Chapter 4

Conclusion

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Chapter 4
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1. Summary of the Study

1.1. Adaptability of biomass co-combustion with coal, Case 1: Indonesia

Case 1 is on lignite/EFB co-combustion with 50 MW CFB boiler in Indonesia. This is a typical case of countries with palm plantation as the main agricultural product. EFB is recognised as unsuitable for biomass combustion in a PC boiler because of its high moisture, alkali, and chlorine contents. Therefore, co-combustion with coal is a way to use EFB as biomass energy.

The unit efficiency decreases with increasing biomass co-firing, i.e. the efficiency at 25% and 50% co-firing is 34.1% and 32%, respectively. The remarkable reduction of CO_2 emission is 19% and 44% at 25% and 44% in biomass co-firing cases.

From an economic point of view, if project profitability is to be kept at 10% IRR, US ¢ 15.2–15.4/kWh is required. In these cases, government incentives, such as feed-in tariff (FiT), are recommended.

1.2. Adaptability of biomass co-combustion with coal, Case 2: Philippines

Case 2 is on sub-bituminous/rice co-combustion with 50 MW CFB boiler in the Philippines. This is a typical case of countries with rice as the main agricultural product. Rice husk has high silica and potassium content and low chlorine. This means a relatively low melting point and adhesion inside the boiler wall is an issue.

The unit efficiency slightly decreases with increasing biomass co-firing, i.e. the efficiency at 25%, 50%, and 75% co-firing is 36%, 34.8%, and 32.6%, respectively. A remarkable reduction of CO_2 emission is expected as in Case 1.

From an economic point of view, if the project profitability is to be kept at 10% IRR, US ¢ 15.5–16.8/kWh is required. In these cases, government incentives, such as FiT, are recommended.

1.3. Input by the Working Group

The working group meeting was held at the ERIA Jakarta office on 6 February 2019 with participants from Cambodia, Indonesia, and Thailand. Each member country presented its power situation, especially biomass installation.

This meeting revealed that the main energy source of these four countries is coal; all countries are intensively increasing renewable energy to mitigate greenhouse gas (GHG) and regional environmental impact. While unused agricultural waste is found to be a potential biomass energy resource in these countries, it has not yet been realised. The capacity of a

biomass-fired plant is thought to be only 50–100 MW. Co-combustion with coal at a coal-fired plant is a more considerable measure to increase the use of biomass.

2. Conclusion of the Study

The study indicates that co-combustion of agricultural waste and coal on CFBC boilers will remarkably contribute to CO_2 mitigation compared with simple coal combustion for power generation.

However, the findings on Case 1 and Case 2 reveal that their economic viability is so far not feasible under the current tariff situation unless the right incentives are in place.

In this connection, further consideration shall be given in the next study to identify tailor-made country-specific models with the optimal capacity and technologies as well as envisaged incentives.

3. Policy Recommendations in the ASEAN Region

3.1. Adaptability of biomass co-combustion

Table shows the current power situation and biomass potential of each country. All countries can potentially expand the application of biomass and coal co-combustion as a GHG mitigation measure. Biomass co-combustion is also beneficial to mitigate regional environmental impact such as SOx, NOx, and suspended particulate matter (SPM) since biomass normally has less heteroatom and ash compared to coal.

Table 4.1. Current Power Situation and Biomass Potential

Country	Capacity (GW)	Renewable Capacity (%)	Biomass Resources	Biomass Potential (MWe)	Current Tariff Incentive, FiT
Cambodia	1.87				
Indonesia	60.79	0.1	Oil palm waste (inc. POME) Sugarcane (bagasse, trash) Wood waste Rice (hull, straw) Corn (cobs, stalks) Coconut (shell, husk, fronds), Etc.	32,654	FiT is not applied. Using reference price for each system.
Philippines[6]	23.81	7.2	Rice (hull,	4,449.5	Php

[6] All data on the Philippines here were provided by the working group member from the Department of Energy, Philippines.

			straw) Corn (cobs, stalks) Coconut (shell, husk, fronds) Sugarcane (bagasse, trash) Hog and chicken manure	4	6.5969/kWh (for approval) (FiT)
Thailand	43.07	15.28			4.00-5.50 B/kWh

FiT = feed-in tariff.
Source: Authors' compilation and calculation

Another advantage of biomass co-combustion is the use of agricultural waste. As described in Section 2.3, a significant volume of agricultural waste to be applicable for co-combustion is expected in ASEAN countries.

