FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

Hydrogen production, distribution and storage: Research and Validation

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PRD 2017

23 November 2017

Agenda

PROGRAMME REVIEW DAYS 2017
FUEL CELLS AND HYDROGEN: FROM TECHNOLOGY TO MARKET
23-24 NOVEMBER, BRUSSELS

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PANEL 5
HYDROGEN PRODUCTION, DISTRIBUTION AND STORAGE: research and validation

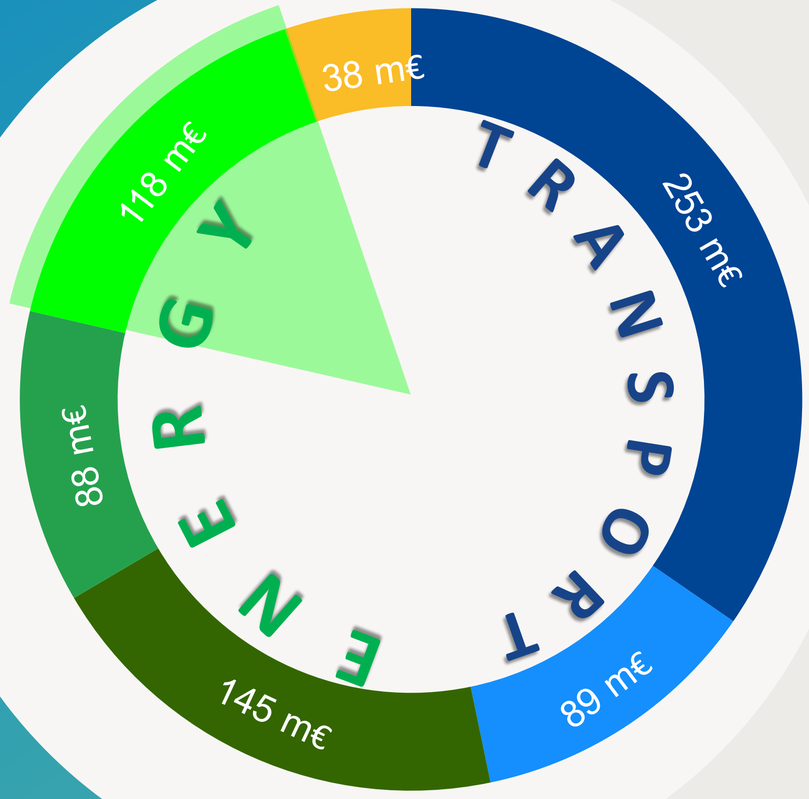
14:30 - 14:50	Portfolio overview by **Lymperopoulos Nikolaos**, FCH JU
14:50 - 15:10	DON QUICHOTE: Demonstration of new qualitative concept of hydrogen out of wind turbine electricity
15:10 - 15:30	ELECTRA: High temperature electrolyser with novel proton ceramic tubular modules of superior efficiency, robustness, and lifetime economy
15:30 - 15:50	HyBalance
15:50 - 16:10	EDEN: High energy density Mg-based metal hydrides storage system
16:10 - 16:30	HYDROSOL-PLANT: Thermochemical hydrogen production in a solar monolithic reactor: construction and operation of a 750 kWth plant
16:30 - 16:50	Early Business Cases study for H2 in Energy Storage

Research and Validation

Related FCH JU Objectives

Increase efficiency and reduce costs of H2 production, mainly from water electrolysis and renewables

Demonstrate on a largescale H2's capacity to harness power from renewables and support its integration into the energy system



