
European hydrogen and fuel cell activities overview and future technologies

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European objectives

- ❑ EU currently imports approx. 55% of its energy
- ❑ The value can rise up to 70% in the next 20 to 30 years -> EU could be importing 84% of its gas, 59% of its coal and 94% of its oil by 2030
- ❑ Key energy policy objectives for the EU:
 - ❑ Enhance security of energy supply
 - ❑ Climate change
 - ❑ Local air pollution
 - ❑ Develop sustainable market
- ❑ In June 2008 the EC announced a package of measures to reach “the three 2020” environmental targets:
 - ❑ Cut of EU greenhouse gases by at least 20%
 - ❑ Increase the share of RE to 20%
 - ❑ Increase energy efficiency to save 20% of EU energy consumption

European Strategy Energy Technology Plan (SET-Plan)

Core idea behind the European SET-Plan: the EU27 must look at and make affordable and competitive low-carbon technologies

EU approach focused on the European Industrial Initiative (EII); EII target sectors are:

- ❖ The European Industrial **Bioenergy** Initiative
- ❖ The European **CO₂** Capture, Transport and Storage Initiative
- ❖ The European Electricity **Grid** Initiative
- ❖ The **Fuel Cells and Hydrogen** (FCH) Joint Technology Initiative
- ❖ The Sustainable **Nuclear** Initiative
- ❖ The Energy Efficiency – The **Smart Cities** Initiative
- ❖ The **Solar** Europe Initiative
- ❖ The European **Wind** Initiative

The Fuel Cells and Hydrogen (FCH) Joint Technology Initiative

FCH JTI established by a Council Regulation on 30 May 2008
public-private partnership for RTD in FC and H2 initiatives

Aims

- ❖ The FCH JU (Joint Undertaking) is the legal entity in which the partners come together to implement RTD activities considering the industry needs and expectations
- ❖ Scale-up and intensify the **links** between the Industry and the Research community
- ❖ **Accelerate the technology development**
 - **Automotive sector:** achieve mass market growth in the time-frame 2015-2020
 - **Stationary FC systems:** initiate market growth from 2010-2015

Members

- ❖ European Union represented by the European Commission (EC)



- ❖ European Industry Grouping for the Fuel Cell and Hydrogen Joint Technology Initiative (NEW-IG)



- ❖ New Research Grouping on Fuel Cell and Hydrogen (N.ERGHY)



FCH JU commitments

- ❖ Place Europe at the front of FCH technologies worldwide and enable the market breakthrough of FCH technologies
- ❖ Support R&D in the EU Member States and Associated Countries participating in the FP7 to overcome the high-market entry barriers, develop market applications and facilitate additional industrial efforts
- ❖ Support the implementation of the RTD priorities of the Multi Annual Implementation Plan (MAIP) 2008-2013
- ❖ Evaluate the energy, environmental, economic and social sustainability of the technological solutions
- ❖ Monitor the progress in relation to competing and complementary technologies to assess sustainability and economic competitiveness
- ❖ Encourage increased public and private RTD investments
- ❖ Promote public awareness and understanding of FCH technologies and their contributions to energy, environment and transport policies
- ❖ Ensure the coordination and efficient management of funds

FCH JU activities

- ❖ Long-term and breakthrough-oriented research, pre-competitive research and technological development
 - ❖ Large-scale demonstration projects in road transport, stationary power generation, early market applications as well as hydrogen production
 - ❖ Support actions such as education and training activities, development of regulations, codes and standards and lifecycle assessment
-
- ❑ The research agenda outlining the activities is set out in the Multi Annual Implementation Plan (MAIP) of the FCH JU (2008-2013)
 - ❑ MAIP is translated into **annual research priorities** in the Annual Implementation Plan (AIP) containing **specific topics** for the call of proposals
 - ❑ To guarantee the industrial relevance of the R&D agenda, the Industry Grouping takes the lead in the design of the strategy

- ❖ Represents industry perspectives
- ❖ 55 member-companies in Europe
- ❖ Almost 50% SMEs
- ❖ Structured in application-lead areas (production, transport, stationary, early markets)
- ❖ Representation based in Brussels
- ❖ Private partner in the JU (**contributes 50% cost**)
- ❖ Accelerate the technology
- ❖ Co-develops the AIP
- ❖ Part of the JU governance through the JU Governing Board

Tasks

- ❖ **Priority setter** by co-drafting AIPs and MAIP
- ❖ **Application oriented** facilitating market development of FCH technologies in a coordinated manners (commercialization plans)
- ❖ **Focused on accelerating development and market deployment** of applications (FCEV, telecom back-up systems, forklifts)

Source: "Public information session on FCH JU 2011 call for proposal", Brussels, Belgium, 12 May 2011,, (http://www.fch-ju.eu/sites/default/files/Presentation%20FCH%20JU%20for%20public%20session%20on%202011%20call.%2012052011_0.pdf)

List of the NEW-IG members and supporters



AVL List GmbH (AT)	NuCellSys (DE)	
Hydrogenics Europe (BE)	Siemens (supporter) (DE)	Hygreen Technologies s.a. (ES)
Toyota Europe (supporter) (BE)	Umicore AG (DE)	Iberdrola (ES)
H2 Logic (DK)	Vattenfall (DE)	E.ON Sverige AB (SE)
Dantherm Power (DK)	Volkswagen (DE)	Volvo (SE)
IRD Fuel Cells (DK)	Advent Technologies (GR)	HyET (NL)
Topsoe Fuel Cell (DK)	Icelandic New Energy (IS)	HyGear b.v. (NL)
Wärtsilä Finland (FI)	Solid Cell Limited (IR)	NedStack (NL)
Air Liquide (FR)	Ansaldo Fuel Cell (IT)	Shell Hydrogen (NL)
Saint Gobain Centre de Recherches et d'Etudes Européen (FR)	Centro Ricerche FIAT (supporter) (IT)	Adelan (GB)
SNECMA (FR)	Electro Power Systems (IT)	AFC Energy (GB)
Total France (FR)	Enel Produzione (IT)	Alstom (GB)
Adam Opel GmbH (DE)	Environment Park (IT)	Air Products (GB)
Daimler (DE)	Labor srl (IT)	Ceramic Fuel Cell Europe (supporter) (GB)
EWE AG (DE)	OBM Saleri (IT)	CCS Global Group Ltd. (GB)
Honda R&D Europe (supporter) (DE)	SAPIO Produzione Idrogeno Ossigeno (IT)	Diverse Energy (GB)
Infraserv GmbH (DE)	SOFCpower (IT)	Johnson Matthey (GB)
Linde (DE)	Statoil Hydro ASA (NO)	Intelligent Energy (GB)
Ludwig-Bölkow-Systemtechnik GmbH (DE)	Selfenergy (supporter) (PT)	ITM Power (GB)
MTU-CFC Solutions (DE)	INEA (SI)	Riversimple LLP (GB)
	Acciona Energia (ES)	Rolls Royce Fuel Cell System (GB)

