ANNEX to GB decision no. CleanHydrogen-GB-2026-01

Clean Hydrogen JOINT UNDERTAKING (Clean Hydrogen JU)

WORK PROGRAMME 2026

In accordance with the Council Regulation (EU) 2021/2085 and with Article 33 of the Financial Rules of the Clean Hydrogen Joint Undertaking.

The work programme is made publicly available after its adoption by the Governing Board.

Table of Contents

Acronyms and abbreviations

AD	Administrator
AEL	Alkaline Electrolysis
AEMEL	Anion Exchange Membrane Electrolysis
AFIR	Alternative Fuel Infrastructure Regulation
AST	Assistant
AS-T	Accelerated-stress test
AWP	Annual Work Programme
BOA	Back Office Arrangements
BoP	Balance of Plant
CAS	Common Audit Services
CAPEX	Capital Up-front Expenditure (Investment)
CCM	Catalyst-coated membrane
CEF	Connecting Europe Facility
CEF-T	Connecting Europe Facility Transport
CEM	Clean Energy Ministerial
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CEPT	Clean Energy Transition Partnership
CHP	Combined Heat and Power
CIC	Common Implementation Centre
CINEA	European Climate Infrastructure and Environment Executive Agency
CO_2	Carbon Dioxide
CRM	Critical Raw Materials
CRMA	Critical Raw Materials Act
CRMS	Critical Raw and Strategic Materials
CSA	Coordination and Support Actions
D&E	Dissemination and Exploitation
DG	Directorate General
DPO	Data Protection Officer
EC	European Commission, also shortened as Commission
ECA	European Court of Auditors
EFTA	European Free Trade Association
EHO	European Hydrogen Observatory
EHS&CP	European Hydrogen Sustainability and Circularity Panel

EHSP	European Hydrogen Safety Panel
EIB	European Investment Bank
ECH2A	European Clean Hydrogen Alliance
EIC	European Innovation Council
EISMEA	European Innovation Council and SMEs Executive Agency
ERA	European Research Area
ERDF	European Regional Development Fund
ETS	Emission trading system (also seen as EU ETS)
EU	European Union
EU ETS	EU Emission Trading System
EUR	Euro currency (€)
E-HRS- AS	European Hydrogen Refuelling Stations Availability System
EURATOM	European Atomic Energy Community
E&P	Exploration and Production
F2P	Feedback to Policy
FAQ	Frequently Asked Questions
FC	Fuel Cell
FCH	Fuel Cell and Hydrogen
FCH (2) JU	Fuel Cells and Hydrogen Joint Undertaking. FCH 2 JU (2014-2020/Horizon 2020) succeeded FCH JU (2008-2014/FP 7) [1]
FCS	Fuel Cell System
FID	Financial investment decision
FP	European Union's Framework Programmes for research and technological development. FP7 refers to the seventh programme (period 2007-2013), H2020 to the eighth (period 2014-2020), while Horizon Europe to the ninth (period 2021-2027).
FTE	Full-time equivalent
FWC	Framework Contract
GB	Governing Board
GDL	Gas diffusion layer
GHG	Greenhouse Gases
GO	Guarantees of Origin
GW	Gigawatt; GW_e refers to GW electric.
H_2	Hydrogen
H2020	Horizon 2020. European Union's Framework Programmes for research and technological development. H2020 refers to the eighth (period 2014-2020)

H2V	Hydrogen Valley
HDV	Heavy-Duty Vehicles
HE	Horizon Europe
HIAD	Hydrogen Incident and Accident Database
HR	Human Resources
HRS	Hydrogen Refuelling Station
HTCP	Hydrogen Technology Collaboration Programme
IA	Innovation Actions
IAS	Internal Audit Services
ICT	Information and Communications Technology
IDMS	Innovation and Document Management System
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IKAA	In-kind Contribution for additional activities
IED 2.0	Industrial and Livestock Rearing Emissions Directive 2.0.
ILCD	International Reference Life Cycle Data System
IPCEI	Important projects of common European interest
IPHE	International Partnership for Hydrogen and Fuel Cells in the Economy
IP	Intellectual Property
IR	Innovation Radar
IPR	Intellectual Property Rights
IRENA	International Renewable Energy Agency
ISAA	Integrated Situational Awareness and Analysis
ISO	International Standardization Organization
IT	Information Technology
IWG	Implementation Working Group
JPP	Joint Procurement Plan
JRC	Joint Research Centre of the European Commission
JU	Joint Undertaking. For the scope of this document, when used as standalone, this acronym is used specifically to refer to the Clean Hydrogen Joint Undertaking. In all other instances or when not obvious the name Clean Hydrogen JU is used.
KPI	Key Performance Indicator
kW	Kilowatt; kW_{th} refers to kW thermal.
kWh	Kilowatt-hour; kWh_{e} refers to kWh electric, while kWh_{th} to kWh thermal.
LAP	Legal and Administrative Processes

LCA	Life-Cycle Assessment
LCCA	Life-Cycle Cost Assessment
LCSA	Life-Cycle and Sustainability Assessment
LCI	Life Cycle Inventory
LDV	Light Duty Vehicles
LHV	Low Heating Value
LOI	Letters of Intent
LT	Low Temperature
MEA	Membrane Electrode Assembly
MGA	Model Grant Agreement
MS	Member state
MSCA	Marie Sklodowska Curie Action
MTBF	Mean time between failures
Mt	Million Tonnes
N/A	Not available
NO_x	Nitrogen Oxides
NG	Natural Gas
NGO	Non-Governmental Organisations
NZIA	Net Zero Industry Act
OCT	Overseas countries and territories
OEM	Original equipment manufacturers
OPEX	Operational Expenditure
PCCEL	Proton Conducting Ceramic Electrolysis
PDA	Project Development Assistance
PEM	Proton Exchange Membrane
PEMEL	Proton Exchange Membrane Electrolysis
PEMFC	Proton Exchange Membrane Fuel Cell
PFAS	Per- and Polyfluoroalkyl Substances
PFSA	Perfluorinated sulfonic acid
PGM	Platinum Group Metals
PMO	Paymaster Office of the European Commission
PNR	Pre-Normative Research
PO	Clean Hydrogen JU Programme Office
POC	Proof of Concept
PPMT	Public Procurement Management Tool

PV	Photovoltaic
PP	Procurement Plan
P4P	Process for Planet Partnership
Q1-4	Quarter 1-4
R&I	Research and Innovation
R&D	Research and Development
RED II	Renewable Energy Directive
RAFS	Research Family Anti-Fraud strategy
RCS	Regulations, Codes and Standards
RCS SC	Regulations, Codes and Standards Strategy Coordination
RIA	Research and Innovation Actions
RFNBO	Renewable Fuels of Non-Biological Origin
RTO	Research and Technology Organisations
SAF	Sustainable Aviation Fuel
SSbD	Safe and sustainable-by-design
SBA	Single Basic Act; referring to the regulation establishing the Joint Undertakings under Horizon Europe.
SET-Plan	Strategic Energy Technology Plan
SG	Stakeholders group
SLA	Service Level Agreement
SNE	Seconded National Expert
SME	Small and Medium-sized Enterprise
SoA	State-of-the-Art
SOEL	Solid Oxide Electrolysis
SOFC	Solid Oxide Fuel Cell
SRIA	Strategic Research and Innovation Agenda for 2021-2027 of the Clean Hydrogen Joint Undertaking (previously MAWP Multi-Annual Work Programme).
SRIA-HE/HER	Strategic Research and Innovation Agenda for 2021-2027 of Hydrogen Europe and Hydrogen Europe Research
SRG	States Representative Group
SSOs	Storage System Operators
TC	Technical Committee
TCO	Total Cost of Ownership
TEA	Techno-Economic Assessment
TEN	Trans-European Network.
TEN-E	Trans-European Energy Network.

TEN-T	Trans European Transport Network.
TF	Task Force
TIM	Tools for Innovation Monitoring
TRL	Technology Readiness Level
UK	United Kingdom
UN-ECE	United Nations Economic Commission for Europe
US, USA	United States of America
VRE	Variable Renewable Energy
WP	Work Programme
WEC	Website Evidence
ZEWT	Zero Emission Waterborne Transport

1. Introduction

Clean Hydrogen JU Vision

Support a sustainable hydrogen economy, contributing to EU's climate goals

Clean Hydrogen JU Mission

Facilitate the transition to a greener EU society through the development of hydrogen technologies.

1.1. Mission statement of Clean Hydrogen JU

This document represents the **Annual Work Programme for 2026 of the Clean Hydrogen Joint Undertaking** (hereafter also Clean Hydrogen JU[1], or simply as "the JU"), outlining the scope and details of its activities for the year 2026 including its related budget.

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 European Union's (EU) funding programme for research and innovation, Horizon Europe[2], and in synergy with other EU initiatives and programmes. The Clean Hydrogen JU is the continuation of the successful Fuel Cell and Hydrogen Joint Undertakings (FCH JU and FCH 2 JU), under the EU's Framework Programme for research and technological development, period 2007-2013(FP7) and, for period 2014-2020, Horizon 2020 (H2020) respectively.

The Clean Hydrogen JU will contribute to the European climate neutrality goal by producing noticeable, quantifiable results towards the development and scaling up of hydrogen production, storage, distribution and end use 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 Clean Hydrogen JU will address areas related primarily to the production of clean hydrogen, as well as the distribution, storage and end use applications of clean hydrogen in hard to abate sectors. They will be guided mostly by EU's Hydrogen Strategy[3] and the policy developments in this context such as the European Green Deal[4] and REPowerEU[5], contributing to its implementation.

The Clean Hydrogen JU will aim to accelerate the development and deployment of the European value chain for safe and sustainable clean hydrogen technologies, strengthening its competitiveness and with a view to supporting notably small and medium enterprises (SMEs), accelerating the market entry of innovative competitive clean solutions. The final goal is to contribute to a sustainable, decarbonised and fully integrated EU energy system, and to the EU's Hydrogen Strategy, playing an important role in the implementation of its roadmap towards climate neutrality.

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[1] For purposes of communication with the public, often the name Clean Hydrogen Partnership is also used instead of the legal name of the JU. In the present document only the legal name is used.
[2] Regulation (EU) 2021/695 establishing Horizon Europe – the Framework Programme for Research and Innovation, OJ L 170, 12.5.2021, p. 1–68.
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0301
[4] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[5] COM/2022/230 final

To this end, cross-cutting aspects such as safety, circularity and sustainability will be embedded continuously throughout the entire Clean Hydrogen JU Programme, guiding and underpinning the activities undertaken within. Concerning circularity and sustainability aspects, in particular, it is foreseen that activities will not only address these aspects as part of the “post-development” assessment, but also for orientating and/or while looking for solutions and/or taking decisions (e.g. materials selection) to develop a product, technology and/or a value chain in a more sustainable and circular manner. In this sense, “Safety and circularity by design” will become essential aspects across the Clean Hydrogen JU Programme.

1.2. Background and link with the Strategic Research and Innovation Agenda

This document establishes the fifth Annual Work Programme (AWP) of the Clean Hydrogen Joint Undertaking, outlining the scope and details of its activities for the year 2026. The Clean Hydrogen JU is a unique public-private partnership supporting research and innovation in hydrogen technologies in Europe. In November 2021 the Clean Hydrogen JU was set up, within the Horizon Europe, as a Joint Undertaking by the Council Regulation establishing the Joint Undertakings under Horizon Europe[6] (also referred to as Single Basic Act – SBA). Its aim is to contribute to the Union's wider competitiveness goals and leverage private investment by means of an industry-led implementation structure.

Hydrogen is expected to play a critical role in filling the gap between electrification and the hard-to-abate sectors, such as high temperature heat applications in industry and heavy-duty transport, including maritime and aviation. Hydrogen can be used as a feedstock, a fuel, an energy carrier and an energy storage medium, and thus has many possible applications across industry, transport, power and buildings sectors. Most importantly, when produced sustainably, it does not emit CO_2 (Carbon Dioxide) emissions. It is therefore an important part of the overall solution to meet the 2050 climate neutrality goal of the European Green Deal.

In July 2020 the Commission adopted the **Energy System Integration**[7] and **Hydrogen Strategies**[8]. Together they aim to address a vision on how to accelerate the transition towards a more integrated and clean energy system, in support of a climate neutral economy. The Energy System Integration Strategy addresses the planning and operation of the energy system “as a whole”, across multiple energy carriers, infrastructures, and consumption sectors. The Strategy sets out 38 actions to implement the necessary reforms, including the promotion of renewable and low-carbon fuels, including hydrogen, for sectors that are hard to decarbonise.

The Hydrogen Strategy aims to create an enabling environment to scale up renewable and low carbon hydrogen supply and demand for a climate-neutral economy. Building on the Commission’s New Industrial Strategy for Europe[9] and the Recovery Plan for Europe[10], the Strategy sets out a vision of how the EU can turn hydrogen into a viable solution to decarbonise different sectors over time. It also tries to address the issue that hydrogen production is today almost completely fossil-based, as low-carbon hydrogen is not yet cost-competitive. To achieve this, the strategy outlines several key actions and presents three

[6] 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 427/17 of 30.11.2021
[7] Strategy for Energy System Integration. COM(2020) 299 final.
[8] A Hydrogen Strategy for a climate neutral Europe. COM(2020) 301 final.
[9] New Industrial Strategy for Europe. COM(2020) 102 final.
[10] Europe's moment: Repair and Prepare for the Next Generation. COM(2020) 456 final.

strategic phases in the timeline up to 2050. Most notably, it sets the ambitious goal of installing at least 6 Gigawatts (GW) of renewable hydrogen electrolysers in the EU by 2024 and 40 GW of renewable hydrogen electrolysers by 2030.

On 11 December 2020, the Council adopted conclusions on steps to be taken towards creating a hydrogen market for Europe.[11] The conclusions gave political guidance to the implementation of the EU Hydrogen Strategy presented by the European Commission on 8 July 2020. In its conclusions, the Council recognised the important role of hydrogen, especially from renewable sources, and the need for the hydrogen market to be significantly scaled up, asking the Commission to further elaborate and implement the EU Hydrogen Strategy. The pathway towards the roadmap's objectives should use joint programmes, be cost-efficient and prioritise energy efficiency and electrification from renewable sources. The Council also sees the need to develop an ambitious hydrogen roadmap and strategy for climate neutrality in the end-use sectors, which makes use of flexible policies.

In December 2020, 22 EU countries and Norway signed a manifesto paving the way for a clean hydrogen value chain and committing to launch **'important projects of common European interest'** (IPCEIs) in the hydrogen sector. The signatories committed to jointly design and coordinate IPCEIs. They also agreed that projects should cover the full clean hydrogen value chain — from renewable and low-carbon hydrogen production to hydrogen storage, transmission and distribution, and hydrogen application, notably in industrial sectors. Following an assessment by the European Commission, the first set of clean hydrogen projects, named Hy2Tech, received approval in July 2022. These 41 projects located in 15 EU countries will receive up to €5.4 billion in public funding. This is expected to unlock an additional €8.8 billion in private investments. The second group of clean hydrogen projects, named Hy2Use, received approval from the European Commission in September 2022. These 35 projects in 13 EU countries will receive up to €5.2 billion in public funding, which is expected to attract an additional €7 billion in private investments. In 2024, the Commission has approved two more IPCEIs to support hydrogen infrastructure (IPCEI Hy2Infra[12]) and the mobility and transport sectors (IPCEI Hy2Move[13]).

On 19 May 2021, the European Parliament also adopted a resolution[14] on the **European Strategy for Hydrogen**. The Members of the Parliament requested for incentives to encourage demand and to create a European hydrogen market and fast deployment of hydrogen infrastructure. They also emphasised the need to phase out fossil-based hydrogen as soon as possible, while certification should be applied to all hydrogen imports, similar to EU-produced hydrogen. Finally, they requested to assess the possibility of repurposing existing gas pipelines for the transport and underground storage of hydrogen.

On 28 June 2021 the first ever **Climate Law for Europe**[15] was adopted, writing into law the goals set out in the European Green Deal. The first European Climate Law sets the goal of climate-neutrality by 2050 and includes a binding EU climate target for reducing net greenhouse gas (GHG) emissions by at least 55% by 2030 compared to 1990, significantly increasing the previous 2030 target of 40% agreed a few years back in 2014.

[11] European Council conclusions, 10-11 December 2020.
[12] https://ec.europa.eu/commission/presscorner/api/files/document/print/en/ip_24_789/IP_24_789_EN.pd
[13] https://ec.europa.eu/commission/presscorner/api/files/document/print/en/ip_24_2851/IP_24_2851_EN.pdf

[14] European Parliament resolution of 19 May 2021 on a European Strategy for Hydrogen (2020/2242(INI))
[15] Regulation (EU) 2021/1119 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law').

To achieve these ambitious goals, the European Commission adopted on 14 July 2021 the **'Fit for 55' package**[16] of policy proposals to make the EU's climate, energy, land use, transport and taxation policies fit for this target. It is a broad package, containing 13 different proposals approaching the goal of emission reductions from many different angles, with both targeted and horizontal policy measures. Increasing renewable energy, energy efficiency and member states' non-ETS targets, while strengthening the EU emission trading system (EU ETS), including creating a new ETS for buildings and road transport. Restructuring energy taxation in Europe – including the introduction of a carbon border adjustment mechanism –, but also revising the CO_2 emission standards for new cars. Accelerating the development of alternative fuel infrastructure, while at the same time promoting the use of sustainable fuels in Aviation and Maritime. Creating a social climate fund and acknowledging the importance of forests and land use in achieving our climate goals. Its proposals were complemented in Quarter 4 (Q4) 2021 with the Hydrogen and Gas markets Decarbonisation Package[17] and in Q4 2022 with the CO_2 Standards on Heavy-Duty Vehicles[18].

As the first step in the implementation of the EU Hydrogen Strategy, the 'Fit for 55' package contains a number of measures aiming to promote the production and use of hydrogen and hydrogen-based fuels in the different sectors of the economy. The revised Renewable Energy Directive[19] proposes the extension of the EU-wide certification system for renewable fuels to include hydrogen[20], as well as targets for transport[21] and industry[22] that include renewable hydrogen consumption. Additional financial incentives for hydrogen are foreseen by the revision of the **EU ETS proposal**,[23] which shall extend to maritime, establish emissions trading for transport and buildings; and include electrolytic hydrogen under ETS, thus making low carbon hydrogen eligible for free allowances. Further incentives shall be given through the preferential taxes for the use of low carbon hydrogen, foreseen in the revision of the Energy Taxation Directive.[24] Hydrogen is promoted specifically in the transport sector by three additional targeted proposals: the more stringent CO_2 standards for Cars and Vans;[25] the revision of the Alternative Fuel Infrastructure Regulation, requiring hydrogen refuelling stations serving both cars and lorries to be deployed by 2030 in all urban nodes and every 200 km along the TEN-T (Trans European Transport Network) core network; and the FuelEU Maritime proposal promoting strongly low carbon hydrogen and hydrogen-based fuels (including methanol and ammonia).

The 'Fit-for-55' package is complemented by the proposals for the **Gas Markets Decarbonisation package**[26], released on 15 December 2021, aiming to enable the decarbonising of the gas networks and revise the EU gas rules to facilitate the market entry for renewable and low-carbon gases, mainly biomethane and hydrogen, and remove any

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[16] 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality, COM(2021) 550, July 2021.
[17] The combined evaluation roadmap and inception impact assessment of the initiative can be found here. This initiative aims to address a number of issues associated with gas markets and networks, including hydrogen.
[18] Announced on August 2021, timeline can be found here.
[19] Proposal for a Directive as regards the promotion of energy from renewable sources. COM (2021) 557 final.
[20] Renewable Fuels of Non-Biological (RFNBO) now include renewable hydrogen.
[21] at least 2.6% share of RFNBO in the energy supplied to the transport sector
[22] 50% of the hydrogen used for final energy and non-energy purposes should come from RFNBO
[23] Establishing a system for greenhouse gas emission allowance trading with the Union. COM (2021) 551 final.
[24] Restructuring the Union framework for taxation of energy products and electricity, COM (2021) 563 final.
[25] Regulation 2023/851 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0851).
[26] New EU framework to decarbonise gas markets, promote hydrogen and reduce methane emissions (https://ec.europa.eu/commission/presscorner/detail/en/ip_21_6682)

undue regulatory barriers. The revised gas markets and hydrogen regulation[27] and directive[28] aim to establish a market for hydrogen, create the right environment for investment, and enable the development of dedicated infrastructure, including for trade with third countries: market rules in two phases similar to the existing ones for natural gas, new governance structure in the form of the European Network of Network Operators for Hydrogen, removal of tariffs for cross-border interconnections and lowering tariffs at injection points, introduction of a certification system for low-carbon gases, consumer empowerment and protection etc. This is to ensure that the gas market framework is in line with the Fit for 55 ambitions.

In May 2022, the European Commission presented the **REPowerEU Plan**[29] to respond to the unprecedented global energy market disruption caused by Russia's invasion in Ukraine. Renewable hydrogen is recognised as a crucial contributor to reaching the REPowerEU Plan objectives to reduce the dependence of Russian fossil fuels and to accelerate green transition.

To accelerate the deployment of renewable hydrogen, the European Commission allocated an additional funding of €200 million to the overall budget of the Clean Hydrogen JU, with the aim to double the number of Hydrogen Valleys by 2025 and to be matched by the same amount by the private members. More recently, in June 2024, the European Commission's set an inspirational target to have at least 50 Hydrogen Valleys under construction or operational by 2030 across the entire EU[30].

Also, the **EU External Energy Strategy**[31] was adopted as a part of the REPowerEU Plan. This strategy promotes diversification of energy supplies and renewable hydrogen investments and indicates the possibility that the European Commission concludes hydrogen partnerships with reliable partner countries and by kick-starting a global hydrogen market. This includes cooperation on renewable hydrogen. The strategy envisages three major hydrogen import corridors to the EU – from the North Sea region (Norway and United Kingdom), the Southern Mediterranean and Ukraine, as soon as conditions allow.

The EU has now a fully-fledged legislative framework for the production, consumption, infrastructure development and market rules for a future hydrogen market, as well as binding quotas for renewable hydrogen consumption in industry and transport. Including the revised **Regulation on CO2 emission limits for Cars and Vans**[32], **ETS Directive**[33], **Regulation on Alternative Fuels Infrastructure**[34], (revised) **Renewable Energy Directive**[35] and **FuelEU Maritime Regulation**[36].

Furthermore, on 21 May 2024, the EU adopted the Regulation[37] and Directive[38] establishing common internal market rules for renewable and natural gases and hydrogen (so-called **EU hydrogen and gas decarbonisation package**) and reforming the existing EU gas legislation setting out EU rules for hydrogen market and infrastructure development. It also introduces a

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[27] Regulation on the internal markets for renewable and natural gases and for hydrogen (recast). COM/2021/804 final (https://ec.europa.eu/energy/sites/default/files/proposal-revised-gas-markets-and-hydrogen-regulation.pdf)
[28] Directive on common rules for the internal markets in renewable and natural gases and in hydrogen. COM/2021/803 final (https://ec.europa.eu/energy/sites/default/files/proposal-revised-gas-markets-and-hydrogen-directive.pdf)
[29] COM/2022/230 final.
[30] Commission Staff Working Document, SWD(2024) 159 final. Towards a roadmap for accelerating the deployment of Hydrogen Valleys across Europe: challenges and opportunities
[31] EU external energy engagement in a changing world. SWD(2022) 152 final.
[32] Regulation (EU) 2023/851, OJ 25.4.2023
[33] Directive (EU) 2023/959, OJ 16.5.2023
[34] Regulation (EU) 2023/1804, OJ 22.9.2023
[35] Directive (EU) 2023/ 2001, OJ 31.10.2023
[36] Regulation (EU) 2023/1805, OJ 22.09.2023
[37] Regulation (EU) 2024/ 1789, OJ 15.07.2024
[38] Directive (EU) 2024/ 1788, OJ 15.07.2024

system of terminology and certification of low-carbon hydrogen and low-carbon fuels, complementing the revised Renewable Energy Directive as well as a new regulatory framework for dedicated hydrogen infrastructure. EU countries have until mid-2026 to transpose the new rules into national law. When transposed, they will facilitate the uptake of renewable and low-carbon gases, including hydrogen, while ensuring security of supply and affordability of energy for all EU citizens.

To ensure that the hydrogen is produced from renewable energy sources and achieves at least 70% greenhouse gas emissions savings, the Commission adopted in June 2023 two **delegated acts**:

- The Delegated Act on a **methodology for renewable fuels on non-biological origin**,[39] defines under which conditions hydrogen, hydrogen-based fuels, or other energy carriers can be considered as renewable fuels of non-biological origin (RFNBO). The methodology also includes rules for (i) the temporal and geographical correlation between the electricity production unit and the fuel production, and (ii) ensuring that the fuel producer is adding to the renewable deployment or to the financing of renewable energy[40].
- The Delegated Act establishing a **minimum threshold for greenhouse gas (GHG) emissions savings of recycled carbon fuels**[41] provides a methodology for calculating life-cycle GHG emissions for RFNBOs. It takes into account GHG emissions across the full lifecycle of the fuels, including upstream emissions, emissions associated with taking electricity from the grid, from processing, and those associated with transporting these fuels to the end-consumer.

In addition, as set out in the Hydrogen and Gas Market Directive, on 8 July 2025, the EU adopted a **delegated act** introducing a comprehensive greenhouse gas emission methodology for low-carbon hydrogen and fuels (to be considered low carbon, hydrogen and related fuels must reach a threshold of 70% greenhouse gas emission savings compared to the use of unabated fossil fuels). This methodology complements the existing ones on renewable hydrogen and renewable fuels of non-biological origin (RFNBOs), completing the EU's regulatory framework for hydrogen.

Also in July 2025, the Commission launched the **Hydrogen Mechanism**[42] under the EU Energy and Raw Materials Platform. The Hydrogen Mechanism is designed to support the market development of renewable and low-carbon hydrogen and its derivatives (ammonia, methanol, electro-sustainable aviation fuel ‘eSAF’).

Also in 2023, the EC proposed the **Net-Zero Industry Act** (NZIA)[43] as one of the pillars of the Green Deal Industrial Plan[44], aiming that the Union’s overall strategic net-zero technologies manufacturing capacity, including hydrogen technologies, approaches or reaches at least 40% of the Union’s deployment needs by 2030. This will be possible through measures that facilitate investments, incentivise demand and up- and re-skill Europe’s labour force via the

[39] Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023.
[40] The Act clarifies the principle of “additionality” for hydrogen set out in the EU's Renewable Energy Directive, meaning that renewable hydrogen must be produced exclusively using additional renewable power plants (to incentivize an increase in the volume of renewable energy available to the grid), and that the hydrogen will only be produced during the hours that the renewable energy asset is producing electricity (hourly temporal correlation), and only in the area where the renewable electricity asset is located (geographical correlation).
[41] Commission Delegated Regulation (EU) 2023/1185 of 10 February 2023.
[42] https://energy.ec.europa.eu/news/new-eu-energy-and-raw-materials-platform-support-competitiveness-and-decarbonisation-european-2025-07-02_en
[43] COM(2023) 161 final/16.3.2023: https://ec.europa.eu/commission/presscorner/detail/en/IP_23_1665
[44] COM(2023) 62 final/1.2.2023: https://ec.europa.eu/commission/presscorner/detail/en/ip_23_510

so-called Net-Zero Industry Academies. These Academies will aim to enable the training and education of 100.000 learners each, within three years of their establishment, to contribute to the availability of skills required for the net-zero technologies and consolidate the existing European's industry leading role in fostering the establishment of small and medium-sized enterprises. The Critical Raw Materials Act (CRMA)[45] is the other pillar, proposing a renewed European approach to the use of raw materials and the revival of Europe's sustainable materials market, focusing on the extraction, processing, recycling, monitoring and diversification of Critical Raw Materials (CRM). Availability and future prices of CRMs will affect the market growth of electrolysers and fuel cells.

Another important step towards scaling up production of renewable hydrogen in the EU is the first pilot auction of €800 million funded by the Innovation Fund under the umbrella of the **EU Hydrogen Bank**[46], which was launched on 23 November 2023. The Hydrogen Bank, implemented by the European Commission, aims to unlock private investments in hydrogen value chains in the EU and in third countries by connecting renewable hydrogen supply with the emerging demand by European off-takers and thus to establish an initial market for renewable hydrogen. The objectives of the auction are to reduce the cost gap between renewable and fossil hydrogen in the EU, allow for price discovery and renewable hydrogen market formation, de-risk European hydrogen projects and reduce administrative burdens. On 30 April 2024, seven European projects (Spain, Portugal, Finland and Norway) were selected for EU financial support (close €700 million) in the Innovation Fund's (first) pilot hydrogen auction[47]. A second domestic auction was closed on 20 February 2025. It selected 15 renewable hydrogen production projects across 5 countries (Spain, Finland, Germany, Netherlands and Norway) within the European Economic Area (EEA) to receive €992 million in EU funding[48]. These projects, expected to produce nearly 2.2 million tonnes of renewable hydrogen over 10 years will help avoid more than 15 million tonnes of CO2 emissions and contribute to the further creation of a European market for renewable hydrogen[49]. A third auction, planned for end 2025, has a budget of up to €1 billion.

On 28 November 2023, the Commission adopted the first Union list of the **Projects of Common Interest (PCIs) and Projects of Mutual Interest (PMIs)**[50] under the new Trans-European energy network regulation (TEN-E)[51]. This list included for the first-time hydrogen projects, such as networks, electrolysers, reception facilities and storages.

More hydrogen-related legislative initiatives concluded in 2024. The **Industrial and Livestock Rearing Emissions Directive**[52] (IED 2.0) exempted electrolysers under 50 tons/day of hydrogen production from the same national permitting rules, giving small to medium electrolysers the possibility to speed up deployment. The **Electricity Market Design reform**[53] recognises hydrogen as a key energy storage medium encouraging investment in storage infrastructure and production of renewable and low-carbon hydrogen. It also promotes support

[45] COM(2023) 160 final/16.3.2023 https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1661
[46] https://ec.europa.eu/commission/presscorner/detail/en/ip_23_5982
[47] https://climate.ec.europa.eu/news-your-voice/news/winners-first-eu-wide-renewable-hydrogen-auction-sign-grant-agreements-paving-way-new-european-2024-10-07_en
[48] https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1264
[49] In parallel, Spain, Lithuania, and Austria intended to allocated up to €836 million in national funding for projects in their countries through the 'Auctions-as-a-Service' feature. This allows Member States to identify and fund eligible projects in their territories that meet the auction's qualification criteria but cannot be funded by the Innovation Fund due to budgetary limitations.
[50] https://energy.ec.europa.eu/publications/delegated-regulation-first-union-list-projects-common-and-mutual-interest_en
[51] Regulation (EU) 2022/869, OJ 3.6.2022
[52] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202401785

[53] https://energy.ec.europa.eu/topics/markets-and-consumers/electricity-market-design_en

mechanisms to alleviate risks for potential investments (e.g. two-way Contracts for Differences to incentivise large scale green hydrogen projects). The **hydrogen and gas decarbonisation package**[54] (also mentioned above) introduces a new regulatory framework for dedicated hydrogen infrastructure. Finally, the Commission proposed an encompassing strategy to move towards EU industrial leadership in advanced materials[55] proposed an encompassing **strategy to move towards EU industrial leadership in advanced materials** aiming to ensure a sustainable and uninterrupted supply of these materials for the successful ramp up of the hydrogen, aiming to ensure a sustainable and uninterrupted supply of these materials for the successful ramp up of the hydrogen sector.

In March 2024, the Commission adopted the **Strategic Technologies for Europe Platform** (STEP) [56] to boost investments in critical technologies in Europe: clean and resource efficient technologies, digital and deep innovation technologies and biotechnologies. STEP will mobilise resources from existing EU programmes to support the development and manufacturing of these critical technologies, while safeguarding and strengthening the respective value chains, as well as associated services and skills critical for and specific to the development and manufacturing of the final products. In line with Article 2 of the STEP Regulation, in May 2024 the Commission issued a Guidance Note where hydrogen technologies were included in a non-exhaustive list of technologies that could be considered within the scope of STEP.

More recently, in February 2025, the European Commission presented the **Clean Industrial Deal** [57](CID), which sets the new strategic direction for strengthening Europe's industrial competitiveness while advancing the green transition. Building on the Green Deal Industrial Plan, the CID seeks to create the conditions for affordable clean energy, the development of lead markets for low-carbon products, improved access to finance, enhanced circularity and material resilience, and the development of skills for the industrial workforce. It positions innovation, start-ups and scale-ups as key enablers of industrial renewal and clean technology deployment across the Union.

The above builds on the analysis provided by the Letta Report [58](April 2024) on the future of the Single Market and the Draghi Report[59] (September 2024) on European competitiveness. Both reports call for deeper economic integration, stronger investment capacity, and the removal of fragmentation hampering innovation. Responding to these recommendations, the EU Startup and Scaleup Strategy[60], adopted in May 2025, recognises that starting and scaling innovative companies in Europe remains difficult today due to fragmented markets, complex regulation, and limited access to growth finance. To this end, the strategy, among other elements, aims to improve access to finance for startups and scaleups by addressing gaps across all development stages, with particular attention to scaleup financing. Furthermore, the strategy seeks to help startups and scaleups expand markets and facilitate uptake of innovation by proposing a 'Lab to Unicorn initiative' to accelerate the commercialisation of research results which would include, but not only, European Startup & Scaleup Hubs, rooted in strong university ecosystems, to network and collaborate across borders to provide access to startups and scaleups to each other's respective services, infrastructures and corporates.

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[54] https://energy.ec.europa.eu/topics/markets-and-consumers/hydrogen-and-decarbonised-gas-market_en
[55] https://research-and-innovation.ec.europa.eu/document/download/0fcf06ea-c242-44a6-b2cb-daed39584996_en

[56] Regulation (EU) 2024/795, OJ 29.2.2024
[57] Clean Industrial Deal - European Commission
[58] Enrico Letta - Much more than a market (April 2024)
[59] The Draghi report on EU competitiveness
[60] EU Startup and Scaleup Strategy - Research and innovation

In line with all the policy developments described above, it is crucial that the Clean Hydrogen JU continues to support its new and on-going projects and develop technology solutions that will help materialise the benefits of hydrogen technologies in support of the high-level EU policy agenda.

To achieve this, the Strategic Research and Innovation Agenda (SRIA)[61] of the Clean Hydrogen JU describes an extensive number of research and innovation activities, covering the areas of renewable hydrogen production, as well as hydrogen transmission, distribution and storage, alongside selected fuel cell end-use technologies. Several scientific challenges, priorities and objectives have been identified, which are described in detail in Section 1.3 and are addressed by the research and innovation actions listed in the SRIA.

In parallel, the SRIA foresees parallel activities, aiming to support the research and innovation agenda and reinforce it, including:

- Seeking synergies with other partnerships and programmes;
- Facilitating the market uptake of hydrogen via a number of Task Forces and Panels[62];
- Enlarging the knowledge base around hydrogen via the knowledge management activities;
- Building awareness and acceptance of the hydrogen technologies, through communication activities, but also the dissemination and exploitation of project results;
- Supporting the European Commission in the implementation of its international cooperation agenda in research and innovation.

The present Annual Work Programme 2026 of the Clean Hydrogen Joint Undertaking consists of the next implementation step of the SRIA. It includes a Call for Proposals, along the lines of the research and innovation actions listed in the SRIA, with an overall indicative budget of EUR 105 million. In addition, EUR 10 million are allocated for a Call for Tender that will set-up and run a European Clean Hydrogen Start-Up Hub to accelerate the “translation” of research into investable start-ups. In addition, specific actions are foreseen to implement complementary activities in line with what is described in the SRIA (see section 1.3.3).

1.3. Strategy for the implementation of the programme

1.3.1. Implementation Strategy

The Clean Hydrogen JU has been set up to achieve a number of objectives described in the European legislation or its SRIA:

- The objectives of the Horizon Europe Programme, as described in Article 3 of the Horizon Europe Regulation[63], including contributing to the Union policy objectives;
- The objectives set out in the SBA establishing the Clean Hydrogen JU, both common for all Joint Undertakings and the specific ones for the Clean Hydrogen JU, as described in Articles 3 to 5 and 73-74 of the SBA;

[61] A revision of the SRIA is under preparation, to be adopted in 2024, to align it with all policy and technology developments since the start of this Programme. The revised SRIA will be the basis for the Clean Hydrogen JU activities during the second part of its lifetime (2025-2027).

[62] Regulations, Codes and Standards Strategy Coordination Task Force, the European Hydrogen Safety Panel and the Sustainability and Circularity Panel.

[63] Regulation (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regulations (EU) No 1290/2013 and (EU) No 1291/2013

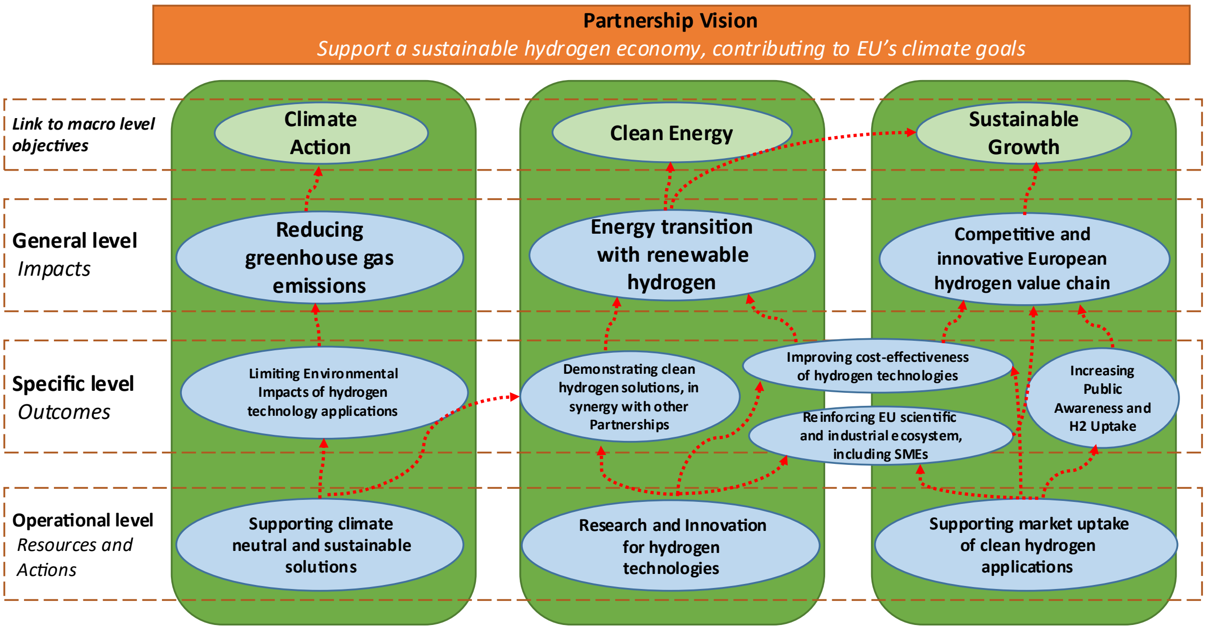
- The research objectives set out in the SRIA per research area.

In general, the Clean Hydrogen JU aims to accelerate the development and deployment of the European value chain for safe and sustainable clean[64] hydrogen technologies, strengthening its competitiveness and with a view to supporting notably SMEs, accelerating the market entry of innovative competitive clean solutions. The final goal is to contribute to a sustainable, decarbonised and fully integrated EU energy system, and to the EU's Hydrogen Strategy, playing an important role in the implementation of its roadmap towards climate neutrality.

In order to prepare the implementation strategy of the Programme, the Clean Hydrogen JU prepared a Strategy Map[65] to identify this large number of (often high-level) objectives to more specific ones. This facilitated the identification of the necessary actions over the lifetime of the JU, necessary to meet its objectives. The Strategy Map links the resources of the JU and the actions taken (operational objectives / indicators) towards concrete outcomes (specific objectives / indicators) and directly to one (or more) of the general objectives and intended impacts of the Clean Hydrogen JU, which would contribute in turn to one or more high-level objectives of the Union. Figure 1 below presents the JU's strategy map, linking actions with expected outcomes and intended impacts.

It needs to be emphasised that the Strategy Map does not aim to replace the legal objectives of the JU, as reflected in the SBA and the Horizon Europe Regulation, but helps to restructure and further specify them, in order to be able to better define the implementation strategy for the Programme and set up relevant indicators for its monitoring framework, while avoiding overlaps among the objectives and making more obvious the interlinkages between them.

Figure 1 Strategy Map of the Clean Hydrogen Joint Undertaking



Considering the different levels of objectives and the high level of ambition associated with the hydrogen sector, a gradual implementation was deemed more appropriate. Therefore, the

[64] "clean" meaning "renewable" in agreement with the definition of the Hydrogen Strategy, the only definition available at the time of adopting the SBA
[65] See Section 7 of the Clean Hydrogen JU SRIA.

Programme is mainly implemented through open and competitive annual Calls for Proposals[66], providing financial support mainly in the form of grants to participants. The planned research and innovation actions for 2026 are described in Section 2.2.3. The topics of each Call are determined on an annual basis through extensive consultation between the three members of the JU[67] and with the support of the Programme Office. In addition, the advisory bodies[68] of the JU are also consulted on the Call topics throughout the drafting process. The progress of the Programme, as observed via the monitoring framework of the JU and the European Commission's Biennial Monitoring Report on partnerships in Horizon Europe[69], are a useful input in these discussions, indicating whether more action is needed in certain area.

Moreover, the Clean Hydrogen JU undertakes in parallel a number of complementary activities, aiming to support the market uptake of hydrogen applications and reinforce the EU scientific and industrial ecosystem. In addition, these activities will address the specific tasks assigned in the SBA to the Joint Undertaking, its Governing Board and its Executive Director, in addition to the indirect actions implemented through grants. These activities are described in Section 2.2.4.

1.3.2. Planned research and innovation actions

Scientific priorities and challenges: Renewable Hydrogen production

Most of the hydrogen that is currently being produced in the EU and worldwide is produced from fossil fuels – either by steam reforming of natural gas or gasification of coal. Renewable hydrogen needs to become cost-competitive, and its technologies need to be scaled up in a fashion similar to renewable technologies during the last decade. For transport, this would require a cost around 5 €/kg at the pump to achieve cost parity with diesel fuel[70]. For industrial applications, renewable hydrogen costs must reach levels between 2-3 €/kg as a feedstock[71], in order to achieve parity with fossil-based inputs, once the cost of carbon is included in the feedstock cost.

To reach these costs, further improvements are required especially in cost reduction and efficiency increase for a variety of renewable hydrogen production routes, the main technology being electrolysis, supported by other routes exploiting direct sunlight such as thermal dissociation of water using concentrated solar energy or through photocatalysis, biomass/biogas or other biological routes.

Water electrolysis will be the main technology supported, covering high technology readiness level (TRL) types - Alkaline Electrolysis (AEL), Proton Exchange Membrane Electrolysis (PEMEL), Solid Oxide Electrolysis (SOEL) - and less mature types - Anion Exchange Membrane Electrolysis (AEMEL) and Proton Conducting Ceramic Electrolysis (PCCEL). The topic of pyrolysis and carbon black production is outside the scope of the Clean Hydrogen JU and should be covered through the synergies with Processes 4 Planet Partnership (P4P).

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[66] In 2026, the Clean Hydrogen Joint Undertaking will also carry out a number of operational activities via calls for tenders, see section 2.2.4 of this document for additional information.

[67] The three members of the JU are the European Commission, Hydrogen Europe and Hydrogen Europe Research.

[68] The advisory bodies of the JU are the States Representatives Group and the Stakeholders Group. In line with the Single Basic Act a formal consultation on the full AWP2026 took place with the SRG whilst the focus of the SG consultation is on potential synergies with adjacent your sectors and/or initiatives.

[69] https://ec.europa.eu/research-and-innovation/en/knowledge-publications-tools-and-data/interactive-reports/performance-european-partnerships-2022

[70] See Figure 15 in SRIA-HE/HER

[71] Green Hydrogen Cost Reduction: Scaling up electrolysers to meet the 1.5°C climate Goal, IRENA 2020

Scientific priorities and challenges: Hydrogen storage and distribution

As explicitly mentioned in the EU Hydrogen Strategy, it is essential that hydrogen becomes an intrinsic part of an integrated energy system. In order for this to happen, hydrogen will have to be used between daily and/or seasonal storage providing buffering functions thereby enhancing security of supply in the medium term. The strategy also calls for an EU-wide logistical infrastructure that needs to be developed to transport hydrogen from areas with large renewable potential to demand centres across Europe.

For distances compatible with the European territory, compressed and liquefied hydrogen solutions, and especially compressed hydrogen pipelines, offer lower costs than chemical carriers do. The repurposing of existing natural gas pipelines for hydrogen use is expected to significantly lower the delivery cost, making the pipeline option even more competitive in the future. By contrast, chemical carriers become more competitive the longer the delivery distance (due to their lower transport costs) and thus can more easily be traded in the global hydrogen markets.

In line with the above, a pluralistic approach with respect to the technologies that will be investigated and supported is envisaged, to have a complete set of technologies that can serve as building blocks of the EU-wide logistical infrastructure.

Scientific priorities and challenges: Hydrogen end uses – transport

Transport is a key area of economic growth in our society, responsible for around 30% of EU total CO_2 emissions. The European Green Deal has set the ambition for at least 90% reduction in transport emissions by 2050 to be consistent with climate neutrality. Hence, there is a need to urgently take measures to decarbonise the transport sector. Regulatory aspects will define the speed of adoption of new zero emissions transport means. The 'Fit for 55' package proposes a number of policy measures that promote the use of hydrogen as a low carbon fuel in the transport sector.

The technology developments so far are not sufficient to meet the ambitious emission reductions in transport. The required solutions can be based on the transfer of technical knowledge already gained in fuel cell (FC) light duty vehicles (LDV) and FC buses, while cost reductions and higher efficiencies can be achieved by scaling and by process integration, improving the competitiveness of these technologies with a roll down effect, e.g. by platform approaches of FC modules across sectors.

A number of technology routes still need further improvements, especially in the context of reducing costs and increasing durability, in order to make them competitive with incumbent technologies. These should be further validated and integrated in the different transport modes in synergies with the end-use partnerships of Horizon Europe (such as Clean Aviation JU, EU-Rail JU, Zero-Waterborne partnership, 2ZERO partnership) and include:

- Improvement of main technology building blocks that can be applied across a range of different transport applications, notably fuel cell stacks and hydrogen tanks;
- Adapting fuel cell systems from other vehicles (urban buses / cars) for long distance coaches and heavy-duty vehicles;
- Producing components for rail freight and shunting locomotive applications;
- Adapting FC components to waterborne transport, and developing next generations based on learnings from first demonstrations;
- Developing tanks and FC technologies specifically adapted for aviation.

It should be also stressed that, especially in the case of hydrogen-based transportation, the competitiveness of hydrogen technologies is dependent on research and innovation breakthroughs, on production volumes of vehicles and components and on the price and availability of hydrogen as a fuel. Therefore, actions aimed at stimulating a broad rollout of FC vehicles around Europe are equally important to research and innovation actions, in particular for heavy-duty sectors, in order to drive the Total Cost of Ownership (TCO) of the FC vehicles down. This is particularly true, for example, for the road heavy-duty transport segment where the TCO is extremely relevant for final users and ultimately for the market uptake. Monitoring of the FC trucks TCO and comparison with battery-powered trucks electrified trucks and others decarbonisation technologies will be needed. Addressing all of these aspects simultaneously is necessary to allow for hydrogen transport applications to enter mass market. This should be also performed in synergies with the Connecting Europe Facility, CEF Programme for implementation of related Hydrogen Refuelling Stations (HRS) network and in line with the Alternative Fuel Infrastructure Regulation (AFIR).

Scientific priorities and challenges: Hydrogen end uses - clean heat and power

Hydrogen can under certain conditions help to decarbonise the power generation and difficult to electrify industrial heating sectors reliably and independently from weather or seasonal conditions.

The overall goal of this pillar is to support European supply chain actors to develop a portfolio of solutions providing clean, renewable and flexible heat for particular end users' needs and power generation across different system sizes; from domestic systems all the way to large-scale power generation plants. Preferential support will be for solutions running on 100% hydrogen. However, to develop solutions for a transitional period, support may be also offered to solutions running on a hydrogen mixture in the gas grid targeting difficult to decarbonise sectors during this transition phase[72].

For gas turbines, in order to enable a smooth transition and assure backward compatibility with conventional fuels during the transition, support for actions running with different hydrogen admixtures are likely to be required to facilitate the development process and to achieve the final goal of 100% hydrogen turbines.

Scientific priorities and challenges: Cross-Cutting activities

Mass-market commercialisation of hydrogen-based technologies presents a number of systemic (or horizontal) challenges that need to be addressed to effectively kick-start a hydrogen ecosystem of significant scale throughout the EU in the coming decade.

Cross-cutting activities are structured around three focus areas: (i) Sustainability; (ii) Education and public awareness; and (iii) Safety, pre-normative research and regulations, codes and standards.

As hydrogen-based technologies become a market value proposition, strengthening the focus on environmental and sustainability aspects (such as water resources for electrolysis, critical raw materials use along hydrogen value chains and pollutant emissions) is required in the framework of the transition to a circular economy. Furthermore, continuous education and training are fundamental to safeguard existing expertise and to prepare a well-educated workforce needed for a competitive hydrogen market, while underpinning the jobs and value creation in a knowledge-based society in Europe. Public awareness activities are essential for

[72] According to the "Hydrogen strategy for a climate-neutral Europe", the blending of hydrogen in the natural gas network at a limited percentage may enable decentralised renewable hydrogen production in local networks in a transitional phase.

increasing social acceptance and trust in hydrogen-based technologies throughout Europe but in particular, for bridging the potential lack of knowledge or mistrust of key stakeholders directly involved in the first phases of mass deployment in Europe. Moreover, for a safe deployment of clean hydrogen technologies in Europe, safety-related aspects are of paramount relevance. As the technologies will shift from the industrial domain to the public domain, strengthening hydrogen safety is one of the priorities of the Clean Hydrogen JU Programme. Besides, a suitable regulatory framework for hydrogen-based technologies is necessary for an EU-wide deployment of clean hydrogen technologies. To this end, pre-normative research activities and desk research activities are fundamental for supporting regulations, codes and standards (RCS) development.

Scientific priorities and challenges: Hydrogen Valleys

Since 2014, the predecessor FCH 2 JU has pursued the concept of hydrogen territories, which have evolved into the most recent concept of Hydrogen Valleys with the new Clean Hydrogen JU. Hydrogen Valleys are hydrogen ecosystems that cover a specific geography ranging from local or regional focus (e.g. industrial cluster, ports, airports, etc.) to specific national or international regions (e.g. cross border hydrogen corridors). Hydrogen Valleys showcase the versatility of hydrogen by supplying ideally several sectors in their geography such as mobility, industry and energy end uses. They are ecosystems or clusters where various final applications share a common hydrogen supply infrastructure. Across their geographic scope, Hydrogen Valleys cover multiple steps in the hydrogen value chain, ranging from hydrogen production (and often even dedicated renewables production) to the subsequent storage of hydrogen and distribution to off-takers via various modes of transport. Whilst most of the projects are in the EU, over the past years, Hydrogen Valleys have gone global, with new projects emerging worldwide. Mission Innovation on Clean Hydrogen has set a target of deploying 100 large-scale Hydrogen Valleys worldwide by 2030[73].

The concept aims to demonstrate how all the different parts of the hydrogen value chain fit together in an integrated system approach. This concept has gained momentum and is now one of the main priorities of the industry and the European Commission (EC) for scaling-up hydrogen deployments and creating interconnected hydrogen ecosystems across Europe.

A Hydrogen Valley should not only demonstrate how hydrogen technologies work in synergy, but it should also offer a competitive solution and work complementary with (or reuse of) other elements such as renewable production, gas infrastructure, electricity and thermal grid, energy storage solutions, etc.

The REPowerEU Plan acknowledges the need to develop Hydrogen Valleys based on local renewables, demonstrating ecosystems that contribute to a faster sustainable energy transition via renewable hydrogen across the EU. The Commission therefore allocated an additional EUR 200 million for doubling the number of Hydrogen Valleys in the EU by 2025, while contributing to the wider goal of consuming 10 million tonnes of domestic renewable hydrogen by 2030. More recently, in June 2024, the European Commission's set an inspirational target to have at least 50 Hydrogen Valleys under construction or operational by 2030 across the entire EU[74].

A key objective will be to progressively set up hydrogen local ecosystems which will accelerate the development of an EU hydrogen economy, interconnecting them step by step, and building on local renewable energy resources including mixing them to produce renewable hydrogen.

[73] http://mission-innovation.net/wp-content/uploads/2022/09/Clean-Hydrogen-Mission-Action-Plan-Sept-22.pdf
[74] Commission Staff Working Document, SWD(2024) 159 final. Towards a roadmap for accelerating the deployment of Hydrogen Valleys across Europe: challenges and opportunities

In that respect, Hydrogen Valleys could have various dimensions and various sets of end use applications.

Scientific priorities and challenges: Hydrogen Supply Chains

Hydrogen technologies and systems have been identified by the European Commission as an emerging and strategic value chain for Europe.[75] A strong and sustainable European supply chain of hydrogen technologies will avoid that the manufacturing capacity becomes a limiting factor to technology uptake, improve the competitiveness and innovation of industries, support the decarbonisation of the economy and reduce dependence on fossil fuels, critical raw materials (CRM) and components imports. Following this, the European Clean Hydrogen Alliance[76] was set up in July 2020 to support the large-scale deployment of clean hydrogen technologies by 2030. The Alliance brings together renewable and low-carbon hydrogen production, demand in industry, mobility and other sectors, and hydrogen transmission and distribution. Its members come from industry, public authorities, civil society, and other stakeholders.

The SRIA foresees a set of actions aiming at strengthening the overall supply chain of hydrogen technologies, from processing the raw materials into specialised materials (e.g. electro-catalysts), production of components and sub-system to system integration. The supply chain is complemented by the wider view of the value chain approach vis-à-vis creation of jobs, added value to economy and industry competitiveness.

Scientific priorities and challenges: Strategic Research Challenges

To ensure a continuous generation of early-stage research knowledge, the above actions will be supplemented by multidisciplinary investigations, gathering expertise at different technology scale (materials, component, cell, stack and system). All the generated knowledge needs also to be combined in such a way to allow further comprehensive interpretations. The usual 3-year focused research projects do not really appear to be the optimum option to ensure a continuum in early-stage research knowledge. The proposed approach considers gathering, with a long-term vision and covering the whole Clean Hydrogen JU activities, the needed capabilities and expertise from European Research and Technology Organisations (RTOs) while preparing the next generation of products (lower cost and better performance), beyond 2030.

Based on the early-stage research actions mentioned in the different previous roadmaps, the following strategic research challenges appear the most relevant:

- Low or free platinum group metal (PGM) catalysts (including bioinspired catalysts), reducing critical (raw) materials use in electrolysers and fuel cells, and safe and sustainable use of all material, including developing of perfluorosulfonic acid (PFAS)-free ionomers and membranes;
- Advanced materials for hydrogen storage (e.g. carbon fibres, H_2 carriers);
- Advanced understanding of the performance / durability mechanisms of electrolysers and fuel cells.

1.3.3. Other activities

Although the financial support to research and innovation actions is the main tool of the JU to

[75] Strengthening Strategic Value Chains for a future-ready EU Industry, EC, 2019.
[76] https://single-market-economy.ec.europa.eu/industry/strategy/industrial-alliances/european-clean-hydrogen-alliance_en

achieve its objectives, it is not sufficient. A number of additional support activities are necessary to fulfil its objectives in relation, for example, to developing synergies with other partnerships and programmes, strengthening scientific excellence and its links to innovation and increasing public awareness.

For this reason, the SBA[77] includes a number of tasks that the JU, its Governing Board and its Executive Director (supported by the Programme Office) should carry out, which were then translated into specific activities in the SRIA.

Activities related to Synergies

The overall principle is that the JU activities shall be implemented in synergy with other Union programmes while aiming for maximal administrative simplification.

In line with the SBA, the JU will develop close cooperation and ensure coordination with other European partnerships, including by dedicating, where appropriate, a part of the joint undertaking's budget to joint or complementary calls.

Moreover, it will seek and maximise synergies with and, where appropriate, possibilities for further funding from relevant activities and programmes at Union, national and regional level, in particular with those supporting the deployment and uptake of innovative solutions, training, education and regional development, such as Cohesion Policy Funds, or preparing for support from deployment funds like the Innovation Fund, or the National Recovery and Resilience Plans.

In 2025 the JU has developed its Synergies strategy for the current Multiannual Financial Framework (MFF) and beyond. Starting with a mapping all the relevant synergies for the JU, and following an analysis on the lessons learned, the strategy proposes improvements to be implemented in the short term as well as strategic priorities for the future. In particular, the strategy includes a strategic roadmap which will be the basis for development of the action plan for 2026, as well as for upcoming discussions for the continuation of the JU.

Activities related to Regulations, Codes and Standards

The Clean Hydrogen JU will contribute to supporting the implementation of hydrogen-specific regulatory and enabling frameworks by a strategic and coordinated approach to RCS issues within the Programme, which will mostly be implemented through Pre-Normative Research (PNR) activities. To this end, PNR activities will encompass research activities and desk research activities in view of supporting RCS developments.

Moreover, an RCS Strategy Coordination (RCS SC) Task Force composed of the Commission (incl. links with the European Clean Hydrogen Alliance and its plan on standardisation), Hydrogen Europe and Hydrogen Europe Research, and the Clean Hydrogen JU Programme Office (PO) will be set up to better coordinate these activities. Altogether, the RCS SC Task Force will contribute to coordinating and establishing an approach to enhance European participation and contribution in international and European RCS bodies while contributing to lay down a regulatory friction-less hydrogen market in Europe and beyond if possible. According to the SBA, the JU should also support the Commission in its work in the Clean Energy Ministerial (CEM) and International Partnership on hydrogen and fuel cells in the economy (IPHE) both entities working on standardisation.

