

Green Hydrogen for Climate Action



COP25
C H I L E
MADRID 2019
UN CLIMATE CHANGE CONFERENCE





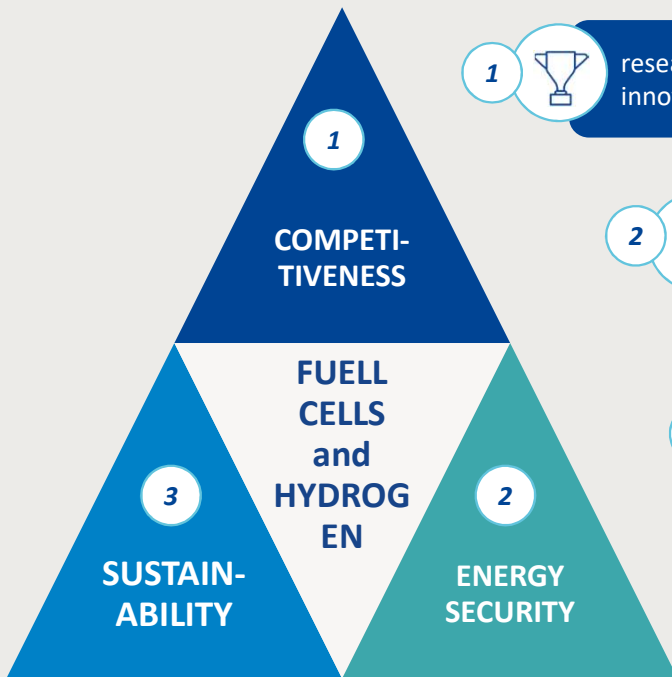
FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

***FCH-JU:
Making Fuel Cells
and Hydrogen an
everyday reality***

Bart Biebuyck
06 / 12 /2019 Madrid



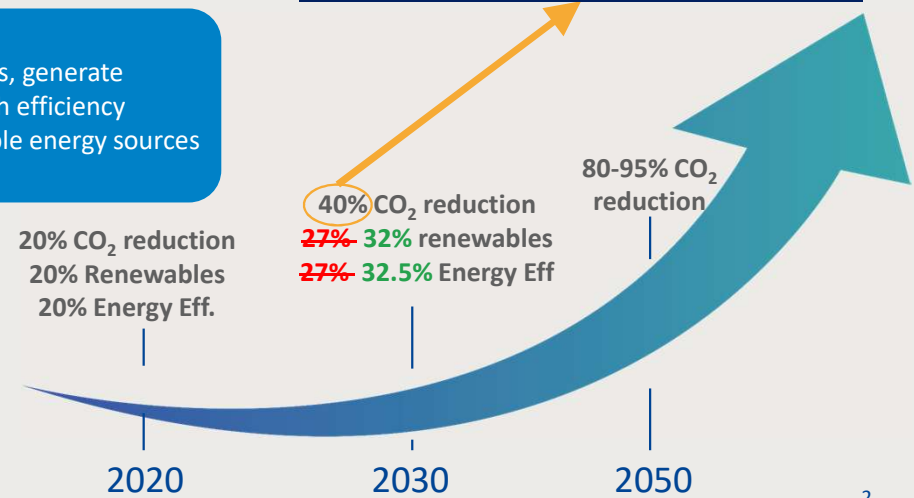
Fuel Cells & Hydrogen technologies in the context of the European Energy policy



1 research excellence leading to industry innovation and growth

2 Increase independence from unstable outside regions

- 3
- H2 is a clean energy carrier
 - Transport and Energy applications, generate electricity and heat with very high efficiency
 - Possibility for storage of renewable energy sources
 - Reduction of CO2 emissions



Strong public-private partnership with a focused objective

A combined private-public of 1.85 billion Euro has been invested to bring products to market readiness by 2020



FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Industry grouping
>150 members
50% SME

