Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2 JU)

ANNUAL WORK PLAN 2014

Adopted by the FCH2 JU Governing Board on 30/06/2014

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1. Introduction: mission, objectives and challenges

This document establishes the first Annual Work Plan (AWP) of the Fuel Cell and Hydrogen 2 Joint Undertaking (FCH 2 JU), outlining the scope and details of its operational and horizontal activities for the year 2014, with a focus on research and demonstration activities prioritized for the first call for proposals, together with supportive actions required. It also describes the objectives of the FCH 2 JU, the policy and global context, assessment criteria, technical targets and rationale for individual activities.

In addition, the General Annexes to this Work Plan (available in the H2020 Participant Portal) contain: the list of countries eligible for funding and applicable rules; the standard admissibility criteria for grant proposals; the standard eligibility criteria; types of action including their specific provisions and funding rates; the description of Technology Readiness Levels (TRLs); a description of the evaluation criteria; a note on budget flexibility; and financial support to third parties.

Fuel cell and hydrogen technologies have enormous potential in terms of contributing to a number of Europe's key policy goals, including the reduction of carbon dioxide emissions (in the energy system and particularly in transport), improving energy security and promoting innovation-driven growth and employment. The European Strategic Energy Technology (SET) Plan[1-2], which was adopted by the European Council,[3-4] has identified fuel cells and hydrogen to be among the technologies needed for Europe to achieve the targets for 2020[5]: 20% reduction in greenhouse gas emissions; 20% share of renewable energy sources in the energy mix and 20% reduction in primary energy use. Additionally, it has been identified as a key sector for contributing towards Europe's long-term (2050) vision for a decarbonized energy system[6]. This is in line with the European Commission's (EC) Communication "Energy for a Changing World – An Energy Policy for Europe", the goals of the Lisbon Strategy and the European Strategic Transport Technology Plan.

The Fuel Cells and Hydrogen Joint Undertaking, set up by Regulation (EC) No. 521(2008) of the Council of 30 May 2008[7] has demonstrated the potential of hydrogen as an energy carrier, and of fuel cells as energy converters, to offer a pathway for clean systems that reduce emissions, enhance energy security, and stimulate the economy. The second interim

[1] A European Strategic Energy Technology Plan (SET Plan) – "Towards a Low-Carbon Future". COM(2007) 723 final

[2] European Commission: Investing in the Development of Low Carbon Technologies (SET Plan). COM(2009) 519 final

[3] Council of the European Union: Council Conclusions on the Commission Communication "A European Strategic Energy Technology Plan (SET Plan)." Brussels, 28 February 2008

[4] Council of the European Union: Council Conclusions on the Commission Communication "Investing in the Development of Low Carbon Technologies (SET Plan)". Brussels, 12 March 2010

[5] COM(2010) 2020 final.

[6] Council of the European Union: Council Conclusions on the Commission Communication "Investing in the Development of Low Carbon Technologies (SET Plan)". Brussels, 12 March 2010

[7] OJ L153/1, 12.6.2008, p. 1-20, as amended by Council Regulation 1183/2011 of 14.11.2011, OJ L302, 19.11.2011, p. 3-4.

evaluation of the Fuel Cells and Hydrogen Joint Undertaking[8] has shown that the Joint Undertaking has served as a platform for creating a strong partnership, for leveraging public and private funding and for the strong involvement of industry, in particular SMEs. The interim evaluation also suggested that the FCH JU research area should continue to be supported under the new Research Framework Programme with the aim of developing, to the point of market introduction, a portfolio of clean, efficient and affordable solutions.

Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020)[9] aims to achieve a greater impact on research and innovation by combining Horizon 2020 Framework Programme and private sector funds in public-private partnerships in key areas where research and innovation can contribute to the Union's wider competitiveness goals, leverage private investment, and help tackle societal challenges. Those partnerships should be based on a long-term commitment, including a balanced contribution from all partners, be accountable for the achievement of their objectives and be aligned with the Union's strategic goals relating to research, development and innovation. The governance and functioning of those partnerships should be open, transparent, effective and efficient and give the opportunity to a wide range of stakeholders active in their specific areas to participate. The involvement of the Union in those partnerships may take the form of financial contributions to joint undertakings established on the basis of Article 187 of the Treaty under Decision No 1982/2006/EC.

In order to realize the public benefits referred to herein above, the FCH 2 JU was set up, within the Horizon 2020 Framework programme, as a Joint Undertaking by Council Regulation N° 559/2014 of 6 May 2014 for a period lasting up until 31 December 2024. It brings public and private interests together in a new, industry-led implementation structure, ensuring that the jointly defined research program better matches industry's needs and expectations, while focusing on the objective of accelerating the commercialization of fuel cell and hydrogen technologies.

The FCH 2 JU members are: the European Union, represented by the European Commission (EC) as a public representative; the 'New Energy World Industry Grouping Fuel Cell and Hydrogen for Sustainability – NEW-IG' (hereafter "the IG") which represents European companies; and the 'New European Research Grouping on Fuel Cells and Hydrogen - N.ERGHY' (hereafter "the RG"), representing European research organizations and universities.

The FCH 2 JU shall have the following objectives:

(a) to contribute to the implementation of Regulation (EU) No 1291/2013, and in particular part III of Council Decision 2013/743/EU;

(b) to contribute to the objectives of the Joint Technology Initiative on Fuel Cells and Hydrogen, through the development of a strong, sustainable and globally competitive fuel cells and hydrogen sector in the Union.

[8] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 'Partnering in Research and Innovation', COM(2011) 572 final, 21.09.2011

[9] OJ L 347, 20.12.2013, p. 104 [H2020 FP]

It shall, in particular:

- reduce the production cost of fuel cell systems to be used in transport applications, while increasing their lifetime to levels competitive with conventional technologies,
- increase the electrical efficiency and the durability of the different fuel cells used for power production, while reducing costs, to levels competitive with conventional technologies,
- increase the energy efficiency of production of hydrogen mainly from water electrolysis and renewable sources while reducing operating and capital costs, so that the combined system of the hydrogen production and the conversion using the fuel cell system is competitive with the alternatives available in the marketplace;
- demonstrate on a large scale the feasibility of using hydrogen to support integration of renewable energy sources into the energy systems, including through its use as a competitive energy storage medium for electricity produced from renewable energy sources;
- reduce the use of the EU defined "Critical raw materials", for instance via low or platinum free resources and through recycling or reducing or avoiding the use of rare earth elements.

Fuel cell and hydrogen technologies constitute emerging technologies that have to compete with incumbent ones, with a high commercial risk for first movers. Large investments in hydrogen distribution infrastructure will be needed, and an improved performance and lower cost of all parts of the value chain are still required. This chain includes the production, purification, transport, storage and distribution of hydrogen, and the conversion of its energy content into electricity through fuels cells, taking advantage of the heat generated whenever possible. Technology improvements can be achieved by the development of innovative materials, better system integration and new manufacturing processes. All contribute to increased performance and cost reduction which are the driving criteria for market implementation. Significant improvements have been achieved over the last decades[10] through R&D, but these improvements are up to now insufficient to support mass market applications. To overcome this challenge, it has been decided to continue the activities of the FCH JU under Horizon 2020.

[10] '*Hydrogen and Fuel Cells*', Scientific Assessment in support of the Materials Roadmap enabling Low Carbon Energy Technologies, JRC Scientific and Technical Reports, May 2012

2. FCH 2 JU Governance

The FCH 2 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 States Representatives Group and the Stakeholder Forum.

2.1 Governing Board

The Governing Board (GB) shall have overall responsibility for the strategic orientation and operations of the FCH 2 JU and shall supervise the implementation of its activities in accordance with Article 7 of the Statutes.

The IG has 6 seats, the EC 3 seats and the RG 1 seat respectively.

The GB is planning to hold three meetings during 2014. The key activities are listed below:

Key activities in 2014 – timetable	
Adopt its own rules of procedure	Q2
Adopt the Financial Rules of the FCH 2 JU	Q2
Adopt the decision delegating the relevant appointing authority powers to the Executive Director	Q2
Adopt the updated Implementing Rules regarding Staff Regulation	Q2/3
Approve the organizational structure of the Programme Office	Q2
Where appropriate, set up additional advisory groups to the FCH 2 JU	Q2-3
Where appropriate, establish rules on the secondment of national experts to the FCH 2 JU and on use of trainees	Q2/3
Approve the calls for proposals as well as, where appropriate, the related rules for submission, evaluation, selection, award and review procedures	Q2
Approve the lists to start negotiations for call 2014, including reserve lists, lists of proposals which failed thresholds and ineligible proposals	Q4
Approve the annual additional activities plan	Q2-3
Adopt the updated communication policy/strategy	Q3-4
Approve the amendment to the 2014 budget	Q4

2.2 Executive Director and the Programme Office

The Executive Director is the legal representative of the FCH 2 JU, and the chief executive for the day-to-day management in accordance with the decisions of the GB in line with Articles 6 and 7 of the Statutes.

The Executive Director, assisted by the Programme Office (PO), shall carry out the tasks listed in Article 9 of the Statutes in an independent manner.

The PO, composed of full time employees (temporary and contract agents), shall implement all the decisions and activities adopted by the GB; establish and manage an appropriate accounting system; manage the calls for proposals; provide to the Members and the other bodies of the FCH 2 JU all relevant information and support necessary for them to perform their duties as well as responding to their specific requests; act as the secretariat of the bodies of the FCH 2 JU and provide support to any advisory group set up by the GB.

The PO will continue to facilitate and maintain institutional relations at EU level for monitoring EU legislative activities and policy orientations with a view to promote FCH 2 JU and its activities.

2.3 States Representatives Group

The States Representatives Group (SRG) shall consist of one representative of each Member State and of each country associated to the Horizon 2020 Framework Programme.

According to Article 11 of the Statutes, the SRG shall be consulted and, in particular review information and provide opinions on the following matters:

(a) programme progress in the FCH 2 JU and achievement of its targets;

(b) updating of strategic orientation;

(c) links to the Horizon 2020 Framework Programme;

(d) annual work plans;

(e) involvement of SMEs.

The SRG shall also provide information to and act as an interface with the FCH 2 JU on the following matters:

(a) the status of relevant national or regional research and innovation programmes and identification of potential areas of cooperation, including deployment of fuel cell and hydrogen technologies to allow synergies and avoid overlaps;

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

The SRG may issue, on its own initiative, recommendations or proposals to the GB on technical, managerial and financial matters as well as on annual plans, in particular when those matters affect national or regional interests.

The GB shall inform without undue delay the SRG of the follow up it has given to such recommendations or proposals, including the reasoning if they are not followed up.

The SRG shall receive information on a regular basis, among others on the participation in indirect actions funded by the FCH 2 JU, on the outcome of each call and project

implementation, on synergies with other relevant Union programmes, and on the execution of the FCH 2 JU budget.

The SRG will hold two meetings in 2014. Its main activities will be:

Key activities in 2014 - timetable	
Dissemination and communication of actions at national level	Q3-4
Provide opinions on programme progress	Q3-4
Input for the Stakeholder Forum 2014	Q3
Contribute to the initiative "Smart Specialization"	Q3-4

2.4 Scientific Committee

The Scientific Committee (SC) is an advisory body to the GB. 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-wide recognized expertise from academia, industry and regulatory bodies. Collectively, the SC members shall have the necessary scientific competencies and expertise covering the complete technical domain needed to make strategic science-based recommendations to the FCH 2 JU. It shall consist of no more than 9 members.

According to Article 10 of the Statutes, the role of the SC is to:

(a) advise on the scientific priorities to be addressed in the annual work plans;

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

The SC will hold two meetings in 2014. Its main activities will be:

Key activities in 2014 - timetable	
Provide input on scientific priorities in the fuel cell and hydrogen sector	Q1-4
Advise on scientific achievements	Q3-4
Input for the Programme Review Days	Q4

2.5 Stakeholder Forum

The Stakeholder Forum (SF) shall be open to all public and private stakeholders, international interest groups from Member States, Associated Countries as well as from other countries.

The SF shall be informed of the activities of the FCH 2 JU and shall be invited to provide comments.

The SF is an important communication channel to ensure transparency and openness of the FCH 2 JU activities with its stakeholders. It shall be convened once a year.

The SF is scheduled to take place in November 2014.

Key activities in 2014 - timetable	
Stakeholder Forum	Q4

3. Operational Activities

3.1 Results from projects from the FCH JU Programme (2008-2013)

The FCH 2 JU will continue the management of projects funded under the FCH JU (2008-2013). While established and supported under the previous programme, the FCH JU-funded projects form the first part of a body of research, development and demonstration that will be continued under the FCH 2 JU.

Projects funded by FCH JU over the period 2008-2013 are producing research results towards technological advancement and fostering the development and deployment of new technologies and concepts. Over 30% of FCH JU finished projects have generated one or more patent applications and almost 70% have publications in peers reviewed journals. Moreover, in the transportation sector 150 cars and 45 buses are being deployed through financed projects, together with at least 20 hydrogen refuelling stations. In addition, over 400 material handling vehicles (MHVs), or 25% of the EU 2015 target, will be met through FCH JU projects (under the 7th Framework Program). In the energy sector, deployment of micro-CHP (residential) units through the FCH JU programme alone is expected to exceed the EU 2015 target (see Table 1).

Table 1: FCH JU contributing to EU-level targets

		Volume	
Application Area	**Market application**	**Target increase EU-level (2010 to 2015)**	**Target increase via FCH JU (2008 to 2013) (with progress to-date)**
Transport	Cars	>4000 vehicles	150 vehicles (33 to-date)
	Buses	~400 vehicles	45 vehicles (30 to-date)
	Refuelling stations	~200	20 stations (7 to-date)
H2 Production & Distribution	Distributed production of hydrogen by water electrolysis	Increase of 3% efficiency (65% to 68%)	Increase of 1% (65% to 66%)
	Distributed storage of gaseous H2	4t cap.	Data not yet available†
	H2 storage in solid materials	2 t cap.	Data not yet available†
	High capacity (cap.) compressed H2 trailer	0.7 t cap.	Data not yet available†
Stationary Applications	Residential micro-CHP (natural gas based)	1000 units	>1000 (200 to-date)
	Industrial/Commercial (H2 based)	>5MW	2MW (~)
	Industrial/Commercial (natural gas based)	>5MW	0MW
Early Markets	Material Handling Vehicles (MHVs)	1500 units	400 units (11 to-date)

† Projects in this Activity Area are largely research-oriented, aimed at materials improvement. No installations have been deployed to-date.

3.2 Cooperation with JRC

The Commission's Joint Research Centre (JRC) undertakes high quality research in the field of fuel cells and hydrogen that is of considerable relevance to the implementation of the FCH 2 JU activities. During the FP7 period, the JRC and FCH JU cooperation was structured under a Framework Agreement that covered support activities that JRC provided in-kind to FCH JU as well as possible funded JRC participation to FCH JU projects. Based on the lessons learned and considering new implementation aspects of the Horizon 2020 program and of its activities, a second Framework-up agreement between FCH 2 JU and JRC for the period 2014-2020 is being prepared. As before, this follow-up agreement defines areas where JRC, as a neutral European Union research institute, provides an in-kind contribution to projects and areas where JRC may participate in FCH 2 JU funded projects with a view to enhancing their specific impact, next to aspects of more strategic importance to the FCH 2 JU program. In particular, the JRC contribution could cover:

- Participation in monitoring scientific and technical progress achieved by FCH 2 JU projects and evaluating the FCH 2 JU programme contribution to the Europe 2020 Strategy objectives for smart, sustainable and inclusive growth
- Support to individual projects, offering the services of a reference laboratory upon request by the projects or by the programme office
- Support, upon request of the Governing Board, the formulation and implementation of the FCH 2 JU strategy, as well as monitoring its progress (e.g. via the programme review days)
- Conducting specific pre-normative research, helping to define the technical inputs necessary for safety and RCS activities, assisting the RCS-WG and acting as a relay with European and international standardisation and regulatory bodies
- Contribute to ensuring consistency/complementarity with relevant Commission initiatives (SET-Plan EIIs, EIT, KET, FET, EGVI, …)

3.3 The 2014 Call for Proposals

The 2014 Call for Proposals 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 objectives of the FCH 2 JU, and is divided primarily into the Pillars identified in the Multi-Annual Work Plan: Transport, Energy and Cross-Cutting. In addition, Overarching projects, combining the entire supply chain from production of hydrogen all the way to its use in transport applications, are also included.

The emphasis given to different actions in different pillars reflects the industry and research partners' assessment of the state of the technological maturity of the applications and their estimated importance to achieve critical objectives of the FCH 2 JU.

3.3.1 Transportation

Introduction of fuel cell electric vehicles (FCEVs) in the passenger vehicle segment is of highest priority because the reduction of energy consumption and greenhouse gas emissions from replacement of conventional fossil fuelled vehicles with FCEVs is significantly higher than any other transport market segment. Thus, a significant part of the program funding in the 2014 call is devoted to the large-scale demonstration of such FCEVs including the build-up of the necessary refuelling infrastructure for these FCEVs. After a number of smaller,

individual demonstration projects in the first phase of the program (FCH JU), the second phase of the program (FCH 2 JU) will focus on projects which provide the necessary experience with larger numbers of FCEVs and higher capacity hydrogen refuelling stations (HRS), starting with this call. Further technological developments, especially in the field of fuel cell systems which have not been adequately covered in the FCH JU, will be pursued in the 2014 call to meet the technical targets required for mass market introduction of FCEVs. Improved cell and stack components, stack and system manufacturing technologies and quality assurance constitute other important areas which will be addressed to ensure the launch of competitive products in the market. In the field of hydrogen storage systems, standardization and components optimization for mass production is required to meet the cost targets. Moreover, the technologies for HRS need to be further developed and improved to prepare for large volume hydrogen refuelling especially within the public transportation segment (buses) in compliance with expected roll-out of vehicle fleets.

