



**CLEAN
HYDROGEN**
MISSION

SEPTEMBER 2022

Action Plan 2022–2024



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Foreword

We launched our Joint Mission Statement in June 2021 (signed at the time by Australia, Republic of Austria, Canada, Chile, China, the European Commission, Germany, France, India, Italy, Japan, Republic of South Korea, Morocco, Norway, Saudi Arabia, United Kingdom, United States, and the United Arab Emirates). Since the launch of the Joint Mission Statement in June 2021, Finland and The Netherlands have joined the Mission and we are in the process of welcoming Spain as our newest Member. It gives us great pleasure in welcoming our new Members to the Mission coalition as a member country.

We subsequently published a Discussion Paper at COP26 in November 2021, which provided momentum to Mission's activities and helped us engage closely with our coalition base to shape and direct our thinking and scope the Mission's next phase of activities. We are now happy to present the MI Clean Hydrogen Mission Action Plan at the Global Clean Energy Action forum in Pittsburgh in September 2022. Our Action plan is a result of dedicated discussions with the members of the mission and with several key international hydrogen initiatives and stakeholders. I would like to thank the members of the core team (Madhu Madhavi, Pete Devlin, Camilo Aviles, Trevor Rapson, Amalia Pearson, Daniel Staehr, Lorena Steinle, and Vendula Jirouskova) for their continued support and contributions in shaping and drafting this plan.

It gives me great pleasure to present our Action Plan to the stakeholder community for discussions and deliberation here at the first Global Clean Energy Action Forum in Pittsburgh. We intend to routinely review the actions to ensure that we capture the rapidly evolving global energy landscape. Our Action Plan will be formally adopted pending formal approval of the Mission Innovation steering committee, which is expected soon after the forum. In the next phase, it will be important to implement the actions. Some of these are already starting and I would like to invite you all to work with us to help establish a global clean hydrogen economy.

Dr. ir. Matthijs Soede
Director, MI Clean Hydrogen Mission

Preface

Mission Innovation is a global initiative of 22 countries and the European Commission (on behalf of the European Union) to reinvigorate and accelerate global clean energy innovation, achieve performance breakthroughs and cost reductions, and facilitate widely affordable and reliable clean energy solutions.

On 2 June 2021, the Mission Innovation Clean Hydrogen Mission – a new global coalition to support the development of the clean hydrogen economy – was launched at the 6th Mission Innovation (MI) Ministerial meeting, hosted by Chile. The goal of the Clean Hydrogen Mission (‘the Mission’) is to reduce the costs of clean hydrogen to the end user to 2 USD/kg by 2030. This will be achieved through the Mission supporting both innovation and the development and delivery of at least 100 large-scale integrated hydrogen “valleys” worldwide. These valleys or clusters would involve large scale hydrogen production, infrastructure and end use applications and can pave the way for economies of scale and commercial viability, reducing cost and enabling market adoption. The MI Clean Hydrogen Mission is launched for an initial period of five years and, depending on progress, may be extended for a further five years to support the delivery of its key objectives by 2030.

The Mission is building a dynamic, ambitious and delivery-focussed alliance between countries, businesses, investors, and research institutes to accelerate innovation on clean hydrogen. It is a key priority to align with and to leverage the strengths of other global hydrogen partnerships to deliver maximum impact.

To facilitate the 2 USD/kg tipping point, the Mission’s activities are organised into three key pillars (Figure 2) targeting:

- the promotion of research, development and innovation, including across clean hydrogen production, distribution and storage, and end-use applications (Pillar 1);
- demonstration of different production, storage and transportation methods by working with relevant stakeholders to explore sector coupling and creating concentrated demand centres through integrated clean hydrogen valleys (Pillar 2); and

- identifying ‘demand-pull’ efforts to diffuse and deploy solutions, facilitate the creation and dissemination of non-technological and non-commercial knowledge and create positive engagement from relevant stakeholders (Pillar 3).

