

Overview of the Clean Hydrogen JU Electrolysis Programme

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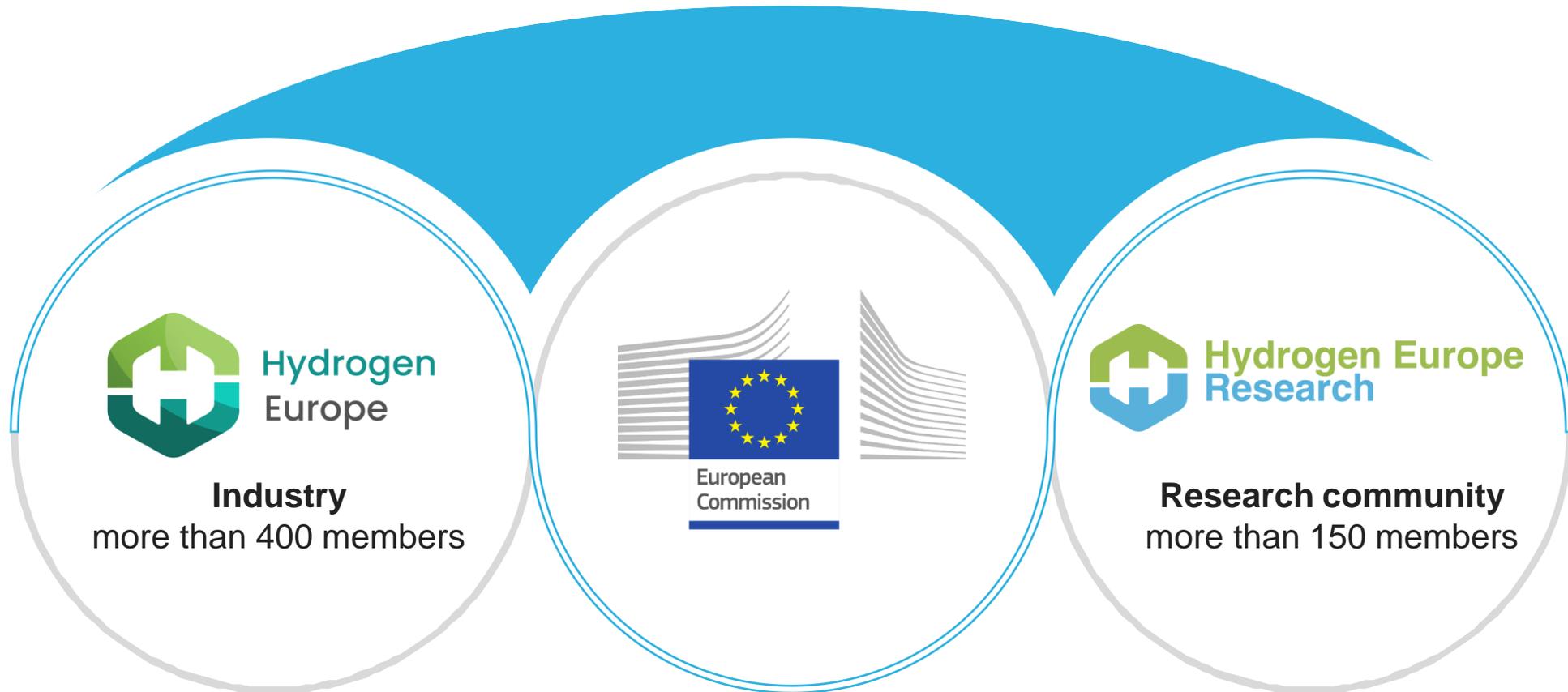
CLEAN HYDROGEN JU AEMEL PROJECT FINDINGS & JRC ELECTROLYSER DEGRADATION
"2 IN 1" WORKSHOP

