FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

FCH2-JU

Bart Biebuyck

3 / 03 /2020 Brussels

Strong public-private partnership with a focused objective

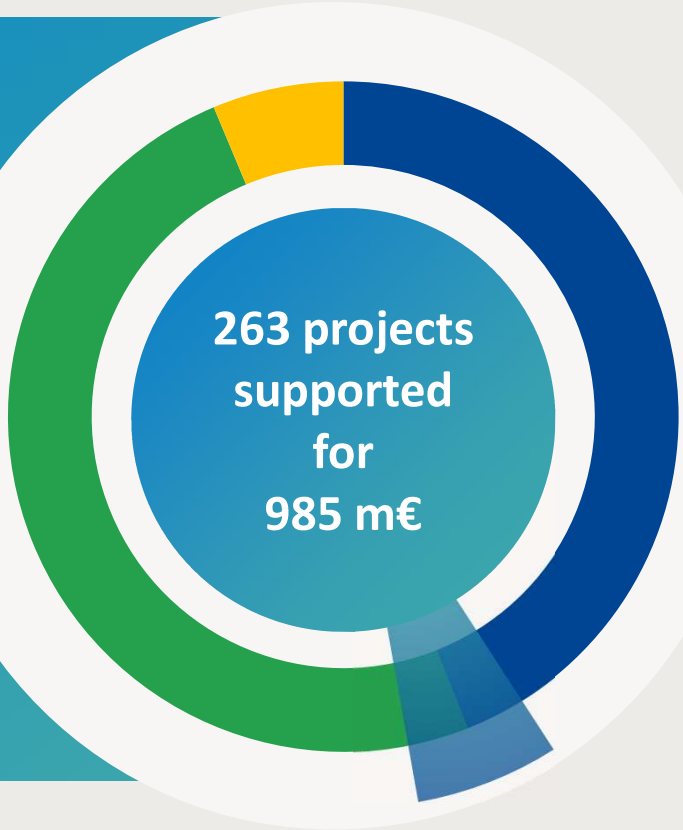
A combined private-public of about 2 billion Euro has been invested **to bring products to market readiness by 2020**

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Hydrogen Europe
Industry grouping
153 members (40% SME)
(65 in '08)

European Commission

Hydrogen Europe Research
Research grouping
78 members
(45 in '08)



Energy
H_2 production and distribution
H_2 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, …

46 %
457 million euros
145 projects

41 %
404 million euros
70 projects

6 %
58 million euros
43 projects

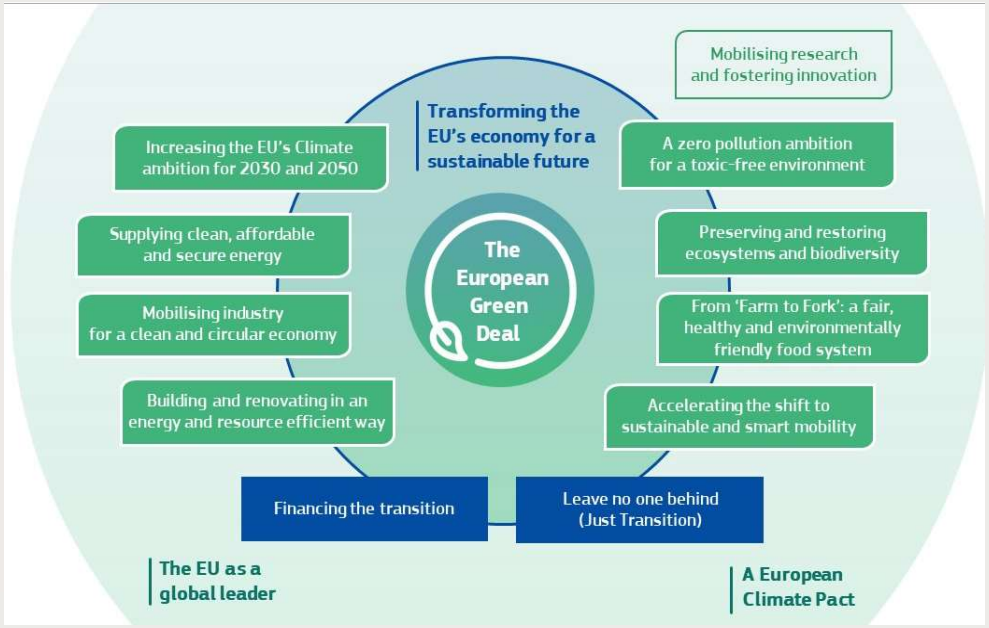
7 %
66 million euros
5 projects

Similar leverage of other sources of funding: 1.005 b€

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

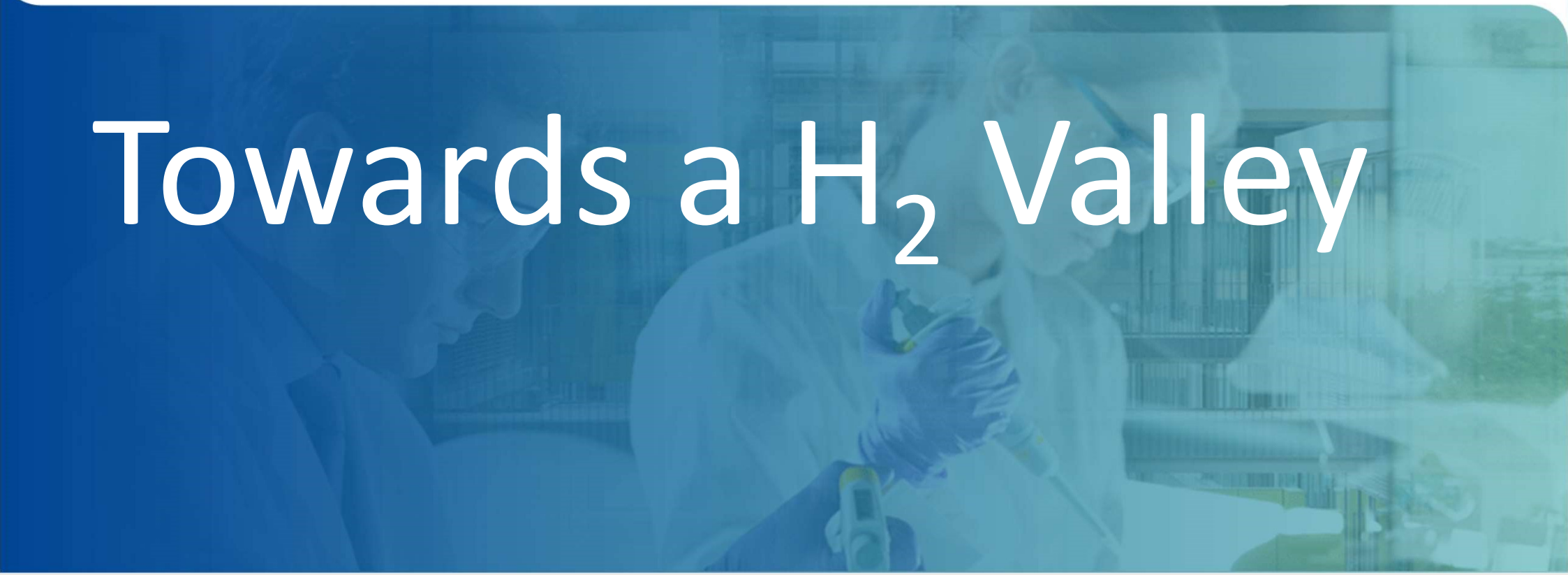
The FCH JU in a Public-private-partnership is key for building the ECO-system of an emerging technology like Hydrogen & Fuel cell technologies and bring new ideas towards commercialization.

