



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

ANNEX I Work Plan 2015 – Part I Operations

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1. Introduction

This document establishes the second 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 2015, with a focus on research and demonstration activities prioritized for the second call for proposals, together with supportive actions required.

Fuel Cell and hydrogen technologies hold great promise for energy and transport applications from the perspective of meeting Europe's energy, environmental and economic challenges. The European Union is committed to transforming its transport and energy systems as part of a future low carbon economy¹. It is recognised that fuel cell and hydrogen technologies have an important role in this transformation and are part of the Strategic Energy Technologies Plan (SET) Plan²⁻³, which was adopted by the European Council⁴. This is in line with recent strategic policies and directives⁵⁻⁶, 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.

¹ 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

² A European Strategic Energy Technology Plan (SET Plan) – "Towards a Low-Carbon Future". COM(2007) 723 final

³ European Commission: Investing in the Development of Low Carbon Technologies (SET Plan). COM(2009) 519 final

⁴ Council of the European Union: Council Conclusions on the Commission Communication "A European Strategic Energy Technology Plan (SET Plan)". Brussels, 28 February 2008

⁵ See: (1) A policy framework for climate and energy from 2020 to 2030 - COM(2014) 15 final, and (2) European Energy Security Strategy - COM(2014) 330 final

⁶ Directive on the deployment of alternative fuels infrastructure - 2014/94/EU

2. The 2015 Call for Proposals

The 2015 Call for Proposals is jointly prepared 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 covers the Pillars identified in the Multi-Annual Work Plan: Transport, Energy and Cross-Cutting. In addition, Overarching projects, addressing objectives from the Transport and Energy pillars, 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.

2.1 Strategic Scope

2.1.1 Transportation

The road sector will continue to be of highest priority because the reduction of energy consumption and greenhouse gas emissions from replacement of conventional fossil fuelled vehicles with fuel cell electric vehicles (FCEVs) is significantly higher than any other transport market mode. Thus, a significant part of the program funding in the 2015 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 a series of projects which provide the necessary experience with larger numbers of FCEVs and higher capacity hydrogen refuelling stations (HRS).

Further technological developments, especially in the field of fuel cell stacks, will be pursued in the 2015 call. In addition to those projects already funded in the first FCH JU in this field from 2008 to 2013, one bigger effort focussing on new materials and designs for next generation PEM-FCs also considering lifetime issues is included in the 2015 call. Tools for prognostics/diagnostics on e.g. for monitoring degradation rates and further operating parameters of PEM-FCs are key for a reliable fuel cell system supporting service and replacement strategies. Therefore one of the topics is dedicated to such tools. Advanced/Next Generation PEMFC systems and system components for road transport applications are still to be improved and therefore also included. Hydrogen storage on board of road vehicles is another issue which needs to be improved with respect to storage density and costs. Whereas compressed hydrogen storage is currently the only solution which is suitable for series produced road vehicles, new approaches considering hybrid solutions, shall be investigated. The successful market introduction of FCEVs relies also on a reliable and mature technology for hydrogen refuelling stations. Thus, the development of hydrogen refuelling infrastructure technology (systems and components) for FCEVs is also included.

For other transport applications, the systems developed for road transport should be used as far as possible, making use of synergies between the different sectors. Therefore, the adaptation of road vehicle FC technologies (fuel cell systems/stacks and storage systems) to air, maritime and rail applications is another important topic. Auxiliary power units (APU) based on FC-technology have the potential to solve some of the problems of electricity supply in road and non-road vehicles. Thus, the development of technologies for achieving competitive solutions for APU applications for road vehicles, airplanes, ships and railway based on the existing technology for drive train applications from road transport and stationary applications is also included.

