



**FUEL CELLS AND HYDROGEN**  
JOINT UNDERTAKING

***FCH JU***  
***Support to***  
***Electrolysis***  
***Development***

***Nikolaos***  
***Lymperopoulos***

**HPEM2GAS Workshop**

*Emden, 12<sup>th</sup> February 2019*





# Strong public-private partnership with a focused objective

EU Institutional Public-Private Partnership (IPPP)



## Fuel Cells & Hydrogen Joint Undertaking (FCH 2 JU)



**Industry grouping**  
More than 130 members  
50% SME



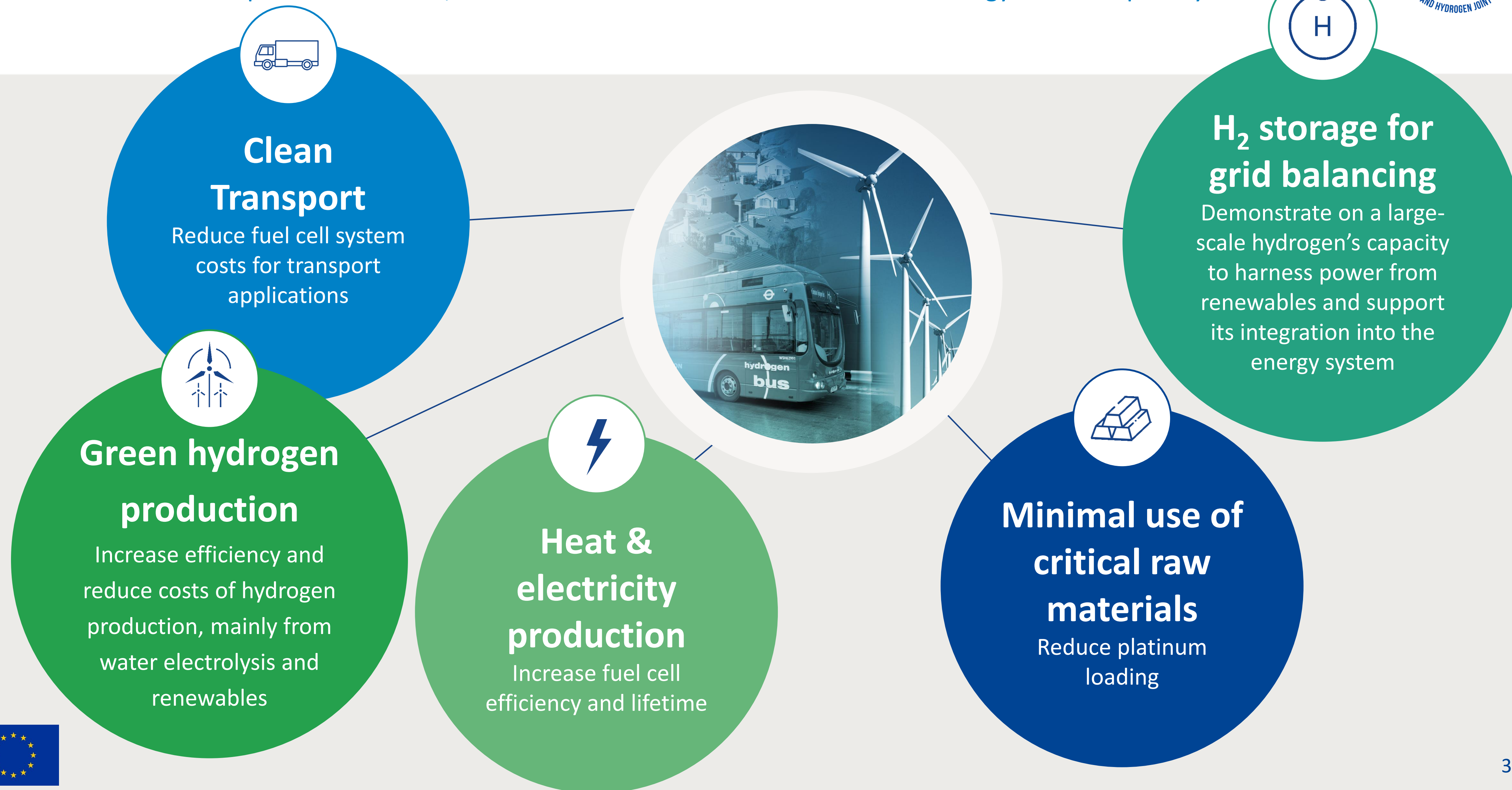
**Research grouping**  
over 60 members

To implement an *optimal research and innovation programme* to bring FCH technologies to the point of market readiness by 2020



# FCH 2 JU Objectives

Market readiness of a portfolio of clean, efficient and affordable solutions for our energy and transport systems



# FCH JU programme implementation



## Energy

- Hydrogen production and distribution
- Hydrogen storage for renewable energy integration
- Fuel cells for power & combined heat & power generation



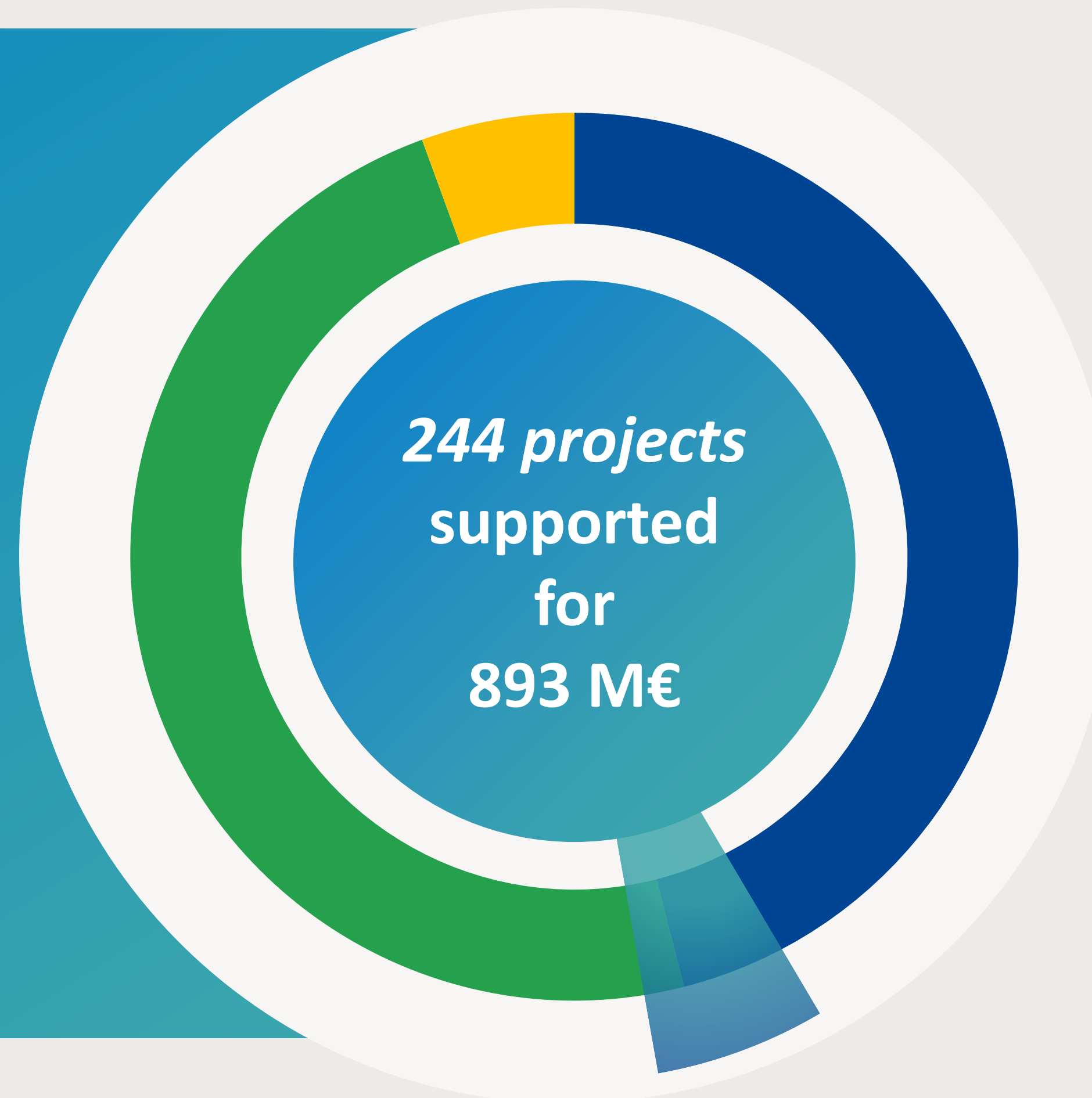
## Transport

- Road vehicles
- Non-road vehicles and machinery
- Refuelling infrastructure
- Maritime rail and aviation applications



## Cross-cutting

- E.g. standards, safety, education, consumer awareness ...