- Strong collaborative research and innovation
- Build trust and bring significant private investment
- Bring tangible benefits to citizens fast due to flexibility
- Foster SME participation in Research and Innovation
- Ideal testbed to identify policy gaps and issues
- Turn science into investments and jobs
- Tackling of societal challenges efficient and effective



50-55% CO_2 reduction proposed in "The new green deal"

Towards a H_2 Valley



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

Planned deployments result in total investments of >EUR 1.8bn in the next 5 years

Belgium
>Flanders
>Pom West-Vlaanderen

United Kingdom
>Swindon and Wiltshire
>Aberdeen
>Birmingham
>Cornwall
>Dundee
>Fife
>Leeds
>London (Greater London Authority)
>Newcastle
>Orkney Islands
>Oxfordshire
>Perth and Kinross
>Manchester
>Tees Valley

Norway
>Akershus
>Møre og Romsdal
>Oppland County Municipal
>Sogn og Fjordane

Iceland
>Reykjavik

Sweden
>Gavleborg
>Mariestad

Finland
>Kokkola

Germany
>Baden-Württemberg
>Bremerhaven
>Hamburg
>HyCologne-Hydrogen Region Rhineland
>Kreis Steinfurt
>North Rhine-Westphalia
>Heide region
>HYPOS (East Germany)
>Recklinghausen
>Saxony-Anhalt

France
>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

Spain
>Aragon
>Barcelona
>Cantabria
>Castilla – La Mancha
>Murcia
>Port of Valencia
>Puertollano
>Valladolid

Netherlands
>Assen
>Drenthe
>Emmen
>Groningen
>Helmond

Italy
>Lazio
>South Tyrol
>Favignana
>Torino
>Venice
>Toscana

Austria
>Tirol

Portugal
>Torres Vedras
>Médio Tejo

Estonia
>Tallinn

Denmark
>Guldborgsund
>Lolland

Latvia
>Riga

Czech Republic
>Trutnov

Slovenia
>Velenje

Croatia
>Split
>Split-Dalmatia County

Romania
> Constanța

Bulgaria
>Bulgarian Ports
>Sofia

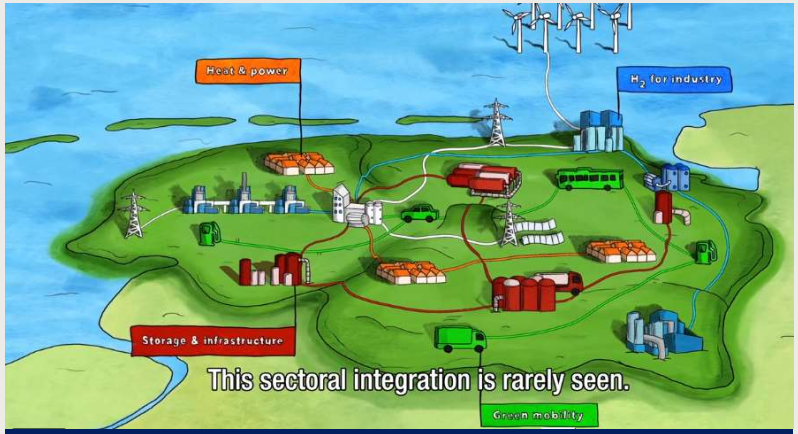
Greece
>Alimos
>Agia Paraskevi
>Ierapetra
>Kozani
>Milos
>Vrilissia
>Kalymnos
>Heraklion
>Western Macedonia
>Papagoou-Halargos
>Region of Crete

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

H_2 Valley Support for 20 Million Euro (Call Jan. 2019)

6 proposals received and 1 project was granted, this lead to a huge investment from Shell and Gasunie, creating 1000's of jobs

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



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)

NortH$_2$

GRONINGEN SEAPORTS

gasunie crossing borders in energy

provincie groningen

- Energy from source to customer – from renewable power to green hydrogen distribution – where different partners can collaborate on achieving the scale to realise this ambition.
- New wind farms in North Sea feed a mega-hydrogen facility in Eemshaven, possibly complemented with offshore hydrogen production.
- The ambition is to generate around 3 to 4 GW of wind energy for hydrogen production before 2030, possibly 10 GW around 2040.
- Green hydrogen production of 800,000 tonnes, avoids around 7 megaton CO_2 emissions annually.
- Gasunie infrastructure transports green hydrogen to industrial customers in the Netherlands and Northwest Europe.
- A large green hydrogen buffer provides the necessary flexibility because solar and wind energy are susceptible to fluctuations.
- Province of Groningen becomes the European centre of green hydrogen production and a European example as the first European Hydrogen Valley.
- The investments in NortH$_2$ can create thousands of jobs in the northern Netherlands.
- The project starts with a feasibility study

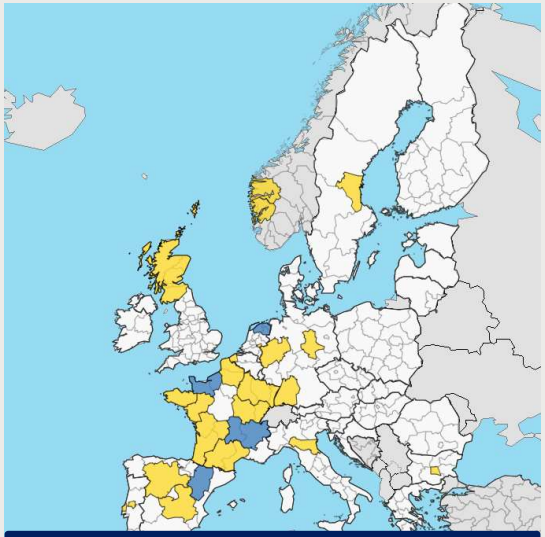
Hydrogen Valleys Partnership (European + Worldwide)

Established under the EC smart specialization platform for Industrial Modernization

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

EUROPEAN HYDROGEN VALLEYS PARTNERSHIP

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



Partnership led by:

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

32 regions joined and more will follow.

Tender: 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.

STATUS: Kick-off mtg. with consultant held

Hydrogen in the international context

IPHE – International Partnership for Hydrogen and Fuel Cells in the economy
19 member countries; meeting 2 times / year
Objective: to facilitate and accelerate the transition to clean and efficient energy and mobility systems using Hydrogen and fuel cell technologies across applications and sectors

MISSION - INNOVATION – Innovative Challenges 8 « Renewable and Clean Hydrogen Challenge"
May 23-24, 2018, Malmö, Sweden
Objective: To accelerate the development of a global hydrogen market by identifying and overcoming key technology barriers to the production, distribution, storage, and use of hydrogen at gigawatt scale

Informal EU energy ministerial – The Hydrogen Initiative (signed by 29 countries)
Sept. 17-18, 2018, Linz, Austria
Objective: the signatory states commit themselves to continue research and investment in the production and use of hydrogen as a future-oriented technology

HEM - Hydrogen Energy Ministerial Meeting 2019
1st one held Oct. 23, 2018; 2nd one on Sept. 25, 2019, Tokyo, Japan
Objective: Follow up "Tokyo Statement" to realize it and set "Global Hydrogen Target" to share global goal.