H2 production, distribution & storage

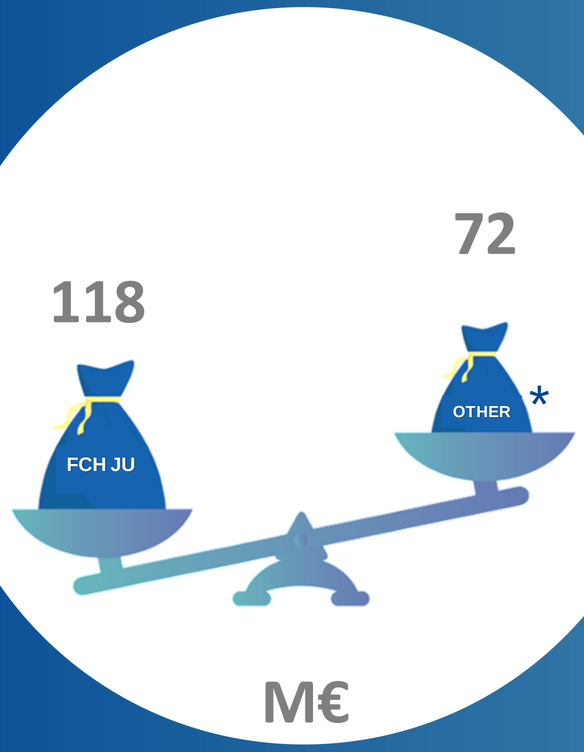
16.1%

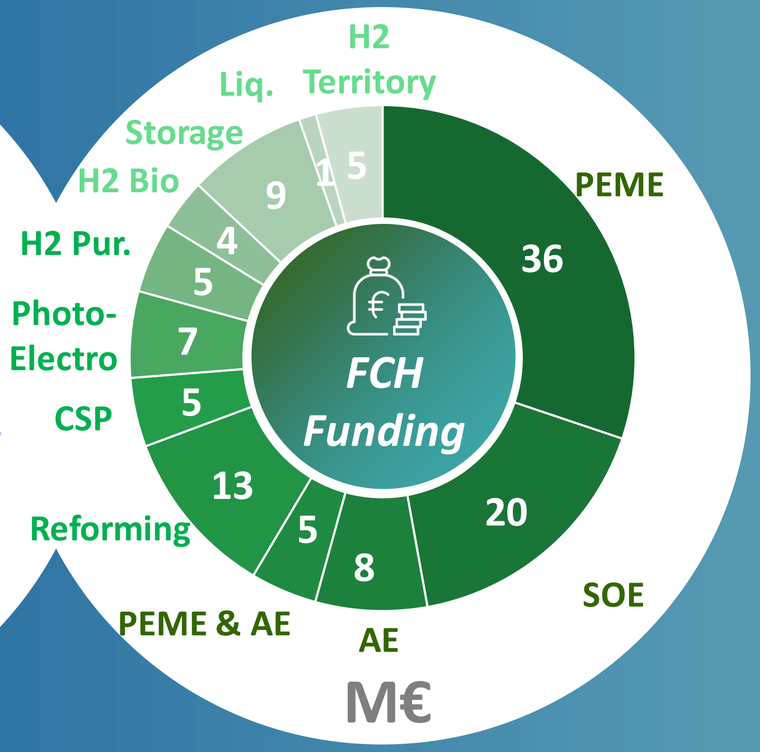
118 M€

47 Projects

“in the pipeline” to deployment

47 projects –190 M€





Electrolysers proving themselves in Energy Market

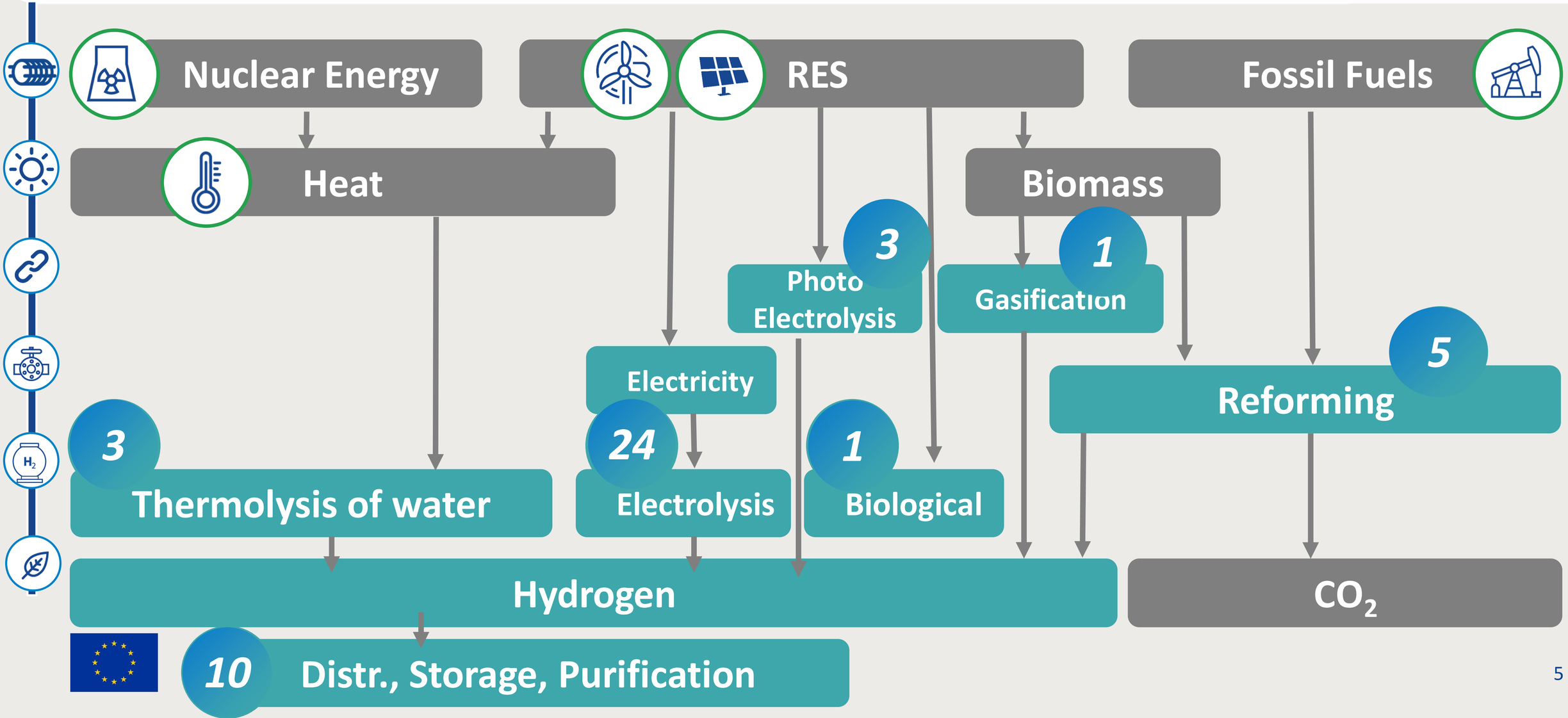
Alternative RES routes exiting lab

