REPORT

Biomass Open Research Forum
Biomass Resource Assessment for ASEAN+6 Countries






9th-10th July 2015
Bangkok, Thailand

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REPORT

I. BACKGROUND

Biomass is one of the principal sources of energy in ASEAN member countries and accounts for 40% of total energy consumption in the ASEAN region. In countries such as Indonesia, Malaysia, Philippines, Thailand and Vietnam, the share of biomass energy in the total energy mix is significantly high when compared to other countries in the region. However, the share of biomass energy in total energy consumption has been decreased for most other countries in the region, which often leads to the misconception that decease in the share of biomass energy is substituted by modern energy in these countries. The ground reality is that in these countries, conventional energy is mostly used for new applications including industries, transportation, and electricity for households, whereas wood and other biomass resources continue to dominate in domestic activities such as cooking and in various traditional industries.

In spite of their technological capabilities, there is a huge untapped potential for biomass energy in the 6 countries that form the ASEAN+6 (China, India, Japan, Republic of Korea, Australia and New Zealand). In order to leverage the maximum potential for biomass energy resources in a sustainable and inclusive manner, these countries need to enhance collaboration for cross-border sharing of skills, experiences, best practices and technologies related to biomass energy.

The United Nations Framework Convention on Climate Change (UNFCCC) also endorses the initiatives by countries across the globe for planning and performing renewable energy resource assessments as Nationally Appropriate Mitigation Actions (NAMAs). Given this direct contribution to the global initiatives combating climate change, ASEAN+6 could leverage this opportunity and accelerate the biomass resource assessments at the national level. Biomass energy can be sustainable, environment-friendly and economically viable if the appropriate technologies and strategies are used. Biomass energy also has the potential to create significant employment opportunities both in terms of biomass production and consumption related aspects.

Leveraging biomass for the production of biofuels could transform the transportation industry and significantly reduce green-house gas (GHG) emissions. Many countries are actively engaged in R&D on production of biomass from various types of biomass. However, it seems

likely that the regular biomass feedstock supply is a bottleneck in actual commercialization of biofuels. There are several challengers in this field of research that require cross-border cooperation among countries including sustainability of biomass feedstock, availability of appropriate technologies based on biomass compatibility, economy of the process Vis-à-vis conventional fuels and so on.

As an initial step towards identifying the needs of member countries, Asian and Pacific Centre for Transfer of Technology (APCTT) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) and the International Renewable Energy Agency (IRENA) jointly organized an Expert Group Meeting (EGM) on Renewable Energy Resource Assessment for Countries in the Asia-Pacific Region from 25 to 26 September 2014 in Bangkok, Thailand. This EGM was hosted by APCTT's focal point in Thailand, the Ministry of Science and Technology. Twenty-six experts from 13 member states (Afghanistan, Australia, Cambodia, China, Japan, Kazakhstan, India, Indonesia, Islamic Republic of Iran, Pakistan, Singapore, Thailand and Vietnam) participated in the EGM and shared global expertise and practices as well as country perspectives for renewable energy resource assessment. One of the significant outcomes of the EGM was the collective request from many ASEAN member countries, especially, Thailand, Indonesia and Cambodia for strengthening cross-border cooperation on biomass / biofuel related research and technology transfer. Thailand has an ambitious goal to set up the ASEAN Network on Biomass Open Research (ANBOR) for facilitating cross-border cooperation among the ASEAN+6 countries in the area of biomass research.

The proposed Biomass Open Research Forum on Biomass Research Assessment for ASEAN+6 Countries is envisaged to be an effective platform for ASEAN+6 countries to share experiences, successes, challenges and best practices on biomass resource assessment in ASEAN+6 countries and also to brainstorm on the possibilities for setting up an ASEAN Network on Biomass Open Research (ANBOR) for enhancing cross-border collaboration on biomass research and knowledge sharing. This forum will be jointly organized by APCTT, Thailand Institute of Scientific and Technological Research (TISTR), National Science and Technology Development Agency (NSTDA) of Thailand and hosted by the Ministry of Science and Technology (MOST) of the Royal Thai Government.

II. PROCEEDINGS

Inaugural Session

Dr.Krishnan S Raghavan, Coordinator, Technology Transfer, United Nations APCTT-ESCAP welcomed all participants and addressed about the importance of biomass and biomass resource assessment. He also expressed his sincere thanks to MOST, APCTT and IRENA for theirs excellence supports.

Mr.Yongvut Saovapruk, Governor of TISTR welcomed all the distinguished participants to the meeting. He delivered the purposes of the meeting as to share the current situation on biomass and biofuel technology development among ASEAN+6 state members, to share the meeting outcomes from the Asia Pacific Regional Workshop on Biomass Resources Assessment, which held on 6^{th} – 8^{th} July 2015 by jointly organizing of MOST, APCTT and IRENA, to provide a platform for knowledge sharing related to biomass open research and innovation, and to brainstorm on the ways and means to establish ANBOR as a regional cooperation mechanism for enhancing cross-border cooperation on biomass research among the ASEAN+6 state members. He highlighted that the ambitious goal of ANBOR could reinforce the regional economic competitiveness, energy security and environmental safety. And eventually it could be operated as a firm platform for the establishment of ASEAN Biomass Open Research Center (ABORC) in the future. Finally, he expressed his gratitude to MOST, APCTT, IRENA and NSTDA for theirs support and enthusiasm in this forum.