Research grouping
73 members



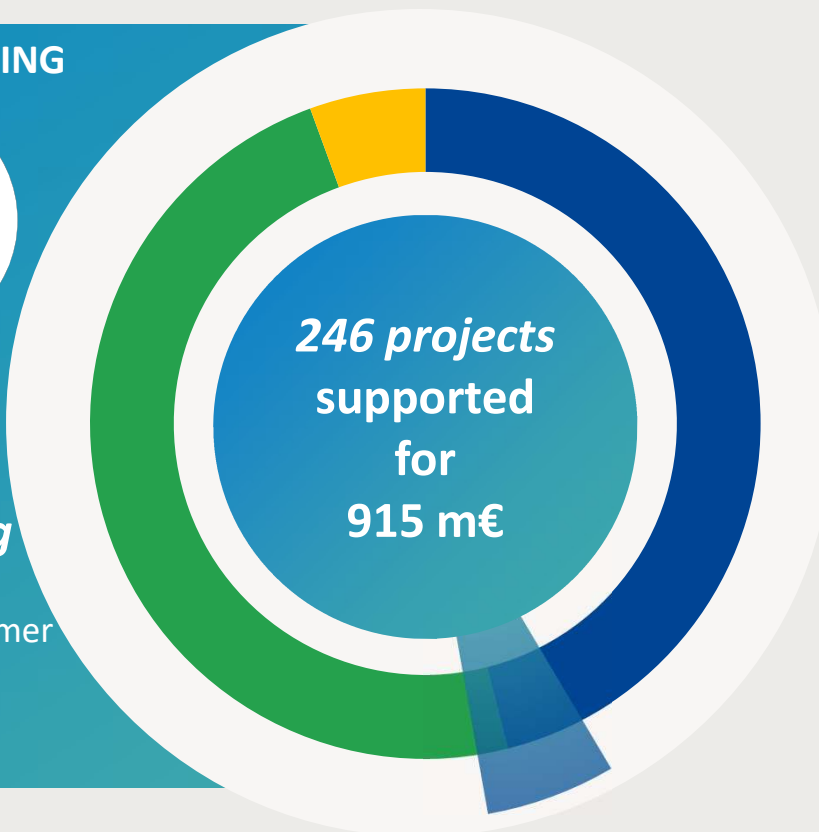
Energy
H₂ production and distribution
H₂ storage
F/C for CHP



Transport
Road vehicles
Non-road vehicles
Refueling infra
Maritime, rail and aviation applications



Cross-cutting
standards, safety, education, consumer awareness, ...



47 %

428 million euros
136 projects

42 %

388 million euros
66 projects

6 %

53 million euros
40 projects

5 %

46 million euros
4 projects



Similar leverage of other sources of funding: 935 m€

Besides CO₂ abatement, deployment of the hydrogen roadmap also cuts local emissions, creates new markets and secures sustainable employment in EU



2050 hydrogen vision



~24%

of final energy demand¹



2

~560 Mt

annual CO₂ abatement²



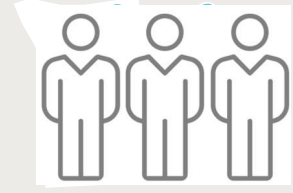
~EUR 820bn

annual revenue (hydrogen and equipment)



~15%

reduction of local emissions (NO_x) relative to road transport



~5.4m

jobs (hydrogen, equipment, supplier industries)³



1 Including feedstock 2 Compared to the reference technology scenario 3 Excluding indirect effects

SOURCE: Hydrogen Roadmap Europe team

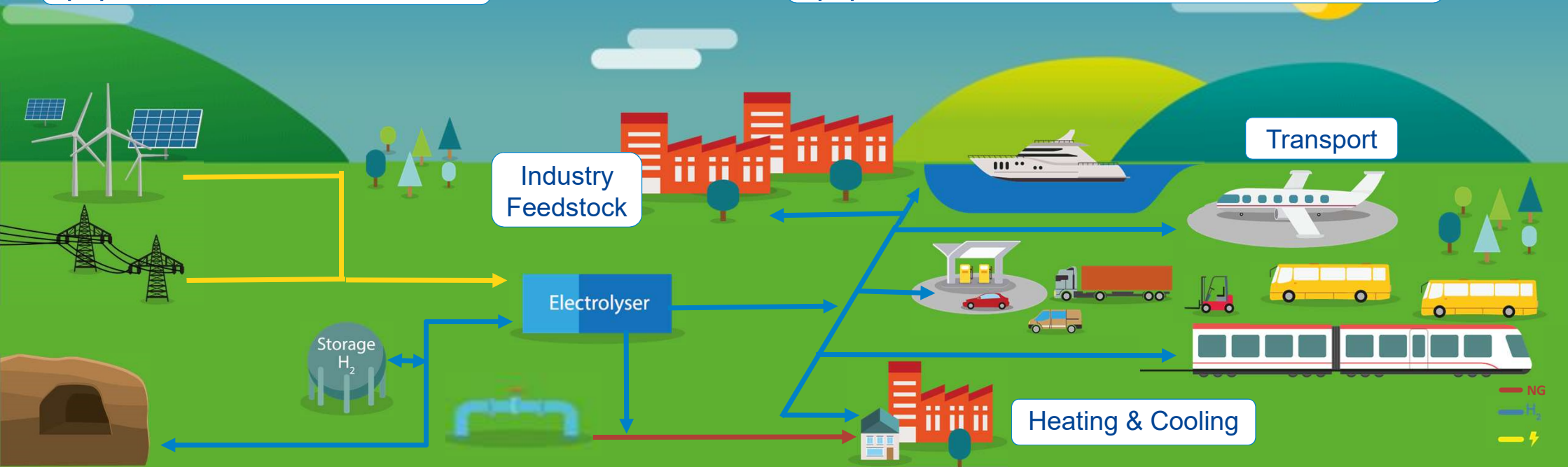
The role of hydrogen in our society & economy

