MISSION INNOVATION

GREEN POWERED FUTURE MISSION

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METI Ministry of Economy, Trade and Industry

Mission innovation
Clean Hydrogen Mission & Green Powered Future Mission
Joint Workshop Summary

Advancing Power and Hydrogen Synergies through Technologies, Policies, and Global Collaboration

4-5 February 2026

Joint Workshop Summary Report

Contents

Day 1: Cutting-Edge Green Power × Hydrogen Technologies. Next-Generation Energy Systems Enabled by Renewable Energy and Hydrogen

Welcome Address

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Ministry of Economy, Trade and Industry (METI), Japan

Japan joined both Clean Hydrogen Mission (CHM) and Green Powered Future Mission (GPFM) at their launch in June 2021, engaging in multiple projects and organizing 6 workshops conducted online or in hybrid formats over the past 3 years. Under the CHM, activities have covered hydrogen safety, hydrogen carriers, and hydrogen production. Under the GPFM, work has addressed innovative solar photovoltaic technologies, grid flexibility and stability, and grid digitalization.

Building on the insights gained from the past workshops and considering that both Missions jointly developed factsheets last year, Japan is excited to hold this joint workshop for the first time. Over the next 2 days, the workshop will deepen synergies between the power and hydrogen sectors through presentations and 4 panel discussions focused on frontier technologies, policy, and regulation.

From my perspective as a member of the Mission Innovation Steering Committee, the GPFM and CHM are regarded as highly valuable platforms for sharing best practices in clean technologies and for accelerating international collaboration. In addition, involvement in the standardization office at METI provides a strong interest in understanding current trends and challenges in standardization at both international and regional levels. It is also interesting to know how hydrogen and renewable energy systems can be effectively interconnected. A productive and fruitful workshop is anticipated.

Opening remarks – MI CHM & GPFM Overview

VENTURI Piero
Director, Mission Innovation "Clean Hydrogen Mission"
European Commission

The CHM is a public–private partnership comprising 21 participating countries and 7 partner organizations. It is co-led by Australia, Chile, European Union (EU), the United Kingdom, the United States, and Spain. CHM's objective is to catalyze international cooperation in research and innovation (R&I) to build a global value chain for clean hydrogen. In 2025, its targets were revised to place particular emphasis on the Global South, aiming to establish multiple hydrogen valleys across diverse regions. By demonstrating commercially viable hydrogen technologies by 2030, the CHM seeks to enable hydrogen to complement electrification and drive deep decarbonization in hard-to-abate sectors.

CHM operates through 3 pillars:

- Stimulating research, development, and innovation
- Integrating production, storage, distribution, and end use applications in hydrogen valleys
- Preparing the ground for the scale-up of the hydrogen economy

According to International Energy Agency's (IEA) Global Hydrogen Review 2025, demand for low-emission hydrogen increased by approximately 10% in 2024 compared with 2023. However, deployment has not reached previously forecast levels due to high costs, uncertainty regarding demand and the regulatory environment, and delays in infrastructure development.

In light of this context, CHM's strategy for 2026 pivots toward the demonstration of end-use hydrogen technologies to support demand creation and the growth of global supply chains, build buyer confidence, and encourage the adoption of supportive government policies. The 2026 action plan will focus on a shortlist of activities including the H2 innovation spotlight (central repository of successful projects to inform data-driven policy design and innovation programmes.), taskforce on sustainable aviation fuels (SAF) with Integrated Biorefineries Mission (IBM), and an industrial hydrogen valleys report. A strategy document summarizing the 2026 action plan will be published shortly.

Japan, the host of this workshop, has made various contributions to the CHM over the past several years. It is a pleasure to convene a joint workshop with the GPFM.

MARTINI Luciano
Director, Mission Innovation "Green Powered Future Mission"
Director, Generation Technologies and Materials Department
Ricerca sul Sistema Energetico (RSE), Italy

The GPFM is a public-private partnership comprising 27 members from MI countries, private sector companies and international organisations.

GPFM aims to demonstrate that by 2030, power systems in different geographies and climates can effectively integrate up to 100% variable renewable energies (VRE), such as wind and solar, in their generation mix, and maintain a cost-efficient, secure and resilient system.

The Mission is structured around 3 R&I Pillars:

- Affordable and Reliable VRE
- System Flexibility and Market Design
- Data and Digitalization for System Integration

According to the IEA's report "Electricity Grids and Secure Energy Transitions", by 2040 it is needed to globally add or refurbish a total of 80 million km of grids for reaching countries' national energy and climate goals. This highlights the critical role of modern and digital grids in enabling a successful clean energy transition, with global grid investment to nearly double by 2030 to over USD 600 billion per year.

Since its inception, the GPFM has achieved significant milestones in the period 2021-2025. The Mission identified 100 Innovation Priorities (IPs) in its 2021 Joint Roadmap of Global Innovation Priorities, followed by the Action Plan 2022-2024 prioritizing 50 urgent IPs, and the National Pilots Report, collecting 80 national pilot projects across coalition members. Most recently, GPFM released its Action Plan 2025-2027, addressing over 70 Innovation Priorities.

Knowledge sharing and dissemination represent core activities of the Mission. All information collected from national pilot projects is showcased through various dissemination channels and tools, including technical factsheet case studies, a series of online public webinars, the GPFM Toolbox, updated National Pilots Reports, and side events and workshops at relevant international fora such as the CEM/MI Ministerial meetings and COP events.

The GPFM maintains strong alignment and collaboration with several other MI Missions. In particular, the collaboration with the CHM represents a successful example of ongoing fruitful joint activity. It includes the release of the joint factsheet on "Clean hydrogen for a green powered future" at CEM16/MI-10 in Busan, Republic of

Korea, with contributions by several GPFM-CHM coalition members including Australia, Canada, Italy, Japan, Spain, and the United Kingdom, and in the organization of this GPFM-CHM joint workshop hosted by our METI Japan focusing on the synergies between power systems and hydrogen technologies.

Keynote Speech

Integrating High Shares of Renewables: The Role of Grid Flexibility, Hydrogen, and Digitalization for an Innovative Energy System

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International Renewable Energy Agency (IRENA)

In 2024, global additions of renewable energy capacity reached 585 GW, and renewables accounted for more than 90% of total capacity expansion. At the same time, in most markets worldwide, new solar and wind power are the cheapest generation options. The levelized cost of electricity for solar and wind has fallen below that of fossil fuels, contributing to accelerated deployment. IRENA has set a target of achieving 11.3 TW of installed renewable capacity by 2030. While solar deployment is accelerating, progress in wind power—both offshore and onshore—has been lagging.

Merely deploying renewable generation facilities is insufficient; innovation in power grids and flexibility is an essential prerequisite for a successful energy transition. The transition is reshaping the overall structure of the power sector with system-wide impacts, placing grids and storage systems at its center. Investment needs for the transition include approximately doubling grid investment to around USD 780 billion, with commensurate increases required in storage systems. Transmission networks and broader flexibility measures must grow in step with the expansion of renewables. Achieving the transformation requires consideration of physical and digital infrastructures beyond generation.