CEM -New Hydrogen Initiative
May 27-29, 2019, Vancouver, Canada
Objective: Advance policies, programs and projects to accelerate commercial scale deployment of hydrogen and fuel cell technologies across all sectors of the economy

G20 Ministerial Meeting on Energy Transitions and Global Environment for Sustainable Growth
June 15-16, 2019, Karuizawa, Japan
The importance of hydrogen mentioned for 1st time in the G20 Ministerial Communique and IEA released their H2 report.
=> Japan, US and EU agree to collaborate closely on hydrogen

SECTOR

Green H_2 production and industry

Electrolysis demonstrations for energy storage and greening of Industry

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

Project: Don Quichot
Place: Belgium
Date: 2011
Electrolyser: Hydrogenics (PEM)
Funding: 5.0 m€

Project: Haeolus
Place: Norway
Date: 2017
Electrolyser: Hydrogenics (PEM)
Funding: 5.0 m€

Project: H2future
Place: Austria
Date: 2016
Electrolyser: Siemens (PEM)
Funding: 12 m€

Steel

Project: Djewels
Place: The Netherlands
Date: 2018
Electrolyser: McPhy (ALK)
Funding: 11 m€

Fertilizers

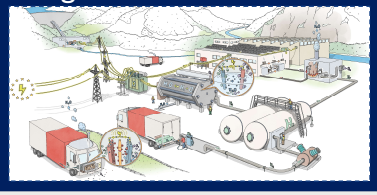
Djewels

0.15 MW → 1.2 MW → 2.5 MW → 4.0 MW → 6.0 MW → 10 MW → 20 MW

Project: Hybalance
Place: Denmark
Date: 2014
Electrolyser: Hydrogenics (PEM)
Funding: 8.0 m€

Project: Demo4grid
Place: Austria
Date: 2016
Electrolyser: IHT (ALK)
Funding: 2.9 m€

Food

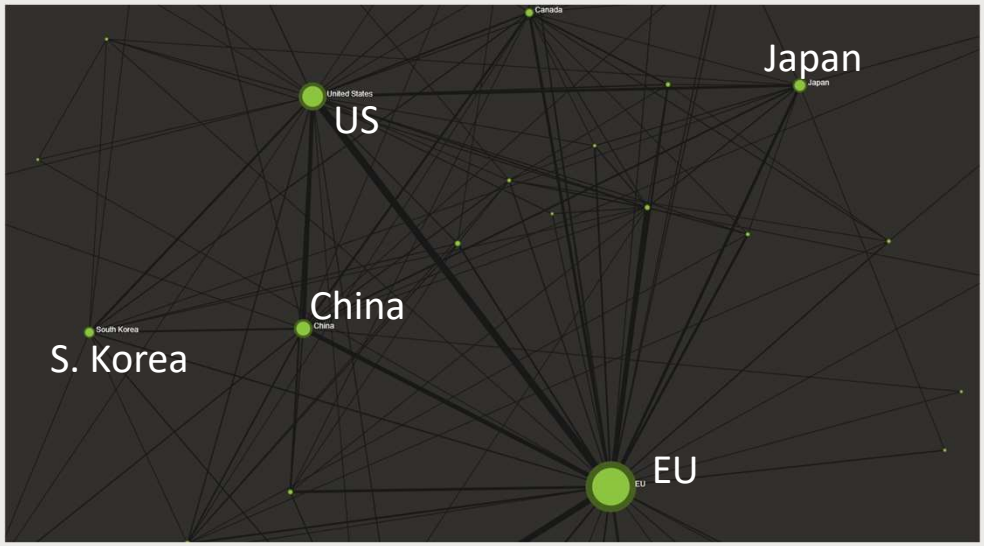


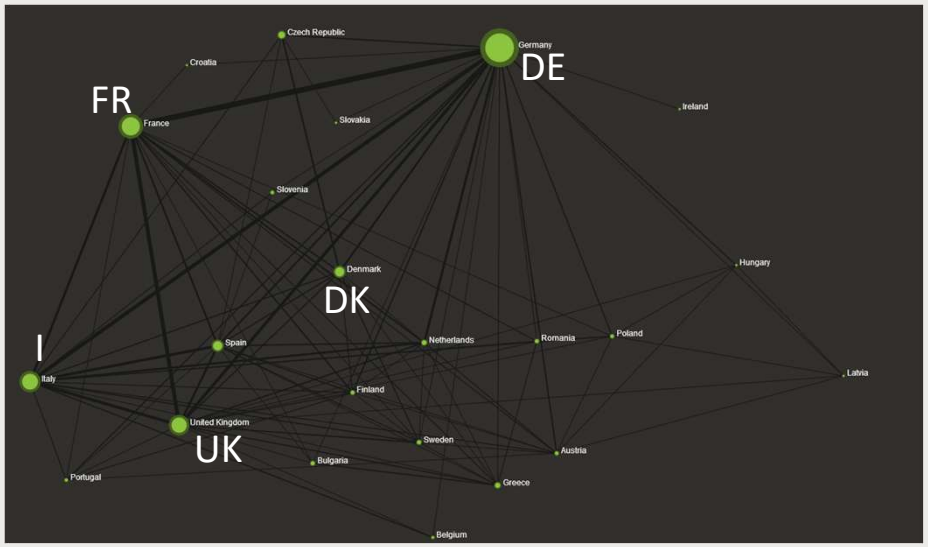
Project: Refhyne
Place: Germany
Date: 2017
Electrolyser: ITM (PEM)
Funding: 10 m€

Preparing >100 MW and GW scale

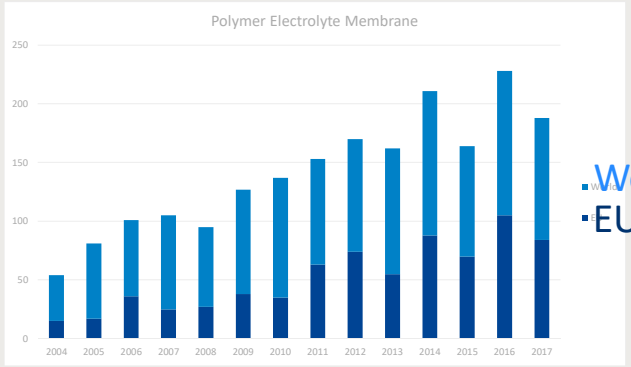
PEM electrolysis: Number of publications, patents, etc. 2004 - 2017

https://fch.europa.eu/page/tools-innovation-monitoring-tim





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



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

Developing an EU wide Guarantees of Origin Scheme for Hydrogen

Important for the JU's to have input to policy as part of the mandate in the council regulation

Four production plants included in the pilot scheme which have been already audited

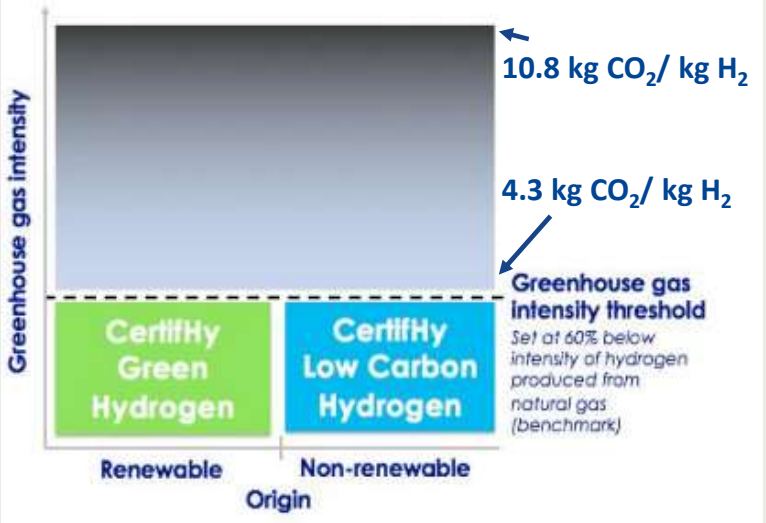
Air Liquide, Port Jerome (SMR +CCS)

Colruyt Group, Halle (Electrolysis +RE)

Air Products, Rotterdam (by product H2 from Chlor-alkali process)

Uniper, Flakenhagen (Electrolysis + RE and methanation

Two labels are defined for hydrogen



Energy Source	Issue	Transfer	Cancel	Export	Import	Certificate expiry
F01000000 Renewable	2 868	10	1 643	-	-	-
F02000000 Fossil	73 739	-	1 964	-	-	-
Total	76 607	10	3 627	-	-	-

Name	GSRN	Installed Capacity (MW) (MW)	Commissioning Date	Domain	Fuel	Technology
Eoly H2 Production Plant	643002406971000037	8,50	2017-10-23	CertifHy	F01000000 - Renewable	W010101 - Hydrogen/Water electrolysis/Low temperature/Main-product
MEB Rotterdam	643002406971000068	2 000,00	1983-01-01	CertifHy	F01000000 - Renewable	W020001 - Hydrogen/Chlor-alkali electrolysis/By-product
Port Jerome	643002406971000051	4 200,00	2007-07-01	CertifHy	F02000000 - Fossil, F01000000 - Renewable	W030201 - Hydrogen/Steam methane reforming/With CCS or CCU/Main-product
WindGas Falkenhagen	643002406971000044	32,13	2013-08-01	CertifHy	F01000000 - Renewable	W010101 - Hydrogen/Water electrolysis/Low temperature/Main-product

https://cmo.grexel.com/Lists/PublicPages/Statistics.aspx

Next:

Expanding the GO scheme to all Member States and establish one central GO scheme.

