Asia-Pacific
Economic Cooperation

Advancing Free Trade
for Asia-Pacific Prosperity

Green Synergy Solutions in APEC Region

APEC Policy Partnership on Science, Technology and Innovation

March 2021

APEC Project: PPSTI 06 2019A

Produced by
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APEC#221-PP-01.1

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ACRONYMS & GLOSSARY

Acronyms used in this report:

APEC-ACABT	Asia-Pacific Economic Cooperation- APEC Research Center for Advanced Biohydrogen Technology
ABAC	APEC Business Advisory Council
EGNRET	Expert Group on New and Renewable Energy Technologies
EWG	Energy Working Group
PPSTI	Policy Partnership on Science, Technology and Innovation

Glossary used in this report:

Capacity Building	As activities - for example workshops, training courses and seminars - that enable people, businesses and government departments to improve their skills and knowledge to better engage in trade and investment. *(Sources: APEC website)*
Green Synergy	A green symbiotic system for integrating all green growth technologies that will complimentary, cooperative, and harmonic to factor X of productivity and resources saving. For example, integrate renewable energy with heat and hydrogen storage without battery system, and then apply to the smart grid with low costs.

1. OVERVIEW

Facing the ongoing environmental issues brought by global warming and climate change, developing sustainable, stable and environmentally-friendly green powers has been one of significant goals for governments and private sectors within APEC member economies. Green Synergy Solutions that integrate renewable energy with heat and hydrogen storages without battery system and then apply to the smart grid with low costs could become a possible solution. Moreover, Green Synergy Solutions concern about utilizing biomass resources from agro-waste to bioenergy and bio-economy, especially applying bio-waste via bio-refinery process to produce biohydrogen and related products, to increase economic development and application, to reduce carbon dioxide (CO_2), and eventually to produce green energy and biomaterials for environmental protection and energy security to empower the local community in a sustainable way. This project aimed to promote sustainable growth by integrating the heat and hydrogen storage from renewable energies for energy conversion into electricity, and applying to the smart grid system for solving the significant uncertainty of solar and wind power issues in APEC Region.

In order to enhance the capacity building and to promote the green technologies and low carbon strategy, this project has generated several outputs such as the draft of policy framework review, project-based training program for young entrepreneurs and the conduction of the Green Synergy Solutions event with theme “Green Synergy Solutions in APEC Region,” including Policy Dialogue, Workshop, Offline Project-based Training Program and Technical On-site Practice (Self-Fund). Due to the COVID-19 pandemic, the event was held in hybrid format: Physical Meeting at Chinese Taipei and Virtual Meeting on Cisco Webex Platform. The oversea participants who were not able to travel to Chinese Taipei all attended the virtual meeting. During 18-21 December 2020, 70 participants attended the physical event at Chinese Taipei and 59 participants attended the virtual event on Cisco Webex meeting platform. As mentioned earlier, the project aimed to eliminate gender barriers. This time, approximate 46% of total participation, 59 out of 129 participants were female; 54% of total participation, 70 out of 129 participants were male, which had reached the gender-friendly issue. In total, 129 participants (59 women) from 13 APEC member economies (Canada; China; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; The Philippines; Russia; Singapore; Chinese Taipei; Thailand and Viet Nam) represented different viewpoints from APEC PPSTI/EWG delegations, research institutes, universities, private sectors and governments.

The Green Synergy Solutions event, at first, has created opportunities for all participants to better understand the current energy demands and bioenergy application in different APEC member economies. As challenges and domestic plans within each economy were different, participants could exchange opinions, discuss the potential development and solutions to the current issues, and generate new measures of capacity building based upon research expertise and implementation experiences.

As a result of expanding mutual understanding among stakeholders, specialists and young entrepreneurs in APEC region, this initiative of opinion and experience exchange could also become a foundation to further generate policy recommendations, research plans and teaching methods.

The policy recommendations and research plans will boost the intended integration; support the innovative ideas of Green Synergy application in APEC member economies

with better-enhanced technologies to tackle possible situations. To consolidate and further accelerate the improvement, the outcomes of this event, the received comments and suggestions, and the identical factors related to this field have to be carefully examined.

2. METHODOLOGY

This project aimed to promote sustainable growth by applying Green Synergy Solutions to integrate the heat and hydrogen storages from renewable energies, and then convert to electricity and to smart grid system for solving the significant uncertainty of solar and wind power issues. As the ongoing climate change issues and COVID-19 pandemic continued to spread, the collaboration, opened discussions and new actions were required for people living in APEC region. The project also targeted to meet the 2019 APEC priorities, monitored global change of the focus of PPSTI and reduced energy intensity for low carbon development of the major goals of EWG.

Supported by this project, the event "Green Synergy Solutions in APEC Region" containing Policy Dialogue, Workshop, Offline Project-based Training Program and Technical On-site Practice (Self-Fund) was conducted with physical meeting at Taichung, Chinese Taipei and virtual meeting on Cisco Webex meeting platform on 18-21 December 2020.

In order to engage the policy makers, delegations, experts and young entrepreneurs for the knowledge and skill exchange in relation to the growth of economic benefits, social solutions, policies and life changes, the development of policy recommendations, the sharing of latest research outcomes, the training in capacity building, the expansion of a far-reaching network were executed in this first hybrid event "Green Synergy Solutions in APEC Region." To start the work of the project and to prepare for the event, APEC-ACABT has formulated the following work schedule as **Table 1** and taken various methods to overcome challenges brought by hybrid meeting.

Table 1: Work Schedule of the Project

Dates	Key activities	Deliverables
1 June – 31 July 2020	Set up website, modules and case study materials via training program platform	• Website and online training program platform completed
1 August – 15 December 2020	Preparation for the events, invitation to the participants from the member economies, the draft of the Policy Framework Review by leading researchers	• Agenda created (For the detailed agenda of the event, please refer to **ANNEX I**.) • Participants invited • Policy Framework Review drafted • 10 Young Entrepreneurs teams selected
18-21 December 2020	Implementation of the Green Synergy Solutions events	Events implemented as follows **Hybrid event**

		Physical meeting (full in-person meeting at Chinese Taipei for local participants) with virtual participation for oversea participants Day 1: Policy Dialogue Day 2: Workshop Day 3: Offline Project-based Training Program **<u>Physical event</u>** Day 4: Technical On-site Practice (Self-Fund)
1 February 2021	Dissemination of project findings	Project Report of the events outcomes discussed and endorsed by PPSTI / EWG disseminated in APEC economies

Firstly, as the event was announced to be held, APEC-ACABT invited speakers and experts from academia, research institutions and private sectors from APEC member economies to attend the event. To engage the speakers and experts in the opened discussion, the moderator of Policy Dialogue, Assistant Professor Dr Yi-Yuan William Su from Chinese Taipei drafted the Policy Framework Review to lead the experts to generate policy recommendations.

Since capacity building was a long term continuous process and must always be prepared to take action on new issues that arise, the project encouraged the young entrepreneurs from universities/research institutions within APEC region to propose innovative ideas and solutions in Offline Project-based Training Program, for not only tackling affordable energy, climate change and community problems but also promoting sustainability awareness in the APEC region.

The Offline Project-based Training Program, which contained a challenge-based learning activity called “YES Challenge,” had 20 young entrepreneur teams registering and submitting the initial project-based plans in Preliminary Round in July 2020. By turning in preliminary plans, the reviewers selected 15 teams to attend Semi-Pitch which were Module 1 and Module 2 to participate in the online case-study learning. Finally, only 10 finalist teams were enrolled to attend the final pitch and training program which were Workshop and Offline Project-based Training Program on 19-20 December 2020.

Meanwhile, APEC-ACABT also recruited an event secretary and assistants and held training courses to prepare them to arrange the event. In addition to the event preparation work, the event secretary was also in charge of contacting the invited experts, speakers and stakeholders, submitting the General Information Circular to APEC Secretariat for circulation and inviting the active participants from APEC member economies. After the end of the event, Event Secretary has submitted the Executive Summary, Project Report and Project Completion Report to APEC Secretariat on schedule.

As it was the first time for APEC-ACABT to hold a hybrid event, APEC-ACABT collaborated with several service providers to set up the equipment and to create the best environment for the event. To prevent any possible technical issues and to make sure the whole event could run smoothly, three test runs with oversea speakers, experts

and participants were conducted, and all the occurring technical problems were reported to the event organizer via online surveys and emails.

After the event ended, a questionnaire survey form was spread to the participants. The oversea participants could finish this survey via Google survey form, while the local participants at Chinese Taipei completed it in paper. Total of 65 responses were received. (Please refer to **ANNEX 2**)

Within two years, annual Long-Term Evaluation of APEC Projects (LTEAP) will be conducted by APEC Secretariat to collect suggestions and feedbacks from the event participants to further improve the upcoming APEC projects.

3. DELEGATES

The set of actions to be developed within this project aimed to benefit a broad range of stakeholders involved in the professional field of green technology and renewable energy. Beneficiaries were expected to include APEC PPSTI and EWG Delegations, policymakers of governments, invited speakers, experts and young entrepreneur teams from APEC member economies, and members of APEC-ACABT Steering Committee.

While developing new policies and regulations required preparation, promotion and implementation at governmental level, the sharing of practical experiences and research outcomes among APEC region needed to be completed first among public sectors, academia and private sectors. Beneficiaries were also expected to be knowledgeable with their economies' priorities for science, technology, and innovation for Green Synergy Solutions.

In order to develop policy recommendations and to exchange ideas within the event, the organizers have invited participants from a broad range of institutions and economies:

A. Governmental entities (ministries, councils, and others) and APEC PPSTI, EWG and EGNRET Delegations related to policy-making on green technology and renewable energy;
B. Experts from research institutions and academia of science, technology and innovation;
C. Relevant experts from public or private sectors
D. Young Entrepreneurs (team leaders, members and mentors included) from universities/research institutions

Attended by 129 participants from 13 APEC member economies, please refer to the following **Table 2** for the detailed number of participants.

Table 2: The number of participants from each of 13 APEC member economies

	Participating Economies	Number of participants
1.	Canada	1
2.	China	5
3.	Hong Kong, China	2
4.	Indonesia	8
5.	Japan	2
6.	Republic of Korea	1
7.	Malaysia	13
8.	The Philippines	1
9.	Russia	4

	Participating Economies	Number of participants
10.	Singapore	1
11.	Chinese Taipei	69
12.	Thailand	15
13.	Viet Nam	7

Gender equality can certainly contribute to the development and achievement of the project, therefore the project strived to target women participation and speaker to 50% and three pillars of criteria are No. (3) Skills, capacity building and health, No. (4) Leadership, voice, and agency, No. (5) Innovation and technology (Source: Appendix G-Contents No. 2 in Guidebook on APEC Projects). The event this time turned out to contain 46% women participation with 59 women out of 129 participants, which had been in the range of 45~50%. Although the targeted 50% female participation had not been reached this time, 8 of the 18 speakers were female, which could demonstrate APEC-ACABT's dedication to eliminating the barriers brought by gender-inequality.

Regarding the numbers of APEC member economies participating in the event, due to COVID-19 pandemic and the travel restrictions within some APEC member economies, most of economies did not nominate candidates for the event and the number of participating economies was 13. For more details of 129 participants from 13 APEC member economies, please see the list of participants at **ANNEX 3**.

4. PROJECT OUTPUTS

Aiming to integrate resources of renewable energy, to reach the goal of capacity building, to generate policy recommendations related to Green Synergy Solutions for public sectors and private sectors within APEC member economies, to promote sustainable growth and to solve environmental issues, the project conducted the event "Green Synergy Solutions in APEC Region" with the key project outputs as follows.

4.1 Policy Framework Review drafted in preparation for Policy Dialogue to generate policy recommendations
4.2 The 4-day Green Synergy Solutions event, including
  4.2-1 Policy Dialogue on two panel topics: "Land-use, Land-use Change and Food Security" and "Biomass: a value-added resource technology and management on agriculture residues"
  4.2-2 Workshop on Green Energy Technology and Sustainable Development, in relation to concepts of "Bionergy, Bioprocesses, Energy Management System and New and Renewable energy,"
  4.2-3 Offline Project-based Training Program with project plans in related fields such as "Bioenergy, Bioprocesses, Energy management system and New and renewable energy," and

4.2-4 Technical On-site Practice (Self-Fund) that visited Dongshi Hakka Cultural Park to explore an existing smart solutions system and the cooperation between local communities, universities and ecological villages.

4.1 POLICY FRAMEWORK REVIEW

In the project, the invited experts focused on climate changes and renewable energy, searched for Green Synergy Solutions and explored the issues from perspectives of policies, technologies and researches. As the issues required attention and changes at governmental level, APEC-ACABT invited Assistant Professor Dr Yi-Yuan William Su who is the expert in Law and Policy of Climate Change and Energy, to research and review the policies enactment, regulations and plan implementations within APEC region, to draft Policy Framework Review, and to be the moderator at Policy Dialogue on 18 December 2020. The offered Policy Framework Review would be a reference source and key indicator to develop the policy recommendations after the Policy Dialogue ended.

To start the first stage study, the legal team adopted a literature review to collect reports and materials produced by the following global institutions and organizations, including the United Nations (UNs), Food and Agriculture Organization for the United Nations (FAO), United Nations Framework Convention on Climate Change (UNFCCC), European Union (EU), The International Renewable Energy Agency (IRENA) and the Association of Southeast Asia Nations (ASEAN).

Climate change has had an impact on people's lives and could cause extreme weather conditions, destroy and deplete natural resources and affect livelihoods and food security (Dev, 2011; FAO, 2008). Climate change could also contribute to 70 percent of natural disasters within the Asia Pacific region. APEC member economies, which accounted for about 60 percent of world energy consumption, reduced the use of fossil fuels to meet the ever-increasing energy demand (APEC, 2015). As APEC and ASEAN have been working on climate change mitigation in different directions, these two organizations are still in the stages of pursuing collaboration and program initiatives in issues related to food security, climate change and energy consumptions. The essential role to play in developing policies and programs aimed to help restore growth and combat climate change and environmental pollution and damage in APEC member economies, especially in Southeast Asia region.

Therefore, the Policy Framework Review completed by Assistant Professor Dr Yi-Yuan William Su offered the analyses of current situations in the following APEC member economies: Indonesia, Malaysia, Chinese Taipei, The Philippines, Thailand and Viet Nam. As the issues of climate change, energy consumption, food security, land-use such as agricultural land and forestry and renewable energy usage have been intensively inter-related, the integrated viewpoints and resources would help the participants and experts to receive the outlook and professional suggestions as references to the two panel topics of Policy Dialogue such as “Land-use, Land-use change and Food Security” and “Biomass: a value-added resource technology and management on agriculture residues.” The indicators to be examined in the project targeted to raise awareness and to combine applicable resources for land usage and food production, effective energy usage, the increase in biodiversity, and climate change mitigation. (For the detailed contents of Policy Framework Review, please refer to the **ANNEX 4**)

4.2 GREEN SYNERGY SOLUTIONS EVENT

4.2-1 POLICY DIALOGUE

For the Policy Dialogue on 18 December 2020, eleven speakers from 8 economies such as Canada, Indonesia, Japan, The Philippines, Singapore, Chinese Taipei, Thailand and Viet Nam, were invited to deliver speeches based on their expertise on the topic of two panels: “Land Use, Land-use Change and Food Security” and “Biomass: A Value-added Resource Technology and Management on Agriculture Residues.” The moderator of the day, Assistant Professor Dr Yi-Yuan William Su had completed the Policy Framework Review, which analyzed the topics from the historical background, current status and economic situation of APEC member economies, to the domestic energy demands and technology applications, and finally to the new possibilities and potential solutions to solve the existing issues in each member economy.

The invited speakers for two panels introduced the issues from different aspects, shared their analysis, observation and researches on energy use, and provided solutions and suggestions for public sectors and private sectors to address. With the increase in awareness of sustainable development, energy and food security policies at governmental level would be tangible support to create more economic benefits and a more secure and environmental-friendly community. After the speeches of each panel, the Panel Discussion session led by the moderator began to help the experts and policy-makers to extend the discussion to a broader range and further exchange more opinions and solutions.

The official outset of the event was the Project Overseer, CEO of APEC-ACABT, Professor Dr Shu Yii Wu extending his warmest welcome to the local participants at Chinese Taipei and to the oversea participants online. **(Photo 1)**

Photo 1: Project Overseer, Professor Dr Shu Yii Wu delivered welcome remarks at the opening ceremony of Policy Dialogue.

APEC-ACABT also had an honor to invite the representatives of government officials of the hosting economy, including Mr Alpha Lowe, the Director-General of Finance Bureau from Taichung City Government, Mr Hsieh-Tang Chiang, the Senior Executive Officer in Department of International Cooperation and Science Education from Ministry of Science and Technology (MOST), and Mr Jeffrey Wang, the Counselor in Department of International Organizations from Ministry of Foreign Affairs (MOFA). The distinguished guests delivered their opening remarks and demonstrated a positive attitude to see more global exchange and future cooperation between organizations within APEC region. (**Photo 2**) On the other hand, although oversea participants were not able to be in present, they could still join the event via virtual meeting and take group photos with participants who were at event venue. Mr Nicholas Brooke, the ABAC Principal Advisor to APEC PPSTI from Hong Kong, China also delivered an online welcome remark to all the participants. **(Photo 2)**

Photo 2: Mr Alpha Lowe from Taichung City Government (Upper left); Mr Hsieh-Tang, Chiang from MOST (Upper right); Mr Jeffrey Wang from MOFA (Bottom left) and Mr Nicholas Brooke, the ABAC Principal Advisor to APEC PPSTI (Bottom right)

After the opening and welcome remarks session, the oversea participants took photo with the guests at Chinese Taipei for this first hybrid event of APEC-ACABT. **(Photo 3)**

Photo 3: Online Speakers and Participants turned on their camera lens to take group photos with the participants attending physical meeting at In Sky Hotel.

(A) Panel I- Land Use, Land-use Change and Food Security

Land is an essential resource to develop food crops and energy crops. In recent years, the energy crops plantation grows rapidly and increase incomes for the landowners and farmers. However, the land is a limited source and the government shall have a clear plan to secure the land acres for food crop production. To explore the development and current situation of land-use and food security, APEC-ACABT invited two keynote speakers: Mr Yudi Anantasena and Associate Professor Matthew Tan Kim Chuan and three invited speakers: Associate Professor Dr Hanilyn A. Hidalgo, Assistant Professor Dr Yuwalee Unpaprom and Dr Po-Han Richard Hsu, while Assistant Professor Dr Yi-Yuan William Su was also invited to serve as the moderator of the day to lead Panel Discussion session after speeches.

At the beginning of the first panel, Mr Yudi Anantasena, the Deputy Chairman of Technology for Natural Resources Development, Agency for the Assessment and Application of Technology (BPPT), Indonesia first shared the land use change and food security issue in Indonesia. Later on, he explored the issues from technology perspectives and proposed methods to achieve cooperation and sustainability. Representing Singapore, Associate Professor Matthew Tan Kim Chuan, the CEO of Asia of Assentoft Aqua Asia Pte Ltd, talked about the issues from the aquaculture perspectives, revealing the development, trends and possible transformation for ecologic equilibrium and food security under the COVID-19 pandemic and the continuous warming environment. From Central Bicol State University of Agriculture (CBSUA), The Philippines, Associate Professor Dr Hanilyn A. Hidalgo delivered her speech regarding the small farms and the importance of increasing profitability and consumability for small farmers. Later, Assistant Professor Dr Yuwalee Unpaprom from Maejo University (MJU) compared the differences and pros and cons between food crops and energy crops, and shared the food security strategies and potential development in Thailand. The last invited speaker of Panel I, Dr Po-Han Richard Hsu from Taiwan Association of Green Energy Transition (TAGET), Chinese Taipei, analyzed the development of Green Electricity from various perspectives, including law regulations, market demand, public interest and proposed applications heading towards a revolution of sustainability. Regarding the photos of these five speakers, please refer to **photo 4**.

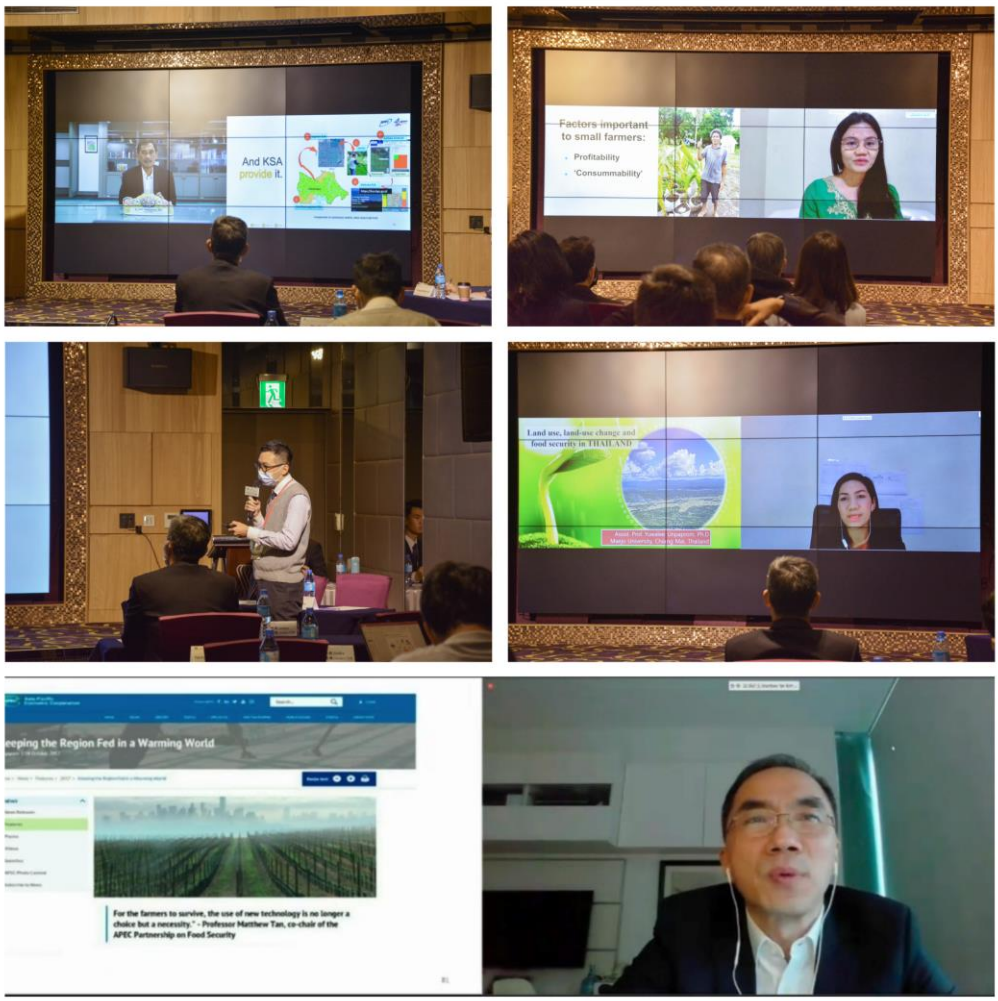

Photo 4: Mr Yudi Anantasena, Agency for the Assessment and Application of Technology (BPPT), Indonesia. (Upper left); Assoc. Prof Matthew Tan Kim Chuan, Asia of Assentoft Aqua Asia Pte Ltd., Singapore (Bottom); Assoc. Prof Dr Hanilyn A. Hidalgo from CBSUA, The Philippines (Upper right); Asst. Prof Dr Yuwalee Unpaprom from MJU, Thailand (Middle right); Dr Po-Han Richard Hsu from TAGET (Middle left)

After the speech session of Panel I was over, the moderator Prof Dr Yi-Yuan William Su led the Panel Discussion, raised questions to speakers to clarify subjects mentioned in the speeches and combined viewpoints with the current policies of different economies. **(Photo 5)**

Photo 5: The moderator, Assistant Professor Dr Yi-Yuan William Su led the five speakers to extend the discussion of Panel I on the topic “Land Use, Land-use Change and Food Security.”