Activities related to European Hydrogen Safety

Independently of the research and innovation actions addressing hydrogen safety issues, the

[77] See Articles 5(2), 17 (2), 19(4), 74, 82 and 83 of the SBA.

Clean Hydrogen JU will retain and further reinforce the European Hydrogen Safety Panel (EHSP), aiming to support the development and deployment of inherently safer hydrogen systems and infrastructure.

The mission of the EHSP in the Programme is twofold:

- To assist the Clean Hydrogen JU at both programme and project levels, in assuring that hydrogen safety is adequately addressed and managed;
- To promote and disseminate a high-level hydrogen safety knowledge and culture within and beyond the Programme.

Activities related to European Hydrogen Sustainability and Circularity

The research and innovation actions under the Cross-cutting and the Hydrogen Supply Chain scientific priorities will play a key role in providing the methodological foundation to strengthen the sustainability and circularity of these technologies and their industrial value chains in Europe. Nevertheless, the transition towards a fully-fledged sustainable and circular hydrogen economy requires an integrated approach beyond these activities.

To this end, the Clean Hydrogen JU will set up a European Hydrogen Sustainability and Circularity Panel (EHS&CP) at the Programme level which will act as a focal point or "advisor" to the Programme in these matters in an independent, coordinated and consolidated way. This Panel started working in March 2024.

The EHS&CP will assist the Clean Hydrogen JU in assuring that sustainability and circularity aspects are adequately addressed and managed at both programme and project levels, encompassing environmental, social and economic aspects as a whole. Moreover, it will promote and disseminate knowledge and a more sustainable and circular culture within and beyond the Programme.

Activities related to knowledge management

The main goals of the Clean Hydrogen JU knowledge activities will be to support the collection and diffusion of high-quality new knowledge and support evidence-based implementation of Union policies.

It will monitor progress towards the achievement of the objectives of the Clean Hydrogen JU and its technology key performance indicators (KPIs), while strengthening the knowledge capacity of hydrogen value chain actors through data collection and knowledge collection.

Moreover, it will contribute to developing a more effective science-policy interface, fostering open science by ensuring better use of results and to addressing policy needs, as well as to promoting faster exploitation, dissemination and uptake of results.

Activities related to SMEs

The Clean Hydrogen JU will continue to rely on the innovativeness of SMEs. To do this, it will need to deal with two of the largest obstacles that SMEs must overcome, the need to raise financing, especially in the early stages of growth, and to kick-start sales and thereby gain valuable field experience.

In order to address the specific limitations and risks of SMEs, the Clean Hydrogen JU will continue to explore ways to open access to the necessary manufacturing and process capabilities through partnership schemes and education initiatives. It will help raise awareness of projects' results within the finance community, while at the same time trying to address the private sector funding and financing challenge that acts as a market barrier for deployment of hydrogen technologies and wider hydrogen integrated solutions.

Activities related to international cooperation

The Clean Hydrogen JU will build on the actions undertaken by its predecessor and expand them accordingly, in order to support the European Commission in the implementation of its international cooperation agenda in research and innovation.

Its activities will include strengthening the links with the major deployment programmes globally, continue providing technical support to the European Commission on its international activities in relation to hydrogen research and innovation, most notably in relation to the International Partnership for Hydrogen and fuel cells in the Economy (IPHE), the Clean Energy Ministerial Hydrogen Initiative, Mission Innovation 2.0 and Hydrogen Energy Ministerial. Similarly, the Clean Hydrogen JU Programme Office will continue to support the Joint Research Centre (JRC) and Directorate-General (DG) R&I by contributing to the Commission activities for the International Energy Agency (IEA) Hydrogen Technology Collaboration Programme (HTCP) where the Clean Hydrogen JU is participating in Task 41 on Analysis and Modelling of Hydrogen Technologies and Task 42 on Underground Hydrogen Storage.

Activities related to Communication

The JU will continue to undertake a number of communication activities with the objective to promote the development of the hydrogen technologies sector, build public awareness and acceptance of the hydrogen technologies and ensure communication towards and between stakeholders.

2026 is a crucial year, for the future of the Clean Hydrogen JU. Especially when communicating about its impact, there is a need to communicate the Clean Hydrogen JU's core messages with even more clarity, focusing on achievements, concrete actions and results that are important for all stakeholders.

We will therefore provide state of the art communication products and services to accompany the crucial period of the run up to the new partnership announcements and beyond.

During the past years, Clean Hydrogen JU has built up its communication around the programme success stories, to demonstrate the benefit of the instrument and the impact of its results. This approach will continue as it proved to be extremely valuable. The stories about the technology, the journey and the successes are a powerful tool; we aim to improve their outreach by reaching out to new target groups and by enhanced cross-promotion. We will therefore continue the campaign around success stories started at the end of 2025.

Several flagship events will be organised by the JU aiming to gather independent opinions and advice of the wider scientific community on the future Strategic Research and Innovation Agenda (SRIA), the future MFF and work programmes and developments in sectors of interest. In particular, we will convene the annual European Clean Hydrogen Innovation Forum, including the Annual Programme Review , within the Hydrogen Week 2026 and continue the series of events dedicated to the hydrogen valleys.

2. Work Programme 2026

2.1. Executive summary 2026 and message from the Executive Director

2.1.1. Message from the Executive Director

Dear Readers,

2026 is undoubtedly an important year for all of us in the research and innovation sector, and the Annual Work Plan we have developed together with our partners reflects this. The Clean Hydrogen Joint Undertaking has ambitious plans for 2026, continuing to accelerate the development and adoption of clean hydrogen technologies across Europe. Our global objective remains unchanged: strengthen Europe's leadership in clean hydrogen technologies.

Europe's appetite for innovation continues to exceed what we can fund. The total subsidies requested in our last call amounted to over €1bn, 7 times the amount available for fundings, reflecting the scale of ambition and confidence in hydrogen's potential. That is why, a key highlight of 2026 is the launch of a Call for Proposals with a total budget of €105 million. A new initiative will also be launched in 2026 to help turning research into investable start-ups, driving innovation in the hydrogen sector. The European Clean Hydrogen Start-Up Hub is a new €10 million initiative designed to accelerate the commercialisation of hydrogen-related research results by transforming them into scalable, investment-ready start-ups. The Hub will act as a central European platform that connects technology developers, researchers, entrepreneurs, investors, industrial partners, and regional innovation ecosystems.

The path ahead is clear. Hydrogen will not exist without cooperation — national, European, or international, and synergy across funding programmes will be key. Building on past successes, the JU will continue fostering synergies with EU partnerships, programmes, and funding initiatives. It will work closely with the Implementation Working Group on Green Hydrogen under the Strategic Energy Technology Plan (SET-Plan) and support EU policies such as the Net-Zero Industry Act.

We will also continue our successful cooperation with international partners, including Japan's national research agency and the IEA Hydrogen Technology Collaboration Program. Our efforts will focus on harmonising regulatory frameworks and safety standards. We remain committed to sound financial management, continuous improvement, and effective collaboration.

The JU will enhance its knowledge-sharing efforts through initiatives like the Clean Hydrogen Knowledge Hub, European Hydrogen Observatory and will also consolidate the Hydrogen Valleys Facility to support project promoters and policymakers, working towards the EU target to have at least 50 Hydrogen Valleys under construction or operational by 2030 .

Communication activities will highlight the JU's role as a leader in clean hydrogen technologies. Our flagship events such as the Hydrogen Valleys days, the European Clean Hydrogen Innovation Forum and the Hydrogen Research and Innovation Days will continue to drive engagement among our stakeholders and promote awareness and uptake of clean hydrogen.

To sum up, our 2026 ambition is simple yet bold: to keep hydrogen a European and global champion.

Valerie Bouillon-Delporte

Executive Director

Clean Hydrogen Partnership

2.1.2. Executive Summary

The fifth Annual Work Programme has been prepared in response to the challenges and R&I activities that still remain to be addressed within the context of the SRIA of the Clean Hydrogen Partnership. It is also accordingly in alignment with the strategy for the implementation of the Programme, as described in Section 1.3.1.

In 2026, one Call for Proposals for an indicative total budget of EUR 105.0 million is foreseen. In addition, EUR 10 million are allocated for a Call for Tender that will set-up and run a European Clean Hydrogen Start-Up Hub to accelerate the "translation" of research into investable start-ups.

The Call addresses key challenges as identified by the stakeholders in the Clean Hydrogen JU. These challenges encompass different areas of research and innovation with direct and quantified impact towards the achievement of the objectives of the Clean Hydrogen JU in general and to each of the Pillars in particular. A total of 21 topics will be part of the call for proposals, including 6 for Renewable Hydrogen Production, 4 for Hydrogen Storage and distribution, 4 for transport and 3 for heat and power. In addition, 2 topics will support Cross-cutting issues. This call also includes 2 Hydrogen Valleys topics. They will be grouped into 15 Research and Innovation Actions (RIA), 4 Innovation Actions (IA), and 2 Coordination and Support Actions (CSA). Two of the Innovation Actions, on Hydrogen Valleys, are considered of strategic importance and are selected as flagship projects. Synergies with other European partnerships and programmes as well as with Member States and regional programmes are at the core of a number of topics.

The Call for Proposals will be subject to independent evaluation and will follow the Horizon Europe rules on calls for proposals. Upon selection, the Partners (the 'consortium') will sign a Grant Agreement with the JU. As in the previous JU Call, the Call 2026 will be implemented using lump sum grants. With this approach the JU aligns with other parts of Horizon Europe and bring simplification and efficiency gains across the overall grant management cycle.

In the same year, the Clean Hydrogen JU intends to also publish up to two Calls for Tenders, covering subjects of strategic nature for the JU, for an indicative amount of EUR 10.5 million These include technical assistance on Hydrogen Quality Standardisation to complement existing European Commission studies. In addition, as mentioned above, the Clean Hydrogen JU is planning to launch a tender to set-up and run a European Clean Hydrogen Start-Up Hub that aims to accelerate the transition from innovation to market.

Building already on experiences (and success stories) of the JU's predecessors as well as in the first years of the Clean Hydrogen Partnership, synergies have become a central piece of the 2021-2027 multi-annual financial framework. In 2025, the JU has developed its Synergies strategy for the current Multiannual Financial Framework (MFF) and beyond. Starting with a mapping all the relevant synergies for the JU, and following with an analysis on the lessons learned, the strategy proposes improvements to be implemented in the short term as well as strategic priorities for the future. In particular, the strategy includes a strategic roadmap which will be the basis for development of the action plan for 2026, as well as for upcoming discussions for the continuation of the JU. The JU will continue with a structured cooperation with relevant European partnerships, EU agencies and other EU funding programmes, including those managed nationally or regionally by Managing Authorities.

In 2026, the Clean Hydrogen JU will continue working closely with the Implementation Working Group (IWG) on "Green Hydrogen" under the Strategic Energy Technology Plan (SET-Plan) activities. The JU will continue monitoring that the implementation of the group's activities is in line with JU's SRIA and provide continuous support to different task forces.

Furthermore, as many of the members of the IWG Hydrogen group are also members of the Clean Hydrogen JU States Representatives Group, the JU will act as the facilitator between the groups and monitor further opportunities for synergies.

The Clean Hydrogen JU support to EU policies will go beyond. For instance, the Clean Hydrogen JU will continue to support DG CLIMA on a number of initiatives aiming at bringing the JU family of projects closer to the Innovation Fund programme. The JU is also ready to continue supporting DG GROW and cooperate with the European Clean Hydrogen Alliance (ECH2A) activities, to ensure synergies. Building on the cooperation that started in 2023, the JU will continue collaborating and supporting DG GROW and other DGs to reach the ambitions of the EU Net-Zero Industry Act on the area of hydrogen in general and concerning skills in particular. On the maritime sector, the collaboration with European Commission services and Zero Emission Waterborne Transport (ZEWT) on fostering the development of alternative powertrains and supply of zero emissions fuels will continue. This will also be the case for the aeronautic sector and the JU will continue working very closely with the Clean Aviation JU at programming and implementation levels.

A new Framework Agreement between Clean Hydrogen JU and the JRC was signed in the spirit of the previous Framework Contract. The annual Rolling Plan 2026 was agreed in 2025 and will be implemented in 2026. It consists of the annual activities and their related deliverables provided by JRC, which include the support to the regulations, codes and standards strategy and its implementation, its contribution to the Programme monitoring and assessment, as well as the JRC contribution to the assessment of sustainability of hydrogen and fuel cells.

In terms of knowledge management, the JU will continue with the annual data collection exercise from its projects and the publication of the Annual Programme Review Report, planned to be published end of 2026. In 2026, the JU will continue supporting the European Hydrogen Observatory and related contract. In addition, the activities of the Clean Hydrogen Knowledge Hub will continue and will be consolidated. Moreover, the Hydrogen Valleys Facility will be consolidated as a one-stop-shop for Hydrogen Valleys project promoters and policy makers, and will continue offering project development assistance services.

In 2026, the Regulations, Codes and Standards Strategy Coordination (RCS SC) Task Force will continue to contribute to coordinating and establishing an approach to enhance European participation and contribution in international and European RCS bodies while contributing to lay down a regulatory friction-less hydrogen market in Europe and beyond if possible.

Similarly, the European Hydrogen Safety Panel will continue its activities, performing safety plan reviews, updating its guidance documents, providing guidance in developing areas (e.g. heavy transport), performing public outreach and continuing with its data collection and assessment activities. In addition, the activities of the European Hydrogen Sustainability and Circularity Panel will be intensified in the areas of Life Cycle Assessment (LCA), energy consumption, resource efficiency , materials, infrastructure, and environmental footprint among others.

The Clean Hydrogen JU will continue supporting the European Commission in its international cooperation activities. It will continue its work in relation to the harmonisation of the regulatory and policy frameworks, as well as safety and education. Moreover, as needed, it will continue its involvement in some working groups of the IEA Hydrogen Technology Collaboration Program. In 2026, the cooperation with Japan's national research and development agency will continue. Finally, the JU will continue supporting the Hydrogen Valleys platform (as part of the wider Hydrogen Valleys Facility), while supporting also the other activities of Clean

Hydrogen Mission under MI2.0. International collaboration.

As part of the knowledge management activities, but also in the context of the Project Management workflow, the Programme Office will continue its activities in dissemination and exploitation of project results. It will continue participating in the Innovation Radar, while also promoting other tools supporting further exploitation and dissemination.

Communication and outreach activities in 2026 will be guided by concrete goals with the objective of positioning the Clean Hydrogen JU as a unique EU tool for the funding and the development of the clean hydrogen technologies sector, strengthening the JU positioning as expertise hub on hydrogen as well as establishing the JU's reputation as a hub for research and innovation of hydrogen technologies at EU level. Furthermore, the JU will continue working to increase awareness, acceptance, and uptake of clean hydrogen, through cooperation with other European partnerships under Horizon Europe. As part of its strategy, but not only, the JU will organise a number of events with both online and physical presence such as European Clean Hydrogen Innovation Forum (part of the European Hydrogen Week), Hydrogen Research and Innovation Days, European Hydrogen Valley 2026 and its Info Day on Call 2026. Furthermore, following up on the results of the public opinion survey organised by the JU in 2022, a new Eurobarometer survey will be organised in 2026, to understand current attitudes on the hydrogen technologies . The survey will inform policy, public education, and messaging, and assist with the implementation of the technology, providing a strategic tool for JU's future work.

In continuation of the previous years, the JU will actively involve, meet and consult its two advisory bodies, the States Representatives Group (SRG) and the Stakeholders Group (SG) on the different activities expected for 2026.

In all its activities, the Clean Hydrogen JU shall fully comply with the requirements of Regulation (EU, Euratom) 2024/2509 (the Financial Regulation). In compliance with its Article 71, the Joint Undertaking will respect the principle of sound financial management. It shall also comply with the provisions of the Financial Rules adopted in 2019[78].

In continuation of previous years, corporate processes and procedures will be further streamlined, using the opportunities offered by new corporate tools (for financial, HR, procurement and contract management processes) in combination with back office arrangements services as well as own continuous improvement actions. The year 2026 will be the first year of use of SUMMA, the corporate tool for finance, budget and accounting.

Together with the 9 other joint undertakings, the Clean Hydrogen JU will continue making the back-office arrangements evolve and optimise their functioning. In particular, as co-lead JU for the back office arrangement on Information and Communications Technology (BOA ICT) with the Innovative Health Initiative Joint Undertaking (IHI JU), the JU will oversee the implementation of the common ICT annual work plan. For other areas of shared services (namely, for back office arrangements, Accounting, HR, Procurement and Facility Management), the Clean Hydrogen JU is a beneficiary or a contributor.

Furthermore, the Clean Hydrogen JU will closely monitor the implementation of its budget and its Staff Establishment Plan.

[78] https://www.clean-hydrogen.europa.eu/document/download/aa91ce3c-5b2d-4c71-ac94-a47a29b76278_en?filename=GB%20decision%20and%20Financial%20Rules.pdf,

2.2. Operational activities of Clean Hydrogen JU for 2026

2.2.1. Objectives, Indicators and Risks

2.2.1.1. Objectives

The operational activities of the Clean Hydrogen JU contribute towards achieving the legal objectives of the JU, as reflected through its implementation strategy of the Programme and its Strategy Map, presented in Section 1.3.1. The links between the specific operational activities planned for 2026 with the Strategy Map are presented in Annex 4.1.

2.2.1.2. Key Performance Indicators

The Clean Hydrogen JU has established a monitoring framework to track the progress towards its objectives as set out in the SBA and the Horizon Europe Regulation, as well as its contribution towards the priorities of the Union and the SRIA[79].

The JU will monitor a number of Key Performance Indicators as described in Section 7 of its SRIA. These indicators can be grouped in the following categories:

- Horizon Europe KPIs[80], defined in the Horizon Europe Regulation as Key Impact Pathways and applicable for the whole Horizon Europe Programme;
- Common JU Indicators, as defined in the monitoring framework[81] developed by the Expert Group set up to support the strategic coordination process of the European R&I partnerships through a more strategic monitoring for European Partnerships, including the preparation of the Biennial Monitoring Report[82];
- Clean Hydrogen JU KPIs, defined by the Clean Hydrogen JU[83] for the purpose of monitoring the progress towards the objectives of the Strategy Map and its relevant targets;
- Technology KPIs, defined by the Clean Hydrogen JU[84] to monitor technology progress and innovation of its projects towards the R&I priorities defined in the SRIA.

The third category of these KPIs, the ones specific for the Clean Hydrogen JU present in **Error! Reference source not found.** below, are the ones that are used to evaluate the p erformance of the JU as an entity and provide quantifiable means to measure any associated risks towards the achievement of its objectives.

[79] Articles 5.2(h), 17.2(a), 19.4(f)/(g)/(o), 36, 74(a) and 171 of the SBA.
[80] HE Regulation Art 50(1) & SBA Art 171(2)(a-c-d-e)
[81] A robust and harmonised framework for reporting and monitoring European Partnerships in Horizon Europe, 2021, RTD, https://op.europa.eu/en/publication-detail/-/publication/6b63295f-d305-11eb-ac72-01aa75ed71a1
[82] https://research-and-innovation.ec.europa.eu/document/04974c33-68e6-4f20-a818-a46e4ecfaa09_en
[83] Annex I of the SRIA
[84] Annexes II-VI of the SRIA.

Table 1 Clean Hydrogen JU KPIs, monitoring the progress towards the objectives of the Strategy Map[85]

KPI Name		Unit of measurement	Baseline	Actual 2024[a]	Target 2023	Target 2025	Target 2027	Ambition 2030	Status
Resources (input), processes and activities									
1. Supporting climate neutral and sustainable solutions	1a. Hydrogen end-use solutions in hard to abate sectors	% of JU budget	2.5[b]	28	15	30	40		On track
	1b. Circular and sustainable solutions	% of JU budget	< 1[b]	12	5	10	15		On track
2. Early research projects		% of budget	10[b]	16	10	10	10		On track
3. Demonstration projects		# of projects	43[b]	34	20	40	60		On track
4. Education and training		# of projects	4[b]	17	2	4	6		On track
5. Monitoring technology progress		*Qualitative indicator*	N/A	AAR24[c]	N/A	N/A	N/A		N/A
6. Supporting EC in H2 market uptake		*Qualitative indicator*	N/A	AAR24[c]	N/A	N/A	N/A		N/A
Outcomes									
7. Environmental impact and sustainability	7a. Reduction in the use and increase in the recycling rate of Critical Raw Materials (CRM)	% of CRM relevant KPIs reached	0	N/A[d]	N/A	75[e]	75	100	N/A[d]
	7b. Improvement in the quality of Life Cycle Assessments (LCA)	Quality of LCA submitted by projects (rating in %)	60[b]	N/A[d]	N/A	65	70	75	N/A[d]

[85] The reported KPIs and their values/baselines/targets may differ in some cases compared to the past, following certain updates in the methodology and data sources, including the first SRIA amendment in June 2024.

KPI Name		Unit of measurement	Baseline	Actual 2024[a]	Target 2023	Target 2025	Target 2027	Ambition 2030	Status
Resources (input), processes and activities									
8. Capital cost of hydrogen applications	8a. Capital cost of electrolysers	% reduction across electrolyser technologies	100	N/A[d]	N/A	65	55	45	N/A[d]
	8b. Capital cost of heavy-duty road applications	Cost of FC module CAPEX in €/kilowatt	1,500	N/A[d]	N/A	420	290	100	N/A[d]
9. Research and Innovation Synergies		# of projects	5[b]	9	5	10	20		On track
10. Public perception of hydrogen		*Qualitative indicator*	N/A	AAR24[c], project HYPOP[f]	N/A	N/A	N/A		On track
11. Total persons trained		# of persons in thousands	5[b]	N/A[d]	N/A	110	160	240	N/A[d]
12. Patents and publications		# of patents / publications	12[b]/ 289	23 / 391	17/ 100	25/ 400	25/ 450		On track[g]
13. Promoting cross-sectoral solutions		% of budget	15[b]	18	10	15	25		On track
Impacts* (KPIs reporting progress of hydrogen sector at EU level, to which the JU is contributing)									
14. Expected avoided emissions		Million tonnes of CO2-eq/year	0.085	0.91[h]	N/A	N/A	N/A	223	Off track[i]
15. Deployment of electrolysers		Gigawatt	0.077	0.4[h]	4	6	10	40	Off track [i]
16. Market uptake of clean hydrogen		Mt of clean hydrogen consumed	0.008	0.04[h]	0.7	1	2	10	Off track [i]
17. Total cost of producing renewable hydrogen		€/kg	8	6.86[h]	6.5	5.5	4.5	3	Off track
18. Size of private hydrogen sector	18a. Activity in terms of companies	# of companies	300	1,413[h]	1,000	1,500	2,000	-	On track
	18b. Activity in terms of projects in the pipeline (ongoing or under construction)	# of Projects	50	309[h]	200	500	800	-	On track[j]
	18c. Electrolyser manufacturing capacity	GW/year	1	10.2[h]	5	17.5	30	-	Off track[k]

* The set of KPIs under “impact” report the progress of the hydrogen sector at EU level, to which the JU is contributing. Targets for KPI-14 to KPI-17 are based on the relevant ambition set in EU’s Hydrogen Strategy. Targets for KPI-18a and KPI-18b are based on current trends and expectations for the sector, while KPI-18c reflects the 2025 target mentioned in the Joint Declaration signed between the European Commission and the European electrolysers manufacturers in May 2022. For this set of KPIs, the status refers to Europe as a whole and not on the individual performance of the JU, helping to identify where more effort should also be placed by the JU in the coming years.

[a] The latest values available on October 2024 are reported. For KPIs (#1-4, 9, 13) these reflect the signed grants of Call 2022, 2023 and 2024. For the KPIs on project results (#7, 8 and 11) there is nothing to report yet, as the first grants where only signed in 2023. For KPI 12 the latest data by the end of 2024 are reported, as reported in the latest Annual Activity Report of the JU (AAR 24). All KPIs on impacts (14-18) come from the latest available data on the European Hydrogen Observatory. For the qualitative KPIs (#5-6, 10), these are described in AAR24. The methodology for the calculation of all KPIs is described in detailed in the corresponding methodology document published on the JU website.

[b] Baseline refers to the achievement over the lifetime of the predecessor partnership (FCH 2 JU).

[c] More information about this KPI can be found in Section 5.5 of Clean Hydrogen JU’s Annual Activity Report 2024 (published July 2025).

[d] First relevant project was signed only in first half of 2023. Results will become available gradually as the projects advance, mostly towards the end of the projects.

[e] Target for 2025 measured against SRIA 2024 targets, while targets for 2027 and 2030 measured against SRIA 2030 targets.

[f] https://www.clean-hydrogen.europa.eu/projects-repository/hypop_en

[g] Reported figures concern 2024 coming from Annual Activity Report 2024. Current main source of data is eGrants, but it is considered incomplete, especially in relation to patents. The JU is currently working with JRC to improve the data collection methodology concerning this series.

[h] Calculated from the European Hydrogen Observatory, using values only for EU27 countries; data extracted on October 2024. KPI-14 was calculated using the methodology proposed by the Observatory contractors. KPI-15 is extracted from the hydrogen production data, while KPI-16 from the hydrogen demand data. KPI-17 comes from cost of hydrogen production data, KPI-18a from the market directory (not counting associations, public entities, universities and research institutes), KPI-18b from the hydrogen production and consumption projects – but only for clean hydrogen -, while KPI18c from the electrolyser manufacturing capacity data.

[i] KPIs 15-16 are off track, and thus KPI 14 which is directly linked to them, as despite the ambitiousness of the Hydrogen Strategy hydrogen technologies require more time and research to be ready for commercialisation and scaling up. Nevertheless, the significant funding planned via the European Hydrogen Bank and other European, regional and national instruments may be able to turn this around in the coming years. This can be further supported by the activities of the Clean Hydrogen JU, which although may have a limited direct impact to these deployment figures due to its small budget compared to the ambition, it can play an important role in increasing the technology readiness of the hydrogen solutions, allowing their faster market uptake.

[j] Expected to be on track in 2025, based on project announcements.

[k] This number concerns operational capacity by May 2024, with additional 1.0 GW/year being operational in UK and Norway.

2.2.1.3. Risk Assessment

In September 2025, the JU conducted its annual risk assessment exercise in the form of an all-staff workshop. The primary objective was to identify, analyse, and respond to key risks — including potential fraud risks — across all areas of responsibility within the JU.

The process began with a review of the risks and associated action plans identified during previous assessments. These were evaluated for continued relevance in light of the JU's evolving operational and strategic context. The exercise then progressed to the identification of any new risks that may have emerged in 2025.

To guide this process, staff were asked to reflect on the following key questions:

- Are the risks and action plans identified in the previous year's exercise and presented in the AWP 2026 still relevant?
- Have any significant new risks emerged during the course of 2025 that could impact the achievement of the JU's objectives in 2026?
- Are there any new fraud-related risks not adequately covered by existing internal controls?
- Have there been any significant changes in the internal or external environment that could have a material impact on the JU in 2026 and beyond?

By establishing clear and comprehensive action plans, assigned to a specific JU responsible individual for risk implementation and follow-up, the JU ensures effective prioritisation of resources and tasks. This enables timely and adequate mitigation of those risks deemed most significant to the organisation's strategic objectives.

In line with the European Commission's risk assessment methodology — evaluating both impact and likelihood — the following table presents all identified high and medium risks, along with the corresponding mitigation action plans:

Risk(s) short Ranking	Risk(s) identified	Action plan 2026
Insufficient Manpower **[HIGH]**	The Programme Officer/ JU is confronted with a significant operational risk stemming from insufficient staffing to manage the concurrent implementation of Horizon 2020 (HE) and Horizon Europe (HE) programme. H2020 is at the end and needs a lot of vigilance. HE budget has seen a 50% increase compared to H2020, and received additional funding from the RePowerEU initiative, with approximately half of his supplementary budget required to be committed within the first two years. Despite these increases, the staff establishment plan (SEP) allocates only two additional full-time equivalents (FTEs) for 2022-2027 period, and two new additional contract agents in 2025, which is inadequate to effectively handle the increase of workload. Back Office Arrangements (BOA) are helping to harmonize the working processes, however, have revealed that they do not represent a solution for the headcount issue. Extra-muros are hired for the project officers' support, in the area, restricted by the PTA engagement contract. This staffing shortfall is further increased by the risk of high turnover among key personnel, which turned to be a higher risk in 2026, potentially leading to knowledge gaps and diminished capacity, until we reach certainty on the exact contents of FP10 and the situation of the JU.	The JU will continue to use service contracts for support activities in the Operations, while increased coordination will be explored through synergies with other joint undertakings on administrative activities. The JU will continue to investigate further simplification opportunities. The JU will continue to analyse and monitor tasks allocated among staff members to measure the staff workload. The JU will continue to explore best ways to shorten time for recruitment for staff by using other JUs reserve list. Vacancy posts will be published to get a reserve list at disposal to prevent the gap between the arrival and departure of a staff member. The JU will continue to discuss with the Governing Board (GB) on the adequacy of the current staff establishment plan supported with a real workload analysis for the entire organization.

Risk(s) short Ranking	Risk(s) identified	Action plan 2026
Staff Resilience **[MEDIUM]**	The growing risk to staff resilience, driven by sustained resource constraints and consistently increasing workload demands over recent years, presents a significant operational concern. The combination of high-pressure working conditions and limited personnel undermines efficiency and stability, posing challenges to the sustainable management of business activities. This situation may impact the Programme Office's ability to achieve its strategic objectives and could lead to disruptions in ongoing operations.	In September 2025, the JU launched a staff survey. The results, along with the areas identified as needing improvement, will be a key priority and focus area for JU management throughout 2026. In parallel, the JU will continue to: - Organise well-being initiatives and encourage staff to participate to training opportunities for professional development and for resilience-building initiatives (e.g. stress management workshops). - Provide coaching sessions to support staff development and performance. - Ensure adequate back-up systems are in place to maintain business continuity.
Staff Turnover **[MEDIUM]**	There is a material risk to business continuity arising from the departure of key staff within a lean and time-limited organisation such as Clean Hydrogen JU. Operating with minimal redundancy, where staff frequently manage multiple roles, significantly limits the capacity of the JU to absorb the loss of experienced personnel. This situation increases the likelihood of potential operational disruption and impacts the organisation's ability to maintain continuity of activities.	The JU will implement initiative aimed at enhancing job satisfaction, motivation and overall productivity at both individual and organisational levels. The JU will continue to explore best ways to shorten time for recruitment for staff by using other JUs reserve list. Vacancy posts will be published to get a reserve list at disposal to prevent the gap between the arrival and departure of a staff member.

Risk(s) short Ranking	Risk(s) identified	Action plan 2026
Projects Execution **[HIGH]**	The JU faces the risk that programme objectives may not be fully achieved - or not achieved within the planned timeframe - due to delays in project execution. These delays are driven by several external factors, including the Russian war of aggression against Ukraine, the crisis in the Middle East, shifts in the hydrogen market, and changing priorities among national governments. At the same time, ongoing market consolidation - reflected in bankruptcies, merger, acquisitions, change in strategies - is contributing to increased disruption across the hydrogen value chain. This, combined with broader economic impacts such as rising prices, scarcity of raw materials and energy resources, is worsening the situation. In addition, complementary source of fundings (for project not fully financed) are more difficult to obtain. The cumulative impact of these factors is increasing project complexity, is delaying the duration of the project, is negatively affecting the Financial Investment Decision (FIDs) for demonstration projects as regards co-funding and is slowing the budget execution. Ultimately, this situation may hinder the programme's ability to achieve its objectives and could result in reputational risks for the JU.	The JU will conduct monthly monitoring through budget execution reports submitted to the Management Team and provide quarterly reports to the Governing Board on budget execution. The JU will closely monitor planned activities and budget with the aim to evaluate if projects under risk should continue or be terminated to avoid the use of budget for projects with little prospects to succeed. The JU will maximise the use of carry-over funds by reallocating financial resources from underperforming or completed projects. The JU will continue to analyse political, economic, technological, legal, and environmental (PESTLE) factors to better understand their impact on funded projects and modify strategic decision-making.
Membership Data **[MEDIUM]**	Risk that in-kind contribution balances are significantly misstated and some projects failing on eligibility criteria due to lack of clear identification and timely update of private members membership (of Hydrogen Europe and Hydrogen Europe Research) status within JU projects. While membership is identified at the proposal stage via manual checks, there is no systematic mechanism in place to ensure that this status is continuously monitored throughout the project lifecycle—particularly during amendments.	The JU will continue to enhance its process to ensure eligibility criteria are met throughout the lifetime of the project. The JU will continue to have an active dialogue with the private members. The JU, together with the Commission's central services, will continue to explore ways to further automate the process to ensure sufficient data accuracy.

Risk(s) short Ranking	Risk(s) identified	Action plan 2026
Synergies **[MEDIUM]**	Risk of missing and implementing opportunities for synergies with other partnerships and other EC programmes or MS/regional funds for hydrogen technologies, due to lack of strategic guidance, and consequently JU proper involvement in programming activities – particularly regarding the effective combination of funding (EU,national and regional). Even where strategic guidance exists, there remains a risk of inadequate or inconsistent implementation.	The JU will develop a specific action plan for 2026 based on the synergy strategy that should be adopted by end of 2025.
Cyber Attacks **[MEDIUM]**	The JU faces a severe risk to business continuity arising from data breaches and cyberattacks, which may lead to data loss, unavailability of critical information and prolonged service disruptions. Dependence on digital tools, remote working, and online connectivity has increased dramatically, amplifying exposure to cyber threats. such as phishing, ransomware, malware, and intrusion through weak security configurations. Unknown vulnerabilities—whether in software, network architecture, user practices, or third-party systems—pose elevated risks. They not only threaten operational continuity (by undermining system availability, integrity, and performance) but also create openings for fraudulent behaviour, regulatory noncompliance, reputational damage, and financial loss. The potential impact may include operational disruption (temporarily or long-term), data loss or corruption, service outages, regulatory, legal, and financial consequences, increased costs, reputational damage	The JU will continue to raise awareness amongst staff on cyber-attacks and raise awareness amongst staff on mechanisms to prevent attacks such as for instance, improved ex-ante and ex-post security systems controls for automated attacks. The JU will continue to carefully follow the Cybersecurity plan - from CERT EU, and ensure compliance with all the obligations of the Regulation on Cyber Security (2023/2841) - from establishing its own internal cybersecurity risk management, governance and control framework (in the context of the BOA ICT) to reporting individually to the Interinstitutional Cybersecurity Board (IICB) that oversees and monitors the implementation of the regulation across all Union entities.

The JU will report on the status of implementation of the action plans identified above in its Annual Activity Report for 2026.

It is important to note that risk assessment is an ongoing and iterative process, rather than a one-off exercise. Risks and mitigation measures are continuously monitored and reassessed in light of evolving circumstances. Changes may arise from a variety of factors, including: external events beyond the JU's control, internal developments within the JU's control (e.g. changes in strategic priorities, new operational procedures); and organisational changes, such as leadership transitions or changes in key personnel.

The JU remains vigilant to such developments and recognises that any significant change in the internal or external environment may require a new or updated risk assessment in the relevant areas. This proactive approach ensures the continued relevance and effectiveness of the risk management framework.

In 2026, the JU will investigate the use of the proposed by the Commission, CENTRICS database to manage his risk register, and track non-compliance activities.

2.2.2. Scientific priorities, challenges and expected impacts

Throughout its duration, the Clean Hydrogen JU will provide financial support mainly in the form of grants to participants following open and competitive calls for proposals. The awarded Grants are the main instrument of the Clean Hydrogen JU to implement the actions that are needed to reach the SRIA objectives.

In line with the structure of the SRIA, topics in the Call for Proposals are clustered according to Pillars (scientific priorities). Topics under a specific pillar contribute mainly to the objectives of that particular Pillar. Sometimes a topic can contribute to the objectives of several pillars.

In line with the approach of Horizon Europe, the topics in this Call for Proposals have been written following an impact driven approach and in line with the standard structure proposed under Horizon Europe. In this regard, each of the topics include a section on expected outcomes and another one on the scope.

To maximise the impacts that can be achieved by each of the topics, the 'expected outcome' section for all topics includes:

- The outcomes that are expected to be reached as a consequence of the achievements of a particular project;
- The SRIA objectives that for a specific Pillar are addressed by each of the topics. This is complemented by the inclusion of Programme KPIs[86] that each of the topics (and successful proposals) should reach.

The above structure is aligned with the monitoring strategy of the Clean Hydrogen JU. It will allow a streamlined approach to monitor how the Grants that will be supported contribute to the achievements of the Clean Hydrogen JU goals.

In 2026 the Call for proposals will contribute to the objectives of the Clean Hydrogen JU as described below - more detailed information how each of the topics contribute to achieving the objectives of each Pillar is included in the Annexes.

Hydrogen continues to be a cornerstone of Europe's strategy to achieve climate neutrality and strengthen energy independence under the REPowerEU Plan. The Clean Hydrogen Joint

[86] Detailed information on the objectives and KPIs available in the Clean Hydrogen JU Strategic Research and Innovation Agenda 2021 – 2027

Undertaking (JU) maintains its focus on enhancing the competitiveness of European hydrogen industry, by supporting innovation across the hydrogen value chain. As in former Calls, the focus remains on the reductions of costs and improvements of performances as well as on the demonstration of the concepts developed in former Calls. In 2026 , specific actions are also foreseen to support the scale-up of hydrogen technologies as well as on the development and roll-out of innovative business models.

Scientific priority – Renewable Hydrogen production

In 2026, the Call will support the **development and validation of innovative electrolysis technologies capable of operating with low-quality** or impure water sources. This approach aims at reducing the competition with freshwater resources and enable deployment in areas where water scarcity maybe be of concern. Also in this Call, support will be provided into **cost-efficient and reliable components and designs that can support gigawatt-scale hydrogen production plants**.

Safety remains a fundamental prerequisite for electrolysis systems. Therefore, dedicated efforts will be directed toward developing **improved components and tools to enhance the safety of electrolysers**, ensuring robust and reliable operation in diverse environments. In addition, activities will be funded aiming at exploring and rolling-out innovative business models that can accelerate the integration of renewable electrolysis within industrial processes, supporting economic feasibility and market uptake.

Beyond conventional electrolysis, the 2026 Call will support the development of better and more cost effective **sustainable hydrogen production technologies from organic sources** through the design of modular reactors, advanced catalysts, and intensified processes. This is expected to further untap additional; pathways for renewable hydrogen production, making use of organic feedstocks while aligning with circular economy principles. Finally, support will provided to projects developing **scalable and high-efficiency materials and reactors for direct solar hydrogen production**.

Scientific priority - Hydrogen Storage and distribution

According to the same REPowerEU ambitions published in May 2022, about 10 million tonnes of renewable hydrogen should also already be distributed throughout Europe in 2030. It is therefore essential that hydrogen becomes an intrinsic part of an integrated energy system. For this to happen, hydrogen will have to be used between daily and/or seasonal storage. In addition, an EU-wide logistical infrastructure is still to be developed (to transport hydrogen from areas with large renewable potential to demand points across Europe). Significant work is therefore still needed to have a complete set of technologies that can serve as building blocks for such EU-wide logistical infrastructure.

In 2026, the Clean Hydrogen JU will continue supporting innovation to advance hydrogen storage and distribution technologies, focusing on affordability, safety, and sustainability. One key research area will look into the **development of aboveground medium- to large-scale gaseous hydrogen storage systems**, ensuring both cost-effectiveness and operational reliability. These technologies will enable flexible storage solutions that can balance supply and demand, a critical step toward achieving a resilient hydrogen network.

Another priority will be the d**evelopment and demonstration of in-line inspection tools to monitor cracks and material degradation in pipelines for operation with hydrogen in new and re-purposed offshore natural gas pipelines** .

Furthermore, the Call will support the development of **new thermal insulation concepts for bulk liquid hydrogen shipping**. Research on **small-scale liquefaction technologies** will also be pursued to enable decentralised hydrogen logistics and reduce distribution costs.

Finally, in 2026, activities to support pre-normative research (PNR) on hydrogen quality maybe implemented via a Call for Tenders, to complement existing studies undertaken by the European Commission.

Scientific priority - Hydrogen end uses - transport

Decarbonising the transport sector remains one of the EU's most pressing challenges in achieving net-zero emissions. Hydrogen technologies, particularly via fuel cells, are central to reducing emissions from hard-to-electrify transport segments such as aviation, maritime, and heavy-duty mobility.

In 2026, the Clean Hydrogen JU will continue supporting research and innovation that enhances the durability, reliability, and performance of hydrogen fuel cell systems for transport applications. Key activities will include research looking at the **integration of advanced of control and monitoring tools and strategies for improved fuel cell system durability and reliability**

In synergies with the Clean Aviation JU, the Clean Hydrogen JU will also support the **development and testing for an onboard liquid Hydrogen supply and conditioning system in high-power fuel cell aviation application**.

Further support will be directed toward the **development and demonstration of flexible and standardised hydrogen storage systems** that can be deployed across multiple vehicle platforms. Such systems are expected to simplify hydrogen logistics and reduce costs through modularity and standardisation. Finally, the support will be provided to the **design and demonstration of multi-fuel solid oxide fuel cell powertrains for maritime transport**.

Scientific priority - Hydrogen end uses - clean heat and power

In 2026, the Clean Hydrogen Joint Undertaking will continue to support the transition to cleaner and more flexible energy systems by supporting the development and demonstration of hydrogen based clean heat and power systems.

In particular, support will be provide to development of **generation of reversible proton conducting ceramic cells and stacks for efficient energy applications** Furthermore, the JU will support the **demonstration of megawatt scale reversible solid oxide cell based systems connected to local electricity and gas grids**. Moreover, research will be conducted on **fuel-flexible gas turbine combustion technologies capable of clean and efficient ammonia firing**, facilitating the direct use of hydrogen carriers in power generation while maintaining low emissions and high efficiency.

Scientific priority - Cross-Cutting activities

The Clean Hydrogen Joint Undertaking continues supporting several cross-cutting initiatives designed to enhance sustainability, safety, and education and training across the hydrogen Value Chain.

In 2026, special emphasis will be placed on **creating and maintaining public datasets of hydrogen technologies for life-cycle and sustainability assessments**. These datasets will enable transparent evaluation of environmental performance and support evidence-based policymaking, fostering trust and informed decision-making among stakeholders.

Another priority in 2026, will be **pre-normative research on hydrogen odorization**. By identifying safe and effective odorants, this research will help ensure that hydrogen leaks can be reliably detected in various environments, what constitutes an essential aspect of safety.

Scientific priority - Hydrogen Valleys

Building on the extensive support that the Clean Hydrogen JU has provided over the recent years, in support of the REPowerEU Plan objectives, in the Call 2026, the JU will continue supporting several flagship[87] **Hydrogen Valleys**.

From Innovation to Market

It is worth to mention that among the activities in 2026, the Clean Hydrogen JU is planning to launch a tender to set-up and run a **European Clean Hydrogen Start-Up Hub**. This is aiming at accelerating and accompanying the "translation" of research into investable start-ups. Such initiative intends to build the basis for scaling startups by connecting investment to hydrogen innovation with corporates as key enablers. It also aims at building and consolidating European Hydrogen Innovation Corridors.

[87] For definition of flagship see section 5.3 of SRIA

Table 2 Correspondence of topics into the different scientific priorities

Topic identifier		Topic Title	Type
Renewable Hydrogen	HORIZON-JU-CLEANH2-2026-01-01	Development and validation of innovative approaches, catalysts, electrolytes and components for electrolysis technologies based on low-quality water	RIA
	HORIZON-JU-CLEANH2-2026-01-02	Cost-efficient and reliable designs towards gigawatt-scale electrolytic hydrogen production plants	RIA
	HORIZON-JU-CLEANH2-2026-01-03	Improved components and tools to increase the safety of electrolysers	RIA
	HORIZON-JU-CLEANH2-2026-01-04	Innovative business models advancing renewable electrolysis integration in industry	CSA
	HORIZON-JU-CLEANH2-2026-01-05	Sustainable hydrogen production from renewable gases and biogenic waste sources through innovative modular reactor design, process intensification and integration	RIA
	HORIZON-JU-CLEANH2-2026-01-06	Scalable and high efficiency materials and reactors for direct solar hydrogen production	RIA
Hydrogen storage and distribution	HORIZON-JU-CLEANH2-2026-02-01	Affordable, Safe and Sustainable aboveground medium to large GH2 storage	RIA
	HORIZON-JU-CLEANH2-2026-02-02	Demonstrating in-line inspection (ILI) to monitor cracks assuring compatibility for operation with hydrogen in new and re-purposed offshore natural gas pipelines	RIA
	HORIZON-JU-CLEANH2-2026-02-03	New thermal insulation concepts for bulk liquid hydrogen shipping	RIA
	HORIZON-JU-CLEANH2-2026-02-04	Cost-efficient small scale hydrogen liquefaction	RIA
End uses: transport applications	HORIZON-JU-CLEANH2-2026-03-01	Integration of control & monitoring tools and strategies for improved Fuel Cell System durability & reliability	RIA
	HORIZON-JU-CLEANH2-2026-03-02	Components Development and Experimental Testing for an Onboard Liquid Hydrogen Supply and Conditioning System in High-Power Fuel Cell Aviation Applications	RIA
	HORIZON-JU-CLEANH2-2026-03-03	Flexible and standardised hydrogen storage system	IA
	HORIZON-JU-CLEANH2-2026-03-04	Multi-fuel SOFC powertrain for maritime transport	RIA
End uses: heat & power	HORIZON-JU-CLEANH2-2026-04-01	Next generation of reversible proton conducting ceramic cells and stacks for efficient energy applications at ≥1 kW scale	RIA
	HORIZON-JU-CLEANH2-2026-04-02	Demonstration of rSOC operation for local grid-connected hydrogen production and utilisation	IA

Topic identifier		Topic Title	Type
	HORIZON-JU-CLEANH2-2026-04-03	Fuel-flexible gas turbine combustion technology for clean and efficient ammonia firing	RIA
Cross-cutting Issues	HORIZON-JU-CLEANH2-2026-05-01	Public datasets of technologies along the hydrogen value chain for life cycle (sustainability) assessment	CSA
	HORIZON-JU-CLEANH2-2026-05-02	Pre-Normative Research on hydrogen odorisation: enhancing safety and detection along the hydrogen value chain	RIA
Hydrogen Valleys	HORIZON-JU-CLEANH2-2026-06-01	Large-scale Hydrogen Valleys	IA
	HORIZON-JU-CLEANH2-2026-06-02	Small-scale Hydrogen Valleys	IA

2.2.3. Call for Proposals

2.2.3.1. Overview of the Call

The AWP 2026 includes one Call for Proposals as follows:

Call Identifier	Budget (EUR million)	Publication[88]	Deadline
HORIZON-JU-CLEANH2-2026	105.00	20 January 2026	15 April 2026

The Call for Proposals has an indicative total budget of EUR 105.00 million.

Topic descriptions are detailed starting from the next page.

The general call conditions are detailed in section 2.2.3.2.

Common elements applicable to all topics have also been included in section 2.2.3.2 (some of which, when relevant, are also reflected in the topic scope).

In addition, specific conditions have been included in the description of each topic.

[88] The Executive Director may decide to open the call up to one month prior to or after the envisaged date of publication.

RENEWABLE HYDROGEN PRODUCTION

HORIZON-JU-CLEANH2-2026-01-01: Development and validation of innovative approaches, catalysts, electrolytes and components for electrolysis technologies based on low-quality water

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 3.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 3.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 2 and achieve TRL 4 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[89].

<u>*Expected Outcome*</u>

The European Union has a set of policies aimed at preventing water scarcity, putting a special emphasis on reusing treated water. This approach is recognised in Regulation (EU) 2020/741[90], which promotes reclaimed water as an alternative source to reduce the pressure on conventional resources. In addition, the newly adopted Wastewater Directive (EU) 2024/3019[91] raises the bar for effluent quality and treatment efficiency and introduces the requirement for quaternary treatment[92] in large wastewater treatment plants (WWTPs) by 2045. As higher standards for reclaimed water are required by law and the need for energy-efficient technologies and renewable energy integrations increases, the water sector appears as an ideal partner to develop innovative solutions that valorise regenerated water, while increasing the efficiency and sustainability of wastewater systems.

Hydrogen production by water electrolysis can handle both objectives. This technology can evolve to utilise lower-quality water streams and/or take advantage of the relatively high-quality effluents resulting from water treatments. This positions water electrolysis as a strategic production pathway in a scalable and sustainable hydrogen value chain based on diverse water sources. Utilising reclaimed water in electrolysis processes not only reduces freshwater demand but also promotes circularity. However, an important effort is still needed to implement robust water electrolysis technologies that can handle the complexity of different water qualities even in the best scenarios. Therefore, a comprehensive understanding of how the

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[89] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

[90] Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for water reuse.

[91] Directive (EU) 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment.

[92] Quaternary treatment is the fourth stage in wastewater treatment, which specifically targets micropollutants that are often not fully removed by conventional treatment methods.

low-grade water impurities interact with water electrolysis technologies, and to which grade lower requirements treatments could be sufficient in each application, is still missing.

Project results are expected to contribute to the following expected outcomes:

- Contributing to keeping European leadership for hydrogen production including innovative embedded approaches for electrolysis of low-quality water feed taking advantage of the relatively high-quality effluents resulting from advanced wastewater treatment processes (*viz*. tertiary/quaternary treatments);
- Development of impurity-tolerant and durable electrocatalysts, membranes and components, supporting EU strategy towards minimising the use of CRM and/or PFAS, making it circular by design;
- Identifying pre-treatment process steps to minimise organic fouling and scaling at the electrolysis unit;
- Understanding electrolysis cell performance, degradation and failure mechanisms during operation with low-quality water feed while minimising pre-treatment steps;
- Contribute to the EU harmonisation protocols for water electrolysis developing procedures for low-quality water feed.

Project results are expected to contribute to the overall objectives and KPIs of the Clean Hydrogen JU SRIA, notably to increase current density & efficiency, reduce costs, and to decrease degradation & use of CRMs. As low-quality water electrolysis is considered, for which no KPIs are available in the SRIA, specific KPIs, to be met simultaneously, are defined below, that can be accessible to any water or steam electrolysis technologies:

- Electricity consumption @ nominal capacity (kWh/kg H_2):
    - LT water electrolysis: ≤ 55
    - HT water electrolysis: ≤ 39 (Heat demand @ nominal capacity: ≤ 10 kWh/kg H_2)
- Current density (A/cm^2): ≥ 1.0
- Degradation at nominal load (%/1000 h): ≤ 1
- CRM as catalyst (mg/W): PGM ≤ 0.25
- Hydrogen purity should be at least > 99.9%

Proposals are encouraged to propose additional KPIs to quantify the achievement of the innovative approach.

<u>*Scope*</u>

Proposals should aim to realise a breakthrough water electrolysis technology that can produce hydrogen from low-quality water, i.e. beyond tap water[93] and from various sources (excluding saline and seawater) operating at low energy consumption levels. The project should demonstrate a stable electrolyser cell unit incorporating innovative solutions at the material, component, cell architecture level, and alternative half-cell reactions to overcome the challenges in the electrolysis of low-quality water. In line with EU sustainability and CRM strategies and the Clean Hydrogen JU SRIA KPIs for the selected water electrolysis technology, the prototype cell should also minimise the use of PFAS and/or CRM. The target

[93] Tsotridis, G. and Pilenga, A., EU harmonized protocols for testing of low temperature water electrolysis, Publications Office, 2021, https://data.europa.eu/doi/10.2760/58880

is to validate the innovative technology at TRL 4, assessing its potential for circularity, sustainability, and economic viability.

The innovative electrolyte chemistry technology should overcome the limitations of low-quality water electrolysis addressing, amongst others, the stabilisation of pH, suspended solids, inorganic, organic and biological contaminants, material corrosion, low activity, selectivity, and durability of electrocatalysts. Special attention needs to be paid to in-depth experimental, computational, and theoretical insights into the mechanistic pathways of the degradation processes by understanding the impact of water impurities on performance and durability and the potential mitigation strategies. The project should propose innovative approaches, electrodes structures and compositions, membrane/ionomer when needed, and electrochemical reactor cells to reach effective high-performing and contaminant-resistant low-quality water electrolysis materials.

The proposal should consider the following elements:

- Determine the Critical Maximum Concentration (CMC) of the identified water impurities (i.e. inorganic, biological, organic) that will allow the electrolyser cell to operate efficiently while ensuring durability and performance;
- Identify deactivation and degradation mechanisms due to contaminants;
- Investigate the role of low-grade water impurities in the degradation processes of catalysts, membranes and components considering as basis those impurities generated from the self-degradation of stack/BoP materials;
- Develop and validate suitable materials (catalysts, membranes/electrolytes, coatings) and their tolerance threshold to impurities;
- Perform experimental and modelling studies to evaluate and define optimal operating conditions to maximise hydrogen yield while minimising material degradation and system inefficiencies;
- Implement and validate innovative monitoring techniques for establishing recovery, mitigation and maintenance strategies to remove/minimise the impact of impurities over the electrolysis cell lifetime;
- Validate the KPIs of the novel water electrolysis solutions at a relevant scale (>2kW) for at least 2000 hours at relevant operating conditions associated with the selected scenario and the chosen low-quality water;
- Identify application cases (case of study) by selecting potential wastewater sources such as treated industrial and urban wastewater for hydrogen production in circular economy streams;
- Considering sector-coupling (i.e. integration of wastewater treatment with hydrogen production systems), compare and contrast the metrics (economic, social, environmental and circularity analysis) of the proposed low-quality water electrolysis technology against the conventional established water electrolysis technologies considering the operational, maintenance, and energy costs associated with water treatment and electrolysis;
- Evaluate lifecycle, circularity and techno-economic feasibility of the innovative technology, including integration of water conditioning units in comparison with conventional ultra-pure water electrolysis technologies.

Consortia are expected to build further on the findings of previous projects funded by the

European Innovation Council (EIC) Pathfinder Challenge 2021 (e.g. ANEMEL[94]) and explore synergies with relevant ongoing JU projects on direct seawater electrolysis (Sea4Volt[95], HySEas[96], SWEETHY[97] and ASTERISK[98]).

For activities developing test protocols and procedures for the performance and durability assessment of water electrolysers fed with low-quality water proposals should foresee a collaboration mechanism with JRC[99] (see section 2.2.4.3 "Collaboration with JRC"), in order to support EU-wide harmonisation. Test activities should adopt the already published EU harmonised testing protocols106[100] to benchmark performance and quantify progress at programme level.

For additional elements applicable to all topics please refer to section 2.2.3.2

HORIZON-JU-CLEANH2-2026-01-02: Cost-efficient and reliable designs towards gigawatt-scale electrolytic hydrogen production plants

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 2.50 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 2.50 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	N/A
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[101].

<u>*Expected Outcome*</u>

As Europe strives towards its objective of climate neutrality, renewable hydrogen at industrial scale is pivotal for decarbonising energy-intensive sectors. Large-scale water electrolysis is central to this transition, yet Europe faces significant challenges in building gigawatt-scale hydrogen production plants that are reliable enough to ensure consistent operation and financially sustainable to attract unsubsidised investment. Current projects struggle with costly and fragmented system integration, limited scalability from electrolyser providers and unoptimised Balance-of-Plant (BoP) systems, resulting in high electrolytic hydrogen costs. In

[94] https://cordis.europa.eu/project/id/101071111
[95] https://cordis.europa.eu/project/id/101192235
[96] https://cordis.europa.eu/project/id/101192418
[97] https://cordis.europa.eu/project/id/101192342
[98] https://cordis.europa.eu/project/id/101192454
[99] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0_en
[100] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0/clean-hydrogen-ju-jrc-deliverables_en
[101] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

particular:

- Expectations on CAPEX reduction have not been met, recent reports from BNEF[102], IEA[103] and TNO[104] indicate actual hydrogen plant cost of 2160-3050 $/kW, far from SRIA objectives.
- The way to develop large scale projects (>400MW) or a small scale 20 MW projects is very similar and based on the same identical electrolyser bricks thus limiting economies of scale.
- Restricted freedom to adapt or optimise OEM designs depending on the project.
- If the standardised approach has been chosen on most of small-scale projects, there is no or few alternatives available for large scale projects.
- What is optimum for OEMs limit of scope is not always the optimum at the hydrogen plant level.

Aside from these hurdles, the BoP of a hydrogen plant can be built with components (pumps, exchangers, separators, piping, instruments, compression, purification, storage etc.) that already have a high level of maturity inherited from similar industries (oil & gas, water, etc.), apart from stacks for which iterative improvements are still expected.

Thus, it is possible to overcome some of the current limitations by relying on mature components while exploring innovative new plant architectures (electrical, process), new construction philosophies, new integrations between parts of the plant, etc., pushing the mature components to their current capacity limits.

The main challenge is to achieve a unified vision of different stakeholders (OEM, integrator, EPC contractors, operators, developers, etc.) in the design of a hydrogen plant, with a common objective of making it as cost-effective and reliable as possible. Moving away from the pre-existing model to create a new one is challenging even if based on mature components as it requires opening/exploring/closing multiple ways in parallel by engaging all stakeholders in the discussion.

By building robust and efficient system designs, the projects outcomes should identify best fit evolutions to expect in future steps for components becoming bottlenecks to improve and optimise factories, and by such paving the way to future works at European level.

The results are expected to position Europe as a global leader in designing and implementing gigawatt-scale hydrogen plants, stimulate industrial investment, and foster a sustainable hydrogen economy through innovation, integration, and cost-efficiency.

Project results are expected to contribute to the following expected outcomes:

- Acceleration of investment decisions for commercial hydrogen facilities at 400 MW scale and beyond, supported by validated FEED-level designs and Class 3 cost estimates.
- Reduced Levelised Cost of Hydrogen (LCOH) through optimised plant integration, economies of scale, and valorisation of by-products such as heat, oxygen, and grid services.
- Enhanced energy system flexibility, supporting grid balancing and sector coupling

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102 https://www.hydrogeninsight.com/electrolysers/cost-of-electrolysers-for-green-hydrogen-production-is-rising-instead-of-falling-bnef/2-1-1607220
103 https://www.iea.org/reports/global-hydrogen-review-2024
104 https://www.tweedekamer.nl/downloads/document?id=2024D22079

through integration with renewable power sources and industrial processes.

