Part 7. Biomass situation in Asian countries

7.1 China

7.1.1 Background

With rapid economic development, energy demand increases rapidly also in China. China's total energy consumption already occupies the second place in the world. Fig.1 shows the trends of China's oil consumption and net imports from 1990 to 2006. Since 1993 when China became a net import country of petroleum, the dependency of petroleum upon import increased from 7.6% in 1995 to 47.0% in 2006. It is forecasted that in 2020 the petroleum consumption and import in China will amount to 450 million tons and 250 million tons, respectively, with 55% dependency of petroleum upon petroleum import. It’s expected that transportation will contribute the most oil consumption growth in future. Compared to the transportation oil consumption in 2000 which accounts for about 1/3 of the total petroleum consumption, it is forecasted that the ration will rise to 43% and 57% by 2010 and 2020.

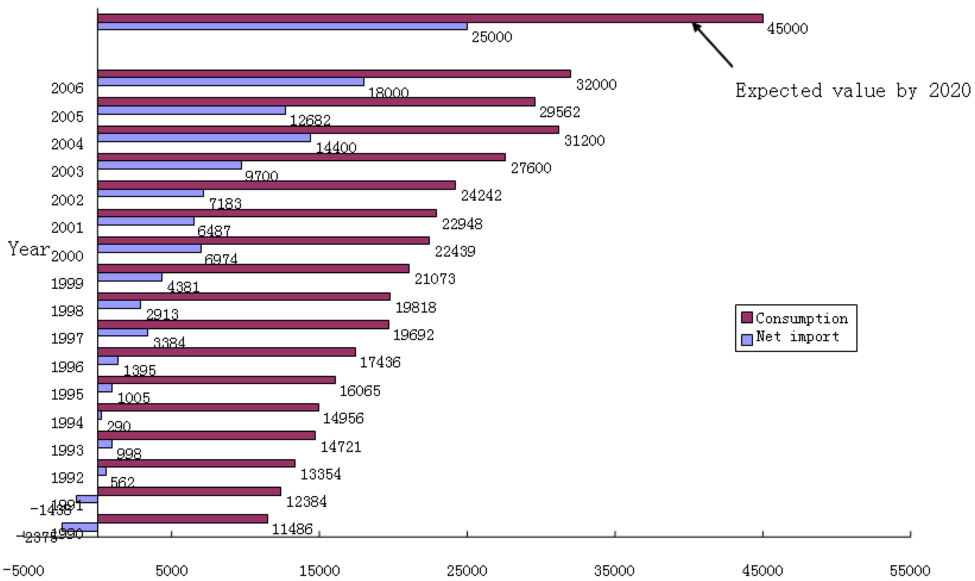

Fig. 7.1.1. Trends of China's oil consumption and net imports from 1990 to 2006

7.1.2 Situation of biofuels development in China

Because of the insufficient fuel supply and the requirements for energy saving and pollutants emissions reduction, China national government pays more and more attentions to research and development of bio-fuels. The People's Republic of China Renewable Energy Law was issued in 2005.

Ethanol gasoline project started in 2001 in China. There are only four plants permitted by the government to produce food based fuel ethanol. The governments' supports play an important role on simulating the ethanol gasoline development in China, especially at the initiation stage of the ethanol gasoline demonstration by preferential policies like incentives. The incentives include: 1) The excise tax of denatured fuel ethanol (5%) is free. 2) The value-added tax of denatured fuel ethanol is imposed first, and then given back to the ethanol provider. 3) The price of denatured fuel ethanol sold to the petroleum companies which are also the blending operators is (0.9111*manufacturer's price of 90# gasoline). While the market prices of all kinds of E10 (90#, 93# or 97#) are the same as 90#, 93# or 97# gasoline. 4) An allowance is paid to the ethanol provider. These incentives will be executed until 2008. Now ethanol gasoline has been used in 9 provinces and the total consumption was 1.54 million tons in 2006. However, to ensure the food safety, no more food based fuel ethanol plants are permitted by the China national government any more. In the future, non-food feedstock including cassava, sweet potato, sweet sorghum and lignocellulose are potential for fuel ethanol production. A 200 000 tons/year fuel ethanol plant with cassava as feedstock in Guangxi province has been permitted by the government and is expected to start up soon. The four exiting fuel ethanol plants are encouraged to use non-food feedstock too.

There are more than 10 biodiesel plants in China. The amount of production is about 100 000 tons/year. <Biodiesel Blend Stock (BD100) for Diesel Engine Fuels> was issued in May 2007. But there is not yet regular policy for biodiesel sales like fuel ethanol. Some biodiesel are for non-engine utilization. One problem of biodiesel development in China now is the feedstock supply. China needs to import more than 6 million tons edible oil per year. It is impossible to use edible oil such as soybean oil and rape seed oil for bio-diesel production. Now most biodiesel plants in China are using waste oils as feedstock. However, with the development of biodiesel, the price of waste oils is higher and higher. Woody oils are getting more and more attentions. The "national bioenergy-directed forest construction program" and "Woody feedstock plantation plan for biodiesel during 11th Five-Year plan" were issued by State Forestry Administration of China, which indicate that 400 000 hectares of Jatropha curcas will be planted in Yunnan, Sichuan, Guizhou and Chongqing provinces; 250 000 hectares of Pistacia Chinensis will be planted in Hebei, Shanxi, Anhui and Henan Provinces; 50 000 hectares of Cornus Wilsoniana will be planted in Hunan, Hubei and Jiangxi Provinces; 133 333 hectares of Xanthoceras Sorbifolia will be planted in Inner Mongolia, Liaoning and Xinjiang provinces.

7.1.3 Conclusion

With the rapid economic development, the great insufficiency of energy supply has become the "Bottleneck" of sustainable development in China. Currently the important issue to be solved is to accelerate the development of biomass energy so as to relieve the pressure of resources and the environment. Moreover, as a responsible country, China should take the international responsibility to save energy and reduce pollution discharge. Hence, the biomass energy industry is promising with a fairly bright future in China. At present, the biomass energy consumption is 8% of the total fuel consumption. According to "Mid and Long Term Development Plan of Renewable Energies" issued on September 4th 2007, the percentages of biomass energy consumption will increase to 10% by 2010 and 15% by 2020. By 2010, annual consumption of non-grain based fuel ethanol shall reach 2 million tons, and that of biodiesel shall reach 200 000 tons in China; by 2020, annual consumption of fuel ethanol shall reach 10 million tons, and that of biodiesel shall reach 2 million tons in China.

7.2 Korea

7.2.1 Amount of biomass resources in Korea

Major biomass resources available in Korea are organic wastes and the agricultural and forest residues. The potential and recoverable amounts of biomass for energy utilization are summarized in Table 7.2.1. According to the data in Table 7.2.1, the total amount of biomass resources available in Korea is about 80 million ton, only 30% of the potential biomass resources are currently utilized for energy production.

Table 7.2.1. Biomass resources in Korea.

Resources	Potential, x 10^3 Mt/ year	Recoverable, x 10^3 Mt/ year
Forest residues	7,830	1,300
Agricultural residues	16,000	4,900
Food waste	5,100	5,100
Municipal waste	1,600	260
Animal wastes	47,000	
Sludge	2,500	280
Total		

S.C. Park et al. (2007).

7.2.2 Policies and Mansatories

New and Renewable Energy Promotion law enacted in 2002 approves bioenergy as a renewable energy and supports its implementation. The total exemption of excise duty is now available for biodiesel used as motor fuel. The current excise duty of diesel is about $0.5/L. All Korean oil refineries should mix a certain amount of biodiesel in their diesel oil products (Table 7.2.2).

Table 7.2.2. Mandatory target for the biodiesel implementation (KMOCIE, 2007).

Year	2007	2008	2009	2010	2011	2012
Biodiesel content in diesel, %	0.5	1.0	1.5	2.0	2.5	3.0

7.2.3 Targets

For bioenergy, the following targets have been set up by Korean Ministry of Commerce, Industry and Energy (KMOCIE) in 2002 (Table 7.2.3).

Table 7.2.3. Targets for bioenergy implementation in Korea.

Year	2004	2005	2006	2007	2008	2009	2010	2011
Heat, x 10^3toe	236	277	283	472	477	483	489	679
Power, x GWh	1232	1848	2465	3081	3383	3697	4000	4313

7.2.4 Other activities

- Biodiesel

Severe air pollution over the big cities in Korea also helps the introduction of biodiesel in the transport sector because biodiesel blended fuels may reduce the emissions of the air pollutants from vehicles. Demonstration supply of BD20 had been started in Seoul Metropolitan and Chonbuk Province from May 2002 and lasted by June 2006. During the period of the demonstration supply, several important works have been done to resolve the controversial issues like the feasibility of BD20 as a motor fuel, the preparation of the biodiesel fuel specification and the establishment of distribution infra for the biodiesel blended fuels. After a year work, the draft for the standards having 16 specification parameters was made. The figures taken in the standards are virtually same to those of the European standards, EN14214. Actual fleet tests also have been done with BD5 and BD20 prepared with the biodiesel which meets the Korean biodiesel standards for two years. Through the fleet tests, BD20 was found to be not suitable for the passenger cars. In the meanwhile, no troubles have been observed with the use of BD5. So KMOCIE prepared a new biodiesel distribution system and enforced it from July of 2006 (Figure 1). According to new plan, all Korean oil refineries should buy 100,000 kl biodiesel /year and mix them into their diesel products and supply the blended diesel to all gas stations. As a result, all diesel oils sold in Korea contain about 0.5% of biodiesel. BD20 is allowed to supply only to captive fleets which have their own gas pumps.

