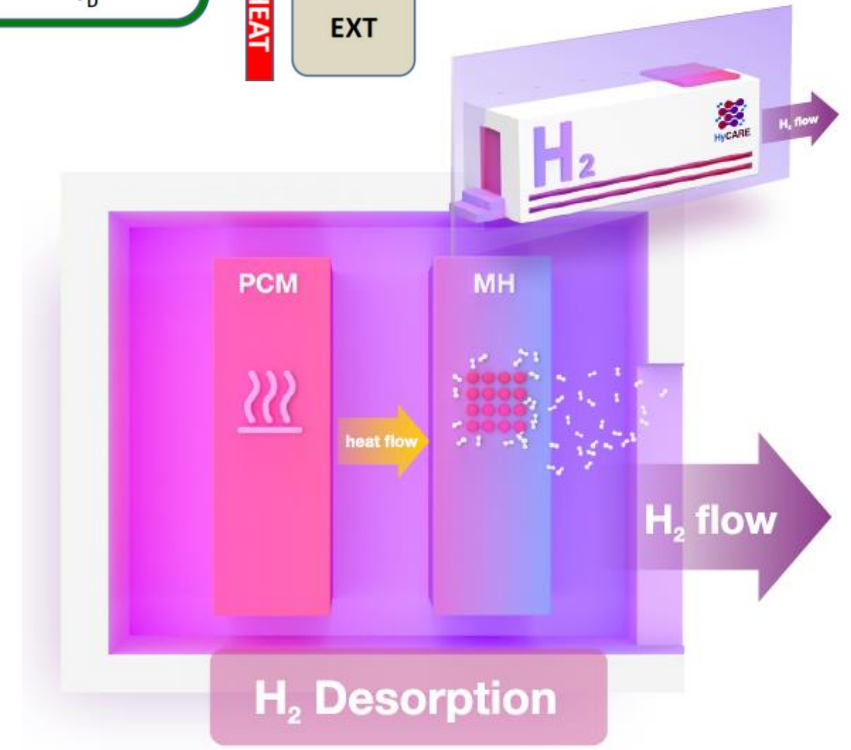
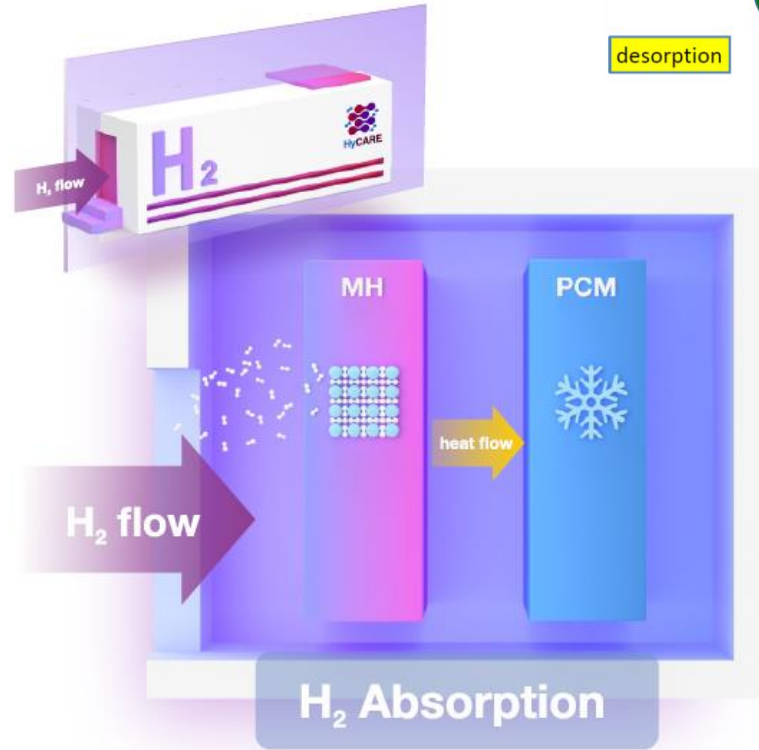
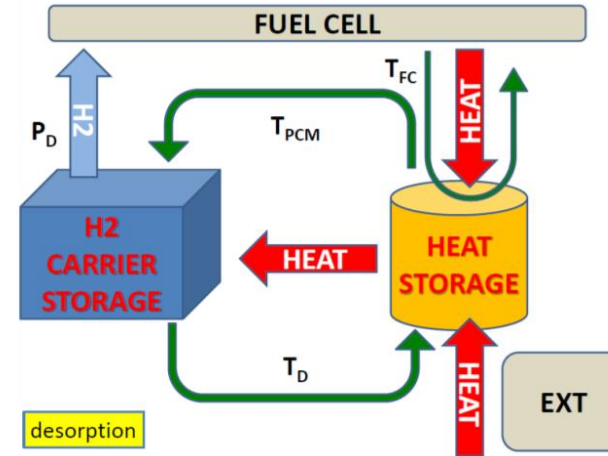
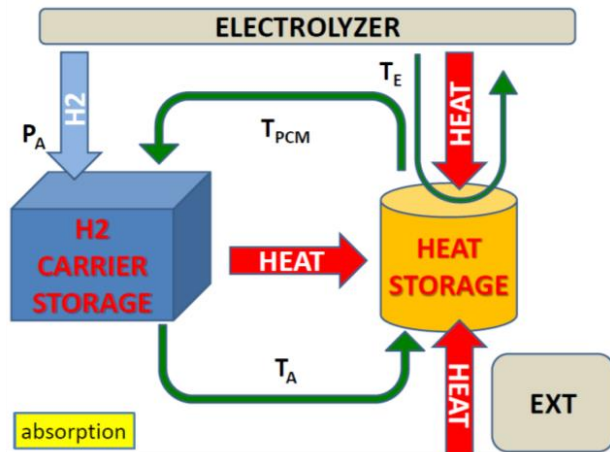
This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 826352. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation program, from Hydrogen Europe and Hydrogen Research Europe.