Viable Early Business Cases

** Other resources including private and national/regional funding*

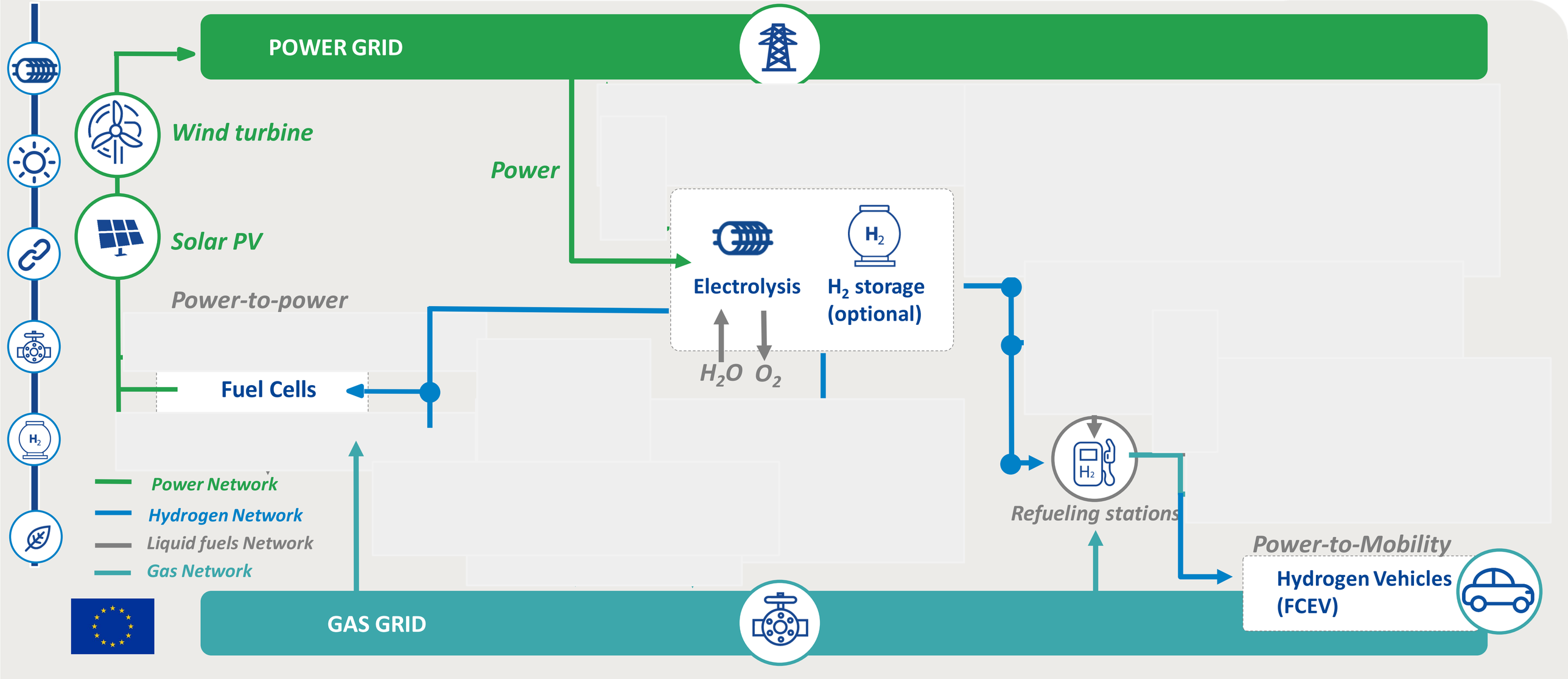
Technical Coverage

95% of FCH JU support to green Hydrogen production



What's New in H_2: Riding the "P2H & H2X" wave

Greening industry, providing electricity grid services, injection in the NG grid