An analysis was conducted of power system flexibility needs at daily, weekly, monthly, and seasonal timescales. By 2030, daily flexibility needs must triple relative to current levels—equivalent to approximately 7% of electricity demand in 2030—and by 2050 they must increase tenfold. Weekly, monthly, and seasonal flexibility needs must increase by about 2 to 2.5 times by 2030 and by 6 times by 2050.

Power systems with high shares of solar tend to exhibit elevated daily flexibility needs, while systems with high shares of wind face higher weekly and seasonal

requirements. Some cases will necessitate long-duration energy storage (LDES), including hydrogen. Each country must establish an optimal flexibility mix aligned with its reliability, affordability, and decarbonization goals.

AI and digital solutions are critical, enhancing customer value and operational efficiency. Data auditing and secure data frameworks are key considerations for digital adoption, and digital technologies can be leveraged for forecasting, optimization, and ensuring transparency.

A taxonomy was developed to categorize actions and innovations for decarbonizing hard-to-abate industries such as steel, chemicals, and cement. In shipping and aviation, hydrogen and other fuels will be needed, but technologies are not yet mature. In the steel and chemicals sectors, there is substantial potential for hydrogen use; in the cement sector, electrification is particularly important. Beyond technology, policies and regulations should account for end-user business cases, and infrastructure and systems development, as well as supply chains, are crucial.

Collaboration with MI and METI on flexibility needs, solutions, and sustainable fuels is welcomed.

Insights on Technology Frontiers

Renewable Energy

Advancing Renewable Energy Independence through Battery Storage and Aggregation

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Toshiba Energy Systems & Solutions, Japan

Japan's renewable build-out features a comparatively large share of solar photovoltaic generation. As a result, surplus daytime generation occurs. Pumped-storage power is used for balancing, and output curtailment is implemented when surpluses arise. Because no remuneration is provided for curtailed energy, curtailment imposes losses on generators. Avoiding curtailment is therefore a priority, and battery storage technologies are drawing increased attention.

The uses of battery storage can be grouped into 3 categories:

- co-located with renewable plants
- grid-scale storage power plants
- demand side

In Japan, although grid-scale storage is increasing, this presentation focuses on co-located batteries at renewable facilities.

The benefits of co-located batteries are threefold: first, enhanced generator revenues by avoiding curtailment; second, smoothing of the supply–demand balance on the grid; and third, community resilience through power supply during disasters. Building on these benefits, initiatives are being pursued to promote the expansion and financial self-reliance of renewables beyond subsidy support.

Monetization pathways for co-located batteries comprise 5 models: curtailment avoidance; arbitrage in the wholesale market; feed-in premium (FIP) uplift; participation in balancing markets; and the non-fossil value, whose worth is expected to rise.

The business model is as follows: renewable generators shift from feed-in tariff (FIT) to FIP scheme and install co-located batteries. The company commits to purchasing renewable electricity at a fixed long-term price, optimizes battery operations, and shares incremental revenues with the generator. The electricity value is sold into power market, while non-fossil attributes are sold to end-use customers via a virtual power plant (VPP). A case exists in Kyushu area of Japan.

A current focus area is hourly time-matching between renewable generation and demand. Through time-shifting with batteries, supply can be shifted to nighttime. In the future, value of non-fossil attributes is expected to become time differentiated. Arbitrage opportunities may emerge not only for electricity but also for non-fossil attributes, contributing to power self-sufficiency. Looking ahead, non-fossil value may be traded bilaterally, and a same-day market could develop. If battery utilization contributes to alleviating grid congestion, distribution system operators may provide incentives. In summary, end-use customers are expected to become key drivers, advancing renewable deployment and the use of distributed energy resources.

Photovoltaic Hydrogen Production for Integrated Energy System: Research and Demonstration

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Associate Researcher
IEECAS, China

Technical challenges in PV-to-hydrogen include the fact that while electrolysis can absorb variable output from distributed PV, power fluctuations reduce efficiency and shorten equipment lifetime. The integrated PV-to-hydrogen energy system

presented incorporates solar utilization, hydrogen supply, and combined heat and power (CHP) in its design.

The demonstration project employs a 5 Nm3/h alkaline electrolyzer driven by a 30 kWp PV array. It was constructed at a gasoline station located at an altitude of approximately 2,500 meters. Matching between distributed PV and electrolyzer was achieved through a DC-DC converter and lithium battery storage.

In the control scheme for hydrogen production using distributed PV, at low load (<250 A) a fixed flow of 0.2–0.3 m3/h is maintained to keep hydrogen concentration below 2.5%. At high load (>300 A), proportional control is applied, and at full load a flow of 0.58 m3/h is supplied to maintain a 15°C temperature differential and keep hydrogen concentration below 2%.

For water electrolysis efficiency, the power split between electrolyzer and auxiliary systems is of paramount importance. Water electrolysis is an effective means of utilizing renewable electricity, but it must adapt to variable and intermittent nature of renewable generation. In addition, short daily operating hours are a critical factor affecting cost-effectiveness.

Impact of hydrogen ecosystem on the Power System

ILICETO Antonio
Chair of Governing Board
ETIP SNET, EU/ Italy

In future energy systems, total energy consumption is expected to decline due to more efficient systems and equipment, while electricity demand is projected to increase substantially. The main trends are deep electrification of end uses and indirect electrification via hydrogen and its derivatives.

Decarbonization strategies include leveraging renewables indirectly to improve efficiency and expanding the use of hydrogen. A decarbonized energy system will require substantial flexibility, including flexibility enabled by sector coupling. Given the diversity of flexibility-providing assets and the differing needs of power systems, effective matching is essential.

Power systems will need a portfolio of diverse flexibility options, yet few are available for long durations. Even if other LDES options emerge, analysis indicates hydrogen will remain indispensable. A matrix mapping electrolyzer technology capability against required power system services suggests that, in theory, water electrolyzers can provide most grid services.

Producing large volumes of hydrogen necessitates commensurate renewable energy. To produce 300 million tonnes of clean hydrogen, up to 8,100 GW of additional VRE capacity would be required. Scenario planning is critical to determine where future large-scale electrolyzers should be deployed. Strategic decisions must address locations of renewable supply and areas with high hydrogen demand, among other siting considerations.

Regarding the relationship between hydrogen and electricity, several factors guide the choice of transporting energy as hydrogen or as electricity over long distances and at large scale: terrain (land/sea), whether infrastructure is existing or new, and the nature of the end use. Where the end use is hydrogen and existing natural gas pipelines are repurposed, costs are comparable. Where the end use is electricity, overhead transmission lines are less expensive, though underground and subsea cables can be costlier. Grid impacts include the need for operational flexibility and system resilience in the short term, and energy system optimization over the long term.

Hydrogen

Green hydrogen production (P2H, electrolysis): current status and challenges

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In current energy markets, hydrocarbon fuels are cheaper than hydrogen and electricity. In the future, renewable electricity is expected to become the cheapest energy, with hydrogen as the second-cheapest option. Water electrolysis systems can utilize surplus or low-cost electricity to mitigate grid imbalance while maintaining sufficient electrolyzer utilization. System costs can be reduced through appropriately designed high current-density operation, together with the use of cost-effective materials. In summary, clean hydrogen is essential for stabilizing power systems with VRE and for long-term or long-distance energy storage and transport.