The speakers considered the raised questions from the perspective of “circular economy,” that waste is not waste but rather a kind of resource for production and benefits. As people consider the effects of climate change, the transformation from petro chemical century to bioeconomical century is important while integrating the wastes, resources, innovations and technologies. Social solutions and new business models are also required from the circular process to benefit the society and communities.

In the discussion, the questions about “if there are any circular processes within the current development of the speakers’ researches / industries,” “as the industries target to reach high productivity, how to balance between profits, technology and ecology,” and “if there are any limitations to prevent agricultural expansion that will danger another land usage such as forest” had been raised to the speakers.

Later on, the speakers answered the questions and shared their observations on the current developments of the agricultural land usage and aqua cultural technologies. According to their sharing, the land use policies and regulations in economies like Indonesia, Thailand, and The Philippines have been strict but were designed to benefit the local residents and agricultural industries. On the other hand, while different private sectors are the major users of energies and resources and consumers have also been benefited from the products offered by the industries, the responsible consumption and the social responsibility need to be emphasized to reach the balance and to generate benefits returned to the society and communities.

Panel I Summary

After the speech ended, the moderator Assistant Professor Dr Yi-Yuan William Su briefly concluded the Panel I on “Land Use, Land-use Change and Food Security.” Extending

from the topic, the issues and concepts related to agriculture, aqua-technology, climate change, land usage policy, circular economy and ethical concerns had all been linked together with the current energy development and demands in APEC region. As people were looking forward to more sustainable developments and effective solutions to mutual benefits, hosting cross-profession conversations to engage participants and multiple stakeholders from various professional fields to explore more complicated issues would be highly recommended.

(B) Panel II - Biomass: a value-added resource technology and management on agriculture residues.

Since many agriculture residues and industrial wastes, including industrial and agriculture waste materials, can contribute to the development of biomass, the usage of these waste materials or agriculture residues shall not compete with other high-value applications. Biomass development is a value-added method for waste materials handling and increase benefits for farmers. Therefore, the development of biomass can reduce quantity of waste materials and increase energy generation. Further advanced technologies or innovated machines are also required to improve the usage of biomass on energy generation. The speakers of this panel included a keynote speaker: Mr Charles Lalonde and four invited speakers: Professor Dr –Eng. Eniya Listiani Dewi, Dr Nguyen Linh Dan, Assistant Professor Dr Prapita Thanarak and Mr Hiroki Yoshida, who generously shared their research outcomes and observations regarding the most advanced and available technologies on usage of biomass resources.

The Panel II began with Mr Charles Lalonde's sharing on the transformation of agricultural biomass in Canada. The policy context and its impact rapidly changed the form of agriculture that could ensure future sustainability and the way agriculture actually took part in bioeconomy. Next, also from Agency for the Assessment and Application of Technology (BPPT) Indonesia, Professor Dr –Eng. Eniya Listiani Dewi introduced the current energy situation and the bioenergy development program in Indonesia, the potential types of biomass, and how to turn the biomass to hydrogen. Prof Dewi also shared the innovations on green fuels within Indonesia and the prospect for both domestic partnership and global collaboration. The third speaker of this panel, Dr Nguyen Linh Dan from Vietnam-Japan Institute for Advanced Technology (VJIAT), National University of Civil Engineering (NUCE) shared the policy strategy and the types of biomass used in Viet Nam, and further demonstrated her research of biomass energy potential in APEC region. The next speaker was Assistant Professor Dr Prapita Thanarak from Naresuan University, Phitsanulok, Thailand. Professor Thanarak mentioned the current situation of electricity consumption and generation in Thailand, and how the community-based power plant policy could boost economic value and create more job opportunities. The last speaker of this day was Mr Hiroki Yoshida from Japan External Trade Organization (JETRO) - Jakarta Office. Mr Yoshida focused on Palm Kernel Shell (PKS) trading, the collaboration between Japan and Indonesia for PKS trading, the progress of biomass, and the ongoing challenges for PKS application in Japan. For the photos of these five speakers, please see **photo 6**.

Photo 6: Mr Charles Lalonde, CJ Agren Consulting, Canada. (Upper left); Professor Dr –Eng. Eniya Listiani Dewi, Agency for the Assessment and Application of Technology (BPPT), Indonesia (Upper right); Dr Nguyen Linh Dan, VJIAT, NUCE, Viet Nam (Middle left); Assistant Professor Dr Prapita Thanarak, Naresuan University, Thailand (Middle right); Mr Hiroki Yoshida from JETRO - Jakarta Office (Bottom)

After the speeches of Panel II, the moderator Prof Dr Yi-Yuan William Su also led the Panel Discussion session, raised questions to speakers to clarify subjects mentioned in the speeches and combined viewpoints with the current policies of different economies. **(Photo 7)**

Photo 7: The moderator, Asst. Prof Dr Yi-Yuan William Su led the speakers of panel II to discuss biomass application and current energy development with different economies.

To address and discuss the topic “Biomass: a value-added resource technology and management on agriculture residues,” the speakers of this panel first shared the regulations and policies regarding to biomass usage within their own economies. For example, Dr Nguyen Linh Dan mentioned that Viet Nam had regulations to guarantee the development of renewable energy usage such as solar power, wind power and biomass. With support of the government, abundant biomass resources among these three types of renewable energies demonstrated huge potentials in Viet Nam.

Next, the speakers also talked about their opinions about the way to improve the bioproduct. Take cars as example. Various regions in the world have been in transitions towards the electrification of cars, which would be a long-term process that requires more advanced technology, countless examinations and continuous governmental subsidies. While experiencing these transitions, people still need to depend on cleaner fuels to protect the environment and to try to transform the residues into biomass resources as a part of community or domestic energy plan. Under the circumstances, the smart-grid technology that distributes energy resources evenly would be a good solution to be integrated with the biomass refinery process to ensure energy storage.

Every economy might deal with the residues and wastes in distinctive ways due to different geographical environments, unique natural resources, its peculiar political and economic situation and the enactment of energy policies. To prevent the residues simply being diminished and not to be transferred to energy resources, the utilization of agricultural residues and industrial wastes and the promotion by the public sectors could reduce the gap and create more opportunities for individuals, businesses and communities.

Panel II Summary

Since the Policy Dialogue was about to reach to an end, the moderator Assistant Professor Dr Yi-Yuan William Su briefly summarized the talks of Panel II on “Biomass: a value-added resource technology and management on agriculture residues” as well. To improve the biomass usage and to advance the current green technology, the knowledge sharing, transboundary communication and networking among individuals, organizations and the governments in APEC region were also suggested to bring more collaborations, innovations and solutions in the future.

(C) Policy Recommendations and Development

Through the researched policies and panel discussions on day of the Policy Dialogue, two Policy Recommendations had been developed by the project to promote various renewable sources to achieve Green Synergy Solutions goal as follows:

i. The APEC leaders or SOM meeting shall make a decision or prepare a proposal to establish investigation methodologies and measures, such as GIS, to calculate the land usage among economic entities. It will also assist the APEC community to establish unified and single data center for designing future land and energy policies.
ii. APEC economic entities shall consider their attitude change from dealing with waste to source management. It would also help the societies to adopt the circulate economic concepts and use the limited sources wisely.

In order to improve the development between food productions, land and renewable energy, the project suggested that APEC shall establish a working group and propose a training program and teach the APEC economic entities to calculate its domestic land-usage conditions. The same calculation methods and methodologies help all data to be collected from the APEC economic entities are comparable and easy accessed. After these investigation efforts done, all these investigation data shall be installed and kept within a database with unified format. It will help the APEC and its economic entities have better understanding on its land conditions and also improve the transparency on the food production and demands in this region, and then finally achieve its protection goals on humanitarian and regional security.

4.2-2 WORKSHOP

As the event continued to the second day, the hybrid Workshop took place at Feng Chia University (FCU) and on Cisco Webex platform. To extend the discussion from Policy Dialogue and to introduce and share the latest Green Energy Technology and sustainable development applications, topics related to Bioenergy, Bioprocesses, Energy Management System and New and Renewable Energy, APEC-ACABT invited three keynote speakers: Professor Dr Alissara Reungsang, Professor Dr Jin-Seek Choi, and Dr Doan Trinh Ta and four invited speakers: Professor Dr Ir. Mohd Sobri Takriff, Distinguished Professor Dr Wan-Yu Liu, Professor Dr Dwi Susilaningsih and Professor Ir. Ts. Dr Pau-Loke Show.

(A) Keynote Speeches

Welcomed by Dr Bing-Jean Lee **(Photo 8)**, the President of FCU, the Workshop began with speakers sharing researches, cases and project implementation by applying the latest green technology. The experts, young entrepreneurs and participants who came to join could not only learn the advanced technology and skills but also enhance their knowledge and develop a new interest.

Photo 8: Dr Bing-Jean Lee, the President of FCU, delivered his welcome remark to all the participants. And the oversea and local participants also took group photo together before the speech session started.

As the first speaker of the morning session, Professor Dr Alissara Reungsang talked about her research in “Integration of dark-photo fermentation and dark fermentation-anaerobic digestion for the valorization of Chlorella sp. Biomass.” Professor Reungsang

revealed how biohydrogen could be used as a clean bioenergy and how to produce this clean energy from micro-algal biomass by dark and photo fermentation. Next, Professor Dr Jin-Seek Choi from Hanyang University (HYU), Republic of Korea talked about the energy management system that could adjust the energy flows of all types of energy systems to achieve cost-effective monitoring and the control of energy resource distribution. Furthermore, Professor Choi also introduced "Energy Management Agent Framework" and its application on architecture. The third Speaker for the Workshop was Dr Doan Trinh Ta representing Viet Nam. Focusing on the topic "Low Carbon Society development in Viet Nam: Green Synergy Pathway to 2030," Dr Ta mentioned the significance of building a Low Carbon Society in Viet Nam, the estimated energy demands and government's goals, policies and actions to reach a more sustainable environment. For the three speakers of morning session of Workshop, please see **photo 9**.

Photo 9: The three keynote speakers of the morning session of Workshop delivering speeches: Prof Dr Alissara Reungsang (Left), Prof Dr Jin-Seek Choi (Middle) and Dr Doan Trinh Ta (Right)

When the keynote speeches of the morning session ended, Distinguished Professor Dr Wan-Yu Liu served as the offline moderator to talk about the research outcomes, energy demands and the potential development with the three speakers, please see **photo 10**.

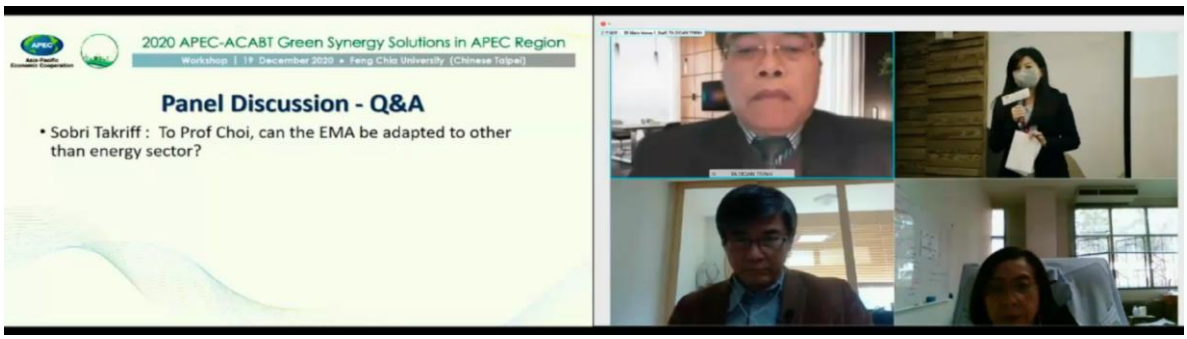

Photo 10: The three keynote speakers of the morning session of Workshop and the offline moderator Distinguished Professor Dr Wan-Yu Liu (upper right) in discussion.

(B) Invited Speeches

The first speaker for the afternoon session of Workshop was Professor Dr Ir. Mohd Sobri Takriff. He discussed the concept of "Smart Circular Economy," compared the advantages of green economy, bioeconomy and circular economy, further shared the real case in Cape Town, and how the circular economy could be related to Industry 4.0 to create more valuable solutions for social problems. Later on, Distinguished Professor Dr Wan-Yu Liu focused on her research in "How to Decide the Forest Biomass to Biofuel Facility Location." Professor Liu shared the decisions variables, including "location," "scale," "the number of facilities," and the applied method "Fuzzy Multiple Objective Linear Programming" to

address uncertain environment factors. Next, Professor Dr Dwi Susilaningsih from Indonesia shared her thoughts on “Lipid Production of Tropical Microalgae and Their Co-Products.” The geological environment in Indonesia had potential for tropical micro-algal resources, and could cultivate the creation of its co-product in biomass refinery. The last speaker of the day was Professor Ir. Ts. Dr Pau-Loke Show from Nottingham University Malaysia Campus to talk about “the Latest Developments of Biorefinery Technology in the Bioenergy Industry.” Professor Show demonstrated the techniques of “liquid biphastic system,” “thermo-separating biphastic system” and “liquid biphastic flotation system,” and the way to carry out them in various kinds of current projects. For the speakers of afternoon session, please see **photo 11**.

Photo 11: The four invited speakers for the afternoon session were delivering speeches: Professor Dr Ir. Mohd Sobri Takriff (Upper left), Distinguished Professor Dr Wan-Yu Liu (Upper right), Professor Dr Dwi Susilaningsih (Bottom left) and Professor Ir. Ts. Dr Pau-Loke Show (Bottom right)

As the speeches of the afternoon session ended, the online moderator of this session, Professor Dr Alissara Reungsang hosted the discussion on circular economy, biomass production and latest biorefinery technology in bioenergy industry. **(Photo 12)**

Photo 12: The four invited speakers for afternoon session of Workshop and the online moderator Prof Dr Alissara Reungsang (the person at the bottom left on the screen) in discussion.

Summary

While the keynote speech session, invited speech session and discussion session came to an end, the Day-2 Workshop had been successfully completed. Starting with keynote speakers' sharing of researches, cases and project implementation by applying the latest green technology, the participants have learned from technology perspective such as the use of bioenergy and biomass production, from energy management perspective such as Energy Management Framework System and from social and governmental perspective to address the significance of low carbon society development. The invited speeches in the afternoon further demonstrated the cases of smart circular economy, the economic benefits brought by biomass production and skills related to biorefinery technology in bioenergy industry. And in the later discussion sessions, the speakers and moderators explored the existing environmental problems of the current used technology and the difficulties in applying the implemented models into other real-life situations to improve the environment and quality of lives.

As the project aimed to achieve capacity building, to search for Green Synergy Solutions and to expand mutual understanding among stakeholders, experts and participants, the outcomes of Workshop contained the increase in knowledge, awareness and innovative ideas, the exchange of experiences, feedbacks and suggestions, and the possibility of new long-term cooperation, all of which reached the targeted objectives and would lead to more opportunities in the future.

4.2-3 OFFLINE PROJECT-BASED TRAINING PROGRAM

This project conducted the 4th APEC YES Challenge in 2020, starting from July to December for Green Synergy Solutions in APEC Region. Total of 20 teams registered and submitted the initial project plans which linked with the theme of event. After reviewed by the experts, 15 out of 20 teams were selected to participate in the Semi-Pitch, which was a part of online project-based training program (link: http://140.134.87.61:3838/fcu/YES2020/course/) with technical support offered by APEC-ACABT Researcher, Associate Professor Dr Jungpin Wu. The online training program started from 25 August to 25 October 2020, including the Module 1 and Module 2 case studies, such as “Discovery the problems and identifying the stakeholders in Manado City, Indonesia” and “Using decentralization bioenergy system to lead sustainability community revitalization for rural area” that could be sourced from implemented projects.”

In the mid-November, 10 finalist teams had been enrolled to deliver their final presentation on 20 December 2020, which was the Offline Project-based Training Program on the third day of the event,. The finalist teams were from 7 APEC member economies: China, Indonesia, Malaysia, Russia, Chinese Taipei, Thailand and Viet Nam. And all the finalist teams had to submit their poster and updated detailed project plans as part of assessments for the reviewers to score.

To enhance their capacity building and to train them to become innovative entrepreneurs, all finalist teams attended the Workshop and Offline Project-based Training Program on 19-20 December 2020. In the Workshop on 19 December 2020, the keynote speakers and invited speakers shared their knowledge, skills and experiences to all young entrepreneurs. The young entrepreneurs could not only learn from the fields that they were not familiar with but also integrated the learned knowledge and skills into their final pitches on 20 December 2020. Through Workshop and Offline Project-based Training Program, the speakers, experts and young entrepreneurs were more aware of the current issues, understood the current situation in other APEC member economies and received comments and suggestions from different perspectives.

Due to the COVID-19 pandemics, the oversea teams took part in form of virtual and local teams attended in physical. Therefore, to decide the order for teams to deliver their final presentation, APEC-ACABT held the “Draw Lots” session on 4 December 2020 which was a part of the online second test run. All the teams were required to attend this test run, with several reviewers and experts as witnesses for the draw lots session and the announcement of teams’ presenting order. The presenting order of finalist teams was shown in **Table 3**.

Table 3: The Presenting Order of Finalist Teams

Order No	Team Name	Economy	Present inform of
1	Bub King	Chinese Taipei	Physical
2	Dua Orang	Malaysia	Virtual
3	SPECS	China	Virtual
4	Biohydrogen	Thailand	Virtual
5	Manta Ray	Indonesia	Virtual
6	ZEST	Viet Nam	Virtual
7	I_Mechanics	Russia	Virtual
8	Greeco	Malaysia	Virtual
9	Symbioenergy	Chinese Taipei	Physical
10	CRAR	Thailand	Virtual

To ensure the fairness of the final pitch, APEC-ACABT invited 7 online reviewers, including Professor Dr Dwi Susilaningsih (Indonesia), Professor Dr Jin-Seek Choi (Republic of Korea), Dr Teow Yeit Haan (Malaysia), Professor Dr Alissara Reungsang (Thailand), Dr Chayanon Sawatdeenarunat (Thailand), Dr Doan Trinh Ta (Viet Nam), Professor Dr Kim Anh To (Viet Nam) and 2 offline reviewers, Professor Dr Mei-Chih Hu and Dr Chen-Hua Hsueh from Chinese Taipei to watch and score the final pitches. **(Photo 13)**

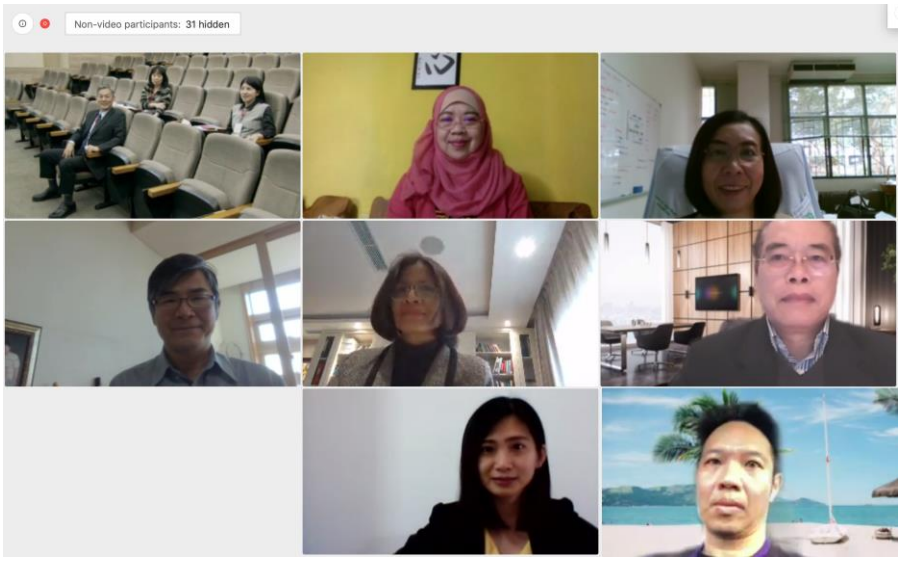

Photo 13: The online reviewers: Professor Dr Dwi Susilaningsih (Upper middle), Professor Dr Jin-Seek Choi (Middle left), Dr Teow Yeit Haan (Bottom middle), Professor Dr Alissara Reungsang (Upper right), Dr Chayanon Sawatdeenarunat (Bottom right), Dr Doan Trinh Ta (Middle right), Professor Dr Kim Anh To (Middle) took photo with the offline reviewers, Professor Dr Mei-Chih Hu and Dr Chen-Hua Hsueh and CEO of APEC-ACABT, Professor Dr Shu-Yii Wu (Upper left).

(A) Team Final Presentation

(1) Team Bub King (Chinese Taipei)

Representing Chinese Taipei, Team Bub King focused on “Circular Economics with Anaerobic Fermentation” and addressed the homeless issues and environmental problems in Silicon Valley. To solve the existing problems, the team proposed to set up portable toilets for homeless, to apply anaerobic digesters to turn excrement to waste and fertilizer, which could be used on farming and cooking to create benefits for the homeless. **(Photo 14)**

Photo 14: Team Bub King delivered their final pitch.

(2) Team Dua Orang (Malaysia)

Team Dua Orang proposed to use microalgae as biofuels, which can generate economic benefits and green resources to reach sustainable growth. By researching and developing the microalgae products and applying the Liquid Biphasic Flotation method, the team’s goal was to provide and promote various types of microalgae products in affordable prices to different sectors. **(Photo 15)**

Photo 15: Team Dua Orang delivered their final pitch.

(3) Team SPECS (China)

Team SPECS from China shared their ideas of Solar-Powered Bio-Ethanol Conversion System. As lignocellulosic biomass contained abundant resources but the used pretreatment systems were not environment-friendly, the team proposed to develop a solar-powered biomass pretreatment system to achieve the efficient production from biomass to bioethanol in a green way. **(Photo 16)**

Photo 16: Team SPECS delivered their final pitch.

(4) Team Biohydrogen (Thailand)

Team Biohydrogen from Thailand presented the current pollution problems brought by burning sugarcane leaves. To solve this problem and use sugarcane leaves in a more sustainable way, the team proposed to turn sugarcane leaves to hydrolysates, which could be further used for Hydrogen production and Methane Production, and finally into biohythane for biofertilizer and electricity. **(Photo 17)**

Photo 17: Team Biohydrogen delivered their final pitch.

(5) Team Manta Ray (Indonesia)

Team Manta Ray representing Indonesia shared their ideas on the topic of “The Utilization of Marine Bacteria to Solve Plastic Problem and Strengthening Coastal Economy.” While the human society utilize the plastic products that are hard to be degraded, the wastes and garbage are still harming the marine ecosystem. To solve this problem, the use of bioplastic could not only help degrade the plastic wastes, but also create jobs in communities and further strengthen costal economy. **(Photo 18)**

Photo 18: Team Manta Ray delivered their final pitch.

