

# EVENT SUMMARY REPORT



**APEC Research Center for Advanced  
Biohydrogen Technology (ACABT)**

**PPSTI 205 2023A**

*Green Synergy Solutions to Net-Zero Emissions Based on  
Bioenergy Technologies for Resilience and Sustainability*

**18<sup>th</sup> – 20<sup>th</sup> September 2024**

**Chiang Mai, Thailand**

## Acronyms

<b>APEC-ACABT</b>	APEC Research Center for Advanced Biohydrogen Technology
<b>APEC-CTF</b>	APEC Center for Technology Foresight
<b>APERC</b>	Asia Pacific Energy Research Centre
<b>APEC-SCMC</b>	APEC SME Crisis Management Center
<b>BRIN</b>	National Research and Innovation Agency
<b>CMRU</b>	Chiang Mai Rajabhat University
<b>CQU</b>	Chonqing University
<b>ENTEC</b>	National Energy Technology Center
<b>EGNRET</b>	Expert Group on New and Renewable Energy Technologies
<b>EWG</b>	Energy Working Group
<b>GDU</b>	Gia Dinh University
<b>HCMUT</b>	Ho Chi Minh City University of Technology
<b>HUST</b>	Hanoi University of Science and Technology
<b>ITRI</b>	Industrial Technology Research Institute
<b>KKU</b>	Khon Kaen University
<b>PhilRice</b>	Philippine Rice Research Institute
<b>PPSTI</b>	Policy Partnership on Science, Technology and Innovation
<b>SMEWG</b>	Small and Medium Enterprises Working Group
<b>UC-Riverside</b>	University of California - Riverside
<b>UdeC</b>	University of Concepción
<b>UKM</b>	National University of Malaysia
<b>UQ</b>	University of Queensland
<b>VNU-HCM</b>	Vietnam National University - Ho Chi Minh City

## General Information

APEC-ACABT set the APEC project “*Green Synergy Solutions to Net-Zero Emissions Based on Bioenergy Technologies for Resilience and Sustainability*” to meet the APEC 2023 United States Theme “*Creating a Resilient and Sustainable Future for All,*” followed by the goals of building resilience and strengthening environmental sustainability in the APEC region; and aligns with the APEC 2022 Bangkok Goals on “*Bio-Circular-Green (BCG) Economy,*” under the 2022 Leaders’ Declaration, which integrates three economic approaches where STI are for creating value, reducing waste, advancing resource efficiency, and promoting sustainable business models.

Besides, in line with the strategic orientations of the APEC fora such as PPSTI, SMEWG, and EWG, the project highlights enhancing capacity building in innovative growth and infrastructure development regarding knowledge, abilities, skills, and uptake of innovation outputs (PPSTI); improving entrepreneurship, innovation, and strengthening young entrepreneurs’ green MSMEs competitiveness with ESG business models (SMEWG); and facilitating clean, efficient; and renewable energy access by sharing knowledge and experience on energy availability with state-of-the-art technologies (EWG-EGNRET).

Based on the above, the Green Synergy Solutions Event aims to build capacity on green MSMEs, especially those from developing economies with women, youth, and untapped economic potentials, to address issues of Net-Zero Emissions with technical and social solutions, contributing to energy transition and BCG transformation for resilience and sustainability across the APEC member economies. The event was expected to facilitate the developmental progress of the economic growth priorities and goals toward the Putrajaya Vision 2040 by applying the Aotearoa Plan of Action to build capacity developing economies for an inclusive, resilient and sustainable future in the APEC region.

## Executive Summary

Green Synergy Solutions Event features the APEC Workshop, APEC Training Course and Demo-Site Best Practice (Self-fund) with event sessions of experts’ speeches, young entrepreneurs’ pitches, panel discussions for key findings for policy recommendations (**ANNEX**) and key learnings for innovative and entrepreneurial solutions, and best practices for technique and method demonstration. The APEC Workshop and APEC Training both feature two themes: 1. Technical Solutions - Green Energy Technologies Empower Net-Zero Energy Transition; and 2. Social Solutions - BCG Economy Models Enhance Net-Zero Societal Transformation.

During the APEC Workshop, the participants, especially those from developing APEC economies, obtained, maintained, reinforced, and cultivated capabilities to advance their policies and regulations on net-zero development. Besides, the APEC Training Course participants, especially young entrepreneurs, acquired practical viewpoints, knowledge, and experience for innovative and entrepreneurial solutions to improve the circumstances of Net-Zero social and environmental issues in their economies. Furthermore, the Demo-site Best Practice (self-fund) made participants explore how the Green Synergy mechanism works with real applications to realize Net-Zero with resilient and sustainable living.