Regarding electrolyzer cost structure, operating expenditures (OPEX) arise primarily from electricity costs, while capital expenditures (CAPEX) decrease with increasing current density. Although cell voltage increases approximately linearly with current density, system-level analysis shows that, on the higher-current-density side of the optimal operating point, hydrogen production cost is relatively insensitive to current

density. This highlights the importance of designing not only the electrolyzer, but also the overall system, for operation with renewable electricity.

Based on analysis using a report published by the Hydrogen Energy Systems Society of Japan, and assuming a competitive domestic renewables scenario with a Cost, Insurance and Freight (CIF) price for clean hydrogen of JPY 37 per Nm3, Japan's energy self-sufficiency could rise to approximately 50%—equivalent to importing around 44 million tonnes of carbon-neutral hydrogen. Under the assumption of a 10-year stack lifetime, annual electrolyzer manufacturing capacity of 60 GW would be required, indicating the need for mass production of electrolyzers in the Japanese context.

While several large-scale water electrolysis plants have been commercialized, significant challenges remain to produce hydrogen at scale while stabilizing the power system with VRE. These include durability and reliability at the materials, system, and energy-system levels, as well as scalability and cost reduction. Addressing these challenges will require collaboration beyond individual companies and organizations, particularly in pre-competitive domains.

In the Platform Project of New Energy and Industrial Technology Development Organization (NEDO), efforts are underway to strengthen research and development (R&D) by sharing procedures, protocols, and benchmarks alongside scientific understanding.

Opportunities for electrolytic hydrogen: UK perspective

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MANLOUK Mohamed
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The Global HyPT Center is an international collaboration aiming to accelerate "just and responsible transition to a hydrogen economy by advancing multiple net-zero hydrogen production technologies, enabling gigatonne-scale production at costs below USD 2per kg".

The research question examines potential interactions arising from electrolyzer intermittency and regional network conditions—specifically, when operating electrolyzers between 1.6 MW and 8 MW, what early-stage savings in hydrogen

production and what carbon-reduction benefits to the power system can be achieved.

Analysis indicates that with an initial electrolyzer setpoint of 8 MW, 2 demand-reduction signals and 278 demand-increase signals were observed. Economic outcomes include GBP 339,478 in ancillary services revenue and an additional 340.23 MWh of hydrogen output. A comparison of system operator balancing actions versus electrolyzer operations yielded a 24.5% emissions reduction, lowering CO2 from 96,399 kg to 72,788 kg.

For hydrogen production costs to be competitive, when electrolyzers operate more than 50% of the time, electricity price becomes the dominant driver.

A cost analysis of producing hydrogen offshore versus onshore and transporting it as liquefied hydrogen or ammonia found that liquefied hydrogen transport is the cheaper option. There is significant potential in directly coupling intermittent renewables to hydrogen production.

Renewable H2 production technologies status in Europe

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Clean Hydrogen Partnership, EU

Clean Hydrogen Partnership is supported by EUR 1 billion from Horizon Europe and conducts R&I activities to advance hydrogen technologies and facilitate the transition to a greener EU society. Under REPowerEU, an additional EUR 200 million has been allocated to hydrogen valleys.

Activities span hydrogen production, transport, storage, end use, safety training, and hydrogen valleys. Over 18 years of work, a cyclical approach has been adopted: advancing research informed by learnings from implemented actions and translating research outcomes into on-the-ground actions.

Regarding low-temperature electrolyzer demonstration projects, over the past 12 years electrolyzer capacity has increased 200-fold, while the funding contribution per installed megawatt has decreased by a factor of 100. For high temperature electrolyzers, a 2.4 MW facility is operating in Rotterdam, with a 4.2 MW project planned to commence. Work on hydrogen storage includes research into underground storage. On hydrogen valleys, support is being provided to 22 initiatives that integrate production, storage, and use, targeting deployment of approximately 600 MW of electrolyzers and more than 60,000 tonnes of hydrogen per year. In

addition to funding, knowledge-sharing is undertaken to support scale-up, with the objective of having 50 hydrogen valleys in operation or under construction by 2030.

Panel Discussions

Unlocking the Potential of Renewable Energy: Grid Integration and Flexibility

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Chair of Governing Board
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Q: What technical challenges have been identified through international collaboration, and how to further enhance the impact of international partnerships?

A: International collaborations have pinpointed challenges like reducing costs, solving large-scale storage and transportation issues, and ensuring safety in integrated power-hydrogen system.

A: Priorities include joint programs to reduce clean hydrogen costs and coordinated safety training; establishing an internationally harmonized hydrogen certification system; and advancing policy dialogue to develop coherent, aligned frameworks.

Q: When the share of VRE exceeds 50%, which innovative solutions and control technologies should be exploited to ensure power system stability?

A: Increasing inverter-based generation reduces system inertia, raising blackout risks. Japan is pursuing synthetic inertia solutions and has developed prototypes; further validation is planned as renewable shares

grow, with an expectation that inertia requirements will enter future grid codes. Global collaboration on this challenge is desired.

A: Different countries have different energy mixes and technical constraints; portfolios must ensure flexibility with robust cost-effectiveness analysis. Lower grid costs will require stronger cross-border/regional interconnections and system-wide demand response mechanisms.

Q: As the need for LDES increases, what are the advantages of hybrid battery-hydrogen systems compared to other solutions, and what challenges must be overcome for large-scale adoption?

A: Advantages include LDES capability and increased system flexibility; challenges mainly concern on technical complexity and integration, plus the need for enabling policies and technological breakthroughs.

A: Batteries alone are insufficient for emergency power; combining hydrogen and fuel cells delivers more robust services. Cost reduction and higher market value will come from pairing electrolyzers with batteries to provide advanced balancing and trade flexibly. Problem-solving will require stacking multiple solutions and sustained international collaboration and knowledge sharing.

A: LDES needs wider energy system governance, remuneration beyond energy markets, considering geographical limits and full-system costs as for the storage and transport.

Q: Are there any recent cases where advanced technologies such as AI or digital twins have been leveraged to optimize grid operations and mitigate supply-demand imbalance risks associated with large-scale renewable integration?

A: AI is opening new opportunities: on the supply side, predictive maintenance and operational efficiency gains; on the customer side, simplified access and engagement via tools such as generative AI.

Q: How do you think about coupling between power systems and hydrogen?

A: Expanding hydrogen use cases is essential; international knowledge sharing, including for SAF production, should be strengthened.

Hydrogen Innovations for Deep Decarbonization

VENTURI Piero (Moderator)
Director, Mission Innovation "Clean Hydrogen Mission"
European Commission

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Head of Unit Operations & Communications
Clean Hydrogen Partnership, EU

Q: R&I including demonstration via HVs: What are the priorities in terms of R&D to ensure that technologies quickly mature, and reliable and cost-efficient hydrogen systems are deployed on a large scale throughout the world?

A: Real-world deployment remains challenging; systems that run-in lab conditions often face issues in operational environments.

A: R&D is needed to integrate electrolyzers with intermittent renewables while ensuring stable operation; independent test environments and open data are essential, alongside scale-up.