(6) Team ZEST (Viet Nam)

Team ZEST from Viet Nam delivered their ideas of “Aromatic straw pellet.” The harm caused by burning straws increased the risk of lung cancer and generated a huge amount of hazardous substance in Viet Nam. The team would like to produce pellet fuel from redundant straws and local aromatic plants with high value, good quality and applicability in the community to reach emission reduction and sustainable development in agriculture. **(Photo 19)**

Photo 19: Team ZEST delivered their final pitch.

(7) Team I_Mechanics (Russia)

Team I_Mechanics from Russia talked about their plan of building a wind power plant. In mountainous areas, even if the wind turbines like HAWT and VAWT were settled, only certain regions could have access to electricity. This team proposed to build a wind power plant that would generate electricity in efficient and relatively inexpensive way by using a new type of autonomous wind turbines. **(Photo 20)**

Photo 20: Team I_Mechanics delivered their final pitch.

(8) Team Greeco (Malaysia)

Team Greeco from Malaysia discussed the sustainable approach on rice straw management. As more than three million tons of rice straw wastes have been produced in Malaysia, the team aimed to turn straw wastes to eco-ware by inventing compostable takeaway lunch boxes which were estimated to have great potentials in the future green packaging market. As a part of circular economy, this solution could not only generate new economic values but also reduce poverty, agricultural waste and pollutions. **(Photo 21)**

Photo 21: Team Greeco delivered their final pitch.

(9) Team Symbioenergy (Chinese Taipei)

Team Symbioenergy from Chinese Taipei attended the final pitch at event venue. Setting in Manado City, the team looked forward to expanding the Symnergy model to an Affordable Symbioenergy System for the communities in rural areas and small islands. By empowering these areas, economy development, promotion of green industry, and changes of people's behaviors, living styles, and mindsets were highly expected. **(Photo 22)**

Photo 22: Team Symbioenergy delivered their final pitch at FCU.

(10) Team CRAR (Thailand)

Team CRAR representing Thailand revealed a new perspective of transforming sugarcane waste residues into a part of circular economy via microbial chain elongation and gasification. As mentioned earlier, burning sugarcane leaves has become a harsh problem and provoked negative impacts and worries in Thailand. Proposing a different method of “medium chain fatty acid production via microbial chain elongation,” the team would like to maximize the use of sugarcane residues to high-value byproduct with concept of zero discharge, reaching the balance among environment, economy and society. **(Photo 23)**

Photo 23: Team CRAR delivered their final pitch.

(B) Award Ceremony

While the final pitches of the 10 finalist teams had all been completed, the selected prize winners were Team Symbioenergy (Chinese Taipei) for the first prize, Team SPECS (China) and Team Greeco (Malaysia) for the second prizes, Team CRAR (Thailand), Team Dua Orang (Malaysia) and Team Manta Ray (Indonesia) for the third prizes. **(Photo 24-29)**

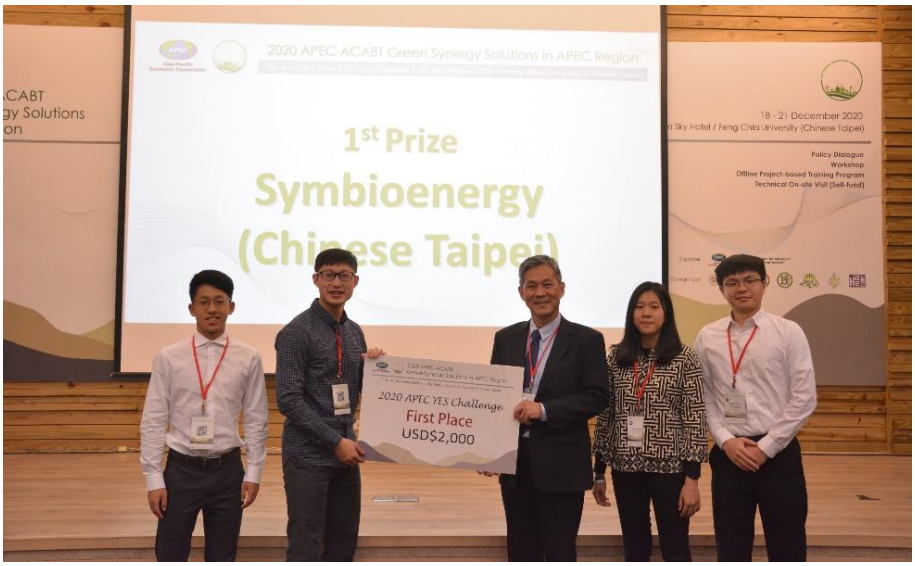

Photo 24: The first prize winner, members of Team Symbioenergy took photo together with the CEO of APEC-ACABT, Professor Dr Shu-Yii Wu.

Photo 25: The second prize winner, members of Team SPECS took photo with online reviewers and the CEO of APEC-ACABT, Professor Dr Shu-Yii Wu.

Photo 26: The second prize winner, members of Team Greeco took photo with online reviewers and the CEO of APEC-ACABT, Professor Dr Shu-Yii Wu.

Photo 27: The third prize winner, members of Team CRAR took photo with online reviewers and the CEO of APEC-ACABT, Professor Dr Shu-Yii Wu.

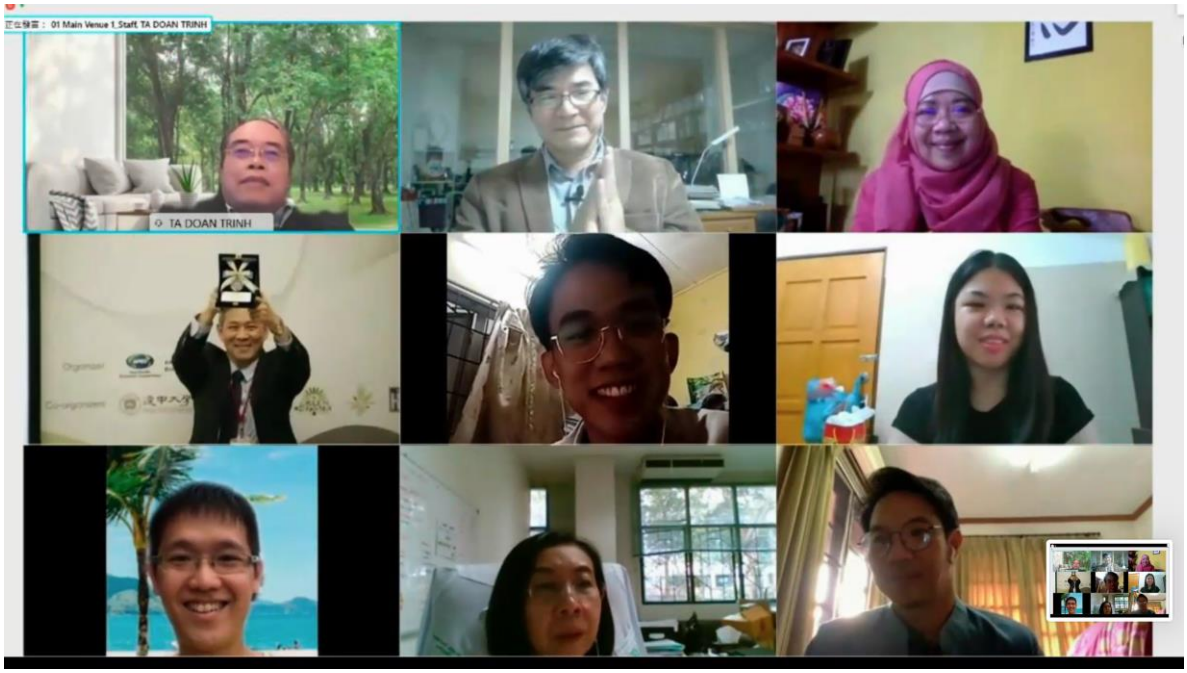

Photo 28: The third prize winner, members of Team Dua Orang took photo with online reviewers and the CEO of APEC-ACABT, Professor Dr Shu-Yii Wu.

Photo 29: The third prize winner, members of Team Manta Ray took photo with online reviewers and the CEO of APEC-ACABT, Professor Dr Shu-Yii Wu.

Summary

While many APEC member economies have all been affected by different kinds of environmental problems and by the ongoing COVID-19 pandemic, the participation and dedication of young generations are required. To prepare the students to better understand the professional fields of “Bioenergy, Bioprocesses, Energy management system and New and renewable energy,” the Offline Project-based Training Program with participatory learning, case studies, opened discussion and final pitch trained students to think, act, cooperate and propose ideas as entrepreneur teams. During the four-month training program, all the teams had put as much effort as they could to tackle the problems that might occur by plan implementation, to integrate more resources to optimize positive effects of solution and to consummate their plans from technological, economic and social aspects. Later on, the 10 finalist teams attending the final pitch all demonstrated the unique advantages of their own plans, the designed business models and their ambition to create mutual benefits for society, communities and individuals among APEC region. As they presented their full plans to other teams and the reviewers, the feedbacks and suggestions they received could bring stimuli and introspection to enhance the plan to a higher level.

As the project aimed to promote the green technologies and low carbon strategy, to cultivate students’ knowledge, skills and capacity building abilities, to support communication among stakeholders, experts and young generation participants, the Offline Project-based Training Program showed the young generation’s dedication, efforts and care that have reached the set objectives and enriched the event to create a better and more sustainable environment. Although the plans proposed by the students still have room for improvement, as they develop more researches, embrace more diverse opportunities and accumulate various kinds of experiences, they will without doubt become remarkable entrepreneurs and researchers.

4.2-4 TECHNICAL ON-SITE PRACTICE (SELF-FUND)

On the fourth day, the participants at Taichung, Chinese Taipei headed to Dongshi to attend the Technical On-site Practice (Self-Fund) **(Photo 31)**. The Demo Site one was to visit the ecological village for anaerobic fermentation tank technical practice, which enabled the participants to learn the theories of anaerobic fermentation and experience some of the steps. After the Demo Site one, the participants went to explore the process of creating biochar. Through the process of “pyrolysis,” which was heating biomass to a certain temperature, the solid and carbonized biochar could be produced as a biofertilizer to increase agricultural production and to reduce chemical fertilizer consumption. **(Photo 30)**

Photo 30: The participants were experiencing the process of pyrolysis to create biochar, and the final product of biochar will be like the black charcoal in the photos. (Middle right and bottom right)

Photo 31: The participants attending Technical On-site Practice took photo together.

Summary

Extending from the previous three days of event, the Technical On-site Practice on Day 4 enabled the local participants at Chinese Taipei to visit the Dongshi Hakka Cultural Park. As planned in the project proposal, the participants completed two Demo Site visits to experience the anaerobic fermentation tank technical practice and the biochar creation process. They also got to know the current cooperation models between local communities, universities and ecological villages, which was the best real practice of capacity building. With the continuing partnership between industries and academia, all the participants realize that Green Synergy Solutions and sustainable growth are actually solutions that are close to everyday life and require everyone’s attention.

5. OVERALL PROJECT IMPACTS AND CONCLUSIONS

Under the outspread COVID-19 pandemic, the shift to hybrid events have transformed the traditional form of meeting and became an effective solution to increase communication and dissemination of information among APEC member economies. According to the received comments from oversea and local participants, the first hybrid event of APEC-ACABT, "Green Synergy Solutions in APEC Region" was well–organized and rounded off with positive reactions and overall impacts in three aspects as follows.

Capacity Building:

- Explored the issues related to climate changes and renewable energy usage from various perspectives and proposed solutions to generate new research plans, projects and policy recommendations
- Demonstrated more possibilities and potentials to increase global and domestic cooperation, economic benefits, social values and technology improvement
- Engaged participants, including young entrepreneurs, policy makers, researchers and experts to enhance Green Synergy Solutions capabilities and to raise their awareness of the problems that affected everyday life

Networking:

- Established a networking platform among participants to communicate and to get to know more experts working in the related field among APEC region
- Exchanged practical experiences and research outcomes for more implementation of sustainable technology application and economic development
- Broadened participants' horizon, facilitated the exchange of knowledge within different professional fields

Gender Equality:

- Improved women's capability of a range of economic pursuits, educationally and technically prepared them for success in the workplace, business and entrepreneurship
- Valued women as contributors, professionals and leaders in the private, non-profit and public sectors
- Eliminated gender barriers, reached gender-friendly goal and encouraged women in STEM by inviting female speakers, experts and participants among APEC member economies. Female would have same opportunities as men to be benefited from and could participate in development and implementation of scientific advances and new technologies

In conclusion, with the supports from the organizing members **(Photo 32)**, oversea and local participants, the project reached the set objectives of enhancing the capacity building and establishing a networking platform for participants among APEC region, engaging participants to address the issues and to exchange ideas, and raising awareness to pursue environmental protection and sustainable growth. While the organizers have overcome the challenges brought by hosting hybrid meetings, the dissemination of knowledge and the discussions for Green Synergy Solutions cultivated participants' passions and strengths and became a foundation for APEC member economies to develop new policies and research plans for sustainability.

Photo 32: Organizing members and local participants took photo together with Project Overseer and CEO of APEC-ACABT, Professor Dr Shu-Yii Wu (front row second from right); Co-CEO of APEC-ACABT, Professor Dr Chiu-Yue Lin (front row fourth from left); Event Coordinator, Ms Kwan Pei Ying (front row sixth from right); Vice Event Coordinator, Ms Mei-Yi Lee (front row sixth from left) and Event Secretary, Ms Joyce Wang (front row fifth from right)

6. OVERALL SUGGESTIONS

In order to sustain and upgrade the APEC project to the next level, the project had collected the comments from oversea and local participants through survey. Even though the project was implemented successfully in completion of the set objectives, the project would certainly have room for improvement with the overall suggestions as follows:

(1) Condense the day of the event, probably from 4 days to 2-3 days.
(2) The hybrid event is a good solution for all participants to share their experiences, to gain skills and knowledge from event and to connect with each other in this COVID-19 pandemic. However, if the circumstances get better, all participants attending the physical meeting will bring the greatest benefit.
(3) Invite more experts and participants from various APEC member economies to strengthen networking and collaborations.
(4) Optimize the online discussion to enhance the capacity building and all participants could gain more skills and knowledge

As stated above, the project will consider and improve in the future to enhance the capacity building, collaborations, networking with policymakers, experts, young entrepreneur and researchers and to create the overall greatest benefits.

ACKNOWLEDGEMENT

This project was funded by the APEC Support-Fund: Energy Efficiency and Low-Carbon Measures, self-funded by MOST, and supported by APEC Secretariat office, APEC-ACABT team, and FCU.

REFERENCES

Videos of Hybrid event

Day 1 Policy Dialogue on 18 December 2020: https://youtu.be/WNWUoU6XyQI

Day 2 Workshop on 19 December 2020: https://youtu.be/vO6jRWwZ_kc

Day 3 Offline Project-based Training Program on 20 December 2020: https://youtu.be/xrjEsS18jmk

Videos of the Webinars

Day 1 Policy Dialogue on 18 December 2020: Due to the recording system's technical issue, no webinar video had been generated, please refer to the hybrid event's Video for more details.

Day 2 Workshop on 19 December 2020: https://youtu.be/M2hE1Xb0kh8

Day 3 Offline Project-based Training Program on 20 December 2020: https://youtu.be/Mnc-y-5FUl0

Website

(1) What APEC is Doing to Promote Capacity Building? https://www.apec.org/Press/Features/2008/0901_What_APEC_is_Doing_to_Promote_Capacity_Building

(2) Guidebook on APEC Projects (Edition 15) https://www.apec.org/projects/forms-and-resources

ANNEX 1

EVENT AGENDA

GREEN SYNERGY SOLUTIONS IN APEC REGION

18-21 DECEMBER 2020

- **Organizer:** APEC Research Center for Advanced Biohydrogen Technology (APEC-ACABT)
- **Venue:** HYBRID EVENT, PHYSICAL EVENT AT IN SKY HOTEL & FCU, TAICHUNG

<table>
<tr><td colspan="3">18 December 2020 (Policy Dialogue) –
Moderator: Dr Yi-Yuan William SU
Researcher of APEC-ACABT;
Assistant Professor, Department of Law, National Chung Hsing University (NCHU)</td></tr>
<tr><td>Time
(GMT+8, Local Time in Chinese Taipei)</td><td>Schedule</td><td>Venue</td></tr>
<tr><td>1100-1300</td><td>Registration/ Test Run</td><td rowspan="5">Physical Meeting: Full in-person –In Sky Hotel ; Lunch and coffee break (Hallway of Conference Room/Dining Area) ; for local participants

Virtual Meeting: for oversea participants</td></tr>
<tr><td>1130-1300</td><td>Lunch (Invited Only)</td></tr>
<tr><td>1300-1320</td><td>Welcome / Opening speech/ Group photo (Virtual & Physical)</td></tr>
<tr><td colspan="2">Panel Discussion I:

Land use, land-use change and food security

The land is an essential resource to develop food crops and energy crops. In recent years, the energy crops plantation grows rapidly and increase incomes for the landowners and farmers. However, the land is a limited source and the government shall have a clear plan to secure the land acres for food crop production.</td></tr>
<tr><td>1320-1510</td><td>Keynote Speech:
1. Landuse Landcover Change and Food Security: Indonesia’s Policies and Technology Perspectives
Mr Yudi Anantasena
Deputy Chairman of Technology for Natural Resources Development, Agency for the Assessment and Application of Technology (BPPT), Indonesia

2. Land Use Change & Food Security in Aquaculture
Assoc. Prof Matthew Tan Kim Chuan, CEO of Asia of Assentoft Aqua Asia Pte Ltd, Singapore</td></tr>
</table>

	Invited Speech: 1. **What to plant? Food or Fuel** Assoc. Prof Dr Hanilyn A. Hidalgo, CBSUA, The Philippines **2. Land use, land-use change and food security in Thailand** Asst. Prof Dr Yuwalee Unpaprom, Program in Biotechnology, Faculty of Science, MJU, Chiang Mai, Thailand **3. Land Use & Green Electricity: From Renewable to Sustainable & Friendly Green Electricity** Dr Richard Hsu, Secretary General, TAGET	
	Panel Discussion I - Group Discussion	
1510-1520	Coffee Break	
Panel Discussion II: **Biomass: a value-added resource technology and management on agriculture residues** Many agriculture residues and industrial wastes, including industrial and agriculture waste materials, can contribute to the development of biomass. The usage of these waste materials or agriculture residues shall not compete with other high-value applications. Biomass development is a value-added method for waste materials handling and increase benefits for farmers. Therefore, the development of biomass can reduce quantity of waste materials and increase energy generation. Further advanced technologies or innovated machines are also required to improve the usage of biomass on energy generation. The keynote/invited speakers shall share the most advanced and available technologies research on usage of biomass sources and reduce the quantities of waste materials.		
1520-1720	**Keynote Speech:** **Sustainable Agricultural Biomass Transformation in Canada** Mr Charles Lalonde, CJ Agren Consulting, Canada	
	Invited Speech: **1. Biomass for Fuel and Electricity** Prof Dr –Eng. Eniya Listiani Dewi, Deputy Chairperson for Technology of Information, Energy and Materials, Agency for the Assessment and Application of Technology (BPPT), Indonesia 2. **Biomass energy potential in APEC and Viet Nam** Dr Nguyen Linh Dan, VJIAT, NUCE, Viet Nam **3. Towards Sustainable Cities: Value-Added of Biomass Technology for Community Energy Management**	

	Asst. Prof Dr Prapita Thanarak, Deputy Director of International Affairs and Quality Assurances; School of Renewable Energy and Smart Grid Technology (SGTECH), Naresuan University, Phitsanulok, Thailand **4. Challenges for stable PKS trading** Mr Hiroki Yoshida, Vice President Director, JETRO - Jakarta Office	
	Panel Discussion II - Group Discussion	
1720-1750	Conclusion Remarks **Dr Yi-Yuan William SU**	
1800-1830	Steering Committee Virtual Meeting (Invited Only)	
1830~	Welcome Dinner (Invited Only) – for Physical Meeting	
19 December 2020 (Workshop)		
Time **(GMT+8, Local Time in Chinese Taipei)**	**Schedule**	**Venue**
0830-1000	Registration/ Test Run	**(A) Physical Meeting:** Full in-person - The 9th International Conference Hall, FCU **(B) Virtual Meeting:** for oversea participants **(C) Lunch Venue:** ● **VIP guests at Meeting**
1000-1030	Welcome Speech / Opening Ceremony/ Group photo (Virtual & Physical)	
1030 -1220	**Keynote Speech: Integration of dark-photo fermentation and dark fermentation-anaerobic digestion for the valorization of Chlorella sp. Biomass** Prof Dr Alissara Reungsang Chair of APEC-ACABT Thailand Branch Center; Department of Biotechnology; Associate Dean for Research and Academic Affairs Organization, Khon Kaen University (KKU) (Thailand)	
	Keynote Speech: Energy Management Agent: State of the Art and Emerging EMA Framework Architecture Prof Dr Jin-Seek CHOI Chair of APEC-ACABT Seoul Branch Center; Mobile Intelligence & Routing Lab, Department of Computer Science, HYU (Republic of Korea)	
	Keynote Speech: Towards Low Carbon society development in Viet Nam – Green Synergy pathway to 2030 Dr Doan Trinh TA Member of APEC-ACABT Steering Committee; Independent Expert to STI policy and development strategy; Former President of National Institute for Science and Technology Policy and Strategy Studies (NISTPASS) (Viet Nam)	
	Panel Discussion – Keynote Speech Session I **Moderator: Distinguished Prof Dr Wan-Yu LIU**	
1220-1330	Lunch Break	

1330-1520	**Invited Speech: Smart Circular Bioeconomy** Prof Ir. Dr Mohd Sobri Takriff National University of Malaysia (UKM) (Malaysia)	● **room 711-1, 7th Floor, Xue Si Building** ● **Others at Room 103, 1st Floor, Xue Si Building**
	Invited Speech: How to Decide the Forest Biomass-to-biofuel Facility Location Distinguished Prof Dr Wan-Yu LIU NCHU	
	Invited Speech: Lipid Production of Tropical Microalgae and Their Co-Products Prof Dr Dwi Susilaningsih Co-Chair of APEC-ACABT Indonesia Branch Center Indonesian Institute of Sciences, LIPI (Indonesia)	
	Invited Speech: Latest Developments of Biorefinery Technology in The Bioenergy Industry Prof Ir. Ts. Dr Pau-Loke Show University of Nottingham, Malaysia Campus (Malaysia)	
	Panel Discussion – Invited Speech **Moderator: Prof Dr Alissara Reungsang**	
1520-1540	**Report of the Policy Dialogue** Asst. Prof Dr Yi-Yuan William SU Researcher of APEC-ACABT; Department of Law, NCHU	
1540-1600	Coffee Time	
1600-1630	Reviewer Pre-Meeting (Invited only) – Reviewer Only	
1830~	Dinner (Invited only)	**Physical Meeting:** Full in-person
20 December 2020 (Offline Project-based Training Program)		
Time **(GMT+8, Local Time in Chinese Taipei)**	**Schedule**	**Venue**
0800-0900	Registration/ Test Run	**(A) Physical Meeting:** Full in-person - The 9th International Conference Hall, FCU ; for local participants **(B) Virtual Meeting**: for oversea participants
0900-0930	• Confirmed schedule • Announcement of Rules • Group photo (Virtual & Physical meeting)	
15 minutes presentation & 15 minutes Q&A		
0930-1000	Team 1- Bub King (Chinese Taipei)	**(A) Physical Meeting:** Full in-person - The 9th International Conference Hall, FCU; **(B) Virtual Meeting:** for oversea participants
1000-1030	Team 2-Dua Orang (Malaysia)	
1030-1040	Break Time	
1040-1110	Team 3- SPECS (China)	

1110-1140	Team 4- Biohydrogen (Thailand)	**(C) Lunch Venue:** VIP guests at Meeting room 711-1, 7th Floor, Xue Si Building **Others at Room 103, 1st Floor, Xue Si Building**
1140-1250	Lunch Break	
1250-1320	Team 5-Manta Ray (Indonesia)	
1320-1350	Team 6-ZEST (Viet Nam)	
1350-1420	Team 7- I_Mechanics (Russia)	
1420-1440	Coffee Break	
1440-1510	Team 8-Greeco (Malaysia)	
1510-1540	Team 9-Symbioenergy (Chinese Taipei)	
1540-1610	Team 10-CRAR (Thailand)	
1610-1700	Reviewer Meeting– Reviewers Only	**(A) Physical Meeting:** Full in-person – Room 103, 1st Floor, Xue Si Building , FCU ; for local participants **(B) Virtual Meeting:** for oversea participants
1700-1800	Award Ceremony	**(A) Physical Meeting:** Full in-person - The 9th International Conference Hall, FCU ; for local participants **(B) Virtual Meeting:** for oversea participants
1830-2000	Dinner (Invited Only)	**Physical Meeting:** Full in-person – **In Sky Hotel**
21 December 2020 (Technical On-site Practice)		
Time **(GMT+8, Local Time in Chinese Taipei)**	**Schedule**	**Venue**
0900-2000	➢ Green Synergy eco-farm ➢ Wetland Wind farm ➢ Offshore wind power ➢ Solar farm	**Physical Meeting:** Full in-person (Chinese Taipei)

ANNEX 2

APEC PROJECT EVALUATION SURVEY

APEC Project Name/Number: ***PPSTI 06 2019A – APEC Research Center for Advanced Biohydrogen Technology (ACABT) – Green Synergy Solutions in APEC Region***

Date: ***18-21 December 2020***

Instructions: Please indicate your level of agreement with the statement listed in the table below. Thank you.