TRANSPORT

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

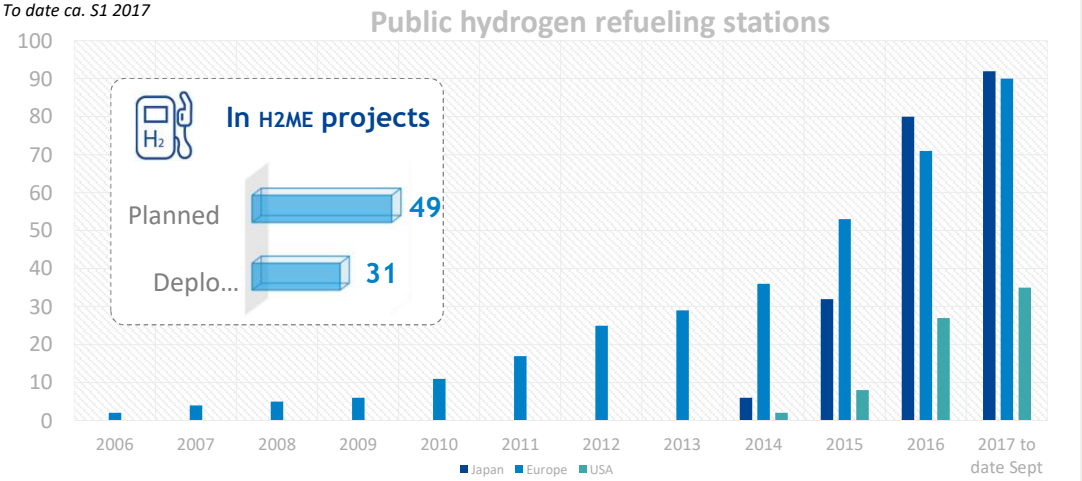
Heavy duty transportation is discovering hydrogen thanks to the huge performance improvements of fuel cells

14

Roll-out of the required infrastructure in Europe

Europe installs Hydrogen Refuelling Stations thanks to European programs (FCH-JU & CEF) & national programs.

Source: FCH JU KM data collection file, 20/09/2017, public stations
USA-DoE & CaFCP, Japan-HySUT
To date ca. S1 2017

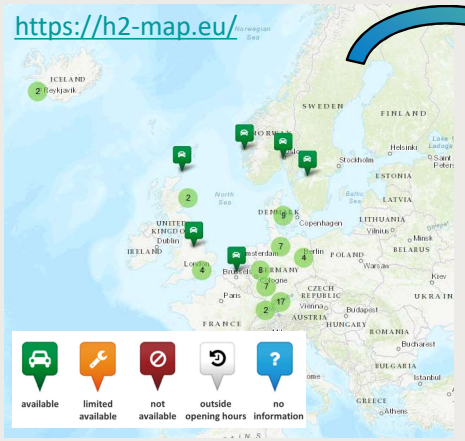


	Dec '19	2020	2022	2025	2030
Europe	139	-	-	(820~842)*	3750 **
China	12	100	-	350	1000
Japan	112	160	-	320	900
USA	44	100	-	200~225	-
S-Korea	34	-	310	-	-

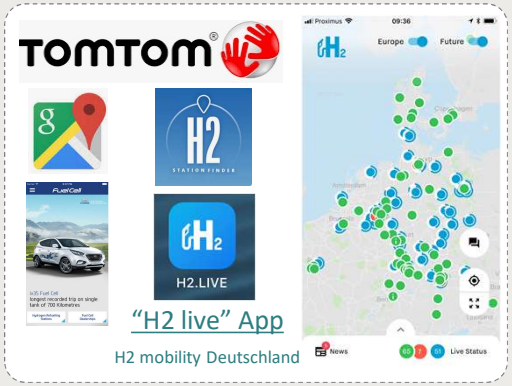
* According to the action plan of Alternative Fuel Directive
** McKinsey study H2: Europe roadmap to be released Oct '18.

Nel ASA: Awarded frame contract for multiple hydrogen fueling stations in California by Royal Dutch Shell Plc

Development of a system for HRS availability in the EU



Possible end users

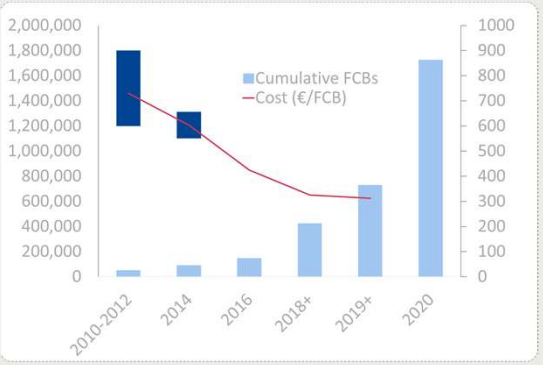


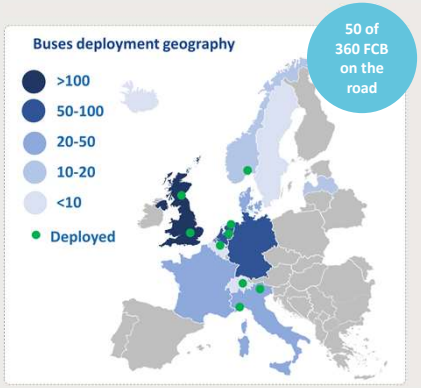
"H2 live" App
H2 mobility Deutschland

KPI	2017	2020	2030
Energy demand (kWh / kg H2)	10	5	3
System cost (Thousands € / kg H2/day)	7	4 – 2,1	2,4 - 1,3
Availability (%)	95	96	99

Roll-out of FC buses accelerates and become commercial

EU is supporting totally 360 Hydrogen buses deployment that lead to a price reduction of 66% vs 2010
and a new initiative through CEF of 1000 buses in EU create scale and get cheaper than other zero-emission buses.





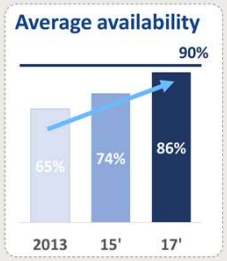
Van Hool hydrogen bus for PAU crowned as best bus of the world 2019!

12 European OEM's are developing H_2 buses:
www.fuelcellbuses.eu

88% *green hydrogen*

Achieved

- **> 6,000,000 km driven since projects started**
- **> 92 t of H_2 consumed only in 2017**
- **> 25,000 h lifetime reached**
- **625,000 €/bus offered**
- From order to operation, 18m delivery time



Everfuel, Wrightbus, Ballard Power Systems, Hexagon Composites, Nel Hydrogen and Ryse Hydrogen, leading players in the hydrogen fuel cell electric value chain, are joining forces to form the H2Bus Consortium. The members are committed to deploying 1,000 hydrogen fuel cell electric buses, along with supporting infrastructure, in European cities at commercially competitive rates.