Source: <http://www.fchindustry-iti.eu/members.asp>



- ❖ Represents research perspectives
- ❖ 60 members from research organizations and universities in Europe
- ❖ Structured in application-lead areas (production, transport, stationary, early markets)
- ❖ Representation based in Brussels
- ❖ Private partner in the JU (**contributes 8+% cost**)
- ❖ Co-develops the AIP
- ❖ Part of the JU governance through the JU Governing Board

Tasks

- ❖ **Priority setter** by co-drafting AIPs and MAIP
- ❖ **Research for the market** providing research expertise in the FCH JU to accelerate hydrogen and fuel cell technology deployment
- ❖ **Emphasis on aligning research and industry activities** for FCH technology market deployment

Source: "Public information session on FCH JU 2011 call for proposal", Brussels, Belgium, 12 May 2011,, (http://www.fch-ju.eu/sites/default/files/Presentation%20FCH%20JU%20for%20public%20session%20on%202011%20call.%2012052011_0.pdf)

List of the N.ERGHY members



ICT (CZ)	Next Energy (DE)	
NRI (CZ)	ZSW (DE)	
DTU (DK)	CPERI (GR)	AIJU (ES)
TKK (FI)	CRES (GR)	CENER (ES)
VTT (FI)	FORTH (GR)	CIDAUT (ES)
CEA (FR)	FBK (IT)	CIDETEC (ES)
CNRS (FR)	CNR (IT)	CIEMAT (ES)
IIFP (FR)	ENEA (IT)	IMDEA Energia (ES)
INERIS (FR)	Politecnico di Torino (IT)	INASMET Tecnalia (ES)
M.I.N.E.S. ParisTech (FR)	University of Genoa (IT)	INTA (ES)
University of Bordeaux 1 (FR)	University of Perugia (IT)	ITMA (ES)
University of Montpellier II (FR)	University of Roma "La Sapienza" (IT)	University of Alicante (ES)
University of Nancy 1 (FR)	University of Salerno (IT)	XaRMAE (ES)
University of Poitiers (FR)	University of Turin (IT)	University of Uppsala (SE)
CUTEC (DE)	LEI (Lithuania)	KTH (SE)
DLR (DE)	IFE (NO)	EMPA (CH)
EIFER (DE)	NTNU (NO)	PSI (CH)
FZJ (DE)	SINTEF (NO)	TUBITAK Marmara Research Center (TR)
FZK (DE)	Instytut Energetyki (PL)	UNIDO-ICHET (TR)
HZG (DE)	LNEG (PT)	UKERC (GB)
IMM (DE)	ICIT (Romania)	

Source: <http://www.nerghy.eu/en/intern/108.php>

FCH JU operational budget (2008-2013)

Budget: 2008-2013 (min.) ~940 M€

- ❖ 467 M€ (cash) European Union (EU)
 - ❖ 3 M€ (cash) Research
 - ❖ 450 M€ (in kind*) Industry
 - ❖ 20 M€ (cash) Industry
- } 50% Industry co-funding

* the participating companies' investments in projects

Operations: to launch **annual**, open and competitive **calls** for project proposals

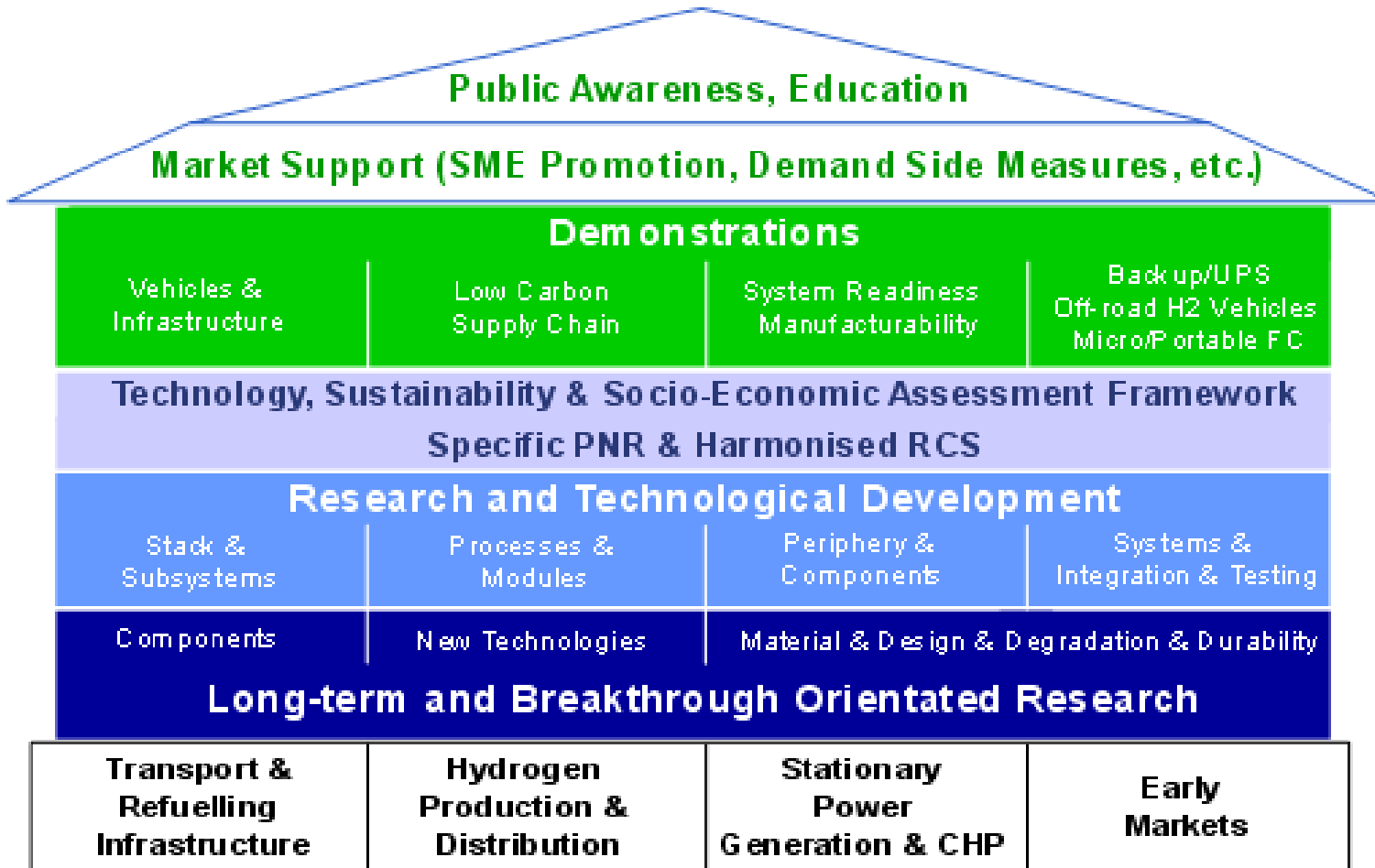
Principle: ~50/50 cost-sharing between the EC and the Industry

