European Commission

Partnership Evaluation Report: **Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2)**

Horizon Europe and the Green Transition
Interim evaluation support study

Independent Expert Report

Research and Innovation

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Horizon Europe and the Green Transition
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2024 Directorate-General for Research and Innovation EN

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1. Executive Summary

This case study on the Clean Hydrogen Joint Undertaking (CH JU) and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2 JU) is part of the Ex-post evaluation of Horizon 2020 (H2020) and the interim evaluation of Horizon Europe (HE) activities related to a green transition. The case study focuses both on the timeframe of H2020 and HE.

The Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2 JU) started functioning in 2014 with funding of EUR 665 million under H2020. The mission of the FCH 2 JU was the development of a portfolio of clean and efficient fuel cell and hydrogen (FCH) solutions to the point of market readiness, boosting their share in a low-carbon energy and transport system. The FCH 2 JU programme was built around three main pillars: transport, energy and cross-cutting activities.

The Clean Hydrogen Joint Undertaking is an Institutionalised partnership, established in November 2021 with the adoption of a Council Regulation 2021/2085 (also known as the Single Basic Act (SBA)). It is the successor of FCH2 and is a public-private partnership supporting R&I in hydrogen in Europe. CH JU is a part of HE's Cluster 5 'Climate, energy and mobility'. As per the Regulation, the main objective of the CH JU is contribution to the climate neutrality goals of the Union and the implementation of the EU Green Deal, the EU Climate Law and the EU Hydrogen Strategy, through the acceleration of the development and deployment of the European value chain for safe and sustainable clean hydrogen technologies.

Both Partnerships conducted a series of activities, the most important being the funding of R&I projects across EU Member States and Associated Countries. In addition, they supported policy studies; the setting up of the Fuel Cells and Hydrogen Observatory (FCHO) (since 2020, revamped to the European Hydrogen Observatory in late 2023); the organisation of the European Hydrogen Week (since 2020) and the Programme Review Days (before 2020) ; the coordination of the FCH Regions' Hub; the (two) Project Development Assistance initiatives, as well as the upcoming Hydrogen Valleys Facility; and the Mission Innovation Hydrogen Valleys Platform.

The activities of both Partnerships were highly relevant to the grand challenges facing Europe such as climate change, climate neutrality, energy security and energy transition. CH JU objectives are relevant to the EU Hydrogen Strategy and to the European Green Deal. Its three pillars include Renewable Hydrogen Production; Hydrogen storage and distribution; and Hydrogen end uses (transport applications; clean heat and power).

The overall coherence of both Partnerships with other initiatives and funding instruments has been good with certain limitations and constraints. Coherence with national hydrogen-related activities has posed a problem but CH JU management is aware of this and has been taking measures to rectify the situation. One notable way to increase synergies is through the Stakeholders Group as one of its main tasks is improving synergies with adjacent sectors and with the European Hydrogen Forum of the Clean Hydrogen Alliance.

FCH 2 JU and CH JU have been effective with regards to multiple objectives. The interviewed stakeholders have emphasized the important of raising the status of Europe as an international leader in technology. Moreover, they have significantly stimulated the formation and development 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. CH JU progress with work with the regions is also expected to lead to tangible results.

The additionality of the two Partnerships was better than expected with more than EUR 660.8 million of expected direct leverage for FCH 2 JU and a direct leverage factor of 1.04. For CH JU first call, the direct leverage was EUR 105 million and a direct leverage factor of 0.75 and a funding rate of 57.1%.

With regard to EU added value, FCH 2 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. 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 point of view of stakeholders, Europe would not be a global leader in Hydrogen without the Partnership.

With regards to cost-efficiency, DG RTD at the European Commission voiced some concerns as the Governing Board needs to accept and validate all decisions. According to other stakeholders, the cost efficiency is reasonable given the volume of funding. Overall, the governance structure of the two partnerships have evolved in the direction of better efficiency.

Overall, the transparency and openness of the Partnerships have been assessed as good with the calls being open to everyone. Preparedness for the discontinuation of funding after 31 December, 2031 has been concretised in an Initial Phasing-out Plan for the CH JU, adopted in December, 2023. The plan provides an initial analysis of different aspects of the functioning of the CH JU such as the status of running grants post 2031, the future of the operational assets and the risks associated with the discontinuation.

2. Acronyms

Table 1: Acronyms

Table	Table
AB	Advisory Board
APUs	Auxiliary Power Units
CEE	Central and Eastern Europe
CH JU	Clean Hydrogen Joint Undertaking
CINEA	The European Climate, Infrastructure and Environment Executive Agency
AWP	Annual Work Programme
CEF	Connecting Europe Facility
CHP	Combined Heat and Power

Table	Table
CINEA	European Climate, Infrastructure and Environment Executive Agency
CSA	Coordination and Support Actions
EASME	Executive Agency for Small and Medium-sized Enterprises
EISMEA	European Innovation Council and SMEs Executive Agency
EC	European Commission
EIC	European Innovation Council
EIT	European Institute for Technology and Innovation
ERA	European Research Area
ESIF	European Structural and Investment Funds
EU	European Union
FCB	Fuel Cell Electric Buses
FCEV	Fuel Cell Electric Vehicles
FCHO	Fuel Cell and Hydrogen Observatory
FCH 1 and FCH 2	Fuel Cells and Hydrogen Joint Undertaking
GB	Governing Board
H2020	Horizon 2020
HER	Hydrogen Europe Research
HE	Horizon Europe
HRS	Hydrogen refuelling stations

Table	Table
JTI	Joint Technology Initiatives
IA	Innovation Action
IC	Innovation Challenge
IEG	Independent Expert Group
INEA	Innovation and Networks Executive Agency
KPI	Key Performance Indicator
LDV	Light-duty vehicle
MAIP	Multi-Annual Implementation Plan
MoU	Memorandum of Understanding
NMP	New Production Technologies
NECPs	National Energy & Climate Plans
PEME	Polymer Electrolyte Membrane Electrolyser
RES	Renewable Energy Sources
R&I	Research & Innovation
RDI	Research, Development and Innovation
REA	European Research Executive Agency
RIA	Research and Innovation Actions
SBA	Single Basic Act
SDGs	Sustainable Development Goals
SET Plan	European Strategic Energy Technology Plan

Table	Table
SGA	Stakeholders' General Assembly
SOE	Solid Oxide Electrolysis
SRC	Strategic Research Challenges
SRG	States Representatives Group
SRI	Sustainability, Research and Innovation
SRIA	Strategic Research and Innovation Agenda
TRL	Technology Readiness Level
UN	United Nations

3. Introduction

3.1. Objectives of the Partnership Case Study

This case study on the Clean Hydrogen Joint Undertaking (CH JU) and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2 JU) is part of the Ex-post evaluation of H2020 and the interim evaluation of HE activities related to a green transition. The case study focuses both on the timeframe of H2020 and HE. The partnership FCH 2 is a part of the H2020 intervention related to the Societal Challenge "Energy". The CH JU is a part of HE Cluster 5 'Climate, Energy and Mobility'.

In the first phase of the evaluation, the partnership case study aimed to provide evidence on the relevance, coherence, effectiveness, additionality, EU Added value, transparency and openness, and efficiency of the implementation of the partnership in relation to the H2020 objectives targeting a Green Transition.

In the second phase, the information obtained has been complemented by an analysis of the transition of the H2020 partnerships to HE. Additional evaluation dimensions include the directionality of the partnership, the international positioning and visibility, and the phasing out and preparedness of the partnerships.

As changes in directionality, international positioning, and visibility as relevant dimensions can only be analysed with respect to objectives/activities set in H2020, we have also collected information on these aspects in this report.

It has to be noted that CH JU replaced the FCH 2 in November 2021. As the latter is still recent, the conclusions on effectiveness and EU-added value mainly concern FCH 2 JU. Wherever possible, an attempt has been made to capture the evolution of FCH 2 JU into CH JU and the reasons behind it which are mainly related to relevance and coherence aspects.

3.2. Methodology

The partnership case study analysis comprises a mixed-method approach of both quantitative and qualitative data analysis.

The quantitative data analysis comprises an analysis of the project portfolio of the institutionalised partnership based on the Partnership reporting and based on a CORDA extraction from March 2023. The period covered in the analysis is 2014 – 2020. Some aspects of the functioning of the CH JU have also been covered to the extent possible.

The qualitative analysis comprises desk research activities and text analysis of the partnership strategic documents and existing monitoring, progress and evaluation reports. The evaluation questions for the analysis can be found in Appendix B.

In addition to the text research activities, ten targeted interviews with partnership members and stakeholders are being performed in order to gain additional insights and validate the findings of the analysis. The interviews follow a semi-structured, exploratory approach based on guidelines referencing the evaluation questions in focus. The organisations and experts interviewed can be found in Appendix C.

4. Background

The **Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2 JU)** was a continuation of FCH1, which ran under the 7th Framework Programme from 2007 to 2013. It is legally based on the Council Regulation (EU) No 559/2014 of 6 May 2014, establishing the Fuel Cells and Hydrogen 2 Joint Undertaking Text with EEA relevance1. FCH2 started functioning in 2014 with a follow-up funding of EUR 665 million under H2020.

FCH 2 JU is a public-private partnership (PPP) between the European Commission, European industry and research organisations from across the fuel cell and hydrogen energy supply chain – all committed to putting hydrogen on the clean energy map. It is a separate entity under the Belgium Law.

The mission of the FCH 2 JU was the facilitation of the market introduction of FCH technologies in Europe and the realisation of their potential in a carbon-clean energy system. This was done by implementing a research and innovation (R&I) programme with the goal of developing a portfolio of clean, efficient solutions that exploit the properties of hydrogen as an energy carrier and fuel cells as energy converters to the point of market readiness.

Figure 1 shows the FCH 2 Intervention Logic drafted during the Interim evaluation of the Partnership for the period 2014-2020.

[1] OJ L 169, 7.6.2014, p. 108–129

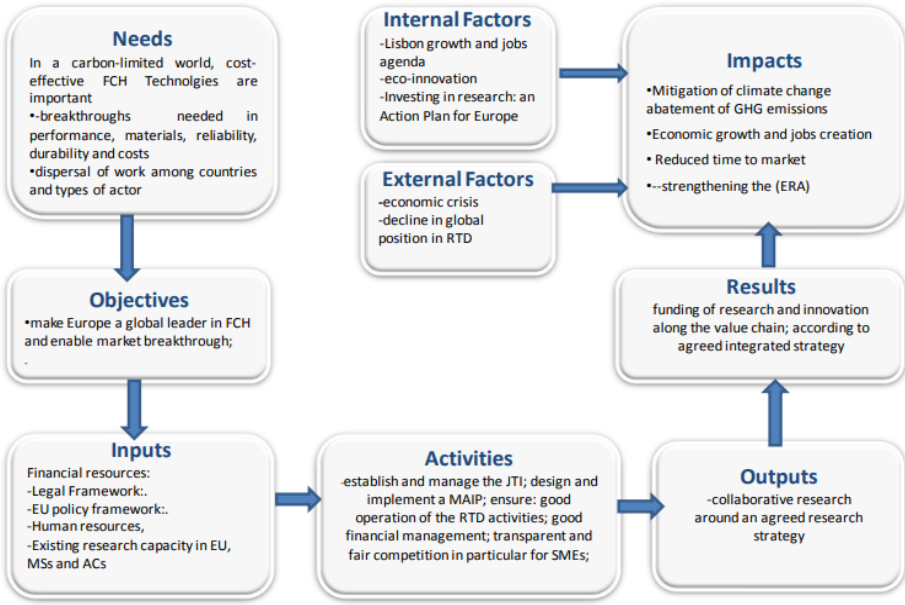

Figure 1 Intervention logic of FCH JU (Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking (2014-2016) operating under Horizon 2020)

The FCH 2 JU programme is built around **three main pillars**:

- ✓ **Transport pillar:** Activities are designed to accelerate the market uptake commercialization of FCH technologies in transport applications through a programme that includes demonstration and research projects. Projects: Trials and Deployment of Fuel Cell Applications and Next Generation of Products.

- ✓ **Energy pillar:** The goal of projects assessed under the Energy pillar is to accelerate the commercialisation of FCH technologies for stationary fuel cells and the production of low-carbon hydrogen as an energy source by increasing efficiency while cutting costs. Projects: Trials and deployment of Fuel Cell Applications; Next Generation of Products and Hydrogen for Sectorial Integration

- ✓ **Cross-cutting pillar:** Within the Support for Market Uptake (cross-cutting) activities, the programme focuses on reducing costs, producing educational tools and developing analytical methods and test procedures, as well as on the overall impact and dissemination of results.

The Clean Hydrogen Joint Undertaking (CH JU) is an Institutionalised partnership established in November 2021 with the adoption of a Council Regulation 2021/2085[2]. It is the successor of FCH2 and is a public-private partnership supporting R&I in hydrogen in Europe. The EU supports CH JU with EUR 1 billion in the period 2021-2027 (including EUR 30.2

[2] Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe

million for administrative costs) to be matched by a similar amount of investment from the private members of the partnership, raising the total budget to more than EUR 2 billion. Additionally, EUR 200 million have been added to the budget specifically for Hydrogen Valleys as part of the RePowerEU Plan from May 2022. This amount is also to be matched by the same amount by the private partners.

Both FCH 2 and CH JU have **three members**:

- The European Commission – representing the European Union.
- Hydrogen Europe - representing the fuel cell and hydrogen industries.
- Hydrogen Europe Research - representing the research community.

As per the Regulation, the main objective of the CH JU is contribution to the climate neutrality goals of the Union and the implementation of the EU Green Deal, the EU Climate Law and the EU Hydrogen Strategy. Moreover, the CH JU aims at 'strengthening the competitiveness of the Union clean hydrogen value chain in particular for SMEs, the acceleration of the market entry of innovative competitive clean solutions. In addition, the partnership aims **to strengthen and integrate the EU's scientific capacity in order to accelerate the development of advanced clean hydrogen applications**. The research and innovation activities of the Clean Hydrogen JU are guided to a large extent by the EU's Hydrogen Strategy and the policy developments in this context, contributing to its implementation. The Strategy's focus is on renewable hydrogen production, as well as hydrogen, distribution and storage, alongside selected fuel cell end-use technologies in transport, buildings and industry.

The CH JU is expected to contribute to the European climate neutrality goal by producing **noticeable, quantifiable results towards the development and scaling up of hydrogen applications**. This will help develop a number of hydrogen technologies, which are currently either not competitive or have a low technology readiness level but are expected to contribute to the 2030 energy and climate targets and, most importantly, make possible climate neutrality by 2050. The research and innovation activities of the CH JU will address areas related primarily to the production of clean hydrogen, as well as the distribution, storage and end-use applications of low-carbon hydrogen in hard-to-abate sectors (SRIA 2021-2027).

Additional objectives include the increase of low TRLs and cost-effectiveness, efficiency, reliability, quantity and quality of clean hydrogen solutions including carrying out demonstrations and increasing public and private awareness.

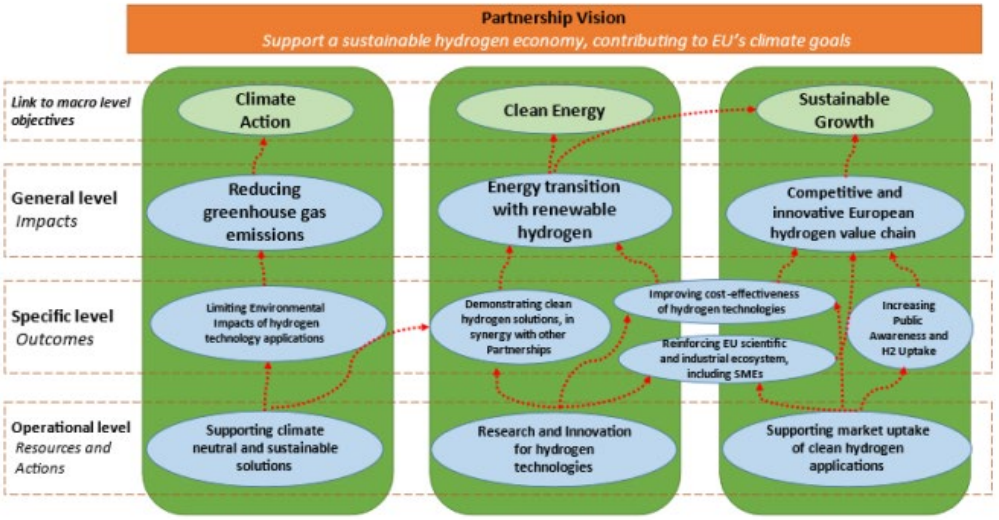

Figure 2 Strategy map of the CH JU (CH JU Work Programme 2022)

5. Implementation state of play

Figure 3 can be found in the latest Programme Review Report of the CH JU and covers all the years since 2008. Although this current case study only focuses on the years after 2014, the figure is a good illustration of the distribution of funding in the lifetime of the FCH1, FCH2 and CH JUs.