3.2. The advantages and spillover effect of biomass co-combustion

Biomass co-combustion with coal can contribute to the increase of universal access in the ASEAN region as an applicable measure of mitigating GHG emissions. The advantages and spillover effects are as follows:

(1) Biomass use in coal-fired power plants is to be applied as direct and effective mitigation measures of CO_2 in the power sector of countries that use coal as the main energy source, such as those in the ASEAN region. CO_2 emission is reduced proportionally by increasing the blend ratio of biomass with coal since biomass is recognised as a carbon-neutral substance.

(2) Agricultural waste, for example, PKS, EFB, sugar cane, rice husk, and food waste, in the ASEAN region is thought to be a potential domestic energy resource. It can also reduce underutilised waste. Biomass can be used in a wider type of boilers such as CFB, small pulverised boiler, and USC of larger capacity.

(3) The effectiveness of biomass as an alternative fuel in a coal-fired power plant is not only to mitigate CO_2 emissions but also to reduce plant operation costs if biomass is efficiently collected from the surrounding area. Since one issue in using agricultural waste as biomass fuel is the seasonal volume change, i.e. supply stability, co-firing with coal can compensate the total energy input to the plant by optimising coal/biomass ratio with seasonal variation.

(4) Although applicable biomass resources and the current utilisation situation is different in each country, biomass co-combustion in a coal-fired power plant might increase regional employment through the collection, selection, and torrefaction processes in the surrounding areas.

Considering the above-mentioned, expediting the realisation of biomass/coal co-firing in a coal-fired power plant in the ASEAN region is deemed crucial in addressing both CO_2 mitigation and surging energy demand.

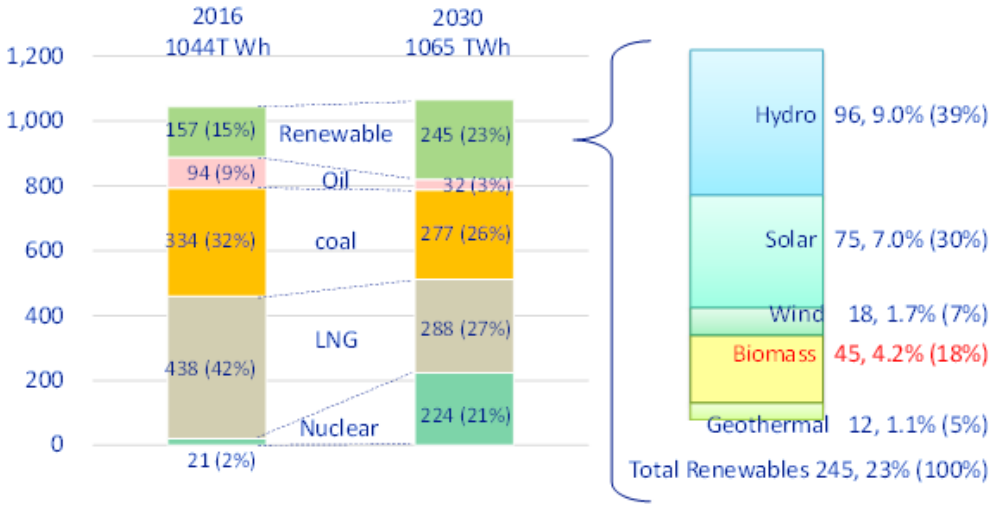
3.3. Policy recommendations to expedite biomass co-combustion

To conclude, policy recommendations are summarised below. The realisation of the following items in each country is basically to be considered by the respective country. Bilateral or multilateral collaboration can expedite the possibility of the realisation.

