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PART 6/21

**COMMISSION STAFF WORKING DOCUMENT**

**EVALUATION**

**Interim Evaluation of the Horizon Europe Framework Programme for Research and  
Innovation (2021 - 2024)**

*Accompanying the document*

**Communication from the Commission to the European Parliament and the Council**

**Horizon Europe: Research and Innovation at the heart of competitiveness**

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# Annex 14: Evaluation of Clean Hydrogen JU

Annex to the Commission's interim evaluation of Horizon Europe

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## 1. Effectiveness

The Clean Hydrogen Joint Undertaking (JU) is a unique public-private partnership supporting research and innovation in hydrogen technologies in Europe. It is the continuation of the Fuel Cell and Hydrogen JUs (FCH JU and FCH 2 JU), under FP7 and Horizon 2020 (H2020) respectively. The overall goal of the Clean Hydrogen JU is to support research and innovation (R&I) activities in the Union in clean hydrogen solutions and technologies, under EU's funding programme for research and innovation, Horizon Europe, and in synergy with other EU initiatives and programmes. Its aim is to contribute to the Union's wider competitiveness goals and leverage private investment by means of an industry-led implementation structure.

Clean Hydrogen JU differs from its predecessors, focusing on 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. They are guided largely by EU's Hydrogen Strategy and REPowerEU Plan and the policy developments in this context, contributing to their implementation. According to the interim evaluation, the 2014-2016 portfolio was well aligned with these objectives, apart from the successful reduction of "critical raw materials"<sup>1</sup>. However, the interim evaluation is not in the position to come up with a definitive conclusion on the degree of achievement for each of these specific objectives<sup>2</sup>. Some key achievements of FCH2 JU projects as the legacy of the Clean Hydrogen JU are:

- In total, Clean Hydrogen JU-funded vehicles have now driven a total of almost 38.7 million km and consumed over 518.3 tonnes of hydrogen since 2016, avoiding emissions of about 1420 tonnes of CO<sub>2</sub><sup>3</sup>.
- After China, European countries have the largest number of fuel cell bus manufacturers, an indicator of technological progress and innovation<sup>4</sup>. This is partly due to the significant contribution of Clean Hydrogen JU demo projects, focusing on the large-scale demonstration of fuel cell buses in Europe since 2010. Additionally, these bus demos have improved the public acceptance of fuel cell buses in Europe. Whereas fuel cell buses are established for urban use, there is the need to advance the technology for longer distances in order to cover interurban and regional routes<sup>5</sup>.
- In electrolysis, based on the figures reported by the projects in 2023, the JU projects have also shown remarkable progress: since 2017, efficiency improvement has been achieved in PEM electrolyzers (PEMEL) and in solid-oxide electrolyzers (SOEL).

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<sup>1</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2), page 34

<sup>2</sup> Interim Evaluation of the Fuel Cells and Hydrogen 2 Joint Undertaking (2014-2016) operating under Horizon 2020, page 6

<sup>3</sup> Programme Review Report 2023, page 38 (<https://op.europa.eu/en/publication-detail/-/publication/00f833fa-7ec4-11ee-99ba-01aa75ed71a1/language-en>)

<sup>4</sup> <https://fuelcellbuses.eu/suppliers#29>

<sup>5</sup> Programme Review Report 2023, page 35.

Scaling up the technology to advanced megawatt-scale enables a reduction of the cost of hydrogen by 50%<sup>6</sup>.

In its first two-and-a-half years of activity, the Clean Hydrogen JU delivered on its operational objectives and additional tasks described in the Single Basic Act (SBA), putting in place the building blocks for the specific and general objectives. These broad areas of activities are identified in the Strategic Research and Innovation Agenda (SRIA)<sup>7</sup> and the Clean Hydrogen JU's Strategy Map<sup>8</sup> and include: 1) supporting climate neutral and sustainable solutions; 2) focusing on research and innovation; and 3) supporting market uptake of clean hydrogen technologies.

### Long-term scientific impacts

The early projects of the EU (Framework Programmes (FPs) 4 to 6) focused on the regulations, harmonisation, licensing and public acceptance of Fuel Cell Electric Vehicles<sup>9</sup> (FCEV) and Fuel Cell Electric Buses (FCEB) technology. Then with FP7 and the establishment of the JU, the focus changed to the demonstration, progress and validation of the FCEV and FCEB technology and its refuelling infrastructure.

The JU has been funding projects towards the development of electrolyser technologies for hydrogen production since it was founded in 2008. The 61 JU projects, funded by the JU with EUR 232.6 million, have led the technological developments in this area, significantly increasing the size and efficiency, while reducing the capital costs, of electrolysers (as reported in the Programme Review Report 2023<sup>10</sup>). For example, the Clean Hydrogen JU still plays a leading role in the development of PEMEL technology, which offers high efficiency, rapid response times, and compatibility with renewable energy sources, making it more versatile and effective compared to other electrolyser technologies. PEMEL is considerably advancing towards reaching 2024 and 2030 Key Performance Indicators (KPIs<sup>11</sup>), as well as showing a strong decrease in the use of Critical Raw Materials (CRMs) in this new iteration of the partnership. Another stepping stone to achieve this objective is the recent establishment of the European Hydrogen Sustainability and Circularity Panel. Also, SOEL shows clear progress regarding durability, a technology known for operating at high efficiencies and directly utilizing heat and electricity – making it particularly suitable for industrial applications and integration with high-temperature processes.

