Private-Public Partnership on Hydrogen

A European success story

#H2020Energy info days

Mirela Atanasiu

Research and Innovation

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

Fuel Cells & Hydrogen technologies in the context of the EU Climate and Energy Framework

Enabling energy to be secure, affordable and sustainable

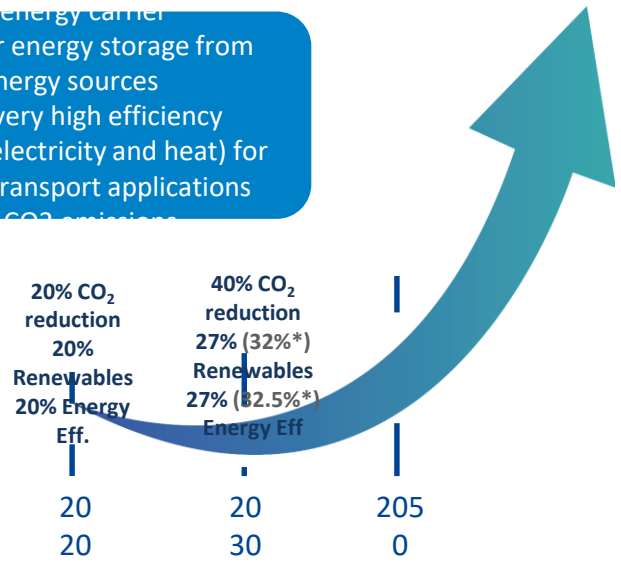
research excellence leading to industry innovation and growth

Increase independence from unstable outside regions

- H2 is a clean energy carrier
- Possibility for energy storage from renewable energy sources
- Fuel cells as very high efficiency convertors (electricity and heat) for Energy and Transport applications
- Reduction of CO_2 emissions

Energy Union dimensions

- ***Security, solidarity and trust***
- ***Fully-integrated Internal Energy Market***
- ***Energy Efficiency***
- ***Climate action - decarbonising the economy***



** 14 June 2018: Commission, Parliament and Council Political Agreement (approved within Clean Energy Package, 19 Dec 2018)*

Besides CO_2 abatement, deployment of the hydrogen also cuts local emissions, creates new markets and secures sustainable employment in EU

2050 hydrogen vision

~24%

of final energy demand[1]

~560 Mt

annual CO_2 abatement[2]

~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]

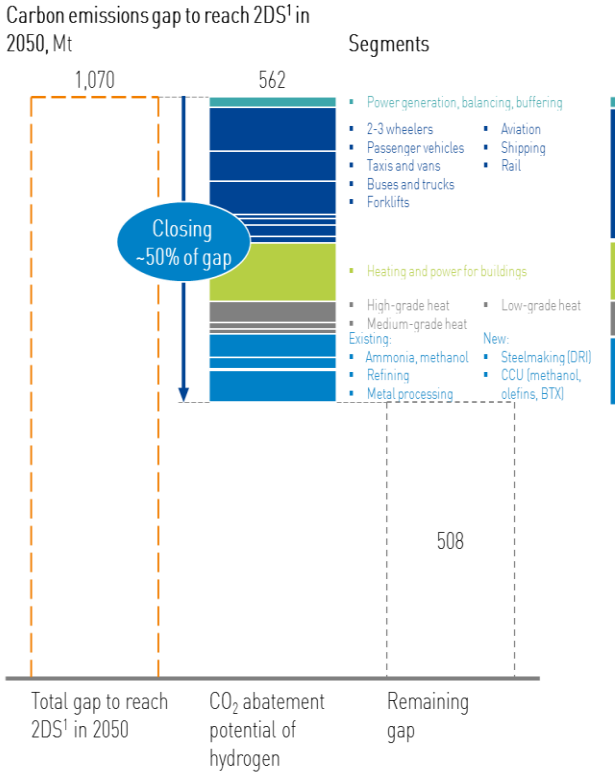
1 Including feedstock
2 Compared to the reference technology scenario
3 Excluding indirect effects

SOURCE: Hydrogen Roadmap Europe team

European Commission

WHY HYDROGEN?

Across applications hydrogen can close half of the gap towards the 2DS



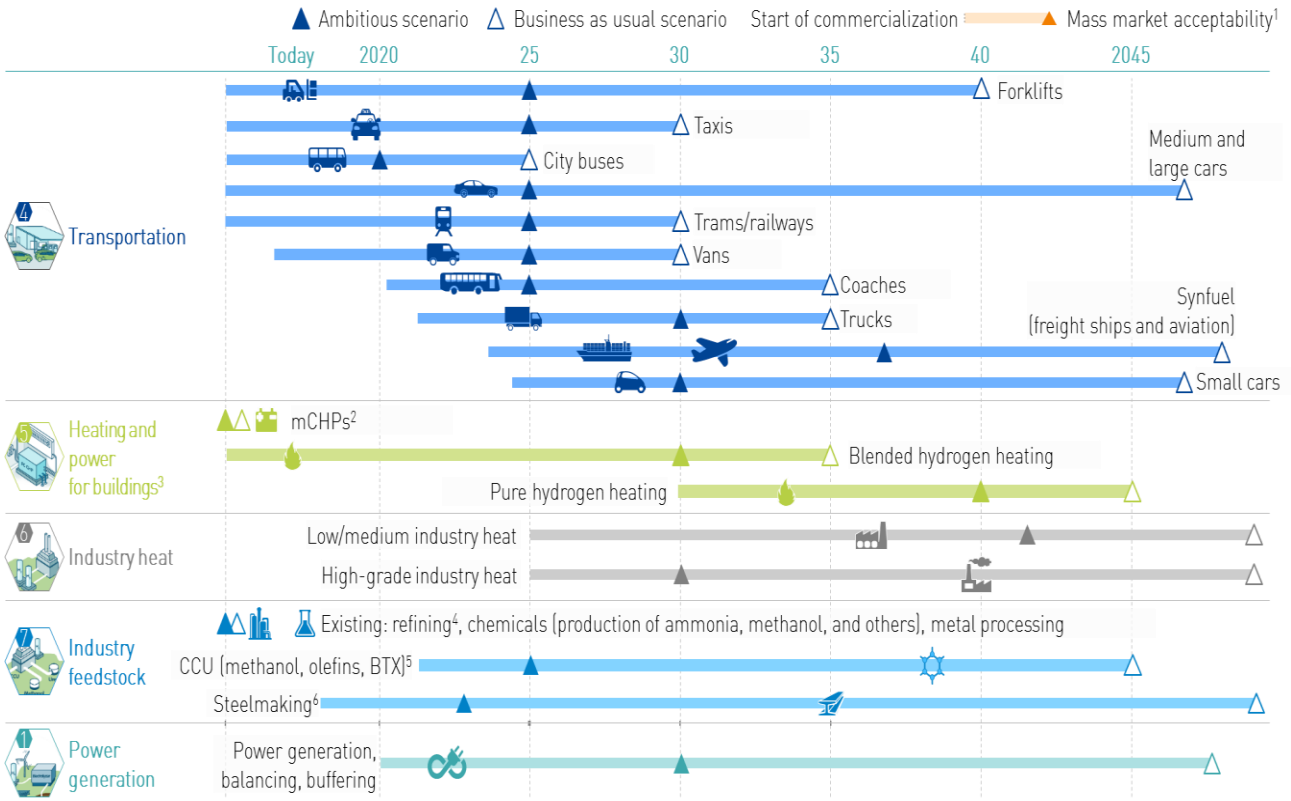
Hydrogen decarbonization levers

Power generation	Integration of renewables into the power sector[2] Power generation from renewable resources
Transportation	Replacement of combustion engines with FCEVs, in particular in buses and trucks, taxis and vans as well as larger passenger vehicles Decarbonization of aviation fuel through synthetic fuels based on hydrogen Replacement of diesel-powered trains and oil-powered ships with hydrogen fuel-cell-powered units
Heating and power for buildings	Decarbonization of natural gas grid through blending Upgrade of natural gas to pure hydrogen grid
Industry heat	Replacement of natural gas for process heat
Industry feedstock	Switch from blast furnace to DRI steel Replacement of natural gas as feedstock in combination with CCU

1 2-degree scenario 2 Please see the chapter on renewables and power for information on the role of hydrogen as enabler of a renewable power system. The "enabled" carbon abatement from renewables is not included here and is an additional benefit of hydrogen for decarbonization
SOURCE: IEA Energy Technology Perspectives 2017; Hydrogen Roadmap Europe team

European Commission

Hydrogen technology exists and is ready to be deployed



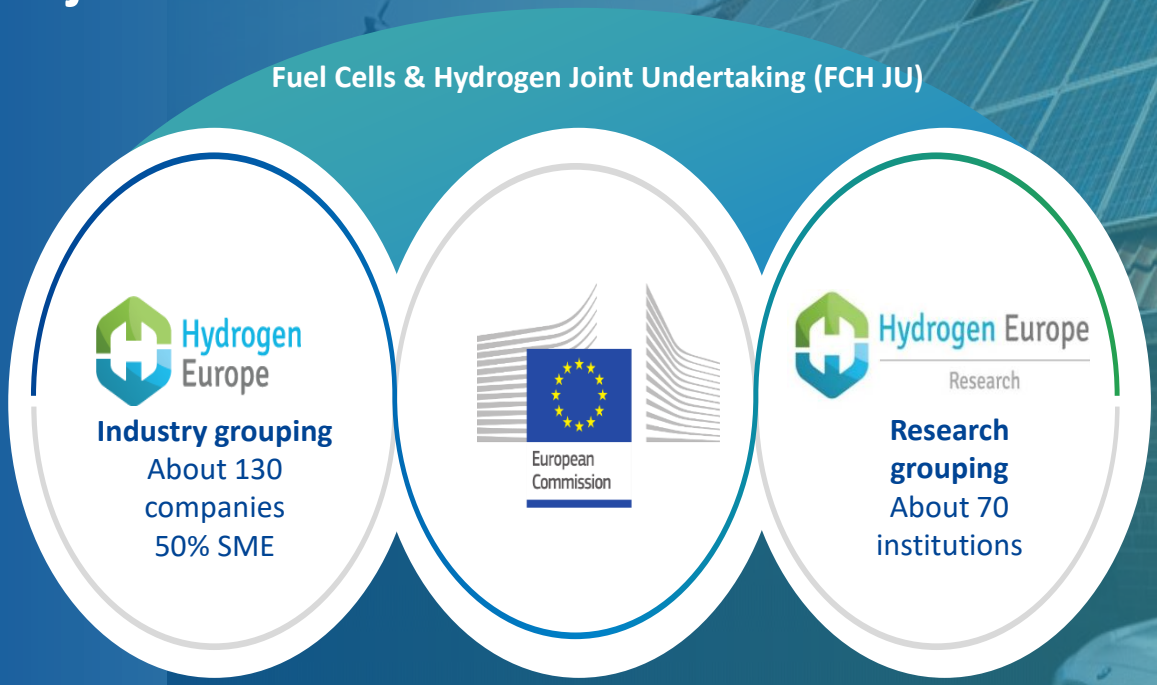
1 Defined as sales >1% within segment; 2 mCHPs sales in EU independent of fuel type (NG or H_2); 3 Pure and blended H_2 refer to shares in total heating demand; 4 Refining includes hydro-cracking, hydro-treating, bio-refinery; 5 Market share refers to the amount of production that uses hydrogen and captured carbon to replace feedstock; 6 CDA process and DRI with green H_2, iron reduction in blast furnaces, and other low-carbon steel making processes using H_2

