Final Evaluation of the Fuel Cells and Hydrogen Joint Undertaking (2008-2014) operating under FP7

Experts Group Report

Ana Sofia Caires Sousa Branco
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ACRONYMS AND ABBREVIATIONS

AA	Application Areas
AAR	Annual Activity Report
AC	Associated Country
AIP	Annual Implementation Plan
AISBL	Association internationale sans but lucratif
APU	Auxiliary Power Unit
AWP	Annual Work Plan
BEV	Battery Electric Vehicles
CAPEX	Capital Expenditure
CCGT	Combined Cycle Gas Turbines
CEF	Connecting Europe Facilities
CF	Cohesion Fund
CHP	Combined Heat and Power
CORDA	Copernicus Reference Data Access
COSO	Committee of Sponsoring Organizations of the Treadway Commission
CSC	Common Support Centre
DG ENER	Directorate-General for Energy
DG MOVE	Directorate-General for Mobility and Transport
DG RTD	Directorate-General for Research and Innovation
DoE	(US) Department of Energy
EC	European Commission
EEO	European Electro-mobility Observatory
EGVI	European Green Vehicles Initiative
EIB	European Investment Bank
EII	European Industrial Initiative
EIP	Entrepreneurship and Innovation Programme
EIT	European Institute of Innovation and Technology
ELENA	European Local Energy Assistance - a project of the EIB
ERA	European Research Area
ERA-NET	A Networking initiative within the ERA
ERDF	European Regional Development Fund
ERTRAC	European Road Transport Research Advisory Council
ESF	European Social Fund
ESIF	European Structural and Investment Funds
EU	European Union
EURICS	Energy Union Integrated Research, Innovation and Competitiveness Strategy
FCEV	Fuel Cell Electric Vehicle
FCH	Fuel Cells and Hydrogen
FCH JU	Fuel Cells and Hydrogen Joint Undertaking under the 7th Framework Programme
FCH 2 JU	Fuel Cells and Hydrogen 2 Joint Undertaking operating under Horizon 2020
FP6	6th Framework Programme
FP7	7th Framework Programme
GB	Governing Board
H2020	Horizon 2020
HRS	Hydrogen Refuelling Station
HyER	Hydrogen Fuel Cells and Electromobility for European Regions
IAS	Internal Audit Service
ICT-PSP	Information Communication Technologies Policy Support Programme
IEE	Intelligent Energy Europe Programme
IEG	Independent Expert Group
IG	Industry Grouping
IKAA	In-Kind from Additional Activities
IKOP	In-Kind from Projects

IMI	Innovative Medicines Initiative
INEA	Innovation and Networks Executive Agency
IPR	Intellectual Property Rights
JRC	Joint Research Centre
JTI	Joint Technology Initiative
JU	Joint Undertaking
KBBE	Knowledge Based Bio-Economy
KIC	Knowledge and Innovation Community
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LEIT	Leadership in Enabling and Industrial Technologies
LHV	Lower Heating Value
MAIP	Multi-Annual Implementation Plan (2008-2013)
MAWP	Multi-Annual Work Plan (2014-2020)
mCHP	Micro Combined Heat and Power
MHV	Material Handling Vehicle
MoU	Memorandum of Understanding
MS	Member State
N.ERGHY	New European Research Grouping on Fuel Cells and Hydrogen
NEW-IG	European Industry Grouping for the FCH Joint Technology Initiative
NGO	Non-Governmental Organisation
NMP	Nanosciences, Nanotechnologies, Materials and New Production Technologies
OPEX	Operational Expenditure
PEFC	Polymer Electrolyte Fuel Cell
PEM	Polymer Electrolyte Membrane or Proton Exchange Membrane
PEMFC	Polymer Electrolyte Membrane or Proton Exchange Membrane Fuel Cell
PNR	Pre-Normative Research
PO	FCH JU Programme Office
PPP	Public-Private Partnership
PRC	Private for Profit Organisation, excluding education
PRD	Programme Review Days
R&D	Research and Development
R&I	Research and Innovation
RCS	Regulations, Codes and Standards
RD&D	Research, Development and Dissemination
RG	Research Grouping
RSFF	Risk-Sharing Financial Facility
RTD	Research, Technology and Demonstration
SC	Scientific Committee
SET	Strategic Energy Technology
SETIS	Strategic Energy Technologies Information System
SGA	Stakeholders' General Assembly
SME	Small and Medium Enterprise
SoA	State-of-the-art
SOFC	Solid Oxide Fuel Cell
SRA	Strategic Research Agenda
SRG	State Representatives Group
STRIA	Strategic Transport Research and Innovation Agenda
TEMONAS	TEchnology MONitoring and ASsessment - a project of the FCH JU
TEN-T (EA)	Trans-European Transport Network (Executive Agency)
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference
TRL	Technology Readiness Level
TRIMIS	Transport Research and Innovation Monitoring System
TTG	Time to Grant
TTP	Time to Pay
UAV	Unmanned Aerial Vehicle
US DoE	US Department of Energy

EXECUTIVE SUMMARY

The activities of the JU were highly relevant to the grand challenges facing Europe - they supported the climate change objectives, helped improve energy security and contributed to the status of Europe as an international leader in technology.

Very importantly, the PPP has stimulated the formation of an FCH community that has become a means for the promotion of FCH technology and helped educate decision makers and the public about the potential benefits and what needs to be done to tap into those.

The general and specific objectives of the JU as established in the founding regulation[1] were very ambitious but have served as an adequate guideline to steer the activities. The three principal external constraints to the full success of the JU were the limitations imposed by the character of the institution, the lack of a clear policy for the future interactions of the transport and energy sectors with consequent technical needs, and the lack of any deployment support framework.

The technical scope of the JU contributed to the ambitions of EU policy in the transport and energy sector, although the process of utilising the R&I results stemming from the JU towards EU policy making was not very efficient and could be improved.

Fulfilment of the initial objectives

The overriding goal of the FCH JU as specified in the founding regulation[1] was to contribute to the implementation of the Seventh Framework Programme. In particular, the body was tasked with the following:

1. *To place Europe at the forefront of fuel cell and hydrogen technologies worldwide and to enable the market breakthrough of fuel cell and hydrogen technologies*

In the view of the IEG the original formulation of the objective "to place Europe at the forefront of FCH technologies worldwide" was too ambitious and unrealistic for all technology areas, given the scale of the global competition and the limited funds made available to the JU.
The position of Europe compared to its competitors varies between the different application areas. The IEG concludes that Europe can reasonably claim to be a global leader in hydrogen fuel cell buses and in the provision of refuelling infrastructure as well as in renewable hydrogen production via electrolysis. It thus has the potential to lead in the development of hydrogen-based technologies to support large-scale integration of renewable energy sources into the broader energy system, including cross-sectorial linkages between energy, transport and industry. It is well-positioned in stationary applications and in fuel cell cars, but is not a global leader.

In each case where Europe leads, it is possible to detect a substantial contribution from the FCH JU through its R&D activities and demonstration projects as well as its capacity to facilitate European collaboration.

The capability of the JU to enable more market breakthrough of FCH technologies has been hindered by lack of a sufficiently favourable regulatory framework and notably lack of quantification of the benefits of these technologies. This is important as regulatory framework conditions are one of the main determinants of economic

[1] Council Regulation (EC) No 521/2008 of 30 May 2008 setting up the Fuel Cells and Hydrogen Joint Undertaking

viability for innovative technologies. Hydrogen has high potential to support renewable energy deployment, but a lack of the necessary incentives hinders its development. In this context Japan can serve as an example of government's commitment to the technology and regulatory stability necessary for long-term investments.
In Europe, where local air quality in cities is of increasing concern, some municipalities have accordingly supported fuel cell buses. The parallel activities of the FCH JU, in particular the demonstration projects, have proven to be of substantial added value. However, the situation of fuel cell cars is not the same. Although the infrastructure has been partially subsidised and there have been some demonstration projects, overall, the regulatory incentives to drive wider uptake remained insufficient

FCH JU support for technologies enabling the use of hydrogen as a storage medium for electricity has proved timely, given that surpluses from intermittent renewables generation are becoming increasingly apparent. As more renewables capacity is encouraged by current support policies, this application may be approaching commercial viability

2. *To support Research, Technological development and Demonstration in the Member States and Associated Countries in a coordinated manner*

The JU did not have strong instruments for influencing national policies and technology priorities of Member States and Associated Countries. Most notably, the SRG did not prove to be a strong and effective entity for facilitating coordination.

Nevertheless, since the creation of the JU there has been some perceptible alignment of Member State activities, visible, for example, in the cooperation between municipalities and regions in the implementation of demonstration programmes for hydrogen fuelled buses and in the strategy for hydrogen refuelling stations being implemented through H2Mobility initiatives. The FCH JU has played an active role in establishing these alignments.

The elaboration of a common research strategy through the Multi Annual Implementation Plan (MAIP) and Annual Implementation Plans (AIPs) provided a mechanism for consolidating opinions which feeds back into national activities. Also, the aggregation of the lion's share of FCH related EU R&I financing under one umbrella has been a success.

At the level of municipalities and regions the JU provides an opportunity to share information on experiences with FCH technologies, problems encountered and on how best to address those. The benchmark studies also contribute to aligning views on key R&I priorities and to the definition of best practice according to European experience and conditions. Finally, the work on RCS makes an important contribution to harmonisation of relevant European plans on Regulations, Codes and Standards.

3. *To support the implementation of the RTD priorities of the JTI on Fuel Cells and Hydrogen*

Seven Calls for proposals have been completed under FCH JU in six years and 155 projects have been funded. The IEG concludes that the FCH JU was effective in the mechanics of managing the Calls and disbursing funds. It was successful in attracting stakeholder interest, organising evaluations, ranking projects and negotiating grants. It satisfactorily overcame unexpected problems in ensuring the obligation to have EU funding matched by contributions from industry.

The implementation of the RTD priorities has been well managed and delivered. The vehicle of a PPP has been shown to be fit for purpose and effective for such tasks; this is an important outcome.

4. *To encourage increased public and private research investment in fuel cells and hydrogen technologies in the Member States and Associated Countries.*

In a survey carried out in 2012[2], more than half of the respondents reported an increase in annual turnover in the FCH sector of more than 10% per year from 2007 to 2011. The respondents also declared that the establishment of the FCH JU resulted in an increase of R&D expenditures for more than 58% of the entities surveyed (and for more than half of those, the increase was greater than 20%).

While some caution must be exercised in relying on unaudited claims, the figures seem consistent with the range of demonstrations and R&D activity observed during this time.

Main achievements

The achievements of the FCH JU can be separated into three parts:

1. creation of an effective community combining diverse skills and functions;
2. agreement of a strategy to guide collaborative work across a broad variety of applications;
3. concrete outputs from funded activities in line with the objectives set out in the regulation;

- *The FCH Community*

The FCH JU brought together a wide range of stakeholders in the sector and provided programming and financing predictability underpinned by the long-term vision contained within the MAIP. The 155 projects funded under FP7 engaged 545 different beneficiaries.
The remarkable way in which industry has built up a representative structure through NEW-IG (renamed Hydrogen Europe in 2014) to deliver its contributions to planning and execution of the programme is an impressive tribute to the value which it sees in this public private partnership and a distinct proof of commitment.
The participation of SMEs at 26% of the funding is very good and considerably higher than FP7 overall where SMEs received on average 13% of funds[3]. On the other hand, institutes of higher education (20%) have been less represented than in FP7 regular calls (44%[4]), most probably because of the JTI's emphasis on commercialisation.
However, as already mentioned, FCH JU was not highly successful in aligning its activities with national governments. Although there are some successes, overall this has not worked well and the lack of effectiveness of SRG can be identified as an important reason behind this situation. The FCH JU compensated for this shortage in making a very good job of successfully engaging regions and this is an important achievement also because specific local energy needs are likely to play an ever increasing role in defining future energy policies, and hence regions and municipalities will be major players.

- *The research agenda*

The creation of the MAIP was a decision of the Governing Board of the JU and this has been a key strategic statement of the JU's objectives for both the research and industrial community.
The JU has conscientiously sought to ensure that all the topics identified in the MAIP were covered by projects at an appropriate time, as described in Section 6.

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[2] Study on the trends in terms of investments, jobs and turnover in the Fuel cells and Hydrogen sector, October 2012
[3] Ex-Post-Evaluation of the 7th EU Framework Programme (2007-2013)
[4] Ex-Post-Evaluation of the 7th EU Framework Programme (2007-2013)

The match between the allocation of funds to the application areas prescribed in the MAIP and that achieved by the Calls was extremely good. Overall this is a creditable performance in matching the work done to the research strategy, given the constraints of a proposal-driven process based on excellence.
The IEG agrees that basic research has not been strongly addressed in the FCH JU, but this is considered to be in line with the industry driven nature of this instrument. Nevertheless, it limited options for funding of breakthrough technologies.

- *Concrete outputs from funded projects*

Transport

The MAIP 2008-2013 contained five areas of focus for transport projects: to increase the number of demonstration FCEVs in Europe; to reduce the cost of FC buses and to improve fuel economy; to demonstrate the business case for MHVs; to validate the technology of APUs and to identify niche markets; to develop refuelling infrastructure at a competitive cost.
In total, 32 transport projects were funded. In conformity with the above listed aims, many fuel cell vehicles were deployed across Europe with funding from the FCH JU. 140 cars and light duty vehicles have been demonstrated in several Member States as well as 6 hydrogen refilling stations. 45 buses have been demonstrated along with 11 new bus-ready hydrogen refuelling stations. 400 material handling vehicles were deployed in FCH JU projects, along with 20 hydrogen filling points. 8 FCH JU projects have developed or are developing APUs for a range of applications, including trucks, aerospace (UAV and aeroplanes) boats and recreational vehicles.
The alignment between projects in the transportation portfolio and the FCH JU's strategy was therefore good. However, given the inherent risk of R&I activities and the fact that in some cases the targets were too ambitious, the projects were not always able to achieve the planned objectives.

Nevertheless, the assessment of project results, performed within the JU's Programme Review Days against the international state of the art, indicated that the JTI's projects are achieving results comparable to those of main global competitors.

Stationary power generation

The R&D portfolio for fuel cells and stationary power was generally in line with the MAIP, but many projects, even if technically successful, were still a long way from commercial exploitation confirming that the objectives set out for the FCH JU were too ambitious, specially taking into account that the regulatory framework fell short of supporting that ambition.
The FCH JU supported activities to demonstrate: micro-CHP and larger-scale power and CHP units; proof-of-concept of whole fuel cell systems and balance of plant components, including diagnostics and monitoring sub-systems; small-scale fuel cell systems for power for a range of back-up and remote locations.
27 demonstration projects were supported by the FCH JU. The conclusions of the Programme Review Days were broadly consistent; they found the demonstrations to have led to substantial improvements in the performance and cost of components and systems, together with advances in manufacturing capabilities. All projects had a significant involvement of industry and were relevant to the FCH JU MAIP; no gaps were identified in the portfolio.

The portfolio maintained Europe at the leading edge of international development, although deployment activities in Europe substantially lagged Japan and the USA, probably due to more favourable regulatory and deployment support regimes in other regions.

Hydrogen production and distribution

The FCH JU funded 31 projects in hydrogen production and distribution during 2008-2013. The reviews of the portfolio performed within the framework of the Programme Review Days found these projects to be in line with the MAIP.

The hydrogen production portfolio was highly relevant, with consistently good achievements, advancing the state-of-the-art. However demonstration activities, especially for hydrogen production from renewable energy sources and hydrogen storage, could have better demonstrated the feasibility, maturity and commercial relevance of the technologies.

The IEG shares this view of achievements; it is possible that industry does not give a high priority to large-scale storage of hydrogen as there are alternatives for grid balancing that seem at present more attractive. This is reflected in the low participation in the FCH JU (until 2014) of the appropriate stakeholders.

Main Conclusions of FCH JU

Relevance of the JU

The activities of the JU continue to be relevant to the grand challenges facing Europe - they support the climate change objectives, help improve energy security and contribute to the status of Europe as an international leader in technology,

Implementation of the PPP

The JU faced significant challenges in implementing the novel concept of a public-private partnership for research with a whole range of new relationships between actors to manage within the constraints of the rules of the Framework Programme. It has met this challenge successfully and is to be commended for its performance.

The JU is well positioned to provide the relevant decision makers with clear and authoritative advice on the policy requirements necessary to support deployment of FCH technologies to meet political goals, but it should take care to remain its neutrality vis-a-vis industrial interests.

Added value and leverage

The existence of the FCH JU has made significant progress in eliminating the fragmentation that previously existed in EU support for FCH technologies that had been dispersed between several support programmes within FP7 and its predecessors.

The FCH JU provided a common ground for interaction between beneficiaries of national, regional and European projects, effectively contributing to overcoming the fragmentation of the sector and reinforcing synergies between stakeholders.

From the reports of the FCH JU for the period of FP7 the EU contribution to projects totalled €437M, with participants self-financing a further work valued at €489M. This indicates an operational leverage effect of the FCH JU of €489M/€437M = 1.12, which is considered an adequate result.

It should be highlighted that this figure does not take into account any further leverage of additional R&D and deployment investments made outside the FCH JU by the beneficiaries. It was clear that FCH JU was an incentive for the FCH community to increase R&I efforts, and provided a good return for the investment of public funds.

Coherence with FP7 and other relevant activities

The FCH JU contributed to the objectives of FP7. Even if there was good complementarity with other FP7 programmes, the separation of spheres of responsibility between the research activities of the JU and those of other themes of FP7 was never clearly defined. Consequently, some work within FP7 also supported FCH technologies, however there is no clear evidence that this was the result of an integrated approach.

The alignment of the work of the FCH JU to other relevant activities outside its direct influence (as for example, infrastructure programmes of the EU or EU financial instruments designed to support commercialisation of new products) posed many challenges which were recognised by the JU, but never entirely resolved, in large part because the means of resolution lay outside of its control.

Factors contributing to success

The main factor contributing to the success of the JU was the robust logic underlying the decision to create a public private partnership for research and innovation in this field. There was a genuine coincidence of interest between public policy, commercial opportunity and research potential. Probably as a consequence of this fundamental rationale industry made significant efforts to organise its participation. The commercial interest has fluctuated according to evolving views of future market opportunities, but has always been significant.

Overall, the IEG finds that the creation of the PPP with a ring-fenced budget reaffirmed the political interest in the technology and thus encouraged industry to invest.

The industrial drive was fundamental to the success of the JU. The IEG would also like to note that the proactive efforts of the PO to solve problems as they arose, and the good technical reputation that it has acquired, have materially contributed to the effectiveness of the programme.

1 INTRODUCTION

1.1 Purpose of the evaluation

The Joint Technology Initiative (JTI) in Fuel Cells and Hydrogen was established under Article 187 of the Treaty on the Functioning of the European Union (TFEU). Article 11(2) of the Council Regulation that established the Fuel Cells and Hydrogen Joint Undertaking required that two interim evaluations should be conducted by the Commission with the assistance of independent experts on the basis of terms of reference drafted after consultation with the FCH JU[5]. The First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking was completed in 2011 and the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking in 2013[6,7]. Their recommendations and the follow-up from the FCH JU are summarised in Section 7.6 of this report. Article 11(3) of the Regulation required that after the winding-up of the Joint Undertaking, the Commission should conduct a final evaluation of the FCH Joint Undertaking. This report fulfils that requirement. It should be noted that the Final Evaluation of the Fuel Cells and Hydrogen Joint Undertaking was made in parallel with the First Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking.

An important theme in the design of Horizon 2020 is the search for synergies through partnership, in particular public-public partnerships with international, national and regional programmes that support research and innovation and public-private partnerships[8]. Public-private partnerships in the form of Joint Technology Initiatives (JTIs) were initiated under the Seventh Framework Programme and continued under Horizon 2020 using a better adapted regulatory regime.

1.2 Scope of the evaluation

The regulation establishing Horizon 2020 provides for detailed scrutiny and evaluation of the programme. In particular, it requires the Commission to perform an interim evaluation of Horizon 2020 and its various component institutions and activities by December 2017. As part of the interim evaluation both existing and new public-private partnerships, including the JTIs, are to be assessed in depth; the assessment is to include an analysis of their openness, transparency and effectiveness. The Final Evaluation of the Fuel Cell & Hydrogen Joint Undertaking and the First Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking will both feed into the interim assessment of the Horizon 2020 and are expected to help strengthen the design and operation of the present and potential future public-private partnerships to implement the JTI concept.

This report complies with the obligation to perform a final evaluation of the FCH JU. It has been prepared by an independent expert group (IEG) convened for the purpose by the Commission in parallel with the First Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking available in a sister report[9]. For reasons explained in

[5]Council Regulation (EC) No 521/2008 of 30 May 2008 setting up the Fuel Cells and Hydrogen Joint Undertaking. O.J., L 153/1, 12.6.2008
[6]First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking, Expert Group Report, Directorate-General for Research and Innovation, May 2011
[7]Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking, Expert Group Report, European Commission, 2013
[8]Regulation (EU) No 1291/2013 of the European Parliament and of the Councilof 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC, O.J. 347/104 20.12.2013
[9] First Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking Experts Group Report

detail in Section 2.1, the present evaluation examines the governance of the FCH JU from its foundation until the 27th June 2014 when the founding regulation was repealed, but also considers the later consequences of any actions initiated by FCH JU.

2 BACKGROUND TO THE INITIATIVE

2.1 Description of the initiative and its objectives

Article 187 of the Treaty on the Functioning of the EU (TFEU) states that 'the Union may set up Joint Undertakings or any other structure necessary for the efficient execution of Union research, technological development and demonstration programmes'. The possibility of adopting this concept as a vehicle for the implementation of the JTIs was noted in the Decision on FP7 and in the event such joint undertakings were created for each of the JTIs. They are 'Union bodies' under Articles 208 and 209 of the EU Financial Regulation and must comply with much of the EU administrative regulations including the Financial Regulation and EC Staff Rules (with derogations applied where required).

In October 2007, the Commission submitted to the Council a proposal for a Council Regulation to establish the Fuel Cells and Hydrogen Joint Undertaking[10]. This was accompanied by a Staff Working Document containing an Impact Assessment of the intervention[11]. Following this proposal, the Fuel Cells and Hydrogen Joint Undertaking was established by a Council Regulation for a period to December 2017[12] with a budget of €470 million from the EU and the expectation of a matching commitment from industry. The EU contribution was sourced from the FP7 Cooperation Programme allocations of DGs RTD, ENER and MOVE.

The justification for the JTI cited in the preamble to the Regulation is interesting. The technical challenge facing fuel cells and hydrogen was acknowledged to be complex and large in scale, and the dispersion of technical competencies to be very high. Therefore, in order to achieve critical mass in terms of scale of activity, excellence, and potential for innovation, the topic needed to be tackled in a focused and coherent manner at EU level. These factors, and the potential contribution to Community policies in energy, environment, transport, sustainable development and economic growth, were argued to call for the JTI approach in this sector. The extent to which these expectations were met is assessed in Section 3.

The overall objective of the FCH JU as specified in the Regulation was to contribute to the implementation of the Seventh Framework Programme and in particular the Specific Programme Cooperation themes for Energy, Nanosciences, Nanotechnologies, Materials and New Production Technologies, Environment (including Climate Change), and Transport (including Aeronautics).

The specific objectives were:

- to aim at placing Europe at the forefront of fuel cell and hydrogen technologies worldwide and enabling the market breakthrough of fuel cell and hydrogen technologies, thereby allowing commercial market forces to drive the substantial potential public benefits;
- to support RTD in the Member States and Associated Countries in a coordinated manner to overcome market failures and to focus on developing market applications and facilitating additional industrial efforts towards a rapid deployment;
- to support the implementation of the RTD priorities of the JTI by awarding

[10] Proposal for a Council Regulation setting up the Fuel Cells and Hydrogen Joint Undertaking, Brussels, COM(2007) 571, 9.10.2007

[11] Accompanying document to the Proposal for a Council Regulation setting up the Fuel Cells and Hydrogen Joint Undertaking, Impact Assessment, SEC(2007) 1272, Brussels, 9.10.2007

[12] Council Regulation (EC) No 521/2008 of 30 May 2008 setting up the Fuel Cells and Hydrogen Joint Undertaking, O.J., L 153/1, 12.6.2008

grants following competitive calls for proposals;
- to encourage increased public and private research investment in the technologies in the Member States and Associated Countries.

The objective of the Lisbon Strategy for Growth and Jobs defined by the European Councils on March 2000 was to enable the EU "to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion". This objective was manifest in an ambitious research and innovation agenda, including a target that spending for research and development should reach 3% of EU GDP[13].

The initiation of the JTIs was coherent with this strategy. It was also broadly contemporary with the launch of the European Institute for Technology and Innovation (EIT)[14],that sought to address the persistent failure of the EU to get innovation to market. The goal was to complement existing Community and national policies and initiatives by fostering the integration of the knowledge triangle — higher education, research and innovation — across the European Union. Attempts were also made to shape public procurement, regulation and standardisation as tools to provide incentives and stimulate market demand for innovative products and services; initial steps were made towards a European patent system. Much of this thinking is still detectable in the activities of the JU.

The founding members of the FCH JU were the European Community, represented by the European Commission (EC) and the European Industry Grouping for a Fuel Cell and Hydrogen Joint Technology Initiative (NEW-IG) formed as a non-profit organisation under Belgian law representing industries in the field of fuel cells and hydrogen. The New European Research Grouping (N.ERGHY), representing the research community, became the third member of the JU by a decision of the FCH JU Governing Board on the 14th July 2008. The first Call for proposals was launched in 2008. The European Commission was responsible for setting up all of the JUs; once they had built up their legal and financial framework and demonstrated their capacity to manage their own budgets, they were granted autonomy. In the case of the FCH JU, autonomy was granted on the 15th November 2010.

The First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking, finalised in 2011 with the help of an independent expert group, concluded that the JU approach generally succeeded in enhancing public-private activities in technology development and demonstration, and provided stability for the R&D community. The overall technical objectives of the FCH JU were judged ambitious and competitive. The evaluation is described more fully in Section 7.6.

In 2013, an ex-ante Policy Impact Assessment of a possible successor to the FCH JU analysed four possible future options for its structure and regulation: a continuation of the JU in the same form under Horizon 2020; a return to collaborative research projects under the Framework Programme; implementation within Horizon 2020 of work in fuel cell and hydrogen technologies using a Contractual Public-Private Partnership; modernisation of the Joint Undertaking with an improved regulatory framework adapted to Horizon 2020. The concept of a contractual PPP had been developed as a part of the European Economic Recovery Plan in 2008. The three research PPPs created on this basis (Factories of the Future, Energy-efficient Buildings and Green Cars) had been judged be effective in stimulating innovation in key industrial sectors, so it was a serious option for the future partnership in fuel cells and

[13] Lisbon European Council 23 AND 24 March 2000, Presidency Conclusions
[14] Regulation (EC) No 294/2008 of the European Parliament and of the Council establishing the European Institute of Innovation and Technology. O.J. L 97/1 9.4.2008

hydrogen. The Impact Assessment concluded that a modernised JU was the preferred option, offering the most efficient opportunity to address the underlying problem drivers and to reach the stated objectives[15]. This assessment was supported by the results from a stakeholder consultation and a public consultation.

The Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking was begun in March 2013 and completed in July 2013. The conclusions of the evaluation were largely favourable and it recommended continuation of the JU within Horizon 2020. The contents of the evaluation and its detailed recommendations are discussed in Section 7.6.

Based on the findings of the Impact Assessment, the Commission proposed a Regulation to the Council to prolong the FCH JU[16]. The proposal noted particularly the relevance to sectorial policies expressed in the Communications of the Commission on Energy 2020 - A strategy for competitive, sustainable and secure energy[17] and 'Clean Power for Transport: A European alternative fuels strategy[18]. The earlier emphasis on the potential of hydrogen in a secure and sustainable energy system had been reaffirmed. Some months later in December 2013 the Parliament and the Council promulgated the Regulation to establish Horizon 2020[19]. The prolongation of the JU under Horizon 2020 was then confirmed by a Council Regulation on the 6th May 2014[20].

The Fuel Cells and Hydrogen Joint Undertaking had originally been established for the period up to the 31st December 2017. The Fuel Cells and Hydrogen 2 Joint Undertaking was therefore charged to provide continued support to the Fuel Cells and Hydrogen research programme by implementing any remaining actions initiated under the original in accordance with that Regulation. The transition from the FCH JU to the FCH 2 JU needed to be synchronised with the transition from the FP7 to Horizon 2020 and accordingly the original founding Regulation (EC) was repealed from the date of entry into force of the new Regulation i.e. 27 June 2014. Since the repealed FCH JU Regulation was the basis for its existence, the FCH JU ceased to exist on the 27th June 2014. On the same date FCH 2 JU was established. Transitional provisions were made for existing activities; actions initiated under this regulation and financial obligations related to those actions continue to be governed by that regulation until their completion, but were managed within the governance structure of FCH 2 JU. The present evaluation therefore covers the period until the 27th June 2014 as far as the governance of FCH JU is concerned, but also takes into account the later consequences of any actions initiated by FCH JU as implemented under the FCH 2 JU under the FP7 rules.

[15] Commission Staff Working Document. Executive Summary of the Impact Assessment accompanying the document Proposal for a Council Regulation on the Fuel Cells and Hydrogen 2 Joint Undertaking, COM(2013) 506. Brussels, 10/07/2013

[16] Proposal for a Council Regulation on the Fuel Cells and Hydrogen 2 Joint Undertaking, COM(2013) 506 Brussels, 10/07/2013

[17] Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions, Energy 2020 - A strategy for competitive, sustainable and secure energy, COM(2010) 639 , Brussels, 10/11/2010

[18] Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions, Clean Power for Transport: A European alternative fuels strategy, COM(2013) 17, Brussels, 24/01/2013

[19] 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) and repealing Decision No 1982/2006/EC O.J. L 347, 20/12/2013

[20] Council Regulation (EU) No 559/2014 of 6 May 2014 establishing the Fuel Cells and Hydrogen 2 Joint Undertaking. J.O. L 169/108 07/06/2014

The principal differences between the governance and regulation of FCH JU and FCH 2 JU are discussed in the sister report[11] to this, which deals with the First Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking.

2.2 Baseline

It is important in evaluating the FCH JU to be aware of the economic and social context in which it was born.

The European Union has conducted research on hydrogen as an energy carrier from its earliest days, initially within Euratom and the associated research centres. One important systematic effort to move the concept from the research laboratory towards the creation of a hydrogen-oriented economy was made in 2002 when the Commission convened the High-Level Group for Hydrogen and Fuel Cells with the mission to formulate a collective vision on the contribution that hydrogen and fuel cells could make to the realisation of a sustainable energy system in the future.

Taking note of the potential that hydrogen and fuel cells offered and of the strong competition from North America and Pacific Rim countries, the High Level Group proposed an ambitious programme encompassing research and development, demonstration, and market entry, together with a substantially increased budget and a coherent policy framework; it envisaged that the research and commercial effort should be monitored by a Hydrogen and Fuel Cell Technology Partnership, steered by a European Hydrogen and Fuel Cell Advisory Council with inputs from a range of stakeholders[21]. Much of this thinking is still influential. Following the recommendations of the High-Level Group, the European Hydrogen and Fuel Cell Technology Platform was launched in January 2004 under the 6th Framework Programme. The aim of the platform was to prepare and direct a strategy to develop and exploit a hydrogen-oriented energy economy in the period to 2050. The platform brought together research interests and industrial companies from the entire hydrogen value chain; its outputs included a Strategic Research Agenda, a Deployment Strategy and an Implementation Plan.

Among the innovations of the succeeding Seventh Framework Programme (FP7) was the formalisation of the mechanisms for stimulating cooperation between public and private interests. The Decision of the European Parliament and of the Council of the 18th December 2006 adopting the Seventh Framework Programme introduced the possibility of a Community contribution for the establishment of long term public-private partnerships in the form of Joint Technology Initiatives[22] and the Council Decision concerning the implementation of the Seventh Framework Programme confirmed that in a few cases, the wide scope of a RTD objective and the scale of the resources involved would justify setting up long-term public private partnerships in the form of a Joint Technology Initiatives (JTI)[23].

The set of JTIs proposed within the Decision included a JTI for Hydrogen and Fuel Cells. In the main, the proposed JTIs were built upon the work of related European Technology Platforms. Their principal novelty lay in the intent to facilitate the deployment of private sector investment and national and European public funding, including grant funding from the Research Framework Programme and loan finance from the European Investment Bank according to a common objective and strategy.

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[21] Hydrogen Energy and Fuel Cells – a vision for our future, High Level Group for Hydrogen and Fuel Cells, Summary Report, European Commission, 2003.

[22] Decision No 1982/2006/EC Of The European Parliament And Of The Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013) O.J. L 412/1 30/12/2006

[23] Council Decision of 19 December 2006 concerning the Specific Programme "Cooperation" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013**).** O.J. L 400/86 30/12/2006

A JTI for hydrogen and fuel cells was included among a tentative list of possible candidates annexed to the Decision. Recognising the scope and complexity of the Joint Technology Initiatives, the Decision emphasised the necessity of strong efforts to ensure their transparent operation and allocation of Community funding based on the principles of excellence and competition.

Figure 1 provides an overview of the intervention logic for the FCH JU and how the different components relate. A more detailed Analysis is include in section Annex 3, Detailed Intervention Logic of the FCH JU

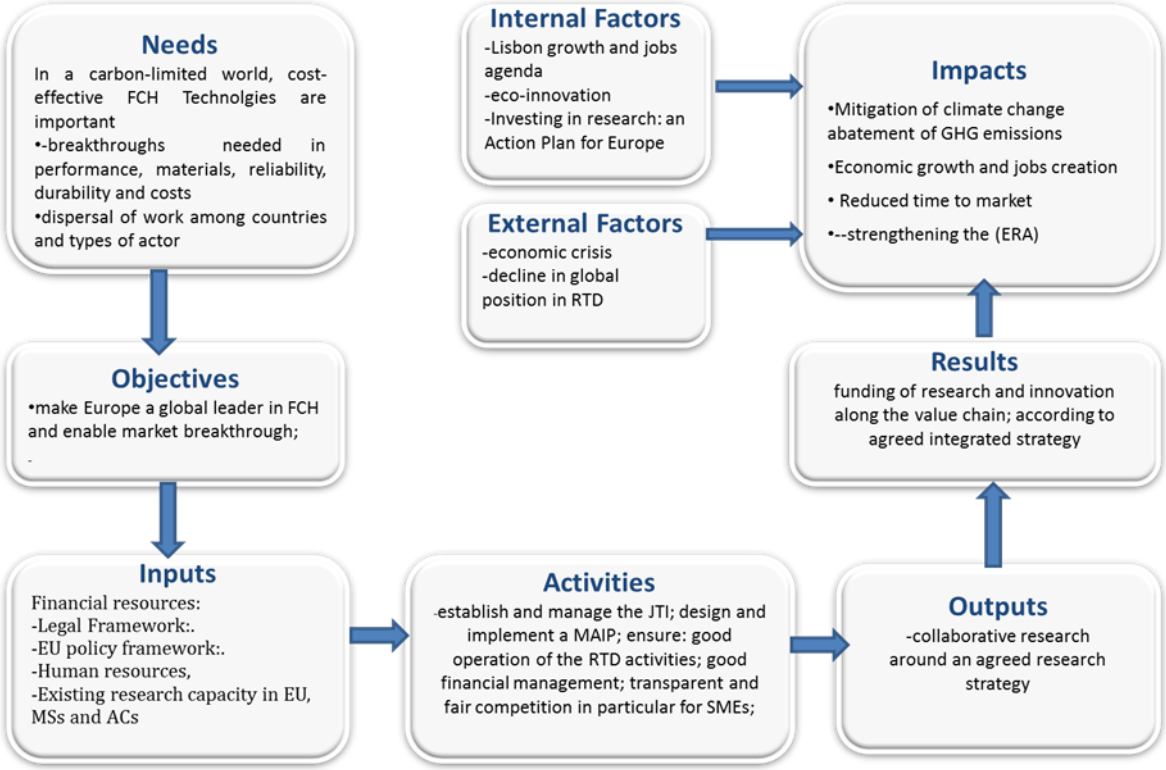

Figure 1. Intervention Logic.

The main tasks and activities of the JU were specified in the Statutes of the Undertaking appended to the founding regulation. The expected outputs can be inferred from the objectives and activities and this has been done in the construction of the Figure 1. The distinction between outputs and results can be elusive and somewhat subjective. Broadly, outputs are expected to be achievable by the intervention with the inputs available in the time available. Results are the consequences (hopefully desirable, but not always) of the outputs which may come later. There is an extensive analysis in the ex-ante impact appraisal of the expected impacts from the intervention. The Figure 1 contains only the most important.

The preamble to the founding regulation cites three texts to justify the JU. The first is the Lisbon Agenda for Growth and Jobs which was intended to deal with the low productivity and stagnation of economic growth in the EU at the millennium. The Council committed to a non-mandatory target of an expenditure on RTD of 3% of GNP of which two-thirds was to be funded by the private sector. Implementation of the original strategy was unsatisfactory and the Strategy was therefore re-launched in 2005 following a mid-term review. The second reference cited in the preamble was the discussion in the Council in its meeting in Brussels in March 2007 of proposals to

strengthen innovation, research and innovation and especially to promote eco-innovation such as low carbon technologies, renewable energies and energy and resource efficiency[24]. Curiously the preamble does not mention the Commission proposal for an integrated climate and energy policy discussed in the same meeting[25]. The third reference is to the Action Plan published in 2003 with four main sets of actions: supporting and coordinating the national and European actions and ensuring coherence; improving the way in which public funds were used to support RTD; redirecting public money towards RTD and improving framework conditions for private investment in research[26]. The evidence from the vocabulary and argumentation of the documents suggests that the focus at the origin of the FCH JU was largely on the promotion of research as a stimulus for growth and jobs, enabled by a PPP in RTD and driven by the difficult economic period through which Europe had passed. The objectives were social and commercial: jobs growth, innovation, products and markets. The merits of hydrogen as a part of a secure and sustainable energy system which had been prevalent in previous thinking were not excluded, but were not much in evidence.

The Intervention logic as set out in the Figure 1 has proved robust. The rationale for a strong Community effort in this area has been amply justified by events.

[24] Council of the European Union, Brussels 2 May 2007, Presidency Conclusions
[25] Communication from the Commission to The European Council and the European Parliament an Energy Policy for Europe. COM(2007) 1. Brussels, 10/01/2007
[26] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, An action plan to boost research efforts in Europe, COM(2003) 226

3 EVALUATION QUESTIONS

The Terms of Reference for the IEG define six aspects of the design and practice of the FCH JU that the evaluation should address. These are summarised below:

- The intervention logic for the FCH JU, including: the strategic context, the problem definition, the objectives of the intervention and the rationale for the selected implementation modalities.
- The effectiveness of the FCH JU, including: the practical aspects of implementation; the main achievements of the intervention and the extent to which the objectives have been reached.
- The efficiency of the FCH JU, including: the legal structure and governance; sources of financing; procedures for defining work; the suitability of the chosen modalities of operation; and the efficiency of conducting operations
- The European added-value, including: the benefits from a coordinated EU intervention; the leverage of resources from industry, municipalities and other actors; contributions to redressing the fragmentation of research in Europe; contributions to definition and implementation of EU policies.
- The coherence in the internal affairs of the JU and with other policies and interventions of the EU, including the extent to which work was coherent with and contributed to related interventions of the EU; the relation with other Union funding programmes; synergies with similar international, national and intergovernmental programmes
- Lessons learnt from previous evaluations, including a detailed review of the recommendations from the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking report.

Based on the findings from the evaluation the IEG was requested to draw conclusions.

4 METHOD/PROCESS FOLLOWED

4.1 Process/Methodology

The report was produced by an independent expert group supervised and supported by the Unit G2 of the Commission's Directorate General for Research & Innovation with the support of an Inter-Service Group comprising other Commission services. The members of the IEG are listed in Annex 1.

The evaluation was based on a wide range of sources. The IEG undertook a detailed review of pertinent literature including: impact assessments on the establishment of the JUs under FP7 and H2020; Council regulations establishing the JUs; Council regulations establishing FP7 / Horizon 2020; 1st and 2nd Interim Evaluations of JUs under FP7; the CORDA database; Annual Activity Reports of the JU; Court of Auditors (CoA) and European Parliament recommendations; the FP7 ex-post evaluation; the Better Regulation Package; sectorial policy document; surveys of and interviews with stakeholders; a public consultation; programming documents of the JU; studies commissioned by the JU; details of Calls; project outputs; mid-term and final evaluations of projects where they were available.