2.1.2 Energy

Special attention is given to the production of hydrogen from intermittent electricity sources like those generated from wind turbines and photovoltaic cells and the integration of electrolyzers in the electricity grid. After a call in 2014 for demonstration of central electrolysis to provide grid services while producing hydrogen, the 2015 call includes demonstration of a number of distributed electrolyzers acting as a single capacity to provide the same grid services. Together these topics shall demonstrate the ability of electrolyzers to provide services to the electricity grid if cost and efficiency targets are met. There is an opportunity to make this an overarching topic, although the electrolyzers can also be placed at existing hydrogen consumers.

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 orders, leading to higher installed capacity and therefore to lower cost.

To enable the electrolyser cost reduction targets in the MAWP a number of R&I topics are called in 2015. These advances in technology have to be in the early calls to enable later demonstration.

The 2015 call includes a complementary topic to the 2014 call (FCH-02.1-2014 Research in electrolysis for cost effective hydrogen production) whose exact proposal can only be written once the results of the 2014 call are known. A second topic investigates cost and efficiency benefits of linking electrolyzers directly to a renewable energy installation by optimising the whole system. An example could be linking to a PV site and removing the AC/DC converter.

A smaller budget is envisioned in 2015 for R&I to increase the scale of high temperature electrolysis and co-electrolysis of water and CO₂. The study “Development of water electrolysis in the European Union”⁷ identified these as the only technologies where a step change in efficiency is possible.

For the hydrogen production line of action, topics related to biomass to hydrogen have been left for after 2015 to make use of the results of the study that has been commissioned in 2014⁸. From the remaining activities hydrogen separation from low concentration hydrogen streams (<30%) has been prioritized as an enabler for generating hydrogen from waste streams and syngas.

For handling and distribution of hydrogen the most important near term requirement is to ensure efficient distribution away from central production centres to customers. Building on earlier projects, high capacity compressed hydrogen trailers need to be demonstrated in the field, including permitting issues and integration / standardisation at the customer site. This could form part of an overarching project.

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

⁷ Available at: http://www.fch-ju.eu/sites/default/files/study%20electrolyser_0-Logos_0.pdf

⁸ More information available at: <http://www.fch-ju.eu/page/vacancies-procurement>

such as residential (micro-CHP) or industrial (sub-MW and multi-MW scale). This is a way to meaningfully reduce harmful emissions like GHG.

In addition, a topic is foreseen to support the development of cost effective manufacturing technologies for fuel cell components in order to achieve significant cost reductions.

2.1.3 Overarching Projects

There is a clear need to showcase projects addressing targets from both Transport and Energy pillars. This need is being supported through a topic, where the added value of such integrated solutions using hydrogen and fuel cell technologies is perceived to be highest.

2.1.4 Cross-Cutting Activities

Cross-cutting activities will support and enable the Energy and Transport Pillars and facilitate the transition to market for fuel cell and hydrogen technologies. Some of these activities should start in the very beginning of FCH 2 JU, to generate the knowledge and information essential for the content of future calls. These activities will be conducted through specific topics within AWP 2015 for the subjects: recycling and dismantling, education and training, best practice guidelines for emerging FCH applications, pre normative research and technology monitoring and market observation.

Education and training are critical activities needed to continuously support the FCH community and should be executed in a continuous manner. To foster the deployment and commercialisation of FCH technologies education and training activities will focus on the requirements of the range of policy and decision makers in government, and for those individuals in administrative capacities who will be responsible for such aspects such as health and safety, regulations, codes and standards etc.

Technology monitoring and market observation appears necessary to the first calls to collect and provide further detailed information about general market situation but especially in identifying drawbacks and bottlenecks.

As fuel cell and hydrogen technologies are commercialised they will be required to meet environmental standards and minimise impact, and part of this will be the ability to recycle and dismantle products at the end-of-life. Safe recycling and dismantling technology should be envisaged and materials and components recycled as is the case for current conventional technologies. There may also be valuable opportunities to recycle critical and scarce materials, such as precious metals used in fuel cell stacks and fuel processing sub-systems.

Market penetration of FCH products and services can be enhanced and accelerated by the sharing of best practices and development of guidelines for use by projects and individual industry participants. Such best practices will ensure that commercialisation activities focus on the factors that drive success, whilst also avoiding issues that retard progress. Such best practices can be captured, compiled in guideline/guidance and disseminated.