Hydrogen allows more renewables in the energy system through storage and enables sectoral integration



(1) STORAGE (seasonal)

(2) SECTORAL INTEGRATION



Orkney Islands: Europe's first Hydrogen territory

Blueprint for other territories which consider hydrogen to decarbonise



<p>A hydrogen territory in Scotland: hydrogen production, storage, transportation and utilization for heat, power and mobility.</p>	<p>HySeas III: the world's first zero emission, sea-going ferry. Demonstrate a circular economy model for the local production of H2 fuel</p>
<p>2016-2021</p>	<p>2017-2021</p>
<p>FCH Funding: ~5M€</p>	<p>H2020 Funding: ~9.3M€</p>



FCH-JU initiative: 92 Regions/Cities from 22 countries (about 25% of EU) study to:



- (1) assess FCH applications,
- (2) identifying financing/funding options
- (3) develop roadmaps,
- (4) engage their stakeholders

<p>Belgium</p> <ul style="list-style-type: none"> >Flanders >Pom West-Vlaanderen 	<p>United Kingdom</p> <ul style="list-style-type: none"> >Swindon and Wiltshire >Aberdeen >Birmingham >Cornwall >Dundee >Fife >Leeds 	<p>Norway</p> <ul style="list-style-type: none"> >Akershus >Møre og Romsdal >Oppland County Municipal >Sogn og Fjordane 	<p>Sweden</p> <ul style="list-style-type: none"> >Gavleborg >Mariestad 	<p>Germany</p> <ul style="list-style-type: none"> >Baden-Württemberg >Bremerhaven >Hamburg >HyCologne-Hydrogen Region Rhineland >Kreis Steinfurt
<p>France</p> <ul style="list-style-type: none"> >Auvergne Rhone-Alpes >Bourgogne-Franche-Comté >Centre-Val de Loire >Grenoble >Grand Dole >La Roche sur Yon >Normandie >Occitanie-Phyrenees >Orléans >Pays de la Loire >Pays de St Gilles 	<p>Spain</p> <ul style="list-style-type: none"> >Aragon >Barcelona >Cantabria >Castilla – La Mancha 	<p>Iceland</p> <ul style="list-style-type: none"> >Reykjavik 	<p>Finland</p> <ul style="list-style-type: none"> >Kokkola 	<p>Denmark</p> <ul style="list-style-type: none"> >Guldborgsund >Lolland
<p>Italy</p> <ul style="list-style-type: none"> >Lazio >South Tyrol >Favignana 	<p>Netherlands</p> <ul style="list-style-type: none"> >Assen >Drenthe >Emmen >Groningen >Helmond 	<p>Estonia</p> <ul style="list-style-type: none"> >Tallinn 	<p>Latvia</p> <ul style="list-style-type: none"> >Riga 	<p>Czech Republic</p> <ul style="list-style-type: none"> >Trutnov
<p>Portugal</p> <ul style="list-style-type: none"> >Torres Vedras >Médio Tejo 	<p>Austria</p> <ul style="list-style-type: none"> >Tirol 	<p>Slovenia</p> <ul style="list-style-type: none"> >Velenje 	<p>Croatia</p> <ul style="list-style-type: none"> >Split >Split-Dalmatia County 	<p>Romania</p> <ul style="list-style-type: none"> >Constanța
<p>Bulgaria</p> <ul style="list-style-type: none"> >Bulgarian Ports >Sofia 	<p>Greece</p> <ul style="list-style-type: none"> >Alimos >Agia Paraskevi >Ierapetra >Kozani >Milos >Vrilissia 	<p>Saxony-Anhalt</p> <ul style="list-style-type: none"> >Recklinghausen >Saxony-Anhalt 	<p>Heraklion</p> <ul style="list-style-type: none"> >Heraklion >Western Macedonia >Papagoou-Halargos >Region of Crete 	<p>Kalymnos</p> <ul style="list-style-type: none"> >Kalymnos