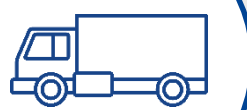
47 %



418 million euro

135 projects

42 %



376 million euro

65 projects

6 %



53 million euro

40 projects



5 %

46 million euros

4 projects

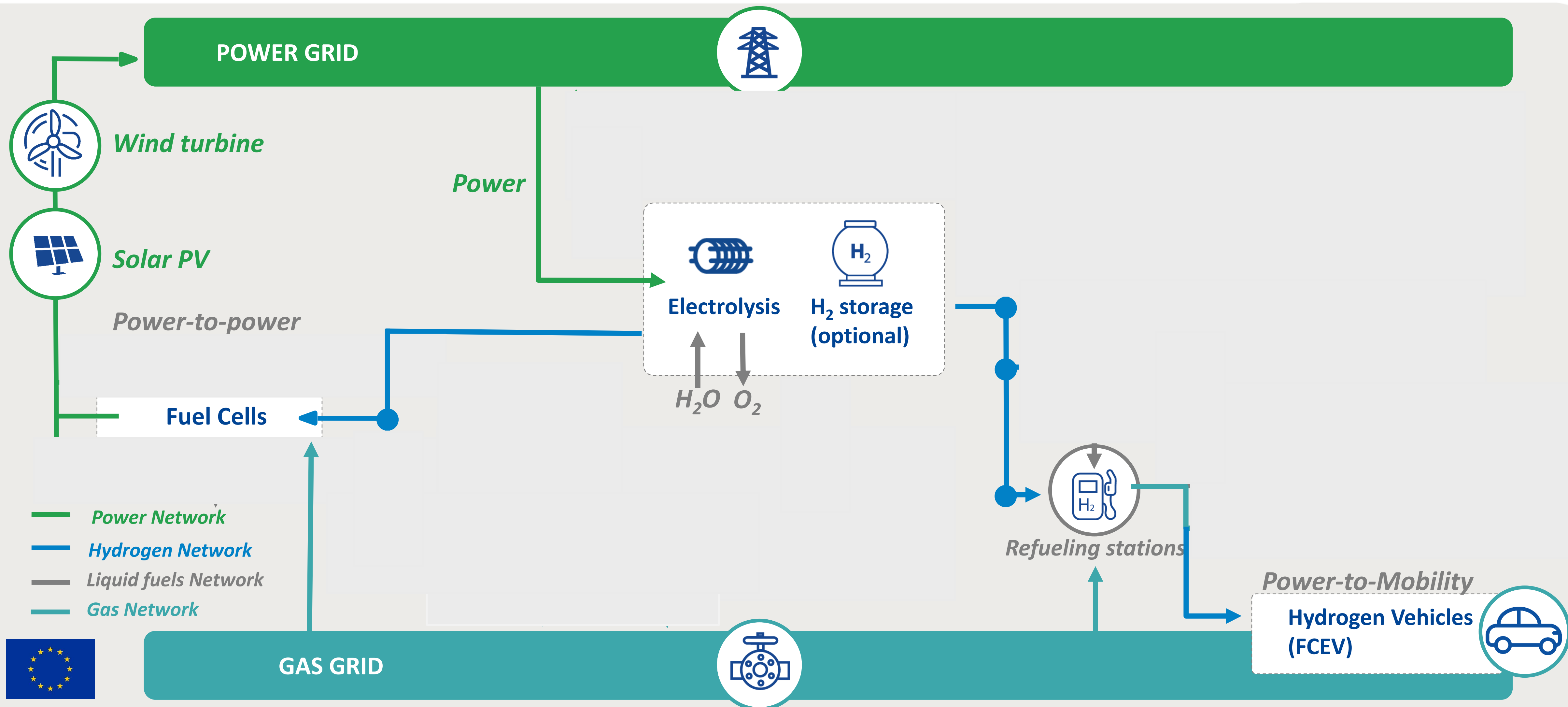


Similar leverage of other sources of funding: 892 M€



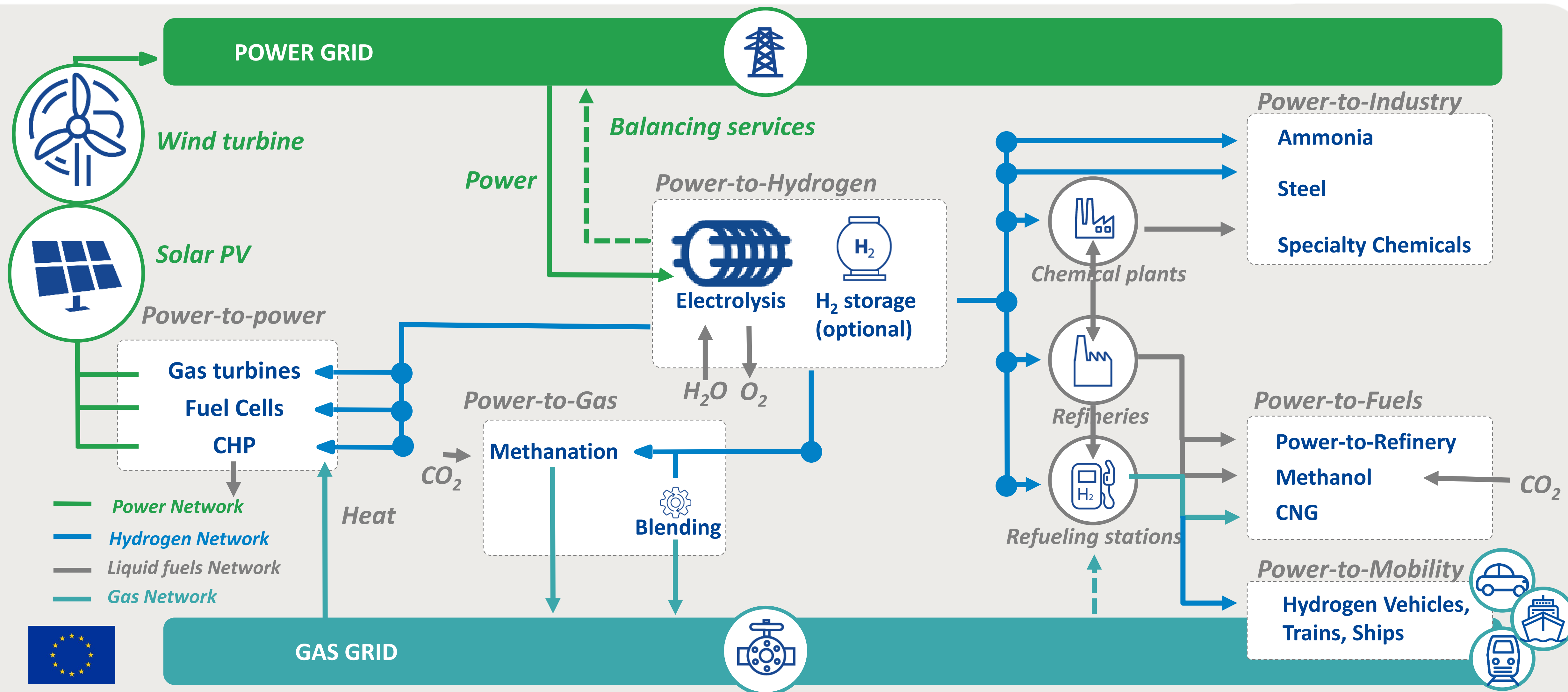
# Early H<sub>2</sub> Production: a facilitator of FCs in Transport and Energy

P2P & FCEVs + “Where will the Hydrogen come from?”



# Today's H<sub>2</sub> Production: enabler of Sectorial integration

H<sub>2</sub> is the best option for deep decarbonisation for a number of sectors