The figure clearly shows that the biggest amount of funding has gone towards transport applications (the focus of the previous FCH 1 and 2), followed by clean heat and power (24%) and H2 production (17%).

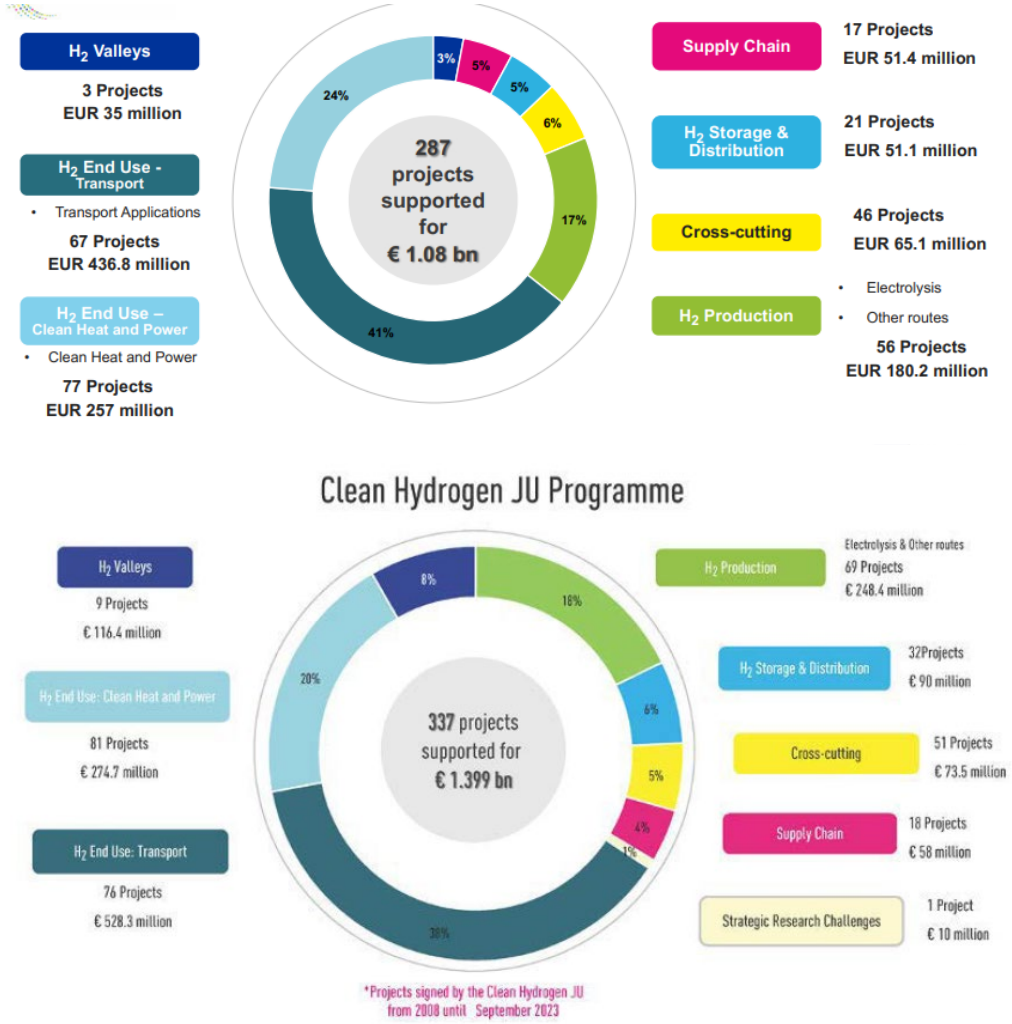

Figure 3 Overall structure of the Clean Hydrogen JU programme and the Pillars for the current review (project call years 2008 – 2020, also within FCH1 JU and FCH2 JU) (Clean Hydrogen JU Programme Review Report 2023)

5.1. FCH 2 JU

FCH 2 JU implemented the following activities:

- The JU's main activity was to fund projects: a total of 134 projects were funded between 2014 to 2022, for a total EU contribution of EUR 632.9 million.

- Supporting activities in the area of Regulations, Codes and Standards (RCS), in particular via the RCS Strategy Coordination group. In general, RCS activities consist of identifying and prioritising RCS needs of strategic importance for the EU, including the necessary pre-normative research activities to support the RCS priorities.

- Supporting activities in the area of Safety, in particular via the European Hydrogen Safety Panel (EHSP), to ensure that hydrogen safety is adequately managed and to promote and disseminate H2 safety culture within and outside the FCH 2 JU programme.

- Policy support through different means:

    - Studies covering may different aspects of FCH, including (a) 'Opportunities arising from the inclusion of Hydrogen Energy Technologies in the National Energy & Climate Plans (NECPs); (b) Fuel Cell Hydrogen Trucks, (c) Hydrogen-Power aviation, (d) Life Cycle Assessment of Hydrogen And Fuel Cell Technologies, etc

    - Participating in a number of technical groups organised by the EC and other international bodies, e.g. SET-Plan, IEA HTCP;

    - Developing a guarantees of origins scheme for renewable and low-carbon hydrogen as part of the CertifHy project and its continuations.

- Launching a pilot Project Development Assistance facility to help develop detailed project planning in regions and cities with a lower maturity level, with a special focus on Central and Eastern Europe

- Introducing and promoting the concept of hydrogen valleys and ecosystems, including via the Hydrogen Valley Platform, released under the umbrella of Mission Innovation.

- Communication activities, focusing in its latter years on media outreach and online communication. More specifically, it enhanced its media efforts, turned to organising online events and made several upgrades to its website. In addition, it continued to build on the programme's success stories to demonstrate the benefits of the technology as well as its results.

- Annual organisation of the JU's flagship events – the Stakeholder Forum, the Programme Review Days and the FCH 2 JU Awards. In 2020 these evolved to the organisation of the first European Hydrogen Week - dedicated to the essential role of hydrogen in reaching the EU's commitment to achieve carbon neutrality by 2050.

- Knowledge Management Activities, which included technology monitoring and the organisation of the Annual Programme Review exercise, leading to the publication of the Programme Review Report at the end of each year.

- Dissemination and exploitation activities of the JU projects.

- Fuel Cells and Hydrogen Observatory (FCHO) (launched in 2020) - open platform providing data and up-to-date information about the entire hydrogen sector. The FCHO has been created for the use of policy makers, industry stakeholders and the general public.

- Coordination with other institutions, regions and networks (e.g., with the Executive Agency for Small and Medium-sized Enterprises (EASME) and the Innovation and

Networks Executive Agency (INEA)), as well as by launching the FCH Regions Hub in 2020).

- International cooperation activities;

Project portfolio characteristics

All projects had a significant involvement in industry and were relevant to the FCH JU Multi-Annual Implementation Plan (MAIP); no gaps were identified in the portfolio. The JU has conscientiously sought to ensure that projects covered all the topics identified in the MAIP at an appropriate time.

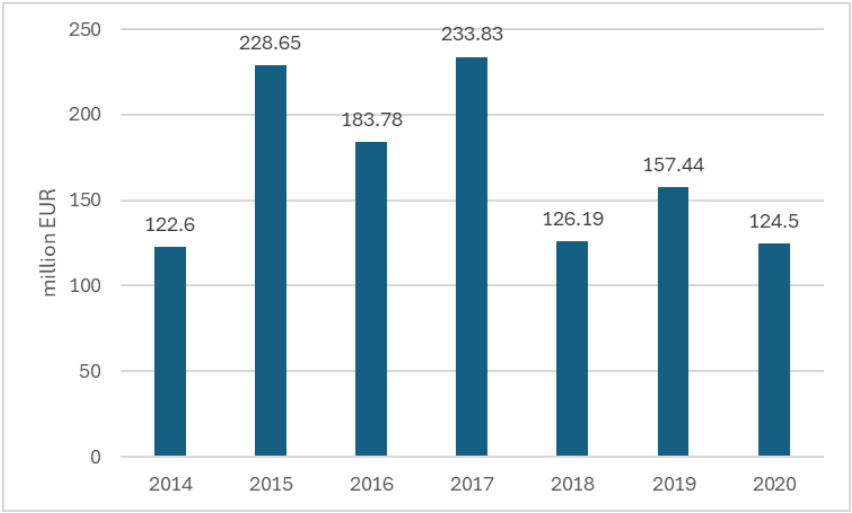

Figure 4 Total committed private and public investment in FCH2 over the period 2014-2020 (in million EUR). (FCH2, Annual activity report, 2020)

Demonstration activities in transport applications:

- Light-duty vehicle (LDV) demonstration – 1,860 LDVs have bene demonstrated, out of which 963 were deployed as of 2020. H2ME[3] and ZEFER[4] are the most notable projects. Different fuel cell electric vehicles (FCEV) cars and vans are being deployed in eight EU Member States plus the UK, Norway, Iceland and Switzerland[5].

[3] https://cordis.europa.eu/project/id/700350
[4] https://cordis.europa.eu/project/id/779538
[5] FCH2 Activity Report 2020

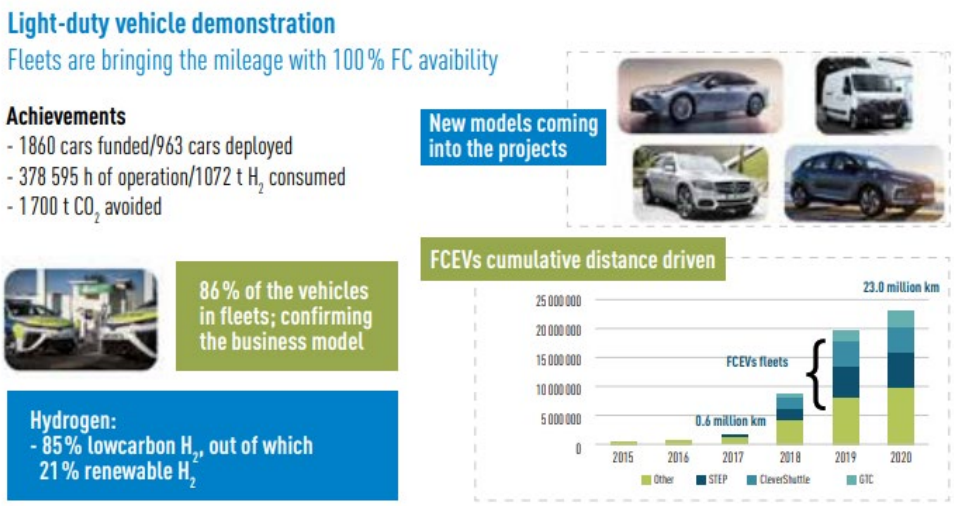

Figure 5 Cumulative distance driven by FCH2 demonstrated LDV (FCH2 Activity Report 2020)

- Hydrogen refuelling stations (HRS) – expanding in new cities and regions. FCH2 has funded HRS Availability System. 112 HRS have been funded by FCH2 and FHC1 (planned, deployed and decommissioned), out of which three have been decommissioned. The H2ME project is key for this activity. The HRS network covered eight countries as of 2020. About 85% of dispensed hydrogen was low carbon, in line with the definition of the CertifHy Scheme[6]. The FCH2 JU has also funded the installation of 23 refuelling stations for buses in 10 European cities.

- FCB demonstration – as of 2019, FCH2 JU bus demonstration activities concerned the projects High V.LO-City[7], HyTransit[8], 3EMOTION[9], JIVE and JIVE 2. Around 360 FCB have been deployed within these projects, most of them through JIVE[10] and JIVE2[11]. It has been reported that 'bus demonstrations have provided positive evidence on the performance and functionality of hydrogen FCBs and associated refuelling infrastructure, progressively reducing barriers for their commercialisation'[12].

- Heavy-duty truck demonstration – the two main projects on the topic are REVIVE[13] and H2HAUL[14]. More than 30 trucks in 12 countries have been demonstrated within these two projects. A study has also been funded on European business cases for FCH trucks.

[6] (https://www.clean-hydrogen.europa.eu/get-involved/hydrogen-certification_en
[7] https://cordis.europa.eu/project/id/278192
[8] https://cordis.europa.eu/project/id/303467
[9] https://cordis.europa.eu/project/id/633174
[10] https://cordis.europa.eu/project/id/735582
[11] https://cordis.europa.eu/project/id/779563
[12] Own calculations based on FCH2 Activity Report, 2020
[13] https://cordis.europa.eu/project/id/779589
[14] https://cordis.europa.eu/project/id/826236

- FC applications in rail transportation – a joint study has been published with the Shift2Rail JU 'Use of fuel cells and hydrogen in the railway environment'[15] to assess the state of the art and market potential of FCH in a railway environment.

- Hydrogen-powered aviation - an independent study commissioned by Clean Sky 2 and FCH2 JU on hydrogen's potential for use in aviation[16], was presented at an online event on 22 June 2020. The projects HEAVEN[17] and FLHYSAFE[18] focus on the topic.

- Maritime applications – MARANDA[19] and FLAGSHIPS[20] address the topic.

Research-oriented activities for transport applications

- Development of non-noble metal catalysts – research activities focused on advancing EU know-how concerning novel materials, processes, architectures and optimised interfaces (PEGASUS[21], CRESCENDO[22]).

- Innovative manufacturing – according to the FCH2 JU Activity Report 2020, 'considerable progress has been achieved by projects involved in the manufacturing of stacks for automotive applications'. Projects addressing the issue included DOLPHIN[23], Fit-4-AMandA[24], INLINE, INN-BALANCE[25], INSPIRE[26] and GAIA.

- New developments in compression and storage technologies – the main priority was the improvement of compression technologies and a reduction in the cost of the compressor. Projects dealing with the topic included COSMHYC[27] and COSMHYC XL[28].

Stationary applications for heat and electricity production:

- Combined heat and power for residential applications, μ-CHP – the PACE project is key for the topic. According to the FCH2 JU Activity Report 2020, the number of systems sold via the project had reached 1877 by April 2020, and 1365 of a planned total of 2 800 systems have been installed.

- CHP for mid-size applications - FCH2 JU also funded several demonstrations of mid-size FC applications, namely through the DEMOSOFC[29] project installing a 175-kWe demonstration system in a wastewater treatment plant.

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[15] 'Use of fuel cells and hydrogen in the railway environment'
[16] https://www.clean-hydrogen.europa.eu/system/files/2020-07/20200720_Hydrogen%2520Powered%2520Aviation%2520report_FINAL%2520web.pdf
[17] https://cordis.europa.eu/project/id/826247
[18] https://cordis.europa.eu/project/id/779576
[19] https://cordis.europa.eu/project/id/735717
[20] https://cordis.europa.eu/project/id/826215
[21] https://cordis.europa.eu/project/id/779550
[22] https://cordis.europa.eu/project/id/779366
[23] https://cordis.europa.eu/project/id/826204
[24] https://cordis.europa.eu/project/id/735606
[25] https://cordis.europa.eu/project/id/735969
[26] https://cordis.europa.eu/project/id/956803
[27] https://cordis.europa.eu/project/id/736122
[28] https://cordis.europa.eu/project/id/826182
[29] https://cordis.europa.eu/project/id/671470

- CHP for large-scale application – the CLEARgenDemo project is a case in point and it aimed to validate the technical and economic readiness of a 1 MWe PEMFC system operating on by-product hydrogen in a refinery. REMOTE focused on off-grid applications. Other projects addressing the topic include EVERYWH2ERE[30], RoRePower[31] and ALKAMMONIA[32] projects.

- Manufacturing processes and balance of plant designs for stationary applications – these were all covered by the 2020 portfolio.

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.

Hydrogen production by electrolysis: Industry – on-grid and off-grid services

The figure shows the level of funding per electrolysis technology, which has clearly grown from FCH1 JU to FCH2 JU. It can clearly be observed that for the calls between 2014 and 2017, the polymer electrolyte membrane electrolyser (PEME) has received the biggest level of funding followed by Solid Oxide Electrolysis (SOE) technology.

