Workshop on Hydrogen and Fuel Cell Standardization, Certification, Law, and System-building

APEC Sub-Committee on Standards and Conformance

July 2025

Asia-Pacific
Economic Cooperation

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Executive Summary

This report is developed within the framework of the project "Workshop on Hydrogen and Fuel Cell Standardization, Certification, Law, and System-Building," endorsed by the Sub-Committee on Standards and Conformance (SCSC) of the Asia-Pacific Economic Cooperation (APEC). The primary objective of the project is to strengthen institutional capacity and policy coordination among APEC member economies in support of a sustainable and inclusive hydrogen economy. The initiative promotes alignment with international standards such as ISO/TC 197 and IEC/TC 105 and supports the broader APEC goals of carbon neutrality, trade facilitation, and regulatory coherence.

The report summarizes the findings of the workshop held on 26 February 2025, in Gyeongju, Republic of Korea, which brought together government officials, industry stakeholders, and technical experts. It focused on the exchange of domestic experiences and best practices in developing legal, regulatory, and institutional frameworks for hydrogen standardization and certification. Key topics included the implementation of clean hydrogen certification systems, international standard participation, infrastructure investment and carbon-border mechanisms such as the EU's CBAM.

Complementing the workshop, a pre-event survey collected responses from APEC economies, offering insight into regional awareness and policy readiness. The results confirmed strong interest in hydrogen energy and widespread recognition of its role in decarbonization, although institutional familiarity with standardization bodies and certification systems remained limited.

Six policy recommendations were derived from the workshop and survey: (1) Strengthen Market-Based Mechanisms; (2) Adopt and Harmonize Certification Systems; (3) Participate in International Standardization; (4) Prioritize Infrastructure Development; (5) Support Capacity Building; and (6) Facilitate Regional Pilot Projects

The conclusions of the project reaffirm the critical role of standardization and certification in enabling the hydrogen economy. The report calls for sustained collaboration among APEC economies, international organizations, the private sector, and standard-setting bodies to ensure the successful scaling of hydrogen technologies through harmonized policy and technical systems.

Introduction

Project Overview

The hydrogen economy has emerged as a key driver for achieving carbon neutrality and transforming energy and industrial systems. Recognizing the critical role of standardization in enabling hydrogen markets, this project aimed to foster regional collaboration among APEC economies by organizing capacity-building workshops on "Hydrogen and Fuel Cell Standardization, Certification, Law, and System Building." The workshop was held in Korea on 26 February 2025.

Through the workshop, the project facilitated the exchange of knowledge, best practices, and technical expertise in hydrogen technologies with an aim to support the development of legal, regulatory, and institutional frameworks for hydrogen standardization and certification—ultimately promoting trade facilitation, regulatory coherence, and sustainable economic development across the APEC region.

Scope and Relevance of the Project

This project directly contributed to APEC's goals of trade and investment liberalization by addressing technical barriers to trade (TBTs) through alignment with international standards and adoption of good regulatory practices. It supported the APEC Sub-Committee on Standards and Conformance (SCSC) by promoting hydrogen and fuel cell standardization and facilitating mutual recognition in conformity assessment.

By providing capacity-building for regulators and technical experts—especially in developing economies—the project advanced clean energy transition, regional integration, and inclusive growth. It also supported broader APEC frameworks such as the Osaka Action Agenda and Aotearoa Plan of Action by enhancing transparency and regulatory cooperation. Discussions focused on ISO/TC 197 and IEC/TC 105 standards and how international best practices could be effectively localized.

Target Beneficiaries and Stakeholders

The project was designed to benefit a wide range of stakeholders in APEC economies, particularly:

- **Government officials and regulators** involved in energy, environment, and industrial policy;
- **Standards and certification bodies** working in hydrogen and fuel cell technologies;
- **Private sector players and SMEs** seeking to enter or expand in the hydrogen market;
- **Researchers and technical experts** engaged in hydrogen R&D and innovation.

The primary focus was on developing economies within APEC, with the aim of strengthening institutional capacity, improving regulatory readiness, and fostering active participation in international standardization processes. Ultimately, this would support the broader diffusion of hydrogen technologies and enable all APEC members to participate more effectively in the emerging hydrogen economy.

Objective

Projective Objective

The overall objective of this project was to strengthen cooperation among APEC economies in advancing hydrogen and fuel cell technologies through standardization, certification, and regulatory alignment. By facilitating capacity building and policy dialogue, the project aimed to support the development of a sustainable and inclusive hydrogen economy in the Asia-Pacific region, contributing to regional carbon neutrality and long-term economic growth.

The project sought to:

- Promote the alignment of hydrogen-related standards and conformity assessment procedures with international norms (e.g., ISO/TC 197, IEC/TC 105);
- Facilitate knowledge sharing on hydrogen policy, legal frameworks, and certification systems among APEC economies;
- Build institutional and technical capacity, particularly in developing economies, to support the safe and effective implementation of hydrogen technologies; and
- Support APEC's broader trade and investment liberalization goals by reducing technical barriers and promoting mutual recognition in the hydrogen sector.

Workshop Objective

The workshop aimed to:

- Provide a platform for policy makers, regulators, and industry experts to exchange best practices and experiences on hydrogen and fuel cell standardization;
- Enhance awareness of international hydrogen standards and explore strategies for their regional adaptation and implementation;
- Discuss the legal and institutional frameworks necessary to support hydrogen infrastructure, safety, and certification systems;
- Encourage collaborative approaches to capacity building in hydrogen-related regulatory systems, targeting government stakeholders at all level;
- Serve as a pilot model for future APEC capacity building programs in the clean energy and standardization fields.

