



# FCH2 JU

## H2 Safety activities

Hydrogen Safety Research Priorities Workshop  
Petten, NL, 26-27 September 2016



<http://www.fch.europa.eu/>

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# Policy background: The Energy Union

*(European Commission Communication Feb.2015)*



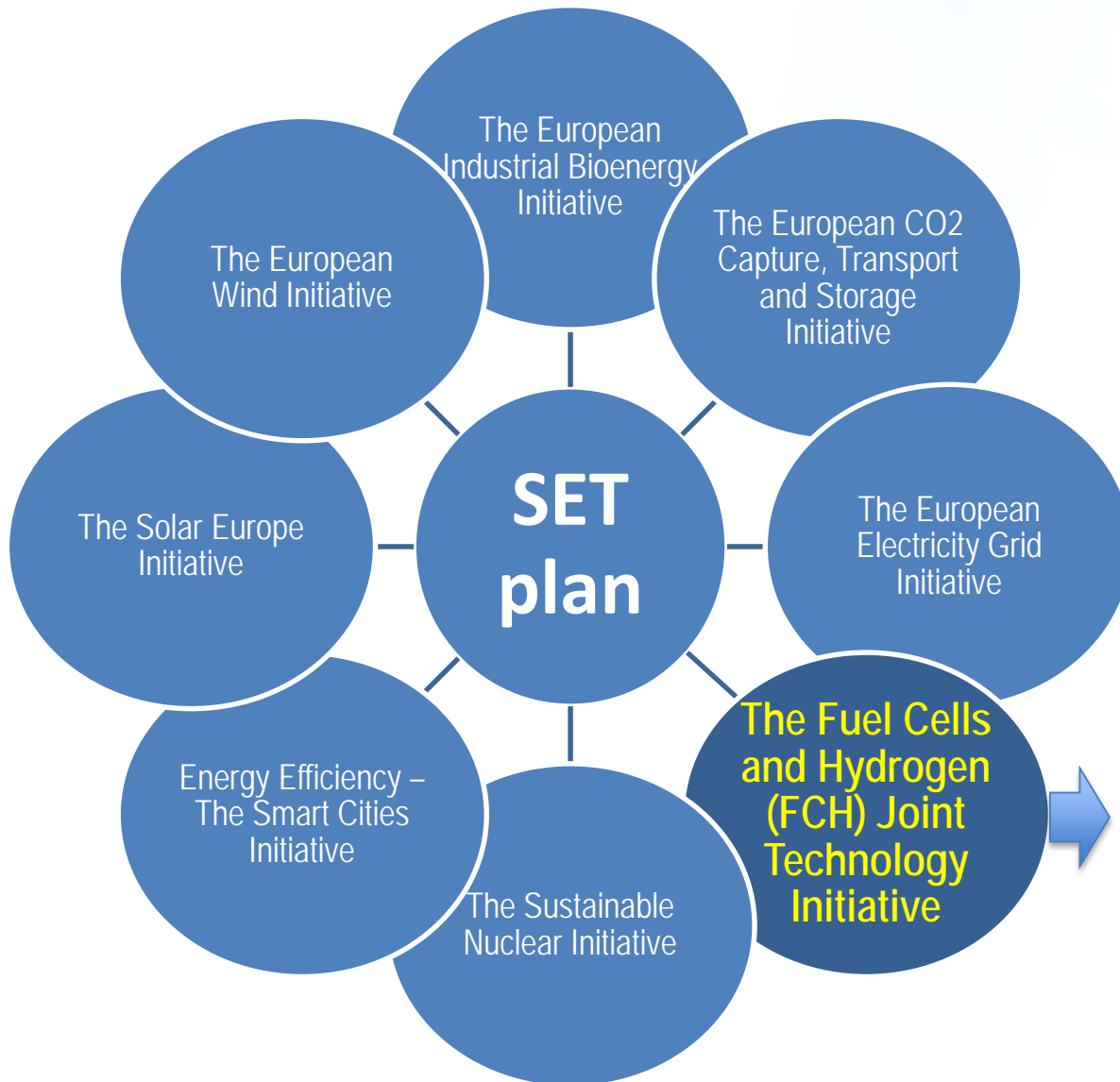
*“I want to reform and reorganise Europe’s energy policy in a new European Energy Union.”*

Jean-Claude Juncker  
(President European Commission)

## The 5 Pillars of the Energy Union:

1. Security of supply
2. Integrated European energy market
3. Energy efficiency
4. Decarbonisation
- 5. Research and Innovation => H2020 & SET-Plan**

# FCH 2 JU part of SET plan, to achieve EU 2030 targets



## EU 2030 targets\*:

27 % increase in renewables  
27 % increase in efficiency  
40 % decrease in emissions

## Fuel Cells and Hydrogen Joint Undertaking

- FCH2 JU - EU body
- Budget: 1.4 bill.€ (2014-2020)\*\*
- FCH2 JU Programme Office

\* European Council, October 2014

\*\* continuation of previous program for 2008-2013 with a budget of approx. 1 bill.€

# Fuel Cells & Hydrogen technologies role in the Energy Union

## Energy Security

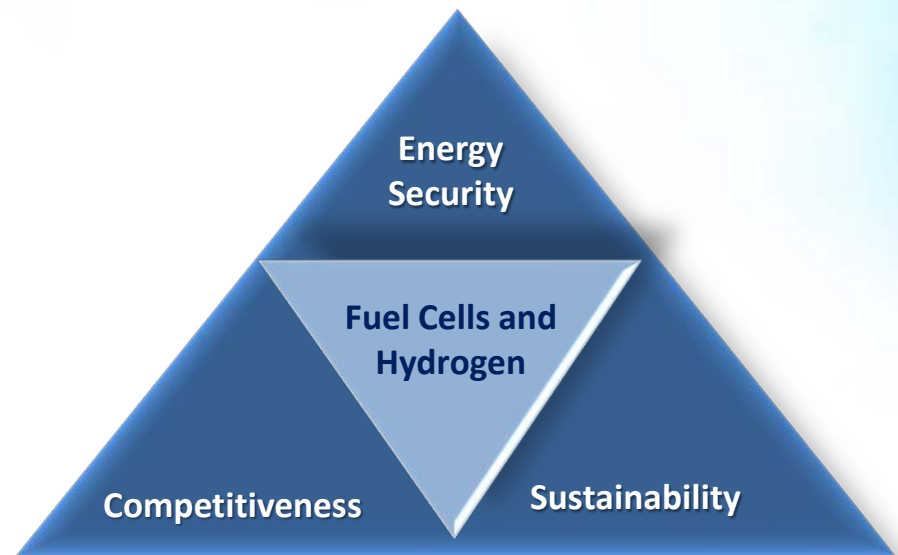
- Increase independence from unstable outside regions