- Improved environmental performance, reducing lifecycle greenhouse gas emissions, water consumption, and overall energy intensity of hydrogen production.
- Increased investor and policy confidence through evidence-based technical, economic, and regulatory feasibility aligned with EU sustainability and certification criteria.
- Strengthened European industrial leadership in renewable hydrogen technologies, supporting a competitive and resilient supply chain for gigawatt-scale deployment.

Project results are expected to contribute to the following objectives at the full plant scope:

- Reduction in CAPEX and OPEX per installed MW;
- Reduction in water and energy consumption per kg of hydrogen produced;
- Increased system availability, maintainability, safety and reliability;
- Reduction in LCOH (€/kg H_2) compared to existing large-scale systems;
- Reduction in physical and environmental footprint;

More specifically for the electrolysis part of the plant, the project results should contribute to the relevant KPIs of the SRIA[105], with an objective to reach 2030 targets in priority. As an example for alkaline technology : Electrical Consumption at 48kWh/kg, CAPEX at 400 €/kW, O&M cost at 35 €/kg/day/year, Turn-Down Ratio (Cold start 300s).

Scope

This topic aims to drive innovation in integrated hydrogen production plants by reimagining plant design, architecture, and deployment models. The focus should be on developing novel concepts for highly efficient, cost-competitive, and reliable electrolytic hydrogen production plants at very large scales (≥400 MW), leveraging commercially available electrolyser stacks, advanced system engineering, and innovative BoP and plant components (e.g., purification, compression, thermal integration, power electronics). As relevant, the design specifications and components innovation roadmaps (e.g to optimise performances and durability when operating dynamically or improve end of life recycling), is also encouraged.

Proposals should deliver a complete fully replicable plant concept: a hydrogen production facility capable of delivering renewable hydrogen ex-works (without transport) at highest consumption quality, using available resources (e.g. water and electricity) and complying with EU regulations (notably RFNBO criteria).

The project should cover the following elements:

- Consider a full system integration of a large-scale (≥400 MW) electrolysis capacity and all necessary BoP subsystems (water treatment, cooling, purification, power electronics, compression, storage, etc) and demonstrate scalability to 1000 MW and beyond with strong replicability potential. When relevant, the project may rely on innovative/breakthrough components developed in previous EU-funded projects on full scope plants and BoPs (e.g. on-going in 2025 DJEWELS[106], ENDURE[107], EPHYRA[108],

[105] https://www.clean-hydrogen.europa.eu/knowledge-management/strategy-map-and-key-performance-indicators/clean-hydrogen-ju-sria-key-performance-indicators-kpis
[106] https://cordis.europa.eu/project/id/826089
[107] https://cordis.europa.eu/project/id/101137925
[108] https://cordis.europa.eu/project/id/101112220

HERAQCLES[109], HOPE[110], HERMES[111], REMEDHYS[112]);

- Technical and economic optimisation across all parameters affecting hydrogen cost: availability, energy efficiency, DEVEX, CAPEX, OPEX, footprint, water consumption, etc;
- The plant design should valorise as far as possible the by-products from the electrolysis plant (e.g. waste heat, oxygen, water, grid services);
- Scenarios exploring infrastructures and layouts, process simplification, and innovative solutions for cost and footprint optimisation (e.g. pooling, massification, standardisation, …) based on mature solutions. Concrete recommendations are expected to be delivered by the analysis of the scenarios;
- A Reliability, Availability, Maintainability (RAM) analysis or equivalent to quantify system availability, ensuring the plant's operational reliability. This includes innovations around operations & maintenance solutions particularly to cope with specific challenges of GW-scale plants constraints;
- Investment-grade engineering documentation, including CAPEX Class 3 estimates (AACEI 18R-97) and Front-End Engineering Design (FEED)-level studies, ensuring technical and financial readiness for industrial deployment;
- An energy efficiency and water consumption estimation based on exhaustive analysis (full plant power balance), feedback data from the field and/or supplier guarantees for the major electricity and water consumers of the plant;
- An OPEX estimate based on an explicit methodology, and with verifiable data;
- Modelling, simulation and optimisation tools (development and/or use) to quantify availabilities via RAM studies, achieve techno-economic sensitivity analyses, OPEX and efficiency of the elaborated designs. (FEED-Ready outputs).

Proposals should include RAM analysis, CAPEX Class 3 estimates with FEED-level documentation, and clear OPEX, energy, and water consumption assessments. Designs development will be supported by advanced modelling and optimisation tools to enable robust techno-economic analyses and guide system optimisation. Innovation will focus on system-level integration using existing, proven electrolyser stacks. Proposals should also validate the proposed approach through a representative project case study, demonstrating practical feasibility and scalability. The designed system will target a minimum capacity of 400 MW, with a clear pathway to scale up to 1 GW and beyond.

The following elements are out of scope:

- Activities related to hydrogen pipeline connection or end-use tie-ins;
- Development of new electrolysis cell technologies or fundamental components.

Consortia should include various stakeholders of the hydrogen value chain including, but not limited to, components manufacturers, system manufacturers (at least 2), system integrators, project developers, plant operators, end users, etc. Consortia will gather all technical & economic expertise needed not only for the implementation of the project but also will associate related sectorial clusters and associations helping to ensure the replicability of the

[109] https://cordis.europa.eu/project/id/101111784
[110] https://cordis.europa.eu/project/id/101111899
[111] https://cordis.europa.eu/project/id/101192352
[112] https://cordis.europa.eu/project/id/101192503

project outcomes. To support the replicability of the projects outcomes, project outputs e.g. deliverables, models, etc. are expected to be mainly publicly available.

Projects should build on previous, and find synergies with projects supported under this year Call such as but not only HORIZON-JU-CLEANH2-2026-01-04 'Innovative business models advancing renewable electrolysis integration in industry' and projects supported by the Process4Planet Partnership and Clean Steel Partnership as well as those projects, activities and initiatives supported by and placed under the Innovation Fund.

For additional elements applicable to all topics please refer to section 2.2.3.2

HORIZON-JU-CLEANH2-2026-01-03: Improved components and tools to increase the safety of electrolysers

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 3.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 3.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 3 and achieve TRL 5 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[113]. Beneficiaries must, up to 4 years after the end of the action, inform the granting authority if the results could reasonably be expected to contribute to European or international standards.

<u>*Expected Outcome*</u>

Hydrogen production via water electrolysis is a cornerstone technology for achieving Europe's climate neutrality goals and supporting the decarbonisation of industry, transport, and the energy sector. As the deployment of electrolyser systems scales up, so do concerns around their safety, durability, and long-term operational reliability. In particular, incidents related to hydrogen and oxygen mixing within cells, stacks and tanks – caused by membrane degradation, structural failures, or inadequate monitoring – pose risks not only to the systems themselves but also to their regulatory acceptance and public perception. These challenges are exacerbated during critical operating phases, such as system start-up, shutdown, and dynamic load transitions driven by fluctuating renewable electricity inputs.

This topic addresses these challenges by focusing on the development and validation of improved components and integrated tools to enhance the safety of low-temperature water

[113] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

electrolysers. Proposals on this topic should cover conventional low temperature electrolyser as well as emerging architectures. It should be open to diverse approaches, provided they address the core issue of increasing system safety while maintaining or improving electrochemical performance and enabling scalable, regulation-ready designs. To address these challenges holistically, proposals should also cover structural and mechanical aspects, including numerical modelling of degradation and failure mechanisms *(e.g.* finite element (FE) modelling), and provide design recommendations for electrolyser components to enhance operational integrity and intrinsic safety.

Project results are expected to contribute to enhancing the safety, reliability, and regulatory readiness of electrolysers by addressing critical degradation mechanisms and system design flaws that may lead to H_2/O_2 mixing and other hazardous failures.

The projects are expected to contribute to the following outcomes:

- Contribute to the safe operation of large-scale low-temperature electrolyser systems through innovative system designs and control strategies;
- Reduce gas crossover rates during dynamic operation mode compared to the current state-of-the-art, thereby enhancing intrinsic system safety, operational reliability, and mitigating critical safety risks;
- Deploy advanced, real-time detection systems for early identification of membrane or electrode degradation, enabling timely and preventive safety interventions;
- Increase electrolyser lifetime through predictive maintenance enabled by validated degradation models and integrated monitoring tools;
- Improve cell and stack designs to achieve superior gas separation performance, while minimising or eliminating the use of per- and polyfluoroalkyl substances (PFAS) membranes and promoting low-permeability alternatives;
- Incorporate Quantitative Risk Analysis (QRA) models for key failure scenarios.
- Support EU-wide safety standards by contributing to pre-normative research and the development of harmonised testing protocols for electrolyser operation and certification.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA:

- Reducing electrolyser CAPEX and OPEX and thus the cost per kg H_2, especially by reducing the amount of Critical Raw Materials (CRM) used;
- Zero use of PFAS in ion exchange membranes and ionomers, by implementing hydrocarbon-based or composite membranes with verified chemical/mechanical stability;
- Increasing the availability of electrolysers reducing safety shutdowns due to leaks and component failures;
- Proof of the technology with long test(s) (3,000 h) under different operative regimes (*i.e.*, RES typical profiles);
- Business model for the scale-up and industrialisation;
- Contribution to at least one new or updated EU safety standard or testing protocol

Project results should contribute to the achievement of the KPIs for increased operation availability and safety of electrolysers:

- Gas crossover incidence rate reduced by ≥ 50% compared to current state-of-the-art (PEMEL: 0.01–0.05%); (AEMEL: 0.05–0.1%) (AEL: 0.1–0.5%) and (< 0.1% in emerging architectures)
- <2 failures per 3,000 operating hours per stack;
- Operational availability increased to >95% due to predictive safety controls and to reduced leak frequencies;
- Stack degradation <0.06% per 1,000 hours under nominal operation;
- Current densities of AEL:1 A/cm^2 ; PEMEL: 3.0 A/cm^2; AEMEL: 1.5 A/cm^2;
- Prioritise materials that avoid PFAS and minimise the use of PGMs, in alignment with EU sustainability and Critical Raw Materials (CRM) strategies and the SRIA KPIs for the selected technology — targeting 0 mg W^{-1} of CRM in AEL, Ir: 0 mg W^{-1} and Pt: 0.12 mg W^{-1} in AEMEL, and Ir: 0.09 mg W^{-1} and Pt: 0.06 mg W^{-1} in PEMEL.
- Reduce electricity consumption at nominal capacity addressing the relevant SRIA 2030 KPIs of 48 kWh/kg for each electrolyser technology;
- Development of harmonised safety diagnostics and models integrated into a TRL 5 prototype.

<u>*Scope*</u>

The focus of this topic is on advancing and validating novel components and control solutions aimed at improving the operational safety of low-temperature electrolyser systems. This topic is open to a broad range of low-temperature electrolysis technologies, including conventional configurations such as Alkaline Electrolysers (AEL), Proton Exchange Membrane Electrolysers (PEMEL), and Anion Exchange Membrane Electrolysers (AEMEL), as well as emerging designs such as membrane-less electrolysers and decoupled electrolyser systems.

Proposals are expected to develop and integrate innovative materials, cell, and stack and balance-of-plant configurations, including connections, intelligent monitoring/control tools that can detect, and reduce or eliminate the risk of hazardous gas crossover, and inherently safer solutions that prevent hydrogen leaks and build-up of critical concentrations in the module. This includes but is not limited to: next-generation membrane materials with reduced gas crossover, hydrogen permeability, and improved mechanical integrity; novel electrode structures that enhance gas separation; architectures that reduce the potential leak points and physically or operationally decoupled hydrogen and oxygen evolution; novel stack and balance-of plant components integrating efficient H-O recombination catalysts. Novel and advanced optical and spectroscopic techniques for real-time, *on-line* monitoring of hydrogen purity can be proposed as an integral part of the system's monitoring and control architecture. These tools can significantly reduce the risk of *in-situ* cell breakdown while simultaneously supporting an increased number of safe start-up/ shutdown cycles. In parallel, failed components should undergo advanced experimental analysis to identify underlying damage mechanisms and material degradation states. These insights will feed into a dedicated numerical tool—coupling finite element modelling, degradation kinetics, and operational data—to simulate, predict, and optimise component performance under varying conditions. This model should support both real-time decision-making and early-stage design improvements to enhance durability and intrinsic safety. Complementary sensing technologies—such as electrochemical and thermal conductivity sensors—may also be integrated to ensure data redundancy and robust fault validation. Sensor data streams should feed into AI/ML-based models for early anomaly detection, predictive maintenance, and optimised system response strategies.

In parallel with materials, components and hardware development, the topic also encourages the advancement of smart sensing and control solutions to ensure safe operation in real-time. These may include AI- or machine learning-based systems, ideally embedded within a digital twin framework that integrates real-time sensor data with numerical models. Such models can simulate and predict system behaviour under varying conditions, enabling early detection of faults such as membrane failure, electrode delamination, or abnormal thermal and pressure events. Spectroscopy-based diagnostics may further enhance this architecture by providing high-resolution insights into critical degradation processes. Long-term degradation modelling should be combined with embedded diagnostics to support predictive maintenance, reduce unplanned downtime, and extend operational lifetimes. Emphasis should be placed on the performance of these tools under challenging dynamic conditions—including intermittent renewable energy supply—to replicate real-world operating environments (TRL5).

Proposal should validate the proposed solutions. Testing should be carried out at the component, cell, and stack level under relevant conditions (*e.g.* pressure, temperature, power cycling), with clear metrics for safety, performance, durability, and regulatory compliance. The safety improvements provided by the proposed solutions should be evaluated for their beneficial effects on risk management procedures. Targeted prototype scale and cell size should be appropriate for the considered technology and future scale-up.

The proposal should demonstrate at the end of the project the construction and validation on a stack with the following requirements:

- PEMEL: minimum 100 kWel designed to operate at >100 bars of output pressure. The stack should exhibit a minimum operation performance of current densities > 3.0 A/cm² at <1.9 V.
- AEMEL: minimum 50 kWel designed to operate at >50 bars of output pressure. The stack should exhibit a minimum operation performance of current densities > 1.5 A/cm² at <1.85 V.
- AEL: minimum 100 kWel designed to operate at >30 bars of output pressure. The stack should exhibit a minimum operation performance of current densities > 1 A/cm² at <2 V.
- Other emerging low temperature electrolysers: minimum 5 kWel designed to operate at >30 bars of output pressure. The stack should exhibit a minimum operation performance of current densities > 1 A/cm².

Stacks should be validated for performance and safety for a minimum of 1000 h under diverse operating regimes (steady-state, dynamic load-following, frequent start/stop cycles, and off-normal transients), with results reported under harmonised EU protocols (see below).

Additional KPIs may be proposed, in particular for non-conventional architectures (*e.g.*, decoupled designs), provided that key safety and performance KPIs are fulfilled. Wherever possible, testing should adopt or contribute to harmonised EU protocols and pre-normative research efforts. Proposals are encouraged to liaise with standardisation bodies (*e.g.*, CEN, CENELEC, ISO) and relevant regulatory stakeholders to ensure compatibility with emerging safety frameworks and certification pathways. This alignment is critical for ensuring that innovations move beyond the laboratory and into safe, deployable commercial systems.

Projects are also expected to contribute to the definition or refinement of safety-relevant KPIs, beyond traditional efficiency and cost metrics. These may include indicators such as crossover detection sensitivity, response time of safety shut-off systems, operational uptime due to preventive maintenance, leak probabilities, or compliance with forthcoming regulatory thresholds on gas purity and leakage. KPIs should be integrated in a comprehensive safety-by-design evaluation of the proposed solutions both at component and at system level. Where possible, KPIs should align with EU safety standards and be backed by sensor-based data to support reliable validation and comparison across systems.

To address the full complexity of the safety challenge, proposals should adopt a multidisciplinary approach and involve actors across the electrolyser value chain. This may include component manufacturers (membranes, electrodes, sensors), electrolyser OEMs, digital technology providers (AI, modelling, control systems), testing laboratories, and certification or regulatory entities.

Applicants should clearly articulate the added value and innovation of their proposed approach relative to the state-of-the-art . Projects should also reference, complement and build on existing European initiatives (*e.g.* European Hydrogen Safety Panel) and projects (e.g., REFHYNE[114], HYScale[115], DELYCIOUS[116], INSIDE[117], , PEACE[118], HYPRAEL[119], ADVANCEPEM[120] and projects funded under Topic HORIZON-JTI-CLEANH2-2023-01-01[121]), and demonstrate how they build upon and complement the results of ongoing JU projects[122]. Duplication of effort should be avoided, and synergies with parallel EU or national initiatives should be identified. In particular, while predictive maintenance tools have previously been explored with a focus on performance and lifetime, their integration here plays a critical role in enabling the early detection of safety-relevant failures, thereby reinforcing the complementarity between the two project scopes.

For activities developing test protocols and procedures for the performance and durability assessment of electrolysers proposals should foresee a collaboration mechanism with JRC[123] (see section 2.2.4.3 "Collaboration with JRC"), in order to support EU-wide harmonisation. Test activities should adopt the already published EU harmonised testing protocols[124] to benchmark performance and quantify progress at programme level.

For additional elements applicable to all topics please refer to section 2.2.3.2

[114] https://cordis.europa.eu/project/id/779579
[115] https://cordis.europa.eu/project/id/101112055
[116] https://cordis.europa.eu/project/id/101192075
[117] https://cordis.europa.eu/project/id/621237
[118] https://cordis.europa.eu/project/id/101101343
[119] https://cordis.europa.eu/project/id/101101452
[120] https://cordis.europa.eu/project/id/101101318
[121] HORIZON-JTI-CLEANH2-2023-01-01: Innovative electrolysis cells for hydrogen production
[122]https://www.clean-hydrogen.europa.eu/projects-dashboard/projects-repository_en
[123] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0_en
[124] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0/clean-hydrogen-ju-jrc-deliverables_en

HORIZON-JU-CLEANH2-2026-01-04: Innovative business models advancing renewable electrolysis integration in industry

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 1.50 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 1.50 million.
Type of Action	Coordination and Support Action
Technology Readiness Level	N/A
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[125].

Expected Outcome

Renewable hydrogen is pivotal for decarbonising energy-intensive and hard-to-abate industrial sectors, such as steel (via combustion or direct reduction), chemicals, ammonia, methanol, and petrochemicals. Challenges related to cost competitiveness should be tackled in earnest. By 2030, these efforts should aim to establish renewable hydrogen as a commercially viable feedstock, reducing agent, energy vector whilst simultaneously enhancing its sustainability (including the potential circularity of hydrogen production technologies), thus positioning Europe as a leader in industrial decarbonisation.

However, recent delays and cancellations have shown that, while technical progress is ongoing, economic, contractual and financial bottlenecks hinder projects from reaching Final Investment Decision (FID). At the same time, innovative business models – including new ownership models, licensing/service-based approaches and variable revenue schemes – are needed to unlock private capital and ensure long-term competitiveness. These should be complemented by appropriate financing and contractual architecture, with the aim of fostering the success of projects under development, raising awareness among public decision makers, and validating strategies through large-scale industrial integration cases.

This topic aims to design and validate innovative business models for industrial renewable hydrogen integration, and to check their bankability through simplified financial, contractual and policy analysis in cooperation with relevant stakeholders.

By addressing these challenges, the CSA will contribute to the objectives of the Clean Industrial Deal, supporting Europe's industrial base in decarbonising competitively, attracting private investment, and strengthening resilience across value chains.

Projects are expected to contribute to all the following outcomes:

- Accelerated financial maturity of Hydrogen integration in industry through innovative

[125] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

business model solutions for industrial hydrogen integration, including diversified revenue streams, new ownership/licensing/service arrangements, and variable-revenue schemes.

- Improvements and validation of investment-readiness, by checking the bankability of these models against simplified financial, contractual and policy criteria.
- Advanced maturity of developers, investors and policymakers with evidence-based recommendations, drawing lessons from both successful and failed projects.
- Facilitated replication and EU-wide applicability, through guidance on how business model archetypes can be transferred to other clean hydrogen production routes.
- EU wide diffused knowledge through tangible publicly available results and materials for uptake, including an innovation compendium, open modelling templates, simplified contractual checklists (e.g. Power Purchase Agreements/PPAs, Hydrogen Purchase Agreements/HPAs) and policy briefs.

Project results are expected to contribute to the objectives and KPIs of the Clean Hydrogen JU SRIA:

- Reduction of Levelised Cost of Hydrogen (LCOH) at end-use;
- Increase of volume of the total clean hydrogen consumed in industrial applications.

<u>Scope</u>

Proposals should center efforts on business model innovation as the primary focus for renewable electrolysis integration in industry (including but not limited to Power-to-X applications), while validating their feasibility in at least one real industrial case.

Activities should include:

- Forensic and business case learnings: structured review of both successful and failed projects across the EU and associated countries, creating a database of known-anonymised FID outcomes, mapping root causes of failure and critical success conditions, with a risk typology by sector.
- Business model design: exploration of new archetypes such as:
  - Revenue diversification (valorisation of co-products, participation in grid/system service markets, guarantees of origin, carbon credits);
  - Innovative commercial and ownership structures (licensing, leasing, tolling, “electrolysis-as-a-service”, Special Purpose Vehicles/SPVs, Public-Private Partnerships/PPPs, Joint Ventures);
  - Variable revenue schemes (dynamic/indexed PPAs, performance-based HPAs, bundled hydrogen + co-product sales);
  - Distribution of responsibilities among actors in Engineering, Procurement and Construction (Management)/EPC(M) with implications for cost, risk and timing.
- Techno-economic optimisation tools: use advanced software-based methods and algorithms to achieve techno-economic optimisation, with the goal of reducing LCOH and increasing overall value. The scope covers optimisation of sizing, flexibility strategies, grid services, coordination between hydrogen production and consumption units, and valorisation of side products such as oxygen and heat. Including the business models schemes designed during the project and finding optimal scenarios among the uncertainty of market offtakes, original equipment manufacturer (OEM)

pricing trajectories or raw materials cost evolutions may lead to target specific models and algorithms development activities.

- Bankability stress-test: simplified financial and contractual analysis, including indicative checklists and templates (PPA/HPA clauses, co-product annexes, risk-sharing examples) and sensitivity modelling to check the investment-readiness of the proposed business models.
- Policy and support framework: concise mapping of EU and national support schemes (including cumulation and cross-border rules), with recommendations for better alignment of national markets within EU instruments, updated during the project lifetime.
- Sustainability and circularity: LCA/LCCA templates, sustainable water supply, reduction of water/energy consumption, recyclability and eco-design, hydrogen safety. Existing work on LCA, e.g. the JRC LCA checklist , should be appropriately considered.
- Application to real cases: at least one real industrial case is mandatory. The consortium shall apply its business model innovations to this case and check their bankability through simplified investment-readiness analysis. A second case may be included for comparative illustration, but only one full assessment is expected. If relevant, real-life tests may be carried out on an existing site to generate data for the techno-economic analysis. However, operating and equipment costs for running these tests are not eligible.
- Replication and future complementarity: guidance on replicability of business models across other clean hydrogen production routes (in line with the SRIA[126]), and structured input for potential future EU tenders or studies specifically targeting detailed bankability frameworks.

Projects are expected to produce key outputs on the following topics:

- Set-up and animate a project legacy Forum to be connected to relevant existing ones (if any) to bring together an extended community, including all the needed stakeholders (including e.g. institutional investors, regulatory bodies, financial institutions). This platform should also be the display and discussion ground for the projects results as described below.
- European White Paper on success and failure factors in industrial hydrogen projects, including critical lessons learned and practical “dos and don’ts” for developers, investors and policymakers within the first year of project.
- Business Model Innovation Compendium, showcasing innovative approach to ownership, licensing and service models, variable revenue schemes and digital tailored optimization tools, with guidance for replication across sectors.
- Open-source parametric economic model pack, including documentation and sensitivity templates to assess investment-readiness of business models.
- Bankability Assessment for at least one real site, presenting results of simplified stress-tests, sensitivity analysis and indicative contractual/financial examples, accompanied by a short replication guide.
- Policy outputs, including concise briefs on state-aid, cumulation and permitting, as well

[126] https://www.clean-hydrogen.europa.eu/about-us/key-documents/strategic-research-and-innovation-agenda_en

as structured input for potential future EU tenders or studies focusing on detailed bankability frameworks.

- The definition of projects as good candidates for a pipeline that could benefit from the application of the results

Projects should build on prior, and find synergies with new, Clean Hydrogen JU projects and/or Process4Planet, Clean Steel partnerships and Innovation Fund initiatives. Proposals should also collaborate as relevant with the Hydrogen Valleys supported by the Clean Hydrogen JU, including those benefiting from the project development assistance provided by the Hydrogen Valleys Facility[127].

The industrial case(s) chosen by consortia may rely on new electrolysis plant components (including compression, heat exchange, purification, cooling, controllers, gas separation, power electronics and storages), or existing ones (improved, revamped).

Purchase of equipment, infrastructure or other assets used for the action are excluded from the eligible costs.

Consortia should include the necessary mix (by size, expertise and value-chain role) of industrial developers/offtakers, technology providers, financial/state-aid/economic expertise, legal/regulatory experts, digital optimisation and business-model solutions. Consortia are invited to propose, build and animate relevant sectorial Collaboration Hubs involving banks, insurers, regulators, promoters, and other primary stakeholders to collaborate and co-create on the long term even outside the scope of the project (e.g. yearly meeting events).

For additional elements applicable to all topics please refer to section 2.2.3.2

[127] https://www.clean-hydrogen.europa.eu/media/news/15-hydrogen-valleys-selected-pda-under-h2v-facilitys-first-successful-call-2025-10-16

HORIZON-JU-CLEANH2-2026-01-05: Sustainable hydrogen production from renewable gases and biogenic waste sources through innovative modular reactor design, process intensification and integration

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 3.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 3.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 3 and achieve TRL 5 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[128].

Expected Outcome

Methods to transform renewable gases and biogenic waste sources into renewable hydrogen are diverse, but those such as pyrolysis/gasification of biogenic waste, renewable gas steam reforming and dark fermentation present a promising alternative. However, efficiency and scalability remain key challenges. While previous projects (e.g. BIONICO[129], HYIELD[130], SYMSITES[131], Waste4Bio[132]) have demonstrated technical feasibility, efficiencies remain limited (around 40%) and further improvement is needed to enhance economic viability and life-cycle performance in an industrial environment. Carbon-based products generated during these hydrogen routes may also be characterised to evaluate valuable applications and boost process economics. Thus, a complete and reliable carbon-utilisation-ready solution can be a step forward within the state of the art of the proposed scope.

Project results are expected to contribute to the following expected outcomes:

- Improved hydrogen yield and energy efficiency, optimising the ratio of hydrogen output to energy input in the production of hydrogen from renewable gases and biogenic waste sources through thermochemical and/or biological pathways;
- Innovative and breakthrough technologies such as reactor designs, fermentation routes and process configurations, including process intensification schemes, catalyst development, biocatalysis routes and relevant Balance of Plant for the low-emission transformation of renewable sources;
- Growing use of renewable gases and biogenic waste sources (wastewater, sewage, agrifood waste and other industrial wastes) promoting a circular approach, and

[128] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under ‘Simplified costs decisions’ or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf
[129] https://cordis.europa.eu/project/id/671459
[130] https://cordis.europa.eu/project/id/101137792
[131] https://cordis.europa.eu/project/id/101058426
[132] https://cordis.europa.eu/project/id/101153928

enabling sector coupling with industries such as chemicals, steel, fertilisers, and materials, among others;

- Reduction of CAPEX and OPEX through process simplification, reactor design, system integration, improved reaction kinetics, and better system integration. Overall processes should be optimised for hydrogen production, but also for use of the by-products (e.g., extracted carbon);
- Advanced source-impurity management to increase feedstock flexibility and hydrogen and co-product purity (e.g. biomolecules or captured CO_2), while minimising pretreatment cleaning costs;
- Maximised process electrification;
- Enhancing energy security by promoting European clean hydrogen production and reducing the dependency on foreign energy and raw material imports.

Project results are expected to contribute to the objectives and KPIs of the Clean Hydrogen Partnership, depending on the technology/pathway followed:

- Reduction in CAPEX and OPEX of the considered technologies, with respect to current state of the art;
  - CAPEX:
    - Hydrogen production from raw biogas: 1,150 €/(kg/d)
    - Hydrogen production from biomass (bioreactors, dark fermentation): 400 €/(kg/d)
    - Biomass/biowaste gasification: 1,514 €/(kg/d)
  - OPEX
    - Hydrogen production from raw biogas: 1.32 €/(kg/d)
    - Hydrogen production from biomass (bioreactors, dark fermentation): 3 €/(kg/d)
    - Biomass/biowaste gasification: 0.011 €/(kg/d)
- Improvement of process energy efficiency:
  - Hydrogen production from raw biogas, system energy use: 60 kWh/kg
  - Hydrogen production from biomass (bioreactors, dark fermentation), reactor production rate: 15 $kgH_2/m^3/d$
  - Hydrogen production via thermolysis:
    - Electricity consumption @ nominal capacity: 20-25[133] kWh/kgH_2
    - Head demand @ nominal capacity: 18 kWh/kgH_2
    - Hydrogen production efficiency: 48%
- Increase in carbon yield:
  - Hydrogen production from biomass (bioreactors, dark fermentation): 0.015 $kgH_2/kgCOD$[134]

[133] Depending on whether compression is considered
[134] Chemical Oxygen Demand

- Biomass/biowaste gasification: 0.22 kgH_2/kgC

- Reduce the land footprint of the hydrogen production plant versus commercial benchmark H_2 production processes;
- Maximised hydrogen recovery >95%;
- Reduce direct CO_2 emissions from feedstock (at least 80% reduction);
- Biochar quality for use in soil enrichment or electronics but not for energy-production purposes.
- Increase in hydrogen yield by ≥ 0.1 – 0.15 L H_2 / g vs[135] for dark fermentation processes.

Furthermore, proposals should include any additional technological KPIs, that demonstrate the progress beyond current State of the Art. For relevant technologies not listed above but aligned with the JU SRIA priorities (e.g. thermolysis), proposals are expected to include the respective relevant KPIs needed to demonstrate advancement beyond the State of the Art.

Scope

The main objective of this topic is to develop novel technologies for high-efficiency hydrogen production from renewable gases and/or biogenic waste sources, ensuring sustainability, cost reduction and process scalability, including thermochemical or biological pathways, or a combination of both. Thermocatalytic, electrochemical, dark fermentation and membrane technologies can be combined to reduce process steps and increase hydrogen yield and efficiency. A target TRL5 is adequate considering the starting TRL of these technologies but also the required improvements and the high degree of integration among process units needed to reach the specific technology KPIs. Biobased processes, e.g. dark fermentation and anaerobic digestion, should target the direct production of bio-H_2 in the bioreactor, while minimising the organic by-product formation and providing a convincing solution to valorise solid co-products such as digestate. In addition, process intensification and reactor technology, hybridising separation, purification and compression technologies, including heat valorisation concepts, can lead to strong enhancement in energy efficiency and downstream processing costs.

Projects should go beyond previous initiatives on waste to H_2, such as BIONICO, HYIELD, SYMSITES or Waste4Bio projects, by demonstrating higher efficiency, higher H_2 yield, and better process economics and integration with other industries, facilitating the transition to sustainable hydrogen production at scale. Furthermore, proposals should also address sustainability and circularity through a life cycle assessment. The considered renewable gases and biogenic waste sources should only be used for hydrogen production and be fully sustainable (e.g. no negative influence on biodiversity). The project could employ, as reactor feed, model feedstocks mimicking biogenic feedstocks while the experimental use of real waste feedstock coming from upstream processes is encouraged and eligible for funding however, the development costs of these upstream processes will not be funded.

The presence of impurities in the inlet waste stream should play a role and thus is expected to be addressed in the proposal, such as the conversion, adsorption or separation of feedstock from undesirable by-products.

Addressing certain limitations is crucial for practical implementation. These include:

- Reducing costs (both CAPEX and OPEX) to ensure viability for industrial applications;

[135] Volatile Solids

- Enhancing process energy efficiency and a high degree of electrification to provide process heat and drive hydrogen separation, purification and compression;
- Enhancing scalability through novel, modular reactor designs, process intensification, and integration strategies;
- Managing impurities in process streams to improve system robustness and feedstock flexibility;
- Characterisation of other fermentation biogenic and/or solid carbon by-products to assess potential carbon-negative hydrogen production and economic benefits;
- Demonstration and report of significant testing time for 1000 h to show operational availability and stability for industrial implementation under industrial-relevant conditions;
- Techno-economic analysis leading to a reduction of current LCOH (€/kg H_2);
- Sustainability analysis of GHG emissions, pollutants, biodiversity, water consumption, amongst others.

Proposals should:

- Show feasible and significant advances (up to TRL 5) with respect to the mentioned limitations;
- Demonstrate a functional process producing from 1 to 10 kgH_2/h (approx. 0,03 - 0,33 MW_{H2}) including relevant Balance of Plant (e.g. innovative purification, separation, and compression, electrical & thermal integration) with a purity acceptable for the proposed direct application;
- Demonstrate a clear pathway for industrial-scale implementation, proving competitive hydrogen production costs and improved climate performance compared to existing technologies, including CCS-based methods;
- Characterise organic molecules or carbon-based by-products generated during this hydrogen route to evaluate valuable applications.

Techno-economic analysis to de developed should consider as relevant complementary integrated actions such as process waste-heat valorisation, carbon capture, and hydrogen production as raw material input for example but not limited to chemical, steel, or other industries would be important for the substitution/reduction of fossil hydrocarbons use in the industrial sector. However, the development costs of these actions will not be funded.

The circular approach should comprise the full process analysis with the evaluation of the impact of the technology into a future carbon market, as key for the viability of the process, as well as multi-product sustainability analysis, minimising critical raw material inputs, wastes and greenhouse gases emissions (even negative) in a variety of scenarios, maximising socio-economic impacts in the European Society.

Natural gas/methane splitting and carbon utilisation activities are not int the scope .

Applicants are encouraged to explore synergies with successful applicants of topic 'HORIZON-CL5-2025-02-D2-08: Coordinated call with India on waste to renewable' included in the Horizon Europe Work Programme.

For additional elements applicable to all topics please refer to section 2.2.3.2.

HORIZON-JU-CLEANH2-2026-01-06: Scalable and high efficiency materials and reactors for direct solar hydrogen production

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 3.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 3.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 3 and achieve TRL 5 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[136].

Expected Outcome

Facing a period of climate emergency and energy crisis, Europe needs to rethink the energy market with solutions based on renewable sources capable of directly generating renewable fuels. Hydrogen is a valuable energy carrier and an important feedstock for industry, but its production still relies almost exclusively on fossil fuels. The conversion of solar energy into chemicals such as hydrogen is expected to grow in importance as a sustainable energy resource. Especially, thermo-chemical cycles (TCC) or photoelectrochemical/photocatalytic (PEC/PC) water splitting using sunlight represent eco-friendly and promising technologies to produce hydrogen with the possibility to have standalone systems for delocalised production not necessarily connected to the power grid.

To date, thermochemical and photo-assisted solar-driven technologies are still in the proof-of-concept stage and face challenges in improving solar-to-hydrogen conversion efficiency to make solar-based hydrogen production competitive. Additionally, R&D in materials should aim to discover novel abundant and cost-effective catalysts and redox materials as well as more integrated process design promises in the respective fields. Development of TCC or PEC/PC reactors is essential along with overcoming challenges related to the efficiency, stability and scalability.

TCC processes use high-temperature solar heat to drive redox reactions that decompose water into hydrogen and oxygen through a series of chemical steps. These cycles typically involve metal oxides or non-metal oxides or other chemicals that undergo reversible oxidation and reduction, enabling the splitting of water. Although several materials and cycle configurations have demonstrated feasibility at kW scale, the technology remains at an early stage of development, with key challenges related to redox material stability, reaction kinetics, and efficient heat integration. Experimental systems have shown proof-of-concept operation under concentrated solar flux, but current solar-to-hydrogen efficiencies and long-term

[136] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

durability need significant improvement to meet industrial targets.

PEC/PC processes utilise light energy (in some cases in combination with electric energy) to drive chemical reactions, particularly for the production of hydrogen from water. This method is regarded as environmentally friendly and holds promise for generating hydrogen with standalone systems that do not require connection to the power grid. The conversion of solar energy into chemicals such as hydrogen is anticipated to grow in relevance as a sustainable energy resource. For instance, PEC water splitting systems are anticipated to play a significant role in renewable hydrogen production, with the goal of competing in the medium to long term with conventional systems that combine separate photovoltaic (PV) panels and electrolysis units. Innovative PEC technologies can support CAPEX and OPEX reduction efforts compared to electrolyser development and thereby can help boost the market competitiveness of renewable hydrogen.

The results are expected to contribute to all the following outcomes:

- Solar-driven water to hydrogen conversion will be demonstrated in relevant scale and over substantial demonstration periods using innovative reactor concepts;
- New TCC or PEC/PC systems integrating components and materials which require only the unavoidable minimum of critical raw materials (CRM) in order to mitigate CRM dependency of renewable hydrogen production paths through diversifying the technology options;
- Novel TCC or PEC/PC reactor and balance of system designs, based on continuous operation rather than batch or semi-batch prototypes, to maximise process efficiency;
- Multiscale model of TCC or PEC/PC reactor to support reactor design and operations;
- Techno-economic and environmental analysis of the proposed technology;
- Contributing to identifying the most cost-effective and highly performing solar water to hydrogen conversion technologies for demonstration and industrialisation after 2030 to accelerate the readiness of renewable hydrogen for all economy sectors;
- Reinforcing the European scientific & knowledge basis and European technology export potential for solar hydrogen production technologies.

The project will contribute to strengthen European leadership for the efficient hydrogen production and create new business models for hydrogen production based on TCC and PEC/PC technologies.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA for both routes (TCC and PEC/PC) unless otherwise stated[137] :

- Hydrogen production rate: on-sun operation at relevant scale (250-500 kW for the TCC route and 10 kW min for the PEC/PC route) for at least 1 month operation time (net operation time; outdoor or indoor testing under simulated sunlight) reaching average hydrogen production rates higher than 0.75 kg/m²/y (land area) with a convincing potential of reaching 1.42 kg/m²/y (land area) by 2030[138];
- Reactor efficiency: demonstrated conversion efficiency of Solar radiation to Hydrogen (STH) of more than 10%, considering the higher heating value (HHV) of hydrogen;

[137] In the currently available version of the Clean Hydrogen JU SRIA, there are KPIs and objectives for the TCC route for hydrogen production but not yet for the PEC/PC routes.

[138] KPI-1: Boundary conditions: location with direct normal irradiation (DNI) of 2500 kWh/m2/year. Output of hydrogen meeting ISO 14687-2 at a pressure of 15 bar and hydrogen purity 5.0.

- For TCC ≥ 20 %
- For PEC ≥ 10 %
- For PC ≥ 10 %

- Less than 10 % decrease per year of the STH extrapolated from the measure performance over 300 hours of cumulated operation under natural or simulated sunlight;
- Hydrogen production costs:
    - For TCC route
        - Calculated system capital cost assuming a scaled-up plant reaching 7.4k€/kg/d by 2030[139]
        - Calculated operational cost assuming a scaled-up plant reaching 0.3 €/kg by 2030[140]
    - For all relevant routes, an overall cost of production of hydrogen of less than 6€/kg H_2[141]

For PEC/PC route, conventional systems that combine separate photovoltaic (PV) panels and electrolysis units are excluded from the scope of this topic.

Scope

This topic seeks innovations in solar thermos-chemical cycles (TCC) and solar Photoelectrochemical/Photocatalytic (PEC/PC), with a strong emphasis on system-level integration (subcomponents: materials, devices, reactors, control systems, etc. into a fully functional, operable system), targeting demonstration at TRL 5, and aligning with EU climate neutrality and energy resilience goals. Proposals should focus on the direct conversion of solar energy into hydrogen, eliminating reliance on intermediate photovoltaic-to-electricity pathways.

Past and current projects supported by the Clean Hydrogen Partnership have established the current technological challenges to overcome for direct solar process generating hydrogen[142,143,144,145]. Therefore, the success of all processes under consideration (TCC and PEC/PC) is strongly linked to the performance of the core components and their interaction. Especially high efficiencies and throughput are required to provide a clear economically competitive scaling and implementation perspective. Innovative solutions including the material, reactor and process level shall be revisited and developed to tackle these significant challenges. The main levers to overcome the efficiency challenges are seen in the following areas: application of advantageous active materials, structures and shapes with better material usage, improved photon and heat management, improved transport processes and heat recovery, as well as co-production of further products besides hydrogen (heat, electricity,

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[139] KPI-2: System capital cost for a specific hydrogen production rate based on kg of hydrogen generated per day at a given cumulative DNI per year. Capital cost should include all the cost related to all the equipment necessary for the normal operation of the plant.

[140] KPI-3: O&M cost averaged over the first 10 years of the system. Routine maintenance and "wear and tear" (rotating parts, cleaning of equipment, etc). Electricity costs for operation of auxiliary units included. System level losses such as heliostat collector area losses, replacement parts, operation, and maintenance are included in the cost calculations.

[141] S. Haussener et al. Energy & Fuels 2024 38 (13), 12058-12077

[142] https://cordis.europa.eu/project/id/303435

[143] https://cordis.europa.eu/project/id/621252

[144] https://cordis.europa.eu/project/id/101101498

[145] https://cordis.europa.eu/project/id/325320

other chemical products). A further key for a deployment of such a technology is a convincing pathway for the scaling of the technology. As such, proposals should provide and demonstrate a clear scale-up strategy for the receiver/reactors to substantiate the claim for competitive solutions at 250-500 kW scale for the TCC route and at minimum 10 kW for the PEC/PC route, while considering critical materials and other sustainability issues.

Proposals should make use of already available solar resource harvesting techniques that convincingly demonstrate the promise of commercial application. Possible integration with existing grids (transport, energy, materials) is very important to address the potential application of the proposed technology in future steps. In line with this, proposals can consider including hydrogen intermediate- and end-users or prosumers (on site generation/use as a chemical feedstock or fuel) to demonstrate successful business cases, making efficient use of existing infrastructure and technologies.[146,147,148,149]

Proposals should aim to conduct extensive research and development on the core functional materials of the targeted processes, *i.e.* redox materials for TCC or light-absorbing and catalytic materials for PEC/PC, as well as innovative reactor and balance of system designs, to produce hydrogen directly from water using solar irradiation in non-concentrated, moderately or highly concentrated form.

Another relevant aspect to consider is the operation of the systems under transient solar irradiation conditions, which may require control strategies or thermal storage elements to ensure process stability and efficiency. Such transient conditions not only demand appropriate control strategies or thermal storage elements to ensure process stability and efficiency but also negatively impact on the lifetime of components, e.g. by accelerating materials degradation. Therefore, adapted suitable operational strategies are needed to deal with intermittency of solar radiation.

The topic should cover the following elements:

- Depending on the proposed technology, improvement of catalyst and redox materials (high thermal stability, cyclability, faster kinetics, and higher hydrogen yield), electrodes and photoelectrodes, receivers and membranes for better efficiency and lifetime minimising CRMs;
- Ensure reusability / recovery of materials and components, as much as possible;
- Work on an integrated architecture and reactor design that minimises material use and optimises the balance of plant, with consideration for modular assemblies;
- Strong focus on scalability of process and design;
- Smart energy and heat management within the process as a whole;
- Assessment of efficiency at relevant scale and representative conditions (including dynamic) and verification of minimal efficiency losses upon upscaling;
- Identifying degradation mechanisms across different scales and implementing countermeasures;
- Support through modelling (*e.g.* development of thermodynamic/electrochemical models to support material developments and/or 3D CFD models for optimised reactor

[146] https://cordis.europa.eu/project/id/245224
[147] https://cordis.europa.eu/project/id/101137889
[148] https://cordis.europa.eu/project/id/325361
[149] https://cordis.europa.eu/project/id/621173

design);

- Full techno-economic and LCA analysis;
- Development of end of life and recycling strategies for functional materials and core components.

Proposals should cover the following elements addressing the described challenges in TCC and PEC/PC processes to advance the technology to achieve at least TRL 5: system performance, reactor development and material development, all supported by a solid business case. This should be validated by developing, building, and testing dedicated reactor units and peripherals to achieve the performance characteristics given in the section Expected Results.

The intended project should consider or even use results and experiences from relevant ongoing or past JU projects such as but not only HYDROSOL-Beyond[150], HySelect[151], FLOWPHOTOCHEM[152] and PH2OTOGEN[153].

Proposals may be developed in accordance with the results of relevant past and ongoing projects funded by the EU, including the HYDROSOL family[154] (HYDROSOL-beyond[155], HYDROSOL-II[156], HYDROSOL-Plant[157]), SOL2HY2[158], PECSYS[159], and PH2OTOGEN[160], among others (e.g. Sun-to-Liquid [161],and NanoPEC[162]) with the objective of ensuring complementarity and clear added value in comparison with the current state-of-the-art.

[150] https://cordis.europa.eu/project/id/826379
[151] https://cordis.europa.eu/project/id/101101498
[152] https://cordis.europa.eu/project/id/862453
[153] https://cordis.europa.eu/project/id/101137889
[154] HYDROSOL, HYDROSOL-II, HYDROSOL-Plant (FP6–H2020, Grant 826379, 20030, 325361) – Series of projects on solar thermochemical hydrogen production via redox cycles, progressively scaling from lab to pilot plant.
[155] https://cordis.europa.eu/project/id/826379
[156] https://cordis.europa.eu/project/id/20030
[157] https://cordis.europa.eu/project/id/325361
[158] https://cordis.europa.eu/project/id/325320
[159] https://cordis.europa.eu/project/id/735218
[160] https://cordis.europa.eu/project/id/101137889
[161] https://cordis.europa.eu/project/id/654408
[162] https://cordis.europa.eu/project/id/227179

HYDROGEN STORAGE AND DISTRIBUTION

HORIZON-JU-CLEANH2-2026-02-01: Affordable, Safe and Sustainable aboveground medium to large GH2 storage

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 4.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 4.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 3 and achieve TRL 5 by the end of the project - see General Annex B.
Procedure	The procedure is described in General Annex F.

<u>*Expected Outcome*</u>

Clean hydrogen plays a pivotal role in decarbonising Europe's energy system by enabling fossil-free energy supply in hard-to-abate sectors. In this context, safe, affordable, and scalable hydrogen storage systems are critical for ensuring energy system flexibility, grid resilience, and continuous integration of variable renewable energy (VRE) sources. Aboveground hydrogen storage solutions, such as compressed gas, are essential for decentralised hydrogen hubs requiring large feedstocks such as refuelling stations, industrial clusters, and Hydrogen Valleys. They offer a medium to long-term storage and servicing solution, high-frequency storage capabilities (in 5 to 20t H_2) near production and demand centres, particularly where underground options are not viable.

Project results are expected to contribute to all the following outcomes:

- Improved materials knowledge through validated data on the mechanical and chemical degradation behaviour of advanced low-cost materials (e.g., hydrogen-compatible steels, nanoparticle-reinforced aluminium alloys, metal matrix composite liners, and multi-layer coatings) for compressed gas storage.
- Development and application of mechanistic-based design and assessment methodologies that capture actual degradation mechanisms under hydrogen service (short, medium and long term i.e., 20-30 years), supporting more reliable and cost-effective storage solutions configuration and design.
- Integration of circular economy principles into compressed gas hydrogen storage through the use of recyclable and low-carbon materials, modular storage solution designs enabling complete reuse of liners and structural components, and energy-efficient manufacturing processes.
- Deliver compressed gas hydrogen storage systems that are affordable, safe, modular, deployable, easily serviceable and long term operable in decentralised hydrogen hubs to support H_2 refuelling stations, large H_2 feedstocks and industrial clusters.
- Demonstrate measurable improvements over state-of-the-art (e.g., reduced material cost, improved safety, extended fatigue life, lower hydrogen permeability)
- Contribute to harmonised EU safety and performance standards for compressed gas storage, including validated operational envelopes for medium to large tank capacities (5-20 tonnes per module).

- Incorporation of breakthrough fire safety features through novel tank designs that enable self-venting behaviour, reducing the risk of catastrophic failure, including under extreme conditions.
- Provide digital design tools and modular frameworks enabling adaptation of compressed gas storage solutions across regional, climatic, and industrial contexts in Europe, while also delivering recommendations for future design standards to ensure safety, interoperability, and harmonisation across the EU market.

Project results are expected to contribute to the following objectives of the Clean Hydrogen JU SRIA:

- Increase fatigue life by ≥30% compared to current SoA (typically <5,000 cycles at 700 bar).
- Reduction of safety design margins by ≥20% compared to SoA, while maintaining equivalent or higher safety levels.
- Increase recyclability of fully metal system, metal with liner systems, composite matrix-particulate/fibre systems from current SoA <30% to ≥70% by 2030. Reduce embodied CO_2 footprint of above-ground GH_2 storage tanks by ≥25% compared to conventional designs (baseline: ~15–18 kg CO_2/kg H_2 stored).
- Reduce CAPEX from current SoA ~600 €/kg H_2 stored to ≤450 €/kg H_2 stored by 2030.

Scope

This topic targets the development and validation of low-cost advanced hydrogen-compatible materials and tank architectures for aboveground compressed hydrogen storage, with modular or containerised units sized 5 - 20 tonnes. Proposed solutions should demonstrate improved material resilience against hydrogen-induced degradation, ≥30% increase in fatigue life (from <5,000 cycles to ≥6,500 cycles at 700 bar), and enhanced performance across varying environmental conditions (temperature range: –40 °C to +60 °C). Materials may include high-strength steels, fibre/nanoparticle-reinforced composites, metal-matrix composites, and multi-layer coatings with low hydrogen permeability.

Projects should prioritise recycled or low-carbon footprint materials, energy-efficient processing (e.g., friction stir welding, heat treatment), and designs enabling ≥70% recyclability and ≥25% reduction in embodied CO_2 (baseline: 15–18 kg CO_2/kg H_2 stored). Validated digital design tools, fatigue/fracture models, and AI-enabled tank material design and optimisation should support predictive low-cost manufacturing, maintenance and safety optimisation of the storage system. Storage systems should target CAPEX ≤ 450 €/kg H_2 stored and exhibit long-term structural integrity under ≥6,500 pressure cycles.

Validated multi-physics simulations should account for fracture, permeability, fire safety, and delivery pressure loss, complemented by lab-scale and pilot-scale testing. Outcomes should support the Findable, Accessible, Interoperable, and Reusable (FAIR) sharing of mechanical performance data and demonstrate pathways toward scalable deployment in Hydrogen Valleys and industrial hubs. To overcome the gaps mentioned above, proposals should address the following:

- Generate new knowledge on the mechanical performance of low-cost compressed hydrogen storage solutions (e.g., high-strength steels, fibre- and nanoparticle-reinforced polymers, aluminium alloys and composites, hybrid/nano composites, multi-layer coated materials) under low-cycle fatigue and pressure variations in hydrogen environments using simulation-driven fatigue, fracture, and deformation models, validated by lab testing in hydrogen environments.

- Investigate degradation mechanisms like permeability loss, embrittlement, corrosion, and material cracking. Emphasise hydrogen purity monitoring before and after storage using full metal and composite liners in controlled environments to simulate operational hydrogen cycling without relying on full-scale demonstrators.
- Assess and optimise the structural performance of various tank types using recycled materials, tanks with liners and coatings. Perform integrity assessments (fracture, porosity, pressure) and develop standardised acceptance testing protocols covering fire safety, weld quality, permeability, and insulation.
- Ensure there are safety provisions in place to exclude tank rupture, long jet flames, flammable cloud formation in naturally ventilated confined spaces, mitigation of the pressure peaking phenomenon in any enclosed rooms.
- Novel tank architectures should incorporate fire safety provisions such as self-venting behaviour to enhance resilience during accidental exposure to fire.
- Design high-performance foundation and support structures (e.g., concrete plinths or buffer layers) to ensure even load distribution and minimise stress concentrations around hydrogen storage tanks. These structures should demonstrate excellent pumpability, self-compacting behaviour, and stability under thermal and mechanical loads.
- Projects should generate knowledge on the influence of environmental and operational conditions—such as temperature fluctuations, wind loads, seismic activity, and foundation settlement—on the durability and safety of above-ground compressed hydrogen storage systems using advanced simulations and modelling techniques.
- Develop preliminary guidelines for material and weld design in hydrogen-exposed tanks and propose a standardised design framework covering tank architecture, material integration, safety margins, and resilience to industrial or natural hazards (e.g., fire, earthquakes, extreme temperatures).
- Investigate advanced real-time monitoring technologies integrating embedded sensors, non-destructive testing, and Generative AI analytics to detect strain, leakage, and degradation—supporting predictive maintenance and future harmonisation of hydrogen storage design standards.
- Validate the design through comprehensive simulation and physical testing, using coupled mechanical, thermal, and hydrogen interaction models.
- A physical proof of concept (PoC) will be developed to assess the impact of cyclic hydrogen pressurisation on key components such as the composite inner liner, metallic shell, insulation layer, and support structures. The PoC will be informed by lab-scale testing and full-system simulations, with recommendations for scaling to commercial demonstration at all levels (5-20 tonnes).
- Evaluate how storage materials and configurations affect hydrogen purity per ISO 14687, identifying degradation mechanisms and purification needs to optimise CAPEX/OPEX and lifecycle performance.

Publicly share validated mechanical performance data following FAIR principles, embedding recyclability and circularity for sustainable, cost-effective hydrogen storage system design.

For additional elements applicable to all topics please refer to section 2.2.3.2

HORIZON-JU-CLEANH2-2026-02-02: Demonstrating in-line inspection (ILI) to monitor cracks assuring compatibility for operation with hydrogen in new and repurposed offshore natural gas pipelines

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 3.50 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 3.50 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 4 and achieve TRL 6 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[163].

Expected Outcome

Current existing natural gas grids are expected to form a substantial part of the future hydrogen transport and distribution system. Current industry initiatives such as the European Hydrogen Backbone Initiative of major TSOs and Ready4H2[164] of the European DSOs is showcasing how this could progress.

While the work to assure the integrity of the pipelines and components in the grid have progressed in previous projects and activities, the main focus has been on onshore infrastructure. Offshore pipelines have specific design rules and different operating conditions and cannot be excavated for maintenance or service purposes in the same manner as onshore pipes. This means that existing infrastructure should maintain longer, without service or exchange of segments. The consequences of fatigue and cracks could endanger the complete business case of the pipeline. Similarly, it is very expensive to retrieve inspections tools if they get stuck and this situation should be avoided by design and by the way of operating and handling the tool. Also, the offshore pipelines have a larger diameter and are operated under higher pressure. Although, it is in the common interest of both onshore and offshore transport grid operators to have In-line Inspection tools that can operate in hydrogen pipelines, higher standards apply for the offshore use case. It has been observed that the most critical points in offshore pipeline integrity are the circumferential welds and seam welds. Therefore, their accurate detection is a key factor in advancing research on the repurposing of gas pipelines for hydrogen transport.

The integrity of offshore pipelines for hydrogen transport cannot currently be guaranteed due to hydrogen's detrimental effect on fracture toughness, ductility as well as the increase of fatigue crack growth rate, especially in regard to stress concentration areas and required performance of ILI-tools are not fully established.

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[163] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf
[164] https://www.ready4h2.com/

The project results are expected to contribute to all of the following expected outcomes:

- Safe operation of repurposed and new offshore pipelines with hydrogen;
- Maintain European technology leadership in ILI-systems;
- Improve ILI efficiency in stress concentration areas, such as welds and crack like defects;
- Extend the lifetime and reduce costs of pipeline operation (also onshore);
- Support the progress of standardisation of gas grid operation and maintenance.

Project results are expected to contribute to the objectives of the Clean Hydrogen JU SRIA.

Scope

The scope of this topic is to demonstrate In-Line Inspection (ILI) tools to qualify existing natural gas pipelines for hydrogen service and to operate in future offshore hydrogen pipelines (new or re-purposed) by validating that the tool is suitable for detecting crack-like defects, especially in stress concentration areas.

Proposals should consider and build on relevant existing work in this area and results from projects related to hydrogen integrity of high-pressure pipelines, ILI-systems and sensor development, such as from Pipeline Operator Forum (POF), European Pipeline Research Group (EPRG), Pipeline Research Conference International (PRCI) and including projects funded by the Clean Hydrogen JU such as HIGGS[165], SHIMMER[166], PilgrHYm[167], etc. and also relevant national projects on the topic, such as TransHyDe[168]. Successful projects are also expected to review the state of the art during their implementation and to identify additional synergies with these and other ongoing relevant projects.

Proposals should develop acceptance criteria for defects, considering the type and size of defects, loading conditions and hydrogen environment. This will be used to prove that inspection methods have sufficient probability of detection and sizing accuracy to ensure the integrity and to determine acceptance criteria for the inspection. Proposals should demonstrate the ability to detect or monitor crack-type defects with satisfactory resolution and detection probability through In-line Inspection (ILI) in offshore high-pressure pipelines, as well as safe and reliable operation of In-Line Inspection tools reaching TRL 6 or higher.

Validation consists of demonstration of the increased performance of the ILI-tools by conducting test-runs in high pressure pipelines.

The validation should be conducted in a hydrogen environment but may take place onshore. Detection results, modus operandi and the in-line inspection device, as such, should be prepared and as far as possible qualified to operate in the hydrogen conditions of the future offshore pipelines, while the dimensions of the tool may be different. The development should consider the securement of the needed material integrity and safety of operation, while also considering the costs of the tool and inspections of the relevant stakeholders. In order to be able to fulfil this scope, proposals should include at least one In-Line-Inspection tool provider and one gas transport grid operator.