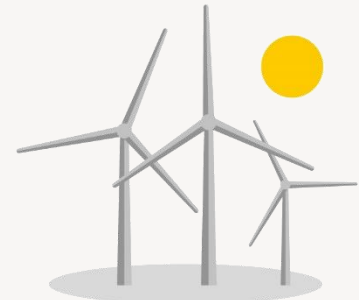


# Hydrogen for Sectorial Integration

Well-positioned FCH JU objectives & Budget

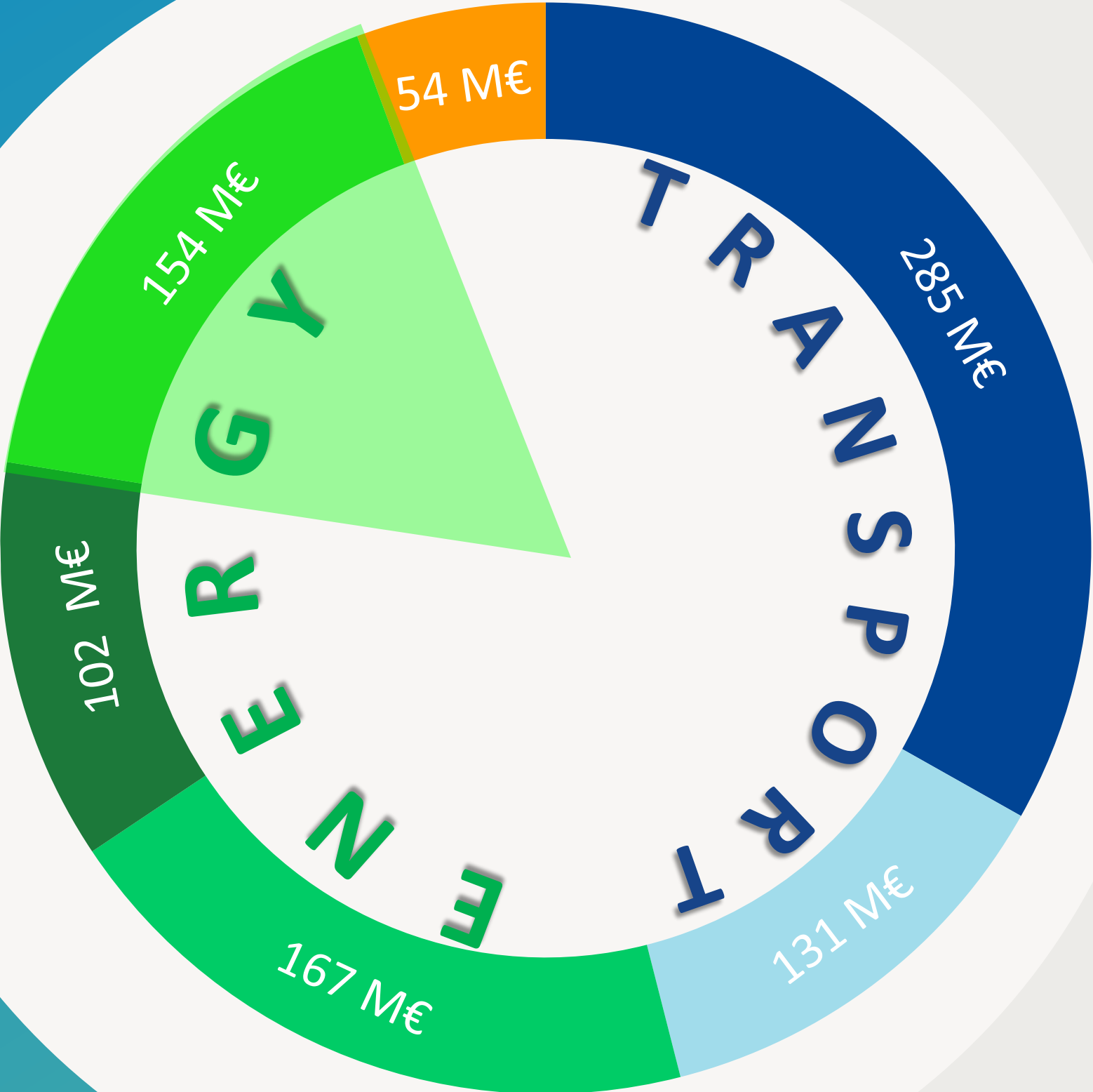


## Related FCH JU Objectives

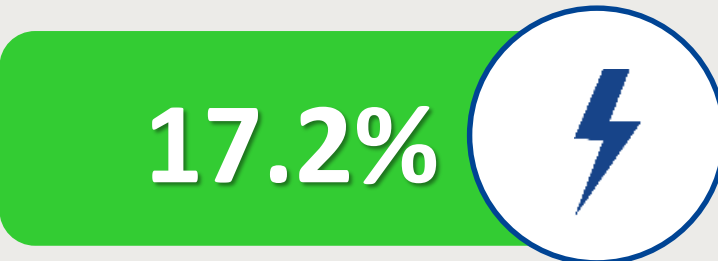


Increase efficiency and reduce costs of H<sub>2</sub> production, mainly from water electrolysis and renewables

Demonstrate on a large scale H<sub>2</sub>'s capacity to harness power from renewables and support its integration into the energy system



H<sub>2</sub> production, distribution & storage



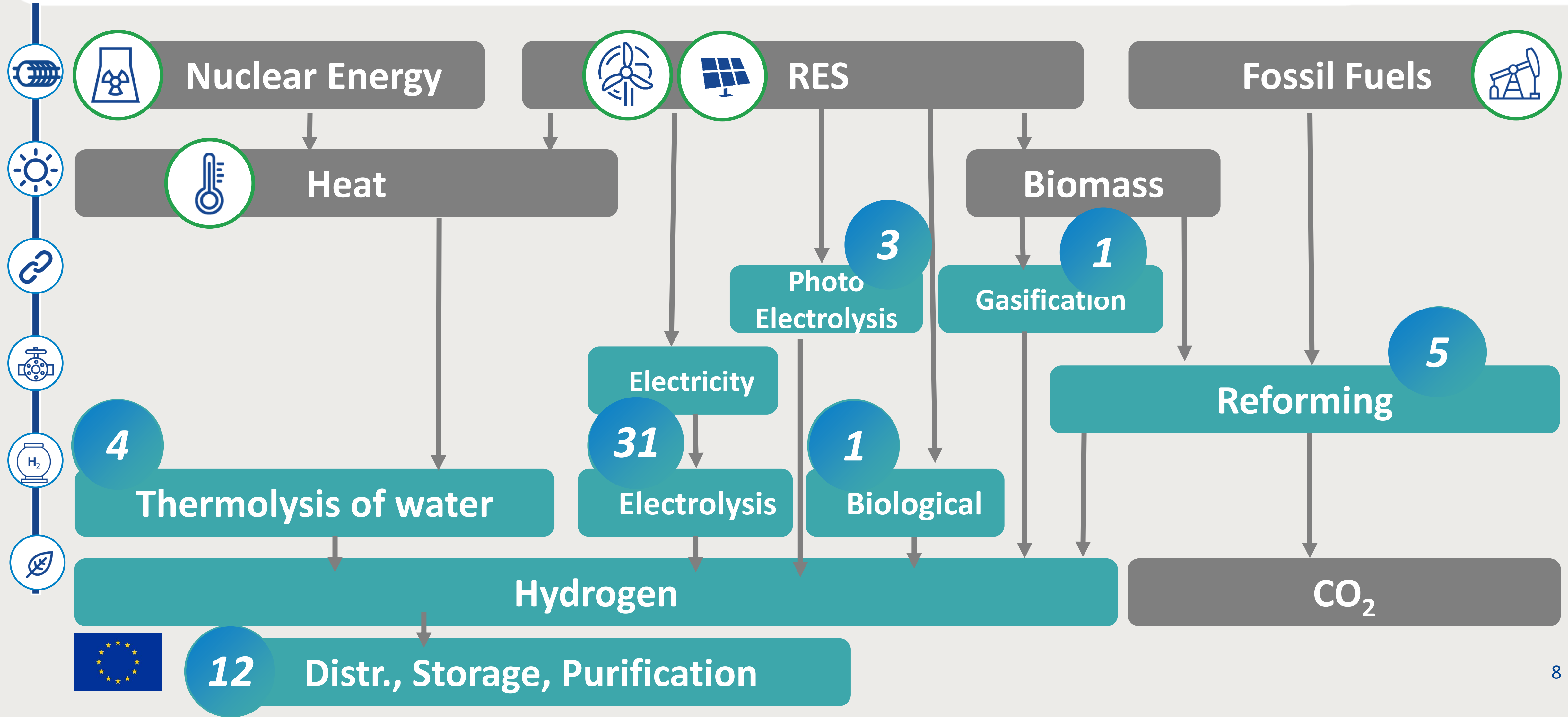
154 M€

57 Projects



# Hydrogen Production Technical Coverage

95% of FCH JU support to green Hydrogen production





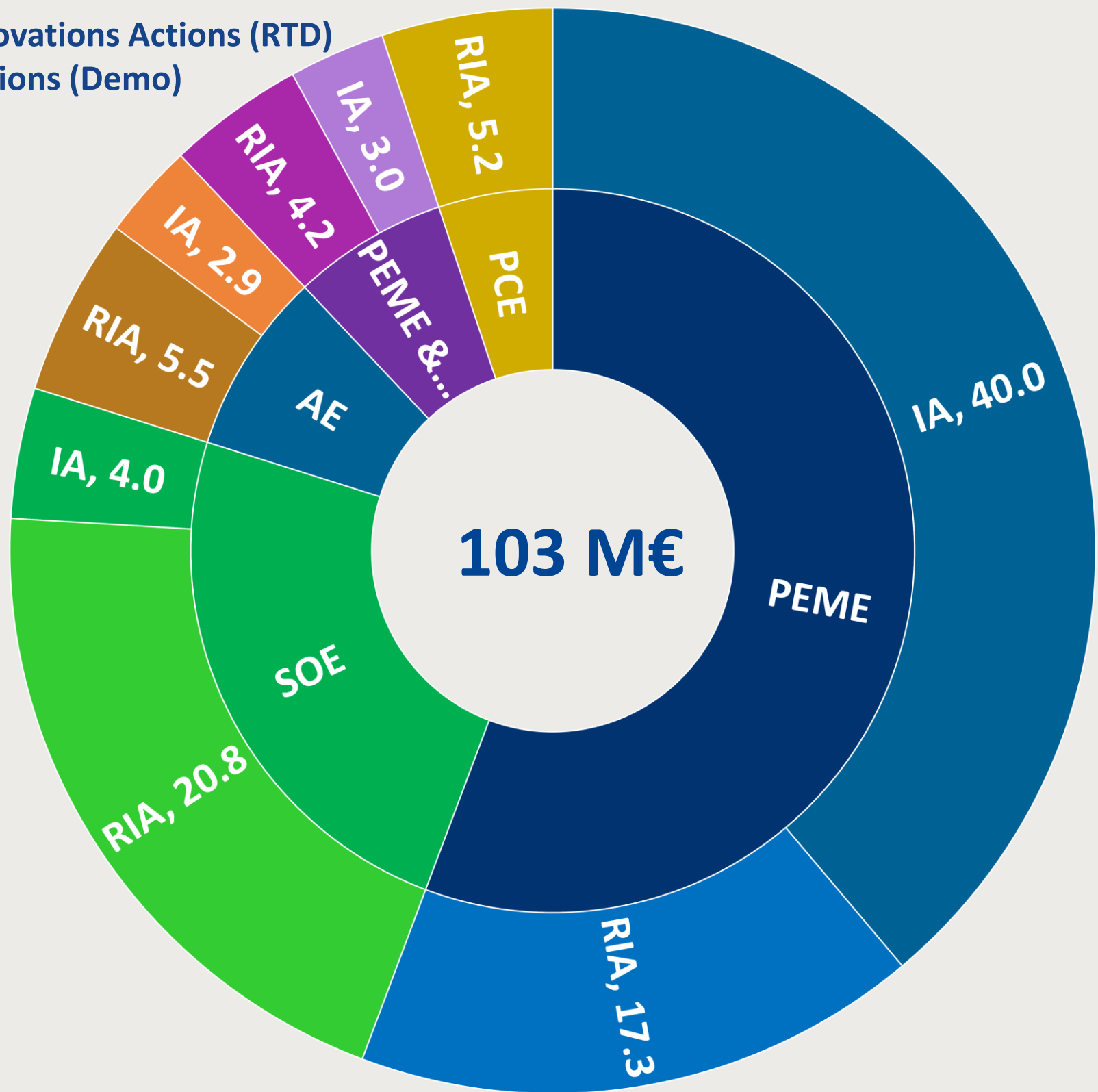
# Electrolysis Research and Demonstration

