Fuel Cells and Hydrogen Joint Undertaking (FCH JU)

ANNUAL IMPLEMENTATION PLAN 2012

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1. Introduction: mission, objectives and challenges

This document establishes the fifth Annual Implementation Plan (AIP) of the Fuel Cell and Hydrogen Joint Undertaking (FCH JU), outlining the scope and details of its operational and horizontal activities for the year 2012, with a focus on research activities prioritised for the fifth Call for proposals, together with supportive actions required. It also describes the objectives of the FCH JU, the policy and global context, assessment criteria, technical targets and rationale for individual activities.

The challenge facing fuel cells and hydrogen technologies is of great complexity, requiring substantial investments and a high level of scientific, technological and industrial expertise. At the same time, their potential contribution to Union policies - in particular energy, climate change, environment, transport and industrial competitiveness – is very important.

The European Strategic Energy Technology (SET) Plan has identified fuel cells and hydrogen among the technologies needed for Europe to achieve the targets for 2020 - 20% reduction in greenhouse gas emissions; 20% share of renewable energy sources in the energy mix; and 20% reduction in primary energy use – as well as to achieve the long-term vision for 2050[1] towards decarbonisation. This is in line with the Commission's Communication, "Energy for a Changing World – An Energy Policy for Europe"[2], the goals of the Lisbon Strategy and the European Council's Conclusion on a European Energy Strategy for Transport, 29 May 2007.

To implement these priorities and bring clean energy technologies to the market, a key element of the SET Plan's implementation strategy is to combine resources with the private sector, allowing industry to take the lead in identifying technology gaps that need to be addressed. The cooperation is structured through public-private partnerships, the European Industrial Initiatives. Among the first such initiatives, the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) was established by a Council Regulation of 30 May 2008[3] as a long-term public–private-partnership under the Seventh Framework Programme (FP7) of the European Union.

The FCH JU pools public and private resources, with activities co-financed by the Commission and the industry and research community partners. The founding members: the Union, represented by the European Commission, and the *European Industry Grouping for a Fuel Cell and Hydrogen Joint Undertaking* (hereinafter referred to as "the NEW-IG"), share the running costs of the JU, with an additional contribution from the third member, *the New European Research Grouping on Fuel Cells and Hydrogen*, N.ERGHY (hereinafter referred to as "the RG").The planning of the agenda for research, technological development and

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[1] COM(2007) 723 final
[2] COM(2007) 1 final
[3] Council Regulation (EC) No 521/2008 of 30 May 2008 setting up the Fuel Cells and Hydrogen Joint Undertaking for the implementation of the Joint Technology Initiative on Fuel Cells and Hydrogen, OJ L 153/1, 12.6.2008, p.1.

demonstration (RTD) is led by industry to ensure that it is focused at the objective of commercialisation.

The FCH JU's first call for proposals, with indicative Union funding of €28.1M[4], was finalised in December 2009 with the conclusion of contracts with 16 project consortia[5]. The second call, with an indicative Union funding of €71.3M[6], finalised in December 2010 with the conclusion of contracts with 28 project consortia. The third call, with an indicative Union funding of 89.1M€[7], entered the negotiation stage in March 2011. The fourth call, with an indicative Union funding of 109M€, was closed on 18 August 2011.

The current AIP outlines the FCH JU's work plan for 2012, in line with the programme priorities set out in the Multi-Annual Implementation Plan (MAIP) adopted by the Governing Board on 22 November 2011[8]. In particular, the AIP establishes the list of topics and detailed topic descriptions for the Call for Proposals to be published in 2012.

The FCH JU was granted autonomy on 15 November 2010 and consequently 2012 will be its second full year of operations as an autonomous entity.

The second risk management exercise carried out in November 2011 identified one critical risk, namely the potential impact on the quality of work of the shortage of staff resources compared to the workload (number of projects to manage). To address this risk the following actions will be pursued (1) the use of all possible resources – including trainees and interim staff where adequate and a close monitoring of resources aiming at ensuring a sustainable workload and (2) negotiation with FCH JU stakeholders on increase in resources notably in the context of "post FP7".

It should be noted the need to increase staff for project management was also identified in the Interim Evaluation report. In 2012, the FCH JU will also follow-up on the recommendations of the evaluators and implement actions as relevant.

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[4] €28,771,590 including European Free Trade Area (EFTA) contributions 2.4% from countries associated to the 7th Framework Programme.

[5] For details of the projects funded in the first call, please see http://www.fch-ju.eu/page/projects

[6] €72,970,240 including European Free Trade Area (EFTA) contributions 2.4% from countries associated to the 7th Framework Programme.

[7] The funding includes the FCH JU's own budget only. The final total funding for projects is expected to be increased by European Free Trade Area (EFTA) contributions from countries associated to the 7th Framework Programme of up to 2.38%.

[8] The Multi-Annual Implementation Plan can be consulted at http://www.fch-ju.eu/page/documents

2. FCH JU Governance

The FCH JU is composed of two executive bodies: the Governing Board and the Executive Director. In addition there are three advisory bodies, the Scientific Committee, the FCH States Representatives Group and the Stakeholders' General Assembly.

2.1 Governing Board

The Governing Board shall have the overall responsibility for the operations of the FCH JU and shall oversee the implementation of its activities in accordance with Article 5 of the Statutes. The NEW-IG has 6 seats, the EC 5 seats and the RG 1 seat respectively.

The Governing Board is planning to hold three Board meetings during 2012. The key activities are listed below:

Key activities in 2012 - timetable	
Adopt the lists to start negotiations for call 2012, including reserve lists, lists of proposals which failed thresholds and ineligible proposals	Q1
Adopt MSPP 2013-15	Q1
Adopt the AAR 2011	Q1
Adopt the 3rd batch of Implementing Rules regarding Staff Regulation	Q1
Adopt the call for proposals 2012	Q2
Approve the final account 2011	Q2-3
Approve the 2013 budget	Q4
Adopt the AIP 2013	Q4

2.2 Executive Director and the Programme Office

The Executive Director is the legal representative of the FCH JU, and the chief executive for the day-to-day management in accordance with the decisions of the Governing Board in line with Article 6 of the Statutes.

Mr. Bert De Colvenaer, following the GB decision taken on 15 June 2010, was appointed Executive Director and took up duty in September 2010.

He is assisted by the Programme Office, which is composed of 20 full time employees (temporary and contract agents).

The activities of the Programme Office include the implementation of all the decisions and activities decided by the Governing Board and support of the advisory bodies described in this chapter and the day-to-day execution of the FCH JU programme as described in Chapters 4 and 5 below.

The Programme Office could also facilitate and maintain institutional relations at EU level for monitoring EU legislative activities and policy orientations with a view to promote FCH-JU and its activities.

2.3 Scientific Committee

The Scientific Committee is an advisory body to the Governing Board. It shall conduct its activities in close liaison and with the support of the Programme Office.

The members shall reflect a balanced representation of world class expertise from academia, industry and regulatory bodies. Collectively, the Scientific Committee members shall have the scientific competencies and expertise covering the complete technical domain needed to make strategic science-based recommendations regarding the FCH JU. It shall have a maximum of 9 members.

According to Article 8 in the FCH JU Statutes the role of the Scientific Committee is to:

(a) advise on the scientific priorities for the Annual and Multiannual Implementation Plans proposal;

(b) advise on the scientific achievements described in the Annual Activity Report;

(c) advise on the composition of the peer review committees.

Nine members were appointed to the Scientific Committee in the first half of 2009[9]. There have been no changes to the membership since these appointments.

The Scientific Committee will hold two to three meetings in 2012. Its main activities will be:

Key activities in 2012 - timetable	
Provide input on the scientific priorities of the AIP 2013	Q3-4

2.4 FCH States Representatives Group

The FCH States Representatives Group (SRG) shall consist of one representative of each Member State and of each country associated to the 7th Framework programme.

According to Article 9 in the Statutes the SRG shall have an advisory role to the JU and shall act as an interface between the JU and the relevant stakeholders within the respective countries. It shall in particular review information and provide opinions on the following issues:

[9] For the list of members, see http://www.fch-ju.eu/page/scientific-committee

(a) programme progress in the FCH JU;

(b) compliance and respect of targets;

(c) updating of strategic orientation;

(d) links to Framework Programme Collaborative Research;

(e) planning and outcome of calls for proposals and tenders;

(f) involvement of SMEs.

It shall also provide input to the JU on the following:

(a) status of and interface to JU activities of relevant national research programmes and identification of potential areas of cooperation;

(b) specific measures taken at national level with regard to dissemination events, dedicated technical workshops and communication activities.

The FCH States Representatives Group may issue, on its own initiative, recommendations to the FCH JU on technical, managerial and financial matters, in particular when these affect national interests. The FCH JU shall inform the FCH States Representatives Group of the follow up it has given to such recommendations.

The States Representatives Group will hold two to three meetings in 2012. Its main activities will be:

Key activities in 2012 - timetable	
Dissemination and communication actions at national level	*Q1-4*
Feedback on Stakeholders General Assembly 2011	*Q1*
Input for the SGA 2012	*Q2-3*
Consultation of the SRG on the topics for the Call for Proposals 2013	Q3-4

2.5 Stakeholders' General Assembly

The Stakeholders' General Assembly (SGA) shall have an advisory role to the FCH JU. It shall be open to all public and private stakeholders, international interest groups from Member States, Associated Countries as well as from Third Countries.

The Stakeholders' General Assembly shall be informed of the activities of the FCH JU and shall be invited to provide comments.

The Stakeholders' General Assembly is an important communication channel to ensure transparency and openness of the RTD activities with its stakeholders. It shall be convened once a year.

The 5th Stakeholders' General Assembly is scheduled to take place in November 2012. The discussion where the SGA should be held (Brussels or other Member State Capital) is still open. The emphasis of the agenda is foreseen to be on policy and market strategies for the commercialisation of fuel cell and hydrogen technologies.

Key activities in 2012 - timetable	
The 5th SGA meeting November 2012	Q4

3. Operational Activities: Objectives and Indicators

3.1 Strategic Objectives

In carrying out a programme of RTD activities in the field of hydrogen and fuel cells, the following constitute the main objectives of the FCH JU:

- Aim at placing Europe at the forefront of fuel cell and hydrogen technologies worldwide and enabling the market breakthrough of fuel cell and hydrogen technologies, thereby allowing commercial market forces to drive the substantial potential public benefits;
- Support RTD in the Member States and countries associated with the Seventh Framework Programme in a coordinated manner in order to avoid market failure, focus on developing market applications and facilitate additional industrial efforts towards a rapid development of fuel cell and hydrogen technologies;
- Support the implementation of the RTD priorities of the Multi-Annual Implementation Plan of the FCH JU, notably by awarding grants following competitive calls for proposals;
- Undertake supporting actions where appropriate through calls to tender;
- Aim to encourage increased public and private RTD investment in fuel cells and hydrogen technologies in the Member States and Associated countries;
- Ensure the coordination and efficient management of funds. Management will be guided by the principles of transparency and openness, competitiveness and excellence, inclusiveness and close cooperation among stakeholders in order to achieve the best possible benefit for Europe. RTD activities will respect the fundamental and ethical principles applicable to the Seventh Framework Programme.

The more specific objectives for 2012 relate to ongoing and new projects funded by the FCH JU and are outlined in the following sections.

3.2 Projects from Previous Calls

A total of 16 contracts from the call 2008 were signed with project consortia. Of those, one project (NextHyLights) ended on December 31, 2010, and two others (Autostack and PreparH2) finished during the year 2011. The rest are ongoing, with most of them reaching the midterm point in June 2011. Several midterm reviews were conducted in Q3-Q4 2011.

A total of 28 contracts from the call 2009 were signed with project consortia. Two projects, HyGuide and H2FC-LCA, finished during 2011.

A total of 26 projects from the call 2010 were negotiated in Q2-Q4 2011. Grant Agreements resulting from the successful conclusions of negotiations are expected to be signed in Q4 2011.

The call 2011 was closed on 18 August 2011. A decision by the GB on lists of projects to start negotiations and reserve lists was made at its meeting of 22 November 2011.

A review day of the finished and running projects took place on 22 November 2011 in conjunction with the Stakeholders General Assembly. The presentations will allow a public assessment of the progress of the programme towards its objectives and will lead to the publication of a document summarising the conclusions of this review exercise. It is expected that this activity will also take place in the SGA 2012.

During the year 2012, several projects will complete reporting periods. Furthermore, a several midterm reviews are foreseen during the second half of 2012.

3.3 The 2012 Call for Proposals

The Annual Implementation Plan (AIP) is the result of a joint effort by the major stakeholders - namely the NEW-IG, the RG and the European Commission. It represents a set of prioritised actions, consistent with the long-term objectives of the FCH JU, which are implemented on an annual basis in order to facilitate the rapid deployment of fuel cell and hydrogen technologies, and to achieve the overall objectives of the FCH JU.

Within the framework of the available annual budget, the actions have been chosen based on their potential contribution to achieving Europe's policy objectives, i.e. the Commission's targets for greenhouse gas reductions, energy security and competitiveness. They include in a balanced way research, technological development, demonstration and cross-cutting activities, including Regulations, Codes & Standards (RCS).

The overall programme of the FCH JU is divided into four major horizontal application areas (AA): Transportation & Refuelling Infrastructure; Hydrogen Production, Storage & Distribution; Stationary Power Generation & CHP; and Early Markets. Cross-cutting activities have also been established as a fifth area in order to make their relevance more visible. The programme structure reflects the RTD cycle from long-term and breakthrough-oriented basic research to demonstration and support activities. Pre-normative research is also included at project level. The emphasis given to different action categories in different application areas reflects the industry and research partners' assessment of the state of technological maturity of the applications.

The main objectives and activities of the different AAs are laid out next.

3.3.1 Transportation & Refuelling Infrastructure

For the transportation applications of fuel cell and hydrogen technology, paving the way to market introduction of fuel cell vehicles is of highest priority as the reduction of energy consumption and greenhouse gas emissions expected from these vehicles is significantly higher than any other application of fuel cell and hydrogen technology in the transport sector. Thus, a significant part is the large-scale demonstration of FCEVs including the build-up of the necessary refuelling infrastructure. After four calls of the FCH-JU program, this application area is close to the foreseen shares between demonstration projects and R&D-projects. To reflect recent technological advancements and promising progress in certain areas, the focus for some topics descriptions have been shifted correspondingly. Along with assessment of the project portfolio and topic coverage after four calls (2008-2011), this years' topics includes a sound set of activities well balanced between demonstration and R&D, focusing on solving the main challenges for this application area.

Large scale demonstration of fuel cell technology for road vehicles and refuelling infrastructure is the pillar and an inherent part of this application area and will also be called this year. Although being farther from commercialisation (than that for vehicle propulsion), fuel cell systems as APUs for airborne applications is of high relevance to reduce GHG emissions, and is consequently included. To support these developments cost optimized, compact and efficient system components are required. Compressed hydrogen is the dominating storage form for transportation applications. Recent developments with potential for cost reduction have led to inclusion of novel (combined) storage concepts in this call.

Building on a series of European R&D projects on developing fuel cell components, such as membranes, catalysts and bipolar plates, this call opens for activities on establishment of a European fuel cell stack for automotive applications. Moreover, recent advances and promising results in lowering the catalyst loading further, justifies the inclusion of such activities, although a series of R&D projects on new cell materials are currently running.

Demonstration projects have revealed that accurate measurement of hydrogen quantity is still an issue, and that there is a need to develop new, approaches to measure the amount of hydrogen filled in the vehicles at the refuelling station accurately and reliably.

3.3.2 Hydrogen Production & Distribution

This application area aims to develop a portfolio of sustainable hydrogen production, storage and distribution processes which can meet an increasing share of the hydrogen demand for energy applications from carbon-free or lean energy sources. Special attention is given to the production of hydrogen from fluctuating electricity sources (Wind, PV), which is needed to enable the integration of the increasing share of RES in Europe. To achieve this, the various sustainable hydrogen production and supply chains must be demonstrated and ready for commercialisation by 2013.

The application area Hydrogen Production and Distribution will continue to strengthen the demonstration phase of pre-commercial technologies based on electricity or biogas as primary energy source. These demonstrations should provide an effective coupling to the hydrogen delivery infrastructure. Demonstration projects on renewable hydrogen production and large storage will pave the way for larger investments in synergy with vehicle fleet deployments.

R&D in innovative hydrogen production and supply chains from renewable energy sources are another priority topic for this application area, with the aim of having launched R&D proof-of-concept projects during the 2008-2013 timeframe for all production pathways identified as promising. Also R&D in solid state storage as well in innovative compression technologies are foreseen, again with the focus on proof-of-concept, given that support to more basic research in materials has been undergone in past calls.

A special effort is devoted in pre-normative research projects and Coordination and Support actions in topics of industrial interest such as enabling certified measurement of hydrogen delivery to vehicles, permitting processes of retail stations, gas transfer procedures for dispensers, or pipeline as well as tank safety issues.

For the purpose of facilitating the process of ranking lists, in case of equal scores of proposals during the evaluation, R&D projects should be favoured over demonstration projects.

3.3.3 Stationary Power Generation & Combined Heat and Power (CHP)

The objectives of this application area are designed to reflect the main needs of fuel cell technologies active in this area, principally PEMFC and SOFC, but along with others such as alkaline and molten carbonate fuel cells. Since the stationary application area includes different technologies which are at different stages of development, a diverse set of actions and targets is therefore required to address the range and cover the different RTD challenges which these technologies must overcome.

The programme aims to achieve the principal technical and economic requirements that will be needed if fuel cells are to compete with existing energy conversion technologies. These include high electrical efficiencies of 45%+ for power systems and of 80%+ for CHP systems, with lower emissions and use of non-fossil fuels. Focused efforts will be required to address lifetime requirements of 40,000 hours for fuel cell systems, and to meet commercial cost targets, which will vary according to the type of application.

Development activities are directed at improving stack and cell designs, achieving robust and reliable control mechanisms and developing components and sub-systems with improved performance, durability and cost for the relevant technologies, in order to achieve system application readiness.

Demonstration activities target proof-of-concept, technology validation or field demonstrations, depending upon technological maturity. Proof-of-concept activities will take place within in-house test facilities at a representative scale, validation activities either in-house or in the field in a representative environment, whilst field demonstrations will be required to be undertaken in a real operating environment with end-users.

Field demonstration activities are split into small (residential and commercial applications) and large (distributed generation or other industrial or commercial applications) scale.

Any validation proposal must show that proof-of-concept has been successfully undertaken, and any field demonstration proposal should show that both proof-of-concept and validation activities have been successfully completed.

3.3.4 Early Markets

This Application Area is aimed at exploring early market opportunities for fuel cell-based products while providing both public awareness and commercial success stories. Approaching that goal will include application specific developments as well as early product demonstrations and continuous improvement of production lines.

The sectors addressed are:

- *Transport:* mainly off-road transport with an emphasis on industrial and material handling vehicles (including their supporting fuelling infrastructure).
- *Stationary:* with an emphasis on Back-up Power (BUP) and Uninterruptible Power Systems (UPS) for telecommunications and other sectors (also including their supporting fuelling infrastructure)
- *Portable:* covering a wide range of possible products such as battery recharging (e.g. for industrial power tools); for emergency and remote power; and for recreational, educational, and personal portable power applications

The 2012 call will cover both demonstration activities to prepare for fuel cell systems market entry and R&D for enhancing systems to meet operational and cost requirements or to reduce the time to demonstration and deployment.

For the demonstration topics, the emphasis is on real-world demonstration and deployment of material handling and BUP or/and UPS products, with improved technology maturity and cost of ownership targets for these applications. These demonstrations are intended to attract additional industrial engagement and to shorten the gap for the market entry of specialized fuel cell products, deliver valuable experience and data from extended fleet operations, establish supporting infrastructure elements and increase customer awareness and user acceptance. The demonstration projects are intended to be at a scale to achieve cost reductions through economies of scale and thereby addressing cost barriers for future commercial deployment. Additional research and development efforts are necessary for 1-10 kW fuel cell systems, for new applications for portable systems and for the fuel supply for small portable systems to achieve focused technology improvements against operational and performance targets, and against future cost competitiveness objectives, and in order to reduce the time to demonstration deployment and market readiness.

To improve possibilities for small and medium sized companies (SME) to take on large scale demonstration efforts projects are called for that can develop new financing and project models and conduct the first test implementation hereof.

There is a general objective that public awareness and understanding of the technologies should be strengthened, especially as concerns code and standards and safety matters amongst early adopters. Recognition of these areas will be expected in all project proposals. The portable sector offers opportunities for greater public awareness (due to the broader outreach of the applications, compared to material handling and stationary installations) and will thus help pave the way for a widespread acceptance of the technology, with fuel cells becoming general consumer items.

3.3.5 Cross-cutting Activities

These activities will serve the objectives of the FCH JU in a variety of ways, in particular to ensure that non-technical barriers to the deployment of these technologies are properly addressed. For the call 2012, cross-cutting topics will emphasise hydrogen and fuel cell safety-related issues in different ways:

- Assessment of commercially available hydrogen safety sensors in terms of e.g. performance and cost-effectiveness for near-term applications. This study will benefit from international collaboration with the US DoE research programme.
- Development of a CFD model evaluation protocol for safety analysis of hydrogen and fuel cell technologies as well as pre-normative research on fire safety of pressure vessels in composite materials.
- Educational aspects, with the development of hydrogen safety training for first responders, considered critical for the successful introduction of market-ready products.
- Assessment of safety issues related to fuel cell and hydrogen applications

3.3.6 Collaboration with JRC

The Framework Agreement between the FCH JU and JRC[10] identifies a number of activities that JRC can provide to the FCH-JU, either upon request of a project consortium, or by the FCH-JU Programme Office. In the latter case, JRC involvement may be identified in the formulation of the call topic, or be called upon during the negotiation phase of an approved project.

3.3.7 List of topics

In line with the political and technical objectives outlined above, a total of 31 topics have been prioritised for the AIP 2012 and the fifth call for proposals of the FCH JU. The table below describes specific topics selected for the fifth call, together with their rationales. For a detailed description of the topics, see Section 3.5 of this document.

