APEC Workshop on Promoting Technology to Contribute to Sustainable Energy Transition

APEC Energy Working Group

September 2024

Asia-Pacific
Economic Cooperation

Asia-Pacific
Economic Cooperation

APEC Workshop on Promoting Technology to Contribute to Sustainable Energy Transition

APEC Energy Working Group

September 2024

APEC Project: EWG 02 2023A

Produced by
Pham Quynh Mai
Multilateral Trade Policy Department
Ministry of Industry and Trade, Viet Nam

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

APEC#224-RE-04.8

TABLE OF CONTENTS

APEC WORKSHOP ON PROMOTING TECHNOLOGY TO CONTRIBUTE TO SUSTAINABLE ENERGY TRANSITION

30 – 31 May 2024

Summary Report

I. INTRODUCTION

On 30 and 31 May 2024, the APEC Workshop on Promoting Technology to Contribute to Sustainable Energy Transition, initiated by Viet Nam and co-sponsored by China; Hong Kong, China; Indonesia; Japan; Chinese Taipei; the United States was held in Ha Noi, Viet Nam. Speakers and participants came from global organizations and research institutions and representatives from APEC member economies' relevant Ministries and government's agencies, companies and business associations that relates to energy in APEC economies and across the APEC region.

The Workshop aimed to provide an opportunity for stakeholders for sharing about the experiences and good practices in promoting technology to contribute to sustainable energy transition towards a low carbon economy.

II. BACKGROUND

It is commonly accepted that the world has been facing unprecedented challenges posed by the impacts of climate change. According to NASA [1] the planet's average temperature in 2020 was 1.02°C warmer than the baseline 1950–1980 mean. As the Planet is heating up, causing many climate change issues. The scientific community is in agreement that the emissions of greenhouse gases into the atmosphere are the reasons for these problems. As such, it is critical to transit to a climate-resilient future global economy and appreciate net zero or carbon neutrality commitments with energy transition playing an important role. The energy transition is a pathway toward transformation of the global energy sector from fossil-based to low-carbon by the second half of this century. At its heart is the need to reduce energy-related CO_2 emissions to limit climate change[2].

There is the replacement of fossil fuels with renewables. On the other hand, we have the development of new technologies such as energy storage and hydrogen, the electrification of certain sectors, and digitalization. As the world's energy sector moves

[1] https://earthobservatory.nasa.gov/images/147794/2020-tied-for-warmest-year-on-record
[2] Energy Transition (irena.org)

toward renewable energy sources, industrial companies are challenged with addressing this transition in transformative ways.

It is undoubtedly true when saying that in order to achieve the sustainable transition, the role of technology is profoundly important. According to Verbruggen, technology is the practical application of knowledge to achieve particular goals [3]. This application requires a certain amount of equipment and information. Every aspect of energy requires technology. For example, extracting resources to generate energy requires technology; building energy infrastructure also requires extensive application of innumerable technologies. Also according to GE, digital is the oxygen of energy transition. Technology will be key to making power-generating assets more efficient, the electric grid more secure and resilient, the aviation industry more sustainable, and helping manufacturers reduce waste.

This project held a 2-day Workshop in Viet Nam in 2024 that helps APEC and non – APEC economies and stakeholders to share about the experiences and good practices in promoting technology to contribute to sustainable energy transition towards a low carbon economy.

III. OPENING REMARKS

In the opening remarks, Mr Doan Ngoc Duong (Deputy Director General, Electricity and Renewable Energy Authority, Ministry of Industry and Trade, Viet Nam) highlighted that dependence on depleting fossil fuel sources not only causes serious environmental pollution including greenhouse gas emissions to water and soil pollution, but also is a major cause of climate changes. This reality poses an urgent need to transform energy towards green, on the basis of meeting the energy supply from clean fuels through the development of renewable energy and the "low carbon" strategy, reduction of greenhouse emissions and efficient energy consumption. Mr Duong observed that with the positive impacts it brings to economies, energy transition has become an inevitable global trend, in which the top goal of reducing greenhouse gas emissions. Specific commitments have been made by many economies, including Viet Nam, at the 26th United Nations Climate Change Conference (COP 26).

Mr Duong mentioned that in this transition, technology plays an important role, from developing efficient solutions for capturing and storing energy, to optimizing its use

[3] Verbruggen, A., W. Moomaw, J. Nyboer, 2011: Annex I: Glossary, Acronyms, Chemical Symbols and Prefixes. In IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation [O. Edenhofer, R. Pichs- Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, C. von Stechow (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

in both daily production and consumption. Some new technologies include carbon capture, utilization and storage (CCUS), production of hydrogen and ammonia, etc. However, due to limited resources, many developing economies have difficulty accessing new technology and are at risk of being left behind. For Viet Nam, science and technology is considered a top policy, a strategic breakthrough contributing to a fair and sustainable energy transition, towards a low-carbon economy.

With that meaning, the Workshop would provide an overview and evaluate the results achieved in ensuring energy security in the APEC region; discuss the opportunities and challenges that APEC members are facing and propose solutions to promote technology that contributes to a fair and sustainable energy transition. This is also the contribution of the Government of Viet Nam to the collective APEC effort in implementing the Just Energy Transition Initiative and aiming to achieve the common goal of the APEC region: to double the share of modern renewables in the energy mix by 2030 (relative to the numbers from 2010) as instructed by APEC Economic Leaders. The Workshop is also expected to discuss and propose feasible and applicable initiatives, recommendations and policy solutions for APEC cooperation in the coming time.

IV. KEY ISSUES

1. OVERVIEW ON ENERGY TRANSITION

There were 2 speakers in the Session: Dr Terry Surles, Consultant, Hawaii Natural Energy Institute, the United States and Mr Hideyuki Umeda, Director for International Policy on Carbon Neutrality, International Affairs Division, Agency for Natural Resources and Energy, Ministry of Economy, Trade and Industry, Japan.

- To begin the presentation, Dr Terry Surles delivered a presentation on Overview on Energy Transition. He stated that net zero technology (carbon neutral) must be supported by integrated approach. According to IEA [4] 2020, 50% of the technologies needed to reach net-zero by 2050 are in the proto-type or demonstration phase. Globally, renewable energy system lead in new installations, coupled with fossil retirements. The speaker presented a chart of year on year global change in electricity generation by source from 2019 to 2026, which shows that the use of renewable energy was increasing year by year. There has also been significant global increases in Li-ion battery installation. Transformation of grid in the USA requires consideration of all of these variables including: climate, environment, environmental justice, job creation, economic competitiveness, and domestic security. In 2023, both renewables and natural gas continue to grow for

[4] International Energy Agency (IEA)

electricity generation. Deployment of solar and now storage is surging. Due to cost benefits, most additions continue to be wind and solar. The solar and wind become more competitive with natural gas and become cheaper than coal. The fossil-fired systems are expected to continue to be retired in 2024. Since 1997, there is a continued funding for CCS[5] and it is anticipated that there is a continued growth in energy storage. Storage will become more important for ramping and load shifting. In the United States, utilities are investing in innovative grid technologies to modernize grid. Therefore, the US Department of Energy (USDOE) proposal for USD3 billion to connect renewable resources with load centers needs to provide for integrated solutions. These considerable funds will be needed for physical infrastructure installation. Dr Surles pointed out that energy AI[6] can provide sets of solutions to better management of a disaggregated grid. Lastly, he said that DOE is focused on numerous issues for deployment of variable renewables on grid. Improvements in information technologies create opportunities for automation for interconnections. Interconnection processes must continue to adapt to a changing generation mix and changing transmission technologies to right-size network upgrades. With a constrained transmission system, making use of available capacity will be critical for timely connection of new resources at low cost. Interconnection and transmission planning require coordination and balance; interconnection reforms must address issues in market design, regulation, fairness, and transmission planning.