Schedule and tasks

Several members of the team attended the Programme Review Days of the JU on the 21st and 22nd of November 2016 and the Stakeholders General Assembly on the 23rd November 2016. An inception meeting with the full team was held on the 24th November 2016. At that meeting comprehensive presentations on the nature and practice of the JU were provided by the Commission, the Executive Director of the JU and members of the Programme Office. The Commission also provided a large set of relevant reports by various organisations of the EU and facilitated access to the relevant parts of the CORDA data base on applicants, proposals, grants and beneficiaries. December 31st 2016 was set as the cut-off point for information. In the following two weeks, the team agreed via email on:

- questions for a public consultation through the internet;
- questions for a survey of beneficiaries and to guide interviews with selected stakeholders;
- written submissions on some specific matters to be requested from the Programme Office;
- a short-list of significant issues for detailed discussion with the Executive Director and his staff.

The Coordinators Survey was launched on 19th December 2016 by the Commission services, and concluded on the 15th February 2017. The survey was sent to 161 beneficiaries of whom 70 replied. An analysis of its results can be found in Annex 4 and 5. The Public Consultation was launched on the 8th December 2016 by the Commission services, and concluded on the 10th March 2017. A detailed analysis of the results can be found in Annex 6. A list of the principal documents studied is given in Annex 9.

Group interviews with selected stakeholders were conducted in Brussels on the 24th January and the 20th and 21st February 2017, addressing both the Final Evaluation of the Fuel Cells and Hydrogen Joint Undertaking and the First Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking; other stakeholders were interviewed at various dates by individual members of the team. A list of the interviewees is given in the Annex 2. A preliminary outline of the report, together with some factual background was compiled by the rapporteur and reviewed by the team at the January meeting. Detailed discussions with the JU were held on the short-list of significant issues. Team members provided written contributions in the areas of their competence, on which basis the rapporteur compiled a preliminary draft report. This

draft was discussed at the meeting of the IEG on the 21st March 2017 and remaining gaps identified. The extent to which the JU had adopted the recommendations of the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking report was discussed at length in this meeting. IEG members reviewed and extended their contributions to remedy the perceived gaps. The rapporteur prepared a new draft of the report for the meeting of the team on the 9th and 10th May 2017. The report was finalised by email exchange and the evaluation was completed on the 30th June 2017. Table 1 lists the dates of the meetings held by the IEG and the main topics that concerned the FCH JU.

Table 1 Dates of meetings and principal agenda topics.

Date	Main topics
1st (kick-off) Meeting 24 November 2016	Agreement on working methodology and distribution of tasks Discussion of prospective interviewees and key questions Review of the FCH JU history, structure and practices by EU staff Transfer from EU of pertinent documentation Preliminary discussions with staff of the JU
2nd Meeting 23-25 January 2017	Discussion of initial contributions of experts Detailed discussions with various members of the PO on a wide range of aspects of the JU according to a schedule previously agreed by the IEG Hour-long interviews with selected stakeholders of the JU
3rd Meeting 20-21 February 2017	Hour-long interviews with selected stakeholders of the JU Expert presentations of their contributions. Review of status. Discussion of the draft materials and agreement on future work plan
4th Meeting 21-22 March 2017	Review of status of report on FCH (1) JU, discussion of gaps and agreement on remedies Work plan until end of project
5th Meeting 10-11 May 2017	Review of final report. Formulation of conclusions and recommendations. Discussions with Commission.

4.2 Limitations – robustness of findings

A limitation encountered by the IEG in this final assessment was the fact FCH JU has not completed all its activities as some projects are still running, and therefore in some cases the numbers provided are not final (e.g. operational costs).

Another limitation is that taking into account the timing of the current final evaluation, it was not always easy to separate opinions and facts between FCH JU and FCH 2 JU (e.g. to identify the data related only with FCH JU in the interviews and survey done in this review (November 2016-June 2017)). This limitation has been overcome by using the material already gathered in the previous evaluations as well as other documents (e.g. in the Satisfaction Survey done in May 2016, the opinions related to project management concern mostly FCH JU projects because there were very few FCH 2 JU projects active).

5 IMPLEMENTATION STATE OF PLAY (RESULTS)

The Governance of the FCH JU

The duties, powers and compositions of the bodies comprising the FCH JU were specified in the Statutes of the Fuel Cells and Hydrogen Joint Undertaking appended to the founding Regulation.

The Undertaking comprised two executive bodies: The Governing Board and the Executive Director and three advisory bodies: the Scientific Committee, the FCH States Representatives Group and the Stakeholders General Assembly provided external advice.

- *The Executive Bodies*

The FCH JU was constructed as a public-private partnership and this was reflected in the composition of the Governing Board. The Board included six representatives of the NEW-IG, five representatives of the EC and one representative of the N.ERGHY. The Commission represented the European Union; the private interests of industry and the research community were represented respectively by the NEW-IG and N.ERGHY. The Governing Board elected its chairperson for a duration of two years; it had overall responsibility for the operations of the Joint Undertaking, including: implementation of the activities, approval of the annual implementation plan, budget, accounts and the balance-sheet and approval of the list of projects proposed for funding. Decision making was by consensus, but if not possible then by three-quarters majority; the EC vote was indivisible.

- The industrial grouping NEW-IG (renamed Hydrogen Europe in 2014) was representative of a large part of the hydrogen and fuel cell industry in Europe. At the end of 2016, it comprised 107 members, within which twenty-one countries were represented[27]. Following the launch of FCH 2 JU the organisation was rebranded as Hydrogen Europe to reflect the maturity of the technology and a new political impetus towards clean energy. More details of the changes within the industrial grouping following the creation of the FCH 2 JU are given in the sister report[11].
- The research grouping N.ERGHY currently represents more than 60 research institutions (21 universities and 44 research centres) from 18 countries[28] and it supports and promotes research interests in the FCH JU creating a framework for cooperation of science and industry in Europe. The members of N.ERGHY participated in the preparation of the FCH JU multi-annual and annual priorities

The Executive Director was the chief executive responsible for the day-to-day management of the FCH Joint Undertaking in accordance with the decisions of the Governing Board. The Director was the legal representative of the FCH JU appointed for four years, renewable once. The particular duties of the Director were specified in detail in the statutes; they included the supervision of the calls for project proposals, evaluation and selection of the projects and gathering the necessary assurance (e.g. through financial audits) on the proper use of FCH JU funds necessary for the annual discharge from the European Parliament. Initially an Interim Executive Director was appointed by the Commission and with the support of Commission ensured efficient execution of activities efficiently during this early period. The first permanent Executive Director was appointed by the Governing Board on the 15th June 2010 and took up duty on the 1st September 2010. The Executive Director was supported by a

[27] Hydrogen Europe, Annual Report, 2016
[28] http://www.nerghy.eu/map/, accessed on 9 June 2016

Programme Office that executed the tasks of the JU under the responsibility of the Director.

- *Advisory Bodies*

The *Scientific Committee* was an advisory body to the Governing Board, composed of no more than nine members from academia, industry and regulatory bodies, chosen to reflect a balanced representation of world class expertise. Collectively, the Committee was intended to encompass the expertise needed to make strategic science-based recommendations across the work of the FCH JU. According to Article 8 of the FCH JU Statutes, the role of the Scientific Committee was to advise on: the scientific priorities for the Annual and Multiannual Implementation Plans, the scientific achievements described in the annual activity report and the selection of independent experts. The Governing Board established the specific criteria and selection process for the Scientific Committee in December 2008. In the selection of members, the Governing Board took into account candidates proposed by the FCH States Representative Group (see below). The first meeting of the SC took place on the 9th March 2009.

The *States Representatives Group (SRG)* comprised one representative of each Member State and of each Associated Country. According to Article 9 of the Statutes, the SRG was attributed an advisory role to the JU acting as an interface between the FCH JU and the relevant stakeholders within their respective countries. Its particular functions were to review and to comment on: the progress of the programme of the FCH JU; compliance and respect of targets; updating of strategic orientation; links to Framework Programme Collaborative Research; Planning and outcome of calls for proposals and tenders; involvement of SMEs. It was also expected to inform the JU about relevant national research programmes and dissemination events and to identify areas of cooperation. The Group was intended to meet at least bi-annually and was convened by the FCH JU. Its first meeting took place on December 16th, 2008.

The *Stakeholders' General Assembly (SGA)* was open to all public and private stakeholders, international interest groups from Member States, Associated countries as well as from third countries. The Stakeholders' General Assembly was an important communication channel intended to ensure transparency and openness of the FCH JU activities with its stakeholders. It was convened once a year: on the first occasion in Brussels on the 14th-15th October 2008.

- *The Programme Office*

The Executive Director was supported by a Programme Office: under the responsibility of the Executive Director, the Programme Office was responsible for the daily management of the Joint Undertaking and executed all its activities, from project management to financial matters and communication. In particular, the Programme Office was required to[29]:

- Monitor, review and update the MAIP, based on programme achievements and information gained from benchmarks and global developments.
- Create synergies and manage the interface with relevant national programmes, identify common interest, scope joint activities and implement them together with the national representatives, companies or research institutes and initiatives.
- Create synergies and manage the interface with relevant regional programmes, notably with Hydrogen Regions and Municipalities Partnership (HyRaMP).
- Establish and maintain high profile communication and dissemination activities.

[29] Multi - Annual Implementation Plan 2008–2013, FCH JU

- Identify, manage and coordinate the implementation of RCS and PNR actions needed to remove market barriers. Disseminate accurate RCS information.
- Identify, manage and coordinate activities to remove other non-technical market barriers, facilitate market drivers and reduce critical investment risks for the industry with specific focus on SMEs.
- Identify and manage the implementation of technology monitoring and bench mark activities including life cycle analysis and safety due diligence to assess relevance and impact of fuel cell and hydrogen technologies.
- Identify, participate in and explore international cooperation activities to address the global dimension of the technology development and to advance programme objectives.
- Establish and maintain proper risk management to identify and mitigate risks associated with programme activities and the financial administration of the JU.
- Identify and manage interfaces with relevant technology platforms and activities and ensure proper coordination and collaboration.

Clarity of legal framework

- *the clarity of the overall legal framework, and the extent to which the Joint Undertaking operated according to this legal framework;*

The legal framework governing a JU is essentially composed of four elements: the Council Regulation (EC) No 521/2008, the Statutes (that are an annex to the regulation), the JU's own Financial Regulation and the EU Staff Regulations.

It should be noted, as already mentioned in the Impact Assessment[30] and in the Sherpa's report[31], that the legal framework is largely based on rules applicable to the European Institutions with little regard to the size of the JUs and nature of their activities. This issue was already highlighted in the previous interim evaluations; this legal framework should be better tailored to the efficient management of a small JU.

In relation to the level of basic research present in FCH JU, it should be noted that one of the main tasks of the FCH JU included in the regulation was "to facilitate the interaction between industry, universities and research centres including on basic research". FCH JU has been an instrument to foster interaction between the different types of entities yet the interaction specifically related with basic research was not very high.

The different assessments made by the European Court of Auditors and the European Parliament, during the period that FCH JU has been active, showed that in general the JU has operated according to its legal framework.

Efficiency of the governance structure and decision-making

- *Have the definitions of roles and responsibilities been clear for the partners and for each of the bodies of the FCH JU?*

The definitions of roles and responsibilities were clearly defined in the regulation. However, the IEG note that from the beginning of the JU some of the roles and responsibilities of the advisory bodies, especially the SC and SRG have not been clear to all the members and therefore their role has not been exploited with all its potential.

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[30] Commission Staff Working Document. Executive Summary of the Impact Assessment accompanying the document Proposal for a Council Regulation on the Fuel Cells and Hydrogen 2 Joint Undertaking, COM(2013) 506. Brussels, 10.7.2013

[31] Designing together the 'ideal house' for public-private partnerships in European research JTI Sherpas' Group, Final Report, January 2010

- The SRG did not prove to be a strong and effective entity in facilitating coordination with Member States. In considering the reasons, it is evident that influence on Member States' expenditure from outside their own decision systems is necessarily limited. However, it should be noted that during interviews participants in the SRG commented that representatives attending meetings were not always occupying a role where they could themselves affect national funding decisions. Some members were themselves from the national research base and thus simply beneficiaries of funding rather than responsible for the scale and content of programmes. Attendance proved less than diligent with typically around half the nominated members present at meetings. It thus seems that Member States did not always regard the FCH JU SRG as either an important body or as a forum informing their own decisions. These shortcomings of the SRG were identified in the interim evaluations of FCH JU and recommendations for improvements made. It seems these have not been effectively implemented by Member States.
- The SC role has evolved during the FCH JU implementation and in the last years of the FCH JU, it contributed very actively in the Programme Review days. However, its knowledge and expertise could have still be better exploited in the design of the MAIP and AIP, as already mentioned in the second interim evaluation report.

- *Have the partners shared the same visions and have they had clearly defined objectives?*

The FCH JU is a Public Private Partnership and therefore there are several different views coming from different sectors (research, industry and the European commission). Consequently there have been some divergences of opinion in relation to the path to reach the objectives, for example, judgements concerning to balance of research and demonstration activities. A MAIP was established to define the shared vision and objectives across the different actors. The IEG commends the capability of the JU to manage those different paths and to achieve an operational consensus in relation to agreeing the main objectives of the JU.

- *Have the communication channels between the different bodies been effective?*

The communication channels improved during the project implementation however some issues restricted their effectiveness. For example, the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking report detected a restricted circle of information flow and mentioned that "The SC, the SRG and HyER remarked independently to the IEG that they were not informed sufficiently early of the critical steps in programme management for them to contribute effectively, whether to the elaboration of the AIP, to the coordination with national programmes or to the creation of regional interest in forthcoming Calls".

Somewhat in conflict with these reported views, Figure 2 shows that in the satisfaction survey made in 2016, after the conclusion of the FCH JU, both advisory bodies (SRG and SC) had a positive opinion of cooperation and consultation with FCH JU PO, although notably higher for the cooperation on scientific priorities with the SC than for the elaboration of the AWP with the SRG.

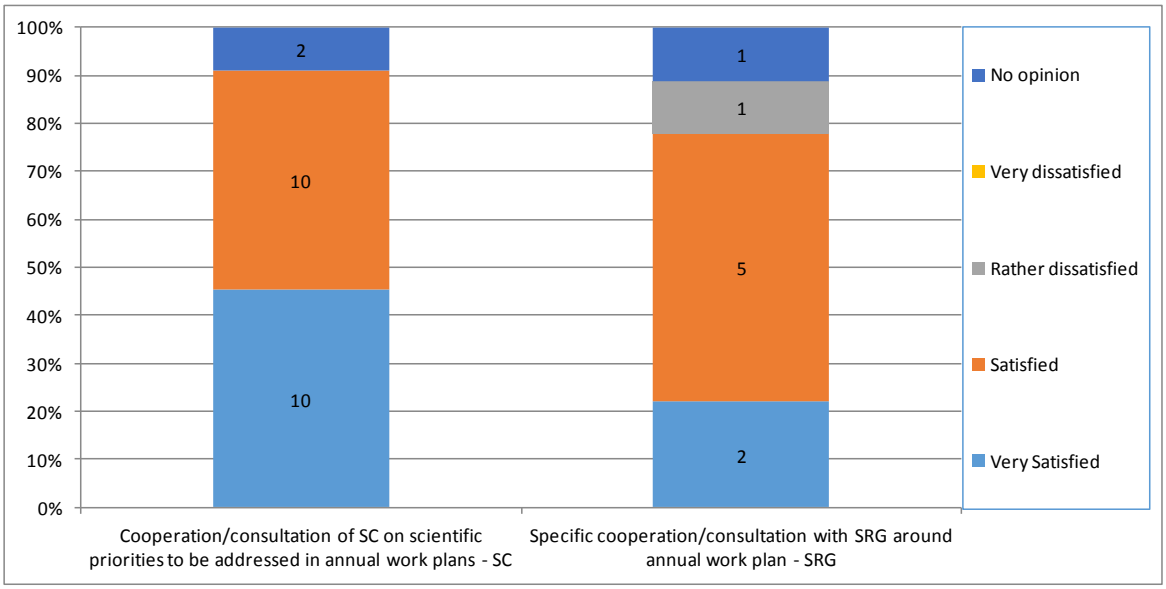

Figure 2. Cooperation with the SC and SRG.

- *Did the different bodies operate and contribute fully to the achievement of the mission and objectives of the FCH JU?*

In general, the operations of the executive bodies have contributed fully to the achievement of the mission and objective of the FCH JU but the contributions of the advisory bodies, specially the SRG to the achievement of the objectives have not been as high as expected. For example, the progress in one of the objectives of the FCH JU included in the regulations- to develop close cooperation and ensure coordination with the national activities- was potentially affected by the low level of effectiveness of the SRG operation.

- *Have the decision-making processes been efficient?*

The decision-making process has been successfully implemented and progressively improved. The second evaluation noted some problems in relation to the division of responsibilities between the Governing Board and the Executive Director that affected the efficiency of (small) decisions. This issue has been addressed under the FCH 2 JU.

The members were charged to use their best efforts to achieve consensus. Failing consensus, the Governing Board took its decisions by a three-quarter majority of the voting rights. The vote of the Commission was indivisible what means that the EC had to take its time to discuss the decision internally and reach consensus, what maybe could not be very efficient but necessary. Also, the role of the EC representatives were very important to ensure the public interest and to avoid the decision to be too much influenced by private interests and ensure a programme that builds on Europe's best interest. Also some decisions (procurements,..) were naturally hindered by the status of the FCH JU as a Community body. The time to grant was too high as mentioned and explained in section 7.2.
Nevertheless, the process taking into account all its restraints can be considered effective.

- *Has the JU effectively implemented mechanisms to ensure transparency of its decision-making?*

The IEG commends the practice of publishing the main decisions of the Governing Board on its webpage, however more information should have been made public in relation to the process of decision-making, especially in relation to the MAIP and AIP elaboration.

In its allocation of funding for projects, the GB followed in a highly transparent manner the ranking recommended by the independent evaluators. In relation to the transparency of the information provided by the PO, the results of the satisfaction

survey, Figure 3 below, indicate that most stakeholders showed a high level of satisfaction in relation to the level of transparency.

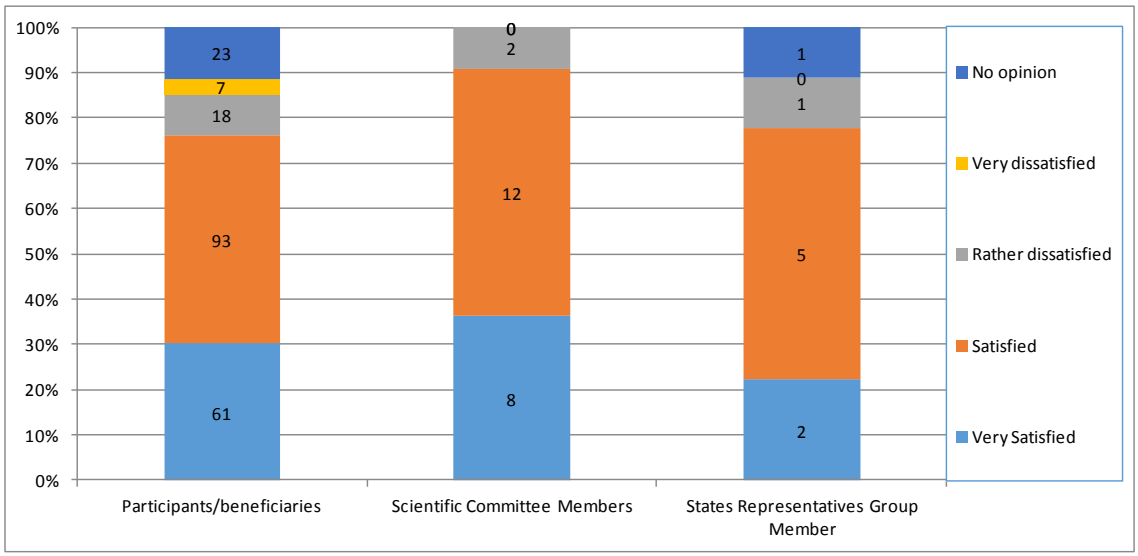

Figure 3. Transparency & timeliness of information supplied by the PO[32].

The Multi-Annual and Annual Implementation Plans

This FCH JU chose to structure its research around a long-term research strategy known as the Multi-Annual Implementation Plan (MAIP). This document sketches the broad outlines of the research activities for the period 2008–2017 and charts a route towards completion of the objectives set for it in the regulation. The first version of the MAIP was adopted by the Governing Board on the 15th May 2009. In 2010, it was reassessed considering the results of the first calls, the contemporary revision of the Council Regulation, the First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking, and the evolution of European Union policies.

The MAIP divided work between five application areas: Transport & Refuelling Infrastructure; Hydrogen Production & Distribution; Stationary Power Generation including Combined Heat and Power (CHP); Early Markets and Cross-cutting activities. The last category includes Regulations Codes and Standards (RCS), Pre-normative Research, socio-economic research, technology and life cycle assessments, market support, public awareness and education. The MAIP was intended to cover the entire research cycle from fundamental research to market support as shown in Figure 4. The document contains: KPIs for 2010, 2015 and 2020; draft budget distribution among applications and over time; priorities for the application areas; guidelines for coordination with other stakeholders; communication and dissemination; responsibilities of the different entities within the JU.

The MAIP is not required by regulation, but was introduced by the Governing Board as a means of programme management. The MAIP and its revision were adopted by the Governing Board, including representatives from the Commission, but were not legally binding.

Each year the FCH prepared in detail a specification of the Annual Implementation Plan (AIP) following the priorities established in the MAIP. Most importantly, the AIP

[32] FCH Satisfactory Survey, http://fch.europa.eu/publications/fch-2-ju-satisfaction-survey

established the list of topics and detailed topic descriptions for the Call for Proposals to be published in that year. The AIP is required under the regulation.

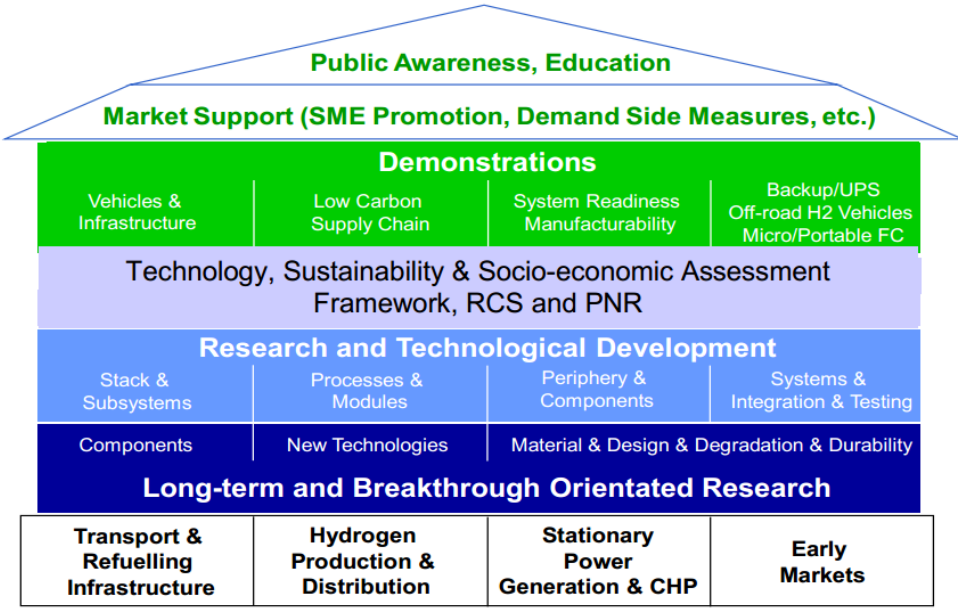

Figure 4. The structure of the MAIP[33].

Construction of the Multi-annual Implementation Plan

- *Mission and Multi-Annual Implementation Plan (MAIP) setting. How were the MAIP scope and priorities developed?*

According to the MAIP, its contents were the result of a joint effort by the major stakeholders, coordinated through the FCH JU Program Office. The main agents participating in the construction of the MAIP were the Industry Group, that set priorities for research and the Research Group that proposed means of achieving those goals. The drafting was performed under supervision of the Commission, to ensure alignment with EU policies and adoption of relevant targets. Support was provided by the SRG, the SC and the PO.

There appears to be no detailed description of the logic and process adopted. Some more detailed discussion on a later procedure for developing the Annual Work Programmes for the FCH 2 JU under Horizon 2020 is available[34].

This later document notes that "the FCH JU was conceived as an industry-led partnership and this was reflected by the approach applied for proposing and drafting the call topics in which working groups comprising representatives of the 3 members (IG, RG and EC) were established with the industry and research members taking the lead in proposing topics, providing their supporting rationale for how they would contribute to the goals of the JU and drafting the topics according to discussions held on their merit, content and alignment with strategy and policy, in close collaboration with the EC". Once the Programme Office was established and the JU was granted autonomy in November 2010, this basic framework was kept and has been used in subsequent calls for proposals through call 2016.

[33] Multi - Annual Implementation Plan 2008–2013, FCH JU
[34] Procedure for Selection and Drafting of Topics for FCH 2 JU, FCH JU, 2016

- *Was the process transparent? Did it include the relevant stakeholders?*

The Industry and the Research Groupings in cooperation with the Commission participated in the elaboration of the MAIP. The Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking report claimed that several interviewees noted that it was difficult to modify the priorities of the original MAIP once established. For the process to be considered fully transparent, more information about how the process is done should have been made public.

- *Were the roles and responsibilities of the various stakeholders involved in the process clear and transparent?*

The second evaluation report found that there had been some difficult in setting a balance between competing interests. External stakeholders as represented by the SC and the SRG were formally involved in reviewing the MAIP and AIP, but in practice they received the documents too late to have a material impact and the effectiveness of their input was limited by the confidentiality of some critical results, that made it hard for the Committees to determine what should be the main future emphasis.

The SC did comment and members felt that they had some modest influence. The SRG appeared in practice not to comment.

These issues, which were highlighted in the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking, seem to have continued during the subsequent years of the FCH JU.

- *Who had the final ownership and responsibility of the MAIP?*

The final ownership and responsibility of the MAIP were clear. According to the MAIP 2011, the Governing Board was the main decision-making body of the FCH JU. It had the overall responsibility for the operations of the FCH JU and oversaw the implementation of its activities in accordance with Article 5 of the Statutes.

The same document states that the Programme Office, under the responsibility of the Executive Director, executed all responsibilities of the FCH JU; in particular it monitored and regularly reviewed and updated the MAIP, based on programme achievements and information gained from benchmarks and global developments to ensure it maintained the proper scope and balance of activities and achievable targets from a European perspective.

Monitoring and control

It should be highlighted that project management, reporting and control (among others) are deeply rooted in the FP7 Rules, which were themselves derived from a long tradition of Framework Programmes.

- *Procedures for submission, evaluation and selection of proposals*

The FCH JU published calls for proposals based on the current Annual Implementation Plan. In response to calls, project consortia could apply for financial support under the through proposals that set out details of planned work, budget and participants. Applications were submitted using a special web-based service before a published deadline. The FCH JU evaluated all eligible proposals to identify those of best quality for possible funding. The FCH JU appoints independent experts (hereafter "experts") to assist with the evaluation of proposals.

The FCH JU entered negotiation with the coordinators of proposals that successfully passed the evaluation and for which there was a budget available. If negotiations were successfully concluded, the project was selected and a grant agreement providing for a FCH JU financial contribution was established with the applicants. The general FCH JU Grant Agreement was adopted by the FCH JU Governing Board on the 10th September 2009 (updated in 2010, 2011 and 2013). The various steps involved in the

proposal, submission, evaluation and selection procedures are summarised in the Figure 5.

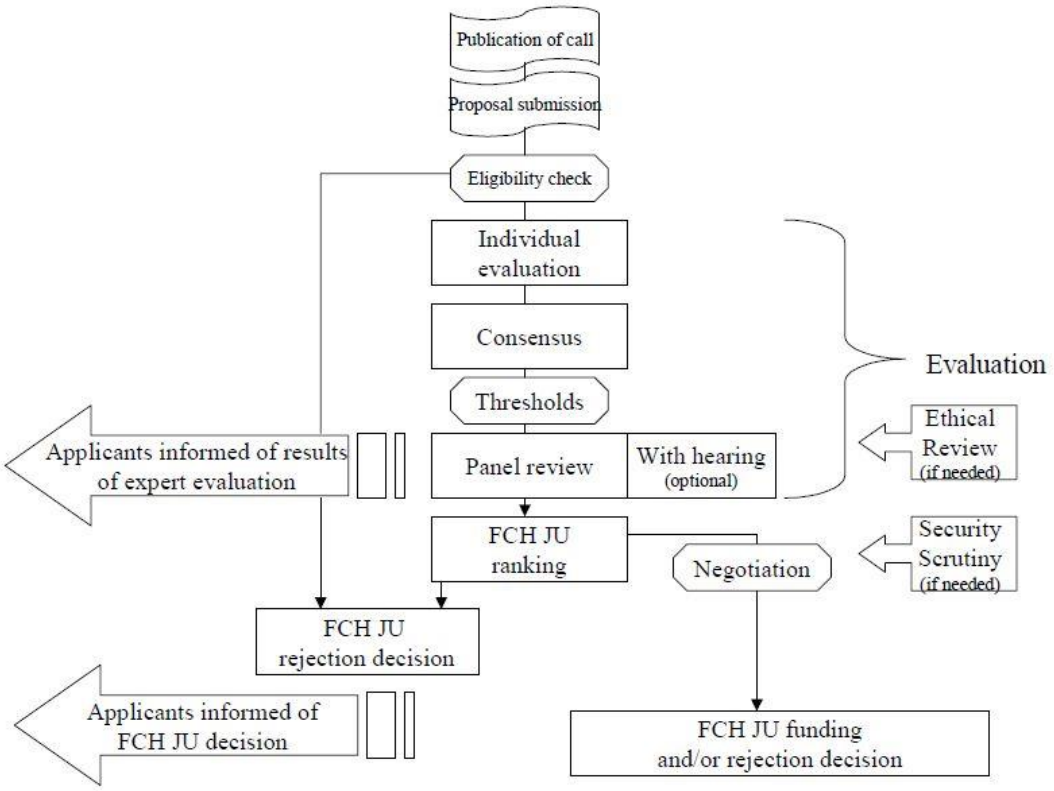

Figure 5. Procedures for proposal submission, selection and evaluation[35].

Seven calls were implemented under FP7. The process of project preparation can be divided in three core tasks:

- Call definition and launch
  - Definition of Research Agenda,
  - Multi-Annual Implementation Plan MAIP (see Section 6 below)
  - Annual Implementation Plan AIP (see Section 6 below)
  - Launch of the Call.
- Evaluation and Selection of projects
  - Submission of proposals by applicants
  - Selection of experts for the evaluation
  - Evaluation of proposals and ranking list (see Section 6 below)
  - Redress procedure (see Section 6 below)
  - Matching calculation (see Section 6 below)
  - Approval of selected projects.
- Contract negotiation and signature of grant:
  - Negotiation phase (budget negotiation),
  - Funding decision on projects, (
  - Signature of grant agreement.

[35] Rules for submission of proposals, and the related evaluation, selection and award procedures, European Commission, 26 September 2008

- *The robustness of the monitoring and control system, including the level of supervision/control within the JU;*

The foundation of the FCH JU's Internal Control Framework is provided by a set of 16 Internal Control Standards (ICS) which were adopted by the Governing Board on the 15th June 2010. The Standards are inspired by the internationally recognized internal control framework of the Committee of Sponsoring Organizations of the Treadway Commission (COSO) and are structured around six areas, namely:

1. Mission and Values,
2. Human Resources,
3. Planning and Risk Management Processes,
4. Operations and Control Activities,
5. Information and Financial Reporting,
6. Evaluation and Audit.

To permit effective implementation and to allow measurement of the maturity of the JU's internal control systems, each standard is complemented by a list of 'Requirements' i.e. the minimum features and specific practical actions[36].

The Ex-post Audit Strategy of the FCH JU is an important part of the JU's internal control system. In the sequence of controls, the ex-post audits of the beneficiaries come at the of the payment cycle. There is a strong legal basis for the JU's audits and reviews of operations:

Article 12 (4) of the Council Regulation setting up the FCH JU states that " The FCH Joint Undertaking shall carry out on-the-spot checks and financial audits among the recipients of the FCH Joint Undertaking's public funding"; Article 12 (5) extends this possibility also to the Commission and the Court of Auditors." Article 39 of the Financial rules of the JU states that "… the authorising officer responsible shall, depending on his risk assessment, carry out an appropriate ex-post verification…. The purpose of ex-post verification of documents and, where appropriate, on-the-spot verifications shall be to verify that operations… have been correctly implemented… These verifications may be organised on a sample basis using a risk analysis"; Article 40 (2) states that 'by no later than 15 June each year, the Governing Board shall send to the budgetary authority and the Court of Auditors an analysis and assessment of the Authorising officer's annual report on the previous financial year. This analysis and assessment shall be included in the Annual Activity Report of the FCH Joint Undertaking, in accordance with the provisions of Article 21 of the Statutes.

In its analysis and assessment of the FCH JU Annual Activity Report adopted in 2014, the Governing Board expressed the opinion that: "in general, the internal control system is working and adequately mitigates the critical risks which could hamper the achievement of the FCH JU objectives and activities.[37]" The IEG entirely concurs with this view.

- *Capacity to monitor use of funds and technical progress*

The procedures to monitor the individual project progress and the correct use of funding were clearly defined in the document FCH JU Internal Procedure for Project Review with External Experts.

The monitoring of research projects comprised an assessment of the work carried out under the project over a certain period (e.g. one reporting period or the entire project

[36] Annual Activity Report 2013, Annex 6, FCH JU, 2014
[37] Analysis and assessment of the FCH JU Annual Activity Report 2013, FCH JU Governing Board, 2014

duration). The mechanisms foreseen to carry out a project review in FCH JU were established in the grant agreement Annex II, Section 3 — Controls and Sanctions - 11.23, Technical audits and reviews. After each reporting period the FCH JU checks deliverables and reports sent by the project coordinator in terms of: consistency with the project work plan and Annex 1/DoW, eligibility of the costs claimed, and compliance with any other obligation under the Grant Agreement.

The IEG considers the procedure correct and notes that in the coordinator survey made in 2013 the reviews and assessments, as well as other issues related to project management, received a high level of satisfaction (more than 80%). In the satisfaction survey done in 2016, the question related to the assessment of the periodic & final reports as well as the project reviews also showed had a high level of satisfaction (Figure 6). This survey mainly concerned FCH JU projects as FCH 2 JU projects were only beginning at that time.

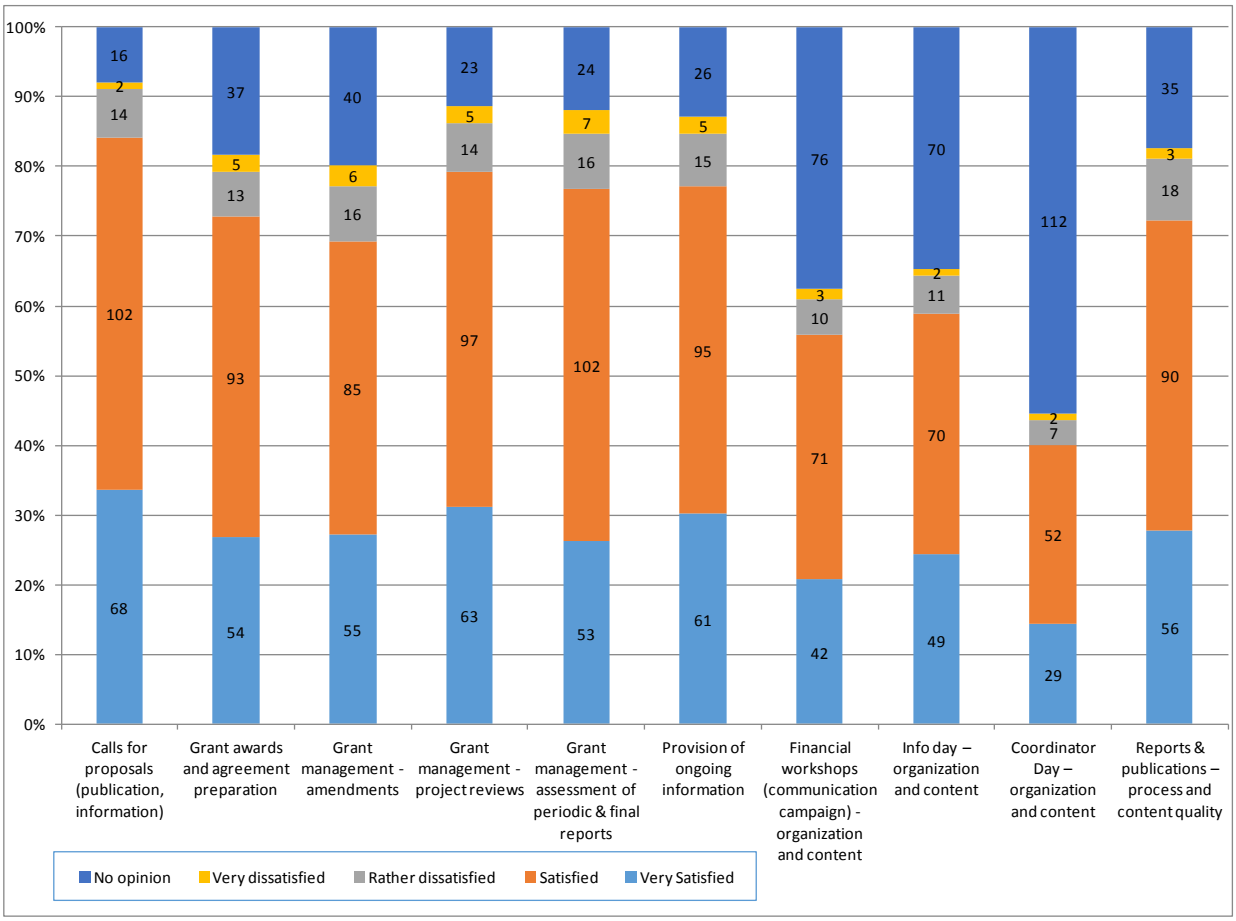

Figure 6. Satisfaction with the service/product provided by the PO[38].

In relation to technical monitoring, the Seventh Framework Programme (FP7) established a monitoring and reporting system related to the protection, dissemination and transfer of research results that was adopted by the JU. The 1st and 2nd Interim Evaluations of JUs both commented on the need for a stronger capacity to monitor and report on the research results of its projects The JU responded by the hiring of a Knowledge Management and Policy officer and by introducing a newly-developed IT tool, TEMONAS (TEchnology MONitoring and ASsessment), to analyse and synthesise the results of the finished projects and reported on its website the first public

[38] FCH Satisfactory Survey, http://fch.europa.eu/publications/fch-2-ju-satisfaction-survey

foreground deliverables arising from completed projects. Problems were experienced in implementation of the software and also in the provision of data by projects that often cited commercial confidentiality as a justification for not releasing data.

- *What is the overall satisfaction of beneficiaries with the services provided by the Joint Undertaking?*

Coordinators' Survey (2013)

A survey of the opinion of the coordinator's regarding overall satisfaction with the services provided by the Joint Undertaking was performed through Coordinators Survey launched on the 27th March 2013 and finished on the 26th April 2013, almost by the end of FCH JU. The questions concerned comparison of FCH JU to Seventh Framework Programme, project management as well as programme design and implementation. A detailed analysis can be found in Annex 9.

The results of coordinator's survey indicate that the performance of the FCH JU in administration of the programme, project management and programme design and implementation was much appreciated by beneficiaries and in many respects was found to be better than under Seventh Framework Programme.

Satisfaction survey (2016)

The overall satisfaction of beneficiaries with the services provided by the Joint Undertaking was also assessed based on the results of the survey that was performed to collect feedback from FCH JU beneficiaries and FCH main bodies regarding the perception of quality of services offered by the FCH JU Programme Office. The services included all aspects of the Programme Office operation: preparation of calls for proposals, grant awards, grant management lifecycle (amendments, project reviews, assessment of interim and final reports), provision of information, financial workshops, info and coordinator days, reports and publications.