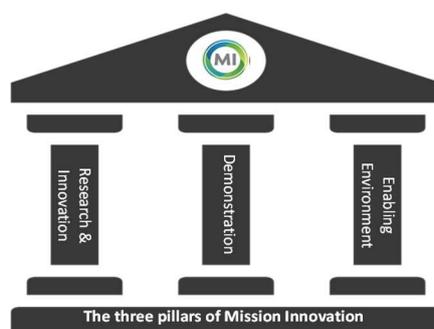


Figure 2: Clean Hydrogen Mission, 3 Pillar structure.

An important early step has included independent research and international expert-level consultations to map the current clean hydrogen policy landscape and to gather an evidence-base of key R&I priorities and sector challenges needed for driving cost reductions. A Discussion Paper was presented during COP26 in November 2021 with an overview of proposed key innovation priorities and areas of focus for the Mission’s Action Plan, which would be developed and adopted in 2022. While various activities are recognised as early priorities for action, the Mission recognises that many more aspects of the clean hydrogen value chain will have a significant impact on reaching the tipping-point. Different regions may also have distinct regional R&I priorities.

This CHM Action Plan for 2022–2024 builds on the discussion paper, including on the range of comments and feedback we received on it from mission members, which have helped us to crystalize our action and better reflect global priorities for clean hydrogen mission.

The action plan sets out a list of key early priorities that are based on a global view, we recognise that there will be many more aspects to reaching the tipping point and that different regions may have different priorities and areas of focus.

The Mission is actively working with its member countries, partner organisations, and initiatives towards the delivery of the objectives.

Towards an action plan

Objective: This paper outlines the next steps and areas of work required to achieve the deliverables of the Clean Hydrogen Mission. This planned approach is needed to ensure timely delivery of key milestones and effective collaborative leadership to overcome the barriers facing the use of clean hydrogen as a novel low emission fuel, or feedstock.

The Mission: The Clean Hydrogen Mission will accelerate the building of a global clean hydrogen economy by reducing end-to-end costs of clean hydrogen to USD 2/kg by 2030. This represents a tipping point in making clean hydrogen¹ cost competitive with other energy vectors in different industries across production, transportation, storage and end-use. To achieve the goal, Mission members together commit to facilitate the delivery of at least 100 large-scale integrated clean hydrogen valleys worldwide by 2030. Hydrogen valleys are integrated hydrogen value chains, which include the production, storage, and distribution of hydrogen to end-users via various methods of transport in a defined geographic area. Hydrogen valleys usually encompass complete hydrogen value chains, can vary in scale and composition, ideally supply multiple end-use sectors, and can cross national boundaries. These hydrogen valleys will generate economies of scale, pushing down clean hydrogen costs to catalyse the development of a global clean hydrogen economy.

Clean Hydrogen Mission Action Plan: As committed in the Joint Mission Statement (June 2021), Members have agreed to a joint Action Plan defining the national and international effort required to achieve the Mission's overarching goal, with a focus on addressing the key barriers and challenges to accelerating necessary innovation and stimulating more action at a national and at an international level in a collaborative manner.

The Action Plan sets out the required actions over the next 2-3 years to stimulate greater international cooperation on clean hydrogen technology innovation,

¹ Clean hydrogen is used to denote fossil-based hydrogen with carbon capture and electricity-based hydrogen. The production routes described don't form an exhaustive list, as other methods of hydrogen production with significantly reduced full life-cycle greenhouse gas emissions compared to existing hydrogen production are also classed as clean by this Mission. Significant reduction is to be understood as being equal to or below the well-to-gate greenhouse gas emissions of steam reforming of natural gas with CCS with 90% capture, which is 1 kgCO₂eq/kgH₂ (IEA, 2019). The definition of Clean Hydrogen continues to be discussed between co-leads and may be subject to further changes.

endeavouring to address gaps in the innovation landscape across the hydrogen value chain, bringing together relevant stakeholders committed to driving down the cost of clean hydrogen through science and technology.

The plan will be reviewed in 2024 and updated with fresh actions to sustain the momentum.

