

Proceedings of International Seminar on Rural Biomass Energy &  
ASEAN Plus Three (China, Japan and Korea) Forum on Biomass Energy

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# 中国农村生物质能源国际研讨会 暨东盟与中日韩生物质能源论坛论文集

Edited by

Ministry of Agriculture of the People's Republic of China

Asian Development Bank

中华人民共和国农业部 编  
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# Policy of Biomass Energy in Thailand

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## 1. Background

In 2007, the energy consumption in Thailand accounted for a value of about 1500 billion Baht (about US\$ 47 billion), which was about 17% of the Gross Domestic Product (GDP), and the value of imported energy was greater than 870 billion Baht (about US\$ 27 billion). The economic growth and the inefficient energy utilization in Thailand are responsible for the rising energy elasticity to an alarming figure. As a country depending on more than 50% of imported energy while biomass potential is substantially high, it is a pressing need for Thailand to develop a renewable energy program to reduce energy supply risk and to contribute to global GHG emission reduction. Renewable energy has continuously contributed to Thailand's energy supply at a portion of around 17%. However, almost all renewable energy use is from traditionally burning of firewood, charcoal and agricultural wastes. Less than 1% has been converted to modern forms of energy such as electricity, methane and liquid biofuels.

In 1992, two institutional infrastructures were formed to tackle the energy problem. They are the Energy Conservation Promotion Act and Energy Conservation Fund. As suggested by the names, 'energy conservation' was the priority of these supporting legal and financial frameworks. Government departments were assigned to formulate the policy and implement the energy-related measures and, consequently, the increasing use of indigenous energy resources was one of the energy strategies. The past policy to promote renewable energy was based on the investment subsidy mechanism, which, according to many energy experts, could not be claimed as a successful mechanism. Since setting up of a new Ministry of Energy in October 2002, the energy policy has been reviewed. This led to preparation of the present renewable energy strategy endorsed by the Cabinet on 2 September, 2003.

This paper gives general background of the biomass energy (including biogas) in Thailand. Biomass resource potential is analyzed and discussed. Biomass energy promotion programs in the past have been reviewed. Barriers to the promotion of the biomass energy and lessons learnt are also presented together with suggestions for policy change to accelerate the utilization of biomass energy.

## 2. Biomass energy promotion mechanisms

The Energy Conservation (ENCON) Program was launched in 1994 to set guidelines, criteria, conditions and priorities for the ENCON Fund allocation. The ENCON Program comprised three sub-programs based on the nature of the work/projects. Two government agencies, NEPO (now EPPO) and DEDP (now DEDE) are implementing agencies of the ENCON Program. Renewable energy funding was

allocated under the voluntary sub-program. EPPO is the implementing agency of the Voluntary Sub-program. The objective of this Sub-program is to support and collaborate with other agencies in both public and private sectors, in order to achieve the following:

- Efficient use of energy in the production processes of both agricultural and rural industries
- Wider utilization of renewable energy, thereby resulting in less adverse impact on the environment
- Marketing of products and services contributing to energy conservation
- Promotion of studies and R&D on energy and energy conservation technologies as well as the application of study/research outcomes in factories, buildings and households.

The Voluntary Sub-program comprises four main projects, namely Renewable Energy and Rural Industries, Industrial Liaison, Research and Development and Energy Conservation in Non-Designated Factories and Buildings. The ENCON Fund Committee has allocated a total budget of 3 176 million Baht for the implementation of 161 projects of the Voluntary Sub-program during the fiscal period 1995—2002.

### 3. Strategic plan for renewable energy development in Thailand

The framework of national energy strategy, which includes renewable energy development, has been approved in principle by the cabinet resolution of 2 September 2003. The objective of the renewable energy development is aimed to replace fossil fuel. Thailand, by the Ministry of Energy, has set the target to increase the share of renewable primary energy from 0.5% (265 ktoe) in 2002 to 8% (6 540 ktoe) by the year 2011. According to the national strategic plan, about 1 380 MW of new power capacity during the next 8 years will come from several renewable energy sources. The major sources are biomass (1 055.7 MW) and biogas (28.8 MW). The following measures will be implemented.

(1) Establish the regulation or legal enforcement on the Renewable Portfolio Standard (RPS) for new power plants that 5% of their generation capacity must be generated by renewable energy such as solar, wind or biomass.

(2) Devise incentive measures encouraging purchase of power generated by renewable energy, for example, provision of tax credit, privilege, and subsidies from the Energy Conservation Promotion Fund.