Participants were also asked to evaluate the available tools, procedures and guidance provided. The survey was executed from the 2nd May 2016 to the 17th May 2016 and in total 793 participants were invited to take part in the survey. 30% response rate was achieved and beneficiaries constituted 84% of the survey participants. At this time the number of beneficiaries participating in FCH 2 JU operating under Horizon 2020 was limited due to the fact that the programme was relatively new. Thus, it might be assumed that the answers provided by the respondents concern in large measure the FCH JU running under Seventh Framework Programme.

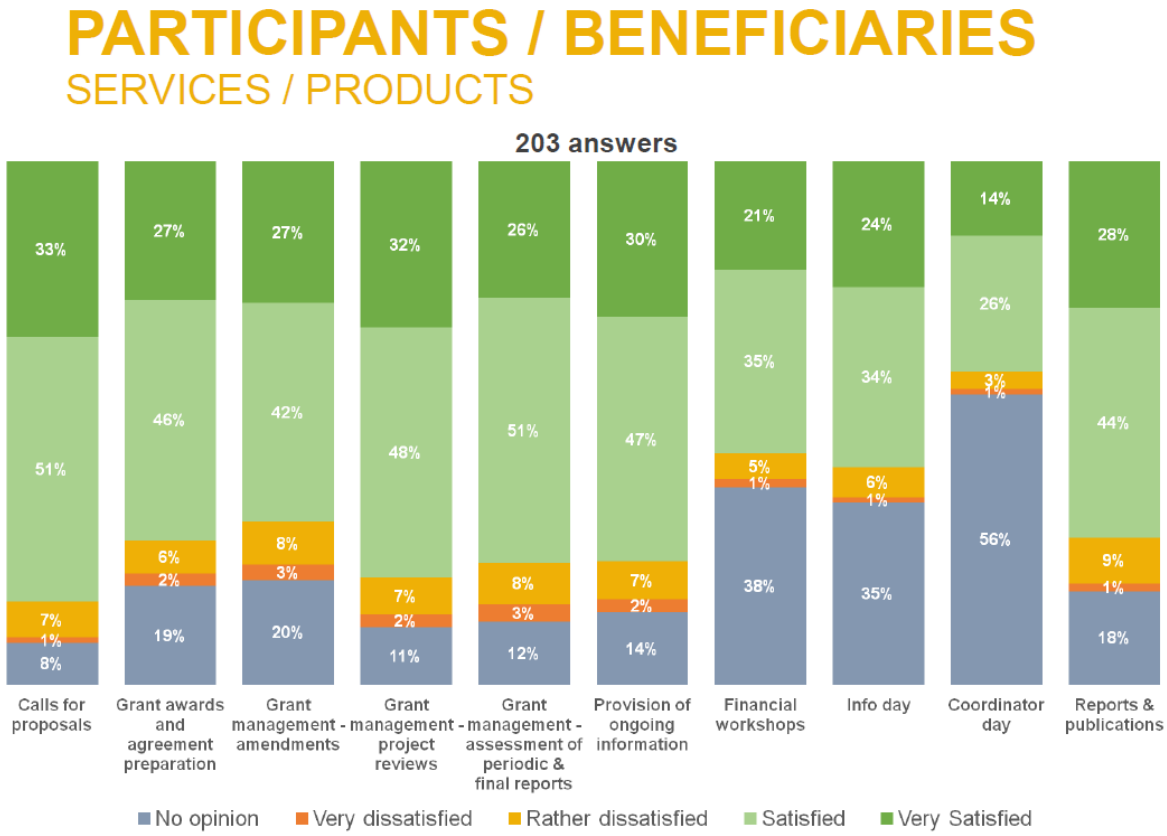

Figure 7. Satisfaction of beneficiaries regarding services and products provided by the Joint Undertaking.

The questionnaire distributed included questions regarding the assessment of services and products delivered by FCH JU. Taking into account all the questions the average satisfaction level of 68.6% among beneficiaries was achieved. The answers "Rather dissatisfied" and "Very dissatisfied" were given by 6.6% and 1.7% of beneficiary respondents, respectively. As a main drawback in FCH JU operation the beneficiaries claimed insufficient or late information regarding outcome of calls, proposals evaluation and project results; complex reporting process; and long time periods for payment. A lack of transparency of internal FCH JU policy and the long time required for amendments processing were also pointed out.

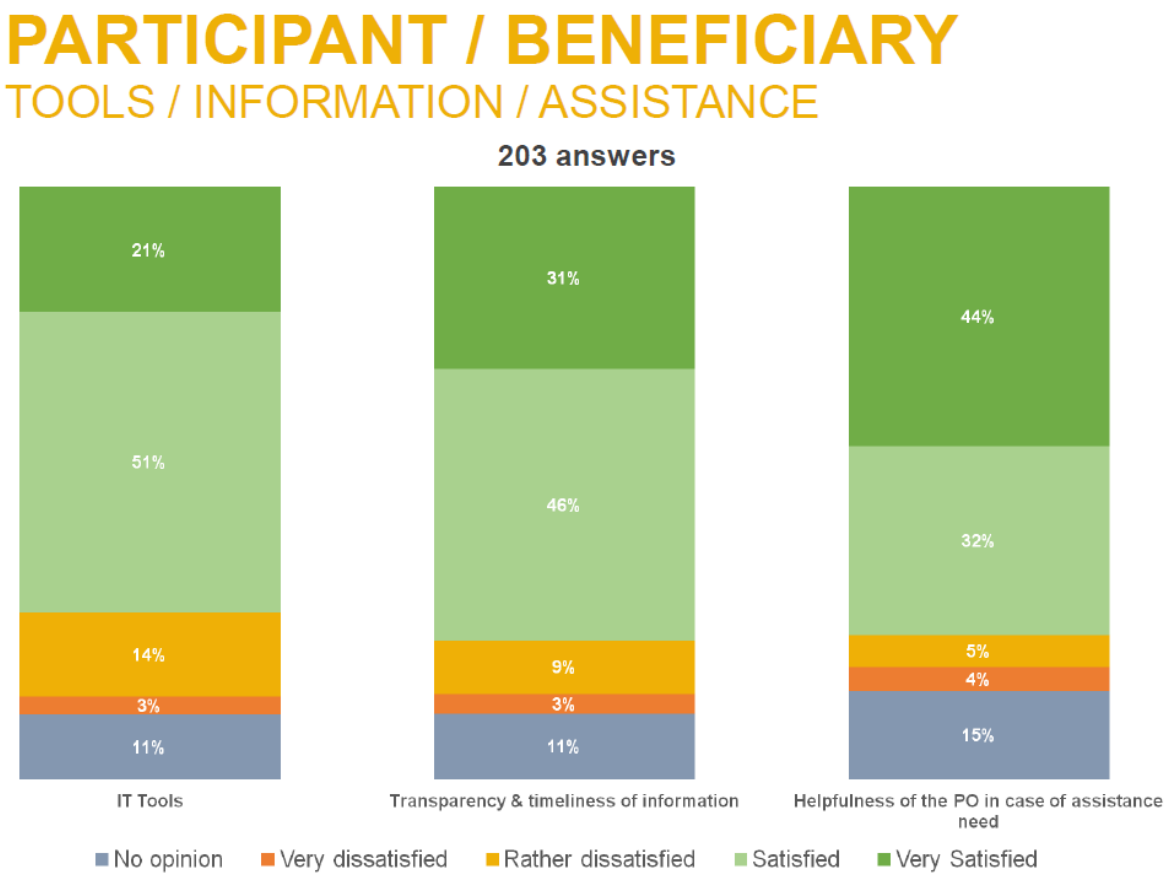

Figure 8. Satisfaction of beneficiaries regarding tools, information and assistance provided by the Joint Undertaking.

The evaluation also addressed IT tools, information and assistance given to stakeholders by Programme Office. In general an average 75% level of satisfaction was achieved. Respectively, 9.3% and 3.3% of beneficiaries were "Rather dissatisfied" or "Dissatisfied" with provided services. As reasons a number of respondents pointed out that the IT tools are complex to use, processes are long and bureaucratic, a. (and information provided in return could be clearer and more frequent.)

The output of the survey assessing the beneficiaries' satisfaction was very positive and in general more than 70% of beneficiaries were satisfied with the services, products and services offered and provided by FCH JU. A general conclusion from the survey is that beneficiaries overall were less satisfied than other stakeholders of FCH JU while coordinators show a slightly higher level of satisfaction among all beneficiaries.

Means of improvement could include introduction of simplified, clearer guidance, increased and enhanced communication as well as improvement of availability and reactiveness of Programme Office.

Communication and dissemination strategies

The Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking report expressed the view that there was a diverse community of stakeholders that needed information (municipal actors, universities, teachers, the public) with which the Programme Office cannot efficiently deal directly, but it should take actions to support others for this purpose.

In the MAIP for 2008-2017, it is already mentioned that: "Fuel cell and hydrogen technologies are as yet relatively unknown to the public. Their benefits and the RTD

results obtained within the programme must therefore be carefully explained and widely disseminated." During the whole FCH JU implementation, the dissemination and communication has improved, but much remains to be done to match this objective.

Communication beyond the members of the JU could be strengthened if projects were to disseminate their results better. In the Programme Review 2013, the technical reviewers were keen to see more active and targeted dissemination, especially to the wider European industry and potential end-users. They identified the workshops and networks run by exemplar projects as good practice that should be encouraged by the FCH JU.

The Programme Office has subsequently developed a formal communication strategy[39], but this falls outside the period covered by the FCH JU and its impact is not reviewed here.

- *To what extent did the FCH JU ensure the visibility of the EU as part of programme promoter?*

The legal basis

As stipulated in Article II.12 Information and communication of the FCH JU Grant Agreement, adopted by the FCH JU Governing Board on the 10th September 2009, unless the FCH JU requests otherwise, any publicity, including at a conference or seminar or any type of information or promotional material (brochure, leaflet, poster, presentation etc.), must specify that the project has received FCH JU research funding emanating from the Community and display the FCH JU logo and the European emblem. When displayed in association with another logo, the FCH JU logo and the European emblem should be given appropriate prominence. Moreover, as defined in Article II.30 Dissemination, all publications or any other dissemination relating to foreground shall include the following statement to indicate that said foreground was generated with the assistance of financial support from the FCH JU:

"The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) for the Fuel Cells and Hydrogen Joint Technology Initiative under grant agreement n° [#]."

FCH JU Website

The first version of a new independent FCH JU website was launched on the 15th March 2011 and it was created as a response to a need for the JU to become the obvious portal for information on European FCH efforts. During the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking it was noted that the website was unappealing and static and relevant information was difficult to find. It was recommended to modify the website to improve FCH JU visibility and to reflect that the FCH JU strives to be the most authoritative source of knowledge in Europe for FCH technology. Significant website updates happened in 2013 and the recommendations were fully introduced in 2014 when the website was redesigned. The update included adding of new interactive tools and a modern look in line with the new visual identity.

At the end of FCH JU activity under Seventh Framework Programme the website was a good source of information regarding FCH technology activities in Europe and available funding provided by European Union. Unfortunately the visibility of the EU as part of programme promoter according to the binding rules was not ensured during the whole period of FCH JU operation. The European emblem appeared on the website only in March 2013 and the probable reason was to underline that the European Commission was one of participants of created PPP, rather than acknowledge the received EU funding. The European emblem was accompanied by two other emblems of PPP

[39] FCH 2 JU Communication Strategy 2014-2020

participants – Industry Grouping and Research Grouping – and appropriate prominence is not given. Based on the internet archive search one can note that the statement demanded by Article II.30 was not present on the FCH JU website.

FCH JU Publications

FCH JU during its operation under Seventh Framework Programme performed a number of studies and prepared many reports and other materials that were published in a printed or an electronic form. The studies concerned in general the FCH technologies and their potential for development and deployment and the reports included information about operation gathered in AARs and summary of organized Programme Reviews.

The documents have visual identity specific for FCH JU but none of them includes proper information concerning the source of funding received from the EU. The requirements concerning the placement of the European emblem and the statement acknowledging the funding are not fulfilled. There is neither mention nor sign for the reader that could convey the message that the EU funding was used. The EU emblem does not appear in the documents and if it does it is not properly presented. In some cases the European emblem is enclosed at the back of the cover but this is done to acknowledge the Publication Office rather than acknowledge the funding received from EU.

Project websites

In total 155 projects were funded by FCH JU under Seventh Framework Programme. A high percentage of project consortia (73%) created websites which aimed at project information dissemination including in most cases the project scope, consortium composition, budget etc.. 15% of projects did not have website and another 12% of websites were not accessible at the time of verification. 15% of websites applied the rules correctly and displayed a suitable JU logo, European emblem and appropriate acknowledgement statement that included grant agreement number. However, 9% do not obey the rules and do not acknowledge the funding received from EU through FCH JU. During verification it was noted that the greatert number of project websites included either the EU or FCH JU logos, respectively 47 and 72 websites.

Project presentations and posters

Only a few project presentations made during PRD displayed the European emblem and FCH JU logo. The priority for the presenters was to display the project logo. It is noted that at the time of organization of the PRD event under the Seventh Framework Programme a presentation template was not available, so the EU logo and funding acknowledgement text was not automatically included in the project presentations.

EU funding information on the posters for scientific conferences and workshops was limited and did not fulfil requirements of the Grant Agreement. Those posters reviewed in most cases did not include the EU logo although a few contained FCH JU logo and acknowledgement of the funding in the text.

Publications from projects

The publication record of the outputs from the projects realized under Seventh Framework Programme reported in the AAR 2016 includes 494 entries. None of the verified publications includes a funding acknowledgement statement in the form specified in the Grant Agreement. Nevertheless, the vast majority of publications (71%), which were accessed during verification, acknowledged in other ways the funding received from the European Commission . The criterion was assumed as fulfilled in every case when the acknowledgement part of the text contained at least the project acronym and contract number and mentioned that the funding was granted by FCH JU or European Commission. 18 % of verified publication did not acknowledge the funding received. In some cases different funding sources, received for example from national programmes, were acknowledged. During the verification 51 publications were not accessed due to limited database access.

It was noted that a few publications were acknowledging two or even three European projects and often the research work was supported by both European Commission and national funding. It may lead to a conclusion that the same research work was funded from two different sources. In a few cases the publication acknowledged a different project than that specified in the list.

Sources of financing

The FCH JU had a total budget of €947M for the period 2008-2017. The Union contributed with a maximum of €470M for the purpose of funding operational (€450M) and running costs (€20M). The remaining €20M to pay the running cost was provided in cash by the Members other than the EU. All legal entities participating in the activities (Members or non-Members) contributed through in-kind contributions to the operational costs. This in-kind contribution was intended to at least match the financial contribution of the Union. Other FCH JU revenues included in their accounts were very small and mainly related to recoveries from audits and early termination of projects or bank interests.

The in kind-contribution has been audited by an external auditor as shown in Figure 9. In its final report, the auditor only identified an issue with a single project in 2008.

Under FP7, the target for the FCH JU was to achieve parity, i.e. that the in-kind contribution should match that of the EU. The total aggregated in-kind contribution from 2008-2013 amounted to €485.73M compared to the €450M invested by the EU for operational purposes, meaning that the target was slightly exceeded. The IEG concludes that the financial contribution from the participants was well in line with

The IEG concludes that the financial contribution from the members was well in line with their obligations.

Call	Total in kind (validated by Authorising Officer) in EUR	Total in kind (according to Independent auditor) in EUR	Difference in EUR
2008	30,639,454.31	30,485,079.47	-155,374.84
2009	104,286,426.45	104,286,426.45	
2010	95,663,534.24	95,663,534.24	
2011	113,926,660.67	113,926,660.67	
2012	55,729,650.99	55,729,650.99	
2013	85,643,049.06	85,643,049.06	
TOTAL	**485,888,775.72**	**485,733,400.88**	**-155,374.84**

Figure 9. In-kind contribution and Independent audit[40].

[40] Final Report –Annual Assessment of the level of in-kind contribution, FCH JU, 12 March 2015

The principle of financing the running costs of the FCH JU and the financing of the research activities.

- *Running costs*

According to the founding regulation, the total running costs of the FCH Joint Undertaking should not exceed €40M. This amount corresponds to the 2008-2017 period and was covered in cash six twelfths by the Industry Grouping (NEW IG), five twelfths by the Community and one twelfth by the Research Grouping (N.ERGHY). Running costs includes administrative expenditures such as staff costs, rental of building, equipment, IT equipment and maintenance, evaluation costs and meetings.

By the end of 2015, the cumulated running costs were €22.016M as shown in Figure 10. The commitment until the end of 2017 will be €30.97M: much less than the maximum initial foreseen (€40M). *Financing of the research activities (Operational costs)*

The operational costs of the FCH Joint Undertaking were covered through the financial contribution of the Community (€450M over the 2008-2017 period) and through in-kind contributions from the legal entities participating in the activities. The contribution from these legal entities (except the JRC) was intended to at least match the Community's contribution. As mentioned already in the section related to the in-kind contributions, this has been achieved.

The FCH JU became autonomous in November 2010. In 2010, FCH JU took over all running projects, and uncleared pre-payments became financial assets for FCH JU. Previous year in-kind contributions from the EC represented the transfer of these assets from the EC to FCH JU for pre-autonomy running costs[41].

	Commission		Industry Grouping		Research Grouping		Total	
	Cash	In kind	Cash	In kind	Cash	In kind	Cash	In kind
A. Running Costs	**7 236**	**1 808**	**11 119**	**-**	**1 853**	**-**	**20 208**	**1 808**
Previous years	*5 423*	*1 808*	*8 943*	*-*	*1 491*	*-*	***15 857***	***1 808***
Current year	*1 813*	*-*	*2 175*	*-*	*363*	*-*	***4 351***	***-***
B. Operational costs (R&D Projects)	**310 839**	**17 299**	**-**	**118 470**	**-**	**67 112**	**310 839**	**202 881**
Previous years	*276 166*	*17 299*	*-*	*77 119*	*-*	*36 167*	***276 166***	***130 584***
Current year	*34 672*	*-*	*-*	*42 898*	*-*	*31 192*	***34 672***	***74 090***
Adjustments	*-*	*-*	*-*	*(1 547)*	*-*	*(246)*	***-***	***(1 793)***
BALANCE AS AT 31.12. 2015	**318 075**	**19 107**	**11 119**	**118 470**	**1 853**	**67 112**	**331 047**	**204 690**
BALANCE AS AT 31.12.2014	281 589	19 107	8 943	77 119	1 491	36 167	292 023	132 392
Contribution in cash/kind in %	*96.08%*	*9.33%*	*3.36%*	*57.88%*	*0.56%*	*32.79%*	***100%***	***100%***
Total contribution in %	*62.94%*		*24.19%*		*12.87%*		***100%***	
Voting rights %	*41.67%*		*50.00%*		*8.33%*		***100%***	

Figure 10. Running and Operational costs of FCH JU under FP7[42].

[41] The Commission supported the FCH JU on the basis of Article 16 'preparatory action' of Council Regulation (EC) No 521/2008. The FCH JU received a financial contribution from the EC for the operational and running costs on its specific FCH budget line.

[42] FCH JU Annual Accounts 2015 (page 20)

There is a difference between the in-kind herewith reported and the one audited in the report "Final Report Independent assessment of the level of in-kind contributions"

- The aggregate level of IK contributions assessed by the independent auditor are calculated in accordance with the IK methodology adopted by the GB in February 2012 and are based (in brief) on Budget figures (total amount as per the signed GA and amendments if any) for ongoing GA and for final amounts for GA for which final payment has been made.
- The amounts in the annual accounts under net assets correspond to the IK validated by the ED (validated cost statements). In addition the accounts include under liabilities contributions in-kind to be validated which related to IK for which there is no validated cost statement at 31.12.

- *Have in particular the levels of funding and other available resources been adequate to reach the established objectives?*

The levels of funding during FCH JU were less than expected for reasons explained in Section 6. In 2011, after the Research Grouping joined the JU, the Council adopted an amendment to the regulation that allowed the in-kind contributions from all legal entities to be counted as matching funds. Even with the amended Regulation the contribution from the participating legal entities was insufficient to match the EU contribution and in 2011 and 2012 the funding rates were multiplied by a factor of 0.8 giving rates of around 40% for industrial participants and 60% for other participants.

Moreover, in FP7, beneficiaries could claim real indirect costs and some entities such as SMEs or non-profit research centres could claim a flat reimbursement rate of 60%; indirect costs were capped at 20% for all beneficiaries of the FCH JU although their real indirect cost was taken into account for the assessment of the in-kind contribution. This was a substantial loss to some participants.

The matching rule has been a persistent cause of confusion; the main consequence has been that funding rates were lower than in FP7 and were unpredictable, as the correction factor varied annually and could not be announced when launching the calls; it was an unpredictable factor for the beneficiaries and consequently a risk[43]. To ensure that industry in-kind contribution matched the FCH JU contribution, the FCH JU proceeded in two stages for the reimbursement of direct costs:

1. The FCH JU started with the maximum reimbursement rates that were aligned with FP7 upper funding limits
2. And then applied a correction factor to ensure the matching obligation. These decreases might be substantial, depending on the type of activity (Research, Demonstration, Other) and type of participants (SME, university, etc.) in the proposals retained for negotiation, as well as on the related matching funds provided by industrial participants in these proposals. The decreases were estimated per call for proposals, after evaluation and before signing the Grant Agreement.

This procedure caused problems for some stakeholders because the level of funding was lower than expected and unknown at the time of submission of proposals, causing them to withdraw. Also, some stakeholders lost interest in participating in the calls as the funding was not very attractive, which could be one reason why the competition in some calls was not very high or that some topics generated no proposal that could be approved . These represented a specific difficulty in following the path foreseen by the MAIP (and AIPs) to reach the overall objectives.

It should be noted that according to AAR 2016, only 96.5% of the allocated FP7 budget will be spent , despite three calls being issued in the last year (2013, 2013-1 and 2013-2 calls) in an attempt to allocate all the budget.

The IEG concludes that the original requirement for matching funding was very complex and there was no practical manner of ensuring it without introducing additional risks and confusion for beneficiaries.

[43] Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking

6 ANSWERS TO THE EVALUATION QUESTIONS

6.1 Effectiveness

The programming procedures of the FCH JU

Management of the FCH JU differed from that of the FP7 in several respects: but mainly through modifications designed to accelerate and to simplify decision-making. The Commission contribution to funding was foreseen for the duration of the programme; this provision was intended to allow a long-term research strategy to be formulated and implemented and to give confidence to partners of the Commission's long-term commitment. There was no process of comitology in the JU, so that executive decisions should not be delayed by negotiation with Member States. Scientific priorities were decided in practice by the private members of the partnership, although the Commission could veto decisions related to spending of public funds. Participation rules varied slightly from those of FP7, in the sense that proposals were obliged to include at least one member from either IG or RG.

In 2010, shortly after adoption of the first MAIP, it was judged necessary to review the contents taking into account the experience of the first calls for proposals, the First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking and changes in the technological, financial and policy environment. The revised MAIP had more aggressive targets, but mainly differed in a much closer specification and a stronger focus on cost and performance indicators[44]; it was adopted by the Governing Board on the 22nd November 2011.

The MAIP is implemented by Annual Implementation Plans (AIPs) which list the topics and detailed topic descriptions to be included within the annual calls for proposals. AIPs are prepared by the Industrial and Research Groupings with inputs from the European Commission and with the support of the Programme Office. Once adopted by the Governing Board, they become formal documents of the FCH JU. The structure of the AIP by research areas is identical to that of the MAIP; the Call *fiche* for the call for proposals associated with the AIP is included within the AIP. Evaluation of Calls follows closely the procedures of FP7. Six AIPs were produced under FCH JU.

Within the Application Areas (AA) all topics specified by the Decision are covered. Each AA contained four "action categories": Break-through research, Research & technological development, Demonstrations, and Support actions. Available EU funds were notionally allocated according to a matrix of the 5 AAs and the four action categories. The budget breakdown was based on a consensus among several working groups comprising representatives of the Industry and Research Groupings working in consultation with the Commission. Performance and volumetric targets for the period were assigned; these constituted decision points where future budget expenditure, including potential redirection of activities might be triggered. Some of the targets have not stood the test of time; for example, the 2015 target for the cost of a fuel cell system for transport was €100/kW – the same as the target for 2020 in the present MAWP of the FCH 2 JU; the target for delivered cost of hydrogen was €5/kg – again the same as the targets in the present MAWP. A recurrent difficulty in setting these targets has been the absence of a clear definition of the present state of the art aggravated by reluctance among participants to reveal results and not helped by the lack of a technology monitoring tool noted in both the 1st and 2nd Interim Evaluations of JUs. The strategy and objectives in the MAIP were translated into Annual Implementation Plans (AIP) on which the annual calls for proposals were based.

[44]Multi - Annual Implementation Plan 2008–2013, FCH JU

Effectiveness of disbursement of funds

- *An overview of calls launched during the period 2008-June 2014.*

Seven Calls for proposals have been completed under FP7 in six years. Two Calls were made in 2013 because the full volume of available funds was not committed in the first Call.

The numbers of projects signed each year in the various thematic areas of the MAIP is shown in the table below. The data show that accumulation of FCH JU Calls process has adequately supported the RTD priorities of the MAIP. Most topics in the MAIP were addressed in the Calls, but in some cases there were no proposals that passed the minimum thresholds. The coverage of topics called for in the 2008-2013 AIPs was 84%. Given the constraints of the proposal-driven process and the demand for quality this is a good achievement.

Table 2 Grants signed by thematic area and year.

	2008	2009	2010	2011	2012	2013	Total
Transport	3	4	4	10	7	4	32
Production and distribution	3	2	8	8	4	6	31
Stationary markets	7	13	9	7	8	9	53
Early markets	2	4	4	6	3	1	20
Cross-cutting	1	5	1	2	5	5	19
Total	16	28	26	33	27	25	155

The number of proposals per year initially increased, but levelled off in the second half of the period. The proportion funded has fallen from 50 – 60% in the early years to between 30-40% towards the end of the period, which lower rate is similar to that in the Energy FP7 Energy programme (usually around 30%), but many FP7-Energy Calls have two stages, so the figures are not exactly comparable.

Table 3. Overview of Calls from 2008 to 2013.

Year	Commission contribution (M€)	Number of proposals submitted	Number of proposals funded	Success rate (%)	Funding correction factor
2008	27,3	32	16	50%	0.67
2009	72,6	49	28	57%	0.67
2010	80,6	69	26	38%	0.72
2011	117,0	80	33	41%	0.80
2012	67,9	78	27	36%	0.80
2013	82,2	71	25	35%	0.67
Total	453,1	379	155	35%	

Article 12(3) of the founding Regulation required that the industry contribution to the cost of the research programme should at least match the Community's budgetary support. The financial contributions from the FCH JU to the various consortium members were aligned on the permitted funding rates established for FP7. If the in-kind contribution from industry (i.e. total eligible costs for industry minus FCH JU contribution paid to industry for projects) was less than the total contribution from the Commission, then the Commission contribution had to be reduced. The calculation of the reduction was required to be "fair and balanced proportionally for all categories of participants in each individual project".

The necessary reduction was implemented through a correction factor calculated by the FCH JU. During the evaluation, the projects were ranked within application areas and then, based on the available EC funding, a cut-off was established in each area. EU funds for each project were reduced by a common factor to match the overall commitment of the beneficiaries. This released more EU funds so that more projects could then be financed and the process was repeated until funds were exhausted. Consequently, more research was funded than expected with lower EU commitments per project. For example, in the 2010 call for proposals, FP7 funding rates were multiplied by a factor of 0.72 giving rates of around 36% for industrial participants and 54% for other participants; these are considerably less than the upper limits for FP7 of 50% and 75% respectively[45]. In 2011, after the Research Grouping joined the JU, the Council adopted an amendment to the regulation that allowed the in-kind contributions from all legal entities to be counted as matching funds[46]. This allowed more attractive funding rates for projects, as is visible in table 3. The level of in-kind contributions is verified each financial year by an independent auditor.

The IEG concludes that the FCH JU was effective in the mechanics of managing the Calls and disbursing funds. It was successful in attracting proposals, organising evaluations, ranking projects and negotiating grants. It satisfactorily overcame unexpected problems in ensuring the obligation to have EU funding matched by contributions from industry.

- *Participation patterns broken down by country and region where possible.*

Figure 11 shows the distribution of coordinators and participants by country over the period 2008 to 2012; there is evidence of significant concentration upon a few countries. The data for Belgium includes the JRC which participates in many projects, but does not often coordinate them. The New Member States does not show strongly, especially in terms of coordination, but do slightly better in terms of participants.

[45] Fuel Cells and Hydrogen Joint Undertaking, Annual Activity Report 2011
[46] Council Regulation 1183/2011 of 14 November 2011 amending Regulation (EC) No 521/2008 setting up the Fuel Cells and Hydrogen Joint Undertaking. O.J. L 302/3 19/11/2011

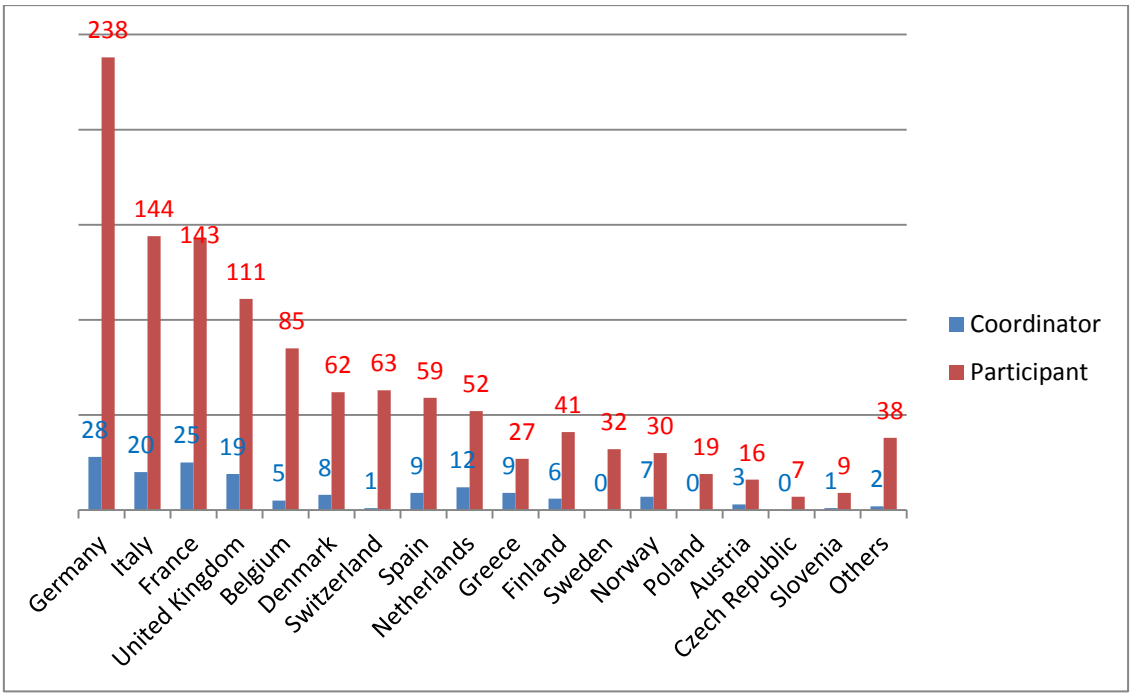

Figure 11. Participation by numbers of coordinators and participants (2008-2012).

Figure 12 shows the growth in the number of entities that had ever participated in proposals selected for funding following each of the successive Calls of the FCH JU. The bottom part of the column shows the number of entities that were new to the FCH JU in each Call. The top part of the column shows the number of repeat entities and together they comprise the running total of all entities that have participated. In the first Call, as expected all entities were new; thereafter the community built up rapidly at the rate roughly of 100 new participants per year. So, by 2011 over 400 entities had at some time participated in a project of which total more than 100 were new to the FCH community. Thereafter the rate of growth declined and by 2013 the number of new entities was low. However it should be noted that even after 5 years, the JU was able to attract a few newcomers.

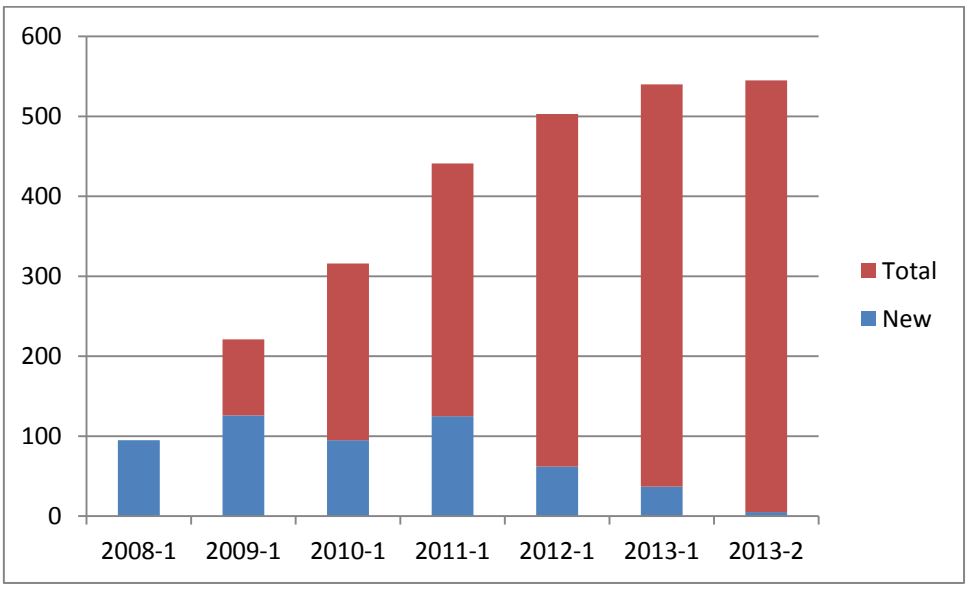

Figure 12. Growth of the FCH JU community.

- *Participation patterns per specific thematic topic broken down by type of beneficiary organisations (universities, research organisations, industrial participation - large companies and SMEs).*

The distribution of funds by topic and by type of applicant is shown in the Table 4. In the view of the IEG, the balance is reasonable both among the topics and among the types of participants.

Transport and stationary power received the largest shares of funding as they are the main applications. Hydrogen production and distribution which is a prerequisite for both were also well-funded. The largest share of the budget was attributed to industry; large industrial companies and SMEs together took 57% of the budget. Promotion of research by SMEs was an aim of FP7 and FCH JU exceeded the programme target of 15%. There was still a reasonable share of funds for research institutes and universities: 32% in total.

Table 4 Distribution of JU funds as a % of total (2008-2013).

	Universities [47] (%)	Research organisations [48] (%)	Large industrial companies [49] (%)	SMEs (%)	Other (%)	Total grants awarded (M€)
Early markets	13%	13%	42%	25%	7%	54.64
Cross-cutting	20%	36%	17%	18%	9%	17.22
Transport and refuelling	5%	16%	42%	18%	20%	148.85
H2 production and distribution	18%	35%	15%	28%	5%	60.59
Stationary power and CHP	14%	20%	25%	35%	6%	151.74
Total	12%	20%	31%	26%	11%	435.13

The origin of the beneficiaries is shown in Table 5: Universities had a larger share of activities as measured in this manner and the share of industry falls. This is unsurprising as heavy expenditure on large rigs and equipment is more likely to be made by industrial research laboratories than in universities. Again, the IEG finds the balance acceptable.

[47] Classified as Secondary and Higher Education Establishments in CORDA database
[48] Classified as non-profit research organisations in CORDA database excluding the Secondary and Higher Education Establishments
[49] Classified as Enterprise in CORDA database

Table 5 Origin of beneficiaries as a % of the total (2008-2013).

	Universities (%)	Research organisations (%)	Large industrial companies (%)	SMEs (%)	Other (%)	Total of Beneficiaries
Early markets	15%	24%	28%	23%	10%	177
Cross-cutting	21%	23%	14%	23%	19%	133
Transport and refuelling	10%	22%	39%	18%	10%	324
H2 production and distribution	17%	29%	24%	26%	5%	241
Stationary power and CHP	20%	27%	25%	23%	6%	437
Total	16%	25%	27%	22%	9%	1312

- *Competition for funding.*

Table 6 shows how well the Calls have covered the topics published and how the quality of the proposals was judged. Coverage of topics has been good, always above 80%, except in 2013. After the first year, the share of proposals passing the threshold was stable at about 65% and the quality of proposals was consistent; about 40% received an evaluation mark of 4 or 5 (very good or excellent) for science and technology, and a somewhat higher share received a mark of 4 or 5 for dissemination. This performance is similar to that found in the evaluations performed for the energy programme of FP7; for FP7 the average share of proposals achieving a 4 or a 5 for scientific quality was 44.3%, slightly higher, but probably not significant.

Table 6 Coverage of Call, quality of proposals.

Year	No. of topics	No. of topics covered by a proposal	Coverage of topics called (%)	Share of proposals passing the threshold	High quality proposals (%)*	High quality of proposed dissemination (%)*
2008	15	13	86.7%	56.3%	28.1%	40.6%
2009	29	24	82.8%	62.0%	42.0%	56.0%
2010	25	23	92.0%	62.3%	37.7%	44.9%
2011	36	29	80.6%	66.3%	40.0%	45.0%
2012	31	28	90.3%	66.2%	44.1%	42.6%
2013[50]	31	19	61.3%	51.6%	n/a	n/a

*Percentage of projects with a mark of 4 or 5 in the evaluation

[50] Refers to both calls launched in 2013

- *What was the distribution of funds, broken down by country and region where possible, activity type of beneficiaries, and thematic area?*

Figure 13 shows the total grant funding awarded over the period by country; the blue columns show the amounts per country in M€ and the red line shows the cumulative distribution. The funding is strongly concentrated on the top four participants: over the period they received 64% of the funding. The EU13 received only 1.9%. Associated Countries received 8.8%, dominated by Norway and Switzerland. Small amounts went to a few third countries. These trends appear to be unchanged over the period: the pecking order for cumulative funding among the top ten participants hardly moved throughout the period[51]. The share of the new member states is very small and has always been so, and even within that small total Poland and Slovenia account for more than half. It is evident that there is a high degree of concentration both among groups and within groups.

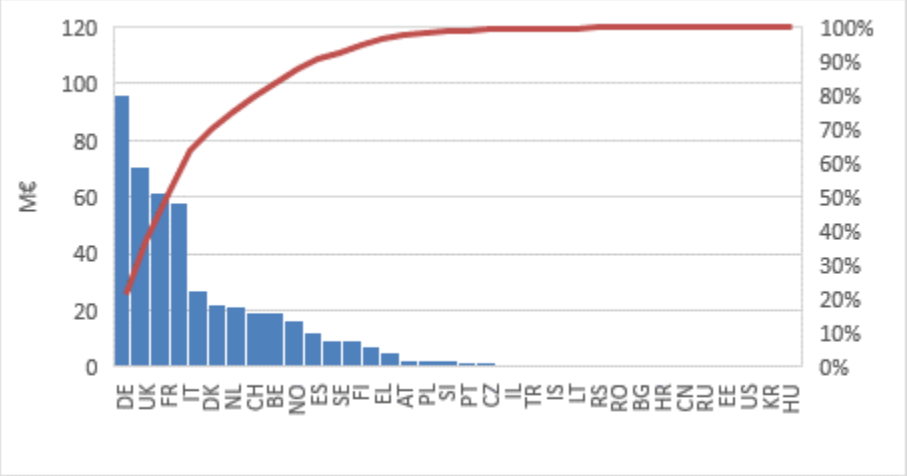

Figure 13. Distribution of EU funds by country.

A similar graph of the distribution of participants by country is shown in Figure 14; it suggests that in terms of people there is rather less concentration than is seen in the distribution of funds and a more visible, although still small, participation of the EU13. It appears that the bigger players concentrate the funds strongly, but that participation is more diffuse. This is not a surprising result; in a technical area that requires large expenditures and high expertise it is probably inevitable that a programme driven by the quality of proposals will tend to be dominated by countries with large high-technology sectors, world-class universities and well-established research institutes that will absorb most of the funding in capital-intensive research. The greater diversity in participation among people is an indication that at the level of human resources the smaller countries are beginning to take more interest. The data therefore is consistent with a slow diffusion of competences. There may be reason to accelerate this diffusion. Some remedies lie within the means of the JU, for example it might be helpful to devise activities that aim to identify and make more widely known the competences that actors in the New Member States can offer.