3.3.2 Energy

The Energy Pillar aims to develop and demonstrate technologies to integrate hydrogen into Europe's energy system. This includes production of hydrogen form carbon-free or lean energy sources, storage and distribution of hydrogen and the use of hydrogen in stationary fuel cells to generate power and heat.

Special attention is given to the production of hydrogen from fluctuating electricity sources like those generated from wind and photovoltaic cells and the integration of electrolysers in the electricity grid. This results in a request for Research and Innovation Action to reduce the cost of electrolysers by simplification of the systems and the use of lower cost the materials. A second request is aimed more at defining the requirements and designing electrolysers for the dynamic environment of an electricity grid with a large renewable power share. In order to demonstrate the future commercial potential of these electrolysers, an innovation project with a large electrolyser that receives compensation for providing services to an electricity network is envisioned.

The FCH 2 JU intends to commission a study on the conversion of bio-based energy to hydrogen technologies, looking in particular at their impact on the European energy system and potential commercial viability. Awaiting the results of that study, the 2014 call is limited to a research and innovation topic on the conversion of CO_2 containing bio- or landfill-gas to hydrogen aimed at removing the cost and energy intensive CO_2 removal step.

In the storage and distribution part of the hydrogen value chain, two areas have been prioritized for the 2014 call. The first area is related to the purification of hydrogen. The aim is to develop purification technologies with very low hydrogen losses to allow efficient clean-up of hydrogen without the need for integration with a chemical plant. These technologies should enable efficient clean-up of hydrogen for example from pipelines or underground storage caverns. The second area is the improvement of efficiency and cost of large-scale compression of hydrogen. Compression is needed for nearly every application of hydrogen. A project could be, but is not necessarily limited to, the development of high speed centrifugal compressors for hydrogen.

The maturity level of several stationary fuel cell technologies is ready to achieve a market entry. Fuel cell power plants will be demonstrated in several challenging market segments like commercial or industrial (50 kW - 10 MW). This is a way to meaningfully reduce harmful emissions like GHG.

The realization of large scale demonstration projects are needed to build up confidence/acceptance of the various stakeholders (electricity/heat producers, public, politicians, investors etc.) and applications to reduce the market entry barriers and to commercialize the technology. These demonstration projects are needed for confidence building to trigger volume scale up with large scale orders, leading to higher installed capacity and therefore to lower cost.
The main objectives of the additional topics of 2014 are related to cost reduction (capex and opex), increasing reliability and quality and further adoption to the market needs.
In comparison to previous calls, the emphasis is more on future commercial viability of hydrogen and fuel cell technologies. In case of equal scores of projects during the evaluation, those with higher impact on this aspect will be favoured.

3.3.3 Overarching Projects

There is a clear need to showcase a whole integrated energy chain using hydrogen from fuel production, storage through distribution to end use by vehicles or stationary fuel cell systems with smart grid integration by coordinating and combining with national or regional projects. This need is being supported through a topic on Hydrogen Territories, where the added value of such solutions using hydrogen and fuel cell technologies is perceived to be highest, since the current energy schemes used carry significant costs and present a need for storage.

3.3.4 Cross-Cutting Activities

Cross-cutting research and development projects will support and facilitate the transition to market for fuel cell and hydrogen technologies.

The projects called for in 2014 will cover education, public acceptance and awareness, and safety.

The educational topic takes up the training of scientists and engineers after the last calls have concentrated on first responder and vocational training. Following up from curriculum developments in former FCH JU projects (especially TrainHy), training material will now be developed across a network of universities, supported by industry, research and other stakeholders. The project will ensure that the highly qualified human resource necessary in deploying fuel cell and hydrogen technology in the mid-term is developed.

The topic on public acceptance and awareness will concentrate on explaining the positive potential of fuel cell and hydrogen technologies in Europe in order to meet any reservations still held by the public towards these technologies. It will develop strategies and tools to communicate the advantages and risks of the technology to the potential future customers.

The topic on safety in this call will concentrate on the aspect of housing of hydrogen handling equipment. This will most commonly be located in containers that will – by certain classes of incidents – be filled with an explosive mixture of hydrogen and air. The project will explore how the sizing of venting openings has to be designed to minimise the harm done within the enclosure.

3.4 Call for Proposals 2014: General Approach

In order to achieve its objectives, the FCH 2 JU should provide financial support mainly in the form of grants to participants following open and competitive calls for proposals.

Participation in indirect actions funded by the FCH 2 JU should comply with Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013 laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" and repealing Regulation (EC) No 1906/2006[11].

In accordance with that Regulation, the FCH 2 JU shall be considered as a funding body and shall provide financial support to indirect actions as set out in clause 1 of the Statutes of the FCH 2 Joint Undertaking.

The Governing Board may decide, in duly justified cases pursuant to Article 9(5) of the Regulation (EU) No 1290/2013, that to be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

At least one call for proposals will be published each year, based on the annual work plan. Proposals may be called for using a single stage process i.e. a single application, assessment and evaluation and award of grant; however, for more strategic actions, a two stage process i.e. outline proposals might be chosen in first stage, with successful ones invited to submit a full proposal at a later stage.

Being part of the Horizon 2020 Programme of the European Union, in determining the contents of this Work Plan, the FCH 2 JU has taken the same new approach underpinned by a strategic programming process where the aim is to increase impact through an integrated, coherent, evidence-based implementation.

For development of subsequent AWPs, further iterations of the strategic programming process will take into account new intelligence on scientific, technological, economic, market, and social trends and foresight, as well as emerging policy needs.

The Work Plan reflects the strong challenge-based approach of Horizon 2020, allowing applicants to have considerable freedom to come up with innovative solutions. The move to challenge-based calls, attracting more multi-disciplinary and multi-sectorial proposals, will go hand-in-hand with changes in the proposal evaluation procedure, particularly in terms of the make-up and briefing of panels of experts.

In addition, a simplified list of possible types of action is to be used (e.g. research and innovation actions – see General Annexes to the Work Plan for more details).

In designing the FCH 2 JU Work Plan (similarly to the Horizon 2020 programme) emphasis has been placed on streamlining the presentation compared with that for Framework Programme 7. This approach will be mirrored in the way the Work Plan is accessed via the web, with new tools designed to allow ease of access including smart searches.

[11] OJ L 347/81 from 20 December 2013

Communication, open access to research results and a new emphasis on data management

Horizon 2020 overall, including FCH 2 JU, takes a new approach to communication and to the access provided to research results and to data management.

First, actions shall develop and implement a comprehensive communication plan to ensure a high visibility of the funded actions and help to maximise the impact of results.

Second, the FCH 2 JU will follow the Horizon 2020 policy on "Open Access to Scientific Publications" and further information is available on the Participant Portal.

Coordination with Member States, Associated Countries and Regions

The FCH 2 JU will aim at a better alignment and coherence between national and regional and its own programmes. It will look at synergies with national and regional initiatives to leverage their action at the European scale, in particular through large demonstration projects. It will also aim to foster jointly funded actions (with other European Industry Initiatives (EIIs) or Key Enabling Technologies (KETs) for example), Smart Specialisation Platform (http://s3platform.jrc.ec.europa.eu/home) in regions and the complementary use of Structural Funds.

The European Structural and Investment Funds (ESIF) will invest up to EUR 90 billion in innovation and research in the period 2014-2020. Therefore, Art. 20 of the Horizon 2020 Regulation and Article 37 Rules for Participation encourage synergies between Horizon 2020 and other European Union funds, such as ESIF.

Synergy does not mean to replace national or private funding by ESIF or to combine them for the same cost item in a project. Synergy means to expand the scope and impact of both Horizon 2020 and ESIF funds in terms of scientific excellence and place-based socio-economic development respectively. Examples for this could be the development and equipment of research and innovation infrastructures or the fostering of innovation skills through ESIF that enable the participation in a Horizon 2020 project, or the transfer of knowledge and technologies resulting from Horizon 2020 projects to firms that can, thanks to ESIF support, develop it further, test, prototype, etc. towards innovations fit for market take-up. ESIF can also be used to expand the support and advisory services for potential Horizon 2020 participants. ESIF can also help deploy innovative solutions emanating from Horizon 2020, e.g. through public procurement in the fields of fuel cells and hydrogen.

Applicants are therefore invited to identify the smart specialisation fields of their EU Member State or region (see: http://s3platform.jrc.ec.europa.eu/eye-ris3) and explore potential for synergies with the relevant Managing Authorities in charge of the ESIF in their territory (see: http://ec.europa.eu/regional_policy/indexes/in_your_country_en.cfm). More details on ESI Funds investments in research and innovation can be found in the following link: http://ec.europa.eu/regional_policy/activity/index_en.cfm.

In addition, synergies with other Horizon 2020 funding instruments will also be investigated.

3.4.1 Conditions for the call for proposals 2014

Call identifier: H2020-JTI-FCH-2014-1
Total budget[12]: EUR 93 million
Publication date: 09 July 2014
Deadline: 06 November 2014
Indicative budget:

Topic	Type of action	Indicative budget (million EUR)
1. TRANSPORT PILLAR		
FCH-01.1-2014: Standardization of components for cost-efficient fuel cell systems for transportation applications	Innovation (IA)	10
FCH-01.2-2014.: Cell and stack components, stack and system manufacturing technologies and quality assurance	Research & Innovation (RIA)	
FCH-01.3-2014: Development of advanced fuel cell systems and system components	Research & Innovation (RIA)	
FCH-01.4-2014: Hydrogen storage standardisation and components optimization for mass production	Research & Innovation (RIA)	
FCH-01.5-2014: Development of cost effective and reliable hydrogen refuelling station technologies and systems for fuel cell vehicles	Research & Innovation (RIA)	
FCH-01.6-2014: Engineering studies for large scale bus refuelling	Research & Innovation (RIA)	
FCH-01.7-2014: Large scale demonstration of refuelling infrastructure for road vehicles	Innovation (IA)	32
2. ENERGY PILLAR		
FCH-02.1-2014: Research in electrolysis for cost effective hydrogen production	Research & Innovation (RIA)	16
FCH-02.2-2014: Decentralized hydrogen production from clean CO2-containing biogas	Research & Innovation (RIA)	
FCH-02.3-2014: Stationary fuel cell system diagnostics: development of online monitoring and diagnostics systems for reliable and durable fuel cell system operation	Research & Innovation (RIA)	
FCH-02.4-2014: Robust production of stationary fuel cells with reduced quality control costs	Research & Innovation (RIA)	

[12] Subject to the availability of the appropriations provided for in the draft budget for 2014 after the adoption of the budget for 2014 by the budgetary authority. The final total funding for projects is expected to be increased by EFTA contributions.

FCH-02.5-2014: Innovative fuel cell systems at intermediate power range for distributed combined heat and power generation	Research & Innovation (RIA)	
FCH-02.6-2014: Development of centrifugal hydrogen compressor technology	Research & Innovation (RIA)	
FCH-02.7-2014: Stand-alone hydrogen purification systems for new hydrogen pathways	Research & Innovation (RIA)	
FCH-02.8-2014: Improvement of electrolyser design for grid integration	Research & Innovation (RIA)	
FCH-02.9-2014: Significant improvement of installation and service for fuel cell systems by Design-to-Service	Innovation (IA)	25.5
FCH-02.10-2014: Demonstrating the feasibility of central large scale electrolysers in providing grid services and hydrogen distribution and supply to multiple high value markets	Innovation (IA)	
FCH-02.11-2014: Large scale fuel cell power plant demonstration in industrial/commercial market segments	Innovation (IA)	
3. OVERARCHING PROJECTS		
FCH-03.1-2014: Hydrogen territories	Innovation (IA)	5
4. CROSS-CUTTING		
FCH-04.1-2014: Educational initiatives	Coordination and Support (CSA)	4.5
FCH-04.2-2014: Develop strategies to raise public awareness of fuel cell and hydrogen technologies	Coordination and Support (CSA)	
FCH-04.3-2014: Pre-normative research on vented deflagrations in containers and enclosures for hydrogen energy applications	Research & Innovation (RIA)	
TOTAL		93

It is estimated that additional 8 mill EUR in-kind contributions will be provided by the constituent entities of the Members other than the Union or their affiliated entities participating in the indirect actions published in this call (consisting of the eligible costs incurred by them in implementing indirect actions less the contribution of the FCH 2 Joint Undertaking and any other Union contribution to those costs).

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to this work plan.

Besides the general conditions that are being referred to above, an additional condition for participation, pursuant to Article 9(5) of the Horizon 2020 Rules for Participation, was introduced for some topics which relate to:

1. Innovation actions of strategic importance of horizontal nature: Large demonstration and overarching projects

2. Specific projects of key significance for the FCH sector from energy and transport pillars

For selected topics it is being required that at least one constituent entity of the Industry Grouping or Research Grouping should be among the participants in the consortia funded under the FCH 2 JU 2014 Call for Proposals.

The justification for this requirement may be summarised as follows:

1) Innovation actions of strategic importance of horizontal nature including large demonstration and overarching projects (Topics FCH.1.7, 2.10, 2.11 and 3.1):

It is imperative that key innovation actions of strategic importance, which accelerate the commercialisation of fuel cell and hydrogen technologies and thereby achieve the principal objective of the FCH 2 JU partnership, are closely linked to the FCH 2 JU constituency in order to ensure full alignment with the FCH 2 JU strategic agenda (MAWP) and to ensure the continuity of the work performed within projects funded through the FCH JU under FP7, by building up on their experience. In this context it is also crucial to secure that relevant project results are exploited fully in line with the commercialization needs of the European industry with maximised cross-fertilization of knowledge within the whole sector, which can be greatly facilitated by the presence of NEW-IG or N.ERGHY members in these consortia. In addition, strengthened exchange of information between the sector players (through presence of members) will help avoid duplication of effort with other activities performed outside the FCH 2 JU and contribute to a maximum coherence of the overall European technology investment and a maximum impact of the EU funding.

2) Specific projects of key significance for the FCH sector:

a) Transport Pillar (Topics FCH.1.4 and 1.5) - emphasis on standardisation:

Cost and reliability are key elements for the successful deployment of fuel cell vehicles and hydrogen refuelling stations. A decisive factor for the improvement of these characteristics is standardization of interfaces between hydrogen refuelling and fuel cell vehicles as well as development of industry standards for a range of their components. By acting as a hub for information exchange, the FCH 2 JU is uniquely placed to support the process of European standardization, facilitating structured discussions both within the European fuel cell and hydrogen industry itself as well as through international mechanisms and fora. Close involvement of the FCH 2 JU constituency - through participation of at least one member of NEW-IG or N.ERGHY in the selected consortia - will also ensure that the objectives set out in FCH 2 JU strategic agenda (MAWP) are fully taken into account.

b) Energy Pillar (FCH.2.1, 2.3, 2.4 and 2.8) - emphasis on energy security:

The top priority EU political agenda requires development of innovative technologies to address the pressing issue of improving European energy security without compromising our industry's competitiveness. In this context fuel cells and hydrogen can offer tailor-made solutions facilitating the integration of renewables into the European energy system and thereby fundamentally improve the energy security in Europe. The selected projects will play a central role in developing such solutions and can significantly accelerate their adoption. With dialogue and cooperation between private and public partners at the heart of the European JTIs and with all partners directly represented in its governance, the FCH 2 JU is ideally positioned to ensure maximum alignment between public and private players in order

to best support Europe's policy priorities. Establishing a clear link between the identified critical projects and the FCH 2 JU constituency to streamline the delivery of results- through participation of at least one member of NEW-IG or N.ERGHY in the consortia - is therefore required.

Proposals are required to provide a draft plan for exploitation and dissemination of results.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part E of the General Annexes to this work plan.

Evaluation procedure: The procedure for setting a priority order for proposals with the same score is given in part E of the General Annexes.

The full evaluation procedure is described in the relevant guide associated with this call.

Indicative timetable for evaluation and grant agreement:

Information on the outcome of the evaluation	Maximum 5 months from the final date for submission
Indicative date for the signing of grant agreements	Maximum 3 months from the date of informing applicants

Consortium agreements: In line with the Horizon 2020 Rules for Participation and the Model Grant Agreement, participants in Research and Innovation Actions or in Innovation Actions are required to conclude a consortium agreement prior to the grant agreement.

3.5 Topic Descriptions

TRANSPORT PILLAR

FCH-01.1-2014: Standardization of components for cost-efficient fuel cell systems for transportation applications

Specific challenge:

Fuel cell system technology has already demonstrated its maturity for automotive application, but still does not meet the cost requirements for a broad market introduction. The reasons are proprietary system architectures and component concepts, too low volume and lack of a competitive chain of suppliers. Therefore a standardization of interfaces and components may be an efficient path to reduce cost and consequently accelerate market introduction of automotive fuel cell technology including qualification of a capable supplier base.

Whereas standardization of refuelling infrastructure is approaching maturity, on the fuel cell system component level the variance is still very high and needs more development. Each manufacturer of a fuel cell system develops and uses its own components and interfaces, mainly based on proprietary requirements, whereas the similarity of requirements appears to be potentially high (e.g. compare with "Auto Stack" specification). Components suitable for OEM-wide standardization include components of air supply, fuel supply, valves, sensors, cooling, water management, DC/DC converters, current connectors, etc. Alignment of requirements and standardization of these Balance-of-Plant components can help keep production costs low. In addition, some of these components affect safety classification (ASIL) of fuel cell systems and must be qualified and tested in order to comply with ASIL standards. In contrast, differentiation is expected to focus on fuel cell system architecture, fuel cell stack and system controls and therefore, these components should not be the focus of the targeted standardisation.

Current RCS are particularly based on manufacturing specification and should be simplified and adapted to performance oriented specifications.