With the strong support of Korean Government on biodiesel implementation, the biodiesel business is getting active. The stable supply of raw material is going to be an important issue. Various activities are under way to secure the stable supply of feedstocks for biodiesel production. The activities include the demonstration cultivation of winter rapeseed to determine the feasibility of mass production of canola domestically and Jatropha plantation in some Southeast Asian countries..

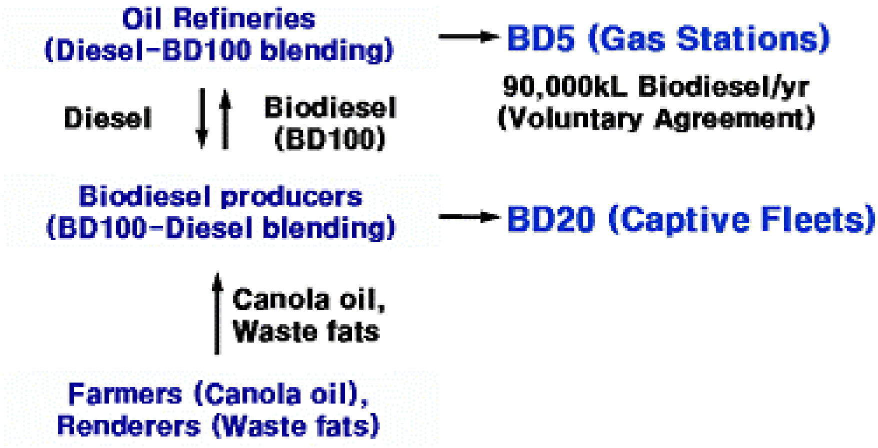

Fig. 7.2.1. New biodiesel distribution infra in Korea.

7.3 Myanmar

The land area of Myanmer is 690,00 km^2 (1.8 times as large as Japan), and it is the larges country in the continental South-East Asia. Its population is 52 million, and its climate belongs to tropical monsoon except northern region. Thus, its nature, biosystem, and biodiversity is unique and precious. Myanmer also enjoys plentiful resources such as rice, forestry resources, and mineral resources. About 70% of the working population belong to agricultural sector and occupies 60% of GDP, and industrial sector contributes to GDP by only 10%. Politically, after the World War II, the democratic system was achieved for a while, but the National Congress was ceased by the Coup d'etat in 1996, and the nation in under military administration since then. It is politically unclear, and economic problems remains, thus being one of the poorest country in the world. There are no laws enforced related with biomass, but all residue is used because of the lack in material and fuel. Mill residue is used as fuel, and livestock and food waste is used as fertilizer, leaving no residue. In a sense, biomass utilization is well made due to the poverty society.

Two interesting examples in terms of rice husk utilization were found during the onsite inspection. Electricity shortage, incomplete infrastructure, and shortage in fossil fuel resulted in employment of rice-husk steam boiler and steam piston engines (made in Germany, 1925) were driving the rice-cleaners (about 600 places). However, the thermal efficiency of the steam boiler is very low, and consumption of the rice husk is large, the number is decreasing.

Another example is the driving of small-scale rice cleaners by rice-husk gasifier and gas engine, which is spreading recently. All the gasifiers are domestic, and of the down-draft type. The rice husk is supplied from the top, and the ash is removed from the bottom. The other elements are combination of water scrubber, filter, and gas engine, and the product of Myanmar. Second-hand Japanese diesel engines (bus and truck) are modified to gas engines by exchanging injection nozzle with ignition plug. The output of the most gasifiers is 20-50 kW. Typically, 20 kW is produced by rice husk supply of 30 ㎏/h. About 100 of this type of gasification and power generation system were used in 2000, and it is estimated that 300 were used in 2005. The gasifier-power generation plant produced by the company under the Ministry of Commerce, Myanmar has electric output capacity of 140-160 kW. The system is equipped with a down-draft gasifier, water-cooling jacket at the bottom section of the furnace, and ash removal system. The product gas is washed with a water scrubber and stored in a gas tank before being supplied to the gas engine. The pamphlet says that this system is sold at about 350 kJPY (The prices of commodities is 1/100 of that in Japan). The composition of the product gas is shown in Table 7.3.1.

Table 7.3.1 The composition of the gas produced from rice husk.

Carbon dioxide	12.6 %
Carbon monoxide	17.9 %
Nitrogen	57.0 %
Oxygen	0.9 %
Hydrogen	8.8 %
Methane	1.9 %
Others	0.9 %

Production of the gasifier is conducted in a ironworks with several employees, but standardization of the parts is made, and they have some stocks of the parts. Myanmar still has many regulations, and biomass and other residues are needed to be used due to the lack in commodities and fuels. Bagasse produced from the sugar mills are used for self power generation. Rice husk and charcoals are used for various purposes, and no residues are available. One of the private rice mills strongly desired to improve the rice husk boiler and steam engine to achieve higher efficiencies.

Recently, private rice mills are gradually getting busy due to the policy of liberating the economy, although it is for the limited area. The shortage in electricity and fossil fuels will continue, and it is expected that the small-scale gasifier and gas engine system will be used more and more for driving rice mill and other devices. Presently, production and introduction of biofuels are not yet made, but Myanmar has a large area and good climate and possesses high potential of producing forest resources and plantation crops. In long term, potential to produce bioethanol and biodiesel is as promissing as Thailand, Malaysia, and Indonesia.

The proper form of biomass utilization differs from case to case depending on the natural, social, and economic conditions, and thus elaborate planning is needed. To collect the latest information for this purpose, collaboration office between universities and other sectors is desirable. This kind of collaborative network among university, academic organization, NPO, and international organization will encourage the utilization of small-scale biomass.

Myanmar is a Buddhist country has a high level of education (the rate of school attendance: 96.56%, the literacy rate: 93.3%). The economic development may be late among ASEAN countries, but for its development foreign universities and academic organizations can be a large help.

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7.4 Laos

Lao PDR is a mountainous country with a population of about 5.6 million, over 80% of which lives in rural areas and is engaged in rice-based agriculture and harvesting of forest products. The narrowly based economy is one of the least developed in Asia with an approximate per capita Gross National Product of around US$ 500 per annum (2006)

The Main Economic in Laos is from the Agriculture , Forestry, Power Generation, Mining, Small industries and agriculture is 42.2 % of the Gross Domestic Product , while the Industry is 31.5 % , Services 25.4 % and Import duties 0.9 % (in 2006) .

Lao PDR is endowed with significant indigenous energy resources for electricity generation. Hydropower is the most abundant and cost-effective form. The energy resources range from traditional energy source such as fuel-wood to coal and hydropower. The forest areas which cover about 40 % of total land are a potential source for substantial traditional energy supplies.

The Lao power sector is in the good progress stage as 54.1 % of the population having access to electricity in 2006 . but the main energy consumption in Laos comes from fuelwood for cooking .

In order to meet the government target for the increasing the households electrification ration to be 70 % of total households in 2010 and 90% in 2020 , the Government set up the Power Sector Policy :

1. Maintain and expand an affordable, reliable and sustainable electricity supply in Lao PDR to promote economic and social development;
2. Promote power generation for export to provide revenues to meet GOL development objectives;
3. Develop and enhance legal and regulatory framework to effectively direct and facilitate power development; and
4. Strengthen institutions and institutional structures to clarify responsibilities, strengthen commercial functions and streamline administration

In order to meet those targets and Policies , now a day there are more than 50 MOU for the hydropower development with the capacity from 5 – 1080 MW and 6 projects are under construction , if we look on those hydropower development plan , we could see that there are many waste wood in the reservoirs need to be clear and if we have the good technologies and investment capital then we could construct biomass cogeneration projects in Laos .

Lao PDR import 100 % fossil fuels , at the present there are 3 companies to conduct the survey for the natural gas and oil and it takes about 10 years for getting all information and for the production of natural gas and oil (if feasible) , for reduction of import fuel and high efficiency fossil fuel consumption , the government of Laos also support the biofuel as biodiesel from the Jatropha and palm oil and bioethanol from the sugarcane .

After the government announced for promotion of biofuel , the are some companies started the business by plantation of Jatropha to produce the bio diesel , the biggest investor is Kolao Farm company , their target is plant the Jatropha 40.000 hac , the factory is under construction , it is far from the Vientiane Municipality about 70 km .