[51] Fuel Cells and Hydrogen Joint Undertaking, Annual Activity Report 2014

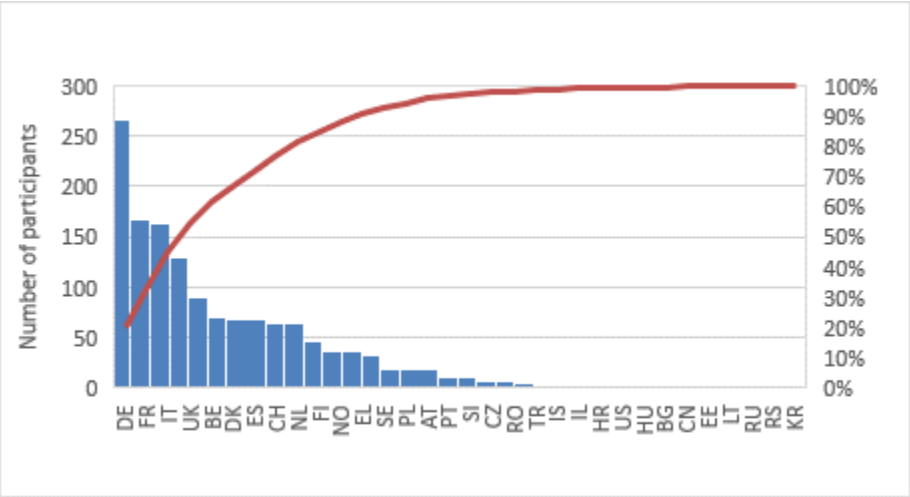

Figure 14. Distribution of participants by country.

The distribution of funds by thematic area is given in the Figure 15. This shows on the right-hand side the actual funding by application area and on the left-hand side the targets for funding included in the MAIP. The match is good, except for cross-cutting activities where the number achieved is a little below target. It is not evident from the Figure 15, but the match between target allocation and actual has been achieved by a progressive adjustment of the AIPs to reflect the result of previous Calls. The result demonstrates a satisfactory management of the funds to achieve the established targets.

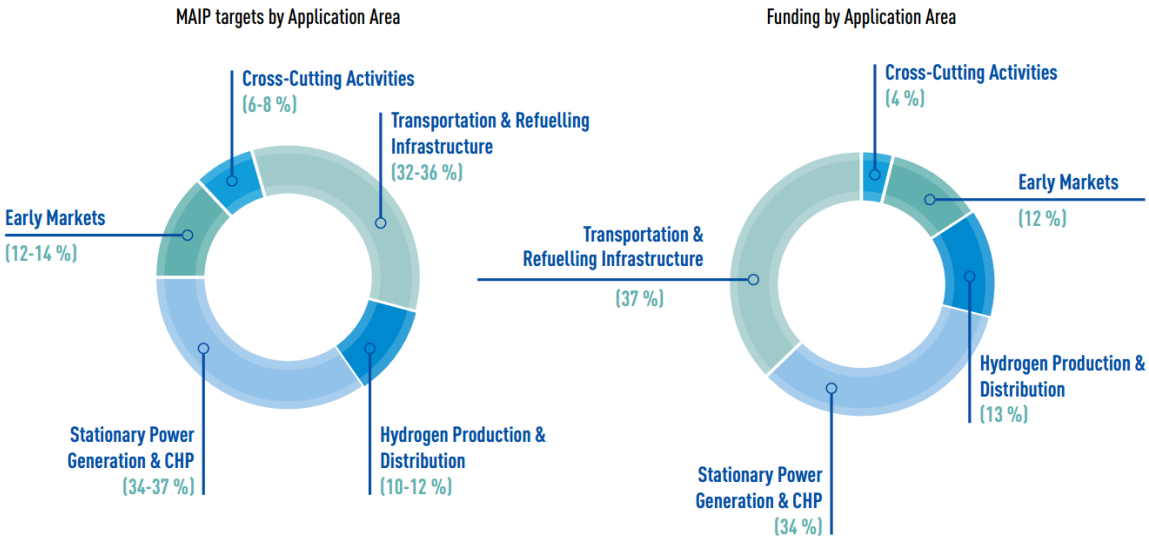

Figure 15. Distribution of funds by application area (2008-2013).

The distribution of funds by class of beneficiary and thematic area is shown in the Table 7; Industry received the major share of funding (31% for large industry, 26% for SMEs).

Table 7 Distribution of funds by thematic area and class of beneficiary (M€).

	Universities	Research Organisations	Large Industry	SMEs	Other
Early markets	7.10	7.10	22.95	13.66	3.82
Cross-cutting	3.44	6.20	2.93	3.10	1.55
Transport and refuelling	7.44	23.82	62.52	26.79	29.77
H2 production and distribution	10.91	21.21	9.09	16.97	3.03
Stationary power and CHP	21.24	30.35	37.94	53.11	9.10
Total	50.14	88.67	135.42	113.63	47.28

- *What is the average grant size in terms of budget and number of beneficiaries (overall and by call and research topic)?*

The average grant size in terms of budget and number of beneficiaries is shown in Table 8. By far the biggest grants per project were given to the transport sector, followed by stationary markets. The largest average grant size per beneficiary is also to be found in transport.

Table 8 Average grants by application area, project and beneficiary).

Application area	per project (M€)	per beneficiary (K€)
Transport	5.21	449.80
Production and distribution	1.88	259.88
Stationary markets	3.41	374.81
Early markets	2.41	295.40
Cross-cutting	1.04	137.47
Overall Average	2,79	303,47

The average grant per beneficiary broken down by application area and type of beneficiary is shown in Table 9. The largest average grants are generally to industry: large industry in transport, SMEs in stationary power.

Table 9 Average grant per beneficiary by theme and type of beneficiary (M€).

	Universities	Research Organisations	Large Industry	SMEs	Other
Early markets	0.27	0.17	0.46	0.34	0.22
Cross-cutting	0.12	0.20	0.16	0.10	0.06
Transport and refuelling	0.23	0.33	0.49	0.46	0.92
H2 production and distribution	0.27	0.30	0.16	0.27	0.25
Stationary power and CHP	0.24	0.26	0.35	0.53	0.35
Overall	0.24	0.27	0.38	0.39	0.40

The average size of projects in terms of the number of beneficiaries is shown in Table 10. Overall, the average number of partners per project is 8.4. This is surprisingly stable over the range of project types; the smallest projects are in cross-cutting (7 partners per project) and the biggest in transport (10 partners per project). Universities perform poorly compared to large industry, SMEs and research organisations.

Table 10 Average grant size by number of beneficiaries by (theme and type of beneficiary).

	Universities	Research Organisations	Large Industry	SMEs	Other	All types
Early markets	1.3	2.1	2.5	2.0	0.9	8.9
Cross-cutting	1.5	1.6	1.0	1.6	1.3	7.0
Transport and refuelling	1.0	2.2	3.9	1.8	1.0	10.0
H2 production and distribution	1.3	2.3	1.9	2.0	0.4	7.9
Stationary power and CHP	1.6	2.2	2.1	1.9	0.5	8.3
Overall	1.4	2.1	2.3	1.9	0.8	8.4

The average grant size by Call is shown in Table 11. In the first year of operation the average grant size was €1.71M; it rose thereafter to €3.10M in 2010 and fluctuated at roughly that level until the end of the period. The behaviour reflects the larger demonstration projects getting underway.

Table 11 Average grant size by Call (M€).

	2008	2009	2010	2011	2012	2013	2008-13
Number of projects	16	28	26	33	27	25	155
Funds disbursed	27.3	72.6	80.6	117	67.9	82.2	453.1
Average	1.71	2.59	3.10	3.54	2.51	3.29	2.92

The following graphs show the size distribution of grants in the period 2008 to 2010 and 2011 to 2013. They both show a moderately strong concentration of grant size. Figure 16 shows that in the period 2008 to 2011 63% of funds went to 80% of the participants; so about 37% of funds went to the top 20% of participants. In the period 2009 to 2013 there was a sharp increase in the concentration of funding. In the period 2011 to 2013, 41% of EU funds went to the bottom 80% of beneficiaries and 59% of EU funds went to the top 20%. The average grant size did not change much in the two periods. From 2008 to 2010 it was €303,000 and from 2011 to 2014 it was €370,000, but the distribution became significantly more skewed. This is a result of the shift towards larger demonstration projects.

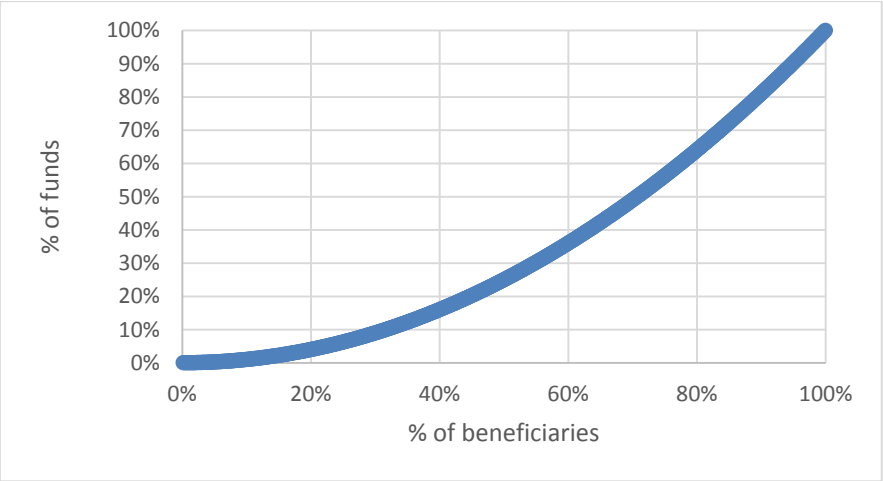

Figure 16. Size distribution of grants (2008-2010).

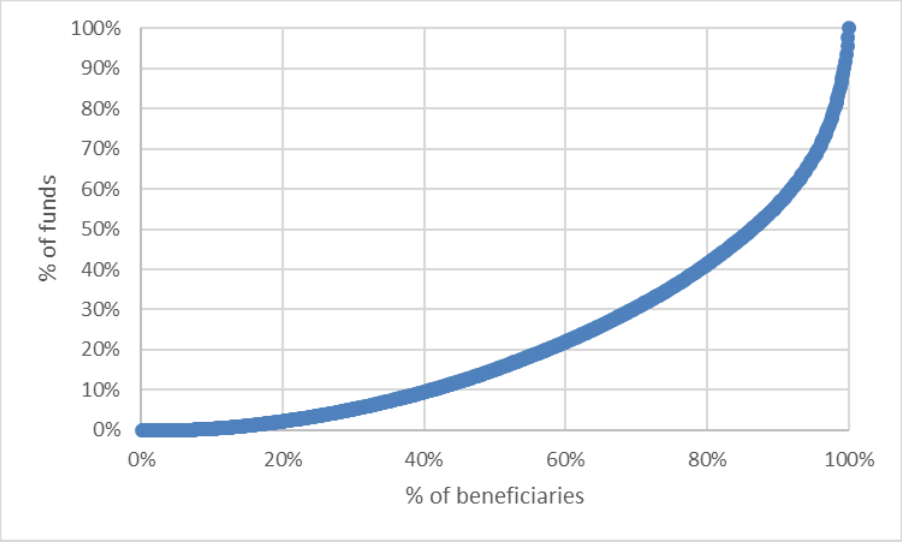

Figure 17. Size distribution of grants (2011-2013).

Main achievements

The achievements of the FCH JU can be separated into four parts: creation of an effective community combining diverse skills and functions; agreement of a strategy to guide collaborative work; concrete outputs from funded activities in line with the objectives set in the regulation; dissemination of project results to appropriate parties.

- *The FCH Community*

The FCH JU brought together a wide range of stakeholders in the sector and provided programming and financing predictability underpinned by the long-term vision contained within the MAIP. The 155 projects funded under FP7 engaged 545 different beneficiaries from 22 EU Member States. The community built up very quickly in the first few years of operation and is now showing some signs of saturating as discussed in Section 7.1. The participation of SMEs at 26% of the funding is good and considerably higher than in FP7 where SMEs received 13% of funds[52]. Institutes of

[52] Ex-Post-Evaluation of the 7th EU Framework Programme (2007-2013)

higher education are not as well represented as in other parts of FP7 presumably because of the emphasis on commercialisation. Commercial or near commercial funding agencies such as EIB and the RSFF were only peripherally involved. FCH JU has successfully engaged regions and this is an important achievement; the specificity of energy strategy by geographical location may well become a more substantial feature of energy policy in which case regions and municipalities would be major players. The FCH JU has been less successful in aligning its activities with national governments, especially due to the challenges facing the SRG. Although there are some successes, overall this has not worked well.

- *The research agenda*

The creation of the MAIP, as noted in Section 6, was a decision of the Governing Board of the JU and this has been an important reference framework for participants from both the research and industrial community. This was attested by respondents to the coordinators survey and the interviews conducted by the IEG. The JU has conscientiously sought to ensure that all the topics identified in the MAIP were covered by projects at an appropriate time, as described in Section 6. The Annual Report of the FCH JU for 2014 gives a detailed account of the extent to which the FCH JU call process has supported the RTD priorities identified in the MAIP. While most MAIP topics were addressed through the various calls, projects did not always materialise for each MAIP topic, either because no project proposals were submitted for the given call topic, or because submitted proposals did not pass the evaluation stage. The table below summarises that data.

Table 12 Summary of coverage of topics (2008-2013).

Application area	Number of topics included in Calls	Number of topics covered by projects	% coverage
Transport	21	16	62%
Production and distribution	21	20	87%
Stationary markets	11	9	69%
Early markets	11	8	62%
Cross cutting	18	16	62%
Total	82	69	68%

The coverage is highest for production and distribution and otherwise at a level of between 60 to 70% for other application areas. The match between the allocation of funds between application areas prescribed in the MAIP and that achieved by the Calls is extremely good. Overall this is a creditable performance in matching the work done to the research strategy, given the constraints of a proposal-driven process based on excellence.

Several interviewees and respondents to the consultation expressed the view that basic research was relatively neglected in the strategy compared to demonstration projects. This led the expert group that conducted the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking to suggest that 6 to 10% of the budget should be allocated to basic research.

- *Concrete outputs from funded projects*

Transport

The MAIP 2008-2013 contained five areas of focus for demonstration projects in transport: to increase the number of demonstration FCEVs in Europe; to reduce the cost of FC buses and to improve fuel economy; to demonstrate the business case for MHVs (material handling vehicles); to validate the technology of APUs and to identify markets; to develop refuelling infrastructure at a competitive cost.

In conformity with these aims, many fuel cell vehicles were deployed across Europe with funding from the FCH JU. One hundred and forty cars and light goods vehicles have been demonstrated in several Member States through four projects: H2MovesScandinavia (completed in 2012), HYTEC (completed in August 2015), SWARM (ongoing, 2012-2017), HYFIVE (ongoing, 2014-2017) and six hydrogen refilling stations. Forty-five buses, within projects CHIC (2010-2016), HIGH V.L.O-CITY (ongoing 2012-2018) and HYTRANSIT (ongoing 2013-2018), have been demonstrated along with 11 new bus-ready Hydrogen refuelling stations; these projects successfully demonstrated that fuel cell buses could be run safely and reliably, but were too expensive and took too long to refuel for normal operation. The bus projects all built on prior experience from earlier framework programmes, demonstrating the benefits of continuity in funding. Four hundred materials handling vehicles were deployed in FCH JU, in projects HyLIFT-DEMO (finished), MOBYPOST (finished), HyLIFT-Europe (ongoing 2013-2017) and HAWL (ongoing 2013-2017), along with 20 hydrogen filling points. They demonstrated high availability of the vehicle (95%) and high availability of the refilling point (99.5%). Eight FCH JU projects (DESTA, FCGEN, HYCARUS, HYPER, PURE, SAFARI, SAPIENS and SUAV) have developed or are developing APUs for a range of applications, including trucks, aerospace (UAV and aeroplanes) boats and recreational vehicles.

The reviewers for the 2013 Programme Review Day, being the last year of operation under FP7, recommended that bus demonstration projects run in parallel with R&D projects focused on cost reductions, as this is the main hurdle for large bus deployment[53]. This is a good example of how higher education and research institutes could be better integrated through a defined programme of commercially valuable fundamental research. The commercial viability of MHVs compared to existing battery options had not been demonstrated, except in some niche, heavy-duty, high-availability applications, and some projects were falling short of their objectives for volume, weight and start-up times; more work be done on the underlying technologies prior to demonstrations, which again could be the basis of targeted fundamental research.

The 2014 Programme Review, although formally performed under H2020, dealt mainly with projects for FP7; it reached similar conclusions as above. Demonstration projects involving fuel cell cars had shown the viability of the technology, but there was a lack of maturity in European solutions, citing for example their concern that in some projects even fuel cell efficiency was not yet known. Alignment between the projects in the transportation research portfolio and the FCH JU's strategy and objectives was good, but projects were not always achieving the planned objectives and that consequently the 2020 targets in the sector would be at risk. An assessment of project results against the state of the art indicated that, at best, projects are achieving results comparable to those from international projects.

The 2015 Programme Review found the portfolio was comprehensive and aligned with the FCH JU strategy and objectives, but that cost-reduction was not adequately addressed. It was not clear that all projects advanced the state-of-the-art and the self-assessments by the projects were weak. There had been important achievements in fuel cell buses including: improved fuel cell stack lifetimes, better fuel consumption and greater operational reliability. Exploitation and dissemination of results, was needed with an emphasis on better, clearer exploitation strategies. Deployment of MHVs fell short of expectations, and project results for APUs were failing to meet performance objectives, especially for fuel efficiency. Coordination with projects funded by other European initiatives should be improved, e.g. Regional and Structural Funds and projects supported directly by Member States.

[53] Programme Review Report, 2013

AUTOSTACK CORE was seen as a key project within the portfolio and a starting point for the evolution of the next stage of the FCH JU programme. This project created a coalition of key industrial players with the objective to develop best-of-class automotive stack hardware with superior power density and performance while meeting commercial targets for cost. The project consortium combines the collective expertise of automotive OEMs, component suppliers, system integrators and research institutes. In the view of the IEG, this is a good example of the kind of project that would have been hard to construct without the foundation of the FCH community offered by the JU. The reviewers expressed some doubt as to the utility of some FCH JU targets; they questioned whether targets for cost and durability were realistic and achievable, or were simply too ambitious and not strictly appropriate to a three-year project period; achieving these targets would take considerable resources and more time than the MAIP allows. The IEG agrees with this observation, but notes that the JU has made significant progress subsequently in the technology monitoring activity and in feeding back results from projects into the MAWP/AWPs.

In general, projects in the transport research portfolio were well-aligned with the MAIP objectives and project targets corresponded to those of the AIP. The assessment of project results performed within the JU's Programme Review Days against the international state of the art indicated that the JTI's projects are achieving results comparable to those of main global competitors.

Stationary power generation

The FCH JU supported activities to demonstrate: micro-CHP and larger-scale power and CHP units; proof-of-concept of whole fuel cell systems and balance of plant components, including diagnostics and monitoring sub-systems; small-scale fuel cell systems to power a range of back-up systems and remote locations.

The portfolio was technology neutral including not only SOFC and PEMFC technologies, but also alkaline and molten carbonate. The targets set out in the MAIP were to:

- demonstrate and deploy 1,000 micro-CHP units (domestic use) by 2015;
- reduce CAPEX to €2,000/kWe (micro-CHP) and €3,000-4,000/kWe (large-scale units) by 2020;
- raise durability to 40,000 hours for the stacks used in large-scale CHP units.

Twenty-seven demonstration projects were supported under the FCH JU. By the end of 2014, more than 1,000 fuel cell CHP units were being deployed across 12 Member States in two micro-CHP projects (ENE.FIELD and SOFT-PACT), improving on the MAIP target for 2015. Three industrial CHP projects (CLEARGEN DEMO and POWER-UP), totalling more than 1.5 MW in capacity, were funded along with five back-up power projects. Fifteen proof-of-concept, components and diagnostic projects for various fuel cell technologies were demonstrated.

The reviews of the portfolio in 2013, 2014 and 2015 were broadly consistent; they found the demonstrations to have led to significant improvements in the performance and cost of components and systems, together with advances in manufacturing capabilities. All projects had a significant involvement of industry and were relevant to the FCH JU MAIP; no gaps were identified in the portfolio. The reviewers again stressed the need for an improved definition of state-of-the-art technology to better judge whether projects were making significant advances and to ensure that they are not duplicating activities elsewhere. They concluded that the portfolio maintained Europe at the leading edge of international development, although deployment in Europe substantially has lagged Japan, Korea and the USA. Of the 18 projects assessed, five were considered to be internationally competitive in terms of SoA, whilst another 11 were seen as leading in some aspects of the project objectives

The R&D portfolio for cells and stationary power was generally in line with the MAIP, but many projects, even if technically successful were still a long way from commercial

exploitation. In the view of the reviewers clearer, smarter targets were needed to ensure projects made genuine progress beyond the state-of-the-art. They found some projects were competitive internationally and others apparently not; a more stringent selection of projects was required. Good projects tended to have significant industry involvement and to demonstrate awareness of the technical state-of-the-art; these were significant indicators of project relevance to industry, and therefore of commercial value.

The IEG is of the view that these reviews constitute a fair appreciation of the achievements of the programme, but again note that, although much remains to be done, the JU has since made progress in its assessment of the SoA both internationally and within its project portfolio and how to use that information in its research strategy.

The portfolio maintained Europe at the leading edge of international development, although deployment activities in Europe substantially lagged Japan and the USA, probably due to more favourable regulatory regimes in other regions.

Hydrogen production and distribution

The reviews of the portfolio in 2013, 2014 and 2015 found the group of projects dealing with hydrogen production and distribution to be in line with the MAIP. The hydrogen storage portfolio was highly relevant, with consistently good achievements, advancing the state-of-the-art. The reviewers regretted the absence of demonstration activities, especially for hydrogen production from renewable energy sources and hydrogen storage and suggested that the objectives of the FCH JU's objectives in this area should be better aligned with Europe's ambitions for green energy and smart energy.

The reviewers were critical of the definition of targets and the monitoring of projects. They expressed that: it was not clear how and to what extent the specific programme targets were being addressed; programme targets were often difficult for single projects to relate to and might be too ambitious; the assessment against SoA was challenging, given the poor information provided by the projects.

Industrial participation by large businesses in this part of the portfolio was modest and the reviewers recommended that the FCH JU should assess the needs of larger companies with established hydrogen businesses to identify industrial needs.

Reviewers noted that the portfolio comprises projects with a range of objectives and at widely differing TRL levels. The lower TRL projects appeared to be performing better than higher-level projects for which cost, durability and efficiency targets were proving difficult to achieve. Reviewers believed that demonstration projects were needed to show that the technologies are feasible and commercially relevant, but that demonstration should be balanced with continued frontier research for scientific and technical breakthroughs.

The IEG shares this view of achievements; it is possible that industry does not give a high priority to large-scale storage of hydrogen as there are alternatives for grid balancing that seem at present more attractive. This is reflected in the low participation in the JU of the appropriate stakeholders.

- *Dissemination*

The effectiveness of dissemination varies across application areas and is often impeded by commercial confidentiality (justified or not). The results of the bus demonstration projects seem to have been effectively disseminated perhaps in part because of the strong regional and municipal interests that may be less concerned with the commercial value of results than is industry and the good networking that

clearly exists among this group. Regions and municipalities only compete weakly with each other and face many common problems; they clearly perceive that they have more to gain from cooperation than from rivalry.

Much of the dissemination of project results is made through web-sites. This is unsatisfactory; it is a passive method, and difficult to evaluate in terms of impact, since there is no record of how visitors to such sites react. Moreover, websites are often not maintained after completion of the project and so all record of the outcomes is lost. The workshops held on specific aspects of demonstration were more successful, such as the international bus workshop in Hamburg held by CHIC. The 155 projects funded under FP7 have produced 114 research publications in peer reviewed journals and 14 patent applications[54]. This is considered to be low compared to the expenditure as a research programme dedicated to excellence should be able to do better. This may be related to the tension that exists in the JU between scientific excellence and the drive to market.

Both the 1st and 2nd Interim Evaluations of JUs recommended a stronger compilation, analysis and dissemination of project results through knowledge management by the JU. This has now been put in place.

IEG is of the opinion that generally, the level of dissemination is uneven. It might be useful for the JU to provide projects with a short manual on best practice in dissemination with examples from the more active FCH JU projects.

Fulfilment of the initial objectives

- *Has the FCH JU adequately placed Europe at the forefront of FCH technologies worldwide?*

The position of Europe compared to its competitors varies between the different application areas. A study undertaken for the JU on the commercial status of distributed generation from fuel cells in Europe concluded there was as yet little commercialisation[55]. In contrast industry has made more progress in other advanced countries, such as Japan, South Korea and the United States where stationary fuel cells are already commercialised. Larger production volumes and greater R&D input has enabled Japanese manufacturers of mCHP to achieve higher electrical efficiencies than in Europe; for example, the government of Japan has subsidised the roll-out of more than 140,000 residential fuel cell heating units. The study suggested that the structural weakness of the small European supplier base was critical for the fuel cell value chain as it heightened investment risk. An important stimulus to the higher degree of commercialisation in Japan, South Korea and the USA has been the support schemes in these markets, which have permitted a positive cycle of commercialisation, higher production, falling costs and more commercialisation. Support schemes in Asia target the residential fuel cell mCHP system, whereas in the US the emphasis has been mainly on the deployment of industrial systems. South Korea is a pioneer in the development and deployment of large stationary fuel cell technology; it has recently completed the world's biggest fuel cell park comprising twenty-one 2.8 MWe units, constructed and put into operation in only thirteen months[56].

Europe is currently the global leader in hydrogen fuel cell buses with the largest deployment of vehicles and a substantial base of innovation. US, Chinese, Japanese and South Korean companies are future potential competitors. A report from 2015 estimated that 84 fuel cell buses were in service or about to start operations in 17

[54] FCH JU Annual Activity Report 2014
[55] Advancing Europe's energy systems: Stationary fuel cells in distributed generation, Roland Berger Strategy Consultants, 2015
[56] Ibid page 171

cities and regions in 8 European countries[57]. Over the last ten years, fuel cell buses in Europe have completed about eight million kilometres in daily service in several European cities, demonstrating reliable, safe and operation. Reasons for the European success include: the traditional importance of public transport in European cities, compared for example to the USA; the relative autonomy of municipalities in many European countries and the importance given in Europe to global environmental issues and more especially to local air quality. EU Directives created a strong regulatory framework[58] that has initiated change in many cities and regions. The contribution of the FCH JU to this was significant through its large demonstration projects: CHIC, High V.L.O.City, Hy Transit deployed 45 buses in various European cities. 3EMOTION is a further project starting in 2015, but that follows on from the previous work. It aims to bridge the gap between current fuel cell bus demonstration projects and larger scale deployment and the procurement. It seems fair to conclude that Europe is the global leader in this field and although this is in part due to external factors, there is little doubt that the FCH JU has played a significant role in mobilising, industry, municipalities and research bodies to produce this result.

In the case of fuel cell vehicles other than buses technological competence is widely distributed with important equipment manufacturers in Germany, France, Japan, Korea and the USA and other suppliers of technology for infrastructure in several other countries. Because of this distribution of competence and in recognition of the technical problems of commercialisation there have been many joint ventures and agreements outside the FCH JU. It would be difficult to argue that Europe has global leadership in fuel cell vehicles; the review done at the 2014 Programme Review Day is consistent with the fact that most commercially available vehicle fuel cell options originate from outside the Union, but it might be argued the status of Europe is sufficient for it to negotiate international commercial partnerships and the work of the FCH JU may have contributed to that.

There is a better claim to have a strong position in hydrogen refuelling infrastructure. In 2009, seven large manufacturers signed a letter indicating an intention to commercialise fuel cell vehicles from 2015 and urging governments and fuel suppliers to develop hydrogen infrastructure, primarily in Europe and especially in Germany[59]. In 2014, six industrial partners, Air Liquide, Daimler, Linde, OMV, Shell and TOTAL founded the joint venture H_2 MOBILITY Deutschland with the mission to develop of the hydrogen infrastructure needed for fuel cell vehicles, in order to provide nationwide coverage. By the end of the first development phase, which is to run until 2018, Germany should have the world's densest hydrogen refuelling network with a total of some 100 stations. By 2023 the number is expected to reach 400. A smaller, but significant programme exists in the UK. Speaking at the Stakeholder Forum in 2016, the Managing Director of the company asserted that without the FCH JU the initial core of the network would not exist; furthermore, the demonstration of hydrogen refuelling stations (HRS) within the FCH JU portfolio had helped mitigate perceptions of financial risk and thirdly that the FCH JU had helped align the different initiatives of the EU to common goals, e.g. to ensure the compatibility of payment schemes across different countries[60]. The ability of the FCH JU to assemble partners from across Europe helped to facilitate European solutions, which it has reinforced through the production of guidelines for best practice.

[57] Commercialisation Strategy for Fuel Cell Electric Buses in Europe, Roland Berger, September 2015
[58] Directive 2008/50/EC of the European Parliment and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. O.J. L 152/1 11/06/2008 and Directive 2009/33/EC of the European Parliment and of the Council of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles. O.J. L 120/5 15.5.2009
[59] Fuel Cell Electric Vehicles: The Road Ahead, FuelCellToday, July 2013
[60] A roadmap for financing hydrogen refuelling networks – Creating prerequisites for H2-based mobility. A study for the Fuel Cells and Hydrogen Joint Undertaking (FCH JU), Roland Berger

Coping with large inputs of intermittent electricity into the power grid is (at present) a relevant European problem. FCH technologies can help balance the grid; storage and cost-efficient end-use of electricity together with the production of hydrogen from renewable sources. The related technologies of electrolysis, large-scale storage and power to gas therefore offer another area in which Europe can potentially lead. The FCH 2 JU has engaged robustly with these opportunities, but it has built on work performed under the FCH JU, and therefore can reasonably be identified as an area where the FCH JU has successfully created a strong global potential.

The IEG concludes that Europe can reasonably claim to be a global leader in hydrogen fuel cell buses and in the provision of refuelling infrastructure. It is adequately positioned in stationary applications and in fuel cell cars, but is not a leader. It has potentially the opportunity to lead in the development of hydrogen-based technologies to facilitate operation of large scale grids for natural gas and electricity.

In each case where Europe leads, it is possible to detect a substantial contribution from the FCH JU through its demonstration projects, its capacity to facilitate European collaboration and its brokerage of cooperative solutions.

In the view of the IEG the original formulation of the objective "to place Europe at the forefront of FCH technologies worldwide" was too ambitious and unrealistic, given the enormous combined competence of the global competition.

- *Market break-through*

Whether the JU has enabled the market breakthrough of FCH technologies depends in the first instance on whether it successfully facilitated the transfer of knowledge from research to market, and whether the projects in its portfolio delivered innovations in the form of marketable products, processes and services. The weak spot of fuel cell and hydrogen technologies is that there is as yet no application that has truly reached a mass market. This is in sharp contrast to competing battery applications, which have made substantial progress towards commercial acceptance. Power-tools with lithium batteries are now almost the norm; electric vehicles are commercially available from almost all large vehicle manufacturers, battery and lithium battery storage has been successful in recent competitive auctions for back-up capacity[61].

In this context, it is notable that the FCH community has made little application to the resources of the EIB, in particular to the Risk-Sharing Finance Facility (RSFF). The RSFF was designed to provide loan finance to R&I companies, with conditions adapted to riskier loans. Within FP7 the concept was well used; by the end of 2013, €16.2 billion of loans had been approved by the EIB with 114 R&I promoters[62]. Few of these loans were taken up by the class of beneficiaries for whom they were initially intended. The second evaluation of the RSFF[63] noted that, "beneficiaries initially earmarked for RSFF financing under the EU Window such as Joint Technology Initiatives (JTIs), Networks of Excellence; and Research for the benefit of SMEs have not signed any operation as a result of an inadequate match with RSFF to serve them which could have been identified with a stronger ex-ante analysis". There appear to have been structural problems with the RSFF that explain part of this disappointing performance, but it may also indicate a lack of suitable projects.

A more profound examination of what constitutes market break-through leads to a more nuanced conclusion. Market prices for energy are at variance with the economic

[61] Younicos Selected by Centrica to Design One of the World's Largest Battery Storage Systems, Dec 14, 2016, Battery Power, Dec 14 2016. http://www.batterypoweronline.com/main/news/younicos-selected-by-centrica-to-design-one-of-the-worlds-largest-battery-storage-systems/

[62] Commission Staff Working Document, Ex-Post Evaluation of the Seventh Framework Programme SWD(2016) 2 Brussels, 19.1.2016

[63] Second Evaluation of the Risk Sharing Finance Facility, Operations Evaluation for the EIB

costs. The biggest discrepancy is the cost of climate change, which is only partially compensated by fuel taxes and then only for transport fuels; the external costs of local air pollution are also significant. In economic terms, it may be that some applications are close to competitive, but this is a cerebral rather than market assessment and lacks objective confirmation from success in the market-place. A consequence of this is that the regulatory framework around a given technology can be the main determinant of its viability. The variety of support policies for renewable energy is a case in point; the relative success of mCHP in Japan is another example. In Europe, where local air quality in cities is of increasing concern, some municipalities have accordingly supported fuel cell buses. Similar support for fuel cell cars has yet to appear, although the infrastructure has been partially subsidised. Technologies for coping with the large inputs of intermittent electricity may also approach commercial viability, driven in this case by the support policies for renewables that underlie the surpluses being generated. There is a substantial difficulty with designing an appropriate regulatory system given the lack of a widely-agreed price for carbon and the disruptive effects that would accrue from incorporating compensating taxes into energy pricing. In this context market penetration in many cases will continue to be difficult.

The design of the FCH JU may be to focus effort more clearly on those applications that, because of local circumstances, Europe is likely to adopt and to promote coordinated programmes of research, deployment and policy development in those areas with the objectives: to reduce costs and improve performance; to undertake deployment where possible to increase production volumes, and to support lobbying where appropriate for favourable regulatory frameworks

- *Support to RTD in Member States*

The JU did not have strong instruments for influencing national priorities comparable to the ERA Networks of FP7. As already mentioned in section 5, the SRG did not prove to be an effective entity in facilitating coordination with MSs. Nevertheless, since the creation of the JU there has been a perceptible alignment of local activities, visible for example in the cooperation between municipalities and regions in the implementation of demonstration programmes for hydrogen fuelled buses and in the strategy for hydrogen refuelling stations being implemented through H2Mobility.

It is not entirely clear how this has come about; there are probably many drivers. Many of the large industries with an interest in hydrogen have international operations and are keenly aware of the need for common standards and practices. They have contacts with national governments and can influence research content to some extent towards a common strategy. This is not perhaps a direct intervention by the JU, but without its existence it would be more difficult for industry to define common positions. The elaboration of a common research strategy through the MAIP and AIPs provides a mechanism for consolidating opinion which feeds back into national activities. At the level of municipalities and regions the JU provides an opportunity to share problems and experience and to align activities on best practice. The benchmark studies also contribute to the definition of best practice according to European experience and conditions. Finally, the work on RCS makes an important contribution to harmonisation of European plans.

The ERA-NETs in FP7 were judged by the post-hoc evaluation of FP7 to have stimulated cooperation between MSs. There may be a case to strengthen the tools available to the JU at some future point, especially were it to shift the emphasis in its operations towards deployment. Joint Calls with Member States or some cooperative venture with an FCH ERA-NET might be considered.

The support to RTD in member States has been hinderd by the low level of activity of the SRG. As already mentioned in section5 The SRG did not prove to be a strong and effective entity in facilitating coordination with Member States.

- *Has the FCH JU supported the implementation of the RTD priorities of the JTI on Fuel Cells and Hydrogen, notably by awarding grants following competitive calls for proposals?*

The implementation of the MAIP through the AIPs follows a common procedure; the paper-trail is public and there seems to be no cause for concern. Projects were evaluated in compliance with FP7 rules and procedures using expert evaluators, chairpersons and observers and careful elimination of conflicts of interest.. When ex-post allocations to application areas did not conform to the specifications in the MAIP appropriate then adjustments were made in the AIP for the following year to ensure the cumulative balance was maintained. As of 31st December 2014, the FCH JU programme consisted of 155 grant agreements resulting from the seven annual calls organised over the years 2008 to 2013, all grants were negotiated and managed by the FCH JU Programme Office.

Despite the reservations noted above, the support offered from the JU has been responsibly imagined and well delivered. The vehicle of a PPP has been shown to be manageable and effective for such tasks; this is an important result.

- *Has the FCH JU encouraged increased public and private research investment in fuel cells and hydrogen technologies in the Member States and Associated Countries?*

This question is fully discussed in Section6.5pertaining to European value added, which concludes that there is evidence for a significant leverage.

- *Knowledge Management*

The first evaluation noted the absence of an adequate system for portfolio management and technology assessment. The Programme Office had requested proposals for such a tool in the 2009 call, but no satisfactory proposal was received. In a subsequent Call, a contract was signed under cross-cutting activities for a technology assessment and monitoring software tool known as TEMONAS (TEchnology MONitoring and Assessment). The tool was delivered to the FCH JU in 2013 and the database and application portals are hosted by the FCH JU. Training has been conducted, but little application was made under FCH JU.

Identifying and agreeing the reasonable limits of confidentiality has been a persistent dilemma. The low-risk strategy for participants is to declare their deliverables to be confidential. There are two distinct issues: how to deal with data from past projects that have been produced under terms of confidentiality and how to deal with new projects to avoid the same thing happening again. The Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking suggested that remedies could be applied during the Call, by requiring a minimum level of disclosure and also during evaluation and negotiations; it suggested also that the FCH JU might also investigate the use of "clean rooms[64]" for the management of confidential data; this technique was used in the production of the benchmark reports and appears to have been successful. It appears that participants have been more cooperative since.

The IEG is of the opinion that high level of confidentiality of results can hinder the definition of appropriate targets in the work programmes and is to some extent unnecessary. The use of the clean room was a positive initiative.

- *Benchmark studies*

The AIPs make provision for selected activities to be implemented by call for tenders. This instrument allows the FCH JU precisely to specify its requirements and is

[64] A clean room is a physical or virtual space wherein confidential data is processed to remove signs of origin; it serves to protect the IPR of participants whilst making consolidated information available to others

particularly suitable for general market intelligence, strategic and policy studies. Significant expenditures have been foreseen in successive AIPs: €2.8 million in 2008; €6.4 million in 2009; €4.5 million in 2012; €4.65 million in 2013. Expenditure on the benchmark studies under FP7 is summarised in the Table 13. In the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking, the IEG remarked that studies were often delayed and suggested this might be due to a reluctance of industry to contribute data.

The studies have been helpful to the JU in defining new topics against the international state-of-the-art and have provided useful technical material for all interested parties. It must be assumed that as the technology monitoring improves the usefulness of the studies for the first purpose will decrease.

Table 13 Benchmark studies (FCH JU under FP7).

Sector	Studies	Amount(€)	Year
FC cars (transport)	Policy justifications to support FC cars and policy instruments to support them	120,888	2011
	Support to UK H2 Mobility initiative (mainly financed by private companies)	27,150[65]	2012
FC Bus (transport)	Urban buses; alternative power-trains for Europe	1,028,000	2012
	Fuel Cell Bus Commercialisation	1,195,570	2013
	Joint procurement strategy for Fuel Cell Buses	300,000	2015
FC Transport	Report on rollout strategy for hydrogen transport in the UK	65,400	2012
Economics/policy	Trends in Investments, turnover and jobs in the FCH sector	160,000	2012
Finance (transport)	Financing mechanism for HRS infrastructure	390,200	2013
Energy	Study on development of electrolysis in the EU	113,848	2013
	Role of H2 in energy storage	1,071,000	2013
	Hydrogen from renewable resources in the EU	98,500	2014
Energy (stationary)	Role of Fuel Cells in distributed power and heat generation	1,093,540	2013
	Preparing terms of reference for study on the role of fuel cells and hydrogen in distributed power generation	104,600	2013
Made with private funds			
FC Cars (transport)	A portfolio of power-trains for Europe: a fact-based analysis: The Role of Battery Electric Vehicles, Plug-in-Hybrids and Fuel Cell Electric Vehicles	Not known	2009-2011
Energy (stationary)	A fact-based study of power/heat technologies for distributed power	Not known	2011-2012

Effectiveness of the implementation

The programme administration of the FCH JU was assessed as good in the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking report and it continued to improve towards the close of its operations. The definition of the work

[65] Refers to FCH contribution for the phase 1A of the study only (there were 4 phases)

programme contained in the MAIP is fully discussed in the later Section 6 which concludes that the process should have been more transparent, but that design of the AIPs is relatively open and transparent and has shown some capacity to adapt the contents to unpredicted events. Administration of the Calls is done well; preparations for evaluation are comprehensive and appropriate. The evaluations conform to the best practice of Horizon 2020, using independent evaluators screened for conflict of interests, under the supervision of expert chairpersons and the scrutiny of independent observers.