Based on the proposed actions and received stakeholder input, but also considering the international initiative mapping exercise done by the Breakthrough Agenda, the Mission is proposing the following actions for 2022–2024.

Action plan 2022–2024

Actions related to all pillars

Achieving a clean hydrogen economy to address the global decarbonisation challenge requires increased global efforts to grow scale and reduce cost along the value chain. The Mission recognises that the use of clean hydrogen as a novel low emission fuel and feedstock faces several limiting barriers.

Large-scale deployment of clean hydrogen technologies will require significant capital investment, a skilled workforce, and land and water resources along with establishment of a supply-chain. While some technologies for hydrogen production, storage and transport are mature, they have not been deployed or tested at a scale required to bring the costs down.

Cost of clean hydrogen is clearly one of the most significant barriers to the deployment and application of hydrogen (hence the primary goal of the Mission 2 USD/kg end-to-end through innovation and research). In addition to the cost of clean hydrogen, innovations to minimise logistical costs (such as for distribution and storage infrastructure) are also critical for achieving cost-competitiveness against higher emitting counterfactuals.² In addition, there are also other barriers that are common for new technologies, including, among others:

- Economic viability compared to incumbent technologies,
- Need for new infrastructure such as refuelling stations and import terminals,
- Lack of a skilled workforce,
- State of existing regulations and standards.

The Mission is structured under the three pillars to effectively tackle the barriers, by focussing on

- performance, costs and risks and stimulating innovation,
- facilitating knowledge exchange and

² IRENA (2020) [Global Renewables Outlook: Energy transformation 2050](#)

- fostering international collaboration,

which will be key to accelerating the progress needed by driving economies of scale needed to bring down cost, establishing common standards and policies to aid smooth cross-border trade and well working markets.

Towards this end, the Mission proposes convening Working Groups (WGs) under each of the three Pillars, engaging members, the research community, and private sector participants. The Mission as a whole will also engage with other multilateral platforms and initiatives to maximize additionality, avoid duplication, and share technological breakthroughs and demonstrations with the global hydrogen community.

Mission Action: Analysing the current state of play by gathering data from Member countries through questionnaires and surveys

The Mission will regularly collect information from its Membership base through questionnaires and surveys to support the development of the Mission's actions and to track progress against a number of key strategic priorities that will provide an indication of the evolving importance of hydrogen in a country's long-term strategy. This will be done in coordination with other international initiatives that regularly gather this kind of information such as the IEA, IEA hydrogen TCP and the IPHE. The information gathered will be used to:

1. Stimulate and carry out additional research and development activities on clean hydrogen technologies and industrial processes.
2. Track Member countries' investment in RD&I over time.
3. Facilitate the creation and diffusion of knowledge needed to overcome non-technological and non-commercial challenges to market creation and scale-up, including identifying the regulatory, standardisation and stakeholder education necessary for deployment of technology and innovations across the clean hydrogen value chain.
4. Identify additional tools and efforts needed to stimulate demand, diffuse and deploy emerging solutions, and partner with others who can deliver those solutions.
5. Develop the Mission's online information repository on hydrogen research and development (including ready to deploy technologies and updated information on the available pipeline of projects).

6. Share technological breakthroughs and demonstrations, and solutions to pre-commercial challenges by connecting and facilitating researchers, innovators and other platforms and initiatives.

The focus will be to funnel the information gathered into relevant Mission pillars to facilitate coordinated action towards meeting the Missions goals and objectives.

Actions: Pillar 1 – Research and Innovation

At COP 26 in 2021, the Mission published its Discussion Paper identifying some of the initial priorities and challenges requiring action to drive technological breakthroughs and cost reduction for clean hydrogen. The aim of the Paper was to spark stakeholder discussions and shape a list of priority areas for the Mission’s Action Plan focussed on addressing key barriers and challenges facing the use of clean hydrogen as a novel low emission fuel and feedstock. Set out against the three pillars of the Mission, the key research and innovation priorities outlined through the Discussion Paper were as follows:

1. Innovation to reduce clean hydrogen production cost, including innovation concerning:
 - a. Carbon capture and storage capabilities
 - b. electrochemical components to scale-up low-carbon electrolysis, and
 - c. efficiency enhancement and recycling materials used in electrolyser equipment.