A: Policy-driven market demand creation is critical, and a clear articulation of how hydrogen scale-up supports economic growth is needed.

A: Internationally harmonized protocols are important; electrolyzer manufacturing considerations, including footprint, must be addressed.

Q: Hydrogen production: In large-scale clean hydrogen production, what is the current state and future outlook regarding technological advances and cost reduction for PEM and SOEC electrolyzers?

A: Large-scale clean hydrogen production requires low-cost, variable renewable electricity, favoring ambient-temperature electrolyzers such as PEM, while SOEC

faces challenges under fluctuating operation. Cost reduction relies on cheap electricity, durable materials, and system-level optimization.

Q: Hydrogen distribution and storage: Among options such as liquefaction, ammonia, and organic hydrogen carriers in the hydrogen supply chain, what technological innovations are expected to reduce transport and storage costs, energy losses and enhance safety?

A: Options include hydrogen, ammonia, CO2 recovery, and methanol. Dehydrogenation for hydrogen and ammonia requires substantial energy, potentially losing 40 - 50% of hydrogen value; more efficient dehydrogenation is under study. Materials R&D continues, for example on liquefied hydrogen tanks.

Q: Hydrogen use: In high-temperature heat demand industries such as steel and chemicals (so-called hard-to-abate sectors), what are the technical barriers to promoting hydrogen use as a chemical feedstock and also the barriers to hydrogen as a fuel or combustion?

A: Hydrogen purity requirements and production costs are key hurdles. For combustion, improved handling of radiative heat is needed; NOx formation from hydrogen - nitrogen interactions must be mitigated. Scale-up must consider practical integration at plants and industrial sites.

Q: Hydrogen Valleys/Demonstration: It is essential to demonstrate hydrogen technologies in relevant environments to validate commercial technologies and pave the way for their large-scale deployment. What key role hydrogen valleys – integrated hydrogen demonstration projects – play in establishing a hydrogen economy?

A: Ecosystems that combine production, use, and distribution are essential. EU's next step is linking dispersed hydrogen valleys into a hydrogen backbone. Valleys foster local jobs, knowledge sharing, and startup creation; for example, Netherlands hydrogen valley provides education and training within and around the region.

Q: Enabling environment - In your opinion, what are the most important steps to take to create a favorable environment for fuel cell and hydrogen technologies with regard to harmonized policies, standardization efforts and capacity building?

A: Develop commercial frameworks for electrolyzers to support grid operations; evaluate uses of curtailed power in both offshore and onshore contexts; deepen

analysis of hydrogen's co-benefits. Globally harmonized protocols and strong knowledge sharing are vital. Given the specialized handling required for liquefied hydrogen and electrolyzer technology, securing skilled personnel is crucial.

Q: International collaboration R&I in hydrogen technologies is global, and international collaboration can accelerate the production and uptake of results. Do you have any best practice examples that support and encourage collaboration in an open science approach?

A: The biggest challenge is achieving low cost under real operating conditions. International collaboration should prioritize sharing pre-competitive, insights, including degradation behavior, test procedures, and common benchmarks-covering both successes and failures.

A: The Clean Hydrogen Partnership advances international collaboration in standardization, safety, skills, certification, and hydrogen valleys; it already partners with NEDO, including joint workshops. Japan and EU are collaborating on ammonia combustion.

Day 2: Forefront of Policy and Standardization for Green Power and the Hydrogen Society

Keynotes: Policy & Standardization for an Inclusive Energy Transition

Hydrogen - Recent Trends and Linkages with Renewable Energy

REMME Uwe
Head of Hydrogen and Alternative Fuels Unit
International Energy Agency (IEA)

Recent trends indicate that the hydrogen sector continues to progress despite recent negative headlines. According to the IEA, low-emissions hydrogen production is expected to have exceeded 1 million tonnes in 2025 and could potentially surpass 4 million tonnes by 2030, based on committed projects, i.e. projects being operational, under construction or having reached final investment decision. Project scale is increasing rapidly: the largest electrolyzer capacity expanded from 30 MW in 2021 to 500 MW in China by 2025, while a project under construction in Saudi Arabia is expected to reach 2 GW. At the same time, hydrogen technologies are advancing from demonstration to commercialization, with several technologies anticipated to become commercially available by 2030.

Notwithstanding this progress, the hydrogen industry is entering a phase of consolidation. The pipeline of low-emissions hydrogen production projects expanded between 2021 and 2024, but declined in 2025, largely due to a reduction in electrolyzer-related projects. Delays and cancellations have primarily affected early-stage developments. Regulatory barriers are identified as one leading cause of project cancellations. In addition, economic challenges such as rising hydrogen production costs, uncertain technology supply chains and insufficient offtake demand also remain significant challenges.

In addition to approximately 4 Mtpa of potential production from committed projects a further 6 Mtpa show strong potential to become available by 2030, based on project status, scale, location, and targeted end uses. Conversely, around half of the announced projects are considered unlikely to be operational by 2030, as they often involve large-scale developments in emerging economies where financing constraints are substantial.

Renewable energy plays a critical role in scaling up low-emissions hydrogen production. Around half of the projects with high potential for availability by 2030 are

directly linked to renewable energy facilities, while approximately 3/4 of the total project pipeline is connected to renewable electricity. By 2030, hydrogen production costs in China and Australia are expected to decline to around USD 2–3 per kg. Although Africa has strong renewable energy potential, CAPEX remains comparatively high.

Renewable hydrogen projects are currently under development in more than 100 countries. In regions that rely heavily on energy imports and face high natural gas prices, the cost gap between renewable hydrogen and hydrogen from unabated natural gas could be significantly reduced by 2030.

Renewable electricity typically accounts for approximately 30–50% of hydrogen production costs, depending on the country. In North Africa, capital expenditure represents around 30% of total production costs, a higher share than in Europe. Alongside technological progress, improving financing conditions remains essential for further cost reductions.

In parallel, hydrogen can support the integration of variable renewables in the electricity system. 100% hydrogen-fired gas turbines could provide flexibility and are expected to be commercially available by 2030. Hydrogen storage is one of the few options to provide seasonal and large-scale electricity storage, with several underground storage projects being under construction.

Policy recommendations are;

- Maintaining support schemes for low-emissions hydrogen production
- Accelerating demand creation
- Expediting the deployment of hydrogen infrastructure
- Enhancing public support to reduce technology risk
- Supporting emerging and developing economies in moving up the hydrogen value chain

The importance of moving toward mutual recognition of hydrogen certification and the role of standardization

ANTONI Laurent
Executive Director
International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)

The IPHE is a government-to-government partnership that recognizes hydrogen as more than a new fuel, positioning it as a potential cornerstone of the future energy system. Effective international collaboration is structured around 4 key pillars: the development of common definitions and standards, the facilitation of global trade, financing and risk-sharing mechanisms, and enhanced R&D cooperation.