Scope:

The objectives of this action are to:

- Identify and select components or subsystems suitable for standardization of TRL 6 and higher
- Differentiate between power-class-dependent and power-class-independent components
- Benchmark concepts of components and subsystems respectively in conjunction with their operating range and higher
- Align specifications and interfaces for each component and subsystem, respectively
- Define and agree on standardized verification, validation and qualification test protocols
- Select, modify and adapt components complying with the agreed specifications
- Generate inputs for further development of advanced fuel cell system components in order to fulfil broader requirements of OEMs
- Transfer of proposals for standardized Balance-of-Plant-components to industry codes & standards and regulations
- Involve suppliers capable of fulfilling automotive standards

Expected impact:
The expected milestones are:

- Components and subsystems identified and selected for standardization in scope of this project
- Compilation of components / subsystems according to their dependence /independence on a power-class
- Specifications and interfaces are aligned
- Test procedures and protocols are defined
- Suitable samples of standardized components are available and testing conducted
- Test reports and corresponding conclusions provided
- Viable supply chain identified
- Whitepapers for RCS prepared

A standardization of Balance-of-Plant components will lead to aligned common interfaces and specifications and will enable higher production volumes for such components, accelerating development of a competitive supplier market, which will in turn enable cost reduction and likely, commercialisation. Furthermore, due to reduced variance of every standardized component, the effort for certification will also be reduced, which allows for an additional cost reduction.

Other Information:

The consortium must include at least three automotive OEMs, fuel cell system integrators, relevant suppliers to the automotive industry. Research institutions and academic groups may also be included. International cooperation is recommended.

Projects should build upon knowledge and experience from relevant previously funded FCH JU projects. A liaison with the currently running and relevant projects should be set up.

As a basic principle the project team may consider sharing the outcome of this project across applications if appropriate.

The activities are expected to be implemented at TRL 6 and higher (please see part D of the General Annexes).

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of between EUR 2 to 3 million each would allow the specific challenges to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 1 project may be funded under this topic.

Expected duration: 3 – 4 years

Type of action: Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-01.2-2014: Cell and stack components, stack and system manufacturing technologies and quality assurance

Specific Challenge:

There has been considerable progress with fuel cell stack designs to meet operational requirements, but many still fall short in terms of manufacturability, production efficiency and production cost. These shortfalls need to be addressed before the full potential of the technology can be realized and commercial market opportunities in the transport sector can be taken up.

This topic is intended to include development and validation activities for existing cell and stack design and material utilisation. The objective of overcoming final stage challenges to achieve operational improvements (robustness, performance, cost targets relevant within the Transport application area, lifetime), leading to and in combination with design for manufacture and production techniques for ease of automated assembly, increased output volumes and reduced reject / fault rates and reduced production costs.

Scope:

The scope of work covers improvements to existing, validated designs for cells, at the individual cell level and at the cell component level (e.g., for BPP and development of membranes, catalyst coated membranes, electrodes and production techniques commensurate with the production of high quality, fully integrated membrane electrode assemblies) and at the stack level to meet robustness, efficiency power density, cost and enhanced lifetime objectives. The scope specifically includes improvements in cell and stack manufacturing, assembly and QA methods that support the same objectives. The TRL at commencement for cells and cell components must be at TRL 5 or above and for stack manufacturing, assembly and QA methods must be at a minimum of TRL 5 or preferably at TRL 6.

The topic is intended to cover alternative fuel cell solutions which, for the Transport pillar, is expected to cover PEM-based designs only. It is specifically not intended to cover basic research on new materials or on fundamentally new cell and stack designs.

Project proposals should focus on development work utilising existing stack, stack material and cell component designs which, in line with the TRL 5 starting point requirement, will have already been tested and validated against automotive requirements.

Projects are expected to cover top-level objectives such as:

- Simplification of design and manufacturing methods of cell components, cells, stacks and/or stack modules (core power generation units)
    - Cell and stack design improvements, such as increasing robustness, performance, power density, and efficiency and/or reducing cost against current automotive designs that have been validated and meet or exceed the TRL 5 level

- Improvement of existing manufacturing methods to increase manufacturing yield and reduce product variation and manufacturing cost (QA strategies)

- Validation of existing manufacturing methods to increase robustness, manufacturing yield and reduce product variation and manufacturing cost (QA strategies)

- Testing and validation of critical manufacturing sub-processes (low yield/high cost)

- Identification of manufacturing failure modes and implementation of manufacturing control plans to redress these failure modes

Proposals under this topic need to identify the current baseline for technology specific gaps and to set ambitious targets for meeting critical cost, technical and manufacture / production parameters - and their improvement over the state of the art - together with the development strategy and rationale for the proposed cell component, cell and stack development / manufacturing activities.

Expected Impact:

The expected outcome will need to include a substantial improvement over the state of the art of the following items:

- Electrical efficiency of relevant individual components, and stacks over the state of the art
- Robustness, including increased lifetime
- Demonstration of the potential to achieve longer run times under relevant drive cycle conditions required to meet market entry requirements of 5,000 hours
- Cost reductions consistent with market acceptance requirements for relevant transport applications for passenger vehicles of more than 500 €/kW down to 150 €/kW at the FC system level
- Manufacturing methods in terms of yield and cost, reducing stack scrap rate (initially to 10% with the objective to reduce it to less than 5%) by the end of the project
- Decreased materials consumption or/and achieve a higher power density in line with progression from the minimum TRL 5 to TRL 6 or beyond

All projects must produce validated evidence of lifetimes, cost targets, high efficiencies throughout life and advances in manufacturing methods, sub and full assembly approaches and QA impacts.

Other Information:

The project will need to focus on immediate stack architecture, material and design for manufacture challenges and successful validation, leading to demonstration and early market introduction, including large scale manufacturing. Projects should build upon knowledge and experience from relevant previously funded FCH-JU projects. Technological performance should be validated using the harmonised testing procedures and cycles agreed by OEMs, when available.

The consortium must be industry-led and must include a fuel cell system developer with an existing cell/stack design at least one vehicle or component manufacturers. It may also include research institutes, test and validation facilities and material developers/producers and equipment manufacturers. Projects will benefit from the inclusion of stack end users such as a vehicle OEM or/and system integrators, possibly in an advisory function.

TRL start: 5 for stack and component designs; a minimum TRL 5 or preferably TRL 6 for manufacturing approaches and concepts

TRL end: 6 for stack and component designs; TRL 6 or preferably TRL 7 for manufacturing approaches and concepts

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of between EUR 4 to 6 million each would allow the specific challenges to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 1 project may be funded under this topic.

Expected duration: 3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-01.3-2014: Development of advanced fuel cell systems and system components

Specific challenge:

A number of demonstration projects have already provided evidence about the maturity of fuel cell technology but further activities are necessary to fulfil automotive standards and requirements. As a result, it is clear that in order to enable high volume production of fuel cell systems for market entry scenarios of upcoming years, cost optimized, compact and efficient systems and system components as e.g. fuel cell stack, the air supply module, the anode module and the thermal management system are essential for the success of fuel cell based mobility solutions. Technology assessments suggest that there are still considerable potentials for improvements in terms of functionality, efficiency, manufacturability and cost for automotive application.

Scope:

The objective of this action is to develop low cost fuel cell system components for automotive application by adopting latest system and component level engineering methodologies and tools. All balance of plant components are addressed 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 and the thermal management system and 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.

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.

- As an initial assessment a comparison of the relative merits of different technologies shall be performed by deploying advanced testing and simulation methods (on system and component level).
- Particularly, the potential of new solutions in terms of 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).
- Fuel cell component configurations shall demonstrate compliance with typical automotive environments, such as wide load range, high dynamics, shock and vibrations, sub-zero and hot environments, 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 development activities on fuel cell BoP-components 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).

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.

Expected impact:

The main impacts are:

- Verification of components on test stations
- Validation of components on the level of a fuel cell system
- Prototyping demonstration in a relevant end-to-end environment

Outputs from the project should be aligned with the following technical targets for a fuel cell system:

- Power (align with output from "AUTO-Stack") 80 kW
- High voltage 380 - 430 VDC
- Low voltage 9-16 VDC
- Lifetime 6,000 hrs and beyond
- 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

Technical key targets for the advanced thermal management system

- Ambient temperature -40 … +50°C
- Freezing capability -40°C
- Freeze start (reliable) -25°C
- Cooling capability in FC continuous operation 100 kW at 45°C ambient temp

Methodologies

- Automotive development methods, design to cost, reliability and robustness methods.
- Detailed component level simulation for analysis and optimization (e.g. of multiphase transport and phase transition processes including multi-component diffusion and mixing phenomena of humidifiers etc.)
- Sub-system and system level simulation for component specification and assessment of overall performance of different component configurations
- Automated-/hardware-in-the-loop-/accelerated testing methods

Other Information: The consortium should include automotive OEMs or subsidiaries of automotive OEMs, relevant suppliers, system integrators and possibly research institutions.

TRL at start: 4

TRL at end: 6

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of between EUR 3 to 4 million would allow the specific challenges to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected duration: 4 -5 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-01.4-2014: Hydrogen storage standardisation and components optimization for mass production

Specific challenge:

Today's onboard hydrogen storage systems for fuel cell powered vehicles do not yet meet cost and performance targets for a broader market introduction, neither for light nor for heavy duty vehicles. This is due to low production volume, proprietary system design, component concepts which are not suitable for mass production and the non-existence of a competitive supplier market.

While in the field of hydrogen infrastructure and supply standardisation activities are in a more advanced state, on the onboard storage component level the variety of component designs is still very high. Such components are for example the pressure vessel, the on-tank valve, the Pressure Regulation Devices, the pressure regulator, hydrogen pressure and temperature sensors, the fittings and the seals of the high pressure lines.

From a customer's point of view these components do not lead to a competitive advantage of one vehicle manufacturer over another as long as the system works within its specification.

A standardisation of systems, processes and components is therefore an efficient means to accelerate market introduction of automotive hydrogen storage technology including qualification of a capable supplier base. Standardisation of hydrogen storage components will lead to generally agreed interfaces and specifications and ultimately to higher production volumes of such components.

Scope:

The hydrogen storage technologies that are closest to the market are currently the 70 MPa compressed hydrogen storage for passenger cars and 35 MPa compressed hydrogen storage for vans and heavy duty vehicles. New storage concepts (cryo-compressed hydrogen storage at 30 MPa) are considered within the scope of this topic, provided that these fulfil all requirements for automotive applications. The work should target a reduction in terms of variety of components and modular designs aiming at decreased development time and cost and facilitating certification.

The work items should be the following:

- Identification and selection of onboard storage system components (sub systems) with the objective of no competitive advantage / differentiation for the OEMs
- Alignment of specifications and interfaces for each component / sub system
- Definition and agreement of standardized test procedures, taking into consideration the standards of the EU and of relevant non EU countries (e.g. Japan, USA)
- Generation of input for further development of each component in order to respond to requirements of OEMs and concepts for modular design
- Benchmarking of component concepts
- Selection, modification and development of components complying with the agreed specifications
- Evaluation of possible cost reductions with novel standardized components
- Proposals for standardized hydrogen storage system components to be transferred to industry standards, codes and regulations

Current TRL for most storage components is between 4 and 6. The objective of the proposed topic would be to raise the TRL by 2, achieving a range of 6 to 8 depending on the individual components and sub systems.

Expected impact:

- A range of hydrogen storage components suitable for standardization on a world-wide level
- Standardized interfaces between selected components and other components of the hydrogen storage system and the drive train
- Accepted test procedures for selected components, like those developed by the JRC.
- Demonstration of a cost reduction to 800 €/kg H_2 stored through standardized components and interfaces in mass production
- Standards for selected components, ready to be transferred to industry standards, codes and regulations
- Whitepapers for RCS

Other Information: The consortium should include a minimum of 2 relevant suppliers and 2 system integrators for each component, at least 2 OEMs and research institutes.

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

TRL start: 4-6 (depending on maturity of concept)

TRL end: 6-8 (depending on maturity of concept)

Projects should build upon knowledge and experience from relevant previously funded FCH-JU projects.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of between EUR 3 to 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: a maximum of 1 project may be funded under this topic.

Expected duration: 3-4 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-01.5-2014: Development of cost effective and reliable hydrogen refuelling station components and systems for fuel cell vehicles

Specific challenge

Major car manufacturers aim for a gradual market deployment of fuel cell electric vehicles (FCEVs) with 700 bar on-board storage in the coming years. Such deployment requires availability of a cost effective and reliable hydrogen refuelling infrastructure. State-of-the-art hydrogen refuelling station (HRS) technologies show part-wise unsatisfactory reliability reducing the availability of hydrogen as fuel for FCEV drivers related to failures in compressors, pumps and other vital parts. End user satisfaction is a key success factor for FCEV deployment especially in the early phase when the number of HRSs is low. Moreover, the relatively high CAPEX of HRSs is related to costly components and to high HRS complexity. Simplifications in system design, development of modular solutions and novel concepts for reducing the number of required components constitute viable pathways towards lower cost hydrogen supply. At low dispensed volumes the CAPEX and HRS maintenance contributes significantly to the hydrogen fuel cost. As the number of FCEVs increases, next generation HRS should be expandable to capacities following the demand for hydrogen. Last, but not least, there is a significant potential for improving the overall refuelling energy efficiency, thereby reducing the OPEX, which is required to reach the targeted fuel supply cost.

Scope

Project(s) should conduct R&D, engineering, prototype manufacturing and/or laboratory testing of key components or complete HRS systems with the aim to further reduce cost, increase efficiency and improve and verify availability and refuelling performance. The focus of these activities needs to ensure that remaining hurdles for commercialisation and specific market requirements are appropriately addressed with the best possible technological solution. For components the project efforts should focus on technologies with a current TRL of at least 3 and ensure an increase during the project of at least up to TRL 5. For HRS systems project efforts should focus on technologies or systems with a current TRL of at least 4 and ensure an increase during the project of up to at least TRL 6.

The scope of potential topic(s) to be addressed includes among others (addressing of several is possible):

Key components

- R&D and optimization should primarily focus on cost, efficiency, capacity, reliability, maintenance, operation and performance for components such as:
    - Compression components
    - Storage components
    - Cooling and refuelling components
    - Regulation and control systems
    - Other supporting components
- and may include additional aspects such as
    - Monitoring and communication systems, such as real time availability of the service station and other web services
    - Other components relevant for parameters such as hydrogen quality and metering accuracy may also be addressed

The scope must include multiple key components (at least 3) in order to maximise the impact of the project.

Complete HRS systems

- R&D and design of larger scale systems designed for high utilization and reliable operation with a focus on additional cost reduction, system efficiency, reliability, performance and market requirements
- Construction and testing of full scale laboratory or pilot systems to validate cost reduction, efficiency and in particular reliability and performance at high utilisation rates in daily operation

Project(s) should take into consideration results of previously supported FCH JU projects that may be relevant for the topic, e.g. failure experiences, and performance indicators.

Expected impact

Newly developed and laboratory or pilot validated HRS key components and/or complete HRS systems fulfilling the following MAWP 2017 targets:

- CAPEX and OPEX costs that enable a feasible roll-out of infrastructure taking into account relevant national/regional market support mechanisms. CAPEX target to be reached within the project in is EUR 0.6-1.8 million per HRS depending on capacity if full HRS systems are addressed. OPEX targets for the dispensing cost should validate that economically feasible operation of the HRS at sufficient utilisation can be achieved at a targeted cost of hydrogen delivered to the HRS of 5.5€/kg. Proposals must document current TRL of at least 4, outlining clearly the anticipated capacity and progress to be achieved within the project. Construction and test of laboratory or pilot HRS systems could be used to verify CAPEX and OPEX achievements.
- Availability & performance that meets market requirements when used at full scale at high utilization rates on a daily basis. The developed components should demonstrate >98% availability and close to 100% performance always offering end-users a fast and high state-of-charge refuelling in accordance with SAE J2601. Other performance parameters such as hydrogen quality and metering accuracy may also be addressed. For HRS systems, construction of laboratory validation systems could be used to verify availability and performance targets, at full scale and under high utilization conditions.

Other Information: The consortium(s) should include participants such as infrastructure technology providers, hydrogen gas providers, refuelling retail operators, energy companies car manufacturers and research institutions with relevant competences, experience and laboratory infrastructure. On research, standardisation and verification testing topics relevant and experienced organizations should be included. Involvement of SMEs is beneficial but not a pre-requisite. The consortium should ensure sufficient connections to various European and international efforts such as the working groups of SAE J2601 and ISO 19880 where applicable.

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

Project(s) should take into consideration results of previously supported FCH JU projects that may be relevant for the topic, e.g. failure experiences, and performance indicators.

TRL start: at least 3-4

TRL end: at least 5-6

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of between EUR 4 to 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: a maximum of 1 project may be funded under this topic.

Expected duration: Up to 3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-01.6-2014: Engineering studies for large scale bus refuelling

Specific challenge:

The FCH JU is developing a hydrogen bus commercialisation activity. This will develop and implement a business case for the roll-out of 500-1000 buses on Europe's roads before 2020.

Today's practice across Europe is that buses refuel at their depots. One of the main challenges to a vision of a commercial fuel cell bus offering is the lack of evidence and understanding about how a large scale bus depot would maintain and refuel a large fleet of buses. Currently the largest bus fleets fuelled at a single depot have between 5 and 20 buses (100-400kg of hydrogen per day). Commercial bus depots could require 75-300 buses to refuel in one day (1,500-6,000kg of hydrogen per day for a typical European 12m bus). This is further complicated by the fact that buses frequently operate for the vast majority of the day and night - an entire depot's fleet could need to refuel within a 4-6 hour window, leading to a requirement for very rapid sequential or parallel filling. Additionally specific hydrogen-ready maintenance facilities are not yet in place.

Hydrogen fuelling systems on this scale have not been developed to a high degree of technical readiness. In order to reduce implementation risks on the pathway to commercialisation and to increase planning certainty, detailed engineering work to understand the options, technical challenges, practical implications and costs of refuelling on a bus depot scale is required. In addition, there may be benefits arising from a hydrogen demand of this scale in unlocking innovative routes to hydrogen production and supply.

