

Workshop Summary

WORKSHOP ON TECHNOLOGY FORESIGHT SCENARIOS TOWARDS NET-ZERO EMISSION AND POLICY IMPACT ASSESSMENT
 “GREEN HORIZON: TOWARDS A HYDROGEN ECONOMY”
 28th – 30th August 2024
 Sofitel Krabi Phokeethra Golf & Spa Resort - Krabi, Thailand

1. Purpose of workshop

Workshop objectives:

- Build capacity in foresight methodology and illustrate energy transition scenarios in APEC.
- Focus on the hydrogen economy to foster STI collaboration and address energy transition barriers.

Key Benefits:

- Gain insights into cutting-edge APEC hydrogen economy.
- Network with leading experts in the fields.

Expected Outcomes:

- Develop recommendations for APEC low-carbon hydrogen integration.
- Create a STI collaborative APEC for net-zero emission.

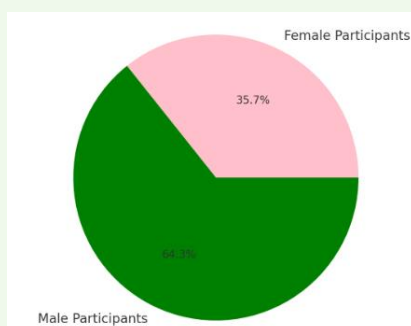
Summary:

In summary, over the course of this 3-day workshop, we successfully achieved our objectives of building capacity in foresight methodology (using STEEP and Foresight Canvas) and exploring energy transition scenarios within APEC, with a particular focus on the hydrogen economy. Participants gained valuable insights into cutting-edge developments in the APEC hydrogen economy and had the opportunity to network with leading experts in the field. As a result, the workshop facilitated the development of strategic recommendations (to be included in the final report) for APEC's low-carbon hydrogen integration and laid the foundation for fostering Science, Technology, and Innovation (STI) collaboration to support APEC's net-zero emission goals.

2. Participants

Summary:

This workshop had a total of 42 participants, with 15 female and 27 male attendees. Representatives from seven APEC economies participated, including Brunei Darussalam, Malaysia, Peru, the Philippines, Russia, Chinese Taipei, and Thailand.



The workshop successfully brought together participants from several sectors, including government, private industry, research institutions, and universities, fostering cross-sector collaboration in this important field.

3. Key takeaways from agenda and sessions

Day 1: 28 August 2024

Keynote presentation: Strategic Foresight: Shaping the Future of Peru

By Felipe Donato Valentín Rojas

Foresight Specialist, CONCYTEC, Peru

Summary:

The presentation "Strategic Foresight: Shaping the Future of Peru" by Felipe Donato Valentín Rojas outlines Peru's foresight initiatives, focusing on the development of "Vision Peru 2050" and the National Development Strategic Plan (PEDN). These efforts aim to build a sustainable, modern state by addressing areas such as competitiveness, innovation, digital transformation, and national defense. The strategy includes the use of foresight tools like STEEP analysis, scenario development, and Delphi surveys. Peru collaborates with Korea to create a Technology Roadmap (TRM) and promote national innovation, identifying key technologies in textiles, clean materials, and Industry 4.0 to position Peru as a global leader by 2050. Strategies involve adopting advanced technologies, improving workforce capabilities, and fostering international cooperation for sustainable development.

Day 2: 29 August 2024

Foresight workshop: The workshop analyzes the impacts of Social, Technological, Economic, Environmental, and Political (**STEEP**) factors within scenarios based on possibility and divergence. The economic models evaluate measurable impacts through global energy-economic input-output models, and the workshop focuses on identifying non-measurable indicators, ensuring a comprehensive impact assessment of the APEC Hydrogen Policies Scenario (HEP). After the break, the focus shifts to the **Foresight Canvas** and the hydrogen economy, with participants examining key aspects needed to advance the hydrogen economy in APEC, contributing to STI collaborations.