A total of 84 attendees, including 16 experts (Speakers / Panelists / Leading Researchers) and 68 participants, were present at the Green Synergy Solutions Event. They were from 14 APEC member economies such as Australia; Brunei Darussalam; Chile; China; Indonesia; Japan; Korea; Malaysia; Peru; the Philippines; Chinese Taipei; Thailand; the United States; and Viet Nam. Among the attendees, there were 41 females (49%), including 7 experts (44%) and 34 participants (50%).

## **APEC Workshop / APEC Training Course**

### ***Green Energy Technologies Empower Net-Zero Energy Transition***

18 September 2024, Kantary Hills Hotel Chiang Mai



**Fig 1. Workshop speech.** *Green Energy Transition in the APEC Region.* Visiting Researcher Dr. Nabih Matussin, APERC, Japan - Brunei Darussalam



**Fig 2. Workshop speech.** *Sustainable Palm Oil-Based Green Energy Technology: Accelerating Indonesia Towards Net-Zero Emissions.* Principal Researcher Dr. SD Sumbogo Murti, BRIN, Indonesia



**Fig 3. Workshop speech.** *Renewable Hydrogen: An Opportunity for Chile and the Biobio Region.* Hydrogen Unit Manager Mrs. Andrea Moraga, UdeC Institute of Technological Innovations, Chile



**Fig 4. Workshop speech.** *From Fossil Fuels to Renewables: Innovations Driving Japan's Green Energy Technologies.* Assoc. Professor Dr. Helmut Yabar, University of Tsukuba, Japan - Peru



**Fig 5. Workshop panel discussion.** 1. *Definition for Green Energy*, 2. *Promotion of Carbon Footprint Assessment and Carbon Credit Trading*, and 3. *Transition from Incentives to Standards and Regulations*. Distinguished Researcher / Professor Dr. Guang Wei Jang, ITRI, Chinese Taipei; Director Dr. Nuwong Chollacoop and Researcher Dr. Kampanart Silva, ENTEC, Thailand (from left to right)



**Fig 6. Training course speech.** *Building Inclusive Innovation Ecosystems in the Inland Southern California*. Assoc. Vice Chancellor - Technology Partnerships / Professor Dr. Rosibel Ochoa, UC - Riverside, the U.S.



**Fig 7. Training course pitch review.** Advisors: Professor Dr. Alissara Reungsang, KKU, Thailand; Director Dr. Hens Saputra, BRIN, Indonesia; Professor Dr. Ao Xia, CQU, China; and Assoc. Professor Dr. Tuan Anh Pham, HUST, Viet Nam (from left to right)



**Fig 8. Training course pitch.** *Micromet: A Novel Bacterial Approach to Microplastic Removal and Biogas Production*. MSME Team AMAL, Thailand



**Fig 9. Training course pitch.** *From Waste to Power: A New Model for Sustainable Energy Supply in Remote Regions*. MSME Team EnergyEdge, Chinese Taipei



**Fig 10. Training course pitch.** *Bridging waste and green energy: A continuous-flow system for enhanced biofuel production and rural development.* MSME Team CQU Green Energy, China



**Fig 11. Training course pitch.** *Sustainable Production of Rhamnose from Palm Oil Mill Effluent (POME).* MSME Team RhamonoGlow, Indonesia



**Fig 12. Training course pitch.** *Using Yeast Isolated from Fermented Pork Roll for Chitin Recovery from Shrimp By-Products.* MSME Team Shrimps, Viet Nam



**Fig 13. Training course pitch.** *Acceleration of Rural and Costal Electrification Process in Sabah via Implementation of Ocean Thermal Energy Conversion (OTEC) Technology.* MSME Team OTEC Warriors, Malaysia



**Fig 14. Training course panel discussion.** 1. *What problem or need to address?* 2. *How to define customer?* 3. *What to do to move technology to market?* 4. *Where to find resource for technology transfer?* 5. *What are key barriers to pitch success?* Distinguished Researcher / Professor Dr. Guang Wei Jang (left), ITRI, Chinese Taipei; and Assoc. Vice Chancellor - Technology Partnerships / Professor Dr. Rosibel Ochoa (right), UC - Riverside, the U.S.