In terms of low temperature electrolysis, the initial JU project electrolyser system capacity of around 100 kW until 2011 in projects like DON QUICHOTE reached 1.2 MW in 2014 in HYBALANCE<sup>12</sup>, 10 MW in 2017 in REFHYNE and, finally, 30 MW in 2023 in EPHYRA.

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<sup>6</sup> Green hydrogen cost reduction, page 8: <https://www.irena.org/publications/2020/Dec/Green-hydrogen-cost-reduction>.

<sup>7</sup> Clean Hydrogen JU: Strategic Research and Innovation Agenda 2021 – 2027 (link)

<sup>8</sup> Clean Hydrogen JU: [Strategy Map and Performance Indicators](#)

<sup>9</sup> Mainly referring to passenger vehicles and vans.

<sup>10</sup> Programme Review Report 2023, pages 23-24.

<sup>11</sup> Ibid. On the average electrolyser footprint, the use of Iridium, the degradation rate and current density.

<sup>12</sup> <https://cordis.europa.eu/project/id/671384>

During the same period, the JU projects reduced the electrolyser capital cost per MW by more than 50-times. Similar advances took place in the field of high temperature electrolysis.

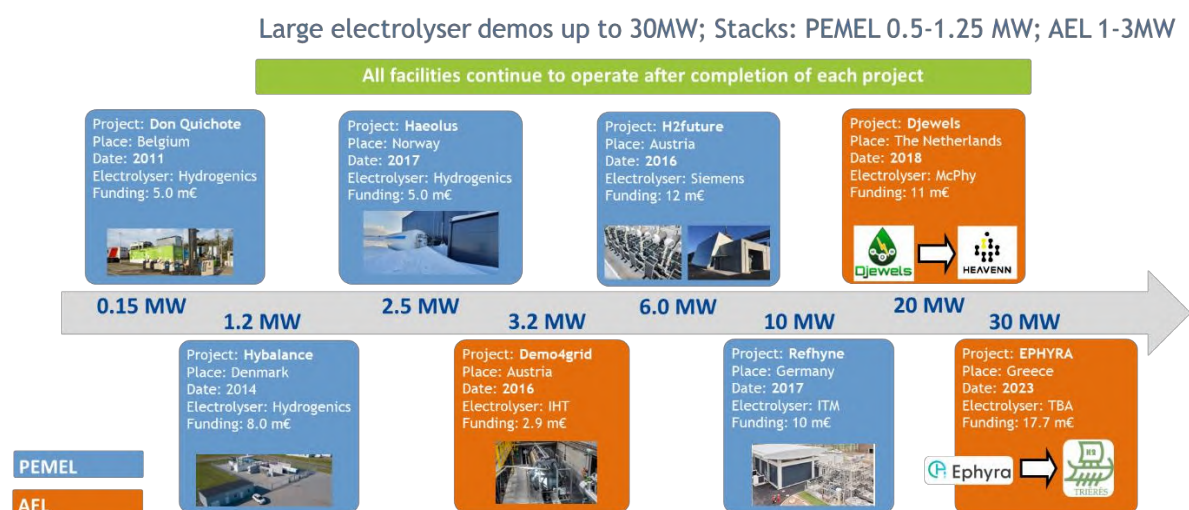


Figure 1 - Evolution of size and cost of low temperature electrolysis demonstration projects of the JU. Source: Clean Hydrogen JU, EU Research Days 2023.

Solid state hydrogen storage is one of the technologies funded by the Clean Hydrogen JU which has certain advantages for aboveground storage. Cyclability, a suitable heat supply, and thermal management have proven to be particularly challenging. This research area currently consists of one finished project, [HYCARE](#), focusing on solid state storage. The HYCARE project target is the upscaling of a solid-state hydrogen storage system based on metal hydrides, albeit at a much smaller scale (44 kg H<sub>2</sub> reversibly stored) than the SRIA target of five tonnes for 2024. Furthermore, and depending on the source of hydrogen, hydrogen may need to be either separated from a gas mixture or further purified. Higher reliability of the compressors must be achieved, especially for Hydrogen Refueling Stations (HRS); work in this area is ongoing in the [COSMHYC XL](#) and [COSMHYC DEMO](#) projects.

The [H2ME](#) – Hydrogen Mobility Europe initiative, originally a Clean Hydrogen JU-funded project, is the largest European deployment to date for hydrogen mobility, planning to deploy more than 1,400 vehicles in nine countries and 50 HRS in six countries. Similarly, [JIVE](#) and [JIVE2](#) are deploying over 300 FCEB in 22 cities across Europe – the largest deployment in Europe to date. The latest success of the JU was in aviation, with the project [HEAVEN](#). The consortium successfully completed, for the first time in the history of aviation, a flight test of a 2–4-seater aircraft propelled exclusively with liquid hydrogen.

The Clean Hydrogen Joint Undertaking (JU) has significantly advanced hydrogen mobility in Europe by deploying over 1,300 Fuel Cell Electric Vehicles (FCEVs) and more than 400 Fuel Cell Electric Buses (FCEBs) between 2005 and 2023. These efforts have demonstrated the

benefits and readiness of hydrogen-powered transport and laid the groundwork for a pan-European hydrogen refuelling network<sup>13</sup>.

There have been many basic and applied research projects funded throughout the lifetime of the FCH 2 JU, targeting consecutive generations of Proton Exchange Membrane Fuel Cell (PEMFC) and Solid Oxide Fuel Cells (SOFC) products in the 0.3-5 kW power range. Several lower TRL projects considered materials development and improved the existing cell and stack technologies, especially in terms of durability.