Reformers
Solar to Hydrogen
Storage
Electrolysis
Distribution
High & Low T
Electrolysis
Towards a more
sustainable world
with hydrogen
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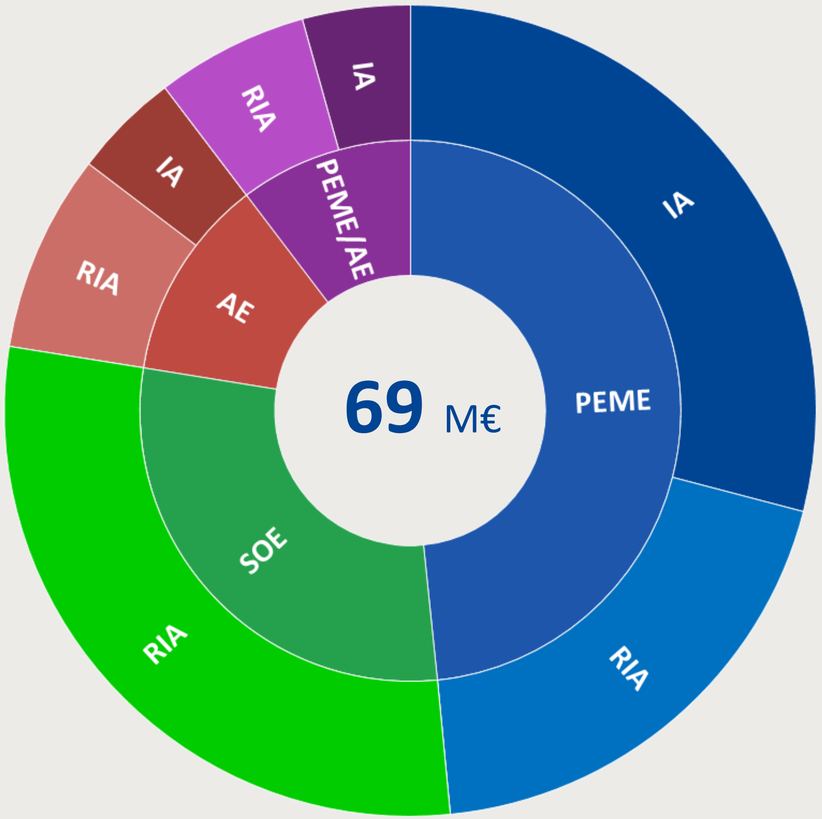
Opportunity for electrolysis to prove itself to Industry