Pre-normative research (PNR) is recognised as essential non-competitive activities which will assist individual FCH businesses and the sector as whole in their commercialisation efforts. Such PNR activities contribute to understanding about the common challenges and solutions to these. Particular emphasis should be given on aligning with international efforts in this area.

Technology Monitoring Assessment (TMA) approach along with a Market Observatory is needed to assess and evaluate the progress and impact of FCH technologies and thereby provide accessible relevant information and objective and quantified data for use by the sector as a whole, and also for end users, as well as policy and decision makers. This will assist the commercialisation process, alongside building an appreciation of the relative strengths and weaknesses to facilitate better focus on future technology research and innovation.

2.2 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 1906/2006⁹.

The General Annexes to the Horizon 2020 programme shall apply with the following exception: the Governing Board has the possibility to 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. This additional criterion will be introduced in duly justified cases for a number of specific topics of the Call at the moment of updating the AWP (expected in April 2015).

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.

Communication and open access to publications

Horizon 2020 overall, including FCH 2 JU, takes a new approach to communication and to the access provided publications.

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 programme. It will look at synergies with national and regional initiatives to

⁹ OJ L 347/81 from 20 December 2013

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 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 by the Programme Office, in collaboration with EU services.

2.2.1 Conditions for the Call for Proposals 2015

The list of topics will be finalised following the outcome of the call 2014, for which the evaluation was not done at the time of adoption of this AWP. Once the evaluation is completed, the AWP 2015 will be amended to include detailed topic descriptions, as well as a potentially revised list of topics in function of the coverage of the work programme. This amendment is foreseen to be adopted in April 2015.

Call identifier: H2020-JTI-FCH-2015-1
Total budget¹⁰: EUR 112 million

¹⁰ Subject to the availability of the appropriations provided for in the draft budget for 2015 after the adoption of the budget for 2015 by the budgetary authority. The final total funding for projects includes EFTA contributions.

Publication date: 15 April 2015

Deadline: 27 August 2015

Indicative budget:

Topic	Type of action	Indicative budget (million EUR)
1. TRANSPORT PILLAR		
FCH-01.1-2015: Low(er) cost and durable European PEMFCs for transport applications	Research & Innovation (RIA)	25
FCH-01.2-2015: Robust PEMFC prognostics/diagnostics for vehicular applications	Research & Innovation (RIA)	
FCH-01.3-2015: Industrialization ready PEMFC systems and system components	Research & Innovation (RIA)	
FCH-01.4-2015: Novel/Hybrid Hydrogen Storage Solutions	Research & Innovation (RIA)	
FCH-01.5-2015: Adaptation of existing fuel cell components and systems from road to non road applications	Research & Innovation (RIA)	
FCH-01.6-2015: Development of hydrogen refuelling infrastructure technology (systems and components) for FCEVs	Research & Innovation (RIA)	
FCH-01.7-2015: Develop technologies for achieving competitive solutions for APU applications for road vehicles, airplanes, ships and railway based on the existing technology	Research & Innovation (RIA)	
FCH-01.8-2015: Large scale deployment of Refueling Stations and FCEV road vehicles/buses	Innovation (IA)	26
2. ENERGY PILLAR		
FCH-02.1-2015: Improve electrolysis for Off-grid Hydrogen production	Research & Innovation (RIA)	24
FCH-02.2-2015: Improve electrolysis performance and reduce costs	Research & Innovation (RIA)	
FCH-02.3-2015: Development of co-electrolysis to produce syngas, using CO ₂ and water	Research & Innovation (RIA)	
FCH-02.4-2015: 1) Development of HT electrolyzer at a scale >20 kW 2) Demonstration of HT electrolysis for small scale applications	Research & Innovation (RIA)	
FCH-02.5-2015: 1) Improved technologies for H ₂ separation from low concentration streams of Hydrogen separation from streams with low concentration (<20%) 2) Development of technologies to separate hydrogen from low-concentration hydrogen streams (<30%)	Research & Innovation (RIA)	
FCH-02.6-2015: Development of cost effective manufacturing technologies for key	Research & Innovation (RIA)	