In the SRIA pillar 3.2 – Hydrogen end uses: clean heat and power, the key objective of the [ComSos](#) project is to validate and demonstrate fuel cell based combined heat and power solutions in the mid-sized power ranges of 10-12 kW, 20-25 kW, and 50-60 kW. As a project important for the SOFC market, the activity developed during the project has increased manufacturing capability, often bringing innovation to the technology (e.g. reducing the number of components and reducing costs). In addition, several thousand units have been deployed in Europe through the JU projects [ENE.FIELD](#) and [PACE](#) (a FCH 2 JU project), creating a track record of micro-CHP installations.

In the area of awareness and education, the FCH Observatory (FCHO) plays an important role. As this knowledge management tool became an overarching provider of structured data and indicators for professional operators, stakeholders and general public. It also provides a list of trainings and course materials. The Clean Hydrogen JU revamped the platform as the [European Hydrogen Observatory](#) in September 2023.

### **Long-term societal impacts**

The FCH 2 JU and the Clean Hydrogen JU have significantly contributed to societal awareness and education about hydrogen technology<sup>14</sup>. By involving a diverse range of stakeholders and maintaining high participation rates from small and medium-sized enterprises (SMEs) – see below for KPI-5, the partnership has fostered an inclusive and well-informed community. The creation of Hydrogen Valleys has been particularly impactful, developing local hydrogen ecosystems and supporting regional industries, which can be replicated across Europe. Hydrogen Valleys play a crucial role in both the clean hydrogen sector and the broader energy transition, influenced by global geopolitical shifts. Developers' motivations for these projects reflect changing macrorends over recent years<sup>15</sup>. By July 2024, more than 50 European hydrogen valleys featured the MI Hydrogen Valley Platform, out of a total of close to one hundred<sup>16</sup>.

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<sup>13</sup> Historical Analysis of Clean Hydrogen JU Fuel Cell Electric Vehicles, Buses and Refuelling Infrastructure Projects, page 98

<sup>14</sup> Awareness of Hydrogen Technologies - Survey Report: [https://www.clean-hydrogen.europa.eu/media/publications/awareness-hydrogen-technologies-survey-report\\_en](https://www.clean-hydrogen.europa.eu/media/publications/awareness-hydrogen-technologies-survey-report_en)

<sup>15</sup> Making it happen: Hydrogen Valleys progress in an evolving sector, page 16: [https://www.clean-hydrogen.europa.eu/media/publications/making-it-happen-hydrogen-valleys-progress-evolving-sector\\_en](https://www.clean-hydrogen.europa.eu/media/publications/making-it-happen-hydrogen-valleys-progress-evolving-sector_en)

<sup>16</sup> Ibid., page 4.

## Long-term economic impacts

The partnership's focus on developing the local hydrogen ecosystem through the Hydrogen Valleys approach created new market opportunities, being an essential feature of the European Hydrogen Strategy. This was made even more evident with the recent publication of the Staff Working Document *“Towards a roadmap for accelerating the deployment of Hydrogen Valleys across Europe: challenges and opportunities”*. The participation of SMEs has been notably high, at 23% for FCH 2 JU and 21% for Clean Hydrogen JU, significantly above the FP7 average of 13%. Being SMEs the majority of companies in the market, this is specially relevant for promoting growth and ensuring economic sustainability.

## Long-term technological impacts

In accordance with the Independent Expert Group (IEG)<sup>17</sup>, however, the objective of "bringing Europe to the forefront of FCH technologies worldwide" had been formulated too ambitiously and unrealistically in view of the considerable combined expertise of the global competition. This is, therefore, a difficult objective to measure. However, and technologically, the FCH 2 JU has ensured that Europe remains a leader in hydrogen fuel cell buses and refuelling infrastructure. The partnership has facilitated the development of numerous prototypes, testing activities, and new products, processes, and methods. Between 2014 and 2020, 101 SMEs introduced innovations, and there were 490 peer-reviewed publications, 15 awarded patents, and six pending patent applications. The partnership's ability to mobilize stakeholders and anticipate future challenges has been critical in maintaining its R&D focus and driving technological innovation. Despite some concerns about balancing R&D with deployment, the Clean Hydrogen JU continues to foster disruptive innovations within the hydrogen sector, as mentioned in the previous sections.

There are areas for improvement, starting for not overlooking the support of demonstrations in detriment of R&D projects – still necessary in technologies such as compression. Advanced hydrogen compression technologies can improve the efficiency of hydrogen storage and transportation, leading to lower operational cost, and enable the handling of larger volumes of hydrogen, which is essential for scaling up hydrogen production and distribution infrastructure.

## 2. Additionality

Joint Undertakings have the highest leverage factor (about 0.9) among main action types. On average, the EU covers 53% of eligible costs in JU projects, with participants covering the remaining 47%. Leverage factors vary widely across JUs, whether additional activities are included or not. Most JUs do not achieve equal contributions between the EU and partners (leverage factor of 1) through call activities alone. However, the Clean Hydrogen JU is one of the two exceptions, with participant co-investment significantly exceeding EU contributions.

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<sup>17</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2) 2023, page 36



The Clean Hydrogen JU has a direct “call” leverage factor – excluding additional activities (AAs) – of 1.75, which ranks the partnership in second place for this indicator. However, when counting AAs, the leverage factor is of 3.62, which is notably higher than any other JU and more than double the average.