29/09/2023



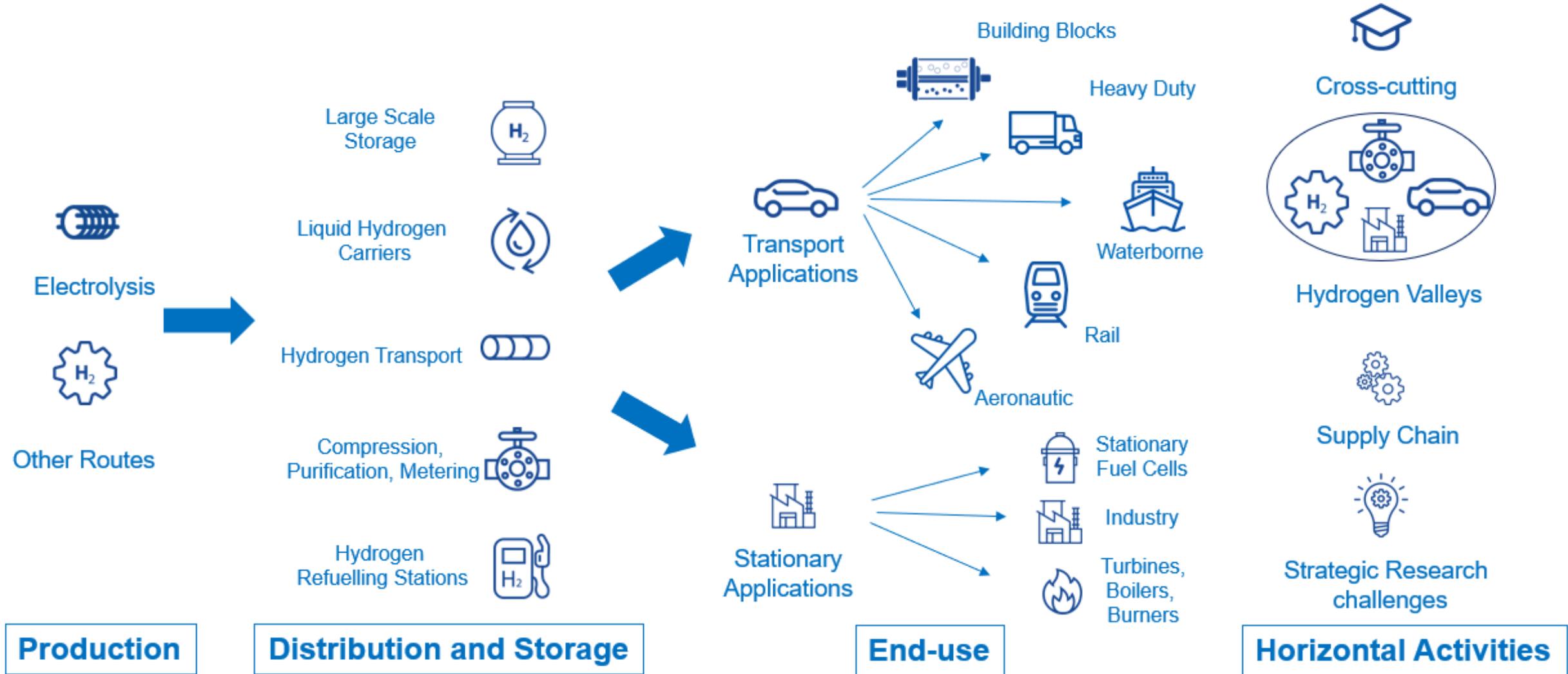
Clean Hydrogen Joint Undertaking

EU Institutional Public-Private Partnership (IPPP)