Limit: the requested FCH JU (cash) funding must be matched by the Industry co-financing (in kind) at **call level**, if not the FCH JU funding is reduced

Correction function: in case of mismatching a correction function is used with the purpose to reflect the reduced FCH JU funding (call 2010: 0.72; calls 2008-2009: 0.67)

Multi Annual Implementation Plan (MAIP)

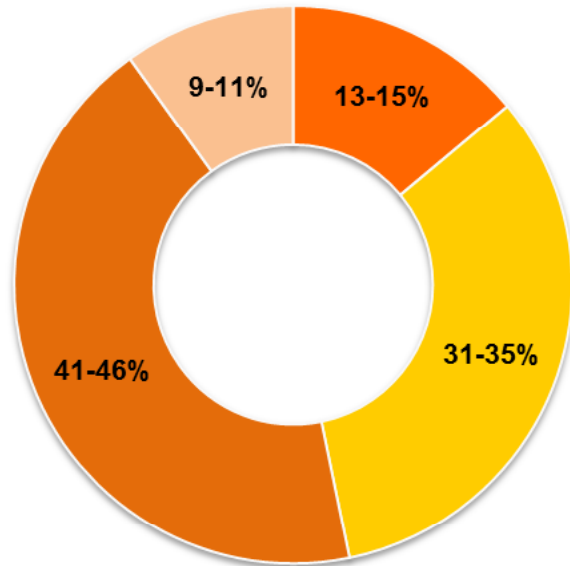
Source: <http://www.fch-ju.eu/page/what-we-do>



MAIP is divided in 4 main application areas (AAs) with a fifth area called “cross-cutting activities” (RCS, PNR, socio-economic modeling and planning, technology monitoring and assessment, lifecycle analysis, market support, public awareness and education)

MAIP budget breakdown

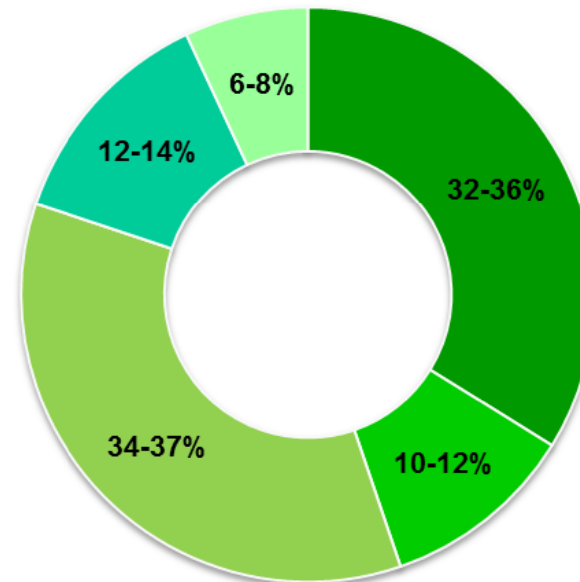
FCH JU Funding by Action Categories



Total funding = 470 M€

- Breakthrough research
- Research & technological development
- Demonstrations
- Support actions