	Strongly Agree	Agree	Disagree	COMMENTS (Continue on back if necessary
The objectives of the training were clearly defined	**43**	**22**		1. The event is very good for sciences connectivity especially during this pandemic time, the event is make us strong bond in science community. 2. Great work during tough COVID-19 season. 3. I am very glad to see that the young generations realize the environmental problems and try very hard to solve the problems 4. Overall, the planning until the executing of the training is well-planned by organizer. Sufficient test run and ICT fund that provided by organizer is significantly help the speakers and participants from oversea to take part the session without any interrupted. Also, the time allocating for each agenda is well scheduled and therefore the session can be conducted smoothly. Lastly, the knowledge that shared by the speakers during the workshop is truly inspired me and I hope I can apply the knowledge gained in the future.. 5. The the event was well-organized. The organizers were very efficient.
The project achieved its intended objectives	**44**	**21**		
The agenda items and topics covered were relevant	**47**	**18**		
The content was well organized and easy to follow	**47**	**17**	**1**	
Gender issues were sufficiently addressed during implementation	**39**	**24**	**2**	
The trainers/experts or facilitators were well prepared and knowledgeable about the topic	**49**	**16**		
The materials distributed were useful	**38**	**25**	**2**	
The time allotted for the training was sufficient.	**45**	**20**		

				6. The preparation for the workshop, in particular, was very careful. 7. Everything is excellent. 8. Great workshop and training programme! 9. The project was well organized and the experts were kind and knowledgeable, which made us learn a lot. 10. I thought that it was a well prepared and very relevant programme. 11. It was an insightful session. Great job. 12. Green Synergy Solutions is a key for sustainability. 13. Experts are well disciplined for Green Synergy Solutions issue.

1. How relevant was this workshop to you and your institution/company?

Very (5)	Mostly (4)	Somewhat (3)	A little (2)	Not much (1)
29	30	5	1	0

Comments received:

Land use and change is evolving in Singapore especially in the light of food security
The project will trigger more researches on issues on land use and food security particularly in developing economies. The idea of balancing productivity and ecology can be an eye-opener to both producers and consumers for long-term sustainability.
Biomass is a very abundant resource in Viet Nam and should be utilized well
Bioeconomy development can benefit from agricultural inputs but synergies are needed.
We are now trying to support to Japanese companies for PKS trading
Biomass is one of value added for agriculture economy.
Very helpful organiser and informative conference

Green synergy topic is essential for Viet Nam because Viet Nam is one of the most affected economy from climate change and green synergy is a best way to overcome the negative peril from it.
Directly related to my research activities
Indonesia rich of materials that possible to convert into New and Renewable Energy, therefore the new methods for manage the biomass is needed. And the information can be obtained from this event, thank you.
Working in agricultural institute
Green Synergy solution is the way to achieve the sustainable development goals that have been adopted by all economies in the world, including Viet Nam
This program is exploring the potential of bionergy and environment which is highly relevant in Malaysia
It is relate about biogas production on my research
The project that presented in YC2020 is not the only problem that our economy face. But we believe that with the clean ocean, it will increased the welfare of the fisher.
Very relevant
Training young generation on sustainability of the economy is crucial and need to be strengthened of. This project creates opportunity for trainees to initiate and build up an idea on the trial business and work in global ambiance.
Some project (low cost) applicable in our economy and can improve our economy.
My research area is Energy management.
Sustainable is become more popular topic nowadays, every institution try to achieve the sustainability as much as possible to utilise the renewable resources on the earth. This project actually stimulate the idea of sustainable and innovation, let people to ponder the problem of the economy and to think and design a sustainable way to resolve the problem.
This program very useful in term of sharing ideas, experiences, and open multi-knowledge field for participants that could bring to develop our work and also cooperate with local community to find a sustainability way for the community.
Well, I'm not really sure if some of the topics presented would be applicable to where I live because I do not completely understand the level of seriousness in my economy regarding some of the issues mentioned.
This project is mostly relevant to our economy because this project can head toward to a circular ecomomy. our project can increase the farmer's income.
The project fits with Thai Governement's policy that is driving towrad Green economy, bioeconomy and circular economy.
In my major, which is biotechnology, the terms "green economy" and "bioenergy" were mentioned a lot so this project is relevant.
The project proposes a lot of useful information about the sustainable green economy which could be applied to mine and from that, I could have a clear vision for the future development
The project arise few topics regarding the region's sustainability which is very applicable to my economy and I'm very inspired on it.
For my information, in our economy, circular economy is a new thing here. Im glad that I can know more about on this before I entering my career.
Because in Indonesia is necesaary to build green energy to keep the ecosystem
Because this project regarding to the green energy for Indonesia that have many source of natural resources and suitable to implement in Indonesia that have limited on green energy.
My research area is in green technology and sustainability

Relevant as in get to know the general economy
It's problem important for our economy. Personally me scientific work near it's area
New insights on some useful developments
My research direction is biomass pre-treatment for later biotransformation. The subject of this project is the recycling of waste biomass resources, which coincides with my research work.
This project is very relevant in our economy particularly in circular economy concept. Circular economy is providing opportunities for Thailand to adopt new resource productivity principles, to improve sustainable product design, and to be leaders in sustainable manufacturing
My family is a farming farmer.If an efficient agricultural waste management is planned It will help promote more income from the transformation of official waste materials.Agriculture It is a valuable product. Reduce production costs such as producing compost manually and biogas production by fermentation.
There were pitched many "green" which could help make my native economy more environmental-frendly.
My focus is the green energy about using cellulose biomass and in China, sustainable development and clean energy are also getting more and more attention.
Some of the agricultural aspects are not directly relevant to a city economy such as Hong Kong.
Through this project, the young generation have learned about how to do the cooperation through teamwork and wider network.
It related to the project I executed.
Two or several speakers come from my economy.
In my economy, the government is currently actively promoting the development of green energy.
It’s the biggest opportunity for me to attend the world conmpetition and it also give me some idea about my futute.
This system can greatly improve the life of monado island.
It is really close. The topic is all around the environment around us.
My working area is related to biohydrogen.
Green Synergy Solutions is a key for sustainability.
Green Synergy Solutions is one of the goals that Chinese Taipei should achieve and this project has increased the opportunities for more people’s dedication and awareness.

2. In your view what were the project’s results/achievements?

Comments received:

A well rounded approach discussion
It sought to solicit the views of the various economic sectors so a good environment policy can be crafted
A fruitful hybrid meeting that can address difficulties brought by COVID-19
Sharing relevant approaches from various member economies
It is important that stakeholders from various fields involved continue to hold discussions for biomass.
Sharing among the APEC Economies.

Research collaborations
Knowledge sharing, mutual understanding and connection effect
Networking, New information
Biofuel and food crop research
Positive impact on all members
Dissemination of knowledge among participants on the need of sustainable initiative to protect our environment.
New knowledge
Interaction, growth and collaboration opportunities
Improve the critical thinking ability, self-confidence and exchange idea and friendship for the students
Save the environment and reduce waste
By knowing each other, we can understand and make sure the energy environment and climate change.
Leading young generation towards a sustainable direction.
Make the idea to the concrete.
Personally, I feel that it provides an opportunity to get students exposed to the sustainable options provided out there. To be frank, I only got to know more of the sustainable inventions in the world after participating in this competition. I think that it definitely brings about the awareness in us participants and also deepens our knowledge throughout this project.
Update some problems, motivate, improve community's life
Planting the awareness on the environmental problems and how to solve the problems sustainability.
The project motivated us to learn more about sustainable developments as well as new green technologies
To update the new technology, the information in the development of a sustainable green economy
The Offline Project-based Training Program definitely have led the teams to probe on the global & regional issue which is crucial in tackling these problems in the future. Also, the entrepreneurship is also inspired among themselves throughout the project executing.
Knowledge transfer among economy
Achieve green energy for each economy to keep nature which avoid from environmental damage
The results of this project that is achieved by green energy in the APEC region and implemented in each economy so through this project we can keep well nature.
Tackling climate change and community problems at the same time promoting sustainability awareness
The project presented by student from various economies is insightful
We know more information about it's problem of different economies
To engage with global participants for ideas and knowledge sharing
The impacts of this project were to make the participants have a deeper understanding of the concept of clean conversion of waste biomass, to set up the economic links of entrepreneurial projects more reasonable, and ultimately to improve the practical feasibility of the entire project.

I believe it was a great environment to exchange experience and information. Many people had the opportunity to get to know about Green Synergy Solutions projects.
Exchange of information, guidelines and ideas about sustainable economic development while preserving the environment.
It helps to share ideas between people from different economies.
This project gave me a deeper understanding of my own project, as well as the ideas of other members in other regions.
This project provides a sustainable development strategy tailored to local conditions in remote and economically underdeveloped areas.
To provide assistance for regional development in rural areas
To provide help for rural areas
It made attendees aware of what was happening in other economies
This system has been set up, now what we have to do is how to expand to other islands
To discuss more possibility of biosynergy.
I think because for the sucessful experience and it also continuing and also help the economy to make economy better.
Through exchanges in various fields of academia, opportunities for mutual cooperation and discussion are increased.
It create a good platform to communicate the economics.
To open the point of view of the participants about other economies' situation and it will be encouraging them to find the solutions to overcome the problems
Share the synergy model to all economies.
To encourage young students join global competition and enrich the knowledge about Green Synergy.
to talk about the latest tech and save the earth
Sharing the skills, knowledge and experiences among APEC economies
Useful policy recommendation, and well-prepared programme and passionate participants
The experts from different economies shared the current situation and demands within their own economy, and they further revealed the opportunity of global and domestic collaborations.
Challenges related to business

3. What new skills and knowledge did you gain from this event?

Comments received:

Supply chain were indeed disrupted in many economies during the current pandemic
Bioenergy, sustainable aquaculture and best practices of other economies
I got to know more people who are working in this field in the APEC region
Perspective on biomass used in economies differs from our economy
Relationship between biomass and food
Smart farm

Bioengineering skills
Collective actions to achieve the goal
New information about other economies
New information about green energies and their processes
Research should be contributed community
Knowledge of circular economy and development in bio-refinery technology
New ideas on sustainability efforts.
Other knowledge such as economics and environment
New knowledge and information
Current situation and trend in bioenergy production.
I experienced on exchanging ideas with students and cooperative working globally
New knowledge on biohydrogen and waste
I know that there are so many filed and activities to conserve the environment .
EMA framework and also the microalgae field, LBF .
Work as a group and Knowledge integration.
I would say, I'd learned a lot on business related tools, green mechanisms and inventions.
From this event, I gain a lot of skills and knowledge such as: presenting in front of Prof, Dr,...enrich my knowledge about sience and technologies, analyse the problems
Circular economy. Green economy.
Through the event, I had a chance to know more specific case studies about green technologies all around the world and skills to deliver a speech online.
I've learn a lot of new things, including the overall problems in each economy, the new technology that could be applied to ease the problems, the new application of existance methods and many more.
First and foremost, the knowledge regarding the environmental and sustainable issues are truly learnt from this event. Next, the event has also allowed me have a chance to develop the presenting and pitching skills.
I know that many kind of waste can actually be used in another system. During semifinals stage, I learn a lot from both module 1,2.
We get knowledge about the solve of energy problem in each economy and the application in each economy
I get knowledge about the solve of energy problems in each economy with green energy.
Mutual learning and the importance of circular economy
Updated knowledge on biofuels production
Understand how sustainable approach in different field can be carried out
It's question more for students. I'm mentor
New processing and green solutions that are potential to be implemented

What I learned from this incident is that when designing the project to run, it is necessary to consider the scientific and humane employment of personnel, so as to ensure the normal operation of the project, while promoting the stable development of society.
I believe now I have a better understanding of what is Young Entrepreneurial Solution idea for green economy and inclusive society. How seemingly simple ideas can be successful.
I have gained a lot of new knowledge, such as the conversion of low-value chemicals into high-value substances through microbial bioprocessing, algal biogas production., Aspen plus model for ethanol production from different types of biomass via thermochemical conversion process, cost estimation of biolubricant oil manufacture dreived from palm oil, effect of the controlling variables of the semi-batch reactor for ligninrecovery via Carbon Dioxide on lignin yield etc.
Skills of project pitching
In the whole process of the project, I really learned a lot, which enriched my ideas. In the process of team preparation, we also deeply realized the importance of teamwork. Personally, I also saw many excellent reports, which are worth learning.
We learned about teamwork, how to prepare and perfect a project, and how to apply our advanced technology to some remote areas to help them achieve sustainable development.
My ability of literature reading, problem analysis and oral expression has been improved to some extent
The ability of literature reading, critical thinking and oral expression has been improved to some extent
I learnt a lot about BIOMASS
The teaching method to the students. And other kind of green energy such as solar and wind power, etc.
Bioenergy
How other economies implement biomass / land use-related initiatives.
How to synergize the renewable energy and agricultural industry in APEC region.
Build global network; teamwork; leadership; technology; innovations
To understand more clear about the social issue in the economics in APEC region.
The importance of attire and the lack of experience in reacting on the spot.
More and more technology and also for knowing the trend in the future and also know how to make the research.
Culture differences and new technology
Learned a lot of energy-related topics, as well as the latest technology, and have a better understanding of what APEC is doing
that there are part of the people using their best to save the environment
New innovative ideas and prototype that proposed by teams from several APEC economies
Well organized for hybrid meeting which included virtual and physical meetings
I had gained much knowledge related to green technology.
Know more about green energy innovation

4. Rate your level of knowledge of and skills in the topic prior to participating in the event:

Very high (5)	High (4)	Medium (3)	Low (2)	Very low (1)
6	15	34	7	3

5. Rate your level of knowledge of and skills in the topic after participating in the event:

Very high (5)	High (4)	Medium (3)	Low (2)	Very low (1)
15	40	9	1	0

Comments received:

I have learnt much in this session - green energy, circular economy, constraint of biology and productivity
The shared experiences of other economies expanded my horizon in understanding bioenergy, food security and sustainability
I am an invited speaker
The purpose was to share experiences and stage of development. This was achieved
I was able to gain good quality knowledge of biomass
Learn from each others. The policy dialogue able to gathering expertise from many economies sharing their experiences.
Good
Understanding the mutual interest and more confident in future achievability
does not change much, enjoy the new information shared by other speakers
New information is precious
Gained knowledge and information from other economies
I am interested in all topics
i learn some new ideas from the speakers.
Get more knowledge and understand information about my project
I gained some knowledge more
I interested in the presentation of Dr Pao Law Show about LBF in microalgae application
Relevant
I can see different approaches to solve problems from young students
l gain more knowledge related to waste and biohydrogen through workshop and presentation by other groups
They are experts in their area.

After the event, what I've learned is we need to consider every aspect of a project, feasibility, durability, and also economic analysis of the project. Circular economy need to be consider and done through cooperation of every sector.
The idea from all participate teams was divers and different. All topics was interesting by their own objectives. Many Ideas are able to develop for industry scale.
I guess I could say that I've learned a lot but because what I've learned might just be the tip of an iceberg so I personally think that I've still got a lot to learn.
after participating in the event, I think my knowledge is enrich, a lot of interesting topics.
I learn more on how to make use of the biomass efficiently by circular economy.
As I have mentioned before, I have learnt how to put a idea into real life through analyze the customers' desire, defining the stakeholders, etc.
I had to read a lot more about the current issues and search for the solutions and the related techonogies. Beside that, I learn more about how to promote a project properly.
After participating the event, there are plenty of topics shared by the participants and the inputs are quite new to me such as circular economy model, biomass handling & management and etc. I am appreciated upon receiving those precious inputs from the event and hope to utilize the knowledge in my study in the future.
After this event, I know that as a chemical engineer. We need to contribute back to the environment. Intergrating both industry and community are vital for us in order to built a green future for our next generation.
Because i get many knowledge regarding to the energy source especially green energy
Because I get many biomass sources that can be changed to the green energy source.
The information gained from this event had further strengthen my knowledge
Is a little bit too much for the session, even better if there is slide to refer afterwards
Know what situation on another economy
Obtained valuable thoughts in green solutions and design
After participating in this event, I not only improved my professional analysis ability in scientific research, but also paid attention to the practicability of the final results of the research, which makes my research work more meaningful.
I just started to work with Entrepreneurial Solution in business model recently. So I have a lot to learn about it, but I believe that getting in touch with that many specialists and hearing about their experiences did help me to learn more quickly.
I have gained a greater level of knowledge and skills on the topic after I participated in the activities.
This event showed how to structure narrative at a presentation of my project.
I learnt a good deal about the subject.
I learn some new skills, since my expertise background was a little bit different. So after the event, my understanding was increased.
Had almost no knowledge in the fields
There is still some technology that I down know because I have not studied anything about that thing yet.
As a student of the business area, it is not very easy to me to learn about some science area, but after the competition, it’s more clearly to me to know about what can I develop in the future.
I am not a student born in a relevant background department.

the topic is quite interesting and not difficult to catch up
Learned a lot from the event and understand the current situations from other APEC economies
Good platform for source input from different economies
Before this event, I had literally no knowledge background in this professional field. However, I have learned a lot from speeches and presentations of young entrepreneurs.

6. How will you apply the project's content and knowledge gained at your workplace? Please provide examples (e.g. develop new policy initiatives, organise trainings, develop work plans/strategies, draft regulations, develop new procedures/tools etc.).

Comments received:

New approach to allocation of land for agri purposes.
propose researches that will answer issues identified in the sessions
This will help me a lot in developing future projects
I will share information gained with policy regulators
More efficiently support to Japanese companies for PKS trading
develop new policy initiatives of the Thailand Smart Grid, organize trainings, develop work plans/strategies on Smart Grid (such as DR, VPP, ESS, Microgrid/ Prosumer)
Considering and developing new more policy and strategy initiatives, disseminating gained knowledge in policy making process
Research and development work
I will organising my laboratory better and goes to current technologies
Develop work plan and research plan by following current trends
At my workplace, I can apply the project's content and knowledge gained for developing work research plan and training material for students
Will use in my current research
develop the project
Develop my research
During following the discussion and YES Challenge project, I have an idea to develop a new strategy of my research in microalgae
Sustainable and renewable source
Initiate new research woks.
it helps organizing training in my home university
Develop new procedures
develop work plans/strategies
Would do more research on the renewable resources, and link with the smart circular bioeconomy to utilise the waste as much as possible.

All topic ideas from this conference can be useful for student project which it relate to, fulfil the gab of research and improve the experimental design.
Actually, my course is currently having a project on sustainable inventions and currently we're still in the preparation process but personally, I would like to fight for the chance to share such knowledge with my circle.
develop new procedures
I will develop the new research project.
After graduating, I will research more to develop new tools.
with the knowledge I gained from the event, I want to share them with my colleges, maybe forming our own project to develop a new product or system
I will integrate the knowledge gained and start practicing the sustainable lifestyle which mostly pay attention to the waste classification and plastic usage.
I would research on develop new product as this project had give same insight by using the concept 'Waste to Wealth'
I will to develop a new policy regarding energy and also organize the training for communities and doing surveys
I will doing surveys and organize the training for communities and after that, I will develop a new policy regarding energy sources.
incorporating the idea into future research works
Initiate new research projects
Apply in the future project that I will possible be involved
Organized events and trainings for other people
I will most likely start with developing new methods and work strategies
When promoting my biomass pre-treatment and conversion system, I will pay more attention to the feasibility of the system's operation, including the convenience of obtaining raw materials, the rationality of personnel employment, and finally the economic value of the results.
I am working right know transferring the knowledge gained with sustainable development program and graduate student in Thaksin university
I am currently studying and conducting research on the production of wastewater biogas. Participation in this activity can be adapted into my research.
I can use ideas presented at this event to create new products.
As a matter of fact, my research direction is similar to that of many members of the project. The knowledge I have learned during the project has not only enhanced my view on my own project, but also helped me expand my research project and do more scientific research work.
After the competition, we will continue to follow up our project, carry out a small pilot experiment to verify the feasibility of the project, and then consider enlarging it for industrial application and promotion.
We have carried out a small pilot-scale test and have plans to expand it later
We have carried out a small pilot-scale test and have plans to expand it later
Share with ABAC and those in the private sector working in this area.
To develop work plans
Organize Training, develop plan and work, transfer technology especially in Indonesia, whereby still many opportunities.

We will try to develop new policy initiatives and also develop work plans in Chinese Taipei.
Make report to my supervisor to determine the next step.
This experiment would help me to develop new procedure for education.
Can roughly understand the background of this event and its focus. But I still don't quite understand what the speakers are talking about.
I think the project might be promote to other economies to reducethe CO2 in the world.
Work plan and discussion
Developing new trainings to enhance capacity buildings
Learn a lot from all participants and experts from different economies
I will do some researches and case studies based on the experience this time.
Use the experience gained this time around in life

7. What needs to be done next by APEC? Are there plans to link the project's outcomes to subsequent collective actions by fora or individual actions by economies?

Comments received:

Yes. A followup report will be most helpful.
the key is collaboration.
APEC can enable more similar activities
Sharing this result and communication with APEC EWG and other relevant forum
Sharing lesson and learns of the achievement of the SDGs throughout the Energy issues.
to expand the gains from green synergy approach to all APEC economies stakeholders
collaborative initiatives among economies
Modelling in field/reality and social sciences for NRE application
Sustainable energy and foods in the future
It should be shared experiences achieved n the strong economies about policy, concept and the way to get the sustainable development
regular meetings and sharing, and possibly some fund to carry out the initiative
Develop my research
If it is possible we would like to have collaboration in microalgae application
Green technology related
If APEC project can develop global training program for young
Organize more exchange workshop or activites
Tutorial for the advanced technology such as AI or IoT.