The second company is LaoBiodiesel company just started the construction of the factory in Champasak province on 10 March 2008 and their plantation is 100 hac for the Jatropha .

There are two companies to invest on the palm oil , the first one in Champsak province with the plantation of 25 hac , this company started in 2006 and the second one in Bolikhamsay province with the plantation of 20 hac this company started in 2006 .

The other companies to invest on Jatropha for biodiesel are small plantation .

Under Lao – Thai cooperation of Energy sector , the Ministry of Energy of Thailand give one set of Biodiesel production equipment from Jatropha to Ministry of Energy and Mines for the demonstration .

The Promotion of biodiesel is much more popular than biothethanol because the investment cost and the technology of bioethanol is high and now there is only one small existing of sugar factory in Laos , there other two factories are under construction in Savannaketh province .

Because of there is no any document for the promotion of biofuel in Laos , the department of Electricity , Ministry of Energy and Mines requested New Energy and Industrial Technology Development Organization (NEDO) , Representative Office in Bangkok to support the finance to hire the Lao Institute of Renewable Energy in Laos (LIRE) to conduct the survey and drafted the recommendation for the Strategy and Policy for the Promotion of Biodiesel in Laos .

The target of the government to reduce the fossil fuel consumption 5 % by promotion of biodiesel production .

The details of Strategy and Policy will be developed more ..

7.5 Brunei Darussaalam

7.5.1 General scope

Brunei has large amount of fossil fuel resources such as oil and natural gas, and obtains half of its GDP by exporting these resources to enjoy good economy. Thus, they do not have interest in biofuel development so much.

Meanwhile, the land area is small (5,770 km2), and agricultural land is very small, thus most of the food is imported. National development plan always aims at improvement of self-supply rate of food. However, since its independence in 1984, governmental sector was developed and stable high-income jobs are available, which lead to the people's removal from agriculture. In general, agriculture is stagnant, and its productivity within total GDP is only 2.7%.

7.5.2 Natural conditions of Brunei

The whole country area belongs to the tropical climate. The tropical rain forest occupies 80% of the national land (4,690 km^2). Seventy per cent of the forest is virgin, and half of which is environmentally preserved. The land is roughly divided into eastern and western regions, and the eastern region, Templon River basin, is undeveloped forest except seaside, and forms a vast national park. Most of the population lives in the three district in the western region.

Agricultural productivity of Eastern Asia countries including Brunei is low compared to the monsoon region. Tropic soil easy loses nutrition salts, and is not suitable for agriculture. Leaves and cut trees are soon decomposed by microbes and termites, leaving no humus behind. Additionally, as the effect of heat and water, soil components other than aluminum oxide and iron oxide are easily washed away, and the soil is barren. In the rain forest, the nutrition to support the forest is collected not by the soil, but by the trees and plants at the canopy.

Small scale agriculture includes dry rice cropping in the forest in the mountain region and rice cropping at the terraced paddy field. For short term, taros are produced by slush and burn agriculture to use the nutrition collected by the forest biomass, but this destroys the forest, which is the main nutrition collector, and the soil nutrition is used up in 2 years, and after that the land becomes barren.

At the low wet land where the washed nutrition is stored, Sago palm plantation is possible. Swamp forest arises at this kind of land. This swamp forest is composed of trees with low height, and the plants grows only by single layer. This leads to good supply of light, but since the oxygen in soil lacks, humus decomposition is prevented, and peat is formed. Thus, even if agricultural field is made, the surface begins to sink soon to form pad. Agriculture is difficult in this region.

At the seaside exists mangrove forest at the brackish water region where seawater is comes and goes with low and high tide. The soil of this forest is strongly acidic due to the root acid that mangrove root secrets. This land cannot be used for slush and burn agriculture, and was barren in terms of agriculture. It was not until 20^{th} century that it got used for fish breeding.

7.5.3 Policy of Brunei

In the 7^{th} 5-year plan (1996—2000年) included activation of agriculture to improve self-supply rate of various agricultural product, but the rate stays only 20%, making biofuel development very difficult.

The plan proceeds study to improve the culturing technology and production system that fits the natural condition of the country so that food demand increasing year by year should be met. It proceeded introduction of new technologies such as water cultivation, and extending of agricultural area. For proceeding water cultivation, half of the expense needed for the tools and fertilizer were supported. The Ministry of Agriculture approved new land-developing zone in 2000. They are for production of vegetables (50 ha), fruits (500 ha), and livestock (100 ha).

The effort to improve self-supply rate of food is taking its effect. In 2004, production of eggs exceeded 100 million eggs/year, and chickens exceeded 13 million, achieving almost 100% of self-supply rate. (Note most of the feed is imported.) However, self-supply rate of other food is still low: tropical vegetables 53%, milk 13%, beef 3.85, goat 3%, other crops 2%, rice 1%. The agriculture has to be much more developed.

7.5.4 Characteristic biomass products

Sago palm (Metroxylon sagu) is characteristic to this region. It produces large amount of starch.

Sago palm production is distributed from Southeast Asia to Oceania. Brunei is classified as sago district with Celebes Island and the Moluccas. This is the district where sago starch supplies several tens of per cent in the main starch supply.

Sago palm belongs to palm family, but is a unique angiosperm because starch can be obtained from its trunk. After 16 years from plantation, or 10 years under good conditions, it forms trunk with a diameter of 40-60 cm, and height of 12-15 m and stores high purity of starch inside in preparation for flowering and fruition. All of this starch is used for breeding, and the tree dies, leaving seeds behind. The tree is cut down just before flowering when the starch amount is the most, and the trunk is cut in the length less than 1 m. The trunk has a skin which is several centimeters thick. It is cut vertically, and the pith of starch which is held by the fibers inside is taken out. Starch is obtained by loosening the pith, washing it with water, and removing the fiber with a net, as precipitation in the water. In this way, 300-500 kg-wet (100-150 kg-dry) of starch is available form one mature tree.

The advantage of sago plantation is the easiness of the job and large amount of starch obtained with small labor. Sago palm can be cultivated with the peat soil, which most of the plant cannot grow with, and sago plantation does not deteriorates the soil. Sago is the most suitable plant for the seaside of the rainforest region.

Production of ethanol from sago starch is technically easy, but the self-supply rate of the region is very low, and production of starch for biofuel is not practical.

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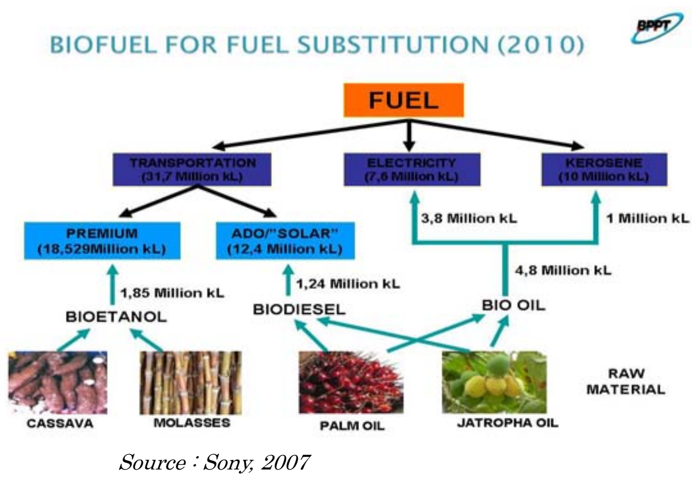
7.6 Indonesia



Source : Sony, 2007

Fig 7.6.1. Biofuel for fossil fuel substitution (2010)

Indonesia has a wide range of indigenous energy resources such as oil, natural gas, coal, hydro-power, geothermal, solar and also biomass. However, Indonesia still has a problem that until now the use of primary energy in the energy mix is still unbalance. A large portion of oil in energy mix still dominates domestic consumption, about 52% respectively, followed by Natural Gas, Coal, Hydro Power and Geothermal. The utilization of Biofuel itself is still very low. In order to balance the final energy mix and to alternate oil as the largest contributor of energy, the Government of Indonesia has set out that in 2025, Biofuel is expected to contribute at least 5% of National Energy Mix. As a mid – term goal, in 2010 Biofuel is targeted to take part as a source of energy in household and commercial sector, transportation and power plant sector. Biofuel will substitute the role of oil. It can be seen in the diagram (Fig. 7.6.1). For transportation sector, Biofuel in form of Bioethanol will contribute to 1.85 million kL of transportation energy mix, Biodiesel 1.24 million kL and Bio-oil 4.8 million kL respectively by 2010. Together, the summary of Biofuel will reach 10% of energy mix, only in transportation sector. For the household and commercial sector and power plant, Biofuel will be utilized in form of Biokerosene and Bio-oil or Pure Plantation Oil.