**Fig 15. Training course award ceremony.** First Place Award: MSME Team OTEC Warriors (OTW), Malaysia. Second Place Award: MSME Team CQU Green Energy, China. Third Place Award: MSME Team EnergyEdge, Chinese Taipei. Honorable Mention Award: MSME Team AMAL, Thailand; MSME Team RhamonoGlow, Indonesia; and MSME Team Shrimps, Viet Nam

**APEC Workshop / APEC Training Course**  
**BCG Economy Models Enhance Net-Zero Societal Transformation**

19 September 2024, Kantary Hills Hotel Chiang Mai



**Fig 16. Workshop speech.** *Towards a Sustainable Future: Circular Economy Roadmap for APEC.* Strategist Dr. Srichattra Chaivongvilan, APEC-CTF, Thailand



**Fig 17. Workshop speech.** *Sustainable Biomass Management in Palm Oil Milling* by Senior Lecturer Dr. Peer Mohamed, UKM, Malaysia



**Fig 18. Workshop speech.** *Bioeconomy – Building a Global Alliance: Tackling Global Themes Head-on for Impact.* Manager - Strategy and Partnerships Ms. Tamara Weissflog, UQ Global Partnerships, Australia

**Fig 19. Workshop speech.** *Precision Agriculture and Industrial Symbiosis: Preliminary Steps toward Achieving Net-Zero Emissions in the Agri- and Fisheries Sectors of the Philippine.* Supervisor Dr. Hazel Biteng Alfon, PhilRice Sales and Promotions, the Philippines



**Fig 20. Workshop panel discussion.** 1. *Policy and Regulatory Frameworks*, 2. *Technological Innovation and Adoption*, 3. *Circular Economy Practices*, 4. *Public-Private Partnerships*, 5. *Education and Capacity Building* 6. *Financial Mechanisms and Incentives* 7. *Global and Regional Cooperation* 8. *Community and Cultural Engagement*. Director Dr. Hong Quan Nguyen (middle), VNU-HCM Institute for Circular Economy Development (ICED), Viet Nam; Asst. Professor Dr. Worajit Setthapun (left) and Asst. Professor Dr. Hathaithip Sintuya (right), CMRU Asian Development Institute for Community Economy and Technology (adiCET), Thailand



**Fig 21. Training course speech.** *Chinese Taipei's SME Just Green Transition: Policy and Cases.* Professor Dr. Yau-Jr Liu, APEC-SCMC, Chinese Taipei



**Fig 22. Training course pitch review.** Professor Dr. Alissara Reungsang, KKU, Thailand; Department Head Dr. Thien Khanh Tran, GDU S&T International Affairs, Viet Nam; Director Dr. Ahmad Fathoni, BRIN, Indonesia; Assoc. Professor Dr. Tuan Anh Pham, HUST, Viet Nam; and Supervisor Dr. Hazel Biteng Alfon, PhilRice Sales and Promotions, the Philippines (from left to right)





**Fig 23. Training course pitch.** *Innovative Algae-Based Oxygenation and Aesthetic Solution for Urban Spaces.* MSME Team AquaVitae, Malaysia



**Fig 24. Training course pitch.** *XOS EcoTech: Empowering Wellness with Sustainability.* MSME Team Gulla Gulli, Indonesia



**Fig 25. Training course pitch.** *Bio-concrete.* MSME Team Verde, Malaysia



**Fig 26. Training course pitch.** *A Sustainable Paper Solution from Brewing Waste.* MSME Team BIU4HUST, Viet Nam



**Fig 27. Training course pitch.** *Unlocking the Potential of Corn: Agronomy, Applications, and Opportunities in the Bio-Circular-Green Economy through Innovative Biojar and Biofertilizer Solutions.* MSME Team ARUSHA, Indonesia



**Fig 28. Training course pitch.** *Sustainable Agriculture Innovation: Sustainable Fertilization.* MSME Team Hy-Tech, Indonesia



**Fig 29. Training course panel discussion.** 1. What are ESG Key Components to MSMEs? 2. How to prioritize ESG components in economies? 3. How to proceed inner process as MSMEs? and 4. What roles would government play if people and society were priorities of MSMEs in Just transformation? Director Dr. Hong Quan Nguyen (left), VNU-HCM Institute for Circular Economy Development (ICED), Viet Nam; and Professor Dr. Yau-Jr Liu (right), APEC-SCMC, Chinese Taipei



**Fig 30. Training course award ceremony.** First Place Award: MSME Team Hy-Tech, Indonesia. Second Place Award: MSME Team ARUSHA, Indonesia. Third Place Award: MSME Team AquaVitae, Malaysia. Honorable Mention Award: MSME Team Gulla Gulli, Indonesia; MSME Team Verde, Malaysia; and MSME Team BIU4HUST, Viet Nam