Most Joint Undertakings under Horizon Europe have predecessors in Horizon 2020, with some previous projects still being implemented. However, the reliability of current data from Commission monitoring systems is not assured. Comparing CORDA data with the latest European Court of Auditors (ECA) report, which covers contributions until 31 December 2022 using JU-provided data, reveals several unexplained differences due to reference date and methodology variations<sup>18</sup>. For the former FCH 2 JU, the direct “call” leverage factor is of 0.86, around the average, and it raises to the second highest when counting AAs – leverage factor of 2.49. Its value is, however, lower in the ECA report – although still being the second highest<sup>19</sup>.

In-kind contributions from JU members are of two types:

In-kind contributions to operational activities (IKOP): Defined in the legal basis (“Single Basic Act”) for JUs as “eligible costs incurred by [members of the partnership] in implementing indirect actions, minus the contributions of the joint undertaking and participating states to those costs.”

In-kind contributions to additional activities (IKAA): Costs incurred by members to implement additional activities, excluding any contributions from the EU and participating states.

In the case of the Clean Hydrogen JU, the entire co-investment from private partners to date in signed grant agreements consists of in-kind contributions. In terms of additionality, stakeholders believe that Hydrogen Valleys achieve excellent leverage due to their specificities. Calculations by the Clean Hydrogen JU show a leverage of 3.75 for H2020 (3 valleys), 4.78 for the 2022 Call of HE, and 5.27 for the combined H2020+2022 Call. For Hydrogen Valleys, the leverage factor (excluding valleys funded under the FCH 2 JU) is predicted to be of 4.92 – for the EUR 151.8 million dedicated in calls 2022 and 2023, an overall investment estimated of 898.8 million is presented in the projects proposals.

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<sup>18</sup> European Court of Auditors, Annual report on EU Joint Undertakings for the financial year 2022. The reports from the Court of Auditors do not distinguish between contributions to project activities and contributions for administrative costs.

<sup>19</sup> CORDA (Horizon Europe contribution and costs), Annual Activity Reports of JUs (for additional activities), European Court of Auditors 2022 report on JUs, table 2.1.

### 3. Transparency and openness

The Clean Hydrogen JU demonstrates a high level of openness to new participants, as reflected in several KPIs related to transparency and engagement<sup>20</sup>. From the Annual Activity Report (AAR) 2023<sup>21</sup>:

#### KPI-5: Share & Type of Stakeholders and Countries Engaged

A substantial number of stakeholders from diverse countries and types have been involved in the JU's activities. This includes participation in proposal submissions, projects, governance structures, and panels<sup>22</sup>.

For the FCH2 JU, the total figure was 1 599 participations (with 823 different beneficiaries) from 50 countries, while for Clean Hydrogen JU the partnership already has 1059 participations with 710 different beneficiaries from 65 countries<sup>23</sup>. The fact that in just its first two years the Clean Hydrogen JU has already two thirds of the number of beneficiaries of the whole FCH 2 JU Programme (noting that these two different periods had a similar level of funding available), and with the participation of 15 more countries, confirms the high interest in the Clean Hydrogen JU Programme<sup>24</sup>.

#### KPI-6: Number and Types of Newcomer Members in the Partnership

It is not applicable to the Clean Hydrogen JU in its current definition as the JU's membership is defined and fixed Article 75 of SBA. The actions of the Clean Hydrogen JU, especially the calls for proposals, are fully open<sup>25</sup>.

#### KPI-7: Number and Types of Newcomer Beneficiaries

The FCH2 JU previously recorded a high number of new beneficiaries in its funded projects, with over 70% being new to the JU, reflecting the growing hydrogen sector. The Clean Hydrogen JU continues this trend, with almost 56.5% of beneficiaries in Call 2023 being new, predominantly private for-profit companies. Overall, more than one-third of Clean Hydrogen JU beneficiaries in Call 2022 and Call 2023 were new<sup>26</sup>.

This data illustrates that the Clean Hydrogen JU remains accessible to new participants, including SMEs, which often comprise new private for-profit companies. The significant proportion of new beneficiaries and the broad engagement of stakeholders across various countries and sectors highlight the partnership's commitment to inclusivity and the promotion of diverse participation in its activities.

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<sup>20</sup> The JU is required to monitor several KPIs as outlined in Section 7 of its SRJA, grouped into: Horizon Europe KPIs (Key Impact Pathways for the Horizon Europe Programme or KIPs); Common JU Indicators (from the monitoring framework by an Expert Group supporting European R&I partnerships); Clean Hydrogen JU KPIs (tracking progress towards Strategy Map objectives); and Technology KPIs (assessing technology and innovation progress towards SRJA priorities).

<sup>21</sup> Clean Hydrogen JU, Consolidated Annual Activity Report 2023

<sup>22</sup> Ibid.

<sup>23</sup> Ibid.

<sup>24</sup> Ibid., page 69

<sup>25</sup> Ibid.

<sup>26</sup> Annual Activity Report 2023, page 69

Membership of the partnership is limited, as per the SBA, to the current three members: European Union represented by the European Commission (EC), Hydrogen Europe (HE) and Hydrogen Europe Research (HER). Calls for proposals are fully open: the Clean Hydrogen JU has established effective procedures to involve new participants in projects. The Clean Hydrogen JU supports non-members and ensures that calls for proposals are open to all interested parties. This inclusiveness facilitates the expansion of the partnership network. However, for strategic topics within the calls, there is a stipulation that requires at least one consortium member to be affiliated with HE or HER. This mechanism ensures that strategic initiatives benefit from continuity and that results are thoroughly exploited for further development. Thus, while maintaining open access to new participants, the Clean Hydrogen JU also strategically involves key organizations to sustain and build upon important areas of research and development.