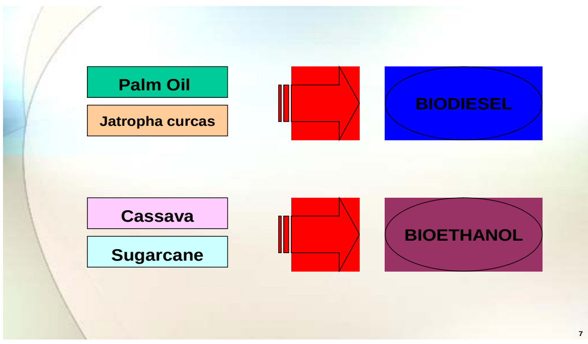


Fig. 7.6.2. Biofuel Feedstock.

The high potential for biofuel feedstock in Indonesia is provided by varies biofuel feedstock that can be developed. Palm oil and Jatropha are developed as feedstock for biodiesel, meanwhile cassava and sugar cane are utilized as feedstock for bioethanol (Fig.7.6.2). However, as mentioned before, Indonesia is also opened for the development of other biofuel feedstock such as corn, sago palm, sugar palm and sweet sorghum for bioethanol and coconut for biodiesel, depends on region's bioenergy potential. The potential land for special biofuel zone has been determined by the Government and is shown in Fig. 7.6.3.



No	Location	Commodity
1	Pacitan – Wonogiri – Wonosari (Pawonsari)	Cassava
2	Garut – Cianjur – Sukabumi Selatan	Cassava
3	Lebak – Pandeglang	Jatropha
4	Lampung – Sumsel – Jambi	Cassava, Sugarcane, jatropha, Palm
5	Riau	Palm
6	Aceh	Cassava, Sugarcane, Jatropha
7	Kaltim	Jatropha, Palm
8	Sulsel – Sultra – Sulteng – Gorontalo	Cassava, Sugarcane, Jatropha, Palm
9	NTB - NTT	Cassava, Jatropha
10	Maluku Utara	Sugarcane, Jatropha
11	Papua Utara and Irjabar	Palm
12	Merauke – Mappi – Boven Digul – Tanah Merah	Cassava, Sugarcane, Jatropha, Palm

Fig 7.6.3. Potential land for special biofuel zone.

Indonesia biomass resources are mainly from forestry (as an important natural resource because its tropical rain forest), estate crops, agriculture crops and municipal (city) waste. From estate crops, one the most important biomass resources (as well as for an energy alternative) is Oil Palm plantation (*Elaeis gueneensis*). Indonesia is the second largest producing palm oil country in the world, after Malaysia, (with the total land area of plantation of about 6 million hectares and *Crude Palm Oil* (CPO) production of 15 million tons in 2006, see Fig. 7.6.4. Area and production Indonesia oil palm plantation) representing 18% of the world-wide production. The Indonesian palm oil industry continues to expand rapidly using large mills which produce hundreds of tons of waste on a year round basis. Considerable opportunity exists in Indonesia and other countries to produce significant quantities of biofuel, (for 100,000 tons of CPO will produce 100,000 tons of biodiesel and 12,000 tons of glycerol), and steam & electricity from the residual

Fig. 7.6.4. Area and production Indonesia oil palm plantation.
Source : Wahono, 2007

biomass while mitigating environmental impacts both locally and globally.

The palm oil residues generated from the palm oil production process are : fresh fruit bunches (FFB) or the oil palm fruit produce Crude palm oil (CPO) and Kernel palm oil (KPO) which can be utilized to produce biodiesel or to generate steam and power.

The climate of Indonesia is also well-known for very suitable of sugarcane (*Saccharum officinarum*). Indonesia is the richest country for sugarcane genetics and is believed as the origin of the world sugarcane (Papua). At least 2 million hectares of land is suitable for cane field which scattered over Papua (majority), Kalimantan, Sumatera, Maluku and Java. By the appropriate planning, policy and development, it is very likely Indonesia in the future will become one of sugar exporter countries and also as a bioethanol producer (similar to Brazil).

Cassava (*Manihot esculenta*), known as one of bioethanol feedstock is cultivated intensively nowadays by the farmers especially in Lampung, Java and NTT regions. The cultivated area is around 1.24 million hectares all over Indonesia and the production was 19.5 million tons in 2005. The conversion of cassava to bioethanol is 6.5:1 or 1 ton of cassava will produce 166.6 liter of bioethanol.

Jatropha curcas (English *Physic nut*) - another biomass source for biofuel, unlike palm oil and cassava, the seed and hence the oil is non-edible, so there is no competition between food vs fuel.

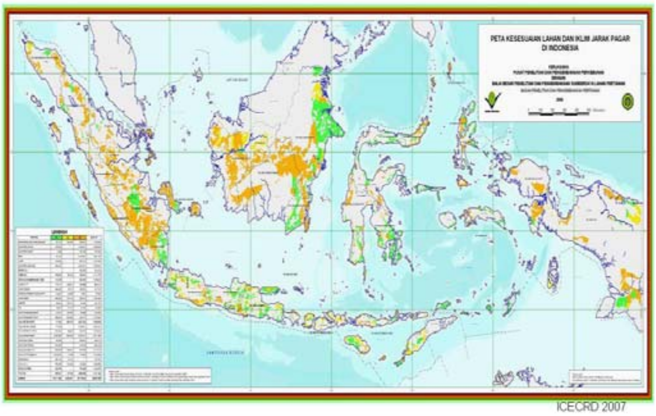
During Japanese occupancy (1942-1945), planting of Jatropha is a compulsory for native people. That's why Jatropha can still be found today in the eastern part of the islands, such as NTT and NTB provinces.

Various local names had been given to Jatropha Curcas, such as : *nawaih nawas* (Aceh), *jarak kosta* (Sunda), *jarak gundul, jarak cina, jarak pagar* (Java), *paku kare* (Timor), *peleng kaliki* (Bugis), etc.

Also, when the jatropha plantation is to be developed in the critical lands or barren lands has two important steps that have been achieved, i.e. afforestation or replanting and the conservation efforts which will result of the improvement of local/regional environment. And also the jatropha oil can be extracted and be used as fuel. Normally Jatropha seeds content average of 1,500 liter of oil/ha/year, with the productivity of 5 tons per ha of dry seeds and the oil yield of 30%.

The R&D of *Agriculture Institute, Department of Agriculture* has identified about 19.8 million ha of land (see map above,orange color) from various provinces in Indonesia are

Land suitability map for Jaropha curcas in Indonesia (1 : 1.000.000)



ICECRD 2007

suitable for Jatropha curcas plantation, in which 14.277 million ha of land is categorized as a very suitable and 5.534 million ha is suitable (green color). The suitable land is scattered within 31 provinces with the largest being in East Kalimantan, South East Sulawesi, East Java, South Kalimantan, Lampung , Papua and West Irian Jaya provinces. It is projected that jatropha cultivation areas in Indonesia will achieve to 3 million ha by 2015. It is expected that jatropha oil as fuel will play an important role in rural villages of Indonesia, so called “Energy Self Sufficient Villages”, and ultimately to achieve poverty & jobless alleviation goals.

Of course Indonesia as a tropical country has many other biomass resources which can be developed and utilized as energy resources such as coconut (*Cocos nucifera*), corn (*Zea mays*), sorgum (*Sorgum bicolor L.*), *arenga pinnata*, rubber (*Hevea brasillensis*), sunflower (*Helianathus annuus*), nipha (*Nypa fruticans*), sweet potato (*Ipomoea batatas L.*), sago (*Metroxylon sp.*) and many others.

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7.7 Cambodia

7.7.1 Biomass resources in Cambodia

Biomass resources such as wood and agricultural residues are abundant in Cambodia. It is estimated that biomass fuel accounted for some 80% of the national energy consumption (MIME 2001) but biomass fuel used for power generation is limited for a few small-scale projects and negligible amount among the total national power production. Woody biomass accounts for more than 95% of the biomass energy used in the country.

According to our initial survey, rice husk and some other agricultural residues, old rubber wood occurred as the result of new planting and forest wood from plantations and managed natural forests are high potential energy source for electricity generation. The status of those high potential biomass resources is described below:

(i) Rice Husk: In 2003, rice was cultivated in 2.3 million ha of the field and 4.7 million ton was produced (MAFF 2003). The COGEN3 program which is funded by European Commission to promote the use of cogeneration in ASEAN countries has conducted a pre-investment study for a potential biomass-fired cogeneration project of 1.5MW electrical capacity at the Angkor Kasekam Roongroeung rice mill just outside Phnom Penh .

(ii) Cashew Nuts Shell: The cashew *Anacardium occidentale* is a tree in the flowering plant family, Anacardiaceae. Cashew nut is the single seed of the cashew fruit. Cashew nuts trees have been planted 37,140 ha in Cambodia (MAFF 2004) and the number of grower is increasing. The production in Cambodia would be 14,000 t/yr.

(ii) Other Agricultural Residues: Bagasse is the residue of sugar processing from sugarcane.