Preliminary Survey: Awareness of Hydrogen Economy among APEC member economies

Objectives of the Survey

The primary objective of the survey was to assess the level of awareness, understanding, and perception of the hydrogen economy among policymakers and private sector stakeholders in APEC member economies.
The survey aimed to gather foundational data on respondents' knowledge of climate change, carbon neutrality, and the role of hydrogen as a clean energy source, while also evaluating familiarity with related international standards and certification systems (e.g., ISO/TC 197, IEC/TC 105).

The outcomes of the survey were intended to:

- Guide the design of workshop content and policy discussion;
- Identify knowledge gaps across member economies;
- Support comparative analysis of hydrogen policy and regulatory environments;
- Enhance the effectiveness of future capacity-building efforts in the hydrogen sector.

Survey Design and Scope

The questionnaire of survey was composed of 22 questions structured into five thematic sections. Each section focused on a distinct area of the hydrogen economy:

1. **General Information about Hydrogen (4 questions)**
    - Interest Level: Degree of interest in hydrogen energy
    - Source of Information: Primary channels (e.g., government agencies, academia, media, industry reports)
    - Level of Understanding: Relative knowledge compared to other renewable energy sources
2. **Hydrogen Energy Policy (8 questions)**
    - Policy Awareness: Familiarity with hydrogen economy policies
    - Key Policy Considerations: Views on environmental concerns, energy independence, industrial competitiveness, public safety, and job creation
    - Global Trend: Whether respondents perceive hydrogen policies as part of a broader global movement
3. **Hydrogen Technology Development (6 questions)**
    - Production: Knowledge of hydrogen production types (gray, byproduct, clean, low-emission)
    - Storage & Transport: Understanding of technologies such as high-pressure vessels and liquefied hydrogen transport
    - Utilization: Awareness of hydrogen's application in transportation, industry, and power generation
4. **International Standards (3 questions)**
    - International Standards & Certification Systems: Awareness of hydrogen-related international standardization and certification bodies
    - Importance: Perceived value of standardization in promoting safety, market confidence, and international trade in hydrogen

5. **Recommendation (1 question)**
    - Respondents were invited to share opinions or recommendations on hydrogen energy policies, including implementation priorities and public engagement strategies.

To ensure data quality and user accessibility, the survey employed a mix of question formats, including a 5-point Likert scale for rating perceptions and levels of understanding (e.g., from "very low" to "very high"), multiple-response options that allowed participants to select more than one relevant answer, and open-ended questions designed to capture qualitative insights and free-form suggestions. This combination enabled both structured data analysis and the collection of nuanced stakeholder perspectives.

Methodology

The survey was conducted online over a three-month period from **August to November 2024**, and responses were collected from government and industry representatives across the APEC region. Among APEC's 21 member economies, **9 economies responded**, with a total of **15 individual responses**, resulting in a response rate of approximately **42.9%**.

Responding economies and number of responses:

- Australia (1)
- Canada (1)
- China (1)
- Indonesia (1)
- Malaysia (4)
- Peru (1)
- Singapore (2)
- Thailand (1)
- United States (3)

The collected data served to guide the planning of the APEC workshop, identify regional knowledge gaps, and inform future collaboration on hydrogen standards and policy alignment.

Results

A total of 15 responses were collected from stakeholders across APEC member economies. The survey results provide key insights into stakeholder awareness, policy perspectives, technical familiarity, and views on international standards in the hydrogen sector.

1. General Information about Hydrogen

Most respondents (86%) expressed strong interest in hydrogen energy, with government agencies, academic sources, and industry reports cited as the primary sources of information. When asked about initial associations with hydrogen, respondents emphasized clean energy, decarbonization, and net-zero goals. While overall sentiment was positive (93%), some noted challenges such as safety, cost, and

commercialization. Respondents generally perceived themselves as well-informed, with half reporting equal or higher understanding of hydrogen compared to other renewable energy sources.

2. Hydrogen Energy Policy

A majority (79%) were familiar with global hydrogen economy policies, and 93% agreed on their importance for achieving carbon neutrality. Respondents prioritized industrial competitiveness and job creation as key policy goals, over environmental and safety considerations. All participants agreed on the necessity of economy-wide hydrogen policies, with preference for early implementation in the public and industrial sectors. Hydrogen production and infrastructure were ranked as the most important policy areas, followed by R&D and corporate reform. Public acceptance was seen as a lower priority at the current stage. Furthermore, 93% recognized hydrogen policies as part of a global trend.

3. Hydrogen Technology Development

Respondents demonstrated high awareness of hydrogen production technologies, storage, transportation, and applications across sectors. Over 70% reported being "very aware" of hydrogen types (green, blue, gray), storage methods, and utilization technologies. Notably, all respondents were aware of hydrogen's applicability in areas such as transport, power generation, and industrial use.

4. International Standards

Awareness of hydrogen-related international standards and certification systems was relatively strong, with 93% rating them as important or very important for the hydrogen economy. However, familiarity with specific certification bodies was more limited—only 43% were "very aware," and 21% indicated limited or no awareness. These findings point to a need for expanded visibility and institutional engagement around standardization frameworks.