FCH JU Funding by Application Areas

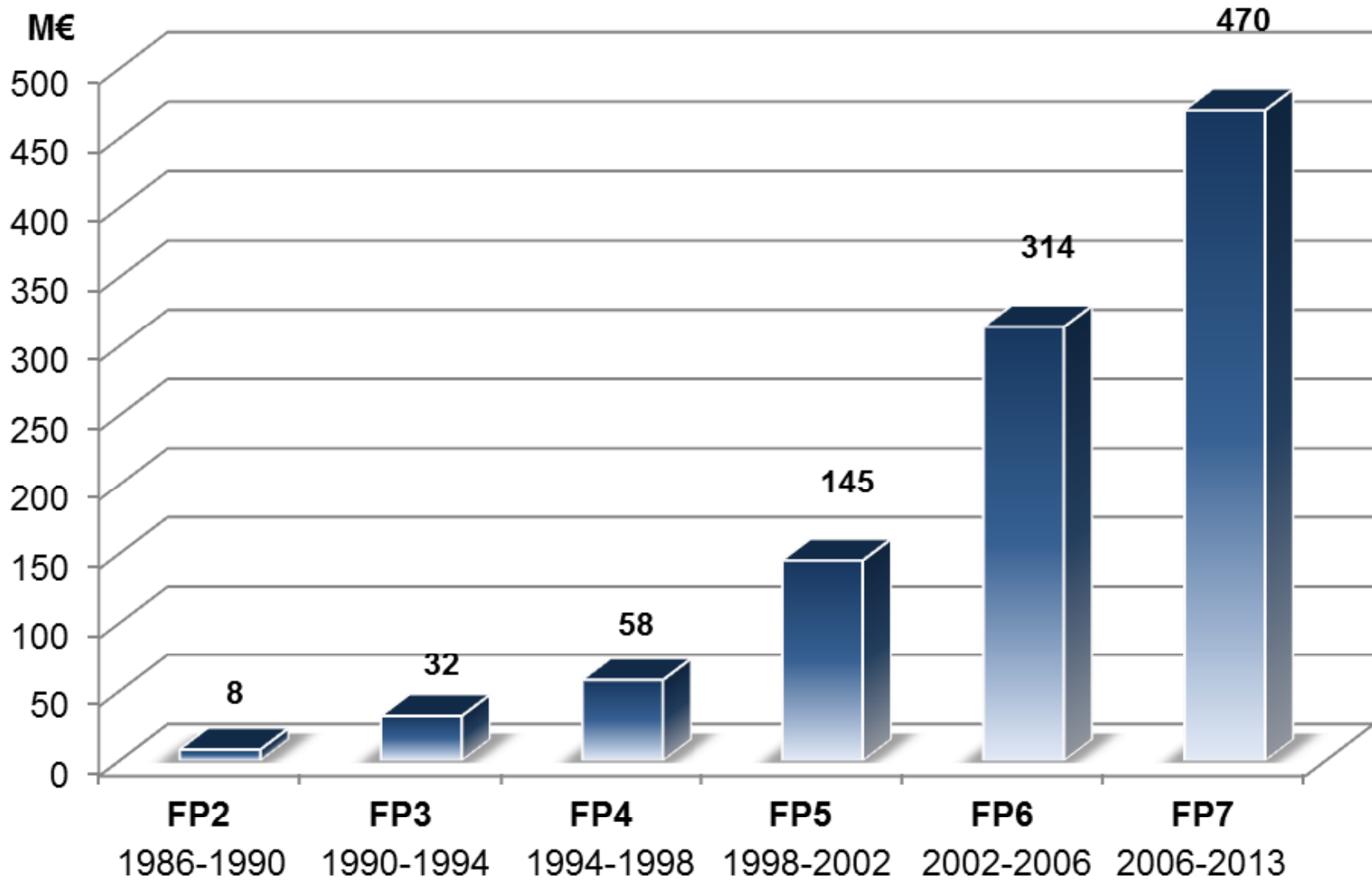


Total funding = 470 M€

- Transportation & Refuelling Infrastructure
- H2 production & Distribution
- Stationary Power Generation & CHP
- Early Market
- Cross-cutting Issues

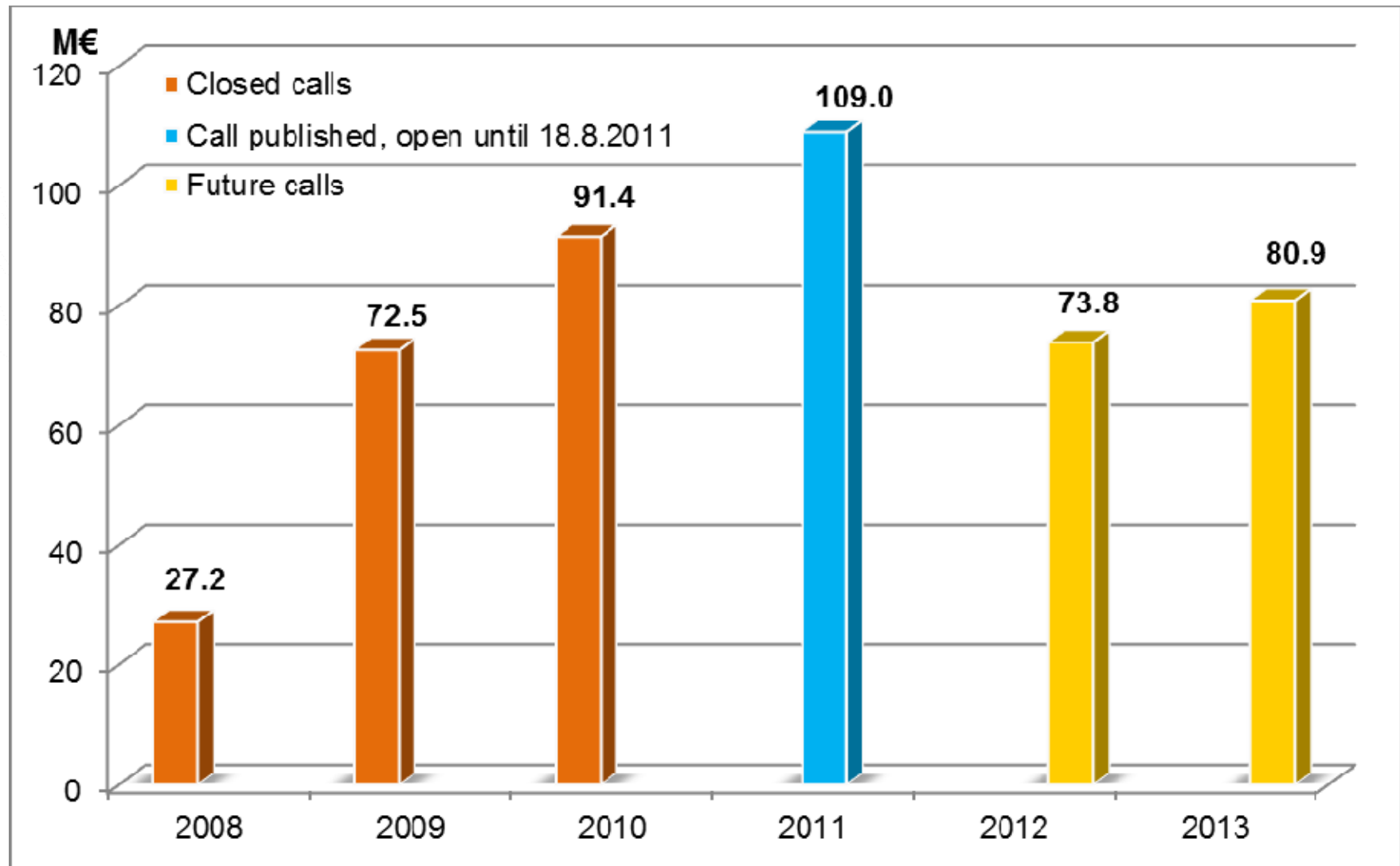
Source: "Multi-Annual Implementation Plan 2008-2013" (http://ec.europa.eu/research/fch/pdf/fch_ju_multi_annual_implementation_plan.pdf)