- Mr Hideyuki Umed presented on Japan's Energy Policy for Decarbonisation. He divided his presentation into 3 main parts: Japan's Energy Policy, Alternate Energy and Power and Cooperation with Asia through the Asia Zero Emission Community (AZEC). Based on the Strategic Energy Plan, Japan sets up the energy policy targets: Safety; Energy security; Economic efficiency and Environment. Mr Hideyuki showed the energy mix of Japan – 6th Strategic Energy Plan which is policy responses for 2030. Japan aims to make renewable energy as primary power resources, further pursuit of thorough energy efficiency and restart of nuclear power plants with safety as a top priority. The Japanese Government supports private companies' efforts to pursue innovation and demonstrations of new carbon neutral technology through JPY2 trillion Green Innovation Fund. He listed out 14 sectors that are expected to grow toward 2050. In 2023, Japanese Government has "Basic Policy" for the Realization of Green Transformation (GX), which delivers both emission reduction and economic growth. Successful GX enhances competitiveness of companies and Japan. The Pro-growth carbon pricing concept is to support the investment. JPY150 trillion of public/private investment over the next decade is necessary for GX. The speaker highlighted that Japan Climate Transition Bond has wide use of proceeds such as the transformation of the

[5] Carbon captured and storage (CCS)
[6] Artificial intelligence (AI)

manufacturing industry, GX of the transportation sector, promotion of carbon recycling, etc. In order to achieve Net Zero economy, transition finance is crucial. Although green projects have attracted investment, transition to net zero requires more. Companies are expected to show their credible transition strategy. Secondly, Mr Hideyuki talked about the Alternate Energy and Power: (i) Offshore wind power generation; (ii) Next generation solar cell development; (iii) Fuel ammonia; (iv) hydrogen utilization in iron and steelmaking processes. Then he mentioned the Supplier support scheme, which is important in hydrogen implementation. CCS is also important in Japan. In Japan, there is an Advanced CCS Program projects. Lastly, he talked about the cooperation with Asia through AZEC. He briefly talked about the definition of AZEC and some main points of AZEC Leaders' Joint Statement, in order to pursuit the Net zero emission community.

2. OPPORTUNITIES IN PROMOTING TECHNOLOGY TO CONTRIBUTE TO SUSTAINABLE ENERGY TRANSITION

There were three speakers in the Session: Ms Fang-Ling Liao, Director, Energy Administration, Ministry of Economic Affairs, Chinese Taipei; Ms Kanyawee Jantaradach, Mechanical Engineer, Senior Professional Level, Department of Alternative Energy Development and Efficiency (DEDE), Thailand and Mr Vu Quang Dang, Independent Energy Specialist, Viet Nam.

- Ms Fang-Ling Liao started her presentation by mentioning some information about Chinese Taipei's geography, GHG[7] emission structure by types and sectors, and electricity supply structure in 2023. She viewed that abundant sunshine and one of the world's best wind farms are strengths of Chinese Taipei. Therefore, Chinese Taipei has strategies in energy transition from low-carbon for the period of 2016-2025 to zero-carbon for the period of 2026-2050. The strategies focus on promoting green, increasing gas, reducing goal and aiming to meet nuclear free. However, there are some challenges that Chinese Taipei are currently facing, which are limited land area and dense population. In comparison with Switzerland, Chinese Taipei has similar land areas, but the population of Chinese Taipei is triple that of Switzerland. To deal with those problems, Chinese Taipei has some solutions with specific targets towards 2050 focusing on 5 aspects, including: solar PV, offshore wind, geothermal, innovative energy and energy efficiency. To implement these solutions, Chinese Taipei has improved the empowerment and communication

[7] Greenhouse gas (GHG)

through promoting mechanism of just transition with participation of many stakeholders in various activities and consultations.

- Ms Kanyawee Jantaradach divided her presentation in four main parts: status on renewable energy development in Thailand, energy plan toward carbon neutrality, driving policies and renewable energy implementation projects and opportunities in promoting technology. Ms Jantaradach has shared some statistics on Thailand's energy situation in 2023, ratio of renewable energy use in the period of 2016 – 2023 and renewable energy production in 2023 compared to its targets in the field of electricity, heat and biofuels. Thailand has energy plan toward carbon neutrality. In order to achieve its 2050 carbon-neutrality target, a study from the Office of Natural Resource and Environment Policy (ONEP) indicated CO2 emission in energy sector need to significantly decrease from 250 MT in 2025 to 95.5 Metric ton (MT) in 2050. The Development of Thailand's Energy Plan (NEP) framework has been approved to drive Thailand energy transition towards carbon neutrality and net zero emission. The Domestic Energy Policy Council (NEPC) approved the NEP framework on 04 August 2021 with four main aspects including new electricity generation, transport sector transformation, energy efficiency adjustment and energy business structure transformation. There are some renewable energy implementation projects and opportunities for Thailand in biomass and biogas, wind and solars, biofuels for transports and community-based power plant platform.

- Mr Vu Quang Dang started his presentation by indicating some statistics of investment flows and investment opportunities in Viet Nam with nearly 100 investable ideas assessed based on abatement potential and deployability. The speaker divided his presentation in two main parts, which are: urban lighting transition in Viet Nam and pilot battery energy storage system. He mentioned about typical smart and energy-efficient lighting system in the urban area of Viet Nam with some main transitions of the smart and energy-efficient lighting system (from traditional lamps to energy-efficient lamps, energy saving by switching off to dynamic dimming, cabinet-based control to lamp-based control, simple lighting control center to smart lighting control center and lighting pole for only lighting to smart poles with several functions). There have been lots of opportunities for the urban lighting transition coming from the legal framework, governmental management, current infrastructure and new requirement. The speaker also introduced the pilot battery energy storage system project including its objective, description, scales as well as barriers and opportunities to the project.

3. OBSTACLES IN PROMOTING TECHNOLOGY TO CONTRIBUTE TO SUSTAINABLE ENERGY TRANSITION – PERSPECTIVE OF THE PRIVATE SECTOR

There were two speakers in the Session: Ms Mung Ada, Manager, Environmental Sustainability, Hong Kong Disneyland Resort, Hong Kong, China and Mr Nguyen Tuan Phat, Legal Manager, Asian Clean Capital Viet Nam.