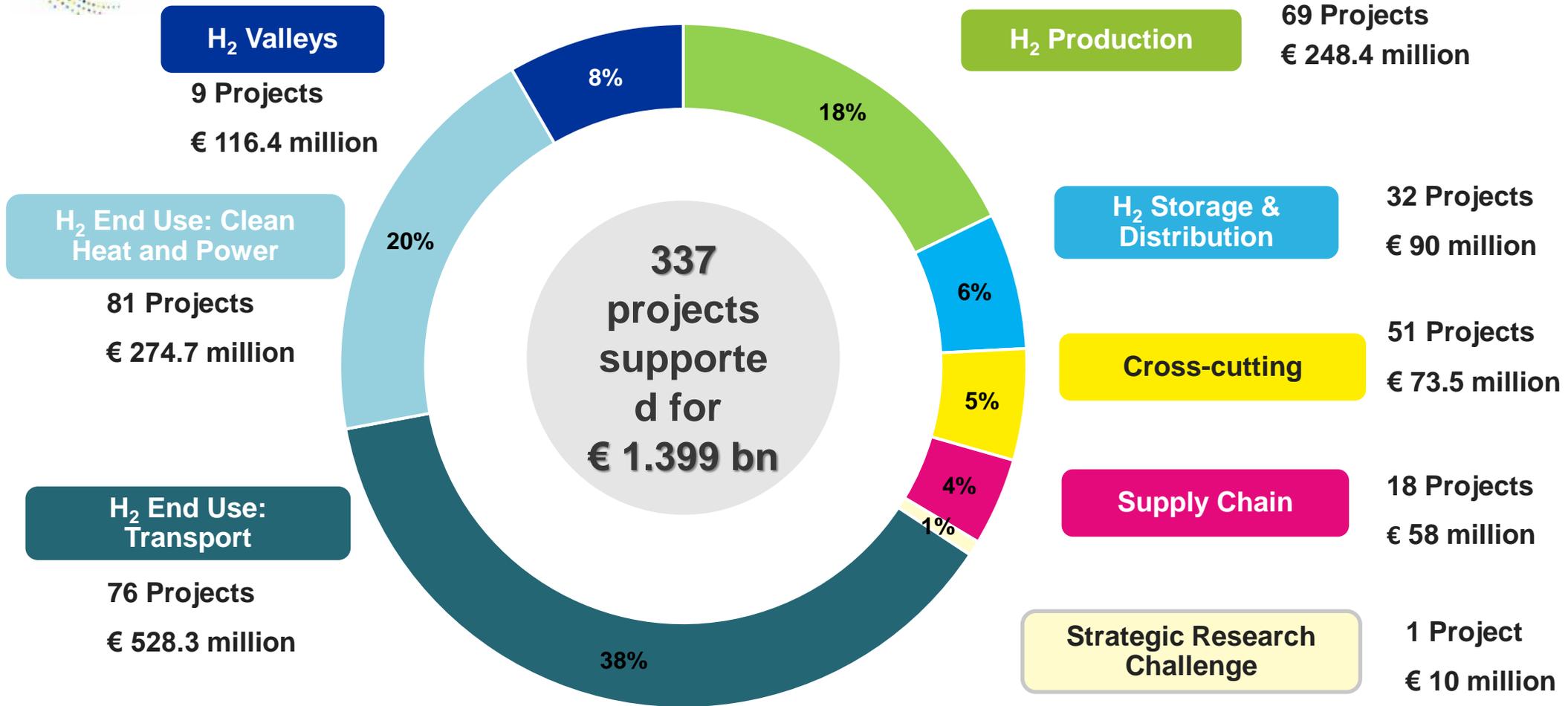


1 billion EURO from Horizon Europe* to implement R&I activities and facilitate the transition to a greener EU society through the development of hydrogen technologies