Harmonization of international standards, certification systems, and trade rules is critical to preventing market fragmentation. Global trade in low-emission hydrogen and hydrogen derivatives enables the matching of supply and demand at an international scale, unlocking significant decarbonization opportunities and cost-efficiency gains. At COP28, a Declaration of Intent signed by 39 countries underscored the importance of mutual recognition of certification schemes based on shared principles, while respecting diverse national strategies, roadmaps, policies, and legislative frameworks for renewable and low-carbon hydrogen and its derivatives. Certification of low-emission hydrogen and hydrogen derivatives has therefore emerged as a central priority for multilateral cooperation, supporting cross-border trade while ensuring transparency, interoperability, and consumer trust.

Achieving mutual recognition of certification schemes requires several foundational elements: the use of a common language, the development of technical recommendations, agreement on harmonized underlying methodologies, and the establishment of a shared understanding among governments regarding certification mechanisms. In this context, the IPHE has developed the Hydrogen Certification 101 paper to support a common terminology. It has also contributed to the development of technical recommendations and harmonized methodologies by working with ISO on GHG emissions assessment methodologies for hydrogen, as well as on conformity assessment and auditing management systems. Furthermore, the IPHE has supported the establishment of a common governmental understanding through coordinated actions, including annual stocktaking and progress monitoring.

With respect to international standardization, ISO 19870-1, which addresses hydrogen production at origin, is expected to become an international standard between April and May 2026. In addition, the IPHE has contributed to the development of 3 further standards: ISO 19870-2, covering gaseous and liquid hydrogen from production to consumption; ISO 19870-3, addressing ammonia as a hydrogen carrier; and ISO 19870-4, focusing on liquid organic hydrogen carriers. Subject to approval, all 4 standards are expected to be in place in 2026.

Through its comparative and interoperability assessment of existing certification landscapes, the IPHE identified several key insights. Greater levels of assessment detail reveal increasing differences among certification schemes, many of which are expected to negatively affect trade in certified hydrogen. A modular approach was identified as an effective means to address these differences and improve tradability, combining common modules with modules specific to individual jurisdictions or certification schemes. The higher the number of common modules, the greater the benefits for international trade in certified hydrogen, as simple comparisons—such as GHG threshold values alone—are insufficient. In this regard, the ISO 19870-x series play a critical role in enabling interoperability and comparability across schemes under ISO TC 197/SC 1. Regardless of the level of ambition, a modular approach could be implemented through a hydrogen digital product passport.

In conclusion, clean hydrogen is on a clear pathway to becoming a globally traded commodity, and international collaboration and coordination are essential to realizing this potential. Alignment on standards, certification, and trade at the international level is as critical as the development of national hydrogen strategies. The coming 2 - 3 years will be decisive: policy choices made during this period will determine whether low-emission hydrogen remains a niche technology or evolves into a backbone.

Insights on Policy, Regulation, and Standardization

Policy

Japan's Recent Policy Developments on Hydrogen

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This presentation examines Japan's recent policy developments in the hydrogen sector. In the Seventh Strategic Energy Plan, published in February 2025, hydrogen is positioned as a key energy source not only for decarbonization but also for enhancing industrial competitiveness. Under the Hydrogen Society Promotion Act, the government plans to provide up to 15 years of support to suppliers seeking to establish commercial-scale supply chains for low-carbon hydrogen and its derivatives.

Strong market interest has been demonstrated in the implementation of this support scheme. By the application deadline, 27 proposals were submitted, with total requested funding significantly exceeding the allocated budget of JPY 3 trillion. Of these applications, 4 projects have been officially certified: 2 domestic and 2 international. One domestic project, led by Toyota Tsusho, focuses on clean hydrogen production using onshore wind power. The second domestic project, developed by Resonac, aims to produce ammonia through the gasification of waste plastics and discarded textiles. On the international front, one certified project is a blue ammonia initiative by JERA, which plans to supply low-carbon ammonia produced in Louisiana, United States, to Japan. The other international project, led by Mitsui & Co., similarly involves the supply of low-carbon ammonia from Louisiana to the Japanese market.

Japan continues to play a leading role in the global hydrogen landscape. In 2018, it hosted the world's first Hydrogen Energy Ministerial Meeting, marking a milestone in international hydrogen policy dialogue. Japan has also been at the forefront of showcasing innovative hydrogen-related technologies, including early demonstrations of hydrogen-powered cooking systems and hydrogen coffee roasters, underscoring its commitment to advancing both technological development and public awareness.

Renewables and Hydrogen: Joining Forces and Building Bridges

PULIDO Jesús
Head of Area
Ministry for Ecological Transition and the Demographic Challenge, Spain

This presentation explores the convergence of renewable energy and hydrogen as mutually reinforcing pillars of the energy transition. Since 2019, Spain has implemented an integrated national energy and climate framework built around 3 core pillars: mitigation, adaptation, and a just transition. Under this framework, Spain has increased installed renewable energy capacity by 78%, expanded employment in the renewable sector by 51%, and achieved a 2,000% increase in self-consumption since 2018. In parallel, fossil fuel imports were reduced, generating savings of EUR 14 billion over 5 years. The deployment of new renewable energy capacity between 2021 and 2023 alone delivered consumer savings exceeding EUR 10 billion. In recent years, Spain has led the Power Purchase Agreement (PPA) market thanks to the growth of solar and wind facilities, enabling companies to secure low long term energy prices while facilitating project financing for facility owners.

Renewable hydrogen has become a central component of Spain's energy strategy. The Spanish government has committed EUR 3 billion in public funding to support renewable hydrogen development. Approximately 1.4 GW of electrolyzer capacity has already received support, with additional capacity expected to be allocated through upcoming funding calls. Strong private-sector interest is evident, driven by Spain's exceptional conditions for renewable electricity generation and substantial public support for hydrogen as a strategic energy vector. These factors are attracting both domestic and international investment.

Progress has also been achieved in the planning and deployment of hydrogen production infrastructure. Electrolysis capacity increased from 22.5 MW in 2022 to 37 MW in 2024. Industrial engagement has been particularly strong: nearly 2/3 of the proposals submitted during the draft planning process for the H2030 electricity transmission network incorporated renewable hydrogen components. In the final version released for public consultation, a total of 13.5 GW of hydrogen production demand was taken into account, underscoring the growing role of hydrogen in Spain's future energy system.

Australia's National Hydrogen Strategy

SKINNER Breandán
Assistant Director, Hydrogen and Industrial Futures Branch
Department of Climate Change, Energy, the Environment and Water, Australia

This presentation examines Australia's hydrogen policy within the broader context of its renewable energy and decarbonization strategy. In Australia, hydrogen policy is not treated separately from renewable energy policy, but rather as an integral component of the energy transition. Under the Net Zero Plan, Australia targets an emissions reduction of 62–70% by 2035 on a pathway to achieving net zero by 2050. Within the sectoral emissions reduction framework, electricity and energy policies enable hydrogen deployment, while hydrogen in turn strengthens the resilience and flexibility of the overall energy system.

A central pillar of this approach is the AUD 22.7 billion Future Made in Australia package, which supports strategic investments through 2 complementary streams. The Net Zero Transformation Stream focuses on industries aligned with the global net-zero transition where Australia can build sustained comparative advantage. The Economic Resilience and Security Stream targets sectors that are vulnerable to supply disruptions, are critical to national resilience, and require public support to mobilize sufficient private investment.

