

The Prospects for the Wooden Biomass in Japan

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1. About Biomass

1.1 Biomass

"Biomass" is the word used by the field of Ecology and it shows "the gathered biomass". In Japan, economic growth & living were greatly influenced by a rise in oil prices & cut off energy supply when 1970's oil shock. Therefore the promotion of the alternative energy came to be strongly proposed. Biomass transcend category of ecological word and it came to have meaning as "resources and energy source". It is the materials such as a tree or the plant produced formerly by photosynthesis and includes a meaning called the city garbage of the forest / agriculture waste, the energy crops and the creature origin by the present.

Biomass had been used as firewood and charcoal biomass has been used as firewood for a long time, however it have not been used in advanced country because it was changed useful fuels like as oil and charcoal.

However, Japan depends on foreign countries for almost energy resource that are used in Japan. Oil holds half of the energy supply. In addition, it is difficult to import electricity from the foreign countries because it is dependence and an island to the Middle East area where the political situation is unstable at most of the oil. Therefore security of the stability of the energy becomes the important problem. Recently biomass attracts attention again because the drying up of global warming and the fossil fuel is worried about.

The biomass has the following advantages.

- ① **Recyclable energy:** Even if we use the energy, it is regenerated by the photosynthesis of the plant. We take it in at the time of reproduction, and the carbon dioxide discharged by combustion of the biomass is fixed. We would not drain carbon dioxide if we could take balance of quantity of the biomass which we used and the quantity of revitalized biomass.
- ② **It can substitute and storage:** biomass is an organically resource. Because they can store it up as raw materials or a solid / liquid / gaseous fuel, as for the biomass, oil or coal can replace it.
- ③ **There is quantity of vast existence:** According to the investigation that Agency for Natural Resources and Energy performed in 2000, Japan has a potential

biomass about 26,000,000kl (crude oil equivalent) .

Biomass classification

classification	division	heading	individual name
agriculture	waste a by-product	Plants and animals waste	Straw/Bagasse/rice bran/rapeseed cake/ soybean cake
	crops for energy	Cultivated plants for energy	Rapeseed/soybean/ All kind of plants An early ripening variety
forestry	waste a by-product	Paper manufacturing/ The scrap woods which are discarded when it sawed up it/ The scrap woods which are discarded when thinning of a forest/ Woods thinned out in the forest	Bark/sawdust/ branch/ leaf/ tree top Inferior wood
	energy afforestation	coppice forest/short periodically fell trees	Castanopsis / Oak Willow / Poplar
stock raising	refuse	excrement processing rest	Domestic animal's excrement/Animal waste
fishery	refuse	processing rest	Fish's ilium/Oil cake
waste	general waste	Domestic waste / a used paper/ a wood chip	Garbage A used paper Waste thread
	industrial waste	a wood chip Discarded vegetable oil/wastepaper Animal waste Sludge	Prune a spray / dismantled woods/ Discarded vegetable oil/Discarded animal oil /Food processing rest/activated sludge

1.3 Carbon Neutral

In biomass, Carbon neutral has an advantage for environment, and biomass has mechanism of the Carbon Neutral by photosynthesis, the atmospheric carbon dioxide concentration does not increase as far as this acts.

It is said to be effective means of the prevention of global warming the permanent biomass production because it has a good balance between amount of carbon dioxide emissions and carbon dioxide absorption. Therefore, it is become disappear greenhouse gas emissions.

2.1 Directly Combustion

Directly combustion of biomass is used since ancient times. Biomass has much moisture therefore volume of heat does not much, compare the coal. So, efficiency of combustion is bad on conventional way to combustion. Therefore efficient combustion kiln has been developing as efficient combustion technology, such as mobile floor kiln, rotary kiln. It is possible to convert biomass into the electrical energy by directly combustion of biomass but in the case of directly combustion, energy is mainly use for heat supply.

In Northern Europe district heating done by large scale biomass combustion plant.

In Sweden and Austria woody pellet become popular. Woody pellet made from piece of wood that smashed and pressed. Woody pellet uses for pellet boiler.

Pellet boiler operates automatically and pellet boiler burn woody pellet efficiently.

In Japan Iwate, Nagano and Osaka prefecture has been introducing pellet boiler.

2.2 Thermo Chemical Conversion

The biomass can do various reactions by putting heat and pressure. The method of thermo chemical conversion includes the method of the gasification, the carbonization, and liquefaction. The research about gasification done in many parts of the world after the oil crisis, and there are a lot of practical use cases, too.

Even if it is small-scale to gasify like the fuel cell, the micro gas turbine, and the gas engine, it is possible to highly effective power generation. It is expected as a technology that uses the biomass with a small scale. In addition, After the gas composition is adjusted, the methanol can be synthesized, and to be able to use also for the fuel of the fuel cell and the fuel for the car, and it is easy to store the obtained methanol from the gas.