SOURCE: Hydrogen Roadmap Europe team

Technology status in EU/H2020 projects

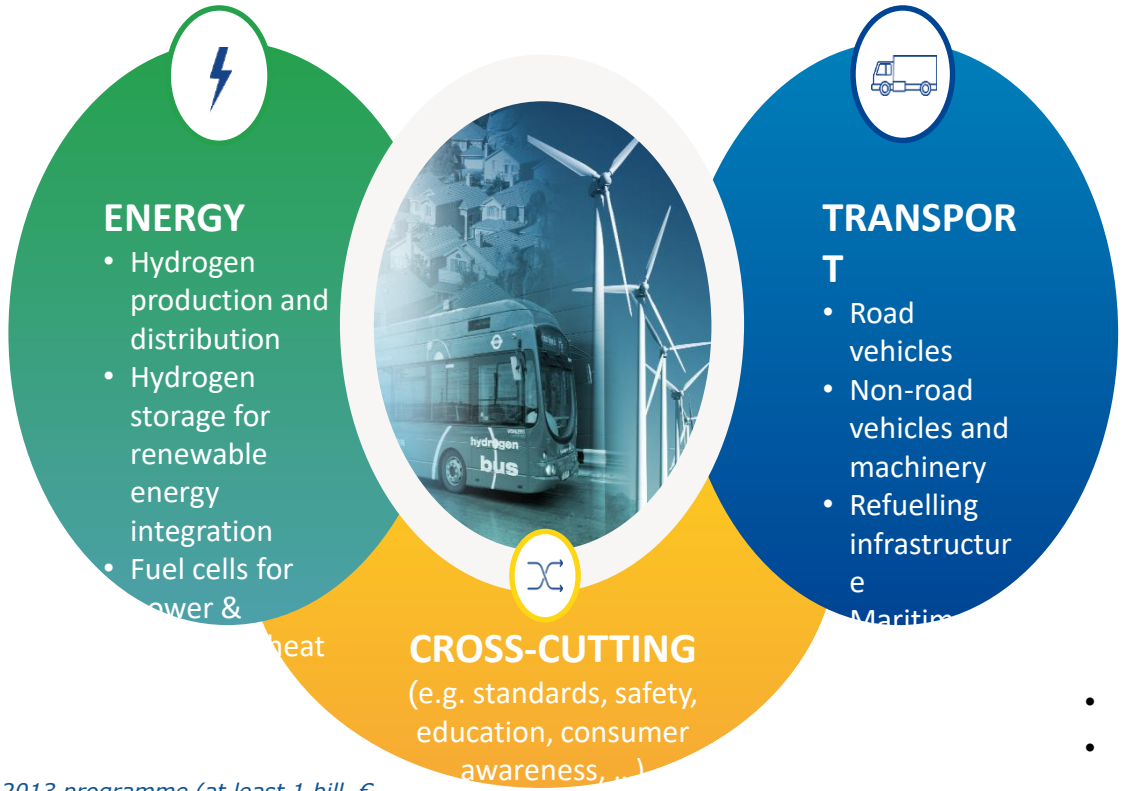
Strong public-private partnership with a focused objective

Institutional Public-Private Partnership (IPPP)



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

FCH 2 JU Programme structure



**Continuation to previous 2007-2013 programme (at least 1 bill. € total budget)*

- FCH 2 JU*:
- Total Budget: at least 1.3 bill.€
- EU contribution: 665 mill.€

FCH JU programme(s) implementation (2008-2018)

Energy

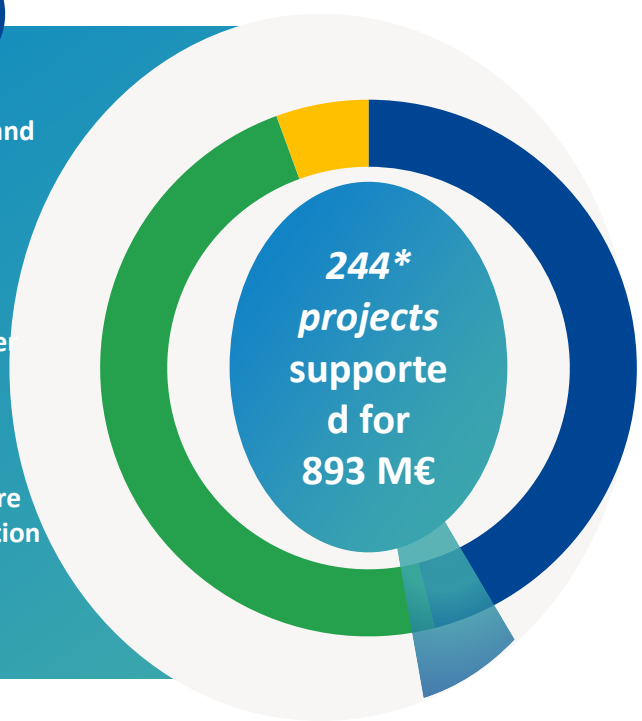
- Hydrogen production and distribution
- Hydrogen storage for renewable energy integration
- Fuel cells for power & combined heat & power generation

Transport

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

Cross-cutting

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



47 %
418 million euros

42 %
376 million euros

6 %
53 million euros

5 %
46 million euros
4 projects

Similar leverage of other sources of funding: 892 m€

** Including recently signed 17 projects from call 2018*

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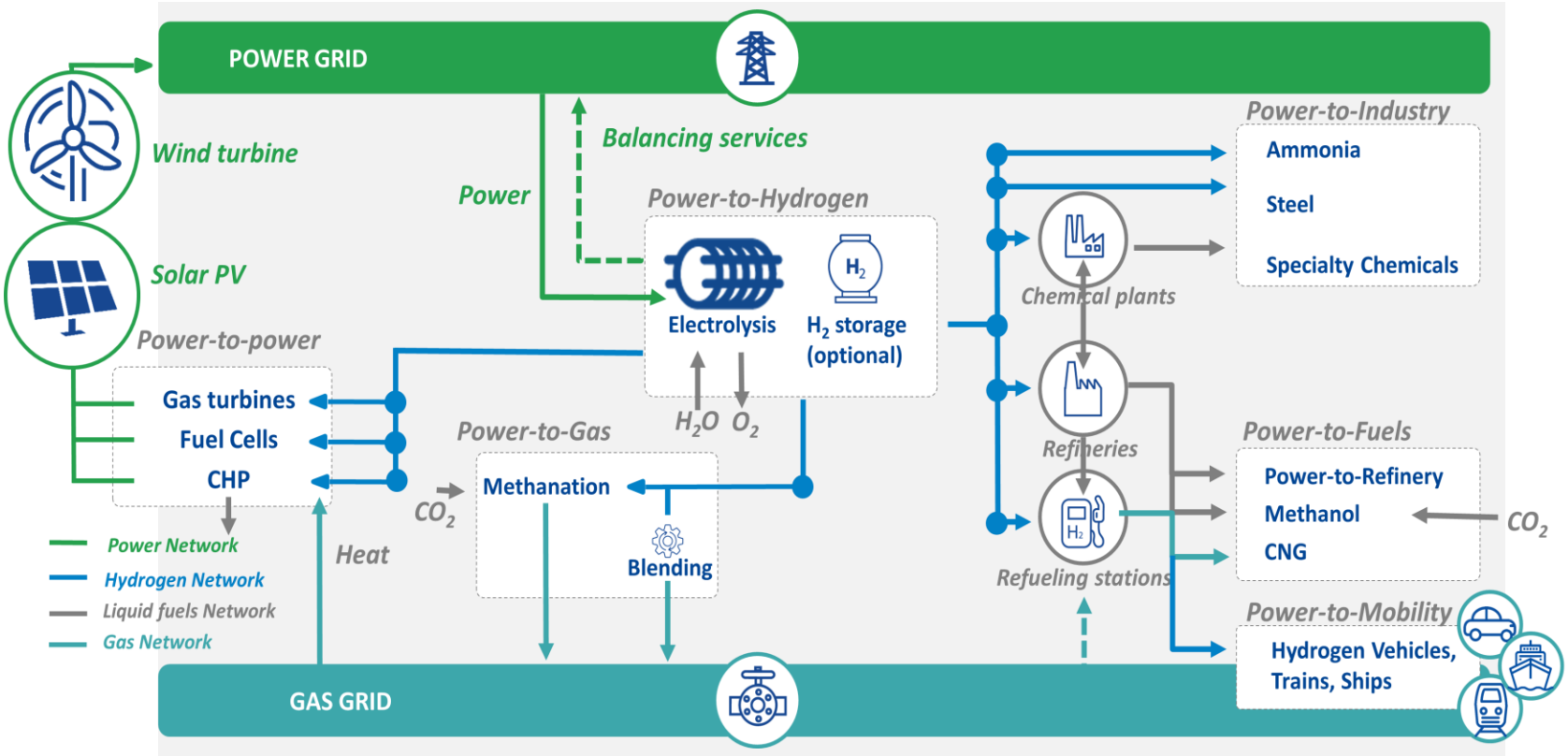
Today's H2 Production: enabler of Sectorial integration

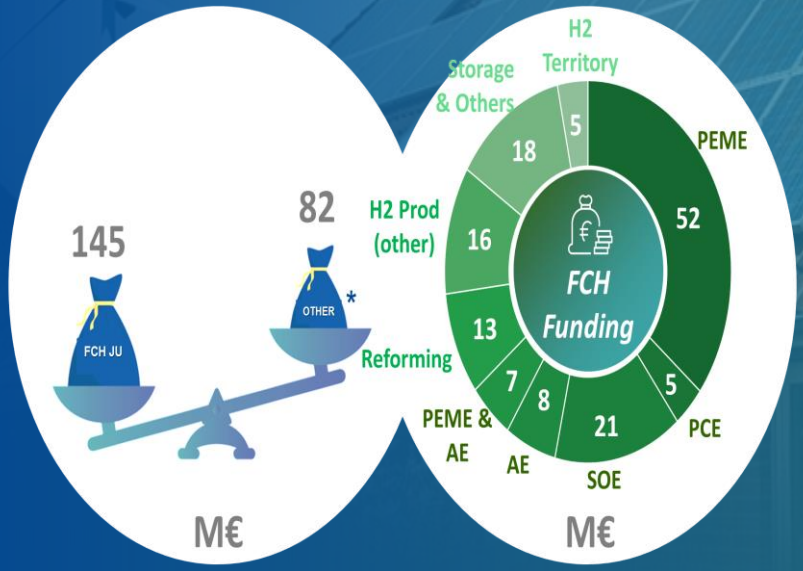
H2 is the best option for deep decarbonisation for a number of sectors



Green H_2 production

Green hydrogen production, distribution and storage

54 projects 227 M€



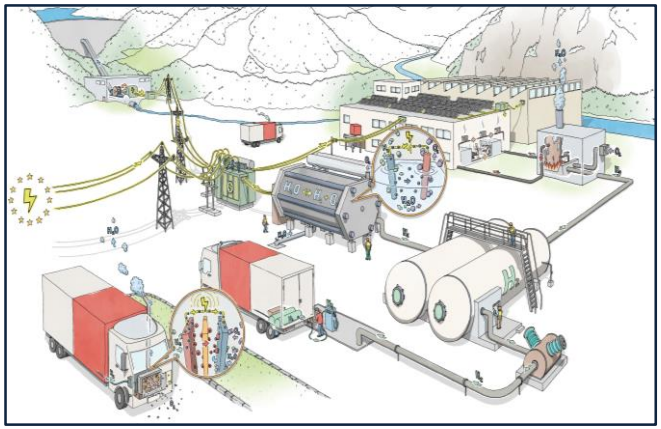
Electrolysers proving themselves in Industrial forecourts & Energy Market

Niche H_2 Territories

Viable Early Business Cases

Big industries are discovering the potential of Hydrogen (1/2)

Costs of electrolysers are decreasing…



3.4 MW electrolyser at MPREIS (bakery plant) in Völs Austria.
The green hydrogen is produced from hydro-electricity (from the Alps) which is being used to heat the ovens to bake the bread. Next step will be the distribution with H2 trucks.