Industry acknowledges the potential of Hydrogen for the greening of industrial products



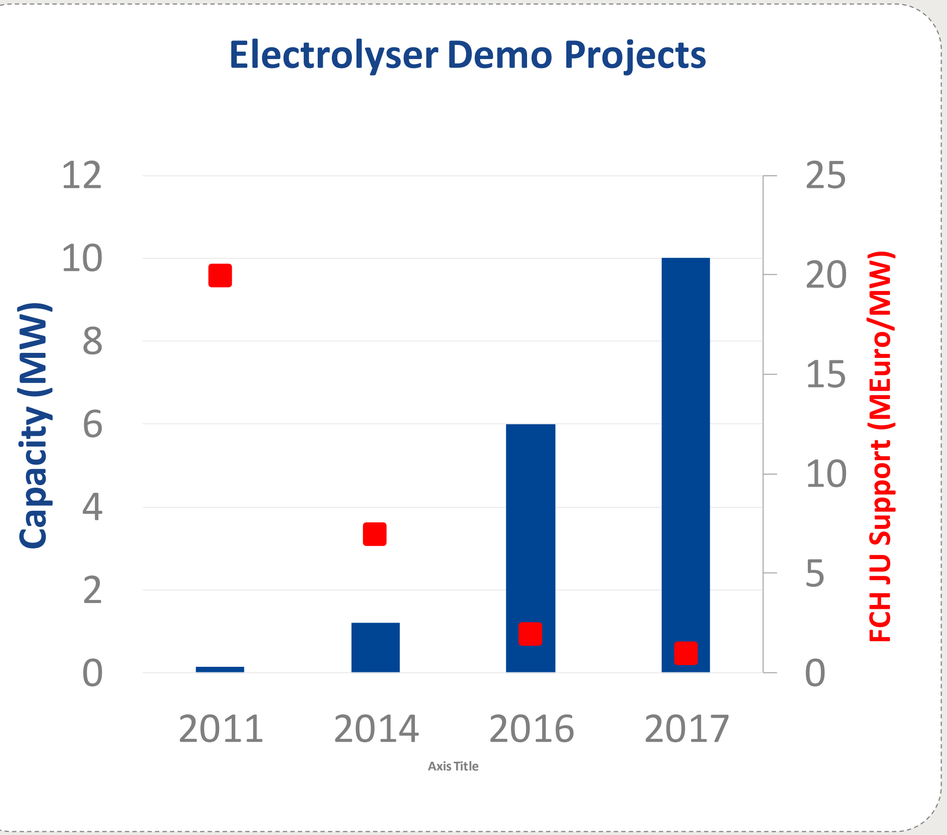
24 Projects

HRS

Steel industry

Refineries

Food industry



Safeguarding Europe's leading position

Vibrant community of OEMs and R&D institutions

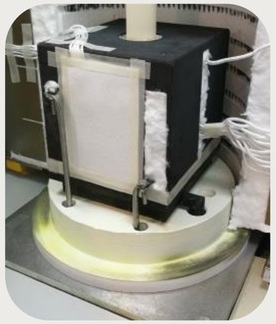
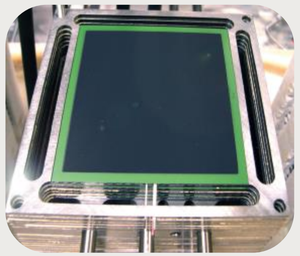
- **Capex targets for AE and PEME < 1.8 k€/kW**
- **Efficiency degradation < 0.8% / yr**
- **Efficiency at system level < 55 kWh/kg**
- **Dynamic performance / Harmonisation of testing**

European leadership in High Temp electrolysers

Field testing of largest in world 150kW reversible SO electrolyser

- Efficiency targets met (90% Ely, 50% FC)
- Lifetime > 1 year, degradation < 1%/1000h
- Pressure 8 bar
- Co-electrolysis / Integrated methanation