*** additional 200 million EURO for Hydrogen valleys (under RePowerEU)**



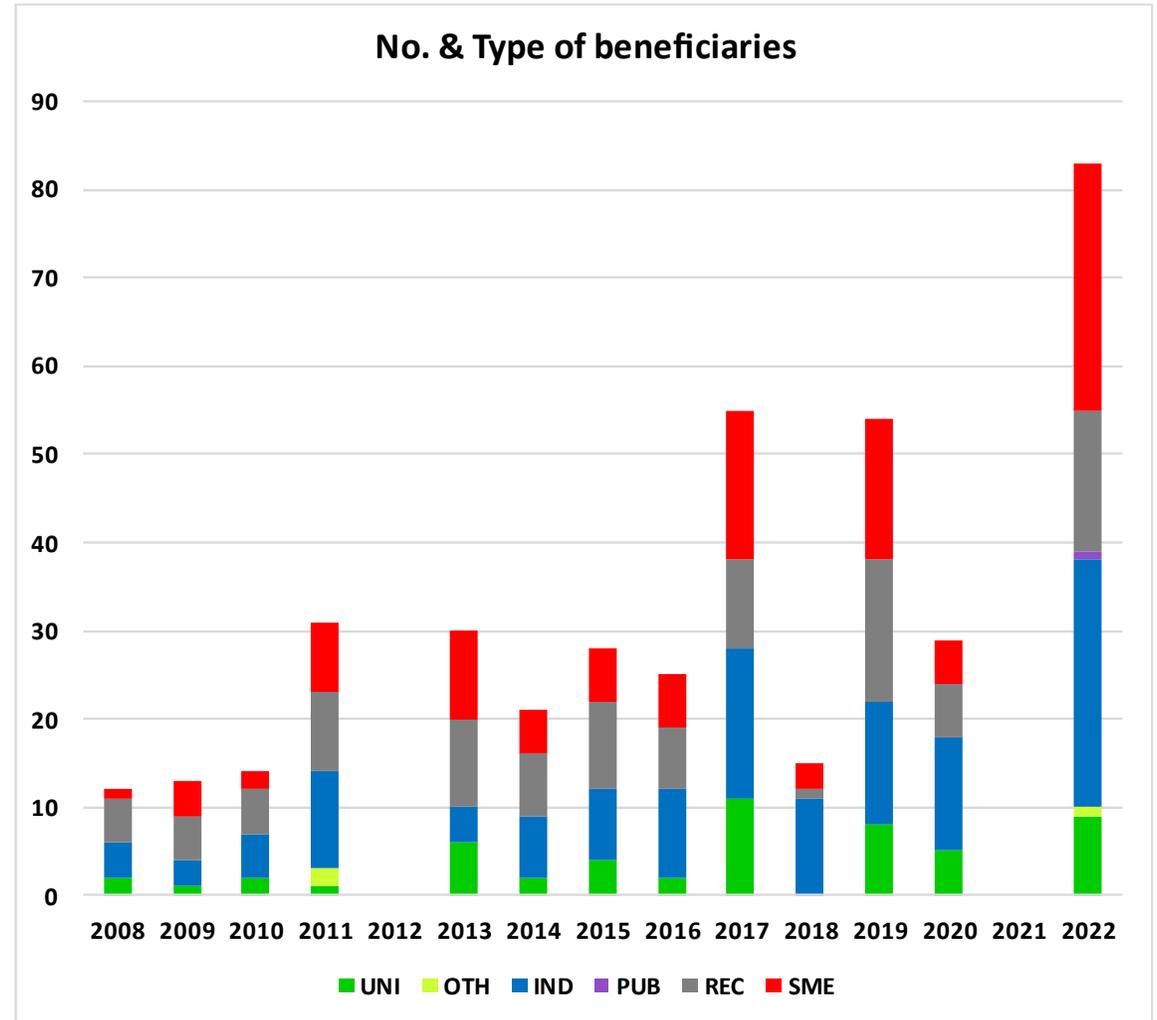
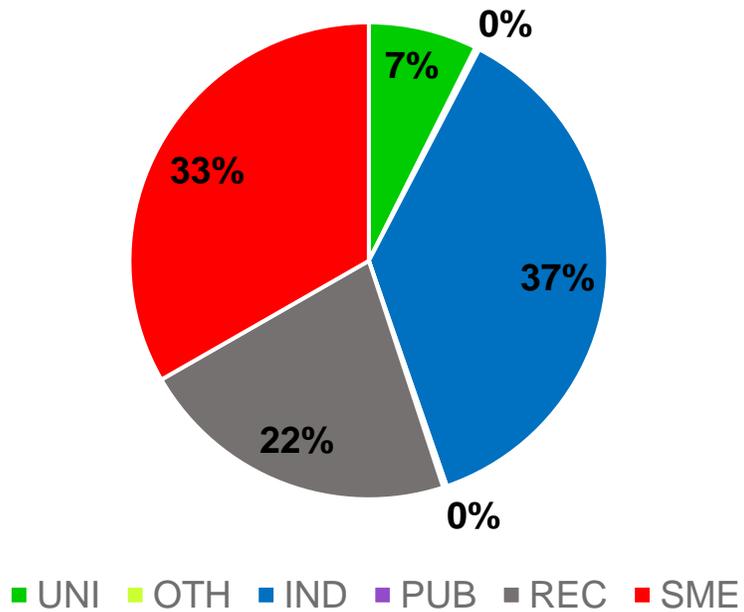
Clean Hydrogen JU Programme