The potential of Hydrogen for the greening of industry has lead to fast capacity increase and cost reduction



## Electrolysers, M€ FCH JU support

RIA: Research & Innovations Actions (RTD)  
IA: Innovations Actions (Demo)



31 Projects



HRS



Steel industry

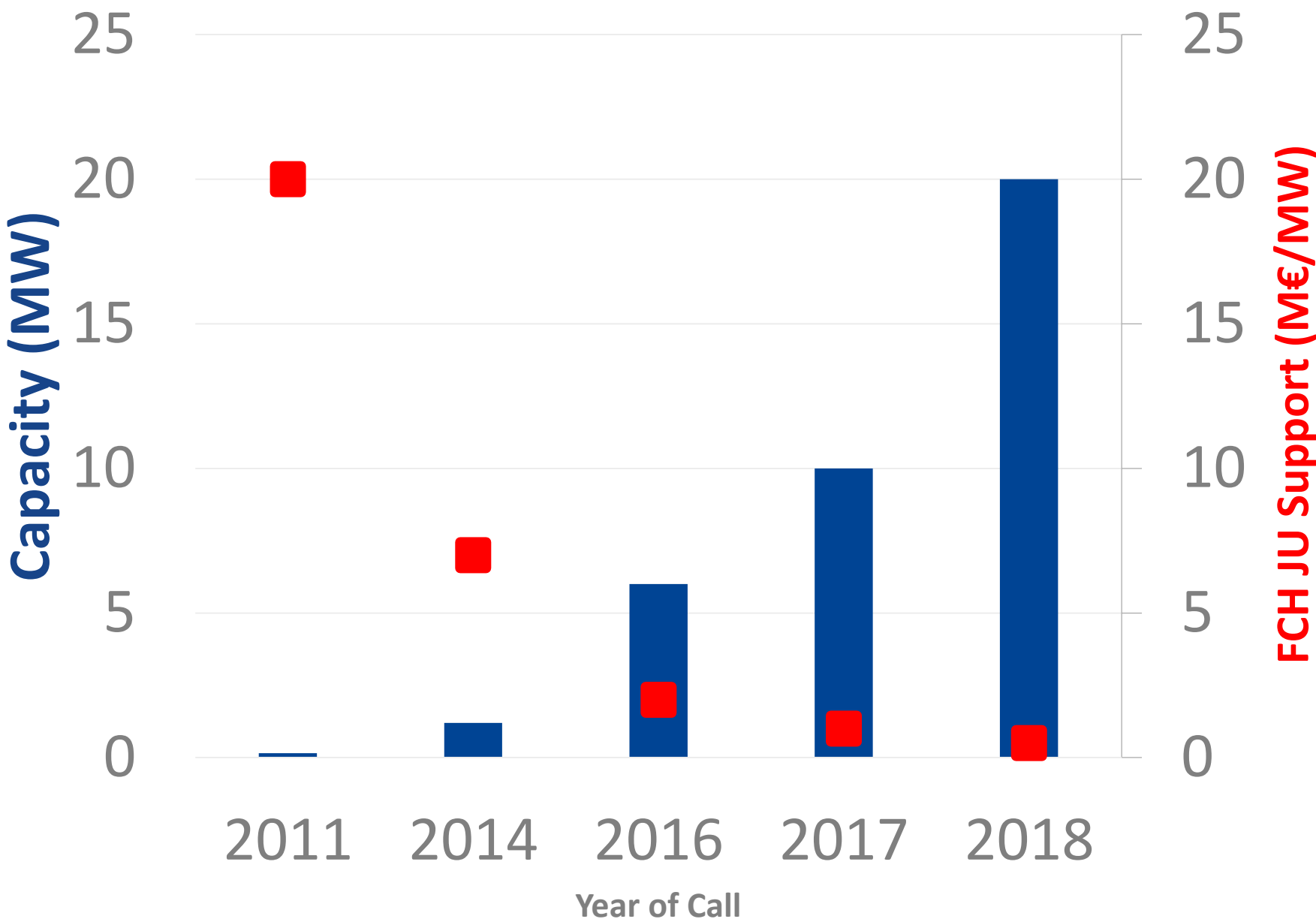


Refineries



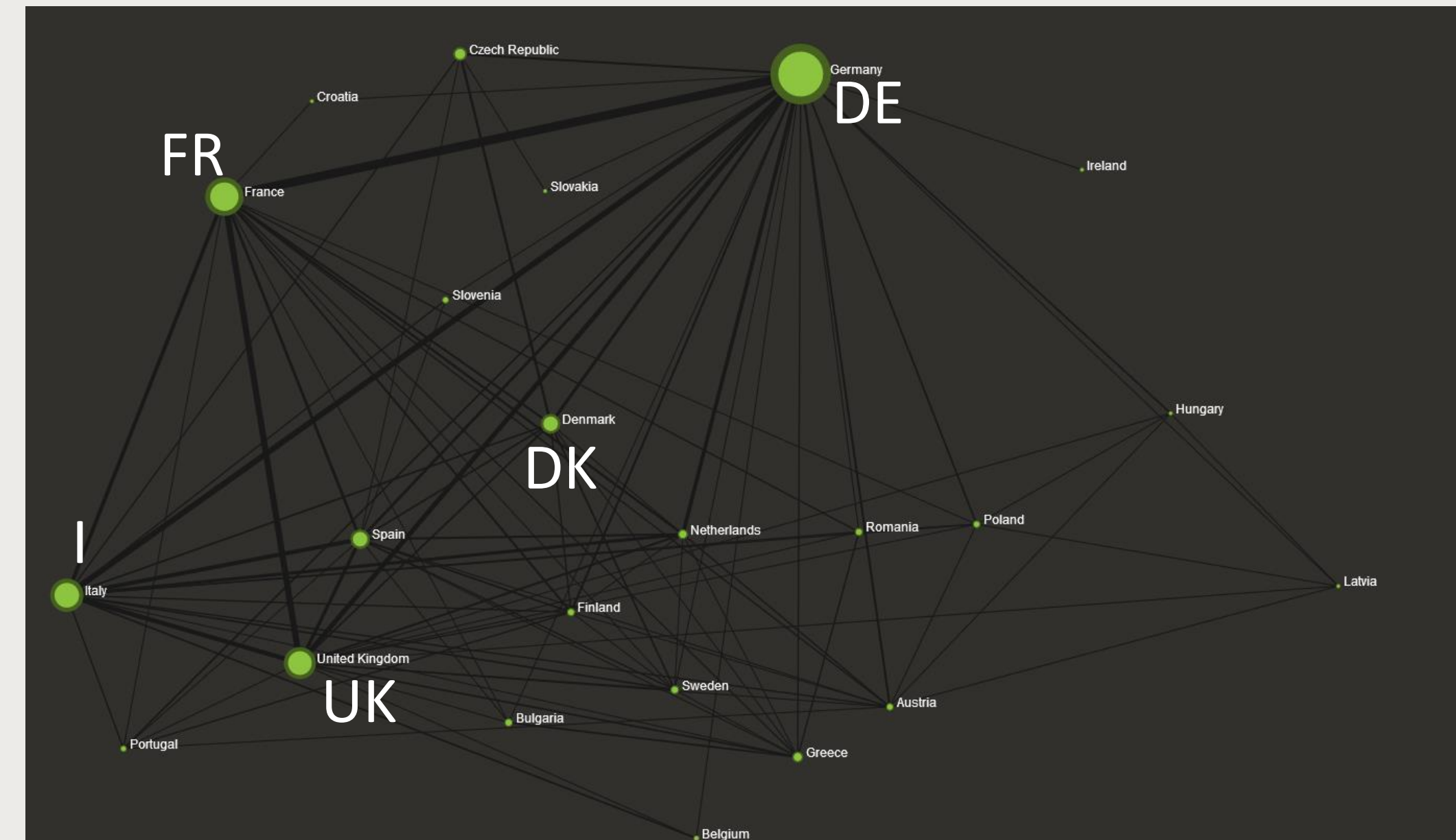
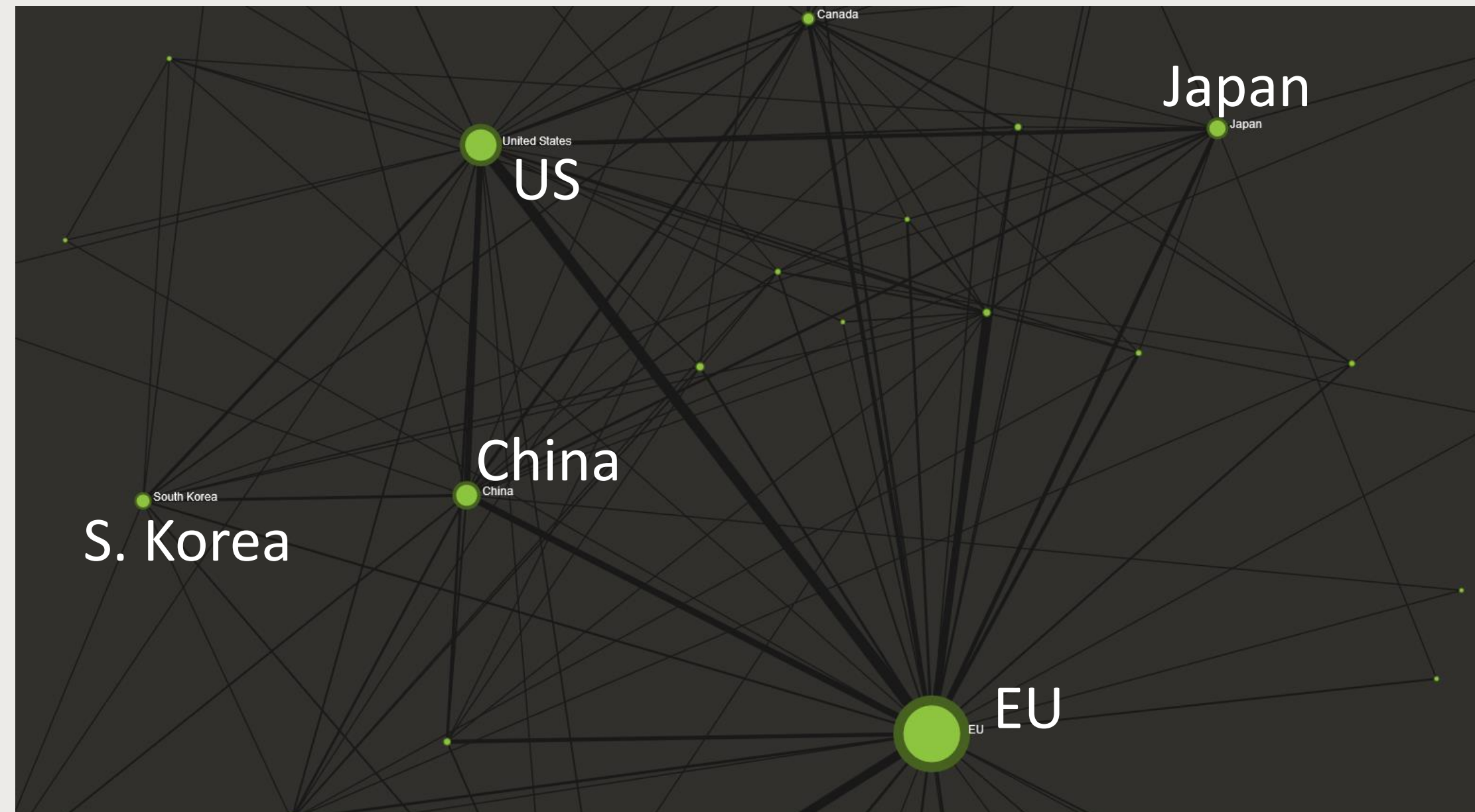
Food industry

