

EXECUTIVE SUMMARY

APEC STI Strategic Foresight PPSTI 05 2023S

Initiated by Thailand
Co-sponsored by Peru and Japan



INTRODUCTION

The project was undertaken to address significant impacts of climate change in APEC region. Employing strategic foresight methodologies, the project aimed to identify future challenges, key agendas, and enabling technologies for achieving net-zero emissions in APEC. Delphi survey and foresight workshop involving participants from APEC economies were conducted to gather insights which were subsequently analyzed and verified by experts to propose key findings and recommendations for decarbonization strategies. The outcome of the project is to provide insightful input for the next PPSTI's strategic plan, aligning with recent recommendations by Australia to refocusing PPSTI by adopting the principles of mission-oriented innovation policy.

This project provided direct benefits to participants from APEC economies with a comprehensive understanding of foresight tools for strategic planning, while the long-term benefits are expected to emerge from collaborations among APEC economies to drive key recommendations proposed in the APEC Strategic Foresight report, designed to guide policymaking for sustainable growth in the Asia-Pacific region.

BACKGROUND

Global warming poses significant and urgent challenges to humanity's collective well-being. Recognizing the severity of this issue, the Intergovernmental Panel on Climate Change (IPCC) emphasized in 2018 the critical importance of achieving net-zero emissions globally by 2050. This target is vital for aligning with the Paris Agreement's ambitious goal of limiting global warming to 1.5°C above pre-industrial levels. The concept of 'net zero' involves the equilibrium between the release of greenhouse gases into the atmosphere and their removal and storage through carbon sinks, such as forests or carbon capture technologies.

Given the gravity of these warnings and the escalating concerns surrounding global warming, extensive literature reviews have been conducted to explore effective strategies for achieving net zero emissions. Through meticulous examination and analysis, five key strategies are identified:

- 1) Energy demand management:** This involves implementing measures to reduce overall energy consumption through efficiency improvements, behavioral changes, and innovative technologies.
- 2) Transition of fuel switching:** Shifting away from fossil fuels towards renewable energy sources such as solar, wind, and hydroelectric power can significantly decrease greenhouse gas emissions.
- 3) Green economy:** Promoting sustainable practices across various sectors, including agriculture, transportation, industry, and tourism, can lead to economic growth while reducing environmental impact.
- 4) Carbon emission sinks:** Investing in artificial storages capable of absorbing and storing carbon dioxide and enhancing natural carbon sinks such as reforestation, can effectively remove carbon dioxide from the atmosphere.
- 5) Offset policies:** Establishing mechanisms for carbon offsetting, such as carbon pricing or cap-and-trade systems, can incentivize emission reductions and encourage investment in carbon-neutral projects.

METHODOLOGY

The methodology employed in this project encompasses a multi-faceted approach aimed at comprehensive understanding and addressing future challenges and opportunities associated with key strategies for achieving net-zero emissions.

- 1) Literature Review:** A thorough literature review was conducted using historical techniques to provide insights into current status, trends and emerging issues related to net-zero emissions. This involved scrutinizing academic papers, reports, and other scholarly sources to gain a comprehensive understanding of the subject matter and identify key areas for further investigation.
- 2) Delphi Survey:** The Delphi survey methodology was employed to gather insights and opinions from a panel of experts regarding net-zero emission strategies and their feasibility. This iterative process involved multiple rounds of surveys, allowing experts to anonymously provide feedback, refine responses, and build consensus on critical issues.
- 3) Foresight Workshop:** Foresight workshop was conducted using techniques such as the “Future Triangle” and “World Café” to engage stakeholders and explore potential future related to net-zero emissions. The Future Triangle methodology facilitated the exploration of three key dimensions: push, weight, and pull, helping participants envision potential pathways towards achieving net-zero emissions. Meanwhile, the World Café provided a collaborative environment for stakeholders to share insights, exchange ideas, and co-create strategies for addressing challenges and seizing opportunities in the transition to a low-carbon economy.

