APEC Workshop on Promoting Biomass Energy for Rural and Remote Area Development

APEC ENERGY WORKING GROUP

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APEC Workshop on Promoting Biomass Energy for Rural and Remote Area Development

22 – 23 October 2024

SUMMARY REPORT

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Summary Report

I. INTRODUCTION

On 22 and 23 October 2024, the APEC Workshop on Promoting Biomass Energy for Rural and Remote Area Development, initiated by Viet Nam and co-sponsored by China; Japan; the Philippines; Chinese Taipei; United States was held in Ha Noi, Viet Nam. Speakers and participants came from global organizations and research institutions and representatives from APEC member economies' relevant Ministries and government's agencies, companies and business associations that relates to energy in APEC economies and across the APEC region.

The Workshop aimed to provide an opportunity for stakeholders for sharing experiences and good practices in promoting biomass energy for rural and remote development as well as develop a set of recommendation on renewable energy policies, especially biomass energy.

II. BACKGROUND

Biomass energy is among the popular topics in many forums when talking about the renewable energy. Biomass is a widely available source of energy when its sources come from trees and plants such as grasses, waste and landfill gases. Forest residuescan also be used to generate energy, heat, and potentially even liquid fuels. Biomass has many advantages over fossil fuel due to its reduction of carbon emissions. When combining economic and environmental character of biomass energy, it is listed as one of the best energy sources. With an abundance of plants on Earth, biomass couldbe a source of renewable energy that's used as sustainable alternative to fossil fuels. In developing economies, biomass energy accounts for about 34% of the total energyboth in traditional and modern forms. However, in some economies, it provides over 90% of total energy consumption. This data shows that biomass energy plays an important role in energy sector of economies, especially developing ones.

As the source of biomass coming from plants, people in rural and remote area

can make use of wastes from crops to produce energy. Bioenergy and rural and remote area development are closely connected. Bioenergy can make a significant contribution to social and economic development in rural and remote areas. The development in rural and remote area is significantly affected by the amount and quality of available energy. Promoting biomass will create more energy. The increasein the amount of energy then brings a lot of benefits as it provides essential servicessuch as cooking, lightning, transport and support industrial development. In short, promoting biomass energy will eventually benefit the whole economy, especiallycontribute to the development of rural and remote area.

This project held a 2-day Workshop in Viet Nam in 2024 that helps APEC and non – APEC economies and stakeholders to share about experiences and good practices in promotingbiomass energy for rural and remote development as well as develop a set of recommendation on renewable energy policies, especially biomass energy.

III. OPENING REMARKS

In the opening remarks, Mr Nguyen Anh Tuan (Vice President, Energy Association, Viet Nam) highlighted that meeting the energy needs of people in remote and rural areas is still limited due to geographical difficulties as most of these households are ethnic minorities living in remote areas. Therefore, promoting biomass energy is one of the suitable solutions to have electricity for daily life and have means of production to escape poverty. The cost of biomass electricity is also often lower than that of the domestic grid, not to mention it will save human resources for management and operation in the electricity industry. In addition, the biomass energy model in rural and remote areas is also becoming a trend in many economies around the world.

Mr Tuan mentioned that in Viet Nam, the potential for energy wood from production forests, perennial trees and other crops is about 9.6 million TOE, from wood waste is 0.9 million TOE, from agricultural by-products is about 19.3 million TOE, from other activities including sustainable agricultural intensification is 5.2 million TOE, from land released by reducing waste and losses in the food chain is 9.1 million TOE. Biomass energy is oriented for use in electricity production, heat production, cogeneration of heat and electricity in industrial production, biofuel production etc. The potential development scale of biomass electricity is estimated at about 7,000 MW, mainly from agricultural by-products.

In addition, the common goal of APEC cooperation in the energy sector is to double the proportion of renewable energy by 2030 compared to 2010 as directed by APEC Economic Leaders in Beijing in 2014. Through policies to promote biomass

energy for the development of remote, isolated and rural areas, APEC economies not only contribute to increasing the proportion of renewable energy in the energy mix compared to 2010, but also help to eliminate hunger, reduce poverty, protect the environment, and move towards sustainable and inclusive development so that no one is left behind.

In developing economies, including Viet Nam, renewable energy, including biomass power, is a relatively new, underdeveloped sector and accounts for a modest proportion of the total energy supply of the economy because of limited financial resources, incomplete legal framework, weak and inadequate infrastructure system, weak management science and technology, etc. For remote, isolated and rural areas, these difficulties are multiplied. This reality has posed many challenges for developing APEC members in planning for biomass energy development in remote/rural areas. Through sharing strategies and case studies, APEC members can learn from each other's experiences in building and implementing development policies, attracting investment in biomass energy in remote/rural areas, contributing to solving energy and social issues in the context of increasing energy demand, especially in localities without grid electricity.

With that meaning, the Workshop is the contribution of the Government of Viet Nam to the collective APEC effort in implementing the Just Energy Transition Initiative and aiming to achieve the common goal of the APEC region: to double the share of modern renewables in the energy mix by 2030 (relative to the numbers from 2010) as instructed by APEC Economic Leaders. The Workshop is also expected to discuss and propose feasible and applicable initiatives, recommendations and policy solutions for APEC cooperation in the coming time.

IV. KEY ISSUES

1. OVERVIEW ON BIOMASS ENERGY DEVELOPMENT

There are 2 speakers in the Session: Dr Zhang Maolong, Vice Dean, Beijing Huaneng Yangtze Environmental Technology Research Institute, China and Dr Terry Surles, Consultant, Hawaii Natural Energy Institute, United States.

- Dr Zhang Maolong delivered a presentation on the Overview of Biomass Energy Development in China. He firstly introduced that China's biomass resources are relatively abundant, but there are huge differences in biomass resources between provinces. Agricultural residues and forestry residues are the two biomass resources potential of China. These two residues are in many provinces of China,

however, each province has different agricultural residues allocation. The biomass disposal will provide cheap energy (under certain conditions) and low-sulfur fuels. It will also reduce environmental hazards and experiences fewer technical difficulties, compared with other non-traditional energy sources. The supply of biomass disposal is instability due to seasonal factors. However, due to the large difference in the composition and nature of biomass, the utilization degree is fluctuating. Also, some biomass utilization equipment is expensive. Dr Zhang then showed the status of biomass utilization industry in 2023. In China, overall, biomass power generation has become increasingly mature, but the advanced biofuel industry still lags behind other economies. The biomass power generation accounts for 29.43% of total energy in China, which has capacity of 44,140 MW in China. While other biomass energy accounts much less than that: Biofuel ethanol accounts for 3.82% of total energy in China; Biodiesel accounts for 3.93%; Biogas accounts for 5.6%. The biomass energy changes by the rural industrial structure and livestock and poultry breeding. Although the economic benefit of biogas project is not significant, more attention is paid to public welfare than business. At the end of the presentation, Dr Zhang showed some difficulties in utilizing biomass energy. For example, (i) the dispersion of resources leads to the difficult acquisition of biomass raw materials and leads to the conversion of local agricultural and forestry biomass power generation to coal-fired power generation; (ii) The implementation cost is on the high side; (iii) Core technologies and equipment of agricultural and forestry biomass power generation are still dependent on imports.

- Dr Terry Surles cited that the USA uses 342 million tons of biomass for fuel and power. The growth of electricity from biomass was previously stagnant, but is expected to grow from USD91 billion in 2023 to USD105 billion in 2028. The Southeastern US and California have the most electricity from biomass. Biomass has a long history for generating electricity. Biomass electricity produced from forest waste reduces the threat of wildfires. Then Dr. Surles showed a case for California. California oversight is by local air pollution control districts, except for facilities over 50MW. Existing facilities required to meet local air district rules and use of best controls at time of permitting, necessitating use of add-on controls for particulate matter (PM) and nitrogen oxides (NOx). New biomass facilities are required to use Best Available Control Technology (BACT). Waste-to-energy is another biomass resource for electricity. Japan is a leader for energy recovery from municipal solid waste (MSW). H-power is a Hawaii MSW success story where landfill MSW was reduced by 85% since 2007. At the end of the presentation, Dr Terry shared that for APEC Southeast Asia economies, biomass use is significant, but it is decreasing. He mentioned that more intensive efforts are needed for economies to accelerate their clean,

sustainable, just, affordable, and inclusive energy transitions, including biomass, biofuels, biogas and biomethane. APEC economies can share resources for capacity building to maximize use of domestically available resources, such as financial programs, policy development, and program implementation.

2. THE NECESSITY OF BIOMASS ENERGY FOR RURAL AND REMOTE AREADEVELOPMENT

There were two speakers in the Session: Dr Pham Thi To Oanh, Director, Viet Nam Cooperative Alliance (VCA) and Ms Anna Mikko G. Realo, Officer-in-Charge, Biomass Energy Management Division, Renewable Energy Management Bureau, Department Of Energy, the Philippines.