(3) Support research and development on renewable energy of which Thailand has high potential, such as solar, micro-hydropower, wind and biomass (agricultural wastes and municipal wastes).

(4) Encourage participation and partnership of the local communities in renewable energy fueled power plants.

Nowadays, in Thailand biogas digester is the popular project of livestock farms to invest as waste treatment system. Not only is waste reduced, but also is biogas produced. Biogas is used to substitute the use of any form of fuels such as fuel wood, charcoal, liquefied petroleum gas (LPG) for cooking and to generate electricity. Using biogas does not increase the concentration of carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) in the atmosphere. Consequently, the biogas digester is chosen as one of the strategies to reduce energy consumption and the corresponding emissions in rural Thailand. At present, biogas project seems very successful, especially in pig farms. ENCON Fund has committed 961 million Baht for financial subsidy (for system construction) to pig farm biogas projects. The total capacity is 326 000 m<sup>3</sup> (gas), which is sufficient to treat manure from 2.3 million heads of pigs. Considering the total head count of 10 million pigs, there is opportunity to increase the biogas project and extend to other

livestock.

#### 4. Government policy

The Seventh Five-year National Economic and Social Development Plan (NESDP) (1992—1996) formulated various energy policy issues related to biomass energy utilization. It emphasized on developing domestic energy resources and encouragement of efficient use and conservation of energy.

The Eighth NESDP (1997—2001) was also stated the promotion of biomass utilization in Small Power Producer (SPP) scheme especially power production from biomass, and encouraged using of green energy sources in order to reduce the environmental impacts causing by green house gases (GHG) .

The Ninth NESDP (2002—2006) is aiming to promote on research and development of renewable energy especially on commercial technology, and to encourage public participation in setting the guidelines of energy utilization for sustainable development.

Recently, Thai government has set a target to increase the share of renewable energy from the present level of 0.5% to 8% by the year 2011.

#### 5. Problem of biomass energy utilization

The major limitations of biomass utilization in Thailand are difficulty in assessment of resources, inconsistent production, inappropriate properties such as low bulk density and high moisture content, problems of collection, transportation and storage, and availability and reliability concerns. In general, barriers in the development of biomass utilization in Thailand can be classified as follows:

**Institutional barriers:** Poor coordination among government agencies and especially with the private sector.

**Policy barriers:** The government policy to support renewable Energy SPPs through bidding process has drawn interest and private sector investments, but this measure seems to bias in favor of large scale and low power production cost SPPs.

**Technical barriers:** Lack of standards on bio-energy systems and equipment.

**Information barriers:** Lack of awareness/confidence in available new and renewable source of energy (NRSE) technologies and applications.

#### 6. Conclusion

Biomass is a major contribution to energy needs in the fast-growing country like Thailand. It is an essential source of energy for energy production particularly for saving the environment of the country. There are many potential biomass energy resources, which are suitable for energy production in both industry and residential sectors. Various technologies for biomass utilization are currently used, ranging from local made to imported technology. Still, many technologies used, especially in rural use and some factories, are considered to be quite an old technology with low efficiency. While there are several constraints still to be overcome, it can be clearly seen that there are enormous opportunities for promoting the utilization of biomass and improving an efficient and most promising biomass technology.

# **Biomass Energy: As an Abundant Renewable Energy for More Efficiently Productive Development in Thailand**

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**Abstract:** The investigation was resulted from an analysis study which were focus on biomass energy utilization and development in Thailand during the years 1988—2008. The aims were to find out the optimum modern technology to survive community economic declined and to gain the strategic implement for biomass energy development as the principle alternative energy for more outcome with high stability 2008—2012. Because of our location in tropical zone, suitable climatic for several trees / economic crops growing, so, it is consequently high potential with a huge biomass production from various cultivars of fast growth tree/economic trees , Economic crops and by - products from oil palm, rice husk and corn cob of which are available for heating power in biogas and ethanol processing. Accordingly, good skill on farming system of Thai-farmers that did not serious problem for yield increasing about those mentioned plants/trees through a long experience / local wisdom. But, the good quality of life and more benefits from higher price should be fair distributed to support farmers' income. With an energy shortage had rather be a good opportunity to agro-sector moving agro-products price was raising up and gained more income to farmers who is over than 60% still earning in agricultural production in rural. It may be good advantage for Thai-producers in the farmland, can be taken on demand increasing and limiting of energy supply. Technology development for more efficiency in commercial scale of biomass energy supply should be more useful as an important renewable energy and also arrive to the goal 10 % on fossil energy reduction in 2012.