By integrating these methodologies, the project aimed to leverage diverse perspectives, expert knowledge, and foresight tools to inform the development of actionable recommendations for policymakers, stakeholders, and other relevant entities seeking to accelerate progress towards a net-zero emissions future.

KEY FINDINGS AND RECOMMENDATIONS

This section offers a concise overview of key findings and recommendations pertaining to each net-zero strategy and its subgroups. It emphasizes the significance of insights gathered from experts participating in the Delphi survey and foresight workshop, as well as the proposed actions stemming from these insights.

1) Energy demand management

Energy demand management encompasses strategies and practices aimed at efficiently controlling and reducing the energy needed to fulfill diverse requirements across residential, commercial, and industrial sectors. It entails implementing measures to balance energy supply and demand, mitigate peak energy consumption, and improve overall energy efficiency. Despite the maturity of some technologies that may not be considered appealing, they remain powerful contributors to sustainable energy consumption, ensuring reliability while minimizing environmental impact.

1.1 Energy Efficiency

Key findings: This issue demands immediate action due to the maturity of technologies available, offering impactful solutions. Further discussions are regarding human behavior and AI technology for energy efficiency, as human behavior is increasingly acknowledged as key for driving significant improvements.

Recommendations: Establishing regulations and incentives for energy efficiency across each sector is crucial. Incentives such as technology transfer, R&D tax credits, and investment tax credits play a role in encouraging adoption. Initiatives like the APEC labeling of energy-efficient appliances is key to ensuring compliance with standards and are integral to addressing this issue.

1.2 Energy Intensity

Key findings: A revised APEC Energy Intensity target is imperative, necessitating a more aggressive approach than the Honolulu declaration, given the current global trend towards heightened ambition.

Recommendations: The Emission Intensity initiative is gaining traction in discussions, as traditional energy intensity metrics encompass all energy types used to generate output, while emission intensity provides a more reliable measure of environmental impacts associated with economic output.

1.3 Electricity Demand

Key findings: A majority express high concern about the rising electricity demand as the primary energy source in APEC economies' efforts to achieve net-zero emissions. This concern is focused on three key sectors: Industry, Transport, and Building, chosen for their substantial contributions to electricity demand.

Recommendations: Solar energy emerges as the most influential alternative electricity source to accelerate progress towards achieving net-zero emissions in APEC economies, endorsing its potential impact. This is followed by nuclear energy, wind energy, and hydroelectric power.

2) Transition of fuel switching

APEC relies heavily on fossil fuels for its energy needs, comprising 86% of total primary energy supply and 75% of electricity supply. Despite efforts to transition to clean energy sources like renewables and hydrogen, managing these shifts poses significant challenges due to technological, socio-economic, and environmental complexities, along with uncertainties about future developments.

2.1 Electricity Supply

Key findings: Findings arise regarding resource scarcity for renewable energy (RE) technology, particularly in mineral mining and processing. Additionally, there is a need for advancements in technology for Smart Grids to accommodate the growing demand for green electricity and facilitate the integration of renewable energy sources into the grid system.

Recommendations: APEC necessitates transition policies with effective governance and capacity building for governments, including the establishment of common institutions or intermediaries to connect APEC economies.

2.2 Hydrogen Economy

Key findings: A significant of respondents express a desire to enhance the role of hydrogen energy in decarbonizing the hard-to-abate sectors, such as fuel cell, power generation and industry applications, in APEC. The majority of concerns revolve around hydrogen production costs, the establishment of hydrogen infrastructure, and a preference for green hydrogen over other hydrogen colors.

Recommendations: Further discussions are underway regarding market demand and public awareness to drive the hydrogen economy forward. An initiative has been proposed for the establishment of APEC carbon emission standards for hydrogen production, aiming to create a common policy framework for trading hydrogen energy within the APEC region.

3) Green economy

The green economy, emerging as key to sustainable development, focuses on balancing economic growth, social equity, and environmental protection. It aims to minimize ecological risks and scarcities across sectors such as industry, agriculture, waste management, and tourism, fostering a transition towards a sustainable future without compromising the planet's health.