Australia's National Hydrogen Strategy is implemented through a comprehensive suite of policy instruments, including the Hydrogen Production Tax Incentive, the Hydrogen Headstart Program, the First Nations Renewable Hydrogen Engagement Fund, the Regional Hydrogen Hubs Program, participation in H2 Global, and the Guarantee of Origin scheme.

The Guarantee of Origin scheme was legislated in December 2024 as a voluntary emissions accounting framework for products and renewable electricity. It consists of 2 components: the Renewable Electricity Guarantee of Origin and the Product Guarantee of Origin. For hydrogen production, this framework underpins bankable offtake agreements and facilitates access to international markets by providing transparency and credibility on emissions attributes.

Overall, hydrogen policy is most effective when designed as an extension of renewable energy policy. Hydrogen enhances the energy system by providing flexibility and storage, enabling decarbonization across hard-to-abate industries, and creating new trade and export opportunities.

Standardization:

JH2A's Standardization Activities Toward Hydrogen Society

MAEDA Seiji
Chair of Regulatory Committee
Japan Hydrogen Association (JH2A), Japan

This presentation highlights the standardization activities of the Japan Hydrogen Association (JH2A) and its contribution to the realization of a hydrogen-based society. JH2A operates under 3 core missions: creating hydrogen demand, reducing costs through technological innovation, and facilitating business development through financing. These missions reflect JH2A's comprehensive approach to addressing both technical and non-technical challenges across the entire hydrogen supply chain. As of December 2025, JH2A's executive board comprises 26 companies, with a total membership of 526 companies and organizations.

International collaboration is central to JH2A's activities. JH2A has signed memoranda of understanding with several international organizations to strengthen cross-border cooperation and to encourage its members to create and scale new hydrogen-related businesses. Through these partnerships, JH2A aims to foster a globally aligned hydrogen market and accelerate innovation.

In 2025, in collaboration with Keidanren (the Japan Business Federation), JH2A submitted a proposal entitled Basic Concepts for International Standardization Strategies for Hydrogen and Ammonia. The proposal underscores the importance of international standardization for hydrogen and ammonia, provides an overview of ongoing standardization activities, identifies priority areas for international cooperation, and emphasizes the need to strengthen Japan's national "control tower" function through enhanced public–private partnerships. JH2A is well positioned to support this effort, given its ability to aggregate insights from private-sector participants engaged in international standardization processes.

ISO TC 197 and ISO TC 197/SC 1 serve as the primary international technical committees for hydrogen technologies. In Japan, METI and NEDO provide financial and strategic support, while the Japan Automobile Research Institute and JH2A contribute operational support.

Japanese manufacturers have demonstrated strong technological progress and international competitiveness in key areas such as liquefied hydrogen transport, water electrolysis, and hydrogen quality and combustion technologies. In this context, ISO 22734-1:2025, which addresses the safety of hydrogen generators using water electrolysis, was published in July 2025. In addition, ISO/WD TS 22734-2, which provides testing guidance for delivering electricity grid services, is currently under development, with active support from JH2A.

While international standards and evaluation criteria for safety and environmental performance across the hydrogen supply chain are still under development, their importance continues to grow rapidly. JH2A is actively seeking partners worldwide to accelerate international standardization efforts and to support the global deployment of safe, sustainable, and interoperable hydrogen technologies.

Green Hydrogen in Chile: Regulation, Certification, and International Alignment

DUEÑAS Daniela
International Relations Coordinator
Ministry of Energy, Chile

This presentation examines Chile's approach to the regulation, certification, and international alignment of clean hydrogen. Under the Green Hydrogen Action Plan 2023–2030, Chile has advanced work on regulatory and certification frameworks as core enablers of market development. To date, Chile has actively engaged with international organizations, including participation in the IPHE Certification Task

Force and the signing of the CertHILAC Declaration in 2023, which established a regional certification scheme for Latin America and the Caribbean.

As part of its strategic approach to certification, Chile has identified the key elements required for a future certification scheme to meet the requirements of major demand centers. This work has been complemented by efforts to define governance, regulatory, and operational actions necessary for effective implementation. In addition, an analytical study was published under the Team Europe Initiative for Renewable Hydrogen Development, further supporting the alignment of Chile's framework with international best practices.

International positioning is a central pillar of Chile's hydrogen strategy, with certification serving as a gateway to international markets by providing credibility, transparency, and compatibility with global standards.

Role of IEC TC 57 standards in the energy transition

DONDOSSOLA Giovanna
Research Project Manager, Transmission and Distribution Technologies Department
Ricerca sul Sistema Energetico - RSE S.p.A., Italy

This presentation explores the role of IEC TC 57 standards in enabling the energy transition. Established in 1964, IEC TC 57 develops and maintains international standards for power system control, monitoring, and associated information exchange. These standards cover both real-time and non-real-time information used in the planning, operation, and maintenance of power systems. Power system management spans control centers, substations, power plants—including distributed energy resources—and individual primary equipment, encompassing telecontrol functions and interfaces to equipment, systems, and databases. A central objective of TC 57 standards is to ensure interoperability of communications while maintaining robust cybersecurity.

IEC TC 57 standards also underpin the deployment of digital twins for power system applications. For grid-level digital twins, the CIM (Common Information Model) standards are used for business processes, state estimation, and planning studies. Digital twins for protection and automation devices are based on IEC 61850, while cybersecurity aspects are addressed through the IEC 62351 series. Together, these standards provide a coherent framework for digitalization, system integration, and secure operation.

Energy regulations increasingly incorporate cybersecurity requirements derived from relevant legislation. Over time, regulatory processes have leveraged IEC TC 57 standards to achieve standardized solutions, such as the deployment in Italy of a standardized central controller for distributed energy resources.

With respect to hydrogen, IEC TC 57 is becoming increasingly relevant as hydrogen infrastructures expand and interact more closely with power systems. Digital twin solutions and decision-support tools are already available to manage these interactions. However, hydrogen-specific data models, communication standards, and cybersecurity frameworks for operational monitoring have not yet been standardized. Addressing these gaps represents an important next step in ensuring the secure and interoperable integration of hydrogen infrastructures into the evolving energy system.

Panel Discussions

Policy Innovation for International Collaboration and Just Transition

Craig Fraser (Moderator)
Green Powered Future Mission UK Lead,
Department for Energy Security and Net-Zero, UK

MIYAGAWA Yotaro
Assistant Director, Hydrogen and Ammonia Division
Energy Efficiency and Renewable Energy Department
Agency for Natural Resources and Energy, Japan

PULIDO Jesús
Head of Area
Ministry for Ecological Transition and the Demographic Challenge, Spain

SKINNER Breandán
Assistant Director, Hydrogen and Industrial Futures Branch
Department of Climate Change, Energy, the Environment and Water, Australia

Q: As countries scale up and diversify their energy systems using renewables and hydrogen, how can policymakers ensure system-wide resilience as well as manage price spikes and regional disparities? What approaches are actually working on the ground?