It represents 30% of total sugarcane weight. Direct combustion power generating system has been widely introduced to the sugar processing factory in the major sugar production countries. Cambodia produced 330,649 t of sugarcane in 2003. The production of cassava in 2003 was 330,649 t and the area of coconut farm was 27,054 ha. The productions of coconut and cassava residues are not known. The peanut production in 2003 was 18,483 t. Peanuts shells represent approximately 30% of the total weight of the peanuts.

(iv) Woody Biomass from Forests : The 95% of population is dependent on woodfuel for cooking (NIS 1999) and the biomass energy covered 86% of the total national energy supply (ADB 1996). The total fuel wood consumption was estimated about 6 million m^3, while log production estimated 1.5 million m^3 in 1995 (World Bank and others 1995).

(v) Plantations: There are total 11,125 ha of forest plantations mainly with *Acacia spp.* and *Eucalyptus spp.* in Cambodia (2003). The purpose of plantation of most case is production of wood chip materials for export.

(vi) Tree Farming: Tree farming of fast growing species is an appropriate method of supplying biomass for village level electrification. Anlong Ta Mei Community Energy Cooperative in Battambang province, the only biomass electricity generation operating in practical manner in Cambodia uses tree farming system for fuel supply.

(vii) Community Forestry: Community forestry (CF) is recognized as an important strategy to manage the forest at sustainable manner in Cambodia. The majority case of CF activity is managing existing primary or degraded forest rather than reforestation by planting.

7.7.2 Current Biomass Electrification Used in Cambodia

There are biomass fuelled electricity generation facilities in Cambodia.

(i) Centre for Livestock and Agriculture Development (CelAgrid)

CelAgrid is the institute conducting various research on rural development mainly based on agricultural technologies. There are 17 academic staff and 40 students working in the institute. They purchased a 9 kWe (gross) biomass gasification electricity generation system from Ankur Scientific (India) in September 2004. Center's currently conducting a research on comparing different biomass such as coconut husk, cassava stem, mulberry stem and Cassia tree for suitability and efficiency for gasification.

(ii) Anlong Ta Mei Community Energy Project

Anlong Ta Mei village (Bannan District, Battambang Province) community energy cooperative project is the only biomass electricity supply system operated profitable base rather than research. The project introduced a 9 kWe biomass gasification electricity generation system (same model as CelAgrid) and set up a mini grid. They use planted *Leucaena* branches for the fuel. They started the operation in February 2005.

(iii) NEDO and Biogas Hybrid Power Generation Project

In December 2003, Japan's NEDO completed the construction of a hybrid electricity generation system consist of a solar photovoltaic (50 kW) and 2 x 35kWe duel fuel biogas engine near Sihanoukville. The biogas is extracted from cattle excrements from a farm. The system is currently operating but the project is considered to be mainly a demonstration and research venture and would not economically viable yet.

7.7.3 Wood and Other Biomass Use in Cambodia

- □ 94 % of fuel wood is used directly as fuel,
- □ 6 % of fuel wood is converted to charcoal,
- □ 90 % of total fuel wood supply is consumed directly by households in rural areas,
- □ 8 % of total fuel wood supply is used in other urban households,
- □ Less than 1 % of total fuel wood supply is used in industrial sector,
- □ Less than 1 % of total fuel wood supply is used in service sector
- □ The other biomasses such as wood, wood waste and rice husk are used by brick kilns, bakeries, and food processing,
- □ Cane husk, palm branches and tree leaf are used by cane sugar and palm sugar producers,
- □ Coconut branches, coconut husk and rice husk are used by rural households for cooking animal food,
- □ Some rural households use coconut branches, palm branches, rice straw with cow dung, rice husk and wood waste for cooking their food.
- □ They use these biomasses for directly firing.

7.8 Malaysia

In Malaysia, biomass resources are mainly from the palm oil, wood and agro-industries. All of these residues come in many forms such as palm oil mill residues, bagasse, rice husks and wood/forest residues. Major sources of biomass come from the oil palm residues in the form of empty fruit bunches (EFB), fibers, shells, palm trunks, fronds and palm oil mill effluent (POME). The energy content in each residue is different to each other. This is mainly because the caloric value, moisture content and some other parameters that are different.

As shown in table below, the palm oil residues accounts for the largest biomass waste production in the country. This is because the palm oil mill residues are easily available and are presently requiring cost effective means of disposal. Currently, most of these residues are disposed of through incineration and dumping. A small portion is used as fuel for the mills' heat and power requirement in a very inefficient manner.

Table 7.8.1. Biomass and energy resource potential.

Sector	Quantity kton / yr	Potential Annual Generation (GWh)	Potential Capacity (MW)
Rice Mills	424	263	30
Wood Industries	2177	598	68
PalmOil Mills	17980	3197	365
Bagasse	300	218	25
POME	31500	1587	177
Total	72962	5863	665

7.8.1 Biomass energy utilization in Malaysia

The abundant biomass resources coming mainly from its palm oil, wood and agro-industries are used mainly to produce steam for processing activities and also for generating electricity. Biomass fuels contribute to about 16 percent of the energy consumption in the country, out of which 51 percent comes from palm oil biomass waste and 27 percent wood waste. Other biomass energy contributors are from plant cultivations, animal and urban wastes. There are currently about 400 palm oil mills in operation, which self generates electricity from oil palm wastes not only for their internal consumption but also for surrounding remote areas. Studies also found that 75.5 percent of the potential biomass that can be harnessed in Malaysia is unutilized and wasted.

7.8.2 Oil palm residues

The oil palm industry generates residues during the harvesting, replanting and milling processes. The residue that comes from the milling processes are fruit fibers, shell and empty fruit bunches (EFB). Other residues including trunks and fronds are available at the plantation area. Currently shells and fibres are used as boiler fuel to generate steam and electricity for the mill's consumption. The EFB is return back to the plantation for mulching. This is only practiced in bigger plantations. For old palm oil mills, the EFB is burned in the incinerator to produce fertilizer. However, there are still palm oil mills disposing the EFB through landfill method particularly the mills without enough plantations or estates.

Palm oil mill effluent (POME) is the wastewater discharged from the sterilization process, crude oil clarification process and cracked mixture separation process. The amount of POME generated depends on the milling operation. For a palm oil mill with good housekeeping, it is estimated that 2.5 tonnes of POME are generated from every tonne of crude palm oil produced. The average value for Malaysian palm oil mill is 3.5 tonnes for every tonne of crude palm oil produced. The POME contains high chemical and biological oxygen demand, total solids and require a treatment system before it can be discharged to the environment. Biogas is generated from the biological treatment of POME. The composition is mainly methane (60-70%) and carbon dioxide (30-40%). The calorific value is between 4740-6560 kcal per Nm^3 and the electricity generation is 1.8 kWh/cm^3 of biogas. Some plantations practice zero waste management system.

Table 7.8.2. Residue product ratio and potential power generation from palm oil mill residues.

Type of Industry	Production Year 2002 (Thousand Tonnes)	Residue	Residue Product Ratio (%)	Residue Generated (Thousand Tonnes)	Potential Energy (PJ)	Potential Electricity Generation (MW)
Oil Palm	59,800	EFB at 65%MC	21.14	12,640	57	521
		Fiber	12.72	7,606	108	1032
		Shell	5.67	3,390	55	545
	Total Solid			16,670	220	**2098**
	POME @ 3.5m³ per ton CPO or 65% of FFB)			38,870		**320**

7.8.3 Paddy residues

There are two seasons of paddy planted in Malaysia. The main season refers to the period of paddy planting from 1st of August to 28th February and off season covers the period of paddy planting from 31st March to 31st July of the year. The total paddy planted areas for Malaysia in the year 2000 was about 600,287 hectares and producing 2,050,306 tones of paddy. Malaysia is about 65% self sufficient in rice supply and another 35% is imported from Thailand and Vietnam. Paddy straw and rice husk are generated as biomass residue during the harvested and milling processes. The paddy straw is left in the paddy field and the rice husk is generated in the rice mill. Both of the biomass are discharged by landfill and open burning. Only a small quantity of rice husk is used for energy generation and other application such as silica production and composting.

It is assumed that only 2% of the rice husk is used for energy production. The balance is treated as landfill method. The paddy straw is usually burned in the open burning areas. The amount of rice husk and paddy straw generated in future are dependent on the planted area, the paddy yield and government policies on agriculture. The government plans to increase the yield from the existing rate to 10 metric tonne per hectare in the future. With this target value more rice husk and paddy straw is available for biomass CHP plant. The issue of solid biomass is difficulties in transportation and handling due to very low density and abrasive nature of the material.

Table 7.8.3. Residue product ratio and potential power generation from rice mill residues.

Type of Industry	Production Year 2000 (Thousand Tonne)	Residue	Residue product Ratio (%)	Residue Generated (Thousand Tonne)	Potential Energy (PJ)	Potential Power (MW)
Rice	2,140	Rice Husk	22	471	7.536	**72.07**
		Paddy Straw	40	856	8.769	**83.86**
TOTAL	2,140			1327	16.305	**155.93**

7.8.4 Sugar cane residues

Basically in Malaysia, there are only 2 out of 5 sugar factories, which use sugar cane as raw materials for refined sugar production. The other plants would use solely brown sugar as raw materials for sugar production. The main objectives of the industry are for food security supply, creation of jobs, development of industrial projects in rural areas and reducing foreign exchange.