## Electrolyser Demo Projects



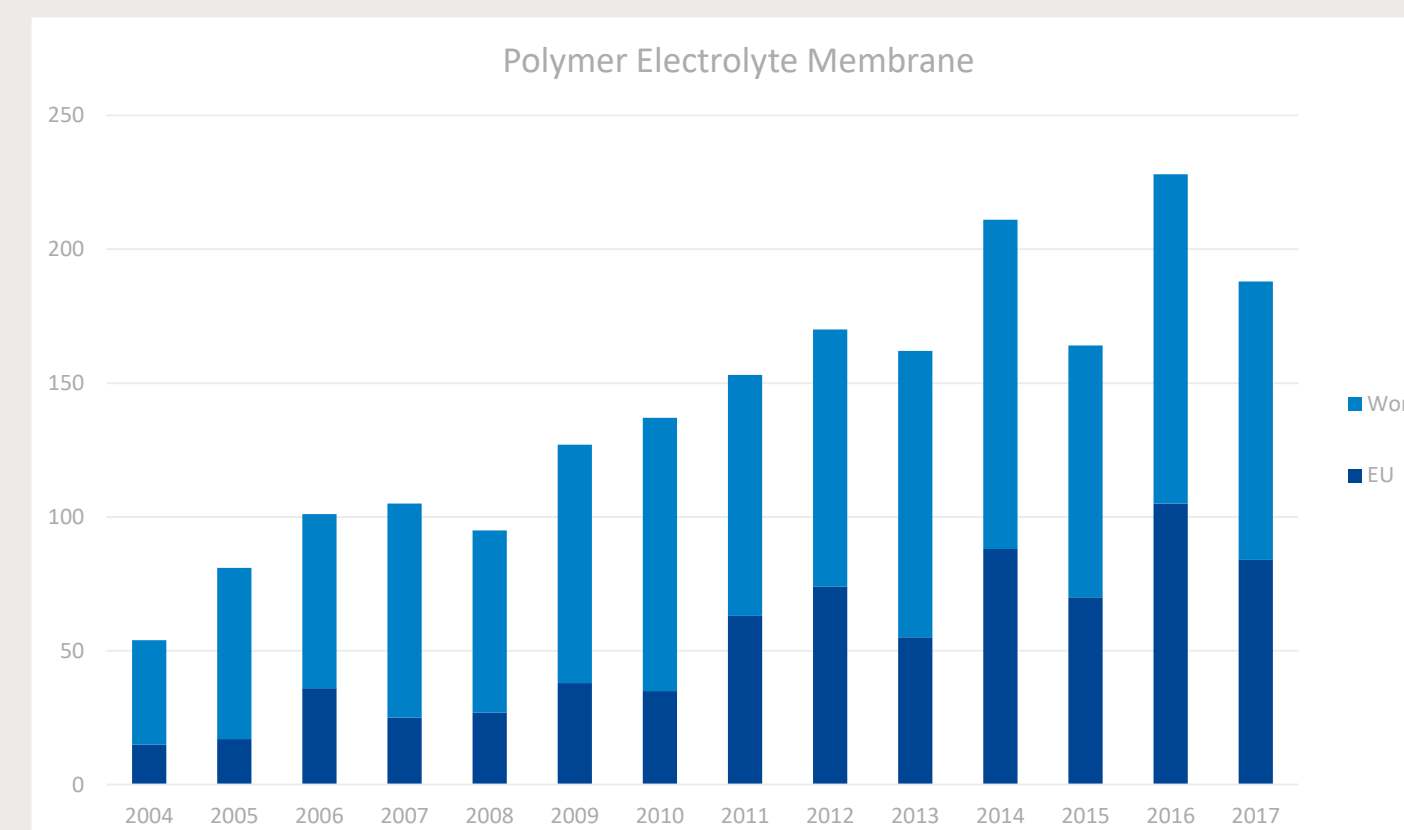
# PEM electrolysis: EU leadership

Total Number of publications, patents, events from 2004 to 2017



EU 823, US 430, China 270, JPN 193,  
S. Korea 143

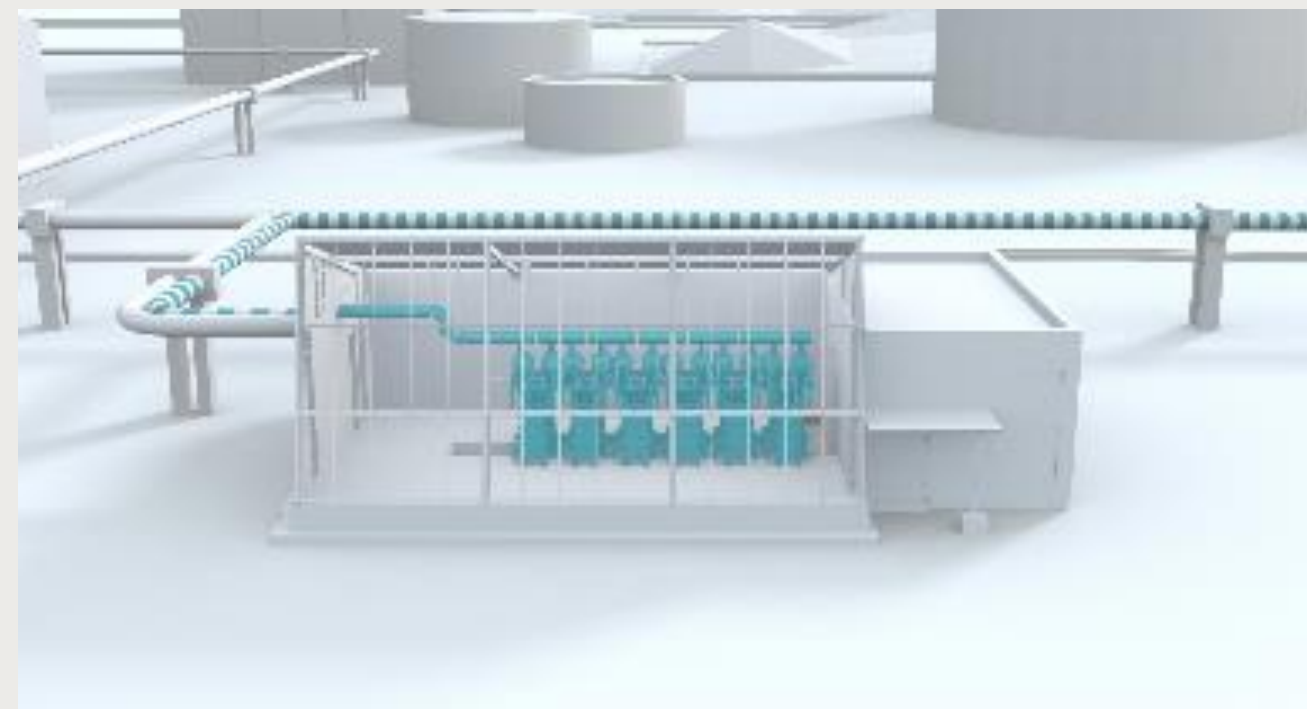
DE 224, FR 136, I 116, UK 111, DK 62





# 2016: Greening the Steel Industry

The H2Future Project: Producing green H2 from hydro power, Injecting in steel industry, providing grid services



Co-ordinated by Verbund (electricity company of Austria)

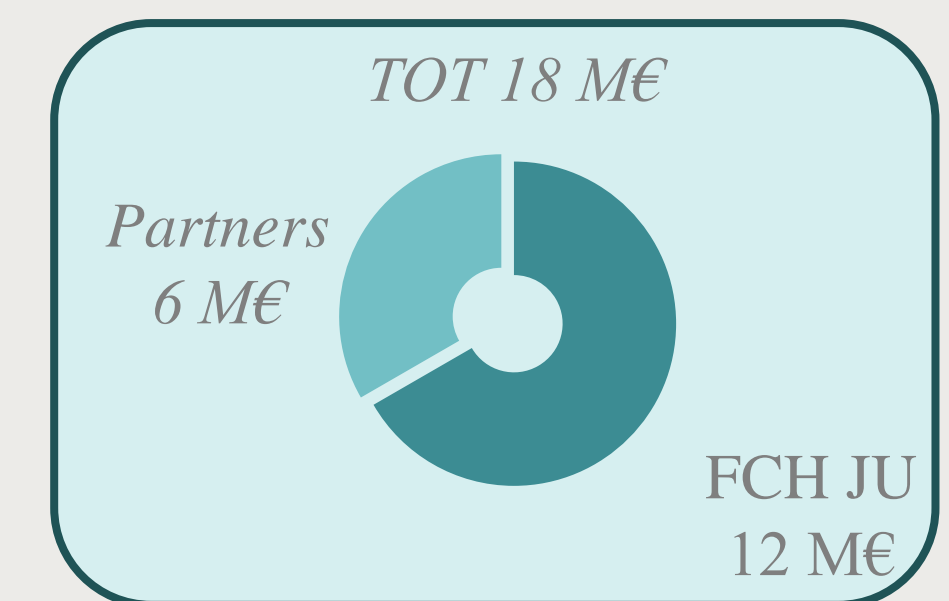