A: Enhancing system resilience requires a combination of market-based instruments and targeted regulatory measures. Spain's experience provides several illustrative

examples. First, market mechanisms and bilateral contracting—particularly power purchase agreements—play a critical role in creating a stable investment environment that encourages private capital. Second, effective network planning and continuous modernization of infrastructure are essential to support large-scale renewable energy integration. Third, system flexibility and energy storage are indispensable components of a resilient energy system. In this context, Spain has introduced dedicated support schemes for large-scale energy storage projects, with the potential to deploy approximately 3.5 GW of new capacity.

A: Rapid, large-scale deployment of renewable energy is also among the most effective strategies for managing energy price volatility. Australia offers a compelling case, benefiting from some of the world's lowest-cost solar and wind resources. Against this backdrop, accelerated renewable energy deployment enhances the cost competitiveness of clean hydrogen while mitigating price volatility. In addition, regional disparities in energy supply and costs have been managed relatively effectively, further strengthening overall system resilience.

Q: When we talk about a "just transition," what practical steps are governments taking to support regions undergoing industrial change and on workforce development, including skills, employment pathways, and economic diversification?

A: Hydrogen represents a significant opportunity for local and regional development in Japan. The Japanese government has introduced incentive schemes to support small-scale, locally driven hydrogen projects. However, one of the central challenges facing hydrogen deployment is the absence of a sufficiently mature business environment to nurture sustainable commercial activity. At the same time, the global energy landscape is undergoing a fundamental shift. Whereas energy production was historically concentrated in fossil fuel–rich countries, nations endowed with strong renewable energy potential are increasingly able to assume the role of energy producers. In this context, international collaboration is essential to enable a just transition and to ensure that the benefits of the energy transformation are shared equitably across countries and regions.

A: Moving from principles to action is critical. Spain's approach to the just transition is structured around 3 core pillars. First, fairness and social inclusion are prioritized, with targeted measures designed to support the most vulnerable communities and individuals. Second, public participation and stakeholder engagement are emphasized, with strong attention to local involvement in decision-making

processes. Third, the creation of decent jobs and the protection of workers are central to the transition strategy. In Spain, the energy transition is estimated to support approximately 560,000 jobs by 2030. The Just Transition Strategy published in 2019 further integrates a gender equality perspective, underscoring the importance of inclusiveness in the design and implementation of climate and energy policies.

Q: Looking at plans like REPowerEU and the U.S. IRA, what lessons stand out for future international collaboration, especially when it comes to funding and managing joint projects?

A: At the domestic level, Australia has introduced policy instruments such as hydrogen production tax incentives to support the development of the hydrogen industry. Internationally, Australia has taken a leadership role in collaborative initiatives, including MI and the Hydrogen Trade Forum, and has signaled a strong commitment to long-term international partnerships. Such international cooperation is vital to scaling hydrogen markets and accelerating global decarbonization.

A: In the context of bilateral cooperation, the Japanese government has established a Contract for Difference scheme, drawing on the experience of the United Kingdom. Japan has also expressed strong appreciation for Australia's leadership in international hydrogen initiatives. The core role of government in the hydrogen sector is to articulate a clear long-term vision that enhances market predictability. Policy instruments such as CfD schemes provide greater certainty for investors and enable companies to make informed strategic decisions. Macroeconomic and structural challenges—including inflationary pressures, currency weakness, and delays in the development of international frameworks such as those under the International Maritime Organization —should not impede progress. Valuable lessons can be drawn from international experience, including China's proactive promotion of fuel cell vehicles, demonstrating that targeted and sustained policy support can overcome barriers and accelerate market development.

Standardization as a Driver for Global Market Integration

Suzi Pugh (Moderator)

Policy Lead, Low Carbon Hydrogen Standard,
Department for Energy Security and Net-Zero, UK

MAEDA Seiji
Chair of Regulatory Committee
Japan Hydrogen Association (JH2A), Japan

DUEÑAS Daniela
International Relations Coordinator
Ministry of Energy, Chile

DONDOSSOLA Giovanna
Research Project Manager, Transmission and Distribution Technologies Department
Ricerca sul Sistema Energetico - RSE S.p.A., Italy

Q: In emerging technology fields such as Power-to-X (P2X), such as e-fuels, and LDES, where are the current gaps in standardization and what risks does a delay in standardization pose to market formation?

A: The pace of technological development differs significantly across solutions such as e-fuels and CCUS. As a result, the timing and maturity of standardization efforts also vary. Against this backdrop, it is essential to carefully address potential inconsistencies within system boundaries when developing standards. In particular, carbon intensity accounting rules and environmental value certification systems each follow established but distinct approaches, requiring careful coordination to avoid misalignment.

In the case of synthetic chemicals, for example, markets for certain products have already been established. Consequently, standardization processes often take existing products into account, incorporating provisions that reflect market realities. Similar dynamics apply to liquid fuels and gaseous fuels, where there is a risk that emerging standards may be overly shaped by pre-existing schemes or legacy systems. This can lead to inconsistencies across value chains and technologies if standardization progresses in a fragmented manner. For this reason, an end-to-end, integrated approach to standardization is required. JH2A aims to accelerate its efforts toward such a comprehensive, value-chain-wide approach.

In Japan, the development of Power-to-Fuel remains relatively limited. While frameworks for environmental value provision are well established in the electricity sector, and certification schemes for clean gas have been developed in the city gas sector, comparable mechanisms in the fuels sector are still underdeveloped.

Establishing robust institutional and certification frameworks for fuels will be a critical next step to support the deployment and market uptake of Power-to-Fuel solutions.

Q: What actions are needed for international cooperation and accelerated standards development?

A: Fostering international collaboration is essential for advancing standardization, including the establishment of joint working groups within international bodies such as ISO and IEC.

A: Clear methodologies, modular approaches, and robust testing schemes are key enablers of effective standards development. During the operational phase, differences in national and regional standards become particularly important. In Latin America, where countries apply diverse standards, understanding and managing these differences is critical to ensuring interoperability and smooth implementation.

Q: What is the future direction for the use of digital certificates or blockchain to ensure certification, data sharing, and interoperability?

A: Digital certificates are a mature and well-established technology. The primary challenge lies in identifying the most efficient system architecture for a given energy ecosystem. By contrast, blockchain-based solutions remain relatively immature, and their practical applicability to certification systems requires further assessment and development.

Q: What are the prospects for strengthening collaboration among international and regional standardization bodies, and what would effective governance models look like?

A: Governments should adopt an inclusive approach that involves all relevant actors at both regional and international levels. Beyond technology, trade and diplomacy play an important role in shaping standardization outcomes. In Latin America, for example, the adoption of different international standards is often closely linked to diplomatic relationships. In this context, dynamic capacity building is essential to ensure flexibility and long-term adaptability of regulatory and standardization frameworks.

A: Energy system structures vary significantly across countries and regions. This diversity has posed challenges in areas such as the standardization of grid connections for water electrolysis systems, where national grid codes differ widely. To accommodate variations in energy supply structures, demand profiles, and existing infrastructure, mutual recognition mechanisms need to be designed with a

high degree of flexibility. Moreover, actively engaging stakeholders and promoting mutual learning are critical to developing practical and resilient standardization and certification systems.