AUSTR
IA

MPREIS

DEMO 4GRID

6 MW electrolyser at VOESTALPINE (steel plant) in Linz Austria.
The green hydrogen is produced from hydro-electricity (from the Alps) which is being used to produce CLEAN(ER) STEEL

Big industries are discovering the potential of Hydrogen (2/2)

By exploiting the results of the FCH JU research projects, the cost of electrolysers has decreased and became interesting for big industries to invest

GERM
ANY

10 MW electrolyser at SHELL refinery in Köln, Germany

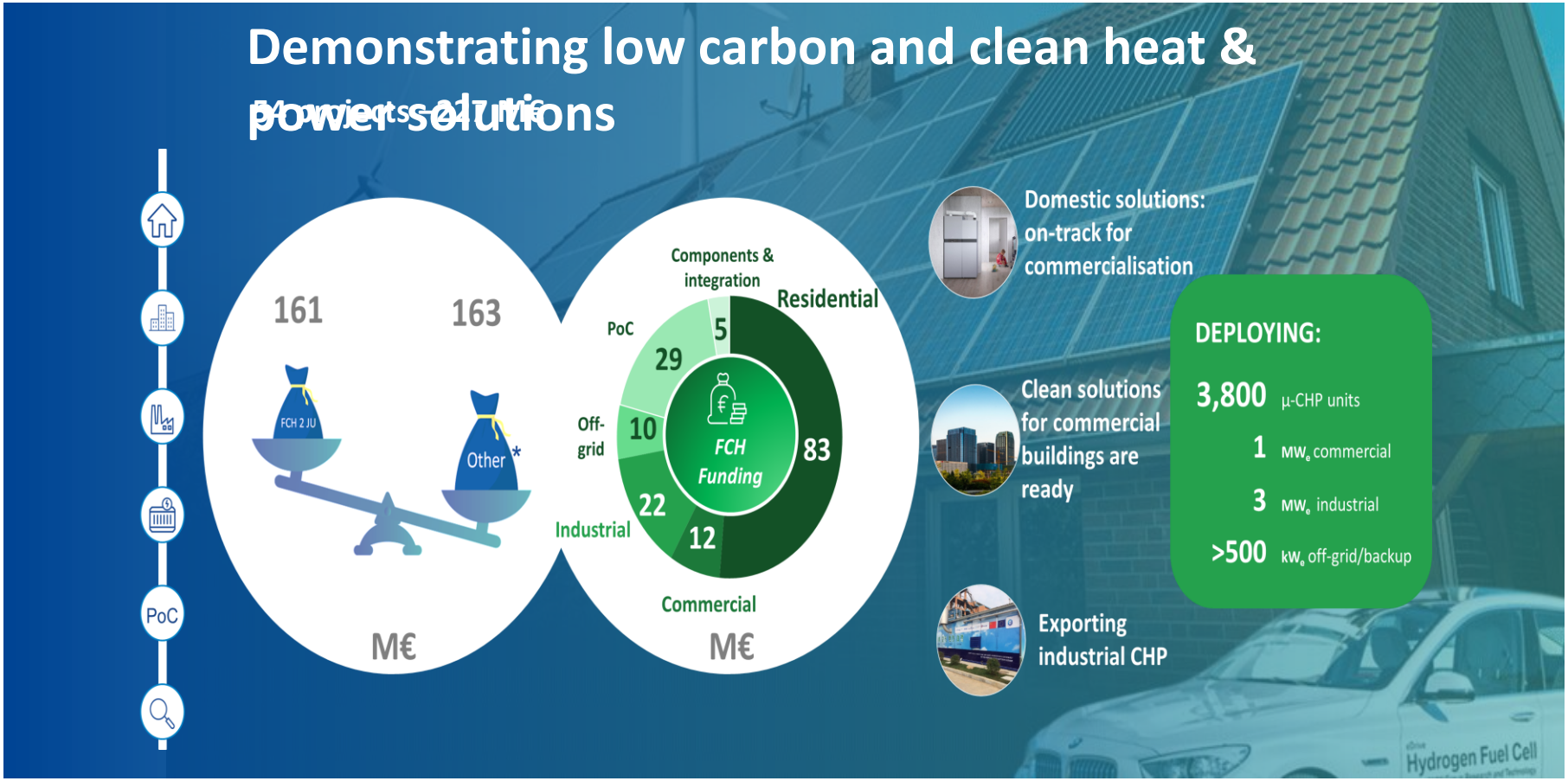
The hydrogen is produced from curtailed wind energy (when electricity network is full) and partly injected in the natural gas grid (while other used for 'greening' Shell internal processes)

150/30kW Reversible electrolyser at Salzgitter, Germany

High-temperature Electrolyser as reversible generator (rSOC, reversible Solid Oxide Cell, to produce either hydrogen or electricity) in the industrial environment of an integrated iron/steel plant (exploiting also high temperature heat available)

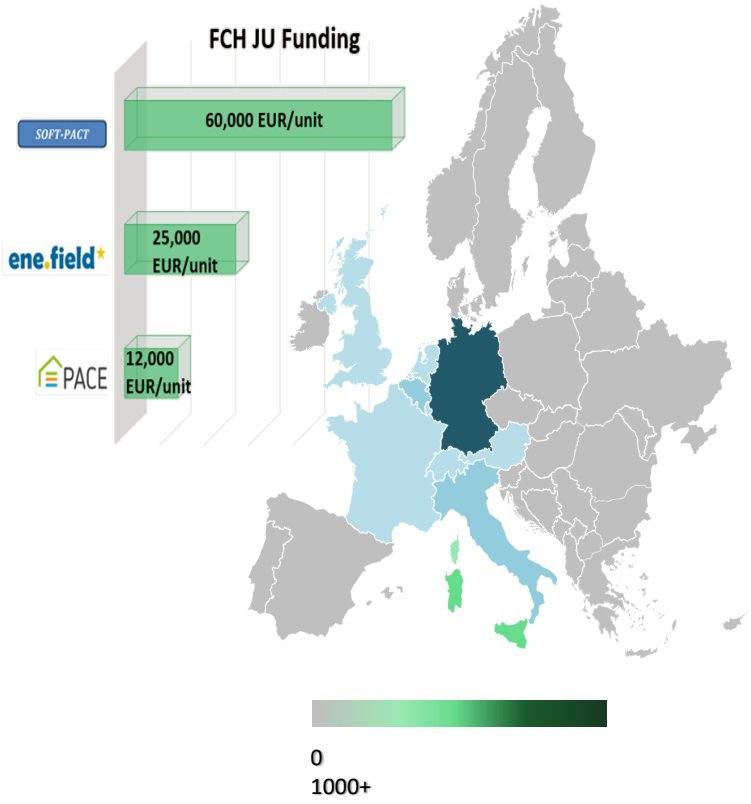
Heating and Cooling

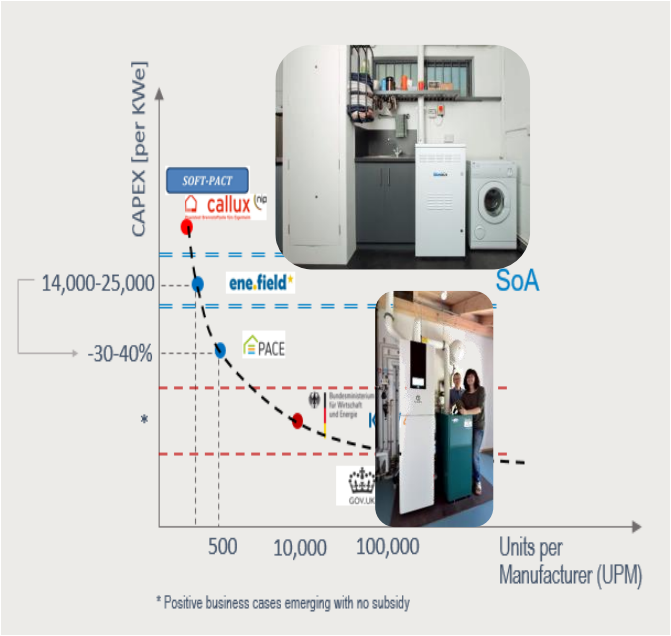
Demonstrating low carbon and clean heat & power solutions



Over 1000 fuel cell µCHP systems installed across EU

Market ready domestic heat and power systems created





1046 units deployed under ene.field project
Over 1 MWe capacity installed
>5 million operating hours
Additional >2,000 units deployed under German incentive scheme (KfW433)

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On the road to cost-competitiveness for m-CHP…

Next generation systems: improved performances and designed for mass manufacturing

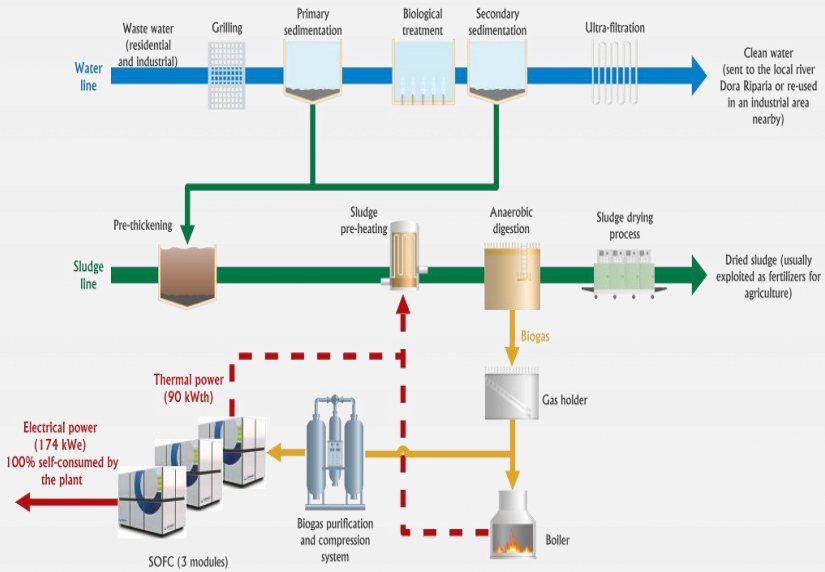
Source: Solid Power ©

Next generation systems being finalised and deployment in PACE started in 2018

Source: Viessmann Group ©

Fuel cells in commercial buildings and service sector

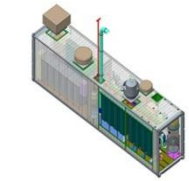
Medium size Fuel cells potential in waste water treatment plants…

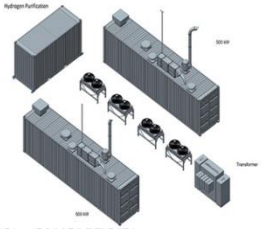


175 kW SOFC on biogas in Collegno Waste Water Treatment Plant, Turin Itay area will guarantee the supply of around 30% of the site electrical consumption, and almost 100% of the thermal requirement.

MW fuel cells greening big industry by using waste hydrogen

Exporting EU technology … Fuel Cells can help to decarbonise Chlor-Alkali industry





1MW plant in Martinique, overseas territory of France

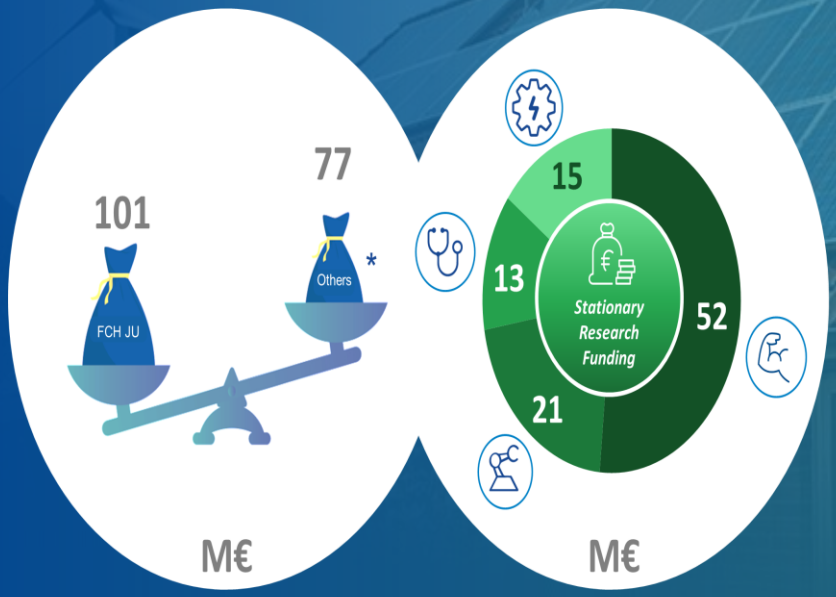
Demonstrate the deployment of a 1MW PEM Fuel Cell, developed and purpose-built for the EU market, running on waste hydrogen from a refinery plant (246 t/year flared)

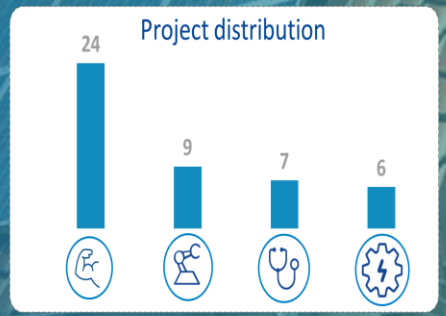
2MW plant at Yinnovate, Yi… Liaoning), China