In Thailand, a lot of biomass materials can be produced from abundance land including totally 20.96 Mha. of cultivated land, 7.68Mha of afforest plantation and 0.64 Mha. of waste land. Both biomass and crop residues need to enhance on research & development with highly attention promoting from its responsible organization along with the national strategic thrust. Meanwhile, biomass energy utilization and development in Thailand (biogas, gasification, power generation, bioethanol, biodiesel) has to join with another countries under international collaboration among Asian , China, Korea and Japan and developed country that will be obtained good advantage from opportunity of cooperation on biomass energy technology transferring as well.

**Key words:** Biomass energy, Alternative energy, Biogas, Gasification, Power generation, Bioethanol , Biodiesel.

## 1. Introduction

Thailand has been a member of ASEAN country since it has been established. Status of the country is gently joint to every international organization for raising her people with an ideal of human mandate being that is beloved in goodness and beautiful inside mankind as well as assistant to everybody and every nation who is living in the same earth look-like the brotherhood. The forgiveness is a first property of Thai-people, so, it can be easily heard “never mind” from anyone whenever it has been found a mistake without attention. In the same way, if there is unsatisfied to some categories, it is very smooth and highly patient with clearly shown to another as well as non-violence is the matter of our common life way. The philosophy of “ECONOMY SUFFICIENCY” how to find out a really happiness and calmness which was provided by His majesty our KING BHIPHOL, the beloved for everyone in his country, has become a normal practical as the best way for living/earning even in business profiles in Thailand. A principal of his theory is that of “RISK MANAGEMENT” such a security concerning for non-forecasting evidence if it will be happened such as drought stress, flooding stress and another perturbation. A sustainable development shall be in mind by every department wherever we will have to work with to public involved. Especially, with a project could be impacted to local farmers who are earning very closely to action area. Some works for shortage energy has been initiated including biomass energy derivative to surplus products from oil palm as biodiesel proceeding. This is a good example methodology how to solve on the problem of renewable energy for the country before a severe from oil crisis appeared to our country as well.

With the forwarding information, this report has been attached some necessary information about Thailand for more vision which covered three dimensions of overview comprising of the former time / history of the country, the common status (physical, economic and socio-political) and dynamic, comparatively that might be more understanding about some characteristics of Kingdom of Thailand, currently.

Meanwhile, the shortage of oil fuel has to more daily paid which is imbalance to income. Accordingly, so as to reduce troubling, a campaign in Thailand is ongoing persuade people turn to use NGV substitute to fuel oil. Subsequently, NGV and LPG demands is presently growing increased, continuously. But, some problems found that non-sufficient service stations distributed to various regional. In future, alternative energy for vehicle will be changed to natural gas beyond domestic production which is predicted by 25~30 years, consistently. The most essential energy for electricity power has to close up to supply to deficit location, especially, in the rural community far away from the metropolitan, in which an opportunity shall have to depended on biogas in order to supply electric current in those area. Also the moving on change behavior of our citizens for more save energy is gearing to motivate to every sector for participatory in this agenda task force.

## 2. Thailand energy situation and energy problem

It is well-known about Thailand as a leader country who has been feeding the world to be called “World Kitchen”. Due to our farmers has such a quite good skill for cultural practiced in their farming system both solid culture and mixed culture and another multiple cropping system. In additional climatic factor and physical feasibility comprised of optimum weather and suitable land as natural resource with a



number river supply. By the way, the shifting plant/crop for food changes to energy crops has been easily to adjust whereas market demands for biomass energy has been increased both domestic and exporting. Recently, in Thailand has also some arguments about food crops may be declined its supplying by competitive area of energy crops growing increased with higher demands for consumption in ethanol and biogas industrial after that, it is presently allowed to conduct, freely. By nature of suitable land for cropping is such a specific land for specific crop wherever lowland is suitable for rice cultivation. For awhile, upland is separated to grow field crops such as cassava, sugarcane, eucalyptus and para rubber etc. Actually, on the paddy soil is fitness for only rice field, exceptionally, after rice harvesting, it can be sequential cropping by legumes and another oil crop such as sweet corn, potato, sesame, sunflower etc. Horticulture and vegetable are preferred in the same land for resident or beside natural water resource/river/dam/reservoir as well. It is consensus that do not be worried about affecting on biomass energy expansion, because, it shall be never declined food land production and effect to food security in Thailand.