5. Recommendation

Respondents offered constructive recommendations for advancing hydrogen policy and standardization in the region. Key suggestions included:

- Ensuring economic viability through stable pricing of green hydrogen
- Aligning policy implementation with infrastructure readiness
- Clarifying sectoral targets and enhancing public engagement
- Prioritizing safety and testing standards
- Harmonizing certification systems across APEC economies
- Transitioning from color-based labels to carbon intensity metrics
- Strengthening collaboration with international bodies such as ISO and API

These inputs reflected strong stakeholder consensus on the need for regulatory clarity, international alignment, and practical steps to scale hydrogen deployment across APEC member economies.

Analysis

■ APEC economies have high Level of Interest and positive perception

- A substantial majority (86%) of respondents indicated they were “Very interested” in hydrogen energy, with an additional 14% expressing moderate interest.
- 93% of respondents described their impression of hydrogen energy as positive, confirming a favorable image across the APEC region.
- There is a strong foundation of awareness and support among stakeholders, which can be leveraged for public engagement, technology promotion, and investment mobilization.

■ APEC economies rely on government agencies to shape awareness and perception

- Government agencies were the primary information source (11 respondents), followed by academic papers, industry reports, and media.
- This indicates that official institutions play a central role in shaping awareness and perceptions.
- Policy communication through public sector channels remains critical. However, expanding engagement through industry and academic collaborations may enrich public discourse.

■ APEC economies perceive hydrogen energy as a strategic policy tool for economic and climate goals

- 93% of respondents agreed that hydrogen policies are essential for achieving carbon neutrality.
- However, when asked about key policy considerations, economic drivers—such as industrial competitiveness (6 votes) and job creation (4)—outweighed environmental and safety concerns.
- While environmental narratives are important, policy framing that emphasizes economic growth, industrial transformation, and employment creation may be more effective in securing buy-in and sustaining momentum.

■ APEC economies have hydrogen energy contributes environmental friendliness and energy independency

- Environmental friendliness (93%) and energy independence (79%) were widely acknowledged.
- Fewer respondents (71%) strongly agreed on hydrogen’s safety, and 4 were neutral, suggesting ongoing concern around risk perception.
- Similarly, 71% believed hydrogen contributes to job creation, but neutral responses indicate some uncertainty about its economic reach.

- Efforts should continue to address safety communication and showcase real-world economic impacts (e.g., jobs, local manufacturing) to build confidence.

■ APEC economies acknowledged that public and private sectors should be first to implement hydrogen energy policy

- Respondents identified the **public sector** and **private companies** as the primary targets for initial hydrogen policy implementation.
- Transportation and power sectors were also highlighted.
- 93% agreed that hydrogen is part of a global policy trend, indicating alignment with international discourse.
- APEC governments should focus initial deployment policies on institutional and industrial sectors while supporting global alignment on hydrogen governance frameworks.

■ APEC economies identify hydrogen production and supply infrastructure as the top priority for hydrogen policy advancement

- When asked to rank hydrogen-related policy priorities, hydrogen production and infrastructure was overwhelmingly selected as the top priority (average rank 1.69).
- **R&D funding** and **corporate policy improvement** followed, while **public acceptance ranked lowest**.
- Respondents emphasize building the physical and regulatory foundation of the hydrogen economy over soft measures. Governments should prioritize infrastructure investments, permitting reform, and value chain development.

■ APEC economies have high technical awareness across the hydrogen value chain

- More than 90% of respondents indicated strong awareness in areas such as hydrogen production, storage, transport, and utilization.
- Awareness was consistent across both upstream and downstream technologies.
- There is a knowledgeable stakeholder base that can support technical collaboration, policy testing, and standard-setting.

■ APEC economies almost recognize Standards and Certification as crucial but lack of awareness on institutions (e.g., ISO, IEC)

- 93% viewed standards and certification systems as important or very important.
- However, only 43% reported being “Very aware” of specific organizations developing these standards, with 21% showing limited or no awareness.

- While the importance of standards is well understood, visibility and engagement with standardization bodies such as ISO, IEC, and API must be enhanced within the APEC region.

■ **APEC economies recommend prioritizing economic viability, safety, and international harmonization in hydrogen policy**

- APEC member economies emphasize the importance of the following in advancing hydrogen policy:
    - Establishing clear market signals and viable pricing mechanisms to support large-scale green hydrogen production
    - Aligning hydrogen policies with the readiness of supporting infrastructure
    - Addressing safety concerns through robust standards and transparent communication
    - Harmonizing certification systems across member economies to reduce trade barriers
    - Shifting from color-based classification to carbon-intensity-based methodologies in line with global low-carbon practices
    - Strengthening collaboration with international standards organizations such as API, ISO, and IEC
- APEC economies advocate for a **practical and coordinated policy framework** that balances innovation, market feasibility, and regulatory consistency. Regional alignment is viewed as essential to unlocking hydrogen trade, investment, and long-term energy cooperation across the Asia-Pacific.

Conclusion

The survey results demonstrated a highly informed and engaged respondent base across APEC economies. There was a shared vision of hydrogen as a clean, transformative energy carrier with significant economic and environmental value. However, practical implementation challenges remained —particularly around safety perception, certification harmonization, and commercialization pathways. Targeted policy, infrastructure investment, and enhanced multilateral coordination will be essential to realize the full potential of the hydrogen economy in the APEC region.

