Clean Hydrogen Partnership

State of Play of off-shore green hydrogen projects

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24 March 2022

EUROPEAN PARTNERSHIP

Clean Hydrogen Partnership

Clean Hydrogen Joint Undertaking

EU Institutional Public-Private Partnership (IPPP)

To facilitate the transition to a greener EU society through the development of hydrogen technologies

Co-funded by the European Union

Clean Hydrogen Partnership

Clean Hydrogen JU Objectives

Support a sustainable hydrogen economy, contributing to EU's climate goals

Support the implementation of the Commission's Hydrogen Strategy

Stimulate research and innovation on clean hydrogen production, distribution, storage and end use applications

Strengthen the competitiveness of the EU clean hydrogen value chain

Contribute to the EU ambitious 2030 and 2050 climate ambition

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EU Hydrogen Strategy launched on 8th July 2020

Objectives in 3 phases with the Hydrogen Alliance to support the investment agenda

Phase 1: 2020-2024

- 6GW of renewable H_2 electrolysers
- 1 million tonnes renewable H_2
- Replace **existing** H_2 **production**
- Regulation for liquid H_2 markets
- Planning H_2 infrastructure

Phase 2: 2025-2030

- **40GW** renewable H_2 electrolyser
- 10 million tonnes renewable H_2
- New applications in steel & transport
- H2 for electricity balancing purposes
- Creation of "Hydrogen Valleys"
- Cross-border logistical infrastructure

Phase 3: 2030-2050

- H_2 technologies matured and deployed at large scale in hard to abate sectors.
- Expansion of hydrogen-derived synthetic fuels
- EU-wide infrastructure network
- An open international market

Clean Hydrogen Alliance to support the EU investment agenda

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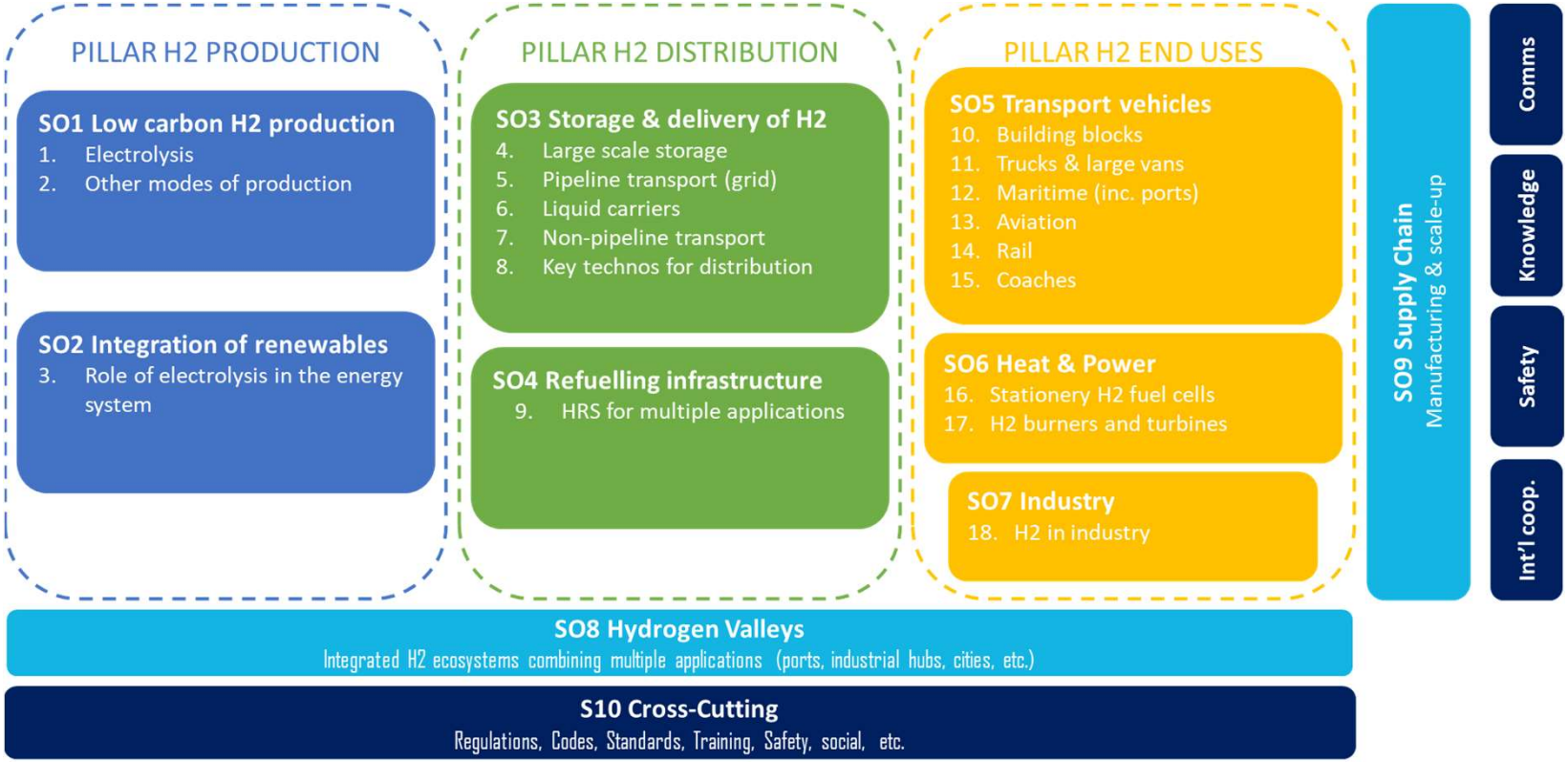
Research and Innovation priorities in Clean Hydrogen JU