- Ms Mung Ada brought to the workshop the experience of sustainable energy transition model from Hong Kong Disneyland Resort, which is the largest single solar site in Hong Kong, China. This resort launched solar energy project in 2018 with the first batch of solar panels installed in 2019 and has been expanding since 2021 until now. By 2024, it is expected that the resort will expand towards more than 8.200 solar panels, 59 locations, 3.3 MW power capacity, 3.7 million kWh annual electricity generation and annual consumption of more than 1.100 (around 3-person households). Hong Kong Disneyland Resort has applied smart technology through cloud data readily accessible by App and real-time performance monitoring for each panel. However, there were four groups of solutions to deal with challenges, namely, site selection, panels at building roofs, installation and investment cost. The resort has used different types of panels for various types of rooftop surface to tackle space limitation issue, invited professionals from different teams involved to address technical complexities, applied safety and maintenance considerations to address complexity at rooftops and joined government incentive scheme to deal with high upfront costs. Current government incentive is limited up to 1MW capacity, Hong Kong Disneyland Resort would like to explore the opportunities to expand more than 1MW capacity. Ms Ada also mentioned about the gender equality and inclusion working at Hong Kong Disneyland Resort through the women's involvement in the sustainable energy projects and equal participation and representation of women in decision – making processes.

- Mr Nguyen Tuan Phat started his presentation by mentioning about the global ambitions for Net Zero. By 2023, around 120 economies have committed or considered to commit to Net Zero by 2050. Also, to limit global warming to $1.5^{O}C$, the world needs to decarbonize at a rate of 17.2% year over year. The speaker showed the process to illustrate the government of Viet Nam's aim to transition its economy towards net zero from 2019 to 2024. According to the speaker, the energy transition of Viet Nam faces with some challenges in meeting that aim such as economic growth goals, undeveloped infrastructure, legal framework and the capital. He indicated the case study of rooftop solar system with zero-export device.

Due to the limitation of power grid capacity, at the current, investors are recommended to install devices that limit the amount of solar power exported to the grid. However, this installation was implicit some disadvantages such as energy waste, holding back investors from achieving "net zero" carbon and not solving problem in the long-term. He suggested the alternative solution was to use battery energy storage system with advantages of minimizing energy waste and maximizing full use of clean energy and disadvantages of high cost, no applicable technical standards yet and limited storage capacity. To conclude, the speaker recommended three methods to promote technology to contribute to sustainable energy transition, including development appropriate legal and regulatory framework, encouraging the private sector to invest in infrastructure, especially the grid and completing loan policies for enterprises.

4. OBSTACLES IN PROMOTING TECHNOLOGY TO CONTRIBUTE TO SUSTAINABLE ENERGY TRANSITION – PERSPECTIVE OF THE ACADEMIC SECTOR AND INTERNATIONAL ORGANIZATIONS

There were 3 speakers in the Session: Dr Terry Surles, Consultant, Hawaii Natural Energy Institute, United States; Mr Phung Quoc Huy, Senior Researcher, Asia Pacific Energy Research Centre (APERC) and Ms Pham Thu Tra My, Researcher, Institute of Energy, Viet Nam.

- Dr Terry Surles started his presentation by saying that the carbon neutrality in the USA goal is essentially to "electrify everything". There is a need for rapid processes for: (i) Aggressive penetration of renewable resources; (ii) Retirement of fossil-fired generation while maintaining the grid services; (iii) Political agreement on overall climate issues and methods for working with impacted areas and across jurisdictions. There will be numerous challenges in extensive development of clean energy systems in terms of grid issues; resource issues; financial issues; institutional, cultural, and social issues. Integrated systems approach is necessary for climate goals, but sectors sometimes have conflicting needs. Then, Dr Surles continued to discussed more about issues. First, he mentioned the technology innovation and deployment activities needed for future grid operations and planning. The future grid will replace dispatchable, inertia-providing thermal generation with lots of less-dispatchable inverter-based resources, operate a faster, more complicated grid, and integrate many distributed and Behind the Meters (BTM) resources with utility-scale resources. However, sufficiently good analytical tools and secure controls are not available now. Some solutions may create problems for grid resiliency and reliability. Therefore, there is a need for better

modeling and planning tools. Second, he talked about the critical materials and supply chain issues which will continue to hinder development. Critical materials are not evenly distributed around the world; as new easily accessed resources may be more difficult to locate. Recent events with supply chain disruptions have led to cancellations of approved projects. Third, the financial issues will need to be seriously considered. He pointed out that Government intervention is a key attribute. The costs of many renewable technologies are starting to rise and the goal of "electrify everything" will require huge build-out of the grid. So, the problem is where does the money come from? Globally, costs to reach carbon neutrality are daunting. The investment needs to increase in the USA and internationally. Additionally, there must be consideration on how to ameliorate impacts on other systems such as water resources and balance ecosystem issues with energy development. Interrelationships between critical infrastructure segments must be considered. Fourth, institutional, cultural, employment, and social issues will be challenging. The "Grid world" is changing, there is a shortage of intellectual and operational talent. Lastly, Dr Surles mentioned that the Government must be consistent, while considering multi-attributes. There must be clear pathways for tech deployers and financiers to make decent returns on investment.

- Mr Phung Quoc Huy delivered a presentation on on Carbon Capture and Storage (CCS) deployment in APEC economies located in Southeast Asia. First, he mentioned the definition of CCS and the need for CCS. The CCS provides a potential way to decarbonize hard-to-abate sectors, enable low-emissions hydrogen production from fossil fuels, and deliver carbon removal technologies. Then, he talked about the CCS deployment in the APEC region and the globe. The IEA World Energy Outlook 2022 notes that under a net zero emissions by 2050 scenario, global Carbon Capture, Utilisation and Storage (CCUS) facilities will have to increase to 1.2 Gt per year in 2030, and to 6.2 Gt per year in 2050. The APEC CCS development will increase 7 times from 2022 to 2030. He showed some examples of operational CCS capacity by sector in some APEC economies such as Australia; Canada; China; Japan; and USA. Then, he showed the planned CCS capacity to 2030 by sector in some APEC economies. Then, Mr Huy gave CCS development status in Indonesia; Malaysia; and Thailand and the bottlenecks to deploy CCS in APEC economies located in Southeast Asia. To conclude the presentation, Mr Huy summarised that CCS technology is a promising solution for the energy sector to transition towards a decarbonised society. The technology has been commercially deployed in multiple regions globally with total of 392 CCS projects: 41 in operational, 26 in construction, and 325 in various stages of development. The APEC economies located in Southeast Asia, which heavily rely on fossil fuels, have limited experience and preparedness for CCS development and have yet to deploy any demonstration or commercial CCS projects. Six major obstacles hinder the

deployment of CCS in APEC economies located in Southeast Asia, including capital and operating costs, policy instruments, legal and regulatory frameworks, CO_2 storage sites, maturity of technology, and public acceptance.