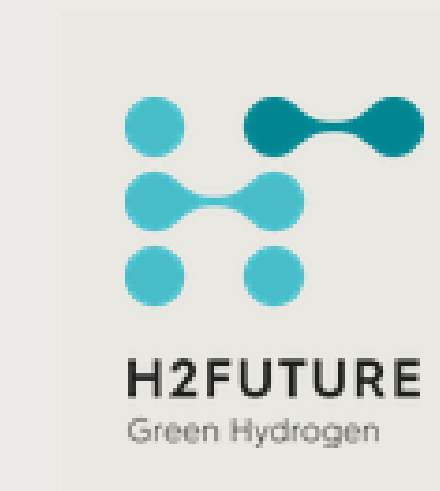
6MW PEM atmospheric electrolyser by Siemens

Installed in voestalpine (steel industry) in Linz

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

Favourable electricity tariffs in Austria for electrolysers

Steel industry a great proponent of green H2 at Commission level



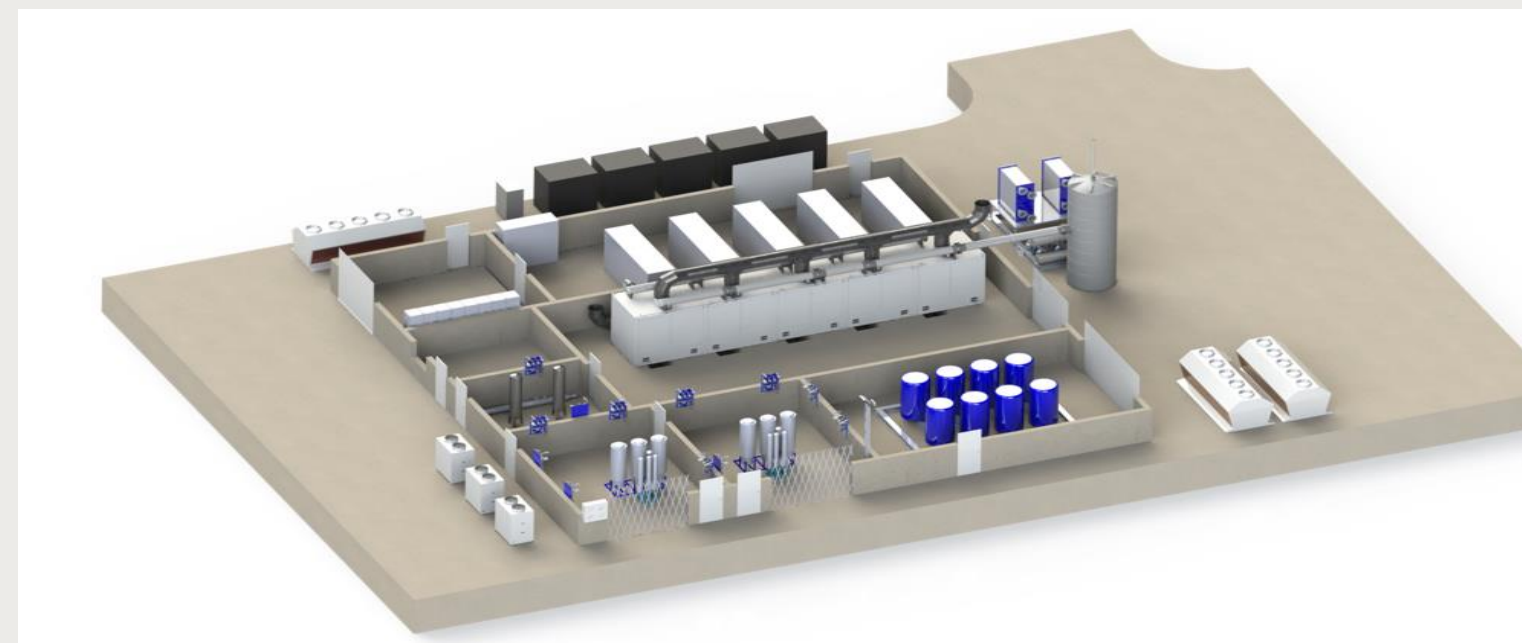


# 2017: Greening the Refining Industry

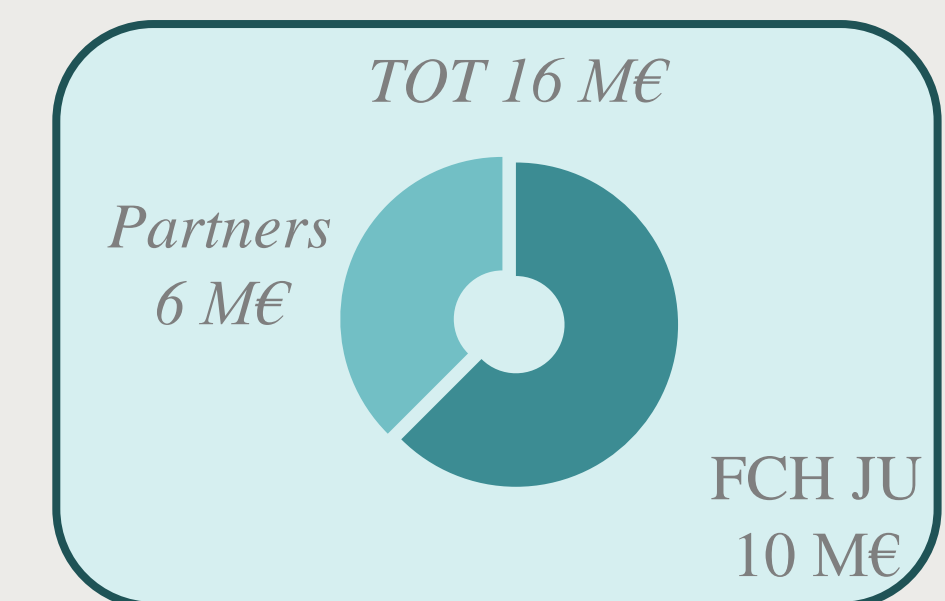
The Refhyne Project: Producing green H<sub>2</sub> from renewables, displacing grey SMR hydrogen