Maintain and strengthen EU's global leadership role through a € 2.0 bn research program



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Clean Hydrogen JU Programme

H_2 Valleys

3 Projects

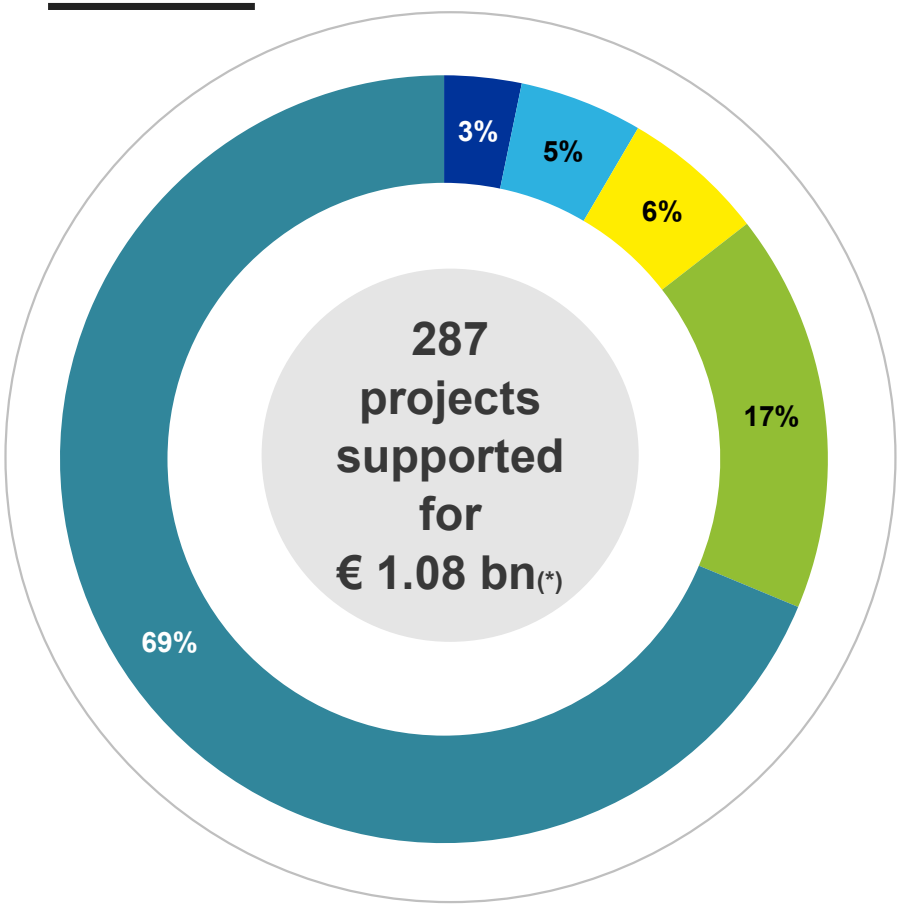
€ 35 million

H_2 End Uses

- Transport Applications
- Clean Heat and Power

159 Projects

€ 739.6 million



H_2 Storage & Distribution

22 Projects

€ 55.8 million

Cross-cutting

46 Projects

€ 65 million

H_2 Production

- Electrolysis
- Other routes

57 Projects

€ 181 million

(*) Similar leverage of other sources of funding: € 1.08 bn

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Electrolysis projects: increase capacity & lowering cost