**Demo-Site Best Practice (Self-fund)**

20 September 2024, CMRU Asian Development Institute for Community Economy and Technology (adiCET)



**Fig 31. Demo-site introduction.**



**Fig 32. Best practice field tour.**

## Annex - Policy Brief

### *Green Energy Technologies Empower Net-Zero Energy Transition*

#### **Background**

At the UNFCCC Conference of the Parties (COP 21) in 2015, the Paris Agreement was ratified with the aim to reduce greenhouse gas (GHG) emissions (UNFCCC, 2015). The world then committed to net zero emission target by 2050 at the COP 26 meeting in 2021, with economies formulating their Nationally Determined Contributions (NDCs) to reduce GHG emissions (UNFCCC, 2020). COP 27 (ADB, 2022) highlighted adaptation and finance mobilization to enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change. Upcoming COP 29 will elevate the ambition of no one being left behind through NDCs and accelerate actions through NDC 3.0 which will address gaps identified in previous submissions.

Many Asia-Pacific Economic Cooperation (APEC) economies pledged to mitigate climate change, resulting in commitments at different stages depending on their capacity to reduce GHG emission. Several economies committed to achieving carbon neutrality or net zero GHG emissions by 2050. Energy use in building, transportation, industry, and power sectors aim to be decarbonized by green energy technologies. Our past study (APEC, 2023) reviewed the methodology and framework of carbon neutral plans of APEC and non-APEC economies in power, transport, and building sectors, synthesized best practices and lessons learned, and built capacity on carbon neutral policy formulation. The findings from this study can be used to identify key green energy technologies and the mechanisms to facilitate their utilization and diffusion.

The definition of green energy may not be straightforward and may vary from economy to economy. Green energy is typically derived from natural resources that have lower environmental impact and are sustainable over the long term, e.g., wind, hydro, solar, biomass, and others renewable sources. Some parts of the world redefined the green energy to include nuclear power or even natural gas (Clifford, 2022). Revisiting the definition of green energy might be another crucial step to clearly define the scope of green energy technologies in order to have a solid approach towards net zero emissions in energy sector.

#### **Policy Analysis - Green Energy Policy Strategy for Net-Zero Emissions**

**Fig 1 – Fig 4** provide the overviews of green energy policy strategies in power generation, industry, transport, and business sectors. They were derived by a comprehensive review of the literature covering certain APEC economies and insights from focus group discussions with government and private sectors in Thailand. They were separated into four main categories, including regulatory measures, taxation measures, supportive measures, and voluntary agreement.

As for regulatory measures across the four sectors, the predominant focus is promoting the transition of energy towards green energy. Key measures include installation of energy storage system, increasing capacity of rooftop solar panels, promoting wind energy, and encouraging use of green electricity, supporting battery recycling, enhancing efficiency in the industry sector, and implementation of carbon tax. Taxation measures are also crucial for reducing energy consumption and promoting green energy technology adoption. Key taxation measures include tax incentives for investment in renewable energy project, tax exemptions, import duty exemptions for equipment and land rental fee, funding support for cell-level battery production, and reduction of import duties on electric vehicles (EV). As new projects or ideas on decarbonization are often not bankable, financial support is needed in all sectors, particularly for low-carbon investment, EV infrastructure, and public transport promotion. Awards for exemplary practices and support for pilot projects are also emphasized as effective measures to encourage adoption of green energy

technologies. Finally, voluntary measures are optional but can be highly effective for promoting green energy technologies and reducing GHG emissions. These measures include promotion of EV, assessment of carbon footprint organization and product, plastic waste reduction, and solar rooftop installation are linked to emission trading. Additionally, collaboration between governmental agencies and local businesses is another measure that facilitates GHG emission reduction, particularly for the SMEs.

Supports for green energy technologies should be strategized according to stages of technological advancement. For instance, grants are appropriate for the pre-feasibility study and research and development phases. Investment subsidies are better suited for the demonstration and pilot stages. Performance subsidies align with the deployment phase towards commercial operation. Preferential debt or equity financing is appropriate for the diffusion stage, where integration at scale is needed. Finally, carbon pricing, green bonds, and climate bonds are most suitable for technologies that have reached commercial maturity and proven stability. **Fig 5** illustrates the policy-technology development stage mapping.

## **Key Issue for Policy Recommendations**

The analysis shows that green energy is a critical component of the shift towards net zero emission in energy sector with outlined below.

### **A. Definition for Green Energy**

The term green energy has been used for several decades without consensus being reached regarding the definition. Many economies strictly limit green energy to only renewable energy while other economies expanded the scope to cover nuclear power and natural gas. Before identifying key clean energy technologies to empower net-zero energy transition, it is essential to take a step back and discuss the definition of green energy to ensure the correct scope of technologies to be considered.