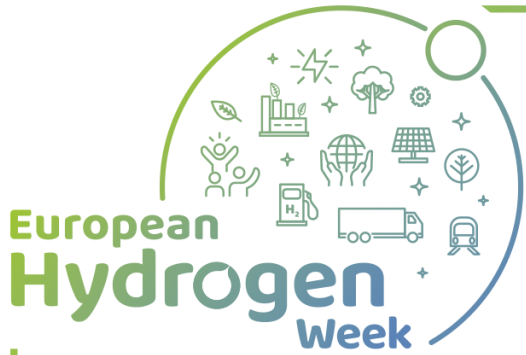


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Project Concept





Project Progress/Actions

Temperature and pressure

Achievement to-date

COMMERCIAL
ALLOYS
< 70 °C
< 100 bar

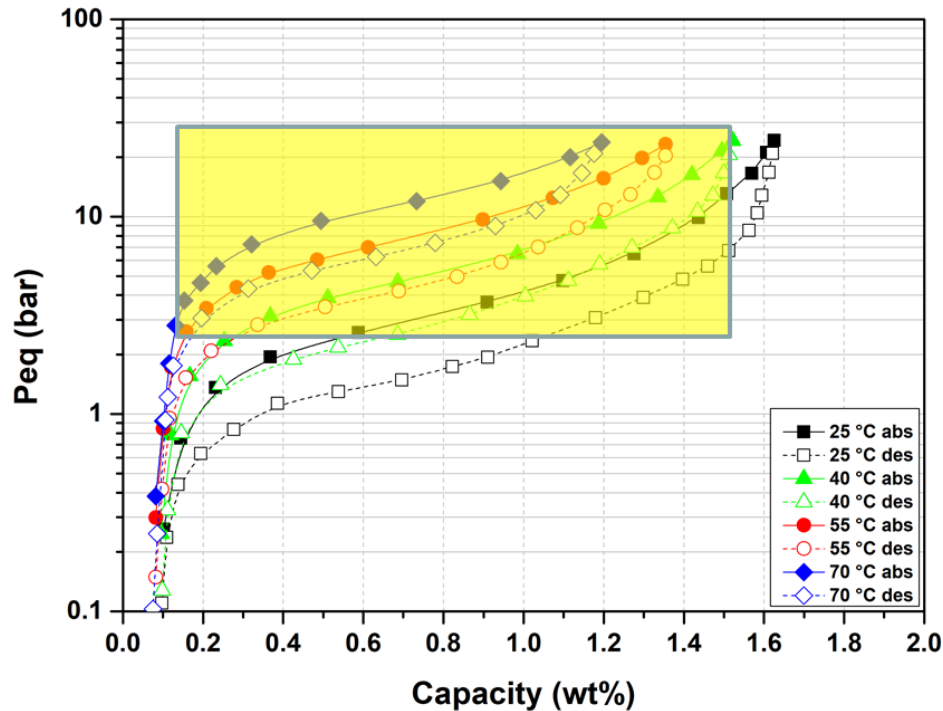


25%

50%

75%

HyCARE