Fuel cell and hydrogen budget: history FP2-FP7



Sources: "European Fuel Cell and Hydrogen Projects 2002-2006", (ftp://ftp.cordis.europa.eu/pub/fp7/energy/docs/hydrogen_synopses_en.pdf)
"Multi-Annual Implementation Plan 2008-2013" (http://ec.europa.eu/research/fch/pdf/fch_ju_multi_annual_implementation_plan.pdf)

Indicative budget for each annual call for proposal (2008-2013)



Sources: “Multi-Annual Implementation Plan 2008-2013” (http://ec.europa.eu/research/fch/pdf/fch_ju_multi_annual_implementation_plan.pdf)
“Public information session on FCH JU 2011 call for proposal”, Brussels, Belgium, 12 May 2011,, (http://www.fch-ju.eu/sites/default/files/Presentation%20FCH%20JU%20for%20public%20session%20on%202011%20call.%2012052011_0.pdf)

Call 2008: Overview

- ❑ **Date of publication:** 8th October 2008
- ❑ **Deadline:** 15th January 2009
- ❑ **Indicative budget:** **28.1 M€** from the FCH JU 2008 budget
- ❑ **Budget breakdown:**
 - Transportation & refueling (8.9 M€)
 - Hydrogen production & distribution (2.9 M€)
 - Stationary power generation & CHP (12.0 M€)
 - Early markets (2.6 M€)
 - Cross-cutting issues (1.7 M€)
- ❑ Totally 32 proposals were submitted involving 243 partners
- ❑ Only 18 proposals went through negotiation. **16 projects awarded funds**

Call 2008: Projects awarded funds

Transportation and refueling infrastructure

- H2 moves Scandinavia (**Demonstration of H2 fuelled road vehicles and refueling infrastructure**), 19.48 M€, 7 partners
- NextHyLights (**Preparation for large scale vehicle demonstrations in Europe**), 1.14 M€, 12 partners
- Auto-Stack (**European fuel cell stack cluster**), 2.87 M€, 14 partners

Hydrogen production & distribution

- NEXPEL (**Efficient PEM electrolyser**), 3.35 M€, 7 partners
- PrimoLyzer (**Efficient PEM electrolyser**), 2.63 M€, 6 partners
- Hydrosol-3D (**Water decomposition control for stationary applications**), 1.79 M€, 5 partners

Stationary power generation and CHP

- GENIUS (**Operation diagnostics and control for stationary applications**), 4.16 M€, 12 partners
- ASSENT (**Component and system improvement for stationary applications**), 4.85 M€, 6 partners

- DEMMEA (**Degradation mechanisms of HTPEM**), 3.10 M€, 8 partners
- KEEPEMALIVE (**Endurance of PEM fuel cells by accelerated lifetime verification experiments**), 2.87 M€, 9 partners
- LOLIPEM (**Degradation and lifetime fundamentals**), 2.93 M€, 8 partners
- MCFC-CONTEX (**MCFC catalyst and stack component degradation and lifetime**), 4.43 M€, 8 partners

- ROBANODE (**Anode degradation in hydrogen and natural gas fuelled SOFCs**), 3.39 M€, 8 partners

Early markets

- IRAFC (**Development of an internal reforming alcohol high temperature PEM fuel cell**), 2.53 M€, 6 partners
- ISH2SUP (**Fuel supply technology for portable and micro fuel cells**), 1.68 M€, 4 partners

Cross cutting issues

- Prepar-H2 (**Planning of socio-economic activities**), 0.56 M€, 5 partners

Call 2009: Overview

- ❑ **Date of publication:** 2nd July 2009
- ❑ **Deadline:** 15th October 2009
- ❑ **Indicative budget:** **71.3 M€** from the FCH JU 2009 budget
- ❑ **Budget breakdown:**
 - Transportation & refueling (26.4 M€)
 - Hydrogen production & distribution (5.7 M€)
 - Stationary power generation & CHP (25.9 M€)
 - Early markets (10.3 M€)
 - Cross-cutting issues (3.0 M€)
- ❑ Totally 50 proposals were submitted involving 395 partners
- ❑ Only 31 proposals went through negotiation. **28 projects awarded funds**

Call 2009: Projects awarded funds (I)

Transportation and refueling infrastructure

- CHIC (**Clean hydrogen in European cities**), 81.92 M€, 26 partners
- HyQ (**Hydrogen fuel quality requirements for transportation and other energy applications**), 3.72 M€, 15 partners
- HYCOMP (**Enhanced design requirements and testing procedures for composite cylinders intended for the safe storage of hydrogen**), 3.80 M€, 12 partners
- PEMICAN (**PEM with innovative low cost core for automotive applications**), 3.96 M€, 6 partners

Hydrogen production & distribution

- ADEL (**Advanced electrolyzer for hydrogen production with renewable energy sources**), 4.16 M€, 13 partners
- SSH2S (**Fuel cell coupled solid state hydrogen storage tank**), 3.50 M€, 8 partners

Stationary power generation and CHP

- ASTERIX3 (**Assessment of SOFC CHP systems build on the technology for htceRamIX3**), 3.10 M€, 4 partners

- CATION (**Cathode subsystem development and optimization**), 7.19 M€, 6 partners
- D-CODE (**DC/DC converter-based diagnostics for PEM systems**), 2.22 M€, 7 partners
- DESIGN (**Degradation signatures identification for stack operation diagnostics**), 3.27 M€, 8 partners
- FC-EUROGRID, (**Evaluating the performance of fuel cells in European energy supply grids**), 0.83 M€, 8 partners
- LOTUS (**Low temperature SOFC s for micro fuel cell applications**), 2.95 M€, 6 partners
- MAESTRO (**Membranes for stationary application with robust mechanical properties**), 2.26 M€, 5 partners
- NH34PWR, (**Ammonia based, fuel cell power for off-grid cell phone towers**), 8.20 M€, 6 partners
- RAMSES (**Robust advanced materials for metal supported SOFC**), 4.70 M€, 10 partners
- PREMIUM ACT (**Predictive modeling for innovative unit management and accelerated testing procedures of PEFC**), 5.37 M€, 7 partners

Call 2009: Projects awarded funds (II)

- ❑ SCOTAS-SOFC (**Sulphur, carbon, and re-oxidation tolerant anodes and anode supports for solid oxide fuel cells**) , 4.37 M€, 5 partners
- ❑ SOFC-LIFE (**SOFCs Integrating degradation effects into lifetime prediction models**), 5.65 M€, 13 partners
- ❑ STAYERS (**Stationary PEM fuel cells with lifetime beyond five years**), 4.31 M€, 5 partners