Summary:

- In the STEEP session, participants expressed concerns about the non-measurable indicators of Hydrogen Economy Policies in APEC. While measurable indicators such as job creation in hydrogen-related sectors, GDP growth from hydrogen, and reductions in CO2 emissions were discussed, more focus was placed on non-measurable indicators like social acceptance, happiness levels, regulatory standards, and other STI collaborations such as capacity building and skills development to align with the disruption caused by hydrogen adoption. Trust in hydrogen technologies, the speed of technological innovation, long-term economic stability, ecosystem health, and the effectiveness of international collaborations were also highlighted. These non-measurable aspects present challenges in assessing the overall impact of the hydrogen economy on APEC economies (More detail in the final report).
- In the Foresight Canvas session, participants expressed concerns regarding the strategic recommendations for achieving the envisioned scenario in APEC's Hydrogen Economy policy adoption. A key issue highlighted was the need to overcome current policy barriers, such as the instability of the global situation, which may hinder progress. Participants emphasized the importance of establishing common regulations or standards to facilitate the practical trade of hydrogen within APEC. Additionally, STI (Science, Technology, and Innovation) collaborations were identified as crucial, focusing on knowledge sharing, technology transfer, and reskilling or upskilling the workforce. Moreover, participants stressed the need to raise awareness about the importance of the energy transition among APEC economies, ensuring that all stakeholders understand and support the shift toward hydrogen as a key energy source (More detail in the final report).

Site visit to Krabi power plant:

Background:

Krabi Power Plant began operations in 1960, initially using heavy fuel oil (HFO) for electricity generation. In 1966, two additional units were added to expand capacity. Over the years, the plant played a key role in providing power to Southern Thailand. However, with increasing operational costs compared to more cost-effective energy systems, the original units were decommissioned in 1995, and a new unit was built in 1997, becoming commercially operational in 2004.

Current Status:

Currently, Krabi Power Plant is in a standby mode due to its higher production costs compared to other plants that use cheaper energy sources. Despite this, the plant remains a crucial backup power source for emergency situations. If any issues arise with other power plants in Southern Thailand, Krabi Power Plant can be quickly brought back online to meet demand.

Co-Firing Process:

In 2013, Krabi Power Plant began testing a Co-Firing process, blending heavy fuel oil (HFO) with crude palm oil (CPO) to reduce greenhouse gas emissions and promote sustainability. By 2020, the plant was further modified to operate using 100% CPO without the need for HFO. However, due to the high cost of CPO, the Thai government has not yet fully supported its widespread use.

Green Hydrogen Project:

One of the key future projects at Krabi Power Plant is the Green Hydrogen Project, which focuses on producing hydrogen using renewable energy sources such as solar power. The hydrogen is produced via an electrolyzer powered by solar energy during the day, and at night, green-certified electricity from the grid is used.

The hydrogen is converted into Methylcyclohexane (MCH) by combining it with toluene, allowing the hydrogen to be stored and transported in a liquid form for safety and convenience. At its destination, the hydrogen is extracted from the MCH through a process called dehydrogenation, and the toluene is returned to the plant for reuse.

This process significantly reduces greenhouse gas emissions. The project is supported by the Japanese government and involves collaboration with Japanese companies such as Chiyoda Corporation and Mitsubishi Corporation. It is part of Thailand's plan to achieve carbon neutrality by 2065, ensuring the use of clean and renewable energy on a large scale.

Day 3: 30 August 2024

Panel Discussion: "Strategic Insights: Navigating APEC's Carbon Neutrality"

Panelist 1: Professor Dr. Shu-Yii WU

CEO of APEC Research Center for Advanced Biohydrogen Technology (ACABT)

Professor Wu highlighted the integration of green growth policies, methodologies, and technologies through Green Synergy Solutions (GSS) and the Bio-Circular-Green (BCG) economy model. The central theme is achieving a Net-Zero Environment (NZE) by combining green technologies that focus on sustainability, resource conservation, and productivity enhancement. The BCG model emphasizes economic growth with minimal environmental impact, incorporating bioenergy, biowaste refineries, and bio-products.