Europe is world-leader in electrolysis systems
(EU has the most patents and publications vs other parts of the world)

Project: Don Quichot
Place: Belgium
Date: 2011
Electrolyser: Hydrogenics (PEM)
Funding: 5.0 m€

Project: Haeolus
Place: Norway
Date: 2017
Electrolyser: Hydrogenics (PEM)
Funding: 5.0 m€

Project: H2future
Place: Austria
Date: 2016
Electrolyser: Siemens (PEM)
Funding: 12 m€

Project: Djewels
Place: The Netherlands
Date: 2018
Electrolyser: McPhy (ALK)
Funding: 11 m€

Djewels → Scale -up → HYDROGEN VALLEY

NEXT:

~2025: several 100 MW's

~2030: GW scale

0.15 MW → 1.2 MW → 2.5 MW → 3.4 MW → 6.0 MW → 10 MW → 20 MW → 60MW → 100 MW

Project: Hybalance
Place: Denmark
Date: 2014
Electrolyser: Hydrogenics (PEM)
Funding: 8.0 m€

Project: Demo4grid
Place: Austria
Date: 2016
Electrolyser: IHT (ALK)
Funding: 2.9 m€

Project: Refhyne
Place: Germany
Date: 2017
Electrolyser: ITM (PEM)
Funding: 10 m€

The European Green Deal call awarded 3 projects to install a 100MW electrolyser each.

REFHYNE2 (D)
GREEN HYSCALE (DK)
GREEN H2 ATLANTIC (PT

Next: building standard modules (10~20MW), replacing materials, cost reduction

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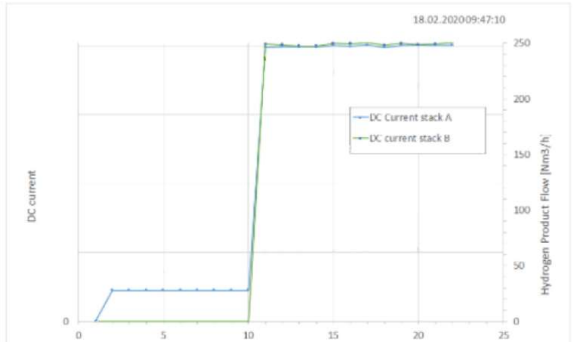
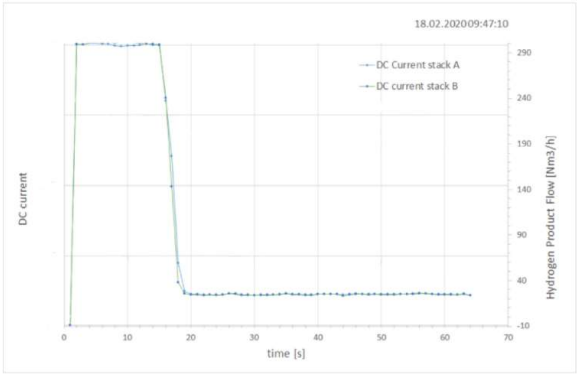
Power to hydrogen : a key building block for energy system integration

The Hybalance project: Producing green H2 from wind, providing grid balancing services (PtH2) and feeding light industry

HyBalance





15.2 M€ (Partners 7.2 M€ & Clean Hydrogen JU 8 M€)

Co-ordinated by Air Liquide

1.2 MW PEM electrolyser by Hydrogenics

Installed in Hobro, Denmark feeding light industry

Commissioned February 2018

Ramp-up and ramp down time within seconds. Loads from 10% to 100%

Provision of electricity grid balancing services reduced the electricity cost by 20%