No.	Topic	Scope	Indicative FCH JU Funding Million €
Transportation & Refuelling Infrastructure			**26.0**
1	*Large-scale demonstration of road vehicles and refuelling infrastructure V*		
2	*Next Generation European Automotive Stack*		
3	*Compressed hydrogen onboard storage (CGH2)*		
4	*Development of peripheral components for automotive fuel cell systems*		
5	*New catalyst structures and concepts for automotive PEMFCs*		
6	*Fuel cell systems for airborne application*		

[10] The Framework Agreement is available at: http://www.fch-ju.eu/page/documents

No.	Topic	Scope	Indicative FCH JU Funding Million €
7	*Recommendations for the measurement of the quantity of hydrogen delivered and associated regulatory requirements*		
Hydrogen Production & Distribution			**8.75**
8	*Demonstration of MW capacity hydrogen production and storage for balancing the grid and supply to vehicle refuelling applications*		
9	*Demonstration of hydrogen production from biogas for supply to vehicle refuelling applications*		
10	*Biogas reforming*		
11	*New generation of high temperature electrolyser*		
12	*Thermo-electrical-chemical processes with solar heat sources*		
13	*Pre-normative research on gaseous hydrogen transfer*		
Stationary Power Generation & CHP			**27.0**
14	*Cell and stack degradation mechanisms and methods to achieve cost reduction and lifetime enhancements*		
15	*Improved cell and stack design and manufacturability for application specific requirements*		
16	*Robust, reliable and cost effective diagnostic and control systems design for stationary power and CHP fuel cell systems*		
17	*Component and sub-system cost and reliability improvement for critical path items in stationary power and CHP fuel cell systems*		

No.	Topic	Scope	Indicative FCH JU Funding Million €
18	*System level proof of concept for stationary power and CHP fuel cell systems at a representative scale*		
19	*Validation of integrated fuel cell system for stationary power and CHP fuel cell systems*		
20	*Field demonstration of large scale stationary power and CHP fuel cell systems*		
21	*Field demonstration of small scale stationary power and CHP fuel cell systems*		
Early Markets			**10.25**
22	*Demonstration of fuel cell powered material handling equipment vehicles including infrastructure*		
23	*Demonstration of portable generators, back-up power and Uninterruptible Power Systems*		
24	*Research and development on fuel supply concepts for micro fuel cell systems*		
25	*Demonstration of portable fuel cell systems for various applications*		
26	*Research and development of 1-10kW fuel cell systems and hydrogen supply for early market applications*		
Cross-cutting Issues			**5.5**
27	*Hydrogen safety sensors*		
28	*Computational Fluid Dynamics (CFD) model evaluation protocol for safety analysis of hydrogen and fuel cell technologies*		

No.	Topic	Scope	Indicative FCH JU Funding Million €
29	*First responder educational and practical hydrogen safety training*		
30	*Pre-normative research on fire safety of pressure vessels in composite materials*		
31	*Assessment of safety issues related to fuel cells and hydrogen applications*		
		Total indicative FCH JU Funding	**77.5**

3.4 Indicators

Indicator	Target	Results 2011
MS represented in the selected proposals	15	17
SME participation in call	15%	26%
Matching correction factor	≥ 67%	80%
Topic coverage by selected projects	60%	55%
Number of assessment studies (including tendered studies or in house studies)	1 in 2011	1 launched
Coverage of topics by proposals	> 90%	80%
Observers report	positive/good	Not available
Minimum score of projects selected	≥ 11.5	10
Number of projects that post a complaint	lower than 10%	4/82
Redress procedure (i.e. number of complaints which led to re-evaluation)	None	Not available

3.5 Calls for Proposals

3.5.1 Call fiche

Call title: FCH JU Call for Proposals 2012 Part 1

Call identifier: FCH-JU-2012-1

Publication date (to be confirmed): 17 January 2012

Indicative deadline (to be confirmed): 24 May 2012 at 17.00 (Brussels local time)

Indicative budget: EUR 77.5 million from the FCH JU 2012 budget[11].

The final budget awarded to this call, following the evaluation of projects, may vary by up to 10% of the total value of the call.

All budgetary figures given in this call are indicative. The repartition of the sub-budgets awarded within this call, following the evaluation of proposals, may vary by up to 10% of the total value of the call.

Topics called:

Area/ Topics called	Funding Schemes	Indicative FCH JU Funding Million €
Area SP1-JTI-FCH.1: Transportation & Refuelling Infrastructure		**26.0**
SP1-JTI-FCH.2012.1.1 Large-scale demonstration of road vehicles and refuelling infrastructure V	Collaborative Project	
SP1-JTI-FCH.2012.1.2 Next Generation European Automotive Stack	Collaborative Project	
SP1-JTI-FCH.2012.1.3 Compressed hydrogen on board storage (CGH2)	Collaborative Project	
SP1-JTI-FCH.2012.1.4 Development of peripheral components for automotive fuel cell systems	Collaborative Project	
SP1-JTI-FCH.2012.1.5 New catalyst structures and concepts for automotive PEMFCs	Collaborative Project	

[11] The funding includes the FCH JU's own budget only. The final total funding for projects is expected to be increased by EFTA contributions.

Area/ Topics called	Funding Schemes	Indicative FCH JU Funding Million €
SP1-JTI-FCH.2012.1. Fuel cell systems for airborne application	Collaborative Project	
SP1-JTI-FCH.2012.1.7 Recommendations for the measurement of the quantity of hydrogen delivered and associated regulatory requirements	Coordination and Support Actions (Supporting Action)	
Area SP1-JTI-FCH.2: Hydrogen Production & Distribution		**8.75**
SP1-JTI-FCH.2012.2.1 Demonstration of MW capacity hydrogen production and storage for balancing the grid and supply to vehicle refuelling applications	Collaborative Project	
SP1-JTI-FCH.2012.2.2 Demonstration of hydrogen production from biogas for supply to vehicle refuelling applications	Collaborative Project	
SP1-JTI-FCH.2012.2.3 Biogas reforming	Collaborative Project	
SP1-JTI-FCH.2012.2.4 New generation of high temperature electrolyser	Collaborative Project	
SP1-JTI-FCH.2012.2.5 Thermo-electrical-chemical processes with solar heat sources	Collaborative Project	
SP1-JTI-FCH.2012.2.6 Pre-normative research on gaseous hydrogen transfer	Collaborative Project	
Area SP1-JTI-FCH.3: Stationary Power Generation & CHP		**27.0**
SP1-JTI-FCH.2012.3.1 Cell and stack degradation mechanisms and methods to achieve cost reduction and lifetime enhancements	Collaborative Project	
SP1-JTI-FCH.2012.3.2 Improved cell and stack design and manufacturability for application specific requirements	Collaborative Project	
SP1-JTI-FCH.2012.3.3 Robust, reliable and cost effective diagnostic and control systems design for stationary power and CHP fuel cell systems	Collaborative Project	
SP1-JTI-FCH.2012.3.4 Component and sub-system cost and reliability improvement for critical path items in stationary power and CHP fuel cell systems	Collaborative Project	
SP1-JTI-FCH.2012.3.5 System level proof of concept for stationary power and CHP fuel cell systems at a representative scale	Collaborative Project	
SP1-JTI-FCH.2012.3.6 Validation of integrated fuel cell system for stationary power and CHP fuel cell systems	Collaborative Project	

Area/ Topics called	Funding Schemes	Indicative FCH JU Funding Million €
SP1-JTI-FCH.2012.3.7 Field demonstration of large scale stationary power and CHP fuel cell systems	Collaborative Project	
SP1-JTI-FCH.2012.3.8 Field demonstration of small scale stationary power and CHP fuel cell systems	Collaborative Project	
Area SP1-JTI-FCH.4: Early Markets		**10.25**
SP1-JTI-FCH.2012.4.1 Demonstration of fuel cell powered material handling equipment vehicles including infrastructure	Collaborative Project	
SP1-JTI-FCH.2012.4.2 Demonstration of portable generators, back-up power and Uninterruptible Power Systems	Collaborative Project	
SP1-JTI-FCH.2012.4.3 Research and development on fuel supply concepts for micro fuel cell systems	Collaborative Project	
SP1-JTI-FCH.2012.4.4 Demonstration of portable fuel cell systems for various applications	Collaborative Project	
SP1-JTI-FCH.2012.4.5 Research and development of 1-10kW fuel cell systems and hydrogen supply for early market applications	Collaborative Project	
Area SP1-JTI-FCH.5: Cross-cutting Issues		**5.5**
SP1-JTI-FCH.2012.5.1 Hydrogen safety sensors	Coordination and Support Actions (Supporting Action)	
SP1-JTI-FCH.2012.5.2 Computational Fluid Dynamics (CFD) model evaluation protocol for safety analysis of hydrogen and fuel cell technologies	Coordination and Support Actions (Supporting Action)	
SP1-JTI-FCH.2012.5.3 First responder educational and practical hydrogen safety training	Coordination and Support Actions (Supporting Action)	
SP1-JTI-FCH.2012.5.4 Pre-normative research on fire safety of pressure vessels in composite materials	Collaborative Project	
SP1-JTI-FCH.2012.5.5 Assessment of safety issues related to fuel cells and hydrogen applications	Coordination and Support Actions (Supporting Action)	
Total indicative FCH JU Funding		**77.5**

Call for Proposals will be selective. There will be competition, based on quality and excellence, between proposals primarily, but nor exclusively, within activity areas, which may result in some topics not being supported in a given call.

3.5.2 Submission and evaluation procedure

Applications to the FCH JU for financial support to the RTD activities are made following competitive calls for proposals. Further guidelines on how to submit a proposal and related templates can be found in the Guide for Applicants, available in CORDIS and the FCH JU website[12]. An additional Excel file has been prepared to help applicants drafting their budget in a proposal (available at: http://www.fch-ju.eu/content/how-participate-fch-ju-projects). While applicants are not required to provide their budget information in the proposal using this tool, applicants should be aware that they will be requested to fill it out if they pass the evaluation thresholds. The evaluation, selection and award procedures of the FCH JU are described in the document "FCH JU - Rules for submission of proposals, and the related evaluation, selection and award procedures".

The evaluation shall follow a single stage procedure.

The evaluation criteria (including weights and thresholds) and sub-criteria, together with the eligibility, selection and award criteria, for the different funding schemes are set out in "Evaluation criteria and procedures" (4.2.1 below).

Proposals will not be evaluated anonymously.

Ranked lists of proposals will be established for each area. At the Panel stage, proposals from different topics with equal overall scores will be prioritised according to the overall FCH JU Annual Implementation Plan coverage. If they are still tied, they will be prioritised according to their scores for the S/T Quality criterion, then by their scores for the Impact criterion, and then by their scores for the Implementation criterion. If they continue to be tied, other characteristics agreed by the Panel members should be taken into account.

Proposals from the same topic with equal overall scores will be prioritised according to their scores for the S/T Quality criterion. If they are still tied, they will be prioritised according to their scores for the Impact criterion, and then by their scores for the Implementation criterion. If they continue to be tied, other characteristics agreed by the Panel member should be taken into account.

A reserve list will be constituted if there are a sufficient number of good quality proposals. It will be used if extra budget becomes available.

3.5.2.1 Evaluation criteria and procedures

1. General

The evaluation of proposals is carried out by the FCH JU with the assistance of independent experts.

[12] FCH JU Rules for submission of proposals, and the related evaluation, selection and award procedures (http://www.fch-ju.eu/content/how-participate-fch-ju-projects)

FCH JU staff ensures that the process is fair, and in line with the principles contained in the FCH JU rules[13].

Experts perform evaluations on a personal basis, not as representatives of their employer, their country or any other entity. They are expected to be independent, impartial and objective, and to behave throughout in a professional manner. They sign an appointment letter, including a declaration of confidentiality and absence of conflict of interest before beginning their work. Confidentiality rules must be adhered to at all times, before, during and after the evaluation.

In addition, independent experts might be appointed by the FCH JU to observe the evaluation process from the point of view of its working and execution. The role of the observer is to give independent advice to the FCH JU on the conduct and fairness of the evaluation sessions, on the way in which the experts apply the evaluation criteria, and on ways in which the procedures could be improved. The observer will not express views on the proposals under examination or the experts' opinions on the proposals.

2. Before the evaluation

On receipt by the FCH JU, proposals are registered and acknowledged and their contents entered into a database to support the evaluation process. **Eligibility criteria** for each proposal are also checked by FCH JU staff before the evaluation begins. Proposals which do not fulfil these criteria will not be included in the evaluation.

A proposal will only be considered eligible if it meets all of the following conditions:

- It is received by the FCH JU **before the deadline**
- It fulfils the **minimum conditions of participation** defined in chapter 3.5.5.
- It is **complete** (i.e. both the requested administrative forms and the proposal description are present)
- The **content of the proposal relates to the topic(s) and funding scheme(s)**, including any special conditions set out in the relevant parts of the Annual Implementation Plan

The FCH JU establishes a **list of experts capable of evaluating the proposals** that have been received. The list is drawn up to ensure:

- A high level of expertise;
- An appropriate range of competencies.

Provided that the above conditions can be satisfied, other factors are also taken into consideration:

- An appropriate balance between academic and industrial expertise and users;

[13] FCH JU Rules for submission of proposals, and the related evaluation, selection and award procedures (http://www.fch-ju.eu/content/how-participate-fch-ju-projects)

- A reasonable gender balance;
- A reasonable distribution of geographical origins;
- Regular rotation of experts.

In constituting the lists of experts, the FCH JU also takes account of their abilities to appreciate the industrial and/or societal dimension of the proposed work. Experts must also have the appropriate language skills required for the proposals to be evaluated.

FCH JU staff allocates proposals to individual experts, taking account of the fields of expertise of the experts, and avoiding conflicts of interest.

3. Evaluation of proposals

At the beginning of the evaluation, experts will be briefed by FCH JU staff, covering the evaluation procedure, the experts' responsibilities, the issues involved in the particular area/objective, and other relevant material (including the integration of the international cooperation dimension).

Each proposal will first be assessed independently by at least 3 experts.

The proposal will be evaluated against the pre-determined evaluation criteria and sub criteria outlined in the tables below.

Evaluation criteria applicable to **Collaborative project proposals - CP**		
S/T QUALITY **“Scientific and/or technological excellence (relevant to the topics addressed by the call)”**	**IMPLEMENTATION** **“Quality and efficiency of the implementation and the management”**	**IMPACT** **“Potential impact through the development, dissemination and use of project results”**
• Soundness of concept, and quality of objectives • Progress beyond the state-of-the-art • Quality and effectiveness of the S/T methodology and associated work plan	• Appropriateness of the management structure and procedures • Quality and relevant experience of the individual participants • Quality of the consortium as a whole (including complementarity, balance) • Appropriateness of the allocation and justification of the resources to be committed (budget, staff, equipment)	• Contribution, at the European [and/or international] level, to the expected impacts listed in the work programme under the relevant topic/activity • Appropriateness of measures for the dissemination and/or exploitation of project results, and management of intellectual property.

Evaluation criteria applicable to **Coordination and support actions (Supporting Actions type) – CSA-SA**		
S/T QUALITY **“Scientific and/or technological excellence (relevant to the topics addressed by the call)”**	**IMPLEMENTATION** **“Quality and efficiency of the implementation and the management”**	**IMPACT** **“Potential impact through the development, dissemination and use of project results”**
• Soundness of concept, and quality of objectives • Quality and effectiveness of the support action mechanisms, and associated work plan	• Appropriateness of the management structure and procedures • Quality and relevant experience of the individual participants • Quality of the consortium as a whole (including complementarity, balance) [only if relevant] • Appropriateness of the allocation and justification of the resources to be committed (budget, staff, equipment)	• Contribution, at the European [and/or international] level, to the expected impacts listed in the work programme under the relevant topic/activity • Appropriateness of measures for spreading excellence, exploiting results, and disseminating knowledge, through engagement with stakeholders, and the public at large.

Evaluation scores will be awarded for each of the three criteria, and not for the sub-criteria. The sub-criteria are issues which the experts should consider in the assessment of the respective criterion. They also act as reminders of issues to rise later during the discussions of the proposal.

The relevance of a proposal will be considered in relation to the topic(s) of the *Annual Implementation Plan* covering the call, and to the objectives of the call. These aspects will be integrated in the application of the criterion "S/T Quality", and the first sub-criterion under "Impact" respectively. When a proposal is partially relevant because it only marginally addresses the topic(s) of the call, or if only part of the proposal addresses the topic(s), this condition will be reflected in the scoring of the first criterion. Proposals that are clearly not relevant to a call ("out of scope") will be rejected on eligibility grounds.

Each criterion will be scored out of 5. Half marks can be given.

The **scores** indicate the following with respect to the criterion under examination:

0 -	*The proposal fails to address the criterion under examination or cannot be judged due to missing or incomplete information*
1 -	***Poor.*** *The criterion is addressed in an inadequate manner, or there are serious inherent weaknesses.*
2 -	***Fair.*** *While the proposal broadly addresses the criterion, there are significant weaknesses*
3 -	***Good.*** *The proposal addresses the criterion well, although improvements would be necessary*
4 -	***Very Good.*** *The proposal addresses the criterion very well, although certain improvements are still possible*
5 -	***Excellent.*** *The proposal successfully addresses all relevant aspects of the criterion in question. Any shortcomings are minor*

No weightings will be applied to the scores for the different criteria.

Thresholds will be applied to the scores. The threshold for individual criteria will be 3. The overall threshold, applying to the sum of the three individual scores, will be 10.

Conflicts of interest: Under the terms of the appointment letter, experts must declare beforehand any known conflicts of interest, and must immediately inform a staff member from the FCH JU if one becomes apparent during the course of the evaluation. The FCH JU will take whatever action is necessary to remove any conflict.

Confidentiality: The appointment letter also requires experts to maintain strict confidentiality with respect to the whole evaluation process. They must follow any instruction given by the FCH JU to ensure this. Under no circumstance may an expert attempt to contact an applicant on his own account, either during the evaluation or afterwards.

4. Individual evaluation

This part of the evaluation will be carried out on the premises of the experts concerned ("remotely").

At this first step the experts are acting individually; they do not discuss the proposal with each other, nor with any third party. The experts record their individual opinions in an Individual Evaluation Report (IER), giving scores and also comments against the evaluation criteria.

When scoring proposals, experts must *only* apply the above evaluation criteria.

Experts will assess and mark the proposal exactly as it is described and presented. They do not make any assumptions or interpretations about the project in addition to what is in the proposal.

Concise but explicit justifications will be given for each score. Recommendations for improvements to be discussed as part of a possible negotiation phase will be given, if needed.

The experts will also indicate whether, in their view, the proposal deals with sensitive ethical issues, or if it requires further scrutiny with regard to security considerations.

Scope of the call: It is possible that a proposal is found to be completely out of scope of the call during the course of the individual evaluation, and therefore not relevant. If an expert suspects that this may be the case, a staff member from the FCH JU will be informed immediately, and the views of the other experts will be sought.

If the consensus view is that the main part of the proposal is not relevant to the topics of the call, the proposal will be withdrawn from the evaluation, and the proposal will be deemed ineligible.

5. Consensus meeting

Once all the experts to whom a proposal has been assigned have completed their IER, the evaluation progresses to a consensus assessment, representing their common views.

This entails a consensus meeting (might be in the form of an electronic forum) to discuss the scores awarded and to prepare comments.

The consensus discussion is moderated by a representative of the FCH JU. The role of the moderator is to seek to arrive at a consensus between the individual views of experts without any prejudice for or against particular proposals or the organisations involved, and to ensure a confidential, fair and equitable evaluation of each proposal according to the required evaluation criteria.

The moderator for the group may designate an expert to be responsible for drafting the consensus report ("rapporteur"). The experts attempt to agree on a consensus score for each of the criteria that have been evaluated and suitable comments to justify the scores. Comments should be suitable for feedback to the proposal coordinator. Scores and comments are set out in a consensus report. They also come to a common view on the questions of scope, ethics and/or security, if applicable.

If during the consensus discussion it is found to be impossible to bring all the experts to a common point of view on any particular aspect of the proposal, the FCH JU may ask up to three additional experts to examine the proposal.

Ethical issues: If one or more experts have noted that there are ethical issues touched on by the proposal, the relevant box on the consensus report (CR) will be ticked and an Ethical

Issues Report (EIR) completed, stating the nature of the ethical issues. Exceptionally for this issue, no consensus is required.

Outcome of consensus

The outcome of the consensus step is the consensus report. This will be signed/approved (either on paper, or electronically) by all experts, or as a minimum, by the "*rapporteur*" and the moderator. The moderator is responsible for ensuring that the consensus report reflects the consensus reached, expressed in scores and comments. In the case that it is impossible to reach a consensus, the report sets out the majority view of the experts but also records any dissenting views.

The FCH JU will take the necessary steps to assure the quality of the consensus reports, with particular attention given to clarity, consistency, and appropriate level of detail. If important changes are necessary, the reports will be referred back to the experts concerned.

The signing of the consensus report completes the consensus step.

Evaluation of a resubmitted proposal

In the case of proposals that have been submitted previously to the Commission or the FCH JU, the moderator will inform the experts and, if possible, give them the previous evaluation summary report (see below) at the consensus stage, if the previous evaluation took place under comparable conditions (e.g. broadly similar work programme topics and criteria). If necessary, the experts will be required to provide a clear justification for their scores and comments should these differ markedly from those awarded to the earlier proposal.

6. Panel review

This is the final step involving the independent experts. It allows them to formulate their recommendations to the FCH JU having had an overview of the results of the consensus step.

The main task of the panel is to examine and compare the consensus reports in a given area, to check on the consistency of the marks applied during the consensus discussions and, where necessary, propose a new set of scores.

The panel comprises experts involved at the consensus step. One panel will cover the whole call.

The tasks of the panel will also include:

- hearings with the applicants of those proposals that have passed thresholds (see below)
- reviewing cases where a minority view was recorded in the consensus report
- recommending a priority order for proposals with the same consensus score
- making recommendations on possible clustering or combination of proposals.

The panel is chaired by the FCH JU or by an expert appointed by the FCH JU. The FCH JU will ensure fair and equal treatment of the proposals in the panel discussions. A panel *rapporteur* will be appointed to draft the panel's advice.

The outcome of the panel meeting is a report recording, principally:

- An evaluation summary report (ESR) for each proposal, including, where relevant, a report of any ethical issues raised and any security considerations
- A list of proposals passing all thresholds, along with a final score for each proposal passing the thresholds and the panel recommendations for priority order
- A list of evaluated proposals having failed one or more thresholds
- A list of any proposals having been found ineligible during the evaluation by experts
- A summary of any deliberations of the panel

Since the same panel has considered proposals submitted to various parts of a call (for example different funding schemes, or different application areas that have been allocated distinct indicative budgets in the Annual Implementation Plan), the report may contain multiple lists accordingly.

The panel report is signed by at least three panel experts, including the panel *rapporteur* and the chairperson. If there are specific ethical issues in any of above-threshold proposals a special review shall be organised by the FCH JU.

3.5.3 Indicative evaluation and contractual timetable

Evaluation of proposals is expected to be carried out in June 2012.

Evaluation results are estimated to be available within 2 months after the closure date.

This Annual Implementation Plan provides the essential information for submitting a proposal to this call. It describes the content of the topics to be addressed, and details on how it will be implemented. The part giving the basic data on implementation (deadline, budget, additional conditions etc.) is presented in the Call fiche.

- **Indicative timetable for this call**

Publication of call	*17 January 2012*
Deadline for submission of proposals	*24 May 2012 at 17.00 (Brussels local time)*
Evaluation of proposals	*June 2012*
Evaluation Summary Reports sent to proposal coordinators ("initial information letter")	*July 2012*
Invitation letter to successful coordinators to launch grant agreement negotiations with the FCH JU	*September 2012*
Signature of first FCH JU grant agreements	*From January 2013*
Letter to unsuccessful applicants	*From January 2013*

- **Further information and help**

The FCH JU website (call 2012 page) and Participant Portal call page contain links to other sources that you may find useful in preparing and submitting your proposal. Direct links are also given where applicable.