### **B. Promotion of Carbon Footprint Assessment and Carbon Credit Trading**

Carbon credit trading is one of the interesting tools for GHG emissions reduction which benefits all sectors by providing an income stream. This should be accompanied by carbon footprint of product (CFP) promotion, which is crucial for evaluating energy consumption and wastes creation, raising environmental awareness in people to understand the impact of their activities on climate change. In particular, the assessment of carbon footprint for organization (CFO) is also becoming a requirement for business, residential, and industrial sectors, which cover all scope of carbon emission.

### **C. Transition from Incentives to Standards and Regulations**

Lastly, it is critical to offer incentives to encourage the use of green energy technologies and low-carbon investment since these actions cannot be carried out successfully without incentivization. However, enormous amount of budget is required for each economy to pursue an incentive program. Given that the capacity of green energy technologies entering the market will significantly increase, government incentive program may not be a sustainable solution. It is time to consider transitioning from incentive programs to standards and regulations when the technologies become mature enough to diffuse across the economies.

With clear definition of green energy, thorough understanding of carbon footprint and emission trading, and well-planned transition from incentive programs to standards and regulations, the economies will be able to sustainably transform energy sectors to contribute toward the society with net-zero emissions.

Regulatory measures	Taxation Measures	Supportive, Subsidy, and Incentive Measures	Voluntary Agreement	
Green Electricity Certification	Tax Incentives for Investment in Renewable Energy Projects	Financial Support for the Installation of Renewable Energy Systems	Developing Projects for Greenhouse Gas Management	Invest in Environmentally Friendly Businesses
Liberalized Electricity Market/Third-Party Access (TPA) to the Grid			Education and Public Awareness	Install Solar Photovoltaic Systems
Installation of Energy Storage Systems at Substations		Financial Support for Promoting Renewable Natural Gas	Carbon Capture and Storage (CCS) and Carbon Capture, Utilization, and Storage (CCUS)	RE100
Improvement of the Permitting Process for Rooftop Solar Panel Installation			Implement Proactive Measures to Reduce Emissions and Decrease Reliance on Carbon Offsets	Develop a Plan to Increase the Share of Clean Energy Electricity in the Future
Increasing the Installation Capacity of Rooftop Solar Panels Beyond 10 Kilowatts				Transition from Fossil Fuel-Based Electricity Generation to Renewable Energy Sources
Support for Domestic Battery Recycling				Green Hydrogen Pilot Projects
Support Plan for Increasing the Share of Renewable Energy from Offshore Wind Power Plants				
Utilization of Onshore and Offshore Wind Turbines				

■ Green Measures Derived from Focus Group Discussions and Comparative Studies of Domestic and International Practices
 ■ Yellow Measures Derived from Focus Group Meetings
 ■ Grey Measures Derived from Domestic and International Policy Studies

**Fig 1. Overview of Policy Strategy in Power Sector**

Regulatory measures	Taxation Measures	Supportive, Subsidy, and Incentive Measures	Voluntary Agreement		
One-Stop Service for Licensing	Support for Waste-to-Electricity Projects through Tax Exemptions, Import Duty Exemptions for Equipment, and Exemption from Land Rental Fee	Financial Support for Low-Carbon Investments	Promotion of Electric Vehicles and Charging Stations	Assessment of Organizational and Product Carbon Footprints	Education and Public Outreach
Green Electricity Certification		Support for Small Enterprises Seeking to Achieve Carbon Neutrality	Support for Carbon Credit Trading	RE100	Reduction of Scope 3 Greenhouse Gas Emissions
Liberalized Electricity Market/Third-Party Access (TPA) to the Grid			Promotion of Alternative Energy-Powered Vessels	Reduction of Carbon Dioxide Emissions through the Utilization of Slag	Improvement of Transportation Efficiency (Scope 1)
Enhance Efficiency and Reduce Energy Consumption in Industry			Increasing the Share of Biomass Fuels and Clean Energy Sources	Utilization of Renewable Energy for Electricity and Heat Production	Greenhouse Gas Reduction Processes in Scope 1 and 2
Halting the Production and Import of Products Containing Microplastics			Zero Carbon Dioxide Emissions in New Vehicle Models	Reduction of Waste Throughout the Food Supply Chain	Application of Economic Tools to Promote Greenhouse Gas Emission Reductions
			Promotion of Public Transportation Usage		

■ Green Measures Derived from Focus Group Discussions and Comparative Studies of Domestic and International Practices
 ■ Yellow Measures Derived from Focus Group Meetings
 ■ Grey Measures Derived from Domestic and International Policy Studies