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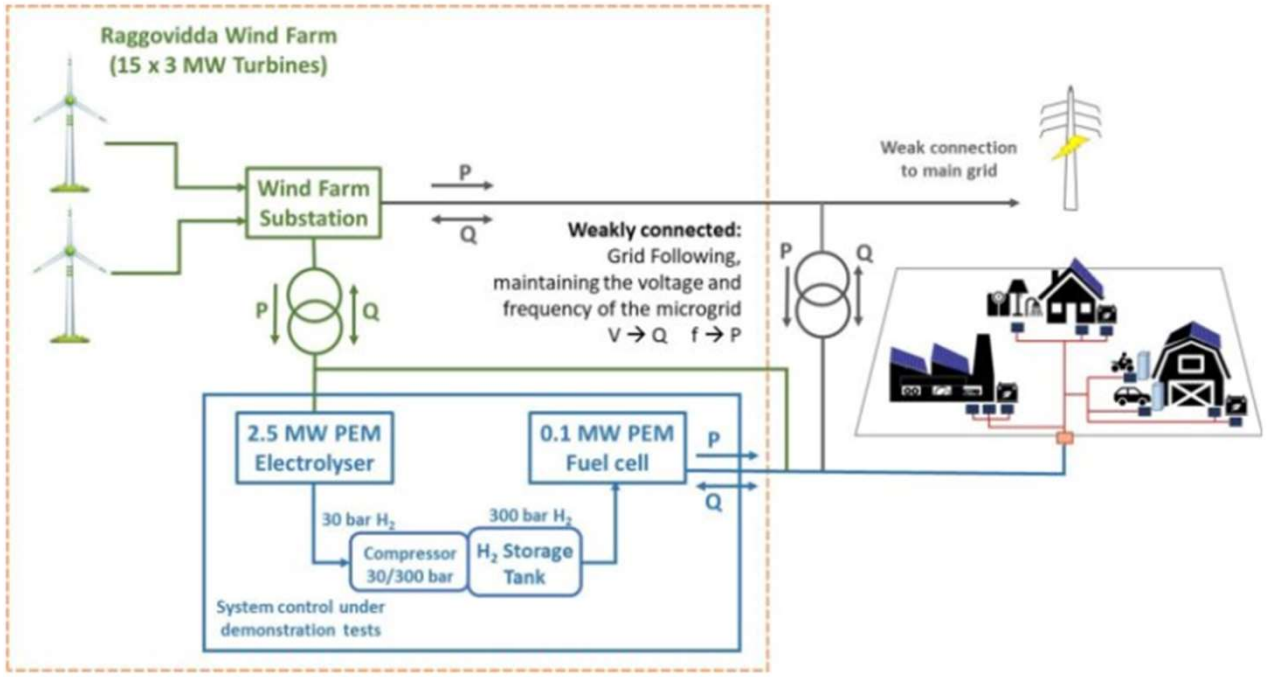
HAEOLUS project : electrolyser integrated in a wind farm in the Arctics

Protocols for demonstration of mini-grid and energy-storage strategy



7.6 M€ (Partners 2.6 M€ & Clean Hydrogen JU 5 M€)

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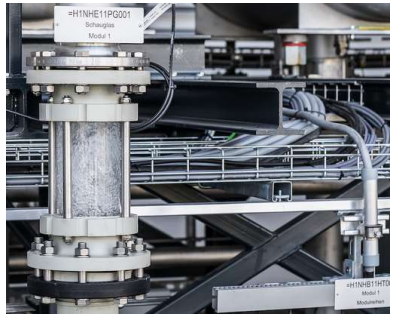
Greening the Steel Industry H2Future Project

Producing green H2 from hydro power, injecting in steel industry, providing grid services



H2FUTURE
Green Hydrogen

18 M€ (Partners 6 M€ & Clean Hydrogen JU 12 M€)

Co-ordinated by Verbund (electricity company of Austria)

6MW PEM atmospheric electrolyser by Siemens

Installed in Voestalpine (steel industry) in Linz

H2 injected in coke oven gas. Long term view is direct iron ore reduction through H2

In operation since 2020

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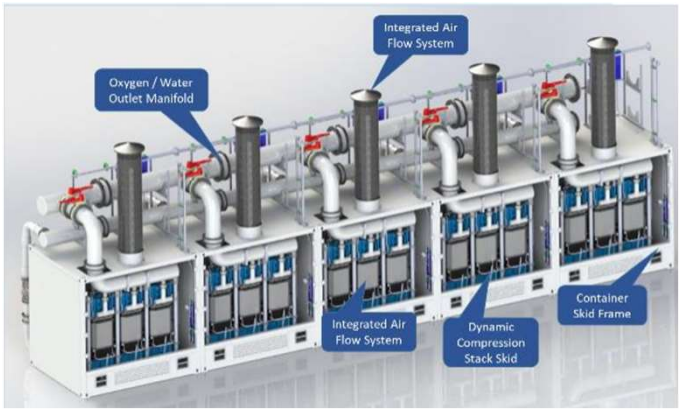
Refhyne project: Hydrogen production for industry and grid balancing



The Wesseling Shell refinery located near Cologne in Germany supplies 10-15% of the fuels demand in Germany