## Competitiveness

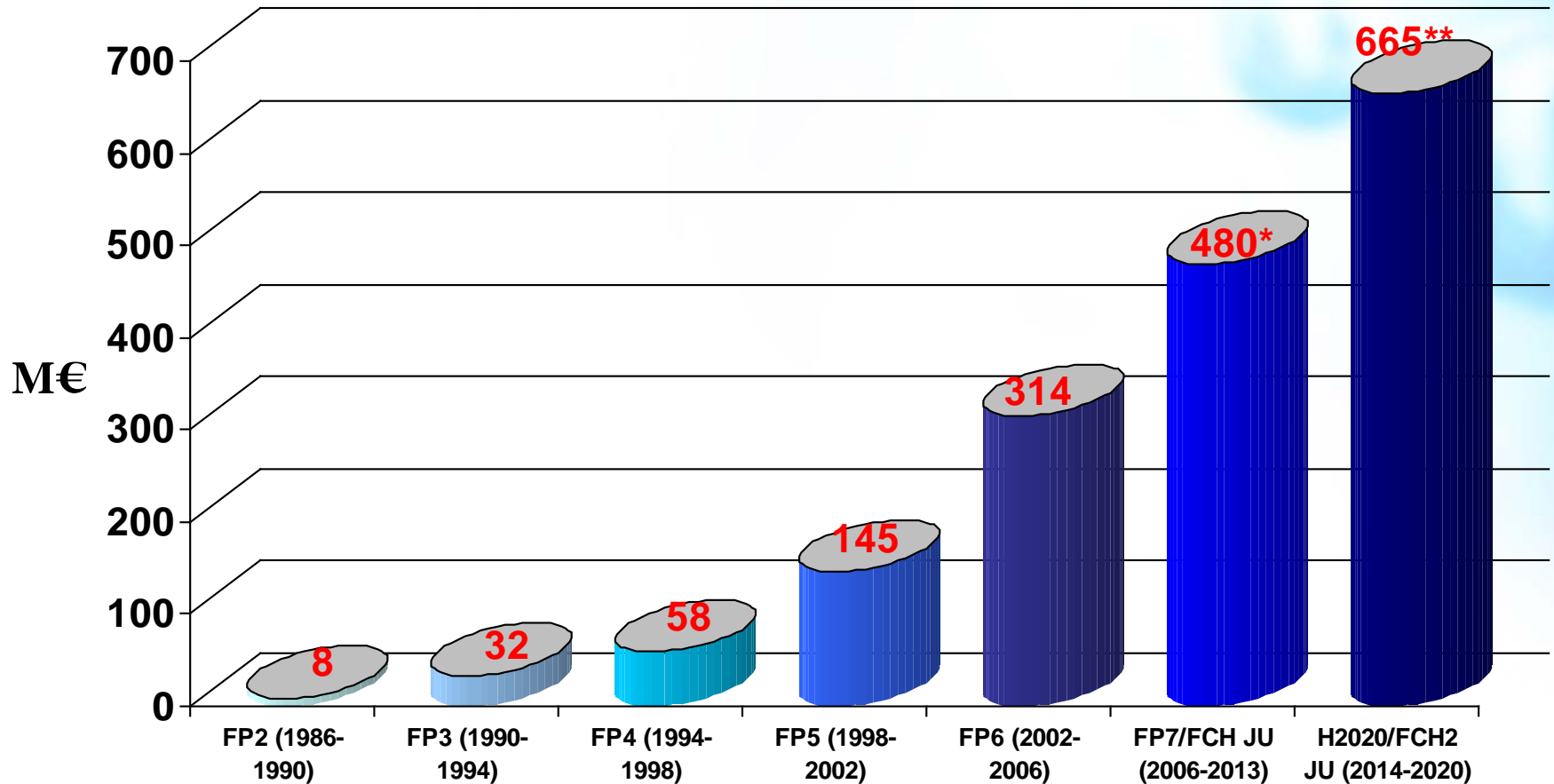
- Research excellence leading to industry innovation and growth

## Sustainability

- H<sub>2</sub> 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 CO<sub>2</sub> emissions



# Continuous Support in the EU Framework Programmes



*\* 470 mill EUR implemented by FCH JU + about 10 mill EUR already spent from EU 2007 budget, before FCH JU in place*

*\*\* 665 mill EUR only to be implemented by the FCH2 JU + additional budget from EU programmes for low TRL (basic research) and structural funds/smart specialisation*

# FCH2-JU is strong Public-Private Partnership with a focused objective

## Fuel Cells & Hydrogen Joint Undertaking (FCH2 JU)



**Industry Grouping**  
Close to 100 members  
~ 50% SME



**Research Grouping**  
Over 60 members



The Joint Undertaking is managed by a Governing Board composed of representatives of all three partners and lead by Industry.

To accelerate the development of technology base towards **market deployment** of FCH technologies from 2015 onwards

### **Legal basis:**

Council Regulations:

521/2008 of 30 May 2008 **(FP7)**  
& amendment 1183/2011 of 14 Nov 2011  
559/2014 of 6 May 2014 **(H2020)**



# FCH2 JU objectives

Reduction of production costs of long lifetime FC systems to be used in transport applications

Increase of the electrical efficiency and durability of low cost FCs used for power production

Transport

Industrial applications

Residential CHP

Feed to electricity grid

Reduce the use of critical raw materials

Existing natural gas, electricity and transport infrastructures

By-product from Chemical Industry

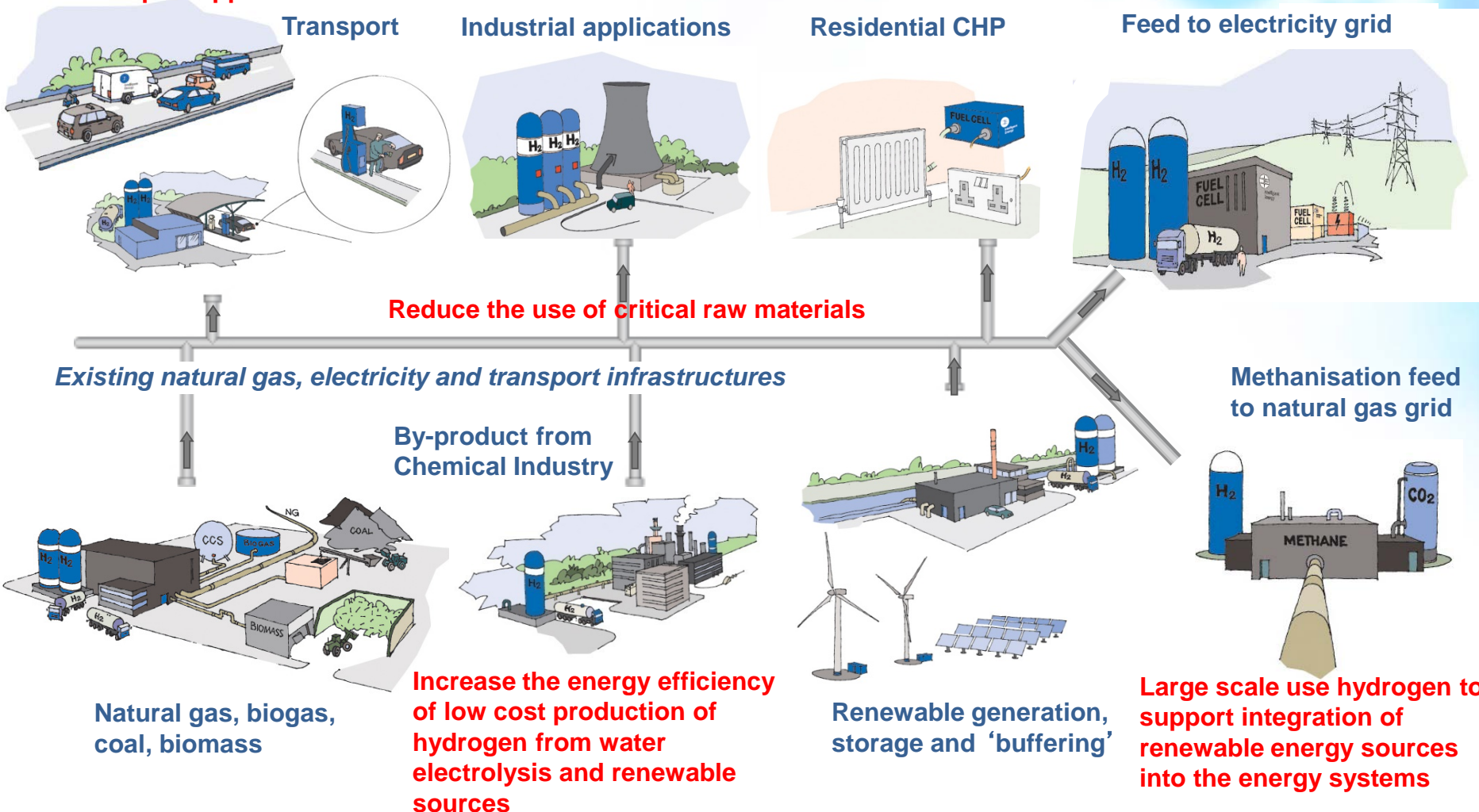
Methanisation feed to natural gas grid

Natural gas, biogas, coal, biomass

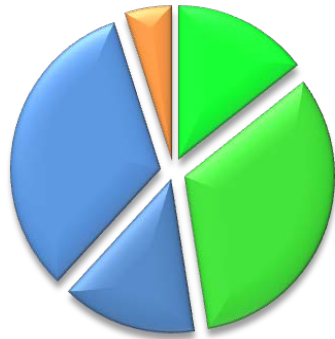
Increase the energy efficiency of low cost production of hydrogen from water electrolysis and renewable sources

Renewable generation, storage and 'buffering'

Large scale use hydrogen to support integration of renewable energy sources into the energy systems



# Multi-Annual Work Plan, MAWP (2014-2020)



- Transports Systems R&I
- Transports Systems I
- Energy Systems R&I
- Energy Systems I
- Cross-cutting activities

## Estimated budget of €1.4 billion

Strong industry commitment to contribute inside the programme + through additional investment outside, supporting joint objectives.