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 and remote control

Research portfolio at all TRLs

46 projects – 178 M€



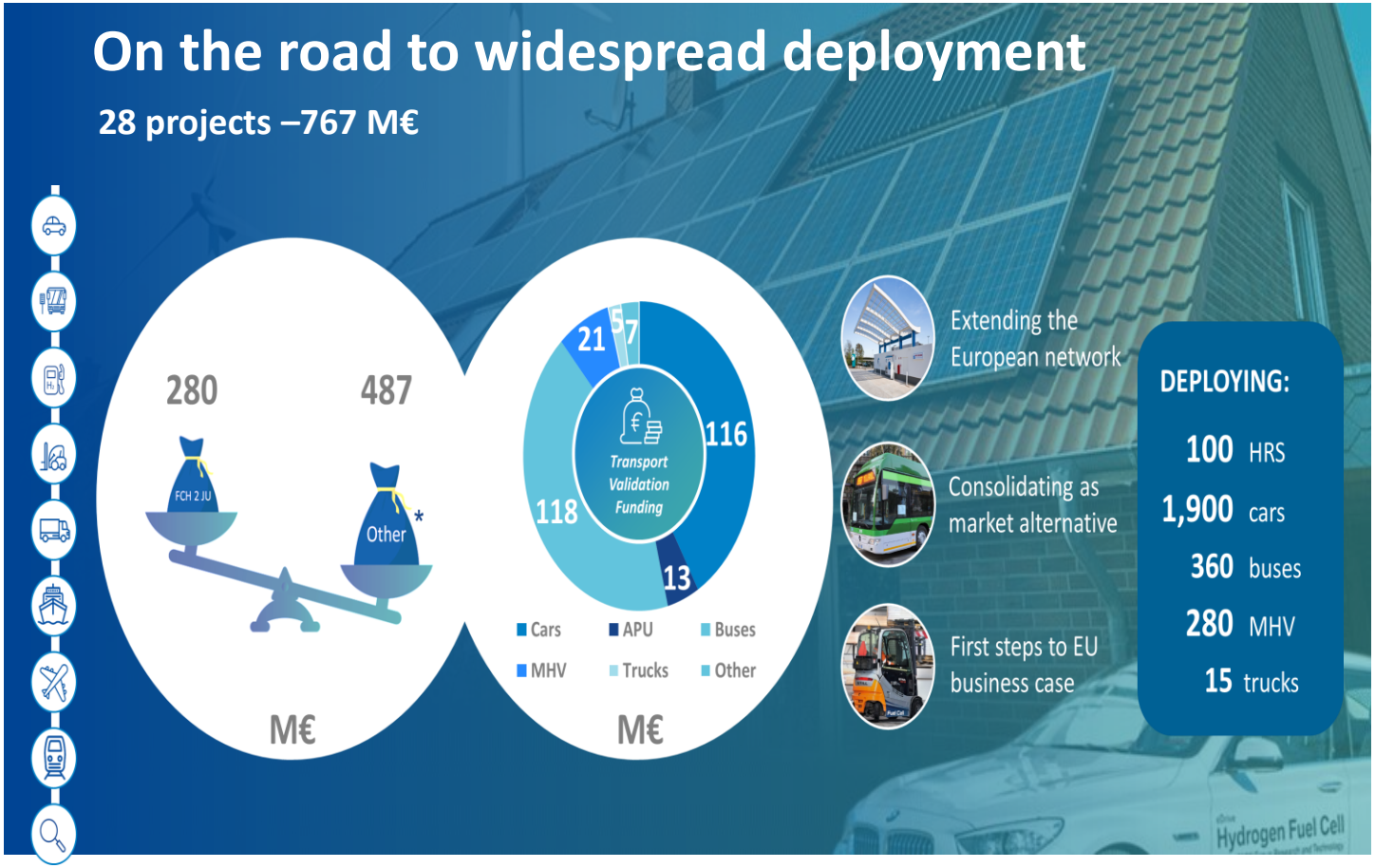


- Next generation, lifetime & performance
- Monitoring & Diagnostics
- System Aspects
- Manufacturing

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

SECTOR

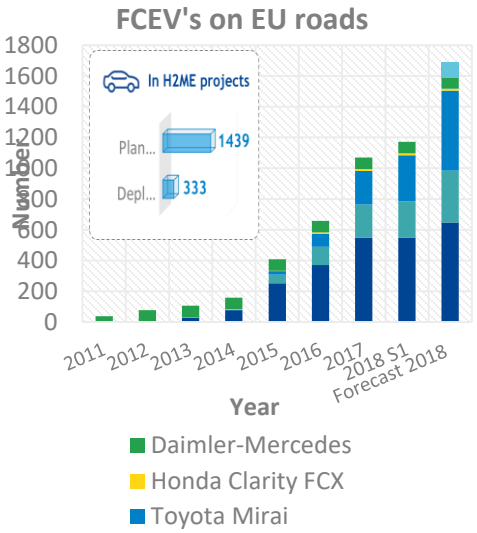
Transport



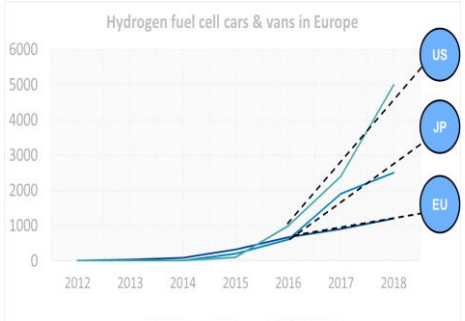
* Other resources including private and national/regional funding

Roll out of cars by FCH JU Hydrogen Mobility Europe projects (H2MEs)

Objective: to enable the EU market to gain experience with the technology and extend HRS network



- About 1300 FCEV's on EU roads
- EU OEM's: small demo's ~2025, mass production 2025~ (EU OEM's part of FCH-JU)
  PSA: start FCV development
- FIA: In 2024 a H_2 class @ Le Mans
- California & Japan sales are going fast due to strong policy support
- EU mobility package is good chance to catch up



	2018	2020	2022	2025	2030
Europe	1273	-	-	(0.9 -1 mill)*	Tbc **
China	150	5000	-	50.000	1 million
Japan	2500	40.000	-	200.000	800.000
USA	5000	-	-	-	-
S-Korea	0	-	16.000	-	-

Fuel Directive
** McKinsey study Hydrogen: Europe roadmap to be released Oct 2018.

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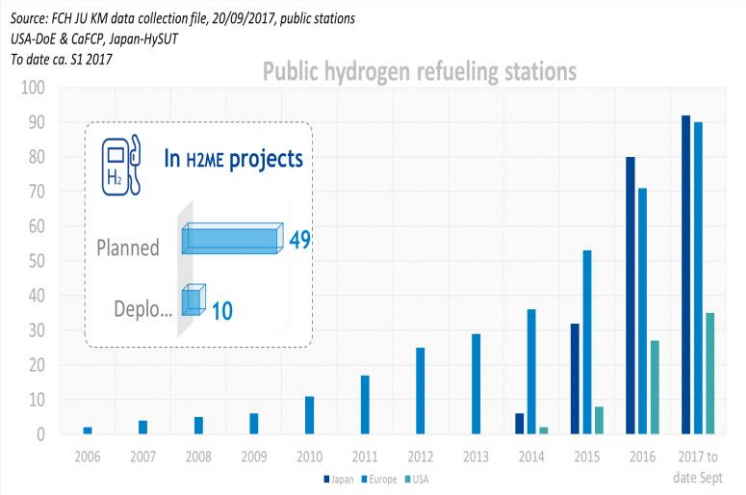
Roll-out of the required infrastructure in Europe

Hydrogen Refuelling Stations network is expanding in EU thanks to European programs (FCH



	2018	2020	2022	2025	2030
Europe	116	-	-	(820~842)*	Tbc **
China	12	100	-	350	1000
Japan	100	160	-	320	(900)
USA	35	100	-	200~225	-
S-Korea	0	-	310	-	-

Japan: Air Liquide opens a hydrogen station in Shichinomiya, Kobe

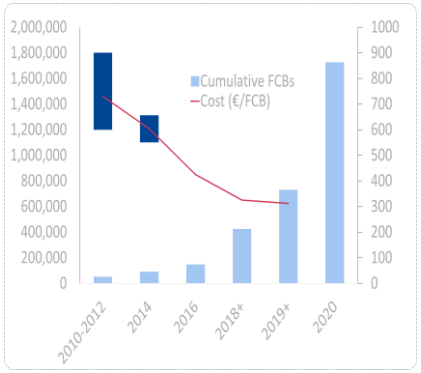
Nel ASA: Awarded frame contract for multiple hydrogen fueling stations in California by Royal Dutch Shell Plc

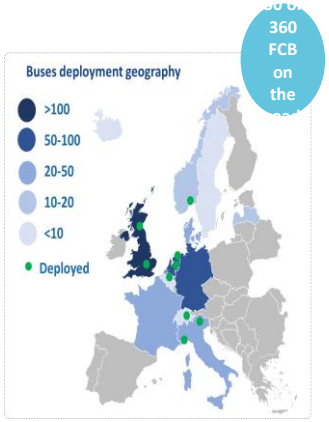
Development of a system for HRS availability in the EU

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

The roll-out of hydrogen buses, created an appetite of >1600 units

EU is supporting nearly 360 Hydrogen buses demonstration that lead to a price reduction of 66% vs 2010 already



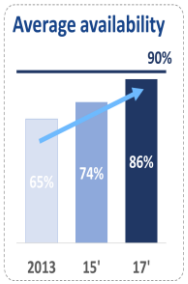


88 % green hydrogen

Achieved

- **> 6,000,000 km driven since projects started**
- **> 92 t of H_2 consumed only in 2017**
- **> 25,000 h lifetime reached**

No.	Parameter	Unit	State of the art, SoA		FCH 2 JU target		
			SoA 2012	International SoA 2017*	Target 2020	Target 2024	Target 2030
1	Fuel cell system durability	h	10,000	16,000	20,000	24,000	28,000
2	Hydrogen consumption	kg/100 km	9	8.5	8.0	7.5	7.1
3	Availability	%	85	90	90	93	93
4	Yearly operation cost (including labour)	EUR/year	-		16,000	14,000	11,000
5	Fuel cell system cost	€/kW			625 (150 units)	600 (250 units)	500 (300 units)
6	Bus cost	kEUR	1,200	650	625 (150 units)	600 (250 units)	500 (300 units)



Reduction of downtime by:

- Easier access to spare parts
- Integration of FC maintenance in bus preventative schedule

operation,
a delivery time ~ 18

10 European OEM's are developing Hydrogen buses: "http://www.fuelcellbuses.eu"

- Presence of OEM staff on-site

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In 2017 first trucks appeared on the EU roads and more are to come

We should see a clear direction towards Hydrogen for trucks due to the limited range of batteries (especially for long-haul)

FCH-JU H2ME project Batt+RE

REVIVE: H2 Garbage Trucks in 8 EU cities

2018: Heavy truck

Call 2018: 1 successful proposal under signature

Nicola Truck

Toyota Truck @LA port

Partners planning 2,000 commercial trucks on the road by

ESORO COOP

ASKO-SCANIA

VDL - COLRUYT

Toyota and 7-eleven collaboration

Hyundai truck

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

Hyundai signs deal to sell 1,000 hydrogen-powered trucks in Switzerland

Hyunjoo Jin

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Norway aims for 1000 hydrogen trucks by 2023

September 19, 2018

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Research and Innovation

Rail discovered Hydrogen and Fuel Cells

The first business models are appearing

- 42% of EU railway not electrified
- H_2 train requires half the investment vs full electric train (e.g. 1 million € investment/km of catenary)

- 17 Sept. '18 commercial operation of Regional train started in Germany. Other EU countries are preparing/homologating the prototypes

"Study on use of fuel cell hydrogen in railway environment"

- FCH JU + S2R JU cooperating in a joined study to look at business cases beyond Regional trains

Maritime discovering Hydrogen and Fuel Cells

To accelerate the decarbonisation of Maritime sector, adapted Regulations for hydro need to be prepared