- Ms Pham Thu Tra My made presentation on Obstacles in Promoting Technology to Contribute to Sustainable Energy Transition in Viet Nam. She divided her presentation into 4 main parts: (i) Energy transition orientation of Viet Nam's power system; (ii) Opportunities in energy transition in Viet Nam; (iii) Obstacles in promoting technology to contribute to sustainable energy transition in Viet Nam and (iv) Solutions. First, about the energy transition orientation of Viet Nam's power system, she mentioned about the load forecast of Viet Nam from 1995 to 2050. Then she mentioned the Power Development Program (PDP) VIII of Viet Nam which sets out two main development directions: (i) Strongly develop renewable energy sources, in which solar power and solar power will become the main sources of the system: The proportion of electricity produced from renewable energy sources will reach about 30.9-39.2% in 2030 and increase to 67.5- 71.5% in 2050 and (ii) Gradually reduce the proportion of thermal power sources and from 2030 aim to co-firing with clean fuels such as biomass/ammonia/hydrogen to reduce emissions and almost completely convert in the period 2045-2050. Regarding the renewable energy potential, she listed out some potentials such as hydropower potential; onshore wind; offshore wind etc. The areas with high potential for wind and solar are concentrated mainly in the Central and Southern regions. The proportion of renewable energy (including hydropower) in the operating scenario reaches 30.9 - 39.2% in 2030, 67.5 - 71.5% in 2050. The CO2 emissions reach 204-254 million tons in 2030, peak in 2035 and gradually decrease to ~27 - 31 million tons in 2050 (mainly from domestic gas sources), which has achieved the goals. Secondly, she discussed about the opportunities in energy transition in Viet Nam. There are 4 main opportunities: (i) Science and technology develop, the cost of producing renewable energy sources decreases; (ii) Energy transition from fossil fuels to renewable fuels has local support; (iii) Able to take advantage of support and financial capital support from the international community; (iv) The demand for purchasing green electricity from international corporations with commitments to sustainable development goals and the use of renewable energy in Viet Nam is large. Thirdly, Ms My mentioned 4 main obstacles including: (i) The power system has not been designed to operate with a high proportion of renewable energy; (ii) Distributed renewable energy sources are located far from load centers; (iii) The system of mechanisms and policies has not kept up with the development of renewable energy and (iv) Some new technologies have not been commercialized or thoroughly researched in Viet Nam. To conclude the presentation, she talked about some solutions to tackle those obstacles for example: Building the electricity market according to the approved roadmap,

ensuring fair competition, attracting resources in power source - grid development, ensuring enough electricity for socio-economic activities; Developing policies and mechanisms to encourage efficient use, save energy and demand respond etc.

5. CASE STUDIES IN SOME APEC MEMBER ECONOMIES

There were 4 speakers in this Session: Ms Mung Ada, Manager, Environmental Sustainability, Hong Kong Disneyland Resort, Hong Kong, China; Mr Nguyen Tuan Phat, Legal Manager, Asian Clean Capital Viet Nam; Dr Terry Surles, Consultant, Hawaii Natural Energy Institute, United States and Mr Joachim Molkelbaan, Global Trade and Sustainable Development Advisor.

- Ms Mung Ada presented the case study of Hong Kong Disneyland Resort, Hong Kong, China. First, she gave an example on the Car Park Solar Canopy. There are 80 parking spaces in the car park with 400 bi-facial solar panels which generates 200,000kWH of annual electricity generation. This is the 1st Car Park Solar Canopy in Hong Kong, China. The Car Park Solar Canopy will generate renewable energy both direct from sunlight and reflect from the ground. It is also the green shelter to reduce heat absorbed of car parking under canopy, so less energy is used to cool the cars at the end of working day. The Government has introduced measures to facilitate the installation of solar system in open car parks by private sector in year 2022 such as Fast-track mechanism; Gross floor area (GFA) concession; Site coverage and Plot ratio calculations. There are some challenges with the car park solar canopy such as (i) Different interpretations on how the existing technical requirements were to be applied; (ii) Extensive discussions with various professionals to ensure the system could fulfill local regulations and requirements; (iii) More coordination and time is required for discussions. The solutions are (i) Providing specific technical requirements on the new system or document on how the existing requirements can be applied to the new system; (ii) A well-defined and agreed-upon set of requirements can help aligning local professionals on the expectations. There is limited land available in Hong Kong, China for traditional ground-mounted solar installation. By installing solar canopy in open car park, it can maximize the use of available land. The solar canopy serves dual-purpose – generating solar energy while providing shade and shelter. It saves energy by reducing the need for air-conditioning when drivers return to their cars and reducing depreciation to vehicles -vehicles can be protected from direct sun exposure. Second, Ms Mung Ada gave examples on the AI Digital Twin. Air-conditioning accounts for around 30% of Hong Kong, China's total electricity consumption on average according to government's statistic numbers. To achieve carbon neutrality, a roadmap was set out by the government which is to reduce the electricity consumption in commercial buildings by 30-40% by 2050. Ms Mung Ada gave an

overview on Current Chiller Plants' at Hong Kong Disneyland (HKDL) using electric and gas chiller plants for separate locations. HKDL has applied AI Digital Twin to combine and optimize the operation of both chiller plants. The AI Digital Twin can show real-time operational status; manage and monitor the operations of chiller plants. The AI Digital Twin can also perform data simulations to identify optimal energy control; maximize energy saving and optimize operation of chillers; and enhance predictive maintenance. There are some challenges of AI Digital Twin for example it would be more complex when combining electric and gas chiller plants with different technical characteristics and requirements. The solution is to allow longer time to gather historical record for AI machine learning. Lastly, Ms Mung Ada listed out some benefits of adopting new technologies in terms of operations, environment, maintenance, cost and learning.

- Mr Nguyen Tuan Phat delivered presentations on Technology's contribution to energy transition. He listed the procedures for developing rooftop solar (RTS) project in Viet Nam. Mr Phat mentioned the case studies of RTS in Da Nang, Viet Nam. According to the city's Plan for the period 2021-2030, vision towards 2050, Da Nang has average annual economic growth rate of the city by 2030 is 9.5-10%, this is also the centre for hi-tech industry, information technology in Viet Nam, a centre for startups, innovative initiatives in Viet Nam, which has high and stable energy demand. Universal Alloy Corporation Viet Nam (UACV) is one of the world's leading manufacturer of aircraft components for aerospace companies. Established its new facility in Viet Nam in 2019, UACV wishes to transform into a sustainable business, prioritizing the use of clean energy, aiming to achieve net zero emissions by 2035. Mr Phat pointed out the Drafted Decree on direct power purchase agreement ("DPPA") in Viet Nam. There are 2 models of DPPA: Direct DPPA through private wires and Financial DPPA. Then, Mr Phat presented the Participants and Contractual Flows for financial PPAs in the Financial DPPA (Model 2). The application timeline for DPPA includes 5 steps: Application submission, Evaluation and selection; Contract negotiation; Competing DPPA requirements; Operation. Companies submit DPPA application to Domestic Load Dispatch Centre of Viet Nam.