## TRANSPORT

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

## ENERGY

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

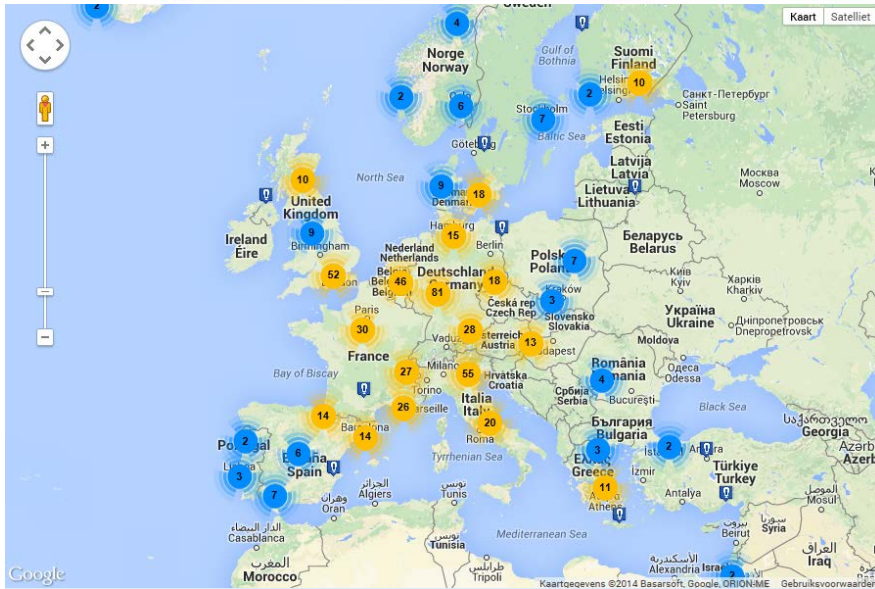
## Cross-cutting Issues

(e.g. standards, consumer awareness, manufacturing methods, ...)



# Strong FCH community in Europe

## *Projects involving 23 EU Member States*



**571** Beneficiaries:

**35%** Industries

**28%** SMEs

**27%** Research Organizations

**4%** High Education Institutions

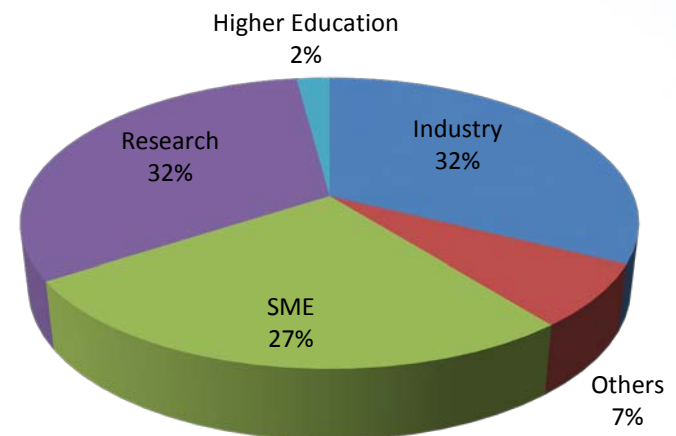
**6%** Others

Incl international cooperation outside EU

(Additional non-EU countries: CH, NO, IL, TR, IS, RS, CN, RU & US)



## Funding of beneficiaries categories

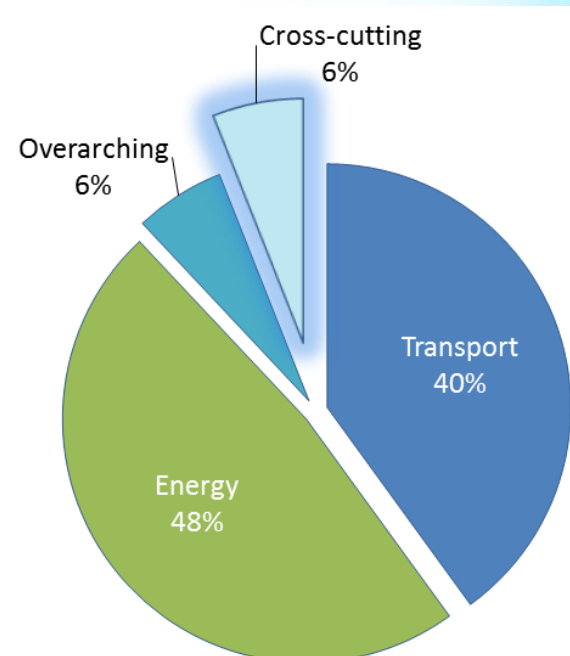
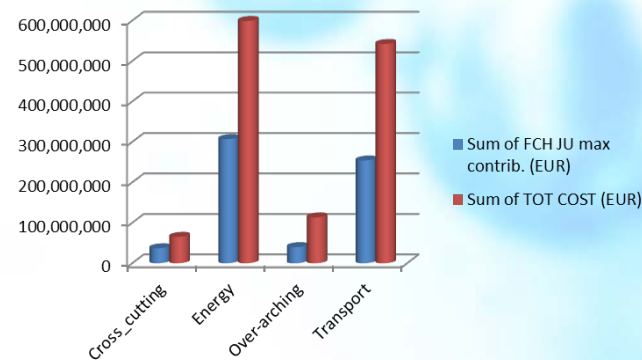


## 185 projects supported for about 638 mill €

[illegible]

## Similar leverage of private funding: 682 mill €

## Continuous/constant annual support (through annual calls for proposals)



# Cross-cutting Issues Overview

Cross-cutting Activity Area **main goals and targets** are set out in...

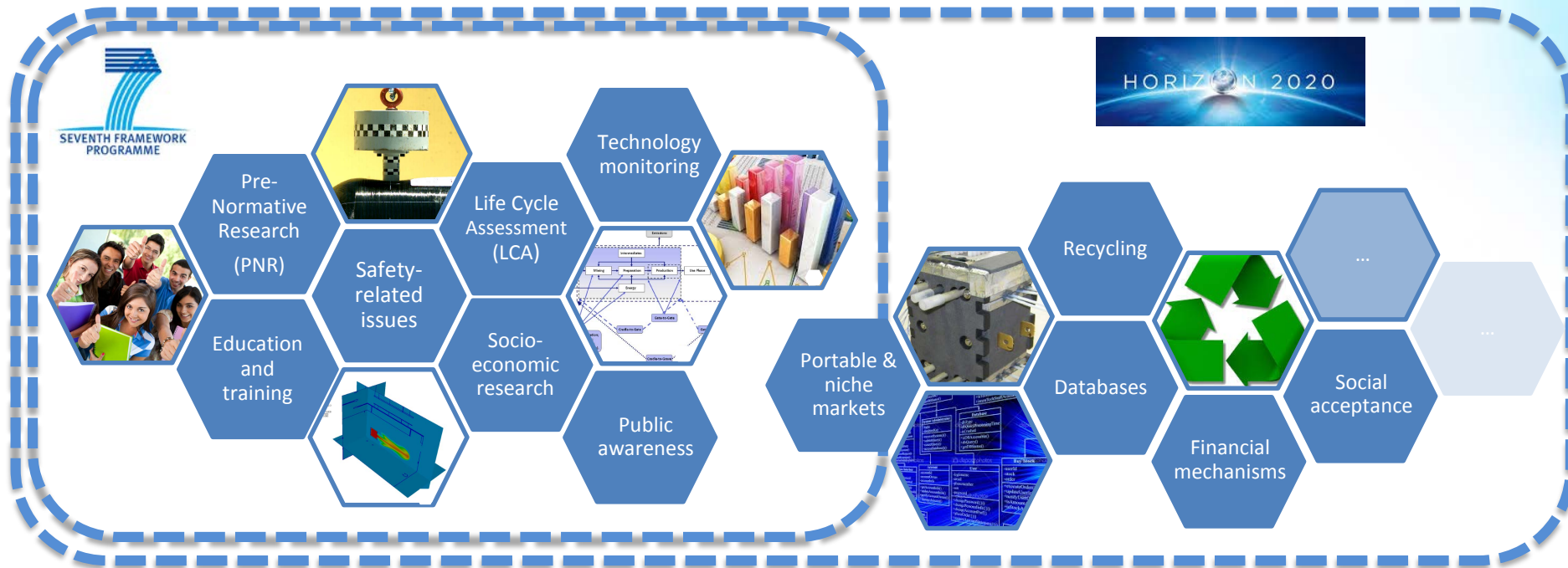
Multi-Annual Implementation Plan, MAIP  
(2008-2013)