The times taken to inform applicants of results and the times taken to signature of the grant (TTG) are discussed in detail in Section 7.2 which concludes that the TTG has throughout been considerably longer than foreseen under FP7 rules, mainly because of long periods of grant negotiation and the calculation and implementation of the correction factor. The spread of value for the TTG within each Call increased towards the end of the period probably as projects became larger and more complicated as they moved towards demonstration.

The engagement of coordinators through the implementation of proposals has generally been well-received by the target audience and generally rated better than in the Framework Programme.

Stakeholder engagement

The FCH JU succeeded in attracting some of the biggest industrial players in the field, including among its participants many of the top-ranking car manufacturers: Volkswagen, Daimler, Honda, BMW, Nissan and Renault as well as top energy and utility companies (Bosch, Siemens and GE), showing that both for transport and energy applications high innovators are very well represented in FCH JU.

The average of the grant awards by the FCH JU to SME's was 28% of total EU funds, much more than requested by FP7 (15%). There are several plausible reasons underlying this high rate of participation: participants value the prospect of obtaining access to the supply chain of a growing sector; the field is highly innovative and in full development, and thus also allows new entrants with limited means to bring new concepts forward; membership of Hydrogen Europe is not onerous and allows them to contribute to the definition of Work Programmes and gives them representation at the Governing Board.

6.2 Efficiency

Efficiency describes the relationship between the resources used and changes generated. The "Better Regulation Package" defines efficiency as "The benefits versus the costs. (Alternatively, to which extent objectives can be achieved for a given cost, defined as cost effectiveness.)". The operational efficiency is evaluated in accordance with the ToR based on an analysis of Key Performance Indicators describing the:

- timely execution of the functions,
- the cost efficiency of the management and control arrangements,
- the budget execution of commitment and payment appropriations as well as
- suggestions for simplification and reduction of the administrative burden for participants.

At the 31st December 2014, the FCH Joint Undertaking FP7 programme consisted of 155 grant agreements resulting from seven annual calls organised over the years 2008 to 2013. However, the CORDA data base now shows only 151 projects, there is no information available when and how the four other projects have been terminated. Figure 18 gives an overview of the status of the projects according to the CORDA database.

The total number of projects which are open in a respective budget year and the number of effectively running projects is depicted in Figure 19 (a project open from January to June is counted with the value of 0.5 to the effectively running projects).

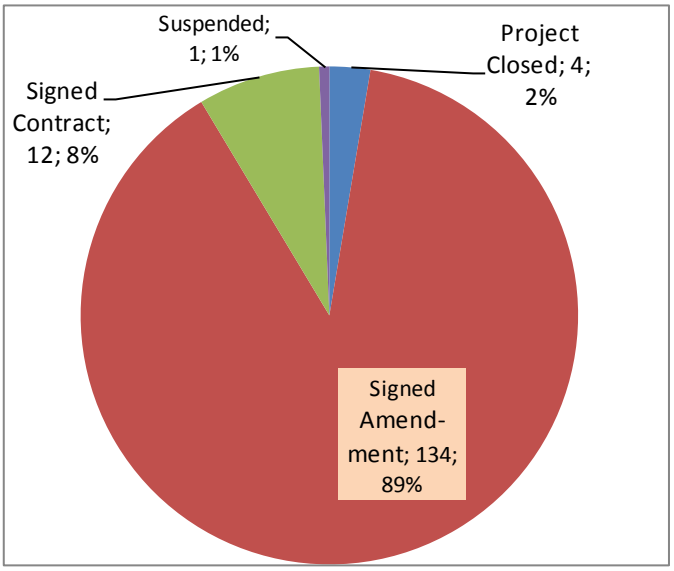

Figure 18. Status of FP7 FCH JU projects (31/12/2016).

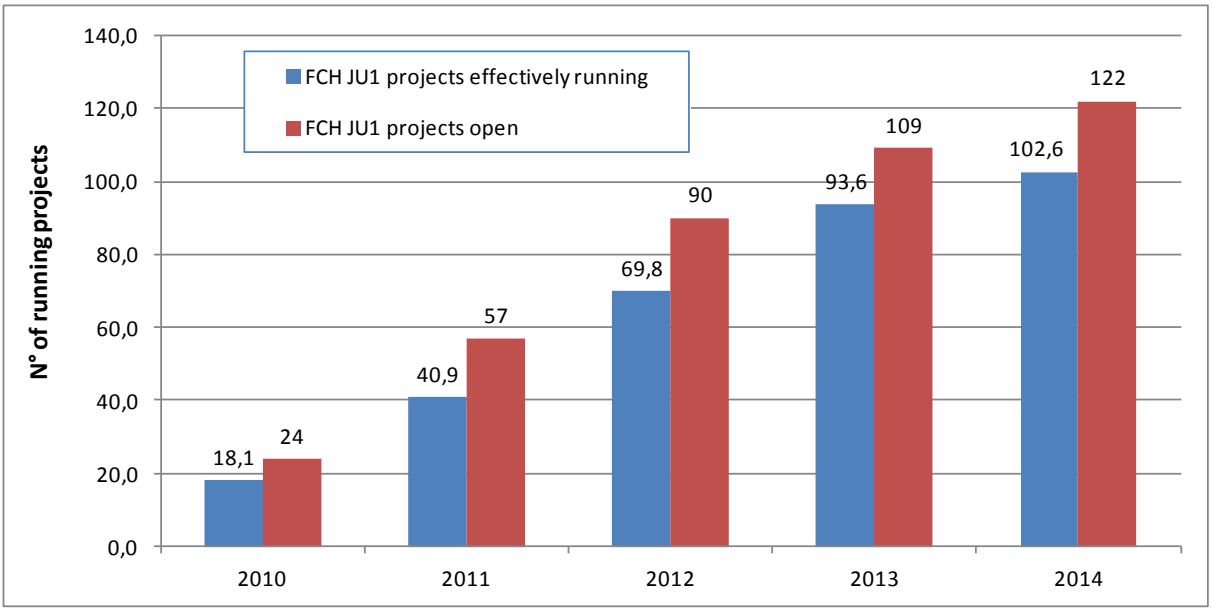

Figure 19. Number of projects open or effectively running based[66].

Timely execution of the functions

This section concerns the timely execution of the project evaluation and payment processes. In particular, it considers the operational efficiency of the FCH JU based on an analysis and interpretation of the indicators related to "Time to Grant", "Time to Pay" and "Average Evaluation Cost per Proposal".

[66] Own depiction of the IEG group based on CORDA database

- *Time-to-grant under FP7*

FP7 set a target for an average time of 225 days or 7.4 months between the deadline for submission of proposals and the signature of grants for successful proposals. FP7 regulations foresaw that the evaluation of the proposals should start immediately after the Call's closure. The Initial Information Letter with the Summary Reports of the evaluation should have been sent to proposal coordinators not later than one and a half month after the Call's closure date.

The average TTG for the FP7 programme was 370 days (or 12.2 months), thus the evaluation process was prolonged by 65% compared to the indicated timeline. Only the last call FCH JU 2013-2, which resulted in only two signed grants, showed a TTG of 280 days (or 9.2 months).[67] In the course of FP7, the TTG of various projects of any one call saw an increasing spread. During the Call 2008, average TTG of 11.1 months, the spread between the first and the last signed grant was only seven days. This spread continuously increased to 9.4 months in Call 2013-1 (average TTG of 12.2 months).

Under FP7, evaluators were encouraged to make recommendations how to improve a proposal. Based on these recommendations, project participants and the European Commission engaged in "negotiations" that aimed at improving or adapting the project proposal. These negotiations contributed largely to the delay in the TTG, where it is clear that the period of negotiations was in all cases the largest part of the TTG. The negotiation procedure was abandoned after FP7, thus significantly shortening the TTG. Also the approval of the Governing Board took time, especially as documents had to be sent 20 days before the Board meeting to allow participants to prepare for the meeting.

The TTG has throughout been considerably longer than foreseen under FP7 rules, predominately arising from the complexity of the FCH JU funding structure. In particular the grant negotiation phase (including the correction factor) contributed to the delay. However, during the course of the programme, the TTG decreased. The spread of value for the TTG within each Call increased towards the end of the period probably as projects became larger and more complicated as they moved towards demonstration. In Call 2012 and 2013, only a few projects still showed a long TTG but had a strong negative influence on the TTG mean.

[67] Report on the annual accounts of the Fuel Cells and Hydrogen Joint Undertaking for the financial year 2014, European Court of Auditors, June 2015

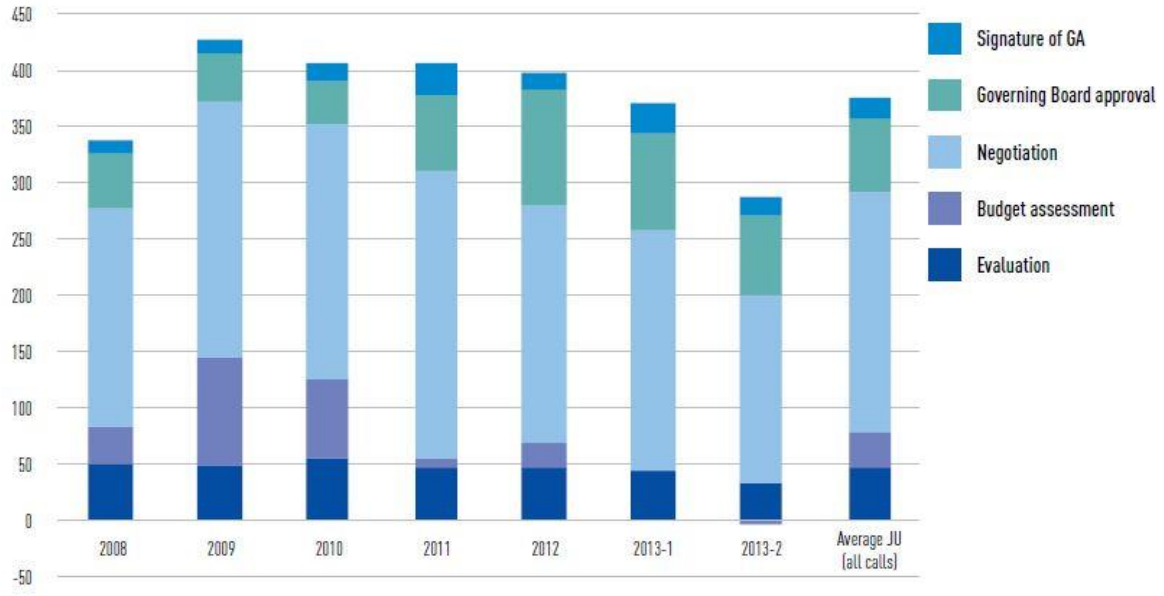

Figure 20. Time to Grant by call in days [68].

- *Time to pay under FP7*

The contract management starts with the signature of the grant agreement and ends with the final payment to the beneficiary. The main financial transactions are the payment of pre-financing, interim or final cost claims as well as clearing of pre-financing or other expenditures linked with the project lifecycle, e.g. payment of experts. 'Time to Pay' is an important indicator concerning payments.

After signature of the Grant Agreement with beneficiaries, pre-financing payments are made to make funds available and allow the project to start. The data show that 100 % of grant pre-payments were made within the binding deadline of 30 days. The average Time to Pay Pre-financing (TTP) was 14 days under FP7 (and only 5 days for the last call).[69]

[68] Fuel Cells and Hydrogen Joint Undertaking Annual Activity Report 2014

[69] Report on the annual accounts of the Fuel Cells and Hydrogen Joint Undertaking for the financial year 2014, European Court of Auditors, June 2015

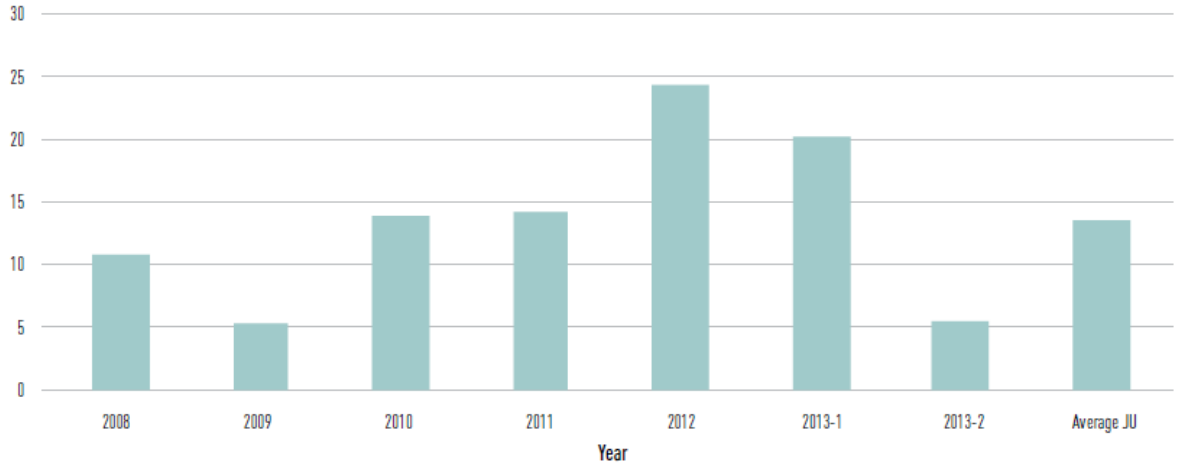

Figure 21. Time to Prepayment by call in days[70].

During project implementation, grants are paid on the basis of the beneficiary's declaration of eligible costs (i.e. cost claims). All interim or final payments under cost claims were made on time (within 90 days), with an average time to pay of 65 days. As shown in Figure 22, the number of validated cost claims from beneficiaries of projects naturally increased with the progress of the programme.

A total of 60% of the payments to expert reviewers and 100% to expert evaluators were made on time, with an average time to pay of 25 days (within a limit of 30 days). The delay in the payment of reviewers was due to different exceptional circumstances, e.g. linked to absences in the Programme Office and to missing documentation from the experts.

The main payments were made punctually or even a good time ahead of the scheduled time, and performance on payment of expert reviewers improved during the course of the programme.

[70] Fuel Cells and Hydrogen Joint Undertaking Annual Activity Report 2014

	CALL 2008	CALL 2009	CALL 2010	CALL 2011	CALL 2012	CALL 2013-1	CALL 2013-2
COST CLAIMS VALIDATED	6 cost claims validated in 2011 (43 beneficiaries) 12 cost claims validated in 2012 (97 beneficiaries) 5 cost claims validated in 2013 (30 beneficiaries) 13 cost claims validated in 2014 (95 beneficiaries)	4 cost claims validated in 2011 (33 beneficiaries) 15 cost claims validated in 2012 (94 beneficiaries) 21 cost claims validated in 2013 (189 beneficiaries) 15 costs claims validated in 2014 (129 beneficiaries)	2 cost claims validated in 2012 (18 beneficiaries) 11 cost claims validated in 2013 (93 beneficiaries) 14 cost claims validated in 2014 (137 beneficiaries)	1 cost claim validated in 2013 (12 beneficiaries) 16 cost claims validated in 2014 (162 beneficiaries)	2 cost claims validated in 2014 (22 beneficiaries)	1 cost claim validated in 2014 (6 beneficiaries)	First cost claims are expected in 2015

Figure 22. Payments by call until 2014[71].

- *Evaluation costs under FP7*

The average evaluation cost per proposal is defined as the number of proposals divided by the costs for the experts. The evaluation of each proposal is carried out by a minimum of three independent experts. In addition, an appropriate number of observers and at least one chair are needed. The evaluation costs per proposal vary between €2,555 and €3,064. This is a reasonable value. The evaluation of the Call 2013-2 took place in 2014, thus already under Horizon 2020.

The IEG judges the average evaluation cost per proposal of €2,600-3,100 to be acceptable.

Cost-efficiency of the program management and control arrangements[72]

This section evaluates the cost-efficiency of the management and control arrangements. Management efficiency for this purpose is defined as the ratio between inputs (staff) and outputs (the budget managed by the JU). Key figures are summarised in Annex 8. It assesses the relationship between the resources used and changes generated based on an analysis and interpretation of the indicators related to:

- Ratio between the administrative and operational budget
- Budget 'per head'
- Average project management cost per running project.

The Executive Director as Authorising Officer is responsible for the proper management of the FCH JU's budget and must report and give assurance on the use of the budget in accordance with sound financial management principles. Mr Philippe Vannson was appointed as Interim Executive Director by the Commission on the 18th November 2008 to fulfil the functions of the Executive Director. During the interim period the responsibility for the implementation of the FCH JU was with the DG RTD.

[71] Fuel Cells and Hydrogen Joint Undertaking Annual Activity Report 2014

[72] Grant management being the core business of the JU and representing more than 90% of its operational budget (AAR 2013, p. 51)

The interim Executive Director was supported by staff from the EC and from the FCHInStruct project (Interim Programme Office).[73] The permanent Executive Director, Mr Bert De Colvenaer, was appointed by the Governing Board on the 15th June 2010 and took up duty on the 1st September 2010.

All bodies (Governing Board; the Executive Director; the Scientific Committee) of the FCH JU[74] were established and fully active from January 2009 onwards. In 2009, budgetary planning for administrative costs was prepared until 2017, the end date for running projects of the FCH JU. In addition, the General Financing Agreement for the FCH JU was prepared and approved by the EC in September 2009. The administrative framework of the FCH JU was completed in 2010 with the adoption of the management and internal control systems and the implementation of the accounting system that became operational in November 2010.

The Programme Office, under the responsibility of the Executive Director, oversees the daily management of the FCH JU and executes all its responsibilities. Staffing of the Programme Office was a multi-annual process. The recruitment of eleven staff members (nine Temporary Agents and two Contractual Agents) was foreseen in the Staff Establishment Plan for 2008. However, the publication of posts was postponed to 2009 due to the need for further negotiations to optimise job descriptions. The 2009 staff appointment scheme included fourteen posts, in total 20 staff members were allocated for the fully operating PO of the FCH JU. The first two members of FCH JU staff, the Legal Officer and the Human Resources Officer, assumed their positions on the 1st December 2009. Thirteen Temporary Agents took up duty in 2010 (i.e. the Executive Director, the Internal Audit Manager, two Financial Assistants, four Project Managers, the Accountant, two secretaries of whom one resigned from her duties in November 2010, the personal assistant to the Executive Director and the Communication and Policy Officer). The Programme Office was fully staffed with eighteen temporary and two contract agents from June 2011.

By the end of 2013 the Programme Office was staffed with sixteen Temporary and two Contract Agents. The recruitment procedure for two posts to reach full establishment plan was ongoing. In 2013, the FCH JU also recruited five trainees, each of them for a period of six months, to support various activities both in the Programme Unit and the Finance and Administration Unit.

Under FP7, 16 to 27 projects were implemented annually. The average annual project funding varied between €1.7M and €3.5M, only a few projects with a funding larger than €10M were implemented (CHIC €25.9M; ENE.FIELD €25.9M; HYFIVE €18.0M; 3EMOTION €15.0M; HIGH V.LO-CITY €13.5M; HYTEC €12.0M). The observed minimum project funding was €0.26M. Projects had an average of 8.5 partners. 80% of the projects had ten or less partners. The largest project counted 28 partners (ENE.FIELD). The frequency distribution of project partners per project is depicted in Figure 23. Under FP7 a project beneficiary is either the project co-ordinator or a project participant.

[73] In accordance with Art. 16 of the Council Regulation (EC) No 521/2008 of 30 May 2008.
[74] Council Regulation (EC) No 521/2008 of 30 May 2008 setting up the Fuel Cells and Hydrogen Joint Undertaking; O.J. L 153, 12.6.2008, p.1

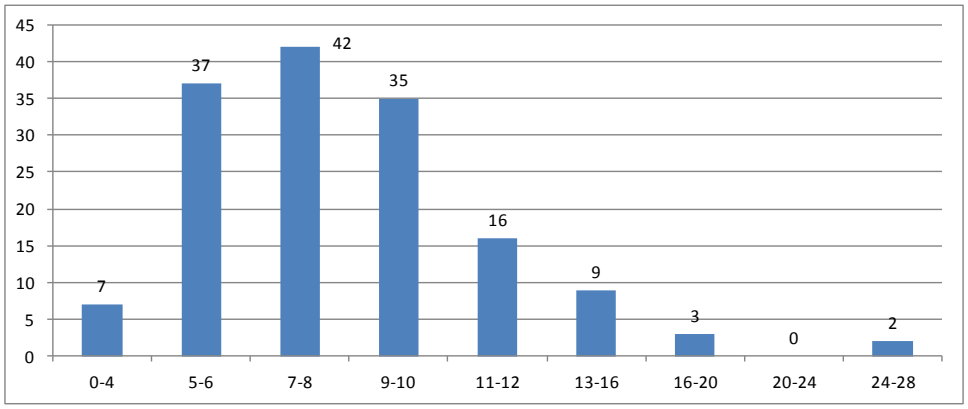

Figure 23. Frequency distribution of number of project partners under FP7 (31/12/2016)[75].

Operating expenses relate to those projects that were carried out in the respective budget year. A certain share of the operating costs had to be estimated, because the related on-going or finalised projects did not provide validated cost claims (or equivalent) by the end of the budget year. The estimation used the best information available at the time of the preparation of the annual accounts, based on the case-by-case assessment (e.g. reports of JU members on in-kind contributions or costs incurred to date as a proportion of the estimated total costs of the projects ("pro-rata temporis") which ensures that only costs that reflect services or work performed by 31 December are included in the operating costs of the respective year. The value of the operational expenses is highly dependent on the number of projects running. They steadily increased from €23M in 2010 to €148M in 2013.

Administrative costs are staff costs and other expenses. Staff costs include the salaries and other staff member employment-related allowances. Other expenses are: adjustments/provisions; property, plant and equipment related expenses; external non-IT services; communications and publications; expenses of experts; external IT services and others. Since the autonomy of the FCH JU the annual administrative costs increased with the level of office establishment from €3.2M to €4.0M.

The ratio between the administrative and the operational budget declined steadily during the course of the programme from 5.1% in 2011 to 2.7% in 2013 due to the increased number of running projects and the respective increase in the operational expenses. The IEG evaluates this, also in relation to the results of the 2016 benchmarking between the various Joint Undertakings, as a good result. The continuous increase in this ratio is a strong evidence for the increasing administrative performance of the FCH JU during the course of the FP7 programme.

This conclusion is supported by the development of the annual project management cost per running project which also declined during the course of the programme (due to the increase of the number of running projects) from €53,000 in 2011 to €23,000 in 2013, i.e. increasing work load to the PO.

The final FCH JU Programme Office's staff establishment plan and organisational structure shows eighteen temporary agents and two contract agents, see Figure 24. For the calculation of the budget per head the real number of staff by the end of the respective budget year has been used. . The budget per head is defined as the

[75] Own depiction of the IEG group based on CORDA database

average operational costs managed per staff member. It increased with the number of active projects. It amounted from €1.534M/head in 2010 to €7.409M/head in 2013. This is a good value. However, taking into account only the operational staff directly involved in project administration would make this KPI even higher.

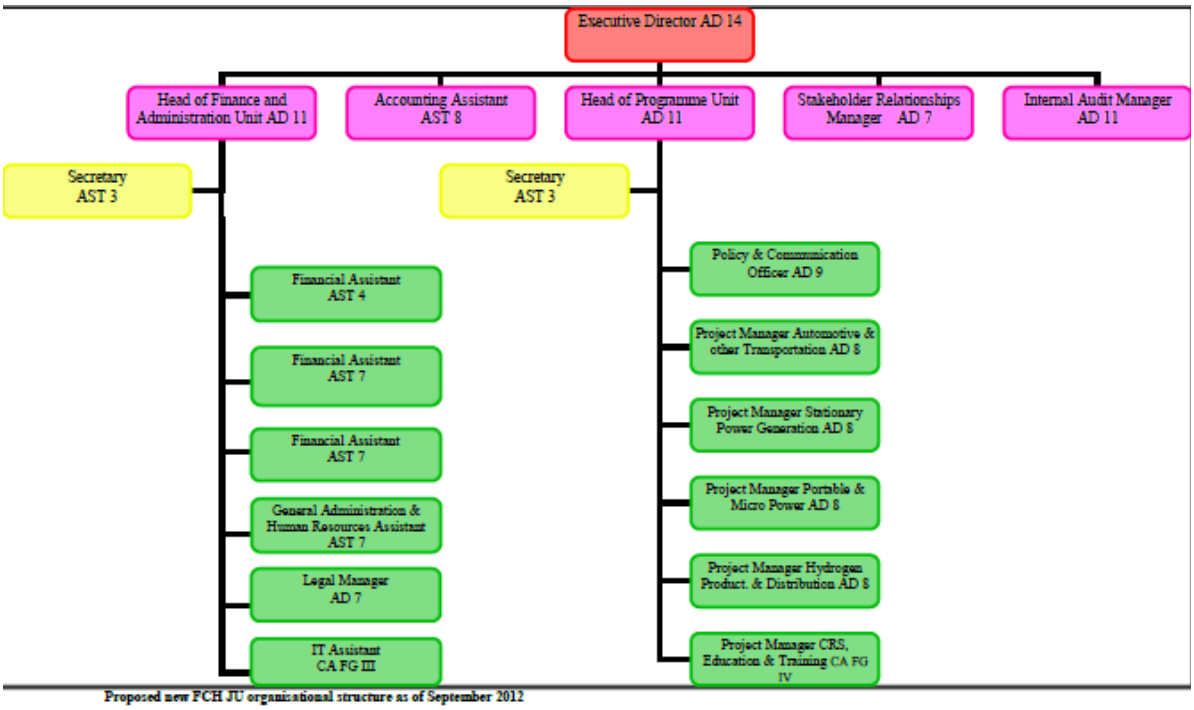

Figure 24. Programme Office Structure (as of September 2012) [76].

The work load of the Programme Office is also highly dependent on the average project duration, average project funding and number of participants per project, Most of the projects (67%) show a "classical" project duration between three and four years, however two projects run seven years (HIGH V.LO-CITY) or more (CLEARGEN DEMO, 8 years), see below.

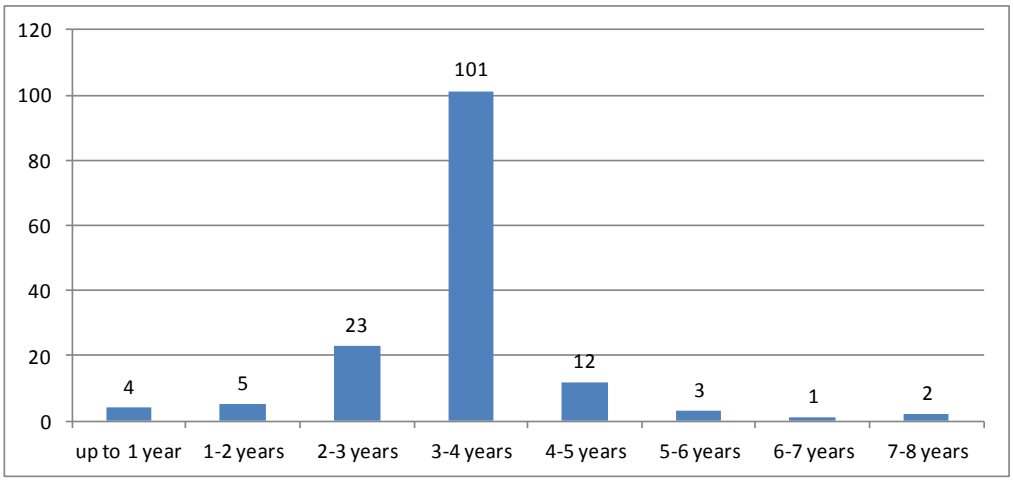

Figure 25. Frequency distribution of the project duration under FP7[77].

[76] Information provided by the EC to the IEG
[77] Own depiction of the IEG group based on CORDA data base

The cost efficiency of the programme management and internal controls improved steadily throughout the period as the number of projects increased. The final value of €23,000 project management cost per project in 2013 and the final budget per head of €7.4M is judged to be acceptable.

Budget execution

The FCH JU budget of the JU is approved by the GB Board on an annual basis. The budget concerns the revenue and expenditure sides. On the expenditure side, the budget is divided into three titles:

- Title 1 covers staff expenditure, such as salaries, training, costs associated with the recruitment procedure, missions, medical expenses and representational costs;
- Title 2 covers the cost associated with the functioning of the FCH JU, such as renting premises, IT needs, expenses related to external communication, expert fees, and the cost of ex-post audits;
- Title 3 covers the FCH JU's operational activities for the FP7 programme.

For Title 1 and 2 appropriations are non-differentiated: commitment and payment appropriations are of equal amount, meaning that the budget cannot be transferred to following years. For Title 3 appropriations are differentiated: commitments are paid over several years in accordance with contractual obligations. Non-differentiated appropriations corresponding to obligations duly contracted at the close of the financial year are carried over automatically to the following year. The Commitment Appropriations include:

- Operational and administrative revenues from the EU,
- Revenues from the Industry and the Research Grouping,
- Reactivations of unused appropriations from previous years.

For FP7, the operational costs execution rate reached 79.6% by the end of 2016. This is due to the fact that a number of large projects initiated under FP7 are still running. It is currently (31/12/2016) anticipated that the final operational costs execution rate will reach 96.3% which should be a very good performance. The remaining budget results for example from unspent budget of completed projects. At the end of the FP7 programme, there was no possibility to distribute this funding to other projects. However, switching of budget between beneficiaries of individual projects is possible under certain circumstances.

The commitments shown after 2017 refer to individual commitments representing the remaining obligations under the open Grant Agreements. Final payments were already executed for 81 projects while 73 projects remained open. In addition, 12 operational studies were conducted.

The administrative budget will be fully spent by the end of 2017. This is due to the opportunity to shift remaining administrative budget to the next budget year.

FP7 (IN EUR)				
Type	Execution until 31/12/2016	2017	Subsequent years	Total
Commitments (operational costs)	453 185 163	-	-	453 185 163
Payments (operational costs)	360 950 056	32 178 026	43 106 543	436 234 625
Cumulative execution (operational costs)	**79.6 %**	**86.7 %**	**96.3 %**	**96.3 %**
Commitments (administrative costs)	26 882 353	4 089 129	-	30 971 482
Payments (administrative costs)	26 313 594	4 657 888	-	30 971 482
Cumulative execution (administrative costs)	**97.9 %**	**100.0 %**	**100.0 %**	**100.0 %**
Overall FP7 execution	**80.7 %**	**86.7 %**	**96.3 %**	**96.5 %**

Figure 26. Overview of FP7 programme implementation[78].

The PO achieved a very good financial budget management resulting in a very high level of budget use.

The administrative burden for participants

The beneficiaries of the FCH JU were asked about the satisfaction with the programme administration. The user-unfriendly IT-tool and the cumbersome processes have been identified as the main sources of dissatisfaction, see Annex 9.5.

However, the closer integration of the FCH 2 JU into the IT-infrastructure and the project management processes of the EC should improve the user-friendliness and satisfaction. This assumption has been confirmed in the 2017 satisfaction survey for the management processes, but not for the user-friendliness of the IT-tool.

The full establishment and staffing of the FCH JU in combination with defined and monitored procedures and the internal control system have already contributed to the accessibility of the Programme Office and the quality of information provision. The FCH JU website is fully workable and is providing manifold information. Dedicated workshops and conferences are established information tools.

The main sources of dissatisfaction among consumers were the cumbersome processes and poor IT tools. However, complaints on administrative burden and IT-tools are not limited to the FCH JU but a common FP7 issue. In particular the project preparation and management processes have improved significantly since the adoption of centralised tools and services under H2020.

[78] Annual Activity Report 2016, FCH JU

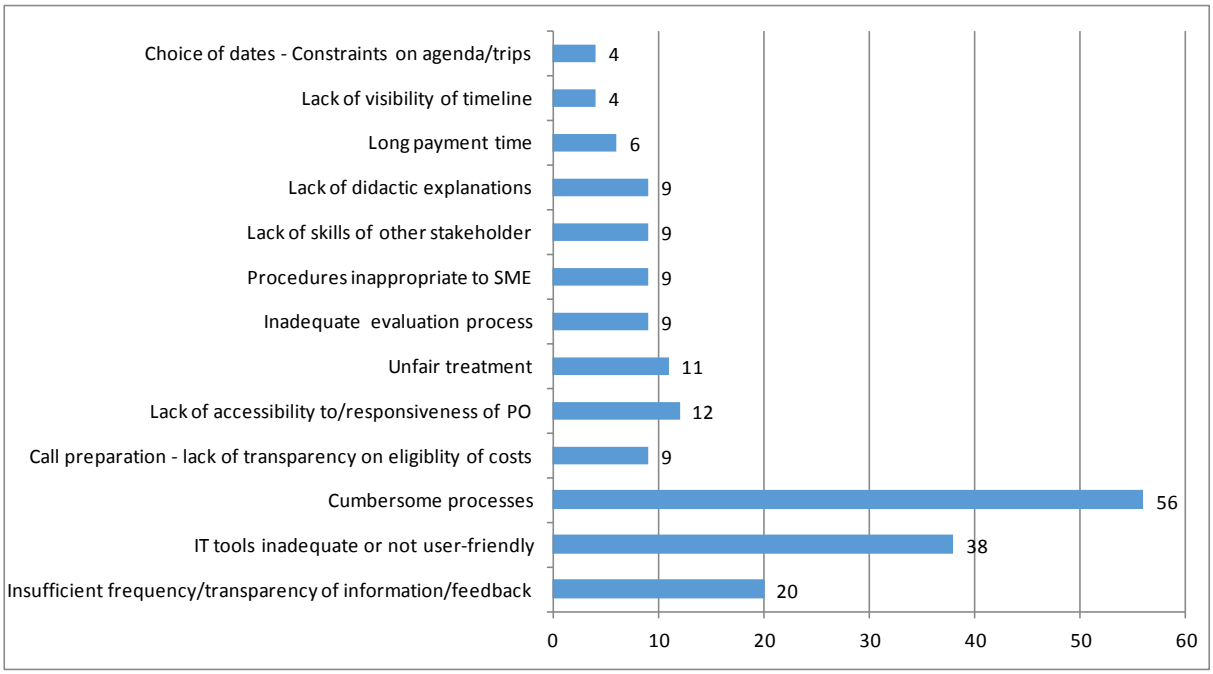

Figure 27. Number of indicating of suggested sources of dissatisfaction[79].

The efficiency of the FCH JU was generally good. Operations were a little slow in the initial period as was only to be expected from a novel institution faced with the complexities of integrating public, industrial and research interests into a single programme with rather rigid constraints imposed by its quality as a Community body. The operational efficiency picked up as the institution matured, although some indicators stabilised and even deteriorated as the projects became larger and more complex.

In summary the JU faced significant challenges in implementing the novel concept of a public-private partnership for research with a whole range of new relationships between actors to manage within the constraints of the rules of the Framework programme. It has met this challenge successfully and is to be commended for its performance.

6.3 Relevance

The decision to create a Joint Technology Initiative to promote fuel cell and hydrogen technologies as a cooperative venture between the Commission services and industry has been amply justified. The case for hydrogen as part of the technical response to the challenge of global warming has been enhanced by developments following the establishment of the FCH JU. The ambitious targets set by the Council of Ministers for reducing Green House Gas emissions in the European Union and the international accord agreed in Paris to limit global emissions have considerably strengthened the case for the promotion of FCH technologies.

In the view of IEG the activities of the FCH JU constituted quite effective methods of achieving the objectives established in the regulations, taking in to account available

[79] Own depiction of the IEG group based on data from the 2016 Satisfaction Survey

resources. Some room for improvements existed but the overall operation of FCH JU under Seventh Framework Programme fulfilled the objectives.

The operation of FCH JU proved and demonstrated the need and benefits of the Public-Private Partnership concept for research in FCH technology area. The formed governance structure, created and ensured effective dialogue between industry and research around which resulted in a common strategic agenda related to FCH technology development and deployment which was successfully implemented through the FCH JU activities.

The activities of the FCH JU continue to be relevant to the grand challenges facing Europe and which guided the design of FP7; they support the climate change challenge, help improve energy security and contribute to the status of Europe as an international leader in technology. The technical scope of the FCH JU was completely coherent with the ambitions of EU policy in the transport and energy sector, although it is less clear that the relationship between the policy framework and the research results was as fruitful as anticipated (see comments on coherence below).

The general and specific objectives of the JU as established in the founding regulation have proved well-chosen.

6.4 Coherence

Coherence with related thematic programmes

In the Regulation of FCH JU[80], the overall objective of the action is specified as to contribute to the implementation of FP7, in particular to the programme Cooperation and in the themes for Energy, Transport including aeronautics, Environment including climate change and Nanosciences, Nanotechnologies, Materials and New Production Technologies (NMP).

In the FP7 Energy theme[81], research funding included, for example renewable energies for electricity, fuel production and heating and cooling and smart energy networks. The Transport theme[82] allocated research funding to develop a safer, "greener and smarter" European transport system that would benefit all citizens. One activity related to the objectives in FCH JU is sustainable surface transport with the development of clean and efficient engines and power trains, thereby reducing the impact of transport on climate change. In the Environment theme[83] a sustainable management of the environment and its resources was promoted through advancing the knowledge of the interactions between the climate, biosphere, ecosystems and human activities. New technologies, tools and services would be developed to address global environmental issues in an integrated way. A promotion of innovative environmental technologies would, among other things, contribute to achieving sustainable use of resources. In the NMP theme[84] a key element was to effectively integrate nano-technology and materials sciences to achieve and maximise the impacts for industrial transformation and to support sustainable production and consumption. Materials with new properties were seen as especially important for the future competitiveness of European industry and the basis for technological progress in many areas. The theme supported industrial activities operating in synergy with other themes.

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[80] Council Regulation (EC) No 521/2008 of 30 May 2008 setting up the Fuel Cells and Hydrogen Joint Undertaking. Official Journal of the European Union, 153/1, 12.6.2008.
[81] https://ec.europa.eu/research/fp7/index_en.cfm?pg=energy Accessed 15/05/2017
[82] https://ec.europa.eu/research/fp7/index_en.cfm?pg=transport. Accessed 15/05/2017
[83] https://ec.europa.eu/research/fp7/index_en.cfm?pg=env. Accessed 15/05/2017
[84] https://ec.europa.eu/research/fp7/index_en.cfm?pg=nano. Accessed 15/05/2017

Under FP7, projects in FCH JU were divided into five application areas[85]; Transport and refuelling infrastructure; Stationary power generation; Hydrogen production and distribution; Early markets and Cross-cutting actions. The initiatives were aligned with the FP7 themes and it has been found that the FCH JU has contributed to the goals set in FP7, primarily by demonstrating the technical feasibility of its technologies. As was concluded by the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking[86] the contribution mainly covered projects within the transport theme, but there was also development in the energy theme.

The objectives of FCH JU and the expected outcome of its projects will all, if realised, have a positive effect on the environment. Consequently the coherence with the FP7 Environment theme is implicit in all it has done. The relation to the NMP theme was not as strong as it to those for transport and energy. The basic research needed to make progress in finding new material was not covered in FCH JU since the main focus was on market implementation. NMP assumed, on the other hand, that the basic research would be performed in the FCH JU and thereby would not be covered in NMP. In the MAIP and the AIPs it is stated that "The programme structure reflects the RTD cycle from long-term and breakthrough-oriented basic research to demonstration and support activities." In the AIP of 2011, basic research was also mentioned as important for developing storage and converting renewable energy into hydrogen. In later AIPs basic research was either not mentioned or the opposite was requested, stating that basic research was not covered in the call. This discrepancy between NMP and FCH JU can be considered as a failure in coherence between the interventions and damaging to basic research within the area.