By the concept of our King has been given to his citizen that on each farmland should be grown 3 kinds of tree for 4 utilization purposes. The meaning that 3 kinds of tree are included of ①fruit tree, ② economic tree/fast growth tree and ③ household used tree. For then, the utilization 4 purposes are combined of ① edible ② fire/energy ③ construction/ multi-purpose and ④ shading. By his wisdom recommend it is lead to meet many acreage has been plant with a large number of tree as biomass energy plantation of those plants around farmland and public land area such school/college, government afforest, both of riverside, beside the roads and along canal and water reservoir. However, the effective land for generate biomass energy comprised of farmland, cultivated land and afforest land. Especially, there is not any evitable for us to choice on essential consumption energy, even though it has been shortage on energy and economic crisis impact increasing at the present. Biomass energy is an principle energy which is abundant production in Thailand. It can be gather direct from wood of tree/fast growth tree and crop residue from its by-product such as rice husk, bagases, starch solution from cassava industry and dung from animal farm etc. Whereas, the mentioned source for each of biomass details is concentrated by the next outline in this paper, furthermore.

From this investigation has been found that biomass energy can be abundant for more needed to research and development how to gain more efficiency used and reducing consumptive demands from oil fuel or fossil energy with more effective. Especially, the utilization is able to support to rural society where is settle far away from electricity available

### **(1) Thailand's outstanding energy problems**

①Thailand has limited indigenous fossil fuel reserves.

Thailand's main fossil fuel resources:

Natural gas

- Proven reserves (15579 bcf) will last 25-30 years at present rate of utilization.
- Lignite (installed capacity: 2400 MW)
- Reserves (2942 Mton) will last 60-100 years at present rate of utilization.

②Thailand has not been able to increase the contributions of the main indigenous energy resources to the country's energy demand.

Thailand's main indigenous energy sources:

Hydropower:

- current installed hydroelectric capacity: 3 000 MW

- reserve hydropower potential : 8 000 MW

lignite:

- installed capacity of lignite powerplants: 2 400 MW
- reserves: 2 342 Mton (2003)

- It has not been possible to develop additional hydropower and lignite powerplant projects due to public resistance.

The public confidence in utilizing coal and hydropower for large scale power generation is currently very low

③Although renewable energy sources appear to have great potential, their current contributions to the country's commercial energy need is not significant.

- Only about 400 MW of power generating capacity have been installed to operate on biomass and biomass residues during the past 5 years.
- About 6 MWp of PV have been installed and a 36 MWp solar home project for rural households has been approved and started.

The capacities of small hydropower and wind turbine systems installed during the past 5 years have not been significant

④Rising up oil price is having adverse effect on the country's economy.

- The burden of energy import on the economy has been rising.
- It is estimated that the energy import/GDP for 2005—2008 will be over 10%.
- Effect of energy import on the economy

	1998	2000	2002	2003	2004
Energy import/Total import (%)	8.3	12.6	12.1	13.0	14.6
Energy import/Total export (%)	6.5	11.3	11.4	12.2	14.3
Energy import/GDP (%)	3.2	6.4	6.2	6.9	8.7

## (2) Biomass resource in Thailand

Thailand is actually an agricultural country in which there are abundant biomass resources . Its amount of biomass can be estimated by existing land use of the earth surface in the country. From overview data of Thailand land use and classification by agro-ecological prospective that can be divided as major land as the following :

①Forest , Mountain and Conservation land covers 104 Million rai (16.64 Mha. ) may be 2.6 billion ton in dry weight that is equal to 900 Mt. TOE.

②Afforested land covers 48 Million rai (7.68 Mha) which has been already planted 11 Million rai (1.76 Mha. ) can be produced approximately 35.2 Million ton in dry weight of its biomass.

③Cultivation land covers about 131 Million rai (20.96 Mha) potential dry weight of cropped 2.00 ton per rai, give biomass about 42 Million ton , yearly. Those biomass are mostly gain from short duration crops, the major economic crops such as rice, cassava, sugar cane, corn, sorghum, eucalyptus, para rubber.

④Resident and Garden land covers about 4 Million rai (0.25 Mha) including rural angel forrest, temple, college/university, beside roads, both riverside etc.

⑤Water resource land covers 34 Million rai (5.44 Million ha) including natural water resource such as river, stream, and man-made such as dam, canal, water reservoir. This area can be found water

favourite plant included of hydrophyte plant, mesophyte plant. Algae will be culture for biodiesel produced as a high potential biomass energy in nearly future.