The Clean Hydrogen JU has implemented open and transparent processes to consult relevant stakeholders and constituent entities in identifying priorities. The recent expansion of the Stakeholders Group<sup>27</sup>, via an open Call for Expression of Interest, meant the inclusion of institutions such as the Committee of Regions, but also private companies and business associations. This group, as well as the States Representatives Group, meet twice per year. As per the SBA, the Stakeholders Group and States Representatives Group both perform an advisory function, for example by receiving multiple iterations of the Annual Work Programmes (AWPs). The organisation of the Programme Review Days at the European Hydrogen Week further contributes to bring the scientific community together and discuss future priorities and the implementation of the SRIA.

Additionally, the Clean Hydrogen JU Governing Board<sup>28</sup> maintains transparency by publishing a list of its main decisions on its webpage<sup>29</sup>, as well as having already addressed the request of EC services for access to projects data. For the AWP 2025, work has been done to better detail to the general public the use of top-ups to the annual budgets (namely, the RePowerEU top-up) when publishing the AWPs.

## 4. Efficiency

The FCH2 JU has been recognized as cost-effectiveness. A support study to the Horizon Europe interim evaluation considered it a "lean and efficient organisation"<sup>30</sup>. The operational efficiency

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<sup>27</sup> As per the Partnership website: the Stakeholders Group is an official advisory body, to be consulted on various horizontal issues or specific questions in areas relevant to the work of the Clean Hydrogen JU ([link](#))

<sup>28</sup> As per the Clean Hydrogen website: The Governing Board is the main decision-making body of the Clean Hydrogen Joint Undertaking. All three members of the joint undertaking are represented on the Governing Board ([link](#)).

<sup>29</sup> [https://www.clean-hydrogen.europa.eu/about-us/organisation/governing-board/governing-board-decisions\\_en](https://www.clean-hydrogen.europa.eu/about-us/organisation/governing-board/governing-board-decisions_en)

<sup>30</sup> European Commission, DG R&I, Zhechkov, R. (2024) 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 : partnership evaluation report. <https://data.europa.eu/doi/10.2777/577004>

of FCH2 JU has improved as the institution matured, with timely settlements of prepayments and cost claims, which are important for SMEs and large demonstration project beneficiaries.<sup>31</sup>

Operational budget and running costs:

The table below includes the total **operational costs** (EU contributions; Validated IKOP; Financial contributions to operational activities by JU partners; Eligible project costs funded by non-JU members to project activities; Contribution from Member States and international organizations to project activities), **certified IKAA** and **running costs** (commitment appropriations EU voted budget and contributions from sources other than the EU) for the period 2014-2023. See also Annex 4.4.1 for a comparison of operational expenditure and administrative expenditure of Joint Undertakings and EIT KICs of the period 2014 -2023.

*Table 1 Operational and administrative expenditures of the JUs (source: CORDA database)*

*The table includes data for Fuel Cell Hydrogen 2-FCH2 and Clean Hydrogen Joint Undertakings.*

**OC:** Operational Costs; **IKAA:** Certified IKAA; **RC:** Running Costs

	2014 [EUR]	2015 [EUR]	2016 [EUR]	2017 [EUR]	2018 [EUR]	2019 [EUR]	2020 [EUR]	2021 [EUR]	2022 [EUR]	2023 [EUR]	Total
<b>OC</b>	-	126,247,377	315,027,394	310,963,339	61,317,172	229,204,964	129,912,445	15,000,558	91,421,770	1,281,429,000	2,560,524,020
<b>IKAA</b>	-	148,435,714	148,435,714	148,435,714	148,435,714	148,435,714	148,435,714	148,435,714	240,429,088	444,905,473	1,724,384,562
<b>RC</b>	602,894	961,116	934,736	113,516	4,683,846	5,369,550	5,304,573	5,298,500	6,880,000	7,060,605	37,209,336

Beneficiary satisfaction:

The Independent Expert Report indicates that, as of 2016, beneficiary satisfaction with FCH2 JU services was high, with almost 100% of survey respondents being either satisfied (55%) or very satisfied (42%). No other survey has been reported to having taken place in the subsequent years.<sup>32</sup>

Budget contributions:

At the end of 2023, half of the overall operational budget of the Clean Hydrogen JU for the period from 2021 to 2031 has been committed, and the overall portfolio of projects has doubled in size (number of projects). As a result, the budget execution figures, both for the administrative and the operational budget, are outstanding: 96.62% in commitments and 85.43% in payments<sup>33</sup>.

For the Clean Hydrogen JU, under Horizon Europe, the EC contribution amounts EUR 1.2 billion budget, including RePowerEU, of which EUR 1.1698 billion are for the operational budget and EUR 30.19 million are for the JU's administrative budget. HE and HER contribution is expected to at least match these figures, with EUR 30.19 million being in-cash (financial) contribution over the period from 2021 to 2027, and the rest being in-kind

<sup>31</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2) 2023, page 29.

<sup>32</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2) 2024, page 30.

<sup>33</sup> Annual Activity Report 2023, page 11.

contributions. At end 2023, the level of in-kind contributions amounted to EUR 851.8 million. Half of the overall operational budget of the Clean Hydrogen JU for the period from 2021 to 2031 had already been committed at this point, and the overall portfolio of projects has doubled in size (number of projects). As a result, the budget execution figures, both for the administrative and the operational budget, are outstanding: 96.62% in commitments and 85.43% in payments.