Workshop Summary

The APEC SCSC Workshop on “Hydrogen and Fuel Cell Standardization, Certification, Law, and System-Building” was held to foster multilateral cooperation among APEC economies in support of building a robust hydrogen economy. The workshop provided a platform for sharing domestic strategies, international regulatory trends, and technical progress in hydrogen technologies. Through active participation from government agencies, industry experts, and academic representatives, the workshop enabled meaningful discussions on standard harmonization, certification frameworks, and the institutional readiness needed to advance hydrogen adoption across the Asia-Pacific region.

Opening Remarks

The workshop began with welcoming remarks by key officials from Korea.

Speaker: Mr. Eungro Lee, Director, International Standards Cooperation Division, KATS (Korean Agency for Technology and Standards)

Mr. Lee emphasized the critical role of international standards in enabling the safe and efficient deployment of hydrogen as a key energy source in the global energy transition. He highlighted Korea’s efforts in advancing hydrogen standardization through the development of KS (Korean Standards), contributions to ISO and IEC, and its leadership in fields such as liquid hydrogen storage and hydrogen vehicle refueling. He reaffirmed the importance of APEC’s multilateral platform in facilitating cooperation on regulation and trade, and called for enhanced knowledge sharing to accelerate regional standard alignment.

Speaker: Ms. Sangme Han, Secretary General, H2KOREA

Ms. Han acknowledged APEC’s leadership and thanked KATS and international stakeholders for their support. She noted Korea’s tangible progress in the hydrogen sector, including the deployment of over 1,400 hydrogen buses, and emphasized the role of global standards in supporting further growth. She introduced Korea’s recent hosting of the ISO/TC 197 Plenary Meeting, attended by experts from 39 economies, as a testament to the importance of global consensus. She concluded by expressing Korea’s commitment as APEC’s Chair Economy in 2025 to promote open trade, innovation, and sustainability.

Presentation Highlights

1. Hydrogen Industry Ecosystem and Policy in Korea

- Presenter: Ms. Yoonhee Ha, Professor, Korea University

- Korea targets 2.7 million tons of hydrogen production by 2050 and a 60% self-sufficiency rate.
- Key policies include revisions to tax legislation and the introduction of a clean hydrogen certification system.
- *Key Takeaway:* Korea’s certification-based strategy is expected to enhance the global credibility of its hydrogen supply.

2. Global Hydrogen Policy Trends and Key Issues

- Presenter: Ms. Meg Jo-Chen Lin, CEO, Taiwan Hydrogen & Fuel Cell Partnership (THFCP)

- Key developments include the “Hydrogen Breakthrough” at COP29, expansion of hydrogen laws in EU; Japan; Korea; and the US, and carbon tax implementation in Chinese Taipei by 2026.
- *Key Takeaway:* Carbon-based trade barriers are rising; establishing global certification standards is vital for hydrogen trade resilience.

3. Korea’s Hydrogen Technology R&D and Deployment Status

- Presenter: Mr. Jinnam Park, Professor, Kyungil University

- Infrastructure developments include 37,930 hydrogen vehicles and 1.08 GW of fuel cell capacity.
- R&D includes clean hydrogen (green/blue/pink), hydrogen blending, and liquefaction pilot projects.
- *Key Takeaway:* Korea’s liquid hydrogen infrastructure is a catalyst for hydrogen mobility and fuel cell market growth.

4. Australia’s Hydrogen Technology and Regulation Update

- Presenter: Ms. Katerina Aleksoska, General Manager, Hydrogen Council

- Australia is advancing policies such as “Hydrogen Headstart” and tax incentives, while building hydrogen hubs in Queensland and Western Australia.
- The economy introduced the “Guarantee of Origin” scheme and is evaluating the EU’s Carbon Border Adjustment Mechanism (CBAM).
- *Key Takeaway:* Export economies must prepare for CBAM; international alignment on clean hydrogen certification is becoming urgent.

5: Overview of International Hydrogen Standards (ISO/TC 197)

- Presenter: Mr. Yongnam Choi, Principal Researcher, Korea Atomic Energy Research Institute

- ISO/TC 197 is developing new LH2-related standards, replacing outdated ones like ISO 13984:1999.
- New protocols (e.g., ISO 13984:2025) focus on high-speed/high-pressure refueling (sLH2), which offers efficiency gains.
- *Key Takeaway:* Korea’s advanced LH2 refueling technologies can accelerate hydrogen mobility and applications in aviation and shipping.

6. Clean and Low-Carbon Hydrogen Standards Evaluation (China)

- Presenter: Mr. Pengcheng Li, Research Fellow, China National Institute of Standardization

- Regions have varying emissions thresholds for hydrogen certification:
  - Korea: four-tier certification based on CO_2 intensity
  - US: 4.0 $kgCO_2e/kgH_2$ (IRA)
  - EU: 3.384 $kgCO_2e/kgH_2$
  - China: low-carbon hydrogen at 14.51 $kgCO_2e/kgH_2$
- ISO 19870 is being discussed as a global basis for standard harmonization.
- *Key Takeaway:* Aligning emissions thresholds is key to enabling international hydrogen trade and minimizing certification-related trade barriers.

Key Discussions and Outcomes

The panel discussion provided a rich and diverse exchange of domestic perspectives on hydrogen-related standardization and policy development. Moderated by Dr. Yong-Nam Choi, the session featured inputs from government officials, technical experts, and industry representatives from Australia; China; Indonesia; Japan; Korea; Peru; and Viet Nam.
Key points are summarized as follows:

- **Indonesia**

A representative from the Ministry of Energy and Mineral Resources of Indonesia shared that the economy launched its National Hydrogen Strategy in December 2023, with the goal of achieving a full transition to green hydrogen by 2060. Indonesia has established Technical Committee 2711 aligned with ISO/TC 197 and IEC/TC 105, and issued three domestic standards in 2023, with two additional ones planned for 2024. Ongoing cooperation projects with international partners, including Korean companies and the Global Green Growth Institute, were also introduced.