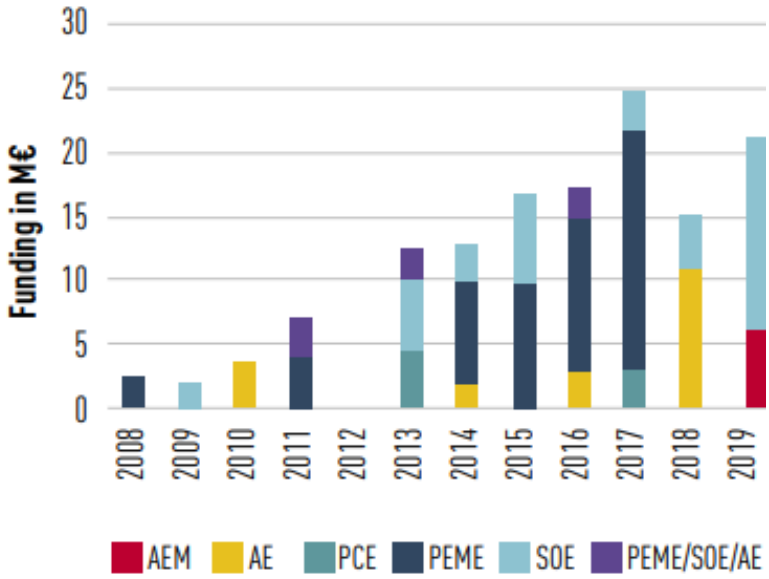

Figure 6 FCH1 and FCH2 JUs funding by technology (Annual Activity Report, 2020)

- Low-temperature electrolysis - the experience gained in these projects has helped to inform the European Hydrogen Strategy and will support the building up of the

[30] https://cordis.europa.eu/project/id/779606
[31] https://cordis.europa.eu/project/id/824953
[32] https://cordis.europa.eu/project/id/325343

related value chain. Relevant projects include Demo4Grid[33], HyBalance[34], REFHYNE[35], BIG HIT[36], etc.

- High-temperature electrolysis - The projects GAMER[37], GrinHy2.0[38], SELySOs[39], REFLEX and WASTE2GRIDS[40] all aim at improving high-temperature electrolysis (HTE) technology.

- Other hydrogen production routes - The BIONICO project has built the largest catalytic membrane reactor for direct biogas-to-hydrogen reforming in the world. The FCH2 JU is also supporting hydrogen production methods at a lower TRL. The PECSYS[41] project is targeting the development of an integrated photovoltaic (PV)-electrochemical cell device.

Hydrogen storage distribution and purification

The HyCARE project is developing a prototype large-scale hydrogen storage tank based on solid-state storage. The HySTOC[42] project aims to demonstrate the feasibility of liquid organic hydrogen carrier (LOHC)-based solutions for hydrogen distribution and storage, in particular for supplying HRSs. The HyGrid127 project aims to develop, scale-up and demonstrate a novel membrane-based hybrid technology for the direct separation of hydrogen from natural gas grids in industrially relevant conditions.

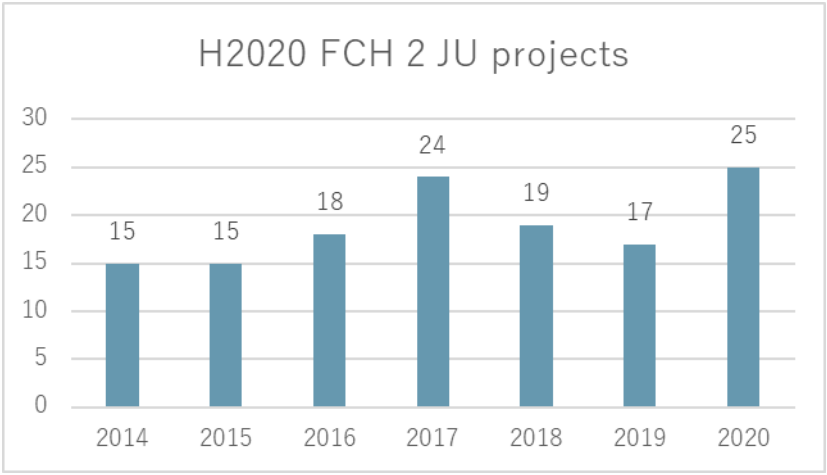

Figure 7 Number of H2020 projects funded by the FCH2 JU 2014-2020 (Based on data from the CH JU website and annual reports for 2020 and 2021)

[33] https://cordis.europa.eu/project/id/736351
[34] https://cordis.europa.eu/project/id/671384
[35] https://cordis.europa.eu/project/id/779579
[36] https://cordis.europa.eu/project/id/700092
[37] https://cordis.europa.eu/project/id/779486
[38] https://cordis.europa.eu/project/id/826350
[39] https://cordis.europa.eu/project/id/671481
[40] https://cordis.europa.eu/project/id/826161
[41] https://cordis.europa.eu/project/id/735218
[42] https://cordis.europa.eu/project/id/779694

Throughout the years, FCH2 JU funded a total of 133 projects in 7 calls from 2014 to 2020 included. This is an average of 19 projects per year/call, with the highest number of projects reached in 2020.

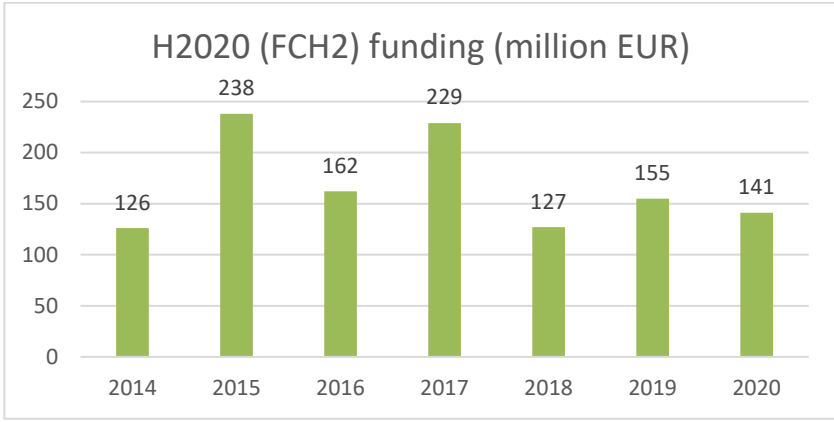

Figure 8 H2020 (FCH2) funding (EUR million) (Based on data from the CH JU website and annual reports)

The total overall funding of all 133 projects amounts to EUR 1 178 million (EUR 646 million of EU contribution/grants as of the end of 2021) or an average of EUR 8.9 million per project (EUR 4.72 million of EU contribution/grants). Together with its additional activities, FCH2 JU managed to achieve a combined amount of private-public investment for the H2020 programme of over EUR 2 billion.

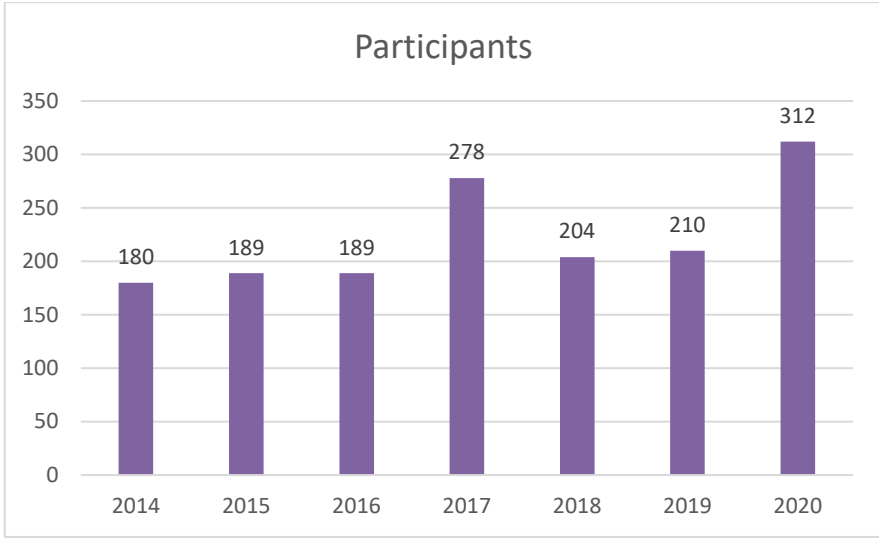

Figure 9 Number of total participants in projects funded by the FCH2 JU (Based on data from the CH JU website and annual reports)

In terms of participants, there is a total of 1 562 participants, which is an average of almost 12 participants per project. Some 23% of these are SMEs, and 70% are large private for-profit companies[43].

In terms of sectors, 66 of the funded projects were in energy, 40 in transport, 7 overarching and 20 cross-cutting[44].

With regard to the type of action, 97 of the projects (around 58% of the overall budget) were research and innovation actions (RIA) and coordination and support actions (CSA), while 36 projects (around 42% of the overall budget) were innovation actions (IA).

5.2. Clean Hydrogen JU

In the first two years of this existence, CH JU continued to implement all the activities of its predecessor, FCH 2 JU, as listed under Section 5.1. In addition to those, it is also implementing the following activities:

- Supporting activities in the area of sustainability and circularity, in particular via the European Hydrogen Sustainability and Circularity Panel (EHS & CP), for which it launched a call for tenders to setup it up in 2023.
- Continuing supporting platforms like the European Hydrogen Observatory (continuation of the FCHO) and the Hydrogen Valley Platform.
- Developing the European Clean Hydrogen Knowledge Hub, a single platform to encompass and enrich the available tools/platforms maintained by the JU, facilitating access to non-confidential information to its members and the wider public.
- Continuing supporting the organisation of the European Hydrogen Week, as well as the more research-oriented EU Research Days.
- Being proactive in taking up opportunities for collaboration with other EU Programmes, European partnerships, EU agencies, initiatives and actions with the potential for synergy with its research and innovation agenda, like the European Innovation Council, Clean Aviation JU, EURAMET, Zero Emission Waterborne Transport Partnership, Processess4Planet and Clean Steel partnerships.
- Project Development Assistance to support developers and regions in their projects.
- Funding studies.

2022 was the first full year of operation for CH JU. There have been two calls for proposals in 2022 and one call in both 2023 and 2024.

The topics covered by the call include renewable hydrogen production, hydrogen storage and distribution, transport, clean hydrogen power, cross-cutting, strategic research challenges and hydrogen valleys (call 2022-2).

[43] FCH2 JU and CH JU annual activity reports and websites
[44] Clean Hydrogen Partnership, Programme Review Report 2022

50 projects have been funded and can be found in Appendix FProject funded by the Clean Hydrogen Joint Undertaking. The highest number of indicative budgets is in the area of H2 end users – transport (32.6%) – followed by renewable hydrogen production (25.6%) and hydrogen storage and distribution (16.3%). The hydrogen valleys represent almost 11% of the overall grant amount[45]. According to the CH JU management, one of the reasons for the high share of transport is the fact that there was a need to fund hydrogen applications for trucks to link the topics of hydrogen and transport and to compensate for the fact that the other relevant partnership funding on decarbonising transport was technology-neutral which directing funding to batteries. This approach skewed the distribution, a situation which would be corrected in subsequent calls.

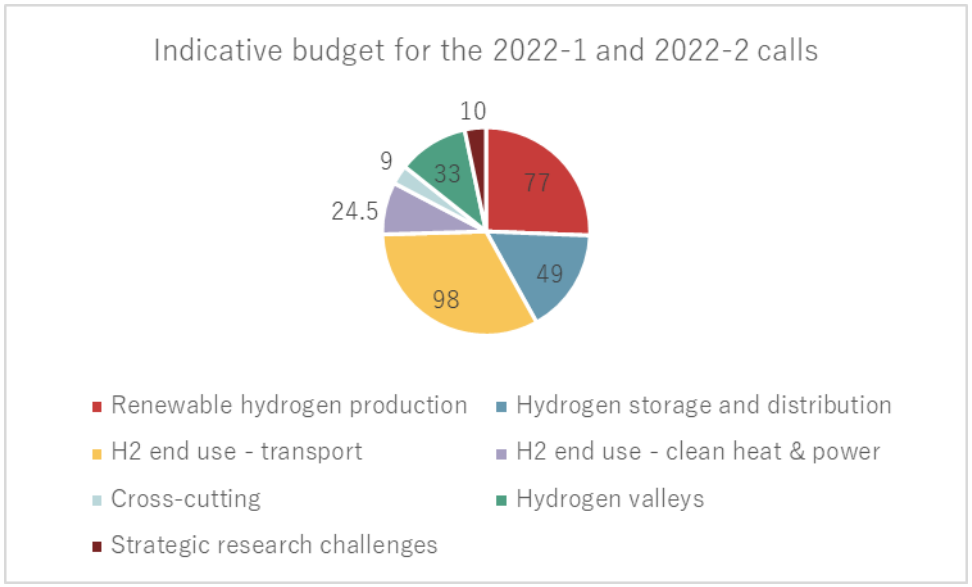

Figure 10 Indicative budget per topic for the 2022-1 and 2022-2 calls in million EUR

In terms of number of entities participating in successful applications, for the first call of 2022 (2022-1), the biggest number comes from France (40), Germany (26), Italy (32), Netherlands (21) and Spain (16). One entity from each of the following non-European countries has participated in the successful applications: Kenya, Mauritius, Morocco, South Africa and the United States.

The 2023 call was closed in April 2023. 132 proposals have been submitted for a total requested budget of EUR 382.2 million. The indicative budget per topic is seen in the figure below illustrating a significant decrease in the transport end-use applications (25.5% versus 41% in the 2008-2020 period). H2 production has increased from 17% in the 2008-2020 period to almost half of the budget (49%).

Call 2024 is open until April 2024, and it features 20 topics for a total funding of EUR 113.5 million. This value is to be topped up by EUR 60 million coming from the RePowerEU Plan, specifically dedicated to funding the two topics on hydrogen valleys. There are 8 Innovation

[45] CH JU data from Annual Reports

Actions, 11 R&I Actions and one Coordination and Support Action, and an important novely is that this call will be implemented by using lump sum grants.

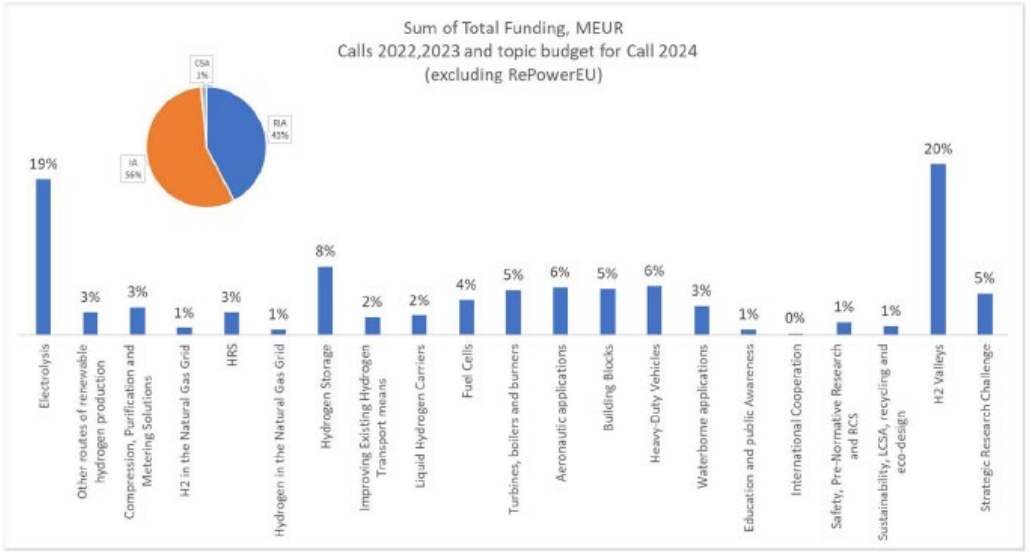

Figure 11 Summary of the total funding for all Clean Hydrogen JU calls 2022-2024.