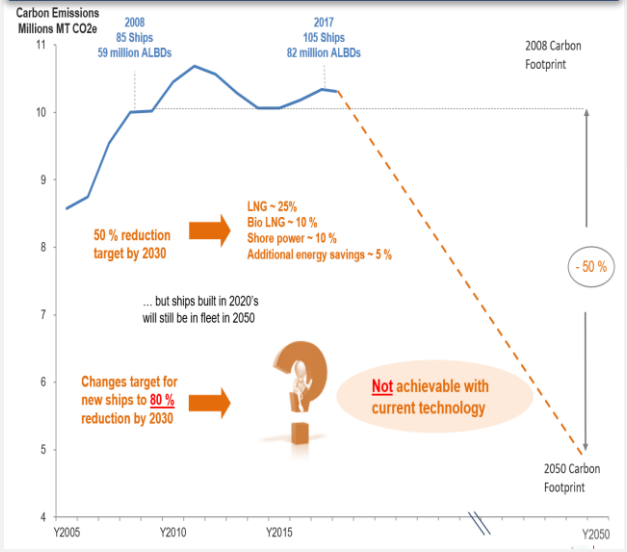
International Maritime Regulations

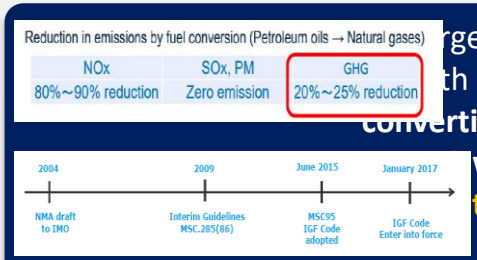
Class Rules

International Standards

National Regulations

- IMO April 2018: "at least 50% of CO_2 reduction by 2050"





…rgets are not achievable …th current technologies, converting the entire fleet to … will not be sufficient. …t need to regulate H2 for ships

PURE aims at developing auxiliary power units (APUs) for …

DURATION: 2013-2016
FCH JU Funding: ~1.6M€

MARANDA: H2 PEMFC based hybrid powertrain for marine applications, validated on board the research …

DURATION: 2017-2021
FCH JU Funding: ~2M€

Call 2018: 2 successful proposals under GAP

…id-size passenger ships of inland freight
FC for port/harbor ecosystems

around 9M€

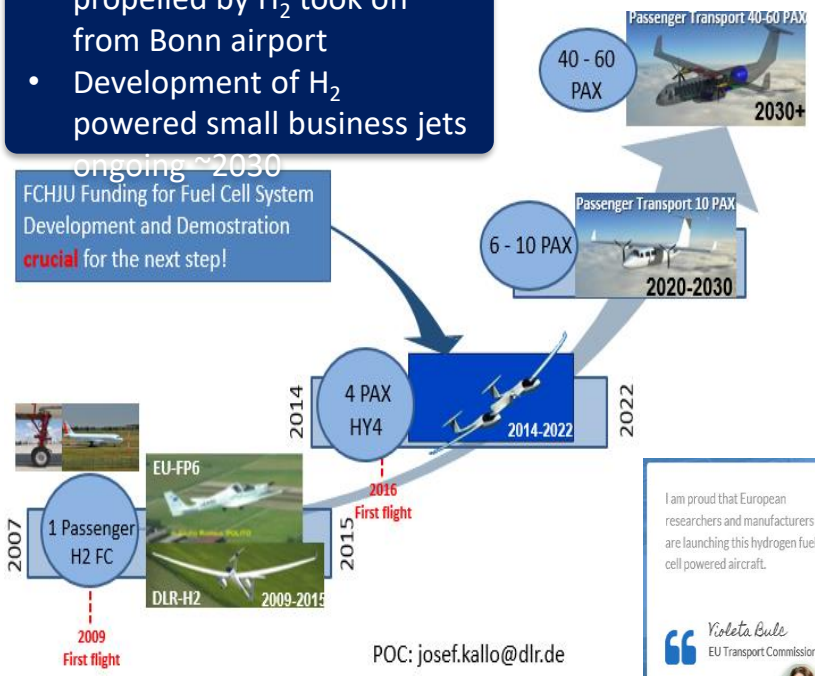
- Further R&D needed e.g. LH_2 storage, MW scale Fuel Cells

Aviation sees a future in Hydrogen for small planes

Hydrogen in the aviation sector causes much less noise and no pollution.

- In 2016 first 4-seater plane propelled by H_2 took off from Bonn airport
- Development of H_2 powered small business jets ongoing ~2030

FCHJU Funding for Fuel Cell System Development and Demostration **crucial** for the next step!

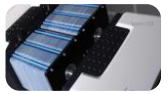


I am proud that European researchers and manufacturers are launching this hydrogen fuel cell powered aircraft.

Violeta Bulc
EU Transport Commissioner

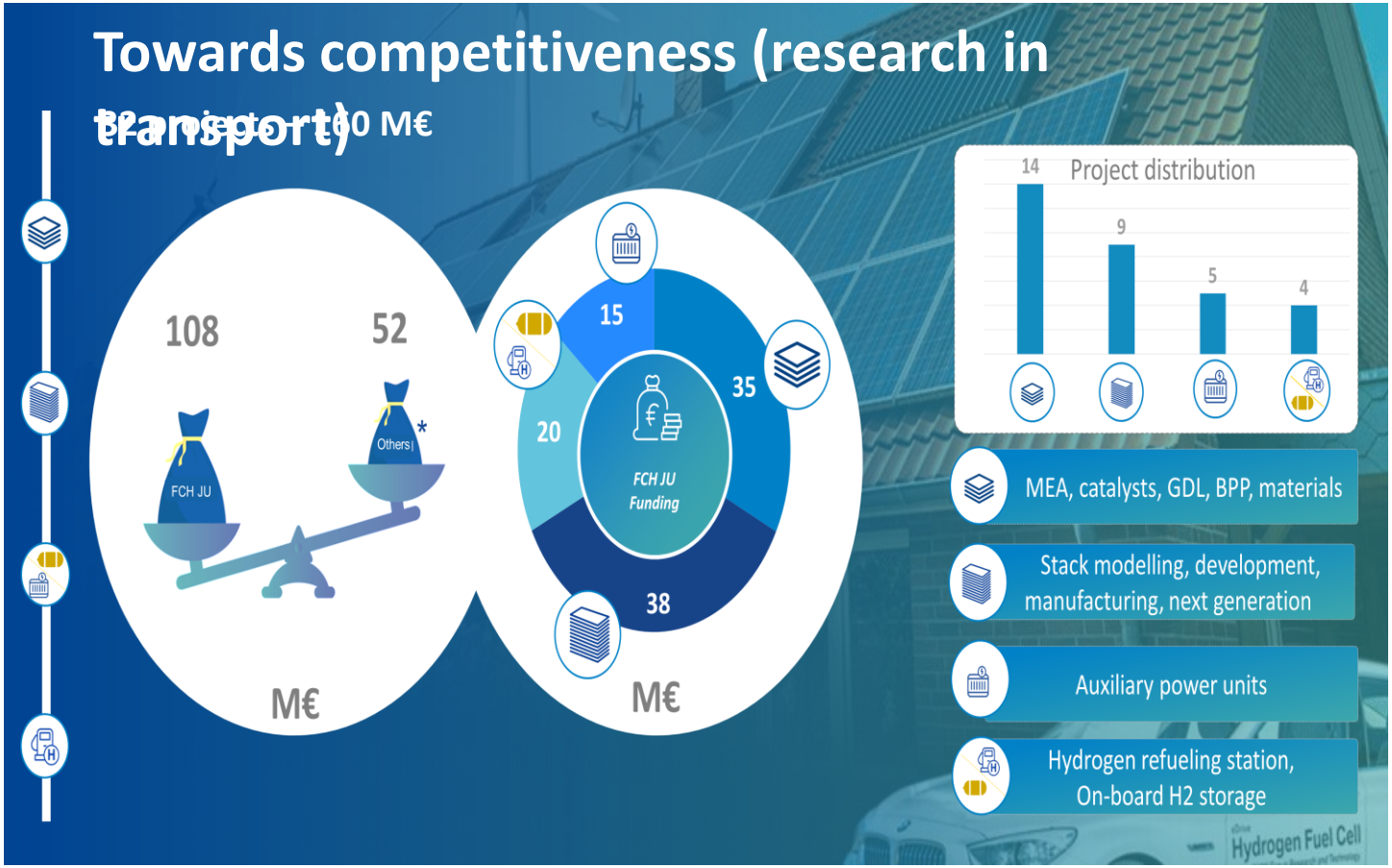
- HYCARUS is a FCH JU project where the kitchenette runs entirely on Hydrogen and Fuel Cells

Maiden flight: Beginning 2019



Call 2018: 1 successful proposal under GAP

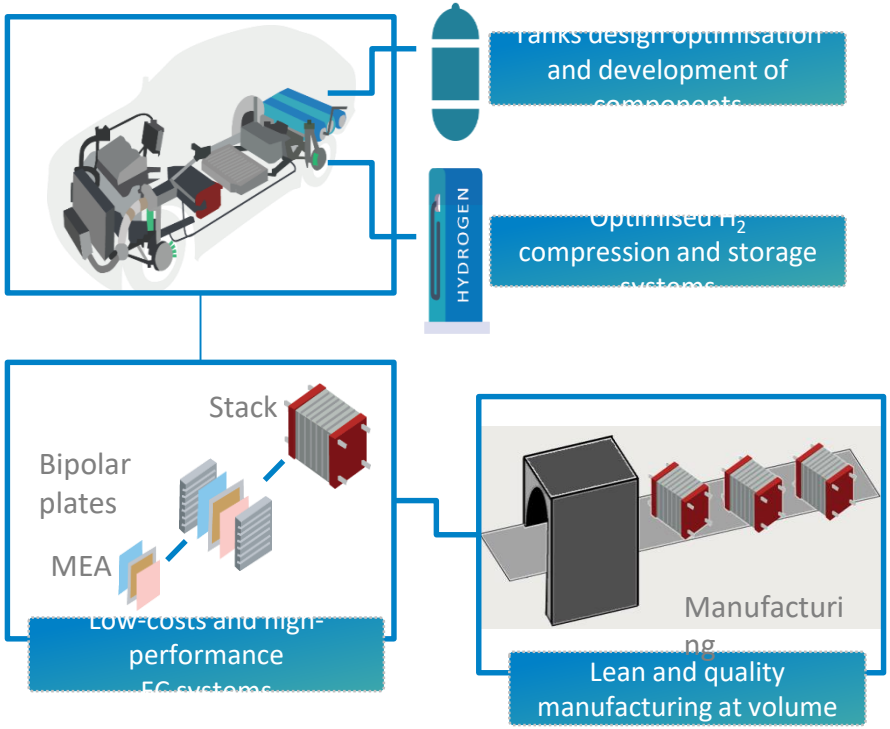
FC system for propulsion of regional passenger aircraft 4M€



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

FCH JU support to all FCEV research aspects

Supporting the competitiveness of the technology and the EU supply chain



- From basic research to validation and testing
- From materials to manufacturing
- Very strong industrial and academic cooperation
- Connected projects

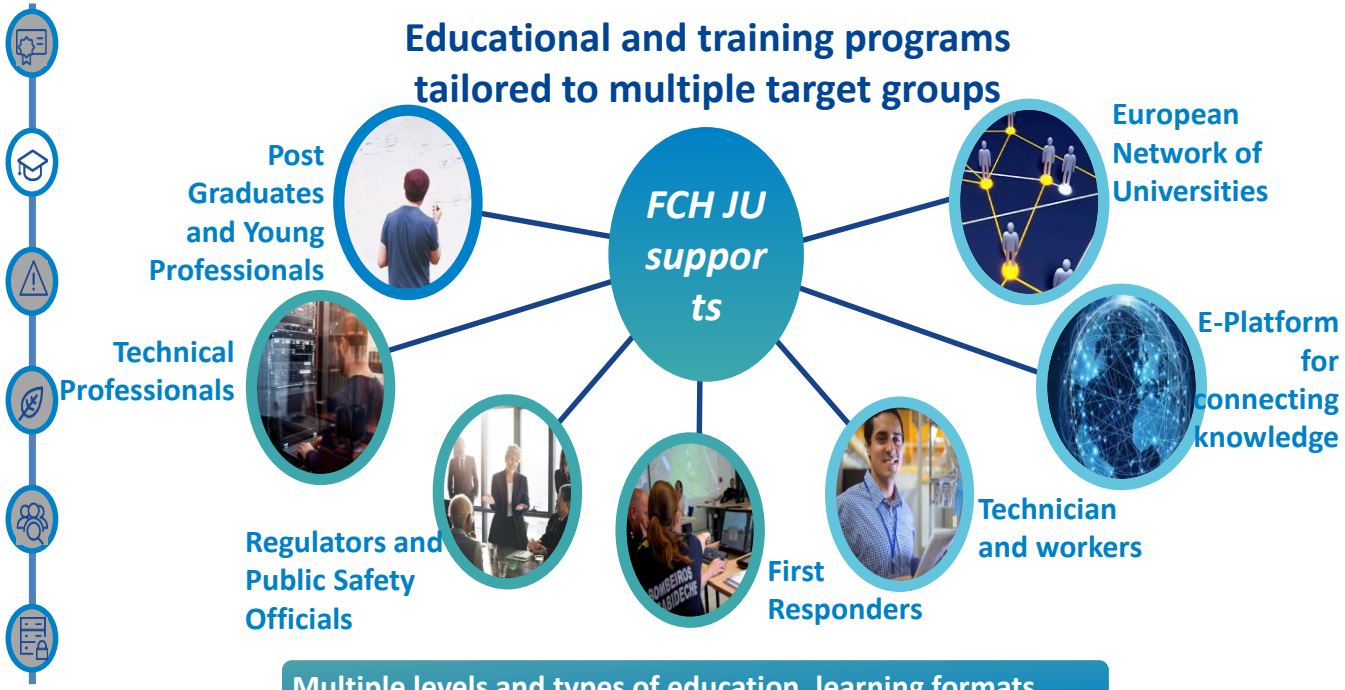
SECTOR

Safety, Standards, Education…

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

Increasing expertise across Europe

Promoting the excellence in education and training, preparing the European workforce