Hopefully the pandemic of COVID-19 would be in control due to I actually want all participants to join this conference in the same place, which more easier to make a conversation than online platform.
Start with individual actions by economies is recommened.
APEC can increase the involvement in the green/sustainability related research of each economies' university by providing funding or technical support in order to facilitate the development of particular field.
I think APEC can involve in more sosial project or research with university student to encourage more young generation involve themself in green solution. It would help the region to steps toward a green future.
I will to find the stakeholders and collab with the goverment to support our project that will be implemented in our economy
I will be doing more research on our project to prepare the implementation of our project soon.
May include young leader training as one of the substance for this event
Is a very important question to ensure the issue will be addressed. I would think we will need economy authority
Have plan to continue research on this area
Yes, the focus on how these development can contribute to a better economy and community will be very beneficial
I hope APEC can provide opportunities to promote our projects, such as contacting certain investors to provide opportunities for cooperation.
This kind of forum/conference should be continued and should be conducted in other member economies of APEC to have a wider reach.
Follow up on performance on the topics presented by each team participant. Developing ideas into action
There are plans to individual actions by economies.
I think it’s necessary to link the project’s outcomes to subsequent collective actions by fora or individual actions by economies, Because all the plans or ideas, no matter how excellent, must be put into practice to see the effect, to achieve the final goal.
I think it’s necessary to link the project’s outcomes to subsequent collective actions by fora or individual actions by economies, Because this can not only test the feasibility of the project, put theory into practice, but also can help those less developed areas to achieve sustainable development.
May be APEC can provide some supports to promising projects
May be APEC can provide more rewards to promising projects
More Events like this
I think this was great since the Covid-19, online program was not bad.
Now we are going to set up some planning in the longest future, before that, it’s necessary for us to analysis the economy trend and the finance to decide the next step of the project.
It is necessary to understand which issues or incidents must be dealt with first after the epidemic.
To share the successful example or project that really increase or help people’s life through policy issue.
Can try to hold a policy recommendation workshop; can try to set up one demo site for training course on the synergy technology in APEC region.

I think starting with Indonesia for initial stage, and then can link the project to fora for wider expansion.
Open more opportunities to the relevant field and share this result with all APEC member economies
Total solutions are not independent that need APEC cross fora to communicate and to share experience together.
I think having more events like this will help participants to get to know others who also work for APEC and will allow them to exchange more experiences and ideas.
I hope to continue to discuss relevant topics with scholars from various economies and promote green energy.

8. How could this project have been improved? Please provide comments on how to improve the project, if relevant.

Comments received:

more audience may be invited
In-person networking is very important. When the situation of quarantine is getting better, I hope we can directly meet and exchange initiatives.
Pre-meting of panelists to synchronize content.
At Corona-pandemic, face-to-face and online hybrid meetings were very good solution
Every participants are trying to exchange their knowledges and situation of their economies was good. The organizer is also well prepared and organized this event.
to continue the second phase of the project and mobilize wider of stakeholders participation because the synergy approach itself requires comprehensive involvement of all spheres of the societal activities and even cross boarder efforts
Make more connections
Speakers should control slide show by themselves (if it possible).
It should do network expansion in APEC economies
less wastage as compared to previous events
Better in physical
Could APEC develops project or link to activities following the initative or business model developed by the event?
Tutorial for the advanced technology such as AI or IoT.
Nope, nice arrangement.
A lot of e-mail I have got (almost everyday, sometime 2 e-mails a day). Its just to remind but it too much.
The project is excellent already. No comments for the improvement.
About the website that we took online course, sometimes it said that the link is expired (I don't remember clearly but it was something like that) so I need that the stability of the website need to be improved
Encourage the participant of teams from other economies so that there is diversification on the topic shared in the event.
The overall project for this year is great.

This project can be improved with the collaboration with stakeholders and also the goverment for the policy. We will hire the communities to improving this project
This project can be improved with the collaboration with stakeholders and also the government for the policy. We also improve through the socialization in the communities.
More support should given to the project won in this event, to realizing the projects or commercializing/promoting the project
It will be really great if this would be a physical meet up.
Projectr so good. In difficult situation event was a very good
The project is well organized and time arrangement are excellent
It is recommended that the project provide more feasibility improvement suggestions to help participants better understand the scientific nature of the project, and at the same time enable the research results to be better applied to real life ◦
In my opinion, in the overall the content of the workshop/conference/competition was very interesting. Maybe if material from the speeches was distributed, it would make it easier to follow the presentations. The idea of making the workshop part of an event not just for specialists, but also for lay people was great, because it raises awareness about the issue.
Unfortunately, this year's event cannot continue due to the COVID-19 situation. It is hoped that this project can continue as the COVID-19 situation improves to give the participants new experiences.
Time difference between teams could be taken into account while making an order at online presentation.
We found that the whole project was basically conducted through oral presentations and written presentations, with very few people modeling or actually applying the ideas in practice. If we can add a parallel game, to make up for this shortcoming.
In my opinion, online discussion is a very good part. We all had in-depth discussions and came up with many interesting ideas. This part can be further optimized.
I think the project has been well done. Thank you again to the organizers and the staff
I think the project has been well done.
3 days is a long time to commit. See if you can condense the programme at all
To invite more expert and students in this field or about entrepreneurship
I think it’s very important for marketing , because it’s necessary for the world to know the information and also reduce the global warming problem
Can invite more participants from various economies, so that this event may become an initial stage of knowledge and technology collaborations before it goes to real implementation.
Can involve industry in this implementation process
Inviting more participants from other APEC economies
everything is great
Great hybrid event but prefer full in physical meeting
Probably shorten the event from 4 days to 2-3 days, for example, combing policy dialogue and workshop in one day
There should be some pre-meetings or idea exchange before the event starts.

ANNEX 3

LIST OF PARTICIPANTS

NO.	Name	Gender	Economy	Organization	Participation
1.	Charles Lalonde	M	Canada	CJ Agren Consulting Inc.	Online
2.	Yudi Anantasena	M	Indonesia	BPPT for Natural Resources Development Technology	Online
3.	Eniya Listiani Dewi	F	Indonesia	BPPT for Industrial Technology, Energy, and Materials	Online
4.	Dwi Susilaningsih	F	Indonesia	LIPI	Online
5.	Hiroki Yoshida	M	Japan	JETRO - Jakarta Office	Online
6.	Jin-Seek Choi	M	Republic of Korea	Mobile Intelligence Routing Lab, Division of Computer Science and Engineering, HYU	Online
7.	Mohd Sobri Takriff	M	Malaysia	UKM	Online
8.	Pau-Loke Show	M	Malaysia	Notthingham University (Malaysia Campus)	Online
9.	Hanilyn A. Hidalgo	F	The Philippines	CBSUA	Online
10.	Matthew Tan Kim Chuan	M	Singapore	Asia of Assentoft Aqua Asia Pte Ltd	Online
11.	Po-Han (Richard) Hsu	M	Chinese Taipei	TAGET	Offline
12.	Yi-Yuan William Su	M	Chinese Taipei	NCHU ; APEC-ACABT	Offline
13.	Wan-Yu Liu	F	Chinese Taipei	NCHU	Offline
14.	Yuwalee Unpaprom	F	Thailand	Program in Biotechnology, Faculty of Science, MJU	Online
15.	Prapita Thanarak	F	Thailand	International Affairs and Quality Assurances; SGTECH, Naresuan University, Phitsanulok	Online
16.	Alissara Reungsang	F	Thailand	KKU	Online
17.	Linh Dan Nguyen	F	Viet Nam	VJIAT, NUCE	Online
18.	Doan Trinh Ta	M	Viet Nam	Independent Experts to STI Policy And Development Strategy; Former President of NISTPASS	Online

NO.	Name	Gender	Economy	Organization	Participation
19.	Teow Yeit Haan	F	Malaysia	UKM	Online
20.	Chen-Hua Hsueh	F	Chinese Taipei	FCU	Offline
21.	Mei-Chih Hu	F	Chinese Taipei	National Tsing Hua University (NTHU)	Offline
22.	Chayanon Sawatdeenarunat	M	Thailand	Chiang Mai Rajabhat University (CMRU)	Online
23.	Kim Anh To	F	Viet Nam	Hanoi University of Science And Technology (HUST)	Online
24.	Kai Lin	M	China	Chongqing University	Online
25.	Cheng Chen	M	China	Chongqing University	Online
26.	Jianyu Wang	M	China	Chongqing University	Online
27.	Hongyan Peng	F	China	Chongqing University	Online
28.	Man Liu	F	China	Chongqing University	Online
29.	Nicholas Brooke	M	Hong Kong, China	ABAC Principal Advisor to APEC PPSTI	Online
30.	Maria Yuk Ling Woo	F	Hong Kong, China	Professional Property Services Limited	Online
31.	Enny Sudarmonowati	F	Indonesia	LIPI	Online
32.	Mikael Pratama	M	Indonesia	Jenderal Soedirman University (UNSOED)	Online
33.	Vera Nopembria	F	Indonesia	UNSOED	Online
34.	Delicia Rahman	F	Indonesia	LIPI	Online
35.	Winky Angga Priatna	M	Indonesia	Director of Industry Department, Indonesian Economic And Trade Office to Taipei	Offline
36.	Jun Miyake	M	Japan	Osaka University	Online
37.	Jamaliah Md. Jahim	F	Malaysia	UKM	Online
38.	Peer Mohamed	M	Malaysia	UKM	Online
39.	Yew Guo Yong	M	Malaysia	University of Nottingham Malaysia	Online
40.	Doris Tang Ying Ying	F	Malaysia	University of Nottingham Malaysia	Online
41.	Chew Kit Wayne	M	Malaysia	Xiamen University Malaysia	Online
42.	Tan Ee Jo	F	Malaysia	UKM	Online
43.	Low Weisheng	M	Malaysia	UKM	Online
44.	Ku Zhi Wei	M	Malaysia	UKM	Online
45.	Cham Eng Kwan	F	Malaysia	UKM	Online
46.	Kin Min Ying	F	Malaysia	UKM	Online
47.	Petr Makhmudov	M	Russia	Lomonosov Moscow State University (MSU)	Online

NO.	Name	Gender	Economy	Organization	Participation
48.	Azim Kurbanov	M	Russia	MSU	Online
49.	Sergey Golovanov	M	Russia	MSU	Online
50.	Andrei Holub	M	Russia	MSU	Online
51.	Bing-Jean Lee	M	Chinese Taipei	FCU	Offline
52.	Shu-Yii Wu	M	Chinese Taipei	APEC-ACABT	Offline
53.	Chiu-Yue Lin	M	Chinese Taipei	APEC-ACABT	Offline
54.	Chen-Yeon Chu	M	Chinese Taipei	APEC-ACABT	Offline
55.	Huang Chih Lu	M	Chinese Taipei	APEC-ACABT	Offline
56.	Chyi-How Lay	M	Chinese Taipei	APEC-ACABT	Offline
57.	Keng-Tung Wu	M	Chinese Taipei	NCHU ; APEC-ACABT	Offline
58.	Jyy-Jiun Lin	F	Chinese Taipei	FCU	Offline
59.	Yun-Ching Pu	F	Chinese Taipei	FCU	Offline
60.	Pin-Yi Yeh	M	Chinese Taipei	FCU	Offline
61.	Jin-Yang Liao	M	Chinese Taipei	FCU	Offline
62.	Ruei (Raymond) Chen	M	Chinese Taipei	FCU	Offline
63.	Po-Shen Lee	M	Chinese Taipei	FCU	Offline
64.	Gracia Imanuella Leonice	F	Chinese Taipei	FCU	Offline
65.	Alicia Amelia Elizabeth Sinsuw	F	Chinese Taipei	PhD Program of Mechanical & Aeronautical Engineering, FCU	Offline
66.	Tsung-Hsien Chen	M	Chinese Taipei	PhD Program of Mechanical & Aeronautical Engineering, FCU	Offline
67.	Hsieh-Tang Chiang	M	Chinese Taipei	MOST	Offline
68.	Jeffrey Wang	M	Chinese Taipei	MOFA	Offline
69.	Shao Chin Cheng	F	Chinese Taipei	MOST	Offline
70.	Alpha Lowe	M	Chinese Taipei	Taichung City Government	Offline
71.	Angelina Shen	F	Chinese Taipei	Industrial Technology Research Institute (ITRI)	Offline
72.	Cleo Hsueh	F	Chinese Taipei	ITRI	Offline

NO.	Name	Gender	Economy	Organization	Participation
73.	Beryl Lu	F	Chinese Taipei	ITRI	Offline
74.	Scott Chen	M	Chinese Taipei	ITRI	Offline
75.	Anna Huang	F	Chinese Taipei	ITRI	Offline
76.	Zih Siang Lin	M	Chinese Taipei	Plastics Industry Development Center (PIDC)	Offline
77.	Tarcy Sih-Ting Jhou	F	Chinese Taipei	ITRI	Offline
78.	Ta Chen Lin	F	Chinese Taipei	Tunghai University	Offline
79.	Da-Yung Wang	M	Chinese Taipei	Mingdao University	Offline
80.	Tzyy-Leng Horng	M	Chinese Taipei	FCU	Offline
81.	Chi-Jung Su	M	Chinese Taipei	Chung Shan Medical University	Offline
82.	Shu-Pi Chien	F	Chinese Taipei	FCU	Offline
83.	Kwan Pei-Ying	F	Chinese Taipei	APEC-ACABT	Offline
84.	Mei-Yi Lee	F	Chinese Taipei	APEC-ACABT	Offline
85.	Joyce Wang	F	Chinese Taipei	Event Secretary to Project PPSTI 06 2019A	Offline
86.	Yu Chen Liu	M	Chinese Taipei	FCU	Offline
87.	Ming-Yen Chiang	M	Chinese Taipei	NCHU	Offline
88.	Cing-Hong Yang	M	Chinese Taipei	FCU	Offline
89.	Guan Zhi Liao	M	Chinese Taipei	FCU	Offline
90.	Wei Ting Lu	F	Chinese Taipei	FCU	Offline
91.	Yi-Hung Liu	M	Chinese Taipei	FCU	Offline
92.	Mei Lan Kuo	F	Chinese Taipei	FCU	Offline
93.	Xin-Yu Zeng	F	Chinese Taipei	FCU	Offline
94.	Kwan Pei-Ting	F	Chinese Taipei	FCU	Offline
95.	Yu Han Cheng	F	Chinese Taipei	FCU	Offline
96.	Yu Hsuan Liao	F	Chinese Taipei	FCU	Offline

NO.	Name	Gender	Economy	Organization	Participation
97.	Nguyen Quoc Huy Phan	M	Chinese Taipei	FCU	Offline
98.	Pei Chieh Wu	F	Chinese Taipei	FCU	Offline
99.	Jia-Ye Li	F	Chinese Taipei	FCU	Offline
100.	Yi Hsuan Wu	F	Chinese Taipei	FCU	Offline
101.	Hoang Nam Dang	M	Chinese Taipei	FCU	Offline
102.	Wei Lun Zeng	M	Chinese Taipei	FCU	Offline
103.	Sheng Hsun Huang	M	Chinese Taipei	FCU	Offline
104.	Chun-Hsiung Lin	M	Chinese Taipei	FCU	Offline
105.	Yu-Yao Tseng	M	Chinese Taipei	FCU	Offline
106.	Yu-Kai Zhou	M	Chinese Taipei	FCU	Offline
107.	Tzu Yu Lai	F	Chinese Taipei	FCU	Offline
108.	Yu-Hsin Hu	F	Chinese Taipei	FCU	Offline
109.	Yi-Chi Deng	F	Chinese Taipei	FCU	Offline
110.	Chia-Min Chang	M	Chinese Taipei	FCU	Offline
111.	Ting-Wei Wu	F	Chinese Taipei	FCU	Offline
112.	Alex Huang	M	Chinese Taipei	FCU	Offline
113.	Jen-Yueh Tsao	M	Chinese Taipei	FCU	Offline
114.	Po-Jui Lai	M	Chinese Taipei	FCU	Offline
115.	Edy Kurniawan	M	Thailand	Thaksin University (TSU)	Online
116.	Wisarut Tukanghan	M	Thailand	TSU	Online
117.	Nikannapas Usmanbaha	F	Thailand	Prince of Songkla University (PSU)	Online
118.	Supattra In-Chan	F	Thailand	TSU	Online
119.	Fidia Fibriana	F	Thailand	PSU	Online
120.	Sompong O-Thong	M	Thailand	TSU	Online
121.	Ayyapruk Moungprayoon	M	Thailand	KKU	Online
122.	Napapat Sitthikitpanya	F	Thailand	KKU	Online
123.	Tanyaporn Siriwong	F	Thailand	KKU	Online
124.	Prawat Sukphun	M	Thailand	KKU	Online

NO.	Name	Gender	Economy	Organization	Participation
125.	Apilak Salakkam	M	Thailand	KKU	Online
126.	Le Ha Quan	F	Viet Nam	HUST	Online
127.	Ha Vi	F	Viet Nam	HUST	Online
128.	Anh Nguyen	M	Viet Nam	HUST	Online
129.	Anh Truong	F	Viet Nam	HUST	Online

ANNEX 4

POLICY FRAMEWORK REVIEW AND RECOMMENDATIONS - A COMPLETE REPORT ON "LAND-USE, LAND-USE CHANGE AND FOOD SECURITY" AND "BIOMASS: A VALUE-ADDED RESOURCE TECHNOLOGY AND MANAGEMENT ON AGRICULTURE RESIDUES"

Dr. Yi-Yuan William Su

A. Background

a. APEC Declarations on food security and forest

APEC economic ministers in charge of agriculture and food met for the first time in Niigata, Japan, in 2010 and issued the APEC Niigata Declaration on Food Security - APEC's first comprehensive plan to promote regional food security. The next APEC ministerial meeting on food security is held biennially in Kazan, Russia (2012), Beijing, China (2014), and Piura, Peru (2016), leading to the Kazan Declaration, Beijing Declaration and Piura Declaration outlining new plans APEC to address food security.

Economics makes a brief update on food security policies and initiatives on rural development, women's empowerment, indigenous agribusiness, smart agriculture, water management, food services, food loss and waste, and climate change and ICTs, emphasizing the three main declarations on food security.

Beijing Declaration on 2014 APEC Ministerial Meeting on Food Security emphasized the productivity of the long-term food security in the Asia-Pacific region. The main points following (Beijing, 2014):

I. Boost agricultural productivity and food production and availability based on sustainable development, innovation, science and technology and an enabling economic environment by: facilitating agricultural production-oriented technical research and innovation; enabling agriculture to be more adaptive to climate change and resilient to disasters; promoting sound development of agricultural biotechnology; facilitating adoption, utilization, extension and transfer of agricultural technologies; accelerating transformation and upgrading of the agricultural industry and promoting sustainable agricultural development.

II. Improve post-harvest management to reduce food loss by: improving management of the food supply chain; enhancing the management of food safety and of food quality; and reducing post-harvest loss and waste in food.

III. Strengthen regional cooperation to promote food security by: strengthening research and development cooperation to promote sustainable agricultural development; strengthening cooperation in seed development; strengthening prevention and control of trans-boundary animal and plant diseases; protecting and developing significant agricultural heritage and boosting modern agricultural and rural development; strengthening exchange and

cooperation on management of food supply chains; enhancing policy coordination and cooperation on food security; liberalizing and facilitating agricultural trade and investment; and strengthening internal exchange and cooperation among APEC economies.

The Kazan Declaration made by the 2012 APEC Ministerial Meeting on Food Security and emphasized: increasing agricultural production and productivity; facilitating trade and developing food markets; enhancing food safety and quality; improving access to food for socially vulnerable groups of population; ensuring sustainable ecosystems-based management and combating Illegal, Unreported and Unregulated (IUU) fishing and associated trade.

The five priority areas of the Piura Declaration on APEC Food Security 2016: regional food market and trade; sustainability for a resilient food system; innovation and technology; rural-urban development; and infrastructure, investment and services for food security (Piura, 2016).

For the forest issue, The APEC Meeting of Ministers Responsible for Forestry (MMRF) is a high-level policy dialogue in addressing regional challenges and opportunities including forest cover increase, illegal logging and climate change mitigation. It promotes the exchange of experiences on good governance and transparency in the trade of legal timber, timber products and frontline services while enhancing and sustaining local forest industries (IENR, 2011). Further recognizing the need for cooperation and proactive discussion, including high-level policy dialogues among APEC economies, the Seoul Statement of the MMRF4 aim to maximize the contributions of forests to the economic, environmental and social development of the region:

1. Maintain and expedite efforts to achieve the goal of increasing forest cover in the region by at least 20 million hectares by year 2020;
2. Strengthen cooperation to combat illegal logging and associated trade, by establishing and implementing effective policies within individual economies and sharing information and best practices among APEC economies, especially through the EGILAT;
3. Further enhance coordination and cooperation amongst APEC economies to promote trade in legally harvested forest products, which would contribute to, among other things, increasing income from forests and global trade opportunities, and to share best practices and information on effective schemes in this regard;
4. Promote the health, productivity, and resilience of forests to ensure that they continue to provide essential goods and services as well as to further contribute to climate change mitigation and adaptation;
5. Promote the revitalization of forest-dependent communities and regional development to increase the benefits of forests, especially in terms of forestry-related job creation and income generation;
6. Enhance the implementation and sharing of successful forest-related policies relating to recreation, healing, education and well-being;
7. Explore future actions and foster closer cooperation with cross-continental organizations such as the FAO, ITTO, and UNFF, and regional organizations such as the APFNet in

order to maximize the contributions of forests to economic, environmental and social outcomes, and address common challenges related to the forestry sector; and

Continue to actively raise awareness on the importance of forests in achieving APEC's mission by sharing the outcomes of the MMRF4 at relevant fora, including the APEC Leaders' Meeting.

It is quite clear that APEC community has not consider the challenges raised by the interactions among food production, forest, renewable energy and lands. The land is a limited nature source and support various human needs for living. The further requirements to increase usage of renewable energy and replace the usage of conventional energy could cause land use change and danger the food production. The adverse impacts caused by climate change might enhance the shortage of land needs among APEC economic entities. The leaders or SOM shall have more detail discussion and consider the food production security as a major principle of sound management on their domestic lands.

b. The Association of Southeast Asian Nations (ASEAN) and Its Member States

The Association of Southeast Asian Nations (ASEAN) is a regional grouping that promotes economic, political, and security cooperation among its ten members. ASEAN was founded half a century ago in 1967 by the five Southeast Asian states of Indonesia, Malaysia, the Philippines, Singapore and Thailand. This was during the polarized atmosphere of the Cold War, and the alliance aimed to promote stability in the region. Over time, the group expanded to include its current 10 members (World Economic Forum, 2017). Regional cooperation was further extended with the creation of the ASEAN Plus Three forums in 1997, which included China, Republic of Korea and Japan.

Ten Member States of the ASEAN: Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam. This area is inhabited by around 649.1 million people, with a total GDP in 2019 of USD 9.34 trillion **(ASEAN, 2019; Statista, 2019).** This is a diverse group, racially, culturally, linguistically, in socio-economic and geographic conditions, but collectively, it is a region with a strong growing economy. Asian Development Bank (ADB) shows that the GDP growth in Southeast Asia stands at 4.9 percent in 2020 **(Asian Development Bank, 2020)**. The region's GDP is projected to nearly triple by 2040. Therefore, keeping up with this growth will require significant amounts of energy.