- Ms Anna Mikko G. Realo delivered a presentation on the necessity of biomass energy development for rural and remote areas. Firstly, she mentioned the 2023 Biomass Power Generation Mix, in which the biomass energy accounted for 0.9% of total share, equivalent to 994 GWh. The biomass resources in the Philippines came from 02 main sources: crop and animal type. The Philippines Government, through the collaborative initiatives between the Domestic Electrification Administration and the Department of Energy, designed the Total Electrification Program (TEP) to support efforts toward achieving universal access to electricity in underserved and rural areas and finance projects that provide electricity to areas lacking access. TEP ensures sufficient and affordable access to electricity is considered a vital element for economic prosperity and enhancing the quality of life of the Philippines, especially the marginalized households in remote areas. The Government has made significant investments in implementing various electrification reforms and related programs. The objective is to promote social equity and reap long -term economic benefits for society. The TEP supports various initiatives, including grid extension, renewable energy projects (i.e. solar and biomass), and the development of microgrids tailored to local needs. Access to electricity also opens opportunities for income - generating activities, promoting commercial development and inclusive social progress. The potential benefits of biomass utilization include: (i) Reducing GHG[1] emissions if managed; (ii) reducing the problem of wastes; (iii) new income opportunities for the local community. there are some challenges to biomass development such as: (i) limited technical capability; (ii) financial limitations; (iii) social acceptability; (iv) feedstock availability/

[1] GHG (Greenhouse gas)

technology matching. Lastly, Ms Anna pointed out some methods to address gender issues in biomass energy development in rural and remote areas including (i) access to clean and efficient biomass technologies; (ii) inclusion in decision-making; (iii) economic empowerment; (iv) policy and institutional support and (v) gender-disaggregated data.

- Dr Pham Thi To Oanh showed some solutions for promote biomass energy. For example, (i) Raise awareness on sustainable energy (biomass); (ii) Promote the accumulation and concentration of agricultural land, the formation of concentrated production areas and large-scale production area; (iii) Agricultural value chains are the main intermediary agent, playing the role of connecting and promoting vertical links with enterprises; etc. There are some difficulties including: (i) The legal corridor to ensure sustainable linkages is weak; (ii) Difficult access to preferential loans; (iii) The small and fragmented land size of production units affect the ability to attract businesses; (iv) Some agricultural inputs and materials are of poor quality and are not used efficiently. At the end of the presentation, Dr Oanh mentioned some solutions such as (i) State management in policies; (ii) international cooperation; etc.

3. OPPORTUNITIES IN PROMOTING BIOMASS ENERGY FOR RURAL AND REMOTE AREA DEVELOPMENT

There were two speakers in the Session: Dr Zhang Maolong, Vice Dean, Beijing Huaneng Yangtze Environmental Technology Research Institute, China and Mr Nguyen Hong Long, Chief Advisor for Development Research, EBG Science and Technology Company Limited, Viet Nam.

- Dr Maolong Zhang delivered presentation on Co-fired, Hydrogen and Methonal: A Multiple Solution of Biomass Energy Utilization in China. He highlighted that the supply of biomass is instability due to seasonal factors and some biomass utilization equipment is expensive. Secondly, Dr Zhang informed that in 2023, China's total installed power generation capacity adds up to 1.39 billion KW. The biomass co-fired thermal power plants has become an important technical approach for biomass disposal, the installed capacity of biomass power generation has reached 44.14 million KW in 2023. By August 2024, more than 80 green methanol projects have been planned in China, with a total output of about 10 million tons. So it can be seen that there are obvious production advantages and large gaps between supply and demand. In summary, to the

speaker, the biomass co-firing in thermal power plants is low cost, nice compatibility, can reduce greenhouse gas emissions in thermal power plant but has high requirements for combustion and equipment modification is needed in thermal power plants. The biomass-based green hydrogen/methanol technology can obtain high value-added products, has social and environmental benefits; but has low technological maturity and industrialization level, insufficient economic viability. At the end of the presentation, Dr Zhang noted some issues in the application. for example, biomass fuel has high volatile matter and low ignition point, making it very easy to ignite. The co-firing of biomass in coal-fired power generation will significantly increase the cost of electricity generation. Without subsidies, it is difficult to sustain related engineering demonstration projects. The benefits brought to investors by the emission reduction achievements of domestic agricultural and forestry biomass power generation projects are not yet clear. Therefore, it is recommended to actively develop carbon reduction methods such as green electricity and China Certified Emission Reduction (CCER) to enhance market potential.

- Mr Nguyen Hong Long mentioned that according to Viet Nam Energy Development Support Center, Viet Nam technical potential for biomass is 160 million tons per year including agricultural and forestry residues, livestock waste and urban solid waste. Using the volumetric biomass gasification technology (VCBG) applications means there are some opportunities promote biomass energy for rural and remote area development such as renewable energy demand and supporting policies. Then, the speaker showed some biomass potential in 4 provinces of Viet Nam: Thai Nguyen, Tuyen Quang, Lao Cai and Yen Bai in 2022 as well as the amount of biomass use in household in each province. According to Mr Long, utilizing agriculture waste will help to improve the economic and social conditions; improve environment quality and has many other potentials in industry and agriculture. At the end of the presentation, Mr Long showed some applications of VCBG such as Gasio Household stove, Green tea processing, Black tea processing, Bamboo shoot processing, Herb processing and Drying System.

4. OBSTACLES IN PROMOTING BIOMASS ENERGY FOR RURAL AND REMOTE AREA DEVELOPMENT

There were 3 speakers in the Session: Dr Terry Surles, Consultant, Hawaii Natural Energy Institute, United States; Mr Vu Quang Dang, Independent Energy Consultant, Viet Nam and Mr Nguyen Hong Long, Chief Advisor for Development Research, EBG Science and Technology Company Limited, Viet Nam.

- Dr Terry Surles mentioned the obstacles are not specific, but federal biomass funding is limited. Financing is the greatest concern and new initiatives that do not treat biomass as renewable may limit growth. Financial issues will need to be seriously considered. Government intervention is key attribute for development and deployment of renewable systems. The costs of biomass systems are higher than variable systems, such as wind and solar. Transportation of low-density fuel increases overall costs. Dr Surles also mentioned that very little funding is going into biomass technology for electricity. Most funding is for biofuel development and industrial chemicals that replace those produced from fossil fuels. Biofuels can be produced from various feedstocks using different conversion technologies. For remote and rural communities, a major technology opportunity will be deployment of microgrids. Hawaii issues are examples of biomass to electricity difficulties. Ho Honua was a coal fired plant converted to biomass (eucalyptus trees). It has not been allowed to operate due to public opposition. The University of Hawaii at Hilo developed plans for a waste-to-energy facility coupled with energy storage in 2018. This project was abandoned after being 55% complete. There must be consideration on how to ameliorate impacts on other systems relating to water resources; competition between agriculture for food and bio-crops; balancing ecosystem issues with energy development and cultural values and community concerns. Dr Surles said that forest biomass is considered renewable energy source if forest productivity is maintained. Switching from coal to woody biomass reduces atmospheric CO_2 over time scales relevant to climate stabilization. Sustainability governance ensures woody biomass used for energy has positive contribution to addressing climate change. Managed forests can provide greater climate benefits than conservation forests. At the end of the presentation, Dr Terry mentioned that careful land use planning can reduce CO_2 emissions. Governance must be consistent, while considering multi-attributes. There must be clear pathways for technological deployers and financiers to make decent returns on investment. The relationships between federal, state, and local governments must be synchronized.

- Mr Vu Quang Dang delivered presentation on Alternative Fuel For The Cement Sector in Viet Nam. Firstly, the Decision 1266/QD-TTg of Viet Nam mentioned that the alternative fuel (AF) from waste will be more than 15% by 2030 and 30% by 2050. The government targets on solid waste management by 2030 is 15% of AF at cement factories and 1182 MW of waste-to-energy. There are some advantages and disadvantages of AF using, co-processing at cement companies and Resource Description Framework (RDF) producing. The advantages are Energy cost reduction; Green marketing tool for cement export; GHG emission reduction, net-zero target, avoided carbon tax for exporting; RDF production could be implemented at a small scale and less investment cost etc. The RDF projects could be invested in small and medium provinces and districts. However, the disadvantages are: No incentives for AF using and co-processing investment (subsidy, tax, tipping fee); Complicated approvals from authorities (Environment Permission, Investment Certificate); No carbon market in Viet Nam; Small RDF market (cement companies as RDF off takers); No inter-province transport of MSW for long-term MSW inputs for RDF factories. At the end of the presentation, Mr Dang showed a successful story on AF using in the Philippines in August 2024, which is the Universal Robina (a Food manufacturer) provides AF to Holcim.

- According to Mr Nguyen Hong Long, the application of Volumetric Biomass Gasification Technology (VCBG) has some obstacles. The first challenge is technical challenge. VCBG is relatively new, so unforeseen technical problems may arise during production, operation or maintenance. Although VCBGs are designed to process a wide variety of biomass, change in biomass composition (e.g moisture content, size) can affect gasification performance. The second challenge is economic barriers. While it can save costs in the long term, the initial investment in equipment can be a barrier for some businesses, especially small farmers or household in rural, remote areas. Switching from traditional cooking and heating method to gasification technology can be met without acceptance due to long-standing technology if the benefits are not immediately apparent. The third challenge is commercialization and market risks. The need for reliable biomass fuel supply chain and mechanical services to support VCBG technology is another barrier. Establishing local service provider and securing biomass resources can be difficult. The fourth obstacle is environmental and regulatory barrier. VCBG technology may require specific certification or approvals in various regions. These regulatory may delay or complicate deployment. Although VCBGs are designed to minimize emissions, improper use or poor

maintenance can still result in emission that do not meet environment standard. The last obstacle is social and cultural barriers. Changing cooking or heating habits from traditional methods to VCBG technology requires a change in long-standing habits. The level access to VCBG technology among social groups is uneven. Regarding the overall biomass challenges, the speaker mentioned some challenges: (i) seasonality and diversity; (ii) ownership issues; (iii) accessibility for local communities. Regarding the challenges in carbon credit, there is difficulty in measurement and verification; lack of legal framework in Viet Nam and violation of carbon credit market. At the end of the presentation, Mr Long mentioned some solutions that VCBG technology offers to promote biomass energy for rural and remote area development. The VCBG has some advantages such as (i) Continuous operation; (ii) high performance; (iii) fuel variety; (iv) low emission; (v) low investment cost. The VCBG can take advantage of agriculture and forestry by-products. It can replace fossil fuels, especially coal and accumulate the atmospheric carbon into soil. The VCBG is also cost saving, safe for users and generate job and income.