Early markets

- ❑ HYLIFT-DEMO (**European demonstration on powered fuel cell forklifts**), 7.08 M€, 9 partners
- ❑ FITUP (**Fuel cell field test demonstration of economic and environmental viability for portable generators, backup and UPS power system applications**), 5.39 M€, 11 partners
- ❑ MOBYPOST (**Mobility with hydrogen for postal delivery**), 8.21 M€, 9 partners
- ❑ SHEL (**Sustainable hydrogen evaluation in logistics**), 4.65 M€, 13 partners

Cross cutting issues

- ❑ H2FC-LCA (**Development of guidance manual for LCA application to fuel cells and hydrogen**) , 0.39 M€, 6 partners
- ❑ HYFACTS (**Identification, preparation and dissemination of hydrogen safety facts to regulators and public safety officials**), 1.40 M€, 6 partners
- ❑ HyGuide, 0.52 M€, 5 partners
- ❑ HYPROFESSIONALS (**Development of educational programs and training initiatives related to hydrogen technologies and fuel cells in Europe**), 0.43 M€, 9 partners
- ❑ TRAINHY-PROF (**Building training programs for young professionals in the hydrogen and fuel cell field**), 0.35 M€, 4 partners

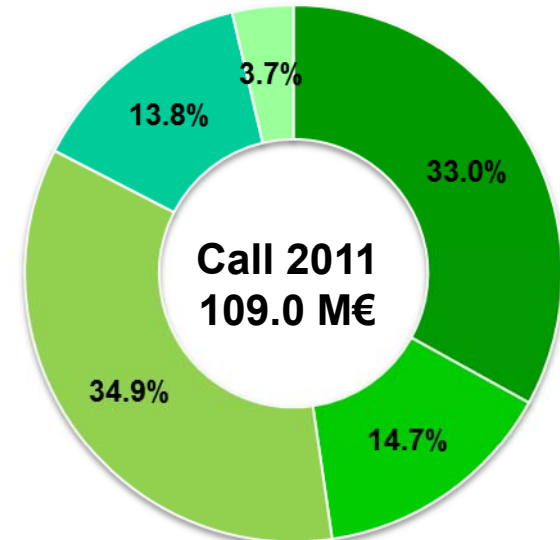
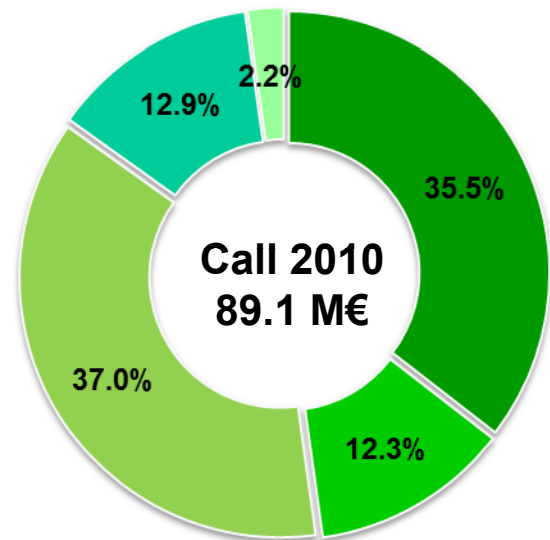
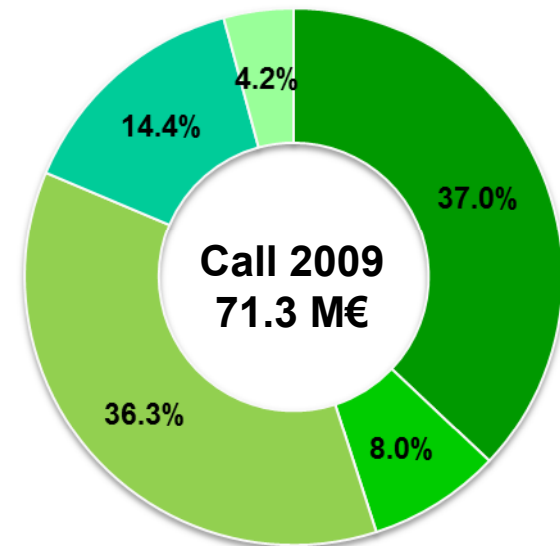
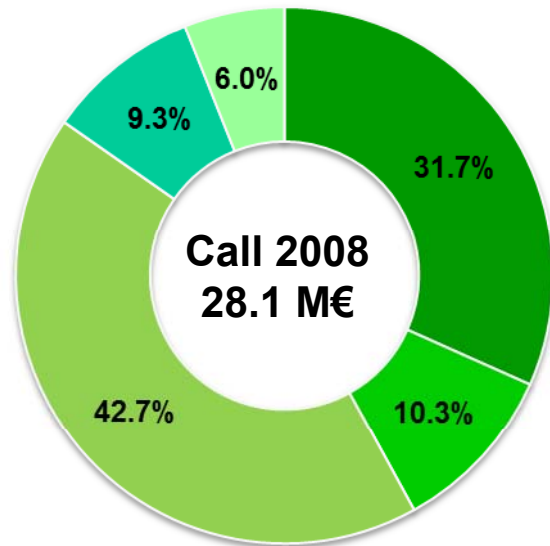
Call 2010: Overview

- ❑ **Date of publication:** 18th June 2010
- ❑ **Deadline:** 13th October 2010
- ❑ **Indicative budget:** **89.1 M€** from the FCH JU 2010 budget
- ❑ **Budget breakdown:**
 - Transportation & refueling (31.6 M€)
 - Hydrogen production & distribution (11.0 M€)
 - Stationary power generation & CHP (33.0 M€)
 - Early markets (11.5 M€)
 - Cross-cutting issues (2.0 M€)
- ❑ Totally 71 proposals were submitted involving 559 partners
- ❑ Only 69 proposals are in the negotiation phase (Q2-Q3 2011)
- ❑ The grant agreements are expected to be signed at the end of Q3 2011