B. Policy Research

(a). Asia-Pacific Economic Cooperation (APEC)

The Asia-Pacific Economic Cooperation (APEC) is a regional economic forum established in 1989 to leverage the growing interdependence of the Asia-Pacific. APEC works to facilitate

economic growth, cooperation, trade and investment in the Asia and Pacific region. The 21-member economies are: Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong, China, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, The Republic of the Philippines, The Russian Federation, Singapore, Chinese Taipei, Thailand, United States of America and Viet Nam (APEC, 2020a)**.** In 2019, APEC Region is the home for nearly 2.9 billion people, accounting for 38% of the global population. The region contributes 61% of the global nominal GDP, accounting for 53 trillion USD. (APEC, 2020b).

(b)The Associations of Southeast Asian Nations (ASEAN)

The Association of Southeast Asian Nations (ASEAN) is a *regional* grouping that promotes economic, political, and security cooperation among its ten members. ASEAN was founded half a century ago in 1967 by the five Southeast Asian States of Indonesia, Malaysia, the Philippines, Singapore and Thailand (World Economic Forum, 2017). In 2020, ASEAN become a home for ten-member states are: Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam. The aims and purposes of ASEAN are to accelerate economic growth, social progress and cultural development in the region and to promote regional peace and stability in Southeast Asia region (APEC, 2009). ASEAN covers a more specific and smaller scope than APEC, however, ASEAN plays an important role in advocating for the interests of the least developed regions in Southeast Asia. ASEAN has been active in promoting dialogue and cooperation between regions by establishing external relations with developed regions and other regional trade organizations (Liu, 2005). ASEAN's role in APEC is to become one of the observers from three institutions: the ASEAN Secretariat, the Pacific Economic Cooperation Council (PECC), and the Pacific Islands Forum (PIF) Secretariat.

(c). The APEC-ASEAN Cooperation toward Climate Change

Climate change has had an impact on people's lives, especially developing economies and poor communities. Climate change can cause extreme weather conditions, destroy and deplete natural resources and affect livelihoods and food security (Dev, 2011; FAO, 2008)**.** Climate change can contribute to natural disasters is around 70 percent in the Asia Pacific region. APEC economy, which accounts for about 60 percent of world energy consumption, reducing the use of fossil fuels to meet the ever-increasing energy demand (APEC, 2015).

APEC and ASEAN each has organization to work on climate change mitigation in different direction. At the moment, these two organization are still in the stages of pursuing collaboration and program initiatives in food security and climate change through the two organizations.

APEC Climate Center (APCC) is the organization under APEC for climate change in Asia Pacific region. The mission is to enhance the socioeconomic well-being of member economies by utilizing up-to-date scientific knowledge and applying innovative climate prediction techniques through Climate Prediction, Climate Information Services, Interdisciplinary Research, and Cross-continental Cooperation (APCC, 2020). The ASEAN Climate Resilience Network (ASEAN-CRN)

is an organization under ASEAN aim at ensuring the member States are in a better position to adapt their agricultural sector to climate change and optimize its mitigation potential. The organization working with APEC for climate change mitigation in Southeast Asia region (ASEANCRN, 2020).

The pillars of APEC's cooperation are trade and investment media and economic and technical cooperation. Meanwhile, the pillar of ASEAN cooperation is cooperation in the political-security, economic and socio-cultural fields. APEC and ASEAN have great economic and trading relations. Even though, APEC and ASEAN have an essential role to play in developing policies and programs that help restore growth and combat climate change and environmental damage in Southeast Asia region.

C. Review of Land Protection Policy for Agriculture and Biomass Land Production

APEC economic entities in the Southeast Asia region keep the potential of agriculture and forestry which can play a role in building clean energy resilience. While they are located in the tropical zone, close and pass by the equator, shows that soils are nutritious, well-distributed rainfall, and fertile rainforest. These areas have huge agriculture and forestry production potential. Based on the publications from the European Union, the forest cover in Southeast Asian economies is estimated at 236 million hectares in 2010 and also found 32 million hectare forest land losing after 1990.[1] The same forest land dropping also happened among APEC economic entities. In Southeast Asia region, the forest sector provides 21,120 million cubic meters and the forest in the APEC economic entities provides 17,640 million cubic meters.[2] For both timber trading and renewable energy sources, these are valuable assets of APEC economic entities. According to European standard, one tone of wood pellets contains 4.9MWh energy, the forest sectors in APEC economies might be able to contribute 86,436 MWh a year.[3]

Table 1. Forest Stocks of ASEAN member States in 2010.

States	Stocks provided by Forest Sector per Year
Cambodia	959Mm^3
Myanmar	1,430 Mm^3
Viet Nam *	87 Mm^3
Lao PDR	929 Mm^3
The Philippines *	1,278Mm^3
Indonesia *	11,343Mm^3
Thailand *	783Mm^3
Malaysia *	4,239Mm^3
Brunei Darussalam	72Mm^3

[1] H.-J. Stibig, F. Achard, S.Carboni, R. Raši and J. Miettinen, Change in tropical forest cover of Southeast Asia from 1990 to 2010, 10 Biogeosciences Discuss. 12625, 12626 (2013).

[2] Maw Maw Tun, Dagmar Juchelková, Myo Min Win, Aung Myat Thu and Tomáš Puchor, Biomass Energy: An Overview of biomass sources, energy Potential, and Management in Southeast Asian Countries, 8 Resources 81, 93~94(2019).

[3] European Pellet Council, Energy Balance of Wood Pellets. Wood pellets are bundled energy: 1kg contains 4.9kWh. https://epc.bioenergyeurope.org/energy-balance-of-wood-pellets/

Total	**21,120Mm^3**

* = APEC economic entities.

Source: Tun et al., (2019).[4]

Based on the research report of IRENA, the total collected residue in the APEC economic entities of Indonesia, Malaysia, the Philippines, Thailand and Viet Nam is 3,503 tones in the year of 2010.[5] Comparing the world total residue 55,179 tones in the same year, the usage of residues from agriculture is obviously low and remain risky to increase greenhouse gas emission in these economic entities. Furthermore, if we look closely to the biomass production in Southeast Asian regions from 2000-2018, only 22 Tera watt per hour (TWh) were contributed by the usage of biomass. If residues collected from the forest and agriculture sectors can contribute more than 20 thousand million tons a year, but only generate 2.2 TWh averages a year, obviously the usage rate of biomass and residues are very low and remains inefficiency among APEC economic entities. It also shows the energy diversity in not broad enough and the emission of greenhouse gas amount might be high because these organic materials are not treated by sound measures and leads tremendous emission of methane.

Although forest sources and acres are abundant in Southeast Asia states, this region also well recognized as a deforestation hotspot in the world. The research indicated 268 million ha to 236 million hectors of forest coverage lost between 1990 to 2010.[6] In order to save valuable habitats for various animals, plants and trees, many solutions have been implemented, one of the most famous being in recent years, Agroforestry, or a mixed species production system based on perennial wood. Agroforestry systems have the potential to stop land degradation and increase site productivity through interactions between trees, soil, crops and livestock. In Asia, Agroforestry systems are booming on under-managed soils and subsistence agricultural conditions. Despite such advantages, Agroforestry as a land use option has not attracted much attention from planners and extension workers. The reasons include inconsistencies in the productivity of understored crops (positive, negative, or neutral effects depending on species, location, and management) and a lack of public policy support that more emphasizes poverty reduction through agriculture production. Food production either directly (producing food grains, tubers, fruits and vegetables) or indirectly (improving soil conditions and thus promoting under-crop productivity, especially in degraded locations) is a central theme of most smallholder Agroforestry practices.

Land is a limited natural source, but utilized by people for various purposes, including food and energy crop plantings. Based on the requirements of the United Nations Convention on Climate Change (UNFCCC), the global communities shall work together to fight against climate

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[4] *Supra* note 1, at 5.

[5] IRENA, Biofuel Potential in Southeast Asia: Raising food yields, reducing food waste and utilizing residues 20 (2017).

[6] Ronald C. Estoque, Makoto Ooba, Valerio Avitabile, Yasuaki Hijioka, Rajarshi DasGupta, Takuya Togawa and Yuji Murayama, the future of Southeast Asia's forests, Nature Communications, 10:1829 (2019). https://www.nature.com/articles/s41467-019-09646-4

change and find alternative energy sources to replace fossil fuels. The use of renewable energy can achieve greenhouse gas emission reduction and secure the land's energy supply security. However, the UNFCCC further requires those Contracting Parties taken such measure shall ensure the food production is not threatened. The European Union also concerns the cultivation of energy crops displaces the traditional production of food crops and feed purpose. Such activities will increase the pressure on land and cause the land changes of forests or wetlands. These indirect land-use change might increase greenhouse gas emissions and biodiversity loss.

According to the Intergovernmental Panel on Climate Change (IPCC), directive land usage changes functions as changes in land use or management of individuals, which can lead to changes in land cover. Whereas interactive land usage change (ILUC) refers to shifts in land use caused by changes as a consequence of market mechanisms or political actions that drive additional demand for biomass or land. Therefore, the decision to change agricultural land use activities in certain areas can also change land use locally and even globally.

The Article 25 of the EU Directive 2018/2001 regulates the all EU member states shall ensure the usage of renewable energy in transport sector shall reach 14% at least within the final consumption of energy by the year 2030.[7] The paragraph 2 of the same Article further regulates "the greenhouse gas emission savings from the use of renewable liquid and gaseous transportation fuels of non-biological origin shall be at least 70% from 1 January 2021." Within the 14% usage of renewable energy in transport sector, "the share of biofuels and bioliquids, as well as of biomass fuels consumed in transport, where produced from food and feed crops, shall be no more than 1% higher than the share of such fuels in the final consumption of energy in the road and rail transport sectors in 2020, with a maximum of 7% of final consumption of energy in the road and rail transport sectors in the Member States."[8] Under this limitation, it will protect the food production and prevent the land for food crops planting losing.

To prevent the effects of ILUC, the EU Directive 2015/1513 also defines the ILUC concept as "biofuel, whose feedstock is produced in a scheme that reduces the displacement of production for other purposes than to make biofuels"[9]. In other words, it concerns measures that reduce displacement, but do not necessarily mitigate complete. In the following, a summary of approaches that help reduce the impact of ILUC is provided, and their effectiveness is discussed: First, prioritize the use of residues and by-products such as agricultural residues, forestry residues, by-products from the food processing industry, wood processing industry or other types of waste and residues such as fractions organic from municipal solid waste. To the extent that these byproducts are not used as byproducts and their use does not cause a decrease in carbon stock or loss of soil fertility, these byproducts can be considered a low ILUC risk.

Second, from an economic perspective, residues generate additional income and

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[7] O.J. L. 328, 125 (21.12, 2018).
[8] *Id.*, Article 26.
[9] O.J. L. 239, 7 (15.9. 2015). Article 1, (1).

consequently can create incentives to expand the production of the main product, both through expanding the area and increasing yields. Utilization and increased productivity by the use of raw materials produced in abandoned, unused, marginal, empty, underutilized or polluted land[10].

D. The Growth Performance Status and Strategic Plan for Food, Forest and Renewable Energy of APEC economic entities

Apart from the similarities among APEC economic entities - especially due to geographical proximity, common economy and political cooperation, above all, there are important differences in economic development patterns, policy focus, and future strategies. This speed of growth of population brings the potential for economic growth as well as social threats such as food security and energy security. This section will discuss the summary and review of each economic entity's strategic plan in its land strategy efforts. Theoretically, by balancing macroeconomic development, strengthening food security and biomass development as clean energy resilience.

(a). Indonesia

Indonesia is a lower middle-income economy with an archipelago of more than 13,000 islands with a population of more than 267 million, the fourth most populous region in the world. Indonesia's economy faces a fluctuating situation mainly due to the ups and downs of oil prices, while it is faced with enormous energy needs to meet the needs of millions of populations. Partly because of unsupportive macroeconomic policies. The impact is an increased current account deficit, constrained infrastructure spending, and high inflation.

In the 1980s, the situation changed since the green revolution and the government's focus were in agriculture, both food and industrial. In addition, flexibility with ASEAN as well as industrial and foreign trade patterns helps Indonesia maintain its economic sovereignty. The economy continues to make significant progress in human development and poverty reduction, with the poverty rate lowering (in 2014 to 2019) from 11.0 percent to 9.2 % (Statistic Indonesia Agency, 2020). Indonesia's domestic statistics show the remainder that less than a percent of the population lives in extreme poverty[11].

Indonesia's strategic plans and top priorities are in line with the United Nations framework for sustainable development cooperation in Indonesia in 2021–2025. The government is strongly committed to achieving the SDGs. Domestic development plans, through the National Medium-Term Development Plan 2020-2024 (RPJMN), is in line with the SDGs and several SDG targets.

Based on the development plan and informed by key stakeholder consultations and

[10] Greet Woltjer, Vassilis Daioglou, Berien Elbersen, Goizeder Barberena Ibañez, Edward Smeets, David Sánchez González, Javier Gill Barnó, Study Report on Reporting Requirements on Biofuels and Bioliques Stemming from the Directive (EU) 2015/1513, 54 (2017).

[11] World Food Programme, 2020 Global Report on Food Crises: Joint Analysis for Better Decisions 47 (2020).

evaluation findings of the economy's strategic plan for 2017-2020, the WFP Strategic Plan (2017-2021) and Sustainable Development Goals 2 and 17 through three strategic outcomes for 2025:

Strategic 1: Governments and other partners have increased capacity to produce and apply high-quality evidence as a basis for reducing food insecurity and malnutrition.

Strategic 2: Government, partners and other communities have increased capacity to reduce the impact of disasters and climate change on food security and nutrition.

Strategic 3: People who are at risk of experiencing various forms of malnutrition benefit from increased domestic capacity to design and implement programs that increase access and promote positive behaviors on healthy diets and prevent stunting and other malnutrition.

Indonesia has the largest geothermal and hydropower potential in the world, as well as resources for the development of solar, wind, marine and bioenergy power. Apart from generating electricity, this source can support heating, cooling, and transportation applications.

The Indonesian government is seeking a breakthrough in biomass utilization to reduce the main role of coal domestically and to encourage the achievement of the renewable energy mix target. Based on Government Regulation no. 79/2014, the target of renewable energy from a mix of sources excluding the traditional use of bioenergy is 23% in 2025. Until the end of 2019, the renewable energy mix only reached 9.15%, where 6.2% came from energy power plants. Renewable energy and 2.95% derived from biofuel or biodiesel. Meanwhile, in 2025, the mix is targeted at 23%, where new renewable energy power plants are targeted to provide a mix portion of 13% to 15%, bioenergy sources 2% to 5%, and biofuel power generation 2% to 3%.

The management of new energy and renewable energy is regulated in Law Number 30 of 2017 concerning Energy. In this case, the Central and Regional Governments are obliged to increase the supply and utilization of new energy and renewable energy. The government is also committed to the Paris Agreement to reduce greenhouse gas emissions by 314-398 million tons of CO2 by 2030, with mitigation actions, including shifting the fuel subsidy budget to productive activities (infrastructure), 23% of renewable energy from the total domestic primary energy mix and waste to energy in 2025 (Directorate General of New and Renewable Energy and Energy Conservation, 2020).

Indonesia's main regulation regarding bioenergy development power is 5.5 GW which is 10% of the total energy mix development. Meanwhile, hydropower is 3%, geothermal is 7% and other mixed EBT is 3%. In the bioenergy sector, the feed-in tariff ranges from USD 0.108 - 0.272 / kWh depending on location, voltage (low / medium) and type of bioenergy (biomass, biogas, municipal waste).[12]

[12] Ministry of Energy and Mineral Resources Regulation No. 21/2016 (biomass and biogas); Ministry of Energy and Mineral Resources Regulation No. 44/2015 (municipal waste); Presidential Decree No. 18/2016 (municipal waste).

Almost all sources of bioenergy in Indonesia come from palm oil production. The Indonesian government implements the B20 program (and B30 for the electricity sector), and compensation is provided by the Indonesian Palm Oil Plantation Fund for subsidized biodiesel (Public Service Obligation), which is blended for use in transportation (IRENA, 2017). The central government has set up the New and Renewable Energy Development Strategy (Finahari, 2020), the contains include:

a) Increasing the supply of domestic electricity through the construction of geothermal and hydro power plants;
b) Distribution of electricity access to rural areas, small islands and border areas with micro hydro and solar power plants;
c) Development of bioenergy power plants through agricultural waste and municipal solid waste for electricity supply and a healthy environment;
d) Pilot projects of wind power and marine energy in preparation for the commercialization stage;
e) Utilization of biofuel for fuel oil substitution; and
f) Research and development of new energy.

The potential of biomass for power generation in Indonesia can be sourced, among others, from oil palm, sugar cane, rubber, coconut, rice husks, maize, cassava, wood, livestock waste and municipal waste, with a total potential in all parts of Indonesia of 31,654 MW. The installed capacity of bioenergy power plants is currently 1,89.8 MW with a total on grid capacity of 206.02 MW and a total of grid capacity of 1,683.78 MW. In 2020, Indonesian Directorate General of Renewable Energy and Energy Conservation announce the new strategic plan in the acceleration of the biomass development as a regional clean and sustainable energy source includes:

1. encouraging the production and development of biomass and Refused Derived Fuel pellets from waste and biomass waste for energy.
2. encouraging an increase in the capacity of biomass power plants (project pipeline) by ensuring the commitment of related parties in the development of biomass power plants.
3. encouraging captive power generators to sell excess electricity to State electricity companies with an excess power scheme.
4. co-firing the biomass pellets on the existing steam power plant.
5. massive development of small-scale biomass power plants in the eastern part of Indonesia (less infrastructure area).
6. development of energy plantations and sub-optimal land use of biomass in collaboration with the Ministry of Environment and Forestry, related regional agencies and the local government.
7. encouraging the use of Agri-industrial waste, including re-planting of oil palm plantations for electricity generation.
8. utilizing marginal land and degraded land through developing superior species of energy

crop.

The regulations for the production of biomass production are still associated with the National Electricity Management Division (PT. PLN Persero) and are regulated in 4 regulations: (1)Regulation of The Minister of Energy And Mineral Resources of The Republic of Indonesia number 39 of 2017 concerning implementation of physical activities utilizing new and renewable energy and energy conservation; (2) Government Regulation Number 70 of 2009 concerning Energy Conservation; (3) Government Regulation of The Republic of Indonesia number 150 year 2000 concerning land damage control for biomass production, and (4) Government Regulation Number 14 of 2012 concerning Electricity Supply Business Activities. Within these 4 regulations, only following 3 rules mentioned the land issues as extracted as following.

(1) Soil conditions for determining the status of soil damage shall be determined based on the results of:
   a. Analysis, inventory, and / or identification of the basic characteristics of the soil;
   b. Inventory of climatic conditions, topography, potential sources of damage, and land use.
(2) Determination of the condition of the land as referred to in paragraph (1) shall be carried out on land areas that have the potential to experience soil damage.
(3) Soil conditions for regency areas are mapped with a minimum level of accuracy of 1: 100,000 and for urban areas 1: 50,000.

Although in Presidential Regulation No. 35 of 2018 concerning the Acceleration of Construction of Waste Processing Installations into Electric Energy Based on Environmentally Friendly Technology (a regulation that replaces Presidential Decree Number 18 of 2016) the definition of garbage power plant as a new and renewable energy is no longer available, but in its implementation garbage power plant is still categorized as renewable energy, especially when referring to regulations within the Ministry of Energy and Mineral Resources. An example of this regulation is the Minister of Energy and Mineral Resources Regulation No. 53 of 2018 regarding the Utilization of Renewable Energy for Provision of Electricity, which categorizes garbage power plants as a renewable energy source. Currently, garbage power plant is defined as processing waste into electrical energy based on environmentally friendly technology that meets quality standards in accordance with statutory provisions and can significantly reduce the volume of waste (Republic of Indonesia Presidential Regulation, 2018; Law of Republic of Indonesia, 2007).

The determination of Garbage power plant as renewable energy makes the development of Garbage power plant a priority and is given various facilities equalized to the development of other renewable energy sources. Of course, this is done to pursue the target of 23% renewable energy in Indonesia's domestic energy mix by 2025. This is as stated in Governmental Regulation 79 of 2014 concerning the Domestic Energy Policy which states that the priority of domestic energy development is based on the principle of maximizing the use of renewable energy by considering

the economic level. In addition, the facilities that can be obtained in the development of Garbage power plant as a new and renewable energy source include providing fiscal incentives, ease of licensing and non-licensing, setting the purchase price of electricity from each type of new and renewable energy source, forming a separate business entity in the framework of the provision of electricity, to the provision of subsidies. Even in the land provision stage, garbage power plant development can also be categorized as a strategic project, where the provisions for land acquisition are carried out based on the provisions in land acquisition for the public interest using a minimum time (Republic of Indonesia Presidential Regulation, 2016; Republic of Indonesia Government Regulation, 2014). According to Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 19 of 2019, solid waste materials for solid waste power plants are applied with maximum levels (with mg / Nm3 standard) particulate PM is 120, Sulfur Dioxide is 210, Nitrogen Dioxide is 470, Hydrogen Chloride is 10, Mercury is 3, Carbon Monoxide is 625, Hydrogen Florida is 2, Dioxin and Furan is 0.1 (Ministry of Environment and Forestry, 2019).

Table 2. The land usage structure in Indonesia in 2019

Lands for fuel crops production	Unused land	Forest land	Rice land
?	11.7 million ha.	94.1 million ha.	7.64 million ha.
Remix renewable energy to 23% by 2025	6% of total lands	50.1% of total lands	4.06% of total lands

In 2019, the forest area was 94.1 million hectares or 50.1% of the total land area of Indonesia (Directorate General of Forestry Planning and Environmental Management, 2020). The total rice field area in 2019 is 7.64 million hectares. Approximately 11.7 million hectares of land or 6% of the total land area of Indonesia is temporarily unused land (Ministry of Agriculture, 2020). The Indonesian government is also targeting an increase in agricultural production by increasing the area of land for food production. However, the land aera used on paddy rice planting smaller than unused land shows a warning sign to Indonesian government not only because this number shows the land is not used in efficiency way but also lacks of self-production or self-sufficiency on food crops. It might cause the shortage on food production or food security concerns. Meanwhile, Indonesia has not yet set up a policy for land use distribution. Without acres protection policies on forest and agriculture lands, whether the development and promotion on renewable energy production will futher compress or change the land usage on forest and agriculture still remain concerns.

(b). Malaysia

Malaysia is the richest among the economic entities under this study, with its per capita income at US$4,000. Other features which distinguish Malaysia from its neighbors are its low

population pressure and abundant natural resources. At the same time, the economy has a more pronounced ethnic and regional differentiation, and a higher degree of income inequality.

Malaysia owns 32.8 million hectares of total land in 2016. Malaysia recorded a total forest area of 19.3 million hectares or nearly 60% of the total land area. Forest areas are classified as Permanent Protected Forests, State Land Forests, Total Protected Areas, National Parks and Wildlife & Bird Reserves, and Rubber Plantations (FAO, 2020). Currently there is no policy for land-use distribution between agriculture and forestry.

The land is a State matter and the Article 76 (4) of the Malaysia Constitution authorized the Federal government to make laws to manage this limited and rare nature sources.[13] The National Land Code (NLC) was established and announced in 1965 and classified the lands into (i) town; (ii) village; (iii) agriculture; (iv) building and (v) industry usages. However, the NLC does not provide acres' preservation on agriculture usage.