5. CASE STUDIES IN SOME APEC MEMBER ECONOMIES

There were 3 speakers in this Session: Mr Natee Sithiprasasana, Board of Directors, Thai Renewable Energy (RE100) Association, Thailand; Dr Pham Thi To Oanh, Director, Viet Nam Cooperative Alliance (VCA) and Ms Anna Mikko G. Realo, Officer-in-Charge, Biomass Energy Management Division, Renewable Energy Management Bureau, Department Of Energy, the Philippines.

- According to Mr Natee Sithiprasasana, the objective of Thai RE 100 Association is (i) To propose policies to the government; (ii) To achieve Thailand's greenhouse gas reduction target; (iii) To enable transition into new industries; (iv) To enhance the capability of the industry. Regarding the biomass power plants, the Small Power Producer (SPP) firms have 30 plants, with installed cap of 839 MW; SPP non-firm has 55 plants and 2,919.6 MW of installed cap; Very Small Power Producer (VSPP) non-firm has 195 plants and generates 2,154.9 MW of installed cap. The total biomass power plants are 280 plants, with 5,913.9 MW of installed cap. On the other hand, the biogas power plant has total of 212 plants, with 469.1 MV installed cap. In terms of community-based economic value, the biomass and biogas energy crop create so many jobs. At the end of the presentation, Mr Natee used the example of bagasse, rice husk and empty fruit bunch to show that the balance of key biomass fuel is very important. The demand and supply of the fuel should be balanced, in order to generate electricity firmly and run business efficiently.

- Dr Pham Thi To Oanh delivered a presentation on case studies in Thailand, Korea, Malaysia and Viet Nam. In Korea, they bury organic waste and collect leachate. They apply accumulated waste collection techniques and use landfill methane as fuel. At the moment, the electric capacity of plant in Korea is 2,2 MW and they have a strategy to develop bioelectricity to 2030. In Malaysia, wood, palm oil waste, rice husk, coconut fiber, municipal waste and annual sugarcane waste creates 168 million tons of biomass. In Thailand, agricultural waste through melting process will produce fuel with greater energy density than standard wood pellets. It is equivalent to Indonesian coal but has same price in the current market. In Viet Nam, electric capacity from biomass aims to increase from 1% (2020) to 2.1% (2030) and 8.1% (2050) of the total electricity capacity. At the end of the presentation, Dr Oanh showed some successful examples/ models in agricultural cooperatives.

- Ms Anna Mikko G. Realo emphasized that the Philippines is an agricultural economy with a high potential for biomass energy utilization. Biomass is renewable and abundant in rural and remote agricultural areas. It reduces reliance on fossil fuels, mitigating GHG emissions and creates economic opportunities in rural communities through waste utilization. Ms Anna then showed 2 case studies. The first case is Biomass Gasification Project in Romblon. Agricultural waste such as coconut shell and frauds, coconut husk, ipil-ipil, and bana grass will be used as feedstock to generate power. The project came to commercial operation on May 2019. The impact of this project is to reduce diesel generator dependence and providing livelihood. The project will act as a pilot project for future efforts to achieve 100% rural electrification through renewable energy and will utilize local agriculture waste. However, the project has some challenges such as (i) Delivery of the materials and equipment; (ii) training of personnel; (iii) varying costs of feedstock. The second case is Establishment of a Pilot Production and Demonstration Plant for Filtered Crude Coconut Oil for Stationary and Mobile Engines in connection with Barangay Electrification Program Project. The project uses the diesel generator fed with filtered crude coconut oil and benefited 52 households. This project has some impacts such as (i) Utilized local coconut waste; (ii) Reduce reliance on traditional fossil fuels and contribute to a more sustainable energy future; (iii) Supports research and development in the field of biofuels and sustainable energy solutions. However, this project also has some challenges in terms of delivery of the materials and equipment; (ii) logistics and unstable feedstock supply/ price; (iii) training and capacity building in local communities; (iv) technology adaptability. At the end

of the presentation, the speaker concluded that biomass energy offers sustainable solutions for rural electrification. There are some opportunities existing to scale these projects across other remote areas though challenges may exist.

6. DISCUSSIONS

- The speakers and participants had an in-depth discussion about the technical potentials of biomass energy in the United States and China. A speaker mentioned that approximately 30% of the total biomass value was currently being burned in biomass energy generation facilities. Such facilities in China were typically located about 30 km away from biomass sources. The annual input of biomass totalled 200-300 thousand tons.
- A speaker also provided an update on China's biomass energy potential. As of late 2023, biomass electricity usage accounted for the equivalent of approximately 28 million tons of coal. This proportion continued to grow in the total energy mix, reaching 460 million tons.
- Another speaker highlighted that the USA had yet to fully exploit the potential of this energy source. For instance, while waste-to-energy facilities existed, they did not cover the entire market. A lot of urban waste materials were collected, but they were scattered and insufficiently concentrated to build a waste-to-energy plant. However, the potential for generating electricity from urban biomass waste recently doubled. That included electricity and heat production, especially in suburban areas. The speaker also pointed out that the cost of collecting agricultural by-products and forest residues for energy production remained a significant challenge. He mentioned a study which indicated that if biomass sources were located more than 40 km away from a production plant, transportation costs would make them commercially unviable. Based on this, he made several policy recommendations, including subsidies for long-distance transport routes and financial support at the local level to encourage biomass collection from various sources. The amount of electricity generated from biomass recently increased from 2.5 gigawatts to 5 gigawatts. He gave examples of small biomass power plants (about 20 MW) in California and identified other potential areas like the Southeastern USA and Central Wisconsin. There were abundant wood-production regions that could be tapped for biomass input.
- A consensus emerged that the key factor hindering the development of biomass energy, compared to such other clean energy sources as wind and solar, was the instability of raw material inputs. Biomass supply remained heavily dependent on agricultural residues and forest materials.
- One of the proposed solutions was to put in place policies to support crop farming, manure management, and livestock production to convert biogas into

electricity and heat on a small scale. Additionally, small biomass power plants (5-10 kW) could be encouraged to provide a stable, albeit small, electricity supply.

- Regarding manure, 3.5 million tons of manure were used every year in the United States for biogas and biomass energy production for heating, instead of electricity generation.
- The speakers and delegates also discussed mechanisms to promote biomass energy. One speaker suggested combining different types of energy sources to develop biomass energy, utilizing relevant technologies and minimizing transportation costs. However, biomass energy had not yet been prioritized in the USA, so there were too few policies encouraging its development.
- One speaker mentioned ongoing feasibility studies related to biomass, methanol, and hydrogen energy in China. Most operations were small-scaled, while large-scaled commercialization projects were still lacking.
- In response to a question from Thailand participants about the importation of equipment for biomass energy production, a speaker from China shared that they were able to handle most equipment and technology domestically. However, certain parts still needed to be imported from Europe to ensure stability and high efficiency, as biomass sources were seasonal and unstable.
- In China, there was a difference in tariff between electricity generated from coal and those from biomass. Biomass-generated electricity is about Yuan2.3/kWh more expensive than coal. This is attributable to the lower efficiency of biomass plants, which are less than 50% as efficient as coal-fired plants.
- Financial and technological challenges were also raised. Examples were some waste-to-energy plants that were abandoned after only a few years of operation. To explore the issue, more detailed studies on the feasibility of raw material supply were required to ensure the sustainability of such projects.
- The differences in the availability of biomass inputs across economies also make it difficult to adopt successful models from one economy to another. Therefore, more updated research in those areas with abundant agricultural and forestry residues is necessary to determine the most appropriate models for each economy.
- The management and use of promising raw materials such as acacia, essential oil plants, eucalyptus, and tea tree acacia was also discussed. For example, in California, biomass power plants were being built in the remote areas using wood resources. It was also considered a solution to reduce forest fires by utilizing the materials left over from tree harvesting.
- A key issue was raised about the quality of biomass and its potential impact on environmental pollution. It was important to exploit biomass in accordance with its biological characteristics, as raw biomass sources varied. For instance, straw

fibres could not be used to generate electricity but it was feasible for other purposes. In general, maximizing and promoting the commercialization of energy sources was crucial when considering individual projects.