Scope:

The project will involve a consortium of bus depot operators, hydrogen refuelling station (HRS) equipment suppliers (at least 3), fuel cell bus developers, hydrogen producers and potentially cities or public transport authorities carrying out a series of detailed engineering studies for specific bus depots across Europe to develop viable refuelling systems for large hydrogen bus fleets. Consortia may opt to include some of the relevant stakeholders in an observer group. The objective for the project is the production of detailed engineering design studies for a minimum of five representative bus depots, from at least three member states across Europe. The studies will consider the hydrogen fuelling station requirements for at least 75 – 150 buses operating from the bus depots. The outputs may feed into business planning activities at a local and European level.

The work will consider the range of options for supplying hydrogen to bus depots, including off-site production (including different options for delivery of hydrogen) and on-site production. For each depot, the local circumstances should be assessed. For each site a pathway to decarbonisation of that hydrogen will be developed in line with local CO_2 emission reduction aspirations. The engineering work should focus on assessing a range of technical solutions, narrowing down on a preferred option and then assessing the implications of that solution in terms of the costs of the solution, the components needed, the approvals and permissions processes and the practical implications for the bus depot. Where opportunities exist for standardising components or specifications, these should be assessed across the five depots considered.

In each depot, the practical implications of supplying a volume of hydrogen on an unprecedented scale will be developed. The aim here will be to understand the additional administrative and practical burdens which large fuelling systems of this type will place on bus depot operators. In addition, the engineering teams should work with bus depot operators on potential solutions to these challenges (e.g. changes in filling patterns). Here, the aim will

be to achieve a balance between the cost of changes to the way bus depots are operated and the cost of the filling solution.

For each location, the implications of local regulations, codes and standards on the designs will be assessed, and the teams will ensure that the process for obtaining approvals and permission to operate stations on busy bus depots is well understood and can be met. Where new regulations are required at these larger scales, or there is merit in challenging existing regulations, this will be highlighted by the consortium

The consortium is responsible for assembling the data produced from the design studies into data appropriate for dissemination both within the consortium and to those participating in the FCH JU's bus commercialisation project. A public dissemination exercise based on a reduced version of this dataset will also ensure that the lessons learned are available to stakeholders in the wider bus industry (both potential providers and users of hydrogen infrastructure).

Expected impact:

- A study covering the high level principles of large refuelling station designs (more than 1,500kg per day) to allow an identification of the factors which lead to the lowest costs of hydrogen supply at a range of specific bus depots
- Given that a number of operators/regions are likely to be interested in the design study process and that is possible that more operators will be affiliated with the study than those for whom there will be resources for technical studies, the consortium will need to:
    - Provide a mechanism to down-select depots for detailed design work
    - Provide a mechanism to allow any operators who are not selected to remain associated with the study and learn from the technical work carried out
- For the selected depots (minimum five):
    - Establish a performance specification for the bus depot HRS
    - Conduct an initial options study to assess the range of configurations for the supply of a large fleet of hydrogen buses
    - For each of the options considered, an indicative assessment of the parameters which influence the cost of hydrogen supply and practical implication should be undertaken
    - Work with the local partners to down-select to one preferred option for detailed design work
    - Develop detailed designs of the refuelling station equipment required for the preferred options at each depot
    - Provide budgeting information for each of the station detailed designs, in terms of both indicative capital and operating costs. Methodologies to respect anti-trust legislation for data sharing need to be implemented. Report on the impact of local regulations codes and standards on the feasibility of the different depot designs, including a comparative study on the situation in different member states and recommendations on where new regulations or revisions to existing regulations would facilitate installation of large HRS
    - Consortia may choose to investigate necessary adjustments to dedicated hydrogen bus maintenance facilities in terms of safety, tooling requirements, accessibility to roof-top installations and spare parts availability
    - Develop a view on the potential for cost reduction through time and/or compromises which could be made by the bus operators in the performance requirements of the station to achieve this

- Establish a forum for exchange of data across the depot design projects on the potential for standardisation of the approach (or specific components)

Knowledge sharing around the engineering solutions generated is an important aspect of the project. The successful consortium will ensure that the following data is shared with relevant consortium member groups and relevant participants in the FCH JU's bus commercialisation efforts respecting sensitive commercial boundaries:

- High level description of the strategy for supplying hydrogen to the respective investigated bus depot
- Indicative layouts for the preferred depot design, indicating the land take and safety zones neutralised by the presence of hydrogen at the depot
- Description of the operational constraints imposed by the fuelling station on the depots
- Indicative cost information for each depot. Data should be sufficient to allow parties to develop a business plan for implementing the preferred fuelling solution
- Information on the environmental footprint of the hydrogen supply options
- Information on required adaption of maintenance facilities (if investigated)

In addition, the consortium will ensure that an aggregated selection of the data above can be made available in a public format to allow those looking to start similar initiatives access to the data required to assess large scale bus depot fuelling.

Other Information: A pan-European consortium should be assembled to carry out the work, including at least three companies with integrated HRS engineering capabilities, bus operators from at least three member states, bus OEMs, hydrogen suppliers, as well as safety bodies and local political authorities as appropriate.

The activities are expected to be implemented at TRL 3, as hydrogen fuelling systems of this size have not yet been designed or tested, although concepts have been proposed.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of between EUR 1.0 to 2.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: a maximum of 1 project may be funded under this topic.

Expected duration: 1.5-2 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-01.7-2014: Large scale demonstration of refuelling infrastructure for road vehicles

Specific challenge:

Hydrogen as a clean energy carrier has a very high potential to contribute to Europe's climate and sustainability targets for 2030 and beyond, in particular for mobility. At the same time studies[13] show that fuel cell vehicles (FCEVs) could be competitive with conventional vehicles on total cost of ownership basis already in the 2020's. However, this vision is constrained by the high early cost of deploying a refuelling infrastructure for an initially limited vehicle fleet. Additionally, it is still necessary to improve FCEV technology and to strengthen customer acceptance, a pre-requisite for successful commercialisation.

In this context, increased reliability, durability, availability and efficiency levels in real operation need to be demonstrated for a significant number of FCEVs and hydrogen refuelling stations (HRS).

Large scale demonstrations of this type are essential to gain real life operational experience, test the attractiveness of FCEVs for customers, and subsequently develop a matching customer value proposition and best business case scenarios.

A number of national or regional initiatives (mostly known under the term "H2Mobility") for planning and development of hydrogen refuelling infrastructure networks in European member states have already commenced. They aim to tackle the challenges of the early years of hydrogen mobility's roll-out by building consensus and synchronising investments. One part of their plans is to prove the necessary technology readiness level for commercialisation in field tests and demonstration projects. It should be highlighted that if the first phase of these "H2Mobility" initiatives demonstrates a plausible business case, it is likely that additional actors and investors will become easier to attract and thereby it will create a virtuous circle towards commercial roll-out of FCEVs. Though the different initiatives follow different approaches, all have common elements and goals. For example, they all share high risk levels for the related investments.

This topic calls for consortia to propose a large scale demonstration project for HRSs and FCEVs in alignment and cooperation with national or regional roll-out activities to underpin the early stages of these initiatives and further stimulate hydrogen infrastructure's build-up across Europe. In particular, the project should aim at benchmarking and establishing links between the existing initiatives in order to synchronize actions and maximise impact Europe wide. The ultimate objective is to complement these existing initiatives, avoiding duplications or mere replications of thereof.

Scope:

The project will focus on the roll-out of a minimum of 100 FCEVs and 23 HRS capable of meeting the performance targets specified in the "Impact" section of this topic. In general, they should represent the best technology available at the time of project implementation.

Proposers should provide a clear evidence of:

[13] E.g. Portfolio of Powertrains for Europe (2010), UKH2Mobility Phase 1 report (2013)

- OEMs' commitment to supplying to the project vehicles (passenger cars and/or utility vehicles) which are in a status of possible series production (at least TRL 7) and have the potential of high market penetration in the future. This should be treated as a key requirement for funding
- A comprehensive strategy for commercialisation, including (novel) ways to attract the customers by appropriate customer value proposition scenarios
- An evidence of political support for the project together with commitment to further involvement in the roll out must be provided as part of the proposal, through a Letter of Intent
- Justification of the way in which the project will concretely contribute to de-risking commercialisation of FCEVs in Europe
- A comprehensive business-plan, for the project should also form part of the proposal. Where contributions from end users to vehicles' costs are assumed, this should be clearly indicated in the project proposal
- Further activities for deployment of HRS and FCEVs additional to the project have to be shown

The main focus of the project will be on FCEVs which use a fuel cell system as the main power source and 700 bar hydrogen storage systems. Range extenders concepts and other hydrogen storage concepts are eligible on condition of demonstrating their pertinence for specific applications. The minimum operation for the last vehicles introduced in the project is 12 months or 10,000 km and the minimum operation for the last HRS built is 2 years. Other vehicles and HRSs are expected to be driven or operated for a longer period or range.

When addressing the passenger car market, filling stations need to be accessible for private customers/users and should preferably be integrated in forecourts of conventional refuelling stations. When addressing the utility vehicle market or local fleets, filling stations might be located on private forecourts, with or without public access, as long as several customers are already identified.

The stations' locations need to be chosen in a way consistent with the creation of a real European network. The demonstration sites must be located in more than one EU member state where H2 Mobility initiatives or similar initiatives aiming at deployment of hydrogen based mobility are in place, in order to enjoy the positive dynamic of these states and to have the best leverage effect. Where relevant, it is recommended that demonstration sites should be located at, or close to, the network of the Trans-European Transport Network (TENT-T), as laid out in Regulation 1315/2013. The selected regions should have a high number of potential customers. Ideally, the project should contribute to assure a minimum HRS coverage in at least one large densely populated regions or cluster, in order to test the willingness of customers to switch to FC vehicles.

The stations may include on site hydrogen production if economically justified.

Ensuring cross-fertilization of knowledge acquired throughout the project will be of key importance and therefore priority will be given to proposals presenting a comprehensive dissemination guaranteeing that the lessons learnt by the project are made available to wider public. In particular, it should be ensured that countries considering development of similar FCEVs/HRS roll-out initiatives should have an easy access to information generated by the consortium.

Additionally, measurement, monitoring and evaluation of specific vehicle and fuelling station parameters (including onsite hydrogen production where appropriate), using methodology

such as the one delivered by the HyLights project, is to be performed in order to highlight the potential of the technology for stakeholders along the value chain and raise their interest.

The use of renewable and low carbon hydrogen for the purposes of the project is recommended and will be considered an advantage during evaluation.

The consortium should include multiple automotive OEMs, refuelling infrastructure providers and operators, fuel retailers, and other actors as appropriate. The composition of the consortium should facilitate establishment of strong links with "H2Mobility" initiatives. The involvement of SMEs is also encouraged.

Expected Impact:

This project shall have a major impact on the FCH mobility deployment in Europe and shall significantly contribute to coordination of"H2Mobility" initiatives at the European scale.

It will develop, deliver and operate hydrogen refuelling infrastructure and a fleet of FCEVs. For both a comprehensive performance monitoring is to be carried out, as a result of which recommendations for technological and commercialisation strategy improvements are to be formulated. Particular emphasis shall be put on the investigation of customer behaviour with a view to proposing actions to increase customer acceptance of FCEVs.

A comprehensive monitoring program together with an in-depth analysis of the data obtained will address the following points:

- The techno-economics of the stations and vehicles deployed on the project vs. the targets identified in the national or regional roll-out strategies as well as the MAWP
- Customer acceptance and the willingness of local populations to switch to FC vehicles when a minimum HRS coverage is in place
- Determination of any new obstacles on the way to hydrogen mobility and assessment of progress towards overcoming the barriers to the roll-out of FCEVs that have been identified in the national or regional programmes, including, for example:
  - Metering of hydrogen
  - Quality Assurance issues around hydrogen purity
  - Integration of hydrogen into conventional vehicle fuel forecourts
  - Land availability for hydrogen stations
  - RCS issues surrounding consenting for hydrogen stations
  - Standard Operation procedures for refuelling
- Customer profiles in order to establish HRS utilization patterns in an early market
- Definition of best practices for mass market roll-out

Project partners are expected to explicitly demonstrate the way in which a demonstration project of this type will help raise public awareness and public support for the technology.

A comprehensive dissemination campaign is expected through the project with maximum outreach possible.

The HRS under the project shall comply with the following requirements:

- For passenger cars, provide a clear network, with a maximum driving distance between stations equal to half the range of the lowest range fuel cell vehicle deployed in the same region
- For utility vehicles, a significant level of utilization per station must be demonstrated and a vision of how these stations belong to the creation of a future network shall be defined

- Comply with requirements of the directive on the deployment of alternative fuel infrastructure package directive (to be imminently published), particularly as regards its standardization requirements. Exceptions may be allowed, if justified by the application (e.g. utility vehicles)
- The HRS shall deliver 700bar H2 and be sized consistently with the deployment strategy for the country. The minimum refuelling capacity shall not be below the threshold of 150 kg of daily refuelling capacity per station for fixed stations. Options for capacity increase at highly frequented stations shall be considered. Mobile stations can be proposed
- Some 350bar HRS (maximum 5) can also be proposed if they are associated with a significant fleet of vehicles close to market readiness (TRL at least 7). In that case, an up-grade strategy to 700bar, or a bi-pressure station (350bar and 700bar) should be proposed if coherent with the foreseen customer(s) requirement(s)
- Availability of the station 97% (measured in usable operation time of the whole filling station)
- Cost of dispensed hydrogen offered in the project to be consistent with the national or regional strategy on hydrogen pricing. Cost improvements due to increased hydrogen production capacity and especially higher utilization rate of the HRSs is anticipated in the course of the project (target <10€/kg)
- Hydrogen purity has to be at least 99.999 %. Vehicle refuelling process must comply with SAE J2601 and IR communication needs to comply with SAE J 2799. Exceptions may be allowed, if justified by the application
- Station hydrogen production efficiency target at 50 – 70%, depending on the method of production (conversion efficiency of the whole production chain from primary energy to filling nozzle)

Technical targets for FCEVs:

- >5,000h vehicle operation lifetime initially, min 6,000h lifetime as program target
- Major power source of vehicles must be a fuel cell system (except for utility vehicles where range extended concepts can be proposed)
- MTBF >1,000 km
- Availability >95% (to be measured in available operation time)
- Tank-to-wheel efficiency >40%, measured in the New European Drive Cycle (NEDC)
- Principle series production ability has to be shown

Cost target for FCEVs:

The consortium has to show the potential to reduce cost of vehicles to the cost targets indicated in the MAWP. Funding is limited to 500 € per kW of installed power in those vehicles where the fuel cell is the primary power source, and to 2000 € per kW where the fuel cell acts as a range extender. A lower contribution should be requested for vehicles coming in the second half of the project, to reflect the cost reduction brought by new generation vehicles.

Apart from liaising with "H2Mobility initiatives", links to relevant projects co-funded by the FCH JU should be established when deemed of benefit (e.g. the HIT project).

Any event (accidents, incidents, near misses) that may occur during the project execution shall be reported into the European reference database HIAD (Hydrogen Incident and Accident Database) at https://odin.jrc.ec.europa.eu/engineering-databases.html.

Other information:

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

A TRL of at least 6 for the HRS and the onsite hydrogen production (if relevant) and 7 for FCEVs is required.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of EUR 32 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 1 project may be funded under this topic.

Expected duration: 4-6 years

Type of action: Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

ENERGY PILLAR

FCH-02.1-2014: Research in electrolysis for cost effective hydrogen production

Specific challenge:

Water electrolysis is considered to have the potential to provide cost competitive hydrogen with a very low associated carbon footprint in comparison to the current best available technology, which is central SMR (steam methane reforming). In order to achieve this goal by 2025 or 2030 at the latest, as suggested by the "Development of water electrolysis in the European Union"[14], electrolysers must at least halve their capital cost while reducing their electricity consumption by 10%.

Electrolyser technology priorities are specific to the different chemistries under development. They respond to the need to reduce cost while maintaining or improving performance and include work on advanced catalysts and membranes as well as system engineering. Alkaline electrolysers are most mature, followed by Polymer Electrolyte Membrane (PEM) electrolysers. Other technologies include the anion exchange membrane (AEM) and the solid oxide electrolyser (SOEC). Each has promise for cost reduction and the solid oxide system, which operates at high temperature, could produce hydrogen with much lower electricity inputs than conventional electrolysers by adding energy to the process as heat. Considerable development of solid oxide systems is still required, however, to demonstrate robust systems.

Scope:

Proposals should address a combination of the following developments:

- Reduction of electricity consumption
- Simplification of systems, size reduction (e.g. through higher current density)
- Reduction of capital cost and use of materials. Enhanced manufacturability. Less expensive materials
- Scalability to multi-MW scale. Modularity
- New component and conceptual systems for improved partial load behaviour and highly dynamic operation
- New materials and component design less prone to degradation. Improved understanding of degradation mechanisms, particularly under dynamic operation
- Better maintenance and higher reliability

Research and innovation activities will contribute to identify and explore improvements towards 2025 central KPIs, as prescribed by the study on "Development of water electrolysis in the European Union", in decreasing electricity consumption and capital cost, improving durability and dynamic behaviour. A technology neutral approach is favoured, allowing all

[14] Available at: http://www.fch-ju.eu/sites/default/files/study%20electrolyser_0-Logos_0.pdf

technologies, whether alkaline, PEM, SOEC or AEM, to propose its challenges and detailed scope of work. As KPIs for SOEC and AEM are not available in the study, proposals addressing these technologies should carefully justify the current state of the art and the potential evolution of the technology until 2025 to be commercially available and competitive *ex aequo* with the conventional electrolysis technologies.

Expected impact:

Proposals are expected to attain cost competitiveness of electrolysis with central Steam Methane Reforming. Proposals should indicate how the technology solution can achieve MAWP targets regarding cost reduction, efficiency improvement and decrease of electricity consumption.

Identifying and validating incremental or break through improvements in materials, components and system concepts directed to set the basis for cost competitive electrolytic hydrogen compared with central SMR should be key drivers in projects led by electrolyser manufacturers, technologists and research institutes. Outcome of the projects must derive in new concepts validated in relevant environments.