 2. Large-scale, low-cost hydrogen storage and distribution system, requiring R&I in:
 - a. efficient conversion and reconversion to and from derivative hydrogen carriers and improved compression and liquefaction technologies, which can help to reduce the cost for hydrogen storage, distribution, and dispensing
 - b. rehabilitating the existing gas network (by finding materials and processes to avoid potential hydrogen embrittlement and leakage) and developing networks compatible with pure hydrogen (e.g. by using polymer materials), and
 - c. optimising and increasing the efficiency of hydrogen storage, distribution and dispensing infrastructure.

 3. Focus on hard-to-decarbonise applications including decarbonising steel, ammonia, and cement manufacturing and use of hydrogen and fuel cell technology to decarbonise heavy duty off-road equipment such as mining vehicles, agriculture and construction equipment. Key innovation priorities will include:
 - a. developing low cost, safe, and efficient end use equipment, and
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- b. reducing the cost and improving the durability and efficiency of fuel cell technologies for off road applications.

The Mission recognises that clean hydrogen production methods, including from renewable energy via electrolysis, conversion of fossil fuels with carbon capture technologies, and many other existing and emerging technologies, differentially affect end-cost. Different countries have diverse visions on how clean hydrogen should be produced, some governments have set a significant role for the production of hydrogen from fossil fuels with CCS, while others consider this option for only the short and medium term to reduce emissions from existing assets while supporting the parallel uptake of renewable hydrogen. However, members of the Mission recognise that innovation across the clean hydrogen value chain will be needed to unleash the full potential of clean hydrogen to reduce global emissions. Mission members aim to catalyse advances in RD&I through enhanced ambition on research, development and innovation, and working with partner initiatives and organisations. The actions under Pillar 1 (R&I) of the Mission seek to carefully assess the gaps, opportunities and challenges that exist globally and then seek to focus RD&I efforts across the range of innovation priorities (starting with the initial recommendations from the Mission’s Discussion Paper) and, particularly, in line with the requirements to meet the target cost of 2 USD/kg, working collaboratively with other partnerships and alliances.

Proposed Actions under R&I Pillar (2022–2024): Key actions and outcomes under the following broad themes will be closely monitored and used to inform the delivery schedule for subsequent years.

- **R&I Pillar Action 1: Analysis of global hydrogen RD&D opportunities**, including detailed analysis of some individual countries identified as example nations with substantive hydrogen RD&D activity. The study will comprise:
 - a Hydrogen RD&D Collaboration Opportunities: Global Overview, and
 - an in-depth analysis of RD&D Collaboration Opportunities for a number of countries in separate report chapters.

The study will aim to provide:

- identification of high-level RD&D priorities in countries, and opportunities for potential bilateral research collaborations, and an
- understanding of connections to key research organisations in selected countries to help lay the foundations for future research collaborations.

- **R&I Pillar Action 2: Assessment of best-practice case studies** across the clean hydrogen R&I value chain with proven cost-reduction potential.

Current production, use, and trade of clean hydrogen are not sufficiently scaled to address the cost differential towards unleashing the full potential of clean hydrogen. Cost reductions across the entire value chain and further efficiencies in handling, transporting, and storing hydrogen will be needed to enable it to become competitive for various end-use applications. Reliable solutions for clean hydrogen production, distribution and storage, and end-use application will be needed to establish clean hydrogen's role in the global economy and to direct relevant investments.

Entries will be invited through an Open Call, including Mission Members, on the most innovative technology solutions that exist across both the physical as well as R&I value chain that have been (or can be) proven effective in driving reductions in the cost of clean hydrogen. Synergies can be drawn with the hydrogen valley work under Pillar 2. This action will help identify areas where more R&I effort could be deployed in the near future and will help to establish knowledge exchange networks with MI member countries and other private sector companies (through members of the MI coalition) to foster collaboration on targeted programmes and initiatives to catalyse cost reductions in hydrogen technologies and industrial processes.