- The speaker from the Philippines noted that calculating revenue and input costs was important for estimating the efficiency of biomass projects to ensure sustainable operation. She also mentioned that rice husks, bagasse, and other mixed materials such as coconut shells, wood chips, and sawdust were commonly used in the Philippines. However, there were currently fewer and fewer sawmill plants, while the new projects to plant trees for raw material production were still in the licensing phase.
- In China since 2005 there have been activities related to planning, making legal regulations, and setting specific policy goals related to biomass. As a result, the government now offers incentives for biomass electricity and enabling policies. However, the economy faces plenty of challenges such as the expiration of central and local government subsidies, unsustainable projects, and concerns about commercial sustainability without government subsidies.
- By contrast, the Philippines has had a renewable energy law in place since 2008. Once projects are registered with the Department of Energy, they are eligible for investment incentives for biomass energy, including tax reductions, VAT exemptions, and other incentives, such as import duty reductions for equipment. Despite that there are no direct subsidies, biomass energy project can enjoy many incentives, most of which are related to tax bonus. There has been a comprehensive potential assessment of biomass development in partnership with US Aid Agency since 2013. It also aims at assessing the current biomass potential and expand it.
- In the Philippines, investors must register with the Department of Energy and complete a feasibility study. It can be difficult due to the highly changeable biomass sources, and long-term contracts are not always available.
- China is now experimenting on a coal-biomass energy mix. The current substitution rate is 10%, which they hope to increase to 20% in the next two years and to reach 50% after four years. However, this is still a proposal and not yet an official roadmap. Pilot projects are being carried out to test the effectiveness of this mix. The Chinese government has also implemented several support programs, particularly to provide raw materials for biomass electricity generation for agricultural processing. However, the problems of environmental pollution and greenhouse gas emissions still need to be addressed.
- Thanks to favorable climate conditions, Viet Nam has abundant biomass raw materials, with millions of tons produced annually. While the technology requires up to 14 years of research and development, the cost of biomass electricity is about USD1.5/kWh, which is affordable for low-income

households. This is a solution with high commercial potential, but it requires collaboration among the government, industry associations, and the community to be widely implemented.

- Biomass energy is not yet a priority in the USA. The economy mainly focuses on solutions like hydrogen and carbon neutrality goals. One reason for this is the high transportation costs of biomass. Biomass is bulky and needs to be compressed to save space, making it less prioritized. However, biomass is highly relevant to small-scaled systems, such as those in the Southeast, Midwest, or California, where biomass can be used to achieve carbon neutrality goals.
- The Philippines has abundant biomass materials, such as rice husks, sugarcane bagasse, by-products from corn and sugarcane plants, and coconut shells. They use boilers and various types of biomass systems to generate electricity and produce heat. However, these projects still face challenges with seasonal supply fluctuations.
- Thailand has implemented a number of projects using biomass from agricultural by-products. One example is the first biomass plant using bagasse from a sugar mill, followed by a rice milling facility and a palm oil production plant. These projects have been successful due to the convenient handling and transportation, as all the facilities are located close to each other. However, the supply depends on the growing season and weather conditions, so careful forecasting of supply and demand is necessary.
- APEC Southeast economies such as the Philippines; Thailand; Viet Nam are all adopting different biomass models to develop renewable energy. However, each economy faces its own challenges, from supply stabilization issues and high operating costs to changes in weather and climate conditions. For these projects to succeed, government support, cooperation among organizations, and collaboration of the community and businesses are essential.
- A question was raised about the sources of funding for these projects and whether there are sustainable financial resources in place to ensure that the projects can be maintained and continue to grow over the next 10 years or longer. This is also a challenge that economies face when implementing renewable energy projects, including biomass-based one. Therefore, to ensure sustainable development of biomass energy, we need to consider comprehensive factors, including policies, technologies, and financial solutions that are appropriate for each economy and region's specific conditions.

V. RECOMMENDATIONS

During the final session, there were 3 panelists in this Session: Mr Natee Sithiprasasana, Board of Directors, Thai Renewable Energy (RE100) Association, Thailand; Dr Terry

Surles, Consultant, Hawaii Natural Energy Institute, United States and Mr Vu Quang Dang, Independent Energy Consultant, Viet Nam.

- Mr Natee Sithiprasasana showed some recommendations and proposed actions in terms of policy framework, regulatory framework and operation framework. Regarding the policy framework, the speaker recommends that the policy should (i) liberalise power business in response to strong demand on green electricity for green supply chain; (ii) have balance variable RE with bio-based energy; (iii) support climate finance for R&D, innovation of low carbon technologies. For regulatory framework, it is recommended that the framework should be away from regulated market and transit to deregulated market. Regarding the operation framework, Mr Natee recommended to take quick actions and executions with ambitious time and target. The speaker then proposed some actions. For example, putting more pressure to policy makers; building network participation among academics, industries, businesses, NGO; improving collaboration with government; studying potential of biomass for power, heat and bio-fuel; studying benefits on community based economy of bio based energy development; Schemes to support enough tariff for development of biomass, biogas; issuing regulation for third party access; Open for digital trading platform; setting up public and private committee, etc.

- Dr Terry Surles mentioned that political will must be consistent, while considering multi-attributes. There must be clear pathways for technology developers and deployers and financiers to make decent returns on investment. The policy support must be present in overall population. Economies must be considerate of their local and cultural issues. For rural biomass development, economies must manage expectations. Economies must work with regional and local partners and private sector developers must be encouraged. The installation of biomass-fired systems for microgrids can be more cost effective. At the end of the presentation, Dr Surles concluded that there were some opportunities to see new energy developments around the Asia-Pacific. The discussion on best paths forward as “one size” does not fit for every economy. Therefore, it leads to collaboration, effective information sharing, and cooperation between economies.

- Mr Vu Quang Dang mentioned some recommendations for biomass development in Viet Nam and APEC. Some of them are:

- Knowledge sharing between provinces with existing biomass projects and proposed biomass projects.
- Close collaboration between the energy authority (energy production) and agricultural authority (biomass sources)
- Clear direction policy, Eighth Power Development Plan (PDP8) implementation of 1088 MW, and project approval procedures.
- Promotion of Renewable Energy Portfolio Standards (RE %).
- Study and pilot biomass for co-firing in coal-fired power plants (PDP8).
- Promote refuse-derived fuel (RDF) from biomass as an alternative fuel in cement, boiler, and other sectors and export to other economies (currently 3-4 tons per year).
- Biomass fertilizers.
- Development of the carbon market in Viet Nam.
- Green finance for biomass projects.

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

- Regarding financial issues, government support is essential to ensure the sustainability of biomass energy projects. Policies should be strengthened through incentives, and each government should improve the legal framework for sustainable projects in remote and rural areas.
- Logistics, especially transportation and collection, is a significant challenge, and using rail transport could be a viable solution. The government should establish farmer groups to promote and train in sustainable farming techniques, ensuring a steady biomass supply while securing food sources for the population at the same time.
- Infrastructure development is necessary to address the issues of supply, distribution, and logistics for biomass in remote areas.
- There is a strong need for up-to-date research. It is recommended that both the government and the private sector should invest in research and development, as this is crucial for enhancing the competitiveness of biomass energy. Data management on biomass plants and a catalogue of solutions for potential investors should be systematized.

- Training and capacity building are vital to ensure the success of biomass energy projects. Investment in local education and training for rural communities, government staff, and related agencies is crucial.
- Inter-disciplinary collaboration is extremely important.
- Compared to other economies, Viet Nam has a master plan for biomass energy development but lacks specific enabling policies. By contrast, other economies already have more effective pricing policies. Vietnamese participants recommends that the government should adopt pricing incentives and different ministries should work together to develop policies for the most efficient use of biomass.
- Supply stability is crucial. The government should create mechanisms to promote organic waste collection at the household level. Technical support from renewable energy organizations and financial support from international institutions should also be accessed to implement best practices.
- The impact on women and society must be considered, with a focus on inclusive development.
- In summary, there is the need to combine financial, technical, human, and institutional efforts. Local priorities should be identified, biomass input sources classified, and stakeholder engagements promoted to expand biomass use in remote regions.
- Different economies have things in common and also unique features. Therefore, specific projects tailored to local characteristics should be developed. Commercializing these projects is essential. Research and development in rural areas should be promoted. As biomass types vary greatly, it is important to identify characteristics of each source. Greenhouse gas emissions and environmental pollution need to be carefully assessed and calculated.
- The participation of the private sector is necessary as biomass energy costs are significant. Managing raw material inputs is critical, and improving standards through biomass standardization systems is essential to ensure consistency.
- There needs to be stronger attention from governments and close engagement between governments and stakeholders to ensure the success and sustainability of biomass projects across the region.
- The participation of technology experts in research and development is vital to accelerate innovations and solutions that can improve biomass energy efficiency.

Recommendations for APEC:

- APEC should establish dedicated working groups to coordinate and implement biomass energy projects across its member economies. These groups would

focus on identifying the common challenges, sharing knowledge, and implementing best practices for biomass energy development.

- APEC should develop a strategy to standardize and ensure consistency in the on-going biomass energy projects across its member economies. This would include regular self-compliance audits and reviews to ensure the projects meet agreed-upon standards and can be replicated effectively in different regions.

VI. CONCLUSIONS

In his closing remarks, Mr Luong Hoang Thai (Director General, Multilateral Trade Policy Department, Ministry of Industry and Trade, Viet Nam) observed that the Workshop's participants have had great opportunities for sharing an overview on biomass energy development, necessity of biomass for the development in rural and remote areas, opportunities and challenges in adopting biomass energy, sharing case studies in APEC member economies as well as discussing and making recommendations to promote the adoption of biomass energy for rural and remote area development.

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

- It is important to raise awareness among people, farmers, MSMEs, local authorities, etc., of the importance and benefits of biomass energy to promote a wider adoption.

- It is important to promote close collaboration between stakeholders such as relevant authorities, entities, agencies of energy (for energy production) and agriculture (for biomass sources), and so on.