First H2 trucks appearing on the EU roads and more are to come

JU's are very important to create the European supply chain and should be priority

FCH-JU H2ME project Batt+RE

REVIVE: H2 Garbage Trucks in 8 EU cities

H2HAUL: 15 Heavy Duty trucks in 4 countries

CNH Industrial takes $250 million lead in Nikola's Series D round

Fuel cell startup gets access to Iveco European network and purchasing might

Alan Adler · 2 days ago · 2 minutes read

ESORO COOP

ASKO-SCANIA

VDL - COLRUYT

FCH-JU started with Fuel Cells in trucks for APU's but was found to expensive, therefor focus shifted to developing and testing trucks with range-extenders or fuel cell only e.g.: garbage trucks in mayor cities.

~~1600~~

Hyundai signs deal to sell ~~1,600~~ hydrogen-powered trucks in Switzerland

Hyunjoo Jin · 3 MIN READ

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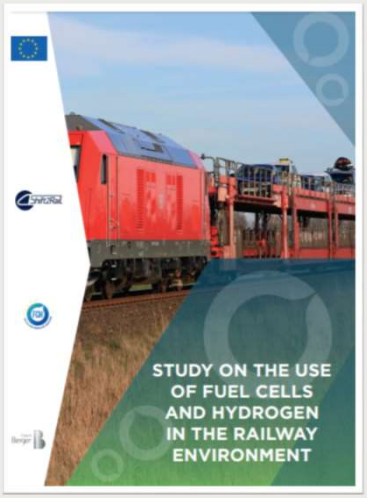
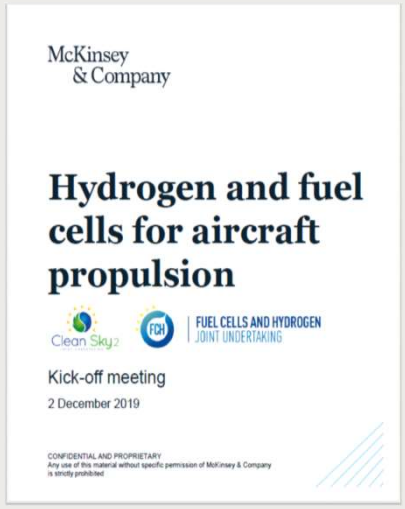
Norway aims for 1000 hydrogen trucks by 2023

September 19, 2018

Synergies with other European Funding instruments for hydrogen

JOINED WS & STUDIES





Shift2Rail

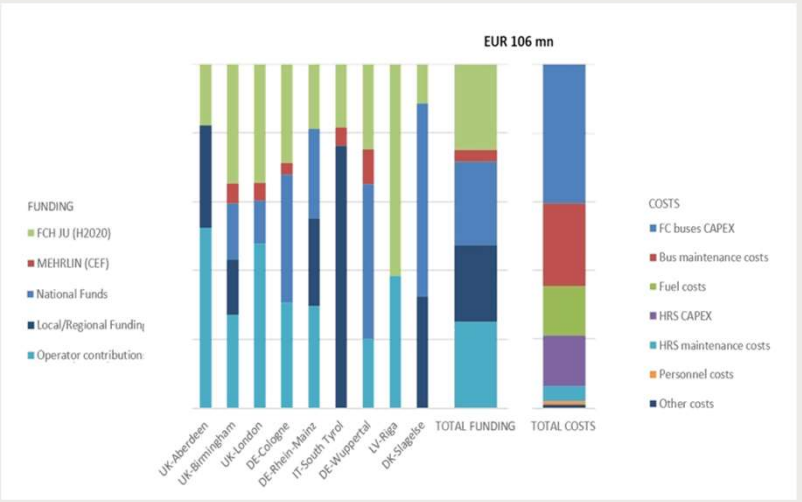
Clean Sky 2 JOINT UNDERTAKING

JOINED PROJECTS

JIVE (FCH JU) and MEHRLIN (CEF)

- Deployment of 139 FC buses in 9 cities.
- Includes 18 HRS (11 new and 7 upgrade) of which 7 funded by CEF (DG MOVE) and 6 by FCH JU

Connecting Europe Facility
Investing in Europe's growth



Funding structure

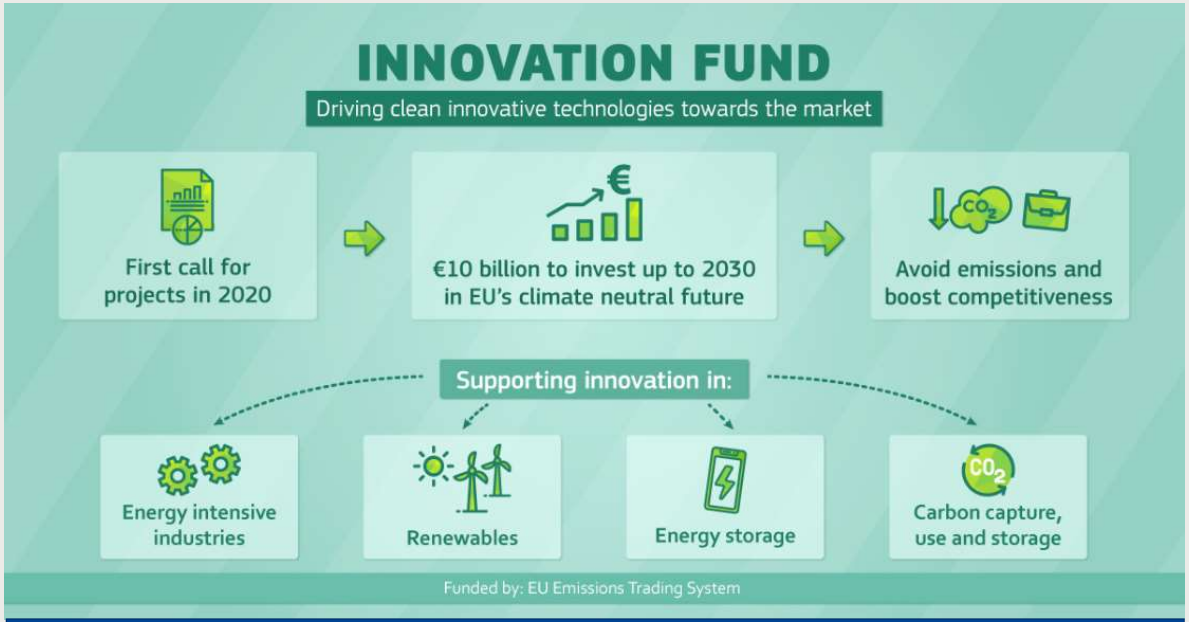
- FCH JU contributed to ¼, i.e. leverage of 3
- CEF contributed to 5 cities/regions
- National funding programs and support in the UK (OLEV), DE (NOW) and DK (ministries)
- Regional/Local funding most relevant in IT
- Offset funds/costs from bus operators cover ¼
- City of Riga secured EIB financing under wider EIB loan pack (Cleaner Transport Facility – DG MOVE)

Next: **1) Importance to make MOU with regional funding bodies**
2) Next

Other European Funding instruments for hydrogen

Depending on the project seize and goal, the right funding instrument should be chosen

IPCEI for scaling up production
(DG GROW)