- Dr Terry Surles gave presentations on some opportunities and challenges of sustainable energy transitions. In California and Hawaii, despite new federal funding, accomplishing things must be done on a state level. Therefore, the States are important. On 8 January 2024, from 1900 to 2100 hours, oil-fired generation was low due to many maintenance outages; limited waste (fuel supply) was available for H-Power; requirements that prevent storage from being charged by fossil limited the use of utility-scale storage. New environmental regulations,

coupled with increased cycling due to variable renewables has increased thermal outages. Dr Surles pointed out some key findings that the 08 January 2024 event caused by higher-than-normal generator outages, exacerbated by low solar. Solar output was very low, with daily capacity factor of ~1%, that led to 200-300 MW higher-than-normal mid-day load due to low rooftop solar generation and an inability for solar and storage and standalone storage to fully charge. While solar output was low, historically, it was not anomalous. Things could have been worse if it occurred in August or September. Standalone storage was only charged to around 85% and could have charged more during early morning hours. Solar and storage projects contractually unable to grid-charge and were unable to charge from solar. In Oahu, the need for dispatchable capacity decreases but remains significant even at very high variable penetration levels. Then Dr Surles discussed how California is trying to move to 100% carbon neutrality. California still uses a lot of natural gas-fired generation. California's energy efficiency regulations and legislation have been very effective, benefitting carbon neutrality. The speaker showed the chart with CO2 emission percentages in the state, in which 25% CO2 emissions come from industry (not buildings), 29% come from transportation, 10% come from agriculture. The electrification of everything requires major upgrades to grid. Excess generation in the middle of the day leads to increased amounts of curtailed production. Load shifting from afternoon to early evening can help to address curtailment issues and make better use of renewable resources, while reducing fossil-fired resource needs. Significant deployment of storage has changed resource mix and could reduce curtailment. Increased storage supports load shifting and can be key component of demand response regulation and implementation. According to a collaborative study which evaluated the best way to get to carbon neutrality, firm power (nuclear, hydro, geothermal, and fossil-fired with CCS) is less costly than only developing excess variable renewable resources. California now has regualtions for zero net carbon new homes. However, buildings need 6 million heat pumps by 2030, but costs and chlorofluorocarbons (CFC) emissions are problems. To conclude the presentation, Dr Surles said that blizzard of legislation can overwhelm regulators leading to implementation of new rules that may have unintended consequences. Technology initiatives require that institutional, financial, and regulatory barriers be resolved. Increased concern of equity, societal, and cultural aspects must be factored into decision. Failure to consider inter-relationships (land, water, energy, equity) can lead to a situation of sometimes conflicting rules (or non-rules).

- Mr Joachim Molkelbaan delivered a presentation on the energy transition in the Kingdom of Saudi Arabia (KSA). Looking at the energy landscape, the energy of KSA mainly focuses on fossil fuel, mainly on oil and metro gas. There is little low carbon energy supply in the energy mix. However, it is possible to change the

energy mix by 2032. In the short term, under current planned policy, the stabilisation in terms of emission will continue. However, there will not be enough for reaching the global 1.5 Celcius Degree reduced target and for reaching the target of domestic emission. Next, he highlighted that the Government of KSA has adopted the Vision 2030. KSA aims to increase the share of renewable energy to 30% of the energy mix by 2030. The Government adopted net zero target (by 2060) in 2021 and an integrated approach to navigate the energy sector's complexity. In the demand side, the industry, buildings and commerce, transport and agriculture are the main sector. On the supply side, they are oil, gas, clean hydrogen, power and nuclear. The reason for integration in energy sector are: interconnectivity, interchangeability and interdependency. Integration will enable KSA to ensure energy security, maintain energy affordability and target energy sustainability. The KSA adopted the Circular Carbon Economy as a wholistic and pragmatic pathway to net zero. Also, Saudi Arabia is making tangible progress in the energy transition in terms of energy efficiency, liquid displacement, CCS, carbon capture and use (CCU), etc. Mr Joachim showed a chart of leading economies' annual renewable energy capacity. What is important for achieving those goals is to increase the public awareness, education and international collaboration. The speaker recommended that it should raise public awareness about the benefits of a low-carbon economy; Educate the public about the impact of their energy consumption; Promote sustainable lifestyle choices and Wider understanding of benefits like job Creation. For international collaboration, he recommended that KSA should collaborate with other economies and organizations to share knowledge and best practices; work together to develop global solutions to climate change; support international agreements and initiatives. Lastly, Mr Joachim concluded that Saudi Arabia, historically reliant on oil, is undergoing a significant energy transition. Saudi Arabia, long resistant to even discussing topics such as climate change mitigation is showing serious ambitions regarding renewables, energy efficiency, CCS, and carbon markets. This shift is crucial not only for domestic sustainability but also for global energy markets and APEC economies. Saudi Arabia's energy transition is gaining momentum, driven by ambitious goals and significant investments. The challenges still remain, but the opportunities for economic growth and environmental sustainability are vast.

6. DISCUSSIONS

- A speaker mentioned that the current trend of renewable energy is focused on wind and solar development and retirement of coal and fossil fuels energy.
- A participant assumed that carbon capture, utilization and storage (CCUS) is the most suitable method for industry but not for all sectors.

- Related to the CCUS, a speaker highlighted that the USA is interested in exploring the direct air capture of CO2.
- In the USA, natural gas is increasing and the natural gas-fired power plant still emits carbon dioxide even though it is cleaner than coal-fired power plants. Fossil-fired systems will continue to be retired to make way for clean and renewable energy transition but this transition could increase risks to grid stability.
- Participants emphasized the potential of hydrogen as a clean energy source.
- Besides, participants also discussed the role of research and development on renewable energy in emerging economies and the need for collaboration between different stakeholders to finance research and development.
- There are many goals set for using hydrogen and related clean sources of energy. However, very few financial supports are available. Biofuels are used with limitations due to the high costs and methods to get these biofuels.
- As compared to the food growing sector, it is much less financially lucrative to grow crops for bioenergy sources, but it is also difficult to produce enough bio-crops that return carbon dioxide to the environment.
- Besides, in most areas there are not enough renewable resources for carbon neutrality and to produce hydrogen by electrolysis.
- Some companies are trying to take off products from the refinery to produce methane and butane. That is why a fair amount of hydrogen is available in the pipeline to provide for heating, cooking, and other uses.
- Some participants raised questions on innovation. A speaker pointed out that with the new technologies, the clean energy transition would be supported significantly. In fact, 50% of the technology needed to reach net zero by 2050 is still in the prototype stage, or not yet completed. However, some new technologies are still very expensive in terms of implementation and monitoring and deployment.
- Regarding the pathway to carbon neutrality, a speaker centered on the interplay between technological advancement and practical implementation. The need for a comprehensive approach to achieve carbon neutrality should be considered, accordingly, a speaker emphasized the importance of early development, demonstration, and deployment of research and development.
- Net-Zero technology must be supported by an integrated approach including innovation, demonstration, and deployment.
- However, the problem is that with state-funded research and development (R&D), the government tends to expect everything under the R&D projects will work well. But in reality, various aspects of the projects do not work properly as expected. These issues happened in various economies. Thus, a speaker suggested that

economies other than China; Japan; USA; the European Union, etc. should not put much money into research to avoid wasting funding and resources.