- The development of carbon market in Viet Nam, in turn, can spur the development and adoption of biomass energy.

- Concrete efforts should be made including promulgation of policies, regulation, and incentives; promoting incubators, R&D, etc., to promote innovation and adoption of advanced technologies for modern biomass energy.

- Green financing would be a practical important means to promote and support the wide adoption of biomass. More serious attention should be paid to help address obstacles in accessing biomass, especially in rural and remote areas.

- APEC should continue to take a leading role in pursuing sustainability in general, concrete efforts and initiatives to promote renewable energy including biomass in particular, through sharing information, knowledge, best practices; promoting capacity building and close collaboration and cooperation among the member economies.

Mr Thai hoped that each and every member economy's participants could have a more in-depth knowledge of the issues, hence promoting further efforts to promote the adoption of biomass energy in rural and remote areas, subject to specific domestic circumstances and long-term development strategies.

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

VII. ANNEX

SUMMARY - PRE-WORKSHOP SURVEY

EWG 203 2023A_ APEC Workshop on Promoting Biomass Energy for Rural and Remote Area Development

1. What are the challenges in promoting biomass energy for rural and remote areadevelopment in your economy?

Chile

In Chile, the second primary energy source is biomass, primarily due to the use of firewood for heating, which is widely used in the southern part of the economy where the climate is colder. However, this has caused serious pollution problems due to the generation of particulate matter from the use of wet firewood. As a result, the challenges are to improve the quality of fuel (using dry firewood, other fuels like wood biomass pellets), enhance heating technologies, and reduce the thermal demand of households.

China

- Limited economic backward technology
- Limited technology, information and communication
- The collection, treatment and processing of biomass raw materials are difficult
- The biomass utilization in rural and remote area is mostly traditional biomass utilization
- High-cost modern biomass is not suitable for rural and remote area
- Lack of a good business model that can benefit all parties involved
- Rural energy infrastructure is relatively poor and lacks an energy service system

Malaysia

Many remote areas lack the necessary infrastructure to support the development and integration of biomass for energy. Poor road access and limited connection to electricity grids make transporting biomass resources and establishing energy facilities difficult leading to increased costs. The initial costs for advanced biomass conversion technologies and equipment can also be prohibitively high.

Papua New Guinea

- Capital Investment or Financial Capacity
- Lack of Advance Technology
- No government Intervention
- Getting investors to agree on private public participation or partnership
- No Regulation
- No Policy to drive the investment

The Philippines

Pursuing biomass energy for rural and remote area development in the Philippines faces several challenges, despite its potential to deliver sustainable and affordable energy, such as:

A. Limited Technical Capability: In the Philippines, some local communities lack information on biomass technology, its benefits, and its potential impact. Also, the operation and maintenance of biomass energy systems necessitate skilled/trained personnel. However, rural areas frequently experience a lack of trained technicians capable of meeting the technical requirements for biomass energy generation and system upkeep. With this, capability building, trainings/workshops, and information, education, and communication (IEC) campaigns must be implemented. Also, resource assessment and identification of suitable biomass technology in rural and/or remote areas must be conducted.

B. Financial Limitations: Establishing biomass energy facilities demands substantial investment in acquiring equipment, constructing power plants, and developing distribution systems. Some local government units (LGUs), Electric Cooperatives, and local entrepreneurs may have limited funding to cover these costs or may exceed the financial grants available.

C. Feedstock Availability/ Technology Matching: In the Philippines, the current biomass technology depends on specific types of agricultural waste as feedstock, which may not always align with the resources available in rural and remote areas. This mismatch presents challenges for implementing biomass projects in those regions.

Thailand

- Biomass power plants generate variable electricity capacity each month depending on seasonal supply of biomass fuels and weather
- Biomass fuels i.e. bagasse from sugar mill, rice husk from rice mill, and empty fruit bunch from palm mill are fully utilized in electricity generation as they are ready-for-collection from the mills, making lower cost of transportation.

Apart from the said 3 biomass fuels, woodchip is widely utilized too. Other biomass potentials are rice straw, cassava root, corncobs, but they are scatter around causing too expensive collection cost.

- Some biomass fuels are too expensive for electricity generation such as palm fiber, palm shell, including biomass pellets. However, they are cost effective from heat generation.

Viet Nam

- Lack of technology
- Access to finance and capital
- Limited Skills of human resources
- Infrastructure is relatively poor

2. What is the most important factor affecting the development of biomass energy in the rural and remote areas in your economy

Option	Number of responses
A. Finance	35
B. Technology	33
C. Government's policy	29
D. Human resources	31
E. Other	- **China:** Cost of use and sustainability - **Malaysia:** Infrastructure readiness - **The Philippines**: Biomass energy offers significant potential for rural and remote area development in the Philippines and addressing the aforementioned challenges will require joint efforts from the domestic government agencies (NGAs), the private sector, and local government units (LGUs). Ensuring feedstock availability and sustainability, strengthening policy frameworks, upgrading infrastructure, increasing public awareness and technical capability, and providing access to financing are essential

	measures to promote biomass as a sustainable energy solution in our economy.

3. Please share some of your economy's policies/ laws/ regulations on promoting biomass energy for rural and remote areadevelopment.

Chile

Solid Biofuels Law: regulates the quality of biofuels sold in Chile, establishing the obligation to have a Quality Seal (certification), among other regulations. It is currently undergoing indigenous consultation and the development of the regulations.

China

Opinions on Accelerating the Comprehensive Utilization of Crop Straw, General Office of the State Council, July 2008. The document proposed that the comprehensive utilization rate of straw in 2015 exceeded 80%, and the value-added tax was collected and refunded.

1. Bioelectricity:

- Notice on improving price policy for bio-power from agricultural and forestry on 18 July 2010. Fixed feed-in tariff: Since 2010, the new agricultural and forestry biomass power generation projects have uniformly implemented the benchmark feed-in tariff of Yuan0.75/kWh (including tax).
- Views on promoting the healthy development of electricity from non-water renewable sources on 20 January 2020
- Improve the implementation plan of bio power project construction and operation on 11 September 2020

2. Bio heating:

- The Chinese Ministry of Finance issued the Interim Measures for the Management of Subsidies for the Utilization of Straw for Energy. In 2008 the Ministry of Finance launched a subsidy initiative to encourage the use of agricultural residues for energy use. The residues are palletized and used to provide heat for rural industry and district heating, replacing coal. Some pellets are also used for cooking in improved cook stoves. The policy provides a stable source of income in rural areas. Farmers can provide the raw materials, provide labor for the process and invest in building palletizing plants. The subsidy standard is RMB140/ton for straw.
- Guiding Opinions on Promoting the Development of Biomass-based Heating in December 2017. The policy has promoted the application of biomass heating in rural areas.

- North of China Winter Clean Heating Planning in December 2017. The planning promotes district biomass heating and residential heating in rural areas of northern China.
- 100 provinces biomass CHP project in January 2018. The policy has led to the transformation and upgrading of rural bio-power project.

3. Biogas:

- In 2003, Ministry of Agriculture issued the "Rural Biogas Construction Domestic Debt Project Management Measures (Trial)"
- From 2003 to 2017, the Domestic Development and Reform Commission (NRDC) and the Ministry of Agriculture have arranged for central investment to actively support rural biogas construction, with a total investment of RMB40.4 billion.

4. Biomass energy utilization project

Special subsidies for investment within the central budget. Special Administrative Measures for Investment in Energy Conservation and Carbon Reduction within the Central Budget. Support range

- Resource utilization of livestock manure (biogas, natural gas)
- Recycling of kitchen waste (biogas, biodiesel)
- Resource utilization of agricultural and forestry wastes (pyrolysis gasification, biogas)
- Sludge energy utilization (biogas, biomass fuel)

The capital support from the central budget shall not exceed 15% of the total project investment, and the support fund for a single project shall not exceed RMB100 million in principle.

5. Clean Heating Plan for Northern Regions (2017-2021).

The plan encourages the use of various biomass energy sources, including biogas, wood pellet, straw briquette, straw bundling and burning, etc. It also promotes the use of solar heating, geothermal, etc.

6. 14th Five Year Plan for the Development of Renewable Energy.

- Steadily developing biomass power generation.
- Optimize the layout of biomass power generation development.
- Orderly development of agricultural and forestry biomass power generation and biogas power generation.
- Orderly development of biomass cogeneration.
- Accelerating the transition from biomass power generation to cogeneration according to local conditions.
- Upgrade to provide heating for densely populated rural areas.
- Carry out demonstration of bio natural gas.

- Overall planning and construction of bio natural gas with an annual output of tens of millions of cubic meters.

Malaysia

Malaysia has introduced several policies and initiatives to promote biomass for energy, including:

- Domestic Biomass Action Plan 2023-2030 (NBAP2030);
- Domestic Agricommodity Policy 2021-2030 (DAKN2030) in chapter 9 and 10;
- Malaysia Renewable Energy Roadmap (MyRER).