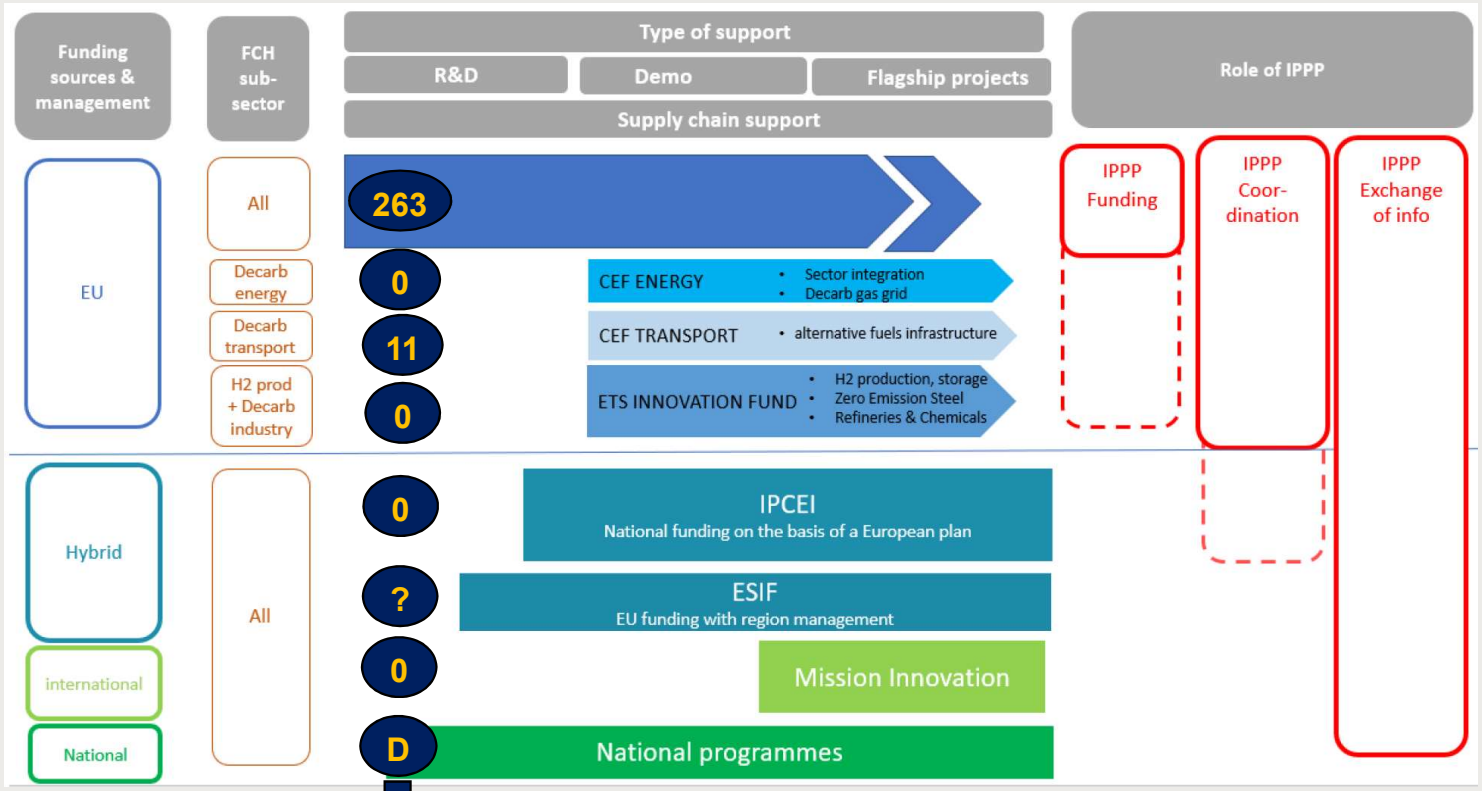


ETS money funds clean technologies
(DG CLIMA)

The coordination of several funding and financing streams will be vital to maximize the impact of this funding program: One-Stop shop

A JU can help the mission and it would be wise to involve the JU's, no discussions started;

for FCH: "Climate-neutral and smart cities" and "Adaptation to climate change including societal transformation" & "Healthy oceans, seas, coastal and inland waters"



The JU proposes to be the ONE STOP SHOP for hydrogen & fuel cells in EU for an efficient and effective coordination:

Through "Contribution agreements" the JU can also launch & manage calls for other EU programs.
Other option is to involve the JU to give input to the work program, do the evaluation and manage the project.

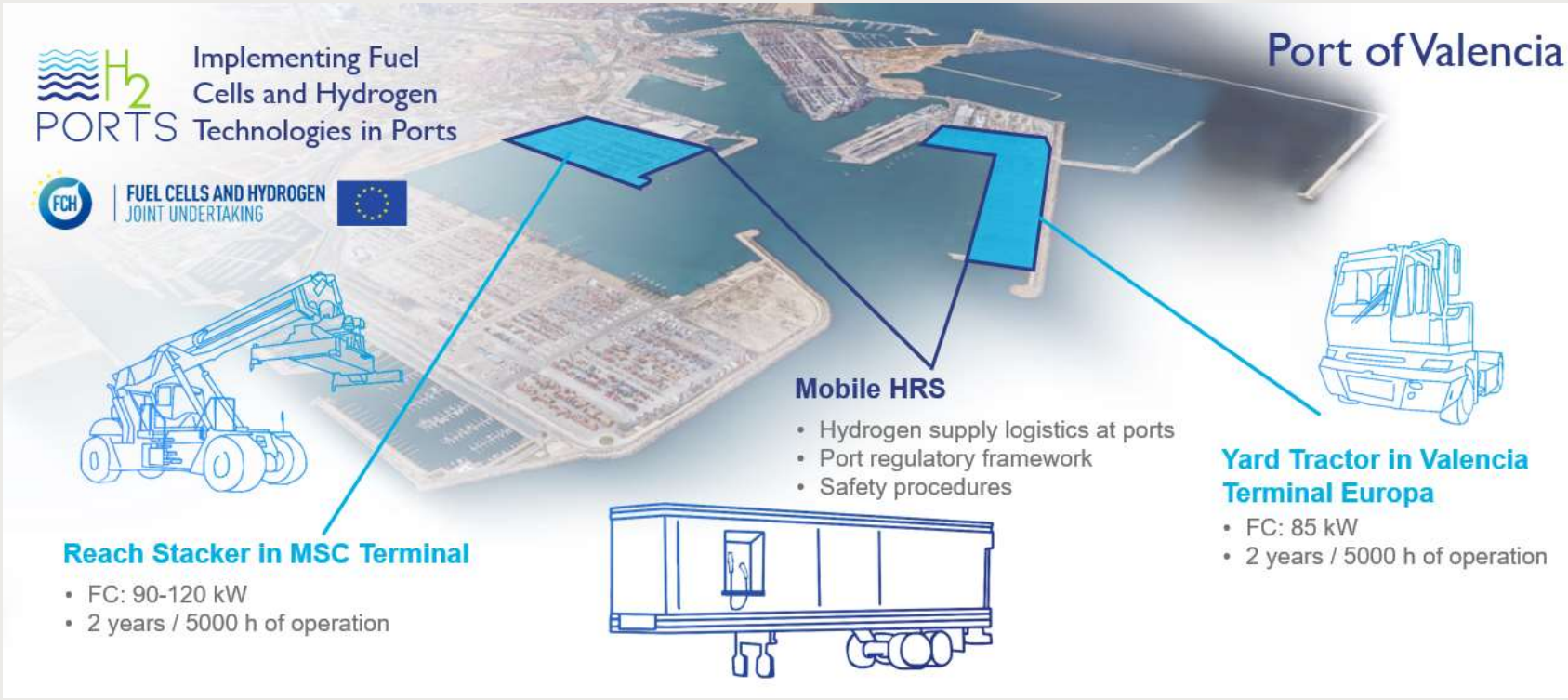
The JU should become the European H2 knowledge hub to give input to policy officers or EIB or invest EU, to exchange info among the different programs or to support the EC in international cooperation.

The JU should be able to access other funds
eg: Bill Gates or Leonardo Di Caprio fund

Number of projects:
>95% of EU projects on Hydrogen managed by the JU; in near future many other programs will start and coordination will be needed! The JU and Germany national H2 program align very well. Regional funded projects are harder to track.