**REFHYNE**  
CLEAN REFINERY HYDROGEN FOR EUROPE



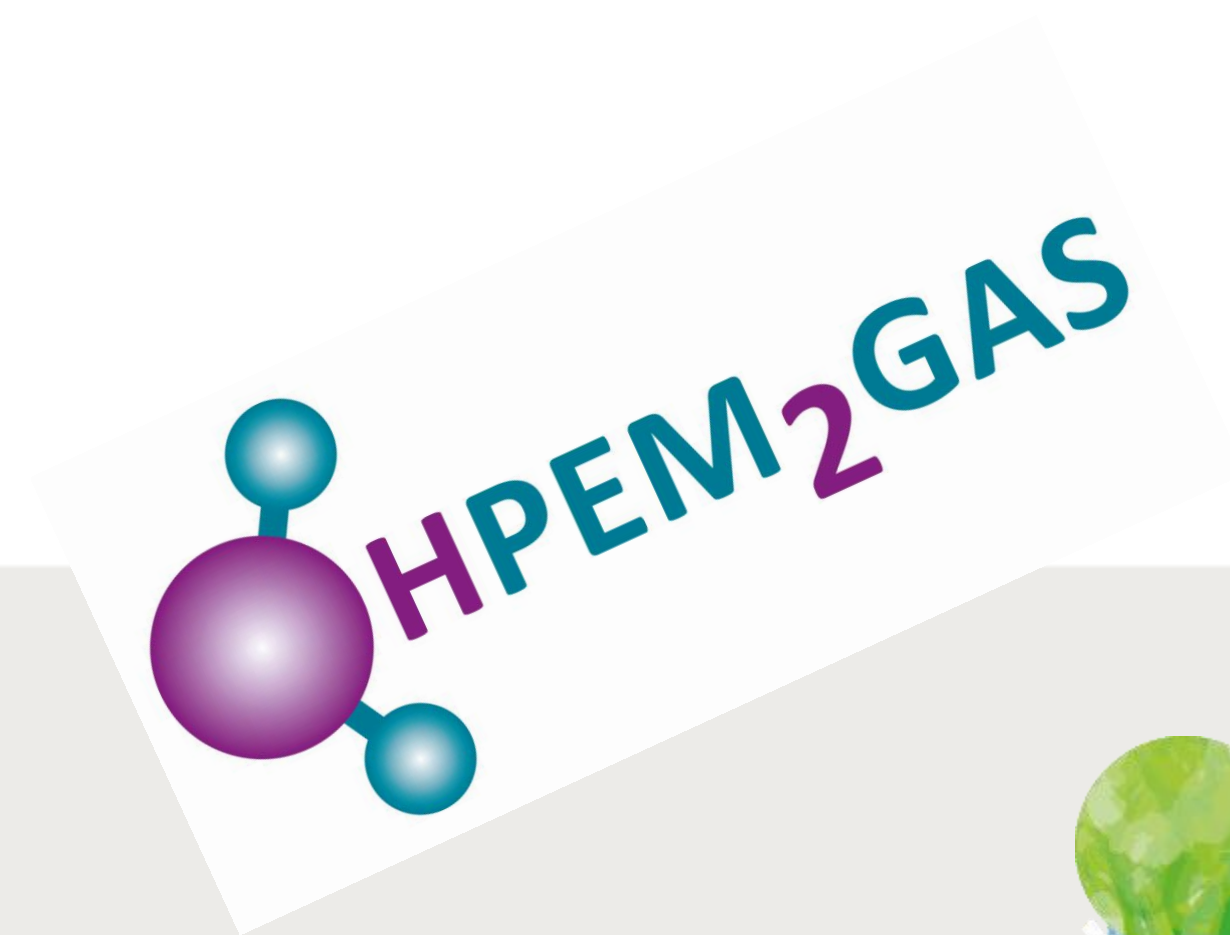
- 10MW PEM electrolyser by ITM Power installed in Shell refinery in Wesseling, Germany
- 3 A/cm<sup>2</sup>, 30bar
- H<sub>2</sub> fed to existing pipeline – grid and load balancing services
- Displacing 1% of 180,000 tons annual consumption





# Pushing the limits of electrolysis

2017 Game-changer electrolysis projects



## NEPTUNE project

- self-pressurizing 100 bar PEM electrolyser system of 48-115 kW
- current densities of 4-8 A·cm<sup>-2</sup>, <50 kWh/kg H<sub>2</sub>
- at least 4,000 hours (cumulative, 2000 h steady-state, 2000 h cycled operation)



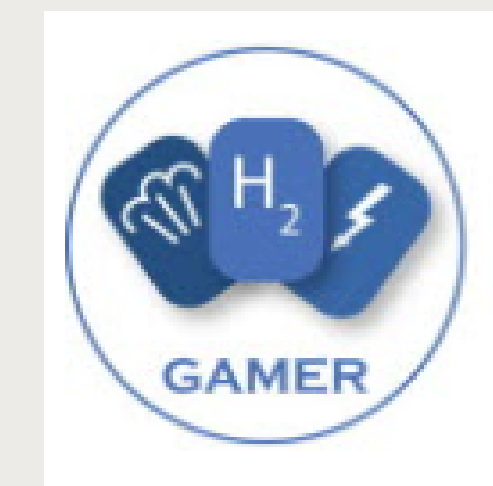
## PRETZEL project

- Cell concept capable of 100 bar, PEM electrolyser system of 25 kW
- current densities of 4-6 A·cm<sup>-2</sup>, non-precious metal coatings
- at least 2000 h operation



## GAMER project

- Tubular proton ceramic electrolyser @ 30 bar, 10kW
- Integrated steam electrolyser to produce dry pressurized H<sub>2</sub>
- current densities of 4-6 A·cm<sup>-2</sup>.
- Operation @ 500-700 °C



# Hydrogen injection in the NG grid

2019 call for proposals: three topics



## FCH-02-1-2019: Combined electrolyser-HRS and Power-to-Gas system

- Up to 600kg/d injection at NG distribution (low pressure) grid

## FCH-02-5-2019: Systematic validation of the ability to inject hydrogen at various admixture level into high-pressure gas networks in operational conditions

- Up to 120kg/d injection at NG transmission (40-80bar) gas grid

## FCH-04-3-2019: Hydrogen admixtures in natural gas domestic and commercial end uses

- Impact of 10-60% H<sub>2</sub> in NG injection to combustion characteristics, appliances performance and safety