Call 2011: Overview

- **Date of publication:** 3rd May 2011
- **Deadline:** 18th August 2011
- **Indicative budget:** **109.0 M€** from the FCH JU 2011 budget
- **Budget breakdown:**
 - Transportation & refueling (36.0 M€)
 - Hydrogen production & distribution (16.0 M€)
 - Stationary power generation & CHP (38.0 M€)
 - Early markets (15.0 M€)
 - Cross-cutting issues (4.0 M€)
- Evaluation of proposals is expected to be carried out in Sept. 2011
- The invitation letter to the successful coordinators to launch the grant agreement negotiations with the FCH JU is expected to be sent in Jan. 2012
- From May 2012 the signatures of the first FCH JU grant agreements are estimated to be done

Summary of the calls 2008-2011



- Transportation & Refuelling Infrastructure
- H2 production & Distribution
- Stationary Power Generation & CHP
- Early Market
- Cross-cutting Issues

Sources:

- http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.FP7DetailsCallPage&call_id=172
- http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.FP7DetailsCallPage&call_id=225
- http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.FP7DetailsCallPage&call_id=309
- http://cordis.europa.eu/fp7/dc/index.cfm?fuseaction=UserSite.CooperationDetailsCallPage&call_id=401

Call 2011: Annual Implementation Plan (I)

Transportation and refueling infrastructure (36.0 M€*)

- ❑ Large-scale demonstration of road vehicles and refueling infrastructure
- ❑ In-situ characterization and diagnostic techniques for optimization of water management and state of health determination of PEMFC
- ❑ Improvement of PEMFC performance and durability through multi-scale modeling and numerical simulation
- ❑ Periphery FC-system components (BoP for PEMFC in transportation applications)
- ❑ MEAs for transportation applications
- ❑ Investigation on degradation phenomena
- ❑ R&D on bipolar plates
- ❑ R&D of 700bar refueling concepts and technologies
- ❑ FC systems for airborne applications
- ❑ PNR on fast refueling

Hydrogen production & distribution (16.0 M€*)

- ❑ Demonstration of a MW capacity hydrogen production and storage for balancing the grid and supply to a hydrogen refueling station
- ❑ Demonstration of a hydrogen production from biogas for supply to a hydrogen refueling station
- ❑ Biomass-to-hydrogen thermal conversion process
- ❑ Novel hydrogen storage materials for stationary and portable applications
- ❑ New generation of high temperature electrolyzers
- ❑ Low temperature hydrogen production processes
- ❑ Innovative materials and components for PEM electrolyzers
- ❑ PNR on design and testing requirements for metallic components exposed to hydrogen enhanced fatigue
- ❑ Measurement of the quantity of hydrogen delivered to a vehicle

*only EU funding contribution

Call 2011: Annual Implementation Plan (II)

Stationary power generation & CHP (38.0 M€*)

- ❑ Next generation stack and cell design
- ❑ Advanced control for stationary power applications
- ❑ Component improvement for stationary power generation
- ❑ Proof-of-concept fuel cell system for any stationary application
- ❑ Validation of integrated fuel cell system readiness
- ❑ Field demonstration of large stationary fuel cell systems for distributed generation and other relevant commercial or industrial applications
- ❑ Field demonstration of small stationary fuel cell systems for residential and commercial applications
- ❑ PNR on power grid integration and management of fuel cells for small residential, commercial, industrial applications

Early markets (15.0 M€*)

- ❑ Demonstration of fuel cell-powered materials handling equipment vehicles including infrastructure
- ❑ Demonstration of application readiness of BUP and UPSs
- ❑ R&D of 1-10 kW fuel cell systems and hydrogen supply for early market applications
- ❑ R&D and demonstration of new portable fuel cell systems
- ❑ R&D for BoP items for small portable and other fuel cell devices

Cross cutting activities (4.0 M€*)

- ❑ Assessment of benefits of hydrogen for energy storage and integration in energy markets
- ❑ Study of financing options to accelerate commercialization of hydrogen and fuel cell technologies
- ❑ First responder educational and practical hydrogen safety training
- ❑ Development of EU-wide uniform performance test schemes for PEMFC stacks

*only EU funding contribution

EU Community funds in H2&FC research activities inside the FPs

	Targets 2015	
Application area	Volume	Cost & Technology
Transport & Refueling Infrastructure	<p>~500 Light Duty Vehicles (mainly cars) at 3 additional sites with 3 new stations</p> <p>~500 buses at 10 EU sites (of which at least 7 new ones) with refueling stations (daily refueling capacity >400kg)</p>	<p>System cost of approx. 100 €/kW</p> <p>Durability in car propulsion systems 5,000h</p> <p>Roadmap for the establishment of a commercial EU hydrogen refueling infrastructure</p>
Hydrogen Production & Distribution	<p>Hydrogen supply chain (including fuel purity) to match transport, stationary and early markets requirements. By 2015 10-20% of general hydrogen demand should be produced via carbon free/carbon clean processes</p>	<p>Cost of H2 delivered at refueling station <5 €/kg (0.15 €/kWh)</p> <p>Improved system density for H2 storage (9%wt of H2)</p>
Stationary Power & CHP	<p>~100 MW installed electric capacity</p>	<p>Cost of 4,000-5,000 €/kW for micro CHP</p> <p>Cost of 1,500/2,500 €/kW for industrial/commercial units</p>
Early Markets	<p>14,000 new units in the EU-market:</p> <ul style="list-style-type: none"> ❖ 1,000 UPS/back-up power ❖ 500 industrial and off highway vehicles ❖ 12,000 /13,000 portable & micro FCs 	

Source: "Multi-Annual Implementation plan 2008-2013", (http://ec.europa.eu/research/fch/pdf/fch_ju_multi_annual_implementation_plan.pdf)