- **Call information**

Participant Portal call page and FCH JU calls web-page:
http://cordis.europa.eu/fp7/dc/index.cfm
http://www.fch-ju.eu/content/call-2011

- **Specialised and technical assistance:**

Participant Portal help desk	http://cordis.europa.eu/guidance/helpdesk/home_en.html
EPSS Help desk	support@epss-fp7.org
IPR help desk	http://www.ipr-helpdesk.org

FCH JU reference documents are available at the website:
http://www.fch-ju.eu/content/how-participate-fch-ju-projects

3.5.4 Consortium

The legal entities wishing to participate in a project shall form a consortium and appoint one of its members to act as its coordinator. In general, the coordinator should come from the IG or from the RG.

3.5.5 Particular requirements for participation, evaluation and implementation

Participation in projects shall be open to legal entities and international organisations once the minimum conditions have been satisfied.

The minimum conditions to be fulfilled for Collaborative Projects and Coordinating Actions funded by the FCH JU shall be the following:

(a) At least 3 legal entities must participate, each of which must be established in a Member State or an Associated Country, and no two of which are established in the same Member State or Associated Country.

(b) All 3 legal entities must be independent of each other as defined in Article 6 of the Rules for Participation of the Seventh Framework Programme[14];

(c) At least 1 legal entity must be a member of the IG or the RG.

The minimum condition for service and supply contracts, Support Actions, studies and training activities funded by the FCH JU shall be the participation of one legal entity.

Forms of grants and maximum reimbursement rates for projects funded through the FCH JU will be specified in the FCH JU Grant Agreement.

3.5.6 Forms of grants

A grant will be awarded by means of a Grant Agreement between the FCH JU and the project participants.

The Grant Agreement will:

- provide appropriate provisions for the implementation of the RTD activities,
- ensure that appropriate financial arrangements and rules are in place relating to the intellectual property rights policy and,
- govern the relationship between the consortium and the FCH JU.

The project activities shall be financed through a financial contribution from the FCH JU and through in-kind contributions from the legal entities participating in the activities. The in-kind contribution from the participating legal entities shall at least match the EU contribution, i.e. the financial (cash) contribution coming from the FCH JU.[15]

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[14] 1. Two legal entities shall be regarded as independent of each other where neither is under the direct or indirect control of the other or under the same direct or indirect control as the other.

2. For the purposes of paragraph 1, control may, in particular, take either of the following forms:

(a) the direct or indirect holding of more than 50 % of the nominal value of the issued share capital in the legal entity concerned, or of a majority of the voting rights of the shareholders or associates of that entity;

(b) the direct or indirect holding, in fact or in law, of decision making powers in the legal entity concerned.

3. However, the following relationships between legal entities shall not in themselves be deemed to constitute controlling relationships:

(a) the same public investment corporation, institutional investor or venture-capital company has a direct or indirect holding of more than 50 % of the nominal value of the issued share capital or a majority of voting rights of the shareholders or associates;

(b) the legal entities concerned are owned or supervised by the same public body.

[Regulation (EC) No 1906/2006 of the European Parliament and of the Council of 18 December 2006 laying down the rules for the participation of undertakings, research centres and universities in actions under the Seventh Framework Programme and for the dissemination of research results (2007-2013)]

[15] Article 12(3) of the statutes of the FCH JU provides: *The operational costs of the FCH Joint Undertaking shall be covered through the financial contribution of the Union, and through in-kind contributions from the legal entities participating in the activities. The contribution from the participating legal entities shall at least match the financial contribution of the Union.*

Reimbursement of direct costs

To ensure that in-kind contribution from the participating legal entities matches the FCH JU contribution, the FCH JU proceeds in two stages for the reimbursement of direct costs:

1. The FCH JU starts with maximum reimbursement rates that are aligned with FP7 upper funding limits. The reimbursement of direct costs will therefore be based on a maximum percentage of actual eligible direct costs, depending on the type of participant, funding scheme and type of activity, as follows:

Type of organisation	**Type of Activity**		
	RTD	Demonstration	Other (including management)[16]
Industry (other than SME)	CP: max. 50%	CP: max. 50%	CP: max. 100% CSA: max. 100%
SME	CP: max. 75%	CP: max. 50%	CP: max. 100% CSA: max. 100%
Non-profit public-bodies, universities & higher education establishments, non-profit Research organisations	CP: max. 75%	CP: max. 50%	CP: max. 100% CSA: max. 100%

Funding schemes: CP: Collaborative project
CSA: Coordination and Support Action

2. The FCH JU will apply a correction factor (reduction) to ensure the matching obligation[17]. Experience from the previous FCH JU Calls for proposals showed that these decreases might be substantial, depending on the type of activity (Research, Demonstration, Other) and type of participants (SME, university, etc.) in the proposals

[16] "Other" activities refer to management activities, training, coordination, networking and dissemination (including publications). It also includes coordination and support activities in case of CSA. Please note that scientific coordination is not considered to be a management activity.

[17] Article 15(3) of the statutes of the FCH JU provides: *"in case lower levels of funding will be necessary to comply with the matching principles referred to in Article 12(3), the decreases shall be fair and balanced proportionally with the above mentioned upper funding limits of the Rules of Participation of the Seventh Framework Programme for all categories of participants in each individual project."*

retained for negotiation, as well as on the related matching funds provided by industrial participants in these proposals.

The decreases will be estimated per call for proposals, after evaluation and before signing the Grant Agreement.

These provisions are further developed in the FCH JU Grant Agreement.

Identification and Reimbursement of indirect costs

Indirect costs shall represent a fair apportionment of the overall overheads of the organisation. They shall be identified according to one of the following methods:

1. Participants who have an analytical accounting system enabling to identify them may declare their **actual indirect costs**. This option is mandatory for industrial legal entities, except for those whose accounting system does not allow distinguishing direct from indirect costs.

    a. In Collaborative Projects, their indirect costs will be reimbursed with a maximum amount equal to 20% of the direct eligible costs, excluding its direct eligible costs for subcontracting and the costs of resources made available by third parties which are not used on the premises of the beneficiaries.

    b. In Cooperation and Support actions, their indirect costs will be reimbursed with a maximum amount equal to 7% of the direct eligible costs, excluding its direct eligible costs for subcontracting and the costs of resources made available by third parties which are not used on the premises of the beneficiaries

2. Alternatively, indirect cost may be identified by means of a **flat rate of 20%** of the direct eligible costs, excluding its direct eligible costs for subcontracting and the costs of resources made available by third parties which are not used on the premises of the beneficiaries.

    a. In collaborative projects, indirect costs will be reimbursed with an amount equal to the 20% flat rate.

    b. In Cooperation and Support actions, their indirect costs will be reimbursed with an amount equal to 7% of the direct eligible costs, excluding its direct eligible costs for subcontracting and the costs of resources made available by third parties which are not used on the premises of the beneficiaries.

These provisions are further developed in the FCH JU Grant Agreement.

3.6 Call for Proposals 2012: Topic Descriptions

APPLICATION AREA SP1-JTI-FCH.1: TRANSPORTATION & REFUELLING INFRASTRUCTURE

Topic SP1-JTI-FCH.2012.1.1: Large-scale demonstration of road vehicles and refuelling infrastructure V

Rationale

In order to start the mass production of competitive hydrogen vehicles and provision of appropriate hydrogen refuelling infrastructure in the 2015 – 2020 timeframe, continuation and extension of the large-scale demonstration projects comprising vehicles and hydrogen refuelling stations is essential.

Overall project objectives/Scope of work

The objective is to continue extending and/or interlinking the earlier hydrogen demonstration sites and to continue setting up and pursuing initial steps for the demonstration of hydrogen fuelled vehicles and the related infrastructure in European regions/municipalities, increasing public awareness and attracting additional candidates for further demonstration activities. Candidate regions/municipalities should be well populated urban areas to either bridge the regions where hydrogen infrastructures already exist or create new markets close to existing ones. The purpose of the project is to add one or more new regions with the minimum of a new hydrogen station and additional vehicles, in hubs with one or more existing refuelling stations and to address the demonstration of FCEVs within intra-urban drive patterns.

The demo project shall focus on public transport buses or a number of passenger vehicles, which are in a development status of principle series production ability as well as provide high visibility. The consortium needs to develop, deliver and operate vehicles and infrastructure, including their comprehensive performance monitoring, and propose recommendations for commercialisation.

The demonstration program needs to address:

- deployment of an additional number of hydrogen vehicles and infrastructure to realise the volume targets set in the multi annual implementation plan of the FCH JU (MAIP)
- measurement, evaluation and monitoring of specific vehicle and fuelling station parameters, such as delivered from the HyLights monitoring assessment framework in order to show the potential of the technology for the industries including suppliers. Specific values are to be defined by the project group at the beginning of the project
- public awareness campaign and networking with potential candidate regions/ sites in order to accelerate the commercialization steps

- documentation on approval and certification process of vehicles and infrastructure aiming at simplification and harmonisation of approval procedures Europe wide to facilitate establishing the RCS framework required to enable the large scale deployment of vehicle and fuelling infrastructure throughout Europe
- dissemination of lessons learned and best practices for next demo sites
- perform safety due diligence for all aspects of the demonstration, including documentation of accidents and incidents and monitoring of safety issues in the context of prevailing regulations on site to provide guidelines for proper handling
- results from the demonstration project to be exchanged with other projects working on fuel cell materials, components and degradation aspects to facilitate new innovations
- the consortium needs to show the path to series production of the vehicles and filling stations applied in the project and prove economic feasibility
- It is recommended that demonstration sites should preferably be located at, or close to, the network of the Trans-European Transport Network (TENT-T), as laid out in decision No 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network (page 21)[18]

Expected outcome

The project shall provide a minimum of 5 urban buses and/or minimum of 10 passenger cars per site, accompanied by at least one additional fully integrated filling station capable of meeting performance targets. Filling stations for passenger cars (and if possible these for buses) need to be accessible for private customers/users. The vehicles or the hydrogen station could also be part of another funding programme, be it European, National or Regional.

The consortium needs to develop, deliver and operate vehicles and infrastructure, including their comprehensive performance monitoring, and propose recommendations for commercialisation. The vehicle types should be such which are usually mass produced with the potential of high market penetration in the future. The minimum operation of the vehicles is 12 months or 10,000 km.

Both enlargement of existing sites and interlinking of new sites are considered relevant. New classes of vehicles (e.g., delivery vans) may be included in addition to passenger cars or buses.

The new refilling stations shall qualify for the following performance targets:

- Both 35 and 70 MPa (depending on whether buses or passenger vehicles are used, respectively), refuelling capacity of 50 kg at the beginning of the project, to be

[18] See for the consolidated version at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:1996D1692:20070101:EN:PDF

extended to 200 kg H2/day ensuring that 50 cars or 5 buses can be re-fuelled per day and 5 cars or 1-2 buses can be re-fuelled within one hour by 2015

- Concept for modular upgrade of the filling station for 100 vehicles/day refuelling capacity must be provided
- Availability of the station 98% (measured in usable operation time of the whole filling station)
- Alternative filling station specifications which will ensure that 50 vehicles can be re-fuelled per day and 5 vehicles can be re-fuelled within one hour will be acceptable, or another alternative several filling stations in the region with the total filling capacity equivalent to 50 vehicles refuelled per day
- Hydrogen cost (based on an operation capital expended consideration) at station <€10/kg (excluding tax) at start of project. Cost improvements due to higher hydrogen production for higher vehicle numbers is anticipated in the course of the project. Conditions under which hydrogen cost can be reduced to < 5€ /kg should be identified. (e.g. use of by-product hydrogen)
- Hydrogen purity and vehicle refuelling time according to SAE and ISO specifications
- Station hydrogen production efficiency target 50 – 70%, depending on the method of production (conversion efficiency of the whole production chain from primary energy to filling nozzle)

Cost targets:

- The consortium has to show the potential to reduce cost of the vehicle by 25% for the next generation.

Targets for the passenger cars are:

- >2,000h vehicle operation lifetime initially, min 3,000h lifetime as program target
- Major power source of the vehicles must be a fuel cell system
- MTBF >1,000 km
- Availability >95% (to be measured in available operation time)
- Tank-to-wheel efficiency >40% (NEDC)
- Pressure at filling station suitable to fill vehicles up to 700 bar CGH2
- Principle series production ability has to be shown

Targets for the buses are:

- >4,000h lifetime initially, min. 6,000h lifetime as program target
- Major power source of the vehicles must be a fuel cell system
- Availability >85% with maintenance as for conventional buses
- Fuel Consumption < 11 - 13 kg H_2 / 100 km depending on drive cycle
- Pressure at filling station suitable to fill vehicles up to 350 bar CGH2

Dissemination of the activities of the project to the broad public is seen as one key part of the demonstration project. It should especially be foreseen to communicate the benefits of hydrogen and fuel cells with reference to the demonstration project. Regional authorities should support the project with communication.

Other information

The project needs to be co-funded by national, regional or private sources in order to demonstrate a strong commitment towards clean propulsion and emission free public transport.

The project consortium should develop concepts to link their projects with other demonstration projects for FCEVs.

The consortium should include automotive OEMs, integrated infrastructure equipment providers, fuel suppliers, bus fleet operators, industrial players, local and regional bodies, as appropriate. The involvement of SMEs is especially encouraged. The project should make proposals how the project can be coordinated with projects funded under the call FCH JU 2008 (topic SP1-JTI-FCH.1.1 and SP1-JTI-FCH.1.2) as well as the call FCH JU 2009 topic SP1-JTI-FCH.2009.1.1, the call FCH JU 2010 topic SP1-JTI-FCH 2010.1.1 and the call FCH JU topic SP1-JTI-FCH 2011.1.1.

Expected duration: At least 3 years

Funding scheme: Collaborative Project

Topic SP1-JTI-FCH.2012.1.2: Next Generation European Automotive Stack

Rationale

Significant high level materials and component development for PEMFC has taken place during the 5th, 6th and 7th Framework Programmes (FCH JU). However, the outcome of these efforts has not been fully exploited due to lack of dissemination of project results and fragmented European research. This is clearly shown by the fact that the vast majority of PEMFC stacks shipped today are developed and manufactured outside Europe. Therefore, there is an evident need to support European fuel cell industry to close the existing gap to global competitors and establish a next generation automotive stack platform with the potential to meeting the industrialization requirements.

The challenging targets must be achieved observing the critical balance of power density and Pt-loading reduction for maintaining high efficiency, while simultaneously meeting the durability targets and automotive target cost.

Overall project objectives / scope of Work

The overall project objective for this topic is design, development and validation testing of a competitive European automotive PEMFC stack including innovative high power MEAs working at minimized Pt-loading and low cathode humidity and corrosion resistant bipolar plates with integrated seals. The activity shall build on a series of EU-funded material and component development activities, and shall focus on integrating the most promising combination of materials available from these European R&D European efforts, more specifically, the FCH JU projects related to membrane, catalyst (MEA) and BPP development.

The scope of work should include:

- Development of an automotive PEM fuel cell stack fulfilling the targets/specification outlined below, by including materials and components developed in other FCH JU projects
- Identification and selection of most promising component specifications to support the stack platform design
- Integration of most promising materials and components in PEMFC stack platform
- Functional and performance testing of the components at short and full stack level
- Durability testing of full size stacks under automotive conditions

Performance testing within the project needs to prove concept readiness of the stack platform and principle compliance of results with the specification requirements. Durability shall be tested for at least 2000 h. The test results shall be assessed based on stack degradation to prove the principal potential of the design to achieve the durability target of 5000 h.

Fulfilling these objectives will require MEAs with high current density at high single cell voltage and reduced Pt-loading while still keeping up with the efficiency and durability requirements. They need to be combined with corrosion resistant, highly conductive bipolar plates with integrated seals allowing for ultra-low cell pitch.

The work shall include a sensitivity analysis of the stack cost using the cost tool developed by the Auto-Stack-project (GA 245142) to support the design to cost strategy by monitoring and managing product cost and allow accurate fuel cell stack cost predictions at various production volumes.

Expected Outcome

A full functional and validated PEMFC Stack meeting the following targets:

- Stack gross power 95 kW
  - Minimum operating voltage under load: 200 V
  - Maximum OCV under cold start: 430 V
  - Specific power (stack) > 2 kW/kg
  - Power density (stack) > 2 kW/l
- Average nominal voltage of individual cells 675 mV @ current density of ≥1.5 A/cm^2
- Maximum operating temperature up to 95 ºC
- Air humidity requirement < 50% RH at operating temperature and nominal voltage of 765 mV @ 1.5 A/cm^2
- Operating pressure < 2 bar (absolute), and
- Life time > 5,000 h under automotive drive cycle conditions.
  - Beginning-of-life (BoL), stack newly manufactured and conditioned: average single cell voltage ≥ 675 mV @ power density of 1 W/cm2
  - End-of-life (EoL), stack after 5,000 h of operation: average single cell voltage of > 640 mV @ power density > 870 mW/cm2

The stack shall be based on a single row stack design to minimize space demand and ensure cost efficient manufacturing of the stack repeating units. The development of a stack platform is envisaged which shall allow power scaling from 10 kW to 95 kW by changing cell count, combining two or more stacks or by means of DC/DC (direct current / direct current) converters to match different vehicle platforms and power requirements.

Other Information

The consortium should include automotive OEMs, MEA and bipolar plate suppliers, research organisations and possibly stack developers. The topic needs to be coordinated with topics 5 and 7 of the AIP2011, i.e. *Next generation European MEAs for transportation applications* and *Research & development on Bipolar Plates* as well as topic 1.5 of the AIP 2012 "*New catalysts structures for automotive PEMFCs*" with the purpose to align the activities and use the materials developed there in the final European Automotive Stack.

Expected duration: 3-4 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.1.3: Compressed hydrogen onboard storage (CGH2)

Rationale

For automotive applications, the compressed gaseous storage of hydrogen (CGH2) is by far the most mature hydrogen storage technology. Several European and global car companies are already operating such cars on public roads using 35 MPa or 70 MPa tank systems, with 70 MPa –CGH2 technology setting the benchmark for any competing system. Throughout Europe, CGH2 hydrogen filling stations compliant to SAE J2601 are expected to be set-up in order to be prepared for an early market introduction of hydrogen vehicles in the 2015 timeframe. For later phases of the commercial introduction of vehicles and in particular to achieve the mass market penetration, further improvements of performance, technology maturity, safety, and cost reductions of the tank systems are still required.

Overall project objectives/Scope of work

The proposed project addresses development activities on materials, components and storage tank systems in order to improve performance and technology maturity, as well as, to achieve cost reductions on the following two technological options:

a) Carbon-Fibre composite vessel with metallic liner (type III), and/or
b) Carbon-Fibre composite vessel with plastic liner (type IV).

Specific technical targets on a system level:

Capacity:	6 kg H2
Volumetric energy density	260 L, 0.023 kg L-1
Gravimetric energy density	125 kg, 0.048 kg kg-1
Shape	Cylindrical
Production cost @ large volumes	2000 Euro
Boil-off losses	not existing
Permeation rate	<1 Ncm3/L/h
Extraction efficiency	97%
Max. extraction rate	2 g H2 s-1
Refilling time	3 min
Refilling efficiency	98%
Heat exchanger capability	0 kW
Operating temperature for tank components	-60°C and +85°C
Operating lifetime design target	>15 years / 4,000 cycles

The scope of work may include:

- Development activities on materials such as:
  - Development of new fibre and resin concepts, optimization of fibre, matrix and carbon-fibre interphase to fully exploit the potential of the carbon fibre composite, cost - efficient manufacturing processes, new permeation-blocking liners or investigation of liner-less vessels, development of high pressure sealing material and design to improve low temperature performance, protection of steels against hydrogen embrittlement development of metallic materials not affected by hydrogen embrittlement and recycling concepts for

carbon composite vessels,. This should be complemented with simulation tools for design optimization, failure mechanisms, aging effects of carbon fibre composite materials, fire protection and crashworthiness of compressed gaseous hydrogen storage.

- Activities of tank components and system development such as:
    - Containers with improved carbon fibre winding to improve load sharing between fibres
    - On- or off-board diagnosis systems for containers
    - On-Board safety systems for fire protection
    - Pressure regulators, valves, sealing, as well as sensors, manufacturing concepts and hydrogen refilling technologies
- Activities of designing hybrid CGH2 storage systems: Integration of room-temperature solid-state adsorption materials into a 35 – 70 MPa CGH2 vessel. An improved performance compared to pure CGH2 technologies and compatibility to current and future fuel stations according to SAE J2601has to be shown.
- Validation operational performances, accelerated life time tests
- Comparative techno-economic assessment

Expected outcome

Enhanced materials, improved complete tank systems and related components characterized by reduced weight and volume, leading to lower cost production processes, establishment and advancement of test methods. The Technical Targets are those specified above.

Other information

The consortium should include research institutions, automotive OEMs and hydrogen supply industry; opportunities for innovative SMEs with expertise in specialised areas.

Expected duration: Up to 3 years

Funding scheme: Collaborative Project

Topic SP1-JTI-FCH.2012.1.4: Development of peripheral components for automotive fuel cell systems

Rationale

In order to enable high volume production of fuel cell systems for market entry scenarios 2015-2020, cost optimized, compact and efficient system components as the air compressor, the anode module, the air humidifier and the air processing unit are the most important ones. Technology assessments suggest that there are still considerable potentials for improvements in terms of functionality, efficiency, manufacturability and cost for automotive application. Some basic technologies are available but need to be further developed and tested in automotive fuel cell systems to prove suitability for this application and to fulfil automotive standards and requirements.

Overall project objectives/Scope of work

The objective of this action is to develop low cost system components for an automotive fuel cell system to a certain maturity level adopting latest system and component level engineering methodologies and tools. All balance of plant components are under consideration such as the air-cathode/exhaust module (air compressor/exhaust turbine), the anode module with recirculation, the air humidifier and processing unit as well as auxiliary components (valves, sensors, interfaces) for both reactant loops. Generally, depending on the research needs and issues to be tackled, projects could address either all components, groups of them (or subsystems with several components) or individual components. In order to exploit the results of projects on a broader basis, the analysis and development tools and environments further developed should be made applicable also for corresponding developments – particularly automated and accelerated testing procedures including related testing environments.