*Some projects of Call 2022-2 are still under preparation and thus excluded from the figures above

Electrolysis Research and Demonstration

JU Funding per type of beneficiary



LT Electrolysis Demonstration projects

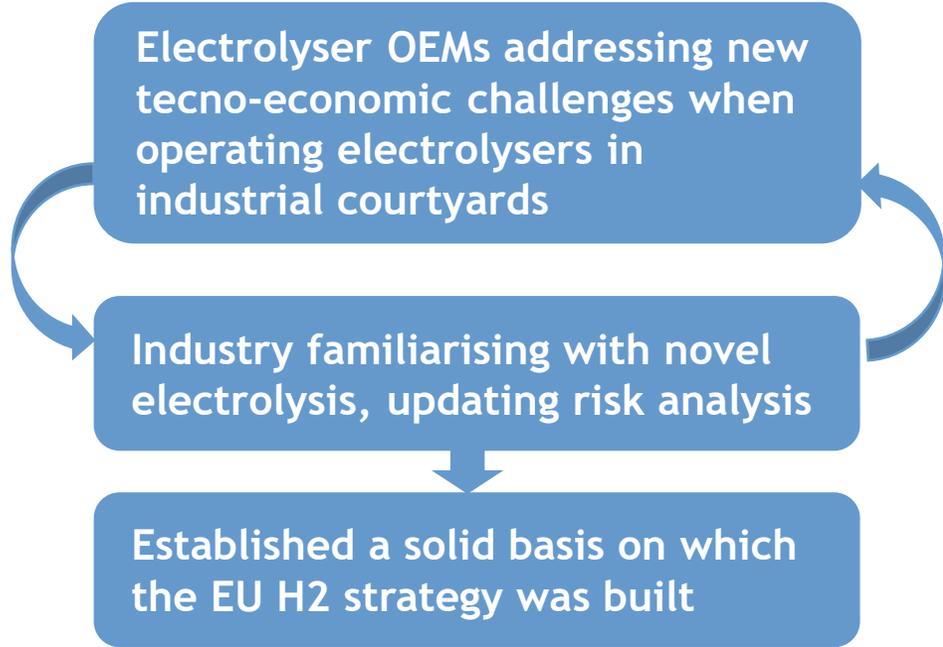
- In 11 years electrolyser capacity increased 500× and funding per MW installed reduced 100×



Stacks: PEMEL 0.5-1.25 MW; AEL 1-3MW

LT Electrolysis Demonstration projects

- EU Electrolyser industry ready to support EU H₂ policies



$\eta=83\%_{\text{HHV}}$, purity 99.9%

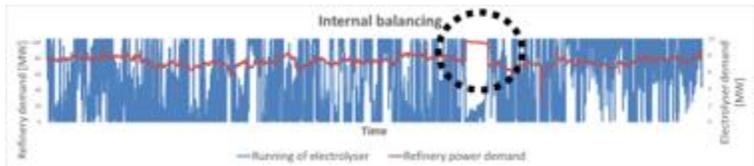
Operating range 15-150%

H₂ production costs < 25-50%



Lack of suitable BoP

Cost of electricity



LT Electrolysis R&I projects

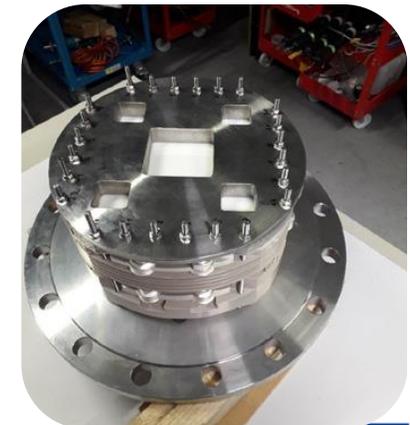
- 2018: 2 projects on game-changer low temp electrolyzers



- 25kW, 100bar self-pressurising PEM electrolyser with simplified BoP
- @ 90 °C, cell voltages of 1.74 V @ 4 A cm⁻² and 1.98 V @ 8 A cm⁻²
- η degradation rate 0.23%/1,000h