The opening speech was delivered by Mr.Somchai Tiemboonprasert, Deputy Permanent Secretary, Ministry of Science and Technology (MOST), Royal Thai Government. Mr.Somchai highlighted on the global collaborations and initiatives for resolving the energy crisis as well as the ten-year National Science, Technology, and Innovation Master Plan (2012-2021). MOST plan and do support to increase efficiency of the research management system through forming a cooperative network with the purposes to reduce technology duplication and enhance S&T personnel capacity, as well as, to promote investment in S&T research networks and mobility of S&T personnel assets. He expressed his gratefulness to project of establishment of ASEAN Network on Biomass Open Research (ANBOR) that has been endorsed in the 69^{th} ASEAN Committee on Sciences and Technology meeting and will be implemented as a part of ASEAN biofuel flagship program. He also believed that this project could raise the possibility of leading our region to achieve sustainable development through low-carbon society, as well as, to ensure our regional energy, natural resource and environmental securities.

Background to Project Concept
Biomass Open Research: Biomass Resource Assessment for ASEAN+6 Countries

Dr. Krishnan S Raghavan, Coordinator, Technology Transfer, United Nations APCTT-ESCAP introduced the background of project concept on Biomass Open Research. He informed that APCTT is a specialized institution under the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP), which is established in 1977 by the member countries of UN-ESCAP. It acts to bridge technological gaps between member countries, realize benefits from trade, leverage technology for sustainable development and promote technology cooperation. Recently, APCTT and IRENA agreed on a partnership to jointly implement capacity building program for countries in the Asia Pacific Region. An Expert Group Meeting (EGM) on Renewable Energy Resource Assessment for countries in the Asia-Pacific Region was held as the initial steps for identifying the needs of member countries. The key outcomes of the EGM on renewable energy resource assessment for countries in the Asia-Pacific regions were to increase capacity to undertake and apply renewable energy resource assessment at the national level as well as developing a joint work plan for 2015-2016 on renewable energy resource assessment with a list of capacity building programmes and activities by APCTT and IRENA. Moreover, there is a huge untapped potential for biomass energy in ASEAN region as well as the 6 countries that form ASEAN+6 which including China , India, Japan, Republic of Korea , Australia and New Zea land. The Biomass Open Forum on Biomass Resource Assessment for ASEAN+6 countries is aimed to bring together key stakeholders from ASEAN+6 countries to share experiences, successes, challenges and best practices on biomass resource assessment in these countries. And the setup of ANBOR could facilitate cross-border cooperation among ASEAN+6 countries in the area of biomass research. Therefore, APCTT, IRENA and ANBOR could work together in promoting knowledge transfer and cross-border collaboration on biomass research among ASEAN+6 countries. Creation of a knowledged community and the development of a blue print for ANBOR would also their target.

Session I
Presentation on the Outcomes of Asia Pacific Regional Workshop on Biomass Resource Assessment and Key Messages for Consideration

Mr. Masaomi Koyama, Senior Programme Officer, Innovation and Technology, IRENA briefly gave the information on Biomass Resource Assessment meeting for ASEAN+6 on 6th-8th July 2015, held by IRENA and APCTT. There were nearly 30 participants from 15 countries attended the meeting to discuss on challenges and opportunities for expanding the biomass energy resource assessment activities in this region. This workshop aimed to strengthen the capacity building of each country to undertake the biomass resource assessment in the national level.

Dr. Shunichi Nakada, Biomass Energy Expert, IRENA summarized the discussion and outcomes of the forum on Biomass Resource Assessment. There were comprehensive

discussion and presentations from representative of ASEAN+6 countries, FAO, IEA, IRENA and APCTT. In term of bio-energy utilization, there were 3 majors area including biomass power generation from biomass residue and waste, biomass utilization for transport (biodiesel, ethanol, etc.), and traditional biomass utilization. In order to achieve the national target to promote bio-energy, most countries have already completed bio-energy resource assessment in the national level. However, there were still some issues to be improved that were expressed in the discussion, such as data quality, actual availability, translation bio-energy potential, data updating, etc. The standardization methods and specific conversion factors were required to cope with the variety of biomass. He also mentioned on the issue related to cost of wastes and residues. Generally, they were claimed as free cost feedstocks. However, theirs price would increase after the utilization project was set and the owner realized that it could be sale. As for the resource assessment, it can be classified into 2 levels; national level and project level. The national level assessment can be made by using national statistical data and modified it with the conversion factors. However, this method is not suitable for the specific project. Thus, the data used in the specific project should be the actual data for identifying type of available and sustainable biomass. The collection of this type of data is both time and cost consuming processes. He also mentioned that there were many areas that were proposed by participants for improving bio-energy resource assessment during this workshop, such as the application and utilization of GIS based data for resource mapping. It is technology intensive and would be powerful for the resource assessment in the national, policy, and project levels. The potential areas which can be considered by international committee or through the collaboration were as follows;

- Support on data collection, comparison, and usage
- Support to country to conduct resource assessment by themselves using technology or methodology from global experts (e.g. FAO)
- Networking and technology transfer (Regional cooperation)-(FAO, Task 43 of IEA, IRENA, APCTT, TISTR's ANBOR project)
    - sharing the knowledge and experience to other, i.e thru the workshop
    - the important point is how to harmonize and integrate
- Capacity building (Tools, Data collections/surveys, Policy formulation/Monitoring and evaluation, Training of Trainers programs under ANBOR project)

Prof. Mark Brown, Director of Forest Industries Research Center, University of the Sunshine Coast, Australia expressed his grateful of 3 days' workshop that a number of country representatives sharing the information. He mentioned that the cross-collaboration of the countries in this region, related to biomass, could be set up. He also shared the experiences of IEA network that he involved in IEA Task-43, specifically on biogas, liquid fuel and higher level policy setting in the international stage.

Dr. Daisuke Kunii, Policy Research Institute, Ministry of Agriculture, Forestry and Fisheries, mentioned that it was a great experience for the participants to share their experiences and information on biomass resource assessment, biomass utilization and biomass energy situation. He also mentioned that many countries, including Japan, have been using GIS

based data for biomass resource assessment. Finally, he hoped that the opportunity for sharing information and discussion related to biomass energy could be continued.