- ✓ 16 M€ (Partners 6 M€ & Clean Hydrogen JU 10 M€)
- ✓ Today the refinery uses 180,000 T of hydrogen per year (SMR)
- ✓ One ITM electrolyser of 10 MW will produce 1,300 T of hydrogen per year (pressure 20 bar)
- ✓ Largest PEM electrolyser in Europe in an industrial environment inaugurated in July 2021
- ✓ Scalable to 100 MW (Green Deal call)
- ✓ Future applications and revenues in grid balancing, mobility, heating of buildings

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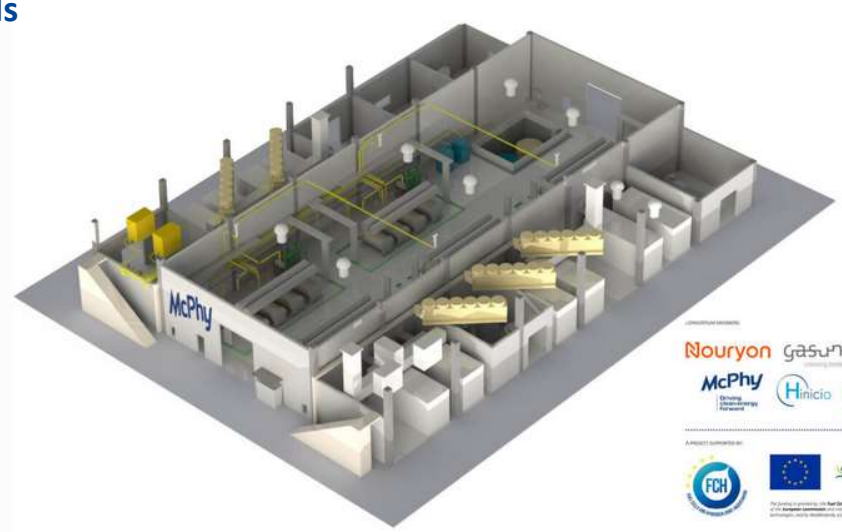
Djewels project: Greening the Methanol Industry - largest electrolyser in Europe

Project located in Groningen Delfzijl industrial park in the Netherlands

- ✓ 43 M€ (Partners 32 M€ & Clean Hydrogen JU 11 M€)
- ✓ **One McPhy alkaline electrolyser of 20 MW, production of 3000 tonnes of green hydrogen/year**
- ✓ **Green methanol is produced by combining CO2 from other processes and green hydrogen (Nouryon, Gasunie)**
- ✓ **Methanol used as a green fuel or a chemical raw material (ethylene, propylene)**
- ✓ **H2 fed to existing pipeline – grid and load balancing services**



Off shore Hydrogen Production

Current project: OYSTER - Electrolyser module for offshore production of renewable hydrogen

- “Marinised” >1MW PEM electrolyser; minimal maintenance; compact; integrated desalination
- Electrolyser to be installed at post of Grimsby, 5m from sea front
- Hydrogen to feed H2-fuelled vessel for servicing wind turbines
- Clean Hydrogen JU funding: 5M€, 100% of total costs; Duration Jan 2021 – Dec 2024
- Project partners: Element Energy, ITM Power, Ørsted, Siemens Gamesa Renewable Energy

Clean Hydrogen Partnership funded Hydrogen Valley

Big Hit project produces hydrogen near the coast

2015: Orkney's Island (Scotland):

- H2 production by wind on Islands
- Storage & transportation by truck
- Use: heat (school), power (ferries) & mobility (municipality cars)

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Important information

Launch of the call

March 1st 2022: Launch of the call for proposals

- 300.5m EUR call for 41 topics:
  - ✓ Renewable hydrogen production (10)
  - ✓ Hydrogen distribution & storage (11)
  - ✓ Transport (8)
  - ✓ Heat and Power (4)
  - ✓ Cross-cutting (5)
  - ✓ Overarching (2)
  - ✓ Strategic Research Challenge (1)

- Two cut-off dates: 31st May and 20th September

https://www.clean-hydrogen.europa.eu/apply-funding/call-proposals-2022/call-proposals-2022_en

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Off shore Hydrogen Production

Current Call for proposals: Demonstrating offshore production of renewable hydrogen

- Clean Hydrogen JU funding: 20M€, < 50% of total cost - Flagship project
- >5MW electrolyser on offshore platform – new or integrated to existing one
- Electrical connection to off-shore wind park, pipeline to shore for hydrogen
- Deadline for proposal submission: 20th September 2022