Other Information: Projects should demonstrate and experience from relevant previously funded FCH-JU projects.

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

TRL at start: minimum of 3

TRL at end: 5

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU between EUR 2 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 1 project may be funded under this topic.

Expected duration: 4 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.2-2014: Decentralized hydrogen production from clean CO_2-containing biogas

Specific challenge:

Conversion of biogas (anaerobic digester- or landfill gas) to hydrogen is an energy efficient and low cost pathway for production of renewable hydrogen. The current available catalysts and reactor systems degrade rapidly in time due to carbon formation on the catalyst, reactor and heat exchanger walls due to the high carbon content of biogas.

The state of the art conversion of biogas therefore consists of first cleaning the biogas from impurities like sulphur, siloxanes and subsequent upgrading the biogas by removing the CO_2. The resulting methane-rich feed is reformed by state of the art SMR. The upgrading step results in high capital and operational costs and lowers the efficiency of the process.

The challenge is to remove the upgrading step and convert clean biogas (still containing CO_2) directly into hydrogen.

Scope:

The scope of work comprises the development and testing of catalysts and reactor designs in order to obtain a continuous and stable process for hydrogen production through direct reforming of clean biogas. It includes a proof of concept of an optimized system with adequate control strategies. The final target should be to demonstrate the technical and economic viability of the total process.

The project should 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
- Increasing High Heating Value (HHV) efficiency up to 72% (clean biogas to hydrogen)
- Eliminate 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 or poisoning by impurities
- Design, build and operate 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
- Adjust Balance of Plant components and burner unit to safely operate with lower caloric value gas streams

Biogas cleaning (removal of impurities like sulphur, siloxanes, ammonia) is not within the scope of the topic.

Projects should build upon knowledge and experience from relevant previously funded FCHJU projects.

Expected Impact

- Technology for reforming of CO_2-containing biogas should be demonstrated in relevant environment

- Improved efficiency of reforming anaerobic fermentation or landfill gas up to 72%
- Reduced cost of reforming biogas

Other Information: Projects are expected to start at TRL of at least 3 and to reach TRL 6.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU between 2.5 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 1 project may be funded under this topic.

Expected duration: 3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.3-2014: Stationary fuel cell system diagnostics: development of online monitoring and diagnostics systems for reliable and durable fuel cell system operation

Specific challenge:

Low-cost and reliable monitoring technologies are urgently needed for stationary applications, where to date no monitoring or diagnostics approach is available. A low-cost prognostics/diagnostics/monitoring approach during operation would enable more reliable systems, effective failure detection and prevention before irreversible damage occurs, more efficient maintenance and drastically reduced warranty costs.

Scope:

The overall objective of the project is to develop a low cost and online system/stack monitoring and diagnostics technology which can be integrated easily into existing fuel cell systems.

The following aspects should be addressed:

- The approach should primarily be used for the detection and hence prevention of damaging conditions during the operation of stationary fuel cell systems
- Detection of major failure modes like air/fuel starvation, sulphur trap breakthroughs, cross-leakages/cell breaks, other cell contamination,…
- State-of-health monitoring (degradation monitoring, remaining lifetime prediction,…)
- Focused on low cost and easy integration into existing systems

No basic research is expected, a proven approach (e.g. with other fuel cell types) should be available already at the beginning of the project.

Expected impact:

The following targets should be met:

- Demonstration of the detection of major stack/system failure modes in stack laboratory tests with at least 2 different stack platforms
- At least 5 of the following failure modes must be detectable and should be demonstrated with the developed approach:
    - Air starvation
    - Fuel starvation
    - Sulphur poisoning (trap breakthroughs)
    - Carbon build-up on cell
    - Cell breaks/cross over leakages
    - Delamination
    - Major change in fuel composition (reformer malfunction or bad fuel quality)
- Lab or field- demonstration of the monitoring/diagnostics approach integrated into at least 2 different fuel cell systems (CHP, APU, backup power,…)

- A methodology for state-of-health monitoring incl. degradation measurement and remaining lifetime prediction should be shown
- It has to be shown that the added cost of the monitoring/diagnostics approach does not increase the overall system manufacturing costs by more than 3%

A liaison with the currently running relevant FCH JU projects shall be established and activities should build on existing results from those projects.

Other Information: A proven approach (e.g. with other fuel cell types) should be available already at the beginning of the project with a TRL between 3 and 4. At the end of the project a TRL level 5 at least of the diagnostics system should be reached.

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of between EUR 1.5 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 1 project may be funded under this topic.

Expected duration: 2-3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.4-2014: Robust manufacturing of stationary fuel cells with reduced quality control costs

Specific challenge:

The specific challenge is stabilization of manufacturing of processes and automation of quality control automation for stationary fuel cells.

In order to achieve cost levels allowing for mass deployment, stationary fuel cells need further significant cost reductions in their manufacturing. The currently still low production volumes do not allow identifying, improving and validating all factors that influence the robustness and yield of the manufacturing processes on cell, stack and system level. Manual quality control steps represent a significant share of the manufacturing cost.

Production processes need to be stabilised already at the level of pilot manufacturing volumes. In particular stack qualification processes need large improvements to reach required yields and performances, and also significant reduction in investment costs for this kind of equipment.

Quality and process control steps and related equipment need to be adapted, automated and implemented. The stabilisation of manufacturing processes, the implementation of in-line quality and process controls on representative pilot production scale needs to reduce the unitary/marginal cost of quality control for cells, stacks and systems to the long-term cost target.

The objective is to implement and validate those improvements in pilot manufacturing in order to establish the trust base for investors to invest in real-scale mass manufacturing plants.

Along with this, fuel cell components need to be optimized to tolerate larger variations of raw materials, allowing for an increased number of suppliers for raw materials. A significant increase in the number of qualified suppliers will strengthen the competitive position of the European fuel cell industry in general.

Scope:

The topic scope includes efforts at process stabilisation in production by process control and improved stack conditioning and qualification, the development of state-of-the-art quality control tools for stack components including cells, interconnects and seals as well as complete stacks.

Means of achieving this can be the transfer of commonly available, touch-less, in-line, fast throughput characterisation methods to fuel cell components manufacturing techniques. Methods include laser and acoustic detection, X-ray screening and others. The development of new, fuel cell specific ad-hoc qualification methods is not included unless they have already reached a TRL of 5 or higher.

All considered methods should reduce the quality control costs at mass manufacturing scale to levels comparable to other similar technologies (e.g. battery). The elaboration of such methods can only be done with components and stacks that are already in pilot production on established lines.

The effectiveness of the quality control process and equipment has to be validated in an established and operating pilot or series manufacturing line for fuel cell stacks or components.

The quality control equipment should be made available for sale on commercial base and a concept for the industrial series manufacturing of the quality control equipment has to be included.

The developed equipment should also enable to monitor closely the tolerance towards variation in raw materials and enable the development of more robust production processes, as well as a broader selection of qualified suppliers.

Expected impact:

Break-through cost reduction for quality control steps in the range of one order of magnitude and higher, increased reliability of the produced fuel components and stacks, increased manufacturing capacity by elimination of slow processes already for pilot manufacturing lines.

- Fast characterisation of cells, stacks and systems through dedicated testing
- Constant quality in manufacturing: Overall manufacturing process yield > 95%
- Yield of all single process steps >98%
- Pilot manufacturing line with constant performance on system level
- Sufficient robustness against variations in raw material and processing parameters
- Enlarged selection of qualified suppliers

Other Information: The project needs to be based on established pilot manufacturing lines TRL 5 and to reach maturity of TRL 7 at the end.

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU between EUR 1.5 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 1 project may be funded under this topic.

Expected duration: 2-3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.5-2014: Innovative fuel cell systems at intermediate power range for distributed combined heat and power generation

Specific challenge:

It is necessary to improve competitiveness and prepare for the commercialisation of fuel cell products for distributed CHP applications in intermediate power range. Also, it is necessary to increase the value proposition of fuel cell based products by increasing power security and reducing exploitation of primary energy resources. Power generation is not limited to electricity only, but including heat, cold and potentially hydrogen as by-products. This topic targets development, manufacturing and validation of a new generation of fuel cell systems with properties that significantly improve competitiveness. New innovative system technologies are implemented and validated in a new product with lower product cost, maintenance need and extended lifetime. Only through development of competitive technologies can fuel cell products achieve market readiness and radically improve the sustainability and security of energy supply.

Building and validating first prototypes of the new product generation will build trust among the stakeholders and build a basis for further growth of the industry. The project will engage dedicated suppliers to establish close cooperation with system integrators to further develop efficient value chains that will support commercialization.

Reduction of primary energy by CHP or other ways of co- and polygeneration, also including co-generation of H_2 as side product (links to mobility).

Scope:

The primary objective of the call is to manufacture and validate 10 – 100 kW next generation fuel cell products having premium electrical efficiency and capability for CHP generation. The products operate on low carbon fuels such as natural gas biogas or LNG. The new innovative system solutions will improve energy efficiency, reliability and product lifetime, thus decreasing the TCO.

- Development and manufacturing of innovative fuel cell systems and the key system components
- Validation of improved system solutions
- Long term operational experience over fuel cell system - Target: 3,000 h operation
- Proof of reliability and durability of fuel cell system
- Development of value chains and innovative business models to enable further growth
- Concept analysis of innovative exhaust heat recovery solutions, including co- and polygeneration
- Concept analysis of co-generation of hydrogen as side product
- Concept analysis of utilizing hydrogen rich low carbon fuels to enable conversion of hydrogen to power

Expected impact:

Demonstrate breakthrough system innovations related to fuel cell system components and their thermal integration that improve energy efficiency and competitiveness of fuel cell

products. Create next generation product that create basis for commercialization and further growth of fuel cell industry. The targeted impact of the project to the product properties compared with state of the art (SoA) in 2014 is the following:

- Improved electrical efficiency by min. +10% points, reaching 57%
- Higher than 82% total energy efficiency by Improved thermal integration
- Improved stack lifetime in system operation from SoA by 50%, reaching >30,000h
- Improved design, manufacturing and supply chain to reduce product cost by 30%
- Improved maintenance interval by 100%, reaching 2 years of operation without planned shut down

Other information: Intended validation activities cover TRL 4. At the end of the project TRL must be increased to TRL 5 at least.

Projects should build upon knowledge and experience from relevant previously funded FCH-JU projects.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of EUR 3.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 2 projects may be funded under this topic.

Type of action: Research & Innovation Actions

Expected duration: Up to 3 years

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.6-2014: Development of centrifugal hydrogen compressor technology

Specific challenge:

The roll-out of hydrogen energy applications requires compression of hydrogen at several stages in the supply chain. When centrally produced, the hydrogen will need to be compressed to the pressure it will be stored or distributed. Examples are hydrogen production via electrolysis at 20 bar followed by underground storage at 200 bar or injection into natural gas distribution pipelines close to 100 bar.

For compression of gases reciprocating compressors are commonly used below flow rates of around 1700 m^3/hr. At larger flow rates centrifugal compressors are recommended. Centrifugal compressors technology is not optimised for hydrogen, where because of the low molecular weight of hydrogen higher circumferential are required which in turn call upon different materials.

The challenge is to develop reliable as well as cost-effective and energy efficient centrifugal compression technology for hydrogen.

Scope:

The objective of the work is to design and test a centrifugal compression system to compress industrial volumes of hydrogen from 20 up to 500 bar, whereby energy efficiency is increased and cost of ownership reduced compared to state of the art compression systems at this scale and pressure ratio. The system should take into account the properties of hydrogen when selecting materials and operational speed and therefore go beyond the direct adaptation of existing compressors to hydrogen.

The concept must be validated in a relevant environment, i.e. operated using hydrogen and run at full speed at a representative size (minimum mass flow rate of 3,000 kg/hr). It should enable validation of the expected efficiency, durability and cost. The validation should be at least at a single stage level.

The concept must be validated in a relevant environment, i.e. operated using hydrogen and run at full speed at a representative size. It should enable validation of the expected efficiency, durability and cost.

A roadmap for further development of large hydrogen compression systems should be presented.

TRL should meet at least 3 at start of the project and 5 at the end of the project.

Expected impact:

The project should enable the further development and future manufacture of large compression systems that are optimised for hydrogen and achieve better efficiency and lower total cost of ownership than existing technology.

The energy consumption of the system should be below 4 kWh / kg H_2 when compressed from 20 to 500 bar.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of EUR 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other

amounts.

Number of projects: a maximum of 1 project may be funded under this topic.

Expected duration: Up to 3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.7-2014: Stand-alone hydrogen purification systems for new hydrogen pathways

Specific challenge:

Common hydrogen purification systems, like membranes and state of art Pressure Swing Adsorption (PSA) systems split hydrogen into a pure fraction and an impure waste fraction. Current hydrogen generation technologies, like steam methane reforming, combust this waste fraction and use it as a source of heat. New hydrogen production methods or pathways under development often have no heat input requirement so they cannot make use of the waste fraction. These include hydrogen from industrial hydrogen pipelines and underground caverns and low-temperature hydrogen production methods. For these applications, efficient and low cost stand-alone clean-up systems need to be developed and optimized.

Scope:

Scope of work comprises the development and optimization and proof-of-concept of hydrogen purification technologies that achieve the purity requirements for fuel cells used in stationary and transport applications. These systems should be optimised for stand-alone operation with zero or close to zero waste gases, used for purification from the new hydrogen production methods, delivery and storage sources.

Projects can focus on central large-scale clean-up after production or storage or address smaller scale clean-up just before use of the hydrogen.

The project(s) shall take into account the following overall technology objectives:

- Low overall energy consumption. This includes energy input, H_2 losses and energy required for re-compression to input pressure
- Low cost (investment and operational cost). The cost of purification is expected to be a small fraction of the final hydrogen cost (ca. 0.15 €/kg)

Expected Impact:

Significant technology advance of a stand-alone hydrogen purification system showing:

- Hydrogen losses below 10%
- Reduction of CAPEX down to 350k€/ (ton H_2/day), with reduction of cost compared to state of art (e.g. palladium or PSA purification)

Other Information: The activities are expected to start at TRL 3-4. TRL expected at the end of the project: 5-6.

Projects should show an improvement to the state of art in the technology.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU between EUR 2 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: a maximum of 1 project may be supported under this topic.

Expected duration: 2-3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.8-2014: Improvement of electrolyser design for grid integration

Specific challenge:

Water electrolysis shows a high potential to produce hydrogen with a very low carbon footprint. Also electrolysers can provide services such as load response management to evolving electricity grids.

Current systems are designed for high efficiency at their operating design point, at typically close to 100% load, and to run continuously. Providing energy services is expected to require start-stop and dynamic operation and high efficiency across much of the load curve. While a number of electrolyser operating strategies can be used to help balance supply and demand, the electrolyser manufacturing industry is still rather uncertain as to which of the requirements will ultimately provide financial income in a future energy market.

Moreover, in order to compete with central steam methane reforming as hydrogen source, electrolysers must both benefit from very low electricity prices as a result of higher volatility, but even more important, to reduce capital cost to a fraction of the current figures, namely -30% in 2020. Proper design of next electrolyser systems, to be commercially available no later than 2020, must focus in developments both in stack design as well as in the balance of plant components and system engineering.

Scope:

Proposals should address the following developments:

- Identification of the performance specifications required to provide grid services in a broad sense, as potential income sources for an electrolyser operator. Fact based assessment of specifications, supported by experimental evidences (i.e. from existing facilities, especially interaction with the grid and renewable electricity sources), is highly valuable
- System and component optimization for partial load operation
- System and component optimization for highly dynamic operation (ramp-up rates, warm start-up, cold start-up, standby behaviour)
- Control system designed to enhance interaction with the grid and renewable sources
- System engineering and improvements in manufacturing process for decreasing costs, contributing to system simplification, cost reduction, material use minimisation or that put in place a path to volume manufacturing
- Characterise and improve understanding of degradation and degradation mechanisms, particularly under dynamic operation
- Assessment of operation at off-nominal conditions (at higher current density) with regard to CAPEX and OPEX cost and additional revenues (through grid balancing services, fees to make available a power capacity to over-consume renewable electricity on request of the grid operator). The economical optimization shall be identified, depending on the geographies, local regulations and tariffs

Individual improvements in technology should aim at a TRL increase from at least 4 (technology validated in lab) to minimum 5 (technology validated in relevant environment). Real environment should be understood as directly scalable to multi-MW electrolysers.

Expected impact:

Identifying incremental improvements of design addressing central KPIs in 2020, as per the study on "Development of water electrolysis in the European Union[15]", as well as adopting innovative approaches in grid and renewable electricity interaction for electrolysers, should be key drivers in projects led by electrolyser manufacturers and technologists. Projects should aim to demonstrate in relevant environments, including fluctuating grid dynamics, incremental applied research already verified at lab scale, in short applied research and innovation cycles paving the way for following projects to full-scale prototyping and even demonstration projects.

Activities will contribute to a faster achievement towards 2020 central KPIs, decreasing electricity consumption to 52 kWh/kg H2 for alkaline electrolysers and 48 kWh/kg H2 for PEM electrolysers, and capital cost to 630 EUR/kW for alkaline electrolysers and 1,000 EUR/kW for PEM electrolysers), whilst allowing electrolysers to a fully integrated operation with renewable sources and grid management services.

Outcome of the projects must derive in components, subsystems, systems and services which can be tested in full scale and operational environment as a next step.

Projects should build upon knowledge and experience from relevant previously funded FCH-JU projects.

Other Information: TRL should be 6 or higher at the start of the project, 7 or higher at the end of the project. Real environment for technology validation should be understood as directly scalable to multi-MW electrolysers.

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU between EUR 2 and 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected duration: 3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

[15] Available at: http://www.fch-ju.eu/sites/default/files/study%20electrolyser_0-Logos_0.pdf

FCH-02.9-2014: Significant improvement of installation and service for fuel cell systems by Design-to-Service

Specific challenge:

Obtaining simple fuel cell systems to maintain and compliant with all regulatory requirements is a significant step towards mass markets for technologies that have so far mostly been driven by engineers and scientists. Those features are required to value the large advantages on performances (e.g. electrical efficiency) and to remove obstacles for the commercialization of fuel cells generators and co-generators.

