

# Topics in the call 2025

## Renewable Hydrogen Production

N. Lymperopoulos, D. Tsimis,  
C. Pavel, E. Kontonasiou



# Renewable Hydrogen Production Overview

2



## Main Focus

- Electrolysers:
  - Going beyond the stack to include BoP for improved lifetime and cost
  - Scaling up manufacturing
  - Integration with Renewables
  - Co-electrolysis



## What is new

- Alternative routes
  - H<sub>2</sub> and solid carbon from renewable gases and biogenic waste
  - Natural H<sub>2</sub>

# Renewable Hydrogen Overview (1/2)

Topic	Type of Action	Budget (M€)
HORIZON-JU-CLEANH2-2025-01-01: Improvements in lifetime and cost of low temperature electrolyzers by introducing advanced materials and components in stacks and balance of plant	RIA	4
HORIZON-JU-CLEANH2-2025-01-02: Improved lifetime and cost of high-temperature electrolyzers by introducing innovative materials and components in stacks and BoP	RIA	2x4
HORIZON-JU-CLEANH2-2025-01-03: Scale-up and Optimisation of manufacturing processes for electrolyser materials, cells, or stacks	RIA	2x4
HORIZON-JU-CLEANH2-2025-01-04: Efficient electrolysis coupling with variable renewable electricity and/or heat integration	IA	6*
HORIZON-JU-CLEANH2-2025-01-05: Innovative co-electrolysis systems and integration with downstream processes	RIA	4

**\*This is the maximum Clean Hydrogen JU contribution that may be requested – proposals requesting Clean Hydrogen JU contributions above this amount will not be evaluated.**

# Renewable Hydrogen Overview (2/2)

Topic	Type of Action	Ind. Budg (M€)
HORIZON-JU-CLEANH2-2025-01-06: Innovative hydrogen and solid carbon production from renewable gases/biogenic waste processes	IA	8*
HORIZON-JU-CLEANH2-2025-01-07: Towards exploration and evaluation of European natural hydrogen potential	RIA	2

\*This is the maximum Clean Hydrogen JU contribution that may be requested – proposals requesting Clean Hydrogen JU contributions above this amount will not be evaluated.

# Renewable Hydrogen - Topics

## **HORIZON-JU-CLEANH2-2025-01-01: Improvements in lifetime and cost of low temperature electrolyzers by introducing advanced materials and components in stacks and balance of plant**



**Development and integration of advanced materials in stack & BoP components (TRL 3/4 → 5/6)**



- Advanced functional and structural materials and/or components for cells, stack and integration with BoP
- > 20kW stack for > 2,000h testing
- PEMEL & AEL TRL 4 → 6, AEMEL TRL 3 → 5
- Testing protocol development; dynamic operation; numerical model for lifetime

## **HORIZON-JU-CLEANH2-2025-01-02: Improved lifetime and cost of high-temperature electrolyzers by introducing innovative materials and components in stacks and BoP**



**Understand degradation mechanisms related to electrolyte, electrodes, interconnects, seals, BoP (TRL 3 → 4/5)**



- Improvements to materials and multi-stack configurations
- > 20kW stack for > 2,000h testing
- SOEL TRL 3 → 5, PCCEL TRL 3 → 4
- Accelerated Stress Testing protocols, modelling

# Renewable Hydrogen - Topics

## HORIZON-JU-CLEANH2-2025-01-03: Scale-up and optimisation of manufacturing processes for electrolyser materials, cells, or stacks



**Maintain European leadership in electrolyser production & deliver high-quality stacks (TRL 4 → 5/6, MRL 4 → 5)**



- Production scale-up of materials, components and stack, improved circularity, reduction of waste
- Increased production rates – use experience of FC or battery industry
- Increased automation to improve throughput, tighten tolerances and reduce scrap
- Validation on OEM-relevant stack (TRL 5/6, MRL 5); AEL, PEMEL, SOEL, AEMEL under the scope
- Use of Artificial Intelligence / machine learning for scalability of processes; develop quality control tools
- Build on existing projects, synergy with Made in Europe partnership and the Zero-Defect Manufacturing Platform
- Relevant to OEMs & component suppliers with support from research and RTOs