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International cooperation opportunities

The EU wants to stimulate international cooperation with entities from the Clean Hydrogen Mission member countries*

Submission by 31st May 2022

- ***Sampling methodology and quality assessment of HRS***
- ***Safety of cryogenic hydrogen transfer technologies in public areas for mobile applications***
- ***Development of validated test methods and requirements for measuring devices intended for measuring NG/H2 mixtures***

Submission by 20th Sept. 2022

- ***Compatibility of Distribution non-steel metallic gas grid materials with hydrogen***
- ***Public understanding of hydrogen and fuel cell technologies***
- ***Safe hydrogen injection management at network-wide level: towards European gas sector transition***
- ***Hydrogen Valleys (large-scale)***
- ***Hydrogen Valleys (small-scale)***

MI CLEAN HYDROGEN MISSION

* Co-leads: European commission, Australia, Chili, UK, USA
Member: Austria, Canada, China, Germany, India, Italy, Japan, Republic of Korea, Morocco, Norway, Saudi Arabia

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Hydrogen Valleys in Europe www.h2v.eu

23 Hydrogen valley's identified in 10 EU countries + U.K.

3 in The Netherlands:
- North Netherland*
- Zuid Holland
- Zeeland (H2 delta)

2 in U.K.:
- North West England
- Orkney Islands*

4 in France:
- Rhone Alpes
- Normandy
- Bourgogne Franche Comté
- French Guiana

3 in Spain:
- Island Mallorca*
- Basque (BH2C)
- Green Crane

1 in Denmark:
Hobro (Hybalance)

5 in Germany:
- Munich (Hybayern)
- Mannheim (H2rivers)
- Heide (eFarm)
- Hamburg (NDRL)
- Oldenburg (HyWays)

1 in Slovakia:
Kosice (Black Horse)

1 in Romania:
Constanza (Blue Danube)

1 in Portugal:
Sines industrial hub

1 in Italy:
Bolzano

1 in Austria:
Linz (WIVA)

By 2030 the EU has the ambition to create multiple H_2 valleys in EU:
Ports, Airports, Industrial hubs, Logistical hubs, cities, cross border

* Financially supported by the Clean Hydrogen Partnership

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CEF (Connecting Europe Facility) funding opportunities

Synergies with other EU funding instruments are envisioned

Call opening	16 September 2021				
	1st cut-off date	2n cut-off date	3rd cut-off date	4th cut-off date	5th cut-off date
Deadline for submission:	19 Jan. 2022 17:00 CET (Brussels)	**7 June 2022 17:00 CET (Brussels)**	**10 Nov. 2022 17:00 CET (Brussels)**	13 April 2023 17:00 CET (Brussels)	19 Sept. 2023 17:00 CET (Brussels)
Evaluation:	Feb. – March 2022	July – Aug. 2022	Dec 2022 – Jan 2023	May – June 2023	Oct. – Nov. 2023
Information on evaluation results:	May 2022	Oct. 2022	March 2023	July 2023	Jan 2024
GA signature:	Sept – Oct. 2022	Feb. – March 2023	July – Aug. 2023	Dec. 2023 – Jan. 2024	May – June 2024

Consortia should submit for some topics another proposal to CEF for the Hydrogen Refueling stations