Integrating first lessons from field operation and the conceptual elaboration of lean after-sale structures for fuel cell technologies that differ significantly from incumbent technologies need to be addressed.

Scope:

The main objective of this topic is adaption of the existing FC-based appliances or a core part (stack module, reformer module) by using a Design-to-Service approach, in a way to significantly improve at least 3 of the following 5 objectives:

- Reduce the service cost, including any spare part required, to meet the end-user requirements for the specific application (frequency of intervention, duration of intervention, availability of appliance, cost)
- Simplify the service operation in a way that normally trained installers/technicians can accomplish the task by using the appliance "service manual" and the standard tools
- Reduce the on-site technical intervention time
- Reduce the total down-time of equipment for servicing
- Increase the service interval time

The first installation and start-up of the system is considered as part of the proposal.

Expected impact:

The project must meet the following targets in its respective market segment:

- Micro-CHP and small generator appliances (1-10 kW):

  - service cost < 600 €/kW per year (including stack and any other hot components)

  - provide guidelines for writing service manuals that are easily understandable for maintenance technicians

  - service time requiring < 4h presence time of maintenance technician

  - total down-time of equipment for servicing < 48 hours

  - service interval: more than 1 year

- Mid-scale power equipment (10-200 kW):

  - service cost < 550€/kW per year (with ref. 1000€/kW stack material cost)

  - provide guidelines for writing service manuals that are easily understandable for maintenance technicians

- service time requiring < 8h presence time of maintenance technician

- total down-time of equipment for servicing < 2 days

- service interval more than 1-2 years

- Large-scale power generators (>200 kW):

  - service cost < 290 €/kW per year (full service including output guarantee)

  - provide guidelines for writing service manuals that are easily understandable for maintenance technicians

  - service time requiring < 300 h presence time of maintenance technician per year

  - total down-time of the plant for servicing < 440 hours per year

  - service interval: more than 2 years without shut down, every 18 months electrical BOP with shutdown

Other Information: The activities are expected to be implemented at TRL 6-7 (please see part D of the General Annexes).

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of EUR 1.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: a maximum of 3 projects may be supported under this topic, with one project maximum per fuel cell technology.

Expected duration: 3 years

Type of action: Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.10-2014: Demonstrating the feasibility of central large scale electrolysers in providing grid services and hydrogen distribution and supply to multiple high value markets

Specific challenge:

A recent FCH JU "Development of water electrolysis in the European Union"[16] has acknowledged both the potential and importance of using central large scale electrolysis for provision of grid balancing and energy storage purposes in European regions with increasing share of intermittent renewable energy. Intelligent operation of the electrolyser in periods with excess or lack of renewable electricity production could help balance the grid and store energy.

This conceptual use of electrolysis is however faced with several challenges that are to be addressed by large scale demonstration. As for existing technologies such as central power plants the use of electrolysis for provision of grid balancing services alone is not sufficient for a feasible business case. Where power plants needs several electricity production hours per year to supplement grid balancing revenue, electrolysis needs multiple high value markets where the produced hydrogen can be stored, distributed and used. This is in particular of importance if green electrolysis hydrogen is to be cost competitive with central SMR fossil production.

Recent years of R&D have significantly improved the production ramp up and down flexibility of electrolysis technology and improved the scalability from kW to MW size. What is still lacking is large scale infield demonstration as sites where both multiple grid services are required and where hydrogen at the same time can be distributed and offered for multiple high value markets, such as e.g. industrial gases, transport fuel and power-to-gas. Only such applications can provide both the scale for providing grid balancing and reaching cost levels where additional revenue can be generated from hydrogen distribution and sales.

Little evidence has been gathered yet of the way electrolysers could operate to maximise their benefits to the grid and revenues from hydrogen supply to multiple markets.

This demonstration call seeks proposals which demonstrate state of the art electrolyser technologies providing and receiving revenue by providing these balancing services, whilst distributing (and receiving revenues from) hydrogen for high value markets.

Scope:

The objective of the project is to deploy and monitor state of the art (2015) electrolyser systems and supporting hydrogen distribution and supply systems configured to attract revenues from grid services in addition to providing hydrogen for multiple high value markets.

The scope of the project should include efforts such as:

[16] Available at: http://www.fch-ju.eu/sites/default/files/study%20electrolyser_0-Logos_0.pdf

- Large scale electrolyser in excess of 1 MW must be tested in order to be in relationship with the grid scale. Power installed should be duly justified along with the advantages offered to the grid and the resulting long term business model
- This topic focuses on the inclusion of specific improvements of the current SoA related to the electrolyser operation under partial loads, quick response, system for reserve and frequency response services, forecasting models for electricity price and renewable energy production
- The technology must demonstrate an electricity consumption of 55 - 60 kWh/kgH2; capital cost of 930 EUR/kW for alkaline electrolysers and 1,570 EUR/kWh for PEM electrolysers. Those target costs do not include the specific tailoring of the electrolysis to be compatible with the grid services to be brought
- Electrolyser system operators will demonstrate that they are able to benefit from grid services revenue streams. Here, the consortium will demonstrate that they are able to obtain these revenues by entering into commercial contracts with the grid operators or utilities who value these services
- A comprehensive operation plan must be put in place. State of the art electrolysers and downstream systems must be installed and operated for a minimum period of two years
- Electrolysers systems will demonstrate a sufficient level of responsiveness to meet the requirements of the grid services they will seek to offer (e.g. rapid modulation, rapid start, as required by the services offered to the grid)
- Proportional scaled hydrogen distribution and supply systems for downstream provision of the produced hydrogen will be valuable strong added value for the proposal, as e.g. innovative hydrogen distribution concepts for industrial gas or transport fuel applications and/or power-to-gas. Correspondingly, the distribution and supply concepts for downstream hydrogen provision should show improvement on scale and current market utilization. In order to the hydrogen to final customers, activities may include the hydrogen distribution and supply systems and market access, such as innovative trailers and filling port and connection concepts at industrial gas customers. Safety of such innovative solutions shall be fully assessed, as part of the project. Additionally local hydrogen pipeline grids or power-to-gas applications can also be included

A technology neutral approach is envisaged, not precluding any of the different technologies. Furthermore, various technologies may apply in the same project and regulatory regimes, while strongly promoting cross-over learning, which enriches the knowledge obtained, provided sufficient information exchange among participating stakeholders and with the broader community is put in place.

Eligible consortia should reflect the value chain for the business case considered, such as for instance electrolyser and hydrogen technology developers, electricity grid operators, gas companies, HRS network operators, industrial hydrogen customers, utilities and energy companies. Specifically, the partnership must include strong links to:

- the necessary contractual and commercial expertise to access revenues from the grid services
- technical expertise for the design, provision and operation of the electrolyser and associated hydrogen distribution and supply technologies

- market access for downstream provision of hydrogen for high value markets such as industrial gas, transport fuel or power-to-gas

It will be valuable if consortia build upon already feasible business cases, so that potential customers (transport use, industry or utility) do not discontinue the use of the installation after project end, but on the contrary support continued market roll-out efforts.

Expected impact:

The proposal is expected to demonstrate in an operational environment state of the art electrolysis technology configured to attract revenues from grid services in addition to providing hydrogen for multiple high value markets.

The consortium will ensure that actions are included in the project in order to generate learning and reach KPI and commercial targets, such as:

- Confirm and validate feasible operation of large scale central electrolysis, together with the necessary grid interfaces as well as hydrogen distribution and supply systems that captures revenue from balancing services and sale of hydrogen for multiple markets
- The environmental performance of the system – with a particular attention to the CO_2 intensity of the hydrogen produced, which should include an understanding of the CO_2 impact of the grid services mode selected and CO_2 footprint impact in the addressed hydrogen end-user markets
- Techno-economic analysis of the performance of these systems
- Projections of the value and size of the markets addressed by provision of the grid balancing services and supply to multiple hydrogen markets
- Assessment and operation experience of the contractual and hardware arrangements required to access the balancing services and operate the electrolyser systems
- Assessment and operation experience, including safety, of the contractual and hardware arrangements required to distribute and supply hydrogen to multiple markets such as industrial gas, transport fuel and/or power-to-gas
- Assessment of the legislative and RCS implications of these systems and any issues identified in obtaining consents to operate the system
- Recommendations for policy makers and regulators on measures required to stimulate the market for these systems
- Public-facing versions of these 'lessons learnt' reports should be prepared and disseminated across Europe and potentially wider

Other Information: Expected TRL increasing from at least 5 (technology validated in relevant environment) to minimum 7 (system prototype demonstration in operational environment).

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

Indicative funding and number of projects: The maximum FCH 2 JU contribution for this topic varies between EUR 14 million and EUR 16 million depending on the number of projects. This funding can be allocated to one large project including the additional activities

suggested under the scope of the topic (hydrogen distribution and supply systems) with a maximum contribution of EUR 14 million. Alternatively, it can be allocated to maximum two smaller projects using different electrolyser technologies or using same technology in two demonstration sites addressing different market schemes, each requesting a maximum contribution of EUR 8 million.

Expected duration: 4 years

Type of action: Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-02.11-2014: Large scale fuel cell power plant demonstration in industrial/commercial market segments

Specific challenge:

The maturity level of several fuel cell technologies is ready to achieve a market entry of fuel cell power plants in the most challenging market segments, i.e. commercial or industrial (50 kW - 10 MW). This is a way to meaningfully reduce harmful emissions like GHG (through improved energy efficiency of using natural gas and utilization of renewable fuels including biogas and/or green hydrogen) and emissions of NO_x, SO_x and PM (particles) and also to assure the security of power supply (through decentralized power production).

The realization of large scale demonstration projects are needed to build up confidence/acceptance of the various stakeholders (electricity/heat producers, public, politicians, investors etc.) and applications to reduce the market entry barriers and to commercialize the technology. These demonstration projects are needed for confidence building to trigger volume scale up with large scale orders. This leads to higher installed capacity and therefore to lower cost.

The main focus of this area would be in reduction of use of primary energy by efficient and direct conversion of chemical energy (hydrogen, biogas, natural gas and other hydrocarbons, power to gas, industrial waste gases etc.) into power in a decentralized power production to reduce losses due to transmission and distribution.

In order to increase competitiveness against standard CHP there is a goal to reduce the total cost of ownership (TCO in €/kWh) in the direction of grid costs and competitive total costs of energy in different applications.

Scope:

Deploy example FC solutions in commercial or industrial market segments through strong partnerships between end users, industry, SMEs, local authorities, and FC suppliers.

The projects will target primarily demonstration of solutions integrating the following:

- 50 kW up to several MW capacity production of power and heat from natural gas, biogas or hydrogen
- Integration of a FC power plant in industrial/commercial processes

The project should aim at creating partnerships between end users, industry, local SMEs, financiers and local authorities, in order to ensure that the solutions are replicated and can be financed through various sources.

Therefore each project should:

- Validate real demonstration units in commercial applications will enable suppliers, various stake holders and end users to gain experience throughout the value chain
- Develop and reinforce business plans and service strategies (e.g. refurbishment of stacks at end of life, full service offers etc.) during the project and Life Cycle Analysis that will be replicable and validated in other market segments after the project
- Have a clearly defined structure, with roles and responsibilities properly spelled out for all involved entities

Cleaning of the fuel is out of scope of this topic.

Expected impact:

The proposals are expected to have the impacts described below:

- Supplier and user experience of installation/commissioning, operation and use of distributed power generation
- Building and validating references to build trust among the stakeholders
- Enable active participation of consumers in order to bring the fuel cells technology closer to their daily business
- Reduction of the CO2 emissions with respect to the local grid by > 10%
- Reduction of the use of primary energy by
    - Electrical efficiency > 45%
    - Total efficiency > 70% (heat cycle: 45°C/30°C)
- Reduction of the CAPEX (no transport, installation, project management, no heat use equipment) to
    - < 7,000 €/kW for systems < 1 MW
    - < 4,000 €/kW for systems ≥ 1 MW
- Reduction of the maintenance costs (full service including stack replacement) to < 0.05 €/kWh
- Reduce the overall energy costs
- Demonstrate a viable solution and a replicable business case

It is envisaged that the proposals will also bring societal benefits such as:

- Economic growth and new jobs at the local level, including supply-chain jobs
- Great basis for further growth of the industry
- Energy security and improved reliability

Any event (accidents, incidents, near misses) that may occur during the project execution shall be reported into the European reference database HIAD (Hydrogen Incident and Accident Database) at https://odin.jrc.ec.europa.eu/engineering-databases.html.

Other Information: The activities are expected to be implemented at TRL above 7 (please see part D of the General Annexes).

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of EUR 2.5 million for fuel cell systems below 1 MW (or EUR 9 million for fuel cell systems at or above 1 MW) would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: a maximum of 3 projects may be supported under this topic, with one project addressing fuel cell systems at or above 1 MW and two projects addressing fuel cell systems below 1 MW.

Expected duration: 5 years

Type of action: Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

OVERARCHING PROJECTS

FCH-03.1-2014: Hydrogen territories

Specific challenge:

Hydrogen and fuel cell technologies are often described as very promising solutions that will help to reshape a new society model as it would guaranty secure, clean and efficient energy solutions while also offering smart, green and integrated transport solutions. However, transport and energy are often treated separately within the FCH JU funding framework programme, thereby reducing the opportunities to demonstrate pioneer hydrogen economy models at territories levels.

Therefore, this topic aims to support territories where there is a strong political commitment to deploy ambitious and innovative hydrogen-integrated transport and energy demonstration projects in European Territories.

This particular "Hydrogen territories" topic is focused on the deployment of hydrogen technologies in European isolated territories in order to prove the viability and feasibility of hydrogen economy concept in off-grid areas.

Scope: To develop and deploy replicable, balanced and integrated fuel cell and hydrogen solutions in both energy and transport fields through strong partnerships between municipalities, industries and academia in European isolated territories disconnected to the main or national electrical grid.

These solutions will demonstrate an integrated hydrogen economy concept focused on small off-grid areas. The hydrogen territory proposals should primarily target transport and energy replicable demonstration applications such as vehicle fleets powered by hydrogen for public and/or private transport, including logistics and/or freight-distribution, MW capacity production of green hydrogen, hydrogen storage for balancing the grid and supply to a hydrogen refuelling station as well as large stationary fuel cell systems for distributed generation and other relevant commercial or industrial applications.

The proposals should address the following main areas:

- Near/fully autonomous hydrogen buildings/quarters/districts: through the integration of hydrogen energy storage chain coupled with renewable energy sources and including heat valorisation, backup power solution, and when applicable, supply to a vehicle hydrogen refuelling station (retail, public transport, or fleets)
- Zero emission mobility: through the integration of hydrogen refuelling infrastructures and provision of vehicle fleets powered by hydrogen for public and/or private transport, including logistics and/or freight-distribution. The project shall focus on hydrogen mobility applications such as public transport buses, passenger vehicles, taxi fleets, boats but also scooters or bikes to ensure a greater public visibility and awareness. The vehicles included must be designed in a way that allows producing them in large series

To be eligible, the proposals should prove a strong commitment from local authorities that reveals a long-term hydrogen-integrated urban plan strategy.

Isolated hydrogen territories should seek to create partnerships between industries, academics and cities, demonstrate replicability of the solutions and ensure funding from various sources.

Therefore each project should:

- Be realised in at least one European isolated territory
- Include industry, city planning authorities, research community, local Small and Medium Size Companies (SMEs)
- In addition the project should co-involve at least one follower territory i.e. an off-grid territory willing to contribute to the process though the replication of solutions at the end of the project and having access to the know-how and results of the project and a privileged contact with the project's partners. The involvement of the follower territory should be relevant (e.g. participating in definition of user requirements and methodology of transferability of solutions, data collection etc.). The follower territory should commit to replicate, improve and follow up integration of hydrogen energy vector solutions in the urban planning. The follower(s) territory(ies) will not be eligible for FCH 2 JU funding to deploy integrated hydrogen and fuel cell solutions in the frame of the project proposals. At least one follower territory should come from a Member State or Associated Country
- Ensure that all proposed activities will be integrated in an ambitious urban plan. The urban plan shall integrate buildings planning, energy networks, and transport/mobility planning; additional issues may be addressed as well if relevant for the territory. These plans shall be submitted with the proposal as a supporting document(s)
- In order to ensure the success of the project, the funding for some parts of the programme or initiative in which the isolated territory project is embedded should be secured from other sources, preferably private ones, but also other EU funding sources, national or regional funding
- Projects should develop and reinforce business plans during the project and Life Cycle Analysis that will be replicable and validated in other territories after the project
- Consortia must have a clearly defined structure with roles and responsibilities properly spelled out for all involved entities

Proposals must also commit to scientific and technical requirements:

- Create a "Hydrogen Territory Platform" to share smart hydrogen solution proposals, best practices, project ideas, collect data from operating systems, measurement and disclosure methodology, in order to facilitate a common footprint calculation methodology and other metrics (especially for energy saving; CO_2 reductions, financial savings, number of jobs created, environmental impact etc.)
- The performance monitoring should last for a period of long-term commitment such as 5 years. Consortia should develop an integrated and common protocol for monitoring energy, infrastructure, mobility and governance practices in the hydrogen territories, enabling documentation of improved performance over short and long term periods. The monitoring protocol should be robust and viable also after the end of the project, supporting and increasing municipal capacity over time

Projects should be co-funded by national, regional or private sources in order to demonstrate a strong commitment towards the 2020 European Energy Policy. This should be explained in the budget justification and supported with a Letter of Intent.