Ms. Emelita A.S. Dimapilis, Department of Science and Technology, Philippines shared the things that she has learned from this workshop. In the Bioenergy and Food Security project or BEFS by FAO, the priority areas in pilot countries were identified which including food security and energy diversification. She mentioned about the presentations on biomass resource assessment status in each country, as well as, IRENA's presentation on types of biomass resource assessment. There are 2 types of biomass resource assessment; policy and project levels. The project level is for the private sector that required detail information for project sighting and accessing of project feasibility. Whereas, the data in the policy level is comprehensiveness use to guide the government for identifying the investment opportunity and for supporting the policy for land use planning and energy supply. She also mentioned about the urgent needs from member countries. That included the update of resource assessment data, set up the standard biomass assessment protocol, which should be including standard methodologies, resource estimation factors, guidelines for estimating transport, storage, and technology costs. Furthermore, incentive may be provided for serving the responder and cooperator, in order to facilitate the data integration and sharing platform to collect the data in the national level.

Ms. Ngoc Anh Luu, Project Coordinator, Biogas Project Management Unit, Department of Livestock Production, Ministry of Agriculture and Rural Development, Vietnam shared the new initiative on the development of biogas sector by subsidize to the mason enterprise for installing bio-digester instead of subsidize to households. This incentive aimed to increase leverage the quality of bio-digester as well as build the win-win situation between government and enterprise. She expressed her impressive on effective and strong networking between researchers and policy makers in Thailand, which facilitated by the international committee. In the same way, Vietnam also required the international committee supporting for setting up the platform and the networking.

Furthermore, the representative from Pakistan, Assoc. Prof. Dr. Ehsan Ali, Center for Energy System, National University of Sciences and Technology, and Prof. Dr.Yogender Kumar Yadav, Director, Sardar Swaran Singh National Institute of Renewable Energy, Ministry of New and Renewable Energy, India also expressed their experienced on the Biomass Resource Assessment Workshop.

Session II
Member Country Perspectives on Biomass Resource Assessment and Open Research Network

Australia
Prof. Mark Brown
Director, Forest Industrial Research Center, University of the Sunshine Coast

The Australia country presentation was made by Prof. Brown. He presented the concept of the Forest Industries Research Center of the USC which aim to leading provider of applied, whole of supply chain, research for commercially managed plantations and forests. The focus of this center is to establish and grow strong collaborative research networks, nationally & internationally, with industry, government and research partners. He also mentioned about the Australian Forest Operation Research Alliance or AFORA, which is the network, that emphasis on supply chain. AFORA has 18 partners from 15 forest growers/managers, 2 universities research centers and 1 bioenergy producer. For the area of forest operations, it aims to improve cost management and value recovery, to improve biomass recovery and utilization, and to improve logistics planning and execution. In the perspective on biomass assessment, they considered on supply and supply chain, the available of operation and economic as well as technology and systems development for mobilization. He also shared the information on the results of AFORA project that working on the biomass supply chain in Australia. Furthermore, BIOPLAN or optimization tool was applied in order to evaluate the lowest cost of the production. Finally, he provided the information on the Australia Biomass for Bioenergy Assessment or ABBA that is the collaboration of State departments and ARENA. ABBA produced the national interactive map of biomass, and it seeks to support investment decisions on approaching "bankable" data, location specific availability, supply chains, costs, etc. as well as include all sources.

Cambodia

Mr. Vibol San

Researcher and lecturer, Faculty of Science, Royal University of Phnom Penh

The Cambodia country presentation was delivered by Mr. San. He provided an overview of biomass resources and consumption in Cambodia. The presentation included the primary fuel for cooking in developing countries, biomass energy consumption as well as energy sources in Cambodia. The main energy source in Cambodia is firewood (accounted for 85%), the rest are charcoal, kerosene, LPG and electricity. The wood/biomass energy value chain considers on demand and supply sided, in order to sustain among the increasing of demand. As for the supply side, wood fuel was collected from natural forest and produced to be charcoal, and then used in household and household-scale industry. According to FAO data, biomass demand was higher than supply sources. If there is no clearly policy, it would cause the deforestation in the future. By these reasons, there are several activities to protect the natural forest, such as training the local people as well as young people to protect their own forest. Nevertheless, there are legal and social constraints, i.e. limited environmental consciousness, weak law enforcement against illegal wood cutting, no regulation of charcoal production, and lack of data on wood use. He also gave the information of charcoal production that produced in the rural areas and delivery to consumer in the city area. Household and household-scale industries are the biggest consumers of firewood with limited thermal efficiency of stoves and kilns. He also presented the case study of garment and brick factories that consumed more than 300,000 tonnes volume of fuel wood per year. Most of them have several constraints such as lack of technical knowledge, financial, and tax incentive for improving machinery, etc. Finally, he shared the information on rice husk as the alternative resources in

Cambodia, which was planned to use as feedstock in power plants through gasification technology.

China

Dr. Zhenhong Yuan

Chief Scientist, Biomass Research Center, Guanzhou Institute of Energy Conversion, Chinese Academy of Sciences

The China country presentation was delivered by Dr. Yuan. He shared the information with the participants on status of biomass resources in China. Currently the available amount of biomass in China is equal to 400 million tons of standard coal. Generally, biomass could be divided into 5 categories, which include agricultural waste, forestry waste, livestock waste, industrial waste and municipal solid waste (MSW). As for the future potential biomass, there are several kinds of resources that could be considered, for example, energy crop (i.e., sweet sorghum, sugar cane and sweet potato), energy forest (i.e. Jatropha, Pistache and Humillis), energy grass (i.e. Arista), and energy microalgae. Biomass resources in China can be classified in to three areas, including biomass residues, new biomass resources and sustainable energy crops. Moreover, he added that bio-energy in China consists of biodiesel from bio oil, ethanol from starches and sugars, methane and fertilizer from MSW and manure, biodiesel and ethanol from lignocellulose. He also mentioned on the objective of 'The National Medium- and Long- Term Program for Science and Technology Development' and 'Medium and Long-Term Development Plan for Renewable Energy'. According to China Government policy, the target of biogas, liquid fuel and briquette utilizations in 2020 as well as the incentive programs policy on bio-energy were set. Finally, he also expressed his willingness to promote the collaboration with ASIAN+6 countries on biomass resources assessment.