- **Republic of Korea**

Korean representatives explained the Clean Hydrogen Portfolio Standard (CHPS), describing it as a market-based incentive mechanism distinct from the conventional Renewable Portfolio Standard (RPS), legally grounded in the Hydrogen Economy Promotion and Hydrogen Safety Management Act. Emphasis was placed on current ISO efforts to develop standardized methodologies for hydrogen efficiency and GHG emissions measurement. Korea also addressed the economic challenges of green hydrogen and highlighted its pink hydrogen demonstration projects based on nuclear energy.

- **Japan**

A representative from the Ministry of Economy, Trade and Industry (METI) in Japan inquired about the role of the Global Hydrogen Industry Association Alliance (GHIAA) in international standardization efforts. In response, Korean participants clarified that GHIAA functions as a platform for strategic cooperation and information exchange, while technical standards are developed by international bodies such as ISO, SAE, and EuroCAE. Ongoing collaboration on liquid hydrogen standards, particularly in aviation applications, was also noted.

- **Australia**

A representative from the Australian Hydrogen Council discussed the complexity of harmonizing hydrogen certification schemes, particularly given regional differences in electricity emissions intensity within Australia. The need for internationally accepted thresholds—especially regarding blue hydrogen's carbon capture efficiency—was emphasized. Concerns about greenwashing were also raised. Despite the cancellation of several recent projects, Australia reaffirmed its commitment to hydrogen development, while acknowledging that future policies may be affected by political changes.

- **Peru**

A representative from Peru's Ministry of Foreign Affairs referred to the "APEC Policy Guidance to Develop and Implement Clean and Low-carbon Hydrogen Policy Frameworks in the Asia-Pacific", endorsed by APEC Energy Ministers during APEC Peru 2024 and which its implementation plan is being considered within APEC´s Energy Working Group. He inquired about the current level of global alignment in hydrogen certification schemes, noting that "Standards and certification" is one of this document's five key areas. In response, representatives from Australia and Korea acknowledged existing gaps but emphasized ongoing efforts to standardize emissions thresholds and calculation methodologies to enhance comparability and mutual recognition.

- **China**

A representative from China emphasized that hydrogen is regarded as a critical component in achieving the economy's carbon neutrality objectives. In 2023, the relevant domestic authorities established a roadmap for standardization related to carbon emissions, which includes the hydrogen sector. The economy maintains a policy preference for aligning domestic standards with international frameworks such as those of ISO and IEC, rather than pursuing standalone systems. To date, over 200 domestic standards related to hydrogen technologies have been developed, supplemented by industry-led voluntary standards that allow for greater flexibility and responsiveness to technological advancements.

- **Viet Nam**

A representative from the Directorate for Standards, Metrology and Quality of Viet Nam raised a question on China's standard harmonization strategy. In response, the Chinese delegation reiterated its principle of ISO alignment and explained current efforts to expand the scope of economy-wide hydrogen standards.

The session concluded with remarks emphasizing the critical role of international standardization in supporting regulatory coherence and technological interoperability. Mr. Choi encouraged underrepresented economies to become ISO or IEC members to actively participate in global standard development. He noted that once international standards are established, domestic codes and regulations often follow, making standardization a foundational tool for advancing the hydrogen economy.

Recommendations

Building on the insights and expert discussions presented during the APEC SCSC Workshop on *Hydrogen and Fuel Cell Standardization, Certification, Law, and System-Building*, this section outlines key policy recommendations to guide APEC member economies in developing robust, harmonized, and forward-looking hydrogen governance systems.

These recommendations reflect common themes that emerged throughout the presentations and panel sessions, particularly in response to varying stages of hydrogen policy maturity, standardization readiness, and international engagement among economies.

1. Strengthen Market-Based Mechanisms to Ensure Economic Viability
APEC economies should prioritize the creation of stable and predictable market signals for hydrogen, including carbon pricing, tax incentives, and public procurement mechanisms. These instruments are essential to enhance the bankability of hydrogen projects and support large-scale deployment, particularly in export-oriented economies.

2. Adopt and Harmonize Clean Hydrogen Certification Systems
The implementation of clean hydrogen certification systems is essential for supporting credible markets and enabling international trade. Economies are encouraged to adopt carbon-intensity-based classification standards (e.g., $kgCO_2e/kgH_2$) and align with ISO 19870 and other relevant standards to promote mutual recognition of certification schemes.

3. Participate Actively in International Standardization Processes
Member economies are encouraged to actively participate in international standardization bodies such as ISO/TC 197 and IEC/TC 105. Enhanced regional coordination on standard-setting and certification frameworks will accelerate interoperability, regulatory coherence, and market access across the APEC region.

4. Prioritize Hydrogen Production and Supply Infrastructure Development
APEC economies should place hydrogen production and supply infrastructure at the core of their hydrogen policy strategies. Survey results indicate that this area is considered the most critical enabler of hydrogen deployment across the region. Governments are advised to prioritize investment in production facilities, transport networks, storage systems, and refueling infrastructure. In parallel, regulatory streamlining—such as permitting reform and inter-agency coordination—is essential to accelerate project development and reduce market entry barriers.