Key concepts include:

- Green Symbiotic System: Integrating technologies that complement and cooperate to enhance productivity and resource efficiency.
- GSS: Green Synergy Solutions, which aligns sustainable growth with the goal of NZE.
- BCG Model: A Bio-Circular-Green economy model focused on sustainability and minimizing environmental impacts.

Panelist 2: Dr. Thanan Marukatat

Research Fellow, Asia Pacific Energy Research Centre (APEREC)

Dr. Thanan provided an overview of APEREC's work in fostering energy cooperation within APEC. Based in Tokyo and established in 1996, APEREC conducts energy research, publishes the APEC Energy Demand & Supply Outlook and APEC Energy Overview, and

offers energy model training. Recent efforts include capacity-building in Malaysia and developing data collection formats for hydrogen. APERC's policy activities focus on hydrogen, oil, coal, gas, and energy resilience in collaboration with APEC expert groups.

Key Findings:

- **CO2 Emissions Reduction:** The 8th edition of the APEC Energy Outlook projects significant reductions in CO2 emissions by 2050, mainly through decarbonization of the power sector. Thailand's emissions are expected to decline from 380 million tonnes in the reference scenario to 170 million tonnes in the target scenario.
- **Green Hydrogen and Energy Resilience:** Green hydrogen and energy resilience are highlighted as key components of APEC's sustainable energy future. Harmonized regulatory frameworks and innovative financing mechanisms are essential to drive the adoption of hydrogen technologies.
- **International Cooperation:** APEC member economies are increasingly collaborating on clean energy initiatives, with recent workshops and policy dialogues focused on green and low-carbon hydrogen held in Lima, Peru

Panelist 3: Assoc. Prof. Wongkot Wongaphai

Deputy Director of Multidisciplinary Research Institute (MDRI), Chiang Mai University

Assoc. Prof. Wongkot presented Thailand's hydrogen strategy and roadmap, focusing on its role in meeting climate goals and ensuring energy stability.

Key findings include:

- **Climate Goals and Hydrogen Integration:** Thailand aims to reduce greenhouse gas (GHG) emissions by 30%, or 170 MtCO₂-e, by 2030 (current emissions were around 372 MtCO₂-e in 2019). The long-term goals include achieving carbon neutrality by 2050 and net-zero GHG emissions by 2065. Hydrogen is a key part of the strategy to meet these climate goals while ensuring energy self-reliance and aligning with global trends.
- **Hydrogen Market Development:** The roadmap includes a phased approach, starting with short-term strategic plans (2023–2030) that involve market incentives, R&D promotion, infrastructure development, and regulation standardization. By 2030, hydrogen use is expected to replace some LPG and residual oil in industrial sectors and enter new markets like fuel cell electric vehicles (FCEVs).
- **Hydrogen Roadmap Timeline:** The strategy envisions hydrogen market expansion in the energy sector through 2050, with incremental increases in hydrogen utilization in power generation, transportation, and industry. Pilot projects and market development will lay the foundation for wider adoption in the medium (2031–2040) and long term (2041–2050).

Panelist 4: Dr. Visarn Lilavivat

National Energy Technology Center (ENTEC), National Science and Technology Development Agency (NSTDA)

Dr. Visarn discussed hydrogen production's role in decarbonization, focusing on renewable energy technologies. He highlighted ENTEC's research on hydrogen production methods and their applications for a clean energy transition.

Key findings:

- **Hydrogen Production:** ENTEC investigates various methods, including fossil fuel resources with carbon capture, biomass conversion, and water-splitting (electrolysis). Green hydrogen from renewable energy has the lowest emissions, while other methods vary based on technology and feedstock.
- **Biomass/Biogas:** Biomass and biogas are abundant resources in Thailand. Using biogas for hydrogen production recycles carbon dioxide and reduces methane emissions, supporting both waste management and clean energy goals.
- **Decarbonization:** Hydrogen has strong potential to decarbonize heavy industries, provide energy system flexibility, and support Thailand's net-zero goals across multiple sectors.

- **Low Carbon Hydrogen:** Hydrogen is categorized as green, blue, or grey based on its feedstock and carbon footprint, with green hydrogen from electrolysis having the lowest emissions.