India

Prof. Dr. Yogender Kumar Yadav

Director of Sardar Swaran Singh, National Institute of Renewable Energy

The India country presentation was made by Prof. Yadav. He reported the overview of India energy scenario that the power generation is mainly based on thermal and hydro with about 13% from renewable. The consumption of oil products was 145 million tons, which around 80% was imported. He added that the drivers for bioenergy in India consist of the increasing of power and exhaustible fossil fuels demands as well as need to control GHG emissions. Moreover, India has the problems in meeting even minimum energy needs for cooking and lighting in many areas, and about 80 million homes still without electricity. The power shortages felt even in cities and affect industrial production. As for India's biomass availability, crop and agro-process waste are dominated and followed by road side and wasteland biomasses. He also mentioned about the problems of biomass conversion to energy. Several bioenergy options are available in India, for example, solid fuels, biomass combustion and co-generation, gaseous fuels as well as liquid fuels (i.e. thermos-chemical or pyrolysis, bio-chemical, and extraction). He shared the information on power generation via biomass combustion and gave the example of bagasse co-generation in sugar industry. For biomass gasification technology, the ranges are 5 to 500 kw for thermal and electrical

applications, where Ankur, Vadodara and IISc, Bangalore are major technology developers in India. He also presented the status of biogas in India that it was produced from cattle manure, segregated wastes, urban and industrial wasted, etc. Furthermore, there are several projects for municipal solid waste (MSW) to energy program that are in operation and under the installation process in various cities. The participants were also briefed on the biofuel production, including 1st generation to 4th generation of biofuel. Finally, he mentioned that the challenge of the bio-refinery development consists of development of feasible process and technology, the studying the pros and cons of every process, upgrading the process to pilot scale level, techno-economic study of different individual units, integration of different units to realize bio-refinery, and economic assessment of the whole set up (output-input).

Republic of Indonesia

Dr. Ir. Adiarso

Director, Center for Energy Resources Development Technology, Agency for the Assessment and Application of Technology (BPPT)

The Indonesia country presentation was made by Dr. Adiarso. He shared information on the Indonesian energy situation. Currently, Indonesia has a critical situation on energy supply. It is hard to rely on the limited fossil fuel in the next decades and likely to have the problem in energy supply. As for the national energy policy, it has the target on increasing the utilization on renewable energy and natural gas to 31 and 24%, respectively. Thus, the utilization of biomass for alternative fuel production has been greatly concerned. It seems to be the only one of renewable sources which can be processed into alternative fuels to replace fossil fuels. He added that BPPT has many approaches for utilizing Palm based biomass for biofuel production. Biodiesel production with the simpler reactor that reduces the capital and operating costs has been studied, and biodiesel washing process that significantly reduces waste treatment cost has been applied. Further, he mentioned that the other biofuel project at BPPT is Dimethyl Ether (DME) for LPG substitution. Recently, BBPT has been granted the research project under SATREPS Program with the aim to develop fluidized bed catalytic gasification of biomass waste and following liquid fuel production in Indonesia. Lastly, he concluded that sustainability of fuels will remain an important national issue and development of biomass based alternative fuels would receive national top priority.

Japan

Mr. Takao Ikeda

Senior Researcher, Institute of Energy Economics

The Japan country presentation was delivered by Mr. Ikeda. He provided the information on biomass status and its utilization in Japan. He informed the participants that food and wood self-sufficiency rate were reduced from 73% (in 1995) to 39% (in 2013) and 90% (in 1950) to 27.9% (in 2012), respectively. Most of potential biomass in Japan is the residue from many sources, i.e. crop residue, wood residue, sewage, food waste, chicken feces, cow and pig feces, used paper, paper sludge, wood waste at construction site, and wood waste at factories. The presentation also included information on biofuel. He mentioned that bio-ethanol utilization target has been set in Japan since November 2010. Currently, E3 is available for

conventional vehicle and E10 is available for proof vehicle. He also gave the information on Feed-in Tariff (FIT) basic scheme which was started from July 2012 and electricity generated by biomass, particularly unutilized wood, is increased from 32 to 40 JPY/kWh. Whereas, FIT of solar power plant became lower. With FIT scheme, the proportion of biomass and waste are slightly increased. He also presented about the long-term energy supply and demand outlook which revised in 2015, that the energy independence will be increased to 24.3%, by 2030.

Malaysia

Prof. Dr. Mohd Sobri Takriff

Head of Center for Sustainable Process Technology, Unversiti Kebangsaan

The Malaysia country presentation was made by Prof.Takriff. He started his presentation with an overview of government strategies, policies and action on National Biomass Strategy, Biomass Industry Strategic Action Plan, and Palm Oil Industry in Malaysia. The main biomass in Malaysia is Palm biomass with the amount of more than 80%. It includes empty fruit bunch, oil palm fronds, oil palm trunks, palm shells and mesocarp fibers. He informed the participants that there are currently many constrain related to palm biomass. For example, all wasted is recycled or reused in the plantation and major palm oil industry is very protective of their biomass. He added that algae are the 3rd generation biomass and it has been considered as the alternative biomass resource. He also pointed out that using POME for algae cultivation is one of the interesting approaches. The advantage of using POME as biomass resource including the abundance of native algae strains, abundant supply of cheap growth media and easily optimized for biomass production. However, there are many challenges that need to be overcome including the inconsistent of influent quality, pretreatments requirements and possibility of contamination by unwanted strains. Thus, when considering the palm biomass, POME is considered to be more sustainable resource than other palm biomass, because, it is easily adopted by the industry.