5. Support Capacity Building and Technical Training
To ensure inclusive hydrogen transition across the region, APEC economies—particularly developing members—are encouraged to expand technical training for government officials, standardization experts, and certification bodies. APEC-sponsored workshops, expert dispatch programs, and e-learning platforms can play a critical role in bridging capability gaps.

6. Facilitate Regional Cooperation and Pilot Projects

Cross-border cooperation is essential for testing and scaling hydrogen technologies. Economies are encouraged to pursue bilateral and multilateral hydrogen pilot projects within the APEC framework. These initiatives can serve as models for regulatory alignment, infrastructure integration, and technology transfer.

By advancing these recommendations, APEC member economies can promote greater coherence in hydrogen regulation, unlock investment opportunities, and facilitate the safe, sustainable, and inclusive growth of the regional hydrogen economy. As underscored throughout the workshop, international collaboration and standardization are not only technical imperatives but strategic enablers for long-term policy success.

Participation Feedback Survey and Evaluation

A total of 13 responses were collected from stakeholders across APEC member economies. The feedback provided valuable insights into the quality, relevance, and future applicability of the workshop, confirming its effectiveness as a capacity-building initiative in hydrogen standardization and policy development.

1. Overall Evaluation

All respondents expressed strong satisfaction with the workshop. All evaluation items—such as clarity of objectives, relevance of topics, and quality of materials—received ratings of either 'Strongly Agree' or 'Agree' from all participants.

Notably, officials from standardization agencies (China; Indonesia; Thailand; Viet Nam), research institutions, and government ministries acknowledged that the event was well-organized, informative, and timely.

2. Relevance to Economies

12 out of 13 respondents rated the workshop as **"Highly Relevant" (5/5)**, and 1 rated it **"Relevant" (4/5)**.

- **Viet Nam** emphasized that hydrogen policy is in its early development stage and that the workshop provided practical and timely input for designing institutional frameworks.
- **China** noted that the workshop content was directly aligned with its dual-carbon goals and ongoing green transition initiatives.
- **Thailand** stated that hydrogen has been identified as part of its energy and decarbonization strategy, and the event helped clarify implementation priorities.

3. Key Achievements

The workshop yielded the following key outcomes, as identified by participants:

- All respondents reported gaining valuable insights into the hydrogen strategies, standardization efforts, and certification systems of other APEC economies.
- The workshop enhanced understanding of international standardization activities, including ISO/TC 197 and IEC/TC 105.
- Participants accessed comparative policy benchmarks and technical case studies from leading hydrogen economies.
- **Viet Nam** specifically noted that the event contributed meaningfully to strengthening its National Quality Infrastructure (NQI).

4. Capacity Building Impact

A majority of respondents reported a clear increase in understanding of hydrogen policy and standards-related topics:

The workshop helped participants understand the full spectrum of hydrogen-related policy, regulation, and technology. Topics such as **standard-setting, certification systems, and international coordination** were frequently mentioned as the most valuable areas.

5. Future Applications

Participants indicated specific ways in which workshop insights will inform domestic policy, training, and pilot initiatives:

- **Indonesia** plans to conduct in-house training and enhance capacity-building efforts to align with international best practices.
- **The Philippines** plans to reflect workshop findings in the Department of Energy's hydrogen policy design.
- **Korea** stated that workshop materials will be used for upcoming technical training sessions for staff.
- **China** indicated that its low-carbon fuel certification roadmap would incorporate case studies shared during the event.
- **Chinese Taipei** expressed interest in pursuing joint pilot projects within the APEC framework.

6. Recommendations for Further APEC Actions

Several participants recommended actionable follow-up measures to sustain regional collaboration:

- **China** recommended organizing follow-up workshops focused on carbon-intensity-based hydrogen certification, which is becoming increasingly important for global trade.
- **Indonesia** suggested transitioning from discussion to action through practical APEC pilot projects or field trials.
- **Chinese Taipei and Viet Nam** proposed establishing a structured mechanism for post-event information sharing, including access to policy documents and technical resources.
- **The Philippines** recommended launching tiered technical assistance programs to provide tailored support for economies at early stages of hydrogen deployment.

7. Workshop Feedback

Participants provided constructive suggestions to enhance future events, including broader participation and deeper technical content:

- **Korea** requested allocating more time for open discussions and economy-to-economy knowledge exchange.
- **Chinese Taipei** expressed concern about the absence of key economies such as Japan and the United States, and recommended broadening the diversity of participating economies and speakers.
- **China and the Philippines** emphasized the need for deeper coverage of hydrogen certification systems, including case-based technical content.
- **Thailand** called for more structured and accessible post-workshop materials to support continued learning.

Conclusion

The APEC SCSC Workshop on “Hydrogen and Fuel Cell Standardization, Certification, Law, and System-Building” underscored the urgent need for regional and global cooperation to accelerate the hydrogen transition. Through a series of in-depth presentations and multi-stakeholder dialogue, the workshop highlighted the importance of harmonizing international standards, aligning certification schemes, and strengthening regulatory frameworks to enable cross-border hydrogen trade and investment. A follow-up survey confirmed the relevance and effectiveness of the workshop, while also providing practical insights and recommendations to guide future hydrogen-related collaboration across APEC economies.