Malaysia's self-sufficiency rate (SSR) in rice is closer to 70% in 2020[14], which is lower than almost all other major rice producers in Southeast Asia. They also only produce 66% of fruit, 40% of vegetables and 29% of ruminants for their own needs. In order to solve this issue, the government now imports roughly a quarter of the food for Malaysian to consume[15]. Recent years, for the economic benefit driven, more than five million hectares of land being cultivated for palm oil, which covered almost 80 % of Malaysia's agriculture lands in 2012 compared with just one million hectares of food crops. Meanwhile, the share of agricultural land accruing to food crops, including fruits, fell to 10% in 2015 and 8% in 2018. Therefore, the land usage and reduce Malaysia's dependency on imported food products are major challenges of Malaysia government.

Table 3. Malaysia land usage on forest and agriculture

Total lands (2016)	Forest lands (2016)	Food crops lands (2012)
32.8 million hectares	19.3 million hectares	1 million hectares

[13] Mccluskey,William James; Burns, Tony; Kelm,Kathrine M.; Kunicova,Jana; Dzurllkanian, Dr; Arimuthu,Arividya P; Foong,Joshua Chee Yan; Pacheco,Chancey Lee; Loo,Carmen, Enhancing Public Sector Performance: Malaysia's Experience with Transforming Land Administration 24 (2017). http://documents1.worldbank.org/curated/en/928151510547698367/pdf/121243-REVISED-World-Bank-Report-06-Land-Administration-FA-FULL-Web-V2.pdf

[14] Darshan Joshi, Building resiliency into Malaysia's long-term food security, 2 April 2020. MalayMail. https://www.malaymail.com/news/what-you-think/2020/04/02/building-resiliency-into-malaysias-long-term-food-security-darshan-joshi/1852701

[15] Khairani Afifi Noordin, Agriculture: Addressing food security in Malaysia. 14 October 2018, The Edge Markets. https://www.theedgemarkets.com/article/agriculture-addressing-food-security-malaysia

Based on the Renewable Energy (Criteria for Renewable resources) Regulations 2011 of the Renewable Energy Act 2011, the definition of biomass is (a) a resource in solid form; (b) comprises of non-fossilized and biodegradable organic materials, including products and by-products and residues from agriculture, industrial or municipal waste originating from Malaysia.[16]

Natural gas contributes more than 50% of the energy supplies in Malaysia and coal contribute nearly 40% of the domestic power sector, meanwhile the central government intend to reduce the GHG emission by 45% in 2030 (Malaysia Gas Institution, 2017; Abdullah, et al, 2019).

Malaysian Ministry Energy, Science, Technology, Environment and Climate Change has set a target of generating 20% of the economy's total electricity from a renewable mix by 2025, while Malaysia in 2019 only has 2% of RE penetration, which mostly is provided by solar Photovoltaic (Abdullah, 2019). Malaysia promotes biomass through its biomass production, which approximately 168 million tons, including resources from palm oil waste, rice husks, coconut waste, sugar cane waste, municipal waste and forestry waste (Ozturk et al, 2017).

The Sustainable Energy Development Authority is the ministerial body that determines renewable energy policies. The following are the main points of the government in the effort to achieve 20% renewable energy, renewable capacity mix by 2025 (SEDA, 2020):

1. implement enhanced Net Energy Metering (NEM) and solar leasing
2. implementing the Large-Scale Solar Power Program 3 (LSS3)
3. implementing the Non-Solar ET Project
4. establishing an ET Facilitation Program in the Sustainable Energy Development Authority (SEDA) Malaysia
5. allows greater access to renewable energy sources. Forestry biomass especially material derived from natural forest, plantation forest, and rubber plantation of Malaysia, material collected upon log production and primary wood manufacturing activities. The information helps to foresee the potential of these promising waste resources to be used for energy products. As Malaysia forest covers from inland to coastal vegetation and natural forest as well as forest plantations plus rubber wood plantation, therefore, a lot of residues have been generated.

The Renewable Energy Transition Roadmap (RETR) 2035 will strike a balance between environmental targets, affordability/economic benefits and system stability. Environmental targets and policies Roadmap to be aligned to and support key policies and targets in Malaysia. Increasing usage of renewable energy in the domestic power mix to 20 % of installed capacity

[16] Federal Government Gazette, P.U. (A) 383. 30 November 2011. http://www.seda.gov.my/policies/rules-and-regulations/

(excluding large hydro1) by 2025.[17]

Ministry of Housing and Local Government, Ministry of Work, Ministry of Natural Resources and Environment and Construction Industry Development Agency (CIDB) guidance for waste management as stated in the 2007 Public Hygiene Management Law (Law 672), Environmental Quality Law 1974 (Law 127) and Guidance Malaysia Act 1994 (Act 520) by using Recycling, Incineration, Landfilling as the waste management method (Wahi, et. al, 2015). Meanwhile, agricultural waste into decomposition energy through anaerobic processes. Anaerobic digestion of agricultural waste (crops and manure) is widely applied to waste management, energy production, energy recovery and the reduction of greenhouse gas emissions and pollution. The Malaysian waste-to-energy concept is commonly applied in agriculture.

Law 672 was passed by parliament to empower the federal government to take over responsibility for sustainable waste management. The implementation of the law began in September 2011 through the MHLG. The current government aims to reduce the amount of solid waste disposed of in TPA by 40% and GHG from solid waste disposal by 38% (Yahaya, 2012).

Landfill is the most common and cheapest method of waste disposal in the world but it is also the least effective option. To date, more than 80% of the collected waste has been landfilled as this is the main disposal technique in Malaysia; However, this method has become a challenge to offset the increasing rate of urban waste production in Malaysia due to land scarcity (Aja & Al-Kayiem, 2013).

Waste incineration technologies are categorized as Combustion, Pyrolysis, Gasification, Plasma Decomposition and Detonation. The process involves burning the trash to boil water, which runs the steam generator to generate electricity and / or heat to meet our energy needs. One of the problems associated with incineration is the potential for pollutants to be dispersed into the atmosphere by the exhaust gases from the boiler. The Malaysian government dedicated a special committee from the cabinet who ordered them to propose a holistic waste management framework for the economy especially for populated areas and the committee proposed to put emphasis on building incineration facilities to contribute to its response.

Biomass production in Malaysia is forestry-based and oil palm industry residues**.** The potential of biomass and biogas is promising, but there will be costs incurred in its supply as the plantations are remotely located, away from most of the population. The Malaysia government also announced the National Biomass Strategy 2020 (NBS 2020) in 2013 and planned to introduce the palm oil industry because they are the major sources of biomass energy. This NBS 2020 is planned to increase 100 million dry tons (solid biomass) from the residues of oil palm industry by 2020. Another 200 million tons of biomass are utilized by 2020 for high-value uses, such as bioethanol and bio-based chemicals, could also contribute to the Malaysia's economy. Both targets will increase the usage of biomass and contribute towards the renewable energy

[17] Sustainable Energy Development Authority (SEDA).

development target of 410 MW of installed biogas capacity and reduce 12 % of carbon dioxide (CO_2) emission by 2030.[18]

Although the Malaysia's renewable energy promotion is using current oil palm industry residues and products to produce biofuels or biomass energy, the land-use changed from forestry or agriculture purpose to oil palm planting remains concerns in Malaysia. The domestic food production only can provide 75% of local consumer needs. The growing populations and economic growth demands will cause more demands on foods and energies, then Malaysia government will need more lands to plant those food crops and energy crops (oil palm). However, the profitable income on selling renewable energy might cause more lands losing from forest and agriculture sectors in the future if the Malaysia government does not take any action to secure its land area on forest and food production.

(c) Chinese Taipei

Chinese Taipei owns 36,000 square km^2 of land and 23 million populations. Since two-third of the lands are covered by the mountain and hills, its population density is 673 per km^2, ranked 57 in the world. The lands uses as agriculture purpose is very limited. Based on the requirement of the Spatial Planning Act 2016, the Ministry of Interior prepared the draft of "Total Land Utilization Plan" in 2018 and identified at least 780,000~810,000 hectors of land shall be preserved and maintained as food production purpose. This area of food production lands not only can guarantee the self-sufficiency rate of food sources but also prevent the lands were changed to other usage purposes. It is a legal mechanism to prevent land use changed and provide a clear number for the government to review developing project on lands and prevent "net loss" on lands.

In order to prevent global warming and lead actions to combat climate change, the government announced new plans to increase the usage of renewable energy, majorly relies on photovoltaic and wind power electricity generation. Based on the new plans announced in 2016, the installed capacities of renewable energy shall reach 20% of total electricity generation by 2025. The Fed-in Tariff (FIT) mechanism is also adopted by the renewable energy development plan and provide fixed purchase price to the renewable power generators. However, the biomass and biofuels are not counted as purchased target in this new plan. The Bureau of Energy of the Ministry of Economic Affairs decided to terminate and usage of biofuels in 2014. The Bureau of Forestry also prohibited any logging or thinning activities operated within public or private forest from 1990. Therefore, the promotion of usage on biomass is limited and do not cause concerns

[18] National Biomass Strategy 2020: New wealth creation for Malaysia's biomass industry, Version 2.0, 2013, 4 (2013). https://51a3e851-5fde-44b7-997b-e0664b7ac40b.filesusr.com/ugd/43b4fe_00564483596c43d5a1619e82131f1832.pdf

on land-use change for growing energy crops. On the contrary, the promotion of photovoltaics installation cause the land-use changed on agriculture sectors. Establishing photovoltaics electricity generations need lands and generally can earn profitable income if the electricity were purchased in fixed price by the public utility providers. Comparing the income from agricultural harvest and the photovoltaic electricity generation, the FIT policy on photovoltaics electricity generation projects provide more profits to the agriculture operations (around 10 times different). This development trend makes Chinese Taipei different from other APEC economic entities because the lands might be taken or foreclosed by photovoltaics electricity generation owners even these were leasing project in the beginning. The rental fees on the lands is much higher than agriculture income during the leasing period. It provides strong economic incentive to the farmers and changing their agriculture land usage purpose but generate photovoltaic electricity. Therefore, the promotion on photovoltaics installation will cause land-use changes, which is very different from other APEC economic entities in this region. Since the government provides minimum quantity standard for food production, the development of photovoltaic panels shall not expand over this amount.

The use of waste is another interesting issue in Chinese Taipei. High environment protection awareness among residents make 98% of the general waste could be recycled in the island. However, the waste management regulations in Chinese Taipei also adopt the same “waste removal” concept and prevent the industrial waste be introduced as energy sources. The air pollution caused by the combustion of these waste material are the major concerns of the competent authorized agency if they were treated as energy sources. The current regulations still prevent the waste materials from energy usage. The agriculture and forest residues are facing different treatment since they were managed by the different agencies. In the Council of Agriculture, the agriculture residues are normally treated as fertilized materials to the soil. However, the Bureau of Forestry treats the forest residues as waste materials and apply the Waste Disposal Act. Although the Renewable Energy Development Act recognize the usage of biomass is one type of renewable energy, these agriculture regulations neither prohibit the reuse of the agriculture residues nor provide further economic incentive to the farmers to use them as biomass sources. Recent years, the Council of Agriculture and Bureau of Forestry are trying to collect agriculture and forest residues separately and contribute them as renewable energy source.

(d) The Philippines

The Philippines is a large economic entity with high population density and 2.2% per year in 1990-94 population growth rate. In the beginning of the 70s, the Philippines was one of the richest

lands in Asia, next only to Japan and Malaysia, with an economic growth of around 5-6 % per year. The economy started sliding down after that, and in 1980-85 it registered a negative growth rate of -1.88 % per year. There has been a revival since then. In the latter half of the 90s, growth has picked up to 5% per year (World Bank, 1993).

The Philippines has 30 million hectares total land area and also owns abundant natural resources[20], including but not limited to more than 1,100 terrestrial vertebrates and vascular plants.[21] The forest lands cover 52.7% of total lands (15,810,000 hectares)[22] and the agricultural land area covers 41.27%, which is 13 million hectares of total lands in 2016[23].

Table 4. the Philippines land usage on forest and agriculture in 2016

Total lands	Forest lands	Food crops lands
30 million hectares	15.81 million hectares (52.7%)	13 million hectares (41.27%)

The development and optimal use of the economy's renewable energy resources is at the heart of the Philippines' sustainable energy agenda. The Philippines' renewable energy is an essential part of the economy's low emissions development strategy and is critical to addressing the challenges of climate change, energy security and access to energy.

Energy security in the Philippines, namely supporting the government's goal of energy self-sufficiency and sustainability, the imperative of climate change, addressing environmental problems, expanding carbon trading opportunities in the economy, and visionary: preparing for when consumers will demand or prefer green energy.

The National Renewable Energy Program (NREP) outlines the policy framework enshrined in the Republic Act 9513. It sets out the strategic building blocks that will help the economy achieve the goals set out in the 2008 Renewable Energy Act. The NREP marks the Philippines 's great leap from fragmentation and to a halt. RE initiatives are becoming a focused and sustained drive towards energy security and increasing access to clean energy.

The NREP sets indicative interim targets for the delivery of renewable energy in the 2011 to 2030 timeframe. NREP lays the groundwork for developing the Philippines 's renewable energy

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[20] Juan M. Pulhin, Mark Anthony M. Ramirez, National Updates on Agribusiness Large Scale Land Acquisitions in Southeast Asia: Brief #4 of 8: republic of the Philippines 2 (2011). https://www.forestpeoples.org/sites/fpp/files/publication/2013/08/briefing-4-8-philippines.pdf

[21] Andrea Monica D. Ortiz, Justine Nicole V. Torres, Assessing the Impacts of Agriculture and Its Trade on Philippines biodiversity, 9 LAND 403, 403 (2020).

[22] Mary Rose C. Posa, Arvin C. Diesmos, Navjot S. Sodhi, Thomas M. Brooks, Hope for threatened Tropical Biodiversity: Lessons from the Philippines, 58 BIOSCIENCE 231, 231 (2008).

[23] Maricel Almojuela-Tolentino, Conrad S. Tolentino, Philippine Agriculture Lands: Are They Worth Protecting? 2 (2015). http://www.angoc.org/wp-content/uploads/2015/12/Phil-Agricultural-etc_final.pdf

resources, stimulates investment in the RE sector, develops technology, and provides a boost for central and local renewable energy planning that will help identify the most viable and cheapest renewable energy development option.

NREP stems from the assumption that certain activities can be carried out immediately; while others take time to implement. As a domestic program, it will require periodic reviews to ensure it complies with the policy objectives set out in RA 9513 (Department of Energy, 2020; IRENA, 2017).

Based on R. A. No. 9367: Department of Energy's Biofuels Act 2006. The Philippines to accelerate the development of its economy's renewable energy resources by providing fiscal and non-fiscal incentives to private sector investors and equipment manufacturers / suppliers. The legal basis for bioenergy is mandated in R. A. No. 9367: The Biofuels Act 2006 on fiscal incentives and mandates the use of petrol and diesel blended biofuels.

The Central Government through the Ministry of Energy established a National Renewable Energy Program: Increase RE-based capacity by 200% in the next 20 years (2011-2030); Increase the non-power contribution from RE to the energy mix by 10 MMBFOE in the next ten years; To become the number one geothermal energy producer in the world (additional 1,495 MW); To become the number one wind energy producer in Southeast Asia (up to 2,500 MW); Dual hydroelectric capacity (additional 5,400 MW); Expanding the contribution of biomass to 265 MW, solar power to a level of at least 280 MW, and marine energy to at least 10 MW (Santos, 2016).

The Philippines has endeavored to improve its management of solid waste through the passage of RA 9003 or the Ecological Solid Waste Management Act that provides for a systematic, comprehensive and ecological waste management program to ensure the protection of public health and the environment. It mandates the bureau to provide secretariat support to the National Solid Waste Management Commission in the implementation of the solid waste management plans and prescribes policies to achieve the objectives of the National Ecology Center that is in charge of information dissemination, consultation, education and training of various local government units on ecological waste management.

Republic Act 9003: The Ecological Solid Waste Management Act of 2000 aims to merge environmental protection with economic pursuits, recognizing the re-orientation of the community's view on solid waste, providing schemes for waste minimization, volume reduction, resource recovery utilization and disposal

Financially, this regulation provides solid waste management incentives in the form of fiscal and non-fiscal incentives, domestic solid waste management fund or special accounts in the domestic treasury to finance: products, facilities technologies and processes to enhance proper solid waste management; awards and incentives; research programs; IEC; technical assistance;

capability building activities, local solid waste management fund and authority to collect SWM fees.

The Department of Environment and Natural Resources (DENR) has issued guidelines on the establishment and operation of waste-to-energy facilities for the treatment of municipal solid waste (MSW) in the Philippines. DENR is looking into technological solutions to the economy's waste problem, even adapting technologies, partnering for proper waste management. Waste-to-Energy regulation refers to the energy recovered from waste, usually the conversion of non-recyclable waste materials into useable heat, electricity or fuel through a variety of processes. Meanwhile MSW is defined in the order as waste produced from activities within local government units, which include a combination of residential, commercial, institutional and industrial trash and street litters.

The new Waste-to-Energy guidelines are embodied in DENR Administrative Order No. 2019-21 comply with Presidential Decree 1586 (Establishing an Environmental Impact Assessment System); emission standards as contained in RA 8749 (Clean Air Act); effluent standards as contained in RA 9275 (Philippine Clean Water Act of 2004); and regulation on the use and disposal of hazardous substances and waste as stipulated in RA 6969 (Toxic Substances and Hazardous and Nuclear Waste Act of 1990). The Waste-To-Energy guideline looks as a cleaner and more sustainable alternative to the traditional sanitary landfill, which is the waste disposal method allowed under RA 9003 or the Ecological Solid Waste Management Act of 2000.

In the Philippines, only three Republic Act was used to manage its forest, there are Central Cebu Protected Landscape Act of 2007(RA 9486), Reforesting 3,000 hectares of public land in Cagayan de Oro in 2012 (RA 10452), and Forestry Profession Act of 2015 (RA 10690).[24] Another useful administrative order is Presidential Decrees 705 (PD 705) or the Revised Forestry Code of the Philippines. Within these regulations, none of them provide specific lands area protection or preservation. The forest land degradation is majorly caused by natural events (such as fire, pets, disease, flooding or typhoons) and human activities (including logging, agriculture expansion or shifting cultivation, cattle ranching, mining or infrastructure constructions).

Although the Philippines owns 13 million hectares of agricultural land area, the harvest area shrinks to 4,293,229 hectares. The domestic rice self-sufficiency rate is 96% and it shows some provinces still remains poverty. The former President Benigni S. Aquino launched the Food Staples Sufficiency Program (FSSP) in 2011 and the congress passed the National Land Use Act (NLUA) for better management on the Philippines land and natural resources in 2015, it defines the protected “prime agriculture lands” to guarantee the domestic food productions for next 30

[24] SONNY N. DOMINGO, ARVIE JOY A. MANEJAR, FOREST PROTECTION IN THE PHILIPPINES: POLICY EVOLUTION AND SECTOR OUTCOMES 14 (2019).

years. Neither the FSSP and NLUA provided a clear definition on “prime agriculture lands” nor assign a specific territorial area for agricultural usage yet.

In order to comply the commitments under the Kyoto Protocol and reduce the usage of conventional fossil fuels. The Philippines passed the Biofuel Act of 2006 and aims to increase usage of biofuels. This also leads biofuel plantations and changes the agriculture land usage. 1.37 million hectares of land are used to grow these agro-fuel plants, such as cassava, sweet sorghum and jatropha, for reaching this development target of the Biofuel Act[25]. The Article 5.3 requires “a minimum of 1% biodiesel by volume shall be blended into the diesel engine fuels sold in the economy,”[26] and increase to 2% in two years (2009) after the effective date. In order to reach this blended diesel increasing target[27], the Department of Agriculture of the Philippines announced the Biofuel Feedstock Program (BFP) to increase more 132,000 hectares for jatropha planting and 372,917 hectares of coconut. The same Act also confirmed the minimum 10 percent of bioethanol shall mix into conventional gasoline by 2011. The BFP also planned to use 118,022 hectares of lands to grow sugarcane, 372,917 hectares of cassava and 107,400 hectares of sweet sorghum by 2011 for reaching this bioethanol developing goal.

Based on the facts discussed above, the promotion of renewable energy in the Philippines will squeeze the food crop production lands, especially when the NLUA has not assigned the area of “prime agriculture lands” yet. The growth of renewable energy usage or biomass might also cause the forest land use change and forest degradation.

(d). Thailand

Thailand owns the largely homogeneous population and its population growth is one of the lowest in the region, slightly above 1 % per year. There is relatively slow growth in urbanization, but Bangkok dominates the urban scene as well as Thailand’s economy. Thailand was traditionally identified as a food-surplus rice-exporting economy, but it does not hold true anymore as its exports are now more diversified. Since 1980, Thailand has changed its economic structure from agriculture-based to manufacturing and service sectors.[28]

Thailand had the fastest growth in the economy at over 8 % per year during the last decade. Industries had a major share in the rapid growth in the economy, with its contribution to economy’s income and exports outstripping that of the primary sector, especially rice, which until recently

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[25] *Id*. at 3.

[26] Republic Act No. 9367, Biofuel Act of 2006, signed on 12 January, 2007. Office of Gazette, Government of Philippines. https://www.officialgazette.gov.ph/2007/01/12/republic-act-no-9367/

[27] Pulhin et. al, *supra* note 23, at 3.

[28] Youngyut Trisurat, Hiroaki Shirakawa and John M. Johnston, Land-Use/Land-cover change from Socio-Economic Drivers and Their Impact on Biodiversity in Nan Province, Thailand, 11 SUSTAINABILITY 649, 650 (2019).

was the dominant export commodity. Rapid growth in the economy and population has resulted significant pressure on land usage and its rising demand for food production.[29]

Thailand has 51 million hectares of total land area and maintains 17,218,429 hectares of forest land, accounted for 33.56% of the total land area in 2019[30]. The 43% of land area is used for agriculture purpose in 2016. In 1985, Thailand government adopted regional forest policy and set the preservation goal to have 40% of the land's geographical area covered by the forest. Thailand also posed domestic logging ban and prohibited all logging activities after 1989[31]. Under this policy, 25% of the domestic forest land is conserved forest and 15 % is economic forest.[32] There are about 4.8% of forest land was changed to other land-use purpose during 2002 to 2013. The area of economic forest is about 6,887,371.6 hectares in Thailand. Because of restricting regulations and enforcement, the forest land cover in Thailand stabilized at 31% to 33% of total land. These are evidences to prove Thailand owns abundant sources to develop biomass energy.

Thailand proposed the Land Degradation Neutrality (LDN) Target in 2017 and planned to increase the domestic forest coverage through reforestation and rehabilitation degraded forest by 2030. It also targeted to emphasize sustainable agriculture measures on the degraded lands and changed those lands to be productive lands.[33] The forest land coverage shall cover 40% of the economy, it could have better conserved on ecological systems and reduce 7% greenhouse gas emission by 2020.[34]

The National Energy Policy Council of Thailand announced the renewable energy will reach 20.3% by 2022 and 30% of the economy's electricity production by 2036.[35] Currently, Thailand is using solar PV, wind power, biomass and biogas generate 45,000MWh electricity, which contribute 10% of the economy's electricity generation. Under the proposed development target

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[29] *Id*.