3.1 Industrial Processes

Key findings: There is a global shift in industrial processes towards sustainability and innovation, driven by higher carbon pricing, technological advancements, and an increasing demand for green products. Despite facing economic and governance challenges, this shift underscores the need for global cooperation, legal modernization, and strategies focused on green funding, intellectual property protection, and technology investment. These efforts, along with collaborative initiatives in knowledge sharing and research, are essential for navigating the transition to a more sustainable industrial landscape.

Recommendations: Emphasizing financial reforms to support SMEs, transitioning away from fossil fuels, enhancing governance, and updating laws for green practices are critical. Key strategies should include raising awareness about sustainability, fostering innovation, enhancing economic incentives such as carbon pricing, and advancing technology. Strengthening supply chain resilience, ensuring inclusive development, promoting global R&D collaboration, and supporting education in green technologies and carbon reduction efforts are crucial for overcoming existing challenges and seizing emerging opportunities.

3.2 Agricultural Practices

Key findings: Agricultural practices are confronting significant challenges from economic volatility, environmental impacts, and food security issues, further complicated by urbanization, regulatory hurdles, and societal changes. The sector is also contending with pressures of global population dynamics and climate change, necessitating agile adaptations like “Agrivoltaics”. Nevertheless, promising advances in biotechnology, precision agriculture, AI, and efforts to improve information accessibility and education present opportunities to mitigate these concerns, highlighting the importance of innovation and adaptability in agriculture.

Recommendations: Advocating for diverse R&D efforts such as agroforestry and supporting farmers with technical assistance tailored to local needs are necessary. Also, improving market access, optimizing supply chains, and enforcing sustainable policies and regulations are crucial. Moreover, promoting trade development, facilitating information sharing, and implementing guidelines for sustainable conduct are recommended. Encouraging cross-sectoral and cross-border collaborations and investing in education and capacity building for farmers through networks and grants are vital steps towards a sustainable agricultural evolution.

3.3 Waste Management

Key findings: Most waste management policies in APEC are moderately effective citing plastic pollution as the biggest obstacles in achieving net-zero emissions. Additionally, there is a need for sustainable material from alternative sources such as agricultural waste, timber, and recycled materials. Thus, reverse logistics system needs to be in place to accelerate waste collection process.

Recommendations: Platform for cross-border waste management in APEC becomes prominent to facilitate international collaboration, serving as a platform for digital data for waste management, capacity building in eco-design, and regulation and standards modernization

3.4 Green Tourism

Key findings: APEC experts express concerns regarding the effectiveness of local authorities in managing tourist expectations for carrying capacity, waste management, and a lack of green products. Further investigation identifies logistics and transportation as a bottleneck to bring about green tourism transformation in APEC region.

Recommendations: Existing arrangement needs to be reviewed and updated to accommodate more green and sustainable tourism establishment such as

registration platform, green finance for MSME, and education for both local and tourist to embrace the notion of 'green spirituality' into their everyday lives.

4) Carbon emissions sinks

Besides mitigation and adaptation measures, carbon emission sinks are crucial in battling climate change by absorbing and storing CO₂ for extended periods using natural or artificial reservoirs. These sinks function by sequestering more CO₂ than they emit. Carbon capture technology has gained significant interest in the past years from many APEC economies, led by the US.

4.1 Carbon Capture, Utilization, and Storage (CCUS)

Key findings: CCUS is expected to play a significant role in achieving net-zero emissions in APEC, especially for hard-to-abate industries. Large-scaled CCS plants using green energy are desirable to store gigatons of CO₂ per year. New businesses would arise from CCS-as-a-Service and utilization of CO₂ in carbon recycling and upcycling. However, major challenges include limitation on appropriate storage sites, lack of regulation for transboundary and transparency cooperation among APEC economies, and expensive/ immature technologies.

Recommendations: A collaboration roadmap for CCUS development in APEC should be drafted to provide a framework, guideline, and timeline for essential collaborations including knowledge sharing such as CCS pilot plant operation, common APEC regulations and standards, R&D collaboration on key research topics such as high storage efficiency and efficient CO₂ conversion, and effective technology transfer mechanism.