General technical targets for a fuel cell system

- High voltage 380 - 430 VDC
- Low voltage 9-16 VDC
- Lifetime 5,000 - 6,000 hrs.
- Ambient temperature -40 … +50°C
- Freezing capability -40°C
- Freeze start (reliable) -25°C

Technical key targets for the air/exhaust management module

- Turbine inlet wet air (100 % rel. humidity)
- Turbine inlet temperature approx. 80°C
- Pressure ratio < 3.5
- Dynamics idle to max power < 800 ms
- Efficiency > 85 %
- Power density > 0.5 kW/kg

Technical key targets for the anode module including auxiliaries

- Hydrogen feed temperature -40°C to +95°C

- Pressure level hydrogen feed inlet 9 - 12 bar absolute
- Pressure level recirculation loop 1.2 – 3.5 bar absolute

Technical key targets for the air humidifier

- Temperature -40°C - +120°C
- Pressure 1.0 – 3.0 bar absolute

Technical key targets for auxiliary components on the air side

- Temperature -40°C to +95°C
- Pressure level 1.0 - 3.0 bar absolute
- Humidity downstream the humidifier 30 - 50% rel. humidity

As an initial assessment a comparison of the relative merits of different technologies shall be performed by adopting advanced testing and detailed simulation methods (e.g. of multiphase transport and phase transition processes including multi-component diffusion and mixing phenomena of humidifiers etc.) on component and system level (e.g. cold turbine compared with a hot turbine and with other available air compressor technologies) including tests with a real fuel cell system or hardware-in-the-loop tests.

Particularly, the potential of new solutions regarding packaging (improvement of gravimetric and volumetric power density), durability and low cost production should be addressed already in the virtual development phase by application of suitable tools (e.g. cost and reliability assessments).

The anode module offers the options to be operated either with a passive or an active recirculation device while a humidifier can be designed with plates and frames or as a tube or as an active component. An air processing unit may contain but may not be limited to an integrated humidifier bypass, a throttle valve and a charge-air intercooler at different integration levels of a fuel cell system.

Selected component configurations shall demonstrate the principle benefits in typical automotive environments with wide load range, high dynamics, shock and vibrations, sub-zero and hot environment, frequent start / stop cycles to achieve high reliability and long life as well as addressing energy density and efficiency criteria. Application of combined physical and virtual testing methodologies is encouraged.

The component development activities shall reflect the standard automotive development processes, leading to a possible continuation of the project to higher volume. These investigations should also include validation of reliability and durability targets envisaged by application of standard industrial methods. Test and comparison have to refer to a mid-class European car under typical certification and OEM test development cycles.

The new solutions for the components to be investigated have to show the potential for improvements of reliability on component and system level. Particularly the interaction of the newly developed components and subsystems with the fuel cell stack regarding the extension of durability and the elimination of critical degradation processes should be part of the validation - preferably proved by dedicated diagnostic devices. Such diagnostic techniques could potentially be also part of later on-board-diagnostics (OBD).

Expected outcome

Components developed shall be tested and evaluated by dedicated component and system testing for automotive usage. After key component and system testing of some first samples the component shall be further developed towards the target for the automotive fuel cell system application. Further samples need to be built and tested on component and system level. Design to cost methodologies shall be applied to analyse cost and to identify cost reduction opportunities for further improvements of the respective components.

The project shall also provide advanced analysis and concepts for further system simplification, ease of manufacturing and cost reduction reflecting typical automotive volumes. Along with the components, also development and production environments should be applied and identified regarding subsequent mass products.

Other information

The consortium should include automotive OEMs or subsidiaries of automotive OEMs, relevant suppliers and system integrators.

Applicants may aim for a number of components as well as an individual component. For the development of the anode module and the air processing unit a joint collaboration with a fuel cell system developer is indispensible.

Expected duration: approx. 3 years

Funding scheme: Collaborative Project

Topic SP1-JTI-FCH.2012.1.5: New catalyst structures and concepts for automotive PEMFCs

Rationale

The Membrane and Electrode Assembly (MEA) constitutes the core energy converting part of the PEMFC. Improvement of PEMFC – membranes, catalysts and their supports, electrodes, and gas diffusion layers (GDLs) as well as MEA processing - is required for further cost reduction and to increase durability of next generation PEMFC stacks. Highly novel and breakthrough technology pathways to new catalyst structures having high mass activity and satisfying durability targets are essential. Key issues of catalyst sintering or dissolution and of carbon support corrosion must urgently be addressed. Significant recent advances have been made internationally in development of highly active non-platinum based catalysts, the performance of which is now able to rival that of platinum catalysts, although their durability must be improved. Alternative corrosion-resistant catalyst supports are required, as well as catalyst layers and gas diffusion layers of optimised composition and morphology. A series of FCH JU-supported projects are initiated and under execution on development of next generation MEAs for PEMFCs, both for stationary and automotive applications. The current situation calls for a narrow approach on break-through research focusing on ultra low platinum and/or non-precious metal catalysts and durable catalyst support materials, as this is a key for cost abatement of stacks to competitive levels. The interaction between catalytic active material and support material is also an important issue in which better fundamental understanding is needed. Such materials improvements, in combination with high quality manufacturing methods of complete MEAs, are required to maintain high power density and efficiency. Materials compatibility and chemical and mechanical stability under automotive fuel cell environment and conditions are pre-requisites for reaching the targeted lifetime of 5,000 h. Since durability of fuel cell vehicles is limited mostly by catalyst degradation, significant advances are required both to further explore promising non-precious metal catalysts and to enhance catalyst and catalyst support stability.

Overall topic objectives / Scope of Work

The objective of this effort is to develop new catalyst structures and concepts with the potential of reaching the long term cost and durability targets for PEMFCs in automotive applications. These novel structures and concepts shall preferably exhibit the ability to operate for automotive power train and range extender applications of PEMFCs, above 100 °C and low relative humidity (RH) while maintaining high power density, reducing the cost and improving lifetime. Proposals can include the development of highly novel catalyst structures having high mass activity and durability, platinum saving approaches or non-precious metal catalysts. Research leading to corrosion resistant catalyst supports should be included. Increase in the temperature of operation should be addressed by combining the developed electrode structures with membrane materials having required properties at low relative humidity and high temperature. Approaches shall focus on development of innovative concepts aimed at the particular and demanding set of properties required for transportation fuel cell applications. Activities with potential for ‘quantum jumps’ in the fundamental areas of research are foreseen. Supporting theoretical modelling efforts to develop of a fundamental understanding of catalytic processes and catalyst-support interactions are considered relevant with a view to reducing experimental efforts required in the selection of new materials. Incremental improvements of existing materials are not considered relevant. The compatibility of materials and their durability under operation conditions consistent with power train or range extender application shall be verified by assembling high performance MEAs for benchmarking purposes. MEAs shall be tested in automotive test cycles to prove their potential to significantly increase existing automotive performance and durability benchmarks at stack level with reduced cost.

The project activities should include the following:

- Development of catalysts and electrode layers allowing for significant reduction in precious metal catalyst loadings (ultra low loadings) or the use of low cost non-platinum based catalysts
- Development of robust and corrosion resistant catalyst supports preferably adapted for high temperature operation
- Optimisation and demonstration of MEA processing at pilot scale based on innovative catalyst and catalyst support concepts
- Demonstration of long-term stability under automotive fuel cell conditions
- Techno-economic assessment showing that new catalyst concepts are compatible with the stringent cost and durability targets for commercialization of fuel cell vehicles.

Expected outcome

MEAs appropriate for high temperature and low RH operation, with a significant reduction in cost and durability of at least 5,000 h under automotive conditions as well as considerations regarding pilot scale processability of MEAs and components are expected.

Technical targets are:

- Specific targets for MEAs:
    - Pt loadings < 0.1 g/kW
    - Efficiency > 55% (LHV, BoL) at rated power density when operated on H_2 (99.995% purity, min. 1.5 stoichiometry) and air (max. 5 stoichiometry)
    - Power density at nominal power :
        - > 1 W/cm^2 at 1.5 A/cm^2 (single cell) at BoL
        - 0.9 W/cm^2 at 1.4 A/cm^2 (single cell) at EoL
        - >2kW/l (short stack)
    - Lifetime > 5,000 h at dynamic operation (car)* Operation temperature: - 25 °C up to 95/120 °C* (power train) or 160 °C (range extender)
    - Cost of PEMFC system (potential from techno-economic assessment):
        - 100€/kW (2015)
        - 50€/kw (2020)

** demonstrated for complete MEAs/single cells or short stacks, applying representative power train load profiles and following commonly agreed accelerated stress test protocols at automotive conditions (including start-stop and freeze-thaw cycles) preferably operating at temperatures up to 120°C. Lifetime is defined as the time until a maximum of 10% reduction in power output at peak power is reached.*

Other Information

The consortium should include academia/research institutes, materials developers, cell and/or stack manufacturers, SMEs, OEMs and application related end-users. The project should be consistent with results and recommendations from recent EC funded FP6 and FP7 projects. The action will have to take into account the recommendations end requirements from the AUTOSTACK project from topic SP1-JTI-FCH.1.3 – "European Stack Cluster" of the FCH JU 2008 call (GA 245142), and must be linked to any project selected under topic 1.2 of the AIP2012 call, to ensure synergies with European stack integration activities. The action must also link to activities which would be developed by a project submitted under topic 5.4 of the AIP2011 call. Interfacing and information sharing with other current FCH JU funded projects are recommended.

The consortium should consider if the harmonised testing procedures as developed under the FP6 FCTES^{QA} project (accessible at http://fctesqa.jrc.ec.europa.eu) can be used in addition to its in-house testing procedures.

Cooperation with JRC-IE (http://ie.jrc.ec.europa.eu) which is active in fuel cells testing and standardisation is to be considered by the project consortium.

Expected duration: Up to 4 years

Funding scheme: Collaborative Project

Topic SP1-JTI-FCH.2012.1.6: Fuel cell systems for airborne application

Rationale

Fuel cell systems for airborne applications (such as emergency power, RAT replacement, cabin power, APU replacement) need to meet safe operational requirements in terms of efficiency, reliability, performance, mass/volume, cost and lifetime under flight conditions at altitude and under high and low ambient temperatures in the air and on the ground.

Hydrogen based fuel cell systems are expected to facilitate the introduction of PEM fuel cell system applications and early examples derived from automotive system designs have already been flight and/or ground tested at the TRL 4 to TRL 5 level. Hydrogen is expected to provide the fuelling source and for use in first commercial aircraft applications while reformation of aviation fuel may in the longer term provide for greater aircraft autonomy (flexibility in range and duty cycle) for future aircraft applications. Nevertheless, the available fuel cell technologies need substantial mass/volume, cost and lifetime improvements to meet aircraft installation and airborne applications requirements.

Overall project objectives / Scope of Work

The overall objective is to design, develop and flight test an aircraft related fuel cell system against realistic (TRL 6) flight / application specific requirements.

The project should also address auxiliary subsystems optimization, covering air supply, water management, thermal and power management, and potentially the use of inert air within overall system efficiency optimization and system multi-functionality requirements.

In addition, the programme should evaluate current safety, codes and standards (derived from automotive applications) and how these will need to be extended to meet regulations and standards applicable to aircraft requirements.

The proposed demonstrator should be in the power range of 20-100kW, where it is representative of and appropriate to system power output and functionality in order to provide proof of concept for the application.

Expected Outcome

The system is expected to be fuelled by hydrogen and should achieve:

- Fuel cell system efficiency (LHV) at 25% of rated power: 55%
- Durability with cycling hours: 2,500 hours under flight representative load profiles
- Fuel cell system lifetime 3,500 hours
- Fuel cell system power density W/L: 400 (EoL)
- Fuel cell system specific power W/kg: 650 (EoL)
- Status of results achieved globally for airborne fuel cell applications, including hydrogen and other fuel sources

- Fuel cell system operational capability at ambient temperature ranges and cycles typical for such packaged systems in aircrafts
- Fuel cell system operational capability at ranges of altitude and in-flight variations typical for such packaged systems in aircrafts
- Set of system design and operational recommendations together with future development targets including identification of areas for improvement of existent system technologies to meet aircraft installation and airborne application needs, also taking into account proposed regulations for fuel cell system on board aircrafts
- Proof of concept and validation of operational performance up to full "real life" operating conditions for key components and the entire fuel cell system, according to the maturity of the proposed technologies, in flight mode
- Proof of concept of H2 storage and supply on-board an aircraft

Other Information

The consortium is expected to include system integrators (OEMs), fuel cell technology suppliers, application related end-users and possibly regulatory officials, including opportunities for research organisations and SMEs in specialised areas design, installation, operation and test / certification roles.

Expected duration: 3 years

Funding Scheme: Collaborative project

<u>Topic SP1-JTI-FCH.2012.1.7: Recommendations for the measurement of the quantity of hydrogen delivered and associated regulatory requirements</u>

Rationale

Accurate and controlled measurement of the quantity of hydrogen transferred across the supply chain, and in particular during vehicle refuelling is required for using hydrogen as fuel. However, currently applied metering technologies generally do not comply with the accuracy typically specified by weights and measures authorities.

Overall project objectives / Scope of Work

The objective is to propose regulatory criteria for application across Europe and evaluate existing technical solutions for measuring the quantity transferred with regards to currently applicable criteria and proposed criteria.

This will involve the following activities:

- Identification of requirements for existing fuels at different points of the supply chain
- Proposal of criteria for hydrogen
- Evaluation of existing technical solutions
- Demonstration that meeting the criteria proposed is feasible

Expected Outcome

- Overview of the state of the art, determination of achievable accuracy, and identification of potential technologies that could be implemented.
- Overview of the legal requirements applicable in Europe to quantity measurement system used in commercial fuel dispensing applications.
- Evaluation of the feasibility of meeting existing requirements.
- Proposed criteria
- Recommendations regarding the adaptation of the existing regulation for covering the delivery of hydrogen.

Other Information

Project consortium should include a refuelling technology supplier, a metrology expert, and a testing facility.

Expected duration: 1 year

Funding Scheme: Coordination and support action

APPLICATION AREA SP1-JTI-FCH.2: HYDROGEN PRODUCTION & DISTRIBUTION

Topic SP1-JTI-FCH.2012.2.1: Demonstration of MW capacity hydrogen production and storage for balancing the grid and supply to vehicle refuelling applications

Rationale

Hydrogen as an energy carrier is recognised as a possible way to: (i) increase the use of intermittent renewable energy sources, potentially limited by electrical grid balance constraints, by providing an effective means to store energy produced in excess of immediate consumption, for any later use; and (ii) decarbonise the transport sector.

Having a part of the transport sector's energy needs met with intermittent renewable energy converted to hydrogen effectively increases the share of renewable energy in both the overall and transportation energy mix. Hydrogen can either be produced onsite at the Hydrogen Refuelling Station (HRS) (which requires an increased footprint not always available and leaves open the issue of managing intermittent renewable energy), or coupled to the electricity producer (which needs logistics for hydrogen delivery but offers dispatchability to the producer). Other more convenient topologies which meet both requirements of better grid services and enhanced hydrogen logistics may be explored.

Hydrogen production by water electrolysis and storage above ground in compressed gas form for subsequent use are both known technologies that are available at enough capacity as required both for decentralised grid balancing and massive fuel supply to the transportation sector, but have not been intensively validated and demonstrated yet. There is a need to demonstrate system level technology readiness and generate further facts-based data for deployment studies through implementation of all the functions required to bring intermittent renewable energy to vehicles with hydrogen as the energy carrier. Hydrogen produced by these means could in the interim serve also for conversion to electricity in peak hours, when very special pricing conditions or restrictions are met, or as high-grade chemical for various uses.

Overall project objectives / Scope of Work

The objective is to demonstrate the technological readiness, performance, reliability and total cost of ownership of installations for production and short-term storage of hydrogen via electrolysis from renewable electricity sources, with subsequent supply as a high value fuel/chemical, such as a hydrogen vehicle refuelling station (retail, public transport, or fleets) or other uses as well as grid services as controllable load.

The aim is to show that providing hydrogen to transport applications from grid electricity can be an economically viable solution for reducing greenhouse gas emissions of transport while facilitating intake by the grid of renewable energy.

Means for the production of electricity, logistics of the hydrogen produced and equipment for the use of the hydrogen are out of scope.

Optimal logistics from the production site to the point of use (by road transport or existing pipeline) as well as advantages related to the infrastructure needed (dedicated electricity distribution lines) should be considered to select proper locations for the demo site.

Expected Outcome

- Definition of a standard optimised hydrogen production and storage system as a function of grid balancing constraints, as reflected by the spot purchase price, and local hydrogen fuel needs
- Installation and continuous operation of a standalone electrolyser (between 100 and 500 kg/day) associated with a hydrogen storage system, used as a source of supply of CO2-free or high-grade hydrogen (e.g. for the operation of a fleet of hydrogen vehicles such as buses, material handling trucks, passenger cars), and other possible applications as well
- Study of regulatory aspects associated with the implementation of this integrated energy function, such as access to spot purchase prices, renewable electricity certificates, as well as RCS related to hydrogen production and stationary storage; identification of barriers to deployment and recommendations to address them
- Evaluation of capacity utilisation, economics, efficiency, and availability based on actual operation. Targets for operation are:
    - Efficiency > 65% (from electric supply to locally stored hydrogen, LHV based)
    - Cost of hydrogen delivered short term < 15 €/kg, long-term < 7 €/kg
    - Hydrogen production facility turn-key CAPEX: 3.1 M€/(t/d) Hydrogen quality ISO/DIS 14786-2 compliant
    - Availability > 95%
    - > 12,000 h operation within the project, expected durability >10 years
- Regarding a potential industrialisation and production scale-up, assessment of CAPEX and cost of hydrogen delivered evolving with volume (both size of installation and number of installations deployed)
- LCA/LCI analysis (using FC-HyGuide guidance document available at: http://www.fc-hyguide.eu/

Other Information

The consortium should include an electrolyser manufacturer, as well as the required actors for system integration (including storage), operation and hydrogen fuel delivery, and RCS experts.

The vehicle fleet(s) and hydrogen refuelling stations to which the produced hydrogen will be made available shall be identified (these are not in the scope of this proposal).

Projects should be coordinated with other existing hydrogen vehicle and hydrogen refuelling station deployment projects, and evidence of cooperation has to be stated in the proposal.

Expected duration: Up to 5 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2012.2.2: Demonstration of hydrogen production from biogas for supply to vehicle refuelling applications

Rationale

Conversion of biogas to hydrogen for use in fuel cell vehicles is not only a way forward towards a decarbonised transport, but also an energy efficient pathway for implementing this renewable primary energy in the transport sector.

Mature and cost effective technologies for biogas conversion to fuel cell grade hydrogen are available. There is a need to demonstrate system level technology readiness at the MW level through implementation of all the functions required to bring bio-resource energy to vehicles with hydrogen as the energy carrier.

Overall project objectives / Scope of Work

The objective is to demonstrate the technological readiness, performance, reliability and total cost of ownership of installations for production and short-term storage of hydrogen from biogas with subsequent supply as a high value fuel to e.g. a nearby vehicle fuelling stations (retail, public transport, or fleets), by road transport or pipeline.

The aim is to show that providing hydrogen to transport applications from biogas can be an economically viable solution for reducing greenhouse gas emissions of transport.

Means for the production of biogas, logistics of the hydrogen produced and equipment for the use of the hydrogen are out of scope.

Optimal logistics from the production site to the point of use (by road transport or pipeline) should be considered to select proper locations for the demo site.

Expected Outcome

- Installation and continuous operation of a hydrogen production unit from biogas (between 100 and 500 kg/day), associated to a hydrogen storage system, with means of supply to a fuelling station.
- Study of relevant regulatory aspects associated with use of renewable certificates, access to spot purchase prices, as well as RCS relative to hydrogen production and stationary storage. Identification of barriers to deployment and recommendations to address these.
- Evaluation of costs, efficiency, and availability based on actual operation. Targets for operation are:
    - Efficiency > 64% (from biogas, LHV based)
    - Cost of hydrogen delivered short term < 10 €/kg, long-term < 5 €/kg
    - Hydrogen production facility turn-key CAPEX: 4.2 M€/(t/d)
    - Availability > 95%
    - > 25,000 h operation within the project, expected durability >10 years
    - Hydrogen quality ISO/DIS 14786-2 compliant

- Assessment of CAPEX and cost of hydrogen delivered evolving with volume (both size of installation and number of installations deployed).
- LCA/LCI analysis (using FC-HyGuide guidance document available at: http://www.fc-hyguide.eu/) to be conducted

Other Information

The consortium should include a BtH conversion/gas purification equipment supplier, as well as the required actors for system integration (including storage), operation and hydrogen fuel delivery, and involve RCS experts.

The vehicle fleet and fuelling stations that will be supplied shall be identified (these are not in the scope of this proposal). Projects should be coordinated with existing hydrogen vehicle and refuelling station deployment projects, and evidence of cooperation has to be stated in the proposal.

Expected duration: Up to 5 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2012.2.3: Biogas reforming

Rationale

There is an increasing amount of biogas streams within Europe. The conversion of this continuously available feedstock can produce a steady amount of renewable hydrogen.

The current available catalysts and reactor systems degrade rapidly in time due to carbon formation on the catalyst and reactor and heat exchanger walls. The state of the art conversion of these carbon streams consists of converting the gas stream into a methane rich feed which is upgraded by a cleaning step before it is reformed to hydrogen. Such an upgrading step requires expensive capital and lowers the efficiency of the process. The direct reforming of biogas will reduce the costs and increase the well-to-wheel efficiency of producing renewable hydrogen.

Overall project objectives / Scope of Work

Scope of work comprises research and technological development activities on materials, catalysts and processes for chemical conversion, as well as their integration and prototyping in an efficient, thermally optimized system. The project should focus on hydrogen production by direct biogas reforming (not from purified biomethane). To reform this gas stream identifying suitable catalytic systems is needed, so to that over time lower susceptibility to degradation due to carbonaceous material fouling or sulphur poisoning is achieved.

Additionally to enhanced catalytic and reactor systems, improvement of control strategies are needed for independent and robust operation. The control strategies should ensure the operation independent of feedstock composition variations in time. The control strategies and processes layout should avoid carbon deposition formation.

Expected Outcome

Scope of work comprises the development and testing of catalysts and reactors design in order to obtain a continuous and stable process for hydrogen production from direct reforming of biogas, and proof of concept of an integrated optimized system with adequate control strategies. The final target should be to demonstrate the technical and economic viability of the total process.

The project shall focus on:

- Conception of low cost and energy efficient systems to produce renewable hydrogen from biogas. Assessment of performance in terms of CO_2 footprint and cost per produced amount of H_2
- Limit the upgrading steps of the feedstock by developing catalytic and reactor systems that are more stable in time due to a lower susceptibility to degradation by carbonaceous material fouling and/or poisoning by impurities
- Design and build a reactor for the continuous production of hydrogen at a pre-commercial scale (between 50 and 250 kg/day), displaying an improvement with respect to the current state of the art

- Feasibility assessment of the process taking into account the amount of the hydrogen produced (PEMFC grade), by-products and potential integration with feedstock production
- Economical assessment of the total system, from feedstock to produced hydrogen. This should involve capital investments and operational costs
- Development/usage of improved reforming catalysts with high stability against coke formation in high CO2-containing gas feed

The catalysts chosen for the experimental campaign can be either commercial or properly prepared in laboratory using various technologies.