# Renewable Hydrogen - Topics

## **HORIZON-JU-CLEANH2-2025-01-04: Efficient electrolysis coupling with variable renewable electricity and/or heat integration**



### **Integration of electrolysis plants into energy systems fed with variable renewable energy (TRL → 7)**



- Coupling of multi-MW electrolysis plants to variable renewable energy generation (both on- and off-grid, directly or indirectly coupled);
- Synergies between electrolysis plants and external heat stakeholders (producers and consumers) with improved thermal management of electrolysis plant;
- Smoothen ramp-up and ramp-down through storage (H<sub>2</sub>, heat, water, power)
- BoP, power electronics, grid services, digital technologies
- Minimise power consumption @ stand-by
- > MW, > 6 months demonstration
- existing electrolyzers could form basis of advanced plant
- “It is expected to have an electrolyser manufacturer in the consortium for this topic. In addition, it is encouraged to include a balance of plant manufacturer. Cooperation with renewable hydrogen production plant operators is also encouraged”
- demonstrate contribution to EU competitiveness



# Renewable Hydrogen - Topics

## HORIZON-JU-CLEANH2-2025-01-05: Innovative co-electrolysis systems and integration with downstream processes



### Co-electrolysis for hydrocarbon synthetic production processes & production of e-fuels (TRL 3 → 5)



- improvements in efficiency, cost-effectiveness, environmental sustainability, technological advancement, market competitiveness
- SOEL, PCCEL, Molten Carbonate Electrolysers; different catalysts & operating conditions – avoid coke formation
- Design integrated co-electrolyser and downstream reactor with ad hoc BoP to increase global  $\eta$  and promote syngas production stability, supported by simulation
- Operate co-electrolyser and downstream process @ short stack scale > 3000h
- Costs related to downstream process unit design and development will not be funded
- Coupling should be performed in a location where such a reactor is available at the adequate size for a good matching with the co-electrolyser
- An electrolyser OEM should be involved in the consortium for this topic. Participation of industrial partners in the integration downstream and valorisation of the co-electrolysis product is expected.



# Renewable Hydrogen - Topics

## HORIZON-JU-CLEANH2-2025-01-06: Innovative hydrogen and solid carbon production from renewable gases/biogenic waste processes



**transform biogenic wastes/biogas/biomethane/renewable gases into hydrogen and solid carbon (TRL → 7)**



- Diverse methods in terms of energy input (microwave, thermal and non-thermal plasma, induction, shockwave, radiation heating, direct thermal heating) and reactor design (bubble column, plug, fluidised-bed, packed-bed, pulse tube, tubular, fluid wall, honeycomb monolith)
- Production of 30 kgH<sub>2</sub>/h; purity suitable for downstream use (98-99.97%)
- Significant carbon material production (> 50% of the initial carbon in the material input)
- Proposals should consider different feedstocks and routes to identify optimal techno-economic option
- Explore synergies with EURAMET and its projects
- Contribute to European competitiveness

# Renewable Hydrogen - Topics

## HORIZON-JU-CLEANH2-2025-01-07: Towards exploration and evaluation of European natural hydrogen potential



### Strengthened European leadership in the exploration of Natural H2 to identify and evaluate reserves (TRL 2 → 4)



- Improved understanding of the occurrence and the resource potential of natural hydrogen in Europe; define prospective areas for exploration and production
- support both the development of new methods, technologies, and workflows that will enable the development of Exploration & Production of natural hydrogen in Europe.
- Develop tools, techniques, methods to understand the formation and accumulation of H2 - > 1 case study to test sensors
- Experimental simulation of in situ conditions & numerical modelling
- LCA & Guidelines for identification of potential sources
- Can natural H2 be classified as RFNBO?