Papua New Guinea

- Domestic Constitution
- Domestic Energy Authority Act 2021
- Electricity Industry Amendment Act 202
- Environment Act 2000
- Medium Term Development (MTDP IV) 2023 - 2027
- Policy addressing the Licensing of Biomass Energy and the Biomass Energy Process.
- Regulation and Policy around the Pricing regulation and Tariff Systems
- Mandatory Regulation and Compliances Enforcement in the Policy and Regulations.
- Technology and Standards aligned with the ANZ Standards.
- Waste Management Policy and Regulations
- Domestic Content and Access to Land or Landowner Mobilization.
- Waste to Energy
- Energy Efficiency
- Energy Transition

The Philippines

The Philippines has implemented a range of policies, laws, and regulations to encourage biomass energy, with a particular focus on fostering development in rural and remote areas. Below are some important frameworks and initiatives:

a. Renewable Energy Act of 2008 (Republic Act No. 9513)

The Philippine government, through the Department of Energy, promulgated Republic Act No. 9513, also known as the Renewable Energy Act of 2008. This law was enacted to accelerate the exploration, development, and utilization of indigenous renewable energy resources and technologies throughout the economy, including rural and remote areas, in order to achieve energy self-reliance and mitigate the effects of climate change. To achieve these objectives and encourage RE investments, the RE Act defined a set of fiscal and non-fiscal incentives or RE policy support mechanisms. The policies and programs under the Non-Fiscal Incentives are composed of voluntary and mandatory programs such as:

1. Renewable Portfolio Standards: Requires all load-serving entities, both in on-grid and off-grid areas, to source or produce a specified portion of their supply from eligible RE facilities.
2. Net-Metering: Allows end-users to generate electricity from RE-based systems up to 100 kW for own use and sell their excess to the grid.
3. RE Market: Serves as the venue for the transparent and fair trading of RE Certificates.
4. Green Energy Option Program: Provides end-users the option to choose RE resources as their electricity source
5. Green Energy Auction Program: Provides additional market for RE through competitive electronic bidding of RE capacities. These policies and programs ensure the creation of a market and promote the utilization of RE resources, however, these may be limited to medium-to large-scale biomass power projects and may not be suitable for rural and remote areas. Meanwhile, fiscal incentives consist of the privileges of developers or investors engaged in the RE sector, such as: (i) 7-year Income Tax Holiday; (ii) Duty-Free Importation of Machinery, Equipment, and Materials; (iii) Special Realty Tax Rate; (iv) Zero VAT Rate, and (v) Cash Incentives for Missionary Electrification.

The growth of the RE industry in the Philippines from the enactment of the Renewable Energy Act of 2008 brought more than 2700 MW of additional renewable energy capacity installations. The majority of these new installations were driven by the FIT system which provided a guaranteed fixed rate per kWh of electricity generated from eligible renewable energy power plants.

b. Micro-grid System Provider (MGSP)

The Philippine Government through The Department of Energy (DOE) collaborates with micro-grid system providers to promote the development and implementation of decentralized energy systems. This partnership aims to enhance energy access, particularly in remote and underserved areas, by integrating renewable energy sources and improving energy resilience.

c. NREP

The NREP provides a comprehensive roadmap for the development of renewable energy sources in the Philippines, including biomass. It sets specific targets for

increasing the share of renewable energy in the domestic energy mix and outlines plans for infrastructure development, capacity building, and rural electrification. This program includes initiatives to promote decentralized energy systems, such as biomass-based micro-grids, to serve remote communities. The updated NREP for the period 2020-2040 sets targets for the Government of the Philippines to achieve a 35% share of renewable energy in the power generation mix by 2030, and 50% by 2040. Through the revitalized NREP 2020-2040 framework, the components of the whole of-economy and whole-of-government approaches are integrated to address the issues and challenges by the RE sector. Also, includes RE policy mechanisms and support programs implemented by the Philippine Government, as well as initiatives and provisions specifically targeting rural and remote areas:

- **RE Transition Pathways** identify the mandatory policies and voluntary programs that will establish the robust demand and market for RE
- **RE Transition Enablers** include laws, programs, and activities that will create an enabling environment for RE investments and empower local communities
- **RE Off-Grid and Productive Uses of RE or PURE Strategies** support the provision of social services, livelihood, and enhanced quality of life in rural communities and off-grid areas through RE; and
- **Resource-Specific Programs** define the strategies that will promote and develop specific RE resources and technologies.

d. Total Electrification Program

The Philippines government, through the collaborative initiatives between the Domestic Electrification Administration and the Department of Energy, designed the Total Electrification Program (TEP) to support efforts toward achieving universal access to electricity in underserved and rural areas and finance projects that provide electricity to areas lacking access, promoting economic development and improving quality of life. Moreover, TEP supports various initiatives, including grid extension, renewable energy projects (i.e. solar and biomass), and the development of micro-grids tailored to local needs.

e. Local Government Initiatives

Many local government units (LGUs) have implemented their policies and programs to support biomass energy development. These initiatives often focus on local biomass resources, such as agricultural residues and waste, to create community-based energy projects.

Thailand

- Thailand supports biomass power plants by The Feed in Tariff scheme (FiT). FiT is Baht4.8482/kWh for a power plant, less than or equal to 3 MW, and Baht4.2636/kWh for a power plant, higher than 3 MW to 10 MW. The period of The FiT contract is 20 years.

- Funding support for procurement of machinery and equipment for 3 groups 1) Biomass processors such as wood chips or biomass pellets producers; 2) Biomass fuel users, entrepreneurs using biomass in the heating sector received support about biomass burners, pollution treatment systems, fuel conveyance systems and fuel storage space; 3) Biogas for heat production by improving gas quality and operational system.
- Community power plants for local economy aims to promote community participation in sustainable production. Producing electricity from energy crops (Napier Grass) and Fast-growing trees by planting in community areas around power plants. Contracts occur between private sectors and community enterprise (around 200 households) community enterprise produces energy crops and sell to private sectors to produce electricity in community power plants. Some profit from produce electricity can share with community enterprise and can use in developing community around power plants.

Viet Nam

In order to encourage the development of biomass power projects, the Government issued Decision No. 08/2020/QD-TTg amending the Decision No. 24/2014/QD-TTg on the mechanism to support the development of biomass power projects. At the same time, there are preferential policies on land when implementing biomass energy projects which sign 20-year electricity purchase contracts.

Additionally, the Government has introduced policies to encourage investment in biomass energy such as:

- **Investment in Grid Power**: The Government is investing in upgrading the power grid to connect renewable energy projects to the domestic grid.
- **Promoting Biomass Energy Development**: The Government is investing in research and development for biomass energy, including seeking new technologies, enhancing cooperation with international partners and establishing research and training centers.
- **Encouraging Investment in Renewable Energy**: The Government has issued various support policies including import tax exemption for renewable energy production equipment, tax reductions and financial support for renewable energy projects.

4. If possible, please share a case study/ case studies with the development of biomass energy in the rural and remote areas in your economy

Chile

Firewood Quality Seal: it is a voluntary certification seal that gives rise to or inspires the Solid Biofuels Law, where recognition is granted to producers and sellers of firewood who offer a quality product.

China

Case 1:

In the rural areas of Northeast China, 300,000 to 380,000 tons of straw can be collected within the province area of 1.2 to 1.5 million mu of planting area, which can basically meet the raw material demand of a biomass power plant with an installed capacity of 30 MW, and the green electricity produced can meet the production and living electricity demand of local rural residents (about 100,000 people). At the same time, it can provide about 2 million square meters of clean heating for local rural residents.

Case 2

- **Project name**

Jilin 2×30MW Biomass CHP Project

- **Project overview**

The total area of the project is 150,000 square meters, of which the construction area is 30,000 square meters. The scale is 2 sets of 130t/h high-temperature and high-pressure circulating fluidized bed biomass boilers, equipped with 2 sets of 30 MW condensing steam turbine generators. The heating area is 2.1 million square meters. In terms of technology, the cold source loss of the steam turbine unit is fully utilized. The circulating water absorbs heat in the condenser and does not enter the cooling tower of the circulating cooling system for heat dissipation, but is directly sent to the heat user. After the heat user dissipates the heat, it returns to the condenser for re absorption and circulation. According to the heat load, the circulating water volume is adjusted to ensure the continuous and stable operation of the heating network system. Since the power plant was put into operation, the unit has been running stably and the heating supply is reliable.

- **Experiences and lessons**

To develop a circular economy, raw materials are directly purchased from farmers' straw through straw storage and transportation companies. The actual implementation method is to establish eight straw storage and transportation companies in Qian'an rural areas, townships, and surrounding provinces and villages. It covers a total area of 1.5 million square meters. The project owner has integrated and driven more than 30 large agricultural machinery cooperatives to provide harvesting services for farmers at half of the market price, and used straw and other agricultural waste to power the plant (with an annual consumption of 500,000 tons of straw). And equipped with 50 large natural gas fueled transport vehicles, forming a one-stop storage and transportation system. Provide sufficient guarantee for the production of raw materials in power plants. By using the above model, it creates employment for more

than 500 people, the per capita income can be increased by Yuan20,000. The project not only solves the problem of on-site use of straw, but also indirectly increases farmers' income.

In terms of heating, low vacuum operation of the steam turbine is adopted, using circulating water for heating. The heating method is that the circulating water in the heating network directly supplies heat to users. The characteristics are low water supply temperature, small temperature difference between supply and return water, large circulating water volume in the heating network, and 24-hour continuous heating. The supply and return water temperature is 55/42 ℃, and the supply and return water pressure is 0.6/0.2 MPa. In extremely cold weather, the heating temperature can be raised to 58 ℃. The heating effect has received high recognition from users and social praise.