Key performance indicators:

- Catalyst efficiency: reforming catalyst system should exhibit enough shift activity to reduce CO concentration below 10 vol% (dry basis) thereby reducing shift catalyst quantity
- Catalyst durability: after initial normal deactivation (10 days of operation), show conversion degradation of < 2% per 1000 hrs. Selectivity to H_2 should be stable and high. Formation of intermediates (ethene, acetaldehyde etc.) should be negligible to prevent deactivation of downstream catalysts
- System cost: For pre-commercial units materials cost should be reduced to 5,000 €/Nm^3 H_2 (5.0 quality) plant capacity for a plant with a capacity of 50 Nm^3/hr. Therefore, the materials cost of a 50 Nm^3/hr capacity plant should not exceed €250,000
- Availability / recyclability: Catalyst replaceable within 4 hours; Active metal recovery > 85% possible
- High degree of reactor compactness & design simplification
- System efficiency: biogas to hydrogen efficiency should be >65%
- Scalability: Scalable from 2 to 750 Nm^3/h of H_2
- LCA/LCI analysis (using FC-HyGuide guidance document available at: http://www.fc-hyguide.eu/)

Other Information

The consortium should include broad industry & research participation with opportunities for SMEs in the field of: catalysts materials & supports, micro reactor technologies. The consortium is encouraged to include system integrators with control development skills. Activities shall be coordinated with other projects funded by the FCH JU. This project should aim to stimulate the development of packaged, modular systems. Work should not duplicate or overlap efforts in previous or ongoing FCH-JU projects.

Expected duration: Up to 3 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2012.2.4: New generation of high temperature electrolyser

Rationale

High temperature electrolysis (HTE) has excellent perspectives for an efficient use of renewable solar, wind or geothermal as well as nuclear energy, especially for large-scale centralised hydrogen production, and with substantial improvement of energy-efficiency. Overcapacities from renewable energy resources, as well as dedicated renewable energy production, can be transformed into fuels for the transport sector. HTE has the advantages of high conversion efficiency (expected to become above 90%), and that external heat sources, such as waste heat from industrial production or from natural, underground sources, can increase even further the efficiency. HTE can electrolyse also CO_2 into CO. By a syngas (CO + H_2) production, synthetic fuels such as methanol, methane, and DME can be produced, which are used easily in the existing infrastructure.

More efficient HTE systems will require high temperatures, pressurised systems and next generation of cells and stacks, which have to be further developed and up-scaled. Progress has already been obtained for HTE (e.g. in the RelHy project), in part because it is building on the SOFC development. However, there are still gaps to cover pressurised systems, stack development and system development, which is needed to bring the technology closer to the demonstration phase. Alongside with needed up-scaling, long-term research is required to help overcome technical constraints and allow proof of concept technology demonstration.

Overall project objectives / Scope of Work

- Develop cells and up-scaling the production of such cells that can sustain the conditions needed, high current loads (> 1 Acm-2), high durability and reliability, high temperature (700-1000º C), and show the potential for efficient, reliable, environmentally friendly and economically feasible production of hydrogen. Optional syngas production from CO2 and steam is also valuable
- Demonstrate low degradation rate (< 0.5% per 1,000 hrs. of operation) under electrolysis conditions (high humidity, high current density, high temperature), and sufficient mechanical strength for large area cells
- Develop concepts of HTE for use in connection with renewable energy production (wind, solar) and nuclear power
- Develop concepts for pressurised electrolysis for more economical systems (production of hydrogen, but also methane, methanol or DME are valuable)
- Test and evaluation of cells, stacks and systems under realistic conditions

Expected Outcome

- Development of cells and stacks designed for high-temperature (800-1000 ºC), high current density (>1 Acm-2), pressurised conditions
- Manufacture of dedicated HTE cells and stacks for use in large systems for the conversion of electricity from renewable sources and from nuclear power, i.e. large-area cells, high durability under realistic conditions

- Demonstration of a HTE system of kW size under realistic operating conditions (high humidity, high temperature, pressurised, fluctuating production), showing degradation around 1% per 1,000 hrs. of operation, and durability that can be extrapolated to minimum 5 years of continuous operation
- Proof-of-concept for co-electrolysis, syngas production and final chemical product, and validation of efficiency figures. Total efficiencies are expected in the 85-95% range

Other Information

Projects shall not duplicate outcomes achieved already in past and current European and JU projects on HTE, but extend these results. The consortium should include broad Industry & Research participation.

Expected duration: Up to 4 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2012.2.5: Thermo-electrical-chemical processes with solar heat sources

Rationale

Hydrogen production by water decomposition pathways powered by solar energy is a major component of the long-term R&D strategy of the FCH JU for sustainable and carbon-free hydrogen supply. Solar thermo-chemical cycles are capable to directly transfer concentrated sunlight into chemical energy by a series of chemical reactions. The direct application of heat for hydrogen production allows reducing electricity consumption and therefore also reducing production cost. Out of a very high number of thermo-chemical cycles considered in the past only a few turned out to have the potential to be practicable, to be scalable up to a demonstration level and to be competitive with other technologies. The success of those processes is often strongly linked to the availability of material with the required performance. In order to achieve the relevant objectives and to bring the most promising thermo-chemical process to technical realisation, focusing and strengthening research and development activities in this area is needed.

Overall project objectives / Scope of Work

Basic and applied research on materials and key components for the most efficient thermo-electrical-chemical water splitting cycles: to improve the technical & economic feasibility of these processes for CO_2 free H_2 production with focus on the scale up of the technology. The solar interface, solar reactors, materials' performance and process strategies have been identified as aspects crucial for a reliable and economic operation of a respective plant. Work on the following topics can be envisaged:

- Development of key components like reactors with enhanced efficiency in relevant scale (500 kW- 2MW)
- Modelling and simulation of the plant and of key components
- Field tests of prototype plant including key components on a solar plant (e.g. a solar tower)
- Development, qualification and optimisation of key materials (catalysts, construction materials, redox materials…)
- Compare/analyse/benchmark the place of these electrochemical steps in the various high temperature hydrogen production means

Expected Outcome

- Development of real size components (e.g. reactors, absorbers, separation systems, heat exchangers integrated with solar systems)
- Materials with performances suitable for economic operation, i.e. life times in the range of more than 1000 operational hours, i.e. catalyst with catalytic activities of at least 30 % above the state-of-the-art and redox materials with conversion rates doubling the state-of-the-art

- Solar hydrogen generator in a demonstration range @ 0.5-2 MW scale for high temperature water splitting, with the following targets:
    - Realisation of solar interface (e.g. solar reactor) in the relevant scale
    - Realisation of a closed cycle with all necessary peripheral units
    - Determination of long-term behaviour of the plant
    - Demonstration of hydrogen production and storage on site (>3kg/week)
    - Provision of hydrogen qualities suitable for use in fuel cells
    - Analysis of strategies to transfer technology to the market.

Other Information

The consortium should include innovative SMEs with specific expertise in the field of R&D on new materials as well as design optimization; the project should build upon relevant actions financed under the European Framework Programme or the JTI FCH programme, e.g. those cross cutting actions working on codes and standards for the required hydrogen quantities and qualities of production sites of the future. Links to relevant materials related projects of the European Framework programme should be established. Only one project is to be funded in this call.

Expected duration: Up to 3 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2012.2.6: Pre-normative research on gaseous hydrogen transfer

Rationale

Bringing compressed hydrogen from the point of production to the point of use involves pressure driven gaseous transfer between systems. Apart from the dispensing of hydrogen to a vehicle fuel tank (passenger car, bus or material handling vehicle), such transfers are also performed to deliver hydrogen to a fuelling station or to a stationary application, and may also occur further upstream for filling transportable containers used for the delivery of hydrogen. With pressure vessels constructed in composite materials, which is increasingly the case in the supply chain as well as in the end user application, this transfer must be done such as to avoid overheating from adiabatic compression in the receiving tank by controlling the rate of transfer. In addition, cooling may be applied to the hydrogen stream to limit the maximum temperature reached in the receiving pressure vessel. There is a need to minimize the time required for the transfer, for end user convenience and for minimization of delivery cost to a fuelling station.

There are significant optimization opportunities for performing the transfer as quickly as possible without exceeding temperature limits while minimizing pre-cooling requirements. One such opportunity is to take into consideration the tank characteristics as the temperature increase depends upon the type of tank constructions. This raises the question of characterizing thermal behaviour in a way that it may easily be taken into account for applying the right transfer rate. Another optimization opportunity resides in basing gas transfer control on the material temperature of the receiving pressure vessel rather than on the gas temperature (which is higher).

Overall project objectives / Scope of Work

- Identify, define, and evaluate approaches for optimized trans-filling procedures, with regards to required pre-cooling and/or allowable filling speed
- Evaluate the influence of tank construction on the maximum allowable filling speed

Expected Outcome

- Identification of opportunities for optimization
- Evaluation of potential benefits provided by these opportunities with regards to refuelling performance and constraints, as well as refuelling safety
- Proposed approach for standardization, by means of requirements on both the originating system and the receiving system
- Improved approaches for carrying out the transfer with less pre-cooling, for instance by taking more accurately into account the temperature of the tank materials, as well as the tank characteristics for determining maximum pressure ramp rates.
- Experimental implementation and evaluation of selected approaches
- Recommendations for implementation in international standards

Other Information

The consortium should include hydrogen transfer technology providers, fuel/storage system developers, testing entities, and involve standardization experts.

Expected duration: Up to 3 years

Funding Scheme: Collaborative Project

APPLICATION AREA SP1-JTI-FCH.3: STATIONARY POWER GENERATION & CHP

TARGETS:

A set of targets for the efficiency, lifetime and cost of the main FC technologies has been indicated in the following table as a reference for the expected outcome of any topic of the Stationary Power Generation & CHP area for the AIP 2012. Other specific figures that are included in the topic description represent an addition and complement the table below. This Table is derived from the 2011 revision of the MAIP target table.

Application	**Technology**[19]	**Efficiency**[20] **2015**	**Lifetime/ Durability 2015**	**Cost**[21] **2015**
Small Scale - Domestic 1 - 5 kWe	All technologies	35% to 45% (elec) 75% to 85% total		
Small Scale - Commercial 5 - 50kW	SOFC system	55%+ (elec) 85%+ (total)		4000 €/kW
	PEMFC system	35% to 45% (elec) 80% to 90% total		4000 €/kW
Mid Scale - Commercial < 300kW	SOFC system	55%+ (elec) (b) 85%+ (total)		4000 €/kW (d)
	PEMFC system	35% to 45% (elec) (b) 80% to 90% total		4000 €/kW (d)
Large Commercial/ Industrial Scale - >300kW to < 5MW	MCFC system	47% (elec) (b)	30,000 hrs.	4000 €/kW (d)
	PEMFC system	55% (elec) (b)	20,000 hrs.	3000 €/kW (d)
	AFC system	58% (elec) (a)	16,000 hrs.	850 €/kW (c)
	SOFC system	55% (elec) (b)	20,000 hrs.	<4000 €/kW (d)

Source: Revised MAIP 2011

[19] Fuel cell technologies not mentioned must meet the threshold for relevant fuel within category
[20] System efficiency on LHV basis. AC electricity (a) hydrogen fuel, (b) natural gas/biogas fuel
[21] System cost (c) hydrogen fuel (d) natural gas/biogas fuel

Topic SP1-JTI-FCH.2012.3.1: Cell & stack degradation mechanisms and methods to achieve cost reduction and lifetime enhancements

Rationale

Degradation at cell and stack level is the major challenge to obtain the necessary endurance for relevant field use. Most stationary applications require a high on-line availability, and long endurance is a key feature to meet minimum service intervals and low cost of ownership.

Overall project objectives/Scope of Work

There is an industrial developer requirement for applied research and development activities on cell and stack degradation to improve endurance and maintenance intervals, and to reduce total cost of ownership for relevant applications. Primary focus will be long term (>20,000 hrs.) degradation of cell, interconnect/bipolar plate, sealants and other stack components with a detrimental effect on cell and stack endurance. The call is open to improvements in material composition and coatings, processing and design modifications, but is not open to basic research on new cell and/or interconnect material compositions. The project proposals should be small and focused, including validation of the solutions/methods.

Projects are expected to cover at least two of the objectives from among those listed below:

- Adjusted materials, manufacturing processes and/or operational/design strategies to improve lifetime and tolerance to contaminants
- Robustness to cycling and transient operating conditions
- Longer service interval and lower total cost of ownership resulting from less frequent replacement of stack, filters or contaminant traps

The activities are open to all fuel cell technologies. Proposals need to identify the technology/application specific gaps, and set the targets for critical parameters, including their improvement over the state-of-the-art.

Expected Outcomes

Outcomes must include a minimum of four of the following six top-level items:

- Increased knowledge with respect to the most pronounced degradation and failure mechanisms for stationary applications, including:
    - Slow loss of fuel cell efficiency due to microscopic processes including migration and contamination
    - Delamination
    - Pin-hole formation
    - Interconnect/Bi-polar plate corrosion
    - Sealing fatigue
- Established (accelerated) test protocols and lifetime prediction methods for 20,000+ hours life time

- Tolerance to relevant field contaminants in relevant levels for EU applications/sites based on hydrogen, natural gas and biogas/landfill-gas fuel (i.e. humidity, dust, salt, sulphur, CO, CO2, ammonia, higher hydrocarbons, halogen, siloxane)
- Tolerance to load cycling between idle and rated load with less than 5% total loss of performance (voltage/power) for the rated stack life cycle
- Tolerance to on/off cycling room to operating temperature with less than 5% total loss of performance (voltage/power) for the rated stack life cycle
- Tolerance to typical failure modes, i.e. REDOX, carbon corrosion etc. identified in previous projects with less than 5% total loss of performance (voltage/power).

The project must provide evidence, physical and/or modelling based, of the solution/methods in terms of the metric listed above.

Degradation from vibrations and electromagnetic noise from power electronics is not covered by this topic. Strategies involving improved control strategies are excluded from this topic.

Other Information

The project consortium must include a cell and/or stack manufacturer with an existing cell/stack design, and the project must use this design as point of departure. Additionally, the project must include degradation field data from this existing cell/stack design. The project must be organised to focus on industrially relevant results for near term proof-of-concept and validation, either with the cell/stack manufacturer as project coordinator or with a prominent participation in all main working packages of the project. Other consortium members may include academia, research institutes, and material producers. In addition, projects will benefit from the inclusion of stack end users i.e. system integrators, possibly in an advisory function.

The project proposal must document clear and considerable add-on value compared to previous and ongoing projects funded by the FCH JU.

A maximum of 2 projects are expected to be funded: maximum one for high temperature (>300 C) fuel cell technologies and maximum one for low temperature fuel cell technologies (<300 C).

As a voluntary option, the consortium could consider linking the activities to demonstration projects in order to make a long-term real-life validation.

The consortium should consider if the harmonised testing procedures as developed under the FP6 FCTESQA project (accessible at http://fctesqa.jrc.ec.europa.eu) can be used in addition to its in-house testing procedures.

A combined maximum FCH JU support of up to 3M EUR is available for this topic.

Expected duration: Up to 3 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2012.3.2: Improved cell and stack design and manufacturability for application specific requirements

Rationale

Existing cell and stack designs still fall short in terms of the principle market drivers: robustness, manufacturability, efficiency and cost. These shortfalls must be addressed before the advantages of the technology can be realized.

This topic includes development activities on cell and stack design with the objective of 'trouble shooting' challenges identified in existing cell and stack designs, and providing improvements over existing technology in terms of robustness, performance and cost targets relevant within the application area.

Overall project objectives/Scope of Work

The scope of work covers improved designs for cells and stacks required to meet market entry levels in terms of robustness, efficiency and cost (including power density). The scope includes improvements in cell and stack manufacturing methods supporting the same objectives.

The call is open to a range of fuel cell solutions, including operating ranges, geometries and material improvements, but not to basic research on fundamentally new cell and stack designs. The project proposals should be small and focused, leading to a validated proof of concept and/or manufacturing method. The project proposals should state improvements over the state-of-the-art.

Projects are expected to cover at least three, preferably four of the five top-level objectives from among those listed below:

- Simplification of design and manufacturing methods of cells, stacks and/or stack modules (core power generation units)
- Adaptation of cell and/or stack designs to larger scale applications and system designs
- Cell and stack design improvements, e.g.
  - increasing robustness, performance, power density, and efficiency and/or reducing cost
  - active area optimization, flow field improvements
- Improvement and validation of existing manufacturing methods to increase manufacturing yield and reduce product variation and manufacturing cost
  - Redundant testing of critical manufacturing sub-processes (critical in terms of low yield/high cost)
  - Identification of manufacturing failure modes and implementation of manufacturing control plans to redress these failure modes
- Improved manufacturing methods supporting product robustness and cost reduction and eliminating failure modes in existing manufacturing processes

The activities are open to fuel cell technologies supported in previous and on-going projects supported by FCH JU or FP6. However, the project proposal must document clear and considerable add-on value compared to such projects.

Proposals need to identify the remaining technology specific gaps, set the targets for critical parameters including costs, technical parameters (e.g. efficiency and their improvement over the state of the art), define applications and conditions and develop a structured concept for the development activities.

Expected Outcome

Outcome will include a minimum of four of the following six top-level items:

- Improved electrical efficiency over the state of the art, cf. the target table above
- Better robustness, including better lifetime
  - Operation in simulated real-life environment > 4,000 hours)
  - Demonstration of the potential to achieve longer run times required to meet market entry requirements, cf. the target table above
- Considerable cost reductions consistent with market acceptance requirements for industrial or residential or other relevant applications, cf. the target table above
- Definition of stack/system interface and stack acceptance criteria from a system integration perspective
- Improved manufacturing methods in terms of yield and cost, reducing stack scrap rate to 10% by 2014 and the objective to reduce it to less than 5% by 2017
- Decreased materials consumption/higher power density

All projects must produce evidence, physical and/or modelling based, of lifetimes, cost targets, high efficiencies throughout life and/or advances in manufacturing methods.

Other Information

The project must be organised to focus on challenges en route to successful validation, demonstration and market introduction, including large scale manufacturing, either with the cell/stack manufacturer as project coordinator or with a prominent participation in all working packages of the project.

The consortium must include industry, and may include academia, research institutes, and material producers. Industry must be represented at the very least by a cell/stack manufacturer with an existing cell/stack design, and the project must use this design as point of departure. In addition, projects will benefit from the inclusion of stack end users i.e. system integrators, possibly in an advisory function.

A maximum of 2 projects are expected to be funded: maximum one for high temperature (>300 ºC) fuel cell technologies and maximum one for low temperature (<300 ºC) fuel cell technologies.

Coordination with ongoing projects funded by the FCH JU is required.

The consortium should consider if the harmonised testing procedures as developed under the FP6 FCTESQA project (accessible at http://fctesqa.jrc.ec.europa.eu) can be used in addition to its in-house testing procedures.

A combined maximum FCH JU support of up to 6M EUR is available for this topic.

Expected duration: Up to 3 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2012.3.3: Robust, reliable and cost effective diagnostic and control systems design for stationary power and CHP fuel cell systems

Rationale

Effective diagnosis and control of stationary fuel cell stacks in real systems is vital for CHP plants optimum operation, as it influences their performance, life and reliability, as well as ultimate efficiency, fuel utilization, response times, emissions and waste. For this purpose, it is necessary to develop better means of diagnosing critical parameters affecting the performance and lifetime of stacks, and hence develop a robust control system to optimise system performance under all operating conditions.

"Reliable lifetime prediction" is also required to improve fuel cell system operation for better performance and extended lifetimes, whilst also achieving a better understanding of critical operating conditions and operation strategies. Estimation of degradation as well as its mitigation is extremely challenging research topics.

In order for applications to achieve commercialisation it is vital to implement cost effective methods that can handle real time system control and O&M functions. Advanced control can modify management laws to reduce the effects of system degradation as well as to limit the occurrence of critical operating conditions. This is challenging for systems. Although the basic methods may be elected and refined based on typical systems, the essential differences between, e.g., small- and large-scale systems must be taken into account. For multi-stacks systems, with variations between individual stacks, system lifetime will be dictated by the worst performing (fastest degrading) stack. This requires robust and reliable tools to diagnose and prevent such differences from causing shortened system lifetime.

As heavy instrumentation is expensive, and in several cases it is even impossible to directly measure certain critical the diagnosis and resulting control responses should be based on intelligent indirect methods. Such methods may include e.g. physical state estimate modelling, performance deviation diagnosis by neural networks, and other sophisticated calculation-based approaches.

Overall project objectives / Scope of Work

The project activities are expected to cover most of (but not necessarily all) the objectives listed below:

- Development of advanced methods of diagnosing/predicting deviations in state-of-health between different stacks/stack ‘bundles’ in either small or large stationary systems. To be integrated with advanced control strategies able to optimise FC operations
- Development of advanced diagnostics methods enabling significant reduction of required instrumentation to predict and prevent critical conditions towards enhanced degradation and/or potential sudden failures
- Development of system and BoP (Balance of Plant) related sophisticated diagnostics methods; such as component and system simulation based on-line diagnosis tools are envisaged as a potential part of the activities

- Development of adaptive control algorithms to improve overall FCS performance, via monitoring and diagnosis information, and to enable reliable and cost effective means for system life-time extension
- Control, monitoring and diagnostics oriented models for fuel cell CHP systems. These three are by no means equal, although one "system model" may include elements of all three; be it ranging from first principles to data-based MIMO models, a neural net or regression model, or a mixture of them all
- Implementation of developed methods in a real/simulated system to validate the approach(es)

The activities are open to all types of stationary fuel cell systems. The proposals should identify technology specific gaps, critical parameters and conditions, and identify how the proposal activities will eliminate/narrow these gaps and how critical parameters could be reliably estimated with sophisticated approaches. Results from previous calls especially in topic "Operation diagnostic and control for stationary power applications" should be taken into account where possible.

Expected Outcome

- Improved robust and reliable method(s) for diagnostics and control approach(es) for stationary fuel cell systems.
- Advanced fuel cell lifetime prediction methods.
- Improved and robust fuel cell system control algorithms and hardware.
- Advanced control methods to counter-act diagnosed deviations enabling life time extension of fuel cell systems.
- Integration of advanced control and communication modules.
- Specific targets:
    - Anticipated lifetime of stacks ≥ 20,000 h with state-of-the-art degradation rates (technology specific targets may deviate from each other)
    - Additional cost of diagnosis and control system <100 €/kW with value analysis showing positive effect on system life cycle cost compared to a case where such methods are not used
    - Anticipated reliability figures (e.g. Mean Time Between Failures –MTBF-, availability) according to application and technology specific requirements, corresponding analysis comparison to a case where such method not used

Other Information

The consortium should include industrial system integrators (OEMs) and research organizations specialized in the defined area. Inclusion of SMEs specialized in diagnosis and control application development and stack developers is possible according to need. If stack developers are not included, then proposals must explain how the input from stack requirements will be accommodated and are taken into account (e.g. through other intensive joint collaboration etc.). If several different technologies are submitting projects for the topic, their interaction on general methodological aspects should be ensured.