Bagasse is the residue after sugarcane has been processed to remove the sugar juice. On average, about 32 % of bagasse is produced from every tonne of sugar cane processed. The amount of sugar cane processed in 2002 is about 1,111,500 tonnes. Thus, the amount of bagasse produced is 355,680 tonnes. This bagasse is not wasted as it acts as a biomass residue fuel to the boiler for its cogeneration plant. This saves the factory expenditure in boiler fuel oil and electricity expenses.

At the current rate of usage, all of the bagasse is used as fuel for its cogeneration plant. In fact there is insufficient bagasse for the sugar mills. Thus, they are buying other biomass residues such as rice husk, wood off cuts and palm oil residues to be used as fuel.

7.8.5 Wood residues

Total forest areas in Malaysia are about 5.9 million hectares. Only 1.29% of the total area is allowed for logging industry. The balance is mainly for permanent forest estate, forest plantation, state land, and wildlife reserve and annual coupe for permanent forest estate. Wood industries are mainly referred to the logging industry, saw milling industry, the panel product industry (plywood, veneer, particle board, and medium density fibre board), the moulding industry and the furniture industry. The forest industries are rapidly moving away from manufacturing low value products to value added products. These industries generated different type of biomass residues namely sawdust, off cut and wood barks. A waste minimization program is implemented in the wood based industries due to shortage of tropical wood supply. A value added such as particle board and finger joints are manufactured from the wood waste for the furniture industry.

The wood industries maximized the biomass residues into the value added products. The residue such as off-cut from the saw mills is used as fuel for the kiln drying or sold as boiler fuels. The middle portions of the log from the plywood and veneer mills are used as boiler fuels. The remaining wastes are mainly the bark and the saw dust. In the isolated areas they are burned in the incinerator or boiler to produce heat.

The generation of biomass residues from the wood based industry is declined due to limited supply of logs and maximization of residues into value added product. The biomass from the processing plants is used as fuel for their combined heat and power plant or sell to the potential users such as brick manufactures. The chart below shows the estimated potential energy and electricity from the waste generated from the saw mills, plywood and moulding plants.

7.8.6 Municipal solid waste (MSW)

The Malaysian population has been increasing at a rate of 2.4 % per annum or about 600,000 per annum since 1994. With this population growth, the MSW generation also increases, which makes MSW management crucial. Currently, the MSW is managed mainly through landfill. However, due to rapid development and lack of new space for it, the big cities and islands are considering incineration to tackle this problem.

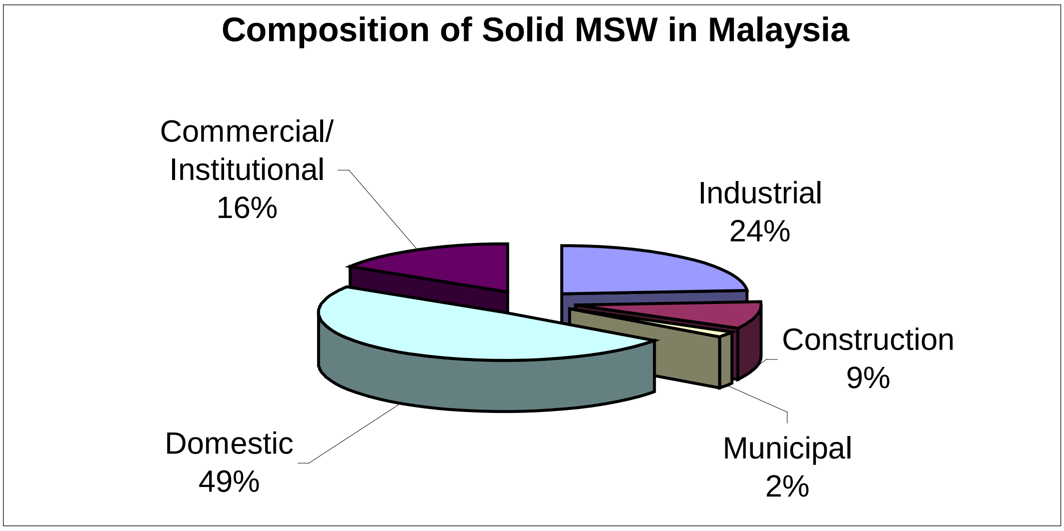

Fig. 7.8.1. Pie Chart of Typical Malaysian MSW Composition.

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7.9 Philippines

7.9.1 Fundamental energy policy

The Philippine Energy Plan is focused on its primary goal of energy independence and power market reforms.

As a major reform agenda of the Arroyo Administration, the objective of the energy independence package is to reach an energy self sufficiency level of 60% by 2010 and beyond. To realize this goal, five major strategies have been identified and this includes two major strategies directly related to renewable energy (RE) to include biomass energy. The two major strategies are the following: 1) intensifying renewable energy resource development and increasing the use of alternative fuels.

7.9.2 Intensifying renewable energy resource development

In line with the government's intensified efforts to promote RE development and use, the Philippine Department of Energy (DOE) formulated the Renewable Energy Policy Framework which embodies its objectives, goals, policies and strategies as well as programs and projects to further develop the RE sector within the perspective of the sector's supply and demand prospects and its current stage of development. Specifically, the identified long-term goals are the following: (i) increase RE-based generating capacity by 100 percent within the next ten years; and (ii) increase non-power contribution of RE to the energy mix by 10 MMBFOE in the next 10 years. Included in these goals is the increase in the contribution of biomass, solar and wind in power generation.

Resource Potential

Based on current projections of the Philippine Department of Energy (DOE), RE will provide at least 40 percent of the country's primary energy requirements for the next 10 years beginning 2005. Other RE such as biomass, used mostly for non-power applications, will remain to be the largest contributors to the total share of RE in the energy supply mix with at least 30 percent share. According to the Power Development Plan, biomass will provide 30 MW capacity in 2007 and will increase to 55 MW in 2008.

Based on the study, "Power Switch and Strategies for Clean Power Development in the Philippines", the country has a potential resource capacity of 235.7 MW from bagasse resources. Other studies as well, shows the potential of the country for several small 1-2 MW rice hull fired power plants just like 1 MW rice hull fired power plant currently installed in the Northern part of Luzon.

7.9.3 Increasing the use of alternative fuels

The government will continue to promote the use of alternative energy in the transport sector particularly biofuels (i.e cocobiodiesel or cocomethyl esther, fuel ethanol and jatropha carcus.)

The President has signed into law RA 9367 or the Biofuels Law that mandates the use of biodiesel and bioethanol nationwide.

At present, biodiesel is already being used nationwide at 1% of the total volume of diesel sold.

This is in accordance with the provision of the Law that , three months after the approval of the Act, a minimum of 1% biodiesel by volume shall be blended into all diesel engine fuels sold in the country. The country has 211.3 million liters per year capacity from 5 accredited biodiesel producers.

Biodiesel requirement in 2007 is 41 million liters at 1% blend. 100% compliance nationwide.

Targets:

Within two years from the effectivity of the Act, the Philippine Department of Energy, may mandate a total of 2% blend depending on the results of the study by the national Board created under the Act. Provided that the ethanol and biodiesel blends conform to Philippine National Standard. Two years from the effectivity of the Act, at least 5% bioethanol by volume of the total volume of gasoline fuel sold and distributed by each and every oil company in the country. Within four years from the effectivity of the Act, the Philippine Department of Energy, may mandate a mimimum of 10% blend depending on the results of the study by the national Board created under the Act.

Raw Material Requirement:

For bioethanol, supply of feedstock is initially from sugar based ethanol. With 880,000 liters per day committed capacity from various plants. Other feedstocks considered are sweet sorghum and cassava. For biodiesel, is currently from coconut oil or CME but Jatropha is also being considered.

Current feedstock yield: sugarcane has 23.98 million metric tons, corn has 5.25 million metric tons, and cassava 1.64 million metric tons. Coconut oil production is 1.4 billion liters per year (80% for export and 20% for local use).

Biodiesel requirement : 85 million liters in 2008, 229 million liters in 2010 and 277 million liters per year in 2015.

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7.10 Singapore

Singapore has always enjoyed a reputation as a "Garden City" for being "clean and green" due to its effective management of the urban environment and maintenance of the green space. With a land mass of approximately 700 square km and population of 4.5 million, it has also invested heavily on the environmental infrastructures such as waste water treatment and waste disposal facilities. Most recently, it has embarked on the recycling and reuse of the water resources under a program called "Newater" which has become a model for many countries to follow.