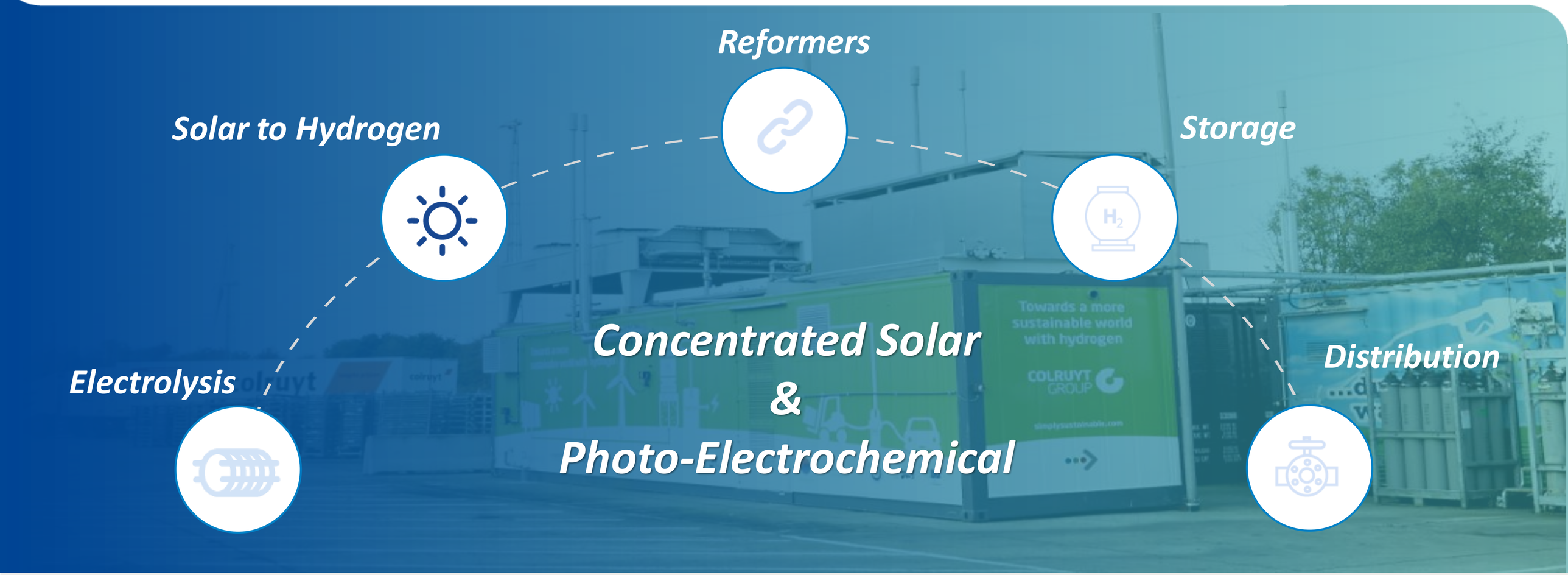


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Photo-Electrochemical
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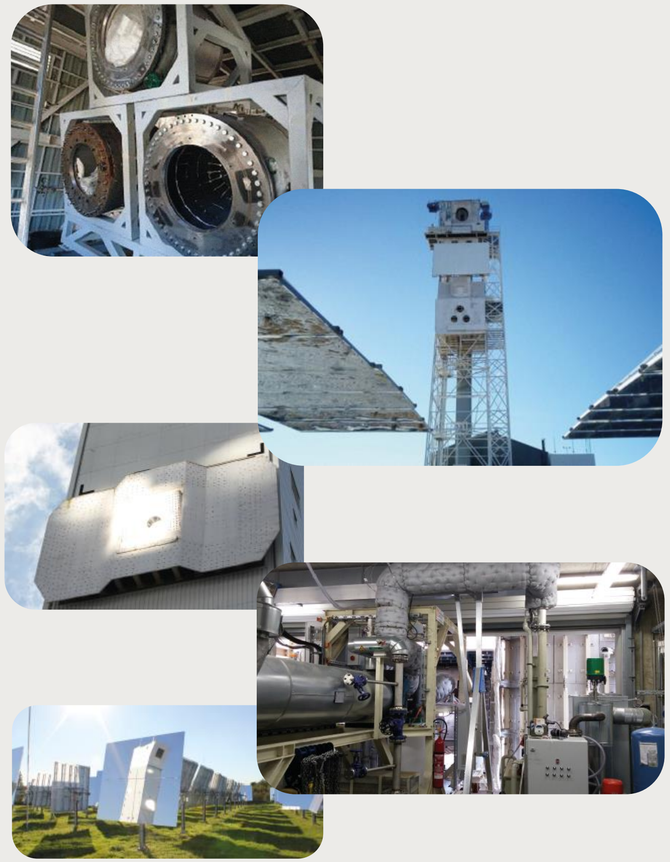
Concentrated solar demonstrated in the field