Multi-Annual Work Plan, MAWP  
(2014-2020)

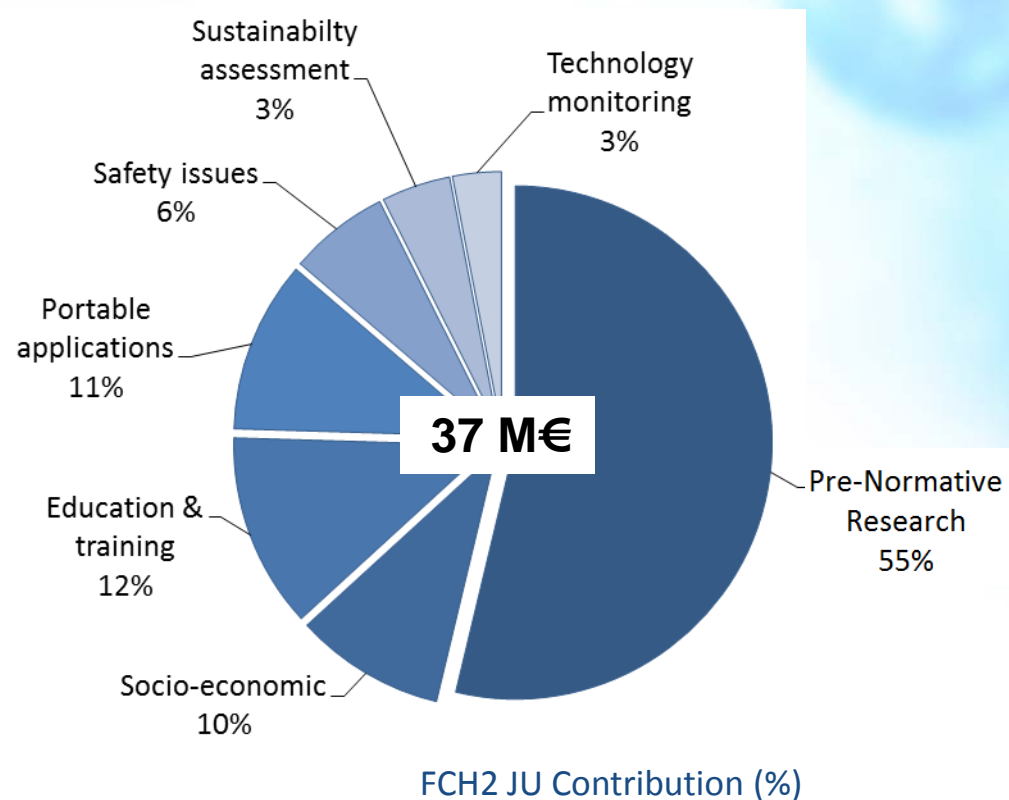


Activities are mainly supported through R&D projects (RIA) and Support Activities (CSA) on...



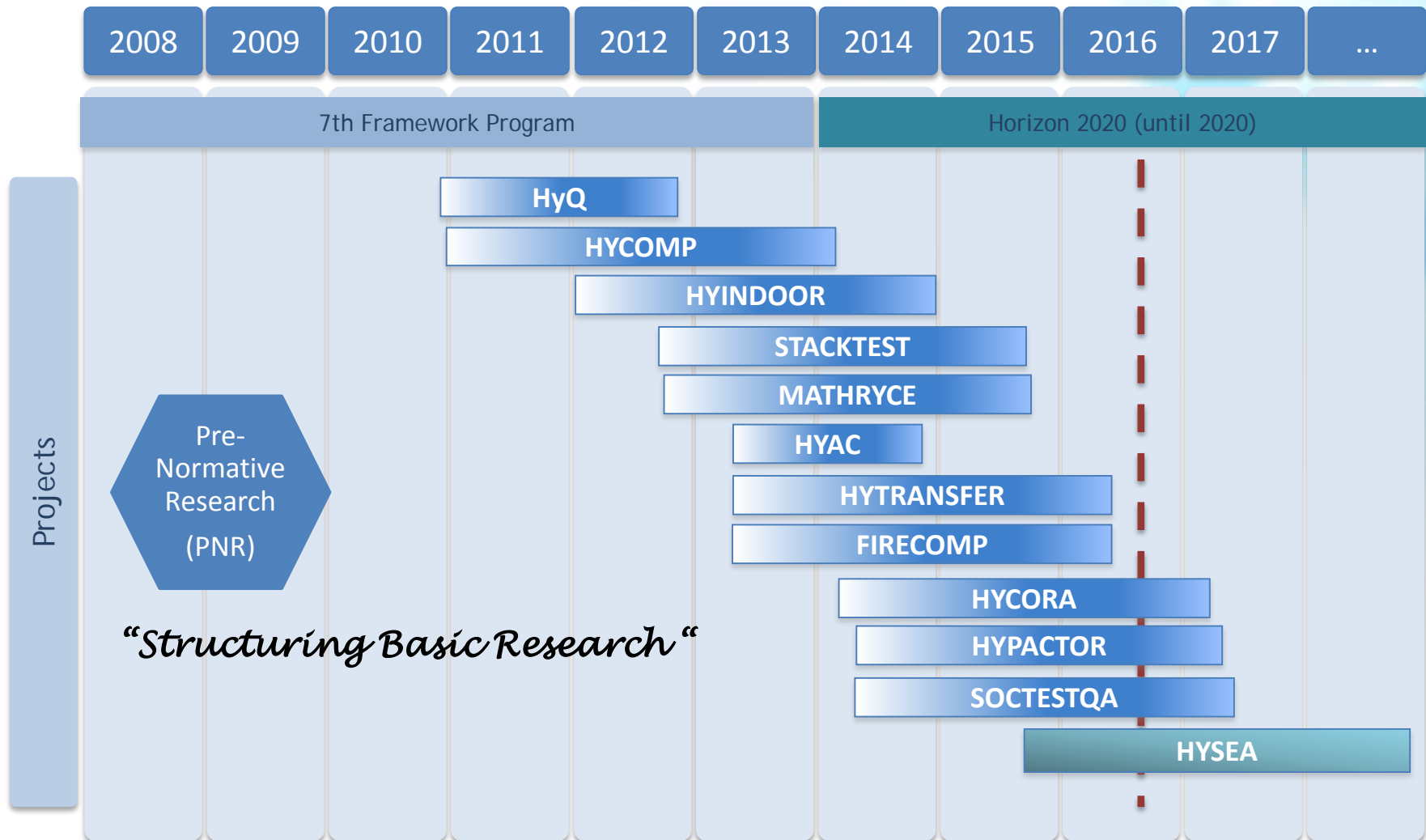
## 32 Cross-cutting projects

- Pre-Normative Research (12)
- Education & Training (5)
- Socio-economic research & public awareness (5)
- Portable applications (3)
- Safety-related issues (3)
- Sustainability assessment (3)
- Technology monitoring (1)





# Pre-Normative Research (I)



# Pre-Normative Research (II)

PNR projects nature are...