FeTi alloy
55 °C
25-2 bar



Safety

< 30 bar

Low pressure storage

Safety

< 70 °C

Low temperature storage

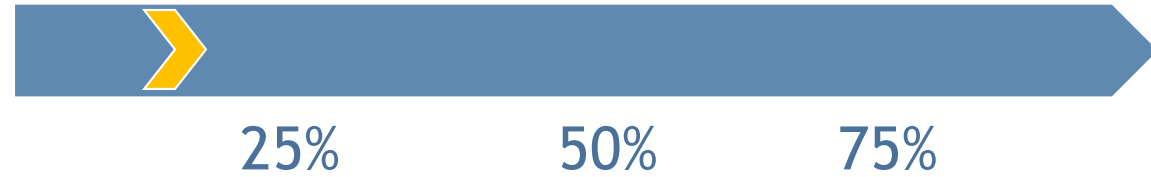
Project Progress/Actions

Amount of stored hydrogen

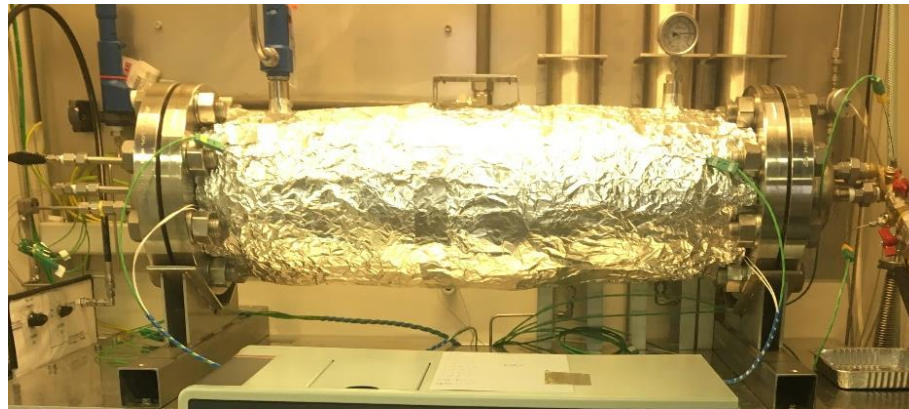
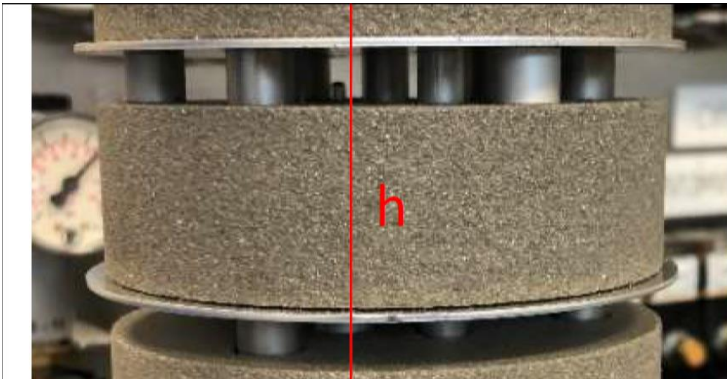