[30] Changtragoon, S., Ongprasert, P., Tangmitcharoen, S., Diloksampan, S, Luangviriyasaeng, V., Somsathapornkul, P. and Pattannakiat, S., Country Report on Forest Genetic Resources of Thailand 1 (2010).

[31] Yongyut Trisurat, Applying Gap Analysis and a Comparison Index to Evaluate Protected Areas in Thailand, 39 ENVIRON MANAGE 235, 236 (2007).

[32] Econ, Renewable energy goal raised to 30%, 14 June, 2018. The National Thailand. https://www.nationthailand.com/Economy/30347776

[33] Kingdom of Thailand, Ministry of Agriculture and Cooperatives, Land Degradation Neutrality (LDN) Targets 2(2017). https://knowledge.unccd.int/sites/default/files/ldn_targets/Thailand%20LDN%20Country%20Commitments.pdf

[34] Office of the National Economic and Social Development Board, Office of the Prime Minister, Summary, The 12th National Economic and social Development Plan (2017-2021), 16 (2017). https://www.nesdc.go.th/ewt_dl_link.php?nid=96408

[35] Sophie Materia, The future Is Renewable: Targets and Policies By Country, (2017). https://www.phillipriley.com.au/wp-content/uploads/2019/06/PR-Report-Thailand.pdf

of the Thailand Power Development Plan 2015-2036 (PDP)[36], Thailand will focus on increasing the biomass contribution to 3486.5 MW respectively by 2036[37]. The sources used to produce agrofuel are cassava, sugarcane, soybean, and jute. The needs for developing biomass will cause indirect land-use change and danger the food production if lacking of proper land management.[38]

The Ministry of Energy of Thailand targets to promote energy-from-waste production to 160 megawatts of power and 100 kilotons of oil equivalent (ktoe) of thermal by 2021. The 10-year (2012-2021) Alternative Energy Development Plan, aiming to boost the portion of alternative energy usage to 25% of overall usage, has targeted to boost energy-from-waste production to 160 megawatts of power and 100 ktoe of thermal from 44,324 megawatts at present. Of the current capacity, 22.23 megawatts are produced from gas at landfill waste, 20.06 megawatts from incineration and gasification, 2,034 megawatts from biogas generated through waste fermentation. Of the current 78.59 ktoe thermal capacity, 1.28 ktoe were from the replacement of cooking gas with biogas while 77.31 ktoe were from Refuse-Derived Fuel, or RDF. Moreover, wastes were also used as fuel at cement plant as substitution to coal. (Ministry of Energy, 2021).

National 3Rs (Reuse, Recycle, and Reduce) Strategy Development is Thai government program Supported by UNEP RRC.AP under Advance Waste Management in Asia and the Pacific (AWMAP). The strategy is to apply various principles and measures of waste management to all processes of waste generation such as production, distribution, consumption, waste recycling, treatment and disposal (Piyapanpong, 2020).

Since Thailand established the forest land area protection and only allow 6,887,371.6 hectares can be used as economic forest. It also indicates the maximum quantity to produce woody biomass from the forest in Thailand. However, the Thailand government does not establish policies or regulations to preserve the maximum land area for agriculture usage yet. The land usage is facing many challenges and various demands from commercial usage purposes. Thailand's policies and regulations also show the government concerns the forest land is cultivated by the agriculture usage (including food crops and energy crops planting).

(e). Viet Nam

Viet Nam is the easternmost region on the Indochina Peninsula in Southeast Asia with an

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[36] Ministry of Energy, Thailand Power Development Plan 2015-2036, 7 (2015). http://www.eppo.go.th/images/POLICY/ENG/PDP2015_Eng.pdf

[37] Materia, *supra* note 30, at 7.

[38] Natedao Taotawin, Preuk Taotawin, Crop booms and changing land use and land control in Thailand's agriculture frontier, 2 (2015). https://www.iss.nl/sites/corporate/files/CMCP_66-Taotawin.pdf

area of approximately 330,000 km2. Viet Nam is nominated as the 65th largest state in the world and the 15th most populous region. The domestic economy is highly dependent on the extraction and use of natural resources. Currently, about 85% of the waste generated in Viet Nam is buried without treatment in the landfill, 80% of which is unhygienic and pollutes the environment. The reduce, recycle, and reuse domestic campaign is gaining momentum by throwing garbage into the nearest landfill. The majority of companies in Viet Nam's solid waste management industry are state-owned with technology provided by foreign investment.

With the fast rate of economic growth, some structural change inevitably takes place. This is evident in Viet Nam, but the change has been slow. There has been a marginal shift of work force from agriculture, from 73 % in 1980 to 71 % in 1990. There is a more marked shift in the contribution of agriculture to GNP. The other major achievement of the economy is the control of inflation, which has been substantially brought down from 70 % to 15 %. All these happened when agriculture was freed from State control to a large extent, mainly by giving farmers long term land leases; introducing macroeconomic adjustments in the economy; dismantling distorted incentive system; export orientation; liberal infusion of foreign capital; and above all, by improving productivity in agriculture.

Viet Nam's biggest potential is hydro power, with 2020 its capacity will be 29.5%. The central government is implementing targets for increasing other resources such as wind, biomass and diesel. The Vietnamese government is focused on reducing GHG emissions to zero by 2050 and anticipating catastrophic climate change. To achieve this target, the world needs to make a paradigm shift towards 80% renewable energy and 70% electric vehicles by 2050. This target is an application of the Vietnamese government's commitment to only use renewable energy by 2050 (Lai, 2018).

The Vietnamese government has implemented various policies for domestic and foreign companies involved in waste to energy projects. The main regulations are mentioned in Decree 31/2014/QD-TTg ("Decree 31"), Circular 32/2015 / TT-BCT ("Circular 32"), and Decree 118/2015 / ND-CP ("Decree 118").

Decree 31 - establishes a support mechanism or the development of a power plant using solid waste; Circular 32 - discusses the development of grid-bound generation projects using solid waste and provides a model of electricity sales contracts for projects using solid waste in Viet Nam; and Decree 118 - provides for incentives and investment schemes in various sectors including the construction of zones for concentrated solid waste treatment and waste collection, treatment, recycling and reuse. The entry rates for power generation projects that use solid waste are 10.05 US cents per kWh (direct combustion) and 7.28 US cents per kWh (burning gas from landfills). Incentives include tax exemptions, exemptions from import duty for equipment, land lease exemptions, and low-interest loans.

The waste-to-energy project has two-fold benefits: first, it helps in energy generation and waste processing, which has grown exponentially in urban Viet Nam. Second, increasing

investment in new factories or expanding the capacity of existing facilities, the government also needs to focus on promoting research in clean technology and supporting domestic companies financially as a time to recover capital investment in the sector (Das, 2018).

In 2015, the Vietnamese government developed a policy strategy prioritizing electricity, biogas, biomass pellets, biomass to liquid fuels: Increase the utilization rate in 2030 as agricultural and industrial waste from 45 to 60%, animal waste from 5 to 50%, solid waste urban from 0 to 70%. As well as the total biomass energy from 14.4 MTOE to 32.2 MTOE in 2030 for power 0.3 to 9, thermal power from 13.7 to 16.8, and biofuel from 0.2 to 6.4 (Dan, 2020).

Based on decision No. 428 /QDTTg, the Prime Minister set up the National Power Development Plan VII (hereinafter referred to as PDP 7 Rev) for the period of 2016 - 2030 with the vision to 2030. The specific objectives of PDP 7 Rev are described as follows:

1. Providing adequate electricity for domestic needs, meeting the socio-economic development goals with an average GDP growth rate of 7% during 2016-2030.
2. Commercial electricity: 235-245 billion kWh in 2020; 352 - 379 billion kWh in 2025; 506 - 559 billion kWh by 2030.
3. Electricity production and imports: 265 - 278 billion kWh in 2020; 400 - 431 billion kWh in 2025; 572 - 632 billion kWh by 2030.
4. Prioritizing the development of renewable energy sources for electricity production; increase the proportion of electricity generated from renewable energy sources (excluding large, medium and pumped storage hydropower) to about 7% by 2020 and above 10% by 2030.
5. Build a power transmission network with flexible operation and high automation capabilities for power transmission to distribute; developing substations and unmanned substations with 50% human participation to increase the capacity of the electricity industry.
6. Accelerate electrification distribution programs in rural and mountainous areas to ensure that by 2020 most rural households have access to electricity.

Natural forest covering an area of 10,236,415 hectors and plantations covering an area of 4,178,966 ha. In the late 1980s, the Vietnamese government adopted a massive, ambitious policy reform program for forest reforestation. In 2017, total forest cover again reached 14,415,381 hectors covering 41.6 % of the economy's area, supporting economic growth, job growth and poverty reduction (Forest Protection Department, 2016; Regional Forestry Sub 1, 2017; World Bank Group, 2019). Viet Nam's central government has domestic programs such as 327/556 and the new 5-million-hectare program sets very ambitious targets for physical reforestation measures.

In 2020, the Government of Viet Nam issued Resolution 67 / NQ-CP concerning the program of drafting National Land Use Plan for the period 2021-2030, with a vision of up to 2050. The resolution program aims to identify and delineate areas of central-government-level land use targets by 2030 such as crop productive land, forest land, urban land in detail.

Limits on land for agricultural land

The National Assembly No. 45/2013/QH13 is the law of Viet Nam land use. Including the agriculture and forestry land also biomass production.

1. The limits for the annual delivery of land for planting trees, aquaculture land and salt-making land for each household or individual directly producing agriculture are as follows:

   a) No more than 0.3 hectares per type of land for provinces and centrally-aid cities in the Southeast region and the Mekong Delta region;

   b) No more than 0.2 hectares for each type of land for other provinces and centralized cities.

2. The limit for allies of land for each household or individual must not exceed 10 hectares for communes, wards and townships in the land; no more than 30 hectares for communes, wards and towns in the mid-west and mountainous areas.

3. The land all delivery limit for each household or individual must not exceed 30 hectares for each type of land: a) protective forest land; b) production forest land.
4. Where households and individuals are assigned a variety of land, including annual crop land, aquaculture land and salt-making land, the total land delivery limit must not exceed 0.5 hectares.

In case households and individuals are assigned more land to grow perennial trees, the land limit for perennial crop cultivation must not exceed 0.5 hectares for communes, wards and townships in the land; no more than 25 hectares for communes, wards and towns in the middle of the economy and mountainous areas. In case households and individuals are assigned more production forest land, the limit for allies of forest land for production must not exceed 25 hectares.

5. Limits for all allies of land, bare hills and water surface land belonging to unused land groups for households and individuals put into use according to planning for agricultural production, forestry, aquaculture, salt making not exceed the land allies specified in Clauses 1, 2 and 3 of this Article and do not include the limits for allies of agricultural land for households, individuals specified in clauses 1, 2 and 3 of this Article.

   Provincial-level People's Committees stipulate limits on allies of land, bare hills and water surface land belonging to unused land groups for households and individuals put into use according to land use planning and plans approved by competent state agencies.

6. The annual limits for allies of agricultural land for planting trees, planting perennial trees, planting forests, aquaculture, salt making in buffer zones of special-use forests for each household or individual are made in accordance with clauses 1, 2, 3, 4 and 5 of this Article.

7. For agricultural land area of households and individuals currently used outside communes,

wards or townships where permanent residence registration is registered, households and individuals may continue to use, if the assigned land does not collect land use proceeds, it is counted as the limit for all-time agricultural land transfer of each household Personal. The land management agencies where agricultural land has been assigned do not collect land use interest to households or individuals to send notices to the commune-level People's Committees where such households and individuals register permanent residence to calculate the limits for allies of agricultural land.

8. The area of agricultural land of households and individuals due to the transfer, lease, sub-lease, inheritance, donation of land use rights, capital contribution by land use rights of other people, receiving securities, which are not counted by the State in the limits of agricultural land all-overs specified in this Article.

Forestland Production

1. Viet Nam assigns production forest land which is natural forest to forest management organizations for forest management, protection and development.

2. Viet Nam assigns land or leases, production forest land which is planted forests, according to the following regulations:

a) handing over land to households and individuals directly producing agriculture, according to the limits specified in Point b of Clause 3, Article 129 of this Law for use for forestry production purposes. For the area of forest land produced by households and individuals that exceed the limit, they must be transferred to lease land;

b) leasing land to economic organizations, households, individuals and Vietnamese residing abroad, foreign-invested enterprises to carry out plantation investment projects;

c) economic organizations, households, individuals and Vietnamese residing abroad, foreign-invested enterprises which are assigned land or leased forest land produced by the State in accordance with point a and point b of this clause may use land areas without forests for planting forests or planting perennial trees.

3. Economic organizations, Vietnamese residing abroad, foreign-invested enterprises using production forest land are combined with landscape business, ecological tourism - environment under the forest canopy.

4. Production forest land concentrated in places far from residential areas which cannot be assigned directly to households and individuals is assigned to organizations by the State to protect and develop forests in combination with agricultural, forestry and aquaculture production.

E. Review in Issue of Agriculture and Food Security in APEC economic entities

The APEC economic members, including Indonesia, Viet Nam, Thailand, and the Philippines are still remaining poverty, food insecurity and malnourishment. Food and Agriculture Organization of the United Nations (FAO) explains that food security is generally understood as access to sufficient food for all households at all times so that they can live healthy and active lives. Food insecurity is associated with poverty, ignorance and stagnant economic growth[39]. Food security represents an enormous challenge in Southeast Asia economies. With its rapidly growing population, deteriorating environmental conditions, and vulnerability to climate change. In 2007 and 2008, the world was gripped by a dramatic food crisis, as a confluence of factors—including the rising price of oil and oil-derived inputs like fertilizer and the dwindling of reserve food stocks across the global south—conspired to drive the prices of staples like wheat and rice to record heights[40]. Till today, Southeast Asia has not been protected from the fear of food shortages at every societal level. Since then, the governments have emphasized poverty alleviation by ensuring food security and sustainable agriculture[41]. Since policymakers in Asia determine that rice is a staple food and income source for low households, rice is the primary policy attention for food self-security and poverty reduction (Asia Society and International Rice Institute, 2010)

Food insecurity is also overshadowed by the increasing trend of land grabbing issues that can have severe environmental and social consequences, and the conversion of traditional land uses in industry and leaving many farming families vulnerable to exploitation. Land rights and land-grabbing have affected Southeast Asian communities; it led the farmers and landowners to fear and mistrust their government. Both foreign or domestic investors have handed over millions of hectares of land. Land grabbing is a large-scale acquisition by corporate investors or government entities through legal or illegal purchasing, subleasing, or approaching land for food and industrial crops, or even derivative purposes, such as hydropower dams and logging. Agriculture poses a threat to food security because of its vast access to freshwater. One sector that can most commonly symbolize a transformation where global processes have impacted land grabbing is the fast-growing tree plantation sector.

Food security issues are very complex; socio-economic issues of corruption, weak political representation, and inadequate legal regulations are the causes of food security problems. Weak and corrupt, autocratic governments make it easier for foreign investors, state-owned companies, and other actors to exploit large land portions in developing economies. Land grabbing shows a

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[39] FAO, The State of Food and Agriculture. Biofuels: prospects, risks and opportunities (2008). http://www.fao.org/3/i0100e/i0100e.pdf

[40] LESTER R. BROWN, FULL PLANET, EMPTY PLATES: THE NEW GEOPOLITICS OF FOOD SCARCITY (2012).

[41] THERESA W. DEVASAHAYAM, ENSURING A SQUARE MEAL 5 (2018).

significant problem in modern global governance, which includes, among others, the fields of development, investment, and food security[42].

However, in other perspectives, study of Marzeda-Mlynarska, 2017 mention that the root of the food insecurity problem is not in the amount of food or food production, because the problem remains unsolved even though food production has begun to exceed the needs of the world's growing population. It is clear that food insecurity is not caused by the food shortage but has deeper roots. The problem of food security is likely closely related to macroeconomic conditions. Domestic food insecurity, in the sense that an economy experiences food-insufficiency and import dependency to meet food market demand. Food prices will rise and more and more households will become food insecure.

World Bank data reflect the most recent state-level data available for all component indicators and all economies spanning the period of 2015. The fact that Brunei Darussalam and Singapore are small economies, both in terms of size and population. Limited space precludes the development and rate of change in agricultural land policies.

The Food and Agriculture Organization of the United Nations (FAO) defines a food deficiency, or malnutrition, as consumption of less than about 1,800 kilocalories per day - the minimum amount most people need to live a healthy and productive life. While strong GDP growth, increased agricultural productivity, and strong growth in the agricultural sector have boosted the region's economy, an estimated 60 million people are still malnourished. In 2020, the Global Hunger Index (GHI) report revealed the result that APEC economic entities (excluding Brunei Darussalam and Singapore) relatively in moderate and serious situation[43].

F. Domestic Regulation and Plan in Agriculture and Food of APEC economic entities

The Southeast Asian region is surrounded by Asia-Pacific largest economy, such as Japan, Republic of Korea, China, and Australia. However, it is surprising that eight ASEAN member states: Indonesia, the Philippines, Malaysia, Thailand, Viet Nam, Cambodia, Laos, and Myanmar stated as the developing economies, even Laos, Cambodia, and Myanmar categorized as the world less-developed economies. Furthermore, while these three economies facing heavy turbulences on food security, poverty, and hunger, it is a responsibility for neighboring economies to lift them up. Five APEC economic entities include Indonesia, the Philippines, Malaysia,

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[42] Matias E. Margulis, Nora McKeon & Saturnino M. Borras, Jr., Land grabbing and global governance: critical perspectives, 10 *Globalizations* 1, 2 (2013). https://dspace.stir.ac.uk/bitstream/1893/21870/1/MargulisEtAl_LandGrab&GlobGov_Article_2013.pdf

[43] KLAUS VON GREBMER, AMY SALTZMAN, EKIN BIROL, DORIS WIESMAN, NILAM PRASAI, SANDRA YIN, YISEHAC YOHANNES, PURNIMA MENON, JENNIFER THOMPSON, ANDREA SONNTAG, GLOBAL HUNGER INDEX: THE CHALLENGE OF HIDDEN HUNGER 3 (2014).

Thailand, and Viet Nam keeps the potential of agriculture and forestry which can play a role in building clean energy resilience. While they are located in the tropical zone, close and pass by the equator, shows that soils are nutritious, well-distributed rainfall, and fertile rainforest. These regions have huge agriculture and forestry production potential.

The rate of population growth in Southeast Asia keeps increasing; accelerated with numbers socio-economic problems arising from minorities. Poverty and food insecurity are centered as the enormous favor for policymakers. The inequality issue came from the backward environment due to geographical disadvantages. Food security poses a special challenge in the Southeast Asia region. The deteriorating environmental conditions, vulnerability to climate change, and rapid urbanization, the region is particularly exposed to negative consequences **(Mlynarska, 2017).** The growth of population in those areas in line with encasement of the food insecurity number.

G. Growth performance, plan, and strategy toward Agriculture land use

Most of the APEC economic entities have pursued market-oriented policies and in the consequences, they have successfully created significant economic growth. Through the macroeconomic developments currently pose problems. The Malaysia, Thailand and Indonesia are dynamic economies, and regarded as the next “tigers”. The rate of growth the Philippines have also picked up in recent years. Viet Nam, in spite of its being the poorest in the region, has made significant progress, especially in the 1990s. With the exception of Viet Nam, agriculture accounts for a small and declining share in the economies of these regions in terms of its share in GDP, employment, and global trade. In Viet Nam the process has begun and is gathering momentum. These economic entities have invested heavily in human resource development, as reflected in their high literacy rate (80% or above). However, other indicators of social development, e.g. infant mortality, life expectancy, prenatal and post- prenatal care, are not high enough for their level of economic development. There remains gender bias against women.

H. Policy Recommendations and Development

Apart from the similarities among APEC economic entities - especially due to geographical proximity, common economy and political cooperation, above all there are important differences in economic development patterns, policy focus, and future strategies. This speed of growth of population brings the potential for economic growth as well as social threats such as food security and energy security. This section will discuss the summary and review of each government's strategic plans in its land strategy efforts. Theoretically, by balancing macroeconomic development, strengthening food security and biomass development as clean energy resilience.

Biomass production is the largest sector in renewable energy, provides 77.4% of RE production worldwide (Tun, et al, 2019). The APEC economic entities in the Southeast Asia region became an attractive potential market for biomass production as energy sources. With global pressure on carbon emission and environmental protection, Southeast Asian states are still working on establishing the regional regulations toward biomass production. At the same time,

each government working on balancing between food and energy production.

Renewable energy targets contribute to developing a clearer vision for the development of this sector and enable stakeholders to allocate funds more effectively. Specific design issues that policymakers need to consider include whether targets should be set in absolute terms such as a specific amount of energy to be supplied or relative to a moving baseline and whether electricity targets should be set in megawatts capacity or output in megawatts per hour. Renewable energy targets need to be accompanied by clear strategies, supported by specific policies and actions.

Most of the APEC economic entities in Southeast Asia region do not have clear number or investigation conclusions on its domestic land area. Most of the land area number is provided by the cross-continental institution, such as World Bank or United Nations Food and Agriculture Organization (FAO). The clear number on lands helps the governments to prepare sound management policies on land usage, based on the principle of food security, and also establish reasonable target on renewable energy promotion, especially the usage on bioenergy (including biofuels and biomass). Therefore, the APEC leaders or SOM meeting shall make a decision or prepare a proposal to establish investigation methodologies and measures, such as GIS, to calculate the land usage among economic entities. It will also assist the APEC community to establish unified and single data center for designing future land and energy policies.

Most of the economies in Southeast Asia region are developing economies, their municipal solid waste and waste-to-energy management has not developed properly. The waste to energy sector is also in the early development stage. During the study phase, it was difficult to collect the latest data on regulations and management systems for urban solid waste and the waste to energy sector. Most of the waste management regulations made by the APEC economic entities remains on the concept of waste removal but not consider these waste materials as energy sources. The waste materials shall be treated by add-value measure before they have no other usage purpose. Therefore, APEC economic entities shall consider their attitude change from dealing with waste to source management. It would also help the societies to adopt the circulate economic concepts and use the limited sources wisely.

Learning lessons from European Union, the renewable energy Directive established a maximum usage amount on renewable energy. The quantity limitation on usage of renewable energy could cause directly land usage on energy crops planting. Most of the forest in the APEC economic entities are removed and changed because of the introducing of oil palm planting, it dangers the biological diversity and valuable species conservation, even cause unwilling displacement and cause harm on indigenous culture conservation. In agriculture sector, ~~only~~ Chinese Taipei prepares the area quantity protection on agriculture fields. It basically provides objective number and area for food production protection.

The issue connects food production, land and renewable energy development are not yet discussed among the APEC leaders. In the past, the food and renewable energy were separate

issues and the APEC also established working groups to raise concerns and suggestions. However, the land usage and its interactions with food and renewable energy are not mentioned yet. The rapid economic growth and demands on renewable energies among APEC economic entities will enhance this land shortage and land-use changed concerns more and more severe than ever. Hence, this research strongly suggests the APEC leaders or SOM shall show their concerns on this land usage and raise the discussion in both domestic and APEC related forum. This research would also suggest the APEC shall establish a working group and propose a training program and teach the APEC economic entities to calculate its domestic land-usage conditions. The same calculation methods and methodologies help all data collected from the APEC economic entities are comparable and easy accessed. After these investigation efforts done, all these investigation data shall be installed and kept within a database with unified format. It will help the APEC and its economic entities have better understanding on its land conditions and also improve the transparency on the food production and demands in this region, and then finally achieve its protection goals on humanitarian and regional security.

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