#### Time-to-Grant (TTG):

Across the calls for proposals launched in 2022 (with two deadlines) and 2023, the Clean Hydrogen JU invited 85 proposals to grant agreement (GA) preparation stage. On average, the applicants were informed on the evaluation results in 103 days (Time-To-Inform) well below the maximum of 153 days set by Horizon Europe, and the 85 GAs were signed with an average TTG of 231 days, which is below the maximum threshold of 245 days set by Horizon Europe.

#### Governance efficiency:

The governance of the Clean Hydrogen JU, as defined in the SBA, consists of a Governing Board and Executive Director, supported by two advisory bodies (the Stakeholders Group and the States Representatives Group). The Governing Board comprises representatives from each its three Members. The EC (with seats for DG RTD, DG ENER and DG MOVE), 6 industry representatives and 1 research representative. Collectively, Governing Board members provide a good coverage of the hydrogen value chain and political interests. The States Representatives Group has representatives of the 27 Member States and of Associated Countries. The Stakeholders Group is composed of representatives of stakeholders to the hydrogen sector, selected by the Governing Board of the JU in early 2022 following a call for expression of interest, and extending in 2024 following a second call for expression of interest. The Stakeholders Group has representatives from 18 organisations.

#### Administrative efficiency:

The JUs have reviewed their back-office arrangements, identifying 21 potential synergies organised around four main areas: accounting, infrastructure management (ICT and facilities), procurement, and human resources management. This review was supported by an external consultancy firm to obtain an independent view and reinforce existing cooperation. The implementation of the synergies is ongoing and builds on existing collaborations established prior to the review.

The administrative expenditure represents less than 5% of the overall budget for both the FCH2 JU and the Clean Hydrogen JU. While specific data on applicant costs and administrative burdens is not available, the partnership's evolution towards greater efficiency and the positive dynamics between members highlight its success. Continued focus on improving knowledge management and leveraging synergies will further enhance the partnership's impact and cost-effectiveness. This efficiency is made more evident when considering that between the FCH 2 JU and the Clean Hydrogen JU, the hired staff increased by 7% while the managed budget was raised by 80%.

## 5. Coherence and synergies

### Complementarity with relevant regional, national, and EU policies/programmes

The FCH 2 JU management highlighted that the Partnership has collaborated with the EC to create synergies with other JUs and partnerships, leading to the signing of several MoUs. Success was seen in cases where joint efforts were possible, such as with the Clean Aviation JU on hydrogen-related topics. However, synergies with other sectors like maritime and rail have yet to be demonstrated. Previous evaluations<sup>34</sup>, supported by interviews, revealed that FCH2 projects often struggled to secure necessary co-funding from national and regional programs due to complexities, including unclear State-aid General Block Exemption rules and challenges in supporting full hydrogen R&I ecosystems with multiple funding sources.

While some synergies with other EU programs were achieved in FCH2 JU through planned joint calls, this was not the case with national and regional programs. Interviewees confirmed these issues, noting the ineffectiveness of the State Representative Group and the lack of alignment and guidance on applying exemption rules for R&I projects requiring co-funding from national and regional sources<sup>35</sup>.

The FCH 2 JU addressed co-funding challenges the regional level by engaging regions through its "Regions Initiative," now "Regions Hub"<sup>36</sup>. The involvement of regions is crucial as local energy needs are shaping future policies, making regions and municipalities key players in the hydrogen economy. Despite the success with regional and local authorities,

The FCH2 JU aims to maximize synergies and secure additional funding from Union, national, and regional programs, especially those supporting innovative solutions, training, education, and regional development, such as Cohesion Policy Funds and the National Recovery and Resilience Plans. The Stakeholders Group plays a key role by providing suggestions for synergies with adjacent sectors and the European Hydrogen Forum of the Clean Hydrogen Alliance. Involvement from DG RTD, DG ENER, and DG MOVE in governance ensures coherence across different sectors<sup>37</sup>. However, aligning the FCH2 JU's work with external EU programs and financial instruments posed unresolved challenges due to factors beyond its control such as being managed by different EC services.

In 2023, the Clean Hydrogen JU worked on establishing a cooperation mechanism with Managing Authorities (MAs) of Member States and Regions. Subsequently, a Call for Expression of Interest was launched to select 10 regional or national MAs for tailored cooperation. Memoranda of Cooperation (MoC) are planned to be signed in Q2 2024. Additionally, Project Development Assistance (PDA) for regions, especially targeting Cohesion Countries, Outermost Regions, and Islands, continued in 2023, providing 15 regions

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<sup>34</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking (FCH 2), page 27

<sup>35</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 26

<sup>36</sup> [https://www.clean-hydrogen.europa.eu/get-involved/working-regions\\_en](https://www.clean-hydrogen.europa.eu/get-involved/working-regions_en)

<sup>37</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 27

with support to create detailed hydrogen project plans. A specific version of this PDA for hydrogen valleys (H2 Valleys Facility) is the subject of a call for tender under the AWP 2024.

### Synergies with other parts of Horizon Europe

Understanding coherence requires awareness of the broader hydrogen ecosystem in Europe. In 2020, the EC launched the [European Clean Hydrogen Alliance](#) (DG GROW) to support companies, SMEs, and startups, with a membership of around 1,000 companies, more than double that of the FCH 2 JU. Other financial instruments like the European Innovation Council (EIC) with its Pathfinder, Accelerator, and Transition programs, as well as the SME Instrument, support SMEs. The Pathfinder funds low TRL projects, the Accelerator connects them with investors, and the Clean Hydrogen JU speeds up technology development. Additionally, DG REGIO has funded hydrogen projects involving regions, such as hydrogen valleys<sup>38</sup>.