The aim of this Action is to:

- Update our shared understanding of sector strengths, opportunities and gaps for future work.
 - Outline next steps in supporting the development of a global clean hydrogen economy.
 - Set out the Mission's actions to support cost reduction potential, focussing on R&I across the clean hydrogen value chain.
- **R&I Pillar Action 3: Working Groups:** Supporting the Mission's aim to stimulate innovation, knowledge exchange, and international cooperation, the Working Groups (WGs) under the R&I pillar will comprise of Members of the Clean Hydrogen Mission coalition, innovation centres, international agencies and private sector representatives. The WGs will convene and, among other self-directed research activities, deliberate on cross-cutting themes of R&I research and develop case-studies of best practice in RD&D of hydrogen production, storage and distribution and end-use application to accelerate progress towards a global clean hydrogen economy.

The activities within the WGs under the R&I pillar include:

- Engaging with the Mission's coalition of stakeholders to facilitate actions to catalyse cost reductions by increasing research and development in hydrogen technologies and industrial processes.
- Facilitating exchange and dissemination of information and learning-by-sharing to showcase best practices and discuss innovative solutions to the current hydrogen production, storage and distribution and end-use challenges.
- Identifying gaps where research should be focused to achieve cost reduction.
- Identifying other emerging priorities based on data and evidence and the evolving sectoral landscape.

R&I Pillar Action 4: Clean Hydrogen Mission Partnership Coalition: The working groups' membership together will form a Clean Hydrogen Partnership Coalition. This Coalition will leverage their expertise, resources, and networks to create a collaborative platform to overcome common challenges across the value chain and accelerate

knowledge diffusion. This Coalition will meet at 6-monthly (twice yearly) joint meeting of the three working groups to share in:

1. Identification of needs and barriers facing the rapid deployment of technology and innovation in hydrogen valleys
2. Presenting workshops and sharing technological breakthroughs and demonstrations with a broader community
3. Research exchanges and collaborative work on a range of emerging themes
4. Host knowledge-exchange on project pipelines, funding support, innovative hydrogen business models and various end-use applications of hydrogen.

Members of the WGs, and hence the Coalition, are encouraged to propose themes and ideas for new projects, webinars, activities and workshops for consideration to advance the objectives of the WGs or the broader Mission. These will be discussed during the regular WG meetings and upon initial scrutiny presented to the Clean Hydrogen Co-leads Meeting for a final endorsement. The Co-leads Meeting of the Mission reserves the right to alter, modify or reject any proposal as relevant. A detailed and updated calendar of activities proposed by Members of Mission will be made available through the Clean Hydrogen Mission webpage.

Actions: Pillar 2 – Demonstration and Clean Hydrogen Valleys

The Mission is committed to facilitating the delivery of 100 large-scale integrated hydrogen valleys worldwide by 2030. Successfully demonstrating economically viable applications and end uses for clean hydrogen in different geographical onshore and offshore locations, is an important aspect of reducing end-to-end costs of clean hydrogen by building-up of scale. Co-locating producers, suppliers and end-users of hydrogen, clean hydrogen valleys help in achieving economies of scale through shared infrastructure and creating concentrated demand centres, which in turn helps to reach critical scale and unlock learning curve effects. By offering unique opportunities for sector coupling, building international linkages, and stimulating trade, clean hydrogen valleys have the potential to further stimulate innovation and support skills development needed to establish a global clean hydrogen economy. Mechanisms for coordination and information sharing such as through Mission Innovation’s Hydrogen Valley Platform could be an effective tool for monitoring progress. Integrated with other international partnerships to leverage existing resources and avoid duplication, the platform will present up-to-date information on hydrogen valley project developments globally and will serve as a project incubator and collaboration enabler between mature hydrogen valleys.