In the FP7-themes mentioned above, research including fuel cells and hydrogen could have been relevant topics. However, there is evidence that some project proposals that included fuel cell or hydrogen related topics were rejected by evaluators in the FP7 themes since there was a notion that this research should be in FCH JU only. The benefit of the latter case could have been that the research in fuel cells and hydrogen was concentrated within one organisation, leading to better control, information and coordination of the activities in the field. The potential disadvantage was that the research would be "isolated" and lacking a wider system perspective to identify how this technology could contribute most effectively. To manage this, an exchange of information and collaboration between different initiatives is vital for a successful development and implementation of new innovations and technologies that can complement and reinforce the outcome of the projects. Unfortunately this was not the case under FP7 and in future greater clarity of respective roles is essential.

Nevertheless, considerable research within FP7 had some bearing on FCH technology. According to data compiled by the Commission services there were 212 relevant projects under FP7 of which, unsurprisingly, a large majority (152) was managed by the FCH JU; 20 came under the Energy Programme; 16 under Nanosciences, Nanotechnologies, Materials and New Production Technologies (NMP); 10 under Research for the Benefit of SMEs; 4 under Environment; 4 under Regional Potential; 3 in Transport. Infrastructure, KBBE and Regions of Knowledge had one each. Judging by the brief project titles there seems therefore to have been good complementarity with FP7 programmes, but there is no evidence of joint approaches to solve agreed problems.

The IEG concludes that FCH JU has contributed to the goals set in FP7, primarily by demonstrating the feasibility of its technologies. This is especially valid for the FP7 Energy and Transport theme, which was a logical progress since the main input from

[85] http://www.fch.europa.eu/page/fp7-projects-application-area,. Accessed 15/05/2017
[86] Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking

the EC to FCH JU came from DG RTD, DG ENER and DG MOVE, all of whom were represented in the FCH JU Governing Board.

JU has also made efforts to foster coherence, but sometimes the barriers have proved too strong, and the separation of spheres of responsibility were never clearly defined between the research programmes of the JU and those of other themes of FP7. Work has been done within FP7 that supports the activities of the JU, but other projects of a similar nature have been refused funding because it was argued that all funding for research should go through the JU. This argument became less tenable as the activities of the JU moved increasingly towards demonstration.

Coherence with other EU funding instruments

Other funding instruments, besides the thematic framework, and with most relevance to FCH JU were the Competitiveness and Innovation Framework Programme (CIP) and the Structural funds.

CIP[87] had a total budget of €3.6 billion for the period 2007-2013. It was divided into three operational programmes:

- The Entrepreneurship and Innovation Programme (EIP);
- The Intelligent Energy Europe Programme (IEE);
- The Information Communication Technologies Policy Support Programme (ICT-PSP).

Each of the three programmes had its specific objectives, with the overall aim at contributing to the competitiveness of enterprises and their innovative capacity. Of the three CIP programmes the EIP and IEE were of possible relevance for FCH JU.

EIP[88] focused on access to finance for SMEs and support investments in technological development, innovation, technology transfer and the cross border expansion of business activities. The programme also included services to enterprises to help make them more competitive, and support for improving innovation policy by transnational networking and exchange of best practice. Furthermore, pilot testing of innovative products, processes and services in real conditions. These should be innovations that were not fully marketed due to residual risks, and were aimed at reducing environmental impacts, preventing pollution or achieving a more efficient use of natural resources.

The IEE[89] was intended to help deliver the energy and climate change targets of the EU. The IEE supported concrete projects, initiatives and best practices. Some areas that were supported were: assisting Europe's cities to develop more energy-efficient and cleaner transport; and improving the effectiveness of support schemes for producing electricity from renewable energy sources. A search in the IEE database of projects with funds during the period 2007-2013 and using the key words "fuel cells" and "hydrogen" reveals that 2 projects were funded. ALTER-MOTIVE studied least-cost policy strategies for alternative automotive concepts and alternative fuels, and RES-FC MARKET studied regional markets for renewable energy and fuel cell systems for households. The topics and short summaries of these studies reveal they were complementary to and overlapping with FCH JU.

With a Cohesion Policy, the Structural Funds aimed to reinforce economic and social cohesion in the EU by equalising the main regional imbalances. The management and

[87] http://ec.europa.eu/cip/. Accessed 15/05/2017
[88] http://ec.europa.eu/cip/eip/index_en.htm. Accessed 15/05/2017
[89] http://ec.europa.eu/energy/intelligent/. Accessed 2017-05-15

programming was decentralised, where the implementation and allocation of funds to projects was handled by managing authorities in Member States. The Structural Funds were divided into the European Regional Development Fund (ERDF)[90], the Cohesion Fund[91] and the European Social Fund (ESF)[92]. It was primarily ERDF and the Cohesion Fund that were related to activities in FCH JU, since they covered areas such as energy efficiency, renewable energy, clean transport, strengthening competitiveness through innovation, and promoting entrepreneurship, however in a much wider sense than FCH JU.. Due to this there was a possibility for both complementarity and over-lapping studies. There is no systematic way to track whether FCH JU projects have received funding from the structural funds, but there is little evidence that there has been any effort to cooperate and align the policy frameworks, programmes and actions. It may also be a difficult task to achieve since the JU is industry driven, whereas the Structural Funds are managed by the Member States.

Another programme of relevance during 2007-2013 was the trans-European transport network (TEN-T)[93]. The funding opportunities were open to all Member States, and also to international organisations, JUs and public/private undertakings or bodies if there was an agreement with the Member State concerned. TEN-T was to support the construction and upgrade of transport infrastructure throughout the European Union and with the purpose to ensure cohesion, interconnection and interoperability. All modes of transport were covered by the programme. Since the infrastructure for hydrogen is a vital prerequisite for a deployment of fuel cell vehicles, including road, railway and waterway, the TEN-T could have been a possible mean to finance complementary studies to the projects in FCH JU, thereby facilitating a trans-European infrastructure to be built. There is evidence of projects related to FCH JU that were funded by this programme. Hydrogen Infrastructure for Transport (HIT)[94] started in 2012 with the aim to define optimal strategies to move from hydrogen hotspots to local markets with the goal to have long distance transport and mobility along the TEN-T corridors. The successor project HIT 2[95] started in 2014 continuing with developing regional and national implementation plans as well as pilot deployment and testing of three hydrogen refuelling stations along parts of the TEN-T network.

There is a great opportunity in principle for the JU to work with the structural funds to design and implement the infrastructure that is necessary for FCH options to work. But the allocation of structural funds is largely determined by Member States and beyond the influence of the JU. The JU has attempted with partial success to bridge this gap, notably through its enrolment of regional support, and has now engaged a financial specialist to foster interaction, but the impact has been limited.

A common problem with new and innovative technology is to move from the stage of research and innovation to demonstration and to reach the market stage with deployment. For this to happen, there is a need for venture capital and risk funding. During FP7 there was the possibility with the Risk Sharing Finance Facility (RSFF)[96] that were built on the principle of risk-sharing between the EC and the European

[90] Regulation (EC) No 1080/2006 of the European Parliament and of the Council of 5 July 2006 on the European Regional Development Fund and repealing Regulation (EC) No 1783/1999

[91] Council Regulation (EC) No 1084/2006 of 11 July 2006 establishing a Cohesion Fund and repealing Regulation (EC) No 1164/94

[92] Regulation (EC) No 1081/2006 of the European Parliament and of the Council of 5 July 2006 on the European Social Fund and repealing Regulation (EC) No 1784/1999

[93] http://ec.europa.eu/inea/en/ten-t. Accessed 15/05/2017

[94] http://ec.europa.eu/inea/ten-t/ten-t-projects/projects-by-country/multi-country/2011-eu-92130-s Accessed 15/05/2017

[95] http://ec.europa.eu/inea/ten-t/ten-t-projects/projects-by-country/multi-country/2013-eu-92077-s. Accessed 15/05/2017

[96] Banking on Research, Banking for Research Risk-Sharing Finance Facility (RSFF) innovative loans for innovative ideas. http://ec.europa.eu/invest-in-research/pdf/download_en/rssfb_brochure.pdf. Accessed 15/05/2017

Investment Bank (EIB)[97]. With the RSFF, which aimed at supporting private investors into research and development actions, there would be improved access to loan finance from the EIB. RSFF would cover the risks when EIB lend directly to the promoter, or when they guaranteed loans made by financial intermediaries such as banks in Member States and Associated Countries. Among those that were eligible to apply for RSFF were partners in large projects supported by FP7, such as JTIs, collaborative projects and research infrastructures. As mentioned in section 6 no such loans were granted to any FCH related project since it appears that EIB was not convinced of the financial viability in the short-to-medium term (5-10 years), and therefore was unwilling to take on the risk.

Many of the applications of the FCH JU face the well-known struggle to find funding to bring innovation from the stage of demonstration, where it can seek support from research instruments, to that of commercial implementation where normal banking procedures would apply. The RSFF of the EIB seemed to fit this need, but it transpired that the EIB was only prepared to provide funding where there was a separable technical risk and a proven commercial case if that risk were successfully mitigated; no such projects were found.

6.5 EU Added Value

Based on the self-assessment of the Industry Grouping, the presence of the FCH JU resulted in an increase of private sector R&D funding for FCH work, outside the FCH JU programme, from €2,600M to €3,200M over the period of FP7[98]. While some caution must be exercised in relying on such unaudited claims, the figures seem consistent with the range of demonstrations and R&D activity observed during this time.

From the reports of the FCH JU for period of FP7 the EU contribution to projects totalled €437.1M, with participants self-financing a further work valued at €488.9M. This indicates an operational leverage effect of the FCH JU of €488.9M/€437.1M = 1.12, which is considered an adequate result, especially taking into account that the leverage of the overall 7th framework programme has been estimated in 0.74[99].

This figure is broadly consistent with the leverage effect identified for current activity, so is likely to give a reasonable indication of the impact of the EU funding. It provides evidence that the FCH JU did act as an incentive for the FCH development community to increase RD&D efforts, and provided a good return for the investment of public funds.

No directly comparable figures are available for national programmes over the same period. However, since such programmes offer a comparable level of support to individual projects, or perhaps a little better in some cases, it would be reasonable to conclude that the FCH JU achieved similar leverage from its activities to those realised in Member States.

Overcoming Fragmentation

The FCH JU 2013 Programme Review noted that, in the transport field, connections and coordination existed between different FCH JU projects. Between FCH JU projects and national programmes linkages were evident but these tended to be at the level of partner organisations. From interviews with project participants it is clear that there is considerable value to them of learning from, and exchanges with, other partners, but this is difficult to quantify or even fully record. At a more strategic level there was no

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[97] http://www.eib.org/. Accessed 15/05/2017

[98] JTI Industry Grouping members - Declaration of commitment to the process of creating a Joint Technology Initiative on Hydrogen and Fuel Cells, letter to the European Commission, 18th June 2007

[99] Commitment and Coherence – Ex-Post Evaluation of the 7th EU Framework Programme, November 2015

evidence of an overt influence of the FCH JU programme portfolio on the structure, content, or objectives of national programmes, nor of structured learning between them. Similarly, in the energy, hydrogen, and cross-cutting fields there were a number of instances identified by the reviewers of connections between projects within and outside the FCH JU portfolio but not of national programmes themselves being influenced by, or designed to be complementary to, the FCH JU programme.

The Review conclusions emphasised the potential value of greater efforts to improve cooperation between FCH JU and national and regional programmes, and also to improve learning from greater links to programmes outside the EU.

From interviews conducted with both project participants and members of the SRG it seems that while the FCH JU programme was regarded as a valuable complement to national activities there were limited indications it was strongly influencing the content of the latter. In the instance of the CUTE and CHIC projects, for example, there was a suggestion that these multi-country demonstration activities arose from the existing intent of the partners to collaborate which then used the FCH JU structure as a platform for delivery. While there is no suggestion that these were not valuable and successful projects for the FCH JU programme, the demonstrations may well have happened anyway without its existence, but at a slower rate or smaller scale in the absence of the additional funds made available by FCH JU.

It is an objective of the development of the European Research Area that actions of the EU Framework Programme should seek to leverage and improve the coherence of the R&D expenditure of Member States. Within FCH JU the SRG was expected both to provide guidance to the JU activity to help realise this, and provide a forum through which the content of the Member States' own programmes might be influenced. From the observations of previous reviews, and the comments from SRG members it seems that this has happened to only a limited extent, so in this area the FCH JU has not brought about significant changes. It is not alone in finding this a difficult task, so the outcome does not indicate any specific failing, but it remains a disappointment.

From a technical viewpoint, the existence of the FCH JU has made a major improvement in eliminating the fragmentation that previously existed in EU support for the range of technologies being dispersed between several support programmes within FP7 and its predecessors. The development of the MAIP has enabled the programme managers to ensure that the full range of technical needs is fully recognised and an integrated programme developed to meet them. Reviews of the FCH JU programme judged this aspect to have been effectively managed and a coherent development strategy both created and delivered. The input of both the Industry Grouping and Research Grouping to the Board decisions also ensured that views from both these Europe-wide communities contributed to a comprehensive assessment of all technical needs.

Consistent & Coherent long-term strategic investment

There is some evidence that the existence of FCH JU has initiated consideration of complementary FCH programmes in certain countries where they are not currently active, such as Portugal. Amongst those countries where FCH programmes already existed there is not, as noted above, any firm evidence that there has been an explicit change in FCH strategies or programme structures and scale. However, from interview comments there are indications that an indirect influence has been made. The strategic nature of the MAIP and the associated FCH JU funding appears to have impacted on the content and durability of national funding through providing a research and innovation programme to which national programmes have maintained some coherence so as to support the ability of national researchers to participate in the FCH JU programme. This 'drag' effect was recognised by a number of interviewees and so seems to be an important contribution to the impact of the FCH JU.

6.6 Lessons learnt from previous evaluations

The First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking

The First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking took place between December 2010 and April 2011, shortly after the beginning of the autonomous operation[100]. The independent expert group (IEG) which conducted the evaluation concluded that the overall technical objectives of the FCH JU were ambitious and internationally competitive; it commended the concept of public-private partnership for technology development and demonstration. The group found the FCH JU to enjoy strong stakeholder representation and to provide stability in an uncertain funding climate. The group criticised the length of time taken to establish the JU; it noted the low and unpredictable funding rates and the modest technical resources of the Programme Office. External relations were, in its view, insufficient in particular the collaboration with Member States' related programmes and international engagement.

Recommendations were divided into five blocks; they were mainly addressed to the Executive Director, the Governing Board and the European Commission, but in a few cases to the Scientific Committee and the State Representatives Group. They are summarised below:

- To reinforce the portfolio management. The IEG took the view that the FCH JU should be more pro-active in delivering its technical objectives; to this end it should manage its project portfolio through targeted call processes and on-going project review.
- To ensure high agility of operations and adaptability to changing competitive forces. The FCH JU needs to maintain its focus on innovation and respond to emergent competing technologies and extend its efforts to engage stakeholders from the complete value chain.
- To improve visibility, communication and outreach. The IEG proposed a strengthening of the FCH JU visibility within and beyond Europe.
- To improve collaboration and alignment with Member States. The States Representatives Group is important in coordinating with the activities of Member States; not all the country representatives in the SRG had the necessary links to policy-making to achieve this aim.
- To ensure high efficiency of operations. The IEG detected several failings in efficiency, some of which it attributed to the status of the FCH JU as a Community body which it felt ill-suited to a public-private partnership.

The Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking

The Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking began in March 2013 and was completed in July 2013. The expert group convened for the purpose found that most of the recommendations of the first evaluation concerning implementation bottlenecks had been adopted, but that compliance with some of the recommendations to reinforce portfolio management and to improve communications with stakeholders was only partial. Overall, the second IEG concluded that performance had progressed and that the JU had successfully demonstrated the viability of a Public-Private Partnership (PPP) for research in FCH. The JU had developed an adequate governance structure, improved the dialogue between industry and research around a common strategic agenda, and had initiated the implementation of that agenda. The expression of a long-term political commitment

[100] First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking

by EU institutions that was manifest in the FCH JU, coupled with stable funding, had given confidence to industry and helped the sector through difficult times. In the view of the second IEG, the FCH JU continued to be relevant to the grand challenges facing Europe, in particular climate change and energy security, and it recommended therefore that the FCH JU should be continued under Horizon 2020.

The IEG nevertheless found several areas that could be improved, some related to the findings of the first evaluation, and made recommendations for: programme governance, design and management; technology monitoring and policy support; engagement with Member States and regions, and communication and dissemination. The extent to which the JU has complied with these recommendations is discussed in detail in the following section.

Follow-up by the JU

An action plan to address the recommendations of the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking was adopted by the Governing Board on the 11th November 2014[101].

The authors of this final evaluation have assessed the status of the JU at the end of December 2016 and the extent to which the recommendations of the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking have been addressed.

The IEG concluded that the recommendations have been generally addressed in a satisfactory way. Most of the issues detected by the Second Interim Evaluation have been dealt with even if not always in the way that had been recommended. Good compliance is noted for: knowledge management, financial engineering and communication where new staff members have been appointed and for the relationship with regions and municipalities where there is significant progress as well. The coherence between the activities of the JU and public policy goals of the EU is still not entirely satisfactory and better alignment with other activities of H2020 still needs attention. The involvement of member states is poor; this is a serious concern.

Table 14 below summarises the view of the IEG on the extent to which the recommendations of the Second Interim Evaluation have been resolved.

It should be highlighted that due to timing most of the recommendations of the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking were implemented only in the FCH 2 JU that was initiated in July 2014. More information is therefore available in the First Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking.

[101] Not available publicly

Table 14 Compliance adoption of the recommendations from the 2nd Interim Evaluation of the FCH JU.

Recommendation	Responsibility	Assessment of IEG
• The JU has been largely successful in achieving the objectives assigned to it, is very relevant to the grand challenges of H2020, and should be continued.	European institutions	• The JU was continued under H2020 with revised objectives and a modernised regulatory framework (Council Regulation 559/2014)
Programme governance, design and management		
• Governance of the programme needs to ensure: that decision-making is more prompt; that more resources are assigned to programme and knowledge management and that the private sector's commitment continues to be comparable to the EU's effort. • The Executive Director should have greater executive authority; administrative functions should be shared with other JUs and / or taken back into the Commission services; the Commission should agree a mechanism to demonstrate that the industry adopts "stretch" targets for its own research and early deployment expenditure. • Contractual targets steadily to reduce time-to-grant should be introduced under Horizon 2020.	European institutions GB	These issues have been addressed under the FCH 2 JU: • Some tasks have been delegated by the GB to the ED: e.g. approving grants, some aspects of human resources and procurements; • Provision of support services to all JUs has been streamlined through the introduction of the Common Support Centre, which after initial difficulties now appears to work well. • A knowledge manager and additional project officers have been appointed. • Industrial commitment is now measured through IKAA • Targets have been set for time-to-grant in H2020 and the delay has been substantially reduced.
• The research strategy for the continuation of the FCH JU in Horizon 2020 should focus more sharply on three main principles: alignment with EU policies; areas where Europe has or can achieve leadership; adaptation to changing needs of the sector.	GB Advisory bodies	• FCH 2 JU is well aligned with EU policies, the outputs support key EU policy goals but direct correlation between these outputs and policy making is difficult to identify • Support has been given to areas where EU has strengths/ competencies but no strategy has been put in place to systematically identify areas where EU might aim to achieve leadership • Adaptability to evolving

Recommendation	Responsibility	Assessment of IEG
		market needs has been improved by the scheduled revision of the JU's strategy enshrined in the MAWP • AWP preparation has systematically taken into account market situation • The studies procured by the FCH JU have provided information that could help identify areas where Europe can achieve competitive advantage;
• Storage and cost-efficient end-use of electricity together with the production of hydrogen from renewable sources should be priorities of the energy pillar; additional actors (e.g. network operators) will need to be recruited. • Synergies and interaction with other programmes along the whole value chain should be maximised (e.g. "Advanced Materials" and with "Advanced Manufacturing and Processing"), Green Vehicle, SET-Plan EIIs (e.g. Smart Grids). • Six to ten per cent of the FCH JU budget should be preserved for breakthrough oriented research.	GB PO	• These applications are prioritised in the MAWP, but there is still a debate on whether the focus is sufficient. • FCH JU has made a reasonable attempt to reach out to new actors, • Attempts to exploit synergies with H2020 are restricted by the belief that all R&I activities related to FCH are to be covered uniquely by the JU • Basic research has reappeared in the FCH 2 JU's annual work plans as recommended
• The capacity to adapt to change should be strengthened. • Programme results should be fed back more effectively into the AIP and MAIP whilst preserving stakeholders' confidence in the long-term vision; a closer integration of industrial interests with those of other stakeholders should be sought through joint workshops with the research community, advisory bodies and representative regional organisations.	PO IG	• The capacity to adapt to change has been strengthened as more studies to assess market situation have been procured. They feed back into the AWPs. • The knowledge management function has had initial problems with the software tool and data collection, but is progressing and is used to influence the contents of the multi-annual and annual work plans.
• Certain research areas need greater prominence: the FCH JU should develop a strategy for Regulations, Codes and Standards including international dimension across the FCH businesses that is agreed by all	PO GB	• A coordination group on RCS has been established, initiated by the JRC. • This group has an influence in the AWP

Recommendation	Responsibility	Assessment of IEG
(IG, RG, SRG, Commission) and that draws upon the resources of the JRC.		elaboration.
• SME participation should be further strengthened through a scheme of financial guarantees as in the Framework Programme and linkage between research projects and venture capital funding from the RSFF to generate new and innovative European companies and businesses.	European institutions	• All JUs are now a part of the EC guarantee fund. • The desirability of leveraging additional financing sources is widely recognised although there is little evidence of this being achieved. • In spite of these challenges, the JU continues to maintain an impressive level of SME participation, exceeding the FP7 and H2020 targets
Technology Monitoring and Policy Support		
• The JU should implement a robust technology monitoring procedure adapted to project, programme and policy levels. Results should be used to adapt the research programmes and made available to the SET Plan and for policy support.	PO	• There is considerable progress. TEMONAS tool proved not to be suitable and a new, simpler tool has been created. • Procedures to gather and process data are being developed, but the output is still inadequate for policy support • The JRC now participates in the technology monitoring at a programme level through its framework agreement with the JU.
• Much greater disclosure and dissemination of results is essential. Future proposals should be obliged to include a list of publishable KPIs and evaluation should penalise low levels of disclosure. Existing projects should be encouraged to *post hoc* disclose some of their results. The FCH JU should introduce "clean rooms" for this purpose.	PO	• The actions of the JU in this regard are subject to the rules of H2020 where there is a commendable increase in public disclosure. • As of the 2017 Call all beneficiaries will be required to disclose data with the possibility of derogation only if justifiable and agreed before conduct of the work.
• Policy DGs within the Commission need to provide greater clarity and visibility of public policy for FCH related activities (e.g. zero emission vehicles, energy storage). • The procedures for incorporating	European institutions + PO	• The visibility of FCH solutions in EU energy & transport policies remained limited throughout the duration of the FCH JU. Only

Recommendation	Responsibility	Assessment of IEG
scientific evidence into transport and energy policy should be transparent and effective and be consistent across the sectors.		recently, does there seems to be some improvement, notably in regard of energy storage • A coherent support framework (comparable to those for renewables) is required and this does not yet exist.
Engagement with Member States and Regions		
• Member States involvement with the programme must be strengthened. The mandate of the SRG should to be upgraded to cover strategic functions including a proactive role in the choice and design of large-scale demonstration and deployment projects and participation in technology monitoring; the flow of information between the SRG and the Programme Office needs to be improved; members should be more clearly associated with national research and / or industrial policies; innovative solutions for co-funding by Member States should be explored (e.g., ERA-NET activities or conditional co-funding within Calls).	European institutions GB SRG PO	• No progress has been achieved in this respect. • There is no proof of active alignment between MS and EU activities. • There is little systematic data exchange by MSs of the content and achievements of national programmes. • Membership of the SRG is still in part inappropriate. • There is no "formal" co-funding with MS or regions at this stage although a MoU has been signed with the latter.
• Relationship with regional and local authorities is critical to deployment. The relationship with organisations such as HyER is important for transport and should be better exploited. Similar relationships must be built for storage and other aspects of infrastructure.	PO	• Strong relationships have been developed with many regions and an MOU has been signed to cooperate in integrating fuel cells and hydrogen into their planning.
• Finance of future deployment and capacity build-up projects is vital and will require new financial arrangements. The Commission should investigate whether Hydrogen infrastructure can be made eligible for funding within the new National Strategic Reference Frameworks for Structural Funds. • The FCH JU should prepare to facilitate developers by providing advice on available financial options from EU institutions, including the EIB, Structural Funds and TEN-T loans and grants; calls for preparation of fundable projects should be considered.	European institutions, Member States, PO GB	• A financial engineer has been appointed in the FCH 2 JU with these duties, but the activity has only just been initiated and there is therefore as yet little tangible result. • Without a supportive policy framework that incentivises FCH technologies, financial instruments alone are insufficient to catalyse deployment.

Recommendation	Responsibility	Assessment of IEG
Communication and dissemination		
• The FCH JU should strive to be the most authoritative source of knowledge in Europe for FCH. • The visibility of the FCH JU should be greatly improved and the website needs to evolve to reflect this ambition. • The rules governing the provision of information about the programme to various stakeholders (Scientific Committee, SRG, Commission services) should be reviewed to determine whether the JU can disseminate more within a proper interpretation of those rules. If this is not possible then the rules should be modified appropriately for H2020.	PO	• The PO staff are progressively building up a recognised knowledge base of FCH in Europe • The JU has developed a Communication strategy which is to be implemented annually by a communication plan, starting from 2016. At the moment of this evaluation, there are no significant outcomes, beyond a strengthened presence on social media. • A specialist member of staff in communication has been appointed which should improve the communication efforts. • During FCH JU confidentiality rules governing the provision of information about the programme appeared to be an obstacle to dissemination, e.g. in the case of SRG. This has been partially solved during FCH 2 JU, as the JU has committed to providing basic information on call outcomes early on.
• The FCH JU should support the engagement, education and training of stakeholders beyond the immediate FCH Community and should engage the SRG in this process.	PO/GB	• Some initiatives have been launched to foster training and educational curricula, including web-tools, nevertheless there still seems to be room for improvement • There does not appear to be any involvement of the SRG

In relation to the recommendation that administrative functions should be shared with other JUs and / or taken back into the Commission services, it should be noted that most functions and tools are now being shared as can been seen in Annex 7 Administrative functions shared with JU's and EC.

7 CONCLUSIONS

- **Relevance of the JU**
  - *The activities of the FCH JU continue to be relevant to the grand challenges facing Europe; they support climate change objectives, help improve energy security and contribute to the status of Europe as an international leader in technology*
  - *The general and specific objectives of the JU as established in the founding regulation were demonstrably over-ambitious but have served as an adequate guide to the activities.*

- **Implementation of the PPP**
  - *Performance*
    - *The JU has implemented the concept of a public-private partnership with considerable skill. The operational phase has revealed both the strengths of the approach and its limitations.*
    - *The performance of the FCH JU was generally good. Operations were a little slow in the initial period, but this was to be expected from a novel institution faced with the complexities of integrating public, industrial and research interests into a single programme with fairly rigid constraints imposed by the JTI's nature of a Community body.*
  - *Efficiency*
    - *The overall operational efficiency of the FCH JU improved as the institution matured. The cost efficiency of programme management and internal controls improved steadily as the number of projects managed by the FCH JU increased. The final annual costs for management of the PO are judged to be acceptable and the execution of the budget has similarly improved over the period and is now very good.*

- **Added value and leverage**
  - *Creation of a Long-term vision*
    - *The development of the MAIP has defined strategic innovation objectives which enable programme managers to ensure that the full range of technical needs is fully recognised and an integrated programme developed to meet them.*
    - *The input of both the Industry Grouping and Research Grouping to the Governing Board decisions also ensured that views from both communities across Europe contributed to the assessment of technical needs.*
  - *Catalyst Effect*
    - *Although the collaboration with SRG has not been as effective as expected, the strategic nature of the MAIP and the associated FCH JU funding appears to have impacted on the content and durability of national funding through providing a research and innovation programme to which national programmes have maintained some coherence*
    - *This 'catalyst' effect was recognised by a number of interviewees and so seems to be an important contribution to the impact of the FCH JU.*
    - *There is also interaction between common project participants in different national, regional and FCH JU projects which resulted in an effective reduction in fragmentation.*
  - *Creation of a strong FCH Community*
    - *An important strength of the approach was to create an incentive for industry to form a joint view on their various priorities and to collaborate with research interests in defining a path towards their*

achievement.

- *The results of this collaboration have been appreciable; it is difficult to imagine that the demonstration projects undertaken by the JU could have been achieved at this scale and speed without the existence of a collaborative framework in the JU; the same applies to some of the more ambitious research projects*
- *The PPP has stimulated the formation of an FCH community that has become a means for the promotion of FCH technology and helped educate politicians and the public about the potential benefits and what needs to be done to access those.*

- *Leverage Effect*
  - *FCH JU exceeded its matching target specified in the Regulation and there are good indications of additional investments from industry triggered by the existence of the JU.*
  - *The FCH JU helped in achieving a long-term vision for FCH and acted as an incentive for the FCH development community to increase RD&D efforts, and provided a good return for the investment of public funds.*

- **Coherence**
  - *Coherence with FP7*
    - *The existence of the FCH JU has enabled a significant reduction in the fragmentation that previously existed in EU support, where the support for FCH technologies was dispersed between several programmes within FP7 and its predecessors.*
    - *JU has made efforts to foster coherence, but the barriers have proved too strong to overcome completely. The separation of spheres of responsibility between the low-TRL research programmes of the JU and those of other themes of FP7 were never clearly defined for instance.*
    - *Low TRL research was not adequately supported and the IEG is of the opinion that a clear identification of FP7 and JU boundaries, as well as better coordination with Member States, to identify the main gaps and needs for funding for basic research should have been made.*
  - *Coherence with National Initiatives*
    - *The relationship with programmes of the Member States was quickly recognised as problematic. The SRG was set up as an advisory group to avoid the complications of comitology, but the result was that Member States saw little benefit in, or opportunity to, work with the JU which in some cases resulted in inappropriate or ineffective representation at SRG level.*
  - *Coherence with Other Relevant Initiatives*
    - *The fruitful alignment of the work of the FCH JU to relevant activities outside its direct influence posed many challenges which were recognised by the JU but not entirely resolved, in large part because the means of resolution lay outside of its control. As an example, it should be highlighted that the SET-Plan has given a low priority to FCH technologies on the basis that they are already being addressed by the FCH JU. This is, of course debatable, as the two initiatives have different rationales.*
    - *A transition to market necessitates fit-for-purpose demand-pull instruments in support of progressive volume build-up and creation of economies of scale, well beyond the mandate and capacity of the FCH JU. The IEG is of the opinion that such frameworks still need to emerge both at EU and national levels. This is a matter of priority and will be key for the future commercial exploitation of FCH technologies.*

- **Factors contributing and detracting from success**
  - *Factors contributing to success*
    - *The main factor contributing to the success of the JU was the robust logic underlying the decision to create a public private partnership for research and innovation in this field. There was a genuine coincidence of interest between public policy, commercial opportunity and research potential. Probably as a consequence of this fundamental rationale industry made significant efforts to organise its participation. The commercial interest has fluctuated according to evolving perceptions of the market opportunities, but has always been significant.*
    - *The industrial drive was fundamental to the success of the JU. Inevitably there are side effects from this strong involvement of industry; there is a widespread and at least partially justified view that research routes to better and cheaper products have been neglected in favour of the more costly and complex demonstrations favoured by industry.*
    - *The ability of FCH JU to demonstrate the technical feasibility of a broad range of FCH solutions at scale was new within the EU for these technologies and proved effective.*
    - *There were some strong national efforts that provided complementary activities and a pool of expertise, as for example H2Mobility initiatives.*
    - *The IEG notes also that the proactive efforts of the PO to solve problems as they arose, and the good technical reputation that it acquired, have both contributed to the effectiveness of the programme.*

  - *Factors detracting from success*
    - *The three principal constraints to the success of the JU are the limitations imposed by the character of the institution, the lack of an accepted common strategy for aligning the technology needs of transport and energy, and the lack of the deployment support framework*
      1. *The expectations of the JU were excessive, particularly in view of the budget available in comparison to the projection of sector's needs.*
         - *It was expected to fund research, achieve market penetration, align EU and MS programmes and exploit the opportunities of a range of EU funding instruments. As our conclusions on coherence noted above indicate, the JU has attempted to meet these expectations, but with limited success. The likely cost to do so is estimated to be €18 billion[102] including private, national and EU support, the latter alone being estimated between €2.5-4.0 billion which materially exceeds the means of the FCH JU.*
      2. *There is too much uncertainty to allow a single coherent EU-wide view of FCH prospects.*
         - *The lack of a common vision of how the energy and transport sectors will interact in future, what the role of FCH technologies will be, and where the critical gaps are to be found, hindered the JU success.*
         - *This common vision is important as the specific value of*

[102] Fuel Cell and Hydrogen technologies in Europe 2011 , Financial and technology outlook on the European sector ambition 2014-2020

hydrogen as a flexible energy carrier lies in exploiting cross-sectorial synergies and this calls for a well-articulated political vision that rewards the benefits that hydrogen delivers to the optimisation of the energy system as a whole.

- *A review of plausible future scenarios or objectives for exploiting FCH in the EUs energy and transport sectors, and the identification of the most probable technical requirements would be helpful in defining a work programme consistent with the aims of public policy.*

3. *The third constraint was the absence of a deployment support framework of the nature provided for renewable and other new energy technologies.*
    - *Without this, there was no incentive for exploitation of technologies still at an early stage of development and at an economic disadvantage compared to alternatives.*

Extent to which shortcomings were resolved under H2020

- *The Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking made several recommendations to improve some of above mentioned shortcomings and these were in large part adopted. More information on how the recommendations have been taken into account can be found in section 7.6.*
- *Many of the limitations to coherence that have been identified here were also noted during the second interim evaluation, but that review stopped short of proposing new structural solutions. H2020 did not effectively tackle the main coherences at EU level. For instance, the SET plan and STRIA have not produced the interactions and synergies as expected.*
- *Even if there was a welcome increase in budget for FCH 2 JU within H2020, this is still considerably below the means necessary to trigger commercialisation. Should it not prove possible to identify how to achieve the necessary future development budgets, and deployment support schemes, to reach commercialisation then a review of whether there is value in continuing to support FCH development at a lower level should be undertaken.*

8 ANNEXES

8.1 Annex 1 Members of the Independent Expert Group

Name of experts	Nationality and gender	Short biography
Ana Sofia Caires Sousa Branco	PT Female	Ana Sofia Caires Sousa Branco is a Technological Physics Engineer with postgraduate qualifications in Innovation Management and the European Union. Having worked previously as a project manager in a multinational and as a technology transfer expert in a research centre, she is now an independent advisor, assisting private and public entities in the market uptake of research results and innovation ideas. She has participated in many EC projects and in several evaluation exercises as an independent expert for the EC, having been also the secretary of EARPA's Urban Mobility TF. She participated in the First Interim Evaluation of the FCH JU.
John Loughhead OBE	UK Male	John Loughhead was appointed Chief Scientific Adviser to the Dept. of Energy and Climate Change in October 2014, and subsequently to its successor department, BEIS. He was previously Executive Director of the UK Energy Research Centre. He is a professional engineer and has worked in new energy systems R&D for over 30 years. His current role covers UK research into new sustainable energy systems. Much of his career has been spent in industry, latterly as Corporate Vice-President for Technology and Intellectual Property of the Alstom group, where he was responsible for technology management and new product developments related to energy systems. He participated in the first interim evaluation of the FCH JU.
Annelie Carlson	SE Female	Annelie Carlson has a PhD in energy systems analysis. Her current position is as a researcher at VTI (Swedish National Road and Transport Research Institute). She has a broad knowledge on both transport and energy, and has through her carrier worked with projects regarding bioenergy, energy efficiency, district heating and CHP. In her present line of work she is focusing on a life cycle approach and different system perspectives in analysing the transport sector in regards to energy and fuel use.
Piotr Bujło	PL Male	Dr Bujło has a PhD in Fuel Cell technology from the Wroclaw University of Technology, he has worked as Associate Professor at the Electrotechnical Institute, Wroclaw Division. He is currently employed as Key Technology Specialist at Hydrogen South Africa Systems Integration & Technology Validation Competence Centre at the University of the Western Cape, where researches fuel cell stacks for combined heat and power applications.
Renate Lemke	DE Female	Renate Lemke is environmental engineer and economist with a broad international experience. She has worked at Berlin's Municipal Waste Management Company for the past 13 years, where she has been

		responsible for the fleet management logistics, including the fleet strategy and investigation of fuel cell or hybrid options. She is currently Chief Executive for two plants for the production of high-quality substitute fuel. She holds a PhD on market introduction of hydrogen.