components or fuel cell systems		
FCH-02.7-2015: Study on carriers for hydrogen storage and/or delivery to end use, whether for transport of stationary applications (excludes on-board vehicle storage)	Coordination and Support (CSA)	
FCH-02.8-2015: Use of Electrolyser - HRS for decentralized energy storage	Innovation (IA)	21
FCH-02.9-2015: Demonstration of high capacity compressed gas trailer	Innovation (IA)	
FCH-02.10-2015: Multi-MW demonstration for industrial customer	Innovation (IA)	
FCH-02.11-2015: Sub-MW demonstration of stationary FC fuelled with biogas from wastewater or biowaste treatment	Innovation (IA)	
FCH-02.12-2015: Large scale demonstration μ CHP fuel cells	Innovation (IA)	
3. OVERARCHING PROJECTS		
FCH-03.1-2015: Demonstration of distributed electrolysis integrated into local energy systems including HRS	Innovation (IA)	8.5
FCH-03.2-2015: Development of HRS interface with High Pressure Gas Trailer	Research & Innovation (RIA)	2.5
4. CROSS-CUTTING		
FCH-04.1-2015: Study concerning major technological problems on recycling of FCH-Technology components	Coordination and Support (CSA)	5
FCH-04.2-2015: Education and training	Coordination and Support (CSA)	
FCH-04.3-2015: Best practices and guidelines development for various emerging FCH applications	Coordination and Support (CSA)	
FCH-04.4-2015: Pre-normative research activities	Coordination and Support (CSA)	
FCH-04.5-2015: Technology Monitoring Assessment and Market Observatory	Coordination and Support (CSA)	
TOTAL		112

It is estimated that additional 6 million 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.

3. 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). It is to be noted that the list provided below is indicative and subject to revision when AWP 2015 will be amended.

Subject (Indicative title)	Indicative distribution of the funding between the studies in EUR
1. Business model and financing arrangement for the commercialisation of micro-CHP Fuel Cells	400,000
2. Alternative stationary storage for Hydrogen	150,000
3. Implementation, planning and requirements for a vision on hydrogen and fuel cell technologies	300,000
4. Early business case for energy storage through Hydrogen	300,000
Total FCH JU Funding	Total: 1.15 Million

4. 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, cooperation between the JRC and FCH JU 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.

For the Horizon 2020 period, a new Framework Agreement between FCH 2 JU and JRC, is under finalization and subject to approval by the Governing Board.

This Framework Agreement will include activities at programme level to support the Strategy Formulation, as well as some specific research and innovation activities related to standardisation and pre-normative research. These activities will be provided free of charge to the FCH 2 JU Programme Office and to the FCH 2 JU funded projects.

Other activities, at programme and project level, including support to the implementation of the MAWP and the consecutive AWP, will be funded from the FCH 2 JU operational budget. These activities will be discussed and agreed on an annual basis between the JRC and the Program Office and will be included in a rolling collaboration plan, to be approved by the Governing Board of the FCH 2 JU. These activities will be subject to annual monitoring against agreed key performance indicators. The collaboration plan will list the activities, the expected outcomes/deliverables and the estimated necessary resources for each activity.

For 2015, a maximum budget of 1 million euros from the 2015 FCH 2 JU operational budget is foreseen.

The specific list of activities for the year 2015 shall be finalised in time for approval of the amendment of the AWP2015 in Q2-2015.

5. Abbreviations and Definitions

Term	Definition
APU	Auxiliary Power Unit
AWP	Annual Work Plan
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
EFTA	European Free Trade Area
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
Horizon 2020	EU Research and Innovation programme over 7 years for the period 2014 to 2020
HRS	Hydrogen Refuelling Station
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)
MAWP	Multi Annual Work Program
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
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