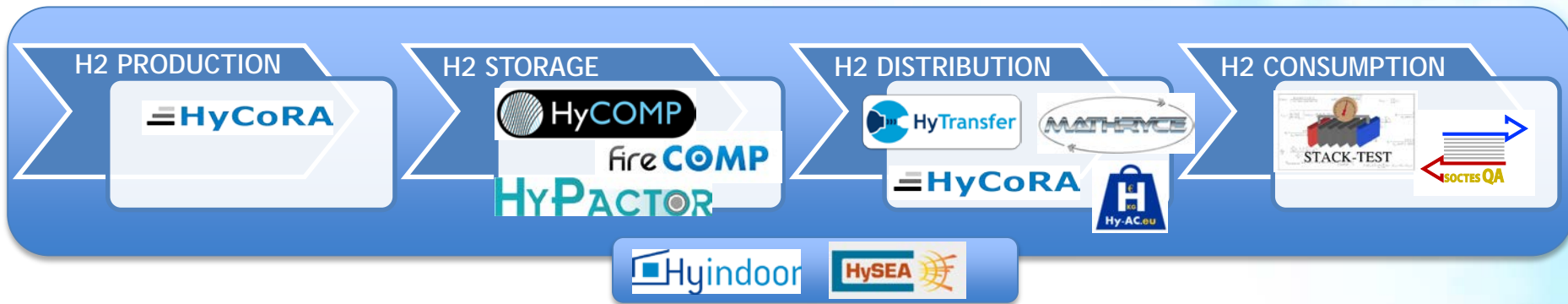
Projects	Stack tests protocols	
	STACKTEST (*)	Development of <b>PEM fuel cell stack</b> reference test procedures for industry
	SOCTESQA	Development of standardized industry wide test protocols for <b>SOFC and SOEC</b>
	Materials	
	MATHRYCE (*)	PNR for metallic components exposed to <b>hydrogen fatigue</b>
	HYCOMP (*)	Enhanced <b>design and testing procedures</b> for composite cylinders intended for the safe storage of H <sub>2</sub>
	FIRECOMP	Modelling the <b>thermo-mechanical behavior</b> of high pressure vessels in composite materials when exposed to <b>fire conditions</b>
	HYPACTOR	PNR on resistance to <b>mechanical impact</b> of composite overwrapped pressure vessels
	Indoor use & vented deflagrations	
	HYINDOOR (*)	PNR for safe <b>indoor use</b> of fuel cells and hydrogen systems
	HYSEA	PNR on vented deflagrations in <b>enclosures and containers</b> for hydrogen energy application
H <sub>2</sub> Quality, metering and transfer		
	HYQ (*)	PNR to provide a support to organizations in order to normalize an acceptable <b>fuel quality for PEMFC</b>
	HYAC (*)	Provision of information & recommendations for legal requirements & procedures for verification & approval of <b>hydrogen metering accuracy</b>
	HYCORA	Provision of information to lower the costs of <b>hydrogen fuel quality assurance</b>
	HYTRANSFER	PNR for <b>thermodynamic optimization</b> of fast hydrogen transfer

(\*) finished



# Pre-Normative Research (III)

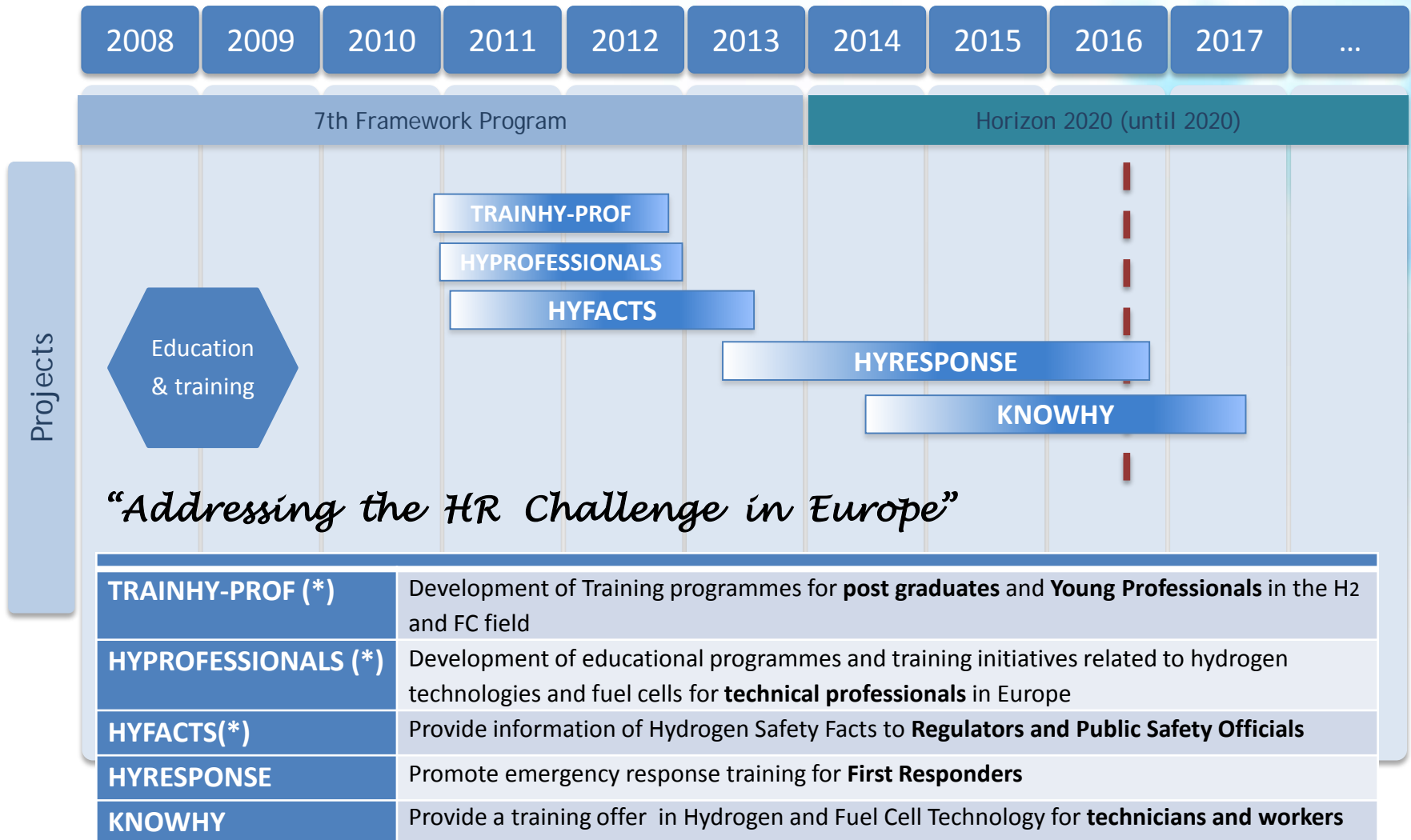
PNR projects contribute to the overall hydrogen chain...



...supporting both Transport and Energy applications...

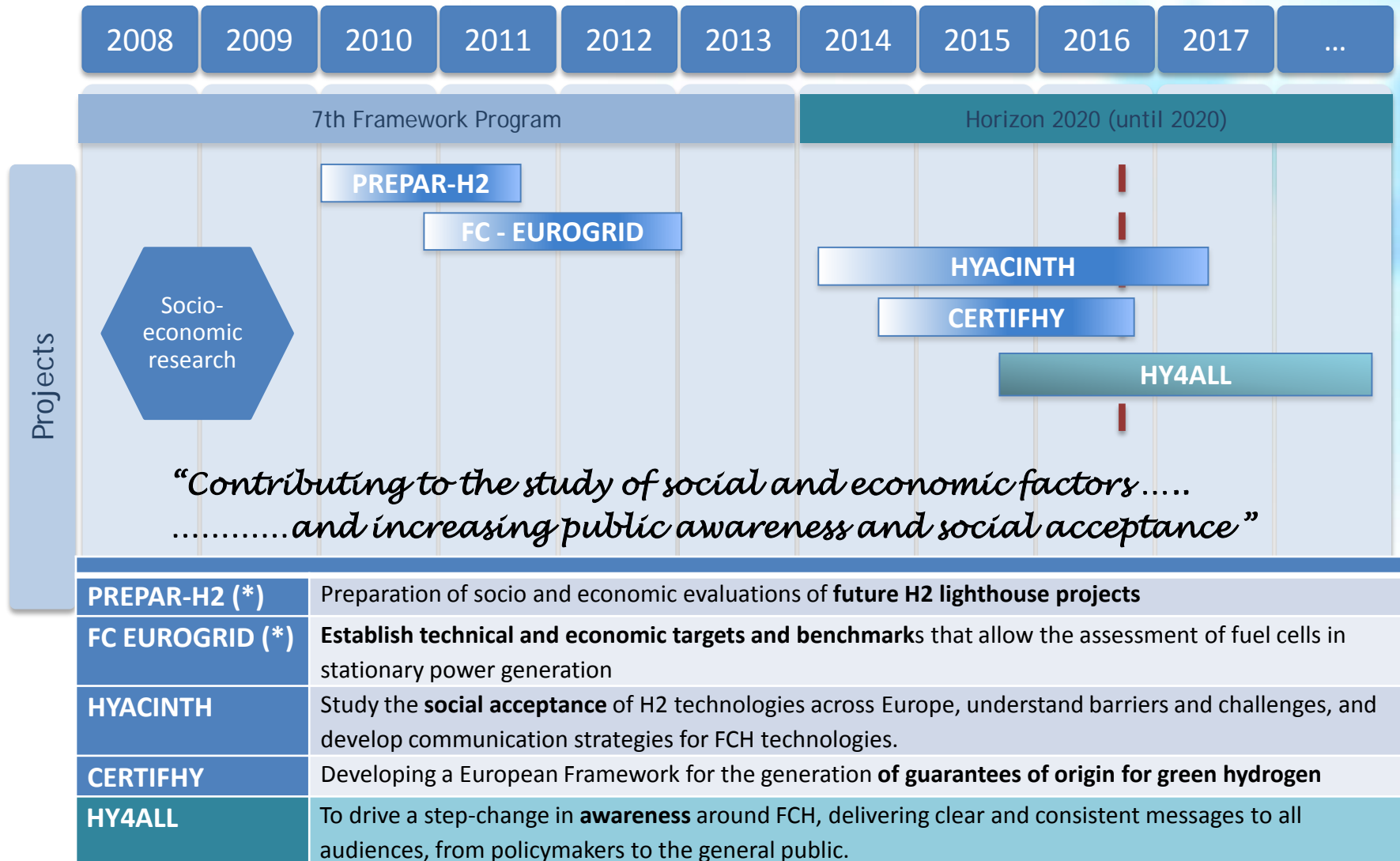
and providing inputs to SDO...