Proposed Actions under Demonstration and Clean Hydrogen Valleys (2022-2024):

- Continuation of the Hydrogen Valley Platform and introducing additional functionalities to enable it to play a role as incubator for emerging Hydrogen Valleys and enhance cross border and international cooperation.
- Developing concepts and options for a Global Hydrogen Valley Project Development Assistance (PDA) Network. MI Members may support directly or indirectly via PDA services at national or regional level but, through a global network of project developers from public or private sector, exchange of experiences and knowledge can be stimulated to build more effectively on the clean hydrogen valleys.
- Building on the results of the Mission’s hydrogen valley insights report to create a central repository of best-practice, or a ‘toolbox’ for creating enabling environments for valleys, including business models, market structures and other systemic rules.

- Supporting the development of 100 hydrogen valleys globally by concerting action with other international initiatives, such as, the CEM Global Ports Hydrogen Coalition, MI Shipping Mission and Green Powered Future Mission.

Recognising the importance of hydrogen valleys in establishing a global clean hydrogen economy and their role in tackling the barriers facing the global clean hydrogen economy, the Mission is proposing two Sprint-level deliverables for Hydrogen Valleys. These sprint ideas have received the support of the MI Steering Committee in its annual gathering in New Delhi (April 2022). The focus of the pillar actions will be on the targeted delivery of two sprint actions.

Sprint 1: Identification of 100 Clean Hydrogen Regions, enhancing the ambition to identifying 100 Clean Hydrogen Valleys, through partnerships and linkages

The Mission is committed to exceeding its initial ambition of delivering 100 fully operational hydrogen valleys by 2030. Towards this end the Mission will work with its membership coalition to ensure the identification of 100 hydrogen valley regions globally by 2023, which are willing to develop concrete project ideas/plans by 2023, and to facilitate the delivery of these valleys. It will ensure that the number of Hydrogen Valleys presented at the revamped H2V.eu platform will be doubled by 2025.

A MI hydrogen valley label will be developed to stimulate the development of the hydrogen valleys from project idea to operation and to give recognition of the contribution of the valleys to the build of a global hydrogen economy.

The Mission will work with motivated stakeholders and facilitate stakeholder-matching and collaborating with other MI Missions (Shipping and Green Powered Future) and international initiatives. With the CEM Ports Coalition and CEM Twin Cities the Mission will aim and anticipate for the numbers of planned and implemented hydrogen projects to increase from year to year. A major focus for deployment of new hydrogen valleys will be around ports and cities. Ports are particularly likely to be a forerunner regarding the implementation of hydrogen co-location (infrastructure, end-use and import & export).

Potential announcements to be made in Pittsburgh:

- 1) Call to region authorities, public and private stakeholders in 100 regions willing to develop a concrete project plan for the deployment of a hydrogen valley.
- 2) Announce the “MI hydrogen valley label” and open the application to apply for the label.

- 3) Announce an interim target of doubling the current number of hydrogen valleys until 2025 (meaning from 34 to 70 Valleys).
- 4) Announce the total amount of planned investments of the MI Hydrogen Mission participants.

Sprint 2: Hydrogen Exchange Support of non-MI countries to develop Hydrogen Valleys

The Mission is dedicated to support other non-MI countries and developing countries to create and deploy Hydrogen Valleys. The aim is to enable countries who have not started their hydrogen economy, or are at a very early stage of planning, to be able to kick-start their transition.

To reach these ambitious goals the Mission will search for suitable countries and discuss with the relevant stakeholders within those countries (government, initiatives, private sector) to start its work. The Mission will further set up a core working group with relevant shareholders from the public and private sector and the above-mentioned countries to identify which resources, knowledge and funding is necessary and available to sustainably develop clean hydrogen valleys and to initiate a hydrogen economy. The key tasks within this Sprint are to identify relevant countries and stakeholders for establishing the hydrogen valleys in non-MI countries; transfer and sharing of knowledge with and between them; and, helping the countries to identify the tools for a successful energy transition.