Key **takeaways** include:

- **Hydrogen energy** is broadly **recognized as a strategic tool** for achieving both industrial competitiveness and carbon neutrality. Early policy implementation should focus on the public sector and high-emission industries.
- **Hydrogen infrastructure development, particularly in production and supply**, **remains the highest policy priority** and requires coordinated public investment and permitting reform.
- **Standard harmonization** — particularly for clean hydrogen certification, carbon intensity calculation methods — **is essential** for enabling mutual recognition and reducing technical trade barriers.
- **Broader participation** from developing and underrepresented economies is necessary to ensure fairness and inclusivity in **global standardization processes.**

It is clear that a stepwise, cooperative approach will be essential. APEC economies are encouraged to:

- Strengthen engagement in international standard-setting bodies
- Promote joint research and demonstration projects on hydrogen certification
- Facilitate ongoing policy exchange and best practice sharing through structured multilateral dialogue

By fostering a more coherent and interoperable hydrogen governance system, the APEC region can play a pivotal role in building a resilient, inclusive, and low-carbon energy future.

APPENDIX A (Preliminary Survey)

APEC Hydrogen Economy Awareness Survey

This survey aims to gather important data for "The APEC Workshop on Hydrogen and Fuel Cell Standardization, Certification, Law, and System-building" project, based on the understanding of the hydrogen economy among public officials and industry professionals in APEC member economies.

Each question in this survey is structured on a 3~5-point Likert scale, and you are requested to select the option that best represents your response.

All information provided in this survey will be kept confidential and will only be used for the purpose of the project. We kindly ask for your cooperation in taking a few moments of your time to complete this survey.
Thank you for your participation.

July 2024

Which APEC economy do you belong to

_____

What is your primary field of employment?
(example : Public Sector (Energy) Private Sector (Agriculture)

_____

※ Please check your answer in " ✔ " or "○"

I. General Information about Hydrogen

Hydrogen energy is a clean energy source that can be produced from various resources including natural gas, nuclear power, biomass, and renewable energy like wind and solar. It is considered a key component in the transition to a low-carbon economy due to its potential to significantly reduce greenhouse gas emissions. Hydrogen can be used in various applications such as fuel cells for transportation, power generation, and industrial processes. Its only by-product when used in fuel cells is water, making it an environmentally friendly alternative to fossil fuels. Ongoing advancements in hydrogen production, storage, and distribution technologies are crucial for the widespread adoption of hydrogen energy.

1) How interested are you in hydrogen energy?

Not interested at all	Somewhat uninterested	Neutral	Somewhat interested	Very interested

2) Please respond freely to the following:
When you think of "hydrogen energy," what comes to mind first?

_____

2-1) Regarding the image that came to mind above, how would you describe it?

Negative	Neutral	Positive

3) Where do you primarily get your information about hydrogen energy?

Government agencies	Academic papers	Media	Industry reports

4) How would you rate your overall understanding of hydrogen energy compared to other renewable energy sources (e.g., solar, wind)?

Much lower	Slightly lower	About the same	Slightly higher	Much higher

II. Hydrogen Energy Policy

Globally, hydrogen energy policies are rapidly evolving as economies seek to transition to cleaner energy sources. Global economies are collaborating on international hydrogen projects to accelerate the development of a global hydrogen economy.

5) How well do you recognize about the global hydrogen economy policies?

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

6) What do you think is the most important consideration in establishing hydrogen energy policies?

Climate change/Air quality (Environment)	Public safety (Safety)	Energy independence (Stable supply)	Industrial competitiveness (Economy)	Growth drivers (Job creation)

7) Do you think hydrogen energy policies are crucial for achieving carbon neutrality?

Not at all	No	Neutral	Yes	Absolutely

8) Please indicate the extent to which you agree with each statement about hydrogen energy:

8-1) It is environmentally friendly.

Not at all	No	Neutral	Yes	Absolutely

8-2) It is safe.

Not at all	No	Neutral	Yes	Absolutely

8-3) It is effective in increasing energy independence.

Not at all	No	Neutral	Yes	Absolutely

8-4) It is effective for economic development.

Not at all	No	Neutral	Yes	Absolutely

8-5) It is effective in creating jobs.

Not at all	No	Neutral	Yes	Absolutely

9) Do you agree with the necessity of these hydrogen economy policies?

Strongly disagree	Disagree	Neutral	Agree	Strongly Agree

10) Which sector do you think should be the first to implement hydrogen energy policies?

Public Sector	Private companies	Households	Transportation	Other (Please specify)

11) Do you agree that hydrogen energy policies are a global trend?

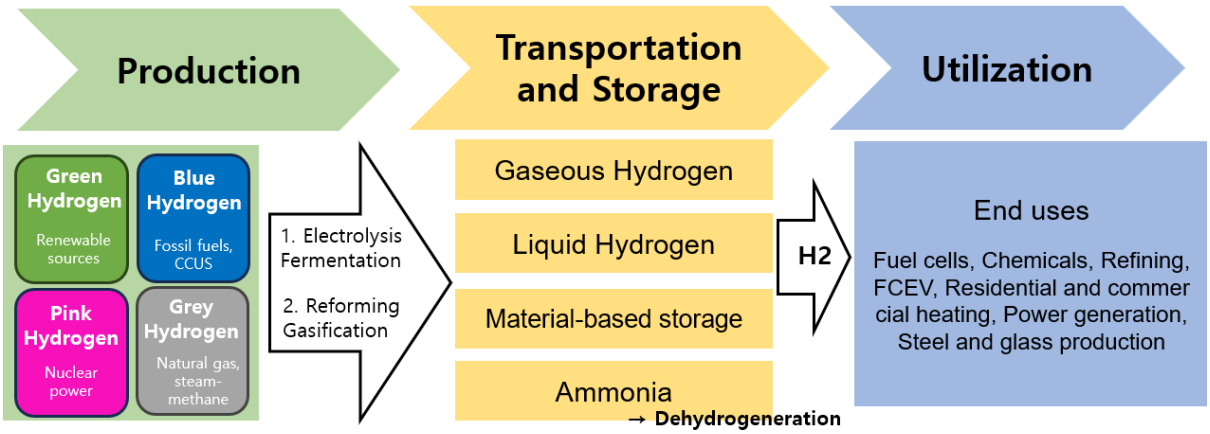
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