The following aspects are to be addressed in the scope of the project:

- Determine acceptance criteria for defects including critical flaw characteristics and

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[165] https://cordis.europa.eu/project/id/875091
[166] https://cordis.europa.eu/project/id/101111888
[167] https://cordis.europa.eu/project/id/101137592
[168] https://www.get-h2.de/en/geth2-transhyde/

sizes. This will set the required detection sensitivity for the in-line inspection method and device differentiate between categorising the effectiveness in seam welds, girth welds and pipe body according to the wall thickness. However, it should be the minimum ambition that the tool can detect internal surface-breaking circumferential flaws and surface defects not larger than 3×20 mm in the pipeline. The minimum acceptable performance with respect to axially oriented cracks and crack-like defects are:

  - Minimum depth at a Probability of Detection (POD) = 90% of a crack of a length of 25 mm: 1 mm or 10% of the wall thickness, whichever value is greater and a minimum crack opening: < 0.1 mm
  - Depth sizing accuracy at 90% certainty: ± 0.5 mm or 5% of the wall thickness, whichever value is greater and a length sizing accuracy at 90% certainty: ± 5 mm
  - Orientation limits for detectability: ± 10°

- Determine required conditions for the tool and its operation:
  - The tool should have long term hydrogen compatibility/stability and consider the operational condition (acceleration, mechanical impact, etc.) of the future offshore hydrogen pipelines. One may consider an increased exchange rate of components by design, in a deliberate trade-off between performance and minimisation of costs, considering tool preparation for inspection and all required maintenance on the tool in preparation of a tool run.
  - The tool should be able to negotiate at least 1,5D 90° bends, can collapse and pass bore restriction to 75% of the inside diameter, can pass 1:1 offtakes without pig bars and generally have a low tool drag and friction.
  - Furter criteria such as: Low cost by design, be easy to handle and have low risk of failure, should also be considered
- Develop and test ILI-tools to the specifications defined;
- Define guidelines and protocols for the execution, including launch and receive, of in-line-inspections for qualifying existing offshore pipeline and for maintaining pipelines with hydrogen, including velocity control of the ILI tool. Pipeline cleanliness level and cleaning pigging launch protocol between crack detection pigs. Combining other methodologies such as MFL- A/C;
- Identify and provide suggestions for amendments of existing RCS for the secure monitoring of offshore high-pressure grids;
- Validate the reliable operation of the ILI tool according to defined specification, guidelines and protocols under real conditions to qualify the design at TRL 6. It is assumed that validation in hydrogen environment and in high pressure pipelines between NPS 16”/DN 400 and NPS 32”/DN 800 are sufficient with controllable pressure and flow conditions to adapt to requirements for testing.

For additional elements applicable to all topics please refer to section 2.2.3.2

HORIZON-JU-CLEANH2-2026-02-03: New thermal insulation concepts for bulk liquid hydrogen shipping

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 4.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 4.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 3 and achieve TRL 5 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[169].

Expected Outcome

Shipping of bulk liquid hydrogen (LH2) requires concepts that are applicable, cost and energy-efficient, as well as safe, to make it attractive for the industry. However, the cryogenic storage conditions demand highly efficient insulation to reduce venting losses, as it is applied e.g. from NASA, JAXA or ESA for space applications, in the Hydrogen Energy Supply Chain (HESC) project of Japan, as well as it is proposed by the most recent interim recommendations of IMO for carrying LH2 in bulk by ship. Traditional vacuum-jacketed dewar tanks provide excellent insulation, but their performance is highly dependent on vacuum integrity and precise installation. Furthermore, there is only one vacuum volume which is lost in case of a single leakage of the inner or outer tank wall. In addition, large-scale production of these tanks is time, personnel, and material intensive, and limits the possibilities of quality assurance[170].

To enhance robustness, new insulation concepts need to be explored and demonstrated. Examples include multi-layer insulation (MLI) or variable-density multilayer insulation (VDMLI) combined with, for example, spray-on foam insulation (SOFI), aerogels, and nano-cellular foams, or hybrid solutions. Modular and layered solutions in the design of the insulation system may be investigated as well. However, these techniques need further investigation to achieve the best trade-off between robustness and insulation performance.

Several promising projects (e.g. NICOLHy[171], LH2Craft[172]) and industry consortia are currently researching advanced storage concepts targeting cost and energy-efficient, as well as safe large liquid hydrogen bulk storage systems[173]. Also, insulation concepts are under research, both for shipping (e.g. project LH_2 Pioneer) and aeronautics (e.g. project H2ELIOS[174]), offering

[169] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf
[170] Fesmire, J. E., Energy Efficient Large-Scale Storage of Liquid Hydrogen, CEC – ICMC, 2021
[171] https://cordis.europa.eu/project/id/101137629
[172] https://cordis.europa.eu/project/id/101111972
[173] NICOLHy, Deliverable 1.1, LH2_storage_tank_and insulation_technologies,_applications,_and standards, https://cordis.europa.eu/project/id/101137629
[174] https://cordis.europa.eu/project/id/101102003

additional potential candidates for the bulk transport.

This topic focuses on transport tanks for shipping of LH2. These tank types are more challenging than stationary tanks, in design, thermal insulation, structural integrity, manufacturing, operation, and service. Furthermore, they have more dynamic boundary conditions that should be regarded while in operation, loading, and unloading. Findings from demanding applications such as aeronautics and space could contribute in this sense. Nevertheless, relevant findings from research activities on ship insulations can be adapted to stationary tanks.

Project results are expected to contribute to all of the following expected outcomes:

- Develop an economically viable technology solution strengthening the European import and export market for LH2;
- Contribute to the development of safe, cost- and energy-efficient tanks for LH2 that should be scalable up to a size of a transport volume of up to 250000 m^3 per ship, in line with world-wide LNG trade today, and in compliance with the most recent design and safety standards set by IMO;
- Foster the basis for large-scale trade and associated green fuel markets for shipping, heavy-duty mobility, aviation, high energy intensity industries like cement, steel or copper, as well as for thermal use, for instance for refrigeration or superconductor applications;
- Support and promote the European and associated industry in LH2 insulation technologies.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA for large-scale shipping of bulk LH2 and should be considered as a reference to meet the desired performance requirements for the new insulation concepts.

- KP13: LH_2 ship tank capacity (350 t in 2024, 2800 t in 2030)
- KP14: LH_2 ship tank Capex (50 Euro/kg in 2024, <10 Euro/kg in 2030)
- KP15: LH_2 boil-off (0.5 %/d in 2024, <0.3 %/d in 2030)

Scope

The scope of this topic is to develop validated containment concepts intended for bulk shipping of LH2. The concepts developed should also be suitable for a later scale-up.

To achieve this, several new challenges that greatly impact bulk LH2 storage scalability need to be addressed, ideally by an industrial lead consortium. The scope for the development of new thermal insulation concepts for bulk LH2 shipping requires:

- Assessment of the regulatory requirements for the transportation of bulk LH2 on ships;
- Development of an insulation system solution, notably the pipes through the insulation and pipe feedthroughs, the connections, and the supporting structures, during normal operation, loading and unloading processes, maintenance, and inspection;
- 2D Numerical analysis of tank heat ingress and internal heat and mass transfer (boil off rate, stratification, and temperature distribution in the insulation) taking into account thermal cycling (e.g. as those related to sloshing events, loading or unloading);
- Numerical analysis of tank internal and external supports to minimise heat leaks through thermal bridges while keeping structural integrity under high thermal stresses

and transport conditions at sea;

- Design and manufacture a tank prototype with a capacity of at least 30 m^3 to trade-off costs and representativeness and test it at relevant environmental conditions (with LH2, appropriate heat loads, accelerations) to confirm the benefits of the new insulation approach and to validate the numerical analysis;
- Analysis of the scalability of the concept among transport volume ranges;
- Demonstration of the techno-economic viability of the concept;
- Investigate cost-efficient manufacturing processes;
- Develop a System Oriented Digital Twin to assess the impact of the insulation at tank level within its functional operation/scenarios (venting, cool down, first-filling, refuelling), and to serve as support for scalability studies after its validation against the prototype experiments;
- Failure Modes and Effects Analysis (FMEA) for the tank concept, and analysis of the resilience and fault-tolerance of the system;
- Demonstration of the safety performance of the insulation concept;
- Evaluate the effects of the insulation system design on the risk management of the LH2 tank;
- Fire resistance of the insulation assembly by modelling and testing;
- Design a tank with improved insulation within the minimum size among proper transport volume ranges;
- Pre-normative standardisation of integrity assessment for LH2 and marine environment exposure and test methods in cooperation with relevant stakeholders from the industry.

Proposals are expected to demonstrate the contribution to EU competitiveness and industrial leadership of the activities to be funded including but not limited to the origin of the equipment and components as well infrastructure purchased and built during the project. These aspects will be evaluated and monitored during the project implementation.

Applicants are encouraged to seek synergies with the Zero Emission Waterborne Partnership concerning regulatory requirements and pre-normative standardisation.

Proposals should provide a preliminary draft on ‘hydrogen safety planning and management’ at the project level, which will be further updated during project implementation.

For additional elements applicable to all topics please refer to section 2.2.3.2

HORIZON-JU-CLEANH2-2026-02-04: Cost-efficient small scale hydrogen liquefaction

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 6.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 6.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 4 and achieve TRL 6 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[175].

<u>*Expected Outcome*</u>

As the hydrogen economy grows and diversifies itself, the need for smaller-scale, point-of-use hydrogen liquefaction will become increasingly important. For applications such as remote transportation hubs, off-grid or remote communities as well as hydrogen-powered industrial facilities with lower LH2 demand (less than 5 metric tons per day (tpd)), having efficient and decentralised liquefaction capabilities is crucial.

While centralised, large-scale liquefaction plants can achieve economies of scale, small-scale facilities need to be cost-competitive and efficient to ensure their viability. This includes optimising energy use, ensuring safety, and designing equipment that can handle fluctuating demand. New technologies and innovations are required to bring down the capital and operational costs associated with small-scale liquefaction of LH2.

Project results are expected to contribute to all the following outcomes:

- Contribute to the roll-out of next generation decentralised hydrogen liquefaction technologies;
- Initiate the deployment of liquid hydrogen for off-takers with lower LH2 demand.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA:

- Increase efficiency and reduce costs of hydrogen liquefaction technologies for small scale liquefaction (<5 tpd);
- Reducing the energy intensity for small-scale hydrogen liquefaction to 12 kWh/kgH_2 at 500kg/day and 10 kWh/kgH_2 at 5 tpd.
- Reducing H2 liquefaction cost to about 3.5 €//kg

[175] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

Scope

The hydrogen liquefaction process is generally composed of the following main technological sub-systems: pre-cooling (incl. heat exchangers with cooling fluid & compressors), cooling (incl. compression), coldbox (including heat exchangers and ortho-para conversion), expansion and boil-off gas management.

To overcome the technological barriers of small-scale hydrogen liquefaction and to prepare a future deployment of smaller LH2 volumes at a higher TRL, the innovative hydrogen liquefaction system developed in proposals should address the following elements:

- Assessment of currently offered technologies for small scale liquefaction plants (<5 tpd)
- Description of proposed technology elements, including e.g.:
  - O-P conversion
  - Precooling to an intermediate temperature in the range of 80-110 K
  - Cryogenic cooling further to 20-30 K
  - Handling/re-liquefaction of gas return from adjacent storage
- Conceptual design optimisation at system scale (incl. all necessary BoPs)
- Development of an innovative small-scale hydrogen liquefaction system (sub-modules, cycle or even equipment) that should:
  - Demonstrate technical and economic improvements at scale (at least >500 kg/day) with a potential for scaling up.
  - Be capable of reducing the energy consumption and specific cost of hydrogen liquefaction at indicated scale.
- Demonstrate the capability of the concept for operating at lower and/or fluctuating load (50-100 %) to be in line with hydrogen production via e.g. water electrolysis from renewable sources;
- Demonstrate through to the prototype's operation, a specific power consumption of 12 kWh/kg for 500 kg/day liquefaction capacity considering feed hydrogen at 20 bar and 20 °C.

The focus should be on the following:

- Reduce the specific energy requirements, e.g. by optimising pre-cooling to an intermediate temperature in the range 80-110 K, and/or by applying innovative thermodynamic optimisation, and/or by improving boil-off recovery strategies etc;
- Evaluate the cost-benefit for handling/re-liquefaction of gas return from adjacent storage;
- Conduct advanced thermal studies on those components or processes generating the highest irreversibility, providing key design features to optimise the small-scale units;
- Create a system's oriented Digital Twin of the new thermal/thermodynamic concept to support the design phase, to extend the description of its behaviour beyond the experimental set-up limits, and by scalability studies generate data to assess the feasibility up to 5 tpd;
- The validated industrial prototype should prove and support the scalability of the

innovative concept to suit flowrates up to 5 tpd.

The proposed technology to be developed should be benchmarked against the technologies commercially available today based either on the Helium Brayton and the Claude cycle at 1 tpd and 5 tpd and should demonstrate reduced liquefaction cost.

Proposals should also address the following economic and regulatory issues:

- The innovative concept should demonstrate a specific liquefaction cost of around 3.5 €/kg for a small-scale unit (1 tpd);
- The project should define a suitable roadmap to prepare the deployment of small volumes of liquid hydrogen solutions;
- Perform techno-economic analysis to identify CAPEX and OPEX drivers, potential paths to improvements, and assess the scalability of the technology. The analysis should focus on especially relevant business cases for the technology such as distributed small-scale liquefaction and re-liquefaction of gas return from adjacent storage.
- Perform conceptual design optimisation to enhance performance, reduce costs, ease of installation and meet stakeholder requirements more effectively;
- Propose accurate business models for commercialisation purposes;
- Contribute to the development of regulations, codes and standards needed for the LH2 safety issues;

Proposals are expected to address sustainability and circularity aspects.

For additional elements applicable to all topics please refer to section 2.2.3.2

HORIZON-JU-CLEANH2-2026-03-01: Integration of control & monitoring tools and strategies for improved Fuel Cell System durability & reliability

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 4.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 4.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 4 and achieve TRL 6 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[176].

<u>*Expected Outcome*</u>

The transition to sustainable mobility is accelerating the adoption of hydrogen-based powertrains, integrating fuel cells, batteries, electric motors and power electronics. In particular, fuel cells (low and high temperature) represent a very promising technology for decarbonising various sectors of mobility, including maritime applications, heavy-duty vehicles and aeronautics. However, remaining aspects that hamper the large-scale diffusion of Fuel Cell Systems (FCS) include their limited lifetime and operational reliability. Moreover, higher fuel cost puts even more stringent requirements and emphasis on system efficiency.

To increase the useful life and reliability of FCS, not only improvements in material and designs are required, but also on control, diagnostic, failure prediction and energy management strategies. It is thus key to integrate advanced prognostic and health management strategies into real operating FCS, suitable not only to enable the detection of anomalies, but also the real-time assessment of the current state of health, developing and integrating proper adaptive recovery strategies to mitigate FCS components' deterioration. These considerations are generally valid for different technologies (PEMFC, SOFC…), which need to be optimally managed: all the components, both in the stack and Balance of Plant (BoP), should be continuously monitored to maximise the FCS lifetime, reliability as well as efficiency.

Project results are expected to contribute to all of the following expected outcomes:

- Improvements of control and energy management that enable increased lifetime and operational reliability at system level, while retaining high system efficiency;
- Providing new product ideas and solutions addressing monitoring and diagnostics of FCS, including hardware and software;

[176] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

- Enhanced durability and reliability of fuel cell systems, including Balance-of-Plant (BoP) components, through predictive maintenance and operational optimisation;
- Development of specific hardware and software platforms, with modular and adaptable architecture enabling application across multiple FCS technologies, to implement diagnostic methodologies for identifying technology-related issues;
- Developing a European open-source platform for sharing data, simulation models, and strategies for control and diagnostics of different FCS technologies (PEMFC, SOFC…) in maritime transport, heavy-duty vehicles, and aviation;
- Building confidence in FC technology for all of the mobility applications, thus accelerating the market uptake;
- Supporting manufacturers, researchers, system integrators, and policymakers and promote technological sovereignty, industrial innovation, and decarbonisation in Europe.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA:

- Reduction of FCS OPEX through predictive maintenance and improved fault detection coupled with fault mitigation;
- Improvement in dynamic operation and efficiency of the FCS, with high durability and reliability, especially when operating dynamically following an established load profile (representative of the application considered);
- Development of tools and methods for monitoring, diagnostics and control of fuel cell systems;
- Increase in FCS durability with regards to the established KPI targets (depending on the selected application) for the End-of-Life (30,000 hours for heavy duty vehicles, 80,000/100,000 hours for marine applications or 50,000 hours for aeronautics);
- Increase in Mean Time Between Failures (MTBF) of critical components and FCS;
- Increase in lifetime of the fuel cell stack or Balance-of-Plant (BoP) components by 15%, directly attributable to the implementation of predictive maintenance and anomaly mitigation strategies, supported by diagnostic tools capable of identifying and isolating at least 95% of degradation mechanisms and malfunctions under representative operating conditions;
- Contribute to increased deployment and adoption of fuel cell technologies by demonstrating long-term system robustness;
- Enable cross-sectoral applicability of solutions across different fuel cell technologies (e.g., PEMFC, SOFC) and fuel types.

Scope

The scope of this topic is on the development, integration and validation of robust online monitoring and control algorithms for FCS, targeting prediction and mitigation of degradation, faults and failures throughout the system lifetime. Focus shall be on Balance of Plant (BoP) components rather than fuel cell stack. Activities should combine experimental testing, digital modelling and may use AI-based techniques to develop and validate predictive tools for health management. Proposals should clearly explain how they go beyond the achievements of previous projects (namely Ruby [1] and Giantleap [2]), identifying specific technical or methodological advances.

Proposals should address the following aspects:

- Develop innovative control, monitoring and diagnostic strategies to enhance FCS durability and reliability, leveraging predictive tools;
- Contribute to the development of standardised protocols for State of Health (SoH) diagnostics and components interoperability in FCS;
- Integrate developed strategies in an open framework, with adaptable hardware/software platforms as core systems for diagnostics and prognostics, adaptable to different types of FCs and other components of the powertrain (i.e., battery, motors, etc.)
- Identify and quantify how BoP components influence FCS durability and reliability, and integrate measures to mitigate degradation and FCS fault and failures;
- Improve the FCS reliability (e.g. increasing Mean Time Between Failures, MTBF) through approaches such as predictive maintenance and condition monitoring applied to key components, using additional (e.g. vibration) or standard (e.g., current/voltage, temperature measurements) or virtual sensors (e.g., estimation of local compositions/conditions);
- Use of artificial intelligence and data-driven methods is encouraged, especially when combined with physics-based modelling. Physical modelling can be used both to develop real-time diagnostic/prognostic strategies and to implement reference models that justify the adoption of specific diagnostic/prognostic strategies;
- As far as possible, all tools and methodologies developed should be made available through open data infrastructure, using common/open data formats and providing interfaces for data access and visualisation.
- Regardless of the type of diagnostic/prognostic algorithm developed (model-based or data-driven), these should be validated using experimental data obtained from real demonstrators. As in previously funded projects such as Helenus [3], experimental data could be obtained from small-scale components (down to low power levels, around 5–25 kW), which may be subjected to specific duty cycles and stress tests (corresponding to at least 1000 hours of accelerated aging tests, run in a laboratory environment or in real vehicles).
- Development of two power system demonstrators integrating FCS, software/hardware for diagnostic/prognostic functionalities and power electronics. Each demonstrator should be based on a relevant FC technology (e.g., one based on a PEMFC and the other on a SOFC system, with single or multiple stacks), with a power output representative of at least 100 kW and taking into account environmental and duty cycle constraints coming from potential OEMs involved. If aging and malfunction models are available (validated on real components of a specific FCS technology), one demonstrator could be replaced by a Hardware-in-the-Loop (HiL) system. In this case, diagnostic/prognostic methodologies should be run on a dedicated real-time target (the same used to monitor the real application);
- Demonstration of the versatility of the methodologies for different fuel cell technologies and with different fuels (when applicable); The demonstrators should be tested under representative duty cycles and operating conditions, providing sufficient evidence to support the achievement of TRL6.

- Creation of an open-access, anonymised datalake, integrating both experimental and high-fidelity simulated datasets (e.g., from digital twins), organised with open standards and anonymised metadata, to enable reproducible research, AI-based diagnostics training, and broad industrial adoption.

Projects should build on the results obtained in previous projects funded in this area of research, such as Ruby[177], GiantLeap[178], Helenus[179] or Virtual-FCS[180], developing and testing (on real systems) innovative methodologies that can be adapted to different FCS technologies.

Furthermore, depending on the application addressed, synergies with the relevant partnerships such be explored, e.g EU-Rail JU (rail), 2ZERO Partnership (road) or Zero Emission Waterborne Transport Partnership (waterborne).

For activities developing test protocols and procedures for the performance and durability assessment of fuel cell components proposals should foresee a collaboration mechanism with JRC[181] (see section 2.2.4.3 "Collaboration with JRC"), in order to support EU-wide harmonisation. Test activities should adopt the already published EU harmonised testing protocols[182] to benchmark performance and quantify progress at programme level.

For additional elements applicable to all topics please refer to section 2.2.3.2

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177 https://cordis.europa.eu/project/id/875047
178 https://cordis.europa.eu/project/id/700101
179 https://cordis.europa.eu/project/id/101056784

180 https://cordis.europa.eu/project/id/875087
181 https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0_en
182 https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0/clean-hydrogen-ju-jrc-deliverables_en

HORIZON-JU-CLEANH2-2026-03-02: Components Development and Experimental Testing for an Onboard Liquid Hydrogen Supply and Conditioning System in High-Power Fuel Cell Aviation Applications

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 8.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to achieve TRL 5 at components level and TRL 4 for integrated subsystems by the end of the project- see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[183].

Expected Outcome

Cryogenically stored hydrogen is the preferred energy carrier for commercial aircraft powered by fuel cells due to its better volumetric energy density. This conditioning system connects the cryogenic hydrogen storage to all onboard propulsion and auxiliary systems, that directly consume hydrogen. However, since fuel cells require gaseous hydrogen, the hydrogen supply system should reliably evaporate hydrogen and provide stable pressure and temperature outputs across a wide range of operating conditions and varying fuel demands, during different flight phases. The system should also be capable of responding to critical scenarios, such as (partial) engine failure, ensuring continuous hydrogen supply to remaining power units. Furthermore, it should be lightweight and aerodynamically efficient, to avoid degrading performance or interfering with flight dynamics.

Such an LH2 supply and conditioning system shall be developed in cooperation between the Clean Aviation and Clean Hydrogen Joint Undertakings, requiring two projects to run in parallel and in synergy[184]. More specifically, while the Clean Aviation JU's project will focus on creating a foundation for a certifiable hydrogen supply and conditioning system by defining system-level requirements, developing system architecture designs and carrying out system performance tests with a demonstrator system in the context of the Call Topic HORIZON-JU-CLEAN-AVIATION-2026-04-HPA-02: "Demonstration of an integrated hydrogen fuel system for a fully electric hydrogen fuel cell powered aircraft", this topic focuses on development and testing of key specific components for LH2 supply and conditioning systems for Fuel Cells based electric propulsion such as those specified in the Scope of this topic text. While Clean Aviation is responsible for the development of the overall system architecture and the design

[183] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

[184] In the event that no project is selected under the related Clean Aviation JU topic, the project selected under this Clean Hydrogen JU topic is expected to propose and pursue suitable alternative pathways to enable relevant integration and demonstration activities.

and testing of architecture-driving components such as the LH_2 pump and heat exchanger, the Clean Hydrogen JU project focuses on the development and validation of non-architecture-driving subsystems and components. These include elements like piping, valves, sensors, and control units. Clean Hydrogen JU's project will further contribute with simulation, analysis, and dynamic testing activities that support component development and explore synergies with other heavy-duty applications.

The project results are expected to contribute to the following outcomes:

- Paving the way to define integrable and certifiable architectures for liquid hydrogen storage, supply and conditioning systems for regional aircraft;
- Paving the way to demonstrate a flightworthy hydrogen supply and conditioning system for regional aircraft (up to 10 MW power class) using liquid hydrogen and fuel cells;
- Facilitating cross-sectoral collaboration and knowledge transfer, supporting industry-related skills and enhance awareness, acceptance and fuel cell systems uptake;
- Developing a regulatory framework for widespread use of large hydrogen cryogenic technology and fuel cell systems;

Project results are expected to contribute to the following objectives and 2030 KPIs of the Clean Hydrogen JU SRIA:

- Enabling continuous hydrogen mass flow in civil aircraft of up to 280 g/s (peak power) and 170 g/s (cruise flight) for up to 10 MW propulsive power. Depending on the system architecture the hydrogen mass flow can be provided by multiple LH2-tank and LH2 supply and conditioning systems.
- Achieving a gravimetric index above 30 % for the entire onboard fuel storage, supply and conditioning system. The defined system boundary includes the cryogenic storage tank (including stored hydrogen), piping, venting, supply and conditioning systems.
- Achieving an operational index of one aircraft-on-ground (AOG) events to a maximum of one per 3000 flight hours for the entire onboard fuel storage, supply and conditioning system.

Scope

The scope of the topic is to design, develop and demonstrate on the ground the reliable and safe operation of key components (up to TRL 5) and integrated sub-systems combining them (up to TRL 4). This includes, but is not limited, to cryogenic valves, insulation, piping, sensors, metering systems and interfaces between the tank and the fuel cell systems. The system level requirements, the preliminary system architecture and the operational envelope will be defined in coordination with the project funded under Clean Aviation JU. In return, the project that will be selected from this topic will provide feedback on component feasibility, performance, development status and deliver pre-tested components for final system integration and testing. A number of defined collaborative meetings will be held to ensure alignment between the system-level design and the component development efforts. While each project has its own deliverables, they will collaborate on integrated testing efforts, where the TRL5 components from Clean Hydrogen project are used to build and test the TRL4 system within the Clean Aviation project.

- Suitable test infrastructures should be used, for example by research institutions and the industrial sector to demonstrate respective technology readiness levels;

- Identify, under the Clean Aviation JU funded project, the scope of the components to be developed and tested;
- Derive the requirements for specific components (e.g. sensors, valves, monitoring systems) from the system definition provided in cooperation with Clean Aviation funded project. This ensures that the developed components will be compatible with the overall system architecture;
- Detailed component design of key components e.g. for the hydrogen feed and vent systems. This includes material selection, sizing, mechanical and thermal analysis;
- Manufacture and test prototype components to validate their performance, functionality and reliability in a cryogenic hydrogen environment;
- Develop and test control algorithms necessary to manage the operation of the components (e.g. valve sequencing for venting, pressure control). These algorithms are essential for safe and efficient system operation;

Simulation and experimental component analysis are needed. Simulations are intended to complement component development activities by providing tools and methods to derive control strategies, optimal operating conditions, optimise thermodynamic integration and assess performance impacts at the aircraft system level. They should include component, subsystems and system modelling (if necessary, from hydrogen onboard storage to hydrogen conversion in fuel cells), to analyse thermo-fluid-dynamic behaviour, dynamics and energy flows.

Therefore, the project should address the following:

- Development and validation of sizing- and simulation tools for hydrogen supply components design tailored to application specific requirements;
- Identification of mass sensitivity for hydrogen supply system components enabling further mass reduction. Exploration of potential indirect weight reductions in other systems by using cooling power availability during evaporation and heat up of liquid hydrogen;
- Reduction of aerodynamic drag associated with heat exchange surfaces for in-situ hydrogen evaporation. Consideration of secondary coolant specifications to optimise the heat exchanger in realistic conditions, while maximising potential use of the available cooling;
- Evaluation of component performance across all operating phases in connection with liquid hydrogen and fuel cell powertrains using simulation tools;
- Development of control strategies for the hydrogen supply and conditioning system relevant for the testing purpose as well as for an hydrogen powered aircraft[185] (HPA) mission profile;

The development of components shall be complemented by experimental system analysis - preferably at research facilities or with support from industrial partner - in combination with a high-power fuel cell system, within a relevant system architecture and power class. Leveraging available infrastructure is expected to provide operational experience under dynamic and mission-relevant conditions, allowing early identification of system-level challenges. These insights will inform and improve component-specific development beyond what could be

[185] https://www.clean-aviation.eu/research-and-innovation/clean-aviation/our-strategic-research-innovation-agenda

achieved through systems engineering alone. In parallel, developed components are expected to undergo individual qualification to ensure performance and reliability. These activities contribute to establishing safe, certifiable, and aviation-ready subsystem maturity.

- Demonstrate hydrogen supply and conditioning component and sub-system operations under application relevant conditions and evaluate responses to system-level failure cases and dynamic constraints;
- Address the durability of materials, components and sub-systems under representative environmental- and mission relevant conditions, including cleanliness and fluid purity sensitivity of the components.

The component development work and the broader sub-system analysis (simulation and experimental testing) are expected to contribute to light weight, energy efficient and low-maintenance designs. The analysis should explore enabling factors (smart topologies, reduction of components & sensors) to achieve such designs, relevant but not limited to the component-level improvements. With system analysis and simulation, critical safety aspects (e.g. failure scenarios, leakage risks, purity effects) are also expected to be assessed.

Scientific analyses and innovation activities should aim to explore the scientific and technological foundations that support safe, certifiable, and high-performance hydrogen supply systems:

- Perform safety and failure mode, effects and criticality analysis in alignment with aviation standards;
- Consider safety requirements for liquid hydrogen supply components: perform review of available liquid hydrogen fueling safety knowledge, prioritise potential incident scenarios, identify and address safety knowledge gaps, propose safety solutions` strategies. Where appropriate based on engineering and development needs, complement these activities with a detailed quantitative risk analysis and derive applicable risk management measures (including safety devices);
- Enablement of robust and safe fuel cell operation in aviation environments;
- Validation of hydrogen leakage rates considering both safety and climate impact;
- Conduct scientific analyses of the potential cooling systems optimisation/reduction by using cooling power available during evaporation and heat-up of liquid hydrogen.

This project should build on insights from Clean Hydrogen JU projects such as ELVHYS[186], HEAVEN[187], BRAVA[188] and COCOLIH2T[189]. HEAVEN contributed to modular fuel cell and cryogenic storage solutions, while BRAVA sets the foundation to demonstrate a hydrogen-powered fuel cell system exceeding 2 MW (propulsive power for one out of several aircraft powertrains), highlighting the potential of hydrogen in future aircraft energy systems. COCOLIH_2T aims to develop a safe composite and vacuum-insulated liquid hydrogen (LH2) tank for the aviation sector, using innovative fabrication technologies to design and manufacture a conformal tank. It should also leverage findings from the Clean Aviation JU projects HEROPS[190], NEWBORN[191], FAME[192], H_2ELIOS[193], which explores the integration of

[186] https://cordis.europa.eu/project/id/101101381
[187] https://cordis.europa.eu/project/id/826247
[188] https://cordis.europa.eu/project/id/101101409
[189] https://cordis.europa.eu/project/id/101101404
[190] https://cordis.europa.eu/project/id/101140499
[191] https://cordis.europa.eu/project/id/101101967
[192] https://cordis.europa.eu/project/id/101140559
[193] https://cordis.europa.eu/project/id/101102003

liquid hydrogen and fuel cells in propulsion architectures for emission-free regional aircraft.

In order to secure the exchange of the necessary elements (such as, but not limited to, liability, background and foreground IP, hardware, digital and physical assets) and information (requirements, specifications, etc.) needed to perform the components testing activities at the TRL targets defined in this topic at project completion, the project selected under this topic will require an enhanced cooperation with the project(s) funded under the Clean Aviation topic "HORIZON-JU-CLEAN-AVIATION-2026-04-HPA-02: Demonstration of an integrated hydrogen fuel system for a fully electric hydrogen fuel cell powered aircraft".

The project may also build on prior developments from earlier national or other European programs.

Development of cryogenic tank and fuel cell system are excluded from the scope of the topic.

Additional considerations:

- R&D activities should be scalable and transferable to aviation and potentially present positive spill-over effects with other heavy-duty applications.
- Projects should outline how the developed components - while tailored for fuel cell applications - could also enable positive spill-over effects for hydrogen combustion in aviation, supporting broader hydrogen use cases across propulsion technologies;
- Projects should justify proposed budgets based on component/system test size, test duration, and TRL objectives;
- Innovation activities should clearly define the novel aspects and demonstration scale;
- Collaboration across relevant stakeholders and end users (e.g., aircraft manufacturers, fuel cell and hydrogen technology developers, certification bodies) is encouraged;
- While formal certification is not required within this call, proposals should demonstrate how their results and activities support future certification processes and compliance with relevant aviation standards.

For additional elements applicable to all topics please refer to section 2.2.3.2.

HORIZON-JU-CLEANH2-2026-03-03: Flexible and standardised hydrogen storage system

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 5.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 5.00 million.
Type of Action	Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 5 and achieve TRL 7 by the end of the project - see General Annex B.
Admissibility conditions	The conditions are described in General Annex A. The following exception applies: The page limit of the application is 70 pages.
Eligibility	The conditions are described in General Annex B. The following additional eligibility criteria apply: At least one partner in the consortium must be a member of either Hydrogen Europe or Hydrogen Europe Research. The maximum Clean Hydrogen JU contribution that may be requested is EUR 5.00 million – proposals requesting Clean Hydrogen JU contributions above this amount will not be evaluated.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[194]. Beneficiaries must, up to 4 years after the end of the action, inform the granting authority if the results could reasonably be expected to contribute to European or international standards. Purchases of equipment, infrastructure or other assets used for the action must be declared as depreciation costs. However, for the following equipment, infrastructure or other assets purchased specifically for the action (or developed as part of the action tasks): hydrogen storage system, costs may exceptionally be declared as full capitalised costs.

Expected Outcome

To achieve the Clean Hydrogen JU's objective of accelerating hydrogen deployment across multiple sectors, the development of flexible, interoperable, and standardised hydrogen

[194] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

storage systems is critical. The proposed topic aims to reduce the entry barrier for OEMs, especially SMEs, by delivering a modular and standardised approach to hydrogen storage integration. Standardising storage systems, connections and control systems is important to help new and advanced hydrogen storage technologies grow. It sets a unified framework that makes it easier and faster to implement innovative storage systems and materials in different applications. Standardisation supports a wider use of next-generation hydrogen solutions, in line with the Strategic Research and Innovation Agenda (SRIA) goals.

While the StasHH project developed standard fuel-cell modules that can be easily integrated by OEMs into their vehicles, a similar solution does not exist for hydrogen storage, which can present a similar hurdle for OEMs.

Fuel-cell manufacturers have noted OEMs often engineer in-house with custom, incompatible solutions. This places a significant burden on OEMs, who need to integrate hydrogen storage solutions into their products, requiring significant experience and know-how. Standardised storage solutions with clear boundaries and requirements will allow OEMs to include hydrogen storage into their designs faster and with less effort, enabling also smaller OEMs to deploy hydrogen-fuelled prototypes.

The project results are expected to contribute to the following outcomes:

- Availability of modular hydrogen storage solutions based on a limited set of standardised block sizes, suitable for use across a wide spectrum of heavy-duty applications, such as trucks, trains, buses, off-road vehicles, ships, and stationary generators. The solution should allow extending the storage capability across the full range of applications;
- Interoperability between different OEM components through standardised physical interfaces and communication protocols;
- Lowered development and innovation costs for OEMs developing their first hydrogen prototypes;
- Standardised refuelling procedures that can be automatically adapted by hydrogen refuelling stations based on the actual composition and capacity of the storage system;
- Increased safety and efficiency in deployment by simplifying installation, validation, and regulatory approval of hydrogen systems;
- European and international standardisation activities, including CEN/CENELEC, ISO or SAE, and alignment with ongoing regulatory frameworks;
- Harmonisation of technical standards as well as certification and approval for hydrogen storage across the EU;
- Improve public trust and acceptance of hydrogen-fuelled vehicles and vessels.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA:

- Supporting and accelerating the wide roll out of FC HDVs;
- Improvements in design and monitoring procedures of FC systems;
- Prototyping activities, development of control, diagnostic and prognostic procedure, interfaces between sub-systems and integration;
- Storage tank CAPEX targets: 500 €/kg (CH2), 320 €/kg (LH2); these numbers refer to mass production.

- Gravimetric capacity: 7% (CH2), 12% (LH2);
- Volumetric capacity: 45 gH2/litre (LH2);
- Conformability: 55% (LH2).

For the technologies for which the SRIA does not provide KPIs, proposals should define their own based on the state of the art.

Additionally, projects should address the following supplementary KPIs:

- Demonstrate modular storage units that are interoperable across, at least three different OEM systems or platforms;
- For the technologies for which this is relevant, the energy consumption for defueling and hydrogen preconditioning in kWh/kgH2 and its nature (electricity, heating, cooling, …) and its impact on TCO.

Scope

The scope of this topic is to develop a flexible and standardised hydrogen storage interface that supports the integration of multiple storage technologies and is easily deployable across mobility sectors, with possible spillovers on stationary applications. The interface should provide a limited set of basic sizes for the storage units (joinable to reach an adequate capacity for each specific application); this set should be as small as possible to simplify hydrogen storage manufacturing, and as large as necessary to cover relevant mobility applications. Proposals should build on the outcomes of StasHH (Standard-Sized Heavy-Duty Hydrogen) and extend the concept toward hydrogen storage. Projects should include at least compressed hydrogen and may include other storage forms such as liquid hydrogen, cryo-compression, metal hydrides, ammonia followed by cracking systems, or methanol followed by reforming technologies, LOHC, or any other.

Proposals should develop storage technologies that achieve safety levels equal to or exceeding the current state of the art; the topic covers pre-normative research into any engineering solution for hydrogen storage, including compressed, liquefied, cryo-compressed, metal hydrides, and hydrogen carriers such as ammonia, methanol and LOHC, etc.

There is no requirement that the stored hydrogen is to be used in a fuel cell in a demonstration; any use of hydrogen, including combustion, is acceptable. However, the storage system should output hydrogen at conditions acceptable for usage with fuel cells (purity, temperature, pressure etc.). While the topic allows the use of hydrogen for combustion-based applications, fuel cell compatibility should be prioritised. Any combustion-related activities, if chosen and proposed, should clearly demonstrate alignment with SRIA objectives and justification for their relevance in the targeted use case.

Proposals should address:

- Development of standardised containers/modules for hydrogen storage for at least gaseous and one other storage technology, using standardised interfaces;
- Design of universal mechanical and digital interfaces enabling plug-and-play integration. These interfaces should be compatible across different storage technologies to allow OEMs to easily swap storage technology;
- Demonstration of compressed hydrogen storage and of another technology on at least two TRL 7 prototypes. Prototypes should be heavy-duty vehicles such as trucks, trains, buses, off-road vehicles or ships; these do not need to operate on fuel cells, but in case of hydrogen storage based on chemically bound hydrogen (ammonia, methanol,

LOHC, etc.) the storage system should be able to produce FC-grade hydrogen. Each prototype should store at least 25 kg of hydrogen;

- Proposed storage solution(s) should have modular and/or scalable structure that can be flexibly configured to accommodate the spatial, structural and operational constraints specific to the selected application, e.g. rail, maritime, off-road and heavy-duty road transport;
- At least one demonstration should be run with two different hydrogen storage technologies, which can be replaced without significant modification of the host prototype to validate the flexibility in terms of the ability of both technologies to operate with the same interface;
- Validation of system safety and performance under real-world operational conditions. Safety should be thoroughly assessed with explosion prevention and mitigation strategies, with an approach applicable to all possible storage configurations;
- Quantify the total cost of ownership (TCO) of the solution compared to the state of the art and perform a life-cycle analysis of the solution; the life-cycle analysis should include the hydrogen production step;
- Testing campaigns to be conducted at system-level, lasting at least a total of 6 months, including at least one operational demonstrator above 50 kg usable H_2 capacity;
- Submission of the standard to a relevant standard institute (ISO, IEC or similar), also beyond the EU.

The design should be compatible with all requirements of the specified application, such as durability, exposure to harsh environments, vibrations, accelerations, refuelling/bunkering safety, fire safety, etc. Modifications of standard storage units for specific applications may be acceptable as variants if they entail low costs and effort by the manufacturer, and do not compromise compatibility and reusability.

Proposals should elaborate on the potential technological scalability and applicability in domains other than those demonstrated, e.g. stationary systems or different means of transportation (road, rail, marine, aviation, etc.). Particularly, applicants are encouraged to consider maritime applications and to create synergies with the relevant initiatives such as Waterborne Technology Platform and ZEWT partnership projects, to make sure there is an alignment with ongoing developments in waterborne sector. Furthermore, depending on the application addressed, synergies with other partnerships such be explored, e.g EU-Rail JU (rail) or 2ZERO Partnership (road).

Involvement of a representative set of stakeholders including OEMs, Tier 1 suppliers, system integrators, and end-users, as well as standardisation bodies , formal notified bodies and regulators is encouraged. Consortia should include manufacturers of the relevant hydrogen storage systems, system integrators and end users; they may also include fuel-cell system OEMs and mobility OEMs if appropriate.

Proposals are expected to demonstrate the contribution to EU competitiveness and industrial leadership of the activities to be funded including but not limited to the origin of the equipment and components as well infrastructure purchased and built during the project. These aspects will be evaluated and monitored during the project implementation.

Proposals should consider circularity and recyclability of the storage units and support a clear pathway toward certification and future commercialisation.

Note that, while the SRIA mentions consistently FC HDVs, HDVs based on hydrogen combustion engines are not excluded from this topic.

Proposals should provide a preliminary draft on hydrogen safety planning and management at the project level.

For additional elements applicable to all topics please refer to section 2.2.3.2

HORIZON-JU-CLEANH2-2026-03-04: Multi-fuel SOFC powertrain for maritime transport

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 8.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 4 and achieve TRL 6 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[195].

<u>*Expected Outcome*</u>

Maritime transport is a vital component of society worldwide and faces environmental challenges due to its contribution to global greenhouse gas (GHG) emissions. The International Maritime Organisation's (IMO) revised GHG Strategy includes an enhanced common ambition to reach net-zero GHG emissions from international shipping by or around 2050, with a commitment to ensure an uptake of alternative zero and near-zero GHG fuels by 2030, as well as indicative checkpoints for 2030 and 2040 considering different national circumstances.

This creates an urgent need for innovative solutions not only to reduce local pollutant emissions (SOx, NOx and PM) but also to decarbonise maritime transport. Current technologies based on hydrogen, ammonia and sustainable fuels have become important alternatives and have attracted the interest of port authorities, ship builders' propulsion systems manufacturers as well as end-users (ship owners).

From the users' side, Internal Combustion Engines (ICEs) are currently being developed to use the above-mentioned alternative fuels. Nevertheless, PEMFCs are gaining momentum with increasing sizes, making it possible to use FCs in propulsion of waterborne vessels. Although ICEs can already be operated with alternative fuels and in multi-fuel arrangement, challenged remain to match the very low emissions achievable by FCs, especially under dynamic and idling operation. Moreover, ICEs may reach efficiencies in the 50 % range, inferior to most FC technologies.

[195] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

PEMFCs require high-purity hydrogen but storing hydrogen onboard as a gas is bulky and less suitable for long-duration missions or high-power demands. Although liquid hydrogen offers higher energy density, it introduces energy penalties and operational complexities—such as cryogenic storage—which makes it a less preferred option for many types of vessels. Besides, given the limited availability of hydrogen as a fuel, there is a strong desire for FC technologies which can be operated with either higher energy dense decarbonised or green fuels in multi-fuel mode. Such technology is represented by Solid Oxide Fuel Cells (SOFCs), exhibiting higher tolerance to hydrogen impurities, to the presence of carbon in the fuel formulation, and the capability of converting hydrogen derived fuels directly. Currently, the most limiting characteristics of SOFCs are the stack size (typically < 10kW) and the cost, which so far have prevented the use of SOFCs in maritime transport at MW size.

SOFC development for maritime applications can contribute to significant reductions in GHG emissions and increase the maritime sector's energy fuel efficiency. This will be possible if state-of-the-art SOFC stack/systems are addressed in a more focused way for maritime applications. Nevertheless, the adaptation of SOFCs to harsh maritime environments presents unresolved challenges including durability, availability, maintenance, potentially more frequent starts and stops and changes of load, more frequent off-design and transient operation, system integration and availability of components for the Balance of Plant (BoP), reduced footprint and increased safety issues, onboard integration and space requirements, and fuel flexibility[196].

Project results are expected to contribute to all the following expected outcomes:

- Further development of SOFC technologies capable of converting the carbon-neutral fuels directly and efficiently to power for reduced operational costs for maritime operators;
- Strengthen the European industry's competitiveness and market share in an emerging global market for low and zero emission maritime power conversion technologies;
- Speed up the implementation of zero emission maritime propulsion systems in Europe by paving the way for using available fuels in an early phase of the green energy transition;
- Establishment of regulations codes and standards for the use of alternative fuels in maritime applications.
- Develop and demonstrate solutions for the use of climate-neutral, sustainable alternative fuels applicable to ships with energy demand (20 solutions by 2030);
- Develop and demonstrate solutions to be able to reduce the fuel consumption of waterborne transport, including by the use of non-fuel based propulsion (such as wind), by at least 55% before 2030, compared to 2008.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA:

- FC power rating: 10 MW as a sum of smaller building blocks
- Maritime FCS lifetime: 80.000 h
- CAPEX: 2000 €/kW
- Efficiency (%LHV H2): electrical: 60%, with heat recovery :95%

[196] Horizon 2020 Project Reports, "Advancements in SOFC Technology for Maritime Applications"

- Availability (%): 99
- Warm startup time (min): 2

Scope

The proposal should be based on further developing the results of previous projects that have laid a foundation in SOFC development for stationary applications and correctly consider the challenges met from a holistic perspective. Projects such as Helenus[197] ,Fuelsome[198] and ShipFC[199] are currently active, and proposals should consider the publicly available results and the problems faced by those projects and activate possible interactions and collaborations to produce technological advancements and novel solutions.

The scope of this topic is to address remaining technological challenges beyond TRL4, specifically focusing on the development, design, and demonstration in a real environment of a robust SOFC system. Proposals should focus on innovations in components, system engineering, and integration techniques which enhance the durability and efficiency of SOFCs, the installation and operation onboard of waterborne vessels. The intention is to develop a SOFC based building block for future higher power and long-lasting SOFC modules eventually leading to multi-MW SOFC systems for maritime applications in multi-fuel operational mode. Furthermore, the project will tackle the regulatory landscape, supporting policymakers through the development of standards and guidelines that facilitate the integration of SOFCs into maritime vessels.

Proposals should address the following elements:

- Design and manufacturing of a minimum 100 kW SOFC system, specifically designed to operate with multiple fuels and at ambient aggressive conditions typical of a ship machinery space capable of operating when subject to vibrations, shock and tilting of +/- 22.5 degrees in all directions and work in an environment with marine aerosol and at temperature and humidity conditions typical of a waterborne vessel;
- Design the system as a building block for a MW scale power system, designed for propulsion, hotel load or both, aiming at a comparable installation footprint to a 1 MW PEMFC for the same application, and in any case optimising the spatial footprint considering safe and effective operation and ease of maintenance;
- Improved durability and efficiency of SOFC system in maritime conditions, addressing common challenges such as corrosion, vibration, aggressive environmental conditions (reduced temperature and increased humidity) and saltwater mist exposure;
- Improvement in the design of control system to follow the load in maritime applications and for increased numbers of start and stops. Modelling the SOFC system with special attention to energy efficiency, dynamic load, and heat balance, as well as emissions for various alternative fuels;
- Testing for validation the SOFC system under simulated maritime conditions (experimental lab validation and/or hardware in the loop modelling validation), including mechanical vibrations, tilting, salt mist exposure, and temperature/humidity variations, to ensure safe and reliable operation onboard;

[197] https://cordis.europa.eu/project/id/101056784
[198] https://cordis.europa.eu/project/id/101069828
[199] https://cordis.europa.eu/project/id/875156

- Testing of the SOFC system performance with each proposed fuel and over at least 1000 hours total with one or successively two fuels, in relevant environment, providing power, in a fuel cell/battery hybrid arrangement, following the load profile representative of a real maritime application;
- Developing, quantifying and validating degradation mitigation strategies for the >100 kW system.
- Feasibility study of a scalable, MW scale SOFC system for maritime use with design of BoP components, considering at least those related to heat management/balance and fuel processing (internal and/or external reforming or cracking), including improvement in design, maximise lifetime, reliability and availability and simplify the maintenance and repair;
- Carrying out Techno-economic and sustainability assessments by using LCA (Life Cycle Assessment) and LCC (Life Cycle Costing) documenting the environmental and economic viability of the selected fuels and their compatibility with SOFCs and considering the circularity of materials and end-of-life aspects.
- Define all the specifications and set out the process to achieve classification requirements, including reliability and operational safety in marine environments, and to develop specific training and skill developments models.

The consortium should include stakeholders from across the value chain, including FC manufacturers or integrators, shipbuilders and/or designers, maritime operators, research institutions, classification societies and regulatory bodies, to ensure comprehensive industry insights and facilitate market adoption.

Multi-fuel mode can be included but is not exclusively aimed at green hydrogen derived fuels containing carbon (such as e.g. methanol or methane). At least one fuel should be fully decarbonised, such as hydrogen or ammonia.

Applicants are expected to demonstrate how they will work in synergies with the relevant projects and initiatives supported by the Zero Emission Waterborne Partnership including but not only the Helenus[200] project. Applicants should also consider the experiences and learning of other relevant projects like Fuelsome[201] and ShipFC[202] projects (this last one supported by the Clean Hydrogen JU).

Proposals are expected to demonstrate the contribution to EU competitiveness and industrial leadership of the activities to be funded including but not limited to the origin of the equipment and components as well infrastructure purchased and built during the project. These aspects will be evaluated and monitored during the project implementation.

Furthermore, proposals are expected to explain the contribution of their objectives, results, IP management and exploitation strategy to the EU Maritime Industrial Strategy and the Net-Zero Industrial Act with a particular aim to enhance the EU's R&I capacity, technological know-how capabilities and human capital, and resilience of the EU industrial and manufacturing base. In addition, proposals are encouraged to include synergies with EU and EEA[203] shipyards, equipment manufacturers and providers, including start-ups and SMEs as relevant.

200 https://cordis.europa.eu/project/id/101056784
201 https://cordis.europa.eu/project/id/101069828 (not flagged as a ZEWT topic, but still relevant to this topic)

202 https://cordis.europa.eu/project/id/875156
203 European Economic Area

For activities developing test protocols and procedures for the performance and durability assessment of fuel cell components proposals should foresee a collaboration mechanism with JRC[204] (see section 2.2.4.3 "Collaboration with JRC"), in order to support EU-wide harmonisation. Test activities should adopt the already published EU harmonised testing protocols[205] to benchmark performance and quantify progress at programme level.

For additional elements applicable to all topics please refer to section 2.2.3.2

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[204] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0_en
[205] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0/clean-hydrogen-ju-jrc-deliverables_en

HORIZON-JU-CLEANH2-2026-04-01: Next generation of reversible proton conducting ceramic cells and stacks for efficient energy applications at ≥1 kW scale

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 3.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 3.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to achieve TRL 4 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[206].

Expected Outcome

The growing global energy demand coupled with the concerns about environmental pollution necessitates an increased share of renewable energy sources, implementation of C-free fuels and electrification of energy intensive industry. This calls for developing an efficient reversible proton conducting ceramics (PCC) technology capable of producing hydrogen and operate with hydrogenated fuels to reduce operational downtime and benefit from sector coupling. A flexible solution can be implemented with the use of proton conducting ceramic cells, which can selectively extract hydrogen from various gas streams through proton transport in the dense electrolyte at intermediate temperatures ranging from 450 to 750 °C. For instance, electrochemical proton conducting ceramics (PCC) are investigated for reversible steam electrolysis and hydrogen fed fuel cells, ammonia fed fuel cell, ammonia cracking to hydrogen, CO_2 conversion to chemicals, dehydrogenation of hydrocarbons. Extensive research at the single cell level for these applications is showing that PCCs can produce, extract, purify, electrochemically compress, and use hydrogenated molecules as feedstock for power and/or chemicals production. While PCC cells are investigated in many applications, limited studies have been conducted on assessing the techno-economic potential of this technology for reversible operation.

There are several challenges to overcome to reach higher technological scales. The research work is primarily directed at cell level, which precludes the possibility for optimising thermal management. Reversible operation contributes to accelerated degradation in fuel cell mode, requiring more research on materials and cell assemblies, and their thermomechanical stability. In addition, there are challenges in developing reversible electrodes, which are equally active in both fuel cell and electrolysis modes. Improved electro-catalytic performance and faradaic efficiency have been observed when operating the cells in pressurised electrolysis or fuel cell mode. However, the mechanical integrity of the cells and traditional

[206] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

ceramic-based seals is difficult to maintain under these conditions (typically above 5 bar, and/or small pressure fluctuations).

Electrochemical devices integrating proton-conducting ceramics (PCCs) represent an emerging class of high-temperature energy systems. While conventional solid oxide cells (SOCs) rely on pure oxygen-ion conduction, PCCs transport protons either predominantly or in combination with oxide ions (co-ionic conduction) in some specific conditions through a dense ceramic electrolyte. The co-ionic electrolyte-based ceramic cells introduce simultaneous protonic and oxide-ion transport, enabling dynamic in situ water management across both electrode chambers. This dual ionic conduction opens new pathways for optimising electrode architectures and interfacial processes with the potential for significantly enhancing electrochemical performance, stability, and integration with downstream hydrogen and synthetic fuel production systems. PCC enables operation at lower temperatures ranging from 450 to 750 °C, offering significant advantages such as reduced thermally induced material degradation, lower system costs, and could improve compatibility with intermittent renewable energy sources. These attributes make PCCs highly promising for accelerating the transition toward more sustainable energy infrastructures.

Project results are expected to contribute to all the following expected outcomes:

- Development of reversible PCC technology that will enable the replacement of energy/emission-intensive thermal processes by electrochemical ones;
- Integration of PCC systems with renewable energy sources (e.g., solar or wind) to validate dynamic performance and grid-balancing capabilities;
- Reduction of CAPEX and OPEX of the PCC technology through innovation in cell and stack design, manufacturing, durability, and operational strategies;
- Evaluation of new business cases benefiting from reversible operation and/or multi-mode operation and/or fuel flexibility of the PCC stacks, contributing to paving the way for further scaling up and deployment of PCC technology;
- Contribution to the establishment of European leadership in reversible PCC technology with European supply chain of cells and stacks.

Projects should deliver a clear pathway for roll out of the technology and industrial uptake.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA for 2030:

- Cell current density (at operating voltage and temperature): > 0.75 A/cm^2
- Degradation rate of cell: < 1% /1000 hr in each operational mode
- Stack current density: > 0.5 A/cm^2
- Degradation rate of stack: < 2.5% /1000 hr in each operational mode
- Faradaic efficiency: ≥ 84% in electrolysis mode

Scope

This topic focuses on the development of advanced protonic or co-ionic ceramic electrochemical cells and stacks for reversible application to improve performance and durability. This should take into consideration strategies for reducing and/or recycling critical and strategic raw materials at cell/stack level. All geometries (e.g. tubular or planar) and cell architectures are in the scope of the topic. The applications of hydrogen separation, and/or hydrogen pumping or related (either side of the PCC in reducing gas atmospheres) are not in the scope.

The proposals should focus on the development and validation of novel proton ceramic or co-ionic (dual transport of protons and oxygen ions) electrochemical cells and stacks, which operate reversibly in electrolysis and fuel cell mode with high efficiency and durability. The reversible technology should be integrated in various use cases (e.g., considering various sectors, use of different fuels for the fuel cell mode, integration with renewable sources, etc.). The proposals should demonstrate how the reversibility is beneficial to the selected user cases and establish how the performance and durability of both cells and stacks are affected by the cell/stack design and the operational strategies.

Proposals should go beyond the scope and ambition of previous European projects (e.g., eCOCO2[207], WINNER[208], PROTOSTACK[209], GAMER[210], HySPIRE[211], PEPPER[212], ECOLEFINS[213]) and should address:

- Innovations in design and manufacturing of materials, components and assemblies to improve performance, efficiency, and durability under reversible operation;
- The proposal should demonstrate how sustainability aspects - such as reduction of Critical and Strategic Raw Materials (CSRM) content or incorporation of recycling strategies - are addressed;
- Cell and stack design advancements to optimise operation under dynamic conditions, as well as optimisation of thermal management within the stack undertaken through both modelling and experimental validation to provide design guidelines for scaling-up the stack technology. Thermal management of the stack and analysis of thermo-mechanical stresses in the different operation modes (e.g. in fuel cell mode and electrolysis mode) at stack design shall be considered;
- Validation of the reversible operation in both fuel cell (power generation) and electrolysis modes involving hydrogen, and where relevant for the use case scenario, operation with other hydrogen carriers (e.g. ammonia), co-electrolysis or (de)hydrogenation processes, etc;
- Validation of cell and stack operation in testing conditions representative of the selected applications for 2,000 hr operation;
- Production of stacks with multiple repeating units;
- The reversible operation should be demonstrated at a minimum scale of 1 kW power class;
- Elucidation of degradation mechanisms at component, cell and stack levels with the support of modelling and/or advanced characterisation techniques;
- Techno-economic assessment of the reversible technology, demonstrating system-level feasibility, impact of thermal management and associated benefits in selected user cases;

[207] https://cordis.europa.eu/project/id/838077
[208] https://cordis.europa.eu/project/id/101007165
[209] https://cordis.europa.eu/project/id/101101504
[210] https://cordis.europa.eu/project/id/779486
[211] https://cordis.europa.eu/project/id/101137866
[212] https://cordis.europa.eu/project/id/101192341
[213] https://cordis.europa.eu/project/id/101099717

- Evaluation of at least two use cases with assessment of the environmental impact. This includes environmental life cycle analysis (LCA), demonstrating added value, decarbonisation potential, and compatibility with future energy system scenarios.

Experimental activities are expected to start at the material and cell level and end at the stack level with validation under relevant operation conditions. Broad engagement of stakeholders across the value chain is encouraged to support the transition towards industrial deployment and to ensure alignment with market needs.