It is expected that one to a maximum of two small scale, focused, projects will be supported, of two to three years duration.

Expected duration: 3 years

Funding Scheme: Collaborative project

<u>Topic SP1-JTI-FCH.2012.3.4: Component and sub-system cost and reliability improvement for critical path items in stationary power and CHP fuel cell systems</u>

Rationale

It is necessary to improve availability and cost-competitiveness of balance of plant (BoP) components, systems and sub-systems as well as their efficiency, durability and suitability for mass production to meet performance and lifetime targets.

Overall project objectives / Scope of Work

Fuel Cell related sub-system components based on developed stack designs may typically include:

- Power generation unit (integrated stack/ BoP)
- Power electronics
- Reforming and fuel/oxidant processing (including clean up)
- Heat exchangers/thermal management
- Air and fluid flow equipment, including subcomponents
- Fluid supply and management including pumps, turbines, compressors, valves, flow meters, desulphurisation, humidification, gas/CO_2 separation systems from anode exhaust
- Pressurisation devices (e.g. turbine, compressor) for pressurised systems

Projects are expected to cover a range of objectives from among those listed below:

- Novel designs and optimisation of stack integration and non-stack components
- Manufacturing processes and quality control techniques for high performance and cost effective components
- Protection of fuel cell stack from contaminants emanating from BoP components (e.g. chromium release)
- Validation of lifetime, durability/robustness, corrosion rates in application specific environments
- Demonstration of ability of components to meet required life-cycle performances
- Cost assessment vs. target cost and demonstration of considerable cost reduction
- Concepts for reworking, recycling, and/or disposal including cost and environmental impact

The activities are open to all fuel cell technologies, relevant fuels and levels of power.

Expected Outcome

Development of improved components which are:

- viable for mass production and low-cost manufacturing
- provide evidence of realistic component life and maintenance cycle consistent with system life >15 years for large scale and >10 years for small scale applications and consistent with market acceptance requirements achieving cost targets using a manufacturing model with high volume manufacturing targets

Proposals need to identify and will be measured against technology and application specific targets:

- Micro- and small systems (<10 kWe): <5% parasitic power loss based on input fuel LHV. A major loss occurs in the DC→AC conversion, the specific efficiency target for the inverter is >95%; BoP electrical efficiency >95%
- Medium- and large systems (>10 kWe): <3% parasitic losses based on input fuel LHV. The specific efficiency target for the inverter is >97%
- System investment cost incl. fuel processing, but excl. FC stack for small systems (5-10 kWe) of <2,300 €/kW in mass production
- System investment cost incl. fuel processing, but excl. FC stack for medium- and large systems (>10 kWe) of <1,750 €/kW in mass production
- System reliability expressed as an O&M-cost (excl. FC stack, but incl. fuel processing) for micro- and small systems (<10 kWe): <5 €/MWh
- System reliability expressed as an O&M-cost (excl. FC stack, but incl. fuel processing) for medium- and large systems (>10 kWe): <1 €/MWh
- The cost contributions of capital cost and operational cost (including efficiency and maintenance) may be alternatively demonstrated in terms of Cost of Electricity over the product lifetime
- Regarding thermodynamic characteristics of the components, particular target performance figures have to be specified in the proposal (e.g. efficiencies or losses under well-defined operating conditions) as they cannot be defined in advance here. These targets have to reflect the progress intended to be achieved within the project

Other Information

The consortium should include system integrators (OEMs) and component and stack suppliers, including opportunities for academia, research organisations and SMEs in specialised areas. A maximum of up to 3 projects are expected to be funded. Coordination with ongoing projects funded by the FCH JU is required. However, the project proposal is required to document clear and considerable add-on value compared to previous and ongoing projects funded by the FCH JU.

Expected duration: Up to 3 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2012.3.5: System level proof of concept for stationary power and CHP fuel cell systems at a representative scale

Rationale

In order to exploit technology and design improvements at the stack, subsystem and system control level, projects are needed which will lead to advanced fuel cell systems proving their performance and viability against specific stationary application requirements. Proof-of-concept (PoC) is a necessary step which should precede validation and demonstration activities. It will assess system performance against a range of functionalities required by any stationary application, close existing gaps and highlight areas where further development steps may be required.

Overall project objectives / Scope of Work

This topic will support the development and construction of PoC fuel cell systems for any stationary application and fuel cell technology, and show interaction with other devices required to deliver power, with or without heat, and/or cooling to end-users, and which will draw upon appropriate fuel supplies, utilising any necessary processing technology. PoC systems will need to demonstrate their ability to meet end-users' requirements and expectations. Key functionalities include: performance, robustness, ease of use (including fully-automated operation), and the potential to meet industrial cost targets for the targeted application(s)/market(s) when produced in large quantities. System integration is expected to make use of the most advanced technologies at the stack, subsystem and control levels.

Projects are expected to cover a range of objectives from among those listed below:

- Development of PoC prototype systems that combine advanced components into complete, fully integrated systems
- Integration and testing of PoC prototype systems complete with fuel delivery and processing sub-systems; interface with devices necessary to deliver power, with or without heat and/or cooling
- Assessment of the fuel cell system's ability to successfully compete with existing technologies operating in the target application(s)/market(s)
- Dissemination of results to industry and research
- Novel system architectures, including new fuel processing and storage materials and processes
- The PoC system will be required to comply with all relevant CE regulations and international fuel cell system standards

The activity is open to all fuel cell technologies, relevant fuels and electrical power output provided that the market potential of the proposed combination is also proven. Proposals need to identify – and will be measured against – technology- and application-specific targets.

Expected Outcome

- Proof of feasibility of integrated fuel cell units by demonstrating sufficient duration (i.e. several thousand hours), including operation in a simulation of a representative real life context
- Proof of potential to achieve targets required by targeted application(s), consistent with market acceptance requirements such as system cost, system life and system reliability and thorough cost analysis
- The proof-of-concept system must comply with relevant CE regulations and international fuel cell system standards

Other Information

The consortium should include (future) system integrators (OEMs) and component and stack developers and suppliers together with end-users. A maximum of 3 projects will be funded.

Expected duration: Up to 3 years

Funding Scheme: Collaborative project

Topic SP1-JTI-FCH.2011.3.6: Validation of integrated fuel cell system for stationary power and CHP fuel cell systems

Rationale

Prior to deployment in large-scale demonstrations, fully integrated systems must be tested under real-world conditions by end-users who are representative of the target stationary markets. By completing the validation phase in the overall development cycle, disappointment in the market can be avoided, since a small, well prepared number of representative end-users can provide valuable feedback to system integrators and their suppliers on those aspects which require further refinement before commercialisation. Manufacturing routes also need to be identified in order to establish a sustainable path to commercialisation. This readiness will be validated by performing demonstration tests from fuel input to power output. Additional services such as heating, cooling may be included for validation.

Overall project objectives / Scope of Work

This topic will support the transfer of proof-of-concept fuel cell systems into a validated system that will then be ready for demonstration in larger series. All stationary applications and technologies are eligible. However, from the start of the project, the fuel cell system must demonstrate a level of maturity consistent with the outputs listed in topic 2012.3.5.

Successful projects in this topic will focus on achieving improvements to the fuel cell system by incorporating lessons learnt from “real-world” operation and feedback from end-users by daily operation. By the end of the project, systems should be ready to be deployed in large-scale demonstrations without the need for further significant re-design.

Proposals must demonstrate that an appropriate level of system maturity has been achieved at the start of the project and that there is proven market potential in the targeted application area (domestic, commercial or industrial).

Projects should verify relevant technology approaches to specific applications and markets by demonstrating full systems in operation under these requirements over sufficient periods of time. In addition, they would be expected to focus on:

- Meeting the relevant application needs in representative environments
- Whole system validation, including build, supply chain, costs and end-of-life considerations
- Establishment of quality-control procedures and techniques to ensure quality and safety of the system
- Integration into an anticipated real world environment
- Consideration of maintenance and repair issues, to reduce downtimes resulting from foreseeable failure mechanisms

The validated system should show that it is capable of achieving costs which will allow it to successfully compete in the target market(s).

Proposals must identify – and will be measured against – technology- and application-specific targets.

Successful proposals will include consideration of:

- manufacturing process(es)
- integration of the hardware necessary for the validation tests and related costs
- engineering support for the test itself

Expected Outcome

Projects shall include at least three of the following outcomes:

- Validation of fully integrated systems that fulfil specifications required by end-user(s), including identification of a path to mass-production at a defined quality and cost
- Proof of successful integration in the anticipated real world environment
- Operation in real-life environment (> 4,000 hours) without a hardware change
- Demonstration of the potential to achieve longer run times required by the application area by extrapolation of test data, and identification of failure mitigation strategies by design and/or maintenance and demonstration of the ability to meet market entry requirements
- Validate maintenance and repair strategies that demonstrate ability to meet reliability and robustness targets required by the target application area/market.
- Incorporation of feedback from other RD&D activities in order to remove technical barriers to successful large-scale demonstration
- System compliance with all relevant CE regulations and international fuel cell system standards
- Identification of pre-normative RCS in the targeted application(s)/market(s)
- Easily understandable documentation on technology status for dissemination to potential end-users

Other Information

The consortium should include a system developer, a system integrator (OEMs who may or may not be the same organisation), an end-user and may also include a relevant fuel supply company. The inclusion of component and stack suppliers is advised. A maximum of 3 projects can expect to be funded.

Expected duration: 3 years

Funding Scheme: Collaborative project

<u>Topic SP1-JTI-FCH.2012.3.7: Field demonstration of large scale stationary power and CHP fuel cell systems</u>

Rationale

Large scale projects are the final step in the development cycle, and critical to establish system viability which is required for successful market deployment.

Successful projects will make an important contribution to realising the objectives of the MAIP, and will demonstrate the ability of fuel cells to play a key role in distributed generation and larger industrial applications by achieving reduced costs per kW. They will also provide an opportunity to develop expertise in operating and maintaining fuel cells.

Demonstrations will also increase public awareness in Europe’s regions and municipalities, will provide opportunities for building local support structures and may potentially attract further support from local and regional governments.

The demonstration projects shall be performed in real application environments and include interfaces with the infrastructure for electricity supply as a minimum, and for heating, and/or cooling where appropriate. Based on the end-user requirements, projects may interface with renewable fuels, smart grids, fuel/oxidant processing or other systems as necessary. These options must be a strategic component of the energy policy of the end-user, in order to convince other end-users, integrators etc. of the relevance of fuel cells for stationary applications.

Overall project objectives / Scope of Work

Projects must prove that submitted technology has undergone both a system level proof of concept (similar to topic 3.5 of this call) and validation of integrated full scale review (similar to topic 3.6 of this call) before submitting to this field demonstration call.

In addition, projects are expected to cover a range of objectives including most of those listed below:

- Must address how this system will tackle potential reliability issues (redundancy in design, installation of multiple units etc.)
- Install complete integrated systems/applications with significant power generation capacity (> 100 kWe) per system
- Develop the potential for European businesses to realize supply chain opportunities
- Demonstrate integration into power, and where appropriate heat, and/or RES and/or smart grids
- Gain operating experience and identify improvement areas for future projects
- Estimate the full life cycle costs and revise periodically this estimate
- Show a strong commitment towards the running of the system by the operator after the end of the support phase. Note that stack changes can be sponsored as part of the project.

Given that the projects will be in a real environment, they will face tight requirements, for reliability or availability, codes, standards and type approval. Therefore, they need to demonstrate a sufficient level of technology readiness.

The activities are open to all fuel cell technologies, common infrastructure and other fuels and field of applications with relevant power generation capacity.

Expected Outcome

As part of this topic, the following objectives have been defined:

- Installation and operation of one or more identical system; each system to provide at least 100 kW with on-stream availability of 95% or higher, for a minimum of 15,000 hours
- The opportunities to maximise European contribution to the supply chain should be addressed
- Target efficiencies, cost and lifetimes must be demonstrated with a thorough techno-economic analysis, which shows that the long-term minimum performance targets are achievable, in order to make the fuel cell system an acceptable proposition to end-users. This may be expressed as a lifetime Cost-of-Electricity including both capital and operational costs
- Environmental sustainability: assessment by means of Life Cycle Assessments studies should be carried out according to the requirements in the FC-HyGuide guidance document (available at: http://www.fc-hyguide.eu/).
- Identification of barriers or risks to full implementation
- Public awareness: strong dissemination efforts to a wider audience, preferably to potential customers and to industrial stakeholders, shall be included

Other Information

The consortium may include system integrators (OEMs), component / stack suppliers (who may or may not be the same organisation) and end-users (also electrical grid operators), including opportunities for academia, research organizations or SMEs in specialized areas. The projects may be coordinated with ongoing and upcoming projects in verification and validation and may be co-funded by national, regional or private sources in order to demonstrate a strong commitment towards the 2020 European energy policy.

A link to project activities under the EU Smart Cities and Communities Initiative could be considered as a non-compulsory option.

A maximum of 2 projects may be funded with a duration of between three and five years. A combined maximum FCH JU support of up to 12M EUR is available for this topic.

Expected duration: Minimum 3 years

Funding Scheme: Collaborative project

<u>Topic SP1-JTI-FCH.2012.3.8: Field demonstration of small scale stationary power and CHP fuel cell systems</u>

Rationale

Complete fuel cell systems need to be demonstrated and proven to pave the way for large scale deployment. These demonstrations must be performed in real application environments which include interfaces with the infrastructure for power, heat, and fuel/oxidant processing as necessary. Demonstrations in European regions/municipalities will in addition increase public awareness, build local support capabilities and potentially may attract further support.

The number of systems needs to be significant in size in order to substantially contribute to the completion of the 2015 installed capacity objectives described in the MAIP and the technology outlook on the European sector ambition 2015 and beyond.

In order to better address the requirements of electricity grid operators, the system design preparation for smart grid integration should be addressed.

Overall project objectives / Scope of Work

Projects need to cover a range of objectives from among those listed below:

- Must prove that submitted technology has successfully undergone both a system level proof of concept (similar to call topic 5) and validation of integrated full scale review (similar to call topic 6) before submitting to this call.
- Install complete integrated systems (electrical power <100kWe) in sufficient numbers to build confidence by redundancy (exceeding 25 identical units in the range 1-10 kWe, at least 3 identical units for units > 10 kWe)
- Must address how this system will tackle potential reliability issues (redundancy in design, installation of multiple units etc.)
- Demonstrate integration into existing power and heat infrastructures and potentially smart grid infrastructures
- Demonstrate capture of heat generated by the fuel cell sub-system and deployment within the home heat and hot water systems, to show genuine CHP operation at total efficiency >85% (LHV)
- Increase the operational experience (incl. maintenance) of fuel cells in Europe
- Provide for training of personnel for installation and maintenance
- Estimate the full life cycle costs and periodically revise this estimate
- Demonstrate the commercial mass manufacturability of the designs to be trialled, including volume capable supply chains. Help build the supply chain and support activities for complete systems

Given that the projects may face tight reliability constraints, they need to demonstrate sufficient levels of technology readiness and capacity to meet key challenges (cost reduction curve to meet 2015 and 2020 targets indicated in the MAIP) these include having undergone both a system level proof of concept (see call topic 5) and validation of integrated full scale review (see call topic 6). Redundancy through different technology solution providers is encouraged, but not critical, in order to minimize the chance of failure for the operator.

As the purpose of this topic is to develop a fleet of small scale applications, investments may be significant. It is therefore required that the project describes the concept for the duration of the support program as well as the operation thereafter. For instance, the project could consist of a period of manufacturing, installation, “normal operations”, optimization, reliability improvement and first stack change (3-4 years, supported by the call).

Expected Outcome

Successful demonstration of FC-based integrated generator systems that provide:

- Required efficiencies (minimum 80%, total efficiency), cost (below 20,000 € per unit installed) and lifetimes (8 to 10 years) which must be demonstrated through a thorough techno-economic analysis, indicating the minimum performance to be achieved in order to provide an acceptable initial proposition to consumers
- Identification of barriers or risks to full implementation
- Identification of benefits and risks considering integration with future smart grids
- Proof of suitable supply chain and field support concept
- Feedback to RD&D activities on required mitigations
- Environmental sustainability assessment
- Dissemination efforts to a wider audience, preferably to potential customers and to industrial stakeholders (also electricity grid operators)

Other Information

A strong commitment towards the running of the system after the end of the support phase should be evident.

The consortium could include system integrators (OEMs), component and stack supplier’s service providers (e.g. installation and maintenance providers) and end-users, including opportunities SMEs in specialized areas.

The project will be coordinated with ongoing and upcoming projects in verification and validation and may be co-funded by national, regional or private sources in order to demonstrate a strong commitment towards the 2020 European energy policy.

A link to project activities under the EU Smart Cities and Communities Initiative could be considered as a non-compulsory option.

A maximum of 2 projects are expected to be funded, with a duration of three to five years. A combined maximum FCH JU support of up to 12M EUR is available for this topic.

Expected duration: Minimum 3 years

Funding Scheme: Collaborative project

APPLICATION AREA SP1-JTI-FCH.4: EARLY MARKETS

Topic SP1-JTI-FCH.2012.4.1: Demonstration of fuel cell-powered material handling equipment vehicles including infrastructure

Rationale

The powering of material handling equipment (MHE) vehicles is a promising early market application of fuel cells and hydrogen. The technology has already been adopted, particularly in North America, by industrial end-users who have commenced fleet implementation and hydrogen re-fuelling system solutions, at the individual site level. To promote European based technology and commercialisation of hydrogen and fuel cells for MHE, vehicles demonstration at the fleet level of the latest fuel cell technologies is required in order to prove out performance and reliability for customer acceptance and also to enable system and hydrogen infrastructure cost reductions. Demonstration projects are needed at several end-user sites/MHE applications in order to clearly show that the total cost of ownership can be appreciably reduced using a developed fuel cell technology and the demonstration focus should be on MHE applications where hydrogen and fuel cells show a clear benefit to the end user (e.g. in terms of savings, increased output, emission reduction etc.).

Overall project objectives / Scope of Work

- Projects shall focus on achieving a cost competitive Total Cost of Ownership (TCO) compared to conventional MHE vehicles (battery, LPG and/or diesel) with the inclusion of FCH-JU support. This may be in one or several types of any MHE vehicle application where a competitive TCO can be achieved
- Projects shall be based on a fuel cell technology platform with high credibility for fleet level MHE vehicle demonstration, but where the proposed project activities will achieve or exceed cost, efficiency and durability benchmarks to provide a clear advantage to the end-user over incumbent technology
- Projects should show clear cost targets within the project for the different applications addressed, documenting a competitive TCO, as well as showing performance improvements and/or cost reductions achieved by the development work and demonstration unit volumes
- Projects shall evaluate achieved benefits (e.g. in terms of savings, increased output, emission reduction, operating hours etc.)
- Projects should contribute to the setting of clear technical targets on costs, durability, efficiency and serviceability in order to establish a path forward for commercial deployment.
  Targets should be specific and relevant for the MHE vehicle type(s) to be developed, demonstrated and commercialised for future deployment. Indicative targets could be:
  - Total cost of fuel cell system (at early volume production): <€3,000/kW (for fuel cell systems >3kW)
  - System lifetime (with service/stack refurbishment): >7,500 hours

    - Fuel cell system efficiency (tank to wheel): >45%
    - Refuelling time: 3 min
    - Hydrogen price dispensed at pump (end-user price): <10 €/kg
    - Availability of vehicles & refuelling to match conventional & competing technologies
- Projects should show a solid approach for permitting and provide clear recommendations with regards to the Regulation, Codes and Standards (RCS) that are needed to facilitate permitting and commercialization of HFC technology for the material handling application(s) addressed
- The projects should be based on business plans and committed partners to continue on the pathway to volume deployment and roll-out to commercial market introduction

Expected Outcome

- Demonstration shall comprise at least 200 or more fuel cell MHE vehicles at one or across several end-users sites and applications proving a commercial customer value proposition. Demonstration should include necessary and relevant supporting hydrogen supply infrastructure
- Clear TCO evaluations for each application shall be delivered together with cost targets for formulating future deployment schemes and mechanisms
- Environmental sustainability: assessment by means of Life Cycle Assessments studies should be carried out according to the requirements in the FC-HyGuide guidance document (available at: http://www.fc-hyguide.eu/)

Other Information

The project consortium should be lean focusing on demonstration activities, and may include for example system developers, materials handling equipment providers, technology providers and support for permitting and RCS development, fuel suppliers, end-users or other relevant types of actors. They should focus on the maximum number of MHE vehicles for demonstration e.g. by pooling of several end-users through joint project constellations. The project should be coordinated with material handling demonstration projects funded under previous 2009, 2010 and 2011 calls.

Expected duration: Up to 5 years

Funding Scheme: Collaborative Project

Topic SP1-JTI-FCH.2012.4.2: Demonstration of portable generators, back-up power and Uninterruptible Power Systems

Rationale

Back-Up Power (BUP) and Uninterruptible Power Systems (UPS), together with base load power supply, are promising early market applications for fuel cells and hydrogen and these technologies are being taken up by end-users in the telecoms, utilities, IT and other industry sectors. The potential to move into formal system implementation in the field is driven by the Total Cost of Ownership (TCO) gains resulting from the substitution of diesel gensets and batteries by hydrogen fuel cells. These gains can be very significant in areas where grids are unstable (Asia, Africa, etc.) but are still significant in Europe where grid networks are quite stable.

To promote European based technology commercialisation of hydrogen and fuel cell solutions for BUP and UPS applications (and where applicable base load power systems) needs to be demonstrated at representative end-user sites and against specific end-user requirements to show that acceptable performance, reliability and lifetime targets can be met and that a lower total cost of ownership can be achieved. In the telecom sector the trend is for a reduced power requirement per site and 1-3 kW scale BUP and UPS systems are becoming more prevalent. However, site consolidation is also occurring with multiple operators co-locating their equipment and using the same BUP or UPS system, and providing base power for all system requirements. The major part of the market can be reached with solutions up to 10 kW but TCO gains for fuel cells might be found for systems of up to 50kW in off-grid applications.

Overall project objectives / Scope of Work

The overall objective is to deploy BUP or/and UPS units that can show a cost competitive total cost of ownership (TCO) when compared to legacy solutions (battery and diesel generators). The demonstration focus will be in the power requirement range of 1-10 kW or up to 50 kW on an exceptional basis. Fuel cell BUP and UPS demonstration sites could include more than one power range and type of fuelling solution (hydrogen logistics or on-site reforming of multiple fuels as well as integration with renewable sources where available).