Achievement to-date

LAB SCALE
COMMERCIAL
TANKS
< 1 kg



HyCARE
50 kg



Quantity

50 kgH₂

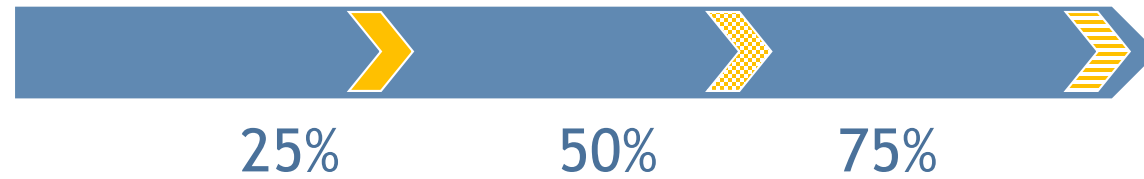
High quantity
of stored hydrogen

Project Progress/Actions

Energy efficiency

Achievement to-date

COMMERCIAL TANKS NO HEAT RECOVERY



HyCARE HEAT RECOVERY WITH PCM

HTF Inlet



HTF outlet

Efficiency

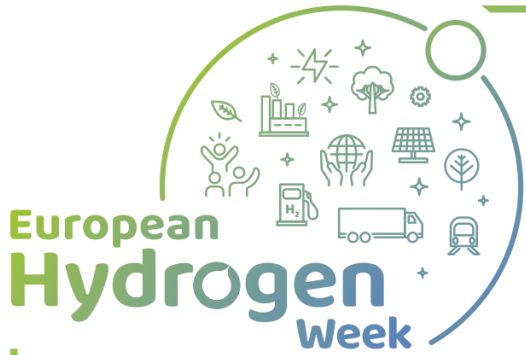
< 70 %

Total round trip energy efficiency

Environmental impact

< 5.0 kWh/kg H₂

External energy source with innovative design for large scale storage and use of non-critical raw materials



Project Progress/Actions

Integration



Achievement to-date

NO
COMMERCIAL
SYSTEMS

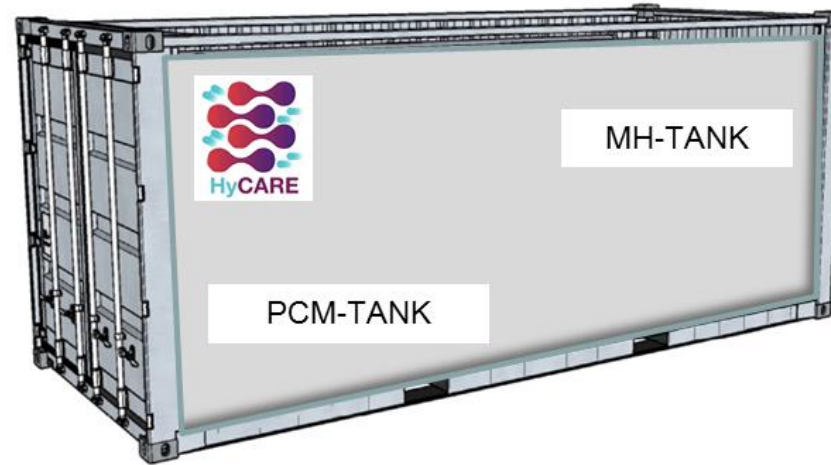


HyCARE
INTEGRATED
SYSTEM

25%

50%

75%



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Exploitation Plan/Expected Impact

Exploitation



Support Services for Exploitation of Research Results



SERVICE 1
PORTFOLIO DISSEMINATION & EXPLOITATION STRATEGY:

SERVICE 2
BUSINESS PLAN DEVELOPMENT:

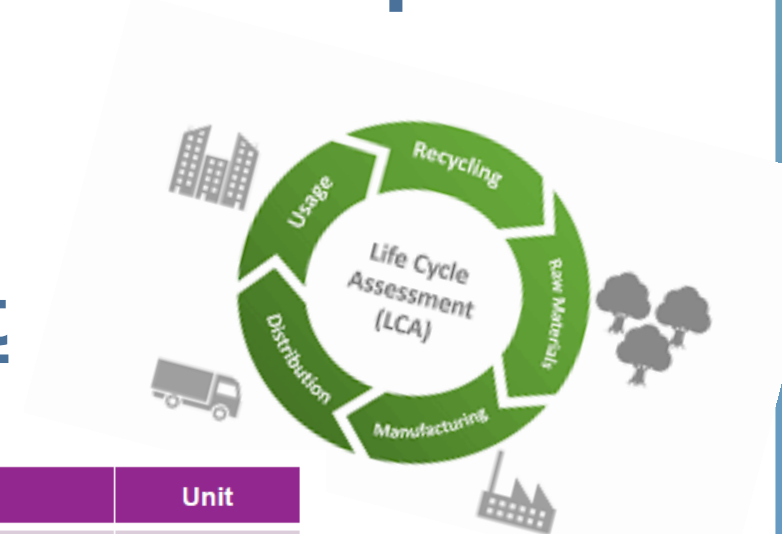


SERVICE 3
GO-TO-MARKET SUPPORT:

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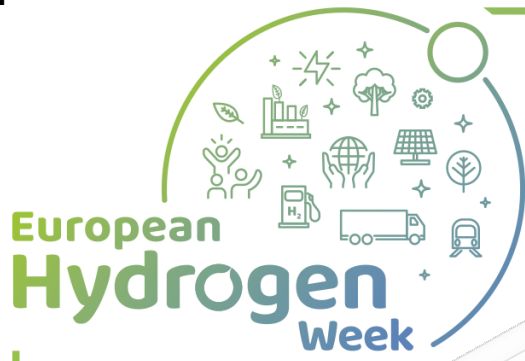