For activities developing test protocols and procedures for the performance and durability assessment of (reversible) electrolysers proposals should foresee a collaboration mechanism with JRC[214] (see section 2.2.4.3 "Collaboration with JRC"), in order to support EU-wide harmonisation. Test activities should adopt the already published EU harmonised testing protocols[215] to benchmark performance and quantify progress at programme level.

For additional elements applicable to all topics please refer to section 2.2.3.2.

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[214] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0_en
[215] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0/clean-hydrogen-ju-jrc-deliverables_en

HORIZON-JU-CLEANH2-2026-04-02: Demonstration of rSOC operation for local grid-connected hydrogen production and utilisation

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 8.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 8.00 million.
Type of Action	Innovation Action
Technology Readiness Level	Activities are expected to start at TRL 5 and achieve TRL 7 by the end of the project - see General Annex B.
Admissibility conditions	The conditions are described in General Annex A. The following exception applies: The page limit of the application is 70 pages.
Eligibility	The conditions are described in General Annex B. The following additional eligibility criteria apply: At least one partner in the consortium must be a member of either Hydrogen Europe or Hydrogen Europe Research. The maximum Clean Hydrogen JU contribution that may be requested is EUR 8.00 million – proposals requesting Clean Hydrogen JU contributions above this amount will not be evaluated.
Procedure	The procedure is described in General Annex F.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[216]. Purchases of equipment, infrastructure or other assets used for the action must be declared as depreciation costs. However, for the following equipment, infrastructure or other assets purchased specifically for the action (or developed as part of the action tasks): (reversible) solid oxide cells system, hydrogen storage and other hydrogen related infrastructure needed for the demonstration of the (reversible) solid oxide cells system, costs may exceptionally be declared as full capitalised costs.

Expected Outcome

Given the increasing penetration of Renewable Energy Sources (RES), Long Duration Energy Storage (LDES) is essential to facilitate their integration into the power grid and avoid

[216] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

overbuilding infrastructure. Reversible Solid Oxide Cells (rSOC) offer a valuable solution to this problem, also leveraging the effective coupling between the gas and electricity grids. Reversible fuel cells could be a solution to this problem, but they are still in the early stages of commercial deployment, with ongoing research focused on improving efficiency, durability, and cost-effectiveness. The project should demonstrate the use of rSOC for providing services to both the electric and hydrogen grids or proxy environments (*e.g.*, on-site usages) including heat recovery. When operated in electrolysis mode, the MW-scale system should produce hydrogen to then be compressed and injected into the hydrogen infrastructure or a storage solution. When operated in Fuel Cell (FC) mode, the system will consume hydrogen to produce electricity.

Despite their potential, the widespread adoption of rSOC technology still faces several challenges. One of the primary issues is the need for large-scale demonstration projects to validate their performance, reliability, and economic viability in real-world conditions. Additionally, the integration of rSOC systems into the existing electricity grid requires advanced control strategies and robust system designs to ensure seamless operation and grid stability.

The topic of the project will focus on validating the system's ability to support grid stability, also assessing the impact of hydrogen pressure in the hydrogen pipeline, and the stability of energy price. This will contribute to the development of a more flexible and resilient energy infrastructure, supporting the sector coupling and transition to a decarbonised energy system.

Project results are expected to contribute to the following expected outcomes:

- Demonstrate the integration of rSOC to enhance the coupling between the hydrogen and electricity grid;
- Contribute to the definition of best practice guidelines and support regulation definition for the development and monitoring of reversible systems for sector coupling and grid balancing;
- Contribute to the European energy supply and exploitation of Renewable Energy Sources providing solutions for Long Duration Energy Storage (>8 hours) applications;
- Support the integration of scalable and replicable rSOC-based Long Duration Energy Storage (LDES) solutions into European energy strategies and infrastructure planning, enabling more efficient use of renewable generation and reducing the need for overbuilding grid infrastructure.

Project results are expected to contribute to the following objectives and KPIs of the Clean Hydrogen JU SRIA:

- For Pillar 1, “Renewable Hydrogen Production” and sub-Pillar 1, “Electrolysis”: renewable hydrogen to become competitive by scaling up rSOC systems, increasing the efficiency of renewable hydrogen production and increasing profitability by also using the same system for efficient electricity generation, thereby increasing overall utilisation.
- For Pillar 3.2, “Hydrogen end uses – Clean heat and power” and sub-Pillar 1, “Stationary fuel cells”: enhance the flexibility of systems in operation through reversible fuel cells.

Scope

The scope of this topic builds on the significant advancements made by previous European projects in the field of reversible solid oxide cells systems (rSOC). The REFLEX[217] project has developed an innovative renewable energy storage solution called "Smart Energy Hub", which is based on rSOC technology. The SWITCH[218] project focused on the development of a rSOC able to guarantee highly pure hydrogen production in compliance with main industrial and automotive standards. The European project REACTT[219] focused on developing and demonstrating advanced diagnostic and control tools for rSOC, highlighting the importance of monitoring, diagnostics, prognostics, and control tools for SOE and rSOC stacks and systems with the aim of enhancing the system reliability and extend stack lifetime. Within the SO-FREE[220] project, they developed a solid oxide FC-based system for combined heat and power generation. More recently, the 24_7 ZEN[221] project has contributed to understanding Solid Oxide Cells by developing and demonstrating a cutting-edge reversible solid oxide cell (rSOC) power-balancing plant at a 33/100 kW scale, designed to be compatible with both gas and electricity grids.

Despite advances in addressing key technical challenges and demonstrating the feasibility of rSOC systems across various operational contexts, several challenges remain in integrating rSOC systems with existing gas and electric grids. Building on these results, the scope of this topic is to validate the performance, reliability, and economic viability of MW-scale rSOC systems in real-world conditions, providing valuable insights and data to support the broader adoption of this technology to the grid, and generating data which serve as basis for comparison with battery storage of electricity, for instance.

The reversible solid oxide system (rSOC) should be designed, developed, installed, and operated to demonstrate its capability, availability, and reliability in real-world, MW-scale applications.

The costs (CAPEX) of the whole system including multiple stacks, BoP and gas handling system (purification, compression, and control), as well as the costs for the construction and commissioning phase (e.g connection to the electricity/gas grid, electricity/gas/hydrogen costs) of the reversible solid oxide system may be funded. The OPEX (electricity and gas/hydrogen costs in demonstration/business operation) will not be funded.

Key requirements include:

- A minimum system capacity of at least 1 MW in electrolysis mode to ensure that the solution is scalable and representative of real-world deployment scenarios. The system can contain multiple modules. The modules, as building blocks for the whole system, should provide at least 10 kW electrolysis power. Modules can contain several stacks to reach at least 10 kW electrolysis . This will help in addressing the knowledge gaps associated with rSOC;
- The system should be designed to be able to deliver services to the electricity infrastructure, contributing to sector coupling and overall energy system flexibility;
- The rSOC should be connected to the electricity grid. Where relevant, a hydrogen storage system should be included to enable flexible operation in both electrolysis and fuel cell modes. The setup should allow simulation of ancillary service provision and

[217] https://cordis.europa.eu/project/id/779577
[218] https://cordis.europa.eu/project/id/875148
[219] https://cordis.europa.eu/project/id/101007175
[220] https://cordis.europa.eu/project/id/101006667
[221] https://cordis.europa.eu/project/id/101101418

validate the system's role in sector coupling and grid balancing of the electric grid;

- Leverage hydrogen and/or biofuels/biogas grid connection to enable electricity generation and ensure continuous system operation when it is not operated in electrolysis mode.
- Operation for over 5,000 h under dynamic conditions, including both operation modes (SOFC/SOEC and switching) and H2 purity at least 99.5%, with performance data addressing key operational characteristics such as:
  - High ramp-up speed and cycling capability.
  - Effective heat management strategies.
- Demonstrate at least 1000 h of electrolysis operation at thermoneutral voltage according to nominal temperature with or without temperature adjustment.
- The entire setup should also include the infrastructure required for injecting hydrogen into the hydrogen grid or a storage facility.
- Hydrogen produced from the rSOC should be compressed using a compressor unit to ≥5 bar output from the complete system. This will ensure hydrogen is adequately pressurised for various applications (*e.g.*, injection into the hydrogen infrastructure or storage tanks);
- Implementation of advanced control strategies, robust system design and optimisation of the Balance of Plant (BoP) to guarantee optimal operation and integration of the system in the electric and hydrogen infrastructure (pipeline or storage). This also includes the development of advanced control for reducing cost of maintenance and operative cost, even considering the HiL/SiL approach;
- The solution should explore the potential of reversible systems as a Long Duration Energy Storage (LDES) option, providing power-to-power conversion (from electricity to hydrogen and vice versa) and enhancing the exploitation of renewable energy sources;
- The project should produce comprehensive development and monitoring guidelines for rSOC-based systems aimed at sector coupling, also including support to regulation and standards definition;
- A comprehensive techno-economic analysis (with a focus on balancing the electricity and, potentially, the hydrogen grid) should be conducted, focusing on capital and operational costs, system lifetime and performance under real operating conditions, potential revenues from market participation (*e.g.*, ancillary services, etc.), and the overall economic viability of integrating rSOC systems into the energy value chain;
- The analysis should also include a comprehensive Life Cycle Assessment (LCA) and Life Cycle Cost (LCC) analysis, to evaluate the environmental impacts and economic costs associated with the entire lifecycle of rSOC.

In doing so, the following KPIs should be addressed:

- Roundtrip electrical efficiency (net) of the whole system ≥50% by 2030, with target of ≥60% by 2035. The efficiency should consider the whole system, involving the BoP (*e.g.*, steamer, compressor, H_2 processing unit, inverters, etc.) and rSOC connection to the hydrogen infrastructure;
- Reversibility – The system should demonstrate fast transition capabilities, with

switching mode time from one configuration to the other equal to at least 5 min by 2030, targeting ≤2 min by 2035;

- The system should ensure a warm start time of at least 10 min achievable by 2030, targeting 5 min by 2035;
- The system should achieve low electrical energy consumption in electrolysis mode (<37 kWh/kg).
- Low level of stack degradation (<0.3%/1000 h);
- Specific cost of stacks <1000 €/$kW_{Fuel\ Cell}$.

This holistic approach will help unlock the full potential of rSOC technology, contributing to a resilient, flexible, and decarbonised European energy system.

It is expected that Guarantees of origin (GOs) will be used to prove the renewable character of the hydrogen that is produced/used. In this respect consortium may seek out the issuance/purchase and subsequent cancellation of GOs from the relevant Member State issuing body and if that is not yet available the consortium may proceed with the issuance and cancellation of non-governmental certificates (e.g CertifHy[222]).

For activities developing test protocols and procedures for the performance and durability assessment of (reversible) electrolysers proposals should foresee a collaboration mechanism with JRC[223] (see section 2.2.4.3 "Collaboration with JRC"), in order to support EU-wide harmonisation. Test activities should adopt the already published EU harmonised testing protocols[224] to benchmark performance and quantify progress at programme level.

Proposals are expected to demonstrate the contribution to EU competitiveness and industrial leadership of the activities to be funded including but not limited to the origin of the equipment and components as well infrastructure purchased and built during the project. These aspects will be evaluated and monitored during the project implementation.

Proposals should provide a preliminary draft on hydrogen safety planning and management at the project level.

For additional elements applicable to all topics please refer to section 2.2.3.2.

222 https://www.certifhy.eu
223 https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0_en
224 https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0/clean-hydrogen-ju-jrc-deliverables_en

HORIZON-JU-CLEANH2-2026-04-03: Fuel-flexible gas turbine combustion technology for clean and efficient ammonia firing

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 5.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 5.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	Activities are expected to achieve TRL 5 by the end of the project - see General Annex B.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[225].

Expected Outcome

The use of hydrogen in gas turbines holds significant promise as an enabler for a low-carbon economy and may serve as a pivotal tool in achieving the objectives of the European Green Deal. Nevertheless, the challenges associated with hydrogen storage and distribution remain major obstacles for its widespread adoption. Ammonia emerges as a complementary enabler of the hydrogen economy, functioning as a carbon-free energy carrier with properties well-suited for long-term storage and long-distance transport. Compared to hydrogen, liquefied ammonia storage is significantly less expensive and complex, and it exhibits a much narrower explosive range, enhancing its safety profile. Furthermore, a single mole of ammonia contains more hydrogen atoms than a mole of pure molecular hydrogen and it is entirely carbon-free if it is produced from renewable hydrogen. These characteristics make ammonia not only a practical medium for hydrogen transport but also a viable fuel option for direct use in gas turbines, supporting efforts to decarbonise the existing power generation infrastructure.

However, the direct use of ammonia as gas-turbine fuel presents several significant challenges. Firstly, its narrow flammability limits, low reactivity, and slow burning rate introduce serious issues with flame stabilisation. Recent research suggests that partially decomposing ammonia into a mixture of ammonia, hydrogen, and nitrogen — achieved by utilising waste heat from the gas turbine — can help overcome these combustion challenges while also enhancing cycle performance. Secondly, a more challenging issue arises from the fuel-bound nitrogen in the ammonia molecule. Under the fuel-lean conditions typical of modern, clean and efficient natural gas-fired gas turbines, this nitrogen is readily oxidised in the presence of excess oxygen, leading to unacceptable emissions of nitrogen oxides (NO_x), which are strictly regulated atmospheric pollutants, as well as nitrous oxide (N_2O), a potent greenhouse gas. Lastly, eventual emissions of unburned NH_3 and of HCN (from methane co-firing) — both very toxic compounds at low concentrations — pose serious health risks. All these issues necessitate careful optimisation of the combustion system to ensure both efficiency, safety

[225] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under ‘Simplified costs decisions’ or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

and environmental compliance.

Consequently, a paradigm shift that re-assesses state-of-the-art Dry-Low Emission (DLE) combustion technologies is required to improve fuel flexibility and enable clean and efficient combustion of ammonia in modern gas turbines.

The term "NH_3-based fuel" introduced here and used below indicates a fuel consisting of pure ammonia or of partially decomposed ammonia. The case of complete ammonia decomposition to a binary mixture of hydrogen and nitrogen as well as the removal of nitrogen are considered out of scope.

Project results are expected to contribute to all the following expected outcomes:

- Fundamental understanding and detailed characterisation of the combustion physics of NH_3-based fuels at gas turbine-relevant operating conditions, i.e., high reactants temperature and pressure, including the potential occurrence of blending with backup fuels;
- Provide the basis for a reliable and fuel-flexible combustion system and verify its ability to cleanly and efficiently operate with NH_3-based fuels, or hydrogen , at gas turbine-relevant operating conditions, i.e., high reactants temperature and pressure.;
- Enable breakthrough multi-fuel combustion system technology and facilitate a full-scale gas turbine demonstrator by 2035 to enhance European leadership in decarbonisation technologies for gas turbines;
- Pave the way for utilisation of ammonia as carbon-free energy vector in power generation by means of substantiated technological feasibility, safety and risk assessment, including the environmental, social and economic benefit/risk balance.

Project results are expected to contribute to the following objectives and Key Performance Indicators (KPI) of the Clean Hydrogen Joint Undertaking (JU) Strategic Research and Innovation Agenda (SRIA):

- Development of new gas turbine combustion system characterised by increased fuel flexibility to allow clean and efficient operation with pure ammonia or ammonia blended with hydrogen.

The proposal is expected to address following KPIs:

- (KPI 1): Dual-fuel operation & firing capability across the complete range from 100% NH_3-based fuels to 100% backup fuels
- (KPI 2): NO_x emissions for NH_3-based fuels: <300 mg/MJ[226]
- (KPI 3): Maximum efficiency reduction[227] in operation with NH_3-based fuels: <2% points
- (KPI 4): N_2O, NH_3 & HCN emissions for NH_3-based fuels: <10 ppm (@15% O_2)

Scope

Standard gas turbine combustion technologies developed and optimised for ultra-low NO_x emissions of lean premixed natural gas mixtures are not able to burn ammonia or ammonia-hydrogen blends within existing normative emission limits. Therefore, a paradigm shift is required to develop novel fuel-flexible combustion technologies that enable clean and efficient ammonia operation of gas turbines, as well as backup fuels as fallback solution. In this context,

[226] <30 mg/MJ with use of SCR or operation with backup fuel
[227] with respect to NG operation

the development of novel combustion systems for clean and efficient utilisation of NH_3-based fuels in gas turbines should investigate, understand and solve challenges related to: 1) poor flame stability due to low ammonia reactivity; 2) significant NOx and N2O emissions due to oxidation of fuel-bound nitrogen; 3) lethal levels of toxic compounds in the exhaust gas, as unburnt NH_3 (ammonia slip) and HCN .

The proposed project is expected to address the following areas of research and innovation to achieve the expected outcomes for NH_3-based fuels.

- Improved chemical reactions kinetics for the oxidation of NH_3-based fuels, including validation against available measurements of fundamental flame properties (flame speeds, ignition delay times, extinction strain rates), its pyrolysis and relevant emissions (NO_x, N_2O, NH_3, HCN);
- Fundamental combustion properties of NH_3-based fuels at high reactants temperature and pressure (minimum 10 bar);
- Static flame stabilisation (flashback and blow-out characterisation and control) of premixed and non-premixed flames of NH_3-based fuels at high reactants temperature and pressure (minimum 10 bar);
- Dynamic flame stabilisation (characterisation and control of thermo-acoustic instabilities) of premixed and non-premixed flames of NH_3-based fuels at high reactants temperature and pressure (minimum 10 bar);
- Design of novel injection schemes and staging strategies to enable clean (low emissions) and efficient (no unburnt fuel) combustion of NH_3-based fuels;
- Demonstration of combustion concepts for NH_3-based fuels and validation of combustion models in dedicated atmospheric and high-pressure combustion tests with full-scale engine combustor hardware (TRL 5);
- Advanced combustion models and combustor concepts enabling clean and efficient gas turbine operation with NH_3-based fuels;
- Technological feasibility, safety and risk assessment for utilisation of NH_3-based fuels in power generation, including the environmental, social and economic benefit/risk balance (e.g. evaluation of cost reduction and efficiency improvements vs consequences in case of accident).

The topic provides an excellent opportunity to enhance the maturity level of combustion of NH_3-based fuels for power generating systems, enabling their widespread deployment and utilisation in the future energy system. In this regard non-proprietary fundamental experimental and numerical data should be made available after project completion to facilitate the development of future combustors.

Proposals should build upon and complement projects funded by the Clean Hydrogen JU such as Flex4H2[228], HyPowerGT, InsigH2t[229], ACHIEVE[230], ACCEPT[231].

International cooperation with entities with suitable expertise, interest, or facilities, from Countries which are neither EU Member States nor Horizon Europe Associated countries, is

[228] https://cordis.europa.eu/project/id/101101427
[229] https://cordis.europa.eu/project/id/101192349
[230] https://cordis.europa.eu/project/id/101137955
[231] https://cordis.europa.eu/project/id/101192557

encouraged, in particular with the Japan's[232] national research and development agency, NEDO[233] (see section 2.2.6.7 International Cooperation).

For additional elements applicable to all topics please refer to section 2.2.3.2.

[232] A Cooperation Agreement was signed in 2024 between the Clean Hydrogen JU and NEDO, which had the purpose of accelerating the deployment of hydrogen through exploring synergies between these two organsations https://www.clean-hydrogen.europa.eu/media/news/clean-hydrogen-partnership-signs-cooperation-agreement-japans-nedo-2024-06-03_en

[233] New Energy and Industrial Technology Development Organization of Japan.

HORIZON-JU-CLEANH2-2026-05-01: Public datasets of technologies along the hydrogen value chain for life cycle (sustainability) assessment

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 2.50 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 2.50 million.
Type of Action	Coordination and Support Action
Technology Readiness Level	N/A
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exception apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[234].

<u>*Expected Outcome*</u>

Sustainability of Fuel Cells and Hydrogen (FCH) products is a key requirement in the path towards a hydrogen economy. In this regard, measuring the sustainability of FCH systems from a life cycle perspective has become a crucial need. To that end, guidelines for life cycle sustainability assessment (LCSA) of FCH systems have already been developed and applied within the scope of the JU-funded project SH2E[235], as well as ecodesign guidelines based on life cycle sustainability within the JU-funded projects eGHOST[236] and GUESS-WHy[237]. Moreover, when considering only the environmental dimension, the first Product Environmental Footprint Category Rules (PEFCRs) specific to FCH products are being proposed and applied within the JU-funded project HyPEF[238]. This expands the spectrum of methodological initiatives on environmental life cycle assessment (LCA) guidelines for FCH systems under the JU-funded projects SH2E[1] and FC-HyGuide[239]. Hence, beyond regular LCA implementation in JU-funded projects, previous LCA and FCH-specific efforts have focused on providing guidance for calculating products' life cycle impacts with increased reproducibility, relevance, and consistency. However, a successful and widespread adoption of these FCH-specific approaches is mainly conditioned by the limited availability of high-quality datasets (i.e. inventories) across the value chain of hydrogen-related systems. According to the identified gap (lack of robust datasets relevant to FCH systems), this topic addresses the development and application of a number of high-quality, open-access (e.g. CC BY license) and freely accessible datasets, also referred to as Life Cycle Inventories

[234] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf
[235] https://cordis.europa.eu/project/id/101007163
[236] https://cordis.europa.eu/project/id/101007166
[237] https://cordis.europa.eu/project/id/101192392
[238] https://cordis.europa.eu/project/id/101137575
[239] https://fc-hyguide.eu/

(LCIs), to enhance the data used when performing LCA, LCC (life cycle costing), S-LCA (social life cycle assessment) or LCSA studies of FCH systems.

Accordingly, the main outcome of the topic will consist of a number of datasets developed for, and applied to, FCH product systems. Moreover, project results are expected to contribute to all of the following outcomes:

- Enhanced applicability of methodologically robust life cycle approaches specific to FCH products systems through increased public data availability and quality;
- Enhanced reporting of the life cycle profile of FCH products along the hydrogen value chain through application of the public inventories to be built within this topic;
- Strengthening the focus on environmental and more far-reaching sustainability aspects in the framework of the transition to a circular economy;
- Strengthening the European value chain of FCH products by facilitating the application of life cycle thinking in the FCH sector, reinforcing EU leadership position and accelerating mass-market adoption of sustainable FCH products;
- Enabling an extended use of robust life cycle approaches relevant to the identification of FCH products as a sustainable investment.

Project results are expected to contribute to the following objectives of the Clean Hydrogen JU SRIA for cross-cutting issues and the specific area on sustainability:

- Development of life cycle thinking tools addressing the three dimensions of sustainable development (economic, social, and environmental) and database for life cycle sustainability indicators. In this regard, this topic should specifically contribute to the inventory component of these tools for application to product systems in the FCH sector. Inventory building will be relevant to at least the environmental dimension, while exploring opportunities for economic and social dimensions. Moreover, application of the datasets for testing purposes should result in an increased availability of life cycle indicators of FCH-relevant products;
- Development of ecodesign guidelines for FCH technologies. In this sense, the datasets to be developed within this topic will facilitate the LCSA studies required in the development of those guidelines. Hence, project results are expected to contribute to the achievement of the specific key performance indicators (KPIs) on the number of ecodesign guidelines for FCH technologies.

Scope

Given the importance of further enabling a robust and transparent assessment of FCH products to support the penetration of those in compliance with sustainability standards, this topic promotes the timely development of high-quality datasets for key FCH-relevant products and technologies across the hydrogen value chain. As regards scope, the project is expected to focus on the development of at least 20 high-quality, open-access and freely accessible datasets (LCIs) for several key FCH-relevant products and technologies. Besides, projects should also illustrate LCIs usefulness through their application in life cycle (sustainability) assessment studies.

The addressed materials, components, equipment, and technologies should be relevant to the hydrogen value chain, involve different technology readiness levels (thus including emerging technologies), and enable the assessment of a complete FCH system. In this regard, at least one entire FCH product system should be fully covered and assessed using both existing LCIs and the new ones to be built. When relevant, the developed inventories should address current data gaps regarding aspects such as critical raw materials, hydrogen losses, recycling, and end-of-life processes. According to current maturity in life cycle databases, inventory building should be relevant to at least the environmental dimension, while exploring opportunities for economic and social dimensions (which are subject to deeper geographical concerns).

The funded project should involve:

- Review of individual foreground datasets developed in previous FCH-relevant projects, particularly those funded by the JU, and scientific literature.
- Building of open-access, high-quality inventories respecting FAIR (Findable, Accessible, Interoperable, and Reusable) data principles and assessing data quality considering technology (including technology readiness level), time, and region. The involvement of industry actors for the generation of new datasets is expected. Documentation on standardised data structures and modelling principles for the resultant database (i.e. collection of structured datasets), as well as on specific details for each dataset, should be prepared.
- Application of the developed datasets in life cycle (sustainability) assessment studies for testing purposes.

The expected consortium should involve experts in the field of LCA/LCSA of FCH product systems and FCH companies relevant to data acquisition. Letters of support from OEMs (original equipment manufacturers) should be made available at the proposal stage.

The datasets developed by the project for environmental LCA should be ready for their publication in the hydrogen node of the Life Cycle Data Network (LCDN)[240], which is managed by the European Commission's Joint Research Centre (JRC).

Cooperation with the JRC and the European Hydrogen Sustainability and Circularity Panel (EHS&CP) should be foreseen. Moreover, synergy with other initiatives such as the IEA Hydrogen TCP Task 50 on Cost and Carbon Intensity Analysis and Model Comparison of Hydrogen Supply Chains[241] could be considered.

For additional elements applicable to all topics please refer to section 2.2.3.2

240 https://eplca.jrc.ec.europa.eu/LCDN/

241 https://www.ieahydrogen.org/task/task-50-cost-and-carbon-intensity-analysis-and-model-comparison-of-hydrogen-supply-chains/

HORIZON-JU-CLEANH2-2026-05-02: Pre-Normative Research on hydrogen odorisation: enhancing safety and detection along the hydrogen value chain

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 3.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative budget for the topic is EUR 3.00 million.
Type of Action	Research and Innovation Action
Technology Readiness Level	N/A
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[242]. Beneficiaries must, up to 4 years after the end of the action, inform the granting authority if the results could reasonably be expected to contribute to European or international standards.

<u>*Expected Outcome*</u>

In the European Union, depending on the Member State, natural gas is odorised, primarily for safety reasons, according to ISO16922[243]. This standard provides guidelines for odorising natural gas and other methane rich gases. However, with a switch to hydrogen, new risk mitigation strategies need to be developed or existing adapted.

With the switch from natural gas to 100 % hydrogen, especially in hard-to-abate industries, safety measures have to be established. Historically, odorisation proved to be an easy applicable safety measure.

Due to different requirements for hydrogen, such as purity and physical properties of the molecule, different odorants have to be used for hydrogen than the ones currently used for natural gas. Therefore, odorants, that are non-toxic and environmentally benign and that provide sufficient olfactory warning, need to be developed and tested. The olfactometric properties should be similar to what is already known and trigger a similar reaction as to natural gas. Especially with sensitive end-users in mind, possible de-odorisation might be needed as well, if the applied odorant is not tolerated by the end-use applications.

A thorough data analysis based on literature as well as already conducted research, such as for example Ready4H2[244], Hy4heat[245], Met4H_2[246], sets the basis for testing new and old odorants. The focus should be on the odorant in hydrogen, for example masking effects,

[242] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf
[243] https://www.iso.org/standard/83835.html
[244] https://www.ready4h2.com/
[245] https://www.hy4heat.info/
[246] https://met4h2.eu/

degradation and other technical aspects.

Project results are expected to contribute to all of the following outcomes:

- Providing data on different odorants or chemical families of odorants to regulatory bodies to ensure that hydrogen gas grids and appliances meet safety and performance standards throughout the European Union, including the tolerance of materials used that come in touch with odorants (and its degradation products if any);
- Harmonised standards and guidelines to reduce over-conservatism and ensure consistent safety measures;
- Standard methods for odorisation and de-odorisation of hydrogen.

Project results are expected to contribute to the following objectives of the Clean Hydrogen JU SRIA:

- By 2030 hydrogen safety is understood and lived holistically and odorisation is one of the applied safety measures;
- By 2030 public awareness of odorised hydrogen is enhanced and the use of hydrogen as an energy carrier widely accepted in the EU, as a target group especially the non-experts.

Scope

While the goal is to have an entirely decarbonised gas grid by the end of 2030, safety measures are needed when switching to 100 % hydrogen. For a safe operation, pipeline components not only need to be checked for hydrogen tolerance, but also whether they tolerate the odorants themselves. Pre-Normative Research (PNR) and the development of regulations, codes and standards (RCS) require an open communication and knowledge transfer across project boundaries and beyond project terms. Generation of experimental data, collaboration and coordination with international partners and stakeholders are essential to ensure that this goal is achieved in the EU and even worldwide.

The warning scent of an odorant should be detectable at very low concentrations. Therefore gas-air-mixtures in indoor areas should reliably be olfactorily detectable at 20% of the lower flammability limit in air[247]. The lower flammability of hydrogen is 4%, therefore the odorised hydrogen should be detectable at 0,8% in air. Olfactory tests in laboratory scale should therefore be executed to ensure the desired detectability.

The development and characterisation of new odorants is encouraged but not mandatory. Additional to this data analysis, literature research for hydrogen detection methods shall be provided, assessing general application possibilities to give a full picture of available leak detection methods. The odorants found suitable for testing should be subjected to tests according to DIN EN ISO 13734[247] and the gathered data publicly shared according to FAIR principles. Additionally, the odorant(s) should be thoroughly analysed and characterised including, but not excluding any other analysis, such as the following:

- Chemical characterisation of the odorant molecule (if already known, based on literature) for example by using GC-MS/MS, NMR and elemental analysis for new compound;
- Provide analytical methods to quantify the lowest concentration (ppb/ppt levels) of the odorant/s detectable by olfactory test, as well as methods suitable for controlling fraud

[247] https://www.iso.org/standard/56767.html

in the odorant employed at hydrogen (i.e. using tracing analysis);

- Stability tests of the odorising molecule and characterisation of possible degradation and transformation products while providing tracing methods to quantify the degree of degradation of the odorising molecule by relevant analytical methods;
- Assessment of in-silico toxicity of the odorant/s at different concentrations, and eventually of the transformation products/degradants;
- Absorption/permeation tests for the odorant (including the degradation molecules (differentiation for example via chromatography)) in hydrogen for different polymers (pipes or seals) and examination of possible material alterations ;
- Impact on end users' system in term of performance or environmental impact (i.e., fuel cell, combustion, chemical use as for fertiliser etc.).

The odorant itself should be tested in a close to real-world environment or conditions (test bed), to ensure it is tolerated by the materials used for example in pipes, compressors, valves and other materials getting in touch.

With regards to safety, proposals should ensure that the odorant and or its degradation molecules do not enhance hydrogen embrittlement, hydrogen permeability through polymers or other ways of hydrogen corrosion or be corrosive themselves. Tests could be performed for example after ASME B31.12[248] or be tackled via modelling / numerical studies.

Due to some sensitive hydrogen appliances, at least a validated strategy for the removal of odorant molecules for sensitive appliances, either with fitting absorbents, adsorbents, membranes, PSA or other, should be demonstrated. The purity of the de-odorised hydrogen should meet the requirements according to ISO 14687[249].

Hydrogen odorisation takes place in specific parts of the transmission and distribution network, usually at feed-in of the gas, but sometimes at compressor and pressure regulator stations. To ensure safety throughout the entire hydrogen supply chain, it's important to study the quality of the hydrogen-odorant mixture, especially how it moves through the pipes of the different networks e.g., transportation or distribution. This involves modelling and simulating how the mixture flows under different pressures and different flow velocities. By doing this, it can be understood how the odorant spreads, including how its concentration changes over time and how much of it is lost at different points in the network.

The expected results, aim to support the definition of regulatory standardisation frameworks. Given the scope of this topic, the involvement of formal standardisation bodies as part of the consortia is encouraged, with the aim of facilitating the uptake of the project results. Furthermore, participation of gas distributors and regulatory institutions, with practical experiences concerning the odorisation of hydrogen, is encouraged.

Proposals should pay special attention to the dissemination of the results and enhance exchanges with relevant stakeholders mentioned above, e.g via annual workshops and by working in synergies with others as follows.

The proposal should complement, built and create synergies with relevant projects. In particular, synergies should be foreseen with the project supported by the European Partnership on Metrology, EURAMET, Met4H2[250], where standards for sulfur-free odorants

248 https://www.asme.org/codes-standards/find-codes-standards/b31-12-hydrogen-piping-pipelines
249 https://www.iso.org/standard/82660.html
250 https://met4h2.eu/

were developed with support of the hydrogen distribution sector.

Furthermore, proposals should create synergies and collaborate with relevant recent and new developments on regulation, codes and standards including but not only, the project HyQualNet, whose results should be taken into account [251]. For additional elements applicable to all topics please refer to section 2.2.3.2

[251] https://www.cencenelec.eu/media/CEN-CENELEC/News/CallForTender/Documents/2025/HyQual/hyqualnet_opencallfortender.pdf

HYDROGEN VALLEYS

HORIZON-JU-CLEANH2-2026-06-01: Large-scale Hydrogen Valley

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 17.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative cumulative budget for the two Hydrogen Valleys topics is EUR 25.00 million.
Type of Action	Innovation Action
Technology Readiness Level	The TRL of the applications in the project should be at least 6 at the beginning of the project while the overall concept should target a TRL 8 at the end of the project - see General Annex B.
Admissibility conditions	The conditions are described in General Annex A. The following exception applies: The page limit of the application is 70 pages.
Eligibility	The conditions are described in General Annex B. The following additional eligibility criteria apply: At least one partner in the consortium must be a member of either Hydrogen Europe or Hydrogen Europe Research. The maximum Clean Hydrogen JU contribution that may be requested is EUR 17.00 million – proposals requesting Clean Hydrogen JU contributions above this amount will not be evaluated.
Procedure	The procedure is described in General Annex F. STEP Seals will be awarded to proposals exceeding all of the evaluation thresholds set out in this work programme.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[252]. Purchases of equipment, infrastructure or other assets used for the action must be declared as depreciation costs. However, for the following equipment, infrastructure or other assets purchased specifically for the action (or developed as part of the action tasks): hydrogen production plant, distribution and storage infrastructure and hydrogen end-uses, costs may exceptionally be declared as full capitalised costs.

[252] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

Expected Outcome

Hydrogen Valleys are hydrogen ecosystems that cover a specific geography ranging from local or regional focus (e.g. industrial cluster, ports, airports, etc.) to specific national or international regions (e.g. cross border hydrogen corridors)[253]. Hydrogen Valleys showcase the versatility of hydrogen by supplying several sectors in their geography such as mobility, industry and energy end-uses. They are ecosystems or clusters where various final applications share a common hydrogen supply infrastructure. Across their geographic scope, Hydrogen Valleys cover multiple steps in the hydrogen value chain, ranging from hydrogen production (and often even dedicated renewables production) to the subsequent storage of hydrogen and distribution to off-takers via various modes of transport. Whilst most of the projects are in the EU, over the past years, Hydrogen Valleys have gone global, with new projects emerging worldwide. Mission Innovation has set a target of deploying 100 large-scale Hydrogen Valleys worldwide by 2030[254].

Hydrogen Valleys are starting to form the first regional "hydrogen economies". Already under the previous programme, the Clean Hydrogen Partnership provided support to several Hydrogen Valleys across different locations in EU and of different sizes. It is however necessary to continue the accelerated deployment of Hydrogen Valleys as required by RePowerEU (with a target to double the number of hydrogen valleys by 2025 and an inspirational target to have at least 50 Hydrogen Valleys under construction or operational by 2030 across the entire EU[255]) and to contribute to the objectives of the European Hydrogen Strategy, the EU Green Deal, and Fit for 55, and finally overcome common challenges linked to storage and distribution that may be territory specific. To do this it is necessary to have 'testbed' projects to act as first real-life cases for piloting global hydrogen markets. These projects need to be expanded in scale to demonstrate the full range of benefits from the use of hydrogen and to create interlinkages to allow for the emergence of a hydrogen economy in these regions.

Project results are expected to contribute to all the following expected outcomes:

- Anchorage of new demand for renewable hydrogen;
- Interaction and synergies among initial test beds;
- Full integration into the broader cross-sectoral energy ecosystem;
- Improvement of the perception of public towards hydrogen technologies, by ensuring a high visibility of the project and associated technologies to the local public and EU citizens;
- Emergence of new hydrogen valleys, through dissemination of learnings.

Hydrogen Valleys also offer an opportunity to support the objectives of the Net Zero Industry Act by promoting and facilitating the relocation of net-zero technologies manufacturing facilities in areas with Hydrogen Valleys. In addition, Hydrogen Valleys are very well suited to further support innovation by facilitating the access to Small Medium Enterprises (SME)/Startups to the Hydrogen Valleys, especially those which have technologies that need to scale- up and prove them in a living lab environment.

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[253] https://h2v.eu/media/7/download
[254] https://ec.europa.eu/info/news/mission-innovation-launches-new-global-coalition-support-clean-hydrogen-economy-2021-jun-02_en
[255] Commission Staff Working Document, SWD(2024) 159 final. Towards a roadmap for accelerating the deployment of Hydrogen Valleys across Europe: challenges and opportunities

Scope

The scope of this flagship topic is to develop and demonstrate a large-scale Hydrogen Valley. It could demonstrate a combination of technologies either in existing and/or new markets for clean hydrogen (including hard-to-abate sectors), especially when applications are used in symbiose with each other. Proposals should demonstrate innovative approaches at system level: systemic and synergetic integration of hydrogen production (not restricted to electrolysis), distribution and end-use technologies. Proposals may also investigate interoperability, cause-effect stability of the overall system. Technologies demonstrated should be state-of the-art following technological developments previously funded by (but not limited to) the Clean Hydrogen Partnership.

Proposals should respond to the following requirements:

- Production of at least 3000 tonnes of clean hydrogen[256,257] per year using new hydrogen production capacity (at least for the last 2-years of project demonstration). Due to the large volumes of hydrogen involved, production plants may be distributed across the territories involved but should share common hydrogen supply infrastructure;
- At least two hydrogen applications from two different sectors should be part of the project, with clear focus on energy, industry and transport sectors;
- Demonstrate how new built infrastructure can be integrated and function with existing infrastructure (when relevant), with the aim to maximise the impact of the hydrogen valley in all sectors addressed;
- Monitoring and assessment activities including at least two years of operations;
- Provision of a clear, professional, and ambitious communication plan to ensure high visibility to the public including clear, measurable, and ambitious Key Performance Indicators (KPI);
- Demonstration of how hydrogen enables sector coupling, allows for example H2 storage and/or large integration of renewable energy[258] and provides an optimum techno economic solution for the decarbonisation of the activities in the geographical area being addressed;
- Reduction of the carbon emissions and impact on air quality related to the end-uses compared to incumbent technologies;
- Demonstration of how financial viability is expected to be reached after two years of operation.
- Proposals should also:
- Provide concrete project implementation plans with a clear calendar, defining the key phases of the implementation of the action (i.e., preparation of the specifications of equipment, manufacturing, permitting, deployment, and operation) and their duration;

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[256] As defined in the SRIA of the Clean Hydrogen JU, clean hydrogen refers to renewable hydrogen. To the demonstration addressed in the proposal it can be foreseen that in the early stages low carbon hydrogen could be used. However, the objective is to move to renewable or clean hydrogen as an ultimate objective in the project. Please refer to the paragraph Rationale for support of the section 3.7 of the SRIA of the Clean Hydrogen JU.

[257] Renewable hydrogen is hydrogen produced using renewable energy (Renewable Energy Directive 2018/2001/EU)

[258] In line with the definitions provided in the Renewable Energy Directive 2018/2001/EU

- Provide a funding plan to ensure implementation of the project in synergies with other sources of funding. If no other sources of funding will be required, this should be stated clearly in the proposal, with a commitment from the partners to provide own funding. If additional sources of funding will be required, proposals should present a clear plan on which funding programmes at EU and/or national levels will be targeted[259]. In these cases, applicants should present a credible planning that includes forecasted funding programmes and their expected time of commitment;
- Clearly and coherently present the Hydrogen Valley (across the whole value chain including hydrogen production, distribution and storage and end uses) including the investments/actions supported directly by this topic as well as other investments / actions supported by other funding /financing sources[260] which are part of the hydrogen valley to be deployed and demonstrated in line with the topic requirements;
- Provide evidence of the commitment and role of public authorities (Member States, Regions, and Cities) and of any other necessary stakeholders (e.g. hydrogen off-takers) at least in the form of Letters of Intent (LOI). The practical implementation of these LOI will be followed during the Grant Agreement implementation;
- Provide a preliminary 'hydrogen safety planning and management plan'[261] at the project level, which will be further updated during project implementation;
- Ensure coverage of aspects such as replicability and (cross-border) cooperation between regions to facilitate transfer of knowledge across the EU with a focus on fostering replication of Hydrogen Valleys elsewhere;
- Demonstrate how synergies with existing hydrogen valleys will be ensured especially when it comes to skills and know-how exchange;
- Provide a scalability analysis that includes the broader energy system showing how the valley is expected to grow, where applicable, in view to connect initial demonstrations and create synergies with existing energy infrastructure, as well as its possible contribution to the progress of the five hydrogen corridors;
- Highlight sustainability aspects in their description.

The costs for the construction and commissioning phase of the hydrogen production technologies including connection (e.g connection to the electricity grid, electricity costs) and other hydrogen infrastructure (e.g Hydrogen Refuelling Station (HRS), storage, pipelines, etc) may be funded while costs of renewable energy plants (e.g., photovolthaic or wind plant) or related costs for operation of the Hydrogen Valley (e.g., electricity for electrolysers) will not be funded.

Proposals are expected to collaborate with the successful applicants under topic HORIZON-JU-CLEANH2-2025-05-03 on 'Knowledge transfer and training of civil servants, safety officials, and permitting staff to improve safety assessment and licensing procedures across Europe'.

Proposals are expected to demonstrate the contribution to EU competitiveness and industrial

[259] Including applications for funding planned, applications for funding submitted and funding awarded.
[260] In the context of the topic other investments/actions refer to parts of the hydrogen valley which are necessary to respond to the topic requirements and to deliver a fully functional hydrogen valley but that are not supported with the funding of the Clean Hydrogen JU (e.g. hydrogen production plant supported with national funding, or HRS supported with funding from the Connecting Europe Facility – Transport (CEF-T))
[261] In the context of this topic this refers to an early plan indicating how safety will be managed in the project https://www.clean-hydrogen.europa.eu/get-involved/european-hydrogen-safety-panel-0/reference-documents_en

leadership of the activities to be funded including but not limited to the origin of the equipment and components as well infrastructure purchased and built during the project. These aspects will be evaluated and monitored during the project implementation.

It is expected that Guarantees of origin (GOs) will be used to prove the renewable character of the hydrogen that is produced/used. In this respect consortium may seek out the issuance/purchase and subsequent cancellation of GOs from the relevant Member State issuing body and if that is not yet available the consortium may proceed with the issuance and cancellation of non-governmental certificates (e.g CertifHy[262]).

Proposals are expected to contribute towards the activities of the EU Mission on Climate-Neutral and Smart Cities, Mission Innovation 2.0 - Clean Hydrogen Mission and the H2V platform. Cooperation with entities from Clean Hydrogen Mission member countries, which are neither EU Member States nor Horizon Europe Associated countries, is encouraged (see section 2.2.6.7 International Cooperation).

Proposals should provide a preliminary draft on 'hydrogen safety planning and management' at the project level, which will be further updated during project implementation.

For additional elements applicable to all topics please refer to section 2.2.3.2.

[262] https://www.certifhy.eu

HORIZON-JU-CLEANH2-2026-06-02: Small-scale Hydrogen Valley

Specific conditions	
Expected EU contribution per project	The JU estimates that an EU contribution of maximum EUR 8.00 million would allow these outcomes to be addressed appropriately.
Indicative budget	The total indicative cumulative budget for the two Hydrogen Valleys topics is EUR 25.00 million.
Type of Action	Innovation Action
Technology Readiness Level	The TRL of the applications in the project should be at least 6 at the beginning of the project while the overall concept should target a TRL 8 at the end of the project - see General Annex B.
Admissibility conditions	The conditions are described in General Annex A. The following exception applies: The page limit of the application is 70 pages.
Eligibility	The conditions are described in General Annex B. The following additional eligibility criteria apply: At least one partner in the consortium must be a member of either Hydrogen Europe or Hydrogen Europe Research. The maximum Clean Hydrogen JU contribution that may be requested is EUR 8.00 million – proposals requesting Clean Hydrogen JU contributions above this amount will not be evaluated.
Procedure	The procedure is described in General Annex F. Sovereignty STEP Seals will be awarded to proposals exceeding all of the evaluation thresholds set out in this work programme.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[263]. Purchases of equipment, infrastructure or other assets used for the action must be declared as depreciation costs. However, for the following equipment, infrastructure or other assets purchased specifically for the action (or developed as part of the action tasks): hydrogen production plant, distribution and storage infrastructure and hydrogen end-uses, costs may exceptionally be declared as full capitalised costs.

[263] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/lsdecision_he_en.pdf

Expected Outcome

Hydrogen Valleys are hydrogen ecosystems that cover a specific geography ranging from local or regional focus (e.g. industrial cluster, ports, airports, etc.) to specific national or international regions (e.g. cross border hydrogen corridors)[264]. Hydrogen Valleys showcase the versatility of hydrogen by supplying several sectors in their geography such as mobility, industry and energy end uses. They are ecosystems or clusters where various final applications share a common hydrogen supply infrastructure. Across their geographic scope, Hydrogen Valleys cover multiple steps in the hydrogen value chain, ranging from hydrogen production (and often even dedicated renewables production) to the subsequent storage of hydrogen and distribution to off-takers via various modes of transport. Whilst most of the projects are in the EU, over the past years, Hydrogen Valleys have gone global, with new projects emerging worldwide. Mission Innovation has set a target of deploying 100 large-scale Hydrogen Valleys worldwide by 2030[265].

Hydrogen Valleys are starting to form the first regional "hydrogen economies". Already under the previous programme, the Clean Hydrogen Partnership provided support to several Hydrogen Valleys across different locations in EU and of different sizes. It is however necessary to continue the accelerated deployment of Hydrogen Valleys as required by RePowerEU (with a target to double the number of hydrogen valleys by 2025 and an inspirational target to have at least 50 Hydrogen Valleys under construction or operational by 2030 across the entire EU[266]) and to contribute to the objectives of the European Hydrogen Strategy, the EU Green Deal, and Fit for 55, and finally overcome common challenges linked to storage and distribution that may be territory specific. To do this it is necessary to have 'testbed' projects to act as first real-life cases for piloting global hydrogen markets. These projects need to be expanded in scale to demonstrate the full range of benefits from the use of hydrogen.

Furthermore, the previous calls for proposals of the Clean Hydrogen JU, have awarded Hydrogen Valleys projects that are well spread across the European Union territory[267]; however, the deployment of Hydrogen Valleys in specific countries of the European Union, and in particular in EU-13, remains limited

Project results are expected to contribute to all the following expected outcomes:

- Anchorage of new demand for renewable hydrogen;
- Interaction and synergies among initial test beds;
- Full integration into the broader cross-sectoral energy ecosystem;
- Improvement of the perception of public towards hydrogen technologies, by ensuring a high visibility of the project and associated technologies to the local public and EU citizens, to connect initial demonstrations and to create synergies with existing energy infrastructure;
- Increase the deployment of Hydrogen Valleys across EU-13
- Emergence of new hydrogen valleys, through dissemination of learnings.

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264 https://h2v.eu/media/7/download

265 https://ec.europa.eu/info/news/mission-innovation-launches-new-global-coalition-support-clean-hydrogen-economy-2021-jun-02_en

266 Commission Staff Working Document, SWD(2024) 159 final. Towards a roadmap for accelerating the deployment of Hydrogen Valleys across Europe: challenges and opportunities

267 https://www.clean-hydrogen.europa.eu/get-involved/hydrogen-valleys_en

Scope

The scope of this flagship topic is to develop and demonstrate a small-scale Hydrogen Valley. It could demonstrate a combination of technologies either in existing and/or new markets for clean hydrogen, especially when applications are used in symbiose with each other.

Proposals should demonstrate innovative approaches at system level: systemic and synergetic integration of hydrogen production (not restricted to electrolysis), distribution and end-use technologies. Proposals may also investigate interoperability, cause-effect stability of the overall system. Technologies demonstrated should be state-of the-art following technological developments previously funded by (but not limited to) the Clean Hydrogen Partnership.

Proposals should respond to the following requirements:

- Geographical location of the Hydrogen Valleys should be in EU-13 countries[268]
- Production of at least 400 tonnes of clean hydrogen[269,270] per year using new hydrogen production capacity (at least for the last 2-years of project demonstration). Due to the large volumes of hydrogen involved, production plants may be distributed across the territories involved but should share common hydrogen supply infrastructure;
- Use of the hydrogen produced to supply one or more end sector or application in the energy, industry, and transport sectors;
- Monitoring and assessment activities including at least two years of operations;
- Provision of a clear, professional, and ambitious communication plan to ensure high visibility to the public including clear, measurable, and ambitious Key Performance Indicators (KPI);
- Demonstration of how hydrogen enables sector coupling, allows for example H2 storage and/or large integration of renewable energy[271] and provides an optimum techno economic solution for the decarbonisation of the activities in the geographical area being addressed;
- Reduction of the carbon emissions and impact on air quality related to the end-uses compared to incumbent technologies;
- Demonstration of how financial viability is expected to be reached after two years of operation.

Proposals should also:

- Provide concrete project implementation plans with a clear calendar, defining the key phases of the implementation of the action (i.e., preparation of the specifications of equipment, manufacturing, permitting, deployment, and operation) and their duration;
- Provide a funding plan to ensure implementation of the project in synergies with other

[268] The term "EU13" refers to the 13 countries that joined the European Union during the 2004 and 2007 and 2013 enlargements. These countries are: Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Bulgaria, Romania and Croatia

[269] As defined in the SRIA of the Clean Hydrogen JU, clean hydrogen refers to renewable hydrogen. To the demonstration addressed in the proposal it can be foreseen that in the early stages low carbon hydrogen could be used. However, the objective is to move to renewable or clean hydrogen as an ultimate objective in the project. Please refer to the paragraph Rationale for support of the section 3.7 of the SRIA of the Clean Hydrogen JU.

[270] Renewable hydrogen is hydrogen produced using renewable energy (Renewable Energy Directive 2018/2001/EU).

[271] In line with the definitions provided in the Renewable Energy Directive 2018/2001/EU

sources of funding. If no other sources of funding will be required, this should be stated clearly in the proposal, with a commitment from the partners to provide own funding. If additional sources of funding will be required, proposals should present a clear plan on which funding programmes at EU and/or national levels will be targeted[272]. In these cases, applicants should present a credible planning that includes forecasted funding programmes and their expected time of commitment;

- Clearly and coherently present the Hydrogen Valley (across the whole value chain including hydrogen production, distribution and storage and end uses) including the investments/actions supported directly by this topic as well as other investments/actions supported by other funding /financing sources[273] which are part of the hydrogen valley to be deployed and demonstrated in line with the topic requirements;
- Provide evidence of the commitment and role of public authorities (Member States, Regions, and Cities) and of any other necessary stakeholders (e.g. hydrogen off-takers) at least in the form of Letters of Intent (LOI). The practical implementation of these LOI will be followed during the Grant Agreement implementation;
- Provide a preliminary 'hydrogen safety planning and management plan'[274] at the project level, which will be further updated during project implementation;
- Ensure coverage of aspects such as replicability and (cross-border) cooperation between regions to facilitate transfer of knowledge across the EU with a focus on fostering replication of Hydrogen Valleys elsewhere;
- Demonstrate how synergies with existing hydrogen demonstration projects or hydrogen valleys will be ensured especially when it comes to skills and know-how exchange;
- Provide a scalability analysis that includes the broader energy system showing how the valley is expected to grow, where applicable;
- Highlight sustainability aspects in their description.

Proposals are expected to collaborate with the successful applicants under topic HORIZON-JU-CLEANH2-2025-05-03 on 'Knowledge transfer and training of civil servants, safety officials, and permitting staff to improve safety assessment and licensing procedures across Europe'.

The costs for the construction and commissioning phase of the hydrogen production technologies including connection (e.g connection to the electricity grid, electricity costs) and other hydrogen infrastructure (e.g HRS, storage, pipelines, etc) may be funded while costs of renewable energy plants (e.g., PV or wind plant) or related costs for operation of the Hydrogen Valley (e.g., electricity for electrolysers) will not be funded.

Proposals are expected to demonstrate the contribution to EU competitiveness and industrial leadership of the activities to be funded including but not limited to the origin of the equipment

[272] Including applications for funding planned, applications for funding submitted and funding awarded.

[273] In the context of the topic other investments/actions refer to parts of the hydrogen valley which are necessary to respond to the topic requirements and to deliver a fully functional hydrogen valley but that are not supported with the funding of the Clean Hydrogen JU (e.g. hydrogen production plant supported with national funding or HRS supported with funding from the Connecting Europe Facility – Transport (CEF-T))

[274] https://www.clean-hydrogen.europa.eu/get-involved/european-hydrogen-safety-panel-0/reference-documents_en

and components as well infrastructure purchased and built during the project. These aspects will be evaluated and monitored during the project implementation.

It is expected that Guarantees of origin (GOs) will be used to prove the renewable character of the hydrogen that is produced/used. In this respect consortium may seek out the issuance/purchase and subsequent cancellation of GOs from the relevant Member State issuing body and if that is not yet available the consortium may proceed with the issuance and cancellation of non-governmental certificates (e.g CertifHy[275]).

Proposals are expected to contribute towards the activities of the EU Mission on Climate-Neutral and Smart Cities, Mission Innovation 2.0 - Clean Hydrogen Mission and the H2V platform. Cooperation with entities from Clean Hydrogen Mission member countries, which are neither EU Member States nor Horizon Europe Associated countries, is encouraged (see section 2.2.6.7 International Cooperation).

Proposals should provide a preliminary draft on 'hydrogen safety planning and management' at the project level, which will be further updated during project implementation.

For additional elements applicable to all topics please refer to section 2.2.3.2.

[275] https://www.certifhy.eu

2.2.3.2. Conditions of the call and call management rules

Conditions for the Call

Call identifier: **HORIZON-JU-CLEANH2-2026**

Overall Indicative Budget: **EUR 105.00 million**

Indicative budget(s)[276]

Topic	Type of Action	Budgets (EUR million)	Expected EU contribution per project [277] (EUR million)	Number of projects expected to be funded
Publication[278]: 20 January 2026 Deadline[279]: 15 April 2026				
HORIZON-JU-CLEANH2-2026-01-01	RIA	3.0	3.0	1
HORIZON-JU-CLEANH2-2026-01-02	RIA	2.5	2.5	1
HORIZON-JU-CLEANH2-2026-01-03	RIA	3.0	3.0	1
HORIZON-JU-CLEANH2-2026-01-04	CSA	1.5	1.5	1
HORIZON-JU-CLEANH2-2026-01-05	RIA	3.0	3.0	1
HORIZON-JU-CLEANH2-2026-01-06	RIA	3.0	3.0	1
HORIZON-JU-CLEANH2-2026-02-01	RIA	4.0	4.0	1
HORIZON-JU-CLEANH2-2026-02-02	RIA	3.5	3.5	1
HORIZON-JU-CLEANH2-2026-02-03	RIA	4.0	4.0	1
HORIZON-JU-CLEANH2-2026-02-04	RIA	6.0	6.0	1
HORIZON-JU-CLEANH2-2026-03-01	RIA	4.0	4.0	1
HORIZON-JU-CLEANH2-2026-03-02	RIA	8.0	8.0	1
HORIZON-JU-CLEANH2-2026-03-03	IA	5.0	5.0	1
HORIZON-JU-CLEANH2-2026-03-04	RIA	8.0	8.0	1
HORIZON-JU-CLEANH2-2026-04-01	RIA	3.0	3.0	1
HORIZON-JU-CLEANH2-2026-04-02	IA	8.0	8.0	1
HORIZON-JU-CLEANH2-2026-04-03	RIA	5.0	5.0	1
HORIZON-JU-CLEANH2-2026-05-01	CSA	2.5	2.5	1
HORIZON-JU-CLEANH2-2026-05-02	RIA	3.0	3.0	1
HORIZON-JU-CLEANH2-2026-06-01	IA	17.0	17.0	1
HORIZON-JU-CLEANH2-2026-06-02	IA	8.0	8.0	1

General conditions relating to the Call

This section sets the general conditions applicable to call and topics for grants under this

[276] Budget flexibility — The budgets set out in the call and topics are indicative. Unless otherwise stated, final budgets may change following evaluation. The final figures may change by up to 20% compared to the total budget indicated in each individual part of the work programme. Changes within these limits will not be considered substantial within the meaning of Article 110(5) of Regulation (EU, Euratom) No 2018/1046.

[277] Unless otherwise stated in the specific topic conditions, this does not preclude submission and selection of a proposal requesting different amounts

[278] The Executive Director may decide to open the call up to one month prior to or after the envisaged date of publication.

[279] The Executive Director may delay the deadline by up to two months. The deadline is at 17.00.00 Brussels local time.

Annual Work Programme. It also describes the evaluation and award procedures and other criteria.

The call included in this Work Programme, including evaluation and award procedures, will be managed according to and the proposals should comply with the call conditions below and with the General Annexes to the Horizon Europe Work Programme 2026-2027[280] that shall apply mutatis mutandis to the call covered in this Annual Work Programme (with the exceptions introduced in the specific topic conditions).

There is no derogation from the Horizon Europe Rules for Participation.

Admissibility conditions	The conditions are described in General Annex A.
Eligibility conditions	The conditions are described in General Annex B.
Financial and operational capacity and exclusion	The criteria are described in General Annex C.
Award criteria	The criteria are described in General Annex D.
Documents	The documents are described in General Annex E.
Evaluation Procedure	The procedure is described in General Annex F.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G.

If a topic deviates from the general conditions or includes additional conditions, this is explicitly stated under the specific conditions for the topic.