H2Ports project aims to implement Fuel Cells and Hydrogen in Ports

First application of hydrogen technologies in port handling equipment in Europe



H2PORTS project in the port of Valencia

- Reach stackers and yard tractors will be demonstrated in the port
- A mobile hydrogen refueling station will be operated inside the port

DURATION:
2019-2022; project 4.1 M€ (4 M€ by FCH-JU)

Next: to build a worldwide hydrogen ports coalition under CEM

SAFETY, STANDARDS, EDUCATION…

FCH-JU outreach activities in central and East European Countries

Important for the JU's to have outreach as part of the mandate in the council regulation

CROATIA 2020?

HUNGARY: Budapest 2018 → ROMENIA: Timisoara 2018 → BULGARIA: Sofia 2018 → SLOVAKIA: Tale 2019 → ROMENIA: Bucharest & Constanta 2019

European Hydrogen Safety Panel (EHSP) initiative

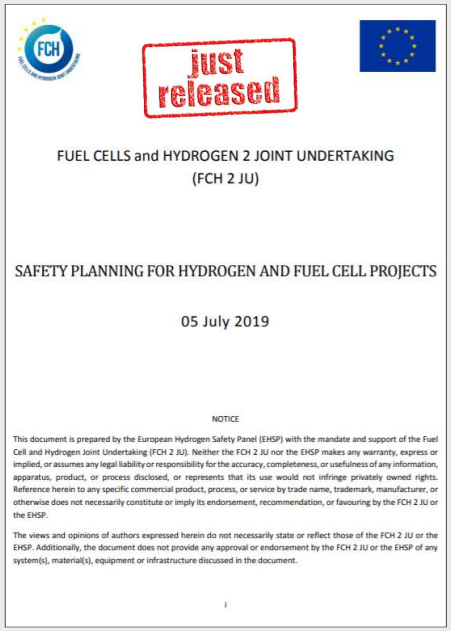
Expert group on hydrogen safety assisting the FCH 2 JU at project and programme level

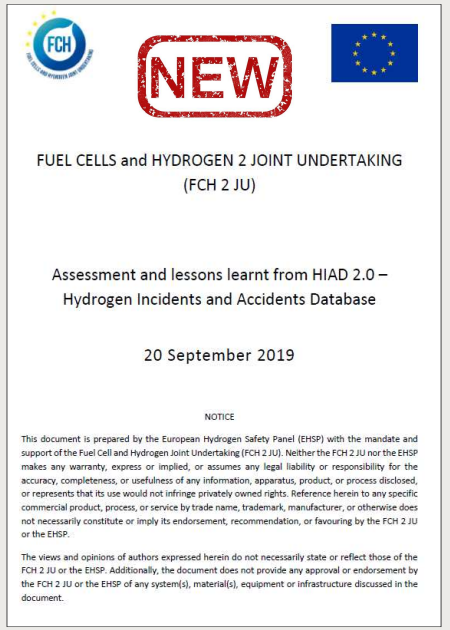
EHSP Launched and running!

16 experts from industry & research

Assuring that H2 safety is adequately handled
Promoting and disseminating H2 safety culture

The EHSP released the first 2 reports on:
- Safety planning in FCH projects
- Lessons learnt from HIAD





Everyone is welcome to cooperate with the European Hydrogen Safety Panel !!!

FUTURE…

Future European Funding opportunities for hydrogen

Depending on the project seize and goal, the right funding instrument should be chosen, FCH can help you

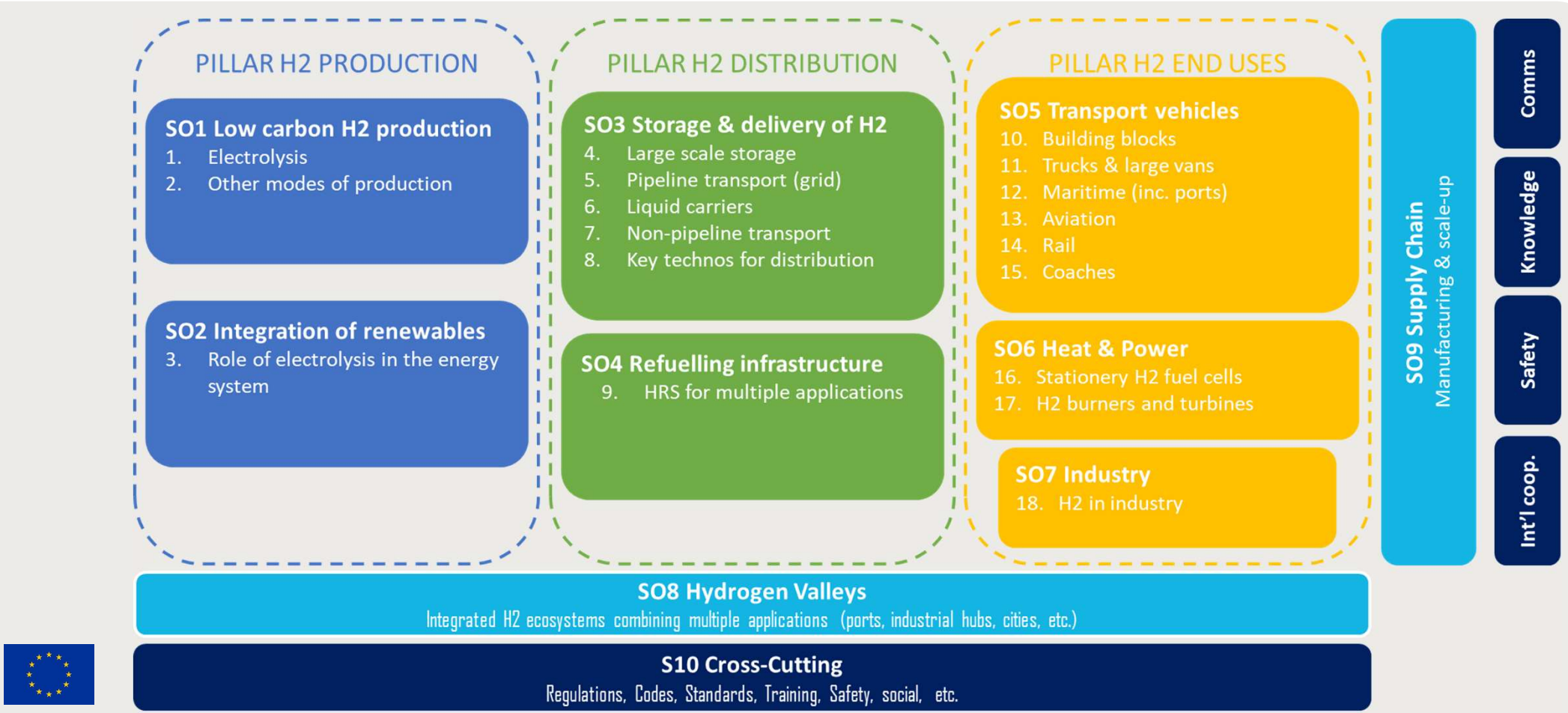
New partnership: CLEAN HYDROGEN EUROPE

- **Channel cross-sectoral collaboration**
- **Involve more energy companies**
- **Include waterborne and rail transport industry**
- **The industrial sectors** (chemical, steel, refineries, etc.)
- **Include civil society and NGOs.**

Start in 2021; industry + research request a doubling of the budget (1.3 b€)
to tackle research in heavy duty, industry and demo's in Eastern and Central Europe