The projects funded under HE in 2022 and those pending to be funded under the 2023 call have not produced sufficient results in order to be able to judge their contribution to the programme pillars:

- Pillar 1 - Hydrogen Production.
- Pillar 2 - Hydrogen Storage and Distribution.
- Pillar 3 - Hydrogen End Uses – Transport.
- Pillar 4: Hydrogen End Uses – Clean Heat and Power.
- Pillar 5 - Cross-Cutting Issues.
- Pillar 6 - Hydrogen Valleys.
- Pillar 7 - Hydrogen Supply Chains.

5.3. Evolution of activities between FCH1 JU, FCH2 JU and CH JU

In 2008, FCH1 JU started from the fuel cells side as an energy-efficient device with hydrogen being one of the fuels. The Partnership was focussing on applications, transport and stationery but hydrogen was only one of the fuels.

As of 2014, the relevant EU policies have changed, shifting the focus to the integration of Renewable Energy Sources (RES) into electricity grid systems, and hydrogen was seen as one of the solutions. With H2020, **FCH 2 JU objectives evolved to also look at the**

feasibility of hydrogen to offer a possibility for energy storage and integration of RES. At this time, the programme started to expand and look at different solutions. In that way, the Partnership was able to demonstrate all the versatility and possibilities that hydrogen can offer.

According to CH JU senior management, the FCH2 JU work has provided fact-based evidence that hydrogen is a viable alternative solution in many areas of energy and transport. Hydrogen technologies became an even more important technology area in the Horizon Europe programme, supported by the end-use partnerships, as well as collaborative research and innovation actions of Horizon Europe and other EU programmes. At the same time, the Clean Hydrogen JU kept the leading role in research activities related to hydrogen. Its main focus is on renewable hydrogen production, as well as hydrogen transmission, distribution and storage, alongside selected fuel cell end-use technologies. In terms of end-use, its main focus is on developing the fuel cell and hydrogen technologies, while the end-use partnerships focus more on their adaptation and demonstration in their respective uses.

Hydrogen is also an integral part of the REPowerEU Plan. To accelerate hydrogen projects, the Commission topped-up an additional funding of EUR 200 million to the overall budget of the Clean Hydrogen JU, to be matched by the same amount by the private members, so as to double the number of Hydrogen Valleys in the EU by 2025.

It is worth mentioning the evolution of the Hydrogen Valley concept whose development started in 2016-2017. The first example of a Hydrogen Valley came through the Big HIT project[46]. The concept tried to prove that (clean) hydrogen can be locally produced and used to serve multiple applications (sharing a common hydrogen supply infrastructure).

Within the Green Hysland[47] project, the ecosystem in Majorca provides up to 300 tonnes of H2/year, new PV panels and Hydrogen for a host of uses - the fleet of buses and a fleet of cars and vans. All of them refuel via an H2 refuelling station. Stationary uses are in the Port of Palma, a hotel (fuel cell for heat and power), municipal building. Additionally, a 3 km H2 pipeline is being installed from which hydrogen will be injected into the natural gas grid.

According to a stakeholder from Green Hysland, hydrogen valleys are not necessarily the only way (and, in some cases, even the most optimal approach) to kick-start a hydrogen project. This is very much case-by-case dependent. While in some cases it is suitable to put different elements and multiple end-uses together, as in a hydrogen valley as a means to kick-start a project (including training and developing local capabilities), in other cases it might be more suitable to initiate a hydrogen project driven by a single (large) hydrogen off-taker (e.g., a single hydrogen use in industry sectors), with other end-users coming at a later stage.

Box 1 Hydrogen Valleys, the example of the Green Hysland project and limitations of the Hydrogen Valley concept

Overall, this has been seen as a positive evolution supporting EU policy underpinned by the fact that the European Commission and the industry commit money to develop the solutions. The Partnership objectives have evolved and adapted to the policy, although, as underlined by the CH JU, the industry has not always been in agreement.

The overall perception is that the two generations of Partnerships (FCH 1 and 2 and CH JU) have been instrumental in reaching speed and green transition. The link to REPowerEU is also perceived as strong.

Knowledge management activities have continued to evolve under CH JU with the continuation of the Fuel Cell and Hydrogen Observatory platform, whereby a new contract

[46] https://cordis.europa.eu/project/id/700092
[47] https://cordis.europa.eu/project/id/101007201

was signed. The JU developed the concept and architecture for the Clean Hydrogen Knowledge Hub, to be procured in 2023.

With regard to communication activities, it is worth noting that the forum of the JU has developed into an integrated Hydrogen Week, including the Forum of the Hydrogen Alliance.

6. Findings

6.1. Relevance

The objectives of the FCH JU were in line with the Lisbon Strategy and the launch of the Joint Technology Initiatives (JTI). It took place at the time of the launch of the European Institute for Technology and Innovation (EIT), which 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 EU. 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 activities of the FCH JU supported the climate change objectives, helped improve energy security and contributed to the status of Europe as an international leader in technology.

The objectives and activities of the FCH JU successor - CH JU - are aligned with the EU Hydrogen Strategy[48] , calling for a strong investment agenda for the EU as well as with the EU Green Deal.

Interviewed stakeholders were unanimous in their assessment that the objectives and activities of both FCH JU and the CH JU have been and continue to be relevant to the grand challenges facing Europe: they support the climate change challenge, help improve energy security and contribute to the status of Europe as an international leader in technology.

There is an expectation that the focus on transport within CH JU will be lower than in the 2008-2020 period. This is due, among other things, to the EU's drive towards energy security additionally fuelled by the war in Ukraine. An additional reason for that is the fact that TRL levels in transport are lower than in energy, while a significant portion of the CH JU budget is expected to go for deployment (e.g., through the Hydrogen Valleys). The distribution of budget per topic for the 2022 and 2023 confirm this.

From the point of view of the research community, represented by Hydrogen Europe Research (HER), with the current emphasis on Hydrogen Valleys, there is a threat to ‘deviate from the DNA of the programme, which is linked to research and developing new systems. Hence, a balance needs to be struck between stimulating the Hydrogen Valleys and forward-looking research. DG MOVE representatives confirmed this opinion especially having in mind that the overall TRL in the transport sector is lower than the one in energy.

With regards to topic coverage, the HER representative underlined that the most important ones are covered, but as there are many important topics, there is a risk of diluting the impact of the Partnership. Hence, there is a need to stay more focused and, for example, cover production and electrolysis and fewer others. From a DG MOVE point of view, the topics covered are the right ones.

[48] A hydrogen strategy for a climate-neutral Europe, COM (2020) 301 final

Strategic Research and Innovation Agenda of the CH JU

The Strategic Research and Innovation Agenda (SRIA) of the Clean Hydrogen JU was adopted on 25 February 2022 by the Governing Board. It covers the duration of HE and identifies the key priorities and the essential technologies and innovations required to achieve the objectives of the joint undertaking.

Clean Hydrogen JU

The research and innovation actions described in the SRIA are implemented through annual calls for proposals. The selection of the actions in the SRIA and the description of the topics comes from a joint effort and intensive interaction between the major stakeholders, namely Hydrogen Europe, Hydrogen Europe Research and the European Commission. They represent a set of priorities consistent with the objectives of the Clean Hydrogen JU and are divided into the Pillars identified in the SRIA:

- Pillar 1: Renewable Hydrogen Production
- Pillar 2: Hydrogen storage and distribution
- Pillar 3: Hydrogen end uses; Pillar 3.1: Transport applications; Pillar 3.2: Clean heat and power.

In addition to working within each of these pillars, mass deployment requires support and coordination action. Four additional horizontal and cross-cutting activities thus complement them.

Box 2 CH JU SRIA pillars

It could be said that there is flexibility in developing the SRIA and that its development has followed a process of co-creation. For example, Hydrogen Europe Research reported that they managed to include Strategic Research Challenges (SRC) as an area for funding. The goal is to form long-term research consortia during the whole programme time. These consortia should work on TRL3 to prepare innovative solutions, and once there are promising results, these can be transformed into RIAs. The goal is also to involve the industry at a later stage once the most promising results are selected together with the public. Some EUR 30 million will be spent on three such low-TRL research projects included in Call 2022 and Call 2023 (3% of the overall amount). The RIAs can also address low TRL, as the SRIA dictates that at least 10% of the total JU budget should be allocated to low TRL activities. It has to be noted that the perception is that while the market evolves, the technology does not evolve that quickly. It would be possible to compensate for changes through the Annual Work Programmes (AWP), which outline the scope and details of the JU's operational and horizontal activities for each year, including the budget and the respective call for proposals. Hence, the flexibility for finetuning the R&I agenda remains, which will result in two amendments to the SRIA in 2024 – one for the research pillars and another for the KPIs.

6.2. Coherence

The CH JU management has underlined that the Partnership had been working with the EC regarding synergies with other JUs or other partnerships and some MoUs have been signed. The process was successful in the cases where co-construction was possible, like in the case of the Clean Aviation JU where there are Hydrogen-related topics. For other partnerships, such as maritime and rail, the synergies are yet to be demonstrated. Previous evaluations underlined (confirmed by interviews) that FCH 2 projects are not always successful in leveraging the necessary co-funding from national and regional funding programmes due to the complexities this requires, including, to name a few, unclarity on how to apply State-aid General Block Exemption rules for projects supported by EU framework programmes,

complexities to support full hydrogen R& I ecosystems using different sources of funding (EU/National and regional). Although there has been some success in synergies with other EU programmes in FCH 2 JU, this is related to contexts in which the JU could plan calls together with other programmes from the beginning (JU funding + CEF-T), while this has not been the case when combining efforts with national and regional programmes. All interviewees confirmed that this had not worked well and that the State Representative Group was not sufficiently well-placed to address this matter. It was also found that there was not sufficient alignment between nor guidance material on these matters, e.g. simplified process to apply the general block exemption rules for R&I projects funding by EU centrally managed programmes (like H2020), which required co-funding from national and regional programmes.

The FCH2 JU compensated for this shortage by doing a very good job of successfully engaging regions via its "Regions Initiative" (now transformed into the "Regions Hub[49]") 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. Hence, regions and municipalities will be major players in the hydrogen economy. Additionally, more and more Member States are drafting national strategic documents on hydrogen and need to report on progress with regard to hydrogen annually.

According to previous evaluations, the alignment of the work of the FCH2 JU to other relevant activities outside its direct influence (as, for example, infrastructure programmes of the EU or EU financial instruments designed to support the commercialisation of new products) posed many challenges which the JU recognised, but never entirely resolved, in large part because the means of resolution lay outside of its control.

As far as the CH JU is concerned, the overall principle is that the JU activities need to be implemented in synergy with other EU programmes and partnerships while aiming for maximal administrative simplification. The intention is that the JU will develop, in line with the Single Basic Act (SBA), close cooperation and ensure coordination with other European partnerships, including by dedicating, where appropriate, a part of the joint undertaking's budget to joint calls. It must be mentioned, though that objective difficulties exist as it is not possible to have common calls.

Moreover, as shared by the CH JU management, the ambition is that Clean Hydrogen JU will seek and maximise synergies with and, where appropriate, possibilities for further funding from relevant activities and programmes at the Union, national and regional levels, in particular with those supporting the deployment and uptake of innovative solutions, training, education and regional development, such as Cohesion Policy Funds, or the National Recovery and Resilience Plans.

One notable way to increase synergies is through the Stakeholders Group, as one of its main tasks is to provide suggestions to enable concrete synergies[50] with adjacent sectors and with the European Hydrogen Forum of the Clean Hydrogen Alliance.

DG RTD, DG ENER and DG MOVE are involved in the governance on behalf of the EC, which is perceived as very positive and ensures additional coherence between different sectors.

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[49] See https://www.clean-hydrogen.europa.eu/get-involved/regions-hub_en

[50] Article 84 (2) of Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe and repealing Regulations (EC) No 219/2007, (EU) No 557/2014, (EU) No 558/2014, (EU) No 559/2014, (EU) No 560/2014, (EU) No 561/2014 and (EU) No 642/2014. OJ L 427, 30.11.2021, p. 17–119

The CH JU management underlined that there is a strong need to align priorities and activities with all other relevant initiatives. If this is not the case, there is a risk of producing technologies that no one uses. Hence, good synergies and coordination are needed. There is also a need for alignment with the Connecting Europe Facility and The European Climate, Infrastructure and Environment Executive Agency (CINEA) to align grants. According to DG RTD, there is also an excellent collaboration between CH and the Connecting Europe Facility (CEF): CH funded the development of hydrogen buses, and CEF funded the infrastructure (refuelling stations). The names of the projects are JIVE (CH) and MERHLIN (CEF). There is a significant margin for improvement of the cooperation with the co-programmed partnerships. The link with the Strategic Energy Technology Plan (SET-Plan) also needs to be strengthened, although currently, there are no tools for that. In the revamp of the SET Plan, there is a need to integrate hydrogen to a higher degree. The deployment pillar of the CH JU could also be improved. From a DG MOVE point of view, the impossibility of having joint calls is a natural barrier to a high level of coherence.

According to the EC, currently, there are two main difficulties. The first one has to do with storage capacity, which is approximately 10% of what would be needed to produce Hydrogen locally. At the same time, the industry seems to lean more towards production and distribution. Moreover, as far as the highly successful Hydrogen Valleys are concerned, the EC's interest is to have wide EU coverage, which may be contrary to industry ambitions. In 2022, an extra EUR 200 million has been allocated to the deployment of an increasing number of Hydrogen Valleys across the EU.

With regards to Hydrogen Valleys, applicants were encouraged to seek additional synergies with Programmes (e.g. European Structural and Investment Funds, Recovery and Resilience Facility, Just Transition Fund, Connecting Europe Facility, Innovation Fund, Modernisation Fund, LIFE, etc.) and/or clustering with other projects within Horizon Europe or funded under other EU, national or regional programmes, or having loans through the EIB or other promotional or commercial banks[51].

Operationally, a representative of a Hydrogen Valley shared that there was such an intense pressure to act in consultation and communication with different stakeholders that this decreases the efficiency of the Partnership.

In terms of support to policies, CH JU has singled out the following streams of work in its 2022 Activity report:

- Support to Energy policies: Hydrogen Guarantees of Origin.
- SET Plan and ERA-net.
- Support to Transport Policies - JU co-organised a standardisation workshop with CEN/CENELEC and JRC on hydrogen as a fuel for maritime transport.
- Support to Industrial Policy - study on sustainable supply chain and industrialisation of hydrogen technologies.

According to a DG RTD representative, several international organisations are using the work done by CH to define the state of the art and adjust their R&I priorities: IEA, IRENA, Mission Innovation, IPHE (The International Partnership for Hydrogen and Fuel Cells in the Economy). In this context, CH JU is clearly the main provider of data on hydrogen technologies and is considered as a reference.

[51] Annual Activity Report 2022

The European Hydrogen Ecosystem

When discussing the issue of coherence, it is beneficial to be aware of the wider hydrogen ecosystem In Europe.

In 2020, the EC launched the European Clean Hydrogen Alliance[52] (DG GROW) based on strategic value chain analysis. The EC considered that it was strategic from an industrial policy point of view to support the companies, SMEs and start-ups through the Hydrogen Alliance, which has a membership of around 1000 companies, more than double of the CH JU 450-500 members.

CH JU does not cover all priorities, and there are other financial instruments and programmes – European Innovation Council (EIC)[53] with EIC pathfinder, EIC Accelerator and EIC Transition as well as the SME Instrument, etc. implemented by the European Innovation Council and SMEs Executive Agency (EISMEA) and related to SMEs. The Pathfinder Instrument funds low TRL projects on breakthrough ideas, while the accelerator Instrument brings them to investors. On the other hand, CH JU supports activities speeding up the technology. Additionally, DG REGIO has funded several projects on hydrogen in which regions participate, such as hydrogen valleys and coordination among regions.

Moreover, Member State ERA, Action 11 has three parts: Update SET Plan's objectives and targets in order to reflect the ambition of the European Green Deal and to navigate the clean energy transition; develop a green hydrogen R&I ERA pilot action while ensuring consistency with other related initiatives and without prejudice to the relevance of a broader hydrogen R&I policy approach; and ERA4FutureWork: a policy approach to address research and development (R&D) funding for the Future of Work[54].

These are not within the remit of the CH JU. EU CH Observatory is within the remit.

Skills are also important, and Erasmus+ plays a role there with the potential to strengthen skills for the hydrogen economy.

EU Mission Innovation has a sub-mission on Hydrogen with the objective to create 100 hydrogen valleys; hence, there is a huge margin for synergies.