New Zealand

Dr. Paul Bennett

Science Leader, SCION

The New Zealand country presentation was made by Dr. Bennett. He gave an overview of bioenergy in New Zealand. It has around 10% of consumer energy from woody biomass and less than 0.1 % of biofuel consumption in total transportation energy section. The GHG emissions in New Zealand was dominated by CH_4 (44%), following by CO_2 (43%) and N_2O (11%). He mentioned that they have a target to reduce GHG emissions by 5% by 2020 based upon its 1990 emissions. Further, the presentation also included information on the national policies, which consist of waste minimization strategy, afforestation grants scheme, energy efficiency and conservation authority (EECA), climate change consultant, and GIS data maps. New Zealand conducted many projects related to biomass resource assessment in national level, for example, Bioenergy options for New Zealand from 2007-2009. The aim of this project was to comprehensive review of biomass resources and derived opportunities for New Zealand. He also informed the participants with the information of the current and

planned programs of national level data. The current program consists of SCION biofuels and bioenergy research, and land use and carbon analysis system (LUCAS) by MfE. The planned program consists of biofuel (liquid) and biomass for heat roadmaps by SCION, and permanent sample plot system of forestry growth by crop type by NZFOA, SCION, and MPI. Finally, he introduced the capacity building in the next steps which include consistent studies on MSW at regional level, on-farm wastes, national data sets, updating of data collected in bioenergy options studies, as well as data improvement.

Philippines

Prof. Dr. Teodoro C. Mendoza

Professor, Crop Science Cluster, College of Agriculture, UP Los Banos

Dr. Mendoza presented the sustainability challenges of biomass for energy in the Philippines. In 2011, 41% of the primary energy mix was contributed by renewable energy and it is expected to increase to 50% by the year 2020. There are several types of biomass that available in Philippines, including Palay, corn, coconut, sugarcane, oil palm and saw mill. As for the aqua based biomass, there has been a great interest in sea-derived biomass or algae for energy. He also shared information on power potential in Philippines from sugar industry that gets feed-in-tariff for biomass co-generation at P6.33 per kWh. He further added that ethanol will be consumed at 20% blend (860 million liters per year) in 2020, according to the biofuels act of 2006. In Philippines, ethanol was produced from 1st generation (e.g. sugarcane, corn, etc.) and targeted to produce from the 2nd generation or Ligno-cellulosic biomass 1 billion liters by 2024. For the assessing the sustainability of some biomass for energy in the Philippines context, he mentioned that sustainability indicators should consist of environmental, availability and sustainability, pricing, and the agronomy of biomass.

Thailand

Asst. Prof. Dr. Sebastian Bonnet

The Joint Graduate School of Energy and Environmental (JGSEE), King Mongkut's University of Technology Thonburi

Dr. Bonnet presented Thailand perspectives on biomass resource assessment and open research network. He started his presentation with the information on the location, climate, and population as well as energy situation of Thailand. He informed that Thai's government has set up the policy to promote the alternative energies for fossil fuel substitute, which is called the Alternative Energy Development Plan (AEDP). It is aiming to increase the renewable energy consumption to 25% of country total energy consumption by 2021. He also explained the latest resolution policies for 2015-2036 by National Energy Policy Council, e.g. AEDP, Power Development Plan (PDP), Energy Efficiency Development Plan (EEDP), etc. Further, he added that Thailand's biomass potential can be classified into three areas; agricultural residues, biogas and biofuels. The data on agricultural residues potential in 2014 revealed that the total remaining potential is 7,318 ktoe. The main agricultural residues are sugarcane top and leave, rice straw, palm oil leave and brunch, palm oil EFB, cassava stalk, rice husk, cassava rhizome and corn-cob. He mentioned on the potential of biogas in 2014 that MSW dominated 326 ktoe/year and followed by cattle and fatten. For biofuel potential,

the current ethanol and biodiesel production capacities are 4.20 and 3.97 million liters per day, respectively. While the targeted values of ethanol and biodiesel are 9 and 7.25 million liters per day, respectively. Furthermore, he shared the information of on-going and completed projects related to biomass resource assessment in Thailand. He also gave the example of research related to biomass resources assessment in Thailand, to explore and identify in Thailand appropriate scenarios for cassava and sugarcane cultivation for bioethanol production using the Hierarchy Assessment Method, which aims to maximum sugarcane and cassava production area.

Vietnam

Dr. Nguyen Kim Thoa
Head of Biomaterials Technology, Institute Biotechnology Vietnam Academy of Science and Technology (VAST)

Dr. Thoa presented the current status and utilization of biomass in Vietnam. Firstly, she gave the information on the socio-economic of Vietnam as well as the current status of potential biomass resources including the annual agricultural crops, production of cereals and other main crops (e.g. maize, cassava, sugarcane, etc.) by province in 2013. The main perennial crops in Vietnam are rubber, coffee, cashew nut, tea, and pepper. She also shared the information on livestock population, area of forest, production of wood, area of water aquaculture and production of fishery as well as the related governmental policies. She added that biomass research activities are including bio-fertilizer production from agricultural and domestic waste, screening lignocelluloses degrading complex enzymes, bio-ethanol production from biomass resources. Moreover, she gave the information on research activities related to bio-energy, such as bio-ethanol from rice straw, biogas production from wastes, bio-hydrogen production, biodiesel production by heterotrophic marine microalga, etc. The expected outcome of theses researches was how to update the newest technologies in the shortest way and how to faster industrialize the laboratory scale results to the pilot and larger scale process.