**Fig 2. Overview Policy in Industry Sector**

Regulatory measures	Taxation Measures	Supportive, Subsidy, and Incentive Measures	Voluntary Agreement		
Enhancing Enforcement in Regulating Illegal Public Transportation	Funding Support for Cell-Level Battery Production	Support for the Transition of Public Transport to Electric Vehicles	Transition to Commercial and Electric Vehicles	Offsetting remaining greenhouse gas emissions through carbon credits	Promotion of Carbon Credit Sales/Carbon Credit Market
Urban Planning to Promote Bicycle Use	Implementation of Carbon Tax	Public Campaign to Promote Public Transportation Use	Installation of Solar Energy Systems	Utilization of hydrogen fuel	Education and Public Awareness
Regulation of the Production and Importation of New Energy Vehicles	Reduction of Import Duties on Public Transportation Vehicles	Expansion of Charging Stations / Support for the Development of Electric Vehicle Charging Infrastructure	Reduction of Non-Essential Fuel Consumption	Carbon Capture and Storage (CCS) and Carbon Capture, Utilization, and Storage (CCUS)	Reduction in Fossil Fuel Investment Proportion
Carbon Pricing	Tax Reductions for Electric Vehicles in the Business Sector	Support for the Development of Technologies, such as Wireless Charging and Solar Glass Panels	Upgrading Building Air Conditioning Systems		Optimization of Maritime Efficiency
Regulation of Personal Vehicle Purchases	Reduction of Value-Added Tax Rates for Long-Distance Train Travel	Support for Investment in New Energy Sources, such as Hydrogen and Ammonia	Carbon sequestration through the cultivation and maintenance of green spaces	Development of hybrid vehicles for small cars and battery electric vehicles	
	Exemption of Corporate Income Tax for Electric Vehicle Manufacturing Enterprises	Allocation of Funding for Rerouting Freight Transport			

■ Green Measures Derived from Focus Group Discussions and Comparative Studies of Domestic and International Practices
 ■ Yellow Measures Derived from Focus Group Meetings
 ■ Grey Measures Derived from Domestic and International Policy Studies

**Fig 3. Overview of Policy in Transportation Sector**

Regulatory measures	Taxation Measures	Supportive, Subsidy, and Incentive Measures	Voluntary Agreement		
Ministerial Regulations to Promote the Reduction of Greenhouse Gas Emissions at the Local Level  Measures for the Utilization of Electric and Clean Energy in Buildings  Achieving Zero Emissions in Buildings	Reduction of Import Taxes on Electric Vehicles  Tax Incentives for Investments in Energy Efficiency Enhancement	Awards for Exemplary Practices/Support for Pilot Hotels	Measures to Reduce Plastic Waste	Education and Public Awareness Campaigns by Government Agencies	Government Agencies Collaborate with Local Businesses (Potentially through MOU)
		Low-Interest Loans to Support Low-Carbon Investments	Installation of Rooftop Solar Panels	Support for Carbon Credit	
		Support for Energy-Efficient Appliances (Energy Label No. 5) and LED Lighting	Application of Green Energy and Green Technologies in Buildings, Including Designation of Green Spaces	Green Airport/ Green Hotel	Development of Policies for Renewable Energy Utilization
		Support for Low-Carbon Activities	Reduction in Energy and Water Consumption	Support for Sustainable Tourism/Carbon-Neutral Tourism	
		Measures to Promote Battery Storage for Energy	Reduction of Waste Sent to Landfills	Installation of Sensors for Monitoring Energy Consumption in Machinery	Selection of Recyclable Plastic Packaging
		Procurement of Renewable Energy from Foreign Sources	Support for Organizational Carbon Footprint Assessment/Monitoring, Reporting, and Verification (MRV)		
Subsidies for Energy Efficiency Improvements					
Subsidies for High-Performance Buildings					

Green Measures Derived from Focus Group Discussions and Comparative Studies of Domestic and International Practices    
 Yellow Measures Derived from Focus Group Meetings    
 Grey Measures Derived from Domestic and International Policy Studies

**Fig 4.** Overview of Policy in Building Sector

Public Interventions at Different Stages of Technologies				Preferential Debt Financing	Carbon Pricing
Grants		Investment Subsidy	Performance Subsidy	Preferential Equity Financing	Green Bond/ Climate Bond
Pre-feasibility Study (initial idea, concept validation)	Research and Development (early to full prototype at scale)	Demonstration/ Pilot (pre-commercial demo to first of a kind commercial)	Deployment (commercial operation)	Diffusion (integration needed at scale)	Commercial Maturity (proof of stability reached)

**Fig 5.** Policy-Technology Developmental Stage Mapping

## References

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## ***BCG Economy Models Enhance Net-Zero Societal Transformation***

### **Background**

The Bio-Circular-Green (BCG) Economy Model is proposed as a new sustainable growth engine to drive Thailand's economic, social, and environmental development. This model integrates the bioeconomy, circular economy, and green economy principles to create a balanced approach to growth that supports Thailand's transition towards net-zero emissions and a sustainable future.