Wrap-up

VENTURI Piero

Director, Mission Innovation "Clean Hydrogen Mission"
European Commission

The workshop discussed the latest advances in renewable power and hydrogen. The first day focused on cutting-edge innovation, while the second day examined policy frameworks and standardization. Recordings of the sessions will be made available, and the insights shared throughout the discussions will be utilized in the ongoing work of MI.

Sincere thanks are extended to all participants, speakers, and organizers. For both CHM and GPFM, this workshop has been a valuable experience, and the 2 Missions will strengthen their collaboration further in the future.

Craig Fraser

Green Powered Future Mission Lead, Science and Innovation for Climate and Energy, Department for Energy
Security and Net-Zero, UK

Sincere appreciation is extended to all participants and the host for their valuable contributions to the workshop. It is hoped that similar collaborative initiatives will continue in the future, building on the outcomes of this engagement, including the possibility of organizing similar workshops.

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Appendix 1: Program Outline

Mission Innovation
Clean Hydrogen Mission & Green Powered Future Mission Joint Workshop
"Advancing power and hydrogen synergies through technologies, policies, and global collaboration"
February 4 (Wed.) – 5 (Thurs.), 2026

Program (time: CET)

Day 1 – February 4 (Wednesday)

07:00-09:10 US (EST) / 12:00-14:10 UK (UTC) / 13:00-15:10 Europe (CET) / 17:30-19:40 India / 20:00-22:10 China / 21:00-23:10 Japan / 23:00-01:10(+1) Australia (AEDT)

Cutting-Edge Green Power × Hydrogen Technologies. Next-Generation Energy Systems Enabled by Renewable Energy and Hydrogen

13:00-13:05 **Welcome Address by METI**

WATANABE Hiroki
Mission Innovation Steering Committee Member
Director, International Affairs Office
Innovation and Environment Policy Bureau
Ministry of Economy, Trade and Industry (METI), Japan

13:05-13:15 **Opening remarks – MI CHM & GPFM Overview**

VENTURI Piero
Director, **Mission Innovation "Clean Hydrogen Mission"**
European Commission

MARTINI Luciano
Director, **Mission Innovation "Green Powered Future Mission"**
Director, Generation Technologies and Materials Department
Ricerca sul Sistema Energetico (RSE), Italy

13:15-13:30 **Keynote Speech**

Integrating High Shares of Renewables: The Role of Grid Flexibility, Hydrogen, and Digitalization for an Innovative Energy System
CONSTANTINESCU Norela
Deputy Director, Innovation and Technology Centre (IITC)
International Renewable Energy Agency (IRENA)

13:30-14:15 **Insights on Technology Frontiers**

Renewable Energy:

Advancing Renewable Energy Independence through Battery Storage and Aggregation
SHINGAI Hideki
Marketing Executive, Energy Aggregation Division
Toshiba Energy Systems & Solutions, Japan

Photovoltaic Hydrogen Production for Integrated Energy System: Research and Demonstration
ZHAO Yong
Associate Researcher
IEECAS, China

Impact of hydrogen ecosystem on the Power System
ILICETO Antonio
Chair of Governing Board
ETIP SNET, EU/ Italy

Hydrogen:

Green hydrogen production (P2H, electrolysis): current status and challenges
MITSUSHIMA Shigenori
Professor, Department of Chemical and Energy Engineering
Yokohama National University, Japan

Opportunities for electrolytic hydrogen: UK perspective
BALTA-OZKAN Nazmiye
Professor and UK Director of the Global Hydrogen Production Technologies Center
Cranfield University, UK

MANLOUK Mohamed
Professor of Electrochemical Engineering
Newcastle University, UK

Renewable H2 production technologies status in Europe
ATANASIU Mirela
Head of Unit Operations & Communications
Clean Hydrogen Partnership, EU

14:15-14:40 **Panel Discussion #1: Unlocking the Potential of Renewable Energy: Grid Integration and Flexibility** – moderated by Luciano Martini, *Director, Green Powered Future Mission*

14:40-15:05 **Panel Discussion #2: Hydrogen Innovations for Deep Decarbonization** – moderated by Piero Venturi, *Director, Clean Hydrogen Mission*

15:05-15:10 **Closing of Day 1**

Day 2 – February 5 (Thursday)

07:00-09:10 US (EST) / 12:00-14:10 UK (UTC) / 13:00-15:10 Europe (CET) / 17:30-19:40 India / 20:00-22:10 China / 21:00-23:10 Japan / 23:00-01:10(+1) Australia (AEDT)

Forefront of Policy and Standardization for Green Power and the Hydrogen Society

13:00-13:30 Keynotes: Policy & Standardization for an Inclusive Energy Transition

Hydrogen - Recent Trends and Linkages with Renewable Energy
REMME Uwe
Head of Hydrogen and Alternative Fuels Unit
International Energy Agency (IEA)

The importance of moving toward mutual recognition of hydrogen certification and the role of standardization
ANTONI Laurent
Executive Director
International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE)

13:30-14:15 Insights on Policy, Regulation, and Standardization

Policy:

Japan's Recent Policy Developments on Hydrogen
MIYAGAWA Yotaro
Assistant Director, Hydrogen and Ammonia Division
Energy Efficiency and Renewable Energy Department
Agency for Natural Resources and Energy, Japan

Renewables and Hydrogen: Joining Forces and Building Bridges
PULIDO Jesús
Head of Area
Ministry for Ecological Transition and the Demographic Challenge, Spain

Australia's National Hydrogen Strategy
SKINNER Breandán
Assistant Director, Hydrogen and Industrial Futures Branch
Department of Climate Change, Energy, the Environment and Water, Australia

Standardization:

JH2A's Standardization Activities Toward Hydrogen Society
MAEDA Seiji
Chair of Regulatory Committee
Japan Hydrogen Association (JH2A), Japan

Green Hydrogen in Chile: Regulation, Certification, and International Alignment
DUEÑAS Daniela
International Relations Coordinator

Role of IEC TC 57 standards in the energy transition
DONDOSSOLA Giovanna
Research Project Manager, Transmission and Distribution Technologies Department
Ricerca sul Sistema Energetico - RSE S.p.A., Italy

14:15-14:40 **Panel Discussion #1: Policy Innovation for International Collaboration and Just Transition** - moderated by Craig Fraser, *Green Powered Future Mission Lead, Science and Innovation for Climate and Energy, Department for Energy Security and Net-Zero, UK Government*

14:40-15:05 **Panel Discussion #2: Standardization as a Driver for Global Market Integration** - moderated by Suzi Pugh, *Policy Lead, Low Carbon Hydrogen Standard, Department for Energy Security and Net-Zero, UK Government*

15:05-15:10 **Wrap Up and Closing Remarks by Piero Venturi and Luciano Martini**

Registration:	https://form.jotform.com/253301661977461 Registration close: February 3, 2026 (JST) **(Recording is available for a limited period upon registration)**
Language:	English (Japanese translation is available for live streaming. The recording is in English only)
Platform:	WebEx
Host:	Ministry of Economy, Trade and Industry (METI), Japan
Contact:	For inquiries on registration, Sato: jumsato@tohmatsu.co.jp, Saito: info.mi-tokyo@f-gbp.jp

Main contacts:

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MISSION INNOVATION

Mission Innovation – Catalyzing Clean Energy Solutions For All