In addition, the Clean Hydrogen JU has continued supporting Commission services as necessary, including internal feedback provided to DG CLIMA during the preparation of the Hydrogen Bank activities; participation in the discussions of the Green Hydrogen technical group of the SET-Plan and regular exchanges with colleagues in DG GROW responsible for the skills part of the Net-Zero Industry Act.

The Clean Hydrogen JU's work is recognised and utilised by international organisations such as the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), Mission Innovation, and the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE) to define state-of-the-art hydrogen technologies and adjust their R&I priorities. In addition, the Clean Hydrogen JU supported DG ENER in their discussions with the Ministry of Economy, Trade and Industry (METI) of Japan, particularly on safety aspects, exchanging information on the Clean Hydrogen JU activities in this field and in particular on the Hydrogen Incidents and Accidents Database (HIAD 2.0) managed by the JRC. Finally, the Clean Hydrogen JU continued to contribute to the successful and close collaboration with EC representatives on Mission Innovation – Clean Hydrogen Mission, through the Hydrogen Valley Platform, a platform for exchanges between worldwide initiatives on hydrogen valleys.

## 6. EU added value

The Clean Hydrogen JU and its predecessor, the FCH 2 JU, have demonstrated substantial added value beyond what could be achieved through regional or national interventions or through collaborative research funded by calls for proposals in Horizon Europe's Pillar 2 (outside partnerships).

The FCH 2 JU significantly reduced the fragmentation that previously existed in EU support for FCH technologies, which was dispersed across several programs under FP7 and its predecessors. By providing a common platform for interaction among beneficiaries of national,

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<sup>38</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 29

regional, and European projects, the FCH2 JU effectively enhanced synergies and cohesion within the sector<sup>39</sup>. This was increased with the establishment of the Clean Hydrogen JU, since it focuses on the whole supply chain from production to storage to distribution to end-uses.

The additional value resulting from the Clean Hydrogen JU and FCH 2 JU partnerships extends beyond what could be achieved through regional or national initiatives or through Horizon Europe's Pillar 2 collaborative research calls. By providing a unified framework, strategic vision, and fostering industry and market readiness, the Partnership has positioned the EU as a global leader in hydrogen technologies. Moreover, it has enhanced knowledge transfer, avoided duplication, supported local and regional initiatives, and contributed to the harmonisation of regulations and standards<sup>40</sup>.

Interviewed EC representatives noted that the main value of the Partnership lies in its vision and foresight. Despite a 40% funding increase from FCH2 JU, EUR 1 billion, plus an additional EUR 200 million for hydrogen valleys, isn't enough to fund all relevant projects. The Partnership can also promote circularity by design and highlight the local benefits of Hydrogen Valleys, such as reducing energy bills for residents.

Increased alignment of research policies between the EC, CH JU, and Member States through stronger involvement of the SRG could enhance added value. This wasn't achieved in FCH2 JU because the SRG lacked the right policymakers from ministries. Strengthening the relationship between the Governing Board and SRG would ensure more feedback on the annual plan and mutual support between Member States and the EU.

Horizon Europe Research highlights that without the Partnership, Europe wouldn't be a global leader in hydrogen. The Partnership has united researchers and industry, shifting from ideas to products, and preparing the industry for production and deployment. Hydrogen is now essential for industry decarbonization and EU industrial development. Without the Partnership, Europe wouldn't have achieved its current global position<sup>41</sup>. The Partnership has also increased awareness in Central and Eastern Europe (CEE), enabling Cohesion countries to start hydrogen projects. In 2020, it supported 11 project development assistance initiatives, including two from Bulgaria, one from Poland, and one from Slovenia. In September 2022, CH JU launched a second wave focused exclusively on Cohesion countries<sup>42</sup>.

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<sup>39</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 38

<sup>40</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 38

<sup>41</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 38

<sup>42</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 39



## 7. Relevance

The objectives of the FCH 2 JU and its successor, the Clean Hydrogen JU, have remained highly relevant in addressing the challenges and needs identified by the EU Framework Programmes.

The FCH 2 JU's objectives aligned with the Lisbon Strategy and the launch of the Joint Technology Initiatives (JTI) and the European Institute for Technology and Innovation (EIT), aiming to integrate higher education, research, and innovation across the EU. It sought to shape public procurement, regulation, and standardization to drive market demand for innovative products, contributing to a European patent system. These principles continue to influence the JU's activities.

The FCH 2 JU supported climate change objectives, improved energy security, and established Europe as a technology leader. Its successor, CH JU, aligns with the EU Hydrogen Strategy and the EU Green Deal, with stakeholders affirming the relevance of their objectives to Europe's major challenges. The focus on transport within CH JU is expected to decrease due to the EU's emphasis on energy security, particularly influenced by the war in Ukraine, and the lower TRL levels in transport compared to energy<sup>43</sup>.

The Strategic Research and Innovation Agenda (SRIA) of the Clean Hydrogen JU was adopted on February 25, 2022, by the Governing Board. It outlines key priorities, essential technologies, and innovations needed to achieve the joint undertaking's objectives. Research and innovation actions are implemented through annual calls for proposals, based on collaboration between major stakeholders, including HE, HER, and the EC. The SRIA's priorities are organized into three main pillars: 1) Renewable Hydrogen Production, 2) Hydrogen Storage and Distribution and 3) Hydrogen End Uses (Transport Applications and Clean Heat and Power).