The BCG policy was officially endorsed as part of Thailand's domestic strategic plan under the 20-Year National Strategy (2018-2037). This strategy is aimed at transitioning Thailand into a high-income economy with resilience and sustainability. The BCG model aligns with global sustainability goals, such as the United Nations Sustainable Development Goals (SDGs), and addresses key challenges such as climate change, resource depletion, and environmental degradation.

The Thai government has positioned the BCG model as a central element in its economic recovery and development plans, particularly in the wake of the COVID-19 pandemic. The model is seen to enhance the economy's competitiveness, particularly in the fields of agriculture, food, energy, and healthcare. Thailand is actively promoting the BCG model within international forums, including APEC and ASEAN, to foster regional cooperation in sustainable development.

APEC endorsed the BCG Economy Model in the Bangkok Declaration during the APEC Economic Leaders' Meeting in November 2022. This endorsement marked a significant moment for Thailand, which championed the BCG Economy Model as a central theme during its hosting of APEC 2022. The Bangkok Declaration emphasized the BCG model to promote sustainable and inclusive growth across the Asia-Pacific region, addressing challenges such as climate change, environmental sustainability, and economic resilience.

### **Policy Analysis - BCG Policy Strategy Structure for Net-Zero Emissions in Thailand**

#### **1. Strategic Vision**

- The BCG Economy is positioned as a mechanism to transform Thailand into a global leader in sustainability. By leveraging the economy's biodiversity and cultural richness, the model aims to enhance competitiveness while ensuring inclusive and sustainable growth.
- The model aligns with Thailand's domestic strategies and global SDGs, integrating the Sufficiency Economy Philosophy (SEP) to promote resilience and sustainability.

#### **2. Key Sectors**

- The BCG model focuses on four main sectors: agriculture and food, health and wellness, energy, materials and biochemicals, and tourism and creative economy. These sectors are seen as critical in achieving a value-based economy and reducing the environmental footprint.
- Emphasis is placed on increasing productivity, enhancing standards, and fostering innovation, particularly in high-value products and services that align with global sustainability trends.

#### **3. Economic Impact**

- The BCG Economy is expected to contribute significantly to GDP growth, aiming to increase the share of BCG-related industries from 21% to 24% of GDP within five years.
- The model promotes the creation of green jobs, particularly in high-skilled areas, and aims to uplift the income of farmers and communities while reducing environmental degradation.

#### **4. Net-Zero Goals**

- Central to the BCG Economy is the pursuit of a low-carbon society, with specific targets to reduce greenhouse gas emissions by promoting renewable energy, improving resource efficiency, and minimizing waste.
- The model supports the development of green technologies and innovations that are essential for Thailand's commitment to achieving carbon neutrality.

#### **5. Implementation Strategy**

- The BCG model calls for a "Quadruple Helix" collaboration, involving government, private sector, academia, and international networks to drive the adoption of sustainable practices.
- The strategy includes capacity building, regulatory reforms, infrastructure development, and fostering global partnerships to enhance the BCG ecosystem.

In summary, the BCG Economy Model is a comprehensive approach designed to drive Thailand's transformation towards a net-zero society, ensuring sustainable and inclusive growth while positioning the economy as a leader in green economy initiatives.

### **Key Issues for Policy Recommendations**

To transform society toward net-zero emissions with the application of the BCG Economy Model, several key policy recommendations are required:

#### **1. Policy and Regulatory Frameworks**

- **Strong Government Commitment:** Clear and supportive policies from the government are essential to drive the BCG agenda. This includes setting ambitious targets for carbon neutrality, establishing regulations that promote sustainable practices, and providing incentives for businesses and individuals to adopt green technologies.
- **Environmental Regulations:** Implementing stringent regulations to reduce greenhouse gas emissions, manage waste, and protect natural resources is crucial. This also involves creating a conducive environment for the adoption of clean energy and sustainable practices.