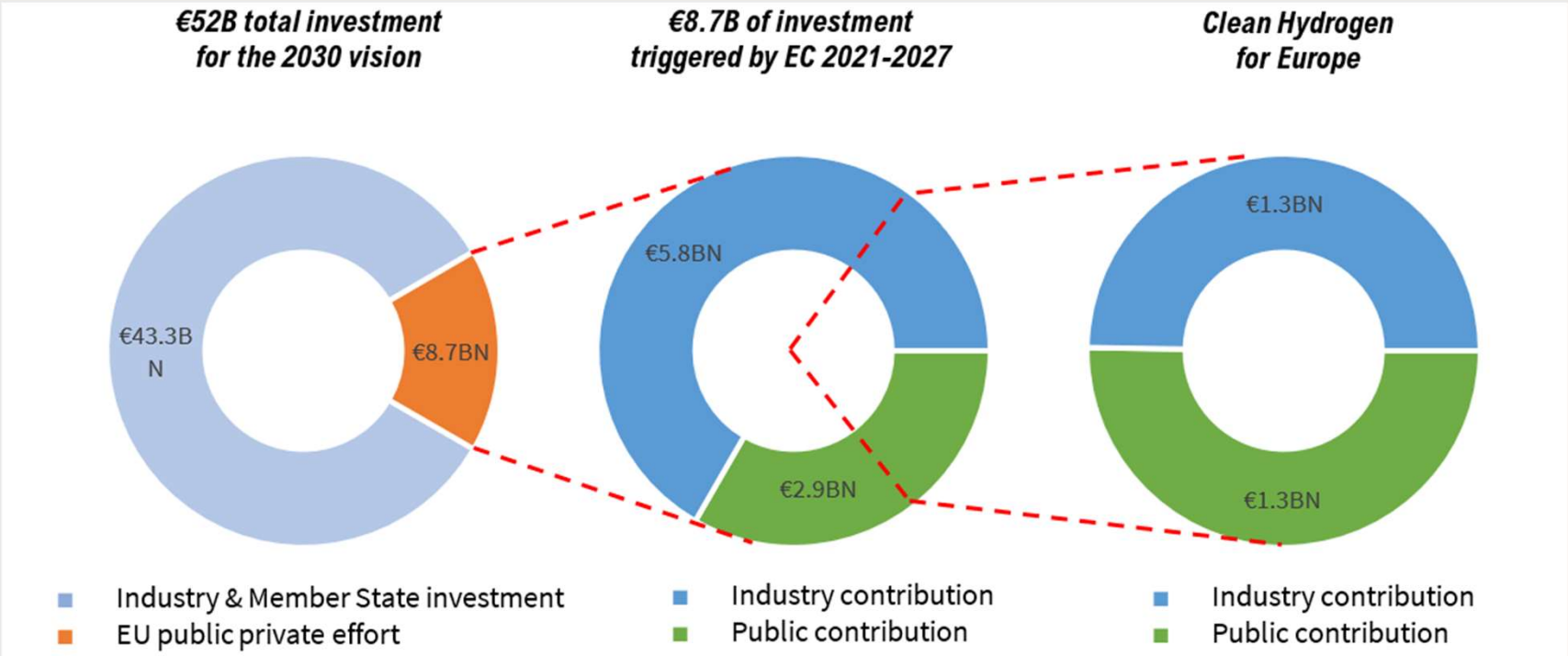
Proposed objectives for Clean Hydrogen Partnership

3 main pillars: H_2 production, distribution and end-uses next to supply chain, ecosystems and cross-cutting.



Proposed a €2.6 BN program for Clean Hydrogen Partnership

Industry requests a €2.9 BN (€1.3 BN for HE) EU public contribution to unlock a nearly €50 BN by Industry & M/S



The **€8.7BN** programme might in 70% be funded through existing or planned EU support funds like **CEF Transport and Energy or the ETS Innovation Fund** (mostly market deployment actions).

The remaining 30%, i.e. **EUR 2.6 BN** would be financed through the **next IPPP on Hydrogen (Clean Hydrogen for Europe)**.

As is expected in case of a public-private partnership the **contribution will be shared equally by industry (and research) and the European Commission**.

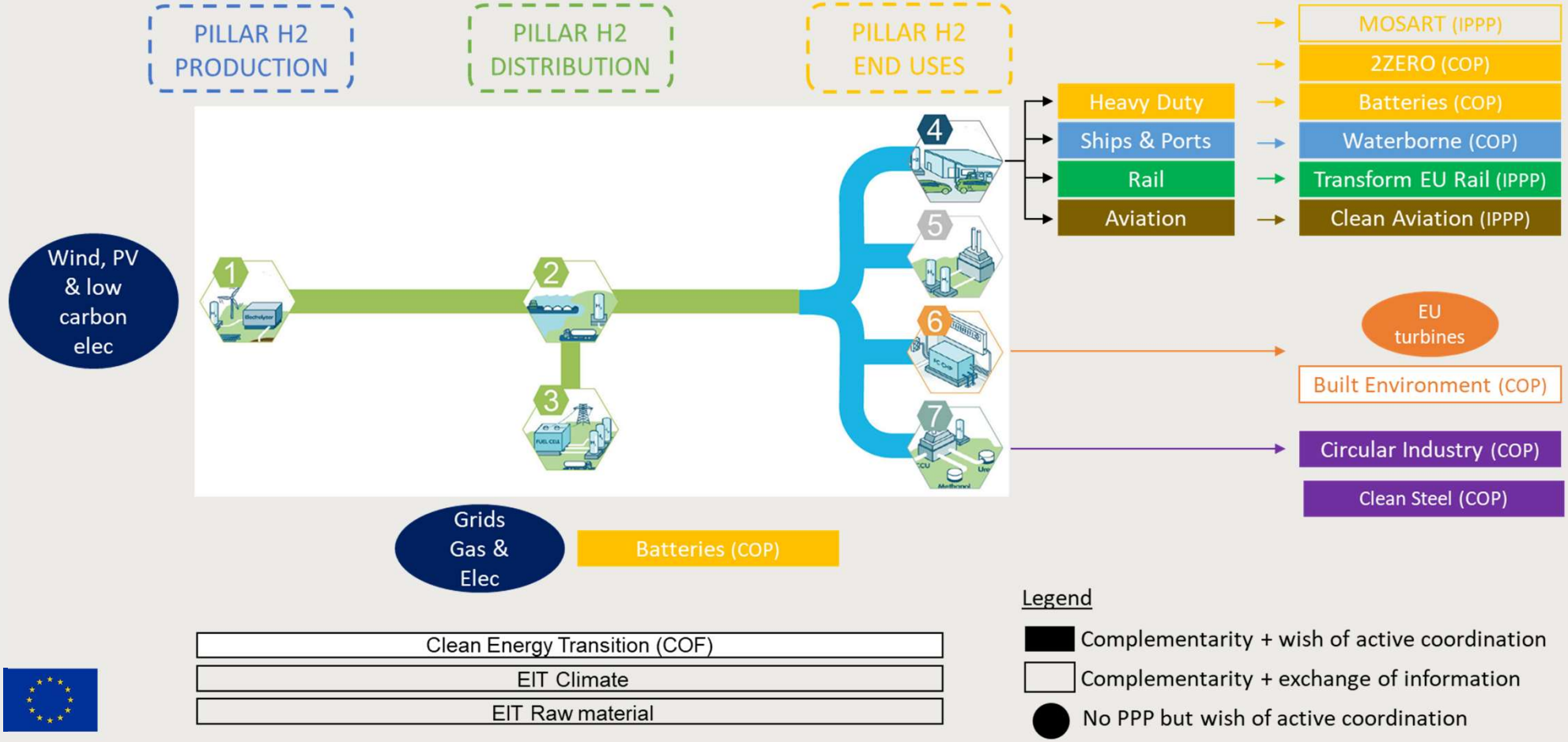
The JU would welcome and is open to discuss a stronger involvement of the Member States or the regions.

Request to double FCH budget (€1.3 BN) to tackle research in heavy duty, industry and demo's in Eastern and Central Europe

EU in the global view of public support for the sector:
China: 4 €/capita/yr.
Japan: 3 €/capita/yr.
US: 0.75 €/capita/yr.
EU: 0.5 €/capita/yr.
-> Doubling the budget will not be enough, international cooperation will be important.

Consultation with other sectors

The Clean H2 JU will do complementary calls with other Partnerships and proposed this for TRL >8 ; cooperation should be mentioned mandatory in council regulation of other partnership with dedicated budget assigned at the beginning.



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

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