- It is essential to utilize new technology and methods in the energy sector to help reduce carbon emissions, considering the application of nuclear power or natural gas with CCUS in appropriate ways.
- The government should consider the development of tax reform for carbon emissions to encourage the development of sustainable energy sources with low levels of carbon emission.
- To promote a low-carbon economy, economies are aiming to use forms of energy such as wind power, solar power, hydrogen and nuclear power. These are the four forms of zero-carbon energy. In Viet Nam, these forms of energy account for a relatively small proportion, only about 5-7%.
- To reduce carbon dioxide, it is advised to consider not only electricity but also transportation, industrial use of power and residential use for heating, cooking, and related activities.
- Regarding the electricity industry in general, by 2023, Viet Nam will have 80 GW installed capacity, about 280 billion KW hours of use, but in reality, Viet Nam has 28% renewable energy installed capacity and 27% hydropower (large and small). By 2025 there will be about 55% low carbon energy and the electricity produced will account for 42%. But in reality, in Viet Nam, most uses focus on low-carbon sources such as wind and solar with unlimited capacity. There is a huge potential to develop renewable energy.
- Regarding coal power, the Vietnamese government has not been developing coal power, only implementing existing coal power to reduce the reliance on fossil fuels to move toward a low carbon economy.
- As for hydropower, when building a hydropower plant, an economy will have to sacrifice part of the forest. Instead of that, the government will plant trees to avoid losing the forest and protect the ecosystem. In addition, the trend for hydroelectric lakes to become tourist attractions is increasing and the government will invest more in reforestation and conservation of tourism and hydroelectric lakes to develop tourism.
- When discussing the transition to renewable energy in Viet Nam, speakers and participants focus on the role of battery storage. A speaker emphasized the importance of government policy in promoting renewable energy, and the need to replace coal-fired power plants with renewable resources. Hydrogen was also mentioned as a potential energy source, while a comprehensive energy mix was highlighted as crucial.

- Battery storage is very significant for the future of Viet Nam but to develop battery storage, a lot of critical materials are required. In Viet Nam, critical minerals are limited.
- China dominates critical minerals and materials for battery storage development.
- For Viet Nam, it is very difficult to develop a huge amount of battery storage for essential use of the community. However, Viet Nam still has conditions for battery storage and some of semiconductor companies have come to Viet Nam to find ways to develop the materials for the battery storage market.
- In Thailand, the Government cooperates with other economies such as Japan to find ways and research for phasing out the coal-fired power plants.
- For natural gas, Thailand does not have a plan to phase out natural gas because they believe the benefit of this source for emitting the CO2 emission. In addition, Thailand has plans to use hydrogen to meet the demands of the market and industry but the plan is still under the research and development phase.
- A speaker shared the potential of successful public-private partnerships in promoting renewable energy development among economies. While one speaker emphasized the importance of private sector investment in developing renewable energy sources, another speaker highlighted the need for clear technical requirements and education for high-quality human resources in energy sectors to support the demonstration and deployment of renewable energy in the region.
- It is essential to have valuable policies, funding, collaboration, and investment in renewable energy to address climate change and net zero carbon emissions. In some economies such as Australia and Germany, the private investors and the government together invested in this sector and shared in different ways to support the zet zero process.
- It is proposed to promote education and capacity building of the stakeholders throughout workshops and sharing of information and good practices.
- Regarding the public-private partnership (PPP) for energy transition, one of the problems that has to face is the time frame of the PPP. The PPP often takes a very long time to complete as well as to receive the approval of investment policy, leading to a high cost of implementation.
- In case the private sector makes the investment, the process may become shorter. Thus, it is suggested to consider carefully the advantages and disadvantages of doing the PPP investment and the timeframe of the private investment.
- Viet Nam needs big investment for energy transition but considering the time frame, the capital as well as the effectiveness of the investment, a speaker suggested having the collaboration between PPP and private sector investment at the same time.

- In Hong Kong, China, if a company has a higher capacity could get involved with the Government, they will have a bigger chance to attract investors or other private companies or contractors to provide solar panel installation.
- One of the challenges for a private company is the technical solutions for building and fulfilling the requirements to adapt to the system and regulation regularly.
- The clearer technical requirements for submission and for the application of new projects, the shorter application and preparation process could be done by the private sector or investors.
- Another speaker shared that as for the investor, investment policies from the Government is highly taken into consideration.
- In Viet Nam, financial issues play an important role in energy projects. In fact, according to international experience, finance is the second most important factor for a successful project.
- Engaging diverse stakeholders, policy support, and incentives for deploying clean energy technologies is a good practice for economies in the region.
- It is recommended to find a way for the public and private sectors to work together on the sustainable energy transition goals. However, a speaker advised that the Government should be realistic, taking into account specific circumstance, and set achievable and reasonable goals for renewable energy transition.
- Almost all CCS facilities are available in advanced economies including Australia; Canada; etc. rather than developing economies. Developing economies need more support from the Government to develop CCS projects and facilities throughout the research, providing pilot projects, demonstration and deployment projects.
- Some kinds of incentives, dedicated programs, technologies, carbon tax, and pricing could be considered to be deployed.
- The CCUS project needs a long time to implement. Then, after the first demonstration project has been done, the economy needs to monitor the side effects of CO2 by sensor or other methods to prevent the emission from coming back into the atmosphere. For example: Japan is monitoring the CO2 liquid underground and maintain it until 2030. After that, Japan will commercialize the CCUS.
- The cost of CCUS is different from sector to sector and the carbon tax is also different among economies and depends on the economy’s policy.
- In the energy sector, the carbon conservation emissions in the gas-fired power plant is just about 4% of the total gaseous emissions and the cost for CCS increases the overall cost.

- In the USA, the Government uses the carbon financial subsidies to support CCUS deployment. The European economies also have support over the carbon price and the actual cost to support the CCUS.
- Power generation using renewable energy has the disadvantage of variable output, due to external characteristics such as changes in wind speed, solar radiation intensity, or differences in grid characteristics, actual operation of the electrical system and other factors related to weather.
- Due to the goal of integrating a large amount of solar and wind power to the grid, it poses a great challenge to the stability of the grid for distributed power, solar and wind power. In many cases, there needs to be significant upgrades for transmission and distribution networks to get electricity for renewable resources to load centers..
- A speaker suggested utilizing different models in the world to optimize the integration of wind and solar power into the domestic grid. Furthermore, it is necessary to identify the causes and risks, especially when rapidly increasing wind and solar energy sources into the system, creating a new operating model.
- Some approaches including solar and wind power, battery storage, and natural gas combined with CCS should be taken into account.
- As calculated, until 2030, solar/ wind energy will not face lots of challenges. After 2030, with the higher function of the solar/ wind power plants, it is required to upgrade the more flexible power systems.
- Advanced technologies such as batteries, and thermal power plants were proposed to improve grid resilience and to compensate for the variable capacity of solar and wind.
- The biggest obstacle for renewable energy transition is capital because finance is critical to build renewable resource and CCUS facilities, which may cost millions of USD.
- Regarding the way to capture the sunlight, a speaker shared the application of bifacial solar panels that could have the unique capability to absorb solar energy not just from the sun's direct rays but also from rays that bounce off various surfaces to maximize the capability of sunlight capture. This installation method is particularly suitable for ground-mounted systems and flat commercial rooftops, where optimizing sunlight exposure is paramount.
- A speaker highlighted that the pressure is that if a company could not follow the requirements of big markets such as Europe or the USA, the company will be left behind and could not compete with others. That is the pressure for them to set an ambitious target for net zero.