Bringing sustainability to FCH technologies

Ensuring FCH technologies are environmentally friendly

Projects

Life Cycle Assessment

Developing guidance for LCA application to FCH

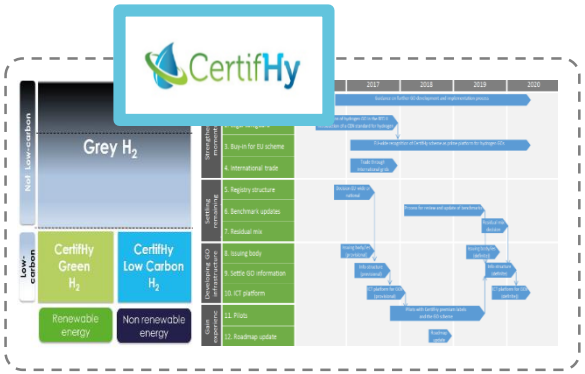
Recycling & dismantling

Developing technologies and strategies for

Guarantees of Origin Framework

Providing truthful information about the

GO for Hydrogen initiative



75,000+ CertifHy Green & Low Carbon H2 GOs are available on the market

Next step: Member States to implement these Guarantees of Origin in their national legislation (according to REDII directive)

CertifHy

http://www.certifhy.eu/

Main objectives:

- To define a widely acceptable definition of green H_2
- Design a robust GoO scheme for green hydrogen
- Propose roadmap to implement the initiative in EU
- Establish a stakeholder platform
- Real trial in 4 pilot operations for a guarantee of origin scheme for green and low carbon H_2

NEXT: **FAST IMPLEMENTATION IN NATIONAL LEGISLATION**

Hydrogen at regional level

European Commission

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

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

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

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

Portugal
>Torres Vedras
>Médio Tejo

Netherlands
>Assen
>Drenthe
>Emmen
>Groningen
>Helmond

Austria
>Tirol

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

Iceland
>Reykjavik

Sweden
>Gavleborg
>Mariestad

Finland
>Kokkola

Denmark
>Guldborgsund
>Lolland

Estonia
>Tallinn

Latvia
>Riga

Czech Republic
>Trutnov

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

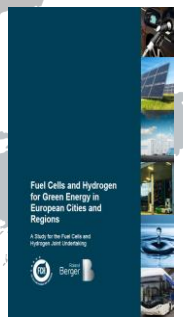
Slovenia
>Velenje

Croatia
>Split
>Split-Dalmatia County

Romania
>Constanta

Bulgaria
>Bulgarian Ports
>Sofia

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



Regions and cities plan to deploy a range of FCH applications mainly from the transport sector – Significant uptake after 2025

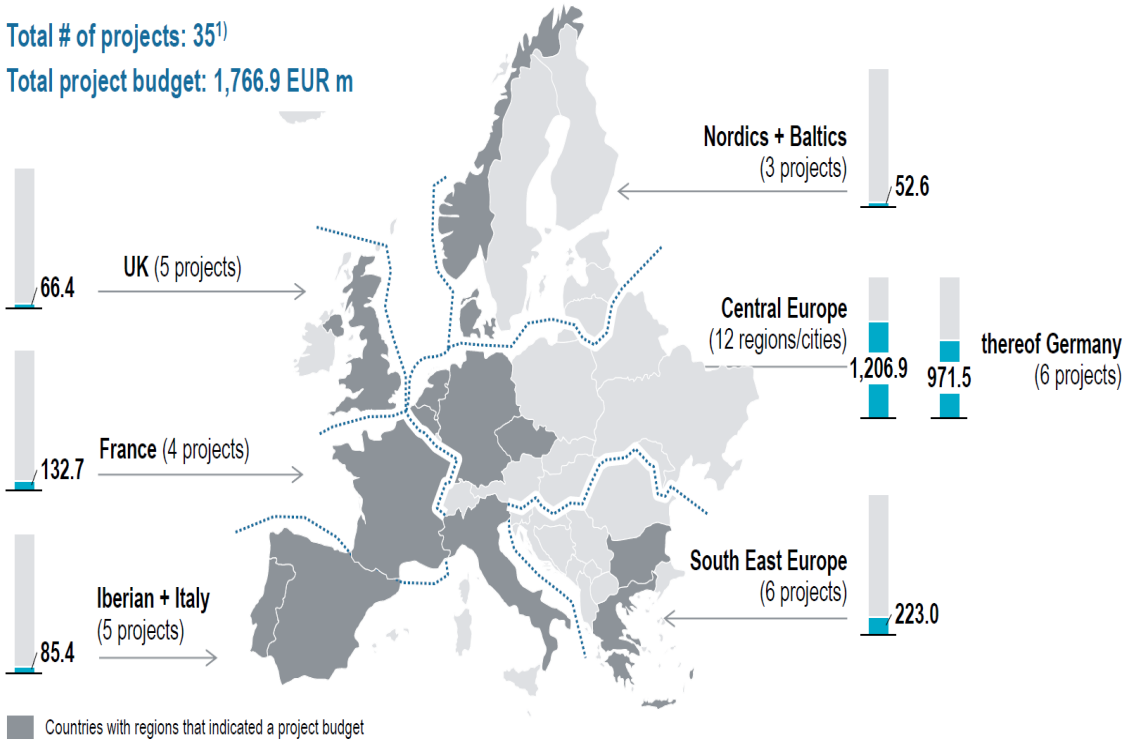
Significant deployment take-up after 2025

	Next implementation projects						Long-term outlook	
	2018	2019	2020	2021	2022	Total 2018-22	Until 2025	Until 2030
Applications								
Trains		52	2	3	29	86	189	161
Buses	8	109	300	218	244	879	1,003	1,659
Heavy-duty trucks	3	17	18	24	8	70	274	9,110
Cars	103	327	488	776	780	2,474	17,405	191,585
Vans	49	167	121	263	355	955	1,565	21,140
Garbage trucks	6	10	60	112	42	230	144	206
Sweepers	1	6	10	9	11	37	2	5
Construction mobile equipment/ tools	3	3	3	3	3	15		
Material handling/ forklifts			41	88	110	239	80	70
Bikes	42	35	25	25	11	138	115	50
Scooters		5	5		3	13		
Ships/ ferries/ boats	3	5	6	4		18	8	57
Port operations equipment			2	2	2	6	2	23
CHP		20	12	1,010	1,007	2,049	10,102	50,161

Hydrogen production and related infrastructure were also assessed

Indicated investments are spread over 35 projects covering 41 regions in 13 countries – Large majority is to be realised in Germany

Total indicated investments per project and per country cluster [EUR m]:



1) Number of projects with an indicated budget covering 41 locations in total

Mirela Atanasiu

HoU Operations and Communication
Mirela.Atanasiu@fch.europa.eu

For further information

www.fch.europa.eu
www.hydrogeneurope.eu
www.hydrogeneurope.eu/research

FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

@fch_ju

Fch-ju@fch.europa.eu

FCH JU

European Commission

Thank you!

#H2020Energy

EU Funding & Tenders Portal

www.ec.europa.eu/research/participants

SPIRE (Sustainable Process Industry)

Research and Innovation

#H2020Energy info days

Carmine MARZANO

Cristina FERNANDEZ-RAMOS

Research Programme Officer

DG RTD

Cross-Cutting Call: *Competitive, Low Carbon and Circular Industries (Section 20. Cross-cutting activities)*

- **Portfolio rationale:** Design and demonstration of
  - profitable and sustainable (circular) value chains of materials, products and services;
  - novel sourcing and value-added destinations for non-product outputs between industrial facilities (industrial symbiosis)
- **Portfolio approach:** clustering activities
  - continuous dialogue and exchange of good practices between all actors involved
  - transfer of knowledge and to identify technological and non-technological barriers.
  - coordinated deliverables and joint dissemination or exploitation activities

NMBP		Budgets
1.	NMBP - ERA-NET on materials, supporting the circular economy and Sustainable-Development-Goals	
2.	NMBP - Materials life cycle sustainability analysis (RIA)	
3.	SPIRE - Tapping into the potential of Industrial Symbiosis (IA)	**118.5 M€**
4.	SPIRE - Preserving fresh water: recycling industrial waters industry (IA)	
5.	SPIRE - Alternative mineral resources for high volume production (IA)	
SC5		
6.	Develop, implement and assess a circular economy oriented product information management system for complex products from cradle to cradle (IA)	
7.	Raw materials innovation for the circular economy (IA): processing and refining of primary and/or secondary raw materials; recycling of raw materials from end-of-life products & buildings; advanced sorting systems for high-performance recycling of complex end-of-life products, sustainable metallurgical processes	**58 M€**
8.	Raw materials policy support actions for the circular economy: Expert network on Critical Raw Materials (CSA)	
SC3		
9.	Low carbon industrial production using CCUS (IA)	**29 M€**
10.	Industrial (Waste) Heat-to-Power conversion (IA)	

Call deadlines:

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2020	
Opening: 02 July 2019		
CE-NMBP-41-2020 (ERA-NET-Cofund)	15.00	05 Feb 2020
CE-NMBP-42-2020 (RIA)	6.00	
CE-SC5-08-2020 (CSA)	3.00	
CE-SPIRE-01-2020 (IA) **CE-SPIRE-07-2020 (IA)** **CE-SPIRE-09-2020 (IA)**	97.50	
CE-SC5-07-2020 (IA)	40.00	05 Feb 2020 (First Stage)
CE-SC5-31-2020 (IA)	15.00	03 Sep 2020 (Second Stage)
Opening: 05 May 2020		
LC-SC3-CC-9-2020 (IA)	14.00	01 Sep 2020
LC-SC3-NZE-5-2020 (IA)	15.00	
Overall indicative budget	205.50	

CE-SPIRE-01-2020: Tapping into the potential of Industrial Symbiosis

Specific Challenge:

Industrial Symbiosis holds significant potential to provide:

- Major improvements in resource and energy efficiency for all energy intensive industries.
- Accelerate the transition to a circular economy and to renewable energy systems, reduce waste heat energy and lead to significant reduction of GHG emissions.
- Challenge: Industrial Symbiosis is currently not yet widely implemented.
- Need to tackle technological and non-technological barriers to harness its full potential.
- Energy grids and adjacent infrastructures as well as the local and regional dimension are all critical factor which must be taken into account.

European Commission

CE-SPIRE-01-2020: Tapping into the potential of Industrial Symbiosis

Scope:

Demonstrate novel symbiotic value chain involving multiple industrial sectors in real industrial settings.

Proposals are expected to address:

- Broader symbiosis with infrastructures communities and energy grids, including the role that IS can play in fluctuating energy grids.
- Management of side/waste streams specifically for the use as resource for other plants and companies across sectors and/or across value chains;
- Process (re-)design and implementation to integrate and adapt existing processes to enhance industrial symbiosis.
- Integration of information technology (e.g. AI) for multi-criteria decision making, the design and management of IS in a dynamic production environment. Considering data sharing and preservation of data confidentiality.

European Commission

CE-SPIRE-01-2020: Tapping into the potential of Industrial Symbiosis

TRL 6 -7

Scope:

- Assessment methodologies and KPIs to measure the performance of symbiosis, including environmental, economic and social impacts, LCA, LCC, LCSA taking into account existing sustainability standards (e.g. ISO 10410) and existing best practices;
- Consider Non-technological aspects (e.g. regulatory issues, standards, and new business models) covering ownership, management and fair sharing of benefits.