Expected impact:

The proposals are expected to have the following impacts:

- deploy and demonstrate wide-scale, innovative replicable and integrated hydrogen energy solutions in both energy and transport
- increase the energy efficiency of isolated territories and valorise the use of renewables for integration of hydrogen-energy solutions and enable active participation of consumers
- demonstrate the positive impact of electrolysis on grid balancing
- increase mobility efficiency with lower emissions of pollutants and CO_2. The proposals will have to specify key objectives and indicators such as gCO_2/km for Well to Wheel analysis
- reduce the energy costs; The consortium will have to commit itself to reaching targets for energy cost reduction
- respect Key Performance Indicators described in the MAWP for both hydrogen transport and energy applications and technologies used in the project
- conclude on a business model for the use of hydrogen in isolated territories
- decarbonise the energy system while making it more secure and stable; clear targets shall be expressed in terms of, for example, gCO_2/MWh electrical and/or g CO_2/MWh heat
- create stronger links between isolated territories in Member States with various geographical and economical positions through active cooperation

It is envisaged that the proposals will also bring societal benefits:

- Reduction of energy bills for all actors and especially for public authorities with clear objectives for both energy applications (e.g. €/MWh elec and/or heat) and for transport applications (e.g. €/km)
- Increase quality of life by creating local jobs (that cannot be delocalised) in the isolated territories
- Increase air quality

Any event (accidents, incidents, near misses) that may occur during the project execution shall be reported into the European reference database HIAD (Hydrogen Incident and Accident Database) at https://odin.jrc.ec.europa.eu/engineering-databases.html.

Other Information: The project will be using very near to market hydrogen technologies (TRL 7 and more at the start or maximum one year after the start of the project) and should be replicable in other territories.

To be eligible for participation a consortium must contain at least one constituent entity of the Industry or Research Grouping.

Indicative funding: The maximum FCH 2 JU contribution that may be requested is EUR 5 million per project. This is an eligibility criterion – proposals requesting FCH 2 JU contributions above this amount will not be evaluated.

Number of projects: A maximum of 1 project may be funded under this topic.

Expected duration: 5 years

Type of action: Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

CROSS-CUTTING

FCH-04.1-2014: Educational initiatives

Specific challenge:

This topic specifically builds on previous projects TrainHy, HyProfessionals and HyFacts and will work with current HyResponse (first responder training) and projects KnowHy (2013 call, e-learning platform for technicians training) as far as sensible and appropriate. Whilst the named projects concentrated on developing the basis of fuel cell and hydrogen-related teaching, for instance in the way of developing a curriculum, this project will now fill these structures by building a network of academic institutions that will develop and provide the adequate teaching material, also integrating vocational training institutes, industry, research organisations and other relevant actors along the technology value chains, which will allow regular updates and supply of relevant educational material. The project extends the scope in providing teaching materials for courses and e-learning and supplying these to the European lecturer community. Universities prepared to participate in the supporting network of the project will be able to access this material as a support to high quality teaching throughout Europe. The emphasis is on university (graduate and post-graduate) teaching and the equivalent level of vocational training (e.g. in processes of continuous professional development etc.).

The supply of high quality teaching and learning material is essential in building the vast human resources needed for further developing and commercialising fuel cell and hydrogen technology. The university type material can also be 'downgraded' and used for specific target groups (e.g. regulators, first responders etc.) and later also secondary schools since the curriculum structure has a general validity.

The described activities and approaches are in line with the educational activities in the area of fuel cells and hydrogen laid out in the SET-Plan Education and Training Roadmap (http://setis.ec.europa.eu/setis-deliverables/education-training-roadmap).

Scope:

The project will develop teaching and experimental material, also in cooperation with business and research organisations, for use in university and vocational training. This will be presented on a web-site in the sense of a source of curriculum structure, of teaching content, and as an e-learning platform. The goal is to integrate such content into (for instance) Massive Open Online Course platforms like OpenupEd or similar. This would be the subject of a further call in 2 to 3 years' time. The project should include or cooperate with university networks with the goal of harmonising teaching materials and concepts and supplying high quality material, as well as for the development of joint degree programmes when of interest to the participating institutions. Activities will include developing access to research and industrial infrastructures in order to allow practical training in real environment. They shall incorporate concepts and elements of the roadmaps developed in other EU contexts, specifically the SET-Plan Education and Training Roadmap.

The project should also take stock of, and include where possible, educational material already produced elsewhere (e.g. as available from the US DoE) in order not to replicate existing material.

Expected Impact:

- Preparation of teaching material to cover the TrainHy curriculum in the form of presentations, scripts handbooks, lecture notes, videos, audio, simulations, tests, etc, for student learning and lecturer preparation; focus on learning outcomes; coverage of a reasonable number of EU languages to make sufficient impact on undergraduate teaching
- Establishment of a network of universities (interacting also with partners outside of the project consortium) participating in quality assurance of teaching material and using the material in their (local) courses
- Establishment of close links to business and research institutes in order to allow quality and timely update of the curricula, access to physical or virtual research infrastructure for training purposes, as well as mobility of students and staff
- Mutual recognition of credit points for the European Credit Transfer System (ECTS according to the Bologna process) throughout this network
- Installation of a web-site hosting this teaching material for access by associated universities
- Installation of a web-site suitable for e-learning or integration into existing, more general platforms and performance of prototype courses
- Update on TrainHy curriculum development
- Expansion of blueprints for experimental equipment developed in TrainHy
- Delivery of educational courses (integration of modules in existing curricula, new courses, summer schools, hydrogen and fuel cell infrastructure dissemination etc.) as developed by TrainHy and HyProfessionals within the project duration (minimum for three years), development of joint–degree programmes when of interest to the participating institutions
- Establishment of a concept how sub-sets of the material or adapted versions can be used for training of specialised staff, for instance with regulators, permit authorities, and certification bodies and any other organisations active in the fuel cells and hydrogen area; development of at least prototype courses covering this clientele
- Development of a concept how the material provided by the project can be adopted for secondary schools and public displays as laid out in the SET-Plan Education and Training Roadmap; prototype material may be developed in the project but this is not an essential requirement

Other information: The consortium will ideally include experienced partners from the named projects in order to supply continuity. It should be expanded to networks of higher education institutions with a proven scope and capability in the field.

Within the project duration, the network shall be grown to include partners outside of the consortium who will then contribute to the cost of running the project.

Indicative funding: The FCH JU considers that proposals requesting a contribution from the EU of between EUR 1 and 1.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: A maximum of 1 one project may be funded under this topic.

Expected duration: Up to 4 years

Type of action: Coordination and Support action

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-04.2-2014: Develop strategies to raise public awareness of fuel cell and hydrogen technologies

Specific challenge:

Public acceptance of fuel cell and hydrogen technologies can be generally regarded as positive - with some safety issues still remaining significant. Global macro benefits remain not widely quantified and known: key features on fuel cells and hydrogen specificities and advantages are not well displayed in an easy to access format, as for instance dedicated internet platforms; introductions to technology uses and supporting demonstrators, apart from cars, are not sufficiently available either. This explains that the public seems to be relatively indifferent to developments regardless of the opportunities offered by these technologies.

Insofar the problem lies not so much with performing research into whether the public would accept widespread employment of hydrogen and fuel cell technologies, but to make the public, including all stakeholders, increasingly aware of the potential of these technologies in order to prepare a commercial market entry, through a widely accepted vision of its macro benefits, concrete facts and figures on hydrogen and on safety and reliability issues, and clever and simple demonstration items and exhibits easy to display and use for a general public audience (for instance fuel cell assisted electric bicycles, mobile charging devices for personal computers and phones, and other gadgets suitable for public exhibitions).

Scope:

The overall objective is to increase public awareness of fuel cell and hydrogen technologies and deliver well-founded information on opportunities and risk management (fight the fear) by developing a strategy to explain these technologies to the general public and to private and public bodies (future potential clients). In order to do so, the consortium will need to include a range of economic academics mastering energy transition matters and issues, marketing and communication experts, and web communication agencies.

We expect the consortium to build a web platform, and to design and use innovative communication tools and the social media to allow the targeted audiences to better understand the opportunities and risk management of fuel cell and hydrogen technology implementation through a multi stage contributive approach.

Expected impact:

- Supply of an overview study compiling the many existing studies showing the potential long term macro benefits of displaying technologies in terms of innovation, job creation, energy security and balance, and health in the European Union
- Dissemination of the results of this meta-study through a well-defined media strategy and development of the associated communication kit reaching out to policy makers at European and national levels
- Supply of a one-stop-shop for information around hydrogen and fuel cell technologies by design and implementation of an internet communication strategy based on a specialised web portal (e.g. news aggregator, social media, videos, mobile apps, games, case-studies, etc.). The platform web site has to document fuel cell and hydrogen technologies, including facts and figures, opportunities and risk management that will set the scene for the fuel cell and hydrogen sector for different key audiences, relay key news, structure the policy and public debates and propose debates on questions, concerns and issues around the technology
- Improved public information by supply of technical content suitable for the general public to platforms such as Wikipedia and others

- Supply of demonstrational items (other than vehicles) for exhibitions, fairs and other events that constitute a basic mobile lighthouse set of objects that can be easily displayed and used for the public in any blue / green society / green mobility event
- Organisation of public debates in different Member States

Other Information: The project is expected to be active in a minimum of ten Member States, with preferably different languages.

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: a maximum of 1 project may be funded under this topic.

Expected duration: 3 years

Type of action: Coordination and Support Action

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

FCH-04.3-2014: Pre-normative research on vented deflagrations in containers and enclosures for hydrogen energy applications

Specific challenge:

Many hydrogen-energy systems such as electrolysers, fuel cell backup systems, refuelling stations, etc. are commonly designed and integrated into containers and/or small enclosures. Such hydrogen products usually comprise high-pressure piping, fittings and components that, in case of failure in such confined and obstructed enclosures, may lead to the rapid formation of a turbulent flammable hydrogen-air mixture. If ignited, such cloud would trigger a deflagration or even a more devastating detonation. This event requires a specific attention where best to apply safety barriers to mitigate the risk from a hydrogen explosion in order to ensure the highest level of safety for hydrogen energy applications.

Explosion venting technique is commonly used in the industry to both mitigate explosion overpressure effects in the surroundings and prevent complete facility destruction and missile effects. Being able to correctly design an effective vent is an essential safety feature for fast-deploying containerized hydrogen-energy products.

Nonetheless, the European standard EN 14994 "Gas explosion venting protective systems" has a very limited range of applicability and can hardly be used for vent sizing of hydrogen-air deflagrations. Despite more recent hydrogen-air vented deflagration experiments available in the safety community, only few data are representative of real-life conditions that can be encountered in hydrogen-energy containers or enclosures. Recent work related to engineering correlations for vent sizing was carried out but still need further development to be straightforwardly applicable to hydrogen-energy enclosures.

Performing experiments in real-life industrial enclosures is thus necessary to improve vent sizing techniques for hydrogen-energy products and further develop analytic and CFD modelling tools. The experiments will have to be representative of different possible scenario/ potential hazards identified in enclosures. This includes in particular the characterisation of venting systems (e.g. doors, natural vent openings, etc.) for combustion of homogeneous hydrogen-air mixtures at different concentrations, formation and combustion of gradient mixtures, delayed ignition of turbulent hydrogen jet inside containers and enclosures, etc…

Another knowledge gap is the structural response of containers exposed to a vented explosion. The overpressure – impulse (P-I) diagram has to be modelled theoretically. Mechanical response experiments should also be performed to check the model and its assumptions.

Scope:

- Conduct pre-normative research on hydrogen-air vented deflagrations in real-scale containers to prepare an International Standard on "hydrogen explosion venting mitigation systems"

Expected impact:

- Coordinated input to an International Standard on "hydrogen explosion venting mitigation systems"
- Safe and successful introduction of hydrogen-energy systems into the market by definition of harmonised and standardised hydrogen vent sizing requirements for installations in enclosures
- Prediction of hydrogen explosion effects for certification and planning purposes by developing, verifying and validating analytical and CFD predictive models

- Verification of models by performance of real-life hydrogen-air vented deflagrations in industry-representative hydrogen-energy enclosures and containers

Indicative funding: The FCH 2 JU considers that proposals requesting a contribution from the EU of EUR 1.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Number of projects: a maximum of 1 project may be funded under this topic.

Expected duration: 3 years

Type of action: Research & Innovation Actions

The conditions related to this topic are provided in the previous chapter and in the General Annexes.

3.6 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 constitute the main means of implementation of the Annual Work Plan.).

Subject (Indicative title)	**Indicative distribution of the funding between the studies in EUR**
1. Alignment on a vision on the future position of hydrogen and fuel cell technologies in a changing world	150,000 EUR
2. Conditions for the emergence of competitive H2 powered transportation solutions and estimation of the long term impact of their market deployment on key macro indicators of European Union (GDP, Employment, Trade Balance, Energy Imports…).	150,000 EUR
3. Green Hydrogen Production Pathways	150,000 EUR
4. Regulatory study: Identification of EU regulations that hamper or that could facilitate the deployment of FCH technologies and recommendations for change.	150,000 EUR
Total FCH JU Funding	**Total: 0.6 Million**

The final budgets awarded to actions implemented through procurement procedures may vary by up to 20% of the total value of the indicative budget for each action.

4. Horizontal and Support Activities

4.1 Policy and Communication

The priority objectives of policy and communication of the FCH 2 JU are: 1) to ensure political and public awareness of its programme, its functioning and achievements; and 2) to provide consistent and comprehensive information to demonstrate the added value of hydrogen and fuel cell technologies in addressing economic, social and environmental concerns of EU citizens.

To effectively implement the above objectives, the FCH 2 JU's communication strategy comprises both internal and external communication activities. It is noted that the FCH 2 JU is expected to adopt an official communication strategy during 2014 that is likely to include internal and external communication activities. As far as is known as of the time of this writing, these activities will include the following:

Internal communication objectives

A) Maximise FCH 2 JU members' involvement and contribution to FCH 2 JU activities, maintaining a coordinated "One Voice" approach with consistent messages.

This objective is implemented through regular communication with and meetings of the Joint Communication Task Force representing all FCH 2 JU members, and through efforts to align the FCH 2 JU vision amongst stakeholders. With respect to the latter, the States Representatives Group could play a very important role interfacing with the FCH 2 JU to identify potential areas of cooperation, including synergies with national and regional research programmes.

In addition, a monthly Governing Board briefing meeting is organized by the Executive Director to provide timely information on FCH 2 JU on-going activities and planned events/initiatives.

External communication objectives

B) Actively promote fuel cell and hydrogen technologies amongst EU and national policy makers, opinion leaders and stakeholders of the FCH sector, making them more visible and understandable in order to gain acceptance and support.

Main external communication activities are likely to cover:

- Actions targeting policy makers, notably Members of the European Parliament and Council representatives, but also Members of the Committee of Regions and Social and Economic Committee, highlighting key issues related to FCH technologies. These actions will likely be carried out in coordination with FCH 2 JU members
- Dissemination of FCH 2 JU achievements and programme results (including studies), through to international workshops, scientific conferences, national/regional events/workshops and information sessions to present FCH 2 JU activities and discuss policy and regulatory tools (e.g. procurement, tax incentives, standardisation) for fuel cells and hydrogen technologies deployment, to leverage national and regional support to complement FCH 2 JU activities
- Organisation of the Stakeholder Forum and Programme Review Days

In 2014, focus will be put more specifically on the following:

- Adoption of the communication strategy of the FCH 2 JU
- Regular contributions to EU public consultations on energy and transport issues in order to ensure, in close cooperation with FCH 2 JU founding members, the proper alignment and a coherent approach
- Exploitation of synergies and coalition building with FCH 2 JU founding members and/or the relevant services of the European Commission (e.g. JRC) in order to optimise communication opportunities at national and international level
- Production of publications, studies, fact-sheets and general brochures about FCH 2 JU activities and results
- Re-design of the FCH 2 JU web site as an effective communication tool and visibility platform
- Participation in the main public events, at EU, national or international level (e.g. Hannover Messe, Open days, High level roundtables, Info Days etc.) to raise the profile of FCH 2 JU and foster media interest

Social media activities (twitter, Facebook, LinkedIn) could be launched provided the proper financial and human research capability.

Achievement is measured by performance against work plan (numbers of presentations at events and at individual level with members of key constituencies), quantitative and qualitative feedback on activities, primarily on the Stakeholder Forum, following the example of Stakeholder General Assembly events through 2013 from the FCH JU.

4.2 Other support activities

Finance and Administration

Finance and Administration is a major component of the 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
- Financial and administrative management of procurement and grants
- Provide financial analysis and financial management support to the operational unit
- Monitor budget execution and report to the Executive Director
- Update multi-annual budget forecast 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 FCH 2 JU's Internal Audit Capability (IAC)
- Coordinate and support visits of the Court of Auditors

In 2014 special focus will be put on the following:

- Update procedures as necessary to take into account changes in rules and requirements, in particular regarding project management and reporting (electronic submission only, automated generation of invoices…)
- Improve procedures and tools for project management by ensuring implementation of the action plan on IAC recommendations related to the audit on grant management

- Ensure implementation of audit findings and further implement the ex-post audit strategy by launching new audits including risk based audits where necessary
- Further implement the communication campaign on how to avoid errors in cost reporting by organizing one or two dedicated sessions and/or presentations at project kick-eff meetings
- Prepare documents and update procedures as relevant in the context of FCH 2 JU and horizon 2020 (financial rules, financial circuits, delegation agreement with the Commission and financing agreements with NEW-IG and NERGHY, etc…)

Achievement is measured through the following indicators:

- Level of budget execution (at least 90%in commitment appropriations)
- 90% of payments made within deadlines. (30 days for contracts and for pre-financing on grants; 90 days for interim/final payments on grants)
- Number of exceptions (deviations from rules and procedures) recorded

Human Resources and General Administration

The priority objectives for Human Resources are to ensure that the Staff 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 2 JU staff strategy and planning processes
- Develop/update HR policies and procedures (including implementation, monitoring and review)
- Monitor adequacy of staff resources in relation to activities
- Launch and follow-up recruitment procedures efficiently to ensure filling of full establishment plan
- 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

In 2014 special focus will be put on the following:

- Developing the organisational structure of the FCH 2 JU in close cooperation with the Governing Board.
- Development and implement a training plan to ensure adaptation of staff skills to the new rules and tools, continuous development of staff competences and to enable performance at the highest quality standards
- Continue to promote good internal communication and positive team atmosphere

- Prepare implementation of the revised staff regulations which enter into force from January 1st, 2014 including adoption of implementing rules
- Reclassification exercise
- Close monitoring of the use of resources aiming at ensuring a sustainable workload
- Carry out recruitment procedures, in particular for the new staff needed for FCH 2 JU in accordance with the establishment plan
- Further develop inter-JUs cooperation (notably common calls for tender, common recruitment procedures, common approach on Implementing Rules, etc.)