- The Vietnamese Government also facilitates the JETP[8] with various activities in Viet Nam and makes Viet Nam become one of the most active economies in the region in this sector.
- Global companies have targets to reach net zero carbon emissions much earlier than the Government. They have 2 options for net zero, the first one is to directly buy renewable energy from the generators; the second option is to buy a renewable energy certificates to fulfill the clean and renewable energy.
- Global companies combine carbon credits and carbon offsets to achieve net zero but need to be careful about the carbon credits and carbon offset to avoid green washing.
- Regarding the policies on transportation and households, a speaker shared the Chinese government distinguished EVs from fossil fuel gasoline vehicles by using the color of the plates. EVs accounted for more than 20% total vehicles in China. In Viet Nam, EVs could be used but it is quite difficult to distinguish it from other forms of fossil fuel vehicles. It is a good practice for the economy and Viet Nam also has a policy regarding transportation.

V. RECOMMENDATIONS

During the final session, there were 3 panelists in this Session: Ms Fang-Ling Liao, Director, Energy Administration, Ministry of Economic Affairs, Chinese Taipei; Ms Kanyawee Jantaradach, Mechanical Engineer, Senior Professional Level, Department of Alternative Energy Development and Efficiency (DEDE), Thailand; Mr Phung Quoc Huy, Senior Researcher, Asia Pacific Energy Research Centre (APERC).

- Ms Fang Ling Liao talked about the Carbon Pricing: Economical tools to reduce GHG emissions. There are 75 carbon pricing instruments in operation worldwide. Then, Ms Liao talked about the Chinese Taipei's climate change response act. On 30 March 2022, Chinese Taipei provided an action pathway for achieving Net-Zero Emissions by 2050. On 15 February 2023, Chinese Taipei has incorporating Chinese Taipei's 2050 net-zero target into law. After that, Ms Liao mentioned about the perfect carbon pricing mechanism. In terms of international competitiveness, there is International Carbon Border Adjustment Measures (CBAM). In terms of domestic competitiveness, she mentioned 3 pillars: Industries, Policy makers and NGOs[9]. In Industries, rates setting must take international competitiveness and other economies' industrial carbon control intensity into consideration. It encourages business to undergo technological upgrade and industrial transformation. The policy makers strike the balance of economic growth and

[8] Just Energy Transition Partnership (JETP)
[9] Non-Governmental Organization (NGO)

environmental protection. They also introduce incentives for low-carbon technologies through carbon pricing. Relating to NGOs, carbon pricing should cover each industry's carbon emissions; Import fuels levied or emission terminals levied; Lower the impacts on climate-vulnerable groups. Lastly, she talked about how carbon pricing contributes to carbon emission. Accelerating the efforts to reduce carbon emissions is essential due to the cost associated with them. Carbon pricing will establish a system for internal carbon inventory and management. It will create the funding to support the development of low-carbon technologies and prevent carbon leakage.

- Ms Kanyawee Jantaradach recommended that (i) we should study the potential of renewable energy to cover all the types that we have and always keep the data as accurate and up-to-date as possible; (ii) Learn the best practices from other economies that have similar renewable energy potential or similar energy usage characteristics to our economy; (iii) develop best practices that we learned for adoption and applying it to suit our context, and considering how to adapt current technology to better fit the way of life of the people in our economy; (iv) promote the use of technology with various measures and (v) Apply successful case to other areas. Then she gave some examples of renewable technology implementation cases. For example: Solar PV on the rooftops of fisherman's boats with Battery energy storage; Renewable Heat Incentive Project (RHI); Agrivoltaics implementation in Thailand. Finally, she concluded that in Thailand, promoting technology should be in line with Thailand's 20 year Domestic Strategy.

- Mr Phung Quoc Huy gave some recommendations for implementing CCS in APEC economies located in Southeast Asia. In the presentation, Mr Huy listed out some bottlenecks that the implementation CCS has been facing and gave some examples relating to each bottleneck. The bottlenecks are (i) Capital and operating costs; (ii) Policy instruments; (iii) Legal and regulatory frameworks; (iv) CO_2 storage sites; (v) Maturity of technology; (vi) Public acceptance. Lastly, he concluded that APEC economies, which heavily rely on fossil fuels, have limited experience and preparedness for CCS development and have yet to deploy any demonstration or commercial CCS projects. To accelerate CCS development and deployment, the APEC economies located in Southeast Asia should further focus on: (i) Investigating, screening the potential CO_2 storage sites; (ii) Improving the regulatory frameworks on CCS; (iii) Issuing policy instruments that support the development of CCS technology; (iv) Developing policies to drive CCS investment; and (v) Cooperating with international and regional agencies in CCS knowledge sharing.

Participants also shared overall views and recommendations on (i) take-aways from the Workshop, (ii) what economies/ APEC should do in term of policies and actions.

Sharing on what the participants have achieved from the workshop sessions

- The participants shared that the workshop is a good opportunity for private sectors, governments, domestic, and international organizations, and other related stakeholders to meet and work together to share information and best practices on sustainable energy transition.
- The participants could learn and share policy, plan and successful cases and best practices that make a good reference for economies in the region.

Brainstorm/ explore possible ways and suggest recommendations to APEC and member economies

- The combination of different energy sources such as biomass and Liquefied Natural Gas (LNG), etc. could be taken advantage of as much as possible to minimize the use and reliance on dirtier fossil fuels such as coal.
- Participants recommended that the private sector and public sector should cooperate to facilitate the development of renewable energy and find solutions to reduce the long time of energy transition to reduce the cost of investment of the private sector.
- It is proposed to develop and adopt new technology and pilot projects to help and share among members in the region with the same situation and facilitate new and renewable energy. Besides, due to the high cost of investment in renewable energy transition, subsidy from the Government is also necessary to support the renewable energy processes and make it more accessible.
- In APEC, due to the differences in the situations, contexts and potential renewable energy sources, economies should develop core technology, cooperate with global stakeholders and learn from international experiences.

VI. CONCLUSIONS

In her closing remarks, Ms Pham Quynh Mai (Viet Nam's Senior Official to APEC) observed that the Workshop's participants have had great opportunities for sharing an overview on energy transition; opportunities and obstacles in promoting technology to contribute to sustainable energy transition from various perspectives; sharing case studies

as well as discussing approaches to promote sustainable energy with a focus on technology.

Through the sharing and discussion of speakers/ experts and floor interventions on policies, best practices, case studies and experiences from member economies during 2 days, a number of key findings and recommendations have been highlighted which might include, but not limited to the followings:

- It is important to raise public awareness of importance of energy transition and identify approaches to promote sustainable energy transition, especiallly through promoting technology as one among feasible solutions.
- Many APEC developing economies, which rely heavily on fossil fuels and have limited experiences and preparedness to promote CCS. To accelerate CCS development and deployment, economies should consider focusing more efforts on investigating, screening the potential of carbon (CO2) storage sites; improving the regulatory frameworks on CCS; issuing policy instruments that support the development of CCS technology and investment; cooperating with international and regional agencies in CCS knowledge sharing.
- Develop and improve legal frameworks to manage and promote sustainable energy transition in practice, in which to facilitate the research and adoption of technologies with a clear pathway for tech deployers and financiers to make decent returns and investment.
- Economies can consider developing a reasonable carbon pricing mechanism including establishing a system for internal carbon inventory and management, supporting the development of low-carbon technologies as a means to accelerate the efforts to reduce carbon emissions.
- Promoting Public – Private Partnership (PPP) to promote the transition for a more competitive and sustainable energy market.
- APEC should lead an active role in promoting sustainable energy transition through identifying feasible approaches to implement through sharing knowledge, experiences, case studies and best practices.