General Annex A (Admissibility conditions): Exceptions

- For all Innovation Actions the page limit of the applications are 70 pages.

General Annex B (Eligibility conditions): Additional conditions

- For some topics, in line with the Clean Hydrogen JU SRIA, an additional eligibility criterion has been introduced **to limit the Clean Hydrogen JU requested contribution** mostly for actions performed at high TRL level, including demonstration in real operational environment and with important involvement from industrial stakeholders and/or end users such as public authorities. Such actions are expected to leverage co-funding as commitment from stakeholders. It is of added value that such leverage is shown through the private investment in these specific topics. Therefore, proposals requesting contributions above the amounts specified per each topic below will not be evaluated:

Additional eligibility condition: Maximum JU contribution per topic
HORIZON-JU-CLEANH2-2026-03-03
HORIZON-JU-CLEANH2-2026-04-02
HORIZON-JU-CLEANH2-2026-06-01
HORIZON-JU-CLEANH2-2026-06-02

- For the topics listed below, in line with the Clean Hydrogen JU SRIA, an additional ·an additional eligibility criterion has been introduced to ensure that **one partner in the consortium is a member of either Hydrogen Europe or Hydrogen Europe**

[280] https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2026-2027/wp-15-general-annexes_horizon-2026-2027_en.pdf

Research. . This concerns topics targeting actions for large-scale demonstrations, flagship projects and strategic research actions, where the industrial and research partners of the Clean Hydrogen JU are considered to play a key role in accelerating the commercialisation of hydrogen technologies by being closely linked to the Clean Hydrogen JU constituency, which could further ensure full alignment with the SRIA of the JU. This approach shall also ensure the continuity of the work performed within projects funded through the H2020 and FP7, by building up on their experience and consolidating the EU value-chain. In the Call 2026 this applies to: development and demonstration of flexible and standardised hydrogen storage systems and demonstration and operation of reversible solid oxide cell systems operation for local grid-connected hydrogen production and utilisation. This will also apply to the Hydrogen Valleys (flagship) topics as they are considered of strategic importance for the European Union ambitions to double the number of Hydrogen Valleys by 2025 as well as to the more recent European Commission's inspirational target to have at least 50 Hydrogen Valleys under construction or operational by 2030 across the entire EU. For the Hydrogen Valleys topics a large amount of co-investment/co-funding of project participants/beneficiaries including national and regional programmes is expected.

Additional eligibility condition: Membership to Hydrogen Europe/Hydrogen Europe Research
HORIZON-JU-CLEANH2-2026-03-03
HORIZON-JU-CLEANH2-2026-04-02
HORIZON-JU-CLEANH2-2026-06-01
HORIZON-JU-CLEANH2-2026-06-02

Technology Readiness level

Where specific call/topic conditions require a Technology Readiness Level (TRL), the definitions included in the General Annexes to the Horizon Europe Work Programme 2026-2027[281] apply.

General Annex F (Evaluation procedure):

STEP (Sovereignty) Seal

For the Hydrogen Valleys topics, as shown below, STEP Seal (so called "Sovereignty Seal" under the STEP Regulation[282]) will be awarded to proposals exceeding all of the evaluation thresholds set out in this Annual Work Programme. The STEP Seal is a label, which aims to increase the visibility of quality projects available for funding and help attract alternative and cumulative funding for quality projects, and simultaneously to provide a potential project pipeline for regional and national programmes[283].

STEP (Sovereignty) Seal is applicable to the following topics
HORIZON-JU-CLEANH2-2026-06-01
HORIZON-JU-CLEANH2-2026-06-02

[281] https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2026-2027/wp-15-general-annexes_horizon-2026-2027_en.pdf
[282] https://strategic-technologies.europa.eu/about_en#paragraph_207
[283] https://strategic-technologies.europa.eu/about_en#paragraph_207

General Annex G (Legal and financial set-up of the grant agreements): Specific provisions

In addition to the standard provisions, the following specific provisions in the model grant agreement will apply:

1. *Lump Sum*

   This year's call for proposals will take the form of lump sums [284] as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021- 2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025)[285].

   Lump sums will be used across all topics in the Call 2026.

2. *Full capitalised costs for purchases of equipment, infrastructure or other assets purchased specifically for the action*

   For some topics, in line with the Clean Hydrogen JU SRIA, mostly large-scale demonstrators or flagship projects specific equipment, infrastructure or other assets purchased specifically for the action (or developed as part of the action tasks) can exceptionally be declared as full capitalised costs. This concerns the topics below:

Exceptional declaration of full capitalised costs
HORIZON-JU-CLEANH2-2026-03-03
HORIZON-JU-CLEANH2-2026-04-02
HORIZON-JU-CLEANH2-2026-06-01
HORIZON-JU-CLEANH2-2026-06-02

3. *Subcontracting*

   For all topics: an **additional obligation regarding subcontracting** has been introduced, namely that subcontracted work may only be performed in target countries set out in the call conditions.

   The beneficiaries must ensure that the subcontracted work is performed in the countries set out in the call conditions.

   The target countries are all Member States of the European Union and all Associated Countries.

4. **Intellectual Property Rights** (IPR), **background and results, access rights and rights of use** (article 16 and Annex 5 of the Model Grant Agreement (MGA)).

[284] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/horizon/lump-sum
[285] DECISION authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025) ls-decision_he_en.pdf (europa.eu)

An additional information obligation has been introduced for topics including standardisation activities: 'Beneficiaries must, up to 4 years after the end of the action, inform the granting authority if the results could reasonably be expected to contribute to European or international standards'. These concerns the topics below:

Additional information obligation for topics including standardisation activities
HORIZON-JU-CLEANH2-2026-01-03
HORIZON-JU-CLEANH2-2026-03-03
HORIZON-JU-CLEANH2-2026-05-02

Common elements applicable to all topics in the Call

EU competitiveness and industrial leadership

In line with the activities started already under the FCH 2 JU, the Clean Hydrogen JU will continue to work to reinforce the EU supply chain of critical key components by e.g. a higher range of common/standardised parts to be produced in EU and Horizon Europe Associated Countries, and to enable start investments in production facilities for further ramp-up in these markets.

All topics included in the Call for proposals 2026 are expected to contribute to EU competitiveness and EU industrial leadership by supporting a European value chain for hydrogen and fuel cell systems components, cells and stacks as well as hydrogen related infrastructure. In particular, proposals are expected to demonstrate supporting European hydrogen value chain, resilience of the supply chains, development of new technology, creating new IP rights, partnerships with European research bodies, recycling and other strategy helping to reduce dependency on critical raw materials, contribution to new industrial ecosystems or other positive spillover effect, jobs created , training or other actions to develop know-how in Europe. As a result, proposals, and specially for all Innovation Actions topics, are expected to demonstrate the contribution to EU competitiveness and industrial leadership of the activities to be funded including but not limited to the origin of the equipment and components as well infrastructure purchased and built during the project. These aspects will be evaluated and monitored during the project implementation.

Synergies

Applicants are expected to pursue the specific opportunities for synergies with other partnerships and programmes as identified in each of the topics (see also section 2.2.6.1).

Applicants in the Call 2026, especially for flagship projects, may consider additional synergies with other 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; such synergies should be reflected in a financing structure and strategy describing the business model, including envisaged sources of co-funding/co-financing and in line with state-aid rules. To this end the European Commission has published a guidance notice which explains the new possibilities for synergies with ERDF programmes and offers guidance on their practical implementation[286].

[286] Commission Notice Synergies between Horizon Europe and ERDF programmes 2022/C 421/03,

Contribution to the monitoring framework of the Clean Hydrogen JU

For the purpose of monitoring technology progress against state-of-art, but also to identify how each of the projects contributes to the Clean Hydrogen JU targets, objectives and indicators described in the SRIA, supported projects will be required to report on an annual basis in a secure online data collection platform (such as the Knowledge Hub, when operational) managed by the Clean Hydrogen Joint Undertaking during the course of Horizon Europe. The reporting will involve filling template questionnaire(s) relevant to the project content (and the technology development and TRL). The projects will need to submit all information included in the questionnaire(s), unless they receive an exception from the Programme Office. The information is submitted by default as public, but the projects can request for certain fields to be considered as "confidential"[287] except for the fields that constitute or directly inform KPIs of the Clean Hydrogen JU. The submission of the questionnaire(s) will be integrated as a specific annual deliverable in the grant agreement. Indicative template questionnaire(s) can be consulted online[288].

Guarantees of origin of hydrogen

For some of the Innovation Actions it is expected that GOs will be used to prove the renewable character of the hydrogen that is produced/used. In this respect consortium may seek the issuance/purchase and subsequent cancellation of GOs from the relevant Member State issuing body and if that is not yet available, the consortium may proceed with the issuance/purchase and cancellation of non-governmental certificates (e.g CertifHy[289]).

Safety

For all topics a 'safety by design' approach should be considered. In particular, in Innovation Actions proposals should provide a preliminary draft of 'hydrogen safety planning and management' at the project level, which will be further developed during project implementation (deliverables to be reviewed by the European Hydrogen Safety Panel). Reference documentation and guidance is available on the EHSP webpage[290]. In particular: (i) Safety Planning and management in EU hydrogen and fuel cells projects – guidance document and (ii) simple template for a safety plan

For all topics, projects should report any safety-related event that may occur during the project implementation to the European Commission's Joint Research Centre (JRC) dedicated mailbox JRC-PTT-H2SAFETY@ec.europa.eu, which manages the European hydrogen safety reference database, HIAD 2.1[291]. Projects reporting on safety should report annually either the safety-related events[292]: near misses, incidents, accidents, or the absence of events.

Contribution to Regulation, Codes and Standards

For Innovation Actions, proposals should consider a public report with both the Legal and Administrative Processes (LAP) and the Regulations, Codes and Standards relevant to the

C/2022/7307; https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ%3AC%3A2022%3A421%3AFULL&uri=uriserv%3AOJ.C_.2022.421.01.0007.01.ENG

287 The Clean Hydrogen JU is committed to respect data confidentiality according to the conditions setup by the Grant Agreement and will only use them in the respect of this attribute: confidential data will not be disclosed as such, but only in aggregated form (following a clean-room approach), and in a manner that ensures non-attribution of their source). Progress and findings that can be shown will be made public (normally associated to the Clean Hydrogen JU annual Programme Review exercise).

288 https://www.clean-hydrogen.europa.eu/knowledge-management/technology-monitoring-trust_en

289 https://www.certifhy.eu/

290 https://www.clean-hydrogen.europa.eu/get-involved/european-hydrogen-safety-panel-0/reference-documents_en

291 https://minerva.jrc.ec.europa.eu/en/shorturl/capri/hiadpt

292 Definitions of near-miss, incident, and accident according to EIGA document INCIDENT/ACCIDENT INVESTIGATION AND ANALYSIS SAC Doc 90/13/E

technologies and/or applications at the project scope, and the barriers and/or gaps identified during the project implementation alongside any other relevant information in order to share the lessons learned and provide recommendations to support the update and/or development of suitable and enabling legal and regulatory frameworks for hydrogen and fuel cell technologies and applications.

Proposals contributing to European or international standards should establish a link to the CEN CENELEC Coordination Group on Hydrogen and its technical committees. Furthermore, proposals should engage National Standardization bodies.

Contribution to sustainability and circularity

For all topics applicants are encouraged to address sustainability and circularity aspects in the activities proposed.

While proposals have a certain leeway to address the sustainability and circularity aspects in general as a function of their activities, for all topics, proposals undertaking Life-Cycle Assessments (LCAs) should follow and comply with the LCA checklist developed by the JRC[293].

Activities developing test protocols

For all topics, activities developing test protocols and procedures for the performance and durability assessment of electrolysers and fuel cell components proposals should foresee a collaboration mechanism with JRC (see section 2.2.4.3 "Collaboration with JRC"), in order to support EU-wide harmonisation. Test activities should adopt the already published EU harmonised testing protocols[294] to benchmark performance and quantify progress at programme level.

Exploitation of project results

For all Research and Innovation actions proposals should describe a clear exploitation pathway through the different necessary steps (research, manufacturing, regulatory approvals and licensing, IP management etc.) in order to accelerate exploitation of the results.

For all Innovation Actions, exploitation and dissemination of results should include a strong business case and sound exploitation strategy. The exploitation plan should include preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan) indicating the possible funding sources to be potentially used (in particular the Innovation Fund). As a project output a more elaborated exploitation plan should be developed including preliminary plans for scalability, commercialisation, and deployment (feasibility study, business plan and financial model) indicating the possible funding sources to be potentially used (e.g., Innovation Fund, LIFE, InvestEU, ESIF).

Beneficiaries are invited to put their results on the Horizon Results Platform, while exploring the use of relevant support services offered by the Commission, such as the Horizon Results Booster. These services can prove useful in bringing results generated from research closer to the market.

International Collaboration

In recognition of the benefits that international collaboration can bring, it will also be promoted via the Calls for Proposals by encouraging international collaboration beyond EU Member States and Horizon Europe Associated Countries.

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[293] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0_en
[294] https://www.clean-hydrogen.europa.eu/knowledge-management/collaboration-jrc-0_en

For the call 2026, low TRL research activities on fuel-flexible gas turbine combustion technology for clean and efficient ammonia firing and the flagship topics on Hydrogen Valleys, are encouraged to include legal entities established in the countries members/participant[295] in the Clean Hydrogen Mission under MI2.0 under the following topics, without prejudice to the countries eligible for funding or applicable participation restrictions set out in General Annexes to the Horizon Europe Work Programme 2026-2027[296]. In particular, for the topic HORIZON-JU-CLEANH2-2026-04-03 on ammonia combustion, International Collaboration with Japan's national research and development agency, NEDO, is encouraged (see also section 2.2.6.7 International Cooperation for additional details):

Explicit encouragement for International Collaboration
HORIZON-JU-CLEANH2-2026-04-03
HORIZON-JU-CLEANH2-2026-06-01
HORIZON-JU-CLEANH2-2026-06-02

2.2.3.3. List of countries entrusting the JU with national funds for the call 2026

Not applicable

2.2.3.4. Country specific eligibility rules

The conditions described in part B of the General Annexes to the General Annexes to the Horizon Europe Work Programme 2026-2027[297] will be applied by the Clean Hydrogen Joint Undertaking without derogation.

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[295] For the list of countries which are members/participant to Clean Hydrogen Mission, please see: http://mission-innovation.net/missions/hydrogen/

[296] https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2026-2027/wp-15-general-annexes_horizon-2026-2027_en.pdf

[297] https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2026-2027/wp-15-general-annexes_horizon-2026-2027_en.pdf

2.2.4. Calls for tenders and other actions

2.2.4.1. Calls For Tenders

In 2026, the Clean Hydrogen Joint Undertaking will carry out a number of operational activities via calls for tenders (i.e. public procurement) for an indicative amount of **EUR 10.5 million.** These activities will be financed with Horizon Europe funds.

The procurement activities are covering subjects of a strategic nature for the Clean Hydrogen JU, providing input to R&I priority setting and supporting further financing, deployment and commercialisation of renewable hydrogen and fuel cells projects.

The following indicative list of procurements is currently foreseen:

Subject (Indicative title)	Indicative budget (EUR)	Expected type of procedure	Indicative Schedule
European Clean Hydrogen Start-Up Hub The Clean Hydrogen JU is planning to launch a tender to set-up and run a European Clean Hydrogen Start-Up Hub aiming at accelerating and accompanying the "translation" of research into investable start-ups, building the basis for scaling startups by connecting investment to hydrogen innovation with corporates as key enablers, and building and consolidating European Hydrogen Innovation Corridors. The initiative shall contribute to the European Commission's planned Scale Up and Start Up strategy.	10 MEUR	Open procedure	Q1/Q2
Hydrogen Quality The Clean Hydrogen JU is planning to launch a tender to provide Technical Assistance on Hydrogen Quality Standardisation. This tender will complement the existing study[298] published by European Commission on this matter	500,000 EUR	Open procedure	Q1/Q2

2.2.4.2. Support to EU policies

Support to Climate and Energy Policies

In 2026, the Clean Hydrogen JU will continue supporting climate related policies, similar to 2025. For instance, the Clean Hydrogen JU will continue to support DG CLIMA on a number of initiatives aiming at bringing the JU family of projects closer to the Innovation Fund programme.

In addition, the ongoing study on 'Sustainable paths for the use and management of water in the hydrogen value chain' will analyse the impact of green hydrogen production in Europe and Neighbouring Countries on water basins. The study should prove relevant to contribute to the

[298] https://op.europa.eu/en/publication-detail/-/publication/864a9f8a-beb9-11f0-a612-01aa75ed71a1/language-en

European Commission planned initiative on water resilience.

Furthermore, the support provided to the demonstration of Hydrogen Valleys via the Clean Hydrogen JU annual call for proposals, together with the project development assistance services provided to hydrogen valleys project promoters, under the ongoing "Hydrogen Valleys Facility", contribute directly to the European Commission's inspirational target[299] to have at least 50 Hydrogen Valleys under construction or operational by 2030 across the entire EU.

Support to Innovation and Industrial Policies

The Clean Hydrogen JU remains ready to continue supporting DG GROW and cooperate with the European Clean Hydrogen Alliance (ECH2A)[300] activities, to ensure synergies as foreseen in Art. 78 (2) of the SBA. The aim is to have a more integrated approach linking research partnerships with the industrial strategy, bringing closer together the hydrogen research and industry communities, as well as sharing more widely the results of research. In line with this, the Clean Hydrogen JU intends to continue taking part in the Steering Committee of the ECH2A. In addition, as requested, the Clean Hydrogen JU is ready to present winning and demonstration ready technologies for further deployment to the Round Tables under the European Clean Hydrogen Alliance. It may also share and discus the state of play of research and development with members of the European Clean Hydrogen Alliance.

In 2026, the Clean Hydrogen JU, building on the cooperation that started in 2023, will continue collaborating and supporting DG GROW and DG EMPL to reach the ambitions of the EU Net-Zero Industry Act [301] on the area of hydrogen in general and concerning skills in particular.

In addition, the ongoing study looking at the 'Role of innovation in enhancing the competitiveness of the European hydrogen sector' is expected to be of relevance to policy makers at, but not only, DG RTD, DG CLIMA and DG GROW. This study aims at identifying the key factors defining hydrogen competitiveness, evaluate the role of innovation in strengthening the competitiveness of the European hydrogen sector and support the prioritisation and optimisation of R&I funding within the current multiannual framework and beyond.

Furthermore, through the dedicated support the JU intends to provide to startups, the Clean Hydrogen JU would address the objectives of the "EU Startup and Scaleup Strategy[302].

Support to transport policies

On the maritime sector the collaboration with European Commission services and Zero Emission Waterborne Transport (ZEWT) on fostering the development of alternative powertrains and supply of zero emissions fuels will continue. This consists of steady exchanges on projects, topics of call for proposals and strategic research and innovation agenda updates. So that the work of the two entities addresses the decarbonisation of the maritime in a concerted and synergetic manner.

In 2026, the Clean Hydrogen JU will also oversee the implementation of a procurement on 'European Hydrogen Refuelling Stations Availability System (E-HRS-AS)'. This activity provides a contribution towards the implementation of the Alternative Fuels Infrastructure Regulation (AFIR), notably by supporting the collection and harmonisation of hydrogen

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[299] Commission Staff Working Document, SWD(2024) 159 final. Towards a roadmap for accelerating the deployment of Hydrogen Valleys across Europe: challenges and opportunities

[300] https://ec.europa.eu/growth/industry/policy/european-clean-hydrogen-alliance_en

[301] https://single-market-economy.ec.europa.eu/publications/net-zero-industry-act_en

[302] https://research-and-innovation.ec.europa.eu/strategy/strategy-research-and-innovation/jobs-and-economy/eu-startup-and-scaleup-strategy_en

refuelling data across Europe. By ensuring that the system evolves in line with AFIR and related implementing acts, the Clean Hydrogen JU helps strengthen the evidence base for policy implementation and contributes to the development of a coherent European hydrogen mobility ecosystem.

Strategic Energy Technology (SET) Plan

The Implementation Working Groups (IWG) on "Green Hydrogen[303]" under the SET-Plan[304], set up in 2023, aims at implementing part of the Strategic Research and Innovation Agenda (SRIA) of the European Research Area (ERA) pilot on green hydrogen and coordinating the work on hydrogen previously split between different IWGs of the SET Plan. This European Research Agenda (ERA) Pilot on green hydrogen SRIA addresses specifically the need to ensure mutual coordination on an ongoing basis among national and regional hydrogen R&I programmes.

In 2025, the Clean Hydrogen JU, has contributed to the development of the implementation plan for the IWG on "Green Hydrogen" under the SET-Plan, which is a key document for transitioning of the group from the temporary working group to the implementation group. In 2026, it is expected that the group will have a more focused and active role and the JU will continue monitoring that the implementation of the group's activities is in line with JU's SRIA and provide continuous support to different task forces. As most of the members of the IWG Hydrogen group are also members of the Clean Hydrogen JU States Representatives Group, the JU will act as the facilitator between the groups and monitor further opportunities for synergies.

Furthermore, the Clean Hydrogen JU will continue following and contributing as necessary also to the SET-Plan Implementation Working Group (IWG) on "Renewable Fuels and Bioenergy".

2.2.4.3. Collaboration with JRC – Rolling Plan 2026

The Commission's Joint Research Centre (JRC) undertakes high quality research in the field of fuel cells and hydrogen that is of considerable relevance to the implementation of the Clean Hydrogen JU activities. During the Horizon 2020 period, a Framework Contract between the FCH 2 JU and JRC was approved by the Governing Board on 23/12/2015 and signed by both parties on 18/02/2016. Under Horizon Europe, a new Framework Agreement between Clean Hydrogen JU and JRC was signed in the spirit and as continuation of the previous Framework Contract on 29/11/2022.

The scope of the Framework Agreement covers the activities that JRC provides to the Clean Hydrogen JU, against payment from the Clean Hydrogen JU operational budget. In line with the JRC mission, these support activities will primarily support the formulation and implementation of the Clean Hydrogen JU strategy and activities in the areas of standardisation, technology monitoring and assessment and sustainability. In addition, Clean Hydrogen JU may call upon JRC to perform specific actions for individual projects, by which the JRC provides added value to programme objectives.

The JRC support activities to the Clean Hydrogen JU programme covered by the Framework Agreement are discussed and agreed on an annual basis between the JRC and the Programme Office of the Clean Hydrogen JU, with involvement of representatives of Hydrogen Europe and Hydrogen Europe Research. This annual Rolling Plan is then presented at the Governing Board of the Clean Hydrogen JU, as well as its outcomes. For the year 2026, a

[303] https://set4h2.eu/
[304] https://energy.ec.europa.eu/topics/research-and-technology/strategic-energy-technology-plan_en

maximum budget of EUR 990 000 from the Clean Hydrogen JU operational budget is foreseen.

The annual Rolling Plan 2026 describes the annual activities and their related deliverables provided by JRC to Clean Hydrogen JU (Article 2 in the Framework Agreement) against payment. Modifications of the annual Rolling Plan are possible at every moment, upon request of all parties involved, and agreed according to the same procedure. These modifications must however remain below the maximum budget agreed beforehand.

A Support to RCS Strategy Task Force

In general, RCS activities at Clean Hydrogen JU consist of identifying and prioritising RCS needs of strategic importance for the EU including the pre-normative activities required to support the RCS priorities identified. Specific to PNR activities, it is critical to ensure that their results are developed for and used for RCS development. The Clean Hydrogen JU will contribute to supporting the implementation of hydrogen-specific regulatory and enabling frameworks by a strategic and coordinated approach to RCS issues within the Programme, which will mostly be implemented through Pre-Normative Research (PNR) activities.

Under Horizon Europe, the approach to RCS strategy is revised, and a RCS SC Task Force has been set up to better coordinate these activities. JRC contributes to the high-level activities of this new body, participating to the activities of the RCS SC Task Force, jointly by all stakeholders. The RCS SC Task Force meets bi-monthly, hence the proposed deliverables may be modified according to the priority set by the RCS SC Task Force activities.

A.1 Support to RCS SC Task force contributing to its activities.

A.2 Short overview on the international progress in the area of RCS by international bodies (UN-ECE, ISO/TC 197, IEC/TC105, IPHE) (December 2026).

B European harmonisation of testing protocols and procedures

In 2024, the JRC conducted a survey on the utilisation of its harmonised testing protocols, which yielded some valuable insights despite a relatively low response rate. Through participation to various electrolysis conferences and other interactions, the JRC discovered that the protocols are being widely used by numerous organisations, albeit without formal communication to the JRC. Furthermore, some organisations have been adapting the protocols to suit their specific needs. To gain a better understanding of (1) the extent to which the protocols are being used and (2) the modifications being made and their rationale, the JRC, in collaboration with the JU, will host a workshop where stakeholders will be invited to share their experiences and opinions. This will enable the JRC to identify areas for future improvement regarding the testing protocols. A report summarising the workshop's outcomes will be prepared by the JRC.

Furthermore, as part of a Round Robin campaign aimed at validating the recently published Accelerated stress testing (AST) protocols, initial tests will be conducted on a 30 kW PEM stack. The preliminary results and test outcomes from this exercise will be shared with the JU and the WG.

As part of an institutional JRC proof-of-concept project, the JRC will deploy a system, featuring an AEM electrolyser, fuel cell, and hydrogen (solid state) storage unit, to showcase the viability of enabling a household to operate autonomously for 72 hours during emergency power outages. The system, powered by a combination of solar panels and a small wind turbine, will be installed at the JRC's Petten premises. The data collected from the system will also serve as a real-world validation of the JRC's AST protocols. Produced results and insights will be shared with the JU when available.

B.1 Report summarising the findings and conclusions from the Workshop on the utilisation of the JRC's harmonised testing protocols, proposing further steps for potential improvement (December 2026).

B.2 Report summarising the preliminary results and insights (if available by Dec 2026) from applying AST protocols on 30 kW PEM stack using the new electrolyser test bench currently being installed at the JRC Petten premises. (December 2026)

C Contribution to programme monitoring and assessment

Programme Monitoring and Technology benchmarking. The JRC will continue supporting the Clean Hydrogen JU on its task under Article 74 of the SBA to “assess and monitor technological progress and technological, economic and societal barriers to market entry, including in emerging hydrogen markets”.

Building on the outcomes of the on-going Clean Hydrogen JU study on the role of innovation in enhancing the competitiveness of the European hydrogen sector, JRC will work with stakeholders on specific areas of interest. (January 2027)

C.1 Stakeholder consultation and interviews with industry representatives and policy makers on the notion of competitiveness (and resilience) of the European electrolyser industry.

Support to Programme Monitoring and Assessment by means of JRC’s TIM analytics.

1. Technology monitoring
    a. Unit JRC.T.5 maintains and continuously adapts the Clean Hydrogen spaces in TIM, ensuring alignment with the needs of the Clean Hydrogen Joint Undertaking.
        i. The mapping of technology fields (e.g.: alkaline electrolysers/FC, H2 production methods, polymer electrolyte membrane FC/electrolysers and solid oxide FC/electrolysers, transport applications, hydrogen safety) undergoes annual expansion, incorporating feedback from the Joint Undertaking to capture scientific areas of strategic importance.
        ii. In 2026 the TIM public spaces shared on the JU websites will be updated and replaced by the new dashboards with enhanced features
            1. Depending on the needs of the JU the technologies followed by the JU can be assigned to the 8 pillars and the dashboards will be adapted accordingly.
        iii. T.5 will continue to provide data exports (Excel format) from the selected hydrogen technology fields, which are used by external partners (e.g. Deloitte) to support analytical activities within the European Hydrogen Observatory.

2. Comprehensive project analysis and metrics development
    a. KPI tracking per pillar

    i. T5 will develop metrics grounded in CORDIS projects, scientific publications, and patent.
    ii. CORDIS Projects: T.5. is working in close collaboration with JRC.C.1 to map the projects into relevant JU research pillars.
    iii. Patent data: T.5 utilizes CORDIS website datasets to link patent publication numbers with relevant projects and subsequently with research pillars
    iv. Scientific publications data: T.5 compiles datasets using the following sources:
        1. CORDIS website;
        2. funding details found within the publication text available in Scopus to associate the publications with CORDIS projects and research pillars.

b. Additional data enrichment/analyses
    i. T.5. will continue to create additional graphs tailored to Clean Hydrogen JU needs.
    ii. T.5. will enrich the data (where necessary) and perform additional analyses which provide insights into organizational participation patterns and the geographical distribution of programme activities.
    iii. T.5. will continue to harmonize organization names to avoid name duplications caused by spelling variations and legal form differences, ensuring accurate entity tracking across the programme lifecycle.
    iv. T.5. will add detailed information about organisation type, particularly for companies SME/non-SME, plus granular sector assignment based on SRIA research area.

c. In 2026 T.5. will acquire a license to Crunchbase database specifically for start-up company identification. Addition of this dataset will enable T.5. to identify and analyse start-up companies participating in Clean Hydrogen JU funded projects, providing insights into the Clean H2 R&D network.
    i. T.5. will match entities between the CORDIS and Crunchbase databases to ensure precise detection of start-ups within the list of funded companies by the JU
    ii. T.5. will, based on the matched entities, perform analyses that reveal the involvement patterns of start-up companies within the projects.

d. Dissemination of the results from the analyses
    i. To disseminate TIM's analytical findings derived from the analyses carried out for the JU, Unit T.5. will prepare reports that present the results in an accessible and easily understandable way for a broader audience.

3. JU benefits from direct access to the TIM platform as internal users. This includes Scopus data on scientific literature, allowing for keyword searches. We will provide consistent content delivery and analysis based on Clean Hydrogen JU's requirements.
4. Horizon Scanning

a. T.5 will conduct a horizon-scanning exercise to detect emerging technologies (weak signals) and research directions relevant to the hydrogen value chain. Using large-scale text data and advanced text mining techniques, TIM will analyse scientific publications, patents, and EU-funded projects to identify weak signals within the focus area. Signals will be detected through an activeness indicator, defined as the ratio of documents published in the last three years to the total number of documents. A sharp local increase in this ratio indicates a potential signal, which will then be validated manually by T.5. analysts to retain only terms representing genuine scientific or technological developments. Validated signals will be indexed in TIM, with synonym expansion, to ensure consistent monitoring. For the selected signals, T.5 will use GPT@JRC within TIM to generate concise technology summaries and estimate the corresponding Technology Readiness Levels (TRLs) based on available metadata and user-defined prompts. The resulting outputs can be used by the Clean Hydrogen JU to support discussions in expert workshops, facilitating evidence-based reflection on technological trends and research priorities across the hydrogen value chain. To ensure the timely preparation of the horizon-scanning outputs, the Clean Hydrogen JU will communicate the dates and thematic focus of the expert workshops no later than 30 days prior to their organisation.

5. Technology gap mapping

a. T.5 will perform a gap analysis of the proposals received by the Clean Hydrogen JU to identify emerging technologies and potential areas insufficiently covered by funded projects. To detect such emerging technologies, TIM will link proposal texts with related publications from Scopus to achieve the document density required for reliable keyword and phrase detection using advanced text and data mining techniques. T.5 will compute text embeddings using the e5 model for all Scopus publications (over 65 million documents) and retrieve the nearest neighbours for each proposal in the embedding space. Signals will be detected through an activeness indicator, defined as the ratio of documents published in the last three years to the total number of documents. A sharp local increase in this ratio indicates a potential signal, which will then be validated by T.5. analysts to retain only terms representing genuine scientific or technological developments. Validated signals will be indexed in TIM, with synonym expansion, to ensure consistent monitoring. For selected signals, T.5 will use GPT@JRC within TIM to generate concise technology summaries and estimate the corresponding Technology Readiness Levels (TRLs) based on available metadata and user-defined prompts. The resulting analysis will highlight technological domains where proposals are actively being selected for funding, as well as those that remain underrepresented in the selection process. To ensure timely preparation of the analysis, the Clean Hydrogen JU will share the received proposals with T.5 no later than 30 days prior to the requested delivery of results.

C.2 Maintenance, operation and extension of FCH Technology Innovation Monitoring System for the Clean Hydrogen JU (January to December 2026).

<u>Annual Programme Technical Assessment:</u>

Similar to previous years, the JRC will conduct a comprehensive programme review for 2026, focusing on projects to be confirmed with the JU at the start of 2026. Following the introduction of a joint JRC-JU report in 2025, in 2026 the JRC will provide their assessment to the JU, which will then be complemented by additional information by the JU. The report's structure will be agreed upon with the JU in early 2026, building on the experiences with the joint report published in 2025.

C.3 Draft report delivered for commenting to JU. If required, including an update of methodology for the Programme Assessment considering the lessons learnt from the previous Programme Review (1st JRC draft July 2026).

C.4 Final JRC-JU version (September 2026).

C.5 Summary of support provided to the study on water management (June 2026).

D Contribution to assessment of sustainability of hydrogen and fuel cells

In 2024, the Clean Hydrogen JU launched the European Hydrogen Sustainability and Circularity Panel (EHS&CP) to address the sustainability and circularity at both the programme and project levels, encompassing environmental, social and economic aspects. The JRC collaborates with the EHS&CP to provide additional support to the Clean Hydrogen JU to assessing the sustainability of hydrogen technologies.

In 2026, JRC will continue assessing the life cycle-based deliverables of all ongoing projects and will work with the EHS&CP to rate the quality of LCA deliverables produced by JU projects based on a methodology developed by JRC in 2025. This task serves as a key framework for programme evaluation by offering an objective framework to track the quality of LCA deliverables.

JRC will keep advising JU-funded projects focused on key aspects for improving the sustainability of hydrogen technologies. JRC will be in the advisory board of the HyPEF project, aimed at drafting the first Product Environmental Footprint Category Rules for hydrogen technologies, of NHyRA, aimed at improving our understanding of the environmental impact of hydrogen losses from the hydrogen value chain, and of GUESS-Why, aimed to produce practical guidance on Safe and Sustainable-by-Design (SSbD) principles for multiple hydrogen applications.

JRC will also provide support in evaluating the sustainability of the Hydrogen Valley projects in collaboration with the EHS&CP. The Clean Hydrogen JU is currently funding 15 Hydrogen Valley projects initiated through the 2022 and 2023 Calls. As part of their development, these projects are expected to consider environmental impacts, with many planning to conduct life cycle assessments (LCAs). To support this effort, JRC will organise an expert consultation on best practices on conducting life cycle assessments. The aim is to work out recommendations that enhance the comparability and reliability of results, and to improve communication with stakeholders and the public regarding the sustainability benefits of Hydrogen Valleys.

JRC will also further develop the social impact assessment methodologies for hydrogen technologies. JRC provided a framework for assessing the social risk and impacts related to hydrogen technologies and their value chains, and applied it to the import of hydrogen to a European port. In 2026, the JRC will draw on the lessons learned from this exercise to address the identified gaps and further refine its approach. To this end, a new contract will be initiated to translate the case study's findings into actionable recommendations for policymakers and stakeholders, ensuring that the results support decision-making.

In 2026, the JRC will build on the findings from the study "Analysis and Recommendations of

Circularity Requirements for Critical Raw Materials Contained in Hydrogen Technologies" (AWP2025) to enhance the circularity of hydrogen technologies. This analysis will focus on consolidating a circularity assessment framework from a life cycle thinking perspective, which aims to strengthen EU competitiveness and resilience. The framework aims to quantify the flows of strategic and critical raw materials involved in hydrogen technologies and assess the capacity of circular economy strategies to optimise these flows. By targeting primary data (e.g. pilot processes), this activity seeks to consolidate knowledge and data that can support strategic decision-making and policy development for a more circular "hydrogen economy" in the EU. This effort will also contribute to the broader goals of sustainability and resource efficiency by integrating circularity considerations into the lifecycle assessments.

The JRC will continue supporting the Clean Hydrogen JU by reviewing the life cycle inventory data developed by the projects and by setting up the node to be linked into the Life Cycle Data Network infrastructure to host the developed datasets. These efforts will contribute to strengthening the methodological framework and data quality, with a focus on incorporating considerations of circularity for End-of-Life modelling.

Finally, the JRC will support the Clean Hydrogen JU assessing the achievements of the programme in terms of greenhouse gas emission avoidance and social impacts. As regards the greenhouse gas emissions, the JRC will develop a methodology to assess what has been the contribution of the programme in supporting the EU climate targets by developing and deploying cleaner technologies. The assessment will include a tailored methodology with a customised approach for each project type. At the same time, the JRC will launch a contract to develop a robust approach to measure the societal impact of the Clean Hydrogen JU programme, including aspects such as job creation, skills acquisition, innovation, etc. The assessment would consider and expand upon the Key Impact Pathways monitoring framework of Horizon Europe and the MAWP targets. The work on the programme achievements will result in two reports: one on the greenhouse gas emissions and one on the social impact. The first report will outline the methodology employed to assess the greenhouse gas emission avoidance and report the results. The second report delivered will document the approach developed for social impact assessment and its application to a case study.

The JRC will also provide support to the JU in monitoring the progress of the study on management of water.

D.1 The report will include the outcomes of the regular review and assessment of the life cycle based deliverables of all ongoing JU projects (i.e., spreadsheet with the review of each deliverable, and a summary of the main outcomes of the review) (December 2026).

D.2 Reporting on the support JRC will provide to the activities of the EHS&CP (December 2026).

D.3 Summary of support provided by JRC to the JU-funded projects HyPEF, NHyRA and GUESSWHY (December 2026).

D.4 Organising an expert consultation on best practices for conducting life cycle sustainability assessments of hydrogen valleys. A summary of the outcomes of the consultation will be provided (December 2026).

D.5 Reporting on the activities performed with regards to the life cycle inventory (LCI) data review process of datasets to be integrated into the node and the support for setting the node. Deliverables will be reviewing reports and a summary of the activities (December 2026).

D.6 Reporting the activities regarding the circularity assessment of hydrogen technologies in collaboration with the EHS&CP (December 2026).

D.7 Reporting the outcomes of the assessment of the social impacts of the JU programme, including aspects such as job creation, skills acquisition, innovation, etc. (December 2026).

D.8 Reporting the outcomes of the assessment of the avoided GHG emissions of the JU programme (December 2026).

D.9 Reporting recommendations derived from applying the framework for assessing the social impact of hydrogen value chains to a case study, to inform and support policymaking (December 2026).

E Contribution to safety, and safety awareness

E.1 Annual report on achievements, updating the HIAD dataset (December 2026).

E.2 HIAD manual (structure, definitions, instructions on how to fill fields, caveats) (December 2026).

E.3 Support of the EHSP work towards improvement of descriptors and assessment the new events (it implies a document with the list of improvements and proposed options) (December 2026).

E.4 Valorisation of HIAD by means of contribution to conferences, submission of scientific articles and possible collaborations with the hydrogen safety community (December 2026).

E.5 Coordinating with the Knowledge Management Hub contractor for the creation of a backend solution for the database (choice of the software, assistance during development) (December 2026).

Enclosure I – RESOURCES REQUIRED FOR THE SUPPORT AT PROGRAMME LEVEL

(these are values reflecting approximately the true figures from the Cost Evaluation Form of the Framework Contract)

	Deliverable title	Effort [PM]
A	Support to formulation and implementation of RCS strategy (RCS SC group)	0.2
B	Direct contribution to implementing RCS strategy (Harmonisation)	3
C	Contribution to programme monitoring and assessment	14
D	Assessment of sustainability	18
E	Hydrogen Safety	5
	Manpower Totals [PM]	**44.2**

	Overview indicative costs (with overhead) [k€]
Personnel costs	*600*
Missions	*20*
Software licences (SIMAPRO + PSILCA, D.7, D.8)	*10*
Subcontract[305] (for Scientific & Technical services, D.7)	*75*
Subcontract[306] (for Scientific & Technical services, D.6)	*15*
Subcontract[307] (for Scientific & Technical services, D.5)	*55*
Subcontract[308] (for Scientific & Technical services, D.9)	*15*
Hardware (TIM Deliverables C.3)	*10*
Specific costs[309] (for TIM Deliverable C.3)	*170*
Licenses (for TIM Deliverables C.3)	*20*
Total indicative cost for 2026	**990**

Costs includes support to EU Habillage.

JRC will report on a regular basis (every month) on deliverables progress.

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305 Expert contract as a follow-up of social LCA analysis
306 Expert contract for circularity assessment
307 Expert contract for data network
308 Expert contract as a follow-up of social LCA analysis, case study
309 These costs include the work of IT consultants, other TIM staff and of the TIM Team leader, as well as queries design, visualisations customization, cleaning of results and other activities identified in the rolling plan. Costs also cover hosting Clean Hydrogen systems, software upgrades, security fixes and maintenance.

2.2.5. Follow-up activities linked to past calls: monitoring, evaluation and impact assessment

2.2.5.1. Knowledge management.

Knowledge management refers to a range of practices and techniques used by organisations to create, share and exploit knowledge to achieve organisational goals. The primary focus of these activities in the Clean Hydrogen JU is:

a. Monitor progress towards the achievement of the objectives of the Clean Hydrogen JU objectives and its technology KPIs;

b. Strengthen the knowledge capacity of hydrogen value chain actors through data collection and knowledge collection;

c. Support evidence-based implementation of Union policies.

The ultimate goal of this approach is to gradually turn the Clean Hydrogen Joint Undertaking into the knowledge hub for hydrogen in Europe, and the Programme Office into a knowledge intensive organisation.

For the coming year, the Knowledge Management Team is planning to work towards these goals through the actions below. JRC will continue being an important partner to the Clean Hydrogen JU, supporting all knowledge activities, as described in Section 2.2.4.3.

A. Programme Review 2026

Technology and programme monitoring will continue through the annual Programme Review performed by the JU, which can be separated into four main activities: (a) The annual data collection exercise, (b) the JRC Annual Programme Technical Assessment Report, (c) the Programme Review Report and (d) the portfolio and projects presentations as part of the European Hydrogen Week.

The annual data collection exercise from projects was mainly performed until 2024 via the internally developed data collection platform TRUST (Technology Reporting Using Structured Templates)[310] and complemented via a questionnaire to collect additional qualitative information, initially through EU Survey, and from 2023 via the Project Fiche form. In 2025 the data collection was performed via the Clean Hydrogen Knowledge Hub (see below), consolidating the different data collection processes and minimising the input effort from the side of the projects. For 2026, the Clean Hydrogen Knowledge Hub will continue to be used, with improved features and useability. Projects will be invited to provide their data in the month of February 2026 concerning results generated in 2025.

Similar to the previous years, a workshop with the data providers will be organised in the second half of January, to introduce the platform and provide clarifications on the process and the templates that the projects need to fill in.

Data collected will allow the benchmarking of the technology progress reported by the projects against the SoA and the Clean Hydrogen JU targets, as defined in the SRIA. Moreover, the annual iterations of the data collection exercise provide the necessary input for the development of a database of project results over time. The Clean Hydrogen JU is committed to respect data confidentiality (according to the conditions setup by the Grant Agreement) and will only use them in the respect of this attribute: confidential data will not be disclosed as such, but only in aggregated form and in a manner that ensures anonymity of their origin.

[310] https://www.fch.europa.eu/sites/default/files/documents/TRUST_ExplanationFile_Draft_2019%20%28ID%205709356%29%20%28ID%205833842%29.pdf

Following the conclusion of the annual data collection exercise, the JRC will perform its detailed technical assessment of the Programme and will produce a report with observations on the major accomplishments of the projects, difficulties encountered and an evaluation of the performance of the Programme against the KPIs. This report will be complemented by the JU's own analysis as well as additional chapters about the European Hydrogen landscape. The result will be the Programme Review Report, which will be a joint publication of the JRC and the Clean Hydrogen JU, scheduled for November 2026.

Continuing the good experience and practice, the Clean Hydrogen JU will present its project portfolio and their achievements, accompanied by individual projects presentations, as part of the European Hydrogen Week (see also section 2.3.1). Initiated in 2011 (as an answer to the JU mid-term evaluation recommendations), this annual event presents the progress of the portfolio of hydrogen relevant projects funded by the EU research programmes, identifying key achievements but also potential areas to be addressed or reinforced in subsequent years. The exercise also provides an excellent visibility platform for projects and technological developments achieved in the sector. Furthermore, the Best Success Stories and the Best Innovation Awards have been lately introduced to highlight and celebrate annually the results of collaboration between research, industry and policy makers, and projects achievements.

B. European Hydrogen Observatory (EHO)

The Clean Hydrogen JU contributes towards the monitoring of the deployment of hydrogen technologies, the adoption of related policies and academic activities and research results through the European Hydrogen Observatory[311] (EHO). EHO is an open platform providing data and up to date information about the entire hydrogen sector, aiming to address the lack of data publicly available at EU and national level concerning the uptake of hydrogen technologies on the EU market and the absence of a coordinated methodology on how to monitor their market evolution.

In September 2023 the EHO was successfully relaunched. A number of new data sets and functionalities have already added compared to its predecessor, the Fuel Cell and Hydrogen Observatory. In 2026 the data sets, reports and tools offered by EHO will be further expanded, aiming to have by end of 2026 the complete set of functionalities and resources envisaged in the related contract.

Existing datasets available in the EHO will be compared with datasets owned by other organizations. Any dataset that presents redundant information will be reviewed or scrapped all together. An example is the Refuelling Stations dataset, which presents information that already exists in the HRS Availability Map (H2-Map). The dataset on the EHO shall be either replaced by a live connected report from the H2-Map or a simple link to it. All other datasets will be scrutinized and either be kept, replaced or scrapped depending on a case by case analysis.

The main source of information in the EHO is Hydrogen Europe. Finding additional data sources will be one of the main objectives of the work with the contractor in 2026.

The EHO platform has a link to IPCEI Waves 1 and 2 projects websites. By 2026 the websites for Waves 3 (Hy2Infra) and 4 (Hy2Move) shall be available as well.

The contract will end in 2026. A potential prolongation beyond 2026 shall be studied and, if appropriate, a solution agreed by the end of the year.

[311] https://observatory.clean-hydrogen.europa.eu/

C. Clean Hydrogen Knowledge Hub

The Knowledge Hub is a unique digital platform that provides the necessary tools and capabilities to better collect and manage the knowledge concerning the JU's activities and funded projects, as well as to facilitate the access to non-confidential information to its members and the wider public. It is the main instruments that will help gradually turn the JU into the central knowledge repository and access point for hydrogen in Europe.

The platform is linked to different data sources, and allows Hub users to manipulate, analyse and visualize this data based on their access rights. In 2025 only a private visualisation tool was available and used by the JU and the JRC. In 2026 additional Hub users are expected to be policy makers (including the EC, national and regional authorities), decision makers, international organisations, academics, the industry and the general public, all with different roles and access levels. The public dashboard shall be released and improved based on feedback from the wider audience.

Additional improvements to existing features of the hub shall be implemented: Improved visuals; further harmonization of technological data; improved useability of the internal portal for project officers and coordinators; full implementation of AI tools, including a chatbot, for fast analysis; complete migration of data from TRUST and the Hub into the visualization tool in PowerBI.

The PowerBI visualization tool shall encompass all the information related to JU's projects. The Knowledge Management team shall use it to answer all internal questions that may arise during the year, by providing automatic and, if necessary, personalized reports to other JU team members.

D. Other

Interoperability of all the platforms managed by the JU shall be sought after. This means that, to the extent that the contracts and the resources allow, all platforms shall use the same visual identity. On top of that any redundant data between platforms shall be harmonized and a single source of truth clearly defined and mentioned. Any replication of data across different platforms shall only be kept if the user friendliness benefits from it. In any case all duplicated data shall be matching exactly and sourced from a single data source.

The Strategic Map and the methodology for KPIs definition and reporting shall also be analysed. Obsolete data shall be revised, replaced or even scrapped if appropriate. New knowledge that the JU has acquired since the creation of the current Strategic Map and the set-up of KPIs shall be considered and added if appropriate.

2.2.5.2. Feedback to policy

The climate and energy policy framework at EU level is constantly expanding. In the last few years it has been further reinforced by the Fit-for-55 gradual delivered acts, combined with the Gas and Hydrogen Market packages adopted in 2021, the REPowerEU Plan and recently with more initiatives like the Hydrogen Bank. Hydrogen has a prominent position in many of these acts and so the Clean Hydrogen JU is frequently asked to contribute to the activities of several services in the European Commission (EC). Contributions vary in content and format, but the common goal is to provide fact-based information on the state-of-the-art of fuel cells and hydrogen technologies and their contribution to the EU initiatives and policies especially in the energy, transport and industry sectors as well as to competitiveness and growth.

In practical terms, this means taking part in several technical groups organised by the EC (e.g. the Horizon Feedback to Policy Group) and other bodies, participation in meetings, providing written technical input and ensuring that hydrogen and fuel cells technologies are properly represented. It also includes feedback from projects and studies to the EC in contribution to relevant energy, transport and clean air policy files.

In 2026, the Programme Office will continue to reinforce its collaboration with policy makers in the European Commission by providing input, under ad-hoc requests or in a more structured manner. The new Framework for Feedback to Policy (F2P) is expected to support evidence-informed policy design and evaluation. Prepared and piloted by the Common Implementation Centre, the new Framework is expected to support and coordinate the process within the Climate, Energy and Mobility Cluster (Cluster 5) in Pillar II of the Programme. The Joint Team in its core consists of members from RTD, DG CLIMA, DG ENER and DG MOVE . The Clean Hydrogen JU will contribute ad-hoc or through sub-groups upon request by the Joint Team or based on the F2P plan of Cluster 5. The implementation of the framework will be also supported by the F2P repository, as part of the R&I knowledge base .

In summary, the Clean Hydrogen JU expects frequent interactions and a high level of requested contributions in this context. For more information on expected activities refer to Section 2.2.4.2.

Finally, the knowledge platforms supported by the Clean Hydrogen JU and described under Section 2.2.5.1, currently the European Hydrogen Observatory and the Hydrogen Valleys platforms and the Clean Hydrogen Knowledge Hub, will allow the capture, use and sharing of know-how, information and experience from the research and innovation funded activities, with the ultimate goal to become a sustainable tool serving research and industrial communities as well as general public. This will include lessons learnt in particular regarding innovation actions and large flagship initiatives. Alliance members will be invited to cooperate with this Knowledge Hub to help identifying hydrogen solutions at high market readiness levels, solutions mature enough for market deployment.

2.2.6. Cooperation, synergies and cross-cutting themes and activities

2.2.6.1. Synergies implemented via the Call for Proposals at programming level

Synergies with other European Partnerships and programmes at programming/planning level

The Clean Hydrogen JU will remain 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.

Regular exchanges with the relevant European partnerships is foreseen either through the Stakeholders Group, the Clean Planet Inter-Partnerships Assembly or bilaterally on an ad-hoc basis, in view of aligning priorities of JU roadmaps[312] with the different Work Programmes timeframes. The aim is to coordinate annual topics to ensure strong complementarity and synergies.

Since the early stages of preparation of the topics included in the Call for Proposals the Clean Hydrogen JU has interacted with the members of its Stakeholder Group as well as with a number of European partnerships, responsible for different parts of EU programmes. To the extent possible, the view of all stakeholders has been considered in the design of this Call for Proposals. In addition, the Clean Hydrogen JU has taken into account the support provided to

312 Annex 7 of the Clean Hydrogen JU SRIA provides more information on Common R&I Roadmap between the Clean Hydrogen JU and other partnerships

hydrogen topics in the draft Horizon Europe Work Programme 2026. All this has allowed to identify synergies on an ad-hoc basis and avoid potential overlaps during the drafting process.

Synergies with the activities of members of the Stakeholder Group of the Clean Hydrogen JU have been identified as follows.

Synergies with the ZEWT partnership have been identified for topics 'HORIZON-JU-CLEANH2-2026-02-03: New thermal insulation concepts for bulk liquid hydrogen shipping' and 'HORIZON-JU-CLEANH2-2026-03-03: Flexible and standardised hydrogen storage system'. This also applies to topic 'HORIZON-JU-CLEANH2-2026-03-04: Multi-fuel SOFC powertrain for maritime transport'.

In addition, synergies with EURAMET have been identified in some topics. This includes topic 'HORIZON-JU-CLEANH2-2026-05-02: Pre-Normative Research on hydrogen odorisation: enhancing safety and detection along the hydrogen value chain' for which synergies with the project Met4H2[313] are explicitly mentioned. Also for this topic, proposals are asked to collaborate with relevant recent and new developments on regulation, codes and standards including but not only, the project HyQualNet (supported under the Single Market Programme Call for Proposals of the European Commission) , whose results should be taken into account.

Finally, as a result of earlier consultation with the JU Stakeholders Group, synergies with national initiatives have been identified. This is the case for topic 'HORIZON-JU-CLEANH2-2026-02-02: Demonstrating in-line inspection (ILI) to monitor cracks assuring compatibility for operation with hydrogen in new and re-purposed offshore natural gas pipelines', where applicants are encouraged to explore synergies with the German TranshYDE project .

Synergies identified in the Call for Proposals, go beyond the JU Stakeholders Group.

For instance, concrete synergies and collaborations with Clean Aviation JU (CA JU) have been identified for topic 'HORIZON-JU-CLEANH2-2026-03-02: Components Development and Experimental Testing for an Onboard Liquid Hydrogen Supply and Conditioning System in High-Power Fuel Cell Aviation Applications'. Furthermore, this topic was drafted in co-creation with CA JU what illustrates the coordination between both JUs, in line with the Joint Roadmaps included in the Clean Hydrogen JU SRIA.

Looking beyond Europe, and building on the collaborations between the Clean Hydrogen JU and Japan over the recent years, for topic 'HORIZON-JU-CLEANH2-2026-04-03: Fuel-flexible gas turbine combustion technology for clean and efficient ammonia firing' explicit collaboration is encouraged with Japan's national research and development agency, NEDO. In addition, for topic 'HORIZON-JU-CLEANH2-2026-01-05: Sustainable hydrogen production from renewable gases and biogenic waste sources through innovative modular reactor design, process intensification and integration' applicants are encouraged to explore synergies with successful applicants of topic 'HORIZON-CL5-2025-02-D2-08: Coordinated call with India on waste to renewable' included in the Horizon Europe Work Programme.

Synergies with other parts of the Horizon Europe are also encouraged. For instance, for topic 'HORIZON-JU-CLEANH2-2026-01-01 Development and validation of innovative approaches, catalysts, electrolytes and components for electrolysis technologies based on low-quality water' consortia are expected to build on the findings of previous projects funded by the European Innovation Council (EIC) Pathfinder Challenge 2021 as well as to collaborate with the family of projects supported by the Clean Hydrogen JU on seawater electrolysis.

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[313] https://met4h2.eu/

Synergies with Member States and regional programmes

Applicants in the Call 2026, may consider additional synergies with other 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; such synergies should be reflected in a financing structure and strategy describing the business model, including envisaged sources of co-funding/co-financing and in line with state-aid rules. This is expected for all flagship projects, which in the Call 2026 concerns proposals under the Hydrogen Valleys topics. To this end, the European Commission has published a guidance notice which explains the new possibilities for synergies with ERDF programmes and offers guidance on their practical implementation[314].

In addition, for the Hydrogen Valleys topics, the STEP Seal (so called "Sovereignty Seal" under the STEP Regulation[315]) will continue to be awarded to proposals exceeding all of the evaluation thresholds set out in this Annual Work Programme. The STEP Seal is a label, which aims to increase the visibility of quality projects available for funding and help attract alternative and cumulative funding, and simultaneously to provide a potential project pipeline for regional and national programmes[316]. The STEP Seal is focused on projects contributing to the development or manufacturing of critical technologies throughout the Union, or safeguarding and strengthening the respective value chains in clean and resource efficient technologies, including net-zero technologies.

2.2.6.2. Synergies with other programmes, agencies and partnerships at implementation level

The effective operational cooperation in 2022 between the Clean Hydrogen JU and the European Innovation Council and SMEs Executive Agency (EISMEA), and namely its flagship innovation programme to identify, develop and scale up deep-tech breakthrough technologies and game changing innovations - European Innovation Council (EIC) – has reached a high degree of commitment, formalised by the signature of a Letter of Intent in November 2022. Its objectives are to (1) Exchange content based information on selected and funded grants and beneficiaries (ongoing and ended grants/projects) as well as non-selected grants and applicants in the field of innovative hydrogen based technologies; (2) enabling effective sharing of information and reporting of EIC hydrogen related grants/projects in the Clean Hydrogen JU database (i.e Knowledge Hub), and vice versa; (3) Aligning funding opportunities regarding hydrogen based technologies within the European institutions; and (4) Enabling pipeline synergies by considering successive funding opportunities for further uptake of results stemming from the EIC topics via the Clean Hydrogen JU annual calls – and vice versa. In 2025 Clean Hydrogen JU and EISMEA had an intensive exchange on support to start-ups, which has facilitated the development of dedicated instrument in the AWP2026 supporting start-ups in hydrogen sector. Follow-up exchange will continue in 2026 to assure the alignment and synergies between the two instruments.

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314 Commission Notice Synergies between Horizon Europe and ERDF programmes 2022/C 421/03, C/2022/7307; https://eur-lex.europa.eu/legal-content/EN/TXT/?toc=OJ%3AC%3A2022%3A421%3AFULL&uri=uriserv%3AOJ.C_.2022.421.01.0007.01.ENG

315 https://strategic-technologies.europa.eu/about_en#paragraph_207

316 https://strategic-technologies.europa.eu/about_en#paragraph_207

On the aviation side, the Clean Hydrogen JU signed a Memorandum of Understanding (MoU) with Clean Aviation JU in March 2023. In 2025 Clean Aviation JU and Clean Hydrogen JU have continued the successful cooperation with planning of dedicated topic in Clean Hydrogen WP2026 on “Development and Demonstration of a Liquid Hydrogen Supply and Conditioning System for High-Power Fuel Cell Applications in aviation”, as well as in exchange on synergies strategies and action plans. In 2026, Clean Aviation JU and Clean Hydrogen JU will continue the collaboration through exchange of information concerning newly signed grants in the field of hydrogen-technologies for aviation, as well as planning and alignment of the respective future Work Programmes and calls for proposals.