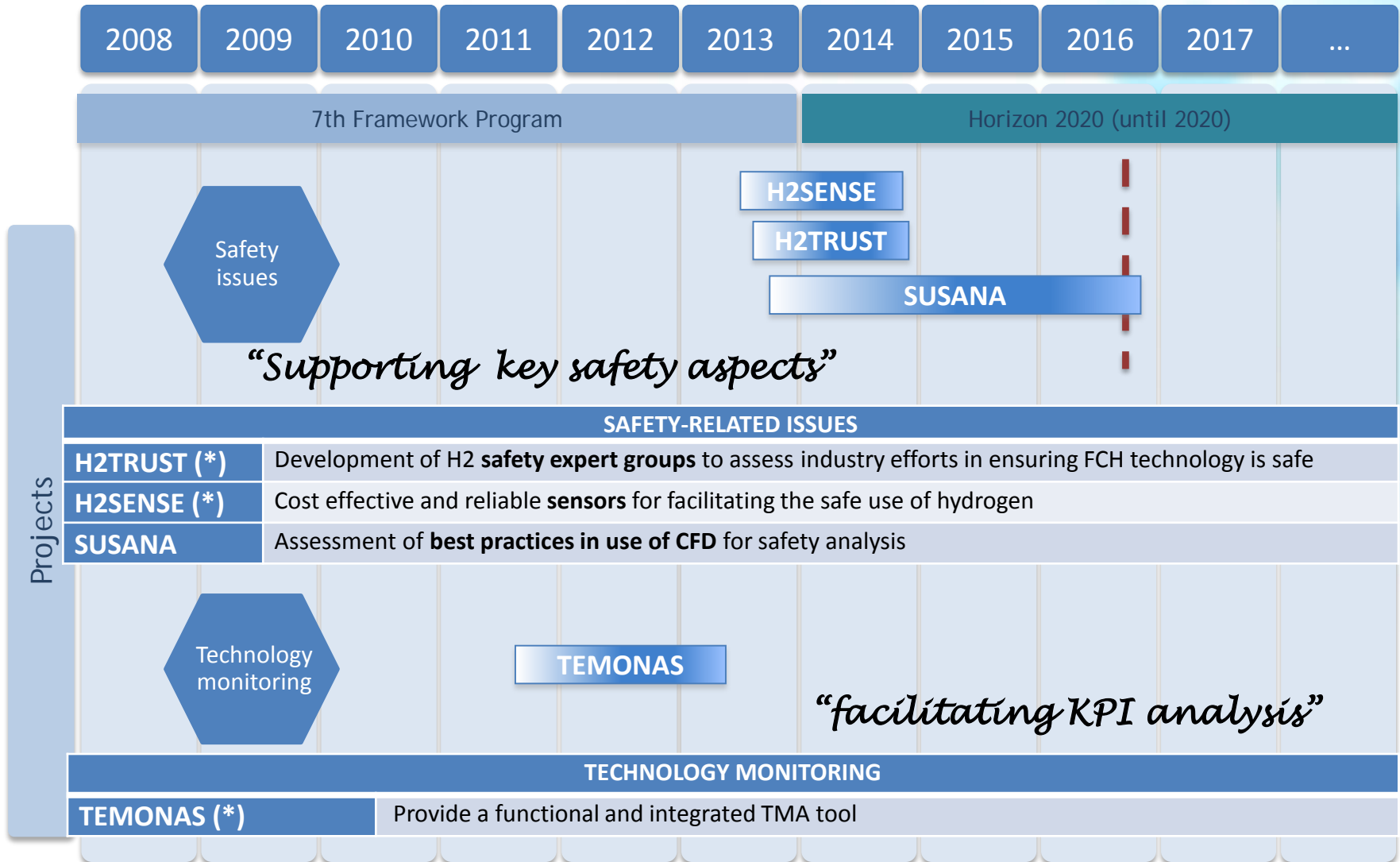
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# Socio-economic research & public awareness