Topics that will be covered in the Working Group:

- Best practices
- Regulatory and Institutionally Framework
- Technology (Innovation/Availability)
- Certification
- Business cases & funding (public/private)
- Project development

The ultimate goal is to enable the stakeholders of this Sprint to have the knowledge and tools at hand to initiate hydrogen projects and move from Sprint 2 of the Clean Hydrogen Mission to Sprint 1 of the Mission, which would be the “Identification of 100 Hydrogen Valleys”.

A focus will also be to funnel the information gathered into the relevant pillars of the mission to facilitate coordinated actions across the Mission towards its goals and objectives. All activities will be supported by the Hydrogen Valleys Platform, which will act as the main platform for communication and sharing information between the stakeholders.

Actions: Pillar 3 – Enabling Environment

There is significant economic opportunity from a successful global hydrogen market. However, multiple aspects need to be carefully assessed to ease its deployment such as cost efficiencies, codes and standards, financing, technology readiness levels and regulation.

To create a better environment for scaling up the global clean hydrogen economy, activities under Pillar 3 of the Clean Hydrogen Mission (Enabling Environment) will be aligned with other initiatives. Activities within Pillar 2 (Demonstration and Hydrogen Valleys) and Pillar 3 (creating an enabling environment) could be effective in facilitating these connections between participants involved in RD&I and those focusing on hydrogen valleys.

A lack of development of legislation, regulations and standards across clean hydrogen production and application technologies can limit the scale-up required for achieving cost-competitiveness. An effective policy and regulatory regime will be key for shaping a conducive landscape for clean hydrogen to reach its full potential. These considerations will therefore remain centerstage throughout the work planning process within the pillar, including setting the foundation for the key interlinkages that are established with other groups such as Clean Energy Ministerial (CEM), International Partnership for the Hydrogen and Fuel Cells in the Economy (IPHE), IEA Hydrogen Technology Collaboration Programme (TCP), World Economic Forum (WEF), International Renewable Energy Agency (IRENA), etc.

Proposed Actions under Enabling Environment Pillar 3 (2022-2024):

Enabling Environment Pillar Action 1: Clean Hydrogen Knowledge Platform: The Mission will leverage information from other pillars and partner initiatives to identify additional activities that may be undertaken to facilitate clean hydrogen market valuation and international trade by outlining a common approach. This includes linking up with initiatives such as the IPHE and the European Clean Hydrogen Alliance, among others.

To accelerate the building of a global clean hydrogen economy, lessons-learned and best experiences from key initiatives and forerunner countries must be communicated and shared. A well-designed clean hydrogen knowledge platform will

be a key step in the direction helping to fostering collaboration and contributing towards a world-wide enabling environment for clean hydrogen.

The Clean Hydrogen Knowledge Platform will allow to collect, centralize and showcase the state-of-the-art and the best experiences on an online portal in relevant knowledge-areas collaboratively with relevant actors, and in so doing, create a conducive environment from the regulatory, financial, value chain integration, demand and supply side, energy security and just transition point of view needed for accelerating the global clean hydrogen economy.

The knowledge platform will aim to:

- facilitate the creation and diffusion of non-technological and non-commercial knowledge, including identifying the regulatory, standards and stakeholder education necessary for deployment,
- identify 'demand-pull' efforts needed to stimulate demand, diffuse and deploy solutions, and partner with initiatives or actors that can deliver those activities,
- generate positive engagement from local stakeholders to facilitate the deployment and growth of hydrogen valleys, as well as the participation of local research and innovation communities, and
- to help increase the knowledge base of different stakeholder groups, from policy to research to industry.

The Mission will collaborate with relevant international organizations and stakeholders working on regulation, codes, standards, and funding mechanisms, to start its work. The Mission seeks to set up a core working group with relevant participants from key international agencies and member countries to closely define the main features and key principles of the knowledge platform to foster a robust approach towards developing a clean hydrogen economy.

The first three knowledge areas that will be covered through the knowledge platform (first wave knowledge areas) of the Mission and which will also unlock and streamline the deployment of hydrogen valleys are:

- Regulation
- Codes and Standards
- Finance and Investment / Funding schemes.