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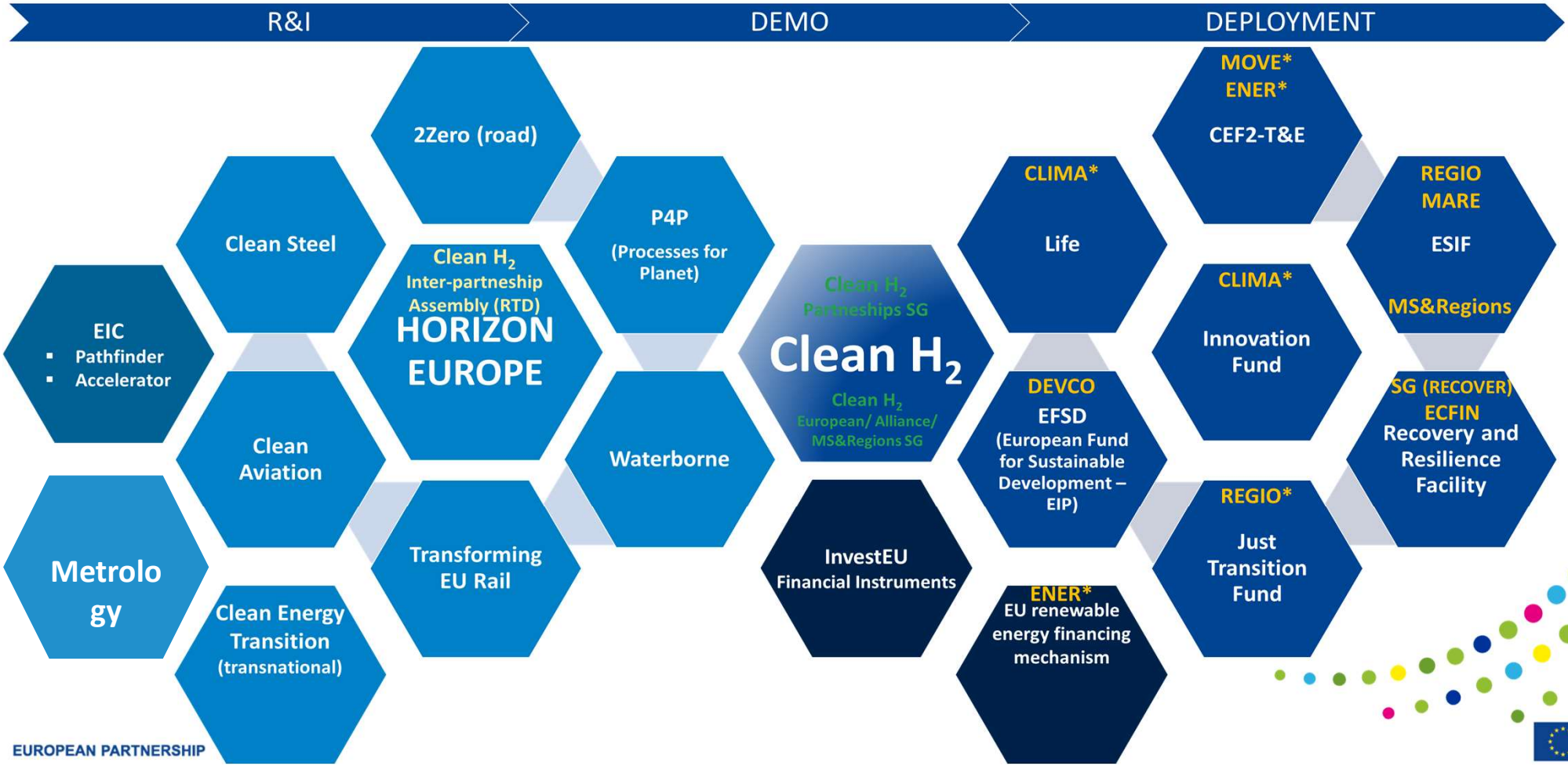
Other EU funding instruments

Synergies with other EU funding instruments are encouraged



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Educational Activities – Overview

Preparing the European workforce is crucial for scaling up the industry.

Educational and training programs tailored to multiple target groups

Multiple levels and types of education, learning formats, features…

Graduate *Undergraduate* … *In person training* … *Serious games* *Mock-up* *installations*

Vocational *Compulsory* … *e-learning* *blended* … *Virtual reality*

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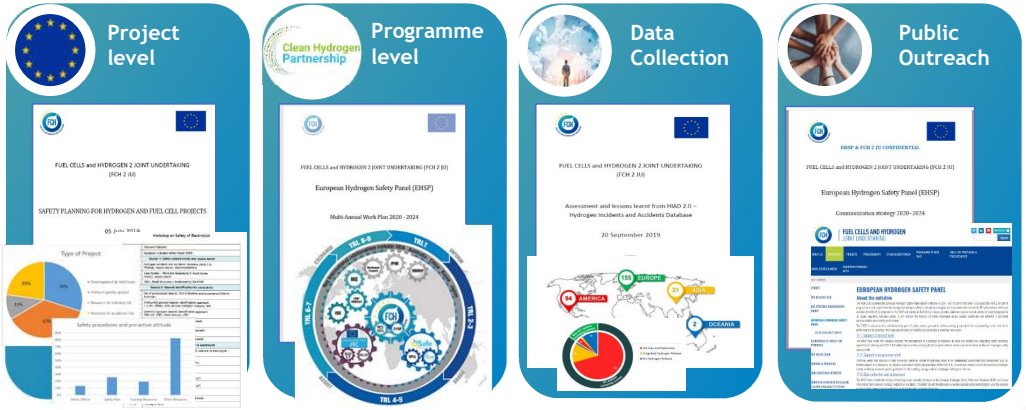
Clean Hydrogen JU safety-related activities