6.3. Efficiency

With regards to the efficiency of FCH2 JU (H2020), the interim evaluation concluded that FCH2 JU 'carried out its operation in an efficient manner' and most consulted experts considered it 'a lean and efficient organisation'. It was pointed out that 'the overall operational efficiency of the FCH2 JU has improved as the institution has matured. Settlements of prepayments and cost claims (TTP) were never late, which is a very important fact in particular for SMEs and beneficiaries of large demonstration projects'[55].

The overall cost-efficiency of the programme management of the FCH2 JU was 5.37% which represents the ratio between administrative and operational budget. This is close to the 5% benchmark for lean structures.

[52] https://single-market-economy.ec.europa.eu/industry/strategy/industrial-alliances/european-clean-hydrogen-alliance_en#:~:text=The%20European%20Clean%20Hydrogen%20Alliance,and%20hydrogen%20transmission%20and%20distribution.

[53] https://eic.ec.europa.eu/index_en

[54] European Research Area Policy Agenda, Overview of actions for the period 2022-2024

[55] FCH2 JU Interim Evaluation

As of 2016, beneficiary satisfaction with FCH2 JU services was rather high, with almost 100% of survey respondents being very satisfied (42%) or satisfied (55%).

The interviewees did not elaborate on the proportionality between the costs of application and participation borne by different stakeholder groups and the associated benefits. No insights were provided either on the administrative costs borne by applicants and participants compared with the previous Framework Programme.

From the point of view of the interviewees, the cost efficiency is reasonable given the volume of funding. The value added to the programme (office, people following the projects, etc.) is clearly seen. An opinion has been voiced that reducing the CH JU's involvement in policy processes can improve the overall cost efficiency of the CH JU. Efficiency could further be improved if the European Commission had access to the CH JU database.

In line with the SBA, the JUs reviewed their back-office arrangements with the support of an external consultancy firm to obtain an independent view. The conclusion was that there would be a need to reinforce their already existing cooperation and identified 21 synergies, which were prioritised along four main areas: Accounting, Infrastructure management (ICT and facility), Procurement and Human Resources management[56].

With regards to contributions to the budget of the JU, we can observe that the EC contributes the huge majority of the EUR 1 billion, with Hydrogen Europe (HE) and Hydrogen Europe Research (HER) contributing EUR 30.19 million for 2021-2022. The biggest contribution is the so-called In-Kind contributions to Additional Activities (IKAA), whose committed amount for 2021-2022 is EUR 522.83 million, out of which EUR 121.07 million have been validated. The overall target is EUR 969.81 million to achieve close to 1:1 leverage effect.

According to the latest data delivered by the EC collected through the common indicator survey for partnerships that responded to the BMR 2022, the leverage factor of the JU is as follows:

Table 2. Leverage Factor Calculations - Horizon 2021-2022

	A. EC Contribution *	B1. Public Partners Contribution	B2. Private Partners Contribution	C1. In Cash Contribution	C2. In-Kind Contribution	D1. Direct Leverage	D2. Direct Leverage Target	E1. Direct Leverage Factor
Value:	1000			174,6	174,6	174,6	1000	0,17
Source:	Cordis BMR 2022			**BMR-Survey 2023**				

*NB! Does not include National Investments.

Source: BMR-Survey Data 2023 received from EC.

[56] Annual Activity Report 2022

NATURE		TARGET[105]	COMMITTED – PENDING CERTIFICATION	VALIDATED / CERTIFIED
Financial contributions (FC) of the members to Clean Hydrogen JU (other than the Union) administrative costs, 2021–2022	Industry Grouping	25.97		0.00
	Research Grouping	4.23		0.00
Total FC for 2021 - 2022		30.19		0.00
In-Kind contributions to Operational Activities (IKOP) for 2021 - 2022		n/a	2.06[106]	0.00
In-Kind contributions to Additional Activities (IKAA) for 2021 - 2022			520.77	121.07[107]
Total In-Kind contributions for Horizon Europe		**969.81**	**522.83**	**121.07**
TOTAL all contributions from private members for Horizon Europe		**1,000.00**	**522.83**	**121.07**

Figure 12 Contribution from JU members other than the Union – HE targets, commitments and actual performance (as of 31/12/2022) (million EUR) (CH JU Activity Report 2022)

6.3.1. Evolution of the governance structure between FCH 2 JU and CH JU

The governance structure of the Partnership has evolved through the years in the direction of greater efficiency.

The FCH2 JU was comprised of two executive bodies, The Governing Board and the Executive Director (obligatory under the Regulation) and three advisory bodies, the Scientific Committee, the States Representatives Group and the Stakeholders Forum, provided external advice. The FCH JU was constructed as a public-private partnership, and this was reflected in the composition of the Governing Board.

The Governing Board of the FCH 2 JU included six representatives of the NEW-IG, five representatives of the EC and one representative of the N.ERGHY. The Commission represented the EU while 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 two years and had overall responsibility for the operations of the JU. Decision-making was by consensus, but if not possible, then by 3/4 majority, the EC vote was indivisible.

For the CH JU, the Governing Board is composed of representatives of the Commission (50% of the voting rights), six representatives of Hydrogen Europe (43% of the voting rights), and one representative of the Hydrogen Europe Research (7% of the voting rights). Hydrogen Europe (known as industrial grouping NEW-IG before 2014) was representative of a large part of the hydrogen and fuel cell industry in Europe. Following the launch of FCH2 JU, the organisation was rebranded as Hydrogen Europe to reflect the maturity of the technology and a new political impetus towards clean energy. Hydrogen Europe had 515 members as of 12/09/2023. Hydrogen Europe Research (previously research grouping N.ERGHY) supports and promotes research interests in the FCH JU, creating a framework for cooperation of science and industry in Europe. Hydrogen Europe Research had 160 members as of 12/09/2023.

The Executive Director has been the chief executive responsible for the day-to-day management of the Joint Undertaking in accordance with the decisions of the Governing Board. The Director was the legal representative of the FCH2 JU appointed for four years, renewable once. Initially, an Interim Executive Director was appointed by the Commission and, with the support of the Commission ensured efficient execution of activities efficiently during this early period. CH JU has a new Interim Executive Director since May 2023

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 FCH2 JU. The FCH2 JU had a scientific committee, but CH JU doesn't, as the research is sitting in the governance structures.

The obligatory States Representatives Group (SRG) comprises one representative of each Member State and each Associated Country. According to Art. 9 of the Statutes, the SRG was (and still is) attributed an advisory role to the JU, acting as an interface between the Partnership and the relevant stakeholders within their respective countries. 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.

The Stakeholders' General Assembly (SGA) is open to all public and private stakeholders, international interest groups from MSs, Associated countries as well as from third countries. The Stakeholders' General Assembly is an important communication channel intended to ensure transparency and openness of the Partnership activities with its stakeholders. It is convened once a year. A list of the members of the SGA is available in Appendix F.

The Regulation establishing the CH JU stipulates that the Stakeholders Group 'consists of representatives of sectors which generate, distribute, store, need or use clean hydrogen across the Union, including the representatives of other relevant European partnerships, as well as representatives of the European Hydrogen Valleys Interregional Partnership and the scientific community'. It is expected to provide input on strategic and technological priorities, increase the synergies, and provide input to the European Clean Hydrogen Partnership Forum and the European Hydrogen Forum of the Clean Hydrogen Alliance. The composition of the Group is a factor for improving synergies with adjacent sectors.

A Programme Office supported the Executive Director: 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.

Currently, the CH JU employs 30 people: 18 in Unit Operations and Communication, dealing with all operations and communications activities and 12 in Unit Finance and Administration. The first unit has, 9 Project Officers overseeing all projects and a team for knowledge management, monitoring the programme the KPIs, annual reviews and the performance of the technology, as well as a person for financial engineering looking at synergies (i.e., Connecting Europe, other parts of HE, ESIF). There is also a team for communications. The other unit, apart from the finance and administration activities related both to operational activities as well as administrative activities, has 4 financial officers, and it also includes the IT officer, and the legal officer.

6.3.2. Dynamics between members

The dynamics and relations between the different members (and the stakeholders they represent) have been well-balanced. Challenges and perceived pressure from the EU side may exist occasionally, but the industry has a strong opinion which is heard. DG RTD, DG ENER and DG MOVE are involved in the governance on behalf of the Commission, which is perceived as very positive and ensures the coherence between different sectors. This is instrumental in balancing the research needs within the Commission and the requirements of the industry. Nevertheless, it appears that other DGs would have also preferred to be involved in the governance, which is proof of the wide sectoral implications of the Hydrogen sector.

In terms of voting rights, industry has 43%, research - 7% and the EC - 50%, the chair being from industry. If research and industry are on the same side, they can block decisions, but this has never been the case, and consensus is sought. At the same time, the industry is

questioning why the research has to be on the Governing Board if they are not contributing financially, as research projects are covered 100%.

From the point of view of the researchers, this is needed as the industry needs to be able to communicate to research what they have to do, but it is up to the researcher to decide how to reach the target. At the same time, strong support from the EC is needed, as well as a direct connection between policy makers and industry.

6.4. Effectiveness

The achievements of the FCH 2 JU can be separated into four parts:

- Support a strong, sustainable and globally competitive FCH sector in the EU.
- Creation of an effective community combining diverse skills and functions.
- Agreement of a strategy to guide collaborative work across a broad variety of applications.
- Concrete outputs from funded activities in line with the objectives set out in the regulation.

It has been pointed out by the FCH 2 JU Interim Evaluation that 'the FCH2 JU has made good progress towards the objectives of the Joint Technology Initiative on Fuel Cells and Hydrogen, to develop strong, sustainable and globally competitive fuel cells and hydrogen sector in the Union'.

The JU was set specific objectives:

- To lower the cost of fuel cell systems for transport, while increasing their lifetime.
- To lower costs and improve performance of fuel cells for power production.
- To lower costs and improve performance of water electrolysis.
- To demonstrate on a large-scale the feasibility of using hydrogen to support the integration of renewable energy sources into energy systems.
- To reduce the use of the EU defined 'Critical raw materials'.

In the absence of a final FCH 2 JU evaluation, this case study is not in the position to come up with a definitive conclusion on the degree of achievement for each of these specific objectives. Nevertheless, the interim evaluation concluded that the 2014-2016 portfolio is well-aligned with these specific objectives with the exception of the last one on 'Critical raw materials'.

6.4.1. Knowledge & Capacity Building

FCH JU strived to be the most authoritative source of knowledge in Europe for FCH technology.

It has been confirmed unanimously that the Partnership 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 way in which the industry has built up a representative structure through NEW-IG (renamed Hydrogen Europe in 2014) to deliver its contributions to the planning and execution of the programme is evidence of the value it sees in this public-private partnership and a distinct proof of commitment. The participation of SMEs at 23% of the funding for FCH2 JU and 21% for CH JU is very good and considerably higher than FP7 overall, where SMEs received on average 13% of funds[57].

From the point of view of the research community represented by Hydrogen Europe Research, the Partnership has gone through three phases, each of them representing a different type of impact on the ecosystem:

- FCH2 – more consolidated Hydrogen community at the EU level; more demonstration projects, including large demos and small deployments. In the opinion of HER, during this phase, there was a clear tendency to decrease the research. The research budget went down to 15%, which was unacceptable to the research community.

- Things have changed, and currently, 22-30% of the budget is channelled to research members not taking into consideration the Research and Innovation Action (RIA). In the CH JU-funded projects, the role of the researchers is to validate systems and materials products in real life.

In terms of knowledge domains, Europe is the strongest in the field of water electrolysis – needed to produce Hydrogen.

According to a project stakeholder, there is a significant margin for improvement with regard to Knowledge Management. While projects are requested to fill in comprehensive information, it is not possible to find good project information on the CH JU website. The JU aims to address this point via the development of the Clean Hydrogen Knowledge Hub.

6.4.2. Market & Business

The R&D portfolio of FCH2 JU for fuel cells and stationary power was generally in line with the MAIP. The hydrogen production portfolio was highly relevant, with consistently good achievements, advancing the state-of-the-art. However, the perception of several interviewees is that many projects, even if they are technically successful, were still a long way from commercial exploitation, confirming that the objectives set out for the FCH JU were too ambitious.

From the point of view of Hydrogen Europe Research, the Hydrogen Valley approach is critical for the overall impact of the Partnership. It develops the local Hydrogen ecosystem and supports local industries. Moreover, Hydrogen Valleys create visibility and awareness and isolate the problems and solutions geographically. At the same time, they could be replicated all over Europe. Nevertheless, it has been pointed out by different interviewed stakeholders that the deployment of technology through the Hydrogen Valleys cannot happen to the detriment of lower TRL pre-deployment solutions.

6.4.3. Technology & Innovation

According to a HER representative, the Partnership did not focus on one technology. At the same time, Europe is an exporter of Hydrogen stations.

[57] CH JU Annual Activity Report 2022

The main threat is to ensure that the JU remains an R&D tool developing disruptive innovations and to focus too much on deployment.

With regards to FCH2 JU, for the whole period 2014-2020 there are 101 SMEs which introduced innovations. There have been 490 publications in peer-reviewed publications. Some 15 patents were awarded, and 6 patent pending applications. For the same period, there are 512 prototypes: 733 testing activities and one clinical trial. 73 new product, 40 new processes and 29 new methods have been launched on the market.

6.4.4. Policy & Standards

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

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 feed back into national activities. Also, the aggregation of a big share of FCH-related EU R&I financing under one umbrella has been a success.

According to an interviewed EC representative, the Partnership has been very effective in anticipating future challenges and priorities.

According to a HER representative, in terms of policy and standards, the main role of the Partnership was to give feedback on what is applicable or not regarding Hydrogen. Moreover, some pre-normative research has been carried out on different topics providing data to build standards and regulations, e.g., Hydrogen quality in a car. CH JU has also launched some projects to build international standards.

The final evaluation report of FCH JU concludes that Europe can reasonably claim to be a global leader in hydrogen fuel cell buses and the provision of refuelling infrastructure. 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 Independent Expert Group (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.

According to the EC, the Partnership has been effective in mobilising stakeholders and visibility enhanced by the Green Deal and the Hydrogen Strategy. The role of the JU in anticipating future challenges and priorities has been great.

6.4.5. Membership and benefits for members

The FCH2 JU partnerships had, and CH JU has three members:

- The European Commission;
- Hydrogen Europe AISBL, a non-profit organisation registered under Belgian Law (‘Industry Grouping’); and
- Hydrogen Europe Research AISBL is a non-profit organisation registered under Belgian Law (the ‘Research Grouping’).

The membership of Hydrogen Europe and Hydrogen Research has increased substantially with 515 members for the former and 150 members for the latter across 27 countries and more than 500 researchers actively involved (as of 12/09/2023). For Hydrogen Research this

is a significant growth from the 30-40 members when the research grouping was launched in 2008. Around 50% of the members are universities, and 50% - RTOs, covering all research topics along the value chain and all TRL levels from TRL1 to TRL7.

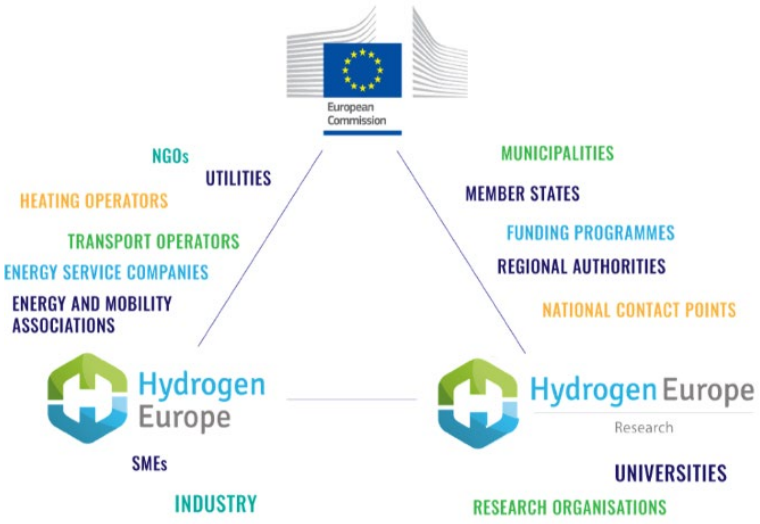


Figure 13 Fuel Cells and Hydrogen Joint Undertaking

The main benefit of being a member is participation in setting the priorities of the Partnership through developing SRIAs, Annual Work Programmes and roadmaps. Members also participate in forecast activities with a 10-20-year horizon. For example, the Fuel Cell and Hydrogen Observatory (FCHO) releases reports on how the market is evolving, predictions, volumes of Hydrogen, supply and demand, etc.