4.2 Land-use Practices

Key findings: Majority of APEC experts raise concerns over the effectiveness of land-use practices in APEC and severe biodiversity loss due to land-use changes. Key bottlenecks have been identified including unattractive incentive schemes and fair compensation for farmers and private landowners, ineffective carbon market, inability to track land-use changes, and lack of knowledge sharing regarding species of plants and their ability to absorb greenhouse gases as well as new method to restore forest ecosystems such as the framework species method (FSM).

Recommendations: A single APEC carbon market and common APEC emission trading system with reasonable carbon prices and acceptable cost of carbon credit verification are desirable to offer appealing incentive and solve carbon market problem. To track land-use changes and prevent deforestation, co-developing low-cost surveillant technologies is required. Besides, dynamic knowledge sharing process that integrates modern knowledge and traditional knowledge regarding local plants and their ability to absorb greenhouse gases should be initiated.

5) Off-set policies

The discussion on the off-set policies revolves Emission Trading Schemes (ETS) and Renewable Energy Certificates (RECs) as mechanisms to meet emission reduction goals. While the EU's Carbon Border Adjustment Mechanism (CBAM) aims to regulate imported product pricing for emission reduction, potentially disrupting global supply chains. APEC economies face the challenge of implementing competitive policies to address this, particularly as products exceeding GHG limits may require offsetting emissions with CBAM Certificates, posing pricing implications and favoring EU goods. Calculating import emissions from both direct and indirect sources adds complexity to APEC's adaptation efforts.

5.1 Clean Development Mechanism (CDM)

Key findings: A strong push for the ETS stems from the Paris Agreement, particularly Article 6. This provision facilitates carbon trading, offering opportunities for both industrial and non-industrial economies to invest in and exchange emissions allowances.

Recommendations: This section underscores the significance of technology, cost, and carbon pricing identification, alongside proposing the Hybrid Market (Trade and Tax) as a strong recommendation. Concerns are raised about the alignment of carbon prices with international verification standards and APEC region standards, suggesting a common price or APEC standard as a potential solution to boost carbon trading in the region.

5.2 Cross Border Adjustment Mechanism (CBAM)

Key findings: APEC anticipates potential inclusion of all major industries in the EU's CBAM, prompting considerations for countermeasures and focus on "Scope 3" emissions. Similar mechanisms from other economies are expected. An approach aiming for balanced development and enhanced environmental governance is proposed. Challenges such as product shortages and increased commodity prices may arise for the EU. Alternative scenarios for CBAM include operational challenges and economic pressures on the EU. Effective data collection and sharing systems are vital for monitoring emissions and fostering global transparency.

Recommendations: Proposed recommendations for APEC in response to CBAM policies include international cooperation and harmonized environmental regulations, establishing dialogue platforms for policy, legal, and technical discussions, and agreeing upon standardized definitions and terms. Prioritizing these initiatives is crucial to effectively respond to CBAM policies in a timely manner.

KEY MESSAGES

- 1) Incorporate decarbonization or accelerate decarbonization technology strategies as one of the primary mission targets of the PPSTI (in the new PPSTI strategic plan). Given its status as a global agenda, it is crucial to recognize the importance of science, technology, and innovation (STI) in driving the implementation of emission reduction initiatives.
- 2) Recommend drafting crucial APEC-wide regulations, standards, and incentives, such as the APEC labeling mechanism used to effectively incentivize energy efficiency measures and sustainable practices across industries. The implementation of labels and common standards will play a pivotal role in guiding and promoting these practices.
- 3) Establish APEC market mechanisms for an emissions trading system. This initiative will stimulate innovation in policy frameworks and platforms, encompassing ETS and CBAM, thus facilitating effective progress toward achieving net-zero emissions targets.
- 4) Establish a technology transfer mechanism for green technology within APEC. This recommendation aims to harness the potential of technology development and facilitate the exchange of technological knowledge among member economies.
- 5) Initiate a sharing management platform within APEC, such as a cross-border waste management platform. This platform will serve to enhance technologies, knowledge sharing, and sustainable industrial/ agricultural processes through collaborative efforts.