Session III
Opportunity for Collaboration among ASEAN+6 Countries on Biomass Resource Assessment and Setting up of Open Research Network

Importance of Collective Effort to Facilitate Research Collaboration

By Mr. Osamu Kobayashi
Director, Singapore Office, Japan Science and Technology Agency (JST)

Mr. Kobayashi delivered a presentation to share information on the importance of collective effort to facilitate research collaboration. Cooperation can be classified into two types; bottom up type and top down type. Bottom up type is the spontaneous cooperation from the intention of the researchers. While top down type is the government supportive cooperation which is also implemented by Japan Science and Technology Agency (JST). JST functions as a strategy-driven funding agency and it can offer the platform of international cooperation.

The objective of international research cooperation is to tackle global issues, complement each other, new idea and new approach, and connect to world trend, etc. He mentioned that JST has been supporting many collaborative programs, i.e. SATREPS program and e-Asia joint research program, followed the role of JST as policy oriented or top-down funding agency. SATREPS program, or Science and Technology Research Partnership for Sustainable Development Program, is the collaboration between Japanese researchers and researchers from developing countries. Under SATREPS project, JST has been supporting 9 projects in biomass fields, including 3 projects in Thailand, 2 projects in Vietnam, 2 projects in Indonesia, and 2 projects in Malaysia. The e-ASIA JRP, or the e-ASIA Joint Research Program, is implemented by various funding agencies from ASEAN+8 countries and 30 countries are participating in this program. Under the e-ASIA JRP, there is one project in the biomass area which is Advancement of Asian Cassava Molecular Breeding by Cutting-edge Technologies. The other program is NexTEP that implemented in Malaysia about the Bio-Coke. He added that as JST are supporting many programs, the big challenge for JST is how they can connect the "resources, knowledge and experience" effectively. Lastly, he also expressed his opinion that ANBOR is a very good platform to collaborate, exchange information and expects the role of ANBOR to facilitate the international collaboration among the stakeholders.

Cascade Utilization of Raw Materials for Biodiesel Fuel Production

By Prof. Yasuaki Maeda

Professor, Osaka-fu University, Japan

Prof. Maeda presented the idea of upstream to downstream researches to cover the cultivation at desolated area, production of high quality biodiesel, and biodiesel (B100) utilization, in order to get the multi-beneficial measure for mitigation of climate change, improvement of air pollution, and green economic growth. The cultivation of biodiesel feedstock, i.e. oil palm, soybean, and rapeseed, generated higher value of Indirect Land Use Change (ILUC) and direct emissions than fossil fuels. Therefore, biodiesel is not effective for mitigation of climate change propose. Consequently, the new feedstocks for biodiesel are considered. He mentioned that Jatropha cultivation was done in coal mining area, in order to protect disasters such as land slide and leakage of waste water. He also added that Vernicia Montana was cultivated in the northern area of Vietnam. Other feedstocks used for biodiesel production are waste from cat fish fillet production and animal fat. Furthermore, he shared the information on the novel technology for producing biodiesel. The co-solvent method was applied to convert vegetable oils, animal fat and waste cooking oil to biodiesel, in order to make a homogeneous condition which resulted in high biodiesel purity and yield. The co-solvent technology for biodiesel production from Catfish oil was also tested in a pilot plant scale. Furthermore, glycerin, which is a by-product from biodiesel production, can be used to produce the super water absorbent polymer as well as the fuel cell. The presentation also included information on the utilization of B100-biodiesel in power generation and Ha Long Bay cruising boat for 3 months. The testing results indicated that there was no effect on engine and exhaust gas became cleaner.

Biomass Inclusive Research through Open Innovation and Talent Mobility

By Dr. Surachai Sathitkunarat

Director, Energy and Environment Department, National Science Technology and Innovation Policy Office, Ministry of Science and Technology

Dr. Surachai delivered a presentation on biomass inclusive research through open innovation and talent mobility. The participants were briefed on the detail of National Science Technology and Innovation Policy office (STI). It has major responsibilities on formulating the national STI policies and plans, developing standard measurements, indicators, database, and conduct policy research on STI, providing support and advice to other government agencies in formulating their own STI implementation plans, coordinating and monitoring the development of national S&T manpower, and monitoring, evaluating and reporting the national STI implementation to the committee and the cabinet. Moreover, he explained the paradigm of open innovation. The ideal of open innovation is used and combined external and internal ideas into systems, in order to reach a target. The concept of closed innovation system is that they would do by themselves. Whereas open innovation system is based on the concept that not all good ideas are developed within the own company, not all ideas should necessarily be further developed within the own firm's boundaries. He also shared the information on STI policy on "Talent Mobility (TM)". The aim of Thailand's TM program is to facilitate the mobility of researches in governmental agencies and higher education institutions to the industry. TM will also mobilize researchers or experts from private sector to public sector. Moreover, the clearing activities of TM consists of TM demand-supply database preparation, talent match-making, facilitating requirements of rules for mobilizing researchers, coordinate for external support and incentive to involved parties.

The Set Up of ASEAN Network on Biomass Open Research, ANBOR

By Dr. Aparat Mahakhant

Chief Research Expert, Thailand Institute of Scientific and Technological Research (TISTR)

Dr. Aparat delivered the presentation on the set up of ASEAN network on biomass open research (ANBOR) including its objectives as followed:

- to develop firms and networks in order to enhancing ASEAN's energy and biomaterials related industries and businesses to be next generation value-creator
- to develop research, development, innovation (RDI), regional technology translation (RTT) and standard setting in order to support and secure ASEAN's energy and biomaterials supply and economic growth
- to strengthen capability of ASEAN's STI suppliers in order to encourage the up-scaling renewable energy mix
- to establish supporting institution in order to encourage ASEAN's inclusive innovation/competitive growth
- to coordinate and follow up on science and technology, human resource development-"talent mobility and brain-circulation" in compliance with the ASEAN's energy supply and economic growth.