European Hydrogen Safety Panel (EHSP) – Expert group supporting the Programme and beyond

- Assuring that hydrogen safety is adequately managed
- Promoting and disseminating a high-level hydrogen safety culture



Working groups

Clean Hydrogen Partnership

Fuel Cells and Hydrogen Observatory (Launched 15 Sept '20)

One stop shop to understand where the Clean Hydrogen sector is at and how it is evolving

FCHO FUEL CELLS AND HYDROGEN OBSERVATORY

- **Go to resource for all things on fuel cells and hydrogen**
- **User friendly and reliable output**
  - charts, graphs and data downloads
  - reports
- **It covers**
  - Technology & Market
  - Policies & regulation
  - Codes & Standards
  - Patents & Publications
  - Funding
  - Education & Training
- **Global resource**

www.fchobservatory.eu

Email: *info@fchobservatory.eu*

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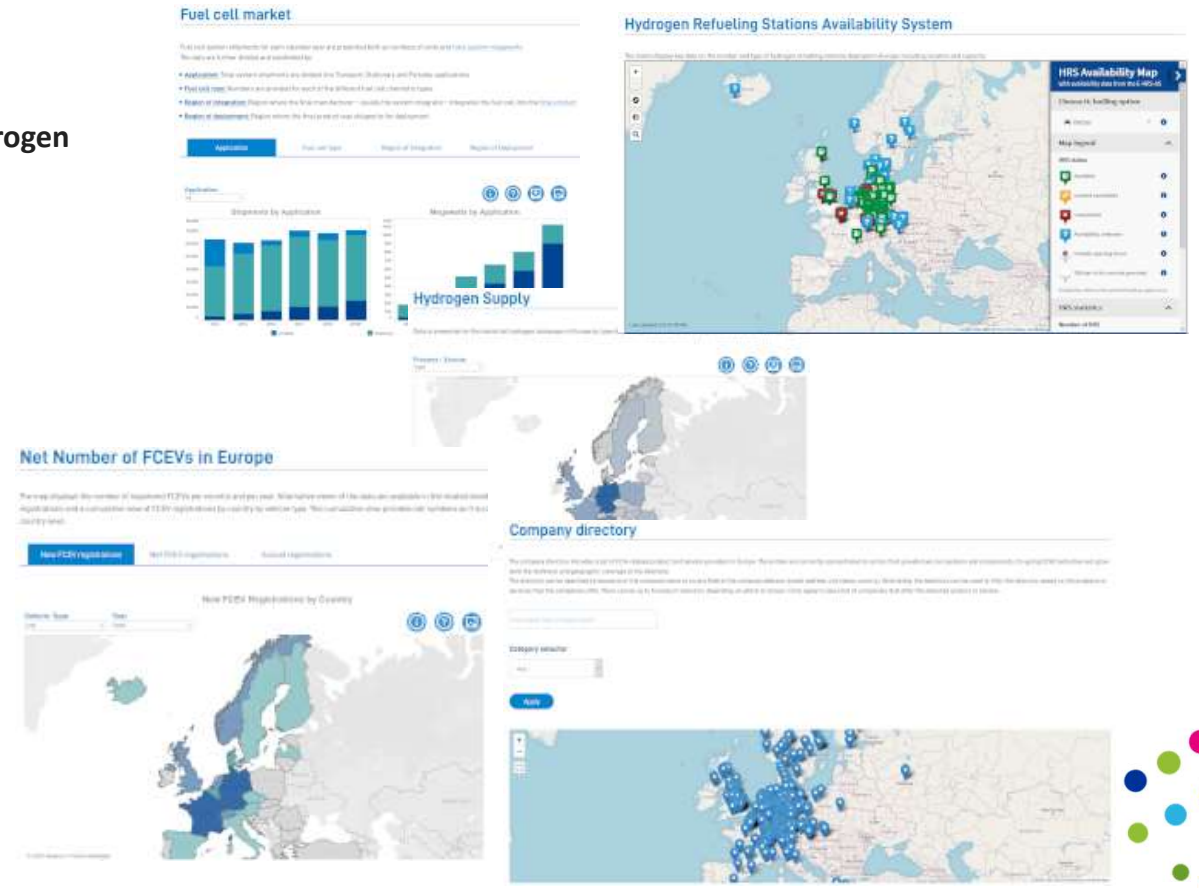

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