(1) *Authorisation by the government to use biomass as renewable energy in the energy development plan of each country.*

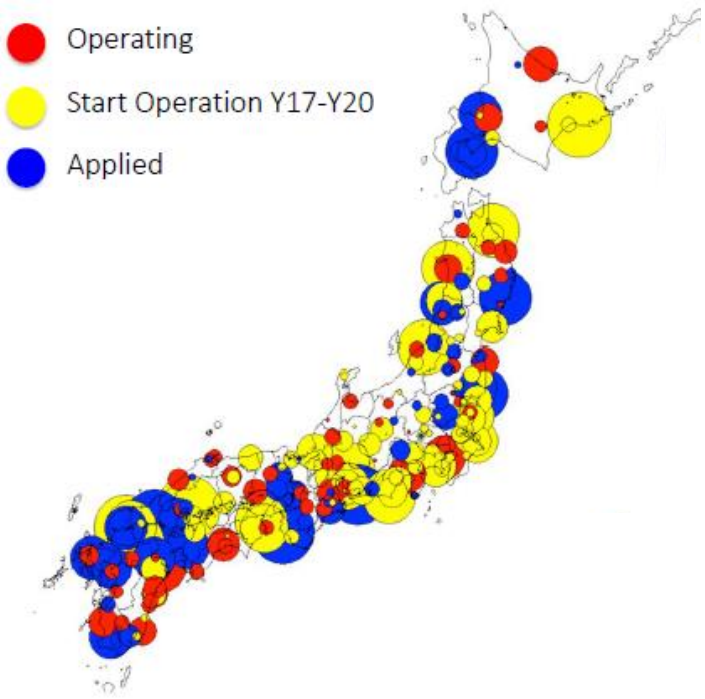
In Japan, the target of the biomass utilisation is clearly shown by the government (Figure 4.1). Expected in 2030 is 45 TW of biomass generation out of total renewables of 245 TWh. Most of the biomass generation will be accomplished by co-combustion with coal. Along with the government's target, a significant number of plants are commissioning or are being planned by the major electric power company and newly joined venture companies.

Figure 4.1. Generation Forecast in Japan, by Source



Source: METI (2017).

Figure 4.2. Biomass Plant in Japan[a]



[a] Diameter of the circle shows the capacity.
Source: Fuji Biomass Energy Sdn. Bhd. (2018).

(2) Tariff and other financial incentives for biomass co-combustion

Tariff incentives for biomass co-combustion, such as FiT, are to be considered for accelerating the investment of biomass co-combustion. If feed-in tariff has been introduced, its rate for each renewable source should be optimised according to the renewable target and energy mix. In this study, US ¢ 13–16/kWh is to be recommended as FiT for further dissemination of biomass use in the ASEAN region.

Also recommended is the establishment of a special purpose financial scheme solely for the biomass utilisation project.

(3) Development of biomass collection scheme

A continuous and stable agricultural waste collection process is essential to establish biomass co-combustion in a coal-fired plant. Depending on the agricultural waste resources, for example, the PKS is already treated commercially as an energy source. Most of the waste of cereal crops is thought to be applicable for biomass energy. To utilise such biomass sources, an integrated collection function should be located at the centre of the collection area and transportation system. If a cooperative association is established by local farmers, business owners, and related organisations to handle the collection and transportation of biomass in the region, the efficiency of biomass delivery can be improved.

The establishment of a cooperative association is also beneficial. A cooperative association is exempt from taxation, while a corporation is not. In addition, activities conducted by such a cooperative association contribute to the local economy and

create jobs. Furthermore, they will be regarded as corporate social responsibility activities of the operator.

In this connection, authorisation by the government of a plant for biomass co-combustion and capacity of the collection function is considered to expedite the realisation of the biomass utilisation project by public or private participators.

(4) Support by the regional government for jobs related to collection of biomass waste

Since the collection of agricultural waste is labour intensive, hiring enough workers to collect, transport, and pelletize it, if required, is very important. Initiatives by the regional government for securing employment are recommended. This has also the advantage of utilising manpower in the agricultural sector during off-season.

Several financial support schemes can be considered, such as subsidy for the number of employees, a discount interest rate for investment, etc. Support for the establishment of a cooperative association might be also effective to secure the required workers.

(5) Collaboration to realise biomass co-combustion projects

Technical collaboration, as bilateral/multilateral cooperation between ASEAN countries and a country which has the experience and applicable technologies, is recommended to materialise the biomass co-combustion project.

This kind of collaboration is effective especially for the introduction of applicable technologies such as CFB boiler for combustion of agricultural waste with coal. Public-based cooperation with technologies owned country is highly recommended.