Clustering and cooperation with other selected projects under this cross-cutting call and other relevant projects is strongly encouraged.

European Commission

CE-SPIRE-01-2020: Tapping into the potential of Industrial Symbiosis

EUR (12-20 millions)

Expected Impact:

- Step change towards closing circular loops;
- Improvement of at least 15% in energy efficiency of the targeted industrial processes, compared to the non-symbiotic scenario;
- Reduction of at least 30% in total energy intensity, on the basis of full life cycle considerations;
- Overall reductions in CO2 emissions of 40% compared to the non-symbiotic scenario;
- Reduction in primary raw material intensity of up to 20%;
- Reduction of waste generation by at least 25%;
- Better understanding of relevant barriers (e.g. end of waste criteria);
- The environmental gains in absolute figures, and weighted against EU and global environmental footprints, should be demonstrated;
- In addition, the replication potential should also be be assessed.

European Commission

CE-SPIRE-07-2020: Preserving fresh water: recycling industrial waters industry

Specific Challenge:

- Energy-intensive industries are major users of fresh water, for e.g. processing, washing, diluting, heating, cooling, and transporting products.
- Since fresh water is a scare resource, breakthrough innovations are needed in energy-intensive industries to recycle water and create closed loops in industrial processes and reduce the use of fresh water.
- Industrial symbiosis offers the potential for energy, water and other resource efficiency at a scale beyond energy intensive industries.

CE-SPIRE-07-2020: Preserving fresh water: recycling industrial waters industry

Scope:

Proposals should aim at near-zero discharge using closed-loop systems in combination with recovery of energy and/or substances (resources) through the development of integrated water-smart strategies for industrial processes.

Strategies should take into account:

- Better characterization of water usage and production in the industrial processes.
- Defining recycling options with a combined water, waste and energy approach in an integrative system design method considering investment and optimal operations.
- Reduce water demand through design, control options, and technologies integration that reduce water consumption, recycle water, and reduce the use of fresh water (e.g. cascading use of different kinds of water in industrial settlements or for compatible re-use in urban and rural areas).

European Commission

CE-SPIRE-07-2020: Preserving fresh water: recycling industrial waters industry

TRL 5-7

Scope:

- Proposals should develop new technologies and approaches at a large scale, considering:
- Real time smart monitoring and management systems with innovative digital solutions for sensors and actuators.
- Recovery technologies such as highly selective separation and extraction processes. and new solutions for water treatment to prevent fouling and corrosion.
- Integrated Water Management should consider different qualities and sources of water
- scale-up testing to robust industrial processes will be required.
- Clustering and cooperation with other selected projects under this cross-cutting call, and with other relevant projects, SC5-04-2019 “Building a water-smart economy and society”, is strongly encouraged.

European Commission

CE-SPIRE-07-2020: Preserving fresh water: recycling industrial waters industry

EUR (8-12 millions)

Expected Impact:

- Significant reduction of the current use of fresh water resources.
- Significant steps towards near-zero discharge using closed-loop systems in industrial processes.
- Significant increase of the recovery of water, energy and/or substances and materials.
- Increase of resource and water efficiency by 30% compared to the state-of-the-art.
- The environmental gains in absolute figures, and weighted against EU and global environmental footprints, should be demonstrated.
- In addition, the replication potential should also be assessed.
- Relevant indicators and metrics, with baseline values, should be stated clearly in the proposal.

CE-SPIRE-09-2020: Alternative mineral resources for high volume production

Specific Challenge:

- Energy intensive industries in Europe depend on the one hand on very large volumes of minerals and other raw materials (e.g. 70% of process manufacturing depends on minerals and metals). On the other hand, they heavily rely on imports from third countries (extraction in Europe covers only 29% of the demand). The environmental footprint of high-volume products is also too high.
- The challenge is to develop technologies for the uptake of secondary raw materials based on industrial symbiosis, waste collection, or water treatment systems, and leading to new value chains or even value loops (i.e. reusing waste, by-products and recycled materials repeatedly).
- Such new technologies should enable overcoming barriers such as low costs of primary raw materials or differences in taxes across countries and regions (e.g. landfilling taxes for primary and secondary raw materials).

European Commission

CE-SPIRE-09-2020: Alternative mineral resources for high volume production

Scope:

- Proposals should address the development of new high volume value loops and integrated supply chains through industrial processes enabling the cross-sectorial, symbiotic, use of mineral waste, by-products and end-of-life materials from other industry sectors. The secondary materials can be used either as raw material for the production process or can be introduced in a subsequent process step to an intermediate product where they become a constituent of the final product. Composition variability of wastes or by-products can be addressed either by purification processes prior to production, or within the production process.
- The following aspects should also be considered:
- Product specifications compliance (e.g. durability, versatility, quality, traceability), clearly shown by involving relevant actors in the value chain.
- Economic viability of the proposed processes together with potential new business concepts and simplified methodologies.

European Commission

CE-SPIRE-09-2020: Alternative mineral resources for high volume production

TRL 5-7

Scope:

- Regulatory aspects such as transport and use of secondary material in new products put on the market.
- Information guides should be provided before the end of the project. These should address elements covering the quality of information from product manufacturers, for the efficient use of secondary materials (beneficiation, quality concepts, test procedures, applications and training) and facilitate decision making.
- Proof of concept should be delivered at pilot or demo scale (excluding commercially usable prototypes) to demonstrate convincingly scalability towards industrial applications. Projects are encouraged to develop advanced modelling tools or to use them to build dedicated pilot installations.
- Clustering and cooperation with other selected projects under this cross-cutting call and other relevant projects is strongly encouraged.

European Commission

CE-SPIRE-09-2020: Alternative mineral resources for high volume production

EUR (8-12 millions)

Expected Impact:

- Reduction potential of at least 30% of primary raw material use per ton of main (high volume) final product;
- Reduction of waste generation by at least 25%;
- Significant energy savings and reductions in CO2 emissions (including through a higher share of renewable energy) in the overall production lines.
- Secure and sustainable provision of secondary resources at total cost lower than existing solutions.
- Contribution to new standards for the use of secondary materials for new products;
- The environmental gains in absolute figures, and weighted against EU and global environmental footprints, should be demonstrated;
- In addition, the replication potential should also be assessed.

European Commission

Call: *Industrial Sustainability*

(Section 5ii. Nanotechnologies, Advances Materials, Biotechnology and Advanced Manufacturing and Processing)

- Goal:
- Further strengthen the global leadership of Europe's industry in environmental sustainability, through a combination of mature and disruptive technologies
- Focus areas:
- Connecting economic and environmental gains- the Circular Economy
- Building a low-carbon, climate resilient future
- Strategic priorities:
  - Strengthening the EU leadership on renewables
  - Decarbonising the EU building stock by 2050: from nearly zero-energy buildings to energy-plus districts;
  - Developing affordable and integrated energy storage solutions
  - Electromobility
- RFCS, Raw Materials EIP

Call deadlines:

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2020	
Opening: 27 June 2019		
LC-NMBP-31-2020 (IA)	20.00	12 Dec 2019 (First Stage) 14 May 2020 (Second Stage)
DT-SPIRE-11-2020 (CSA)	0.60	05 Feb 2020
LC-EEB-04-2020 (IA) **LC-EEB-07-2020 (IA)**	52.50	
LC-EEB-08-2020 (IA) **LC-SPIRE-08-2020 (RIA)**	32.5	
Overall indicative budget	105.60	

RIA

LC-SPIRE-08-2020: Novel high performance materials and components (RIA)

TRL 3-5

Specific Challenge:

- Radical transformation of energy intensive industries
- Future LC technologies: fluctuating and extreme conditions (HT, corrosion, etc…), high-energy performance design
- At present: limitations in materials or components resulting degradation, corrosion, wear → reduced efficiency, shutdowns
- **Develop new materials or combined components, overhaul their performance**

European Commission

RIA

LC-SPIRE-08-2020: Novel high performance materials and components (RIA)

TRL 3-5

Scope (1/2):

Develop and test high performance materials and combined components to withstand extreme and varying conditions, and improve their target performance for a long time.

- **Design** highly innovative materials with improved properties (e.g., temperature and humidity resistance (corrosion, oxidation, thermal insulation), strength, functionality, weight, etc. and components with graded and protective coatings, yield strength, hardness, and resistance to media relevant for specific industrial application;
- Components embedded with sensors aiming at minimising industrial processing conditions constraints;

European Commission

RIA

EUR (4-6 millions)

LC-SPIRE-08-2020: Novel high performance materials and components (RIA)

TRL 3-5

Scope (2/2):

- Significant increase in lifetime of equipment by reducing damage and degradation
- Reduction of environmental impacts in terms of waste management and energy and resource consumption.

Other:

- Business case and exploitation strategy (LEIT introduction)
- TRL 3→5
- EU contribution ~ 4-6 million EUR

European Commission

RIA

LC-SPIRE-08-2020: Novel high performance materials and components (RIA)

TRL 3-5

Expected impact:

At least two out of following **three** impacts:

- Energy efficiency improvement of the target production and/or operation processes of at least 30%;
- Reduction of CO2 emissions and resource utilisation by 20%;
- Increased lifetime of the equipment by at least 20%.

Relevant indicators and metrics, with baseline values, should be clearly stated in the proposal

European Commission

CSA

DT-SPIRE-11-2020: Artificial Intelligence and Big Data Technologies for Process Industries

Specific challenge:

- Digitisation of Process Industries
- Connected devices, sensors and actuators (internet of things) to identify and optimise solutions, make complex decisions
- Vast amount of unexploited data → Artificial intelligence (AI) key enabling technology (wider potential than suggested by industrial applications)

European Commission

CSA

DT-SPIRE-11-2020: Artificial Intelligence and Big Data Technologies for Process Industries

Scope 1/2:

- Identification and mapping of digital technologies, level of penetration, most relevant specific AI- and big data technologies, and most relevant application cases and/or pilots in process industry.
- **Roadmap for all sectors** in the process industries with clear recommendations for researchers, managers, and operators

European Commission

DT-SPIRE-11-2020: Artificial Intelligence and Big Data Technologies for Process Industries

CSA

EUR (0.4-0.6 millions)

Scope 2/2:

- Research and innovation management, planning, and design (e.g. new chemical synthesis strategies, health and safety assessments);
- Process control: yield and accuracy enhancement;
- Supply chain management and scheduling of connected processes, plants and/or sites (e.g. for industrial symbiosis), process flexibility;
- Predictive maintenance;
- Product customisation and product traceability.

European Commission

DT-SPIRE-11-2020: Artificial Intelligence and Big Data Technologies for Process Industries

CSA

EUR (0.4-0.6 millions)

Expected Impact:

- Better exploitation of AI in the process industries;
- Identification of existing and future data requirements for the development of data driven technologies;
- Seamless collaboration of human operators with process control systems and plants;
- Implementation and elaboration of the SRI agenda (EC Com on Artificial Inteligence)

European Commission

CE-SPIRE-01-2020: Tapping into the potential of Industrial Symbiosis

Specific Challenge:

Industrial Symbiosis holds significant potential to provide:

- Major improvements in resource and energy efficiency for all energy intensive industries.
- Accelerate the transition to a circular economy and to renewable energy systems, reduce waste heat energy and lead to significant reduction of GHG emissions.
- Challenge: Industrial Symbiosis is currently not yet widely implemented.
- Need to tackle technological and non-technological barriers to harness its full potential.
- Energy grids and adjacent infrastructures as well as the local and regional dimension are all critical factor which must be taken into account.

European Commission

CE-NMBP-42-2020: Materials life cycle sustainability analysis

Specific Challenge:

- to evaluate material/product improvement, taking into consideration:
  - ✓ all relevant sustainable subsystem interactions (environmental, economic and social)
  - ✓ all the life cycle stages of the product value change (from production to consumption, form design to recycling and up-cycling of waste materials)
- to fit all the causal interrelations into an holistic approach understandable to the different stakeholders.