Members also provide input to the EC in shaping policies.

On behalf of the industry, there is a good representation across the value chain.

6.4.6. Gender

Within FCH2 JU, the FCH2 JU 2020 Annual Report mentions that 40% of the researchers within the funded projects are female.

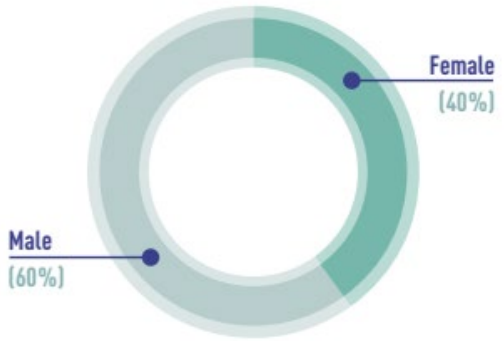


Figure 14 Breakdown of experts by gender within FCH2 JU (FCH2 JU 2020 Annual Activity Report)

The gender split of staff members of the CH JU is also relatively balanced.

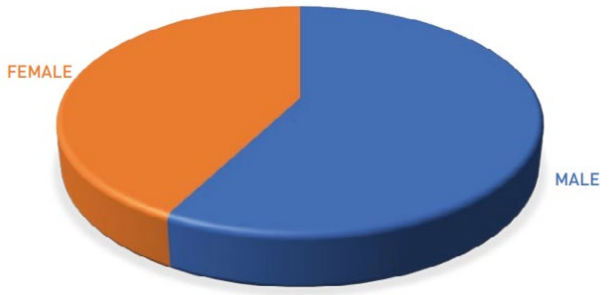


Figure 15 Gender balance of staff members of the CH JU (CH JU Annual Activity Report 2022)

In addition, there are three KPIs on gender. Values are only available for FCH2 JU for the period 2014-2020:

- Percentage of women participants in H2020 projects - According to continuous reporting: 25.89% (12 539 women);
- Percentage of women project coordinators in H2020 - 30/107 (28.0%);
- Percentage of women in EC advisory groups, expert groups, evaluation panels, individual experts, etc. - Scientific Com: 3/9 (33.3%) SRG: 9/42 (21.4%) Evaluators: N/A[58].

[58] CH JU Annual Activity Report 2022

6.5. EU Added Value

FCH 2 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.

According to the opinions of interviewed EC representatives, the main value added is bringing vision and anticipation as even despite the 40% increase from FCH2 JU, EUR 1 billion would not be completely sufficient to fund all relevant projects even if adding the additional EUR 200 million for deployment of hydrogen valleys across the EU.

In addition, the Partnership could be instrumental in bringing circularity by design into all topics as well as emphasize the local (and visible) character of the Hydrogen Valley, such as a reduction in the local citizens' energy bills.

Moreover, as mentioned earlier, the added value could be increased by aligning research policies between EC, CH JU and Member States through a much stronger involvement of the SRG. This has not been the case within FCH 2 JU. The main reason is that SRG did not involve the right policymakers from ministries. Moreover, the relations between the Governing Board and SRG should be strengthened to ensure more feedback on the annual plan and to make sure MS support the EU level and vice versa.

From the point of view of Horizon Europe Research, Europe would not have been a global leader in Hydrogen without the Partnership. The Partnership has been a game changer and has managed to create a community and bring together the researchers. Currently, they are well-organised and coordinated and the same is valid for industry. The shift has been from ideas to products, and now the industry is ready to produce and deploy. Hydrogen is already an integral part of the energy solution for the industry to decarbonise and the EU industry to develop. Moreover, without the Partnership, Europe wouldn't have been where it currently is in terms of a global approach.

Additionally, the value added of the Partnerships (both FCH2 JU and CH JU) comes through avoiding duplication and the enhanced transfer of knowledge. This is particularly important for sectors like transport, where intensive cross-border travel requires EU-wide solutions.

At the level of municipalities and regions, the JU provides an opportunity to share information on experiences with FCH technologies, problems encountered and 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 Regulations, Codes and Standards (RCS) makes an important contribution to harmonisation of relevant European plans on Regulations, Codes and Standards.

The CH JU work with regions has evolved significantly which is attractive for industry. With regard to other types of funding, the European Structural and Investment Funds (ESIF) represent an excellent opportunity for decarbonisation locally. According to the CH JU management, in 2017-18, the FCH2 JU started working with regions and realised there were different levels of knowledge of the Hydrogen technology. Regions which were aware were adopting plans. It was at this point that the idea of Hydrogen Valley[59] came up, and the FCH2 JU (and later CH JU) started complementing ESIF funds and developing projects locally. They created different structures: on the one hand, the EC, on the other hand – the industry

[59] https://h2v.eu/hydrogen-valleys

saw the opportunity to validate the technology. This also helped improve the awareness in Central and Eastern Europe (CEE) as with this type of project they can involve the Cohesion countries to start projects on Hydrogen. In 2020, the Partnership supported 11 project development assistance projects. They called for regions from across Europe to support them with project development: two from Bulgaria, one - from Poland and one - from a Slovenian region. In September 2022, CH JU launched a second wave only targeted at Cohesion countries.

6.6. Additionality

The FCH 2 JU (H2020) contribution to projects for the period 2014-2022 was EUR 632.9 million in 134 projects and 804 participants (or 1562 participations). The total project costs were EUR 1 293.7 million, meaning that the project participants are expected to finance an additional EUR 660.8 million (direct leverage). This indicates a direct leverage factor of the FCH2 JU of 1.04, which is considered very good despite being slightly lower than 1.12 for the FCH1 JU. The average EC contribution per project was EUR 4.72 million, and the funding rate was 48.9%.

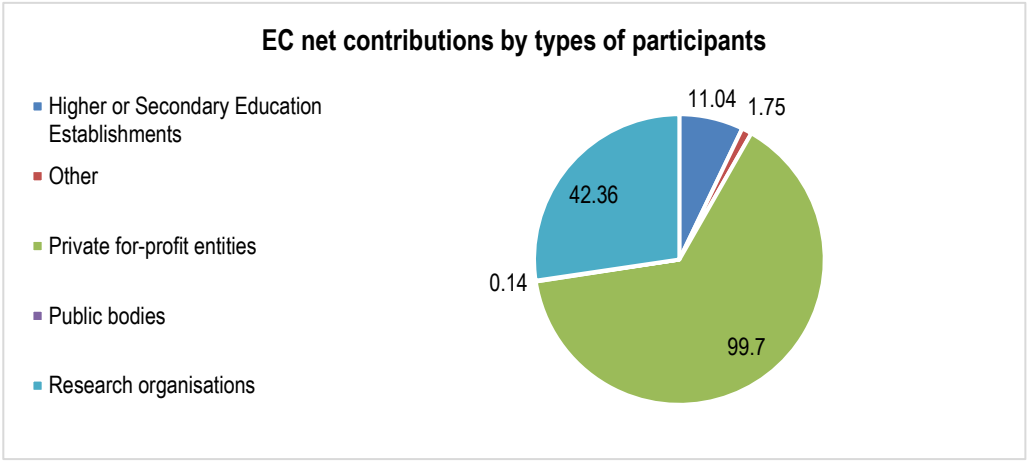


Figure 16 FCH2 JU: EC contributions by types of participants in EUR million (FCH2 JU website)

The biggest EU net contribution went to the private sector (69.8%), followed by research organisations (15.4%).

The FCH2 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.

With regards to the Clean Hydrogen JU, the Commission is contributing 50% of administrative costs while the other 50% comes from the private sector in cash. Regarding projects, the contribution is 50% in cash from EC and 50% in kind from the private sector.

Within the projects signed until December 2021 from the first deadline of the Clean Hydrogen JU Call 2022-1, the EC contribution is EUR 155.02 million while the overall project costs is EUR 245.05 million, which means an additional contribution of EUR 90.03 million (direct leverage) or a direct leverage factor of 0.58 and a funding rate of 63.3%.

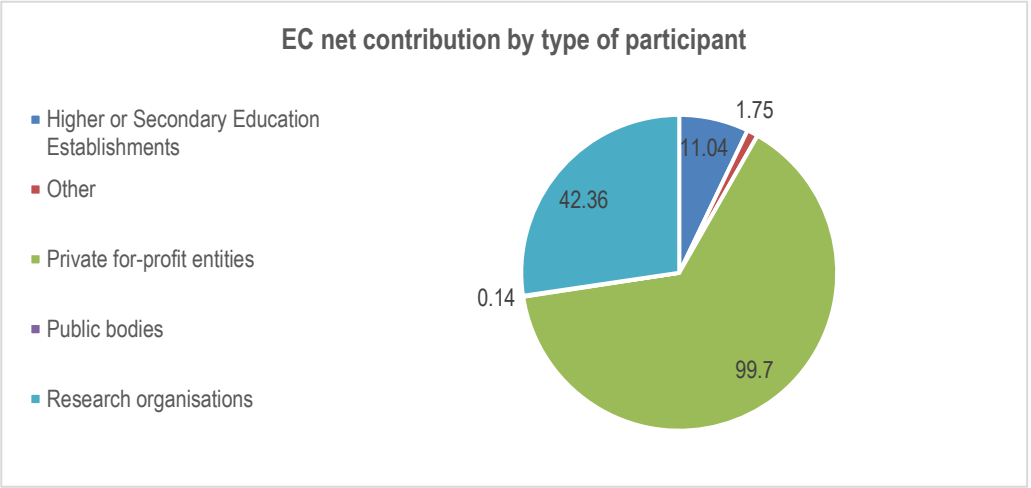


Figure 17 CH JU (first call): EC contributions by types of participants in EUR million (CH JU Annual Activity Report, 2022)

The biggest EU net contribution went to the private sector (64.3%), followed by research organisations (27.3%).

With increased membership, the two-member associations have sufficient resources to contribute. So far, the CH JU management assesses that the current model has been working for members.

In terms of additionality, the perception of stakeholders is that, due to their specificities, the Hydrogen Valleys achieve very good leverage. According to calculations provided by the CGH JU, if we assume that the leverage equals total costs/max EU contribution, then for H2020 (3 valleys), the leverage is 3.75. For Call 2022 of HE, it is 5.78, while combined H2020+Call 2022, it is 5.27.

According to the council regulation establishing the FCH2 JU, the minimum target leverage effect over the whole 2014–2020 period needed to be 0.57. According to the CH JU Annual Activity Report 2022, in the actual performance, industry and research members' overall contributions already reached levels much higher (EUR 1.1 billion) than the anticipated targets for the in-kind contributions in the H2020 legal basis (EUR 361 million) or the EU contribution to H2020 programme (EUR 665 million) itself. Expressed in terms of a leverage effect (1105 / 665 = 1.66), the certified in-kind contributions and received cash contributions far exceeded an initial target of 0.57 (almost three times higher than anticipated) set in the H2020 legal basis.

6.7. Directionality

All evidence points to the fact that both FCH2 JU and CH JU have been fully aligned with the EU policies and priority areas and have contributed towards them. There is one Common JU KPI measuring the criterion of directionality, KPI-3, on overall investments mobilised towards EU priorities. This indicator shows that 100% of the overall investment (300.5 million + IKOP + IKAA for 2022) is mobilised towards the Green Deal and Europe's 2030 climate ambition.

6.8. International positioning and visibility

Both the literature review and stakeholder consultation point to the fact that FCH2 JU and CH JU have put and are putting the EU on the global hydrogen map, especially with regard to hydrogen production. As mentioned previously, the hydrogen valleys are additionally increasing the visibility for the partnership, e.g. through a report for the Clean Energy Ministerial and 7th Mission Innovation (CEM13/MI7) ministerial in Pittsburgh, USA. This is confirmed by both research and industry representatives. There are two HE Common JU KPIs measuring the criterion of international visibility and positioning: KPI-4 on international actors involved and KPI-11 on the visibility of the partnership on national, European and international policy/industry cycles.

In terms of KPI-4, a very large number of actors was involved in activities of the JU, be it participation in proposal submissions, following events and workshops organised by the JU or reading its publications. For the FCH2 JU, the number is 276, while for the CH JU (only 2022) the number is 167. No target is available for 2027.

In terms of KPI-11, in 2022, the CH JU has organised 11 international and national events, 7 International Webinars and Workshops; made 4 publications and supported 3 hydrogen-related web platforms to promote its work, increase its visibility and strengthen the public awareness of hydrogen technologies. For example, there have been exchanges with Australian and US hydrogen actors.

6.9. Transparency & Openness

During the lifetime of FCH2 JU the hydrogen community had been building up rapidly in terms of entities which participated in a project in one way or another.

The CH JU also supports non-members, and the calls have always been open to everyone. The only specificity is that in some strategic topics of the calls there is a requirement that at least one member of the consortium should be from Hydrogen Europe or Hydrogen Europe Research. This is valid for strategic topics to make sure they have a continuation of what they do to make sure someone is exploiting the results to go further.

The Stakeholders' General Assembly was under FCH2 JUs (and continues to be under CH JU), an important communication channel intended to ensure transparency and openness of the FCH JU activities with its stakeholders. It was convened once a year.

The Independent Expert Group (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 the future 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 Governing Board (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 Policy Officers, the results of the satisfaction survey indicate that most stakeholders showed a high level of satisfaction in relation to the level of transparency.

The design of the Annual Implementation Plans is relatively open and transparent and has shown some capacity to adapt the contents to unpredicted events.

In the past, the opportunities for participation in the current way of defining topics for the calls of proposals were not transparent enough. Only 61% of the respondents agreed that the current process is open and inclusive.

There are three HE Common JU KPIs measuring the criterion of transparency and openness: KPI-5 on the share & type of stakeholders and countries engaged, KPI-6 on the number and types of newcomer members in the partnership and KPI-7 on the number and types of

newcomer beneficiaries. As regards KPI-5, a large number of stakeholders from different countries and of different types were invited and engaged in activities of the JU, be it participation in proposal submissions and projects, being members of the governance structure of the JU or participating in the panels and groups supported by the JU. The figure is 1 515 for FCH2 JU and 1 096 only for CH JU 2022 activities.

In terms of KPI-7, in the past, FCH2 JU exhibited a very high number of new beneficiaries in funded projects, something expected considering the emerging hydrogen sector. In fact, more than 70% of the total beneficiaries of FCH2 JU were new beneficiaries. The Clean Hydrogen JU continues to attract new beneficiaries: almost 50% of its beneficiaries in Call 2022-1 were new, mainly new private for-profit companies. For FCH2 JU, the value of the KPI was 573, while for CH JU 2022-1 the number was 104 new beneficiaries.