The Senior Official hoped that each and every member economy's participants could have a more in-depth knowledge of the issues, hence promoting further efforts to realize the transition to sustainable energy, subject to our specific domestic circumstances and long-term development strategies.

By hosting this Workshop, Viet Nam wishes to join and strongly support APEC's common efforts in pursuing green economy, sustainable and inclusive growth and development.

VII. ANNEX 1: RESULTS OF THE PRE-WORKSHOP SURVEY

1. What are the benefits of technologies in promoting sustainable energy transition in your economy?

Malaysia

The benefits of technology in promoting a sustainable energy transition in Malaysia are multifaceted, addressing economic, environmental, and social aspects. Economically, advanced technologies in renewable energy, such as solar can lower the costs of energy production over time, making sustainable energy more competitive with traditional fossil fuels. This transition can create new jobs in various sectors, including manufacturing, installation, and maintenance, and reduce Malaysia's dependence on imported fossil fuels, enhancing energy security and stability. Environmentally, technologies that promote renewable energy sources significantly reduce greenhouse gas emissions, crucial in combating climate change, and decrease air and water pollution, contributing to better public health outcomes and preserving natural ecosystems.

Socially, renewable energy projects, especially in rural areas, can lead to improved infrastructure and quality of life, providing reliable energy access that supports education, healthcare, and economic activities. Innovative technologies can help bring electricity to remote and underserved areas, promoting social equity and improving living standards. Specific technological contributions include the implementation of smart grid technology, which optimizes energy distribution and reduces losses, ensuring a more efficient and reliable energy supply. Advances in battery storage technology allow for better integration of renewable energy sources, addressing intermittency issues and ensuring a stable energy supply. Additionally, technologies that enhance energy efficiency in buildings, industries, and transportation can significantly reduce overall energy consumption.

The Philippines

The integration of advanced technology plays a vital role in promoting a sustainable energy transition in the Republic of the Philippines. By enhancing energy use through innovations such as smart grids and energy-efficiency initiatives and systems, we can significantly reduce energy consumption and waste. Additionally, utilizing renewable energy sources—like biomass, solar, wind, geothermal, hydropower, and ocean energy—is crucial for the environment. Embracing these renewable technologies not only promotes economic growth by creating new industries and job opportunities but also diversifies our energy portfolio. This diversification reduces our reliance on

imported fossil fuels, thereby enhancing domestic energy security and safeguarding our economy from the volatility of global energy markets.

Viet Nam

- Reduce energy consumption and energy waste
- Enhance energy efficiency in buildings, transportation.
- Protect environment.

2. What are the challenges in applying technology to pursue sustainable energy transition?

Malaysia

One major challenge is the high initial capital cost of renewable energy technologies, such as solar panels, which can be a significant barrier for widespread adoption. Additionally, the existing infrastructure is predominantly designed for fossil fuels, requiring substantial investments to upgrade and integrate renewable energy sources effectively. Another challenge is the intermittency of renewable energy sources, which can lead to instability in the energy supply without adequate energy storage solutions.

The Philippines

There are different challenges in applying technology in sustainable energy transition. Here are some difficulties we encounter:

- The integration of renewable energy into our existing grids poses a multifaceted challenge.
- It often demands upgrades and modifications to ensure the stability and reliability of our energy infrastructure.
- Despite remarkable advancements, certain renewable energy technologies still struggle with limitations, particularly in terms of higher maintenance costs compared to conventional energy sources.
- Public hesitation towards new technologies paired with a general lack of awareness about their numerous benefits can serve as significant roadblocks to our progress.

- Access to financing and investment stands as another challenging obstacle, potentially slowing down the pace of adopting renewable technologies.

Viet Nam

- High cost
- High maintenance cost
- Lack of qualified human resources to fully understand and apply new technology
- Lack of training for using of new technology

3. How to speed up the investment in digitalized assets to promote energy transition in your economy/your company?

Malaysia

To speed up investment in digitalized assets to promote energy transition in Malaysia, several strategies can be implemented. Firstly, the government can play a crucial role by offering incentives such as tax breaks, subsidies, and grants to companies investing in digitalized energy assets. Establishing clear and supportive regulatory frameworks that facilitate the deployment of digital technologies in the energy sector is essential. Public-private partnerships can be fostered to pool resources and expertise, accelerating the development and implementation of digital energy solutions.

The Philippines

The Philippines has been actively accelerating investment in digitalized assets

to promote energy transition through several strategies:

- The Department of Energy (DOE) has been developing and implementing policies that incentivize investment in digitalized assets for energy transition. This includes providing support mechanisms such as tax incentives and subsidies.
- The DOE collaborates with industry players, technology providers, research institutions, and international organizations to facilitate investment in digitalized assets. These partnerships help to leverage expertise, resources, and funding opportunities to accelerate the deployment of digital energy solutions.

Viet Nam

- Increase public-private cooperation.

4. Please share some policies/ laws/ regulations on promoting technology that your economy is applying to pursue sustainable energy transition.

Malaysia

- Domestic Renewable Energy Policy and Action Plan
- Domestic Energy Transition Roadmap
- Malaysia Renewable Energy Roadmap
- Domestic Energy Policy

The Philippines

The following policies and initiatives demonstrate the Philippines' DOE's commitment to promoting technologies that support sustainable energy transition, drive investments in renewable energy and energy efficiency, and contribute to the Philippines' long-term energy security and environmental sustainability goals.

- Renewable Energy Act of 2008 (RA 9513): This legislation provides the framework for the development and utilization of renewable energy resources in the Philippines. It includes provisions for incentives, feed-in tariffs, and other mechanisms to promote investments in renewable energy technologies such as solar, wind, hydro, biomass, and geothermal.
- Energy Efficiency and Conservation Act of 2019 (RA 11285): This law aims to promote energy efficiency and conservation measures across various sectors in the Philippines. It mandates the establishment of energy efficiency and conservation standards, labeling programs, and incentives for energy-efficient technologies.
- Net Metering Program: The DOE's Net Metering Program allows consumers with renewable energy systems, such as solar panels, wind turbines, and biomass generators, to offset their electricity consumption by exporting excess energy to the grid. This encourages the adoption of distributed renewable energy technologies and promotes energy self-sufficiency.

- Green Energy Option Program (GEOP): The GEOP enables electricity consumers to choose renewable energy as their main energy source. Under this program, eligible customers can source a percentage or all of their electricity from renewable energy suppliers, thereby supporting the development of renewable energy projects in the economy.

Viet Nam

- The Power Development Program (PDP) VIII
- Decision No. 14/2023/QD-TTg (referred to as Decision No. 14) promulgating the List and roadmap of low-efficiency energy-using vehicles and equipment that must be eliminated