It is now 2008, energy security dominates international stage, crude oil price is nearing a record high of over $100 US a barrel, global warming and climate change are now household concerns. Europe-led market demand for biofuels is all the rage. Singapore claims to be the world's second largest petroleum refinery center with installed capacity of well over 1 million barrels/d. However, Singapore relies on the import of nearly100% of its raw energy supply. This reliance on imported fossil energy necessarily subjects Singapore's economic and environmental sustainability to external factors that all energy importing countries must also face. These included global oil/gas market fluctuations; political instability of the oil exporting countries; international protocol (Kyoto Agreement) to limit CO_2 emission from fossil energy use, as well as changes in public energy consumption patterns.

Government has encouraged development of clean, alternative energy programs such as the Sinergy Program which provided a testbed for hydrogen based fuel cell vehicles since the 1990's. More recently, it has announced major R&D funding program on clean and renewable energy. It has successfully attracted major investments for the manufacturing of solar-PV panels with the announced capacity of 1,500 MWe per year, as well as a wafer manufacturing plant to provide the mono-silicon materials needed for the solar cells.

On the other hand, private sector investors have taken advantage of Singapore's strategic location in the tropical SE Asia together with its well established infrastructures for crude oil handling, storage, and refineries. Singapore is benefiting directly from its proximity to this rich repository of biomass resources. In recent years, Singapore has attracted major foreign direct investments in biodiesel production facilities. All together, 6 biodiesel production projects have been confirmed, with a total combined capacity of close to 2 million tonnes/per year and the total investment dollars is close to S$2 billion. All of these investments aim to bring in crude plant/seed based oil from the region and refine them in Singapore. A regional biofuels analysis center is also being set-up to cope with the anticipated demand from all these activities.

Domestically, Singapore generates about 650,000 Tonnes/year of biomass wastes which includes food waste, wood/timber wastes and sludge/biosolids. Many of the woody biomass comes from the thriving shipping/trans-shipping industry in Singapore where wooden pallets are routinely disposed when they become unrepairable. Increasingly, the government of Singapore, through the National Environment Agency (NEA) and private sector investors are exploring opportunities for their energy recovery and utilisation. Once plant has been built by local investor to convert food waste to biogas, another diverts about 600 tonnes/d of municipal solid waste (MSW) for recycling and reuse, of which about 300 tonnes/d of woody biomass are used as fuel for cogen. The third recovers energy and generates hot water from horticultural wastes. Government is now encouraging more opportunities for diverting biomass waste from the incinerators and landfill sites. It is expected that more private sector investment will see the economic benefit for recovering energy from the biomass resources.

In summary, Singapore is in the forefront of bioenergy R&D, it is also racing ahead to explore more sustainable 2nd and 3rd generation of biofuels technology and will likely to lead the commercial developments of these renewable energy due to its pro-active government policies for attracting investments.

7.11 Thailand

The Royal Thai Government launched a strategy to increase renewable energy share in the energy mix since 2005. This was a cabinet resolution, binding all governmental agencies to harmonize policy direction to achieve the declared policy targets. In response to this policy needs, the Ministry of Energy has set forth the seven strategies for energy sufficiency development as follows.

1. Establish the independent organization to regulate electricity and natural gas
2. Foster energy security by recourse to His Majesty Sufficiency Initiatives
3. Promote efficient energy usage
4. Promote the development of renewable energy
5. Seek for appropriate pricing structure for energy
6. Establish clean energy development mechanism
7. Encourage private sectors and the public to contribute to policy making process.

Targets of Biomass-derived energy :

The target set forth by the government is that Thailand must increase the share of renewable energy in the final energy consumption from 0.5% in 2005 to 8% by 2011 (6,540 ktoe). The target for renewable share in the transportation fuel is 3% for biofuels i.e. bioethanol use must be at leat 3 Million L/day and biodiesel must be 4.0 Million L/day by 2011. A target for biomass-deriveded heat and steam is 4% equivalent to 3940 KTOE by 2011. A share of 1% was set for electricity from renewable resources which is equivalent to 3251 MW by 2011. Due to recent price increase of crude oil, an adjustment of the target has been announced by the government to start implementing E20 gasohol (20% blend of ethanol into gasoline) on January 1st 2008 and B2 (2% blend of biodiesel into biodiesel) has been mandated since February 1st, 2008. This implementation has made Thailand the first country in Asia to fully commercialize both bioethanol and biodiesel blends all over the country.

Duties

The policy targets and implementation milestones are reviewed and adjusted periodically and reported to the government by the National Energy Policy Committee.

Biomass utilization

At the end of 2007 more than 4000 service stations distribute E10 gasohol all over the country and all stations distribute B2 as mandated by the government. B5 biodiesel blend is now available in more than 3000 stations. Bioethanol used in December was 600 KL/day in average. Biodiesel used was 150 KL/day in for low-blend of 2-5% before the mandatory period. After the mandate of blending 2% biodiesel in all highspeed diesel, the use of biodiesel jumped to above 1 million l./day level in February 2008. Renewable eletricity production reached 2057 MWe and biomass-based heat and steam was 1840 KTOE in 2007.

Amount of biofuel production

Biodiesel Production is about 1,150 KL/day; production capacity is 2,185 KL/day. Bioethanol Production is 700 KL/day (Feb.2008) and the production capacity is 1,150 KL/day.

Situation of biofuel introduction

Biofuel introduction is now accelerating in Thailand. Bioethanol-blended gasoline (E10) is now reaching 6 ML/day out of 20 ML/day of total gasoline consumption and the bioethanol blends(E10) gained a market share of 23% of all gasoline use at the end of 2007. Biodiesel-blended diesel is now 3 ML/day out of 50 ML/day total diesel consumption in December 2007. The consumption figure for Feb. 2008, the market for B5 was 5ML/day of the total diesel market of 50 ML/day, the rest of the fuels were B2 blended as mandated by the government.

Energy crops

For ethanol, 1-2 million tons of molasses are used as raw material (this is by-product from sugar production which is about 5 million tons from 64 million cane production), another raw material for ethanol is cassava, only 180,000 tons out of 26 million tons of cassava roots is used for ethanol production. For biodiesel, about 100,000 tons of palm oil is used for biodiesel out of 1.5 million tons production in 2007. The use of palm oil for biodiesel in 2008 is expected to reach 300,000 tons levels.

Future prospects

Many new ethanol plants using both molasses and cassava will begin production in 2008; it is expected that by December 2008 the total production capacity will reach 8 Million litres /day and Thailand can produce much more due to the surplus of raw materials for ethanol. As for biodiesel, the government started to promote the new oil palm plantation with a target to increase area by 200,000 acres/year for the next 5 years so that raw material will be sufficient to meet the target for biodiesel production. By 2011, it is expected that Thailand will have 1.1 million hectares of oil palm plantation, at least half of the production will be used for bioenergy production by 2011. In this respect, the bioenergy crop development in Thailand, given the appropriate policy implementation, will be the new engine of growth to increase the income for rural agricultural sectors. It is also foreseen that co-operation among the Greater-Mekong subregion in biomass energy areas will also enhance the significance of energy sufficiency development in the region.

Successful examples

Thailand is today the only country in Asia to adopt bioenergy into the main consumer market where both bioethanol and biodiesel blends are available in all region of the country. Renewable electricity and heat/steam are also promoted in the industry and substantial progress are being made to meet the target set by the government.

MTEC and NSTDA will focus on the R&D efforts to help the industry and the small and medium enterprize to adopt and integrate bionergy into their respective energy production and utilization. The success of Thailand will be a good example for other countries in the region, especially LPDR, Cambodia, Myanmar and Vietnam, to explore the ways forward with this new developmental vehicle. It is expected that CDM mechanism and climate-change adaptation schemes will become a significant developmental issue in the coming years.

7.12 Vietnam

7.12.1 Governmental policy

Project No 177/2007/QD-TTg (Nov. 20, 2007) of Gov. for development of biofuels to 2015 and line of vision to 2025 and Gov. Strategy No 1855/QD-TTg (Dec. 27, 2007) for development of National Energy to 2020 and line of vision to 2050. The government approves a new and renewable energy as 3, 5 and 11% to 2010, 2020 and 2050 respectively. There are no duties for biomass introduction. Ministry of Industry and Trade; Ministry of Science and Technology; Ministry of Agriculture and Rural Development; Ministry of Natural Resources anfd Environment.

7.12.2 Utilization of biomass

Availability, amount used, and how to use, for each biomass is listed below.