Schematic diagram of biomass CHP project

Malaysia

Sabah Rural Electrification Initiative wins ASEAN Energy Awards

https://www.mgtc.gov.my/2023/08/sabah-rural-electrification-initiative-wins-asean-energy-awards/

Papua New Guinea

Below are the reference and link for the case studies done in PNG regarding Biomass Energy

1. https://png-data.sprep.org/system/files/PNG%20Sustainable%20Agricultural%20%20Commodities_Final%20%20%20Report_070616_Clean.pdf
2. https://www.bsigroup.com/LocalFiles/en-ID/RSPO%20Public%20Summary%20Reports/2009/ASA1%20%20NBPOL%201st%20Surveillance%20Report%20091209%20Amended%2001%20Final.pdf

3. https://openresearch-repository.anu.edu.au/bitstreams/fb0a350c-c36b-4008-bd81-f6364568c386/download

The Philippines

In the Philippines, the development of biomass energy in rural areas has been strongly supported by government initiatives aimed at promoting renewable energy to achieve rural electrification. Through funding programs and partnerships with local cooperatives, renewable energy including biomass energy projects have been implemented to power isolated communities.

One notable project is the installation of an 18 kW biomass gasification plant in a remote village in Sitio Bagong Silang Barangay Alad, Romblon, Romblon designed to provide clean, reliable electricity to the community and showcase its technical and financial feasibility of biomass gasifier technology as an alternative renewable energy source, supporting their goal of obtaining 90% of its power from renewable energy sources.

The project was a collaborative effort between the Department of Energy (DOE) and electric cooperatives (Romblon Electric Cooperative, Inc. (ROMELCO), utilizing agricultural waste such as coconut shell and frauds, coconut husk, ipil-ipil, and bana grass as feedstock to generate power. The DOE and ROMELCO entered into a memorandum of agreement (MOA) for this project. Under the said agreement, the DOE fully funded the initiative through the Household Electrification Project of the Philippines Government and transferred ownership of the completed biomass gasification plant to ROMELCO following its successful commercial operation.

The project utilized biomass gasification technology, converting said locally sourced agricultural residues into electricity. The gasifier plant project was designed to meet the energy needs of around 42 households, helping to reduce dependence on costly diesel generators and providing livelihood. Also, local residents were trained to operate and maintain the plant, ensuring the sustainability of the project.

This project demonstrates the technical and economic feasibility of biomass energy in rural settings and serves as a model for future efforts to achieve rural electrification through renewable energy. Moreover, this initiative supports the Philippines Government's goal of achieving 100% electrification of the remaining unenergized households in remote communities and isolated islands across the Philippines, particularly in provinces like Romblon, where connecting islands/ offgrid to the main grid is often prohibitively expensive.

Another project in Barangay Apad, Jomalig, Quezon, involves establishing a pilot production and demonstration plant for filtered crude coconut oil (FCCNO) as a biomass-derived fuel. This initiative is a collaboration among several entities: the DOE, the Philippine Coconut Authority, the Municipality of Jomalig, and the Quezon II Electric Cooperative (QUEZELCO II).

The DOE provides funding support for the procurement and delivery of a 25 kV diesel engine generator, electrical lines, and associated components, including

social preparation activities, while Quezelco II handles the procurement, delivery, and installation of the equipment. Meanwhile, the PCA is responsible for providing the necessary machines for the production of FCCNO, and the LGU-Jomalig will support the funding for the purchase of coconuts (copra) and allocate land for the processing plant.

The primary goal of this initiative is to showcase the potential of FCCNO as a sustainable fuel alternative for both stationary and mobile engines. The diesel engine can energize the 52 households in Jomalig, Quezon. The use of FCCNO, a renewable energy source derived from coconuts, aligns with the broader objective of promoting renewable power generation technologies in the Philippines. By using FCCNO as a biomass-derived fuel, the project aims to reduce reliance on traditional fossil fuels and contribute to a more sustainable energy future. Additionally, this effort supports research and development in the field of biofuels and sustainable energy solutions, benefiting local communities and creating new opportunities for the coconut industry.

However, the processing plant for FCCNO ceased production due to the market price of coconuts (copra) on the mainland demands higher price than in the island of Jomalig. As a result, coconut farmers opted to sell their coconuts outside the island for high profit, leading to insufficient supply. While the pilot project demonstrates the potential of FCCNO as a biomass-derived fuel, several challenges need to be addressed before it can serve as a viable alternative to diesel. The high viscosity of FCCNO leads to carbon buildup in the exhaust, resulting in frequent maintenance and higher operational costs. Moreover, the cost of generating electricity using FCCNO is higher than the electricity rate in Jomalig, and the price of coconuts remains fluctuating.

The limitations of FCCNO for this project—both technical and economic—make it less suitable as a direct replacement (100%) for diesel fuel. However, it may be more feasible as a blend with diesel fuel and other oils, such as CME (coconut methyl ester) or crude palm oil, in other biomass projects in rural and remote areas.

Thailand

In Thailand, the by-product from industry is used in biomass power plants. For example:

- Sugar Industry, bagasse is used in biomass power plants. Sugar cane (Mitr Phol Group) 1 ton is converted to bagasse 0.27 ton.
- Palm Oil Industry, empty fruit bunch or EFB and pressed EFB are used in biomass power plants. In Thailand, palm kernel shells can be extracted to produce kernel oil that has a higher value than produce electricity. Therefore, and EFB and pressed EFB are mostly used in biomass power plants. Palm fiber is fully used in palm mill itself.
- In the past, bagasse, rice husks, and EFB were treated as waste with no price and not used in energy sectors. The sugar mills, the rice mills, and the palm

mills gave them for free to community or use in other purposes. Once we knew that they can be used in energy sectors, they are pricing higher depending on demand and supply. Lower cost of biomass such as bagasse, rice husk, EFB, woodchip are good for electricity generation. Higher cost of biomass such as palm kernel shell, wood pellet are good from heat generation. It's more useful when we can use biomass as a renewable energy from many sources that have not used in energy sectors before.

- Scraps of wood, sawdust, wood shaving from furniture factories can be used in producing wood pellets and make more money for both furniture factories and wood pellets factories. It is a win-win situation that can make money and career for many sectors.

Viet Nam

Thuan Hai is one of the enterprises in Steam – Heat – Electricity and fuel energy solution in Viet Nam, which provide a variety of energy solution, providing fuels such as biomass, coal, waste, etc.

Recognizing the market trend towards the development of renewable energy sources, Thuan Hai has invested in establishing a production system and supply 1 million ton of biomass annually to the market.

The use of biomass helps businesses diversity their fuel supply source while simultaneously adverse impacts on the environments.

Thuan Hai has established 7 biomass production plants located in various provinces: Thai Nguyen, Binh Phuoc, Long An, Dong Thap, Vinh Long, Can Tho.

Thuan Hai utilizes agricultural forestry by-products such as husks, sawdust, bagasse, palm kernel shell, etc as raw materials for biomass production. The primary sourcing of raw materials for Thuan Hai is mainly in the provinces of the Mekong Delta, known for their strengths in agriculture and forestry.

More information can be found here: https://thuanhai.com.vn/product-solution/fuel/biomass.html

Preliminary Data Collection And Analysis On Using And Promoting Biomass Energy For Rural And Remote Area Development[2]

I. OVERVIEW OF BIOMASS ENERGY

Biomass refers to organic materials derived from plants, animals, and other natural sources that can be used to produce energy. This includes materials such as wood, crop residues, algae, and animal waste. Biomass acts as a chemical storage of solar energy through the photosynthesis process and is a crucial renewable energy resource. It is primarily composed of lignin (about 25%) and carbohydrates like cellulose (approximately 75%) *(Source: Viet Nam Engergy Magazine, 2023)*.

When biomass is burned, it releases pollutants such as particulate matter, carbon monoxide, and volatile organic compounds. However, these emissions are generally lower compared to those from fossil fuels. Biomass also absorbs carbon dioxide during its growth phase, which can contribute to greenhouse gas mitigation if managed sustainably.

The Role of Biomass in Rural Energy Supply

Biomass, when processed with modern technologies, can provide non-polluting and efficient energy solutions. In rural villages, especially in developing economies, bioenergy systems like gasifiers coupled with small engines and generators can meet electrical loads ranging from 10-250 kWe, potentially replacing diesel fuels *(Source: Chapter 3, The Energy and Agriculture Nexus, FAO, 2000)*.

Key Factors:

a/ Efficient Land Use: Biomass can improve land use efficiency in developing economies and provide non-food feedstock in industrialized economies.

b/ Environmental Benefits: Modern biomass production can address environmental issues like land degradation and air pollution.

c/ Cost-Competitiveness: Biomass energy is becoming increasingly cost-effective compared to fossil fuels.

[2] Disclaimer: The contents of preliminary data collection and analysis is prepared by an independent consultant and do not necessarily reflect the opinion or the position of APEC member economies.