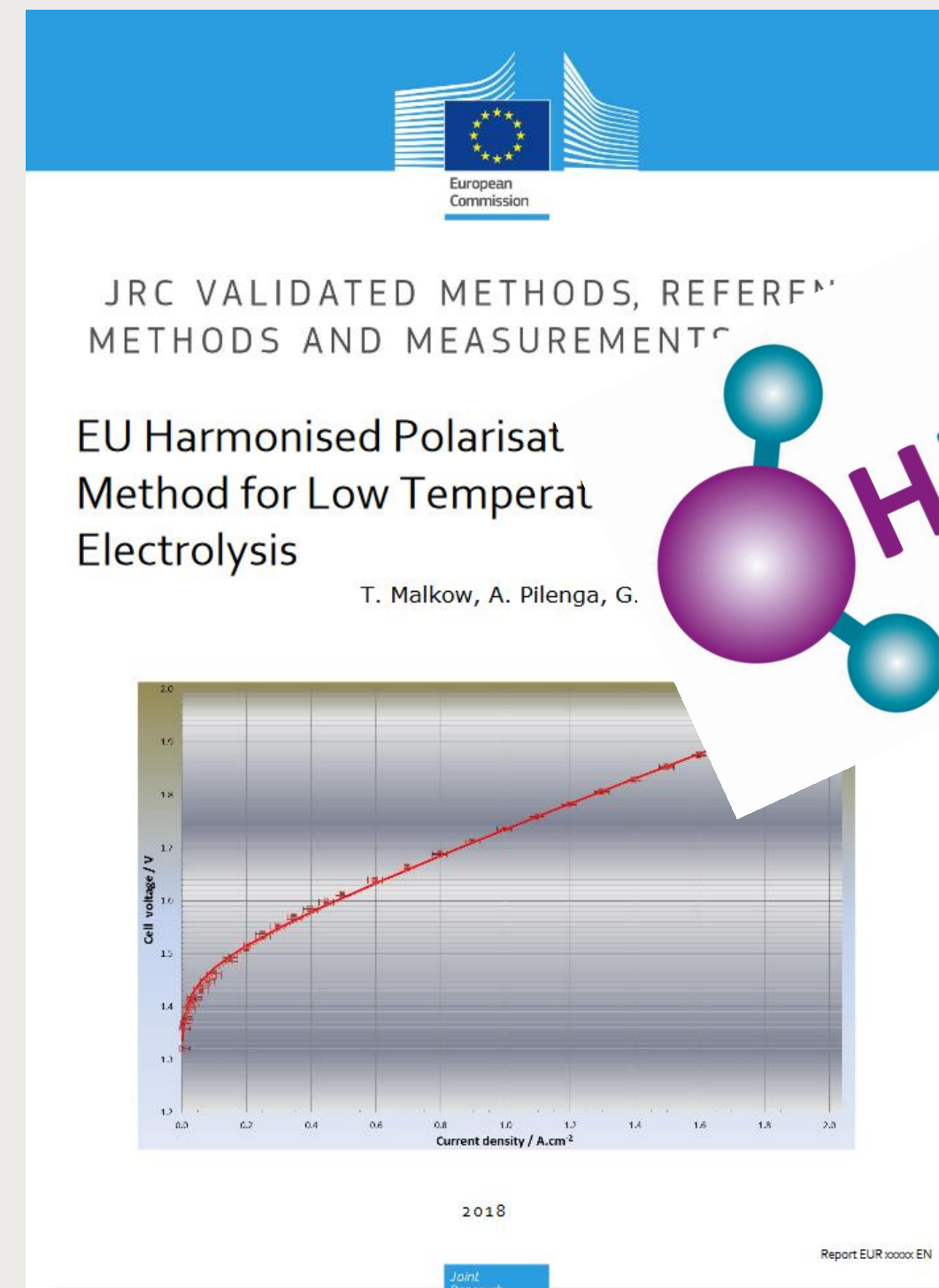
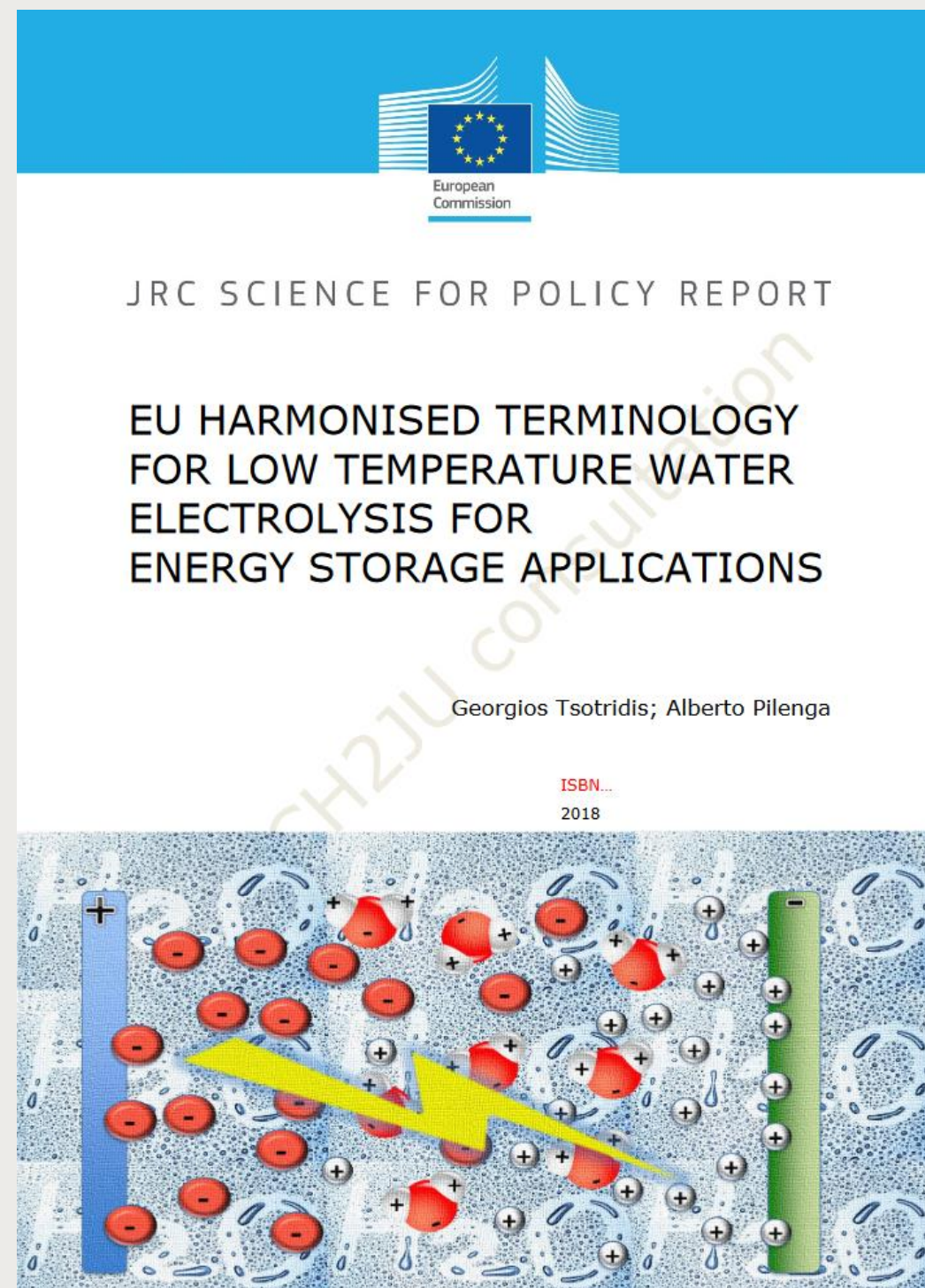


# Standardisation of electrolyser testing protocols

Two parallel efforts

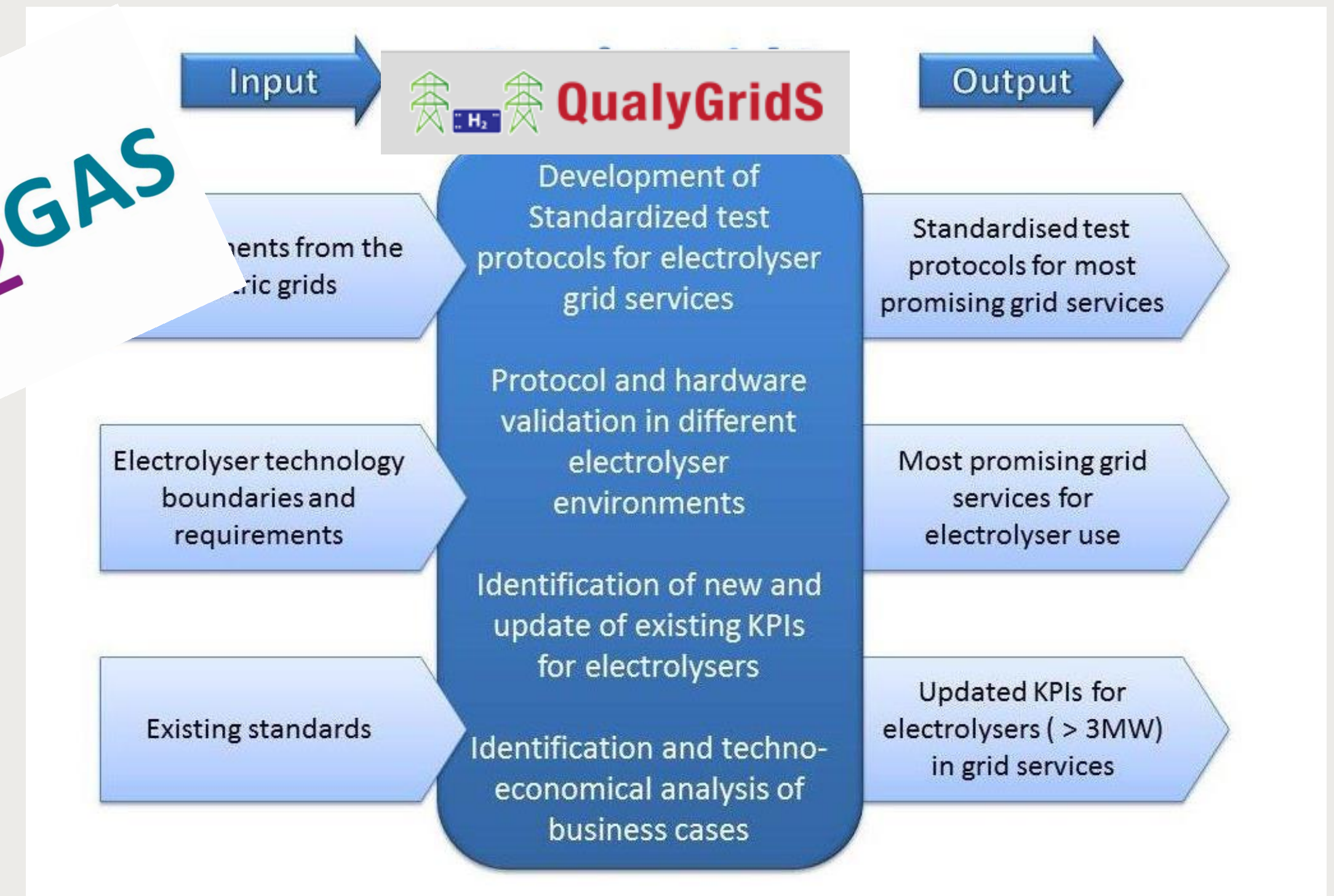


## 1. JRC standardisation of testing @ cell and stack level: two documents finalised



HPeM2GAS

## 2. QUALYGRIDS project standardisation of testing @ system level





# Summary



Sectorial integration, Energy storage, Decarbonizing industry & the Gas grid: mainstream energy policy terms



H<sub>2</sub>: important component – Electrolyser: key technology



FCH JU: continuous support in moving electrolysers from kW to MW, improving performance & reducing costs



The HPeM2GAS project is a major contributor in developing a flexible, high pressure electrolyser operating on high current density with reduced degradation, demonstrated @ 180kW in a P2G application







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**For further information**

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