Impact

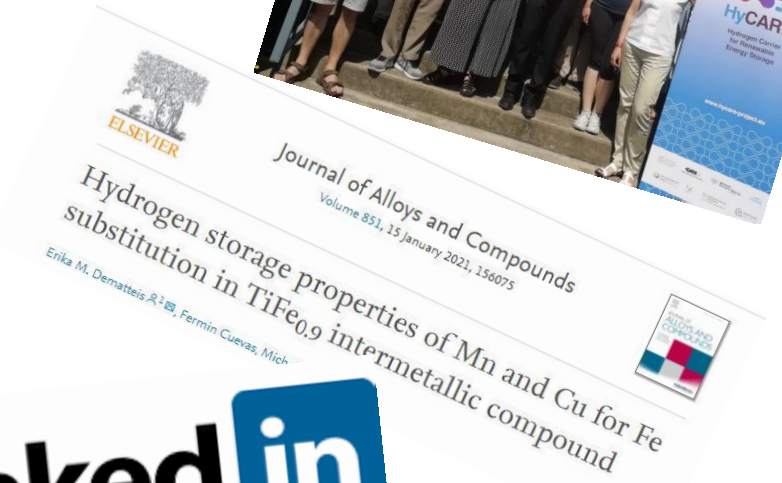
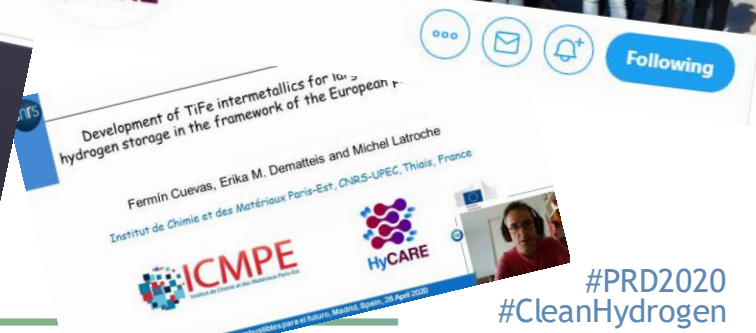
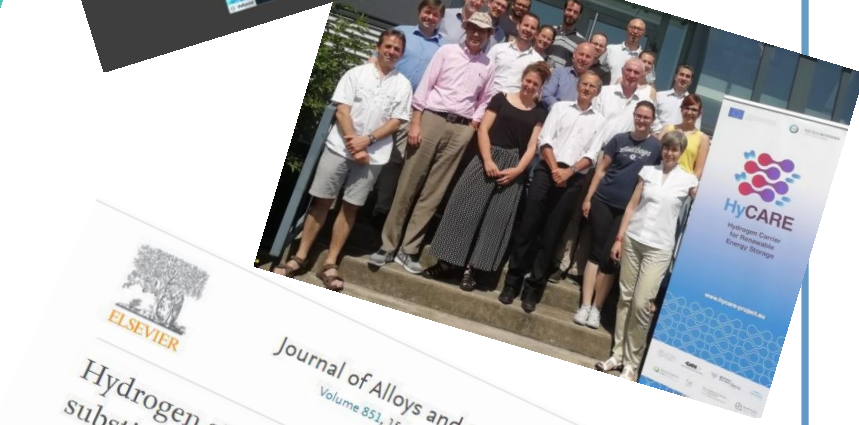
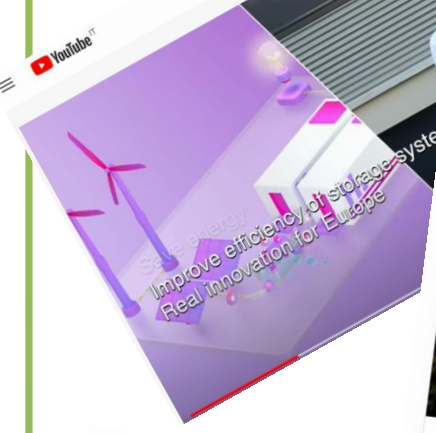
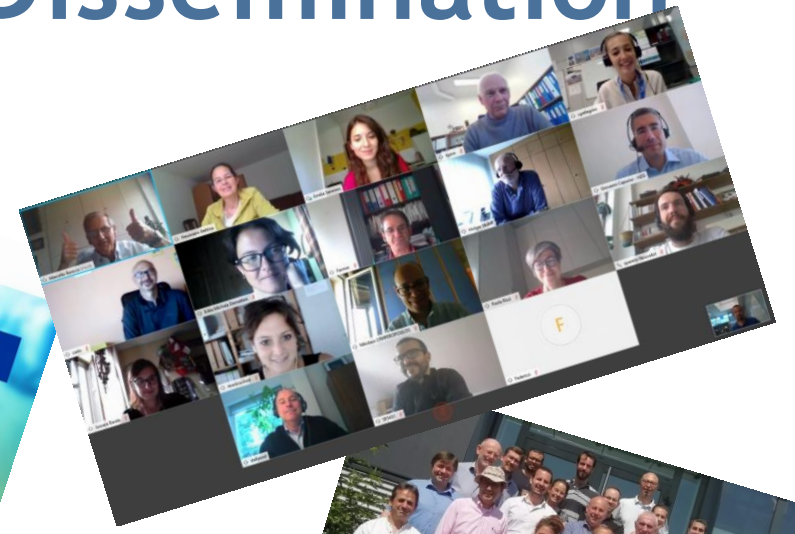
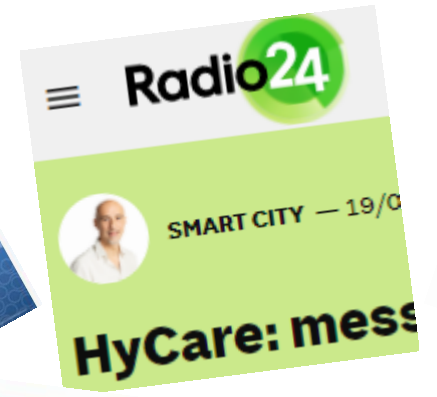