II. PROPORTION OF BIOMASS ENERGY USAGE IN THE WORLD AND IN SOME ECONOMIES

Global Usage: Biomass accounts for approximately 14% of global primary energy consumption. Its importance is particularly pronounced in developing economies, where it can supply up to 90% of primary energy needs. Despite the vast potential for biomass energy, current technological utilization stands at only about 1.8% of its total renewable potential. This disparity underscores the necessity for advancements in technology and infrastructure to fully exploit biomass's capabilities *(Source: Sustainable Production of Woody Biomass for Energy, FAO).*

Sweden and Austria: In these economies, biomass contributes approximately 15% of their primary energy needs. Both economies are increasing their biomass usage as part of broader strategies to reduce reliance on fossil fuels and nuclear energy. These efforts reflect a commitment to enhancing sustainability and energy security *(Source: Bioenergy report, IEA).*

China: As of 2020, China's total biomass power generation capacity is 21.1 GW, accounting for about 1.7% of the economy's total power capacity. Biomass power is distributed as follows: 1.5 GW in Northern China, 6.5 GW in Southern China, and 13.1 GW in Central China. China is a global leader in renewable energy, with biomass power contributing to its total renewable capacity of 35.34 GW. The economy has also implemented numerous policies to support biomass power generation, reflecting its commitment to expanding its biomass energy sector. *(Source: Viet Nam Institute of Strategic and Policy Studies on Industry and Trade, 2022).*

The United States: Biomass represents about 4% of U.S. energy consumption. The U.S. is investing in biomass power plants as a strategy to replace oil imports and nuclear energy. These initiatives align with broader goals of enhancing energy security and transitioning to more sustainable energy sources *(Source: Bioenergy report, IEA).*

Viet Nam: As of 2020, the total biomass power capacity in Viet Nam is 325 MW, accounting for only 0.4% of the economy's total power capacity. This is broken down into 25 MW in the North, 62 MW in the South, and 238 MW in the Central region. Given Viet Nam's strong agricultural sector, which provides abundant raw materials like rice husk, bagasse, and coconut shells, Viet Nam has significant biomass energy potential. The estimated potential is around 160 million tons per year, which could substantially contribute to the economy's energy mix and reduce dependence on traditional fossil fuels.

III. BIOMASS ENERGY POLICY IN SOME ECONOMIES

China: From 2006 to 2021, China issued 62 domestic-level regulations and policies related to biomass power generation, reflecting a strong commitment to the sector. Policies include the “Renewable Energy Law” (2006), tax exemptions for biomass enterprises, and various Five-Year Plans focusing on biomass energy development. Significant policies include the "Notice on Improving the Price Policies for

Agroforestry Biomass Power Generation" (2010) and the "2021 Biomass Power Generation Project Construction Work Plan" (2021), which allocated substantial financial subsidies for biomass power generation *(Source: Rural Biomass Energy 2020, ADB).*

Brazil: Brazil's biodiesel blending program, initiated in 1976, has evolved to support energy security and market predictability. Despite an initially forecasted 15% blending target for 2024, the government has delayed this target to 2026. The ethanol forecast has also been revised downward due to lower blending rates in 2022 and potential high sugar prices affecting ethanol production *(Source: Bioenergy report, IEA).*

European Union: The EU's Renewable Energy Directive III (RED III), which sets new targets for renewable energy in transport, including a 14.5% GHG reduction or 29% renewable energy share by 2030, aims to reduce energy prices and fossil fuel dependence. However, the finalization of these targets and their incorporation into member state policies are still pending. Member states face challenges in meeting these targets by 2024, with Sweden, for example, planning to reduce its blending obligation, which could impact overall demand. *(Source: Bioenergy report, IEA).*

India: India is committed to a target of 20% ethanol blending by 2025. This goal is driving ethanol demand, even though no new biofuel policies were announced in 2022. The economy's commitment includes increasing ethanol prices to support this target and drive growth in ethanol use. *(Source: Viet Nam Institute of Strategic and Policy Studies on Industry and Trade, 2022).*

Indonesia: Indonesia's biodiesel blending program, launched in 2006, has been ramped up to a 35% mandate for 2023. The Ethanol for Energy Security Strategy is expected to support additional growth in biofuel production, aided by surplus palm oil stocks and increased biodiesel allocation. *(Source: Viet Nam Institute of Strategic and Policy Studies on Industry and Trade, 2022).*

The United States: The Renewable Fuel Standard (RFS) and the Inflation Reduction Act (IRA) are key policies aimed at boosting US energy security through increased biofuel use. In April 2023, the US government issued an emergency waiver allowing year-round E15 ethanol blending. However, the IRA's impact might be limited in the short term due to the continuation of the biodiesel blender credit and uncertainties in the 2024 RFS volume obligations. Proposed volume obligations by the Environmental Protection Agency (EPA) for 2023-2025 are lower than initially expected, which may reduce forecasted demand. *(Source: Bioenergy report, IEA).*

Viet Nam: To boost biomass energy development, in 2020, the Vietnamese government introduced Decision No. 08/2020/QD-TTg, amending the support mechanisms for biomass power projects and offering land use incentives and a 20-year power purchase agreement. Additionally, in 2021, the Department of Electricity and Renewable Energy (Ministry of Industry and Trade) issued a guide for developing biomass projects in Viet Nam. This guide aims to streamline project implementation and reduce investment barriers. Another guide in November 2022 focuses on environmental and social impact

assessments for biomass power projects, offering valuable resources for investors and stakeholders.

IV. BIOMASS ENERGY IN RURAL AREAS

1. Traditional Use: In many rural and isolated areas, biomass has been a traditional energy source used for cooking and heating. However, its use is often inefficient due to outdated technology and practices. There is significant potential for improvement through the adoption of advanced technologies and better management practices. *(Source: Chapter 3, The Energy and Agriculture Nexus, FAO, 2000)*

2. Role and Benefits: Biomass plays a crucial role in providing energy in developing economies. It supports local economies by creating jobs and helps reduce rural-urban migration by providing a reliable energy source. In ASEAN's rural areas, where access to modern energy infrastructure is limited, biomass can be a key resource. It not only provides a dependable energy supply but also supports sustainable agricultural practices and local economic development. *(Source: ASEAN Strategy on Sustainable Biomass Energy for Agriculture Communities and Rural Development in 2020-2030 final draft)*

3. Favorable Policies for Biomass Energy in Rural Areas

China: The Chinese Government has integrated the development of rural biomass energy as a key component of its long-term rural development strategy. Notably, the Renewable Energy Law, which came into effect in January 2006, promotes the advancement of bioenergy across various forms, including wind, solar, hydro, and biomass. This legislation encourages the exploration and utilization of bioenergy in rural areas, mandates local authorities to create renewable energy development plans, and provides financial backing for rural projects. Additionally, the Law sets a target for 2020, aiming to generate energy from diverse waste sources such as biogas from livestock farms, crop residues, agro-processing byproducts, municipal waste, and sewage sludge *(Source: Viet Nam Institute of Strategic and Policy Studies on Industry and Trade, 2022).*.

Some more case study programmes: *(Source: ASEAN Strategy on Sustainable Biomass Energy for Agriculture Communities and Rural Development in 2020-2030 final draft)*

***Thailand*:** The economy's grid-based system supports small power producers (IPPs) including renewable energy sources. Examples include TRT Parawood, which uses waste biomass from rubber wood to generate power and reduce costs.

The United States:

- **Forest Biomass Grants**: The Energy Policy Act of 2005 provides grants up to USD500,000 or USD20 per ton of green biomass for communities improving forest biomass utilization. Small businesses can receive up to USD100,000 in matching grants, with a total of USD1 million available annually. The DOE

offers up to USD20 million per year for rural electrification using renewable energy, including biomass.

- **R&D Funding**: The Energy Independence and Security Act of 2007 allocates USD25 million annually for biofuel research and development, focusing on states with low ethanol production. Another USD25 million supports renewable energy tech R&D at universities.
- **Incentives for Biomass**: The 2008 Farm Bill includes USD1 billion for renewable energy investments and creates the Rural Energy for America Program (REAP) for feasibility studies and project planning. The Bioenergy Program gets USD300 million for bioenergy from crops and waste, and the Biobased Markets Program offers USDA certification and federal procurement preferences for biobased products.

(Source: Federal Policies and Incentives Promoting Woody Biomass Production and Utilization, Extension Foundation, 2021)

EC-ASEAN CO-GEN Programme: This initiative promotes co-generation technologies in ASEAN, providing support for investment, training, and demonstration projects. Examples include co-generation in palm oil mills in Malaysia and rice mills in Thailand, showing economic and environmental benefits.

V. CHALLENGES IN USING BIOMASS ENERGY IN RURAL AREAS

Policy and Institutional Gaps: Some Southeast Asian economies lack specific goals and targets for biomass energy development. There is a need for well-defined policy frameworks to support and guide biomass energy initiatives effectively.

1. **Financial constraints:** Economic challenges in economies like Myanmar, Lao PDR, and Cambodia limit funding for biomass research, development, and technology purchases. These financial constraints hinder the sector's growth and its ability to scale up.
2. **Public and private sector involvement:** Uncertainty in participation from both public and private sectors arises from perceived risks and low profitability. Challenges include low energy content of biomass, bulky volumes, high storage and transportation costs, and underdeveloped local industries.
3. **Lack of local expertise and awareness:** The absence of skilled personnel, along with inadequate public awareness and education about biomass energy, impedes effective local cooperation and slows down sector development.
4. **Technology and market development:** Slow technology transfer and market development are due to high costs and insufficient stakeholder involvement. Affordable, effective technologies, and robust research collaboration are needed to address these issues.
5. **Land availability and economics:** At scales over 1 MW, dedicated energy plantations can cause land use conflicts and affect food crop production. Biomass

feedstocks cost around USD3/GJ (according to FAO), comparable to petroleum but with higher capital costs for conversion technology.

6. **Planning, participation, and market access:** Successful biomass energy projects require detailed local planning, active community involvement, and access to commercial markets. Without these, projects may face implementation challenges and limited profitability.