Projects need to:

- Utilise latest development pathways (at the component and full system level) to establish technology platforms with improved reliability, life-time and cost prediction that already show credibility for future volume manufacture and roll-out, and providing a demonstrable advantage to the end-user over incumbent technology
- Measure and evaluate achieved benefits (e.g. in terms of savings, maintenance, emission reduction, operating hours)
- Contribute towards the determination of clear technical targets on costs, durability and reliability in order to establish a path forward for commercial deployment
- Provide for training of personnel for installation, fuelling, maintenance and service
- Provide clear recommendations for the establishment of the Regulation, Codes and Standards (RCS) framework needed to permit and to facilitate the commercialization of HFC technology for the application(s) addressed

- Be based on business plans and committed partners to continue the transition to volume deployment and future market introduction
- Disseminate results to wider audiences, preferably to potential customers and to the application stakeholders

The fuel cell systems to be demonstrated will need to meet key challenges resulting from increased operation such as LHV average electrical efficiency of 50% (35% for reformate based fuel cell systems) and > 1,000 cycles capability. Ideally one scalable system technology can be used to address a broad range of power requirements so as to simplify service and maintenance and to minimise spare parts inventory.

Expected Outcome

- Demonstration shall comprise a sufficient number of sites and a sufficient number of systems (for example up to 10 in the 1-3 kW range, 5 in the 6-10 kW range or 3 systems in the 11-50 kW range) in order to prove a technology solution and commercial customer value proposition thereby leading to a strong potential for future commercial supply without support
- Technical requirements that the proposed systems should include:
  - Reliability >95%
  - Response time of less than 5 ms
  - Projected lifetimes of 3 to 5+ years
  - Target system cost: 3,500 €/kW (if fuel cell system alone is considered); 6,000 €/kW (if fuel cell system + hydrogen generator is considered)
  - Projected number of start-stop cycles 2,000
- Demonstrate a viable hydrogen supply solution for this application
- Demonstration activities should ensure the continuation of efforts in large scale deployment projects and/or market introduction
- Environmental sustainability: assessment by means of Life Cycle Assessments studies should be carried out according to the requirements in the FC-HyGuide guidance document (available at: http://www.fc-hyguide.eu/)
- Systematic identification of technology benefits at system level compared to conventional technologies and TCO evaluations for each application shall be delivered together with cost targets for formulating future deployment schemes and mechanisms for the targeted sectors and markets including wide dissemination to the potential end-user industries and institution

Other Information

The project consortium should include a mix of sector relevant end-users (telecoms, utilities, IT, hospitals and other applicable industry sectors), equipment OEMs or/and service providers, fuel cell system developers and fuelling infrastructure or fuelling replenishment providers, alongside research organizations (testing) and certification agencies.

The delivery of BUP or/and UPS units for field demonstration should be achieved within one year of project commencement. Proposals should indicate a clear commitment of end users and/or service providers to continue with fuel cell system commercialization and technology deployment in Europe and or external market regions post project completion. The project should be coordinated with similar demonstration projects funded under previous 2009, 2010 and 2011 calls.

Expected duration: Up to 3 years

Funding Scheme: Collaborative project

<u>Topic SP1-JTI-FCH.2012.4.3: Research and development on fuel supply concepts for micro fuel cell systems</u>

Rationale

Micro fuel cell applications in power ranges between 50-500 W based on PEM or SOFC require appropriate fuel supply systems. Proposals are sought that address novel approaches for application-specific fuelling requirements of micro fuel cells to achieve a significant higher power density than competing modern Li-Ion-battery systems.

Overall project objectives / Scope of Work

Projects should focus on novel approaches for fully integrated systems including required logistics and distribution channels to meet application and infrastructure requirements. Fuelling options may include hydrogen, direct methanol, DME, propane, LPG, diesel or gasoline as well as suitable containers for fast replacement and safe transportation where appropriate. The fuel supply system including fuel container and reformer unit shall enable an overall energy density of at least 500 Wh/kg and 500 Wh/l to allow future fuel cell system competition with modern Li-Ion-battery systems.

Scope of work may include: research and development, validation testing, demonstration procedures for the required operational and safety properties and production methods to achieve price targets of future mass markets. The fuelling systems routes to be developed may be based on novel approaches as, among others, hydrides, micro-reforming of carbon-containing fuels, or direct feeding for high temperature fuel cells using new materials and/or new mass production methods to reach ambitious price targets.

Projects must include also dissemination of results to industry and research organizations.

Relevant PNR activities and RCS links must be included, where appropriate.

Expected Outcome

- Development of new fuelling systems that meet application targets and the integration of the new fuel supply concept in a complete fuel cell system
- Development of test procedures, including accelerated testing, and characterization protocols based on application specifications
- Integration of a demonstrator of the fuel supply system with a fuel cell

Other Information

Consortia should include industrial companies, research organizations, innovative SMEs with expertise required in the field of:

- Research and/or industry test facilities
- Fuel supply system integration
- System analysis including FME

- User (OEM) requirements

One project may be funded with up to €0.7 million from the FCH JU.

Expected duration: Up to 3 years
Funding Scheme: Collaborative Project

Topic SP1-JTI-FCH.2012.4.4: Demonstration of portable fuel cell systems for various applications

Rationale

Europe has only a very narrow technology base in portable fuel cell systems and related fuelling options, particularly below 100W, which limits opportunities to address a wide number of early market segments which have been shown elsewhere to be attractive for early commercial introduction, such as:

- Construction site tool recharging
- Emergency and/or remote power
- Powering recreational applications (for camping, caravanning, boating etc.)
- Personal portable power / powering consumer electronics
- Educational devices

Development of portable power technologies would also potentially overlap into applications such as powering autonomous airborne and ground vehicles and small auxiliary power units for vehicles, particularly if the fuelling capability is extended across the fuel spectrum to include conventional and renewable liquid fuels.

Consortia involving SMEs who have already built prototypes combined with the expertise of research institutions, driving development of new application specific prototypes with a focus on performance and cost improvement and design for manufacture to reduce material and assembly costs will be a primary project focus. Dissemination across sectors and development of a European supply chain will strengthen the European portable fuel cell industry, its technical expertise, and design for manufacture and production pathways towards future volume production of portable fuel cell systems.

Overall project objectives / Scope of Work

The topic is open to all types of fuel cell technology (low and high temperature) and related key components, provided they can sufficiently demonstrate their ability to meet application and user specific requirements using any suitable (including logistic) fuel source. Electrical power output should be between 5 W and 100 W_e. If possible and applicable, intelligent use of waste heat is recommended.

The objective is to develop complete systems, ready to be used by specified end users. Thus the system development may include:

- Stack
- Fuel storage
- Fuel processing (if required)
- Balance of plant components
- Power electronics and controls integration (if required for the application)

Projects should provide clear recommendations for the establishment of the Regulation, Codes and Standards (RCS) framework that is needed to facilitate the commercialization of these micro fuel cell technologies.

Where appropriate and technically feasible, the system shall be designed on a modular basis to allow scale-up and scale-down for a wider range of application requirements.

Expected Outcome

- Proof of concept stacks, key components, fuel supply and complete systems meeting application specifications;
- Demonstrate system operation with electrical efficiencies in the order of 30%+ (based on a logistic fuel input),
- Implementation in high volume/low power unit applications such as portable, educational and/or electronic devices
- 1,000 h lifetime including 100 start-stop cycles and specific size and weight of less than 35 kg/kW and 50 l/kW (fuel amount excluded);
- System validation through systematic and widely agreed testing protocols/activities, demonstrating a cost prediction for mass production of less than 5,000 €/kW;
- A modular fuel cell technology capable of adaptation to other markets;

Other Information

The consortium should include research and development partners for new ideas, sufficient industrial capacity for commercialization, and at least one end-user / system integrator as a consortium partner as well as support for RCS development. The proposal should cover a mix of RTD, proof of application specific concept, and initial field demonstration of the application specific technology. Involvement of innovative SMEs is strongly encouraged and where appropriate their coordination of the project is also desirable. IPR should be in place at the start of the project with a view for later development. End-user(s) should be involved throughout the project, during early design stages and system validation and testing activities, which may be conducted in research organizations/facilities. Final systems may be flexible for application in several markets to reduce commercial risk and aggregate for reduced cost of production / assembly and market entry. Costs of mass manufactured final systems should be identified in conjunction with end-users or from using commercially experienced production specialist sources.

Up to two projects may be funded under this topic.

Expected duration: Up to 4 years

Funding Scheme: Collaborative Project

Topic SP1-JTI-FCH.2012.4.5: Research and development of 1-10kW fuel cell systems and hydrogen supply for early market applications

Rationale

Further development efforts are needed to create market competitive fuel cell systems in the 1kW to 10 kW range. The applications targeted will be stationary distributed power and forklifts. This topic is for proving cost reductions and improving performances, such as energy efficiency and durability of fuel cell systems and stacks. The hydrogen will be produced from feed stocks such as Water, Ammonia, Methanol, Ethanol and Bio fuels or Bio gases. The development efforts are to focus on reaching targets that enable a commercial market use.

Overall project objectives / Scope of Work

Development of new generation high performance, durable and cost-effective fuel cell systems in the 1-10kW power range for early markets such as long term back-up power, UPS distributed power and material handling equipment. Full concepts across the entire value chain should be pursued both addressing fuel cell system and hydrogen cost.

Emphasis should be on development efforts that help:

- Reduce cost of the fuel cell system by optimization of Balance of Plant components (fewer and more efficient components e.g. air/hydrogen compressors, multipurpose components/valve blocks)
- Improve efficiency of the fuel cell system by optimal power management (e.g. increase of breaking power utilization through use of batteries and/or super capacitors)
- Reduce cost of hydrogen by new innovative supply concepts (e.g. onsite or integrated production or new distribution methods)
- Enlarging the number of applications by using renewable feedstock

The following main elements should jointly be addressed within the same project:

- Hydrogen supply including either distribution or onsite-production concepts with various feedstocks (1 feedstock to focus on per proposal).
- Fuel cell systems, balance of plant components and hybridisation / power management

Expected Outcome

Projects should develop and conduct laboratory testing of new fuel cell system prototypes and hydrogen supply components, verifying reaching of the below listed 2015 targets that enables a full commercial use. At least one of the below listed markets should be addressed by a project, and if justified several applications may be addressed within the same project. Accomplishing or exceeding this list of targets for at least one addressed market has to be demonstrated on at least one prototype.

Heavy duty material handling vehicle targets

- Hydrogen cost at point of consumption <€10/kg with renewables at a production of 1,000kg a day.
- Fuel cell system cost <€1,500/kW (@ >1,000 units per year)
- Fuel cell system efficiency >45%
- Fuel cell system life-time 15,000 hours (fuel cell stack 15,000 hours) – with regular/cost effective maintenance/refurbishment

Stationary – (long-term blackouts every day) targets

- Fuel cell system cost €2,500/kW (including H2 generator) (@ >500 units)
- Fuel cell system efficiency 45%
- System life-time 20,000 hours (fuel cell stack 20,000 hours)
- System efficiency >30% when working with an integrated hydrogen generator

Projects should further detail the above targets in the proposal showing that these on a total cost of ownership basis enables a commercial use in the markets addressed. Also proposal must define their state-of-the-art level, current bottlenecks, the specific progress to be achieved within the project and the development approach to achieve these targets. A roadmap to mass production with intermediate commercial targets through volume build-up shall be delivered.

Other Information

Consortia should include relevant partners to ensure sufficient coverage of the value chain behind the product application(s) and their markets, e.g. research organisations, component suppliers, system integrators and product OEMs. Consortia should be capable of showing a committed development and business approach and to the markets and products in focus, both providing a strong past track-record of activities as well as dedicated efforts and plans to further commercialise and market introduce the products.

Expected duration: Up to 3 years

Funding Scheme: Collaborative Project

APPLICATION AREA SP1-JTI-FCH.5: CROSS-CUTTING ISSUES

Topic SP1-JTI-FCH.2012.5.1: Hydrogen safety sensors

EU/US Common Topic

Rationale

This topic will address application-specific requirements (including sensor placement) for key near-term end users, assess performance targets in light of those requirements, identify gaps in sensor development and validation, and identify and conduct R&D and testing to facilitate the cost-effective development, testing, and application of hydrogen safety sensors.

As more hydrogen facilities are placed in service, selection of effective sensors for a given application requires evaluation and focusing of performance specifications. Many types of hydrogen safety sensors are available in the market, and emerging technologies and products may provide faster, more reliable and more sensitive detection of hydrogen under a broader range of ambient conditions. Nonetheless there are still improvements to be made to develop and fabricate cost-effective commercial products. Furthermore a collection of feedback from current sensor 'end-users' in terms of where and how sensors are being used, issues arising from their use (maintenance, calibration, performance etc.) will provide valuable insight as to how best to deploy these safety devices effectively.

Overall project objectives / Scope of Work

Provide a comprehensive evaluation of commercially available hydrogen safety sensors, strengths and weaknesses of sensor technology types, laboratory and field performance data, emerging sensor technologies and performance trends, selection and laboratory testing of the most applicable and promising technologies for key near-term applications.

Expected Outcome

- Assessment of (i) the SOA of hydrogen sensor technologies, (ii) recommendations for their effective deployment (including placement) for near-term applications and (iii) issues facing their cost-effective manufacture and barriers to commercialisation
- Implications and recommendations for sensor requirements (including placement) in regulations, codes and standards
- R&D and testing and validation in laboratory and field conditions as needed to address critical gaps in safety sensor technology
- A compendium of existing applications and feedback on 'real-life' sensor performance, experiences and best practices to identify recommendations for their more effective deployment

Other Information

Eligibility criteria: Any proposal submitted to the FCH JU will be eligible only if coordinated with a US proposal submitted in parallel to the US DoE. This coordination should be balanced in terms of the R&D efforts deployed by the EU and US respectively.

Expected duration: One year

Funding Scheme: Coordination and Support Action

Topic SP1-JTI-FCH.2012.5.2: Computational Fluid Dynamics (CFD) model evaluation protocol for safety analysis of hydrogen and fuel cell technologies

Rationale

Hydrogen safety issues must be addressed in order to ensure that the wide spread deployment and use of hydrogen and fuel cell technologies can occur with the same or lower level of hazards and associated risk compared to the conventional fossil fuel technologies. CFD is increasingly used in safety analysis to investigate relevant accident scenarios related to the production, storage, distribution and use of hydrogen. CFD is a powerful numerical tool but it requires also a high level of competence and knowledge in order to be applied in a meaningful way.

In order to apply CFD with a high level of confidence on the accuracy of the simulation results, two main issues have to be address: the capability of the CFD models of accurately describing the relevant physical phenomena and the capability of the CFD users of following the correct modelling strategy in applying correctly the CFD analysis.

The CFD Model Evaluation Protocol aims to be the reference document for all CFD users both to assess their capability of correctly using the codes and to evaluate the accuracy of the CFD models themselves. The Protocol would be beneficial for all the CFD users (like industry) but also for regulatory/certifying bodies that have to provide permission for hydrogen vehicles and/or for construction of hydrogen infrastructure/facilities. Regulatory/certifying bodies will have a document that helps them evaluating whether the CFD analysis supporting permission requests is scientifically sounded or it is a meaningless calculations.

Overall project objectives / Scope of Work

The objective of the projects will be the development of a Model Evaluation Protocol for assessment of CFD models/codes accuracy for hydrogen and fuel cell technologies. The Protocol will contain the procedures, recommendations and the criteria on how to perform the scientific assessment of the CFD models by means of validation benchmarking exercises based on comparison between simulation results and experimental measurements. Accidents related to hydrogen and fuel cell technologies typically follow a standard sequence: an accidental release, the mixing of hydrogen with air to form a flammable mixture, the ignition of the flammable cloud and depending on the conditions, a fire or an explosion (deflagration or/and detonation). For each stage, a Model Evaluation Protocol should be developed, including an experimental matrix for validation.

Expected Outcome

A Model Evaluation Protocol including procedures, recommendations, and criteria for the scientific assessment of CFD models/codes will be defined for the modelling of:

- Source term and mixing of hydrogen with air in release of gaseous hydrogen
- Source term and mixing of hydrogen with air in release of liquid hydrogen
- Source term and mixing of hydrogen with air in release of hydrogen through permeation
- Ignition

- Hydrogen fires
- Hydrogen deflagrations (explosions)
- Hydrogen detonations (explosions)
- Deflagrations to detonations transition DDT (explosions)

For each of the above items, a matrix of experiments for code validation will be defined in order to create a Model Validation Database.

Other Information

The Consortium should include research institutes, universities, industries (e.g. gas equipment manufacturers, automotive OEMs, energy companies).

If relevant experiments for the Model Validation Database are performed in other FCH JU projects/topics, the consortium should consider the possibilities to include the experiments from other projects into the Database. Both the Database and the Protocol should be publicly available.

Expected duration: Up to 3 years

Funding Scheme: Coordination and Support Action

Topic SP1-JTI-FCH.2012.5.3: First responder educational and practical hydrogen safety training

Rationale

Hydrogen applications are being demonstrated as a viable economical solution that will take an important place to solve the energy challenges of the 21st century. Projects with Hydrogen Energy storage chain coupled with renewable sources, hydrogen powered vehicles and refuelling stations are being deployed throughout all Europe.

While hydrogen applications are being introduced into the market, fire services awareness and knowledge regarding these new technologies is low. To facilitate hydrogen local project approvals, it is essential to provide them solid theoretical and practical training since they will inevitably face accidental situations during which they will need to know how to respond adequately to protect the public without putting in jeopardy their own life.

Practical training must be provided during full scale accidental scenario exercises taking place in hydrogen Energy storage site and hydrogen refuelling stations with hydrogen powered vehicles. Best practices based on exercises feedback must be disseminated using online tools.

Overall project objectives / Scope of Work

- Support the successful implementation of hydrogen and fuel cell demonstration projects and market transformation by providing educational and practical hydrogen safety training to Fire Services and site operators, who must know how to handle potential incidents; their understanding can also facilitate local project approval

Expected Outcome

- Develop and disseminate first-responder hydrogen safety educational materials in Europe
- Build and disseminate hydrogen safety response approach based on feedback and responders' best practices
- Develop and disseminate first-responder intervention guide
- Install an European Hydrogen Training Platform on which will be realised full scale exercises
- Perpetuate practical training using the platform disseminate best practices using online tools
- Facilitate hydrogen local project approvals in Europe

Other Information

The consortium should include a full scale training platform that can reproduce all fire service commandment chain, web-site training software, academic partner, RCS experts and Europeans Fire Service institutions.

The hydrogen mock up vehicle, refuelling station and hydrogen energy storage chain coupled with renewable energy sources that will be supplied shall be identified. Projects may be coordinated with other cross cutting projects.

Expected duration: Up to 3 years

Funding Scheme: Coordination and Support Action

Topic SP1-JTI-FCH.2012.5.4: Pre-normative research on fire safety of pressure vessels in composite materials

Rationale

Burst in service even in accidental circumstances pressure vessels of composite materials for storage of compressed hydrogen, is very unlikely, due to their intrinsic robustness and structural integrity, except in the case of exposure to fire conditions, where some form of protection needs to be provided to avoid burst. The effectiveness of this protection is crucial for the acceptance of compressed hydrogen storage, because the possibility of exposure to fire conditions usually exists and, at the same time, the burst of a vessel at high pressure is unacceptable.

The most commonly used form of protection is the integration of a thermally activated pressure relief device that will relieve all the pressure when exposed to fire conditions. However this device needs to be properly sized to limit the hazards associated to the release of hydrogen, as reflected by the size of the hydrogen flame produced upon PRD activation, while ensuring that the pressure is vented quickly enough so that the pressure vessels will not fail by burst. To that end, thermal protection may be used to increase the time available to relieve the pressure.

Further understanding of the heat transfer mechanisms occurring in the composite material and the resulting loss of strength associated to exposure to elevated temperature is needed to be able predict how much time a pressure vessel can withstand fire conditions, and, to design based on that, the means of protection that prevent burst without generating a significant hazard upon activation due to the flow rate of hydrogen releases.

Overall project objectives / Scope of Work

- Development of an understanding of the evolution of the composite material when exposed to fire conditions
- Development of a model for predicting the loss of strength of the composite pressure vessel due to fire conditions and for identifying the conditions that need to be achieved to avoid burst.
- Validation of this model by an experimental programme where pressure vessels are subject to fire conditions with application of a specified pressure relief curve.

Expected Outcome

- Model integrating the thermo-mechanical behaviour of the pressure vessel in fire conditions
- Experimental validation of the model
- Proposed approach for standardization
- Recommendations for implementation in international standards

Other Information

The consortium should include a research entity(ies), pressure vessel supplier(s) and GCH technology integrator(s), and standardization expert(s).

Expected duration: Up to 3 years

Funding Scheme: Collaborative Project

Topic SP1-JTI-FCH.2012.5.5: Assessment of safety issues related to fuel cells and hydrogen applications

Rationale

A large amount of efforts has gone into ensuring that the fuel cell and hydrogen technology that will be commercialized is safe (i.e. free of unacceptable risks). This has involved a wide range of activities including research on hazardous phenomena that need to be prevented; identification and development of product concepts that are inherently safe; component and system testing, development of standards providing the relevant safety requirements with regards to design requirements; design qualification; manufacturing quality assurance; installation requirements; user protocols to be complied with; definition of emergency response measures; training of operators and safety inspectors; and documenting and classifying accidents and incidents and compiling best practice to avoid repetition.

In addition to actually achieving the required level of safety through the combination of such means, building public confidence is crucial for the successful commercialization of hydrogen and fuel cell technology. This needs to be based on sound shared evidence in order to minimise the risk of negative public reaction to hydrogen and fuel cells in the event of an accident or incident.

To build this confidence it is necessary to compile and classify the information demonstrating due diligence that the safety issues have been adequately addressed, and apply independent third party expertise to monitor whether FCH stakeholders are as a whole assessing risk systematically and addressing all potentially hazardous situations specific to FCH technologies.

This assessment is likely to lead to the identification of some areas where further efforts should be focussed for achieving demonstrable safety. It should also be useful to develop a communications network to manage public reaction to safety related incidents and prepare appropriate documented responses.

Overall project objectives / Scope of Work

The objective is to assess of how private and public stakeholders are addressing all the issues that require attention from the standpoint of safety where hydrogen and fuel cells will be used in public settings, particularly in the following areas:

- Application of existing knowledge and lessons learnt from past experience
- Identification of hazards
- Understanding on the hazardous phenomena that need to be prevented
- Implementation of product concepts that are inherently safe
- Assurance of fitness for service
- Control of accidental situations and mitigation of impacts
- Coverage by standards and/or regulations of the relevant safety requirements with regards to design requirements, design qualification, manufacturing quality assurance, installation requirements

- Preparedness to emergency situation and effectiveness of emergency response measures
- Ability of safety officials to exercise their responsibility
- Operators and end-user awareness of hazards
- Ability to respond to the public’s and authorities’ safety concerns

The above assessment will be performed by gathering information from industry players, as well as from authorities, permitting officials, operators and end users where deployments are taking place, and will cover at least the following applications:

- Passenger vehicles
- Fuelling stations
- Urban buses (including depot)
- Material Handling equipment
- Industrial and residential power generation, including CHP

Addressing waterborne transport applications, even as an initial scoping exercise, would be desirable.