CE-NMBP-42-2020: Materials life cycle sustainability analysis

Scope:

- To incorporate social and economic indicators in sustainability evaluations;
- Develop approaches and select indicators that allow formalising connections between subsystems.
  Note: Existing standard methods should be used for assessing environmental impacts and to build on the work done by the Life Cycle Initiative (Social Life Cycle assessment);
- Develop a quantitative approach that allows assessment of the sustainability multi-criteria trade-offs of circularity (cradle to cradle) *dynamically* in real cases;
- Stimulate the use of existing ontologies developed under Horizon 2020 NMBP 2018-2020 programme;

European Commission

CE-NMBP-42-2020: Materials life cycle sustainability analysis

TRL 3 -6

Scope:

- public demonstration of the LCSA approach, which can contribute towards effective uptake of LCSA within different sectors;
- to engage with industry and especially SMEs but also with consumer organisations, as well as governmental and standardisation bodies;

Clustering and cooperation with other selected projects under this cross-cutting call and other relevant projects is strongly encouraged.

European Commission

CE-NMBP-42-2020: Materials life cycle sustainability analysis

EUR (6 millions)

Expected Impact:

- More robust early-stage evaluations and increase consistency across sectors and through value chains through improved sustainability evaluation tools;
- Better informed investment decision-making through improved visualisation and communication of potential sustainability trade-offs (of products) with stakeholders
- Support the implementation of EU policies, including the transition to a more circular economy at different scales of economic and social conditions;
- Creation of new business opportunities and increased competiveness of EU industries;
- Supporting SMEs in the transition to the circular and sustainable economy;
- Improved product investment decisions for industry;
- Contribution to a future LCSA at EU level *linked to the certification of final products*.

European Commission

European Commission

Thank you!

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EU Funding & Tenders Portal

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Horizon 2020 Work Programme for Research & Innovation – Energy Efficient Buildings cPPP

#H2020Energy info days

Eleftherios BOURDAKIS

Policy Officer

DG RTD – Directorate Prosperity

F.3 Sustainable Industry System

Research and Innovation

EeB Topics 2020

Budget: 52.5 M€
Deadline: 05 February 2020

- LC–EEB–04 - 2020 - Industrialisation of building envelop kits for the renovation / market (IA)
- LC–EEB-07-2020 – Smart Operation of Proactive Residential Buildings (IA)
- LC–EEB–08–2020 – Digital Building Twins (RIA)

Topic LC-EEB-04-2020: Industrialization of building envelope kits for the renovation market (IA)

Specific Challenge:

- Despite the wide range of products dedicated to insulation, energy supply and comfort available on the market, affordable, ready-to-go, all-in-one, tailor made reliable solutions directed to deep renovation of existing residential buildings are missing.

- Research and Innovations is necessary for all-inclusive envelope industrialised solutions addressing deep renovation of buildings that are sufficiently flexible and customisable to address significant market segments in EU reaching Near Zero-Energy Building (NZEB) standards.

Scope: Proposals should include at least the following elements

- Develop plug & build smart components and modules with the specific connecting and controlling parts
- Decision support tools for the selection of the refurbishment solution based on LCA/LCC
- Adaptable and scalable Building Management Systems (BMS)
- Case modelling applications, analysis prior to installations, guide for installers and support for decommissioning
- Solid plan for industrial uptake at a large scale, meeting eco-construction and eco-production standards
- Retrofit the whole envelope of two to three real scale residential buildings in different climate zones plus at least three virtual demos of the plug & play elements

Expected impact:

- Demonstrate retrofitting plug & build solutions and tools reaching NZEB standards suitable for mass production by industry for buildings under deep renovation;
- Decrease of retrofitting time and costs by at least 50% compared to current renovation process for the same building type;
- Improve Life Cycle Assessment (LCA) standards;
- Accelerate the renovation process by enabling access to better products.

TRL: 5-7

Type of Action: Innovation Action

Budget: 6-8M €

Topic LC-EEB-07-2020: Smart Operation of Proactive Residential Buildings (IA)

Specific Challenge:

- Challenges in building energy management and demand for a new solution;
- Smart operation of proactive buildings based on innovative components, accurate energy performance predictions, control technologies, predictive maintenance and data supply for the customer;
- Future energy management and contracting turning a building from reactivity into proactivity. A building should be able to control a situation rather than just responding to it;
- Buildings should act in advance and ensure interoperability between grid components and Building Energy Management Systems;
- Customer experiences should be simple, smooth and delightful.

Scope: Proposals should include at least the following elements

- Develop, test and promote the necessary technologies, devices and systems for a smart approach of energy management in line with the latest reforms of the EPBD;
- Develop solutions for proactive buildings, which should be safe, healthy (strengthening of the indoor environment quality requirements) and energy-efficient;
- Develop solutions to provide the pivotal parameters to be measured and controlled for integrated and demand-based control of the building service system. Self-management, self-monitoring, self-healing and self-optimisation will be required;
- Utilise a systematic, standardised approach to process the data generated by the sensors, forecasting services and end-users;
- Tackle utilisation of big data by advanced data visualisation to optimise the operation of the building;
- Ensure that fully integrated systems have the capacity to be compact, easy to commission and to operate, exchangeable and easy to interact with the grid;
- Implement and demonstrate new business models providing services that enable buildings to be proactive.

Expected impact:

- Maintenance cost reductions of at least 20%;
- Significant decrease of energy use in buildings through application of technologies such as dynamic models, big data analytics, predictive analytics and ultimately artificial intelligence;
- Improved indoor environment quality and user satisfaction;
- High replication potential;
- Optimise the use of renewable energy resources used in buildings;
- Contribution to standards, namely the establishment of a Smart Readiness Indicator.

TRL: 5-7
Type of Action: Innovation Action
Budget: 6-8M €

Topic LC-EEB-08-2020: Digital Building Twins (RIA)

Specific Challenge:

- Go beyond the data provided through BIM
- Facilitate monitoring of activities and comparison of relevant data against the initially agreed planning
- Answer to the lack of open semantic interoperability standards between actual BIM and future BIM

Scope: Proposals should include at least the following elements

- Automated progress monitoring allowing to verify that the completed work is consistent with plans and specifications;
- Tracking of daily changes in an as-build model, allowing early detection of discrepancies;
- Avoiding over-allocation of resources by dynamic prediction of requirements, thus reducing the need to move resources over long distances and improving time management;
- Assurance of the safety of workers through a system of early detection and notification by applying artificial intelligence;
- Quality assessment by image processing technologies should allow verification of structure conditions and detection of cracks or material displacement, triggering additional inspections;
- Optimisation of equipment usage by advanced imaging and automatic tracking.

Expected impact:

- Better scheduling forecast by 20%;
- Proposals for a future standardisation for Digital Twins at a European scale;
- Better allocation of resources and optimization of equipment usage;
- Reduced number of accidents on construction sites;
- Reduction of costs on constructions projects by 20%.

TRL: 4-6
Type of Action: Research & Innovation Action
Budget: 5-6M €

Topic NMBP-36-2020: Monitoring and safety of transport infrastructures (CSA)

Specific Challenge:

- Too many collapses of aging road bridges in Europe (built more than 40 to 50 years ago)
- Need of sound procedures to ensure efficient monitoring, quality control and preventive maintenance of construction activities (including materials)
- Bridges are in particular sensitive infrastructures subject to volumes of traffic greater than originally designed for. Including Ten-T!
- Action proposed to analyse relevant procedures and examine new technologies for optimising monitoring/ control of bridges
- Identify concrete needs for an harmonized approach, including where possible for other infrastructures (e.g. tunnels)

Scope: Proposals should include at least the following elements

- Critical review of existing procedures across EU
- Analysis of advanced technologies, procedures, methodologies and standards to monitor and control safety and smooth operation of aging bridges
- State of the art for damage detection technologies and methods for assessment of performances
- Barriers (technical, economic, environmental, social, administrative), which hinder the safe operation/ maintenance of bridges
- Identify efficient ways to reflect deviations from design specs in maintenance programmes (more frequent use, higher loads, climate change, extended life)
- A roadmap for adoption of technologies to measure predicted durability of materials, components and overall reliability of existing assets
- The technical input for a future EU standard and guidance material
- Develop networks with relevant stakeholders (e.g. authorities, industry, academia, etc.) to share the findings of this CSA

Expected impact:

- Support the preparation of a mandate for a standard (CEN TC 250) for the maintenance and control of large infrastructures.
- Best practices for monitoring the safety of bridges and other relevant infrastructures
- Significant improvement of the safety of bridges and other relevant transport infrastructure through improved maintenance and control

Type of Action: Coordination and Support Action (CSA)
Budget: 2M €

European Commission

Thank you!

#H2020Energy

EU Funding & Tenders Portal

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Information and Communication Technologies
Cloud, Software, Photonics WP(2018)-2020

#H2020Energy info days

Dirk van Rooy, Ph.D.
Head of Sector, Trusted Cloud
DG CONNECT

Research and Innovation

ICT-40-2020 Cloud Computing: towards a smart cloud computing continuum

Specific Challenge:

- Development towards transparent and adaptive environment for 'everything as a service';
- Complete cloud computing continuum: seamless access to continuous service environments;
- Federation, applications, services, dynamic workflows;
- Interoperability, performance, security, **energy-efficiency.**

ICT-40-2020 cloud cont. 1

Scope:
Research and innovation actions (**RIA**) – at least one of following

- advanced cloud technologies and testbeds for complete solutions (network, computing, data services) and complete lifecycle;
- advanced cloud data privacy and security techniques;
- novel programming models and semantically interoperable services.

And demonstrate applicability across multiple domains.

ICT-40-2020 cloud cont. 2

Scope:
Coordination and support actions (**CSA**)

- Coordinate stakeholders in cloud computing;
- Support R&D programmes and activities;
- Dissemination, opprganise events, develop research and innovation roadmaps, pre-standardisation activities.

ICT-40-2020 cloud cont. 3

Expected impacts:

RIA: contribute to

- Development of ecosystems and testbeds;
- Development of new cloud services and infrastructures across Europe industrial cloud capability;
- Opportunities for European-based providers, [particularly SMEs;
- Leverage of innovative cloud services and applications.

CSA:

- Creation of sustainable European forum of stakeholders for cloud computing research, industry and users.

Expected opening call: 19 Nov. 2019 (**DOUBLE-CHECK!!!!**)

CHECK OFFICIAL TEXT

ICT-50-2020 Software Technologies

Specific Challenge:

- Increased complexity , challenges to integration and cybersecurity;
- Seamless connectivity and access to data, abundant computing power;
- Adaptability, trust, security, reliability, performance **while reducing energy consumption ;**
- Challenges from requirement analysis, design, development, testing, deployment, operations, across heterogeneous and dynamically self-configuring systems.

ICT-50-2020 Software Technologies cont. 1

Scope: Research and innovation actions (**RIA**) – at least one of the following areas

- Development tools & methods for interoperable, adaptive, secure and trustworthy software
  a. New programming models and S/W engineering;
  b. Advanced development environments.
- advanced software systems and architectures
  a. Self-managed software facilitating the semantic adaptation of entities to dynamically changing contexts;
  b. Software systems that effectively deal with resources complexity and volatility.

And demonstrate applicability across multiple domains.

ICT-50-2020 Software Technologies cont. 2

Scope: Coordination and support actions (**CSA**)

Coordinate stakeholders in the area of software technologies, digital infrastructures and cybersecurity;

Support to R&D programmes/activities by disseminating project results and organising scientific and policy events, developing research and innovation roadmaps.

ICT-50-2020 Software Technologies cont. 3

Expected impacts:

RIA:

- Increased capacity of the European software industry;
- Improved reliability and cybersecurity of software;
- Expand research and innovation potential in software technologies & infrastructures while overcoming fragmentation;
- Contribute to EU's technology independence in software.

CSA:

- Creation of sustainable European forum of stakeholders for software research, industry and users.

Expected opening call: 9 July 2019 (**DOUBLE-CHECK!!!!**)

CHECK OFFICIAL TEXT

ICT-36-2020 Photonics iii. Light to Fuel

ICT-36-2020 Disruptive photonics technologies [budget 47.5 M€]

Research & Innovation Actions

i. 3D light field and holographic displays
ii. Packaging and module integration for photonic integrated circuits (PIC)
iii. Light to Fuel
iv. Next generation biophotonics methods and devices as research tools to understand the cellular origin of diseases

ICT-36-2020 Photonics iii. Light to Fuel cont. 1

- **Objective** is to develop photonics devices for the **direct and efficient (>5%) conversion of solar energy into chemical fuel**.

- **Requirements:**

➢ Actions should demonstrate technical and economic feasibility.

- **Expected Impact:**

❖ demonstrate the efficient conversion of solar energy into chemical fuels, with a device efficiency of >5% and payback period of <10 years.

❖ enable Europe taking the lead in related solar energy conversion industry

Thank you!

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