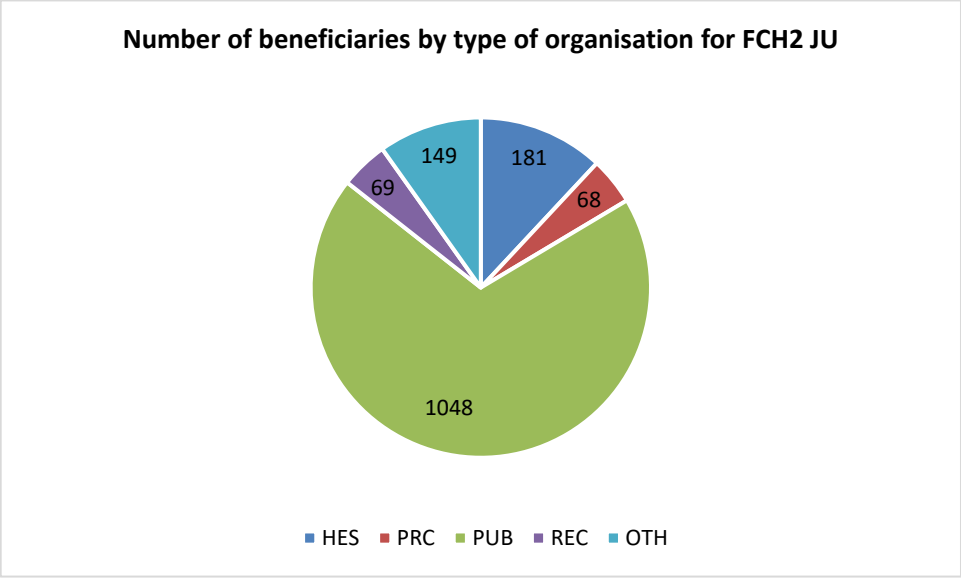


Figure 18 Number of beneficiaries by type of organisation for FCH2 JU (CH JU Annual Activity Report 2022)

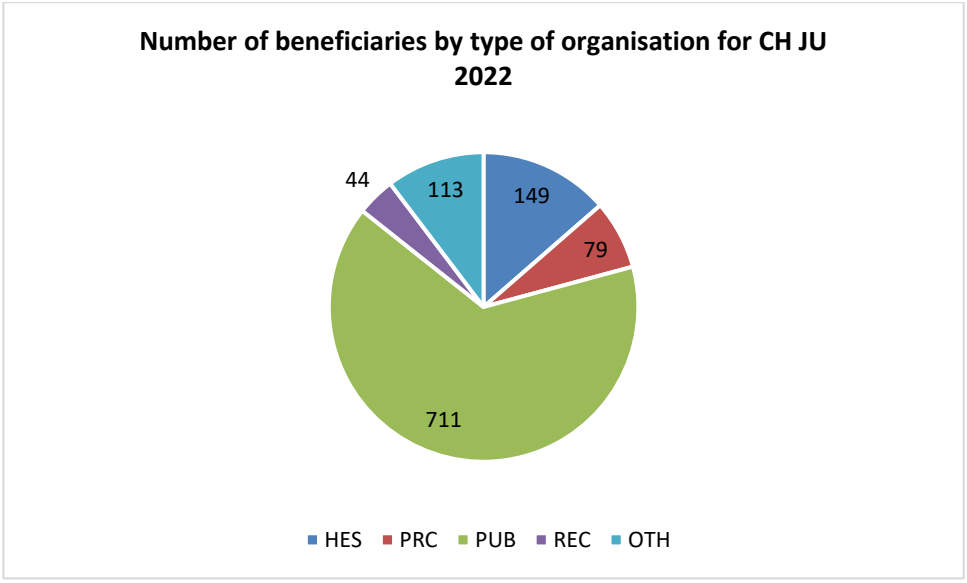


Figure 19 Number of beneficiaries by type of organisation for CH JU (2022) (CH JU Annual Activity Report 2022)

6.10. Phasing-out preparedness

The discontinuation of funding from the research and innovation programmes is expected to happen after 31 December 2031. An Initial Phasing-out Plan for the CH JU was adopted in December 2023. The plan aims at 'providing a pragmatic approach to the discontinuation of all JU's operational and administrative activities, relevant procedural aspects and timeline'. The plan points out that the last call for tenders for four-year contracts shall take place until 2027, with an implementation timeframe from 2028 to 2031.

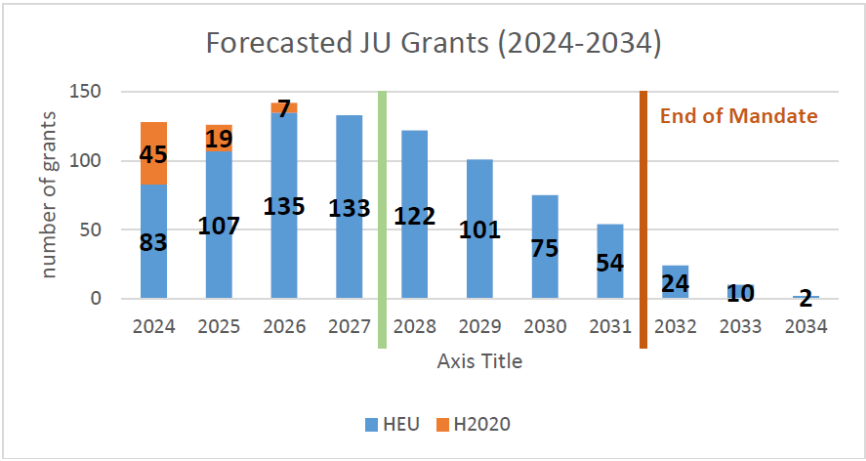


Figure 20 Number of Clean Hydrogen JU ongoing grants (2024 – 2034) (Initial Phasing-out Plan)

It is expected that in 2031, around 68 grants will still be running, all of them finishing by 2034, as indicated in the figure above. This forecasting has taken into account the project delay performance until now. The number of project officers in charge of grants post-2031 is forecasted to go down to 44 in 2032, 13 – in 2033 and 4 – in 2034. The Plan also elaborates

on the future of operational assets such as the TRUST data collection platform, European Hydrogen Observatory, Hydrogen Valleys Platform, TIM, and Knowledge Hub. The Plan outlines a number of risks in view of the CH JU phasing out, namely staff leaving the organisation, grants running after 2031, and retaining JU knowledge and intellectual property.

7. Conclusions: lessons learned and recommendations

7.1. Relevance

Overall, the objectives and the practical operation of the Partnership (both FCH2 JU and CH JU) have been assessed as relevant to the EU policy developments (Lisbon Strategy, EU Green Deal, EU Hydrogen Strategy, etc.) and the needs of the sector for research and innovation. Interviewed stakeholders were unanimous in their assessment that the objectives and activities of both FCH JU and the CH JU have been and continue to be relevant to the grand challenges facing Europe: they support the climate change challenge, help improve energy security (even more important in the context of the war in Ukraine) and contribute to the status of Europe as an international leader in technology.

The balance between different areas has not always been optimal but both FCH2 JU and CH JU have been striving to strike the right balance in line with evolving priority and context. Flexibly navigating the evolving hydrogen landscape is one of the main challenges to the Partnership.

With the success of deployment projects within the Hydrogen Valleys, there is a of deviating from the research DNA of the Partnership. Hence, a balance needs to be found between research and deployment.

The process of drafting the Partnership guiding documents – SRIA, Annual Work Programme – is flexible enough to allow for adaptation of priorities in a changing context. The SRIA comprises three pillars – Renewable Hydrogen Production, Hydrogen storage and distribution, and Hydrogen end uses. In addition, mass deployment requires support and coordination action, complemented by four additional horizontal and cross-cutting activities.

7.2. Coherence

There is a high level of coherence between the Partnership and other related partnerships and programmes. Some room for improvement exists, but the overall operation of FCH2 JU and CH JU fulfilled the objectives. The operation of FCH2 JU proved and demonstrated the need and benefits of the Public-Private Partnership concept for research in the FCH technology area.

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 and HE, such as Cluster 5, needs attention.

Previous evaluations and interviews confirmed that the Partnership under FCH2 JU has not been highly successful in aligning its activities with national governments due to the lack of effectiveness of the State Representative Group.

As far as Clean Hydrogen JU is concerned, the overall principle is and should continue to be that the JU activities need to be implemented in synergy with other Union programmes while aiming for maximal administrative simplification. Moreover, the ambition is that Clean

Hydrogen JU will seek and maximise synergies with and, where appropriate, possibilities for further funding from relevant activities and programmes at the Union, national and regional levels, in particular with those supporting the deployment and uptake of innovative solutions, training, education and regional development, such as Cohesion Policy Funds, or the National Recovery and Resilience Plans.

DG RTD, DG ENER and DG MOVE are involved in the governance on behalf of the Commission, which is perceived as very positive and ensures additional coherence between different sectors.

There is a margin for improvement of the cooperation with the co-programmed partnerships and the SET Plan. The deployment pillar of the CH JU could also be improved.

The Partnership is an important part of the hydrogen ecosystem, but there are some activities outside, such as the European Clean Hydrogen Alliance; European Innovation Council (EIC)[60] with EIC pathfinder, EIC accelerator and EIC Transition as well as the SME Instrument; as well as Cluster 4 and 5 of HE.

The membership of the Partnership (both FCH2 JU and CH JU) is optimal and it reaches out to a wide set of relevant industries and researchers. The Partnership governance has been assessed as suitable for its functioning. Still, there is a need to improve the functioning of the States Representatives Group to ensure better integration of Member States' views, priorities and overall complementarity and coherence. The relationship between members is well-balanced, and despite the diverging immediate interests for certain issues, the EC, industry and research seem to be able to balance their interests for the overall benefit of the Partnership and through the governance set-up.

The objectives and activities of the Partnership have evolved throughout the years since 2008. Their changing objectives reflect the changing context and seem to be recognised by all interviewed stakeholders so far.

7.3. Efficiency

With regard to cost efficiency, so far, there is no data on the proportionality between the costs of application and participation borne by different stakeholder groups and the associated benefits. No insights were provided either on the administrative costs borne by applicants and participants compared with the previous Framework Programme.

There is evidence that the governance of the Partnership has evolved (from FCH2 JU to CH JU) in the direction of bigger efficiency. One of the main differences between FCH2 JU and CH JU is the fact that there is no Scientific Committee in CH JU, as the research is sitting on the Governing Board through Hydrogen Europe Research.

The efficiency of the Partnership also depends on the dynamics between the members, which are overall well-balanced. The involvement of different DGs of the EC is also perceived as very positive. The opinions of different members of the Governing Board differ with regards to the focus of the Partnership on different topics and sectors but this does not seem to pose a significant problem.

[60] https://eic.ec.europa.eu/index_en

7.4. Effectiveness

The FCH2 JU has been effective in managing the Calls and disbursing funds in line with the stated objectives. 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.

Both FCH2 JU and CH JU managed to consolidate and organise a previously scattered and fragmented hydrogen ecosystem. It managed to attract some of the biggest industrial players in the field and led to increased private R&D funding. The Partnership also provided anticipation and vision to the hydrogen sector in Europe.

With regard to knowledge and capacity, the Partnership is the most authoritative source of knowledge in Europe for FCH technology. However, there is a significant margin for improvement in knowledge management and the presentation and capitalisation of project results. The JU aims to address this point via the development of the Clean Hydrogen Knowledge Hub.

Regarding market and business, the Hydrogen Valleys are identified as a very promising activity. The Hydrogen Valley approach is critical for the overall impact of the Partnership. It develops a local Hydrogen ecosystem, supports local industries, and has the potential to be replicated all over Europe.

As far as policies and standards are concerned, FCH2 JU and CH JU did not have strong instruments for influencing national policies and technology priorities of Member States and Associated Countries. The main role of the Partnership was to give feedback on what is applicable or not regarding Hydrogen. Moreover, some pre-normative research has been carried out on different topics providing data to build standards and regulations, e.g. Hydrogen quality in a car. CH JU has also launched some projects to build international standards.

Moreover, CH JU intensified work with the European regions mainly in the context of the Hydrogen Valley concept and by complementing ESIF funds. This provided an opportunity for industries to validate their technologies.

7.5. EU Added Value

FCH JU has made significant progress in eliminating the fragmentation that previously existed in EU support for FCH technologies. It provided a common ground for interaction between different stakeholders from the ecosystem.

Overall, the main value added is bringing vision and anticipation to the hydrogen research, ecosystem and market.

It is worth noting that the Partnership could be instrumental in bringing circularity by design into all topics as well as emphasize the local (and visible!) character of the Hydrogen Valley as citizens need to see a difference in their energy bills.

Without the Partnership, Europe would not have been a leader in Hydrogen. The Partnership has been a game changer and has managed to create a community and bring together the researchers.

7.6. Additionality

The operational leverage effect of the FCH2 JU of EUR 539.21 million/EUR 638.89 million equals leverage of 0.84, which is considered adequate. The average EC contribution per project was EUR 4.77 million.

With regards to the Clean Hydrogen JU, the Commission is contributing 50% of administrative costs while the other 50% comes from the private sector in cash. Regarding projects, the contribution is 50% in cash from EC and 50% in kind from the private sector.

Within the projects signed until December 2021 from the first CH JU Call 2022-1, the EC contribution is EUR 155.02 million while the overall project costs is EUR 245.05 million, which means an additional contribution of EUR 90.03 million (direct leverage) or a direct leverage factor of 0.58 and a funding rate of 63.3%.

7.7. Directionality

All evidence points to the fact that both FCH2 JU and CH JU have been fully aligned with the EU policies and priority areas and have contributed towards them.

7.8. International positioning and visibility

Both the literature review and stakeholder consultation point to the fact that both FCH2 JU and CH JU have put and are putting the EU on the global hydrogen map through the involvement of international actors in projects and through the organisation of international events. Beyond this, the perception of business and research actors is that the EU experience (through FCH2 JU and CH JU) is referred to as an excellent one and emulated internationally.

7.9. Transparency & Openness

Most stakeholders showed a high level of satisfaction in relation to the level of transparency. The CH JU also supports non-members, and the calls have always been open to everyone. The Stakeholders' General Assembly was an important communication channel intended to ensure transparency and openness of the FCH JU activities with its stakeholders. All these trends should be continued during the

7.10. Phasing out preparedness

The thinking on preparedness for the discontinuation of funding after 31 December 2031 has been concretised in an Initial Phasing-out Plan for the CH JU, adopted in December 2023. The plan provides an initial analysis of different aspects of the functioning of the CH JU, such as the status of running grants at the end of 2031 and later until 2034. The plan provides a forecast of the policy officers necessary to manage these grants. Thinking of the future of operational assets has also started and is expected to evolve. It is worth noting the risks mentioned within the Plan, the most serious of which is the staff leaving the JU prior to 2031. Overall, in the next several years, phasing-out preparedness should be developed and finetuned in view of fully optimising the huge potential of the Partnership and leaving a lasting legacy.

Appendix A Literature

Fuel Cells and Hydrogen 2 Joint Undertaking

Council Regulation (EU) No 559/2014 establishing the Fuel Cells and Hydrogen 2 Joint Undertaking

EC 2017, Final Evaluation of the Fuel Cells and Hydrogen Joint Undertaking (2008-2014) operating under FP7

EC 2017, Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking (2014-2016) operating under Horizon 2020

Financial Rules of the Fuel Cells and Hydrogen 2 Joint Undertaking

FCH2 Annual Work Plans from 2014 to 2020 (7 documents)

FCH2 JU Multi-annual Work Plan (2014-2020)

Addendum to the FCH2 JU Multi-annual Work Plan (2014-2020)

FCH2 JU Annual Activity Reports from 2014 to 2020 (7 documents)

FCH2 JU In-kind Additional Activities from 2014 to 2020 (6 documents)

Clean Hydrogen Joint Undertaking

Clean Hydrogen JU, 2021 Consolidated Annual Activity Report

Clean Hydrogen JU, 2022 Consolidated Annual Activity Report

Clean Hydrogen JU, 2022 Annual Work Plan

Clean Hydrogen JU, Programme Review Report 2022

Clean Hydrogen JU, Strategic Research and Innovation Agenda 2021 – 2027 (adopted in 02/2022)

Corrigendum to SRIA (08/06/2022)

Decision SRIA (13/04/2022)

EC, Performance of European Partnerships, Biennial Monitoring Report 2022 on Partnerships in Horizon Europe

EC, A hydrogen strategy for a climate-neutral Europe

Commission Staff Working Document Interim Evaluation of the Joint Undertakings operating under Horizon 2020, SWD(2017) 338 final

JRC, 2021, Historical Analysis of FCH2 JU Electrolyser Projects

Appendix B List of interviewees

	Institution	Date
1	CH JU	27/09/2022
2	European Commission DG RTD	03/11/2022
3	Hydrogen Europe Research	07/11/2022
4	European Clean Hydrogen Alliance: EC DG GROW	24/11/2022
5	Normandy Region (leader of the Valley partnership)	25/11/2022
6	Hydrogen Europe	06/12/2022
7	CH JU	09/12/2022
8	GREENHYSLAND project (Hydrogen Valley)	16/12/2022
9	DG RTD	25/04/2023
10	DG MOVE	09/06/2023