Cooperation with Zero Emission Waterborne Partnership (ZEWP) has also continued in 2025 and includes a regular update on relevant projects and current and future calls. The cooperation has resulted in a dedicated topic in WP2026 on “Multi-fuel SOFC Powertrain for Maritime Transport”. In addition to the increased importance of hydrogen for the decarbonisation of the maritime and inland navigation sector, this cooperation will be intensified in 2026.

Further cooperation is also planned with Clean Energy Transition Partnership (CEPT), especially with Transition Initiative 3 (TRI3: Enabling Climate Neutrality with Storage Technologies, Renewable Fuels and CCU/CCS) and Transition Initiative 5 (TRI5: Integrated Industrial Energy Systems) on hydrogen and renewable hydrogen related calls. This cooperation established in 2024 is also contributing to the support to the implementation of the SET Plan.

As in the past, exchanges of the Clean Hydrogen JU in 2026 will also extend to the Executive Agencies in charge of managing other parts of Horizon Europe (and related partnerships topics) and other Programmes in areas relevant to hydrogen technologies.

In particular, the Clean Hydrogen JU and the European Climate Infrastructure and Environment Executive Agency (CINEA) will continue to explore potential synergies and areas of collaboration for the energy and transport sectors under both Horizon Europe and Connecting European Facility (CEF) Transport and Energy programmes. With Connection European Facility Transport (CEF-T) the Clean Hydrogen JU will continue facilitating the implementation of synergies between the ongoing JU project H2Accelerate TRUCKS[317](Large scale deployment project to accelerate the uptake of Hydrogen Trucks in Europe) and (but not only) the CEF-T supported project Greater4H[318].

As needed, the Clean Hydrogen JU will also continue to collaborate with other European bodies and agencies (under the coordination of the policy Directorates-General in the EC) in view of improving the exchange of information and generating synergies between different initiatives, thus reducing the risk of duplication while increasing the impact within areas that are of common interest.

For instance, cooperation with the Innovation Fund is also envisaged, having in mind the quickest path towards exploitation of results and ramp-up of industrial capacity following successful higher TRL projects implemented under the Clean Hydrogen JU including but not limited to hydrogen valleys, waterborne applications and manufacturing projects. First cooperation was established in 2023 and it is likely to continue in 2026 in the form of workshops and round tables where project beneficiaries of JU projects can share their

317 https://cordis.europa.eu/project/id/101101446

318 https://greater4h.com

learnings and expectations, thus contributing to create a sustainable pipeline of projects to the Innovation Fund.

In 2023 the JU started to have dialogues with those in charge of the Marie Sklodowska Curie Action (MSCA) Staff Exchanges programme. This is expected to continue in 2026 in order to identify how the funding opportunities under the MSCA Staff Exchanges programme could benefit the organisations participating in the projects supported by the Clean Hydrogen JU.

At national level the Clean Hydrogen JU will continue working to identify opportunities for collaboration (co-funding[319] and also at programming level) with national programmes, mainly via the States Representative group - an advisory body to the Governing Board of the JU. Ad-hoc exchanges with responsible of national programmes (e.g. German NOW) will continue in 2026 (building on the good practices of former years).

2.2.6.3. Supporting regions and Member States through technical assistance and synergies

In view of setting up a structured cooperation mechanism between the JU and Managing Authorities of Member States and Regions, in 2023 the Clean Hydrogen JU initiated a Technical Assistance to Generate Synergies with Members States and Regions[320]. The technical assistance finished in 2024 by providing a comprehensive framework for future cooperation. 10 Managing Authorities were selected with whom the JU has identify concrete areas for collaboration and synergies[321]. The ten selected Managing Authorities include nine Members States/Regions and an Associated Country of Horizon Europe. First three bilateral cooperation agreements between the JU and Managing Authorities were signed in June 2024 and the following seven in the second half of 2024. In addition, lessons learnt have been shared to benefit a wider range of Managing Authorities. In 2025, the JU has continued working with these Managing Authorities in the implementation of synergies in the areas of cooperation included in the MoC, mainly on knowledge exchange, building capacity and skills and on synergies between national/regional and EU funding programmes and financial support mechanisms. First joint meeting with 10 Managing Authorities was held in June 2025 as a side event of the Hydrogen Valley Days and has reconfirmed the importance of Clean Hydrogen JU's support to regions in further development of their hydrogen eco-systems. This cooperation will continue in 2026 with a more structured approach and potentially new technical assistance contract to facilitate this cooperation.

The Clean Hydrogen JU has continued providing Project Development Assistance (PDA) for Regions with a dedicated contract for setting-up and running of the "Hydrogen Valley Facility" in order to accelerate the number of hydrogen valleys in Europe. The 5-year contract started beginning of 2025 and the first call for applications for Project Development Assistance was published in July 2025 and closed in September 2025. The second PDA call for applications

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319 Co-funding by using transfer of funds will be one of the possibilities the JU will continue to investigate in cooperation with the European Commission services, with regard to its legal feasibility. In addition, the leveraging of national and regional funds will be fostered by awarding the STEP Seals to the Hydrogen Valleys topic included in the Call 2026.

320 https://www.clean-hydrogen.europa.eu/get-involved/working-regions_en#synergies-with-members-states-and-regions"https://www.clean-hydrogen.europa.eu/get-involved/working-regions_en#synergies-with-members-states-and-regions

321 https://www.clean-hydrogen.europa.eu/media/news/evaluation-results-call-expression-interest-receiving-technical-assistance-generate-synergies-clean-2023-10-04_en"https://www.clean-hydrogen.europa.eu/media/news/evaluation-results-call-expression-interest-receiving-technical-assistance-generate-synergies-clean-2023-10-04_en

in planned in the 1st quarter of 2026.

In addition, in support to Mission Innovation 2.0, the Clean Hydrogen JU has continued with the activities of the Hydrogen Valley platform, under the above mentioned “Hydrogen Valley Facility”. The platform has seen new Hydrogen Valleys added allowing the most advanced Hydrogen Valleys around the globe to provide insights into their project development. In 2025, the maintenance and update of the Hydrogen Valley platform has been done as part of the activities of the ‘Hydrogen Valleys Facility’. In 2026 the platform will be further extended and improved with additional features, such as upgraded search tool and visuals.

In 2025 Clean Hydrogen JU has also continued to support the SET Plan Temporary Working Group on Hydrogen by ensuring that the work of the group is aligned with JU’s Strategic Research and Innovation Agenda. This cooperation will intensify in 2026 with establishment of Implementation Group on Hydrogen, which will continue supporting Member States in their R&I activities related to hydrogen.

At the beginning of 2026, the Clean Hydrogen JU is expected to adopt the Synergies strategy, a document which should guide the JU’s work on synergies by the end of the current MMF period and beyond. At the beginning of 2026, an action plan on synergies will be developed and will provide concrete set of activities with key co-funding instruments, responsible entities and stakeholders as well as link to activities of the DGs (mainly DG RTD, DG ENER, DG MOVE, but also DG CLIMA, DG GROW and potentially others).

2.2.6.4. Regulations, Codes and Standards Strategy Coordination (RCS SC)

The implementation of suitable and hydrogen-specific regulatory and enabling frameworks is crucial for the EU-wide deployment of hydrogen, fuel cells and hydrogen-based technologies to meet the goals set out in the EU Hydrogen Strategy.

As stated in the Clean Hydrogen JU SRIA (JU SRIA, section 4.3), the JU will contribute to supporting the implementation of hydrogen-specific regulatory and enabling frameworks by a strategic and coordinated approach to RCS issues within the Programme, which will mostly be implemented through PNR activities.

Whilst most of the PNR activities in the JU Programme will be implemented as part of the activities within Horizontal Activity 1: Cross-cutting Issues (JU SRIA, Section 3.6), a strategic and coordinated approach is needed at the Programme level.

To this end, in 2023, the Clean Hydrogen JU set up a Regulations, Codes, and Standards Strategy Coordination Task Force, composed of the JU members: the European Commission, Hydrogen Europe and Hydrogen Europe Research, and the Programme Office.

The main goal of the RCS SC Task Force is the definition, coordination and monitoring of the strategy related to RCS within the Programme with the ultimate goal of increasing the EU impact on RCS development in the EU and beyond, with the focus but not limited to Standards.

In 2026, the RCS SC Task Force will continue prioritising the coordination of the following activities:

- Follow up RCS development related to hydrogen, fuel cells and hydrogen technologies through a continuous global watch function with the focus but not limited to standards.
- Assessment of RCS development needs of strategic importance in the EU. Building on the previous activity and in consultation with relevant stakeholders, the RCS SC Task Force will assess what RCS developments could most contribute to fostering a

regulatory friction-less EU-wide hydrogen market while meeting the EU Hydrogen Strategy goals and the interests of the EU industry and research organisations.

- Identification and prioritisation of the needs for research and innovation, and coordination actions to support the RCS development identified as strategic for EU and that standardisation and regulatory aspects are appropriately addressed in the Programme.
- Follow up and support the research and innovation, and coordination actions undertaken in the Programme contributing to ensure to the best possible actual use of PNR results in RCS developments.
- Dissemination of results. This could include collecting and effectively transferring PNR/ RCS-relevant results in regulatory and standardisation bodies, targeted communication actions, awareness workshops, etc.

Furthermore, the RCS SC Task Force will also support the Commission and the Member State organisations in its activities on international regulatory cooperation when required and will support the synergies related to RCS with other partnerships.

2.2.6.5. European Hydrogen Safety Panel (EHSP)

The European Hydrogen Safety Panel initiative[322] was launched in 2017 to support the development and deployment of inherently safer hydrogen systems and infrastructure, contributing to achieving the following vision: "hydrogen and fuel cell technologies shall be safely developed, safely introduced, and safely used in projects as well as in the wider society".

The mission of the EHSP in the Programme is twofold:

- To assist the Clean Hydrogen JU at both programme and project levels, in assuring that hydrogen safety is adequately addressed and managed, and
- To promote and disseminate a high-level hydrogen safety knowledge and culture within and beyond the Programme.

In 2025, following up on the signature of the single service framework contract and subsequent specific contract, the EHSP was operational and, composed of a multidisciplinary pool of 15 experts grouped in ad-hoc working groups (task forces), have the necessary scientific competencies and expertise covering the technical domains needed to make science-based recommendations to the Clean Hydrogen JU.

In 2026, the EHSP will continue and concentrate the effort on several activities within each task force (TF), as detailed in the next sub-sections.

TF.1 Support at project level: The activities in this task force aim at coordinating a package of measures to avoid any accident by integrating safety learnings, expertise, and planning into the JU-funded projects by ensuring that all projects address and incorporate state-of-the-art in hydrogen safety appropriately. In 2026, the guidance document "Safety Planning and Management in EU Hydrogen and Fuel Cells Projects"[323] will be reviewed and further developed. Furthermore, the EHSP will continue to perform Safety Plans Reviews, i.e., assessing the Safety Management of ongoing projects, and Safety Specific Sessions may be organised with projects or sets of projects with similar applications coverage when needed.

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[322] https://www.clean-hydrogen.europa.eu/get-involved/european-hydrogen-safety-panel-0_en
[323] https://www.clean-hydrogen.europa.eu/get-involved/european-hydrogen-safety-panel-0/reference-documents_en

TF.2 Support at programme level: The EHSP works under this task force are intrinsically linked with the activities of the previous task force but with a broader cross-cutting dimension, focused on the Clean Hydrogen JU Programme, and how safety-related aspects can be enhanced within the overall Programme and activities. Activities within this task force in 2026 will be to provide guidance in research needs on safety along the hydrogen chain, with special attention in developing areas such as, but not limited to, heavy-duty vehicles, aviation, rail, and waterborne applications. In addition, international links with the US Hydrogen Safety Panel[324], the International Association HySafe[325] (and related international activities like the International Conference on Hydrogen Safety), the International Partnership for Hydrogen and Fuel Cells in the Economy IPHE[326], and the Hydrogen Council[327] will be further strengthened. Last, the revision of the internal emergency crisis management procedure (and links with 'crisis communication'), will be also performed.

TF.3 Data collection and assessment: Activities in this task force are centred on the collection and analysis of hydrogen safety-related data to derive lessons learnt and provide further general recommendations to all stakeholders.

In 2026, the EHSP, in close cooperation with the JRC, will continue with the addition of new events in HIAD 3.0 (an updated and revamped version of the HIAD 2.0 database). The EHSP will also review and assess these events and the lessons learnt and statistics obtained from this information will be summarised in a new release of the document "Statistics, lessons learnt and recommendations from the analysis of the Hydrogen Incidents and Accidents Database (HIAD 2.0)"[328]. Furthermore, the EHSP will continue updating the lists of the engineering models, CFD models/tools, and risk models/tools, and will release a guidance document on "Hydrogen Safety Engineering".

TF.4 Public Outreach: This task force focuses on the broad exchange of information with relevant stakeholders, including the public. The activities in 2026 will focus on updating the web site for the EHSP, including a set of Frequently Asked Questions (FAQs) on hydrogen safety, updated lists of events and resources, etc. The EHSP may also deliver oral or poster presentations at relevant safety, fuel cell and/or hydrogen technology conferences, organise workshops with relevant stakeholders (either as public outreach from TF4 or targeting specific JU projects in TF1), and work in close cooperation with the Communication Team at Clean Hydrogen JU.

Altogether, the EHSP will contribute to coordinating and establishing approaches to address hydrogen safety-related matters in the EU, while contributing to promoting a high-level hydrogen safety culture and a safe hydrogen market in the EU and beyond, if possible.

2.2.6.6. European Hydrogen Sustainability and Circularity Panel (EHS&CP)

The European Hydrogen Sustainability and Circularity Panel (EHS&CP) was created by the Clean Hydrogen Joint Undertaking (JU) in February 2024 as an expert advisory body. Its role is to integrate sustainability and circularity principles across the European hydrogen value chain, ensuring that hydrogen deployment supports the EU's climate neutrality and circular economy objectives. In practice, the panel serves as a bridge between policy, research, and industry, offering guidance on how hydrogen technologies can be developed and deployed in

[324] https://h2tools.org/hsp
[325] https://hysafe.info/
[326] https://www.iphe.net/
[327] https://hydrogencouncil.com/en/
[328] https://www.clean-hydrogen.europa.eu/get-involved/european-hydrogen-safety-panel-0/reference-documents_en

ways that are environmentally responsible, economically viable, and socially equitable.

The mission of the EHS&CP is to embed sustainability and circularity into hydrogen research, innovation, and deployment, with a focus on ensuring that the hydrogen economy delivers on the ambitions of the European Green Deal, the REPowerEU Plan, and the Net-Zero Industry Act. To this end, the panel has pursued two main objectives. First, it supports the Clean Hydrogen JU in integrating sustainability considerations into both programme-level strategies and individual funded projects. Second, it promotes the dissemination of knowledge and the development of a wider culture of sustainability and circularity within and beyond the JU's activities.

The panel brought together 15 experts from 10 different countries, representing both academia and industry. To cover the hydrogen value chain, the panel has been organised into four Task Forces (TF):

- TF1: Hydrogen Production – Life Cycle Assessment (LCA), energy consumption, resource efficiency.
- TF2: Hydrogen Storage & Distribution – materials, infrastructure, and environmental footprint.
- TF3: Hydrogen End Uses – integration in industry, transport, power.
- TF4: Cross-Cutting Issues – regulatory frameworks, economics, social acceptance.

Together, these groups have provided a comprehensive perspective on how sustainability and circularity can be better embedded across the hydrogen sector.

During its first year of operation, the EHS&CP carried out a structured set of activities designed to build an evidence base and provide recommendations. It began by reviewing 356 projects funded by the Clean Hydrogen JU and its predecessor programmes. This screening assessed the degree to which sustainability principles were integrated into hydrogen production, storage and distribution, end-use applications, and cross-cutting activities.

The assessment of the JU funded projects revealed that economic indicators continue to dominate the evaluation of hydrogen technologies. More than half of the projects reviewed either focused solely on economic performance or lacked explicit sustainability considerations. Environmental indicators, such as life-cycle assessments and greenhouse gas emissions, were incorporated in some cases, particularly in projects funded under Horizon 2020 and Horizon Europe. Circularity aspects, including material criticality and recyclability, were rarely addressed, while social aspects such as labour conditions and social acceptance were largely absent.

This imbalance highlights the progress that has been made but also the significant gaps that remain. The evolution of the funding programmes shows a gradual strengthening of sustainability requirements: early projects under FP7 focused almost exclusively on cost and efficiency; Horizon 2020 introduced systematic use of LCAs and carbon intensity criteria; and Horizon Europe has gone further by introducing specific KPIs for critical raw material reduction, recyclability, and even the first social life-cycle assessments. The trend is clear, but the integration of sustainability and circularity into the hydrogen economy is still uneven and incomplete.

At the same time, the panel developed a framework of indicators and key performance metrics to capture sustainability performance. These covered environmental aspects such as greenhouse gas emissions, water use, and resource depletion; economic aspects such as capital and operational expenditures and the levelised cost of hydrogen; social aspects including labour practices, gender equity, and public acceptance; and circularity aspects such as critical raw material use, recyclability, and resource efficiency.

The panel also worked to improve data collection and reporting practices, proposing common methodologies and templates to enhance comparability across projects.

In addition, it engaged with stakeholders through three major workshops, collaborated with the Joint Research Centre (JRC) on sustainability frameworks, and developed strategic recommendations for embedding sustainability more systematically into future work programmes and calls for proposals.

Looking forward, the panel has identified four priority areas for strengthening the role of sustainability and circularity. The first is improved data collection and assessment, including the creation of common databases, harmonised methodologies, and greater transparency in project reporting. The second is stronger support at project level, through training, case studies, and benchmarking that enable project owners to systematically apply sustainability principles. The third is integration at the JU programme level, where sustainability should be embedded more explicitly in funding calls, coordinated with EU policy goals, and supported through collaboration with the JRC and other stakeholders. Finally, communication and visibility are essential: the panel has recommended stronger public outreach, participation in flagship events, the publication of regular reports, and the use of awards to recognise projects that demonstrate excellence in sustainability and circularity.

Over the first year of implementation, the panel's work has created a methodological and strategic foundation that will support future iterations of the Clean Hydrogen JU, inform policy, and help ensure that hydrogen technologies are not only a driver of decarbonisation but also a cornerstone of Europe's transition to a sustainable and circular hydrogen economy.

The first mandate of the EHS&CP concluded in early 2025, but the Clean Hydrogen JU has launched a new tender to ensure the continuation of the panel's work for up to four additional years. The new framework contract will establish, organise, and coordinate a refreshed pool of 15–20 senior experts, maintaining continuity where possible with current members while also embracing new expertise.

The renewed panel will continue to support the Clean Hydrogen JU at three levels:

- Project-level, by reviewing project deliverables, providing guidance, and helping projects apply state-of-the-art sustainability methodologies.
- Programme-level, by acting as a sustainability advisor, identifying gaps, and aligning JU priorities with EU policy goals, including improving methodologies, ensuring high-quality reporting, and collaborating with the JRC on harmonised assessment frameworks
- In addition to its advisory and technical functions, the continuation of the panel will place greater emphasis on communication and outreach, including participation in major hydrogen and sustainability events, and the production of reports, training materials, and awareness-raising tools for both specialised and general audiences.

By extending the panel's mandate, the Clean Hydrogen JU seeks to consolidate the progress achieved so far and to provide long-term guidance for embedding sustainability and circularity principles across the European hydrogen economy. The renewed EHS&CP will therefore remain a cornerstone of the JU's efforts to ensure that hydrogen technologies contribute fully to Europe's climate-neutral and circular future.

2.2.6.7. *International Cooperation*

The Communication of the European Commission on the global approach to research and innovation[329] presents the EU's new strategy on international cooperation on research and innovation. The EU aims to take a leading role in supporting international research and innovation partnerships and to deliver innovative solutions for making our societies green, digital and healthy.

The strategy builds on two principal objectives: preserving openness in international research and innovation cooperation, while promoting a level playing field and reciprocity underpinned by fundamental values.

In line with these objectives and in order to better support and European Commission to align with, facilitate and accelerate worldwide market introduction of fuel cell and hydrogen technologies, the Clean Hydrogen JU continuously tries to identify priority areas, at policy and technology level, where coordinated and collaborative international activities are of interest. Within the context of 'international cooperation' mainly to refer to cooperation with countries that are neither EU Member States (over countries and territories nor associated to Horizon Europe). For this reason, associated countries are not the focus of this section, which deals mainly with cooperation with non-associated third countries.

As the deployment of fuel cells and hydrogen technology is carried out globally and key stakeholders of the Clean Hydrogen JU are involved in these developments, establishment of links with other major FCH related programmes globally is deemed important. This is particularly valid during 2026 in research activities on fuel-flexible gas turbine combustion technology for clean and efficient ammonia firing (in particular in view of cooperation with NEDO[330], Japan) and for the topic dealing with Hydrogen Valleys (see also below).

On a more general level, the relevant international activities of interest include in particular those carried out by the IEA under the Hydrogen Technology Collaboration Program (IEA Hydrogen)[331], namely with JU participation in Task 49 (Natural Hydrogen) and the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)[332]. In addition, with the planned study on "Hydrogen in Ports" included in the AWP2025, it is anticipated to support the European Commission activities within the Global Ports Coalition under the Clean Energy Ministerial during 2026.

Furthermore, in March 2025, the Clean Hydrogen JU, together with NEDO[333] (New Energy and Industrial Technology Development Organization, in Japan), successfully organised a workshop[334] in the city of Kobe on Hydrogen Combustion Technologies, featuring the most important industries and research and technology centres involved in the matter both from Europe and Japan. The workshop, lasting two days, enabled information exchanges on technological features, future research domains and activities and laid the foundation for future cooperation. The framework for setting up this workshop has been agreed as part of the Cooperation Agreement[335], signed in 2024 between the Clean Hydrogen JU and NEDO, which had the purpose of accelerating the deployment of hydrogen through exploring synergies Collaboration with NEDO will continue in 2026 (see example above).

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[329] Europe's strategy for international cooperation in a changing world, COM(2021) 252 final.
[330] New Energy and Industrial Technology Development Organization
[331] http://ieahydrogen.org/
[332] http://www.iphe.net/
[333] NEDO is Japan's largest public management organization promoting research and development as well as deployment of industrial, energy and environmental technologies.
[334] Advancing Hydrogen Combustion Technologies through International Collaboration - Clean Hydrogen Partnership
[335] Clean Hydrogen Partnership signs cooperation agreement with Japan's NEDO - Clean Hydrogen Partnership

Following the successful and close collaboration of the FCH 2 JU with EC representatives on the Mission Innovation and the setting up of the Hydrogen Valley Platform, a platform for exchanges between worldwide initiatives on hydrogen valleys, the Clean Hydrogen JU will continue to contribute in this direction, as part of the platform activities with the wider "Hydrogen Valleys Facility".

For concrete references to international collaboration in the Call for Proposals see section 2.2.3.2 of this document.

2.3. Support to Operations of Clean Hydrogen JU for 2026

2.3.1. Communication, dissemination and exploitation

2.3.1.1. Communication

A. Communication objectives

The communication plan in 2026 will support the priorities identified in the current work-programme, and Clean Hydrogen JU's communication objectives identified in the communications strategy. Some of the yearly objectives are constant throughout the programme life (such as those related to project communication), while others are changing according to new priorities identified, such as for example a focus on communicating the programme as a centre of knowledge on hydrogen technologies at EU level. In addition, separate communication plans are being developed for the European Hydrogen Observatory.

The following objectives will lead the communication activities in 2026:

Goal	Objectives	Topics / Messages
Position the Clean Hydrogen JU as A UNIQUE EU tool for the funding and the development of the clean hydrogen technologies sector We need to strengthen our unique positioning on energy topics and reinforce our positioning as expertise hub on H2 (which makes a difference with all the other fundings dealing with H2) the tools being implemented such as the Knowledge Hub	Communicate about the added value of the Clean Hydrogen Partnership and its role in driving EU research and innovation. Showcase successful projects Communicate about the funding opportunities offered by the Partnership and continue to attract valuable project applications from across EU MS. Showcase unique expertise	The Clean Hydrogen Partnership accelerates progress in clean hydrogen technologies. JU key results and achievements. Promotion of flagship projects – "success stories" in key areas as a solid foundation for the development of a hydrogen economy in EU. The projects funded by Clean Hydrogen Partnership help make hydrogen technologies more performant, more competitive, more accessible, more circular, and safer (all target groups) Launch (and results) of the 2026 call for proposals Target groups: policymakers, opinion-makers, experts, industry and research, media, other partnerships)
Establish Clean Hydrogen's reputation as a hub for research and innovation of hydrogen technologies at EU level	Communicate about the European Hydrogen Observatory and the launch of Hydrogen knowledge hub and the Hydrogen Valley Platform.	Clean Hydrogen Observatory informs about the development of the technology with data grounded in robust analysis and science. How to get involved, what are these platforms offering, importance of data, who can use the data, what data we provide (objective, often unique). *Target groups: industry / SMEs, investors, academia, citizens*
Increase awareness, acceptance, and uptake of clean hydrogen	Continue to create a positive narrative around clean hydrogen in media across Europe, as an important part of the solution to the current energy and competitiveness challenges.	The Clean Hydrogen Partnership brings innovative technologies from the laboratory to the factory floor and, ultimately, to European businesses and consumers, providing a cleaner environment, economic growth. *Target groups: industry / SMEs, investors, consumers, policymakers, opinion-makers, experts, media.*

Milestone/Activity/Topic	When	Channels / tools	Target group
Info Day(s) & Launch of Call 2026	January / February 2026	Website, social media, newsletter, events (Info Day), brochure	• Potential beneficiaries • Industry representatives • Research representatives • Policymakers and authorities (EU, National, regional, local & International)
Media campaign to promote the achievements of the partnership	January - June 2026 (TBC)	Articles in traditional media, social media campaign	• Policymakers and authorities (EU, National, regional, local & International) • Industry • Opinion formers (media, experts, NGOs, etc.) • Research, academia, education and training organisations, associations
Hydrogen Valley Days	June 2026 (TBC)	Flagship Event: website, social media, newsletter	• Policymakers and authorities (EU, National, regional, local & International) • Industry • Research, academia, education and training organisations • Opinion formers (media, experts, NGOs, etc.)
Hydrogen Week	26 -30 October 2026	Flagship Event: website, social media, newsletter	• Policymakers and authorities (EU, National, regional, local & International) • Industry • Research, academia, education and training organisations • Opinion formers (media, experts, NGOs, etc.)
Hydrogen Research and Innovation Days	November 2026 (TBC)	Flagship Event: website, social media, newsletter	• Project beneficiaries • Policymakers and authorities (EU, National, regional, local & International) • Industry • Research, academia, education and training organisations • Opinion formers (media, experts, NGOs, etc.)

Main channels and tools

To be able to respond to today's fast communication landscape, the tools and channels employed will be **integrated** as much as possible, for maximum impact, allowing for a relay of the content .

We are pursuing a **digital-first approach** that allows us to be impactful in real time with timely news and information. Achieving better digital expertise and social media integration through development of online channels and content is essential in the current context, which is characterised by an increasing flux of information and data, fast-paced (often-instant) communication and social distancing (limited physical meeting opportunities).

We are also **expanding our channels** to reach out regularly to a broader audience, with a variety of content that supports our objectives. To this purpose content for online channels will be continuously developed and new channels will be explored.

Our goal with the development of the **Knowledge hub** is to **shift more findings online** and create a hub for data and analysis, which is up-to-date, dynamic, and easy to use.

Website

The website is the main gateway to the organisation, recent figures highlighting a diverse but primarily direct and search-driven traffic. The visitor acquisition strategy shows that the website also remains the main source of information, with users interested in both funding opportunities and thematic content.

We will continue to address the long-term recommendations identified in the website audit , create new content, and implement measures contributing to the platform's optimal performance. In 2026 new sections will be added to the website, and the projects section will be updated and reorganised, following the integration with the **Knowledge hub**.

In addition to its main website, the Clean Hydrogen JU continues to oversee and relay the activity of several "associated" digital platforms, including the H2V, the European Hydrogen Observatory, and the European Hydrogen Refuelling Station Availability System (E-HRS-AS).

Among other points, the audit recommends strengthening the integration and visibility of the Clean Hydrogen Partnership's affiliated initiatives. This aligns with the organisation's broader digital strategy, which aims to enhance coherence and visibility in cooperation with DIGIT and the Knowledge Management Unit.

Social media

Each year, a dedicated social media plan will complement the overall media plan, ensuring wider distribution of content and consistent visibility around major events and initiatives. Throughout the year, the Clean Hydrogen JU will promote its activities and messages through a organic social media campaigns.

In 2025, this approach was further enhanced with a paid social media campaign aimed at increasing awareness of Success Stories highlighting breakthrough innovations that are transforming Europe's hydrogen landscape. A similar campaign may be implemented again in 2026.

Objectives

- Increase the visibility of Clean Hydrogen JU and its initiatives
- Strengthen engagement and interaction with target audiences

- Expand reach and attract new followers through strategic communications
- Support dissemination of key messages, success stories, project outcomes, and events.

Content Strategy

Through its social media channels, the JU will disseminate a wide variety of digital content quickly, efficiently, and extensively. This content will include:

- Content posts: key messages, news, and updates.
- Videos: project success stories, event highlights
- Visuals: infographics, photos, and other engaging factsheets
- Hashtags: to promote visibility, thematic coherence, and audience engagement

Each piece of content will be tailored to the characteristics and audience expectations of the specific platform (e.g. X/Twitter, LinkedIn, YouTube, etc.).

In addition to our existing social media channels, we will also **launch a presence on Bluesky** to complement our strategy and align with the growing number of EU institutions joining the platform.

Clean Hydrogen JU will maintain frequent contact with its audiences through social media channels, fostering a strong, transparent, and interactive relationship. Engagement will focus on nurturing a growing community of followers, encouraging dialogue, and amplifying project-related content.

Social Media Advertising

To complement organic activities, the JU will increasingly integrate social media advertising within its campaigns (eg LinkedIn promotion) to reach broader audiences and increase follower growth. Paid campaigns will:

- Promote the Success Stories and achievements of the JU
- Target specific countries across the EU to maximise relevance and impact of the programme

By combining organic and paid efforts, the Clean Hydrogen JU aims to enhance visibility, audience reach, and long-term engagement across all major social platforms.

Channel	Audience	Content	Objective
LinkedIn ~47K followers	Professionals, experts, policy makers, industry, research	Pictures; Short videos; links to extended content, news; articles;	Cultivate the relationships with networks of H2 stakeholders, get in touch with industry/business stakeholders
X (former Twitter) ~9K followers	Professionals, experts, policy makers, industry, research	Pictures; Short videos; Links to external content (including projects and news); Polls; Live transmission of events	Build reputation and leadership, focusing on what's new: promote news, partnerships, projects and initiatives events and activities
Bluesky	Professionals, experts, policy makers, industry, research	Pictures; Short videos; Links to external content (including projects and news); Polls; Live transmission of events	New platforms like Bluesky can help connect researchers, SMEs and innovators across Europe faster
YouTube	Non specialist audiences	Videos; Live streaming	Build visibility and reputation with a broader public; You tube has the second-largest search engine after Google Search and its content has a long life

Newsletter

The Clean Hydrogen JU Newsletter is distributed to over **18.153 subscribers** (as of 10 October 2025). It follows the European Commission's Newsroom template and is adapted to feature both "flash news" issued for important programme updates or activities, as well policy-elements and relevant news from media and third-party sources. The focus will be always on the programme activity, with various updates sent out throughout the year.

Media

The Clean Hydrogen Joint Undertaking's media efforts will revolve around these following main topics:

- Status and perspectives of the Clean Hydrogen technology, achievements driven by the Clean Hydrogen JU
- Clean Hydrogen JU's role as a unique JU/expertise hub on hydrogen
- The Clean Hydrogen Partnership is a proven catalyst for innovation, regional development, and job creation, helping Europe lead the global energy transition.
- Clean Hydrogen JU funding opportunities (calls for proposals and expression of interest for various topics).
- EU-funded clean hydrogen projects are delivering on Europe's climate and energy goals, supporting the Green Deal and strengthening energy independence.

These topics are strongly interconnected and will be used as a basis for content development tailored to the different target audiences, focus countries, tools and channels.

We'll be following up on the 2025 campaign to promote the Clean Hydrogen Partnership's success stories to policymakers, expert audiences, and the general public across the EU, emphasizing the impact of funded research and innovation.

To maximise visibility and impact of the partnership, early in 2026 we propose a targeted media relations campaign that leverages high-profile events and focuses on the most influential media outlets within the EU policy sphere.

Target Audiences and Media

Primary Focus:

- The "EU Bubble" (Brussels-based policymakers, EU institutions, and specialist audiences)
- Prominent EU-focused media outlets with Brussels bureaus.

Furthermore, we will nurture lasting connections with key media outlets by maintaining and building relations with journalists, specialising in energy / transport policies and EU general policies. We will brief the media about key events and developments to ensure widespread coverage and hold where possible tailored media events (i.e. press breakfast) to ensure broad coverage across relevant publications and platforms.

<u>Public opinion - Eurobarometer</u>

One of the Clean Hydrogen Joint Undertaking objectives is to increase public and private awareness, acceptance, and uptake of clean hydrogen solutions, through cooperation with other European partnerships under Horizon Europe.

For this purpose, a public opinion survey was conducted in autumn 2022 in 27 EU countries to analyse and assess European citizens' attitudes towards and level of knowledge of hydrogen technologies and determine a baseline for monitoring changes in public opinion over time.

Following up on the results of the public opinion survey organised in 2022 , a new Eurobarometer survey will be organised in 2026, to understand current attitudes on the hydrogen technologies . The survey will inform policy, public education, and messaging, and assist with the implementation of the technology, providing a strategic tool for JU's future work.

<u>Events</u>

The JU will organise a number of events with both online and physical presence. All events will emphasise the Joint Undertaking model as a driver of European competitiveness and sustainability and will serve to showcase its project portfolio and funding opportunities, including information days, sector-specific workshops, and webinars. These activities help raise awareness of the JU's unique role in advancing hydrogen technologies and reinforce its position as a hub for expertise and knowledge.

European Hydrogen Week, 26–30 October, 2026, at **Brussels Expo**

In line with the SBA, the JU will convene an annual **Clean Hydrogen Partnership Forum,** also known as the **European Clean Hydrogen Innovation Forum**. Since 2020, the **European Clean Hydrogen Innovation Forum** and the **EU Hydrogen Research and Innovation Days** (formerly Project Review Days) have been brought together under the umbrella of the **"European Hydrogen Week"**, initiated by the JU back in 2020

Serving as a strategic platform for dialogue, the event will tackle , at a crucial time for the Partnership, key challenges and future priorities in clean hydrogen research, with a strong focus on the current and future role of the partnership in driving innovation, accelerating market deployment, and reinforcing Europe's global competitiveness and leadership.

Both the Innovation Forum and the EU Hydrogen Research and Innovation Days aim to highlight synergies among the JU members, including industry and research associations, and various European Commission services and programmes. The events cover the entire hydrogen value chain, from production, storage, transport, and distribution to utilisation.

More specifically, the **Innovation Forum** aims to highlight the pivotal role of Research and Innovation in driving Europe's competitiveness and accelerating market uptake in clean hydrogen technologies, positioning start-ups and scale-ups as key engines of the green industrial transformation.

The **Hydrogen Research and Innovation Days** spotlight the achievements of projects funded by the Clean Hydrogen Partnership, showcasing advances in hydrogen production, distribution, storage, and use, as well as regional collaboration through Hydrogen Valleys.

European Hydrogen Valley 2026

The third edition of the Hydrogen Valleys Days will feature dedicated sessions highlighting success stories and lessons learned from advanced Hydrogen Valley projects.

It will also present results from the Project Development Assistance (PDA) launched in July 2025, which aims to accelerate the creation of additional hydrogen valleys by providing technical, financial, and legal support, guiding projects from the pre-feasibility stage through to final investment decisions.

Info Day on Call 2026

Each year, following the publication of the call for proposals, the Clean Hydrogen Partnership organises an Info Day to present the various call topics and outline the specific rules and procedures.

The Info Day for the 2026 Call will take place on 21 January 2026 at the Charlemagne building of the European Commission. In addition, a number of national and local Info Days will be organised in selected Member States when requested

Workshops with EU and international counterparts - Collaboration with NEDO

Building on the success of two joint workshops with Japan's New Energy and Industrial Technology Development Organisation (NEDO), the Workshop on Research & Innovation in Electrolysis (Brussels, 18 November 2024) and the Workshop on Hydrogen and Ammonia Combustion (Kobe, 26 March 2025), a third event, the Workshop on Hydrogen in Mobility, is planned for 2026.

These workshops stem from the cooperation agreement signed in Tokyo in June 2024 and serve as a model for future international partnerships. They highlight how the Clean Hydrogen Partnership is uniquely positioned to connect regions, industries, and research communities in pursuit of shared climate neutrality and energy security goals.

Outreach – promotion through participation in external events

Looking ahead, the JU plans to collaborate with the 2026 **EU presidencies** of Cyprus and Ireland for organisation of and participation in thematic events, in particular in the **Transport Research Arena** (TRA) taking place on 18-21 May 2026, in Budapest, under the theme "Regeneration in transport". The participation in TRA will be alongside the other JUs active in the field of transport, with a common booth and potentially other common activities.

Participation in other events such as the European Sustainable Energy Week, and **EU Regions Week** will also be envisaged, should enough human and financial resources be available.

The JU plans to participate in a wide range of major international conferences throughout the year, either with a stand and/or speaking opportunities (list not exhaustive):.

- HyVolution (January 2026, Paris)
- World Hydrogen Summit & Exhibition, (May 2026, Rotterdam)
- The European Fuel Cells Forum in Lucerne

Furthermore, we will actively seek **synergies for expanding our public outreach efforts**, in particular with established organisations and events in the field of hydrogen, such as with Energy Observer (in the field of maritime transport), which is undergoing its new (2025-2026) Mission: to explore approaches to carbon capture, storage, and utilization and visit the most advanced projects across Europe and the North Atlantic, both natural and industrial, and examine their real capacity to reduce CO_2 in the atmosphere.

A well-known event in the field of racing, the 24 Hours of Le Mans, will take place on 10-14 June 2026 , providing opportunities for awareness raising regarding the partnership's work and outreach towards a more diverse, “general” public but also media.

Dedicated project events: demonstrations, projects visits, exhibitions;

Building on its extensive and diverse portfolio of projects, the JU frequently co-organises dedicated project events that showcase key milestones and achievements across strategic research areas of the hydrogen value chain.

Furthermore, to support its activities with independent expertise, the JU has established the **European Hydrogen Sustainability and Circularity Panel (EHS&CP)** and the **European Hydrogen Safety Panel (EHSP).**

The EHS&CP helps the Partnership integrate sustainability and circularity considerations at both programme and project levels, addressing environmental, social, and economic aspects while promoting best practices and fostering a culture of sustainability.

The EHSP provides independent safety expertise, serving as a knowledge hub to guide projects, share objective information, and promote hydrogen safety education.

The work of both panels is communicated through dedicated webinars, final reports, and other outreach activities.

The JU has commissioned several studies to obtain independent expertise, including the **“Study on Water Use in Renewable Hydrogen Production.”** This study highlights the critical role of water in hydrogen production and the variability in water consumption depending on technology, energy source, and cooling method. The final results will be shared through a dedicated webinar and other communication activities.

In addition, following the publishing of Commission's European Port Strategy and Industrial Maritime Strategy (expected in early 2026), Clean Hydrogen JU is planning to organise a dedicated maritime event to support further uptake of hydrogen in the maritime sector.

Monitoring and measuring impact of communication activities

The impact of online communication efforts will be assessed using Europa Analytics reports for website and newsletter performance, alongside standard analytics provided by social media platforms, including Twitter, LinkedIn, and YouTube.

Total outreach across all communication channels, including events, publications, social media, and newsletters, will also be considered. For our flagship events, key performance indicators such as attendance and qualitative feedback collected through surveys will be evaluated to measure impact.

2.3.1.2. *Dissemination and exploitation of projects results*

All dissemination and exploitation (D&E) activities of the Clean Hydrogen JU will be in line with the European Commission strategy for dissemination and exploitation of the projects results in Horizon Europe[336]. The Horizon Dissemination & Exploitation Group will be one of the pillars (together with the Horizon Feedback to Policy Group) to coordinate implementation, according to the D&E Strategy for Horizon Europe. Clean Hydrogen JU shall continue participating and contributing in this group.

Furthermore, an ecosystem of services and tools has been established to enhance circulation of knowledge stemming from R&I projects:

- CORDIS[337]: Multilingual articles and publications that highlight research results, based on an open repository of EU project information.
- Horizon Results Platform[338]: A public platform that hosts and promotes research results, thereby widening exploitation opportunities. It helps to bridge the gap between research results and generating value for economy and society. Beneficiaries can create their own page to showcase their results, find collaboration opportunities and get inspired by the results of others;
- Innovation Radar[339]: A data-driven method focused on the identification of high-potential innovations and the key innovators behind them in EU-funded research and innovation projects;
- Horizon Dashboard[340]: An intuitive and interactive knowledge platform where one can extract statistics and data on EU research and innovation programmes – sorted by topics, countries, organisations, sectors, as well as individual projects and beneficiaries.
- Horizon Results Booster[341]: A package of tailor-made specialised services to maximise the impact of R&I public investment and further amplify the added value of the Programme, by building the capacity of projects for disseminating research results, increasing their potential for exploitation and improving access to markets;
- Horizon Standardisation Booster[342]: An initiative that supports European research and innovation projects to valorise results through standardisation, supporting them to contribute to the creation of new standards or the revision of existing standards. It responds to the main priorities (so-called urgencies) outlined in the European Strategy on Standardisation[343].
- European Intellectual Property (IP) helpdesk[344]: A first-line service aiming to provide free-of-charge support to help beneficiaries of EU-funded research projects manage,

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336 Dissemination & Exploitation Strategy for Horizon Europe - Towards an Integrated Dissemination & Exploitation Ecosystem, European Commission, DG-RTD, CIC, 2020
337 https://cordis.europa.eu/en
338 https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform
339 https://ec.europa.eu/digital-single-market/en/innovation-radar
340 https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard
341 https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/d-e-booster
342 Horizon Standardisation Booster (https://hsbooster.eu/)
343 European Strategy on Standardisation aims to speed up the pace of innovation through the development of efficient Standards that might be capable to accelerate the transition towards a more resilient, green and digital economy and to protect democratic values in technology applications - https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13099-Standardisation-strategy_en
344 https://intellectual-property-helpdesk.ec.europa.eu/regional-helpdesks/european-ip-helpdesk_en

disseminate and valorise their IP in the context of EU research and innovation programmes.

- Open Research Europe[345]: A platform that makes it easy for beneficiaries of European research and innovation projects to comply with the open access terms of their funding and offers researchers a publishing venue to share their results and insights rapidly. The new EC scientific publishing service for fast publication and open peer review for research scientific articles stemming from H2020 and Horizon Europe projects across all subject areas.
- Research and innovation success stories[346]: A collection of the most recent success stories from EU-funded research & innovation.

In particular, Innovation Radar (IR) is a prominent initiative embedded in the project workstream. Clean Hydrogen JU, following the legacy of FCH 2 JU, is supporting and participating through the on-going and new projects. This activity initiates by the project officer in collaboration with the related project beneficiaries in case an innovations is stemming out of their project activities. The process is being conducted during the project mid-term and final reviews, where possible innovative outcomes are analysed by a dedicated expert, filling out a questionnaire. The purpose is to provide information in a structured and quantified way, allowing introduction into the list of the innovations of IR. The Innovation Radar exercise has been incorporated in the eGrants Management tools, which gives the flexibility to the project officers to update existing innovations or submit questionnaires for new innovations that happen up to the final reporting; the Programme Office will assess whether this new feature can be applied successfully and effectively to flag innovations of our projects that comes later in the project lifecycle, even if without the use of experts. The identified innovations/innovators are gaining visibility and can be supported for further exploitation and dissemination by connecting with possible investors and corporates (fundraising, venture building and networking). One concrete example of this is Dealflow.eu[347], a matchmaking platform supported by the EC to help projects commercialize their innovations, by facilitating access to clients and investors and providing high-end coaching services. The service gives priority to the projects that are already analysed by the Innovation Radar. Also, during the Innovation Awards organised each year during the Hydrogen Week, the top-ranking innovations that have been filtered from the Innovation Radar are presented to the public allowing them to vote for the best one.

As part of the knowledge management activities, but also in the context of the Project Management workflow, the Programme Office will keep on checking compliance with the Horizon Europe MGA provisions in D&E, encouraging the projects not only to implement their D&E plans, to update and revise them when necessary, but also to try to benefit from the opportunities provided by the D&E ecosystem to facilitate and enhance their D&E activities during and after the end of each project, focusing especially on the exploitation efforts of the key exploitable results[348]. This provision is valid during and after the end of the funding cycle of the projects (for both the ongoing H2020 and the new Horizon Europe projects), as foreseen in the Model Grant Agreement (MGA), taking into account the changes introduced in Horizon Europe compared to the H2020 as regards D&E, which reinforces the D&E framework for the projects supported under the current programme. Especially after the funding period, projects will be contacted to remind the key results owners about their contractual obligations to enable

[345] https://open-research-europe.ec.europa.eu/
[346] https://ec.europa.eu/research-and-innovation/en/projects/success-stories
[347] https://dealflow.eu/
[348] D&E legal obligations for beneficiaries - extract from the D&E [pdf]

dissemination and exploitation of them and on the available tools provided by the EC to help them accomplish this task.

2.3.2. Procurement and contracts

Clean Hydrogen JU allocates funds to procure the necessary services and/or supplies so that it reaches its objectives and adequately supports its operations and infrastructures.

To make calls for tender and contract management as effective and efficient as possible, Clean Hydrogen JU resorts extensively to EU inter-institutional calls for tenders (including the ones launched in the context of the back-office arrangements for Procurement, as mentioned below in section 2.3.4.2), and their implementation in multi-annual framework contracts. In addition, it must be noted that the Clean Hydrogen JU has also concluded several Service Level Agreements (SLAs) with other Directorate Generals of the European Commission for support to various administrative activities.

The Clean Hydrogen JU expects to either join the EU inter-institutional procurement procedures, or launch its own calls for tenders (as a result of the current framework contracts ending in 2026-2027, or when the need is not already covered in another framework contract):

- Supply of office furniture, furnishings,
- Contract for works for renovation of the office plan and its layout,
- Framework contract for services for advisory and support services in the field of HR.

The Clean Hydrogen JU will work on further simplifying the management of procurement activities by using digital and automated procedures and processes. As of 2024, all of the calls are managed, and published on the Funding and Tenders Opportunities Portal, thus joining all EU public contracting authorities in use of the corporate suite of IT tools for the management of calls for tenders. The JU has also migrated to PPMT. In accordance with a the roll-out programme for e-Contracting, the JU will also continue its efforts for the onboarding to e-Contracting.

2.3.3. Other support operations

2.3.3.1. ICT management

Eight Joint Undertakings are sharing the housing location in the building “White Atrium”, Brussels Belgium. The arrangements for the facilities are subject to a common contract for both the office space and the IT management of equipment, maintenance and help desk.

ICT provides the ICT infrastructure, tools and services to enable the staff members to work and the teams to collaborate. The Joint Undertaking JU strategic objective in the field of ICT is to lead by example in digital transformation. This transition is clustered on the following pillars:

- paperless, streamlined procedures that use technology to remove mechanical tasks.
- improved access to and use of data to work more efficiently and be more transparent.
- staff collaborating efficiently and easily anytime, anywhere and with all stakeholders.

and will be supported in 2026 by specific objectives in the following areas: Information and Communications Technology (ICT) governance, Information and document management, and digital transformation.

Joint Undertakings will take all opportunities to build synergies on areas of joint interest and maintain the strong partnership with DIGIT to harmonise processes and good practice (IT Legacy/Cybersecurity) and feeds into corporate decisions when possible.

ICT Governance will be further developed by renewing, extending, or creating Service Level Agreements for the common digital infrastructure to improve synergies and efficiencies among the Joint Undertakings. Ten Joint Undertakings participate in the back-office arrangements, in which common tasks such as IT governance and shared ICT infrastructure and services have been allocated to the Clean Hydrogen JU as lead. In the context of the back-office arrangements for ICT (BOA ICT, see below in section 2.3.4.2), the Joint Undertakings have adopted at the end of 2025 the common IT annual work plan for 2026. This will also be supported by added-value interinstitutional framework contracts, in particular, the DIGIT Dynamic Purchasing System (DPS), or inter-agency joint procurements the Clean Hydrogen JU will continue joining. The common procurement plan is defined in the annual work plan 2026 for the IT Governance, aligned with the common IT actions approved in December 2026, supervised by Clean Hydrogen with the support of the back-office arrangement for procurements lead by Clean Aviation Joint Undertaking.

Regarding the **digital infrastructure**, the JU will continue to rely on the secure pan-European networks for the Commission, executive agencies and other European institutions. The new TESTA line design shared with more agencies is operated under the new DIGIT broker model and is actually shared as best practice within the IT community. The common conference centre of the White Atrium building will be upscaled with the necessary audio-visual functions to held hybrid meetings. This has been greatly facilitated by the new Memorandum of Cooperation signed with SCIC for installation and support.

In the area of **digital transformation**, the main objective is to build a performing digital infrastructure and a fit-for-purpose Digital Workplace. Each staff member will continue to receive modern IT equipment allowing for more flexibility, but also from 2026 focusing on the digital culture, promoting digital skills, mobile hardware and software solutions, and collaboration:

- The shared spaces specific to the Clean Hydrogen JU or transversal in the common tenant will be encouraged for collaboration;
- The cybersecurity mindsets will be required anywhere and anytime.

Other projects related to the extended use of EC tools will be carried out, such as the deployment of new HRT, and a new modern contract database and management will be developed for monitoring.

The adoption of the new **Regulation on Cyber Security** in 2024 enforces the establishment of an internal cybersecurity risk management, governance and control framework that ensures an effective and prudent management of all cybersecurity risks. The requirements and implementation of the regulation is mutualised within the Back-Office arrangement on ICT under the service group “Security and compliance management” developed in the back-office arrangements for ICT lead by the Innovative Health Initiative Joint Undertaking (IHI JU), with the ultimate objective to develop the common security framework by 2029 in the most effective way. Cybersecurity is reinforced by the dedicated role of Cyber Security Officer to reinforce the JU’s resilience to ever evolving digital security threats, establish a central point of contact with CERT-EU, and follow the developments and practical implementations by the relevant inter-institutional groups.

2.3.3.2. *Document Management*

The implementation and continuous improvement of the Clean Hydrogen JU Information and Document Management System (IDMS) aims to simplify and streamline the management of information and documentation within the organisation. The Clean Hydrogen JU uses a portfolio of secure, state-of-the-art corporate digital solutions. The Clean Hydrogen JU will continue to use and /or adopt corporate digital solutions provided by the European Commission such as ARES, eProcurement suite, eGrants suite. Document management at Clean Hydrogen JU is governed by several regulations. On the one hand, several regulations define the necessary registration and retention, while on the other hand the data protection regulation and the information security policy define access restrictions and deposition of documents. Since 2018, the Clean Hydrogen JU has implemented ARES (the digital corporate tool in the European Commission for document management system) in the wake of the entry into effect of the Decision of the Executive Director on the Document Management Policy establishing a new archiving and registration policy for Clean Hydrogen JU based on the European Implementing Rules of 30 November 2009 for the DECISION 2002/47/EC, ECSC, EURATOM on Document Management, and for the DECISION 2004/563/EC, EURATOM on Electronic and Digitised Documents". Furthermore, the Clean Hydrogen JU has implemented SYSPER in 2019, leveraging on the existing EC infrastructure and processes for staff matters administration. In 2026, the Clean Hydrogen JU will continue its efforts undertaken on these matters to keep awareness among staff at a high level, with procedural guidance and trainings, making use of the trainings dedicated to these applications offered via the EU-Learn platform.

Effective **record management** covers all information, both electronic and physical records, necessary to ensure evidence of Clean Hydrogen JU's activities ensuring an appropriate level of accountability, transparency, retention and public access to documents. The Commission proposed new rules on information security applicable to all EU institutions, bodies, offices and agencies. It is expected that this proposal will be adopted in 2026 by the co-legislators and will become a new regulation to which the Clean Hydrogen JU will have to align. In 2026, the Clean Hydrogen JU will further exploit the potential of data, information, knowledge and content management for running the program, communication to citizens and stakeholders and best staff engagement. New/different digital solutions available to the Joint Undertaking under the Microsoft 365 package will be further investigated in addition to those adopted after the data protection impact assessment performed by Global Health EDCTP3 and Trilateral.

Information Management has been gradually implemented in the Clean Hydrogen JU using the Microsoft 365 SaaS platform to complement the existing document management tool Hermes-ARES-NomCom provided by the European Commission. In 2026 the Clean Hydrogen JU will further develop collaboration spaces in the Microsoft 365 common tenant with dedicated Teams groups, channels and libraries for the internal and external actors of the Joint Undertakings under the ICT back-office arrangement governance service provision. The Clean Hydrogen JU will also identify and invest in emerging technologies such as Microsoft Power Platform, automation, AI, etc. for business optimization. The ICT will also support the modernisation of the digital platforms or applications develop for the knowledge management.

2.3.3.3. *Data protection*

Concerning the processing of personal data, the Clean Hydrogen JU is bound by Regulation (EU) 2018/1725 of 23 October 2018[349] on the protection of natural persons with regard to the processing of personal data by the Union institutions and on the free movement of such data.

[349] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32018R1725

The Clean Hydrogen JU takes all necessary and appropriate measures to provide transparent information and communication for the exercise of the rights of data subjects. Privacy notices for each specific processing operation are available on the JU's website[350]. Additionally, the JU will continue to maintain a public register of all of its data processing activities via its website, in line with the requirements of Regulation (EU) 2018/1725.

In accordance with Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe, and in line with article 13 therein regarding back-office arrangements, the JU will continue to identify and foster synergies and efficiencies in administrative activities related to data protection in coordination with other Joint Undertakings (see section 2.3.4.2).

Regarding the above-mentioned synergies, in 2025 the Clean Hydrogen JU took part in a joint specific contract with all JUs sharing the same IT infrastructure, with the aim to update the data protection impact assessment (DPIA) that was performed in 2020 for the use of Microsoft services. The updated DPIA was finalized in July 2025, in line with the results of negotiations between Microsoft and the European Commission for the review and update of the Inter-Institutional Licensing Agreement .

In 2026 the recommendations in the DPIA, specifically those related to Artificial Intelligence, will be implemented and apply to all M365 applications used in the context of the JU's activities. Considering the sustained increase and deployment of Artificial Intelligence features in all applications, the JU's services will continue to monitor developments in that area to ensure that any use of IT tools with AI features is performed with an acceptable level of risk for the protection of personal data. Moreover, any new data processing activity will be introduced as necessary in the JU's publicly available register.

In 2026 the DPO will perform the annual data protection awareness session in order to inform and update all JU staff with every relevant news and points of attention.

2.3.3.4. Logistics and facility management

Following studies in 2025, a refurbishment of the offices space of the Clean Hydrogen JU is planned in 2026, with the purpose to adapt them to the decision of the Governing Board on working time and hybrid working. The objective of a new use of offices space include in particular the preservation of an adequate welcoming of newcomers, transmission of knowledge and know-how, as well as effective teamworking in a multi-cultural context and informal collaborative exchanges as a source of creativity.

Logistics and facility management is also subject of a newly established back-office arrangement starting to operate in 2026 (see section 2.3.4.2).

2.3.4. Human Resources

2.3.4.1. HR Management

The priority objectives in the field of Human Resources are to ensure that the Staff Establishment Plan is filled, to ensure an efficient management of staff resources and to ensure an optimal working environment.

This is achieved mainly through efficient selection procedures, staff performance appraisals and reclassifications, learning and development opportunities, promotion of open communication and inter-JU cooperation, and by respecting the work life balance procedure in place.

[350] https://www.clean-hydrogen.europa.eu/about-us/privacy-policy_en

Furthermore, in 2026, the following actions will be carried out in the area of HR:

- Finalisation of recruitments to fill the Staff Establishment Plan (see below in section 2.3.4.3): contract agent post for Stakeholders Relationships Officer, and Seconded National Expert (one position);
- Ensuring that all new staff will follow a mandatory training on ‘Ethics and Integrity’.

Furthermore, following the staff engagement survey conducted in 2025, which has resulted in a defined action plan, the JU will implement the action plan throughout the year 2026.

2.3.4.2. Strategy for achieving efficiency gains and synergies

According to Council Regulation (EU) 2021/2085, Joint Undertakings shall achieve synergies via the establishment of back-office arrangements (BOA), operating in some identified areas.

Back-office arrangements for Human Resources support

Article 13 identifies Human Resources Support among the areas where common BOA could be set up. In that context, CBE JU is the lead JU for the BOA HR with IHI JU as “back-up JU”.

The BOA HR implements actions in three main areas of HR Support: recruitment, HR legal framework and HR digitalisation. Its objective is to maximise synergies among the JU’s, harmonise procedures by valorising best practices, ensure coherent HR support services, achieve efficiencies and economies of scale, increase the negotiation power of JU’s operating under the SBA towards contractors and service providers.

The Joint Undertakings established under Council Regulation (EU) 2021/2085 will contribute to BOA HR Support, together with EuroHPC and SESAR JU that will participate on specific initiatives in line with their internal priorities and according to their own specificities.

In line with the proposal of an enhanced coordination of the Network of JUs’ HR officers, the conclusion of a Service Level Agreement (SLA) among the JU’s has been deemed necessary since a clear commitment to the execution of the BOA HR Annual Work Plans must be made by the JU’s under the coordination of the Lead JU. Established in 2024, the BOA HR will build on the achievements of its first two years and will continue in 2026 to focus on the following key areas of HR support, while further developing new projects and activities:

- Recruitment
  - Alignment and harmonisation of the JUs’ recruitment processes: following its finalization in 2025, the common selection process guidelines—designed in accordance with best practices and the applicable legal framework—will be implemented across all JUs, ensuring a consistent and transparent approach whenever a selection procedure is launched.
  - Organisation of joint selection procedures to increase efficiency gains: the JU’s will strive to organise joint selection procedures for common profiles with same grades. This practice already in place, will be strengthened in 2026.
  - Establishment and sharing of reserve lists: where appropriate, the JUs will continue to share their reserve lists to shorten their recruitment processes and time-to-recruit.
  - Inter-JU Competency framework: the BOA HR will continue to work on the common inter-JU competency framework and harmonization of job profiles, reinforcing consistency and clarity across all roles and supporting more effective HR management in JU’s.