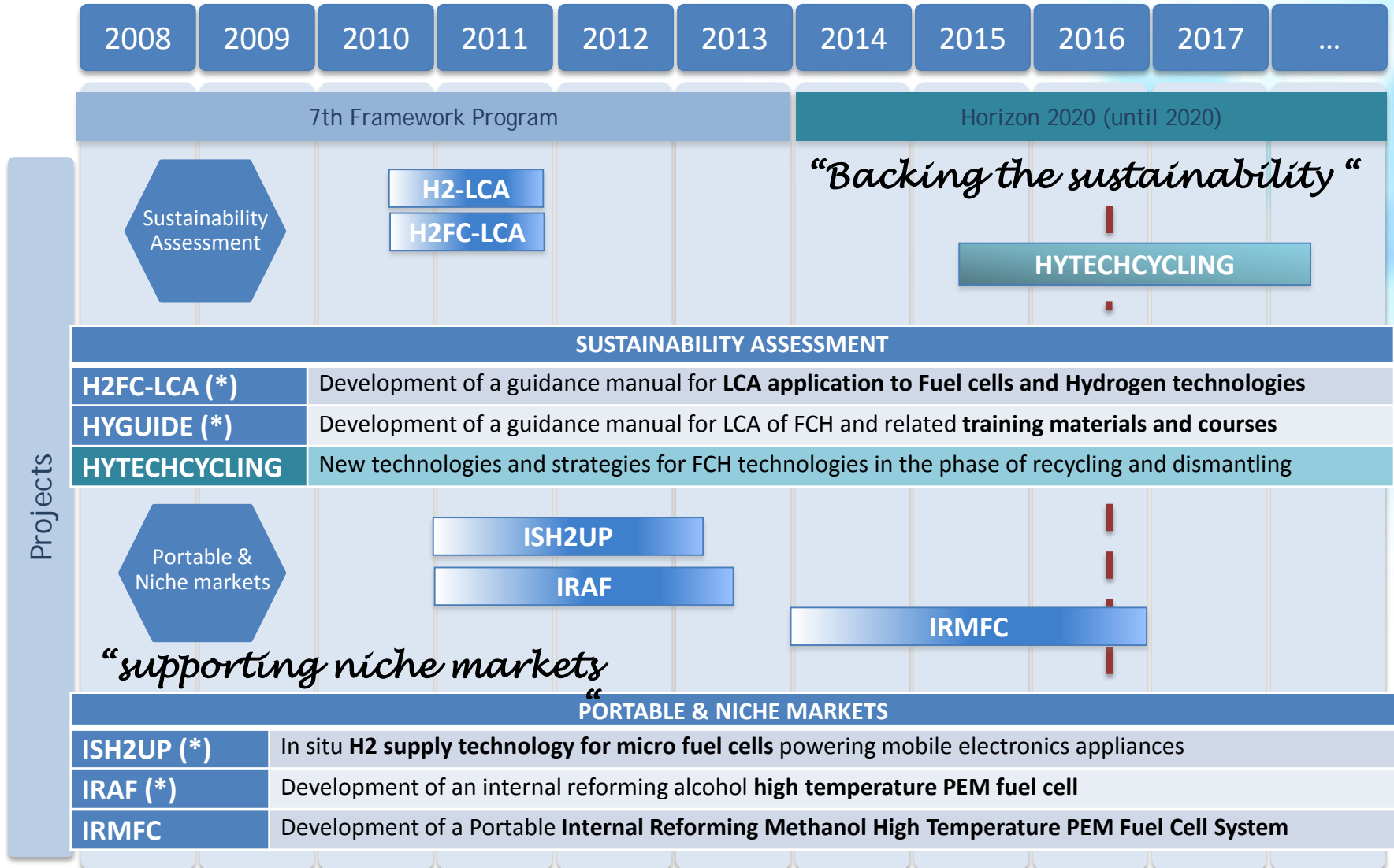
(\*) finished

# Safety issues & Technology monitoring



(\*) finished

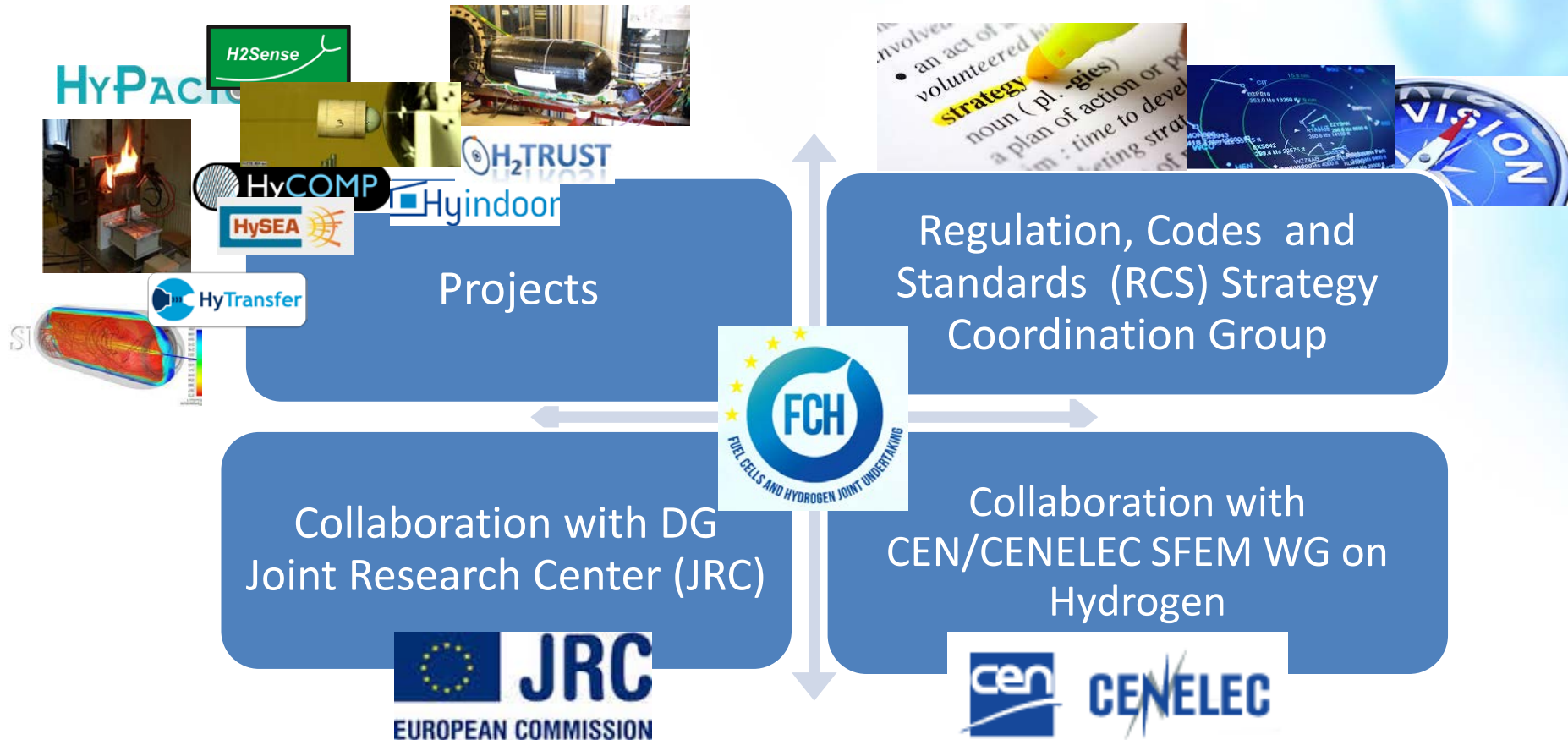
# Sustainability assessment / Portable applications



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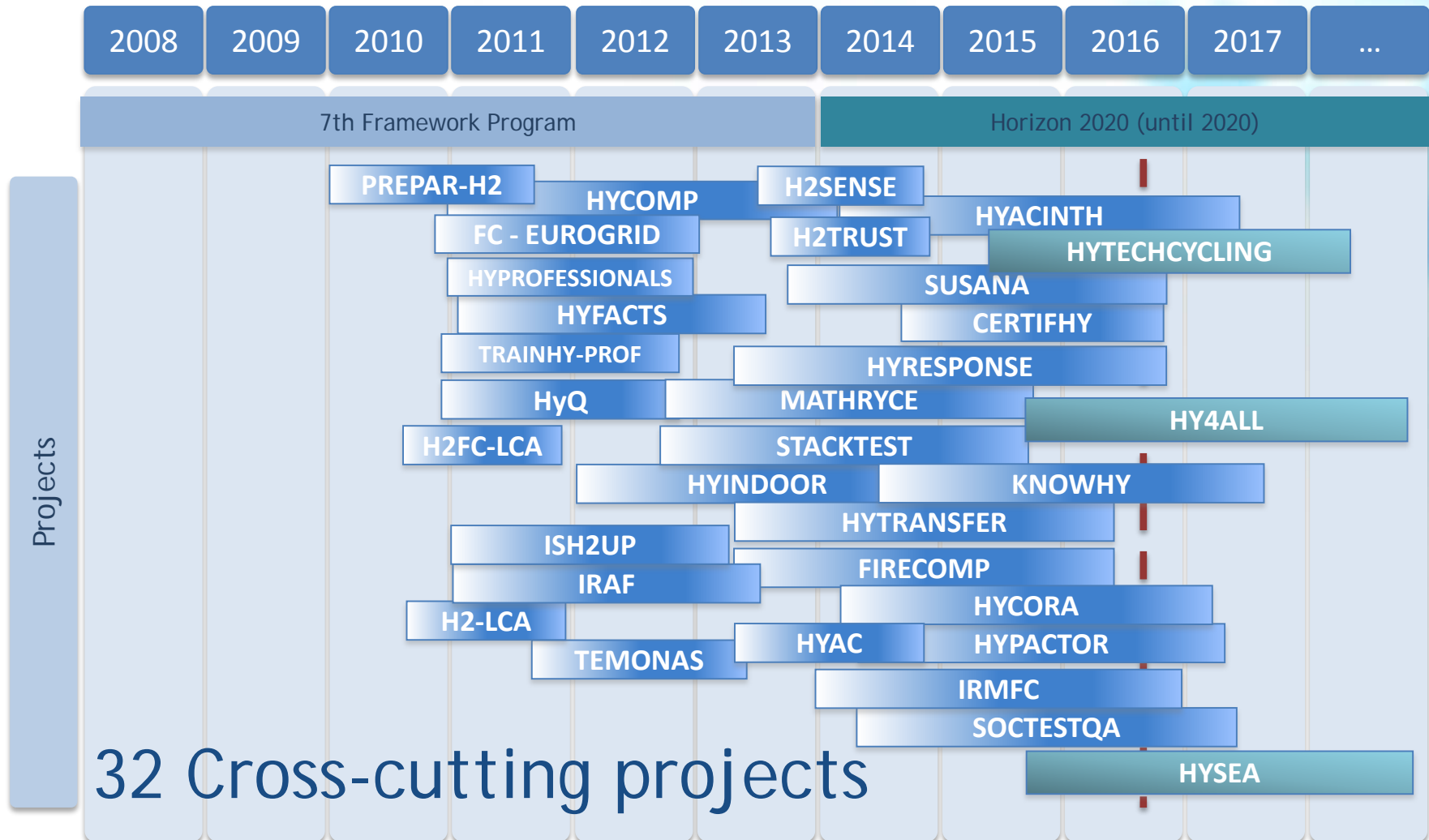
# FCH2 JU's safety-related activities

- The FCH 2 JU is actively contributing to fill the gaps on remaining and upcoming safety-related issues.
- FCH 2 JU's main activities:

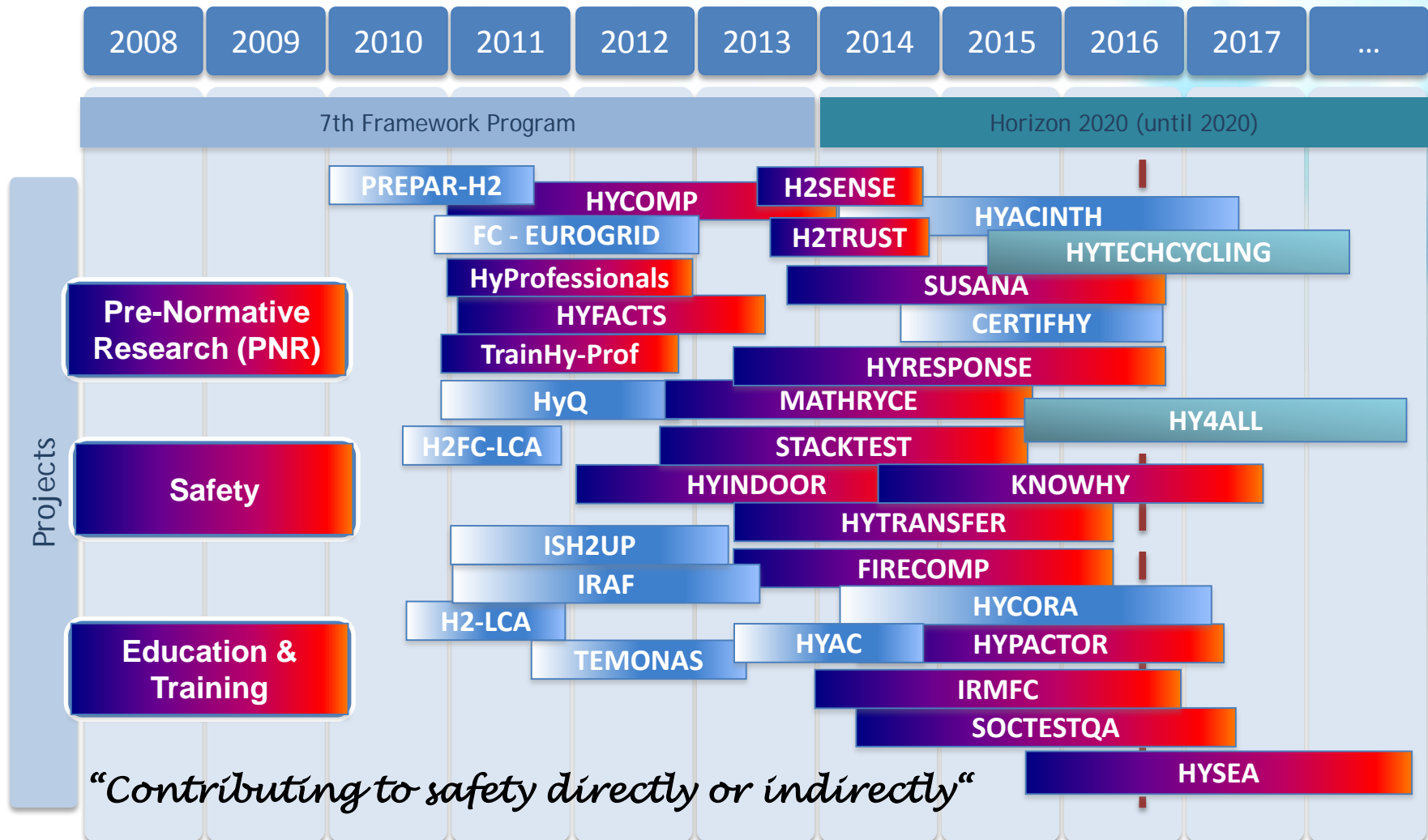




# Projects related to safety (I)



# Projects related to safety (II)



# Projects related to safety (III)

2008

2009

2010

2011

2012

2013

2014

2015

2016

2017

...

## An example of project outcomes

The "H2Sense Hydrogen Sensor Database"

No.	Manufacturer	Sensor Model	Technology	Description / Remark	Application	Detection Range (ppm)	Certification / Approvals / Tests / Classification
1	Hydrex Inc., City, Country	HA-01	Electrochemical	Hydrogen-specific sensor element Part of toxic/leak gas sensors for tanks, "very low sensitivity to CO makes this one of the most selective hydrogen sensors on the market"	Leakage monitoring, process safety, environmental monitoring, volatile organic compounds (VOCs)	Limit of performance warranty: 2000 ppm	N/A
2		HA-03	Catalytic	Palladium	Based on portable application	0-100 % LEL methane	EN 5747EX 2000B, I 2 G Ex d IIC T4 IECEx 5807 20133 Ex d IIC T4 ATEX 20007 20133 IIC 1, II, III, Div. I CSA 22.2 190N33 I, C, 4809.3
3		HA-03	Catalytic	Palladium	Portable application	0-100 % LEL methane	EN 5747EX 2000B, I 2 G Ex d IIC T4 IECEx 5807 20133 Ex d IIC T4

The "H2Sense Hydrogen Sensor Database"

No.	Manufacturer	Sensor Model	Technology	Description / Remark	Application	Detection Range (ppm)	Certification / Approvals / Tests / Classification
23		AST 600	Mechanical	Piezoelectric	Industrial OEM & hydrogen equipment	0-100, 200, 500, 1000, 1500, 1500, 3000, 5000, 7500, 10000, 15000, 20000 PSI	CSA 30 (I, II, III) Part I, Class 1, Zone 1, Group IIC CSA 30 Class 1, Div. 1, Groups A, B, C, D CSA 30 Class 1, Div. 1, Groups E, F, G EN 60069-1-27 (Shock) EN 60069-1-4, EN 60069-1-4-4, EC 48-533 (Vibration) UL 913 Class 1, Div. 1, Groups A, B, C, D
25	Hydrex Inc., New Canaan, CT, USA	HA-01-10	Solid state / Semiconductor	Conductible gas leak detector, hand-held, gas detected hydrogen, etc.	Leak detection	20 ppm Sensitivity, methane-based	
30	ROHM Semiconductor, Duisenberg, Germany	GP2200L	Semiconductor	Gas warning system for hydrogen gas	Monitoring of areas with restricted or no oxygen	min. 0-100 ppm	N/A
32	Beck & Co. GmbH, Aachen, Germany	Beckstar 102, 103	Electro	Hydrogen sensor Measuring range: 0-10 % LEL (0-100 ppm) 0-100 % LEL (0-1000 ppm) Relative humidity: 10% to 100% Relative humidity: 10% to 100% Interference with: hydrocarbons Interference with: hydrocarbons	Monitoring of areas with restricted or no oxygen	min. 0-100 ppm	
33	Hydrex Inc., City, Country	HA-01	Catalytic	Palladium	Based on portable application	0-100 % LEL methane	EN 5747EX 2000B, I 2 G Ex d IIC T4 IECEx 5807 20133 Ex d IIC T4
34	Hydrex Inc., City, Country	HA-01	Catalytic	Palladium	Based on portable application	0-100 % LEL methane	EN 5747EX 2000B, I 2 G Ex d IIC T4 IECEx 5807 20133 Ex d IIC T4
35	Hydrex Inc., City, Country	HA-01	Catalytic	Palladium	Based on portable application	0-100 % LEL methane	EN 5747EX 2000B, I 2 G Ex d IIC T4 IECEx 5807 20133 Ex d IIC T4

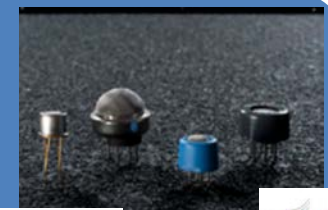
### Hydrogen sensors for the safe and reliable use of hydrogen



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## Hydrogen sensors for the safe use of H<sub>2</sub>



## Main outcomes:

- Hydrogen Sensor Data Base (> 400 references) – publicly available
- Hydrogen sensing technology requirements
- Requirements for RCS
- Best practice strategies in guidelines
- Approaches to get more and better sensors on the market at a lower cost



"Contributing"

# Thank you for your attention !

Further info :

- FCH2 JU : <http://www.fch.europa.eu/>
- HYDROGEN EUROPE : [www.hydrogeneurope.eu](http://www.hydrogeneurope.eu)
- N.ERGHY : <http://www.nerghy.eu>