Expected Outcome

- For each application, systematic mapping of the safety issues, explanation and assessment of how they are addressed, covering all the areas listed above
- Compilation of best practice, assimilating lessons already learned from past and on going technology deployments
- Evaluation of the preparedness in the various application areas for commercial deployment with regards to addressing safety issues and concerns Identification of areas on which further efforts should be focused and recommendations for addressing these

Other Information

The consortium should include highly experienced and qualified industry and public safety experts for the activities to be covered. Participation of an NGO speaking for the public interest could be considered as well. Input should be sought from previous, on-going and upcoming FCH JU demonstrations as well as from pre-normative and training projects. Experience and outcomes from similar international activities should also be taken into consideration.

Expected duration: 12 to 18 months

Funding Scheme: Coordination and support action

3.7 Public Procurement: Benchmark Studies

The activities described in this section are implemented by call for tenders (i.e. public procurement) and fall outside of the call for proposals (i.e. grants, which is the main means of implementation of the Annual Implementation Plan.

As part of the AIP2010 and the AIP2011, four areas were identified. These public procurements referred to commercialisation studies for the following applications: (1) Fuel cell electric vehicles, (2) urban fuel cell bus, (3) fuel cell powered material handling, and (4) fuel cell stationary applications.

Studies in these four areas will actually be implemented or launched in 2012. In addition, a fifth horizontal thematic will be added on the impact of FCH technologies deployment on job creation in Europe.

These studies will be implemented via framework contracts. An open procedure for awarding up to three framework contracts to consultants able to conduct such studies has been launched in Q4 2011[22]. For each study, a specific contract will be awarded after reopening competition between the three selected consultants.

Prior to the launch of each study, the FCH JU will work with coalitions of industrial stakeholders to identify more specifically the areas of interest for each study and to ensure they will support the study, notably by providing the necessary data. A small fraction of the budget foreseen for each study can be used to support the creation of a coalition of industrial stakeholders.

The following funds will be made available to support the activities:

Subject (Indicative title)	**Indicative FCH JU Funding €**
Development of a European Fuel Cell and Hydrogen Vehicles Roll Out Plan	0.6 million
Development of a European Urban Fuel Cell Bus Commercialisation Strategy	1.7 million
Commercialisation roadmap for hydrogen powered fuel cell material handling vehicles	0.5 million
Development of a European commercialisation strategy for fuel cell stationary applications	1.5 million
Jobs Creation Impact of Different Deployment Scenarios for Fuel Cells and Hydrogen Technologies	0.2 million
Total indicative FCH JU Funding[23]	**4.5 million**

[22] The contract notice is available at http://ted.europa.eu/udl?uri=TED:NOTICE:321244-2011:TEXT:EN:HTML and the tender specifications at http://www.fch-ju.eu/page/vacancies-procurement

[23] The amount corresponding to EFTA contributions (2.6 M€) may be used to reinforce the different sub-budgets.

4. Horizontal and Support Activities

4.1 Policy and Communication

The priority objectives of policy and communication are to ensure political and public awareness of the Fuel cells and hydrogen Joint Undertaking, its technologies and activities in order to:

A) Ensure the highest level of FCH JU members' involvement into FCH JU policies and activities as well as ensure consistent messaging, efficient coordination and "One Voice" approach between members

Internal communication objectives

These objectives are implemented notably through regular exchanges and meetings of the Joint Communication task force representing all FCH JU members (exchanges on messaging and feedback received from contacts, on calendars and planning, and on organisation of activities and events).

B) Actively promote the benefits of FCH technologies and contributions of FCH JU activities, making them more visible and understandable to various audiences in order to gain acceptance and support

External communication objectives

In line with the FCH JU communication strategy to be adopted end of 2011, main external activities are identified as follows:

- Define and implement a policy and contact action plan in coordination with FCH JU members towards policy makers

  European policy orientations and roadmaps in the transport, environment and energy sectors (Europe 2020 strategy) deserve particular further and follow-up so that contributions of fuel cells and hydrogen technologies to these orientations and plans are well advocated and taken into account. The shaping of the future European research and Innovation programme- Horizon 2020- needs also a specific focus and attention.

  Messaging, contributions, responses to consultations and contact programme are structured and developed in close and regular coordination between members.

  Activities developed in 2011 will be continued and developed.

- Establish and implement a communication plan to increase awareness of FCH JU activities and FCH technologies towards selected target audiences at EU, national and international level and in turn foster their acceptance. Activities will be developed in close coordination with members and projects teams as well as with other relevant platforms and organisations with a view to optimise synergies and share work.

In 2012 focus will be put more specifically on the following:

- national outreach, to be implemented via multipliers, such as National contact points, Europe Direct Centres, Enterprise Europe Network etc. will be developed in addition to European Outreach towards policy makers. Activities in this regard should consider support and coordination with EHA and its national associations
- dissemination of projects and their results, notably through development of information and communication materials (Report on Programme Review, sheets on applications areas and projects, audio-visual materials, etc.)
- participation in visibility events, such as exhibitions at EU, national or international level (EU Sustainable energy week, Hannover Messe, WHEC…), annual stakeholders General assembly and Programme Review organised at national level in order to raise the profile of FCH JU and the technologies at national level and foster media interest

Achievement is measured by performance against work plan, quantitative and qualitative feedback on activities.

4.2 Other support activities

Finance and Administration

Finance and Administration is a major component of Horizontal and support activities which main objective is to ensure the Programme Office can efficiently carry out its operational mandate.

The Finance and Administration Unit includes Finance and Budget, Human Resources, General Administration, Legal and IT. It also covers the internal control coordination which comprises notably monitoring the follow-up on action plans regarding implementation of internal control standards and on results of audits and coordinating the preparation of the Annual Activity Report.

Finance and Budget

The main objectives for Finance and Budget are to ensure a sound financial management of the Programme Office resources and compliance with the FCH Financial rules and procedures.

Main activities include the following:

- allocate budget resources in line with planned activities
- establish the necessary commitments to ensure the timely availability of resources for the smooth implementation of all operational and support activities
- execute the necessary payments for services and goods delivered
- provide financial and administrative advice on procurement and grant matters, as needed
- provide financial analysis and financial management support to the operational unit
- monitor budget execution and report to the Executive Director
- update budget forecast for the period up to 2017 and report to the Governing Board
- monitor changes in the Financial Regulations and related rules and implement where required
- develop or update procedures and streamline workflows as necessary in coordination with the Programme Unit
- implement the ex-post audit strategy in coordination with the JU's Internal Audit Capability (IAC)
- coordinate and support missions of the Court of Auditors

In 2012 special focus will be put on the following:

- further develop/ improve procedures and tools for project financing management and reporting including process for review and approval of cost claims notably in the context of use of the FORCE application

- review the process for financial verification of participants (FVC) aiming at enhanced efficiency
- follow-up on the first ex-post audits launched in the last quarter of 2011 and launch new audits in accordance with the ex-post audit strategy
- prepare the revision of the FCH JU Financial rules as relevant in relation with the revised EU Framework Financial Regulation and further changes deemed necessary

Achievement is measured through the following indicators:

- level of budget execution (at least 90%)
- 90% of payments made within deadlines. (30 days for contracts; 45 days for pre-financing on grants; 105 days for interim/final payments on grants)
- number of exceptions (deviations from rules and procedures) recorded
- number and importance of findings of the JU's IAC, the Commission's Internal Audit Service (IAS) and opinion of the Court of Auditors
- feedback from staff

Human Resources and General Administration

The priority objectives for Human Resources are to ensure that the Establishment plan and Staff policy plan are implemented, to ensure an efficient management of staff resources and to ensure an optimal working environment.

Main activities include the following:

- contribute to the overall FCH JU strategy and planning processes
- develop/update HR policies and procedures (including implementation, monitoring and review)
- monitor adequacy of staff resources in relation to activities
- efficiently replace posts that become vacant as necessary
- identify training needs and promote professional development through training
- facilitate social contact between staff
- promote internal communication
- ensure delivery of logistical support (stationery, supply of goods and services for administration) including launching and implementation of procurement procedures related to general administration
- implement security policy

In 2012 special focus will be put on the following:

- development of a procedure regarding renewal of contracts
- development of a frame for "core competences"

- staff survey
- adoption and implementation of implementing measures regarding staff committee and prevention of harassment
- follow-up on the revision of staff regulations and communication to the staff and to the GB as necessary
- follow-up/contribute to the discussions on the future FCH JU notably in terms of staffing needs

Achievement is measured through the following indicators:

- vacancy rate (less than 5%)
- average number of training days per employee per year (10)
- number and importance of audit findings (Internal Audit Capability (IAC), Internal Audit Service (IAS), Court of Auditors)
- feedback from staff

Legal

The priority objectives of Legal affairs are to ensure the legality and regularity of grant agreements, contracts and other agreements (memorandum of understanding, service level agreement, amendment to agreements and contracts) and provide guidance and advice to ensure compliance with applicable legislation and rules. Beyond the verification of the legality of operation, the role of the legal manager may involve the complete management of some activities (notably some procurement procedures). It also includes the Data Protection function and the ABAC Local Profile management (LPM).

Main activities include the following:

- generate and check grant agreements
- review contracts prior to signature
- provide advice or input on legal issues, on interpretation of texts, on draft legislation or internal rules and procedures
- ensure the data protection and LPM function
- launch and implement procurement procedures in relation to operational activities as requested

In 2012 focus will be put more specifically on the following:

- procurement of commercialisation studies which involve a strong coordination with the contractors and the industrial coalitions supporting the studies
- legal input on (1) the revision of the EU Financial Regulations and related implementing rules and (2) the revision of the FCH JU financial rules notably as a consequence of the revision of the EU Financial Regulations (more specifically the Framework Financial Regulation)

- legal input in the discussions on the future of the FCH JU and more broadly the Joint Technology Initiatives in the context of the new financial perspectives (2014-2020) and more particularly the Horizon 2020.
- further implement data protection requirements notably by follow-up of EDPS opinions on prior-check notifications
- improve management of ABAC access rights by ensuring implementation of IAC recommendations

Achievement is measured by the following indicators:

- satisfaction of users (Executive Director, Colleagues, partners)
- number of procurement procedures launched and concluded
- number of amendments in agreements and contracts due to inconsistencies
- number of complaints, legal disputes
- number and importance of findings of the IAC, IAS and opinion of the Court of Auditors
- completeness of register of data protection notification; feedback from data subjects and from EDPS

IT

The priority objectives for IT are to ensure a stable and secure IT system, provide IT support to staff in the use of IT applications and equipment and to cooperate with the other JUs to ensure synergy and efficient use of resources.

Main activities include the following:

- follow-up and monitor implementation of the contract with IT supplier, notably service delivery plan; ensure maintenance and upgrades are done as necessary
- monitor stability of the IT system
- participate in coordination meetings with the Commission and other JUs and take action follow-up on the adjustments needed to allow and ensure smooth functioning of FP7 IT tools
- ensure adjustment of IT tools to the FCH needs (expansion, upgrade, etc…)

In 2012 special focus will be put on the following:

- ensure adequate access for the FCH staff to the complete set of IT applications related to the FP7 program and improve the system of access rights to these tools in accordance with the IAC recommendations
- further develop in-house tools for reporting, monitoring and decision-making (matching) with simple common applications like excel or access; These will enable improved internal and external communication and will be integrated in the internal control system

- deploy new and mobile IT equipment and follow-up implementation of VPN, WIFI, voice mail
- finalize the installation of the modular conference room facilities on the 7th floor
- develop in-house tool or acquire application for document management and HR workflows
- finalize the disaster recovery plan

Achievement is measured by the following indicators:

- compliance by contractors/ service providers with the service level agreements
- user satisfaction on the tools (equipment and applications)
- number and importance of audit findings (Internal Audit Capacity, Internal Audit Service, Court of Auditors)

Internal control

The priority objective is to implement and maintain an effective internal control system so that reasonable assurance can be given that (1) resources assigned to the activities are used according to the principles of sound financial management and (2) the control procedures in place give the necessary guarantees concerning the legality and regularity of transactions.

Main activities include the following:

- ensure awareness and implementation of internal control processes and standards
- assess the effectiveness of the internal control system
- report on compliance and effectiveness in bi-annual management reports and annual activity report
- carry out periodic review of risks at least yearly in the context of preparing the annual work programme (Annual Implementation Plan)
- ensure coordination of the drafting of the Annual Activity Report
- coordinate visits of the European Court of Auditors
- follow-up on implementation of action plans on audit recommendations

In 2012 focus will be put on the following:

- further follow-up of the action plan for implementation of internal control standards (ICS) reviewed in May 2011
- finalize the Business Continuity Plan (BCP)
- consider the possibility of ex-post verifications of transactions and quality checks of files.

Achievement is measured by the following indicators:

- degree of implementation of action plans (on effective implementation of ICS, on audit recommendations)

- number and importance of audit findings (Internal Audit Capability, Internal Audit Service, Court of Auditors)

Internal Audit Capability

The priority objectives of Internal Audit Capability are to provide the Executive Director with assurance (i.e. independent assessment) and consulting (i.e. advisory and management requested) services as to the effectiveness and efficiency of the governance, risk management and control processes in the Joint Undertaking.

Main activities include the following:

- Establish a multiannual work plan (to be updated annually), including assurance and consulting services, in coordination with the Commission's Internal Audit Service (IAS)
- Implement the annual work plan
- Maintain a smooth, constructive and transparent liaison with the audit community (i.e. Auditnet, IAS and Court of Auditors)
- Upon the Executive Director's request, provide other ad-hoc consultancy or assurance services not foreseen in the annual work plan
- Ensure an advisory role in the Annual Activity Report (AAR) process, internal control, risk management and ex-post audits of beneficiaries

Achievement is measured by the following indicators:

- Performance against annual work plan
- Participation to Auditnet meetings
- Coordination level with the IAS (joint risk assessment and coordinated multiannual and annual work plan)
- Feedback from audited parties

Accounting

The accountant was appointed by the Governing Board on 29 January 2010 and is functionally independent in the performance of her duties.

In line with article 43 of the FCH JU Financial Regulation the accountant is responsible for:

a) proper implementation of payments, collection of revenue and recovery of amounts established as being receivable;

b) preparing and presenting the accounts in accordance with Title VIII (of FCH JU Fin.reg.)

c) keeping the accounts in accordance with Title VIII;

d) implementation in accordance with Title VIII, the accounting rules and methods and the chart of accounts in accordance with the provisions adopted by the Commission's accounting officer;

e) laying down and validating the accounting system and, where appropriate, validating systems laid down by the authorising officer to supply or justify accounting information; the accounting officer shall be empowered to verify the respect of validation criteria.

f) treasury management

Achievement is measured by the following indicators:

- Payments executed in time, cash available when needed
- Provisional accounts and Final annual accounts are ready for Governing Board approval and audit in time

5. Resources

The staff and financial resources of the FCH for the year 2012 are adopted by the Governing Board subject to adoption of the EU budget by the European Parliament and the Council in accordance with the budgetary procedure and are described in the following sections.

5.1 Staff establishment plan 2012

Temporary Agents

Grade	2012 Establishment Plan Budget / Authorised	
	Permanent posts	**Temporary posts**
AD 16		
AD 15		
AD 14		1
AD 13		
AD 12		
AD 11		3
AD 10		
AD 9		1
AD 8		4
AD 7		2
AD 6		
AD 5		
Total *AD*[24]	**0**	**11**
AST 11		
AST 10		
AST 9		
AST 8		1
AST 7		3
AST 6		
AST 5		
AST 4		1
AST 3		2
AST 2		
AST 1		

[24] AD stands for Administrator

Total *AST*[25]	**0**	**7**
TOTAL	**0**	**18**

Staff resources also include 2 contract agents, 1 in Function Group (FG) III and 1 in FG IV.

[25] AST stands for Assistant

5.2 FCH BUDGET 2012

The 2012 budget includes "reactivation" of unused commitment appropriations from previous years (calls 2009 and 2010, procurement studies 2010 and administrative expenditure) for a total of 11.4 M € that will be used as follows:

- 7.8 M € for projects under call 2011 (for which the list of selected proposals and reserve list was approved by the Governing Board at its meeting of 22.11.2011)
- 3 M € for studies
- 0.6 M € for the call 2012

5.2.1 Statement of Revenue

Title Chapter Article Item	**Heading**	**Budget 2012 CA**	**Budget 2012 PA**
2001	***European Commission subsidy for operational expenditure***	78,888,028	62,461,896
2002	***European Commission subsidy for administrative expenditure***	1,153,310	1,153,310
2003	***Industry Grouping contribution for administrative expenditure***	2,665,973	2,665,973
2004	***Research Grouping contribution for administrative expenditure***	444,329	444,329
2006	***JTI revenues***	160,000	160,000
	Title 2 — TOTAL	83,311,640	66,885,508
xxxx	***C2 carryover of appropriations (2009)***	500,430	56,836
xxxx	***C2 carryover of appropriations (2010)***	10,936,708	484,994
	SUB TOTAL carry over	11,437,138	541,830
	GRAND TOTAL	**94,748,778**	**67,427,338**

5.2.2 Statement of expenditure

Title Chapter Article Item	Heading	Commitment Appropriations 2012 (€)	Payment Appropriations 2012 (€)
1	**STAFF EXPENDITURE**		
1 1	STAFF IN ACTIVE EMPLOYMENT	2,238,000	2,238,000
1 2	EXPENDITURE RELATED TO RECRUITMENT	15,000	15,000
1 3	MISSIONS AND TRAVEL	140,000	140,000
1 4	SOCIOMEDICAL INFRASTRUCTURE	42,000	42,000
1 7	ENTERTAINMENT AND REPRESENTATION EXPENSES	15,000	15,000
	Title 1 - TOTAL	2,450,000	2,450,000
2	**INFRASTRUCTURE**		
2 0	INVESTMENTS IN IMMOVABLE PROPERTY RENTAL OF BUILDINGS AND ASSOCIATED COST	308,500	308,500
2 1	INFORMATION TECHNOLOGY	165,000	165,000
2 2	MOVABLE PROPERTY AND ASSOCIATED COSTS	17,000	17,000
2 3	CURRENT ADMINISTRATIVE EXPENDITURE	41,000	41,000
2 4	POSTAGE AND TELECOMMUNICATIONS	15,612	15,612
2 5	EXPENDITURE ON FORMAL AND OTHER MEETINGS	44,500	44,500
2 6	RUNNING COSTS IN CONNECTION WITH OPERATIONAL ACTIVITIES OF FCH	750,000	750,000
2 7	STUDIES	5,000	5,000
2 8	EXPERT CONTRACTS AND MEETINGS	627,000	627,000
	Title 2 — Total	1,973,612	1,973,612
3	**OPERATIONAL EXPENDITURE**		
3 0	IMPLEMENTING THE RESEARCH AGENDA OF FCH JU	90,325,166	63,003,726
	Title 3 - TOTAL	90,325,166	63,003,726
	GRAND TOTAL	94,748,778	67,427,338

6. Annexes

6.1 Abbreviations and Definitions

Term	Definition
AA	Application areas such as Transportation & Infrastructure, Hydrogen Production & Distribution etc.
AA1 / AA-T	Application Area Transportation & Refuelling Infrastructure
AA2 / AA-H	Application Area Hydrogen Production, Storage & Distribution
AA3 / AA-S	Application Area Stationary Power Generation & CHP
AA4 / AA-EM	Application Area Early Markets, short-term markets encompassing a group of applications for which products can be commercially deployed within the 2007-2013 timeframe
AC	Associated Country means a third country which is party to an international agreement with the Community, under the terms or on the basis of which it makes a financial contribution to all or part of the Seventh Framework Programme
AIP	Annual Implementation Plan
APU	Auxiliary Power Unit
AST	Accelerated Stress Test
BoL	Beginning-of-Life
BOP	Balance of Plant
BPP	Bipolar Plates
BTH	Biomass to Hydrogen
BUP	Back-Up Power
CAES	Compressed Air Energy Storage
CAPEX	Capital Expenditures
CCI	Cross Cutting Issues
CCS	Carbon Capture and Sequestration
CFD	Computational Fluid Dynamics

CHP	Combined Heat and Power
CP	Collaborative Project
CSA	Coordination and Support Action
EC	European Commission
Deployment	Development phase for a given technology and/or infrastructure from its market introduction to its widespread use
DME	Dimethyl Ether
DSM	Demand Side Management
ED	Executive Director
EFTA	European Free Trade Area
EMC	Electromagnetic Compatibility
EoL	End-of-Life
ETP	European Technology Platform
FCH	Fuel Cells & Hydrogen
FCH JU	The Fuel Cells and Hydrogen Joint Undertaking: the name refers to the legal entity established as the public & private partnership to implement the Joint Technology Initiative
FCEV	Fuel Cell Electric Vehicle
FP7	Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013)
GB	Governing Board of the FCH JU
GDL	Gas Diffusion Layer
HFP	The European Hydrogen and Fuel Cell Technology Platform
HTE	High Temperature Electrolysis
IDA	Innovation and Development Actions: A programmatic cluster of the HFP Implementation Plan targeting a specific objective of the programme and encompassing a set of relevant technologies and market enablers along with the actions to achieve it
IP	Implementation Plan
ISO	International Organization for Standardization
JTI	Joint Technology Initiative - a policy initiative introduced in the

	FP7. The Term JTI may also be used to refer to the legally established structure implementing the initiative (cf. above FCH JU)
LCA	Life Cycle Assessment
LHV	Lower Heating Value
MAIP	Multi-Annual Implementation Plan
MCFC	Molten Carbonate Fuel Cells
MBTF	Mean Time Between Failures
MEA	Membrane- Electrode Assembly
MHE	Material Handling Equipment
Members	The term "members" refers to the founding members of the FCH JU (EC & NEW IG) and the RG
MPL	Microporous Layer
MS	The "Member States" shall be understood as the EU-27 Members States
NEDC	New European Driving Cycle
NEW-IG	New Energy World Industry Grouping - European Industry Grouping for a Fuel Cell and Hydrogen JTI also referred to as "Industry Grouping" or " IG"
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
OPEX	Operational Expenditures
PEM / PEMFC	Proton Exchange Membrane Fuel Cell
PNR	Pre-normative research
PO	Programme Office (also referred to as JTI PO)
PoC	Proof of Concept
RAT	Ram air turbine
RCS	Regulations & Codes and Standards
RES	Renewable Energy Sources
RG	New European Research Grouping on Fuel Cells and Hydrogen AISBL, also referred to as " Research Grouping" or "N.ERGHY"
RH	Relative Humidity

RTD	Research, Technological Development & Demonstration
SAE	Society of Automotive Engineers
SME	Small and Medium Enterprise
SOFC	Solid Oxide Fuel Cell
SRG	FCH States Representatives Group: Advisory body of the FCH JU gathering Member States and Associated Countries' representatives
Stakeholders	The term "Stakeholders" embodies all public or private actors with interests in FCH activities both from the MS or third countries. It shall not be understood as “partners" or "members" of the FCH JU.
TCO	Total Cost of Ownership
TRL	Technology Readiness Level
UPS	Uninterruptible Power Supply
WtT	Well to Tank
WtW	Well to Wheel