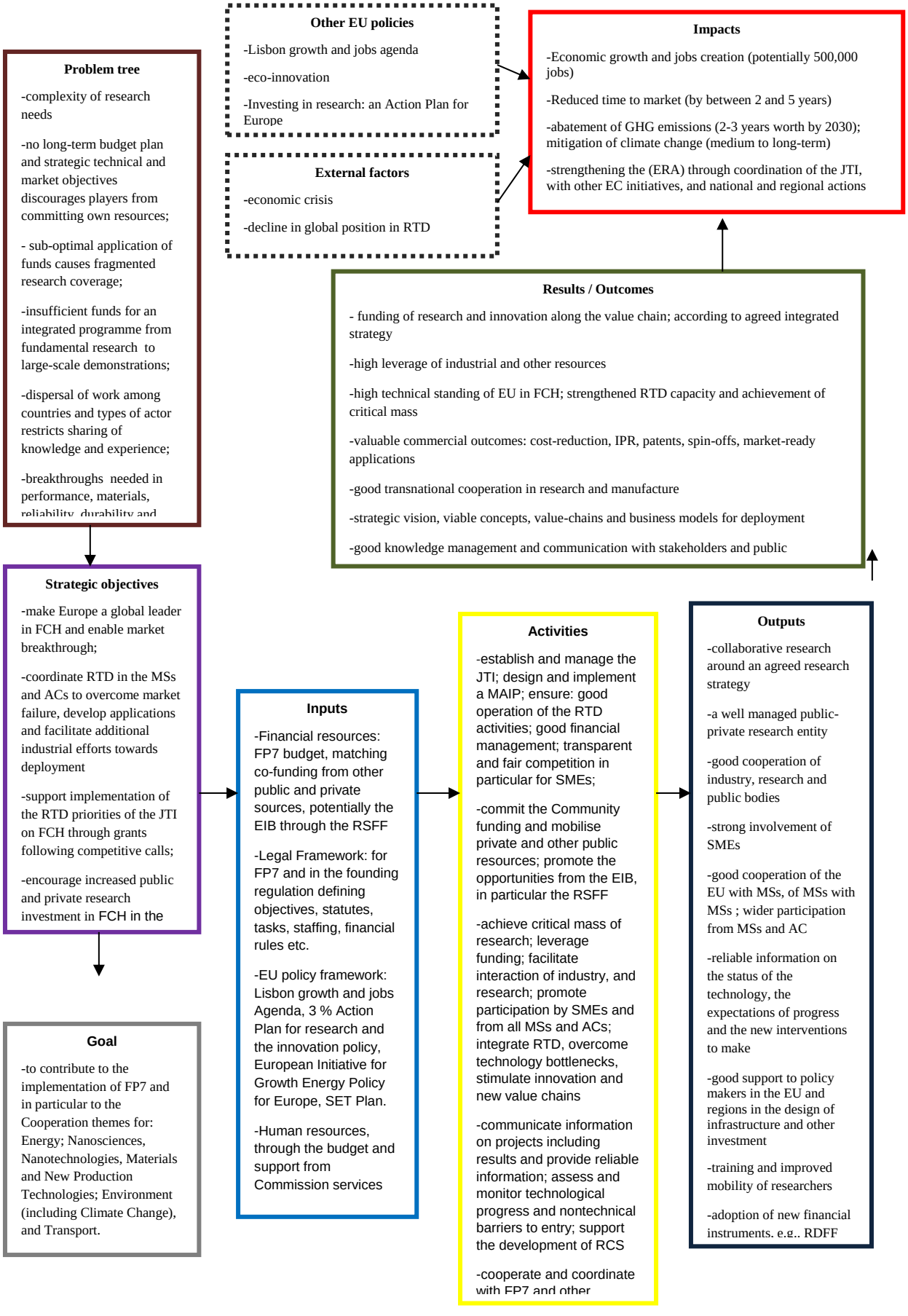
8.2 Annex 2 List of Stakeholders interviewed

Interviewer (group, individual member)	Interviewee	Role in FCH JU
Group	Bart Biebuyck	FCH 2 JU Executive Director (from May 2016)
Group	Eden Mamut	Chair of Scientific Committee
Group	Laurent Antoni	Chair of the N.ERGHY Research Grouping FCH 2 JU Governing Board
Group	Vannson Philippe	Recent FCH 2 JU Interim Executive Director (till May 2016)
Group	Strohmeier Rudolf	Deputy Director General, DG Research and Innovation
Group	Raphaël Schoentgen	Chair of Governing Board of FCH 2 JU
Group	Ruxandra Draghia-Akli	Deputy Director-General of DG RTD
Group	Georg Menzen	Chair of SRG
Group	Bert De Colvenaer	(Former FCH JU Executive Director and actual ECSEL JU Executive Director)
Group	Marc Steen	Head of Unit: Energy Conversion and Storage Technologies, JRC
Group	Nicolas Brahy	Operating Director, Hydrogen Europe
Group	Herald Ruijters	(Acting) Director Transport Networks, DG MOVE)
Ana Sofia Branco	Eunice Ribeiro	Portuguese representative in SRG
Ana Sofia Branco	Maria Jaen Carrapós	Manager of the Hydrogen National Centre in Spain (Centro Nacional del Hidrógeno)
Ana Sofia Branco	Maria Luisa Revillo	Spanish National Representative in the SRG
Ana Sofia Branco	Africa Castro	Director of the hydrogen production by electrolysis working group of the Spanish Technology Platform on Hydrogen and Fuel Cells (PTE-HPC)
Ana Sofia Branco	Antonio González	President of the Spanish Technology Platform on Hydrogen and Fuel Cells
Ana Sofia Branco	Fernando Palacin	General director of Foundation for the Development of New Hydrogen Technologies in Aragon
Annelie Carlson	Lennart Andersen	Senior advisor Innovation fund Denmark, Denmark's representative SRG in 2015
Annelie Carlson	Björn Aronsson	Executive director Hydrogen Sweden, member of the board in Scandinavian

		Hydrogen Highway Partnership
Annelie Carlson	Kristina Difs	Swedish Energy Agency. Swedish representative in the SRG.
Annelie Carlson	Ulrika Lindahl	Development Strategist, Mariestad Municipality
Annelie Carlson	Harald Bouma	Environment- and Work environment Coordinator, Väner Energi
John Loughhead	Graham Cooley	CEO ITM Power
John Loughhead	Nigel Brandon	Director UK HFC Supergen Hub/Imperial College
Nigel Lucas[103]	Robert Steinberger	Head of the FC research programme at Birmingham University. Member of the Scientific Committee
Nigel Lucas[102]	Nigel Holmes	Scottish Hydrogen and Fuel Cell Association
Piotr Bujło	Jakub Kupecki	Head of Fuel Cell Group, N.ERGHY Research Grouping member
Piotr Bujło	Janina Molenda	ViceChair of Polish Hydrogen and Fuel Cell Association, Polish representative in the SRG
Piotr Bujło	Konrad Swierczek	President of Polish Hydrogen and Fuel Cell Association, Polish representative in the SRG
Piotr Bujło	Guntars Vaivars	Latvian representative in the SRG
Piotr Bujło	Zbigniew Turek	Polish National Contact Point for Research Programmes of the European Union
Renate Lemke	Markus Bachmeyer	Head of Hydrogen Solutions, Linde
Renate Lemke	Klaus Bonhoff	Chief Executive, NOW, Germany
Renate Lemke	Michael Eichhorn	H2Mobility
Renate Lemke	Michael Kreuz	Deutsches Zentrum für Luft - und Raumfahrt
Renate Lemke	Frank Meijer	Head of Fuel Cell Electric Vehicles, Hyundai,

[103] Nigel Lucas was a member of the IEG until April 2017, when he decided to withdraw

8.3 Annex 3 Detailed Intervention Logic of the FCH JU



8.4 Annex 4 Detailed analysis of the Coordinators' Survey 2017

The overall satisfaction of beneficiaries with the services provided by the Joint Undertaking is assessed based on the outcome of the Coordinators' Survey (on invitation only) launched by the European Commission that was performed to collect the views of the beneficiaries about the implementation of the Joint Undertaking under Horizon 2020 for the period 2014 to 2016, the consultation was opened on the 19th December 2016 and closed on the 15th February 2017, 70 answers were received and the group of respondents consisted of academia (17.14%), public or government sector (18.57%), private, not-for-profit sector (25.71%), private industry including SME (35.71%) and other entities (2.86%).

The strongest participation was from Germany, Italy, Spain and United Kingdom; 61% of the respondents are from the private industry (including SMEs), of this 26% of the respondents are from the non-for-profit sector, e.g. research foundations.

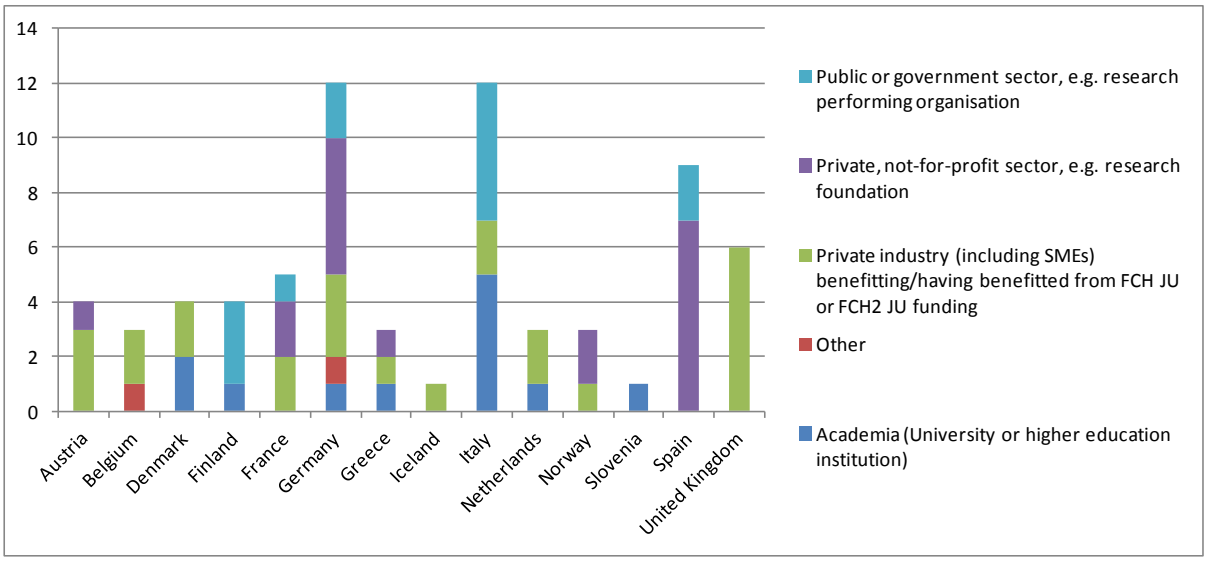


Figure 28. Overview on the participants of the 2017 Coordinators' Survey.

The EC and the PO are with 67% the **main channel of information** on FCH 2 JU opportunities. The European Commission website (e.g. FP7/H2020 portal, JU website, CORDIS) is an information source for 37% of the respondents, EU/JU events or promotional material (e.g. an info day, an EU info stand at a conference etc.) are recognised by 21% of the respondents. The information channel *"Through my work or invitation as an expert evaluator"* has been used by 9% of the respondents. Also recommendations by colleagues, superiors, etc. (16%) play a role.

However, there are not many newcomers participating in the surveys: 83% of the participants in the FCH 2 JU survey had already at least one project under the FCH JU (10% one project, 30% 2-3 projects and even 43% more than 3 projects) and were already aware of the FCH JU. 46% of the respondents have more than one project under FCH 2 JU. In this early stage of the programme, this is a quite high percentage.

The IEG strongly recommends that, in the light of technology commercialisation and market penetration, the FCH 2 JU should strengthen its efforts to enlarge the FCH community, e.g. by design of the Calls to promote the inclusion of municipalities and regions and the use of FCH technology to contribute to clean air issues in respective demonstrations. Doing so, would also strengthen the public side in this public private partnership.

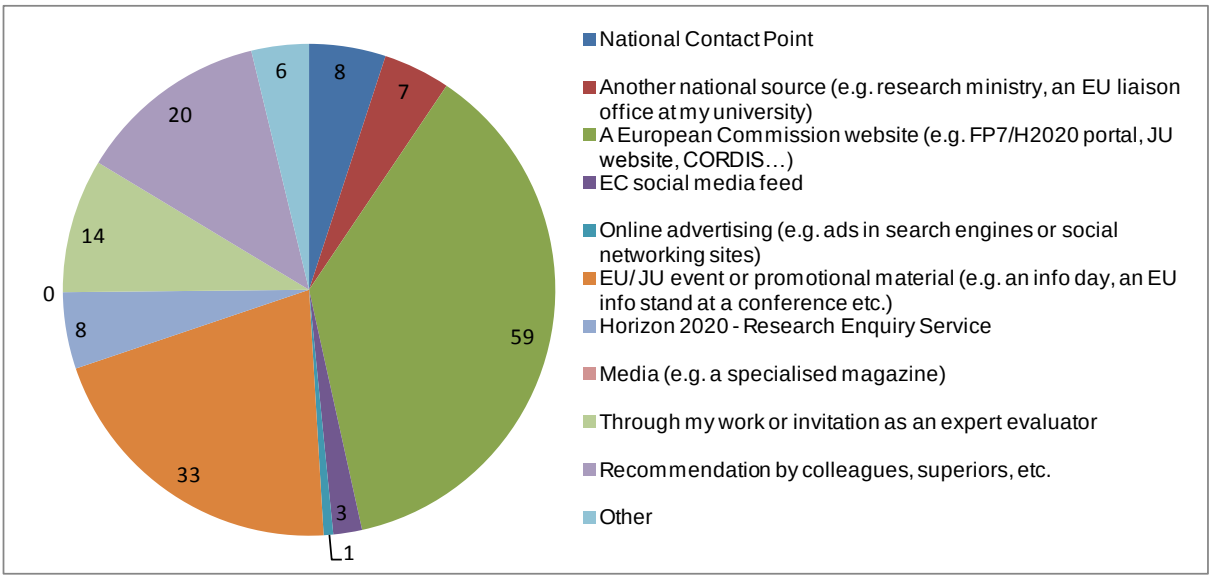


Figure 29. Question A.4. What are your main channels of information on FCH 2 JU opportunities?

The next three blocks of question concerned issues concerning application preparation, submission, timeliness of the processes and application finalization. The block of questions B.1.1. - B1.7. concerned aspects related to the application process, the availability and clarity of information, communication support during application preparation and submission, transparency of the proposal evaluation process and user-friendliness of the IT tool used for application submission.

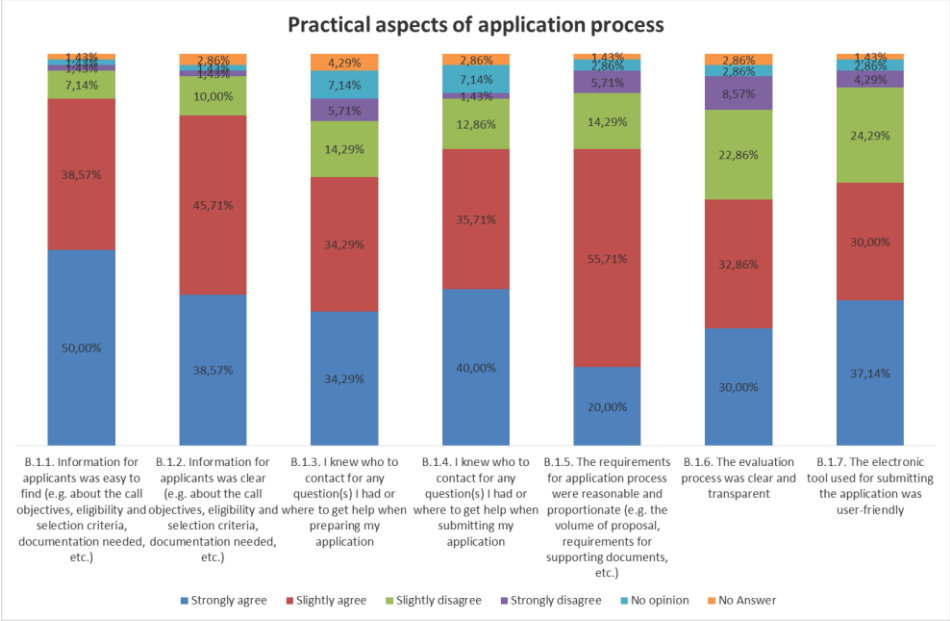


Figure 30. Satisfaction of beneficiaries regarding application submission process.

The obtained results show that beneficiaries did not have difficulties in finding information about the call objectives, eligibility and selection criteria, documentation needed, etc. (almost 90%) and that the provided information was clear (about 85%). In general the beneficiaries were well informed regarding whom to contact in case of questions or where to get help during application preparation and submission process, respectively 68.58% and 75.71%. Nevertheless, 20% of respondents pointed out that

they would not know whom to contact to get help at the stage of application preparation. Strong agreement that the requirements for application process were reasonable was expressed by 20% of beneficiaries and 55.71% slightly agree with the volume of proposal, requirements for supporting documents, etc. For 20% of beneficiaries requirements for documents were not proportionate. The application evaluation process was not clear for more than 30% of beneficiaries. In case of the assessment of the user-friendliness of the electronic tool for application submission, 67.14% responded that the provided tool was user-friendly but at the same time almost 30% did not agree with this statement.

Question *"B.1.6. The evaluation process was clear and transparent"* was evaluated by 65% of the respondents positively. The main criticisms are given in Annex 5. The quality and extent of the Evaluation Summary Report is an important issue of the respondents' remarks. In particular, after the elimination of the negotiation phase as part of the grant agreement procedure, clear and advising evaluation reports are valued by applicants who failed, to allow for a successful redirection of the proposal. The IEG is aware of the difficulties faced by the evaluators in agreeing a common position and translating this to text; it sympathises with applicants, but recognises there are limits to what advice can be given in the context of an evaluation.

The success rate of the respondents was 43%, see Figure 31. Another 13% of the respondents received funding after failing once, 24% failed two to three times and 20% more than three times. However, only 46% of the respondents were positive on the extent to which a clear explanation was provided for the decision why the application was not being selected for funding. Nevertheless 84% of the respondents would definitely apply again for funding, another 7% probably. Another 7% of the respondents announced not to participate in another call. None of the respondents claimed that the eligibility requirements for proposals are too strict. Only one noted that the success rate of applications is too low. However, six respondents highlighted that the administrative requirements for managing proposals or grants are too onerous. Other reasons mentioned were:

- "FCH JU is too bureaucratic, money does not flow and it is not competing with USA and Asia. We have been most depressed by our treatment by Brussels." This is a very individual statement.
- Funding does not cover the costs. This is a very individual statement.
- The potential risk of a consortium member failure can lead to the coordinator losing out financially. The IEG supports this comment, in particular for large projects with a long duration there is a growing risk with time that the commitment of individual project members weakens with detriment to the other consortium members. The IEG recommends paying special attention to the quality of project management in particular for large or long running projects.

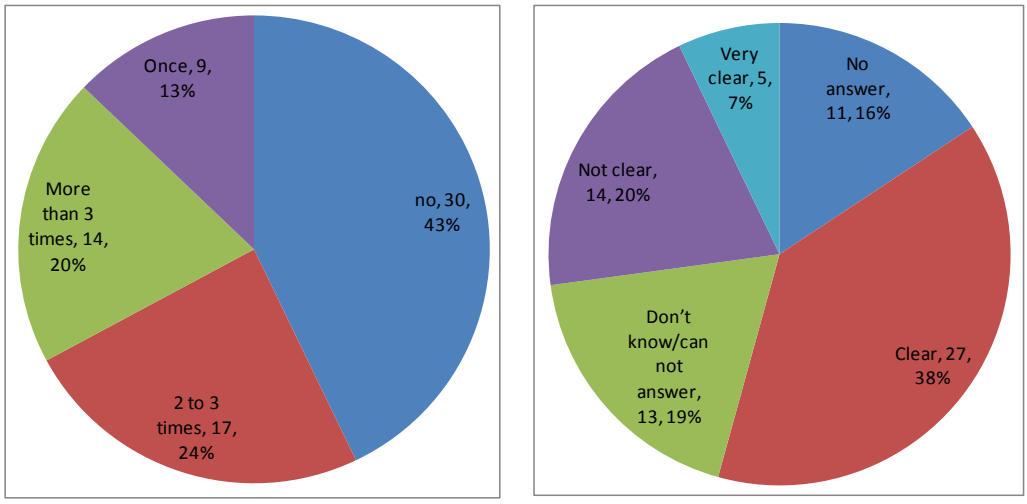


Figure 31. Proposal failure rate (left) and extent to which a clear explanation was provided why the application why the proposal was not being selected for funding (right).

Next the beneficiaries were asked to answer questions concerning the timeliness of the processes during application stage, namely time-to-inform, time-to-to contract and time-to-grant (B.3.1. - B.3.3.).

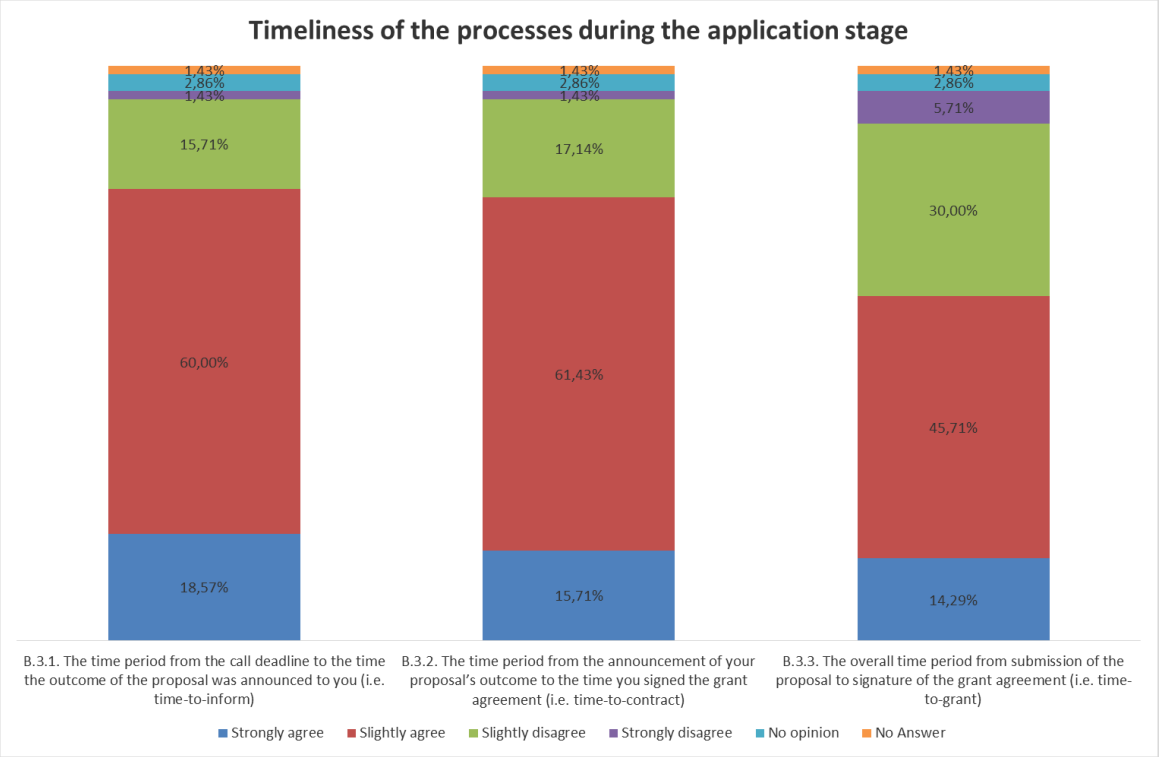


Figure 32. Satisfaction of beneficiaries regarding timeliness at the application stage.

The time-to-inform was for the 2014, 2015 and 2016 calls respectively 124 days (target fixed by the Commission 152 days), 90 days (target fixed by the Commission 153 days) and 126 days (target fixed by the Commission 153 days). This time period was satisfactory for 78.57% of beneficiaries who responded to the consultation, 15.71% slightly did not agree with the length of this period and 1.43% strongly disagreed with it. The time-to-contract was for the 2014, 2015 and 2016 calls respectively 119-281 days, 106-194 days and 92-101 days. The time-to-contract

period achieved by FCH JU was satisfactory for 77.14% of beneficiaries who responded to the consultation, 17.14% slightly did not agree with the length of this period and 1.43% strongly disagreed with it. The time-to-grant was for the 2014, 2015 and 2016 calls respectively 243-405 days, 196-284 days and 218-227 days while the target fixed by the Commission was 243 days. The length of this period was acceptable only for 60% of beneficiaries who responded to the consultation, 30% slightly did not agree with the length of this period and 5.71% strongly disagreed with it.

The next block of questions (C.1.1. - C.1.3.) concerned issues related to application finalization, in particular availability and responsiveness of the FCH JU staff assigned to the project, clarity of requests from JU regarding proposal modification and complementation as well as user-friendliness of the tool used during contracting process.

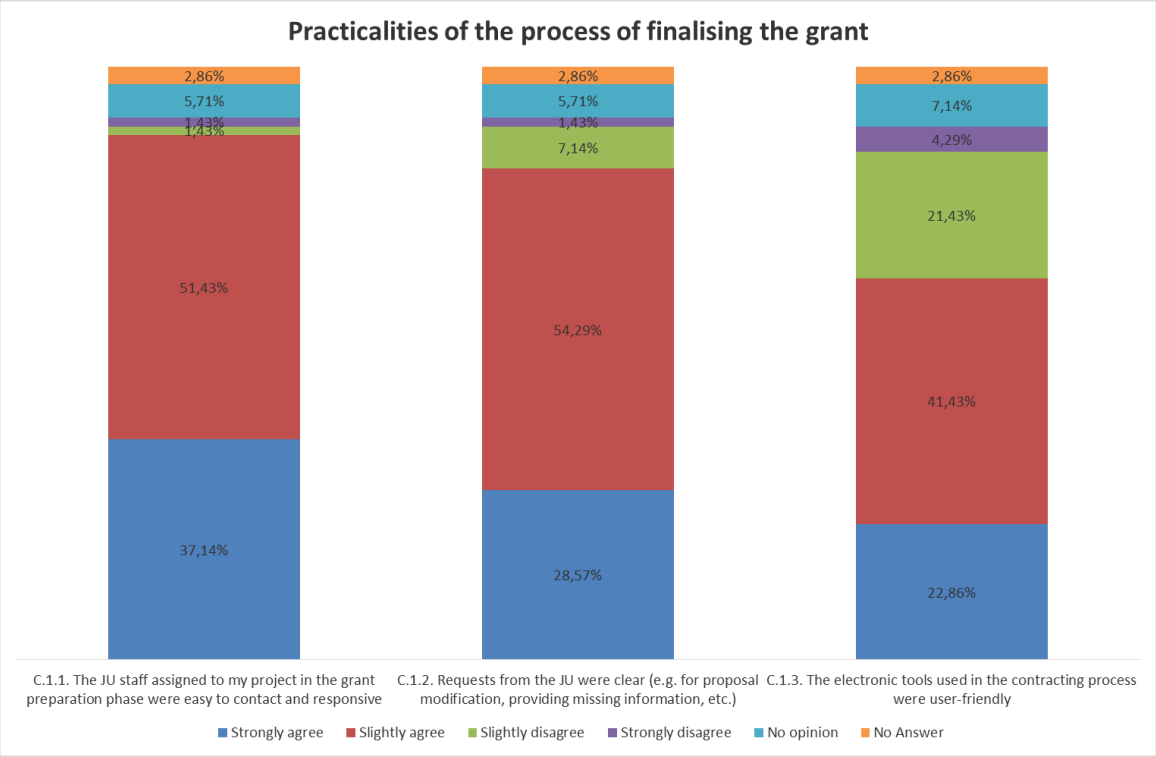


Figure 33. Satisfaction of beneficiaries regarding grant finalisation.

For almost 90% of beneficiaries the JU staff was easy to contact and responsive and only 2 beneficiaries faced problems. Requests from JU regarding grant finalisation were clear for more than 80% of respondents but 8.57% did not understand them. Electronic tool used during contracting process was user-friendly for 64.29% of users and difficult to deal with for 25.72%.

In the next step the beneficiaries had an opportunity to assess the wide range of communication methods that are offered by the FCH 2 JU for participant use at every stage from application preparation and submission to project execution.

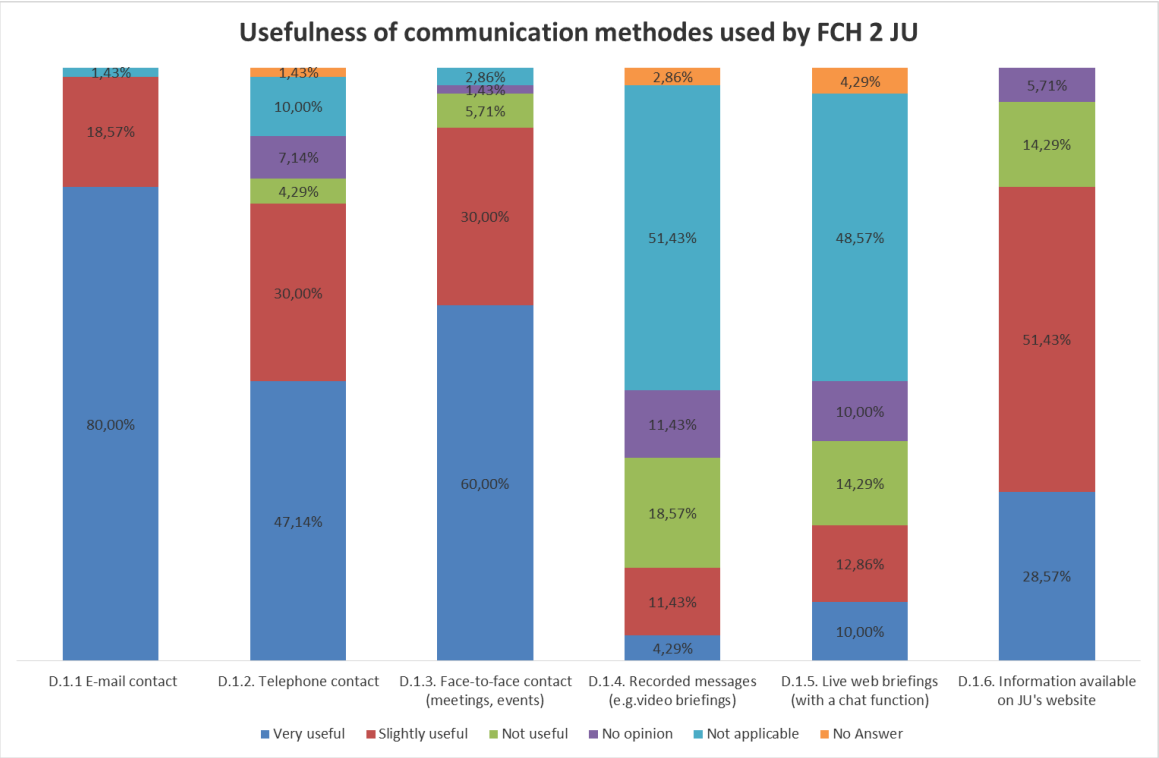


Figure 34. Assessment of communication methods available at FCH 2 JU.

As it might be expected e-mail contact is the most useful way for communication with FCH 2 JU for 98.57%, but telephone contact and face-to-face contact is also highly rated by a significant number of participants, 77.14% and 90.00% respectively. Recorded video briefings and live web briefings with chat function are not popular as a means of communication. It might be that they were not used by beneficiaries because about 50% of respondents answered "not applicable" and a relatively high percentage of respondents did not give any answer. The FCH JU website remains a useful communication tool in the opinion of 80% of beneficiaries participating in the consultation. 14.29% of respondents think that the information available on the website is not useful and 5.71% have no opinion about it.

Finally, the beneficiaries were asked to assess the overall services provided by FCH 2 JU which include information, communication, programme management and offered to the beneficiaries support at different stages of application and project.

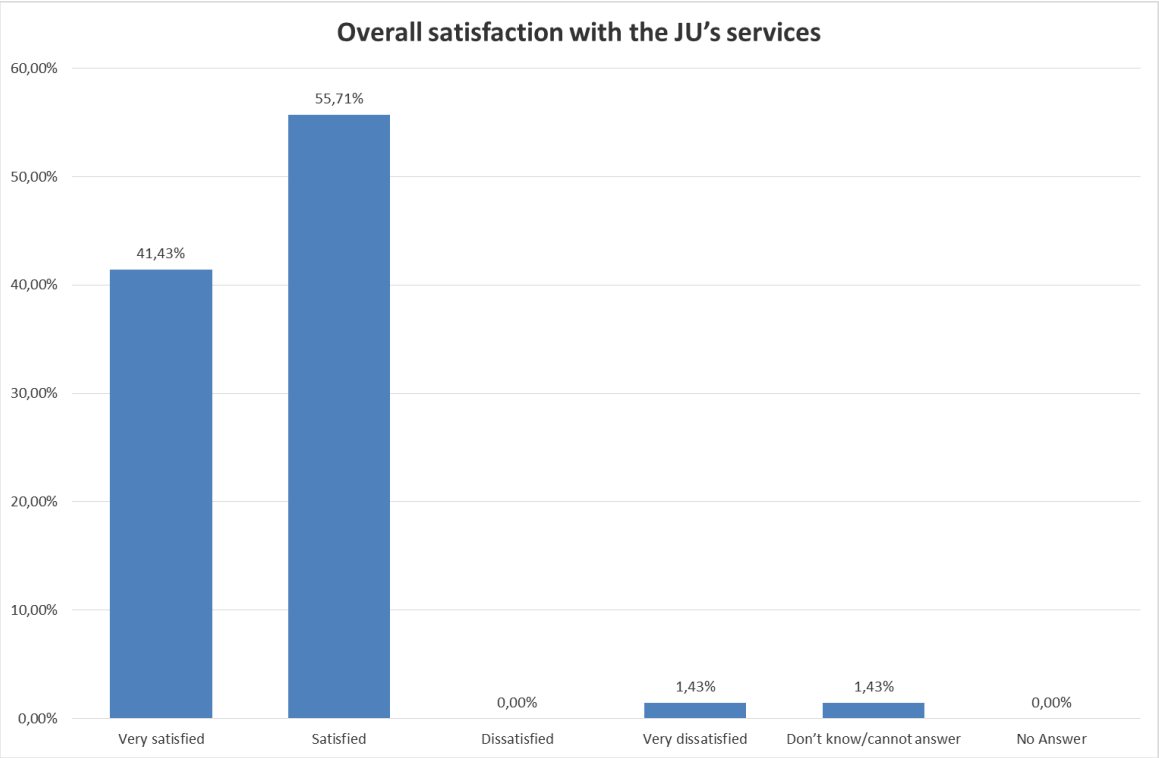


Figure 35. Overall satisfaction of beneficiaries with FCH 2 JU's services.

8.5 Annex 5 Comments from the Coordinators' Survey 2017

Comments from the survey on different topics

General remarks

- FCH 2 JU has become a big company dominated process in my opinion.
- In a lot of cases, the call for topics is giving too many KPI's and mixing too many components: e.g. a call on FC bus, also needs to test an innovative business model AND change HRS technology: too many innovations in one topic.
- As a research group, we find very little opportunities to participate in the FCH 2 JU calls.

Application process

- The application process is competitive as we expected but it has been taken over by professional consultants who write bids full-time. We had two failed attempts in FCH JU and later in FCH 2 JU we have had more failures. Therefore, SMEs like my company have little chance of getting a proposal through.
- Information about the separate payment that is required to FCH JU should have been available in the call. This payment created significant confusion amongst the partners in the consortium after the project was granted. Ideally, this funding of the FCH JU activities should have been handled in a different way, and any dedicated payments from project partners should be incorporated in the electronic application form, and directly deducted from the funding.
- FCH JU shared a word document reflecting the online application: without this Template, the submittal would have been much harder. Please provide this Template (incl. excel for budgeting) on the H2020 portal.
- The general procedure is not anymore fully understandable! Too much documents need to get provided separately and the specific instruction given appears often unclear to none experienced participants. However, too many windows open during editing a proposal and often it appears unclear how to proceed with asked information and requests. At least, partners find heavily their respective parts to enter their individual information.
- Preparing and writing the proposals is too much time consuming. Considering shorter applications would be good idea. Why not a first short step with a pre-selection process?
- Two step proposals will reduce work load a lot.
- A two-stage proposal evaluation could be more convenient. A first evaluation about the technical proposal and its impact can make the proposal preparation much easier.
- Overall application process requires significant efforts and provides little flexibility. This could be improved. Applications process is better suited for "research" process than for "demo" projects.
- The proposal submission procedure with separate plan (5 pages) for dissemination and exploitation may cause confusion.

Evaluation process

- Sometimes the evaluators seem to be not perfectly aware of the evaluation criteria, i.e. almost same proposal submitted two times into two different calls were differently evaluated. Evaluators should be better "taught" on their work.
- Evaluation summary reports should be written by experts in the specific area and should clearly define the weaknesses of the proposal. This is crucial to enable applicants to improve the quality of the document when re-submitting.
- On occasions, it is not always clear to prospective partners exactly what information is being sought in response to some of the proposal criteria, as the language can be ambiguous or unclear.
- The evaluation process is clear and transparent. However the evaluation report is not always clear and fully convincing and there is no way to have re-evaluation

with different experts.

- Careful revision of the comments in the evaluation summary report, second check of the proposal would be appropriate as well as avoiding vague comments in the evaluation summary report i.e. not supported by specific and detailed explanations
- The current review process works well. To increase transparency of the reviewing, a blind review process should be applied. This means that the evaluators would not know the identity of the applicants. In this way, personal agendas of the reviewers would not affect the outcome.
- The evaluation process appears neither transparent nor the evaluation report understandable in all details. To have a meaning is an advantage build mostly on expertise. However, evaluators show more and more not respecting other meanings and views which will lead to a disadvantage, or better said, knock-out.
- The absence of negotiation phase causes some time some troubles. A well-regulated negotiation phase could help on improving the project before its start.
- Sometimes the important facts/information elaborated in the proposal have been completely disregarded (reviewers stated they were missing), and as the system stays one cannot complain against this. Even a reviewer does not get a bad mark for missing something like this.

Timelines

- The time from publishing the call text to submission deadline is too short to form consortia.
- Regarding timelines, although the usual period of around 3 months from time of call announcement to proposal submission appears sufficient, in practice because of the time taken to build suitable consortia and agree roles and then to construct a proposal with all the extensive contributions required from all partners satisfactorily addressed, the time allocated is often insufficient. A four-month period may allow enough time to build a better proposal.

Grant validation process

- As I had the last FP7 projects, it was a difficult process. It seems to have improved significantly under H2020
- In general, procedures were ok except for the following: Information from the proposal (e.g. work package descriptions) has to be filled in again in the grant finalisation phase.
- Speed-up the REA validation procedure and the feed-back time.
- Partners need to get instructed personally due to missing information how to access pages and which information is needed and asked by the Commission
- Submission of the piecemeal information required for Part A is very long-winded and time-consuming in the SyGMa system, whereas submission of the single document for Part B is very straightforward, simple and quick.
- Furthermore, one considerable source of confusion amongst our partners occurred with automatic notification messages generated in the Participant Portal where it was totally unclear who the message was directed at and who needed to act on it, i.e. was the message being sent to the partners for information only or because it required action.
- Inconvenient: in the application phase WP descriptions were in a document, in the grant preparation phase in an online table. This requires extra work and the risk of copy-paste-mistakes.
- We had many problems with the LEAR process.
- Initially the tool did not work correctly - the wrong grant distribution number were stated and it took some time for until they were fixed.
- Far too bureaucratic.
- We would like to have a clearer legal basis of the "Standards Project Contribution Clause" to Hydrogen Europe.
- Duplication of work for entering information into the online tool is time consuming and can lead to discrepancies between working version and inline version. In general, and because of complexity of the system, partners do not

use the online tool as a basis for managing work etc.

Reasons why the second generation of the JU presents generally an improvement compared to its predecessor under FP7.

- Process of call structure.
- More easy administration through PP.
- Better software tools, more professional handling.
- I did not note a real difference: the service of FCH JU was already good under FP7!
- No room for relevant roles in the projects for the research centres.
- Common rules with Horizon 2020 help project management.
- The pre-financing is much lower than in FP7 which is an issue for the demonstration projects.
- Rules of H2020 are less flexible. More Project Officers do help in supporting projects better. So, rules are less good. Support staff/the team is better.
- Under FCH 2 JU the procedures have been simplified making them much easier to manage from the applicant's side.
- Clear and simple rules, funding easy to calculate, no surprise in the grant agreement, fixed time to grant even it should be a little bit shorter, the same for the evaluation phase, perhaps we should try to cut two months from the call to the grant.
- The overall structure is better than FCH JU. What I don´t agree is on the unbalanced degree of high TRLs.
- More structured. Better applications form. Better procedures.
- The simplified rules are an improvement. Entirely electronic processes are more practicable and user friendly. The greater level of support provided by the inclusion of FCH 2 JU in H2020 has significantly increased the appeal of participation in the programme.
- To my experience, the processes for application, grant preparation and modifications are clearer.
- Administrative processes slightly improved. Topics too high TRL-oriented, too little research.
- Slightly more user friendly online system and easier programme rules.
- More low TRL level research needs to be included for funding.
- The project JU fee is not insignificant and the JU should put this money to good use.

8.6 Annex 6 Detailed analysis of the Public Consultation 2017

By the end of 2016, the European Commission launched a public stakeholder consultation "Interim evaluation of the Joint Undertakings operating under Horizon 2020".

This public consultation aimed to collect the views of the public about the implementation of the Joint Undertakings (JUs) under Horizon 2020 for the period 2014 to 2016. 373 persons answered to the questionnaire, mainly from private organisations.

The respondents have a good insight in the FCH 2 JU as 75% already have applied for funding under FCH 2 JU and even 54% were directly involved with the FCH 2 JU. This group of participants included members of Hydrogen Europe or N.ERGHY (26%), beneficiaries (37%), advisory board members (5%) and evaluators (2%).