European hydrogen and fuel cell associations

- ❑ [Bulgarian Hydrogen Society \(BG H2\)](#)
- ❑ [Czech Hydrogen Technology Platform](#)
- ❑ [Danish Partnership for Hydrogen and Fuel Cells](#)
- ❑ [Dutch Hydrogen and Fuel Cell Association \(NWV\)](#)
- ❑ [European Association for Battery, Hybrid and Fuel Cell Electric Vehicles \(AVERE\)](#)
- ❑ [European Hydrogen Association \(EHA\)](#)
- ❑ [European research community on fuel cells and hydrogen \(N.ERGHY\)](#)
- ❑ [Flemish Hydrogen and Fuel Cell Association \(VSWB\)](#)
- ❑ [French Hydrogen Association \(AFH2\)](#)
- ❑ [Fuel Cell Europe](#)
- ❑ [Fuel Cells UK Industry Association \(UKHFCA\)](#)
- ❑ [German Hydrogen and Fuel Cell Association \(DWV\)](#)
- ❑ [Hydrogen Region Rhineland \(HyCologne\)](#)
- ❑ [Hydrogen Sweden](#)
- ❑ [Italian Hydrogen and Fuel Cell Association \(H2IT\)](#)
- ❑ [Latvian Hydrogen Association](#)
- ❑ [Nationale Organisation Wasserstoff-und Brennstoffzellentechnologie \(NOW\)](#)
- ❑ [Norwegian Hydrogen Forum \(NHF\)](#)
- ❑ [Polish Hydrogen Association \(PSH2\)](#)
- ❑ [Portuguese Hydrogen Associations \(AP2H2\)](#)
- ❑ [Scottish Hydrogen and Fuel Cell Association \(SHFCA\)](#)
- ❑ [Spanish Hydrogen Association \(AEH2\)](#)
- ❑ [Swiss Hydrogen Association](#)
- ❑ [The Ruhr H2 Network](#)
- ❑ [United Kingdom Association \(UKHA\)](#)

25 hydrogen and fuel cell associations

**Work performed under the NICOP grant titled
“Energy Research Survey and Collaborations”
awarded by the Office of Naval Research Global, UK**

List of the European research activities in the MAIP 2008-2013

- ❖ Road vehicle large scale demonstration including refueling infrastructure
- ❖ European fuel cell stack including concerted action
- ❖ Storage compressed gaseous hydrogen
- ❖ Periphery-air supply module
- ❖ New catalysts and membrane electrode assemblies (MEAs)
- ❖ New membranes for higher temperatures
- ❖ Investigation of degradation phenomena
- ❖ New bipolar plates
- ❖ Components for hydrogen refueling stations
- ❖ Fuel cell systems for hydrogen fuelled airborne platforms
- ❖ Storage cryogenic hydrogen
- ❖ Rail propulsion
- ❖ Periphery hydrogen tank system & conditioning components
- ❖ Auxiliary power unit (APU) for rail and maritime application
- ❖ Hydrogen internal combustion engine (ICE)
- ❖ PNR on composite storage
- ❖ PNR on fuel quality
- ❖ Support activities - PNR on: fast refueling; vehicle safety; crash tests; hydrogen vehicles in confined spaces

**Transportation & Refuelling
Infrastructure (32-36%)**

List of the European research activities in the MAIP 2008-2013

- ❖ Low-cost, low-temperature, high-efficiency electrolyzer
- ❖ Fuel processing catalysts, modules & systems
- ❖ Gas purification technology
- ❖ Biomass-to-hydrogen (BTH) thermal conversion process
- ❖ New generation of high temperature electrolyzer
- ❖ High temperature thermo-electrical-chemical processes for water decomposition
- ❖ Underground hydrogen storage
- ❖ Low-temperature hydrogen production processes
- ❖ Solid and liquid hydrogen storage
- ❖ Large-scale hydrogen liquefaction
- ❖ Hydrogen pipeline field test & safety analysis
- ❖ Support activity: PNR & RCS

**H2 Production &
Distribution (10-12%)**

Source: "Priority Research, Technological Development and Demonstration Topics 2008-2013", , http://www.fch-ju.eu/sites/default/files/documents/priority_research_technological_development_and_demonstration_topics_2008-2013.pdf

List of the European research activities in the MAIP 2008-2013

- ❖ Degradation & lifetime fundamentals
- ❖ Material development for cells, stacks and balance of plant (BoP)
- ❖ Next generation stack and cell designs
- ❖ Controls, modeling, diagnostics
- ❖ Improvement of components and their interaction
- ❖ System proof of concept
- ❖ Validation of integrated system readiness
- ❖ Market capacity build and field demonstration
- ❖ Development of application targets and technology benchmark
- ❖ Support activities:
 - ❖ PNR on hydrogen devices for residential CHP
 - ❖ PNR on industrial hydrogen systems

**Stationary Power
Generation & CHP
(34-37%)**

Source: "Priority Research, Technological Development and Demonstration Topics 2008-2013", , http://www.fch-ju.eu/sites/default/files/documents/priority_research_technological_development_and_demonstration_topics_2008-2013.pdf

List of the European research activities in the MAIP 2008-2013

- ❖ Demonstration of off-highway vehicles including refueling infrastructure
- ❖ Demonstration of portable generators, back-up and UPS power systems
- ❖ Fuel supply concepts for portable and micro fuel cells
- ❖ Durability of micro fuel cells under typical operating conditions
- ❖ Demonstration of portable and micro fuel cells for various applications
- ❖ Miniaturized BoP for special devices
- ❖ Demonstrate application readiness of stationary fuel cells
- ❖ Manufacturing, assembly and testing for micro fuel cells
- ❖ Feasibility of a small power system platform
- ❖ Support activities:
 - ❖ PNR and RCS in-door use of fuel cells
 - ❖ Small and medium size enterprise (SME) promotion

**Early Market
(12-14%)**

Source: "Priority Research, Technological Development and Demonstration Topics 2008-2013", , http://www.fch-ju.eu/sites/default/files/documents/priority_research_technological_development_and_demonstration_topics_2008-2013.pdf

List of the European research activities in the MAIP 2008-2013

- ❖ Socio-economic planning phase 1: data & result consolidation
- ❖ Socio economic planning phase 2: pathways and impact
- ❖ Technology monitoring assessment - framework and development action
- ❖ Technology monitoring assessment – execution
- ❖ Sustainability assessment software
- ❖ Impact assessment of hydrogen based economy
- ❖ SME promotion: outreach program & presentation platform
- ❖ Educational action with other programs
- ❖ Educational action for specific target groups
- ❖ Public awareness
- ❖ Assessment of financial instruments
- ❖ Recycling technologies
- ❖ International socio-economic and policy evaluation
- ❖ SME production: supply chain
- ❖ Other activities

**Cross-cutting issue
(6-8%)**

Source: “Priority Research, Technological Development and Demonstration Topics 2008-2013”, , http://www.fch-ju.eu/sites/default/files/documents/priority_research_technological_development_and_demonstration_topics_2008-2013.pdf