- Livestock waste: availability: Pig dung - 25.7 million tons/year; Cattle dung - 20.2 million tons/year; Buffalo dung - 16.0 million tons/year; Municipal garbage - 6.4 million tons/year , amount used 70-80% (compost; fertilizer; Biogas...
- Food waste: availability not determined (animal feed)
- Paper: consumpition 997,400t/year, amount used 70% (recylce)
- Black liquor: availability not determined, amount used 40% (combustion)
- Sawn wood: 3,414 thous. m^3 Lumber-mill residue: amount used 100% (energy use)
- Forestry residue: availability 1,648.5 thousand tons/year, amount used 0%
- Non-edible portions of farming crops: availability: rice straws:76 Mt/year; rice husks 7.6 Mt/years; Bagasse2.5 Mt/year, amount used 20% (compost, animal feed, animal bedding material, electrcity, Mushroom production...); 73,800 tons of used cooking oil; 60,000 tons of "Basa" fish oil (2005) now producing 10,000-tons/year

Amount of biofuel production is shown below.
Bioethanol
Feedstock: Casava, molasses, rice
Production:76.63 ML in 2006.
Biodiesel
Feedstock: waste cooking oil; Basa fish oil; rubber oil; Jatrofa
Prodution: R&D project"
Biofuel introduction has not been made, but by plan of Gov. to 2021 will be 100,000 t of E5 and 50,000 t of B5 available on the market

7.12.3 Energy crops

Amount of production and utilization of energy crops are none, but in the future, introduction of 2 ethanol factories using cassava, each productivity of 100 ML/year (1 factory produces 50ML/year using molasses and sugarcane) is planned.

7.12.4 Successful examples

40,000 family-size biogas digesters (1-50 m3) had been installed. Development of new technology for biofuel production from agricultural residue is under way.

7.13 Japan

7.13.1 Policy

New Energy Promotion Law (Jan. 2002) approves bioenergy as a "new energy", and supports its introduction. The council for energy in METI (Ministry of Economy, Trade and Industry) publishes the target values for “new energy” at 2010; thermal use of biomass, 3.08 million kL oil equivalent, and electricity production from biomass and wastes, 5.86 million kL oil equivalent. These values, however, have no duty.

The strategy for biomass utilization “Biomass Nippon Strategy” was published in cabinet (Dec. 2002). The target values at 2010 were revised (Mar. 2006); biofuel for transportation, 0.5 million kL oil equivalent, utilization rate of unutilized biomass, 25%, number of “Biomass Town”, 300 areas. Ministry of Agriculture, Forestry, and Fishery approves municipalities that utilize biomass based on the characteristics of the region as "Biomass Towns".

7.13.2 Status of biomass utilization

The status of biomass utilization in Japan is shown in Fig. 7.13.1. Livestock waste is used as compost etc., food waste as compost and animal feed, lumber-mill residue as energy and fertilizer, construction-derived wood residue as paper production, particleboard production, animal bedding material, combustion etc., sewage sludge as construction material and compost, non-edible portions of farming crops as compost, animal feed, animal bedding material etc. paper waste as recycle and heat production, black liquor as combustion use. Forestry residue is not any used.

Bio diesel fuel from waste cooking oil is produced around 3,000 t/year. Bio-ethanol production is almost in R&D stage, and bio-ethanol is produced commercially 1,400 kL from waste wood in 2007. Test sales of ETBE-mixed gasoline (3%-EtOH equivalent) and E3 just started in 2007.

Energy crops is not tried yet. Introduction is limited due to the limited land and high labor cost, although test production of sugarcane and ethanol production is going on in Okinawa.

7.13.3 Successful example

The First Energy Service Co., Ltd., commercially collects waste wood and produces electricity. They established 3 power generation companies using waste wood; 10,000 kW at Iwakuni Wood Power Co., Ltd., 11,500 kW at Shirakawa Wood Power Co., Ltd., and 12,000 kW at Hita Wood Power Co., Ltd.

7.13.4 Other comments

Non

Further information

MAFF webpage: http://www.maff.go.jp/j/biomass/index.html

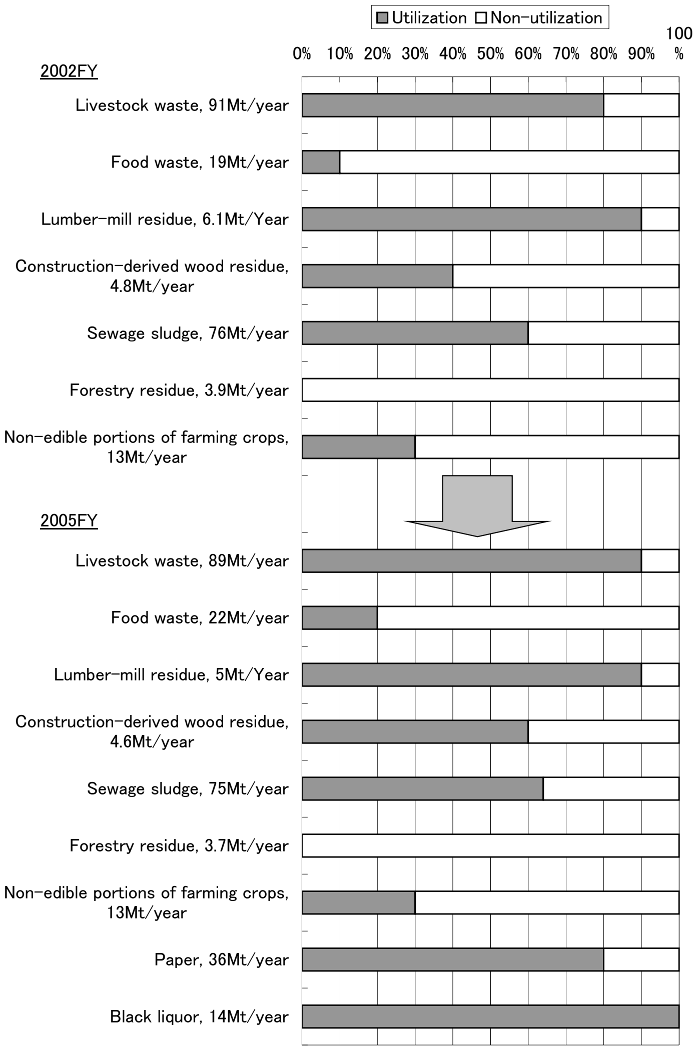

Fig. 7.13.1. Status of biomass utilization in Japan.

7.14 Taipei, Chinese

7.14.1 Policies, mandatories, and targets

One of the key tasks of energy policy in Taiwan is to stabilize energy supply to increase energy independence. The installed capacity of power generation from renewable energy is identified to be 12% in total to enhance energy self sufficiency, and the target of 10% in total is set to be reached in 2010. Power generation from biomass and wastes is set to be the third largest sources of renewable energy, which is 1.44% in total (741MW) in 2010. In order to promote the utilization of renewable energy, the "Renewable Energy Development Bill" has been drafted and submitted to the Legislative Yuan for approval.

The application of biofuels to transportation sector is in growing trend in recent years. The pilot project started by Environmental Protection Administration is to blend 20% of biodiesel (B20) to garbage truck from 2004. Since then, the Bureau of Energy proceeded the demonstration project with four stages. Firstly, the Green Bus Project was started in 2006, which 2% of biodiesel (B2) is blended to bus fleet operated by public sector. Secondly, test sales of B1 at gas station of Taoyuan county,

Chiayi city, and Chiayi county was started in 2007, which is called Green County Project. Thirdly, the target of B1 sales at all gas station will be reached in July, 2008. Finally, the target of B2 applied in nationwide area, which is estimated to be 100 dam^3/year (100,000 kL/year) in total will be reached in 2010.

The application of bioethanol was started in 2007, test sales of E3 at 8 gas station in Taipei city is focused on official's car, and private car is also encouraged to use. The target of E3 at all gas station of Taipei and Kaohsiung city will be started in January, 2009. It is expected to use E3 in nationwide area in 2011, which is estimated to be 100 dam^3/year (100,000 kL/year) in total.

Up to now, subsidizing for biomass utilization is still inevitable. The related mandatories are listed below:

- Measures for purchasing electricity from renewable energy sources
- Measures for rewarding methane power generation in landfill
- Measures for subsidizing energy crop green bus projects
- Measures for subsidizing green county promoting projects
- Measures for subsidizing green official's car pilot projects

Considering the area of farm to cultivate energy crops is limited, it is possible to import biofuels from abroad. The "Petroleum Administration Act" should be revised to enhance the management of imported renewable energy, such as bioethanol, biodiesel etc.

7.14.2 Amount of resources

Up to now, most of biomass utilization in Taiwan is wastes and residues. The noticeable items are listed below:

- There are 24 municipal solid waste incinerators equipped with power generation facilities, and total capacity is 528.8 MW.
- There are installed capacity of power generators utilizing biogas generated from 4 large landfills and some middle to small scale pig farms.
- There are also some power plants using industrial and agricultural wastes, including bagasse, paper mill waste, plastic waste, rice hull and RDF-5 (Refuse Derived Fuel) etc. The total capacity of these plants is around 67.5 MW.

In addition, the enforcement of recycling used frying oil was started in September, 2007 for enterprise. Household is also encouraged. The potential biodiesel product from used frying oil is estimated to be around 80,000 kL/year.

In the near future, 80 km^2 (8,000 ha) of rested cultivating farm is planned to cultivate energy crops. The potential of farmland for cultivating energy crops could be 5,000 km^2 (500,000 ha).

If seaweed could be cultivated around 100 km^2 (10,000 ha) of seashore, the potential product of 150-300 dam^3 (150,000-300,000 kL) biodiesel is expected.