Panelist 5: Mr. Sathawut Suwanthitirat

Senior Business Development Executive, Bio Circular Green Business Development-BIG

Mr. Sathawut outlined BIG's role as a leading climate tech company, with a focus on low-carbon products and hydrogen production. BIG, established in 1988, is a joint venture affiliate serving the Map Ta Phut industrial area. In 2023, the company generated revenues of 6,944 MB and held a 45% market share in gas production, with a capacity of 4,800 tons per day (TPD).

- **Low-Carbon Products & Supply Solutions:** BIG provides a range of low-carbon products, including nitrogen (N₂), oxygen (O₂), hydrogen (H₂), and liquefied natural gas (LNG). These products are supplied through pipelines, on-site gas generation, bulk delivery, and mobile services.
- **Leadership in Hydrogen:** BIG, in partnership with Air Products, holds a dominant position in the global and Thai hydrogen markets. Globally, they produce 7,000 tons of hydrogen per day, representing 45% of the market, with over 100 hydrogen plants and 60 years of experience. In Thailand, BIG commands an 85% market share in hydrogen production, with production reaching up to 185 tons per day.
- **Global Climate Tech Investments:** BIG has committed to significant investments in climate technology projects worldwide, totaling \$15 billion, with \$45 million allocated to projects in Thailand. These projects include blue hydrogen production in Alberta and Louisiana, green hydrogen production in Neom, Saudi Arabia, and other sustainable energy initiatives, such as sustainable aviation fuel (SAF) in California and carbon-free liquid hydrogen in New York.

Future Directions:

Representative from each economy:

Thailand	Dr. Surachai Sathitkunarat Executive Director of APEC Center for Technology Foresight (APEC CTF) & Senior Strategist of the Office of National Higher Education, Science, Research and Innovation Policy Council (NXPO)
Brunei Darussalam	Dr. Lim Ren Chong Universiti Brunei Darussalam
Malaysia	Dr. Tan Shu Ying Principal Analyst, Malaysian Industry-Government Group for High Technology (MIGHT)
Peru	Mr. Felipe Donato Valentín Rojas Foresight Specialist, National Council of Science, Technology and Technological Innovation (CONCYTEC)
The Philippines	Mr. Ulysses M. PALMONES Senior Science Research Specialist, Department of Science and Technology – Philippine Council for Industry, Energy and Emerging Technology Research and Development (DOST-PCIEERD)
Russia	Dr. Antonova Elena Counsellor, Ministry of Economic Development of the Russian Federation
Chinese Taipei	Professor Dr. Shu-Yii WU CEO, APEC Research Center for Advanced Biohydrogen Technology (ACABT)