2.3 Biochemistry Conversion

Biochemistry conversion of the biomass can convert it into the fuel such as ethanol

by resolving the biomass by the microorganism. Ethanol made from Sugarcane behind the oil crisis as a national policy in Brazil, ethanol has used for the vehicle fuel. Moreover, ethanol made from corns in the United States, and the fuel that is called E10 that mixes with gasoline by 10% is used for the car.

The use of crops such as sugarcane and corn as the fuel competing with food becomes a problem. Therefore, the research and development that obtains the ethanol from cellulose, hemicelluloses, and the lignin contained in the plant is advanced.

Utilization of Biomass Energy

classification		Outline of technology	Problems	
combustion	Directly combustion	Obtain heat by the direct combustion of the edge material such as sawdust	Efficiency of energy is low.	
	Mixed combustion	It is a technology to burn wood biomass and coal in the same furnace	Stability of electric power.	
	Solid fuel	Woody Pellets are made from sawdust or barks	The demand creation of the pellet is necessary.	
Thermochemical conversion	gas	Dissolution gasification	Pyrolysis gasifies in 400~600℃, and the flammable gas is generated.	Necessity for attempting enhancement of energy efficiency. Resolution promotion of tar.
		Partial oxidation gasification	The generation gas is manufactured from the partial oxidation.	Enhancement of energy efficiency
		Low temperature flowlayer gasification	It is a technology that gasifies at about 600℃, and it use for power generation and the utilization of heat	The generation of the tar is a problem.
		Supercritical water gasification	Technology that hydrolyzes in supercritical water and gasifies efficiently.	Improvement of efficiency

	Liquefaction	rapid Pyrolysis	Technology that rapidly heats to 500~600℃, resolves by heat, and obtains oily product.	Conversion cost for transportation fuel
		Slurry fuel	Apply high temperature and high pressure and water.	efficient manufacturing
	carbonization		It is used from long time ago	Efficiency improvement of energy utilization
	ester		Technology that makes diesel fuel by synthesize methanol and waste oil	
Biochemistry	Methane ferment		The domestic animal excrement etc. are resolved to the microorganism	It is not easy to be applied to the woody biomass.
	Ethanol ferment		The ethanol is made from starch etc. by fermentation.	Generation of ethanol from woody biomasses

3. Themes of Using Biomass

3.1 Economies

Biomass energy takes cost more than the other fossil fuel. This thing is the biggest problem for spread of biomass energy. If cost of biomass energy is supplied at same place with the other fossil fuels and atomic energy, biomass energy would be used. In fact, in case of black liquor, which takes much cost, we use it as biomass energy. In these days, almost all large pulp industries have cogeneration plant and make necessity energy from black liquor. Accordingly, we save cost by using resources which we do not use or take cost to dispose than productions which are made for a certain purpose like grains. It mean it better to use production we need money to dispose like scrap wood in construction. Amount of scrap wood come 21.8 million squares in 1991. It is same as many as amount of wood production. But 80% of these are not used. However, almost all these wastes are from scrap woods from construction. Because we need separate wastes from these woods to wastes which take a toxic substance by burning like plastic and metal. When I try to use the rest material and the thinned wood

formed in case of forest felling, it takes cost to carry its from a mountain by using a track. And we need equipment of the power generation facility to use these biomass energy. Moreover, the biomass has the feature that distributed widely and the generation of energy per the unit area is low. If we built large facilities for the use of efficient biomass energy, cost of transport will be large because we have to widen the range to collect biomasses. On the other hand, when facilities are small, energy transformation costs a lot.

3.2 Transportation of Biomass

Biomass exists a few in a huge land, so we need gather and transport to use biomass. Besides that, biomass has many kind of form. We need consider the fit way to use each one. When we consider gathering and transportation of biomass we need consider about moisture ratio and ratio and calorific value. Moisture ratio becomes higher, the weight become higher. calorific value is amount of energy that biomass have. Calorific value becomes higher, efficiency of transportation become higher. Wooden biomass moisture ratio is high, 50 to 70%, after cutting. In the process of processing, biomass become dry and moisture ratio of building materials become low, 15 to 30%. When we gather and transport thinning woods and wasting wood of forest, it is better to dry by leaving for a few months after cutting not soon after cutting. On the other hand, an evacuation of cattle, mud and food wastes, etc content water more than 70%, so it costs very much when transported as it is. Not to consider long distance transportation and it is necessary to transform it to the shape transported easily and transport it.

Biomass includes many moisture. It become problem when we use biomass energy. When moisture ratio is 15%, it has 4200 kcal per 1 kg. But when moisture ration is 60%, it has only 1960 kcal per 1 kg. Under the condition of same ratio, compared with liquid natural gas, liquid gas has twice transport efficiency of coal, 3 times transport efficiency than wooden biomass when moisture ratio is 15%. Therefore transport efficiency of biomass energy is low, compared with conventional energy. So it is necessary to contrive.