In addition to these pillars, mass deployment requires support and coordination through four horizontal and cross-cutting activities. The development of the SRIA has been flexible and co-created, allowing for the inclusion of Strategic Research Challenges (SRC) to form long-term research consortia focused on TRL3 innovations. Approximately EUR 30 million is allocated to three low-TRL research projects in Calls 2022 and 2023, representing 3% of the overall budget. The SRIA mandates that at least 10% of the total JU budget be dedicated to low TRL activities. Although market evolution is rapid, technology development is slower, and adjustments can be made through the AWP. This flexibility will lead to two amendments to the SRIA in 2024: one for the research pillars, already completed by summertime, and another for the KPIs until the end of the year<sup>44</sup>.

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<sup>43</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 25

<sup>44</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 26

## 8. Directionality

All evidence indicates that both FCH2 JU and CH JU are fully aligned with EU policies and priority areas, making significant contributions toward them. There is one common JU KPI, KPI-3, that measures directionality in terms of overall investments mobilized for EU priorities. This indicator reveals that 100% of the total investment (300.5 million + IKOP + IKAA for 2022) has been directed toward the Green Deal and Europe's 2030 climate goals<sup>45</sup>.

Contribution to European competitiveness, cost reductions and decrease on Europe's dependencies on CRMs<sup>46</sup>:

- In low-temperature electrolysis, there are a number of demonstration projects, validating electrolyser solutions for a range of environments and applications. The JU is still playing a leading role in the development of PEMEL technologies, contributing significantly towards improvements such as efficiency.
- Regarding high-temperature electrolysis, the increase in capacity to the MW scale helps establishing SOEL as a competitor for the large-scale production of clean hydrogen from renewable energy sources. There is clear progress regarding the durability, to the extent that the targets are made more ambitious.
- For CRMs, noticeable improvements, obtained with innovative fuel cell manufacturing methods, can be detected for many KPIs linked with performance, such as efficiency and recycling from scraps and wastes.

## 9. International positioning

Both the literature review and stakeholder consultations indicate that FCH2 JU and CH JU have significantly enhanced the EU's global presence in hydrogen production. Hydrogen valleys are further increasing the partnership's visibility, exemplified by a report presented at the Clean Energy Ministerial and 7th Mission Innovation in Pittsburgh, USA. Research and industry representatives confirm this trend.

Two HE Common JU KPIs measure international visibility: KPI-4 tracks the involvement of international actors, with 276 participants for FCH2 JU and 167 for CH JU in 2022. KPI-11 evaluates the partnership's visibility in policy and industry cycles. In 2022, CH JU organized 11 international events, 7 webinars, produced 4 publications, and supported 3 hydrogen-related platforms to promote its work and raise public awareness of hydrogen technologies, including exchanges with Australian and US hydrogen stakeholders<sup>47</sup>.

Business and research stakeholders acknowledge the EU's leadership role facilitated by FCH2 JU and Clean Hydrogen JU in the global hydrogen landscape. The Partnerships have been the

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<sup>45</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 40

<sup>46</sup> Programme Review Report 2023

<sup>47</sup> Partnership Evaluation Report: Clean Hydrogen Joint Undertaking and its predecessor Fuel Cells and Hydrogen 2 Joint Undertaking 2024, page 41

organisers of the Programme Review Days and the co-organiser of the [European Hydrogen Week](#), while also sustaining a number of information platforms aiming to disseminate knowledge concerning the deployment of hydrogen technologies in Europe (and beyond), such as the [European Hydrogen Observatory](#) and the [European Hydrogen Refuelling Stations Availability System](#), making them a central reference point for information at a global level.

The international cooperation facilitated by FCH2 JU and Clean Hydrogen JU, evidenced through occasional engagement with international actors, strategic events, and visibility in global fora, has effectively positioned the Partnership as a leader in hydrogen technology on the international stage.

## 10. Phasing-out preparedness

According to the Single Basic Act<sup>48</sup>, all Joint Undertakings have the legal obligation to adopt a plan for the phasing-out of the partnership from Horizon Europe funding by the end of 2023. The aim of the plan is to ensure a smooth continuation of the JUs' activities in the scenario of no funds available under the next Framework Programme. In this perspective, JUs are asked to perform an in-depth reflection on a phasing out strategy leading to a lesser dependence from the Union contribution.

In December 2023, CH JU's Governing Board adopted a preliminary phasing out plan. It included administrative and operational adaptations, which should allow the JU to proceed its activities in case of no Union funding under the next Framework Programme. The adaptations concern several aspects, such as legal status, staffing, accounting and cashflow, procurement, logistic and IT, follow up of the grant agreement obligations after the end of projects.

In detail, the measures foreseen for the phasing-out of the Clean Hydrogen JU from the Framework Programme funding include ceasing new tenders for four-year contracts after 2027, with ongoing grants continuing until 2034. A gradual reduction in project officers is anticipated from 2032 onwards, with operational assets like the TRUST data platform and European Hydrogen Observatory also being evaluated for their future. Risks identified include staff attrition managing grants post-2031 and preserving institutional knowledge and intellectual property. Also, the plan specifies that it should be assured that the knowledge developed with JU funding – i.e. Union financial contribution will not be prevented from benefitting European taxpayers and ensure a just transition for all.

The drafting of the updated phasing out plan is currently ongoing, and it is planned to be adopted in 2025. It should include concrete reflections on short- and long-term targets, strategic alignment and financial sustainability. The aim is to develop a strategy enabling the JU to obtain the objectives beyond the duration of the Union's participation.

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<sup>48</sup> [Council Regulation \(EU\) 2021/2085](#) establishing the Joint Undertakings under Horizon Europe.