⑥In fact, biomass resources available for energy utilized mainly gain from crop residues, firewood, forest wood residues and organic refuses such as bagase, starch solution from cassava industrial, animal dung.

In Thailand, biomass that could be used as energy easily are major included of 4 source such as :

○ crop residues (rice husk, corn cob, ugar cane residue, cassava by product, solution from starch industry),

○ forest and wood residues,

○ animal dung (pig farm)

○ organic refuses.

### **(3) Industrial solid waste (ISW)**

Industrial biomass resource included solid waste from industrial processes such as ethanol distillery, paper mill, timber cutting, rice mill, sugar and food industry production. It is estimated that the total annual yield of biomass residue from the industry may be a large amount. These biomass sources come from ISW can be produced biogas as a good material . Then its current can be power generation for electricity supply to main system of electricity authority. This is good outcome from sell electric current to a government unit. In 2008 , it is ongoing pay attention to invest from many foreign investor in electricity generation from cassava by product at northeast region where has a big growing area and has many sites of cassava industries. The total value of various projects for promotion from BOI-Board of investment promotion is about 10 project over than 1200 million THB. The biogas factory will be established at KALASIN, UBOL RAJATHANI, and KHON KAEN.

### **(4) Municipal solid wastes**

Municipal solid waste (MSW) mainly gain from daily life of residents in the cities, of which some parts come from schools, hospitals, parks and convenient store. The yield of MSW is depended on the size of community level and population density in those cities. The available garbage should be screen for a certain purpose for burn to boil water to compress generation by stream power. This technology is common for all countries used as an efficiency renewable energy operation at different level of the cities requirement. In 2008, there is capacity to produce the electricity current 4.1 Mwatt per year and Thailand has a potential about 300 Mwatt, annually.

From the estimated for MSW come from daily collection in some principal cities as following :

- |                |                           |
|----------------|---------------------------|
| ● Bangkok      | 9 000 ton/day             |
| ● Metropolitan | 6 300 ton /day (50 sites) |
| ● Industrial   | 1 000 ton /day            |

The MSW is a complex mixture of different solid waste from different sources, so, its component is greatly depended on living style, energy structure, city construction and season etc. A component analysis of rubbish is mostly separated such as dry rubbish type and wet rubbish type, whereas the first type can be recycle used and fuel used as heat energy and the latter type can be used as fertilizer or bio-compost by effective microorganism activity for delete non-good smell in fermentation processing.

- Kitchen rubbish
- Waste paper
- Waste plastic

- Fibrin waste
- Furnace Dust
- Glass waste
- Metal waste
- Whole organic

In addition, the heat value of MSW from different sites is also very different from other sites. Averagely, the heat value may be around 4500 KJ/kg of MSW, however, mostly of them could be available for biogas material in any power generation running as well.

### 3. Government policy on biomass energy

#### (1) Energy conservation (ENCON) program (1994)

- The ENCON Program also promoted renewable energy through funding support.
- A renewable SPP project which gave subsidy of up to 0.36 B/kWh was launched in 1995 and 16 biomass projects were approved for about 200 MWe.
- The ENCON Program also provided financial subsidy (for system construction) of pig farm biogas projects with the total funding of nearly 1000 million baht during 1995—2004.
- The Thai government has clear policy to promote renewable in a significant scale.
- Ministry of Energy's Strategy for Competitiveness (August 2003) set clear goals for renewable;
- Increasing the contribution of commercial renewable energies from 0.5% in 2002 to 8% of the primary energy demand in 2011.
- 5 % RPS (renewable portfolio standard) for the power sector from now to 2011.

#### (2) New strategy

In May 2005 the Thai Cabinet approved a new Energy Strategic Plan with very aggressive targets for biomass energy

- Reducing oil for the transportation sector by 25% by 2009 with use of natural gas, gasohol and biodiesel.
- Increasing the contribution of biodiesel to 8.5 million litre per day (10% of diesel consumption) by 2012.
- Transforming the agricultural sector into a modern energy supply base.

### 4. Current biomass energy utilization

#### (1) Main biomass resources

- Wood residues from forest plantations
- Biomass from the agricultural sector (rice husk, bagasse, corn cobs, etc.)
- Biomass residues from wood and furniture industries (bark, sawdust, etc.)
- Wood and wood residues from dedicated energy plantations
- Biomass for ethanol production (cassava, sugar cane, etc.)
- Biomass for biodiesel production (palm oil, Jatropha oil, etc.)
- Biomass wastes (waste water) from agro-industry
- Biomass solid wastes from animal farms
- Municipal wastes solid : MWS