Two main routes developed by European teams performing state of the art work

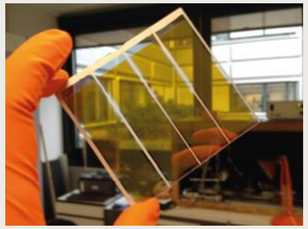
- Material lifetime > 1,000 hr
- Solar Thermal capacity 0.75 MW
- H_2 production capacity < 3kg/day
- Redox and HyS cycles supported

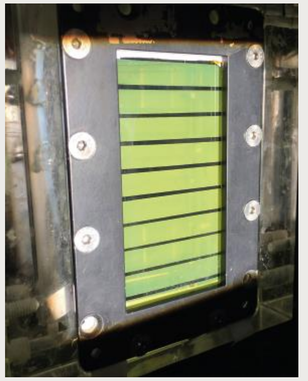


PEC devices: record efficiency in lab

High efficiencies at specimen scale need to be improved in “under sun” operation

- Lab: Highest η in World 16.2%
- Lab: 1,000 hours for Fe2O3 photo-anodes
- 4x50cm^2: critical design issues addressed
- 9 €/kg estimated for house system with η 8%





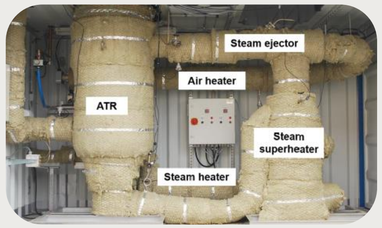
Reformers & Gasifiers

Variety of biofuels, H_2 cost < 5€/kg

Scaling down a commercially viable technology, improving it to run at lower temperatures and on alternative fuels

Lifetime of 10,000 hr (est), capacity 3 -300kg/day

Methanol, bio-ethanol, biogas, biomass (gas.)



Flexibility 20-30%

Cold start 2-6 hrs

H_2 cost: 5.3 €/kg from biogas, <5 €/kg biomass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&
Purification
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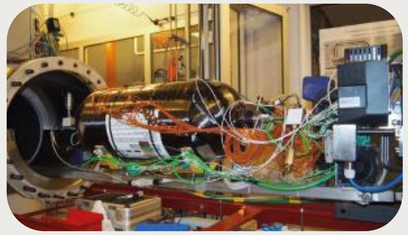
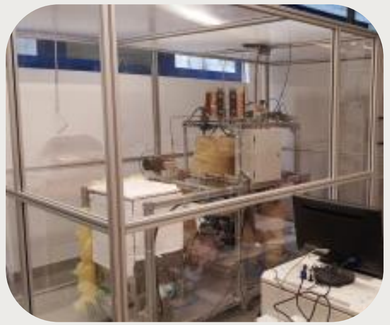
Improved Metal Hydride Tanks; Efficient separation of H_2

Demonstration of MH for stationary storage. Preparing for Hythane

- Material Storage capacity 7.1% weight
- H2 desorption rate < 3 L/min
- Cost of H2 stored in MH 300 €/kg
- H2 recovery using membranes < 5kWh/kgH2





Summary

- Large flexible electrolysers greening the industry
- Green hydrogen from locally available biofuels
- From lab to field
- Metal Hydrides in process of finding their niche

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FCH JU

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