- 25 kW, 90bar PEM electrolyser system
- Cell $\eta=77%$, Ti PTL 6 A·cm⁻² @ 90C, non-precious metal coatings
- 2,000h test @ 100bar



LT Electrolysis R&I projects

2019: 3x Anion Exchange Membrane electrolyser projects



2 kW AEM electrolyser

1.75V @ 1 A/cm²; 0.1M KOH

Reinforced AEMs, no CRM electrocatalysts



2 kW AEM electrolyser

1.8V @ 1 A/cm²; 0.1M KOH

P2D S/W model



2 kW AEM electrolyser, hydraulic compression

2V @ 1.8 A/cm²; 0.1M KOH

AEMs reinforcement using covalent bonds



H₂ & O₂ evol catalysts @ 0.1 M KOH 

Functional materials to be validated @ stack level 

AEMEL Testing protocols 

AEMEL hub 

2022: 2x Anion Exchange Membrane electrolyser projects

HERAQLS: manufacturing processes for 25kW AEMEL - 500 cm² cells, 50 bar, 1A/cm²
 HYScale: upscaling to 100kW AEMEL - 400 cm² cells, 15 bar, 2A/cm²

LT Electrolysis R&I projects

Going off-shore

2020: OYSTER project



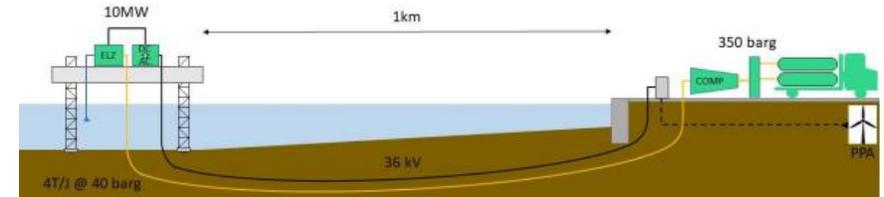
Marinisation of 3MW
AEL

Near-shore operation

W/T following

Integrated
desalination

2022: HOPE project



Marinisation of 10MW
PEMEL

Off-shore operation

Oostende

Recycled barge

LT Electrolysis R&I projects

2022: Development of low temperature water electrolyzers for highly pressurised hydrogen production



Advanced High Pressure and Cost-Effective
PEM Water Electrolysis Technology

Cost-effective solutions for
PEM electrolyzers

H₂ production at high
pressures of up to 200 bar

Solutions at materials, stack,
and system levels

Validation with a 50 kW
electrolyser (24 kg H₂/day)



Advanced alkaline electrolysis technology for pressurised H₂
production with potential for near-zero energy loss

Next generation of AEL

- Highly pressurised H₂ production (80 bar)
- Raise temperature (120°C)

Design of electrocatalysts &
polymers; engineering & process
intensification of cell design

Demonstration at industrial scale
(50 kW)

PEACE

Pressurized Efficient Alkaline EleCtrolysEr

AEL system demonstrator >50 kW

Operation at a pressure up to 90
bar, achieved by a novel concept
in which the pressurization is
done at two stages

Advanced components, innovative
design, optimized operation
strategies through modelling and
experimental testing

LT Electrolysis Demonstration projects

AWP 2022 Topic 01-08: Integration of multi-MW electrolysers in industrial applications

- Project: EPHYRA
- Coordinator: MOH
- Duration: 5 years
- Project Costs = 25.4M EUR, JU contribution = 17.7M EUR.
- Project Objectives:
 - Integrate 30MW improved electrolyser in refinery
 - Industrial symbiotic approach to use of waste heat through ORC, use O₂, optimise water use
 - Digital twin optimal control system



LT Electrolysis R&I projects

- **Topic 01-01:** Innovative electrolysis cells for hydrogen production – 24 proposals
 - 6 MEuro JU contribution
 - Improve efficiency (<48kWh/kg) and life time, reduce CRMs
 - Innovative cells using multi disciplinary approach: material science, nano-engineering, bio-hybrid catalysts
- **Topic 01-03:** Advances in alkaline electrolysis technology – 7 proposals
 - 2.5 MEuro JU contribution
 - Improvements in performance, reduction in cost from materials to BoP components, control, systems

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For further information
<https://www.clean-hydrogen.europa.eu/>