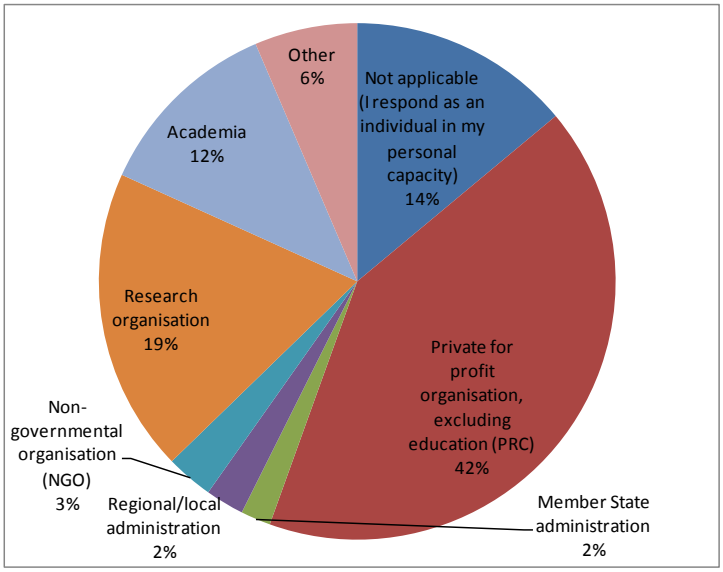
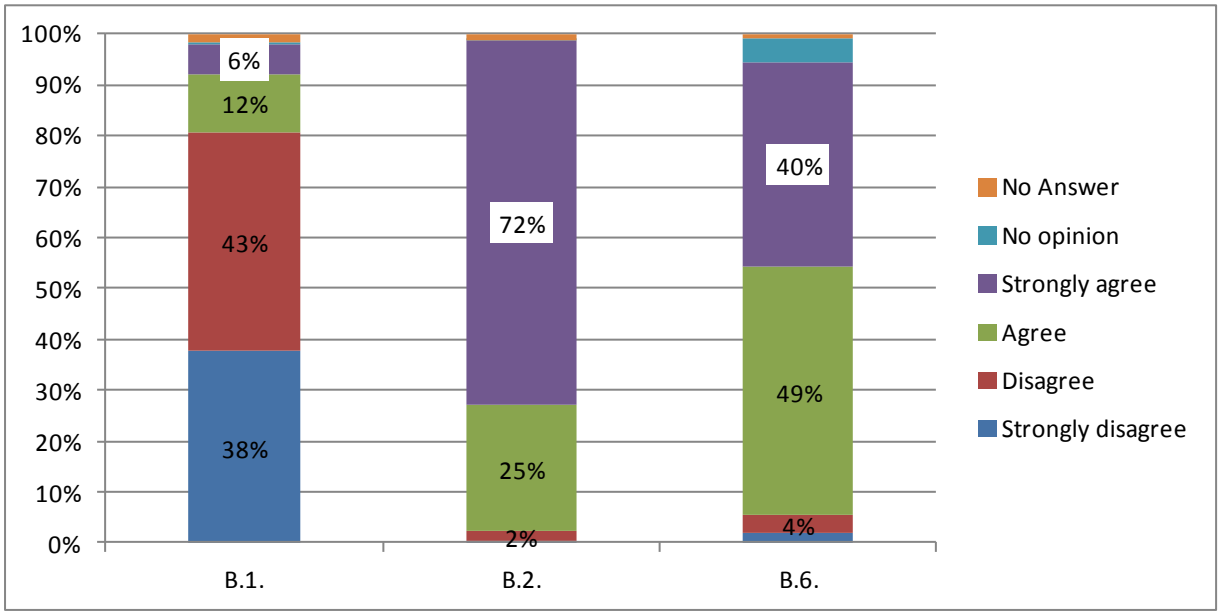


Figure 36. What type of organisation do you represent?

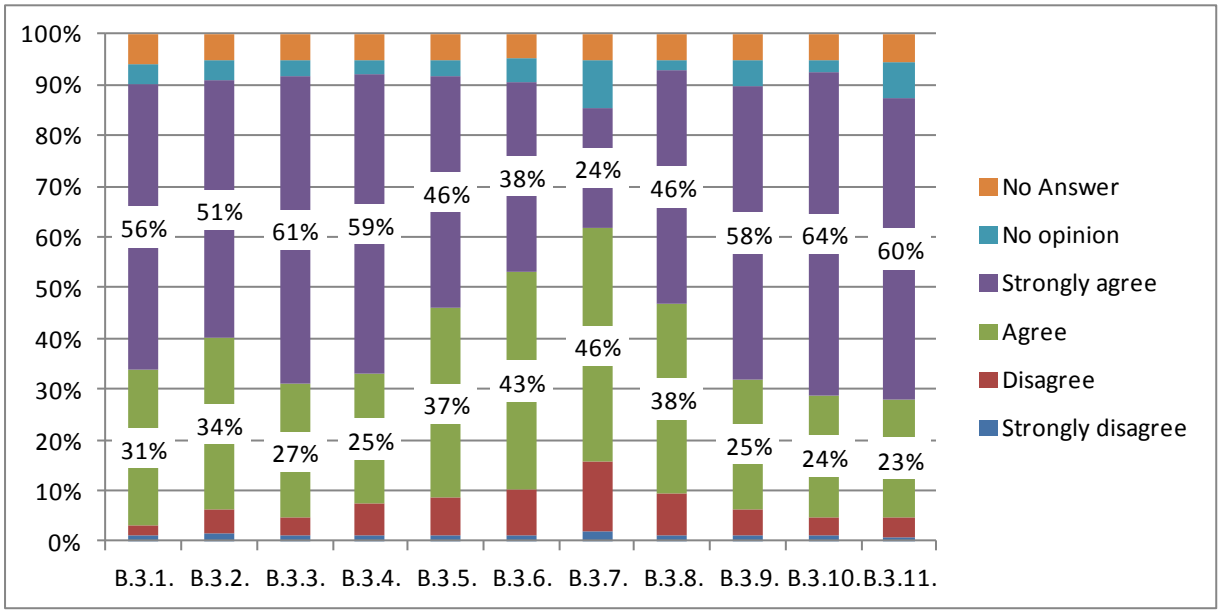
The respondents see a strong dependence of the FCH technology's success on the EC's support. Only 12% agree that the industry along with other possible actors at national level but without the involvement of the EU, would be able to overcome the barriers which hinder the market introduction and deployment of fuel cells and hydrogen technologies. Even 97% agree with the cooperation of the EU in a PPP-model to support FCH technology deployment. 89% of the respondents acknowledge that FCH 2 JU contributes to economic growth and job creation in the EU. In conclusion, respondents strongly believe in the necessity of EU support for FCH technology deployment and strongly agree with the chosen PPP tool.



B.1.	In your view, could industry along with other possible actors at national level but without the involvement of the EU, be able to overcome the barriers which hinder the market introduction and deployment of fuel cells and hydrogen technologies?
B.2.	Do you agree with the EU cooperating with industry in the context of a public-private partnership so that fuel cells and hydrogen technologies can be introduced into the market and deployed?
B.3.	Do you consider that the FCH 2 JU contributes to economic growth and job creation in the EU?

Figure 37. Evaluation of the PPP approach.

The participants were asked their view on the added value of the private-public-partnership. Several benefits were presented. The 'greater scale of cooperation and activities' (88% agreement) and 'better coordination of European research efforts' (87%) were rated highest followed by 'better use of available funding' (87%), 'attraction of best players in the sector' (84%) and 'more cross border collaboration' (84%). 'Increased synergy with sources of funding outside FCH 2 JU' was rated worst (69%). In conclusion, the argument of improved cooperation was evaluated as the most prominent advantage of the PPP.



B.3.1.	Better use of available funding
B.3.2.	Attraction of best players in the sector
B.3.3.	Better coordination of European research efforts, overcoming fragmentation
B.3.4.	More cross border collaboration
B.3.5.	More cross-sector/interdisciplinary/multi-stakeholder collaboration
B.3.6.	Quicker adoption of standards
B.3.7.	Increased synergy with sources of funding outside FCH 2 JU
B.3.8.	Better availability of research results and cross-fertilisation of knowledge
B.3.9.	Help in overcoming first mover risk
B.3.10.	Greater scale of collaborations and activities
B.3.11.	Faster introduction on the market

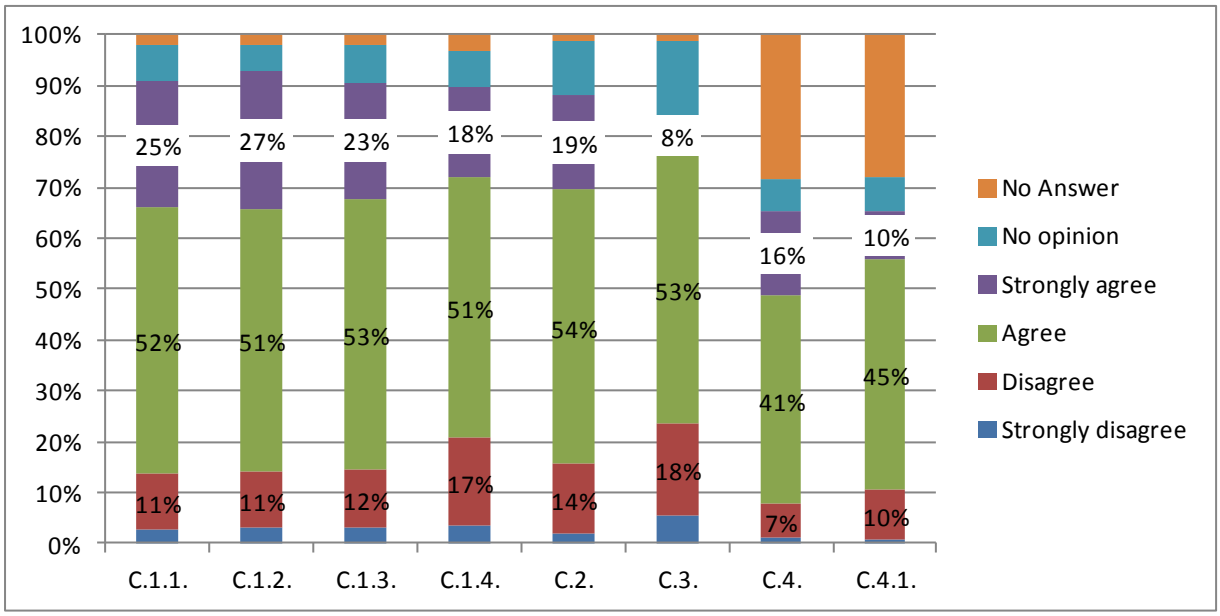
Figure 38 What is the added value of this public-private partnership?

In addition, the respondents were invited to provide any other elements of European added value they considered to be relevant. Comments included the following additional aspects:

Other elements of European added value they considered to be relevant
• Political integration of objectives in the renewable energy area.
• Networking and gathering of critical mass to move from bunch of individual companies towards an industry in an emerging field.
• Underline the strength of European manufacturing versus emerging Asiatic technology markets. Only with innovation and research and so with quality of its products Europe can face the challenges of the future in a competitive market.
• Be a reference for national programmes, i.e. gives clear indication on priorities and KPIs which can be used to steer and align also national activities.
• FCH 2 JU indeed serves as a platform consolidating R&D effort that otherwise would be rather fragmented and scattered, thus helping to achieve "critical mass".
• Sharing the risk especially in the Research Actions, these initiatives allow to the research and industrial agents to develop and introduce in the market disruptive technologies.
• More political focus.
• Strong added value with regard to climate targets of the union and energy independence for Europe.
• Help in overcoming national restrictions e.g. national legal influences.

- Better and broader visibility of activities in fuel cells and hydrogen.

The next set of questions concerned the quality of the JU's homepage: Three quarters of the respondents agreed that the website offers easy and effective access to information to the public; e.g. about funded projects and the application process. However, the level to which access is provided to knowledge generated by the projects funded under this JU is slightly less (69%).



C.1.1.	Do you consider that the FCH 2 JU website provides the general public and potential participants with easy access to information?: easy and effective access to information to the public
C.1.2.	The FCH 2 JU website provides easily accessible and sufficient information about its funded projects
C.1.3.	The FCH 2 JU website provides effective access to information and sufficient guidance to interested organisations facilitating their participation in proposals
C.1.4.	The FCH 2 JU website provides easy and effective access to knowledge generated by the projects funded under this JU
C.2.	Do you consider that the FCH 2 JU encourages the participation of SMEs?
C.3.	Do you consider that the current way of defining topics for the calls of proposals is open and inclusive?
C.4.	Do you consider that the FCH 2 JU organises a sound and fair proposal evaluation system based on both scientific and technological excellence and industrial relevance?
C.4.1.	Do you consider that the communication of the evaluation results and the feedback provided to the applicants is effective and meaningful?

Figure 39. Quality of communication and cooperation?

73% agrees that the FCH 2 JU encourages the participation of SMEs. This seems to be a weak recognition of the achieved high level of SME participation in the FCH 2 JU. Also the opportunities for participation in the current way of defining topics for the calls of proposals is not transparent enough, only 61% of the respondents agreed that the current process is open and inclusive.

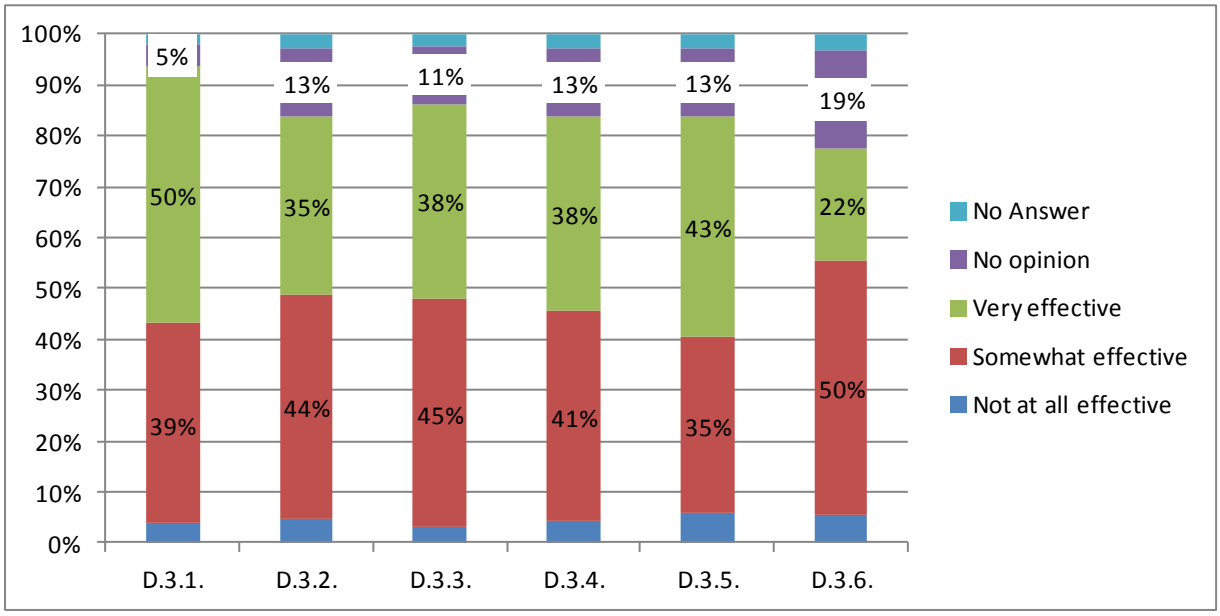
The level of agreement with the proposal evaluation system is poor, only 57% of the participants evaluated this being sound and fair proposal evaluation system based on both scientific and technological excellence and industrial relevance The poor rating on

the current way of communicating the evaluation results and providing feedback to the applicants (55% agreement) could be one reason for the doubts on the evaluation process. Fair proposal application processes are a key aspect of the funding programme. Reasons and measures to improve the situation need to be evaluated carefully by the PO and the EC. A benchmark with the results of the other JTIs should be carried out.

The priorities addressed by the FCH 2 JU are set in the Multi-Annual Work Plan (MAWP). 79% of the respondents agree that the MAWP is relevant and coherent with European transport and energy policies and priorities. However, 42% of the respondents consider other research and innovation areas not mentioned in the MAWP as important to be addressed by the FCH 2 JU. As this is a very high rating, PO should carefully consider the inclusion of more interested groups in the elaboration of the MAWP. Respondents named the following other research and innovation areas as currently not addressed.This is a sample list, however, the better inclusion of low TRL research topics to the MAWP was addressed repeatedly in the comments:

Sample list of comments related with other research and innovation areas as currently not addressed.
• Advanced fuel cell technologies and biomass-integrating chain.
• R &D for investments on pilot lines.
• In general, low TRL activities.
• Fault tolerant control of fuel cell systems.
• The MAWP should keep a certain amount of open activities for issues becoming clear during the execution of projects.
• More socio-economic aspects (+ effect of national tariff and tax policies on deployment)
• Basic research (TRL < 3) is necessary to stay in the race with RIA actions devoted to Gen2 innovations.
• Better tools for the virtual design of FC and hydrogen systems.
• Too dedicated to demonstration and low place for mid-term or long-term research on the field.
• The growing interest for FCH solutions in new applications like train, trucks, maritime and even aeronautical applications was not sufficiently anticipated.
• The growing interest for FCH solutions in new applications like train, trucks, maritime and even aeronautical applications was not sufficiently anticipated.
• The lack of KPIs for materials, MEA and more generally at components level is important.
• Smart Grid area focusing on FCH as demand side integrated technologies.

The respondents certify a good performance of the FCH 2 JU in developing a strong, sustainable and globally competitive fuel cells and hydrogen sector in the EU (89%). The achievement of technical KPIS is rated less (72-83% agreement on effectiveness), see questions D.3.2. – D.3.6. However, 80% of the respondents consider that FCH 2 JU projects have resulted in specific scientific and/or technological successes.

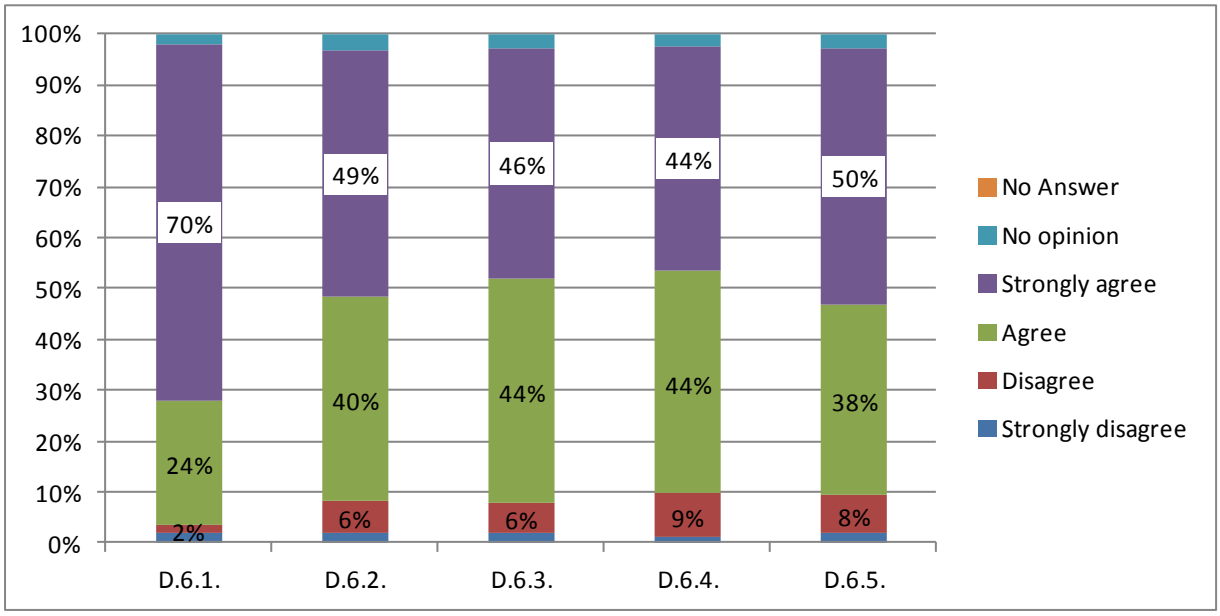


D.3.1.	Developing a strong, sustainable and globally competitive fuel cells and hydrogen sector in the EU
D.3.2.	Reducing the production cost of FC systems to be used in transport applications, while increasing their lifetime to levels which can compete with conventional technologies
D.3.3.	Increasing the electrical efficiency and durability of FC for power production to levels competitive with conventional technologies, while reducing costs
D.3.4.	Increasing 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 can compete with the alternatives for electricity production available on the market
D.3.5.	Demonstrating 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
D.3.6.	Reducing the use of Critical raw materials, for instance through low-platinum or platinum-free resources and through recycling or reducing or avoiding the use of rare earth elements

Figure 40 In your view how effective has the FCH 2 JU been in terms of …

82% of the respondents support the statement that the FCH 2 JU can contribute towards improving the competitiveness and industrial leadership of Europe in the transport and energy sector in the medium term (over the next ten years). This is an excellent prove of the confidence of the FCH community in the work of the FCH 2 JU.

Respondents agree on various advantages resulting from the participation in a FCH 2 JU project among the direct financial support. Greater visibility, access to knowledge, markets, opportunities etc. rank approximately on the same high level of agreement (88-90%).



D.6.1.	Direct financial support for innovative research and development
D.6.2.	Greater visibility across Europe for your entity/Reputation
D.6.3.	Enhanced access to knowledge and technologies
D.6.4.	Enhanced access to new markets, business opportunities and funding sources
D.6.5.	Inclusion in open innovation networks, with direct contact to leading researchers in universities and the industry

Figure 41 Which would you consider as major benefits of participating in a FCH 2 JU project?

Respondents consider the extent of coherence of the activities of the FCH 2 JU with other activities of the Horizon 2020 programme on an acceptable level (somewhat coherent (34%), very coherent (37%). The relation of the FCH 2 JU with other Union funding programmes and/or with similar international, national or intergovernmental programmes is evaluated to be complementary (20%), providing synergies (41%) or overlapping (10%). Only 39% of the respondent had any experience in combining different sources of EU funds and/or with national funds for research and over the innovation value chain.

8.7 Annex 7 Administrative functions shared with JU's and EC

Table 15 Administrative functions shared with JU's and EC.

DG Owner	Name	Description	Used	Comment
RTD	FP7 tools (NEF-CPM-PDM-FORCE-SESAM)	FP7 grant management system	y	
RTD	H2020 tools (COMPASS/SYGMA)	H2020 grant management system	y	
RTD	Secunda+	User account & routing management for H2020 tools	y	
BUDG	ABAC	Financial system	y	
HR	SYSPER	Integrated system for the management of human resources	n	not available; cost to join excessive
HR	EU Learn	Integrated system for the training management	y	
SG	ARES	Electronic document registration & archiving	n	not available in the JU
RTD	EMI	Experts Management Internal tool	y	
REA	PDM/URF	Legal entities related documents	y	
BUDG	EDES exclusion database	Early Warning System and the Central Exclusion Database	y	
RTD	AUDEX	External Audit Research	y	
RTD	CORDA/WebCORDA	Reporting tool for RTD grant management systems	y	limitations in access
EC / BUDG	INTRACOMM	EC & DG BUDG Intracomm	y	limited access
PMO	RCAM	Joint Sickness Insurance Scheme	y	
Shared with other JUs				
IMI JU	ISA	Time recording system & absence management	y	
Other support and shared services				
Common Support Centre (CSC)		H2020 Support services for R&I family: audit and legal support, support business processes, service H2020 information and data, IT service	y	
Shared JU infrastructure		Common IT infrastructure for JU in White Atrium	y	
Joint procurement		participation to inter-institutional procurement launched by DGs or agencies	y	
Shared services		catalogue of shared services and best practices EU network of agencies	y	

8.8 Annex 8 Summary of Previous Coordinators Survey 2013

The first survey of the opinion of beneficiaries regarding overall satisfaction with the services provided by the Joint Undertaking was performed through Coordinators Survey launched on the 27th March 2013 and finished on the 26th April 2013. The investigation was realized for the purpose of the Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking. The questions concerned comparison of FCH JU to Seventh Framework Programme, project management as well as programme design and implementation.

- The clarity of calls for proposals was judged as at least satisfactory by a majority of respondents (63.0%) and much better than average by 30.4%. Better, as compared to Seventh Framework Programme, advice at preparatory stage was confirmed by 86.9% of responders.
- Time to grant, surprisingly, was assessed as much better and little better by 78.2% even though the time was longer as compared to Seventh Framework Programme. This might reflect the low representation of large demonstration projects among respondents because for those projects it was noted that the time to grant was longer.
- The response to questions during project implementation was also positively assessed by 91.4% of coordinators.
- Time to pay was judged as better by 82.6% of respondents and quite high percentage (15.2%) did not have an opinion. No opinion option was chosen by 43.5% of responders answering the question concerning fairness and appropriateness of financial auditing. The probable reason was the fact that they had not been audited.

The responses on project management showed a similar strong appreciation of the FCH JU. All the questions related to project management and concerning clarity of expectations of project management, quality and fairness of feedback on project progress, fairness and helpfulness of mid-term evaluations, facilitation of communication among projects and help with dissemination were positively assessed with an average 73.1% of satisfaction. Quite high percentage of responders chosen no opinion option for questions fairness and helpfulness of mid-term evaluations and help with dissemination, respectively 37.0% and 28.3%, probably because the coordinated projects did not go through the evaluation and the support of FCH JU with dissemination was not used.

95.7% of coordinators thought that the programme objectives were clearer and relevance to calls was better. The structuring of programme by research areas and topics were also better under FCH JU as assessed by 87.0% of coordinators. The clarity of call and criteria for evaluation of proposals improved in the view of 89.2% of respondents. Fairness and transparency of evaluation was much or little better for 71.7% of coordinators but 21.7% did not have an opinion regarding this question. The feedback from evaluation was assessed as much or little better by 69.6% of respondents but once again 21.7% did not have an opinion.

8.9 Annex 9 Detailed information of the FCH JU efficiency

The following tables illustrate different aspects of FCH JU efficiency.

Table 16 Management efficiency under FP7 since autonomy[104].

	2008	2009	2010[105]	2011	2012	2013
Administrative. expenses k€	-	-	2,930	3,217	3,908	3,969
Operational expenses k€	-	-	23,007	62,747	124,440	148,178
Ratio administrative/ operational budget				**5.1%**	**3.1%**	**2.7%**
N° of running projects	-	-	24	57	90	109
N° of "project years"[106]	-	-	18.1	40.9	69.8	93.6
Average project management cost per running project[107]						
... per project k€	-	-	**122.07**	**56.44**	**43.43**	**36.41**
... per project year k€	-	-	**161.90**	**78.63**	**55.96**	**42.42**
N° of staff[108]	-	11	15	20	20	20
- Temporary agents		9	13	18	18	18
- Contract agents		2	2	2	2	2
Budget per head k€	-	-	**1,534**	**3,137**	**6,222**	**7,409**
Staff expenses in k€[109]	-	-	-	2,171	2,273	2,167
Experts in k€	-	-	-	313	364	301
Annual project management cost per running project (staff costs/N° of running projects) k€						
				53.1	32.6	23.2

[104] Respective Annual Accounts and annual Activity Reports
[105] Staff and other operation costs were accounted not for the full year.
[106] Total number of project days per year divided by 365 or 366 respectively
[107] Calculation method: Administrative costs divided by number of running projects or project years respectively
[108] Source: FCH JU Annual Implementation Plan
[109] Included under this heading are expenses related to the salaries and other employment related allowances of the staff members.
Source: Annual Accounts of the Fuel Cells and Hydrogen Joint Undertaking
Including salaries & entitlements, missions and training costs (after autonomy, full year basis only since 2011)

Table 17 Indicative timelines for calls under FP7[110][111].

FCH JU Call for Proposals	2008	2009	2010	2011	2012	2013 Part I	2013 Part II
Publication of call	08.10.08	02.07.09	18.06.10	03.05.11	17.01.12	15.01.13	28.11.13
Deadline for submission of proposals	15.01.09	15.10.09	13.10.10	18.08.11	24.05.12	22.05.13	27.02.14
Evaluation of proposals	02.09	11.09	11.10	09.11	06.12	06.13	03.14
Evaluation Summary Reports sent to proposal coordinators ("initial information letter")	03-04.09	12.09	12.10	10.11	07.12	07.13	01.04.14
Invitation letter to successful co-ordinators to launch grant agreement negotiations with the FCH JU	04-05.09	02-03.10	02.11	01.12	09.12	09.13	05.2014
Letter to unsuccessful applicants	05.09	02-03.10	from 06.11	from 05.12	from 01.13	from 01.14	from 09.14
Signature of first FCH JU grant agreements	09.09	from 06.10	from 06.11	from 05.12	from 01.13	from 01.14	from 09.14
Indicated minimum 'Time to Grant' in months	7.5	7.5	7.6	8.4	7.3	7.4	6.1
Achieved timelines according to Activity Reports (mm-mm.yy)							
Signature of Grant Agreements	12.09	10-12.10	10-12.11	06-12.12	04-12.013	02-12.14	12.2014
Payment of Pre-financing	12.09[112]	12.10[113]	11-12.11	07-12.12	05-12.13	03-12.14	12.2014
Achieved timelines according to CORDA database							
TTG in months	11.0-11.2	12.8-14.2	12.5-14.3	10.1-16.1	10.9-18.6	9.5-18.9	9.2-9.3

[110] Fuel Cells and Hydrogen Joint Undertaking Annual Implementation Plans 2008-2013
[111] Fuel Cells and Hydrogen Joint Undertaking Annual Activity Report 2013
[112] Except of €27,220 in January 2010
[113] Except of €519,508 in Q1 2011 at the request of the beneficiary

Table 18 Average evaluation cost per proposal until 31/12/2013[114].

Evaluation of Calls	FCH-JU-2008-1 in 2009	FCH-JU-2009-1 in 2009	FCH-JU-2010-1 in 2010	FCH-JU-2011-1 in 2011	FCH-JU-2012-1 in 2012	FCH-JU-2013-1 in 2013
Total number of proposals submitted	32	50	71	82	72	70
Total number of eligible proposals	32	50	69	81	68	64
Average N° of participants per eligible proposal	7 .6	8 .0	8 .1	8 .2	8 .1	7 .6
Average proposal EC contribution [k€]	2,223	2,603	3,342	3,499	3,732	3,107
Number of independent experts for evaluation[115]	19+1[116]	30+1	32+2+1[117]	37+1+2	31+1+2	43
Costs for experts [k€]	-	-	181	234	197	215
Average evaluation cost per proposal received [k€]	-	-	2.6	2.9	2.7	3.1

[114] CORDA database and PO
[115] This data is extracted from the respective Annual Activity Reports, however only few reports provide this data
[116] 19 experts plus one observer
[117] 32 experts plus two observer plus one chair

8.10 Annex 10 Documents received and studied

- **LEGISLATION PERTAINING TO THE FCH JU**

Proposal for a Council Regulation setting up the Fuel Cells and Hydrogen Joint Undertaking, Brussels, COM(2007) 571, 9.10.2007

Accompanying document to the Proposal for a Council Regulation setting up the Fuel Cells and Hydrogen Joint Undertaking, Impact Assessment, SEC(2007) 1272, Brussels, 9.10.2007

Council Regulation (EC) No 521/2008 of 30 May 2008 setting up the Fuel Cells and Hydrogen Joint Undertaking, O.J., L 153/1, 12.6.2008

Commission Staff Working Document. Executive Summary of the Impact Assessment accompanying the document Proposal for a Council Regulation on the Fuel Cells and Hydrogen 2 Joint Undertaking, COM(2013) 506. Brussels, 10.7.2013

Proposal for a COUNCIL REGULATION on the Fuel Cells and Hydrogen 2 Joint Undertaking, COM(2013) 506 Brussels, 10.7.2013

Council Regulation (EU) No 559/2014 of 6 May 2014 establishing the Fuel Cells and Hydrogen 2 Joint Undertaking. J.O. L 169/108 7.6.2014

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) and repealing Decision No 1982/2006/EC, O.J. 347/104 20.12.2013

Decision No 1982/2006/EC of The European Parliament and of the Council of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013) O.J. L 412/1 30.12.2006

Council Decision of 19 December 2006 concerning the Specific Programme "Cooperation" implementing the Seventh Framework Programme of the European Community

Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee of The Regions, Energy 2020 - A strategy for competitive, sustainable and secure energy, COM(2010) 639 , Brussels, 10.11.2010

Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions, Clean Power for Transport: A European alternative fuels strategy, COM(2013) 17, Brussels, 24.1.2013

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) and repealing Decision No 1982/2006/EC O.J. L 347, 20.12.2013

Commission Staff Working Document accompanying the Proposal for a Council Regulation defining the objectives, legal status, operational rules and statutes of the Fuel Cells and Hydrogen Joint Undertaking for the period 2014-2024

Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. A Roadmap for moving to a competitive low carbon economy in 2050, COM (2011)112, Brussels 8.3.2011

European Commission, Europe 2020 — A strategy for smart, sustainable and inclusive growth, COM(2010) 2020 final, Brussels, 2010

A New Start for Europe: My Agenda for Jobs, Growth, Fairness and Democratic Change. Political Guidelines for the next European Commission, Opening Statement in the European Parliament Plenary Session 15 July 2014

Communication from the Commission, Energy Union Package: A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy, COM(2015), Brussels, 25.2.2015

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

Proposal for a Council Regulation on the Fuel Cells and Hydrogen 2 Joint Undertaking, Brussels, COM(2013) 506 final, 10.7.2013

EC DG for Research and Innovation, Directorate K – Energy, K.2 - Energy conversion and distribution systems, Extension of the Fuel Cells & Hydrogen Joint Technology Initiative under Horizon 2020, Results of the public consultation

Regulation (EU) No 1299/2013 of the European Parliment and of the Council of 17 December 2013 on specific provisions for the support from the European Regional Development Fund to the European territorial cooperation goal, L 347/259, Brussels 20.12.2013

Regulations Commission delegated regulation (EU) No 275/2014 of 7 January 2014 amending Annex I to Regulation (EU) No 1316/2013 of the European Parliament and of the Council establishing the Connecting Europe Facility

Hydrogen Infrastructure for Transport, http://www.hit-tent.eu/category/about-hit/

- **DOCUMENTS ON RELEVANT FUNDING OPTIONS**

Operations Evaluation. Second Evaluation of the Risk Sharing Finance Facility (RSFF), June 2013

Pan-European Venture Capital Fund(s)-of-Funds programme, link

- **DOCUMENTS ON BETTER REGULATION**

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Better regulation for better results - An EU agenda. Strasbourg, 19.5.2015

Communication From The Commission To The European Parliament And The Council, Proposal for an Interinstitutional Agreement on Better Regulation**.** Strasbourg, COM(2015) 216 19.5.2015

Communication From The Commission To The European Parliament, The European Council And The Council Better Regulation: Delivering better results for a stronger Union**.** Brussels, COM(2016) 615 14.9.2016

The Better Regulation Toolbox, European Commission.

Hydrogen Energy and Fuel Cells – a vision for our future, High Level Group for Hydrogen and Fuel Cells, Summary Report, European Commission, 2003.

- **FP7 DOCUMENTS**

Rules for submission of proposals, and the related evaluation, selection and award procedures, European Commission, 26 September 2008

Commitment and Coherence –Ex Post Evaluation of the 7th EU Framework Programme, European Commission November 2015

- **EUROPEAN POLICY AND SECTORAL DOCUMENTS**

Energy policy:

COMMUNICATION FROM THE COMMISSION, Clean Energy For All Europeans, COM(2016) 860. Brussels, 30.11.2016

Strategic Energy Technology (SET): Towards an Integrated Roadmap and Action Plan, JRC, December 2014

Communication from the Commission, Energy Union Package: A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy, COM(2015), Brussels, 25.2.2015

Communication from the Commission. Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation, C(2015) 6317, Brussels, 15.9.2015

Transport policy:

WHITE PAPER: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, COM(2011) 144. Brussels, 28.3.2011

Clean Power for Transport: A European alternative fuels strategy SWD(2013) 4. Brussels 24.1.2013

DIRECTIVE 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure

ERTRAC Strategic Research Agenda Towards a 50% more efficient road transport system by 2030. Executive Summary, October 2010

ERTRAC Research and Innovation Roadmaps - Implementation of the ERTRAC Strategic Research Agenda 2010, September 2011

Environment and climate policy:

Horizon 2020 Work Programme 2016 – 2017, 12. Climate action, environment, resource efficiency and raw materials, European Commission Decision C(2016)4614 of 25 July 2016

Horizon 2020 Work Programme, 2016 – 2017. Cross-cutting activities. European Commission Decision C(2016)4614 of 25 July 2016

Commission Staff Working Document, Energy storage – the role of electricity, SWD(2017) 61. Brussels, 1.2.2017

- **MATERIAL FROM THE FCH JU**

Reports of Programme Review Days, 2014, 2015, 2016

FCH, Annual Activity Reports 2011, 2012, 2013, 2014, 2015, 2016

Final Annual Accounts, Financial year 2012

Final Annual Accounts, Financial year 2013

Annual accounts of the Fuel Cells and Hydrogen Joint Undertaking, Financial year 2014

Annual accounts of the Fuel Cells and Hydrogen Joint Undertaking, Financial year 2015

European Court of Auditors Report on the annual accounts of the Fuel Cells and Hydrogen Joint Undertaking for the financial year 2012

European Court of Auditors Report on the annual accounts of the Fuel Cells and Hydrogen Joint Undertaking for the financial year 2013

European Court of Auditors Report on the annual accounts of the Fuel Cells and Hydrogen Joint Undertaking for the financial year 2014

European Court of Auditors Report on the annual accounts of the Fuel Cells and Hydrogen Joint Undertaking for the financial year 2015

Final Report –Annual Assessment of the level of in-kind contribution (12/03/2015)

FCH 2 JU Communication Strategy 2014-2020. Promoting Fuel Cells and Hydrogen Joint Undertaking activities and objectives

Procedure for Selection and Drafting of Topics for FCH 2 JU, FCH JU, 2016

Hydrogen Europe, Annual Report, 2016.

JTI Industry Grouping members - Declaration of commitment to the process of creating a Joint Technology Initiative on Hydrogen and Fuel Cells, letter to the European Commission, 18th June 2007

The Ultimate guide to fuel cells and hydrogen technology, Hydrogen Europe

FCH JU Industry Grouping Financial and Technology Outlook 2014-2020

Multi - Annual Implementation Plan 2008 – 2013, FCH JU

Annual Implementation Plan 2011, 2012, 2013

Multiannual Work Plan, 2010-2014, FCH JU

Annual Work Plan, 2014, 2015, 2016

Document FCH JU 2009.8, Grant Agreement FCH JU, Adopted by the FCH JU Governing Board on 10 September 2009

Fuel Cell and Hydrogen technologies in Europe 2011 , Financial and technology outlook on the European sector ambition 2014-2020

Study on the trends in terms of investments, jobs and turnover in the Fuel cells and Hydrogen sector, October 2012

- **PREVIOUS FCH JU EVALUATIONS**

First Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking, Expert Group Report, Directorate-General for Research and Innovation, May 2011

Second Interim Evaluation of the Fuel Cell & Hydrogen Joint Undertaking, Expert Group Report, European Commission, 2013

- **OTHER FCH RELATED DOCUMENTS**

Advancing Europe's energy systems: Stationary fuel cells in distributed generation, Roland Berger Strategy Consultants, 2015

Commercialisation Strategy for Fuel Cell Electric Buses in Europe, Roland Berger, September 2015

Fuel Cell Electric Vehicles: The Road Ahead, FuelCell Today, July 2013

A roadmap for financing hydrogen refuelling networks – Creating prerequisites for H2-based mobility. A study for the Fuel Cells and Hydrogen Joint Undertaking (FCH JU), Roland Berger

Younicos Selected by Centrica to Design One of the World's Largest Battery Storage Systems, Dec 14, 2016, Battery Power, Dec 14 2016. http://www.batterypoweronline.com/main/news/younicos-selected-by-centrica-to-design-one-of-the-worlds-largest-battery-storage-systems/

The Council Regulation (EU) No 559/2014 establishing the Fuel Cells and Hydrogen 2 Joint Undertaking stipulates in Art.19(2) that by 30 June 2017 the Commission shall conduct […] a final evaluation of the FCH JU established under Regulation (EC) No 521/2008.

The current evaluation of the operation of the FCH JU covers the period from 2008 to June 2014. Its aim is to assess the performance of the FCH JU and its progress towards the objectives stipulated in Regulation (EC) No 521/2008, including how the recommendations from the previous interim evaluations have been taken into account.

The evaluation was carried out by a Commission Expert Group registered in the EC Register of Expert Groups under Nr E021499, from November 2016 to June 2017. It is accompanied by an interim report of the FCH 2 JU, published under EUR 28613 EN.

Le règlement du Conseil (UE) N° 559/2014 portant établissement de l'entreprise commune Piles à combustible et Hydrogène 2 stipule au paragraphe 2 de l'Article 19 que la Commission doit procéder, pour le 30 juin 2017, [...] à une évaluation finale de l'entreprise commune FCH au titre du règlement (CE) N° 521/2008.

L'évaluation actuelle du fonctionnement de l'entreprise commune FCH couvre la période de 2008 à juin 2014. Son objectif est d'évaluer la performance de l'entreprise commune FCH et ses progrès vers les objectifs stipulés dans le règlement (CE) N° 521/2008, y compris la manière dont les recommandations des évaluations intermédiaires précédentes ont été prises en compte.

L'évaluation a été effectuée par un 'Groupe d'Experts de la Commission' enregistré au registre des groupes d'experts de la CE sous le N° E021499, de novembre 2016 à juin 2017. Elle est accompagnée d'un rapport intermédiaire de l'entreprise commune FCH 2, publié sous la référence EUR 28613 EN.

Studies and reports

Publications Office