It is acknowledged there are many initiatives supporting the development of clean hydrogen. The Breakthrough Agenda analyzed the complex hydrogen landscape and one of the conclusions is that cooperation between various international initiatives (e.g. CEM, IRENA, IPHE, IEA, etc.) is extremely important to avoid overlap and to use resources effectively. For that reason, the MI Clean Hydrogen Mission will set up a working group for each knowledge area to diversify the scope and expected outcomes with relevant stakeholders and countries.

Enabling Environment Pillar Action 2: Working Groups

The objective of the working group(s) is to stimulate knowledge exchange to deliver knowledge-based recommendations and support other actions in the Clean Hydrogen Mission. The working group(s) will function as a leading state-of-the-art compilatory work, with the aim of providing a comprehensive overview of the existing reports, guidelines, schemes, and their implementation experiences to serve as core, coordinated knowledge for the Mission and interested parties.

The working groups will consist of carefully selected participants from MI countries and other international platforms. The intent is to facilitate focused discussions to enable efficient and stakeholder-oriented work. Initially working groups under four 'knowledge-areas' or themes are planned, each working group will have representatives from three members countries of the Mission and relevant stakeholders from key international initiatives, such as CEM, IPHE, IRENA, HySafe, ICHS, etc.. Each country or stakeholder can designate multiple representatives to the working group. Each of these knowledge-area tracks will be led by specific stakeholder, either from the private or public sector, to guide and shape the design and scope of the activities, working in close coordination with other international partnerships to avoid duplication and leverage resources will be critical.

The criteria to select motivated stakeholders will be based on the scope and objective of the working group while selecting countries will consider:

- country location to have cross-cutting knowledge exchanges and standardization processes
- advances in hydrogen economy with regards to working groups' topics to showcase best experiences

Coordination with other international partnerships to avoid duplication and leverage resources will be critical.

Working Group	Regulation (governmental approach) in cooperation with CEM, IRENA, IPHE	Codes and Standards (technical on the contents) in cooperation with IPHE/IEA Hydrogen TCP	Finance and investment knowledge group / Funding schemes in cooperation with CEM/IEA
Objective	to share best practice on the development of national hydrogen strategies and to accelerate the development of a regulatory framework in all participating MI and non MI countries	to accelerate the rollout of the hydrogen valleys by more rapid endorsement & uptake of new hydrogen codes and standards.	To obtain more insight on the necessary investments in clean hydrogen R&I and investments for demonstration and development of hydrogen valleys..
Tasks	<p>(1) To exchange best practices with regards to: the development of a national/regional hydrogen strategies, the support development of a H2 economy by building regulation, regulation procedures, public funding support, inter alia</p> <p>(2) To collect information from governments and standardization</p>	<p>(1) To collect information of codes and standards including emissions measurement and certification; safety and operational standards, standards for the control of hydrogen leakage enabling H2 valleys rollout.</p>	<p>(1) to collect information about public spending in clean hydrogen (together with IEA/CEM H2I initiative)</p> <p>(2) to analyse public funding support mechanisms for hydrogen R&I and deployment and share good practices in</p>

	bodies to showcase best experiences with implementation	(2) To set up best practices and high-level education and training sessions	the hydrogen community. (3) to collect information about private sector investments in clean hydrogen (4) to build up knowledge on clean hydrogen business models which can help private stakeholders, but will also help to develop tailor-made public funding support mechanisms.
Platforms and documents	The group will share knowledge via the organisation of workshops and make information accessible. It will prepare short report to capture the findings.	The group will share knowledge via the organisation of workshops and prepare short reports to capture the findings.	The group will share knowledge via the organisation of workshops and reports using case studies

Future knowledge areas

The *Knowledge Areas* that should or must be dealt with in the future will be discussed and coordinated with the relevant shareholders of the Clean Hydrogen Mission. Depending on the development and other pillars' findings, more potential working groups could be set.



Mission Innovation – Catalysing Clean Energy Solutions For All



Mission Innovation – Catalysing Clean Energy Solutions For All