The expected outcome of ANBOR consists of firm ANBOR for 3Es (i.e. economic, energy and environment), and platform for setting up of ASEAN+ Biomass Open Research Center (ABORC). She added that the ultimate goal is to be an ASEAN's Biomass Open Research Center for renewable energy, biomaterials, environmental protection and supporting regional economic competitiveness. And it will be end-to-end or upstream to downstream by the innovation along the value chain. She also gave the information on TISTR's preparation and readiness for ANBOR that TISTR energy expert center (TEEC) will support Thailand Biomass Consortium (TBC) which would finally support ANBOR. She added that the TBC executive committee would include 4 key participations, i.e. industrial sector, R&D institutes and universities, funding agencies, and policy makers. TISTR will perform as secretariat for both TBC and ANBOR at the preliminary stage. It will also provide the facilities as an open arena for the development of STI on biomass and bioenergy, talent development and mobility, training and information centers. Further, the presentation also included information on ANBOR moving forward, e.g. MOST-ASEAN Action Plan (2015-2020), the 69th ASEAN COST meeting in the Sub-committee on Sustainable Energy Research on May 2015, Third Country Training Program (TCTP) for promotion and dissemination of "Production of High Quality Biofuel Production from Non-food Biomass" in SATREPS project, etc. In conclusions, she emphasized that biomass and biofuels are crucial not only for Thailand but also for ASEAN+ countries for sustainable energy and environment. Thus, ANBOR must be swiftly setup. Moreover, strong and unalterable collaboration among ASEAN+ countries is extremely required to support the setup of ANBOR.

The panel discussion that followed the presentations resulted in various suggestions from participants, i.e. the opportunity for collaboration among ASEAN+6 countries on biomass resource assessment, the opportunity for setting up ANBOR**,** how to collaborate with each other and also through ANBOR. Many participants highlighted on the importance of open innovation, collaboration and knowledge transfer. However, they all agreed that it was not only the technology that matter, but the collaboration type, analytical, infrastructure facilities, management method as well as IP were also importance.

Session IV
Identification of Priority Areas for Collaboration among ASEAN+6 Countries on Biomass Open Research / Resource Assessment and Setting up of BORC

The questionnaire for research need identification that related to biomass resource assessment was distributed to participants. The research areas were categorized into 2 main parts namely, resource assessment and technology development. Details of them were shown below:-

1. Resource assessment
    - Conversion factor refinement
    - Biomass available assessment (competing use among food / feed / fiber / fuel / fertilizer / disposal)
    - GIS based natural resource / land use mapping

2. Technology development
    2.1 Feedstock
    2.2 Logistic system / technology
    2.3 Conversion technology
    2.4 Technology pathway assessment
    2.5 Policy development support

The standardization of biofuel, i.e. biodiesel and ethanol, was raised by Prof. Maeda, as biofuels could be produced from various feedstock as well as technologies. The center for biofuel quality analysis should be established. Dr. Nuwong, participant from MTEC, shared the information on a working group in the "ERIA" project which aims to ensure the quality of biodiesel for vehicle usage as well as to maintain the standard. He mentioned that the feedstocks have a strong influence to biodiesel quality. Most of biodiesel standards were referred to EU and US standards that feedstocks are different from ASEAN region. Thus, ERIA project conducted the biodiesel standard and set the common standard for this region. Further he added that, in 2007, TISTR has introduced the APEC guideline for biodiesel standardization with the proposing on setting the guideline of biodiesel from APEC's feedstock. Dr. Aparat delivered the information regarding the training need survey under the TCTP project. She also agreed that the standard laboratory testing center is a good idea for setting the ASEAN conformity standard.

Dr. Kunn, participant from PTT Public Company Limited, revealed his view on setting up the standard for quality control by each country and then compared it to others. Due to the different regional geographic, the requirement that suitable in one country might not be able to apply in others such as, cold flow properties, oxidation stability, etc. As for the biofuel trading, it should be relied on the importer country's standard. He added the information that PTT can test and issue a certificate for all items in Thai biodiesel standard.

Dr. Krishnan expressed his idea that biofuel standard is country specific. Thus, it might be too difficult to have a conformity standard. The beginning step might be setting up the protocol or standard testing method. He also mentioned about the sharing of laboratory procedure so that other countries could be followed and started at the project level as it is the initial step for research collaboration. Such a concept was accepted from many countries' representatives, e.g. Pakistan, Iran, Malaysia, Philippines, etc.

Following the discussion of the participants, the initial framework of ANBOR was suggested which including;

- Initiate the website, the initial framework of ANBOR which will be financially supported and maintained by TISTR
- Two type of memberships were offered, i.e. Expert level and Institution level
- Partnership module: search for the project, partnership request and offer.
- Create the knowledge sharing network (i.e via setting an email group of participants)
- Match the training need and research need

- APCCT roles for this network would be offering support, handling support, facilitating support through their platform

Dr. Nakada from IRENA further informed that IRENA works as a hub of renewable energy in term of technology, policy, capacity building. IRENA does not focusing on project implementations but rather knowledge sharing, which is an essential component of IRENA's activity. IRENA can communication to get the information such as priority area in bioenergy researches which is crucial for getting an interest and needs in this region. He added that IRENA has several activities focusing on this region, for example, development of renewable energy roadmap for South Asia and Southeast Asia that could be shared through ANBOR. IRENA also has a capacity building unit that is very important to get the needs from countries. ANBOR can support and improve IRENA's work on communication and the implementation. Furthermore, Mr. Koyama added that IRENA has knowledge preservation function. This function has been provided for members and platform network. IRENA has a lot of activities related to renewable energy development and further potential to expand activity to this platform.