Signing ceremony 23 Nov. 2016 with CqR President Markku Markkula + FCH-JU and 40 regions

H₂ Valley Support for 20 Million Euro (Call Jan. 2019)

6 proposals received and 1 selected to start the grant preparation



HEAVENN KEY FACTS:

- North Netherlands (Gronningen / Delfzijl / Emmen)
- Total project circa 90 million Euro
- 31 partners (public + private)
- Project supported by 65 parties (Nat. + Int.)
- Electrolysis for green H₂ production,
- H₂ Mobility: buses, passenger cars and trucks
- H₂ Refueling stations
- E-Kerosene for aviation
- H₂ for an inland water transport barge
- Domestic Heat applications
- Underground H₂ storage (Hystock)



<https://www.youtube.com/watch?v=L27dkYyg04g>

Hydrogen Valleys Partnership (European + Worldwide)

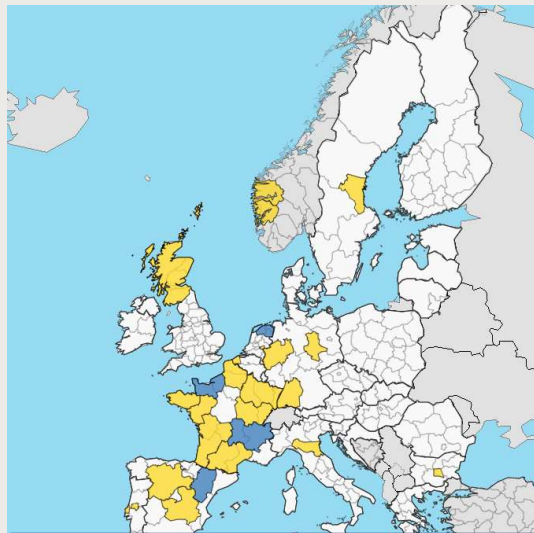
Established under the EC smart specialization platform for Industrial Modernization



European Hydrogen Valleys Partnership launched May '19 at EVS 32 in Lyon



<http://s3platform.jrc.ec.europa.eu/hydrogen-valleys>



Partnership led by:

- North of Netherlands (NL)
- Auvergne-Rhône Alpes (FR)
- Le Normandy (FR)
- Aragon (ES)

Around 40 regions joined and more will follow.



Mission Innovation
IC#8 hydrogen
Workshop

(27/28 March '19 Antwerp, BE)



Platform for Exchanges Between
Worldwide Initiatives on Hydrogen Valleys:

To set-up a global Information Sharing Platform within MI-IC8, to facilitate the emergence and implementation of large-scale hydrogen projects and leveraging the knowledge where IPR issues are less sensitive.

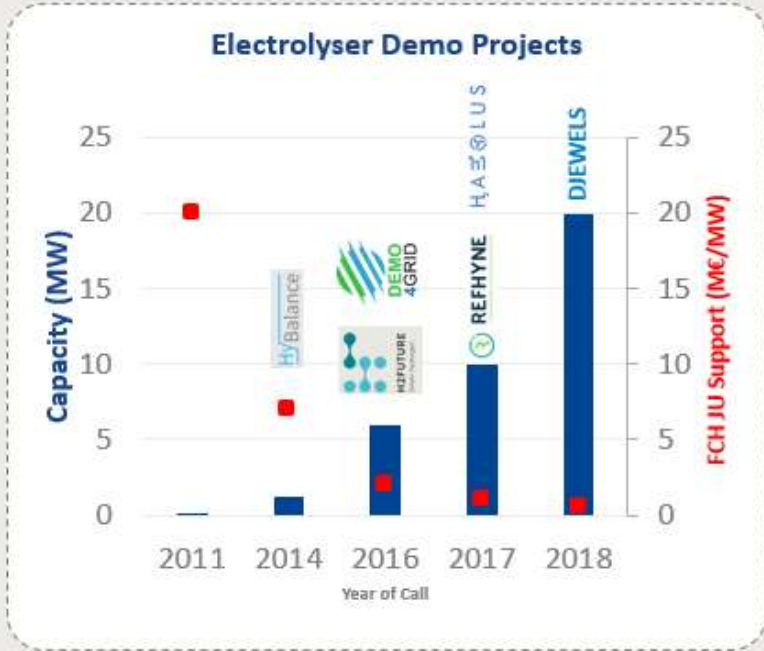
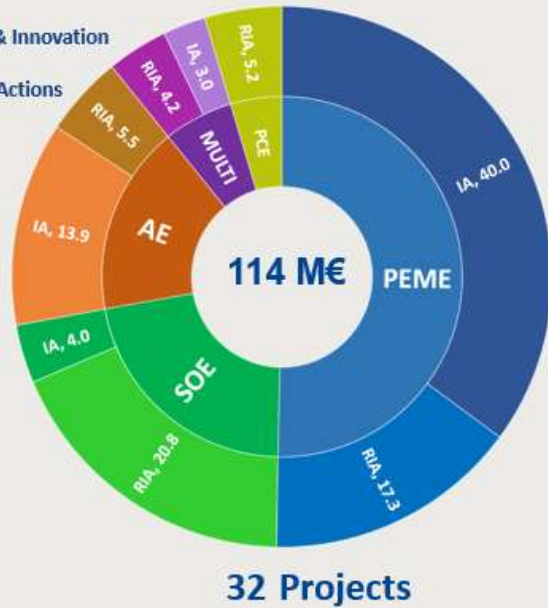
Electrolysis demonstrations for energy storage and greening of Industry