Achievement is measured through the following indicators:

- Vacancy rate (less than 5%)
- Timely submission of new rules and update of procedures
- 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 that the activities of the FCH JU can be organised successfully in compliance with applicable legislation and rules.

Beyond this function of legal advice and compliance, the role of the legal manager involves the complete management of some activities (notably procurement procedures in the administrative budget and the procurement of all studies made with the operational budget). 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 2014 focus will be put more specifically on the following:

- Procurement and monitoring of commercialisation studies which involve a strong coordination with the contractors and the industrial coalitions supporting the studies

- Legal input on the revision of all the implementing rules and procedures that will apply to the FCH 2 JU
    - The FCH 2 JU financial rules and their implementing rules
    - The FCH 2 JU delegation agreement to be negotiated and signed with the Commission
    - The FCH 2 JU grant agreements
    - etc.
- Further implement data protection requirements notably by follow-up of EDPS opinions on prior-check notifications

Achievement can be assessed based on the following elements:

- Completeness of register of data protection notification; feedback from data subjects and from EDPS
- Feedback on quality of input and advice

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 as well as preparation for Horizon 2020 tools
- Ensure adjustment of IT tools to the FCH 2 JU needs (expansion, upgrade, etc…)

In 2014 special focus will be put on the following:

- Keep in place the full access for the FCH 2 JU staff to the set of IT applications related to the FP7 program, ensure adequate development, training and test of the new H2020 applications package in line with the new FCH 2 JU regulatory program, and continue to improve the telecommunication lines which are key to access our business information
- Further develop in-house tools for reporting, monitoring decision-making (matching), dissemination of information and research results (TEMONAS program)with adequate applications; finalize the migration to the new document management system and customize some automated workflows for simplification and quicker reaction of the FCH 2 JU back office. Improve internal and external communication through the website in cooperation with the Knowledge Manager

- Finalize the disaster recovery plan and test the business continuity plan in parallel to the preparation of the new Framework Contract for IT services after 2014

Achievement is measured by the following indicators:

- Compliance by contractors/ service providers with the service level agreements

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 the mid-year management report 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 2014 focus will be put on the following:

- Follow-up of the action plan for implementation of recommendations of IAC audit on grant management
- Follow-up of action plans on effective implementation of internal control standards and on action plan for risk mitigation
- Review the internal control standards to ensure the adaptation of the measures, rules and procedures to the new legal environment (Council regulation on FCH 2 JU, Horizon 2020 programme…)

Achievement is measured by the following indicators:

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

Internal Audit Capability

The priority objectives of the FCH JU Internal Audit Manager (i.e. 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:

- Establishment of an audit work plan, including assurance and consulting services, in coordination with the Commission's Internal Audit Service (IAS)
- Implementation of the annual IAC's 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 and risk management
- Management of ex-post audits of beneficiaries through a Framework Contract with external audit firms

Achievement is measured by the following indicators:

- Performance against annual audit work plan
- Coordination level with the IAS and the Commission Common Support Centre (i.e. Common Audit Service – CAS)
- Compliance with JU's deadlines established in the framework contract for ex-post audits
- Auditee's feedback (i.e. positive average feedback (below or equal to 2) in a scale from 1 (very good) to 5 (insufficient))

In 2014 special focus will be put on the following:

- Implementation of the ex-post audit strategy - new 'representative' and 'risk-based' audits will be launched to ensure appropriate audit coverage of cost claims validated. This will provide the Executive Director with an important building block of assurance on legality and regularity of the JU's transactions
- In cooperation with the CAS, define a harmonised/common H2020 ex-post audit strategy
- Follow up audits will be carried out to confirm the effective implementation of the IAC recommendations from previous audits
- Annual Assessment of the level of in-kind contributions
- Continue the efforts to reduce errors by supporting the Finance Unit in the communication campaigns on "How to avoid errors in cost reporting"

Accounting

The Accounting Officer is functionally independent in the performance of his/her duties.

In line with article 43 of the FCH JU Financial Regulation the Accounting Officer 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 Financial Rules)

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

In 2014, after agreement of the Governing Board, negotiations will be pursued with DG BUDG in view of appointing the Accountant of the Commission as the Accountant of the JU. To that effect an SLA will be signed with DG BUDG.

5. Resources

The staff and financial resources of the FCH 2 JU for the year 2014 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 2014

Temporary Agents

Grade	2014 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		(4)
Total *AD*[17]	**0**	**15 (4)**
AST 11		
AST 10		
AST 9		
AST 8		1
AST 7		3
AST 6		
AST 5		
AST 4		1
AST 3		4(2)
AST 2		
AST 1		
Total *AST*[18]	**0**	**9 (2)**
TOTAL	**0**	**24**

*Numbers in parentheses indicate new posts created

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

[17] AD stands for Administrator

[18] AST stands for Assistant

5.2 BUDGET 2014

The budget presented herein below reflects the contributions of the budgets for the FCH JU for 2014 under FP7 as amended by the GB on 10/04/2014 and the FCH 2 JU budget under H2020.

5.2.1 Statement of Revenue under FP7 [19]

Title Chapter Article Item	Heading	FCH1 Budget 2014 CA (in €)	FCH1 Budget 2014 PA (in €)
2001	***European Commission subsidy for operational expenditure***		67,364,463
2002	***European Commission subsidy for administrative expenditure***	1,713,333	1,713,333
2003	***Industry Grouping contribution for administrative expenditure***	2,056,000	2,056,000
2004	***Research Grouping contribution for administrative expenditure***	342,667	342,667
2006	***JTI revenues***	50,000	50,000
	Sub- TOTAL revenues	4,162,000	71,526,463
3002	***C2 reactivation of appropriations (2010)***		
3003	***C2 reactivation of appropriations (2011)***	97,562	
3004	***C2 reactivation of appropriations (2012)***	10,663,113	23,822,819
3005	***C2 reactivation of appropriations(2013)***	384,800	
	Sub- TOTAL reactivation	11,145,475	
	GRAND TOTAL	**15,307,475**	**95,349,282**

[19] These figures include the EFTA contribution

5.2.2 Statement of expenditure under FP7

Title Chapter Article Item	Heading	Commitment Appropriations 2014 (€)	Payment Appropriations 2014 (€)
1	**STAFF EXPENDITURE**		
1 1	STAFF IN ACTIVE EMPLOYMENT	2,436,000	2,436,000
1 2	EXPENDITURE RELATED TO RECRUITMENT	21,000	21,000
1 3	MISSIONS AND TRAVEL	100,000	100,000
1 4	SOCIOMEDICAL INFRASTRUCTURE	43,400	43,400
1 7	ENTERTAINMENT AND REPRESENTATION EXPENSES	5,000	5,000
	Title 1 - TOTAL	**2,605,400**	**2,605,400**
2	**INFRASTRUCTURE**		
2 0	INVESTMENTS IN IMMOVABLE PROPERTY RENTAL OF BUILDINGS AND ASSOCIATED COST	335,800	335,800
2 1	INFORMATION TECHNOLOGY	135,900	135,900
2 2	MOVABLE PROPERTY AND ASSOCIATED COSTS	10,000	10,000
2 3	CURRENT ADMINISTRATIVE EXPENDITURE	39,000	39,000
2 4	POSTAGE AND TELECOMMUNICATIONS	15,900	15,900
2 5	EXPENDITURE ON FORMAL AND OTHER MEETINGS	40,000	40,000
2 6	RUNNING COSTS IN CONNECTION WITH OPERATIONAL ACTIVITIES OF FCH	650,000	650,000
2 7	STUDIES	20,000	20,000
2 8	EXPERT CONTRACTS AND MEETINGS	310,000	310,000
	Title 2 — TOTAL	**1,556,600**	**1,556,600**
3	**OPERATIONAL EXPENDITURE**		
3 0	IMPLEMENTING THE RESEARCH AGENDA OF FCH JU	11,145,475	91,187,282
	Title 3 - TOTAL	**11,145,475**	**91,187,282**
	GRAND TOTAL	**15,307,475**	**95,349,282**

5.2.3 Statement of Revenue under H2020[20]

Title Chapter Article Item	Heading	FCH 2 Budget 2014 CA (in €)	FCH 2 Budget 2014 PA (in €)
2001	***European Commission subsidy for operational expenditure***	96,154,620	0
2002	***European Commission subsidy for administrative expenditure***	301,447	301,447
2003	***Industry Grouping contribution for administrative expenditure***	259,244	259,244
2004	***Research Grouping contribution for administrative expenditure***	42,203	42,203
2006	***JTI revenues***	-	-
	TOTAL revenues	96,757,514	602,894
3002	***C2 reactivation of appropriations (2010)***		
3003	***C2 reactivation of appropriations (2011)***		
3004	***C2 reactivation of appropriations (2012)***		
3005	***C2 reactivation of appropriations(2013)***		
	SUB TOTAL reactivation		
	GRAND TOTAL	**96,757,514**	**602,894**

[20] These figures include the EFTA contribution

5.2.4 Statement of expenditure under H2020

Title Chapter Article Item	Heading	Commitment Appropriations 2014 (€)	Payment Appropriations 2014 (€)
1	**STAFF EXPENDITURE**		
1 1	STAFF IN ACTIVE EMPLOYMENT	265,178	265,178
1 2	EXPENDITURE RELATED TO RECRUITMENT	53,346	53,346
1 3	MISSIONS AND TRAVEL	4,800	4,800
1 4	SOCIOMEDICAL INFRASTRUCTURE	2,010	2,010
1 7	ENTERTAINMENT AND REPRESENTATION EXPENSES	p..m	p.m
	Title 1 - TOTAL	**325,334**	**325,334**
2	**INFRASTRUCTURE**		
2 0	INVESTMENTS IN IMMOVABLE PROPERTY RENTAL OF BUILDINGS AND ASSOCIATED COST	p..m	p..m
2 1	INFORMATION TECHNOLOGY	p..m	p..m
2 2	MOVABLE PROPERTY AND ASSOCIATED COSTS	p..m	p..m
2 3	CURRENT ADMINISTRATIVE EXPENDITURE	p..m	p..m
2 4	POSTAGE AND TELECOMMUNICATIONS	p..m	p..m
2 5	EXPENDITURE ON FORMAL AND OTHER MEETINGS	p..m	p..m
2 6	RUNNING COSTS IN CONNECTION WITH OPERATIONAL ACTIVITIES OF FCH	17,560	17,560
2 7	STUDIES	p..m	p..m
2 8	EXPERT CONTRACTS AND MEETINGS	260,000	260,000
	Title 2 — TOTAL	**277,560**	**277,560**
3	**OPERATIONAL EXPENDITURE**		
3 0	IMPLEMENTING THE RESEARCH AGENDA OF FCH JU	96,154,620	p..m
	Title 3 - TOTAL	**96,154,620**	
	GRAND TOTAL	**96,757,514**	**602,894**

5.2.5 Statement of Revenue[21]

The following table reflects the sum of the contributions given in sections 5.2.1 and 5.2.3.

Title Chapter Article Item	Heading	FCH Budget 2014 CA (in €)	FCH Budget 2014 PA (in €)
2001	***European Commission subsidy for operational expenditure[22]***	96,154,620	67,364,463
2002	***European Commission subsidy for administrative expenditure***	2,014,780	2,014,780
2003	***Industry Grouping contribution for administrative expenditure***	2,315,244	2,315,244
2004	***Research Grouping contribution for administrative expenditure***	384,870	384,870
2006	***JTI revenues***	50,000	50,000
	TOTAL revenues	100,919,514	72,129,357
3002	***C2 reactivation of appropriations (2010)***		
3003	***C2 reactivation of appropriations (2011)***	97,562	
3004	***C2 reactivation of appropriations (2012)***	10,663,113	23,822,819
3005	***C2 reactivation of appropriations(2013)***	384,800	
	SUB TOTAL reactivation	11,145,475	23,822,819
	GRAND TOTAL	**112,064,989**	**95,952,176**

5.2.6 Statement of expenditure

The following table reflects the sum of the contributions given in sections 5.2.2 and 5.2.4

Title Chapter Article Item	Heading	Commitment Appropriations 2014 (€)	Payment Appropriations 2014 (€)
1	**STAFF EXPENDITURE**		
1 1	STAFF IN ACTIVE EMPLOYMENT	2,701,178	2,701,178
1 2	EXPENDITURE RELATED TO RECRUITMENT	74,346	74,346
1 3	MISSIONS AND TRAVEL	104,800	104,800
1 4	SOCIOMEDICAL INFRASTRUCTURE	45,410	45,410
1 7	ENTERTAINMENT AND REPRESENTATION EXPENSES	5,000	5,000
	Title 1 - TOTAL	**2,930,734**	**2,930,734**
2	**INFRASTRUCTURE**		
2 0	INVESTMENTS IN IMMOVABLE PROPERTY RENTAL OF BUILDINGS AND ASSOCIATED COST	335,800	335,800
2 1	INFORMATION TECHNOLOGY	135,900	135,900
2 2	MOVABLE PROPERTY AND ASSOCIATED COSTS	10,000	10,000
2 3	CURRENT ADMINISTRATIVE EXPENDITURE	39,000	39,000
2 4	POSTAGE AND TELECOMMUNICATIONS	15,900	15,900
2 5	EXPENDITURE ON FORMAL AND OTHER MEETINGS	40,000	40,000
2 6	RUNNING COSTS IN CONNECTION WITH OPERATIONAL ACTIVITIES OF FCH	667,560	667,560
2 7	STUDIES	20,000	20,000
2 8	EXPERT CONTRACTS AND MEETINGS	570,000	570,000
	Title 2 — TOTAL	**1,834,160**	**1,834,160**
3	**OPERATIONAL EXPENDITURE**		
3 0	IMPLEMENTING THE RESEARCH AGENDA OF FCH JU	107,300,095	91,187,282
	Title 3 - TOTAL	**107,300,095**	**91,187,282**
	GRAND TOTAL	**112,064,989**	**95,952,176**

6. Annexes

6.1 Abbreviations and Definitions

Term	Definition
AEM	Anion Exchange Membrane
APU	Auxiliary Power Unit
AWP	Annual Work Plan
ASIL	Automotive Safety Integrity Level
BoP	Balance of Plant
CA	Contract Agent
CFD	Computational Fluid Dynamics
CHP	Combined Heat & Power
Demonstration	Activities for a given technology and/or infrastructure comprising all or some elements of: 1) Validation/field testing of prototype/pilot systems including feedback to RTD, proof of safety aspects, functional and endurance testing under real-life conditions. 2) Market preparation demonstrating relevant numbers of application ready products, aiming at infrastructure development and expansion, customer acceptance and development of RCS, economic assessment, attraction of capital investment and achieving target costs for commercial deployment
Deployment	Activities for a given technology and/or infrastructure from its market introduction to its widespread use
EC	European Commission
ECTS	European Credit Transfer System
EFTA	European Free Trade Area
EGVI	European Green Vehicles Initiative
EII	European Industrial Initiative
EIT	European Institute of Innovation and Technology
FCEV	Fuel Cell Electric Vehicle. This includes passenger cars, buses as well as vans and two-wheelers
FCH	Fuel Cells & Hydrogen
FCH JU, JU	The FCH Joint Undertaking: name used to refer to the legal entity established as the public & private partnership. It may also be referred to as the JTI
FET	Future and Emerging Technologies
Horizon 2020	EU Research and Innovation programme over 7 years for the period 2014 to 2020
IG	European Industry Grouping for a Hydrogen and Fuel Cells JTI also referred to as "Industry Grouping" or NEW IG".
JRC	Joint Research Centre of the Commission
JTI	Joint Technology Initiative - referring to the political research initiative introduced by the EC in the FP7. The Term JTI may also be used to referred to the legally established structure implementing the initiative (cf.

	above FCH JU)
KET	Key Enabling Technologies
LCA	Life-Cycle Assessment
MAWP	Multi Annual Work Plan
Members	The term "members" refers to the founding members of the FCH JU (EC & IG) and the Research Grouping, as the case may be.
MS **Member States**	The "Member States" shall be understood as the EU-27 Members States. If not stated clearly in the document, the term "Member States" can also refer to countries associated to the FP7 (named "Associated Countries" in the current document). It may also be referred to as "MS"
PNR	Pre-normative Research, R&D work that addresses technical knowledge gaps in the development of RCS
RCS	Regulations, Codes and Standards
RG	European Research Grouping for a Hydrogen & Fuel Cells JTI, also referred to as " Research Grouping" or "N.ERGHY"
SET Plan	Strategic Energy Technology Plan, see COM(2007) 723 Final
SF	Stakeholders Forum
SME	Small and Medium size Enterprise
SOEC	Solid Oxide Electrolyser
SRG	States Representative Group, advisory body of the FCH JU gathering representatives from Member States and Associated Countries
Stakeholders	The term "Stakeholders" embodies any public or private actors with interests in FCH activities from the MS or third countries. It shall not be understood as “partners" or "members" of the FCH JU
TA	Temporary Agent
TRL	Technology Readiness Level: TRL 1 – basic principles observed TRL 2 – technology concept formulated TRL 3 – experimental proof of concept TRL 4 – technology validated in lab TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies) TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies) TRL 7 – system prototype demonstration in operational environment TRL 8 – system complete and qualified TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)