Annexure I

Biomass Open Research Forum
Biomass Resource Assessment for ASEAN+6 Countries
9th-10th July 2015, Rama Gardens Hotel, Bangkok, Thailand

Tentative Programme

Thursday 9TH July (Day 1)

Time	Content
8:30-9:00	Registration
Opening Session 09:00-09:20	***Welcome Remarks*** • Dr. Krishnan S Raghavan, Coordinator, Technology Transfer, United Nations APCTT-ESCAP • Mr. Yongvut Saovapruk TISTR Governor
09:20-09:30	**Opening Speech** • Mr. Somchai Tiemboonprasert, Deputy Permanent Secretary, Ministry of Science and Technology (MOST, Thailand)
09:30-09:40	**Group Photo**
09:40-09:50	**Coffee Break**
09:50-10:10	**Background to Project Concept:** **Biomass Open Research: Biomass Resource Assessment for ASEAN+6 Countries** Dr. Krishnan S Raghavan, Coordinator, Technology Transfer, United Nations APCTT-ESCAP
10:10-12:00	**Session I** **Presentation on the Outcomes of Asia Pacific Regional Workshop on Biomass Resource Assessment and Key Messages for Consideration** Dr. Shunichi Nakada, Biomass Energy Expert, IRENA and Selected countries to share their experiences **Moderator: APCTT-ESCAP**
12:00-13:00	**Lunch**
13:00-15:00	**Session II** **Member Country Perspectives on Biomass Resource Assessment and Open Research Network** ***Moderator***: Dr. Aparat Mahakhant, Chief Research Expert, Thailand Institute of Scientific and Technological Research (TISTR)

	Australia : Prof. Mark Brown, Director, Forest Industrial Research Centre, University of The Sunshine Coast **Cambodia :** Mr. Vibol San, Researcher and Lecturer, Faculty of Science**,** Royal University of Phnom Penh **China :** Dr. Zhenhong Yuan, Chief Scientist, Biomass Research Center, Guanzhou Institute of Energy Conversion, Chinese Academy of Sciences **India :** Dr. Yogender Kumar Yadav, Director of Sardar Swaran Singh National Institute of Renewable Energy (TBC) **Indonesia :** Dr. Ir. Adiarso, Director of Technology Center for Energy Resources Development – Agency for Assessment and Application of Technology (PTPSE-BPPT) **Japan :** Mr. Takao Ikeda, Senior Researcher, Institute of Energy Economics **Lao PDR :** Mr. Chantho Milattanapheng, Deputy Director General, Institute of Renewable Energy Promotion, Ministry of Energy **Malaysia :** Prof. Ir. Dr. Mohd Sobri Takriff, Head, Center for Sustainable Process Technology, Universiti Kebangsaan, Malaysia **New Zealand :** Dr. Paul Bennett, Science Leader, SCION
15:00-15:15	Coffee Break
15:15-15:45	**Philippines :** Prof. Dr. Teodoro C. Mendoza, Professor of Crop Science, College of Agriculture, U.P. Los Banos **Thailand :** Asst. Prof. Dr. Sebastien Bonnet, The Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology Thonburi **Vietnam :** Dr. Nguyen Kim Thoa, Head of Biomaterials Technology, Institute of Biotechnology Vietnam Academy of Science and Technology (VAST)
15:45-17:00	**Session III** **Opportunity for Collaboration among ASEAN+6 Countries on Biomass** **Resource Assessment and Setting up of Open Research Network** ***Moderator*:** APCTT-ESCAP and IRENA • Biomass/Bioenergy Collaboration Network *Importance of collective effort to facilitate research collaboration* Mr. Osamu Kobayashi, Director, Singapore Office, Japan Science and Technology Agency (JST) *Cascade Utilization of Raw Materials for Biodiesel Fuel Production* Prof. Yasuaki Maeda, Professor, Osaka-fu University, Japan

	Biomass Inclusive Research through Open Innovation and Talent Mobility Dr. Surachai Sathitkunarat, Director, Energy and Environment Department, National Science Technology and Innovation Policy Office (STI), Thailand *The set up of ASEAN Network on Biomass Open Research, ANBOR* Dr. Aparat Mahakhant, Chief Research Expert, Thailand Institute of Scientific and Technological Research (TISTR) • Panel Discussion on Opportunity for Setting up of ASEAN Network on Biomass Open Research (ANBOR)
18:30-20:30	Dinner hosted by TISTR and MOST

Friday 10TH July (Day 2)

Time	**Content**
09:00-09:20	Recap of Day 1 Discussion Dr. Krishnan S Raghavan, Coordinator, Technology Transfer, United Nations APCTT-ESCAP
09:20-10:30	**Session IV:** **Identification of Priority Areas for Collaboration among ASEAN+6 Countries on Biomass Open Research / Resource Assessment and Setting up of BORC** ***Moderators*:** APCTT-ESCAP, IRENA and TISTR Identification of Gaps and Entry Points • Recommendation on Priority Areas for Collaboration in Biomass Research • Available Resources for Open Research/Innovation Capacity Building
10:30-10:45	Coffee Break
10:45-11:50	Open Forum and Discussion on Key Issues ***Moderators*:** APCTT-ESCAP, TISTR and Prof. Mark Brown, Director, Forest Industrial Research Centre, University of The Sunshine Coast • Brief Review and Summary of Key Elements Stemming from Discussions
11:50-12:00	**Closing**
12:00-13:00	**Lunch**
13:00-16:30	**Visit to TISTR Biomass Pilot Plant and Algal Oil Production Pilot Plant at Technopolis, Pathum Thani Province**
16:30-18:00	Back to Hotel

Annexure II

List of Participants

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