- HR legal framework: the JUs share a common legal framework in the HR domain, therefore, additional synergies can be achieved by enhancing the existing collaboration in this area. The focus in 2026 will be on:
    - Staff Well-being and Conflict Prevention: expanded in 2025 with 4 additional members further to a new call for expression of interest, the JUs will continue to offer to the JU's staff a common network of Confidential Counsellors. Information campaigns and joint actions will be launched to promote staff well-being, raise awareness about psychological and sexual harassment, and implement preventive measures aimed at mitigating workplace conflicts. In this context the JU's will also increase the visibility of mediation services to JU's staff.
    - Collaboration with the EU agencies network (EUAN) and the EC: the JU's will continue to attend EUAN meetings, including possible ad-hoc participation of the HR Officers to different working groups. The JUs will also continue strengthening their collaboration with DGHR /PMO about common HR matters. Notably, building on the recent reinforcement of the collaboration with DG HR, the latter and DG HR will explore the feasibility of working on new synergies including the possibility for JUs to join the Standing Working Party, JUs access to the newly developed modules of the HRT platform of DG HR and a more agile sharing of reserve lists among EU bodies.
    - BOA HR network: the JUs HR Officers will continue their strong collaboration. A new multi-annual work plan which will include inter-JU new projects and activities will be developed and adopted by the BOA HR Steering Committee. After two years of existence, the BOA HR will take stock of its experience and will reflect on the modalities of its governance.
- HR digitalisation: in 2026, the JUs will continue to move towards a digitalisation of HR processes. The BOA HR will continue to share good practices in the use of HR IT systems.

<u>Back-office arrangements for Procurement</u>

The Back Office Arrangements in Procurement ('BOA Procurement') will continue to create synergies among its members across 2026-2027 as reflected in the endorsed by the Steering Committee Joint Public Procurement Planning ('JPPP').

Among the inter-institutional tender procedures planned for the 2026–2027 period, the renewal of a framework service contract for managed IT services is the most strategic priority.

It has been proven that by pooling a negotiation power, the BOA joint administrative calls for tenders draw the attention of higher number of economic operators, ensuring competitive bids and robust market responses.

Finally, in 2026 the BOA will further prioritize the digitalization of contract management processes with a strong focus on streamlining its operating framework.

<u>Back-office arrangements for Information and communication technologies</u>

In continuation of the long-lasting coordination and collaboration practice on information and communication technologies (ICT), and following the signature of the SLA of the BOA ICT in January 2025, the Joint Undertakings have developed and approved a common IT annual work plan for 2026. This plan identifies 7 action lines covering 4 service areas for 2026:

- Service area 1: Governance:
    - Common governance, decision-making and budget monitoring: in this area, the implementation of the IT annual work plan and budget for 2026 will be monitored, and the common annual work plan for 2027 will be prepared in view of an adoption by the BOA ICT Steering Committee before the end of 2026,
    - Management of shared infrastructure, which includes in particular the delivery of Infrastructure-as-a-service (IaaS) under MS 365 technology,
    - Investigation of AI implementation for the JUs;
- Service area 2: Management of shared infrastructure
    - Service delivery and monitoring of the service contract,
    - Preparation of a procurement procedure for the establishment of an FWC for ICT managed services, in coordination with the BOA Procurement,
- Service area 3: Workplace services provision
    - Workplace service delivery and monitoring of the service contract,
    - Continuous improvement of infrastructure in the White Atrium building (especially the meeting rooms);
- Service area 4: Security and compliance management, which includes the continuation of the implementation of the requirements of the Cybersecurity Regulation, and follow-up of other security requirements. This also includes the monitoring of the common business continuity plan and disaster recovery plan (BCP/DRP)

Ten Joint Undertakings are signatories of the BOA ICT, co-lead by the Clean Hydrogen JU and the IHI JU. The common work plan identifies, for each action, a specific JU lead responsible for implementing the action.

In addition to common actions defined in the BOA ICT common IT annual work plan, JUs continue their collaboration with other Commission services and IBAs, and implement their own specific actions as described in section. 2.3.3.1 ICT Management.

<u>Back-office arrangements for Accounting</u>

The Clean Hydrogen JU implements its financial rules which define, inter alia, powers and responsibility of the Accounting Officer. They also make an explicit reference to the possibility that this function could be attributed to the Accounting Officer of the European Commission, and such option was effectively utilised by the JU in the past.

However, in October 2021 the European Commission announced the intention to terminate their role of the Accounting Officer of the JU, except for the treasury function, which became effective as of 1 December 2022. The resulting situation was tackled by applying the back-office arrangements solution for the accounting function of the JUs. Under these arrangements, the Clean Aviation JU provides accounting services to the Clean Hydrogen JU (the JU's Accounting Officer being a staff member of the Clean Aviation JU), while the EU-Rail JU is the Lead JU of the Back-office arrangements on Accounting.

<u>Logistics and Facility management</u>

During 2026, the BOA Facility Management will start functioning. The concept note is expected to be adopted by the Governing Boards of the Joint Undertakings having their seat at the

White Atrium building in Brussels, and the relevant Service Level Agreement (SLA) will be signed. In the previous years, the activities related to the White Atrium building facility management were carried out by informal arrangements by a single JU (Clean Hydrogen JU until 2024 and Chips JU afterwards). To align with Article 13 of the Single Basic Act, a BOA Facility Management has been proposed. This section will be updated with further details when the concept note is adopted and the SLA is signed.

2.3.4.3. Staff Establishment Plan[351]

Function group and grade	2025				2026	
	Authorised budget		Actually filled as of 31/12		Authorised budget	
	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts
AD 16						
AD 15						
AD 14		1		1		1
AD 13		1		1		1
AD 12		1		1		1
AD 11						
AD 10		2		2		2
AD 9		3		3		2
AD 8		3		3		2
AD 7		4		4		5
AD 6		2		2		3
AD 5						
TOTAL AD		17		17		17
AST 11						
AST10		1		1		1
AST 9		1		1		1
AST 8		1		1		
AST 7		1		1		1
AST 6		2		2		3
AST 5		3		3		2
AST 4		1		1		2
AST 3						
AST 2						
AST 1						
TOTAL AST		10		10		10
GRAND TOTAL	27		27		27	

[351] Adjustments to the staffing level may be decided by Corporate Management Board after considering the budgetary top-ups by third country credits and other aspects

Contract Agents	*FTE corresponding to the authorised budget 2025*	*Executed FTE as of 31/12/2025*	*Headcount as of 31/12/2025*	*FTE corresponding to the authorised budget 2026*
Function Group IV	*2*	*1*	*1*	*2*
Function Group III	*2*	*2*	*2*	*2*
Function Group II				
Function Group I				
TOTAL	*4*	*3*	*3*	*4*[352]

Seconded National Experts	*FTE corresponding to the authorised budget 2025*	*Executed FTE as of 31/12/2025*	*Headcount as of 31/12/2025*	*FTE corresponding to the authorised budget 2026*
	3	*2*	*2*	*3*
TOTAL	*3*	*2*	*2*	*3*

Recruitment forecasts 2025 following retirement/mobility or new requested posts					
Job title in the JU	*Type of contract (Official, CA, TA)*		*TA/Official*		*CA*
			Function group/grade of recruitment internal (Brackets) and external (single grade) foreseen for publication		*Recruitment Function Group (I, II, III and IV)*
	Due to foreseen retirement/ mobility	*New post requested due to additional tasks*	*Internal (brackets)*	*External (brackets)*	
Stakeholders Relationships Officer					*1*

2.4. Governance activities

2.4.1. Governing Board

The Governing Board (GB) is the main decision-making body of the Clean Hydrogen JU. It has overall responsibility for the strategic orientation and the operations of the Clean Hydrogen JU and shall supervise the implementation of its activities in accordance with Articles 15 and 80 of the Single Basic Act.

The GB is composed of three representatives of the European Commission on behalf of the EU, six representatives of the Industry Grouping (Hydrogen Europe) and one representative of the Research Grouping (Hydrogen Europe Research).

The GB plans to hold three meetings in 2026. The indicative key decisions of the GB in 2026, adopted by preference through written procedures in accordance with the Rules of procedure adopted in 2021, are listed below:

[352] Of which 3 posts financed from third country contributions

Key decisions in 2026	Timetable
Assessment of the Annual Activity Report for 2025	Q2
Adoption of the Governing Board opinion on the JU's 2025 Annual Accounts	Q2
Adoption of the AWP and budget for 2027	Q4

2.4.2. States Representatives Group

The States Representatives Group (SRG) is an advisory body to the GB. It consists of up to two representatives and up to two alternates from each Member State and from countries associated to the Horizon Europe Framework Programme. In total, there are 33 countries represented in the States Representatives Group. The SRG shall be consulted and, in particular review information and provide opinions on the following matters:

a) programme progress of the Clean Hydrogen JU and achievement of its targets and expected impacts;
b) updates to the SRIA;
c) links to the Horizon Europe and other initiatives related to Hydrogen;
d) draft work programmes;
e) involvement of SMEs;
f) actions taken for dissemination and exploitation of results along the value chain;
g) annual activity report.

The SRG will hold at least two meetings in 2026. Issues to be covered include:

- opinion on the JU's Annual Activity Report for 2025,
- opinion on the JU's AWP for 2027.

Furthermore, the SRG will prepare in 2026 its annual report on national and regional policies and programmes on Hydrogen. This report is a key input to identifying potential synergies on hydrogen-related activities, between countries or regions and with the activities of the Clean Hydrogen JU.

The Chair of the SRG represents the SRG at the Clean Hydrogen Joint Undertaking's Governing Board meetings, where he has an observer status.

In 2026, the SRG will elect a new Chair and new Vice-Chairs for a mandate of 2 years renewable once. Indeed, the Chair and Vice-Chairs have started their mandate in May 2022 and were extended on 29 May 2024 fora duration of two years. According to Articles 3 and 4 of the Rules of procedure of the SRG, "the Chair and Vice-Chairs shall be appointed for a term of 2 years. This term may exceptionally be extended once for a maximum term of 2 years. Following Terms: Up to six months before the end of the term of office of the Chair and Vice-Chairs, the incumbent may request the extension of his or her term."

2.4.3. Stakeholders Group

The Stakeholders Group is the other advisory body to the GB, consulted on various horizontal issues or specific questions in areas relevant to the Clean Hydrogen JU's work. Based on Recital 34 of the Single Basic Act: it requires that "With a view to ensuring that joint undertakings are aware of the positions and views of stakeholders from the entire value chain in their respective fields, joint undertakings should be able to set up their respective advisory stakeholders' groups, to be consulted on horizontal issues or specific questions, as per the needs of each joint undertaking". In accordance with the general provisions of Article 22(2) of the Single Basic Act "The stakeholders' group shall be open to all public and private stakeholders, including organised groups, active in the field of the joint undertaking, international interest groups from Member States, associated countries or other countries" In particular, for the Clean Hydrogen Joint Undertaking, Article 84(1) mentions that "The stakeholders' group shall consist 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 of the scientific community".

The Chairperson of the SG shall have the right to attend the meetings of the GB and take part in its deliberations without voting rights.

The mandate of the current members of the SG ends on 2 February 2026, so a new procedure is being prepared aiming at retaining the active members of the current SG, which will go through GB validation. The new SG members should be appointed in Q1 2026.

The newly appointed SG will hold at least two meetings in 2026, with an initial plan of three meetings. The objectives of the meetings will be to update on the activities of the Clean Hydrogen JU and the activities of the SG members, with a view to understanding the potential to enable concrete synergies between the JU and the sectors represented by the SG members, including the AWP/Call for Proposals 2027.

2.5. Strategy and plans for the organisational management and internal control systems

2.5.1. Organisational management

No change is foreseen on the organisation structure of the Clean Hydrogen JU in 2026.

In continuation of previous years and as mentioned in section 2.3.4.2 above, in 2026 the back-office arrangements will continue to operate in five areas. Based on the experience gained over the first years of operation, the JUs will collectively implement continuous improvement in the way back-office arrangements operate with an aim to optimise their efficiency, avoid duplications and maximise administrative synergies.

2.5.2. Financial procedures

The Clean Hydrogen JU shall fully comply with the requirements of the recast Regulation (EU, Euratom) 2024/2509 on the financial rules applicable to the general budget of the Union entering into force on 30 September 2024.

In compliance with Article 71 of the Regulation, the Clean Hydrogen Joint Undertaking will adhere to the principle of sound financial management. It shall also comply with the provisions of the Financial Rules adopted in 2019. Pursuant to Article 70, any derogation from this Model Financial Regulation, required to address the specific needs of the Joint Undertaking, shall be subject to the prior consent of the Commission.

Monitoring arrangements, including through the Union representation on the Governing Board, as well as reporting arrangements, will ensure that the Clean Hydrogen JU meets its accountability obligations both to the College and to the Budgetary Authority.

Concerning ICT tools used to support financial procedures, the European Commission's SUMMA corporate financial system will replace ABAC as the planning, accounting, budgetary, reporting and treasury system within the Clean Hydrogen JU's financial procedures as of the 2026 financial year.

The SUMMA tool, based on the SAP application, will enable the Clean Hydrogen JU to standardise its processes and adhere to market best practices.

For grant management, the reporting and validation of costs under H2020 and Horizon Europe grants are carried out via the EC IT tools (SyGMa and COMPASS). Experts reports and cost validation are supported through the EC IT tools (ECS and COMPASS).

Regarding the financial procedures including the applicable Financial Circuits[353], the JU adopted them at the time of its establishment. The procedure for the financial circuits was updated in 2025.

These financial procedures are designed to ensure the segregation of duties and apply the four-eyes principle in JU's financial transactions. They describe in detail the financial circuits implemented for each type of transaction, along with the roles and responsibilities of each actor involved. To a lesser extent, they also outline the main principles applicable to key procedures, such as grants and procurements[354] .

2.5.3. Internal control system

The Internal Control Framework (ICF) adopted by the JU through the Omnibus Decision continues to apply. This framework, implemented *mutatis mutandis*, is based on the revised Internal Control Framework of the European Commission, adopted on 19 April 2017, which is based on the COSO 2013 Internal Control – Integrated Framework, which comprises five interrelated components: *Control Environment, Risk Assessment, Control Activities, Information and Communication,* and *Monitoring Activities*, supported by 17 underlying principles.

Together, these components form the foundation of a robust internal control system that promotes sound governance, effective risk management, and supports the achievement of the JU's strategic and operational objectives.

Looking ahead to 2026, the Clean Hydrogen Joint Undertaking (JU) will continue to enhance its internal control system, placing particular emphasis on the following key activities:

- *Conducting regular internal control assessments*. As part of this process, the description of specific controls and their associated monitoring indicators will be reviewed and updated. This proactive and iterative approach ensures that the internal control framework remains dynamic, risk-responsive, and aligned with recognised governance best practices.
- *Delivering a presentation to staff* to raise awareness of internal controls and their importance in daily operations. This initiative aims to improve understanding and foster a culture of shared responsibility across the organisation.
- *Performing an annual risk assessment*, ensuring that potential risks are systematically identified, evaluated, and mitigated. Special attention will be given to ensuring that agreed mitigation measures are implemented effectively and followed up as needed.

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[354] Ares(2025)4145116

- *Organising a risk assessment workshop* involving all staff members, continuing the inclusive approach adopted in previous years. This collaborative exercise helps to build a culture of transparency, accountability, and engagement in risk management and internal control processes.

2.5.4. Ex-ante and ex-post controls

Ex-ante controls

Ex-ante controls are essential to prevent errors and irregularities before the authorisation of operations, to mitigate the risks of non-achievement of the objective, and they avoid the need for ex-post corrective actions.

Clean Hydrogen JU has developed procedures defining the controls to be performed by project and finance officers. These activities are monitored through the defined set of KPIs, in particular, time to pay, budget implementation, work programme execution.

During the period 2026, the administration, finance, and operational unit will continue to work closely in their day-day activities. Specific emphasis will be placed on enhancing the ex-ante control framework through the following key actions:

- *Implementation of the Horizon Europe Ex-Ante Control Strategy and related documents (e.g., e-grant vademecum, e-expert vademecum):* Applying structured control approaches, to guide and document control efforts.

- *Integration of Audit Feedback:* Applying insights and lessons learned from ex-post audits to improve ex-ante checks, particularly focusing on red flags and recurrent errors observed in H2020 audits. The starting point will be the risk-based module in COMPASS.

- *Financial Webinars:* Together with the support of the Commission (DG RTD) offer general and targeted sessions to inform and support stakeholders on the latest Horizon Europe rules, allowing participants to ask questions and clarify requirements.

- Dev*elopment of a JU-Specific Risk-Based Ex-Ante Control Methodology:* As recommended by the European Court of Auditors, tailor a specific JU methodology for the Horizon Europe grant management cycle, ensuring that control intensity is proportionate to the risk level, and adapted to the type of grants (e.g. actual costs, lump sum). The methodology will have to be in line with the HE ex ante control strategy and the inter- HE control strategy.

Ex-post controls

Ex post controls and audits, represents a significant element of the JU Internal Control System, and aims to provide the JU Authorizing Officers with the necessary elements of assurance in a timely manner.

The main objectives are to:

- Assess that the legality, regularity and sound financial management (economy, efficiency and effectiveness) have been respected,
- Provide an indication of the effectiveness of the related ex ante controls,
- Provide the basis for corrective and recovery activities, if necessary.

During the period 2026, the ex-post audits will continue to be performed by the common audit service (CAS) of DG RTD with a focus on actual cost grants. In case of lump sum grants (normally planned for 2027), the JU will apply DG RTD guidelines on HE lump sum ex post technical reviews.

Specific emphasis will be placed on the following activities:

- In cooperation with CAS, launch the 2026 Horizon Europe risk-based ex post audit batch, ensure timely implementation and completion of the audit, and timely implementation of audit results and related extensions.
- Provide adequate reporting through the budget discharge process.
- Draft a specific JU HE ex post audit strategy, as suggested by the Court of Auditor, in line with the Commission HE ex post audit strategy of the Commission and the inter-JU HE control strategy.

2.5.5. Anti-fraud initiatives

The Common Audit Service (CAS), in collaboration with the Research Family, has developed a Common Anti-Fraud Strategy (RAFS) to provide a coordinated framework for fraud prevention and detection activities across the Research Family. This strategy is aligned with the objectives and actions set out in the European Commission's Anti-Fraud Strategy (CAFS). An updated version of the RAFS was endorsed by the Horizon Europe Executive Committee in December 2023.

In May 2024, the European Anti-Fraud Office (OLAF) published the "Methodology and Guidance for the Anti-Fraud Strategies of EU Decentralised Agencies and Joint Undertakings 2024", which sets out specific requirements for anti-fraud strategies that the Clean Hydrogen JU must follow.

Accordingly, in 2026, the Clean Hydrogen JU will:

- Continue to implement harmonised preventive and detective measures to strengthen fraud detection capabilities;
- Raise awareness among employees and actively participate in anti-fraud training sessions;
- Maintain participation in the Fraud and Irregularity Committee (FAIR) meetings organised by DG Research and Innovation;
- Liaise effectively with OLAF in the event of investigations, ensuring timely cooperation and information exchange.

2.5.6. Audits

Internal audits

Internal audits are carried out by the Internal Audit Service (IAS) of the European Commission, in accordance with the Audit Mission Charter, in close cooperation with the Internal Control and Audit Manager of the Clean Hydrogen Joint Undertaking (JU). According to the Strategic Audit Plan 2024–2026, two audits were scheduled:

- An audit on operational synergies, which began in 2024;
- An audit on back-office arrangements, which commenced in 2025.

While no new audits are planned for 2026, the IAS will conduct an in-depth risk analysis to identify emerging risks and update its strategic audit plan for 2027 onwards.

In 2026, the JU's internal audit-related priorities will be to:

- Liaise with the IAS in closing the audit on back-office arrangement and agree on an action plan.
- Follow up on implementation of actions resulting from the audits on operational synergies and back-office arrangements;
- Assist the IAS in updating their Strategic Audit Plan, based on the outcomes of the risk analysis.

Baker Tilly (Independent External Auditor)

In 2026, as in previous years, the Clean Hydrogen JU will support the external auditor Baker Tilly in conducting the audit of the JU's annual financial accounts, in accordance with its Financial Rules and applicable legal obligations.

European Court of Auditors (ECA)

As regards audits carried out by the European Court of Auditors (ECA), the Clean Hydrogen JU will continue its cooperation in 2026 by continuously undertaking the following actions:

- Liaise with the independent auditor assigned to audit the JU's 2025 annual accounts, and provide all necessary information and support (including ex-post DASS included)
- Follow up on the implementation of any recommendations and/or actions from previous ECA reports;
- Assisting the ECA in their horizontal audit of Joint Undertakings scheduled for 2025 (topic to be confirmed).

3. BUDGET 2026

The 2026 budget covers all administrative and operational needs for the year.

It is noted that the budget of the JU shall be adapted to consider the amount of the Union contribution as laid down in the budget of the Union.

The EU contribution to the JU has been reduced by an amount of 4 016 307,74 following a reallocation of budget due to the contribution from the EU budget to the AI Giga Factories initiative.

The following tables present revenues and expenditure in 2026 and a comparison with 2025 budget (as after its amendment in October 2025).

Revenues

The 2026 administrative budget will be financed by fresh appropriations under Horizon Europe, and by private members contributions.

2026 operational budget amounting to a total of 118,804,130 EUR will be financed by:

- Union existing commitments for completion lines (H2020).
- Horizon Europe operational appropriations will be financed by fresh appropriations of the Union and Union commitments entered in previous years.
- In addition, an amount of EUR 1,200,000 in terms of payments will be funded through third countries contribution and will finance additional hydrogen valleys.
- Additional third country credits for Clean Hydrogen JU of EUR 13,000,000 in terms of payments.

These appropriations are complemented by reactivations of appropriations that became available in previous years and are introduced in the initial budget.

The table below provides an overview of the statement of revenues for 2026.

STATEMENT OF REVENUE										
Heading	**Title Chapter**	**Financial year 2025**				**Financial year 2026**				
		Commitment Appropriations	***% Ratio***	**Payment Appropriations**	***% Ratio***	**Commitment Appropriations**	***% Ratio***	**Payment Appropriations**	***% Ratio***	***Remarks***
EU contribution (excluding EFTA and third countries contribution)		102,430,419	52%	48,519,519	27%	119,673,791	*94%*	140,493,675.54	*84%*	
of which (fresh C1) Administrative (Title 1&2)		3,742,515	2%	3,742,515	2%	3,880,292	*3%*	3,880,418.54	*2%*	PA for 2026 include 3 880 292 (VOBU 2026) and 126.54 (VOBU 2024)
of which frontloaded commitments (Title 1 and Title 2)	2002		0%		0%		*0%*		*0%*	
of which H2020 Operational (Title 3)	2005		0%	7,259,223	4%		*0%*	7,510,713	*4%*	In 2026 PA: 7,510,713 from budget 2026, 4,888,224 from budget 2023.
of which Horizon Europe Operational (Title 3)	2006	84,636,358	43%	45,362,179	25%	**115,793,499**	*91%*	129,102,544	*77%*	Before gigafactories cut in 2026: 122,820,438 (119,708,029+3,112,409) from 2026 EC commitments and 132,459,210 from 2026 EC payments After gigafactories cut in 2026: 118,804,130 (115,793,499+3,010,631) from 2026 EC commitments and 132,459,210 from 2026 EC payments Cut including EFTA: 4,016,307.74
EFTA and third countries contribution		102,430,419	*52%*	48,519,519	*27%*	3,111,519	*2%*	17,822,039	*11%*	Clean Hydrogen JU does not manage EFTA and third countries contribution directly. Therefore EFTA lines will be added to the EU contribution as above

STATEMENT OF REVENUE										
Heading	**Title Chapter**	**Financial year 2025**				**Financial year 2026**				
		Commitment Appropriations	***% Ratio***	**Payment Appropriations**	***% Ratio***	**Commitment Appropriations**	***% Ratio***	**Payment Appropriations**	***% Ratio***	***Remarks***
of which Administrative EFTA(Title 1&2)	2002	102,919	*0%*	102,919	*0%*	**100,888**	*0%*	**100,888**	*0%*	EFTA 2026:for HE at **2.60%** EFTA does not apply to PA of 126.54 as they concern VOBU 2024
of which Operational EFTA in H2020 (Title 3)	2005		*0%*	169,140	*0%*		*0%*	**164,485**	*0%*	EFTA 2026: for H2020 calculated at **2.19%**
of which Operational EFTA in Horizon Europe (Title 3)	2006	2,327,500	*1%*	1,247,460	*1%*	**3,010,631**	*2%*	**3,356,666**	*2%*	EFTA 2026: for HE calculated at **2.60%**
Of which operational third countries excluding EFTA (Title 3)	2006	100,000,000	*51%*	47,000,000	*26%*		*0%*	14,200,000	*8%*	20,000,000 in CA in 2025 and 13,000,000 in PA in Horizon Europe in 2026 (UK Contribution) 32,000,000 in PA in Horizon Europe line in 2025 and 1,200,000 in PA in Horizon Europe line in 2026 (RePowerEU2024&2025)
Financial Members other than the Union contribution		3,845,434	*3%*	3,845,434	*2%*	3,981,179	*3%*	3,981,307	*2%*	
Hydrogen Europe contribution to administrative costs	2003	3,307,073	*2%*	3,307,073	*2%*	3,423,814	*3%*	3,423,924	*2%*	
Hydrogen Europe Research contribution to administrative costs	2004	538,361	*0%*	538,361	*0%*	557,365	*0%*	557,383	*0%*	
Unused appropriations from previous		1,819,722	*1%*	70,621,459	*39%*	834,271	*1%*	5,722,494	*3%*	

STATEMENT OF REVENUE										
Heading	**Title Chapter**	**Financial year 2025**				**Financial year 2026**				
		Commitment Appropriations	***% Ratio***	**Payment Appropriations**	***% Ratio***	**Commitment Appropriations**	***% Ratio***	**Payment Appropriations**	***% Ratio***	***Remarks***
years										
Of which administrative 2023	3025	599,000	*0%*		*0%*	834,271	*1%*	834,271	*0%*	
Of which operational 2022	3020	127,286	*0%*	38,660,912	*20%*		*0%*		*0%*	
Of which operational 2023	3023	731,579	*0%*	30,923,280	*16%*		*0%*	4,888,224	*3%*	
Of which operational 2024	3024	5,183,084	*3%*	14,675,880	*8%*		*0%*		*0%*	
TOTAL REVENUE		**202,579,255**		**194,272,522**		**127,600,760**		**168,019,515**		

Expenditure

Overall, the administrative budget (Titles 1 and 2) will show a decrease by 8% compared to 2025. In more details:

Title 1 - Staff

Title 1 (staff costs) represents 58% of the administrative budget for 2026 and will increase by 2% overall compared to 2025. It covers salaries and allowances for staff and external personnel as presented in the establishment plan under section 2.3.4.3. Title 1 also includes mission expenses, training and socio-medical costs, expenditure related to recruitment, reception, events and representational costs. External services costs include interim staff and trainees, installation allowance, daily subsistence and the costs of Paymaster Office of the European Commission (PMO) services.

Salaries and allowances for staff in the establishment plan (Temporary Agents) will show an increase by 5% compared to 2025 due to the expected salary update of +1,2% to be applied as from 1 April 2026 and +3,4% to be applied as from 1 July 2026. An additional 1% is the effect of step advancements and reclassifications as in the staff establishment plan.

Salaries and allowances for external personnel (Contract Agents and Seconded National Experts) will show an increase by 33% compared to 2025 provisions. This rise is due to the salary adjustments explained above, as well as the inclusion of two additional contract agents under this budget line.

Expenditure related to recruitment is expected to decrease by 44% compared to the 2025 provisions. This reduction reflects the expectation that full staffing capacity will be reached in 2026, eliminating the need for further recruitments.

Mission expenses are projected to rise by 7%, primarily as a result of an increased ceiling.

Socio-medical infrastructure costs are expected to decrease by 33%, as the 2025 provision appears to have been slightly overestimated. Conversely, training costs are projected to increase by 33% compared to the 2025 provision, reflecting the need to accommodate the annual team-building events.

Expenditure on external services is expected to decrease by 45% compared to the 2025 provision, returning to the standard level corresponding to one FTA and two trainees engaged for six months.

Representational costs will remain at 2025 levels, as no additional needs are identified.

Title 2 - Infrastructure and operating costs

Title 2 (infrastructure and operating costs) represents 42% of the administrative budget for 2025 and will decrease by 19% compared to 2025.

Rental and building costs are expected to decrease by 47%, returning to normal levels after the temporary increase in 2025 caused by refurbishment activities. In addition, the acquisition of new furniture and IT equipment as part of this refurbishment will lead to an exceptional increase in payments under rental and building costs, as well as movable property and associated costs, in 2026. These additional expenses will be covered through the reactivation of past appropriations.

IT costs are expected to increase by 2% compared to the already elevated 2025 level, which had reflected one-off onboarding fees for HRT and SUMMA incurred during that year due to the higher common IT AWP 2026 requirements in the areas of AI, security, and DPIA.

The current administrative expenses will be decreased by 8% in, as in 2025 had exceptional non foreseen IT supplies costs.

On the other side, there will be an increase by 57% to telecommunication and postage costs as there are expected in 2026 adjustments in telephony contracts due to inflation as it was the case in previous years, as well as higher mailing service costs.

Expenditure on meetings is projected to decrease by 26%, reflecting a slight overestimation in the 2025 provision.

Running costs in connection with operational activities include requirements for project technical assistants. These needs are expected to remain nearly stable in 2026, as technical assistance will be needed in support of the Horizon Europe grant agreement preparations for the whole year.

Information and communication activities, as well as strategic studies, are expected to remain at 2025 levels, as no additional needs have been identified.

Title 3 - Operational costs

2026 budget includes:

H2020: payment appropriations for 12 payments (final).

Horizon Europe: Commitment appropriations will cover for the Call of 2026, JRC collaboration as announced in section 2.2.4.3, operational procurement activities as described in section 2.2.4.1 and experts (evaluators and reviewers), the latter estimated for an amount of EUR 900,000.

Payment appropriations will cover 70 payments (21 final and 49 interim), as well as procurement activities financed under this budget. In addition, they will cover the full pre-financing of grants expected to be signed at the beginning of 2026, relating to the 2nd and 3rd Governing Board decisions on Call 2025, as well as those under Call 2026. Finally, a provision is included for the pre-financing of grants expected to be signed under Hydrogen Valleys and the additional UK contribution.

Note on Call 2026 budget**:**

In accordance with the General Annexes of the Horizon Europe Work Programme 2026-27[355] (European Commission Decision C(2025) 8493 of 11 December 2025), with regard to budget flexibility, the budgets set out in the calls and topics are indicative. Unless otherwise stated, final budgets may change following evaluation. The final figures may change by up to 20% compared to the total budget indicated in each individual part of the Work Programme. Changes within these limits will not be considered substantial within the meaning of Article 110(5) of Regulation (EU, Euratom) No 2018/1046**.**

[355] https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2026-2027/wp-15-general-annexes_horizon-2026-2027_en.pdf

STATEMENT OF EXPENDITURE								
Heading	Title Chapter	Financial year 2025		Financial year 2026				Remarks
		Commitment Appropriations	Payment Appropriations	Commitment Appropriations	% Ratio 2026/2025	Payment Appropriations	% Ratio 2026/2025	
1 - Staff costs		4,978,720	4,978,720	5,097,000	*102%*	5,097,254	*102%*	
Salaries and allowances	11	4,593,000	4,588,000	4,818,000	*105%*	4,818,254	*105%*	
- Of which establishment plan posts	1101	4,203,000	4,198,000	4,300,000	*102%*	4,300,254	*102%*	Includes basic salaries for temporary staff and contract agents, family allowances, expatriation and foreign residence allowances, unemployment insurance, insurance against accidents and occupational disease, annual travel costs
- Of which external personnel	1102	390,000	390,000	518,000	*133%*	518,000	*133%*	Includes salaries, entitlements and allowances for Contract Agents and Seconded National Experts. Additional SNE.
Expenditure relating to Staff recruitment	1200	9,000	9,000	5,000	*56%*	5,000	*56%*	Miscellaneous expenditure on staff recruitment (travel expenses for interviews)
Mission expenses	1300	75,000	80,000	**80,000**	*107%*	**80,000**	*100%*	Mission claims and travel agency tickets. Possibility to be increased during the year.
Socio-medical infrastructure	1401	15,000	15,000	10,000	*67%*	10,000	*67%*	Medical service and mobility costs
Training	1402	30,000	30,000	**40,000**	*133%*	**40,000**	*133%*	Training costs

STATEMENT OF EXPENDITURE								
Heading	**Title Chapter**	**Financial year 2025**		**Financial year 2026**				**Remarks**
		Commitment Appropriations	**Payment Appropriations**	**Commitment Appropriations**	**% Ratio 2026/2025**	**Payment Appropriations**	**% Ratio 2026/2025**	
Additional HR costs	1500	252,720	252,720	**140,000**	*55%*	**140,000**	*55%*	Includes: Interim staff and trainees Installation allowance, daily subsistence, resettlement allowance and removal costs for staff arriving/departing Cost of PMO provisions & HRT
Receptions, events and representation	1600	4,000	4,000	4,000	*100%*	4,000	*100%*	Representation and receptions
2 - Infrastructure and operating costs		4,594,728	3,995,728	3,699,630	*81%*	3,699,630	*93%*	
Rental of building and associated costs	2000	844,000	494,000	**443,555**	*53%*	**443,555**	*90%*	Rent, works, insurance, common charges (water/gas/electricity), maintenance, security and surveillance. Refurbishment.
Information, technology and data processing	2100	728,500	728,500	**738,000**	*101%*	**738,000**	*101%*	IT purchases, hardware and software, licences, software development, PTA licences
Movable property and associated costs	2200	254,000	5,000	5,000	*2%*	5,000	*100%*	Purchases and rental of office equipment, maintenance and repair
Current administrative expenditure	2300	13,048	14,048	**12,000**	*92%*	**12,000**	*85%*	Office supplies, library, translation service, bank charges and miscellaneous office expenditure
Postage/ Telecommunications	2400	7,000	7,000	**11,000**	*157%*	**11,000**	*157%*	Telephones, video conferences and postal services
Meeting expenses	2500	50,000	50,000	**40,000**	*74%*	**40,000**	*74%*	Official meetings such as SRG, SG, Governing Board

STATEMENT OF EXPENDITURE								
Heading	**Title Chapter**	**Financial year 2025**		**Financial year 2026**				**Remarks**
		Commitment Appropriations	**Payment Appropriations**	**Commitment Appropriations**	**% Ratio 2026/2025**	**Payment Appropriations**	**% Ratio 2026/2025**	
								and caterings
Communication costs	2600	800,500	800,500	800,000	*100%*	800,000	*100%*	External communication and events
Support contracts	2700	1,493,680	1,492,680	**1,450,075**	*97%*	**1,450,075**	*97%*	Project technical assistance, audits, consulting activities and accounting services with DG BUDG (until 2022)
Strategic studies	2800	400,000	400,000	**200,000**	*50%*	**200,000**	*50%*	HR and strategy-related procurements: FWC for advisory services in the fields of strategy and HR (lots)
TOTAL ADMINISTRATIVE COSTS (1+2)		*9,573,448*	*8,974,448*	*8,796,630*	*92%*	*8,796,884*	*98%*	
3 - Operational costs		193,005,807	185,298,074	118,804,130	*62%*	159,222,631	86%	
H2020	3002		15,911,984			12,369,767	*78%*	This appropriation shall cover the operational costs of the JU regarding H2020 grants (pre-financings, interim and final payments), studies and JRC contribution.
Horizon Europe	3003	193,005,807	169,386,090	**118,804,130**	*62%*	146,852,864	*87%*	This appropriation shall cover the operational costs of the JU regarding Horizon Europe grants (pre-financings), studies and JRC contribution.
TOTAL EXPENDITURE		**202,579,255**	**194,272,522**	**127,600,760**	***63%***	**168,019,515**	***86%***	

4. ANNEXES

4.1. In-kind contribution for additional activities (IKAA) Plan

IKAA planning and reporting are an obligation for the private members. The IKAA report should be submitted by 31 of May (Article 11(2) of the SBA). This obligation has now been fulfilled, with contributions covering the years 2022, 2023, and 2024 gathered by the Office, for a total exceeding EUR 1.4 billion in contributions from private members. This figure is significantly higher than the initial target of EUR 970 million, therefore no additional IKAA is planned in 2026.

4.2. Link of Clean Hydrogen JU operational activities with its Strategy Map

Table 3. Clean Hydrogen JU Strategy Map: Actions, Outcomes and Impacts

Operational level resources and actions (Linked to the JU's objectives and additional tasks in the SBA and the strategy map)	**Action-1** Supporting climate neutral and sustainable solutions
	Action-2 Research and Innovation for hydrogen technologies
	Action-3 Supporting market uptake of clean hydrogen applications
Specific level outcomes (Linked to the JU's specific objectives in the SBA and the strategy map)	**Outcome-1** Limiting the environmental impact of hydrogen technology applications
	Outcome-2 Improving the cost-effectiveness of clean hydrogen solutions
	Outcome-3 Demonstrating clean hydrogen solutions, in synergy with other partnerships
	Outcome-4 Increasing public awareness and uptake of hydrogen technologies
	Outcome-5 Reinforcing EU scientific and industrial ecosystem, including SMEs
General Level Impacts (Linked to the general objectives in the SBA specific to the JU, the priorities of the Union and the strategy map of the JU)	**Impact-1** Action against climate change by drastically reducing greenhouse gas emissions
	Impact-2 Transition to a clean energy system with renewable hydrogen as one of its main pillars
	Impact-3 Emergence of a competitive and innovative European hydrogen value chain

Table 4. Criteria for linking Clean Hydrogen JU activities with Strategic Objectives

Strategy Map Objective	Criteria for linking Activities with Objectives
Resources (input), processes and activities	
1. Supporting sustainable solutions	The activity should target either the hard to abate sectors (industry, heavy-duty transport) or have as an objective or KPI linked to sustainability
2. R&I for hydrogen technologies	The activity should either start with TRL up to 3 or end with TRL of at least 7.
3. Supporting market uptake of clean hydrogen applications	Either activities addressing education and training, or activities related to the monitoring of technology progress, RCS or international initiatives.
Outcomes	
4. Limiting the environmental impact	The activity should have as an objective or KPI linked to sustainability
5. Improving cost-effectiveness	The activity should have as an objective or KPI linked to the reduction of CAPEX or increase of efficiency
6. Synergies with other partnerships	The activity should demonstrate synergies with other partnerships or Programmes
7. Increasing Public Awareness	The activity should have as an objective to measure or affect the awareness in relation to hydrogen technologies.
8. Reinforcing EU scientific and industrial ecosystem, including SMEs	Either activities promoting research, education and training or ones strengthening the links between various parts of hydrogen value chain and SMEs
Impacts	
9. Reducing GHG emissions	The activity should have a direct or indirect impact on the reduction of GHG emissions, e.g. through clean hydrogen production or consumption
10. Energy transition with renewable hydrogen	The activity should have a direct or indirect impact on the production or use of renewable hydrogen
11. Competitive and innovative European hydrogen value chain	The activity should have a direct or indirect impact on the reduction of cost of hydrogen (to make it more competitive), the innovation aspects of hydrogen or the strengthening of the value chain.

Table 5. Expected contribution of operational actions to Strategy Map elements[356]

Operational Activities	Operational level resources and actions			Specific level outcomes					General Level Impacts		
	Action 1	Action 2	Action 3	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5	Impact 1	Impact 2	Impact 3
Calls for Proposals											
HORIZON-JU-CLEANH2-2026-01-01		✓		✓	✓					✓	✓
HORIZON-JU-CLEANH2-2026-01-02		✓			✓					✓	✓
HORIZON-JU-CLEANH2-2026-01-03		✓						✓			✓
HORIZON-JU-CLEANH2-2026-01-04			✓					✓		✓	✓
HORIZON-JU-CLEANH2-2026-01-05		✓			✓				✓		
HORIZON-JU-CLEANH2-2026-01-06		✓		✓	✓				✓		
HORIZON-JU-CLEANH2-2026-02-01		✓								✓	
HORIZON-JU-CLEANH2-2026-02-02		✓			✓						
HORIZON-JU-CLEANH2-2026-02-03	✓	✓									
HORIZON-JU-CLEANH2-2026-02-04	✓	✓			✓						
HORIZON-JU-CLEANH2-2026-03-01		✓									

[356] Based on the description of the relevant topics. Exact correspondence with KPIs to be determined based on the selected proposal for each topic.

Operational Activities	Operational level resources and actions			Specific level outcomes					General Level Impacts		
	Action 1	Action 2	Action 3	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5	Impact 1	Impact 2	Impact 3
HORIZON-JU-CLEANH2-2026-03-02	✓	✓				✓					
HORIZON-JU-CLEANH2-2026-03-03		✓			✓						
HORIZON-JU-CLEANH2-2026-03-04		✓				✓					
HORIZON-JU-CLEANH2-2026-04-01		✓		✓							
HORIZON-JU-CLEANH2-2026-04-02		✓			✓			✓			✓
HORIZON-JU-CLEANH2-2026-04-03		✓									
HORIZON-JU-CLEANH2-2026-05-01			✓				✓	✓			✓
HORIZON-JU-CLEANH2-2026-05-02		✓									
HORIZON-JU-CLEANH2-2026-06-01	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HORIZON-JU-CLEANH2-2026-06-02	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Other activities											
Support to Policies			✓			✓	✓	✓			✓
Knowledge Management			✓			✓	✓	✓			✓
Collaboration with other entities			✓			✓	✓	✓			✓

Operational Activities	Operational level resources and actions			Specific level outcomes					General Level Impacts		
	Action 1	Action 2	Action 3	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5	Impact 1	Impact 2	Impact 3
RCS SC			✓				✓	✓			✓
EHSP			✓				✓	✓			✓
EHS & CP	✓		✓	✓			✓	✓			✓
International Cooperation			✓				✓	✓			✓
Communication			✓				✓	✓			✓
Dissemination & Exploitation			✓				✓	✓			✓
Procurement -01: European Clean Hydrogen Start-Up Hub			✓					✓			✓
Procurement -02: Hydrogen Quality			✓					✓			✓

4.3. Renewable Hydrogen Production. Objectives of the Clean Hydrogen JU addressed in the Call for Proposals 2025

The following tables indicate the contribution of each of the topics included in the Call for Proposals to the objectives of the Clean Hydrogen JU SRIA.

Where a topic addresses an objective directly this is shown with an “X”. When an objective is addressed indirectly by a topic this is show as a “O”.

Renewable Hydrogen Electrolysis	*Type of Action*	Reducing electrolyser CAPEX and OPEX	Improving dynamic operation and efficiency, with high durability and reliability, especially when operating dynamically	Increasing current density and decreasing footprint	Demonstrate the value of electrolysers for the power system through their ability to provide flexibility and allow higher integration of renewables	Ensure circularity by design for materials and for production processes, minimising the life-cycle environmental footprint of electrolysers, increasing recycling rates of critical materials and optimising the use of drinking water	Increasing the scale of deployment	Improved manufacturing for both water and steam electrolysis	Improve the efficiency and reduce the footprint of electrolyser's Balance of Plant (BoP)
HORIZON-JU-CLEANH2-2026-01-01 Development and validation of innovative approaches, catalysts, electrolytes and components for electrolysis technologies based on low-quality water	RIA	X		O		O			
HORIZON-JU-CLEANH2-2026-01-02 Cost-efficient and reliable designs towards gigawatt-scale electrolytic hydrogen production plants	RIA	X					X	X	O
HORIZON-JU-CLEANH2-2026-01-03 Improved components and tools to increase the safety of electrolysers	RIA		O	O		O			
HORIZON-JU-CLEANH2-2026-01-04 Innovative business models advancing renewable electrolysis integration in industry	CSA	O					O		
HORIZON-JU-CLEANH2-2026-04-02 Demonstration of rSOC operation for local grid-connected hydrogen production and utilisation	IA		O						

Renewable Hydrogen **Other routes of renewable hydrogen production**	*Type of Action*	Reducing CAPEX and OPEX	Improving the efficiency of processes	Increasing carbon yield for processes based on biomass/raw biogas (kg hydrogen / kg carbon)	Scaling up
HORIZON-JU-CLEANH2-2026-01-05 Sustainable hydrogen production from renewable gases and biogenic waste sources through innovative modular reactor design, process intensification and integration	RIA	O	O	X	
HORIZON-JU-CLEANH2-2026-01-06 Scalable and high efficiency materials and reactors for direct solar hydrogen production	RIA	X	O		X

4.4. Hydrogen Storage and Distribution. Objectives of the Clean Hydrogen JU addressed in the Call for Proposals 2025

The following tables indicate the contribution of each of the topics included in the Call for Proposals to the objectives of the Clean Hydrogen JU SRIA.

Where a topic addresses an objective directly this is shown with an “X”. When an objective is addressed indirectly by a topic this is show as a “O”.

Hydrogen storage and distribution **Hydrogen Storage**	*Type of action*	To undertake research aimed at improving cost and efficiency of aboveground storage solutions.	To demonstrate distributed aboveground storage solutions available at a capital cost lower than 300 €/kg by 2030	To undertake research activities on underground storage to validate the performance in different geologies, to identify better and more cost effective materials and to encourage improved designs.	Demonstrate the large-scale underground storage across various media at a capital cost lower than 30 €/kg by 2030
HORIZON-JU-CLEANH2-2026-02-01 Affordable, Safe and Sustainable aboveground medium to large GH2 storage	RIA	X	O		
HORIZON-JU-CLEANH2-2026-02-03 New thermal insulation concepts for bulk liquid hydrogen shipping	RIA	O			

Hydrogen storage and distribution **Hydrogen in the Natural Gas Grid**	*Type of Action*	Development of technologies and materials to explore and support the transportation of H2 via the natural gas grid	Enable through research and demonstration activities the transportation of hydrogen through the natural gas grid either by blending or via repurposing to 100% hydrogen
HORIZON-JU-CLEANH2-2026-02-02 Demonstrating in-line inspection (ILI) to monitor cracks assuring compatibility for operation with hydrogen in new and re-purposed offshore natural gas pipelines	RIA		X

Hydrogen storage and distribution **Liquid Hydrogen Carriers**	*Type of action*	To increase the efficiency and reduce the costs of hydrogen liquefaction technologies.	To contribute to the roll-out of next generation liquefaction technology to new bulk hydrogen production plants.	To continue the research on carrier cycling performance, chemistries, catalysis and reactors which show potential for improved roundtrip efficiency and life cycle assessment.	Develop a range of hydrogen carriers that will be used commercially to transport and store hydrogen while improving their roundtrip efficiency and lowering their cost.
HORIZON-JU-CLEANH2-2026-02-03 New thermal insulation concepts for bulk liquid hydrogen shipping	RIA				O
HORIZON-JU-CLEANH2-2026-02-04 Cost-efficient small scale hydrogen liquefaction	RIA	X	O		

Hydrogen storage and distribution **Improving Existing Hydrogen Transport means**	***Type of Action***	**To increase the pressure and capacity for new builds of 100% hydrogen pipelines while reducing their cost.**	**To reduce road transport costs of compressed hydrogen by increasing the capacity of tube trailers.**	**To improve the efficiency of road transport of liquid hydrogen while reducing costs.**	**To enable scale-up of solutions for shipping of bulk liquid hydrogen and support its commercialisation.**
n/a					

Hydrogen storage and distribution **Compression, Purification and Metering Solutions**	*Type of Action*	To develop more efficient compressor and purification technologies	To reduce the total cost of ownership of compression and purification technologies	To reduce the energy and consumption and increase the recovery factor of purification technologies	To increase the reliability and lifetime of compression and purification technologies	To improve metering technologies and standards, especially in terms of accuracy and protocols.
n/a						

Hydrogen storage and distribution **Hydrogen Refuelling Stations (HRS)**	*Type of Action*	To tackle the technical challenges associated with heavy-duty hydrogen refuelling stations in order to develop a commercial solution that conforms to the heavy-duty requirements;	To increase the reliability and availability of Hydrogen Refuelling Stations;	To support the creation of a network of Heavy-duty HRS across Europe;	To decrease the total cost of ownership of Hydrogen Refuelling Stations.
n/a					

4.5. Hydrogen end uses: Transport. Objectives of the Clean Hydrogen JU addressed in the Call for Proposals 2025

The following tables indicate the contribution of each of the topics included in the Call for Proposals to the objectives of the Clean Hydrogen JU SRIA.

Where a topic addresses an objective directly this is shown with an “X”. When an objective is addressed indirectly by a topic this is show as a “O”.

Hydrogen end uses: Transport applications **Building Blocks**	*Type of Action*	Improving overall system performance for fuel cell stack technology in terms of power density, reliability and durability	Reduction or replacement of PGM loadings and development of new materials advancing the performance of on-board storage technology;	Improvements in design, health monitoring and manufacturability of core components for fuel cell stacks and on-board storage technology;	Extending the EU leadership on FC production from automotive to maritime and aviation, given the high pressure for decarbonisation of these sectors.
HORIZON-JU-CLEANH2-2026-03-01 Integration of control & monitoring tools and strategies for improved Fuel Cell System durability & reliability	RIA	X		X	O
HORIZON-JU-CLEANH2-2026-03-03 Flexible and standardised hydrogen storage system	IA		O	X	O

Hydrogen end uses: Transport applications **Heavy-Duty Vehicles**	*Type of Action*	Reducing the cost of core components such as modules and stacks in order to foster the competitiveness of FC heavy-duty applications;	Improving overall system performance of FC systems in order to improve the availability and durability and meet the needs of FCH HDV end users;	Improvements in design and monitoring procedures of FC systems;	Supporting and accelerating the wide roll out of FC HDV.
HORIZON-JU-CLEANH2-2026-03-03 Flexible and standardised hydrogen storage system	IA				O

Hydrogen end uses: Transport applications **Waterborne applications**	Type of Action	Scaling up FC designs towards commercially relevant applications	Reducing the CAPEX of PEMFC or SOFC systems for maritime applications;	Improving overall system performance for FC and stacks, especially in terms of power density, bunkering rate and operational flexibility;	Supporting the wide roll out of FC ships, by providing adequate fuel, storage and bunkering infrastructure and developing new solutions for ships based on hydrogen and its derivative fuels.

HORIZON-JU-CLEANH2-2026-03-04 Multi-fuel SOFC powertrain for maritime transport	RIA	O	X	X	
HORIZON-JU-CLEANH2-2026-02-03 New thermal insulation concepts for bulk liquid hydrogen shipping	RIA				X
HORIZON-JU-CLEANH2-2026-03-03 Flexible and standardised hydrogen storage system	IA				X

Hydrogen end uses: Transport applications **Rail Applications**	*Type of Action*	Reducing the cost of stacks;	Improving reliability and durability at stack and FC system;	Improving power output while reducing weight and dimension of the module;	Supporting the roll out of FC trains, by providing the viability of the FCH solution in the train transport segment.
HORIZON-JU-CLEANH2-2026-03-03 Flexible and standardised hydrogen storage system	IA				**O**

Hydrogen end uses: Transport applications **Aeronautic applications**	*Type of Action*	Improving overall system and stack performance for scalable FC in terms of power density, durability and availability;	Reducing NO_x emissions of turbines;	Addressing Airport infrastructure (of both liquid and compressed hydrogen) and refuelling tech / procedures;	Developing aviation dedicated technological bricks, focusing in particular on on-board storage and distribution components and system of liquid hydrogen.	Addressing safety and regulation, specific to hydrogen for aviation applications
HORIZON-JU-CLEANH2-2026-03-02 Components Development and Experimental Testing for an Onboard Liquid Hydrogen Supply and Conditioning System in High-Power Fuel Cell Aviation Applications	RIA				X	

4.6. Hydrogen end uses: Clean Heat and Power. Objectives of the Clean Hydrogen JU addressed in the Call for Proposals 2025

The following tables indicate the contribution of each of the topics included in the Call for Proposals to the objectives of the Clean Hydrogen JU SRIA.

Where a topic addresses an objective directly this is shown with an “X”. When an objective is addressed indirectly by a topic this is show as a “O”.

Hydrogen end uses: Clean Heat and Power **Fuel Cells**	*Type of Action*	Reducing CAPEX and TCO of stationary fuel cells of all sizes and end use applications	Prepare and demonstrate the next generation of fuel cells for stationary applications able to run under 100% H2 and other H2-rich fuels whilst keeping high performance	Improve flexibility of systems in operation in particular with reversible fuel cells and integration with thermal storage	Reducing use of critical raw materials and recycling them for further usage	Support development of processes suitable for mass manufacturing
HORIZON-JU-CLEANH2-2026-04-01 Next generation of reversible proton conducting ceramic cells and stacks for efficient energy applications at ≥1 kW scale	RIA	O	X	X		
HORIZON-JU-CLEANH2-2026-04-02 Demonstration of rSOC operation for local grid-connected hydrogen production and utilisation	IA	O	X	X		

Hydrogen end uses: Clean Heat and Power **Turbines, boilers and burners**	*Type of Action*	Allow turbines to run on higher admixtures of H2, up to 100% whilst keeping low NO_x emissions, high efficiencies and flexible operation;	Develop concepts on safety and plant integration and demonstrate the retrofitting of turbines, boilers and burners so that they are able to run up to 100% H2.
HORIZON-JU-CLEANH2-2026-04-03 Fuel-flexible gas turbine combustion technology for clean and efficient ammonia firing	RIA	X	O

4.7. Cross-cutting issues. Objectives of the Clean Hydrogen JU addressed in the Call for Proposals 2025

The following tables indicate the contribution of each of the topics included in the Call for Proposals to the objectives of the Clean Hydrogen JU SRIA.

Where a topic addresses an objective directly this is shown with an “X”. When an objective is addressed indirectly by a topic this is show as a “O”.

Cross-cutting issues **Sustainability, LCSA, recycling and eco-design**	*Type of Action*	Develop life cycle thinking tools addressing the three dimensions of sustainable development: economic, social, and environmental, the latter in terms of reduction of GHG emissions and impact on water resources	Develop eco-design guidelines and eco-efficient processes.	Develop enhanced recovery processes in particular for PGMs/CRMs and per- and polyfluoroalkyl substances.
HORIZON-JU-CLEANH2-2026-05-01 Public datasets of technologies along the hydrogen value chain for life cycle (sustainability) assessment	CSA	X	O	

Cross-cutting issues **Education and public Awareness**	*Type of Action*	Develop educational and training material, build training programs for professionals and students on hydrogen and fuel cells and implement pilot training programmes	Raise public awareness and trust towards hydrogen technologies and their system benefits.
n/a			

Cross-cutting issues **Safety, Pre-Normative Research and RCS**	*Type of Action*	Increase the level of safety of hydrogen technologies and applications	Support the development of RCS for hydrogen technologies and applications, with the focus on standards
HORIZON-JU-CLEANH2-2026-05-02 Pre-Normative Research on hydrogen odorisation: enhancing safety and detection along the hydrogen value chain	RIA	X	X
HORIZON-JU-CLEANH2-2026-01-03 Improved components and tools to increase the safety of electrolysers	RIA	X	O
HORIZON-JU-CLEANH2-2026-03-03 Flexible and standardised hydrogen storage system	IA		O

4.8. Hydrogen Valleys, Supply Chain and Strategic Research Challenge. Objectives of the Clean Hydrogen JU addressed in the Call for Proposals 2025

The following tables indicate the contribution of each of the topics included in the Call for Proposals to the objectives of the Clean Hydrogen JU SRIA.

Where a topic addresses an objective directly this is shown with an “X”. When an objective is addressed indirectly by a topic this is show as a “O”.

Hydrogen Valleys	*Type of Action*	System integration: integrating several elements together to improve overall synergies and facilitate sector coupling System efficiency: improvement of overall energy and economic efficiency of the integrated system Improved security and resilience of the energy system, e.g. via hydrogen production using locally available renewable energy sources Market creation: demonstration of new market for hydrogen	Complementarity of hydrogen with RES , integration with other technologies, existing infrastructure Assessment of the availability and affordability of clean (pollution free) energy provision for industry and cities uses Mutualisation of production or distribution and storage, assuming decentralisation as key parameter Help set or test regulation requirements at the relevant governance level	Increase the knowledge management with assessment of the socio-economic and environmental impacts, including the concept of digital twin assuring an effective monitor and optimization strategy for the operation and further development of the valley Development of public awareness of hydrogen technologies including contributions from Social Science and Humanities if this was relevant
HORIZON-JU-CLEANH2-2026-06-01 Large-scale Hydrogen Valleys HORIZON-JU-CLEANH2-2026-06-02 Small-scale Hydrogen Valleys	IA		X	

Supply Chain	*Type of Action*	Identification of potential vulnerabilities in EUs hydrogen supply chain;	Development of new and improved manufacturing technologies and production processes that facilitate the safe and sustainable use of non-critical (raw) materials as well as facilitate the adoption of the circular economy principles;	Reducing the use of critical (raw) materials with sustainability or environmental concerns, such as for instance those deriving from poly/perfluoroalkyls.
n/a				

Strategic Research Challenges	*Type of Action*	Low or free PGM catalysts (including bioinspired catalysts), reducing critical (raw) materials use in electrolysers and fuel cells, and safe and sustainable use of all material, including developing of perfluorosulfonic acid (PFAS)-free ionomers and membranes.	Advanced materials for hydrogen storage (e.g. carbon fibres, H2 carriers…)	Advanced understanding of the performance / durability mechanisms of electrolysers and fuel cells.
n/a				