12) What do you think is the most important policy in promoting the hydrogen energy policy? Please write the numbers in the order of importance.
(1: Very Important ~ 5: Not Important at all)

Number	Policy	Contents
	Hydrogen Production and Supply Infrastructure Development	Expansion of hydrogen production facilities and technology development, establishment of refueling station infrastructure, etc.
	Funding for Hydrogen Energy Research and Development	Financial support for research on hydrogen fuel cell technology, hydrogen energy utilization in industry and market research, etc.
	Strengthening International Cooperation	Enhancing international cooperation for achieving economies of scale and global competitiveness.
	Improving Corporate Policies	Reforming corporate support policies to boost the hydrogen economy and create jobs, etc.
	Public Acceptance	Enhancing public understanding and acceptance of hydrogen energy transition through effective information dissemination and communication activities.

I. Hydrogen Technology Development

The hydrogen economy comprises the production, storage, transportation, and utilization of hydrogen, with each stage interconnected. Hydrogen production primarily occurs through electrolysis, natural gas reforming, and biomass gasification, resulting in green hydrogen and blue hydrogen. Hydrogen storage can be achieved in various forms, including liquefied hydrogen, compressed gaseous hydrogen, and Liquid Organic Hydrogen Carrier (LOHC) technology. Hydrogen transportation involves pipelines, high-pressure containers, and liquefied hydrogen carriers, emphasizing the need for an efficient and safe hydrogen supply chain. Hydrogen utilization spans multiple sectors, including fuel cell vehicles, industrial processes, and power generation, with global hydrogen infrastructure rapidly expanding.



13) Do you know about hydrogen production technology?

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

14) Do you know about the types of hydrogen by production method? (green, blue, grey etc.)

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

15) Do you know about hydrogen storage methods?

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

16) Do you know about hydrogen storage and transportation technologies?

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

17) Do you know how to utilize hydrogen?

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

18) Do you know the different areas where hydrogen can be utilized? (transportation, industry, electricity generation, etc.)

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

I. International Standards

Hydrogen standards and certification systems are essential for ensuring the safety and reliability of the hydrogen economy. International standards are being developed through ISO and IEC, with guidelines for measuring greenhouse gas emissions during clean hydrogen production and transportation. Clean hydrogen certification verifies the production methods of hydrogen, distinguishing between green hydrogen and blue hydrogen based on their emission characteristics. These standards and certification systems promote international hydrogen trade and enhance market confidence.

19) Do you know about hydrogen-related standards and certification systems?

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

20) Do you know about any hydrogen-related standards and certification bodies?

Not at all aware	Somewhat unaware	Neutral	Somewhat aware	Very aware

21) How important do you think standards and certification systems are for the development of the hydrogen economy?

Not important at all	Not important	Neutral	important	Very important

II. Personal Suggestion

22) If you have any suggestions or opinions on Hydrogen Energy policies, please feel free to write.

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- Thank you for your participation. -

APPENDIX B (Workshop Agenda)

The APEC Workshop on Hydrogen and Fuel Cell Standardization, Certification, Law, and System-building (SCSC_201_2023T)

26 February 2025, 10:00 am – 16:00 pm
#205-206, Gyeongju Hwabaek International Convention Center, 507, Bomun-ro, Gyeongju-si, Gyeongsangbuk-do,, Republic of Korea

Time	Agenda Item
9:30 - 10:00	Registration of participants
10:00 - 10:10	Opening remarks and congratulatory Speech from Republic of Korea
10:10 - 10:20	Introduction to the APEC Project Overview
10:20 - 10:25	Photo Session
10:25 - 10:40	Presentation on Pre-Survey Analysis • Key findings • Good practices as identified by APEC economies
10:40 - 11:00	Coffee Break
11:00 - 11:40	Presentations on issues and identified best practices **Theme 1: Hydrogen Industry Policy** • Development of a Clean Hydrogen Ecosystem in Korea (Speaker: Yoonhee Ha) • Global Hydrogen Policy Trends and Key Challenges (Speaker: Meg Jo-Chen Lin)
11:40 - 13:40	Lunch Break
13: 40 - 14:20	**Theme 2: Hydrogen Technology Development R&D and Regulation** • Current Status of Hydrogen Full-Cycle Technology Development and Key R&D Achievements in Korea (Speaker: Jinnam Park) • Hydrogen Technology Development and Regulatory Status in Australia (Speaker: Katerina Aleksoska)
14:20 - 15:00	**Theme 3: Hydrogen Standards and Certification** • Current status and prospects of international standards for liquid hydrogen technology - Focusing on the activities of the ISO TC 197 committee (Speaker: Yongnam Choi) • Status on the Evaluation Standards for Green or Low-Carbon Hydrogen (Speaker: Pengcheng Li)
15:00 – 16:00	Panel Discussion and Q&A Session
16:00 – 16:10	Closing Remarks