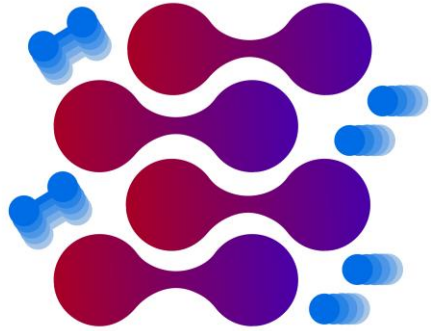
	KPIs	Unit
TECHNICAL	Storage efficiency	$kWh/kg-H_2$
	Gravimetric capacity	$kg-H_2/kg$
	Volumetric capacity	$kg-H_2/m^3$
	Nominal flowrate	kg/h
ECONOMIC	CAPEX	€
	OPEX	€/yr
	Cost of hydrogen (LCoH)	€/kg- H_2
	Lifetime	yrs
	Availability	%



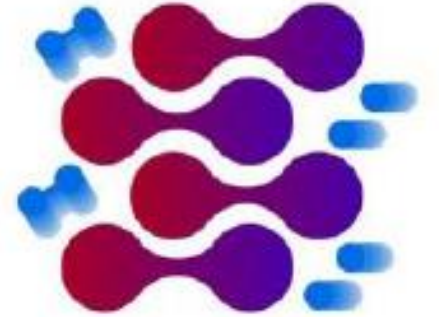


Communications and Dissemination Activities

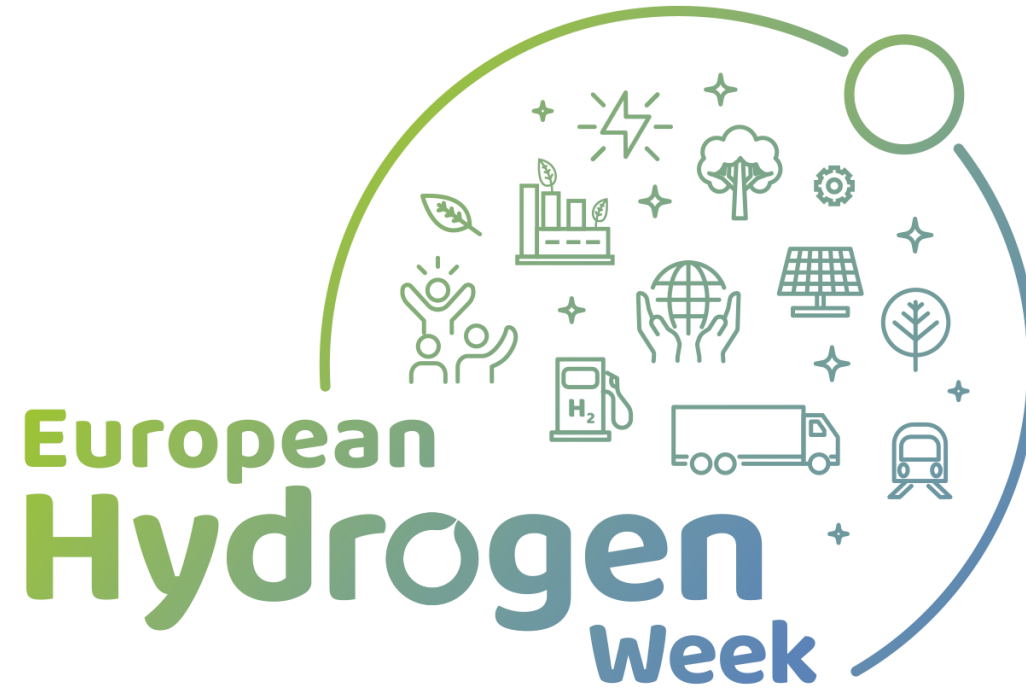




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