Appendix C Projects funded by the FCH2 JU

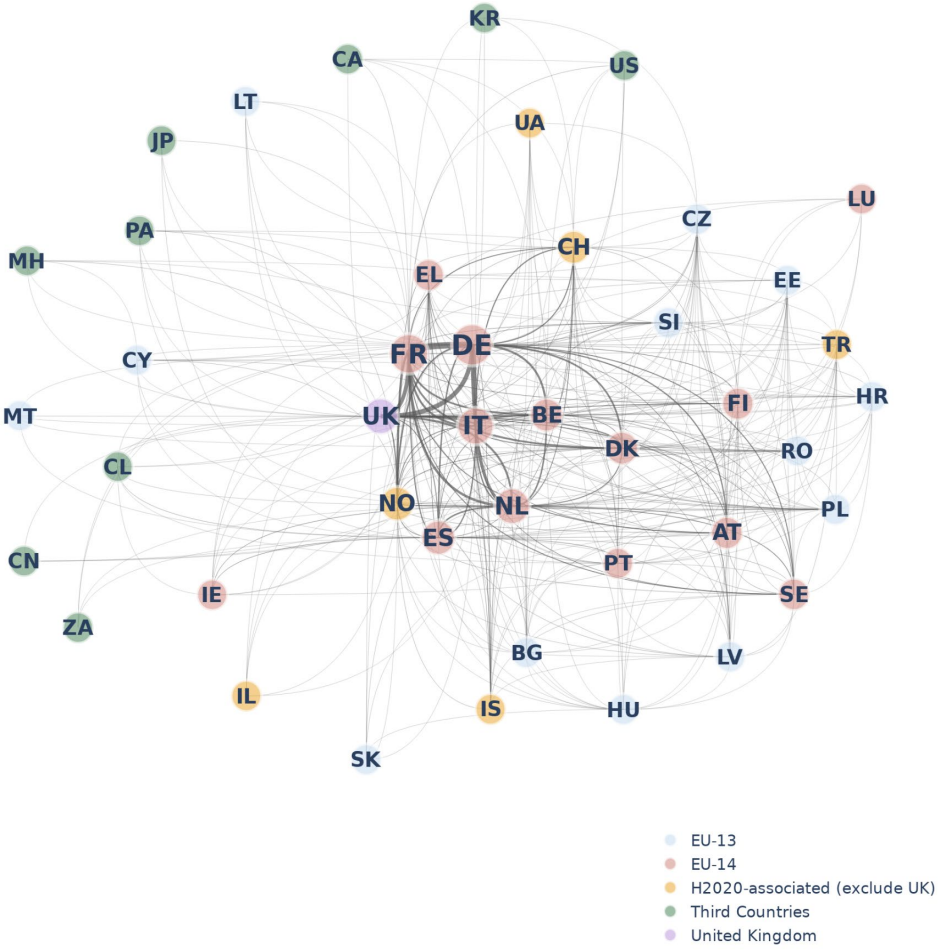
Programme	Project Call year	Project Acronym	Project Total Costs
H2020	2014	HyBalance	15,803,441.25
H2020	2014	AutoRE	4,464,447.25
H2020	2014	INNO-SOFC	3,998,081.25
H2020	2014	NewBusFuel	2,471,144.75
H2020	2014	H2ME	62,308,186.05
H2020	2014	HY4ALL	2,035,349.11
H2020	2014	ELYntegration	3,301,391.25
H2020	2014	BIONICO	3,396,640.00
H2020	2014	HySEA	1,511,780.00
H2020	2014	H2REF	7,127,941.25
H2020	2014	VOLUMETRIQ	4,988,450.25
H2020	2014	DEMOSOFC	5,905,336.25
H2020	2014	D2Service	3,636,797.50
H2020	2014	SElySOs	2,939,655.00
H2020	2014	HEALTH-CODE	2,358,736.25
H2020	2015	ECo	3,239,138.75
H2020	2015	HPEM2GAS	2,654,250.00
H2020	2015	BIG HIT	7,748,848.00
H2020	2015	Giantleap	3,260,297.50
H2020	2015	INSPIRE	6,878,070.01
H2020	2015	HYTECHCYCLING	497,666.25
H2020	2015	COMPASS	3,920,302.50
H2020	2015	Cell3Ditor	2,191,133.75
H2020	2015	GrInHy	4,498,150.00
H2020	2015	PACE	91,681,934.33
H2020	2015	H2ME 2	100,015,655.40
H2020	2015	HyGrid	3,167,710.00
H2020	2015	ELY4OFF	2,315,217.50
H2020	2015	HEATSTACK	2,899,760.00
H2020	2015	SOSLeM	2,944,176.25
H2020	2016	qSOFC	2,110,015.00
H2020	2016	PECSYS	2,499,992.50
H2020	2016	INLINE	3,286,068.75
H2020	2016	QualyGridS	2,811,262.50
H2020	2016	H2Future	17,852,540.38
H2020	2016	MEMPHYS	2,088,195.00

H2020	2016	JIVE	88,770,205.25
H2020	2016	Fit-4-AMandA	2,999,185.00
H2020	2016	CH2P	6,711,722.58
H2020	2016	MARANDA	3,704,757.50
H2020	2016	INSIGHT	3,146,056.25
H2020	2016	INN-BALANCE	6,156,288.75
H2020	2016	HyLAW	1,143,000.00
H2020	2016	COSMHYC	2,496,830.00
H2020	2016	BIOROBURplus	3,813,536.24
H2020	2016	DIGIMAN	3,486,965.00
H2020	2016	Demo4Grid	7,736,682.50
H2020	2016	NET-Tools	1,596,007.50
H2020	2017	CRESCENDO	2,739,602.50
H2020	2017	GRASSHOPPER	4,387,063.75
H2020	2017	Haeolus	7,779,761.25
H2020	2017	HYDRAITE	3,499,867.50
H2020	2017	PRETZEL	1,999,088.75
H2020	2017	ComSos	10,277,897.50
H2020	2017	GAMER	2,998,951.25
H2020	2017	OxiGEN	2,996,873.75
H2020	2017	ZEFER	13,676,254.48
H2020	2017	NEPTUNE	1,927,335.43
H2020	2017	REMOTE	6,740,031.40
H2020	2017	PEGASUS	2,829,016.88
H2020	2017	JIVE 2	105,520,120.12
H2020	2017	ID-FAST	2,748,195.00
H2020	2017	FLHYSAFE	7,296,552.51
H2020	2017	REFLEX	2,999,575.48
H2020	2017	REFHYNE	19,757,847.75
H2020	2017	REVIVE	9,278,697.55
H2020	2017	MAMA-MEA	3,189,816.00
H2020	2017	EVERYWH2ERE	6,770,248.74
H2020	2017	PRESLHY	1,905,862.50
H2020	2017	TAHYA	3,996,943.75
H2020	2017	HySTOC	2,499,921.25
H2020	2017	TeacHy	1,248,528.75
H2020	2018	RoRePower	4,220,093.75
H2020	2018	AD ASTRA	3,008,426.25
H2020	2018	Djewels	41,967,250.00
H2020	2018	GAIA	4,493,025.00

H2020	2018	WASTE2GRIDS	528,750.00
H2020	2018	COSMHYC XL	2,749,613.75
H2020	2018	HyTunnel-CS	2,500,000.00
H2020	2018	DOLPHIN	2,962,681.25
H2020	2018	FLAGSHIPS	6,766,811.83
H2020	2018	WASTE2WATTS	1,681,602.50
H2020	2018	H2Haul	28,137,376.80
H2020	2018	FCHgo	502,498.75
H2020	2018	HEAVEN	6,903,128.81
H2020	2018	THOR	2,884,330.29
H2020	2018	LOWCOST-IC	2,335,997.50
H2020	2018	H2Ports	4,117,197.50
H2020	2018	GrInHy2.0	5,882,492.50
H2020	2018	HyCARE	2,024,230.00
H2020	2018	HYDROSOL-beyond	2,999,940.00
H2020	2019	NewSOC	4,999,726.25
H2020	2019	THyGA	2,468,826.25
H2020	2019	PRHYDE	3,167,078.16
H2020	2019	ANIONE	1,999,995.00
H2020	2019	FURTHER-FC	2,735,031.25
H2020	2019	RUBY	2,999,715.00
H2020	2019	EMPOWER	1,499,876.25
H2020	2019	VIRTUAL-FCS	1,897,806.25
H2020	2019	CHANNEL	1,999,906.25
H2020	2019	HyResponder	1,000,000.00
H2020	2019	HEAVENN	96,191,883.93
H2020	2019	HIGGS	2,107,672.50
H2020	2019	NEWELY	2,597,413.75
H2020	2019	MultiPLHY	9,751,722.50
H2020	2019	SWITCH	3,746,753.75
H2020	2019	CAMELOT	2,295,783.50
H2020	2019	ShipFC	13,179,056.25
H2020	2020	StasHH	14,514,575.80
H2020	2020	HyUsPRe	3,714,850.00
H2020	2020	FCH2RAIL	13,378,484.93
H2020	2020	IMMORTAL	3,825,927.50
H2020	2020	SO-FREE	3,045,355.00
H2020	2020	HYPSTER	15,514,301.73
H2020	2020	CoacHyfied	7,329,180.25
H2020	2020	MultHyFuel	2,121,906.25

H2020	2020	MegaSyn	7,785,793.75
H2020	2020	SH2E	2,142,778.75
H2020	2020	WINNER	2,931,788.75
H2020	2020	eGHOST	1,133,541.25
H2020	2020	OYSTER	4,999,843.51
H2020	2020	MORELife	3,499,913.75
H2020	2020	COSMHYC DEMO	3,773,858.75
H2020	2020	REACTT	2,712,322.50
H2020	2020	HyStorIES	2,499,911.75
H2020	2020	SH2APED	1,993,550.00
H2020	2020	PROMETEO	2,765,206.25
H2020	2020	GREEN HYSLAND	20,453,569.28
H2020	2020	HyShip	10,796,560.00
H2020	2020	BEST4Hy	1,586,015.00
H2020	2020	E2P2	3,576,995.38
H2020	2020	SHERLOHCK	2,563,322.50
H2020	2020	e-SHyIPS	2,500,000.00
TOTAL			**1,178,096,298.00**

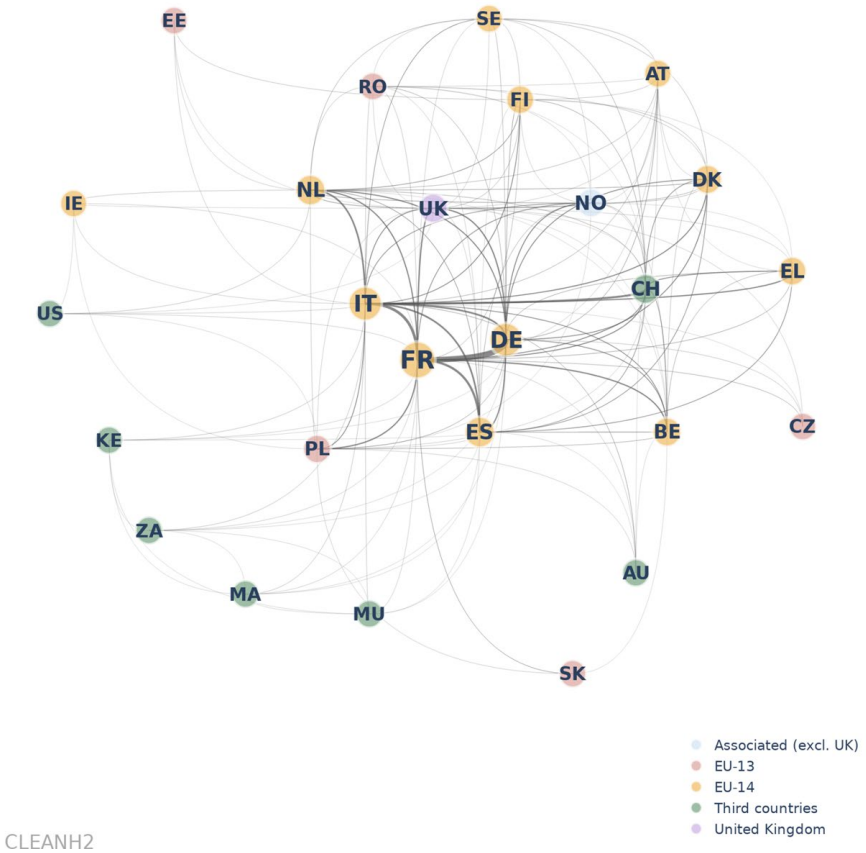
Appendix D Network of participating countries in "FCH2 - Fuel Cells and Hydrogen 2"



Appendix E Project funded by the Clean Hydrogen Joint Undertaking

Programme	Project Acronym	Project Total Cost
Horizon	HyP3D	€ 2,543,398.75
Horizon	ADVANCEPEM	€ 1,631,066.56
Horizon	PressHyous	€ 2,499,426.00
Horizon	PEACE	€ 2,504,965.00
Horizon	HIGHLANDER	€ 3,331,247.50
Horizon	RH2IWER	€ 20,531,971.25
Horizon	ELVHYS	€ 1,433,960.00
Horizon	COCOLIH2T	€ 8,726,769.50
Horizon	NIMPHEA	€ 4,942,898.75
Horizon	BRAVA	€ 19,986,841.75
Horizon	OPTHYCS	€ 2,499,428.75
Horizon	24_7 ZEN	€ 5,499,822.50
Horizon	MEAsureD	€ 2,989,060.00
Horizon	ROAD TRHYP	€ 2,642,912.59
Horizon	FLEX4H2	€ 4,872,197.50
Horizon	PEMTASTIC	€ 2,748,608.75
Horizon	OUTFOX	€ 2,925,824.50
Horizon	RHeaDHy	€ 4,734,730.00
Horizon	H2Accelerate TRUCKS	€ 110,946,587.25
Horizon	HQE	€ 3,453,685.00
Horizon	HYPRAEL	€ 3,134,235.00
Horizon	HyLICAL	€ 4,677,848.75
Horizon	HELIOS	€ 3,984,187.50
Horizon	JUST-GREEN AFRH2ICA	€ 999,995.00
Horizon	SUSTAINCELL	€ 9,993,652.00
Horizon	HySelect	€ 3,982,105.00
Horizon	PROTOSTACK	€ 2,497,013.75
Horizon	H2REF-DEMO	€ 5,786,712.50
Horizon	AMON	€ 4,293,653.75
Horizon	THOTH2	€ 1,997,361.25
Horizon	HERAQCLES	€ 2,342,385.00
Horizon	AMPS	€ 8,711,520.00
Horizon	SHIMMER	€ 3,037,265.00
Horizon	CANDHy	€ 2,607,481.25
Horizon	HOPE	€ 40,287,430.00
Horizon	RealHyFC	€ 3,487,157.50
Horizon	NAHV	€ 345,326,582.18
Horizon	HYPOP	€ 1,062,755.00
Horizon	UnLOHCked	€ 2,941,312.75
Horizon	LH2CRAFT	€ 5,627,595.94
Horizon	PilotSOEL	€ 2,000,000.00
Horizon	BalticSeaH2	€ 33,235,406.25
Horizon	HYSouthMarmara	€ 37,798,575.00
Horizon	HYScale	€ 5,295,799.25
Horizon	TRIERES	€ 10,492,431.25
Horizon	TH2ICINO	€ 18,506,850.00
Horizon	ANDREAH	€ 2,980,361.25
Horizon	SINGLE	€ 2,989,671.25
Horizon	CRAVE-H2	€ 11,201,812.00
Horizon	EPHYRA	€ 24,631,840.00
TOTAL		**€ 817,356,397.00**

Appendix F Network of participating countries in CLEANH2 projects



Appendix G Composition of the CH JU Stakeholder Group

European Network of Transmission System Operators for Gas (ENTSOG)

Technical Association of the European Gas Industry (MARCOGAZ)

European Industrial Gases Association (EIGA)

The Energy Materials Industrial Research Initiative (EMIRI)

European Association of Gas and Steam Turbine Manufacturers (EUTurbines)

European Aeronautics Science Network (EASN)

Polish Alternative Fuels Association (PSPA)

Waterborne Technology Platform (Waterborne TP)

European Steel Technology Platform (ESTEP)

European Green Vehicles Initiative Association for the 2Zero Partnership (EGVIAfor2Zero)

The European Association of National Metrology Institutes (EURAMET)

European Hydrogen Valleys Interregional Partnership (H2 Valleys S3P)

European Energy Research Alliance (EERA)

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This evaluation report is part of the interim evaluation of Horizon Europe activities related to the Green Transition. It presents the assessment of the Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen Joint Undertaking 2 (FCH2) against the evaluation criteria of relevance, coherence, efficiency, effectiveness, EU added value, additionality, directionality, international positioning and visibility, transparency and openness as well as phasing out preparedness. The evaluation of the partnership is based upon a mixed-method approach including quantitative and qualitative data analysis.

Studies and reports

Publications Office
of the European Union