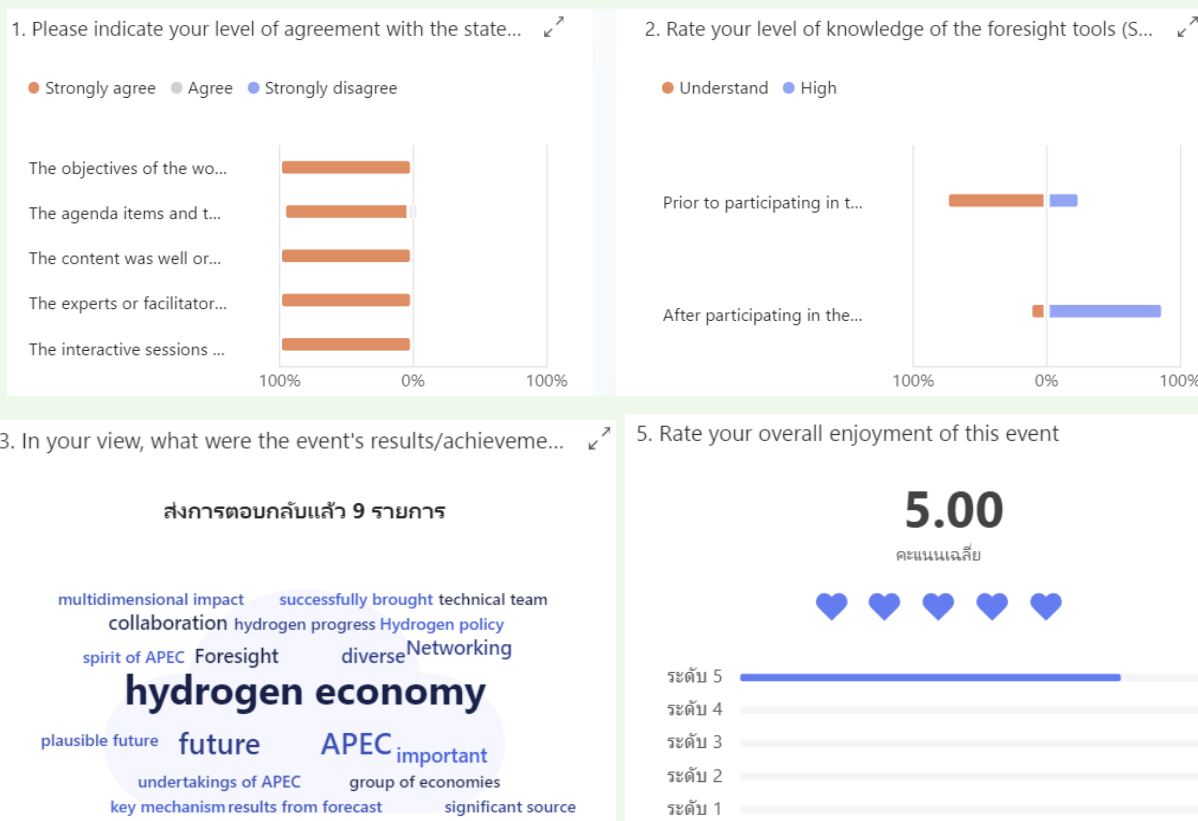
Summary of Future Directions based on expert opinions:

- **Collaboration Over Competition:** The focus is on promoting collaboration among APEC economies, even when competing for resources. This entails fostering partnerships across sectors and disciplines to ensure shared growth and development.

- **Cross-Border Cooperation:** There is a pressing need for stronger partnerships between economies to tackle common challenges, such as climate change, achieving net-zero emissions, and ensuring food security. Cooperation in these areas is essential for collective progress.
- **Innovation Hubs & Information Sharing:** The creation of open innovation hubs and the improvement of data-sharing mechanisms are vital. These efforts should be balanced with protective measures to prevent unfair competition and mitigate potential social risks or hazards.
- **Capacity Building:** Emphasizing the importance of developing skills through training programs, particularly in technology and innovation, to support sustainable development across economies. This will ensure that economies are prepared for future challenges.
- **Foresight & Policy Alignment:** A strategic focus on both short- and long-term foresight is critical, with an emphasis on aligning policies to support science, technology, and innovation (STI) development. This alignment is key to addressing current challenges while safeguarding future needs.

4. Feedback from participants

The feedback on the workshop was overwhelmingly positive, with participants strongly agreeing that the objectives were clearly defined, the agenda and topics were relevant, the content was well-organized and easy to follow, and the facilitators were knowledgeable and well-prepared. The interactive sessions were also deemed highly useful. Many participants indicated a significant increase in their understanding of foresight tools, particularly STEEP and the Foresight Canvas, after attending the event. Key achievements included enhanced networking among APEC economies, a clearer vision for advancing clean energy through hydrogen, and valuable insights for future initiatives. The event facilitated collaboration, discussions on hydrogen economy progress, and the importance of carbon-neutral and AI transformation, all while promoting a forward-thinking approach to achieving net-zero emissions.



Thank you for your participation. See you again when the time comes.

Link to presentation slides: <https://apecctf.org/news-release-and-events/documents-released-from-the-krabi-workshop/>

Link to all photos:

https://drive.google.com/drive/folders/1Mctv5gAGcV9vHtc_sEn_iK8XNU8lgk5A

Link to all video: <https://www.youtube.com/@APECCTF1998>