#### **2. Technological Innovation and Adoption**

- **Research and Development (R&D):** Continuous investment in R&D is needed to develop new technologies that can reduce emissions and improve resource efficiency. This includes advancements in renewable energy, bio-based products, waste management technologies, and sustainable agriculture.
- **Smart Technologies:** Adoption of smart technologies like smart grids, energy storage systems, and AI for resource management can optimize energy use and reduce emissions.
- **Biorefinery and Bioenergy:** Developing infrastructure and technologies for biorefinery and bioenergy can help produce low-carbon fuels and materials, reducing reliance on fossil fuels.

#### **3. Circular Economy Practices**

- **Resource Efficiency:** Encouraging the efficient use of resources by promoting recycling, reuse, and reducing waste is fundamental. This involves rethinking product life cycles to minimize environmental impact.
- **Waste Management:** Implementing circular economy principles in waste management can significantly reduce emissions by ensuring that waste materials are reprocessed and reintegrated into the economy rather than being discarded.



#### **4. Public-Private Partnerships (PPP)**

- Collaborative Efforts: Strong collaboration between government, private sector, academia, and civil society is necessary to implement the BCG model effectively. Public-private partnerships can drive innovation, mobilize resources, and scale sustainable practices.
- Investment in Green Infrastructure: Encouraging private sector investment in green infrastructure projects, such as renewable energy facilities, sustainable transportation, and eco-friendly industrial processes, is crucial.

#### **5. Education and Capacity Building**

- Public Awareness and Education: Raising awareness about the importance of sustainability and the benefits of the BCG model is essential to gain public support. Education and training programs should be implemented to equip individuals with the knowledge and skills needed to participate in a green economy.
- Workforce Development: Developing a skilled workforce capable of working in emerging green sectors is necessary for the transition. This includes retraining workers from traditional industries to adapt to new, sustainable practices.

#### **6. Financial Mechanisms and Incentives**

- Green Financing: Developing financial mechanisms that support green investments, such as green bonds, carbon credits, and subsidies for renewable energy, is essential. Financial incentives can help lower the cost of transitioning to sustainable practices.
- Carbon Pricing: Implementing carbon pricing mechanisms can create economic incentives for reducing emissions and investing in low-carbon technologies.

#### **7. Global and Regional Cooperation**

- International Collaboration: Engaging in global and regional partnerships to share knowledge, technologies, and best practices is crucial for achieving net-zero emissions. Collaboration with international organizations and other countries can enhance the BCG model effectiveness.
- Alignment with Global Goals: Ensuring that the BCG model aligns with global initiatives, such as the Paris Agreement and the Sustainable Development Goals (SDGs), can strengthen international cooperation and access to global funding.

#### **8. Community and Cultural Engagement**

- Community Participation: Engaging local communities in the transition to a BCG economy is critical for its success. This involves supporting community-based projects that promote sustainable practices and enhance local resilience.
- Cultural Shift: Fostering a cultural shift towards valuing sustainability, conservation, and responsible consumption is essential for long-term societal transformation.

By addressing these elements, society can effectively transition toward net-zero emissions while fostering sustainable development and resilience through the application of the BCG model.

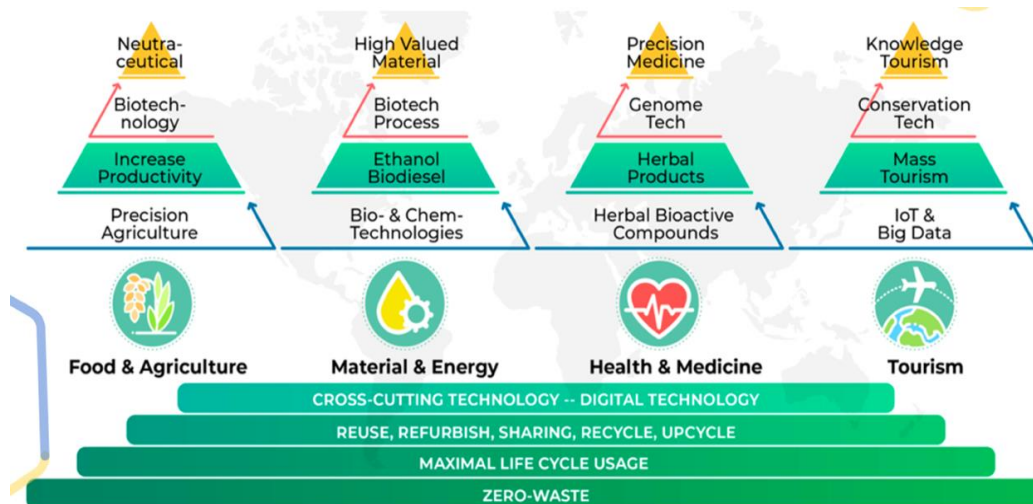


Fig 6. BCG Pillars and Value Creation

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