Continues support to develop higher capacity electrolyzers led to cost reduction and increased interest by industry



Electrolyzers, M€ FCH JU support

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



6MW @ Steel factory

<https://www.h2future-project.eu/>



10MW @ Refinery

REFHYNE
CLEAN HYDROGEN FOR EUROPE

<https://www.refhyne.eu/>



HRS



Steel industry



Refineries



Food industry

FCH-JU has projects related to many different modes of transport

Heavy duty transportation is discovering hydrogen thanks to the huge performance improvements of fuel cells

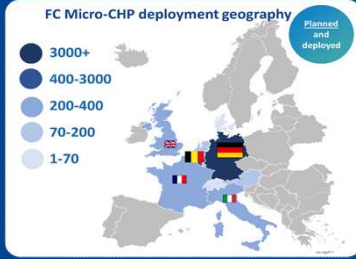


Fuel cell systems generating heat and power installed across EU

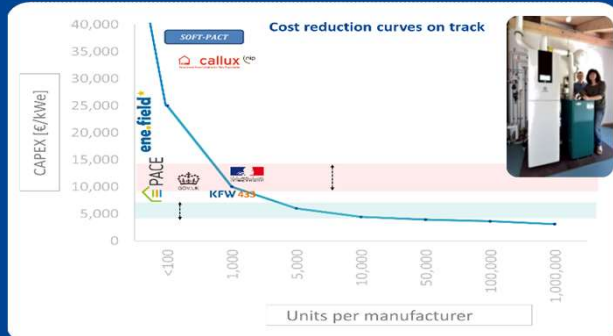
Depending on the application fuel cells in the range from 1kW up to 2MW can be selected



0.5~1.5 kW



<http://www.pace-energy.eu/>



Thousands of units deployed in various EU countries

- >1 MWe capacity installed; >5 million operating hrs.
- Cost reduced drastically through various projects
- National authorities start own subsidy scheme (e.g. >1,000 units deployed by a German scheme)

DURATION: 2016-2021 with FCH JU Funding: ~34M€

50~200 kW



175kW SOFC in waste water treatment plant, Turin Italy
Area will guarantee the supply of around 30% of the site electrical consumption, and almost 100% of the thermal requirement.

DURATION: 2015-2020 with FCH JU Funding: ~4.5M€

1 ~ 2 MW



2MW plant at Ynnovate, Yingkou (province Liaoning), China
Design, build and operate a 2 MW power generator, with full integration of heat and power with an existing chlorine production plant. Fully automated way of operation + remote control

DURATION: 2015-2018 with FCH JU Funding: ~5.5M€

Preparing the European workforce

Projects running include training packs in different languages, formats, means, etc.



European hydrogen emergency response training program for first responders
Follow-up project to start in Jan '20



**in person training, e-learning, blended learning...virtual reality, serious games...
 ...mock-up installations...**

HyResponse A comprehensive training program

Educational



Virtual reality



Operational



undergraduate & graduate education PhD BEng/BSc MEng/MSc



Courses for professionals/ general public



<https://fchgo.eu/>






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