3.3 Legal Problem

Legal effect biomass a lot. New energy law, RPS law, recycle law were enforced as introduction of biomass. On the other hand, there are law that restrict biomass. For example, waste biomass takes cost to disposal. So to use waste biomass have merit in point of cost. When I charge a commission and try to get a biomass, the biomass conversion facilities are judged to be a waste disposal facility by Public Cleaning Law.

It is necessary to obtain biomass for value to avoid that. Therefore we can not use waste biomass. When it's possible to process the biomass of similar properties, sewage mud, feces and urine of cattle and food wastes, at the same time, it is effective economically. Complex procedure is needed to process it at the same time because the respective supervisory authority is difference. Therefore, the law revision to a new request that assumes the use of the biomass is requested. No standard concerning the biomass fuel prevent biomass from expansion. For example it's performed on a large scale in United States and Brazil to mix ethanol with gasoline and use it. It is not advanced in Japan though there is technically no problem. It is one reason that neither the safety of the car that introduces the ethanol fuel nor the adjustment for the vehicle performance securing are advanced in the car industry. It is said that it is impossible to correspond in the car industry because there is no clear standard of the circulating ethanol mixing gasoline.

It's thought that the remodeling is unnecessary when it's about 3 %. Especially, appropriate correspondence is difficult under the situation that the standard of the fuel used is indefinite in the car industry which safety is emphasized. Similar is pointed out about the biodiesel fuel and the wood pellet fuel. Introduction of the biomass isn't developed in point of a financial principle, it is requested to give some incentives to a law. New energy low, RPS low are examples. The other measure, preferential tax treatment, exemption of a business tax and setting of carbon tax are requested as measures against the Kyoto Protocol.

4. Law and Policy Surround Biomass

4.1 Biomass Nippon

Various policies and laws of the environment exist in Japan today. "Biomass Nippon Strategy" is the one of these which has strong relation with biomass. It is an action plan which profit use of promotion of biomass from viewpoints of global warming prevention, recycling society formation, strategic, industrial promotion, and rural fishing village activation was decided by the Ministry of Agriculture, Forestry and Fisheries and related government in December, 2003. In March 2006, they reconsidered base on the change of situation of profit use of biomass and after settling on the strategy such as Kyoto Protocol (Feb, 2005), and they are promoting the state measure which is the construction of biomass town by introduction of domestic bio-fuel and use of unused biomass such as woods surplus material.

According to outline of Biomass Nippon strategy that the Ministry of Agriculture, Forestry and Fisheries is announcing, they are aiming to indicate "Biomass Nippon" on around 2030. For that, it is necessary to have image of "Biomass Nippon" which is

expected to development of technology for getting public understanding.

Though wood system scrap and the unused material (about five million tons a year) from sawmills are used for the reproduction use as energy and fertilizer, when you pay attention to the woody biomass, the woods surplus material (about 3.7 million tons a year) including the thinning material and the damage tree are used for material of the paper product, but only few. Also the use ratio of the construction wood is expected to increase in the future.

4.2 Carbon Offset

A “carbon offset” is an emission reduction project that results in less carbon dioxide or other greenhouse gases in the atmosphere than would otherwise occur. There are two markets for carbon offsets. One is companies, governments, or other entities buy carbon offsets in order to comply with caps on the total amount of carbon dioxide they are allowed to emit and another market is individuals, companies, or governments purchase carbon offsets to mitigate their own greenhouse gas emissions from transportation, electricity use, and other sources.

4.3 Environmental Protection Ordinance

The Environmental Protection Ordinance is enforced in Tokyo for the CO2 emission right. It is the ordinance for making 1700 companies which discharge CO2 a lot to decrease amount of CO2 emission. These companies have to keep the level of amount of CO2 emission it decided by the ordinance.

5. The Situation of Japanese Forestry

5.1 Artificial Forests in Japan

About 40% Japanese forests are artificial that is forested to use as lumber. The artificial forests are close trees which breeding such as cutting and forestation are managed by people. When the people control that trees, varieties and qualities of that will be kept in order. Then that will be proper forests for producing timber.

The percentage of imported woods in Japan is about 80; accordingly, there are many left forests because of decreasing demands of domestics. The forests have several benefits such as absorbing carbon dioxide, maintaining soils and reserving water, however, insufficient maintenances make forests be useless. Actually, the forests need appropriate sunshine to grow healthfully.

5.2 Lack of Successors

Maintenance of those forests needs adequate workers. Although young hands are increasing because of rising of nature orientations in recent years, there are so many laborers over 65-year-old. The number of those workers was about 440,000 in 1960 yet 50,000 in 2005. Comparing other industries, the index number of aging of workers in forestry is high; 25% in 2005.

It is important that training and keeping human resources in next generation to manage Japanese forests and to make good use of that for the global environment and communities.

5.3 Declining wood prices

When you cut a forest of Japanese cedar which trees are about 50 years old, the profit will be about 1,260,000 yen per a hectare. However, the forests need clearing underbrush for 5 years after the cutting, about 1,350,000 yen to reforest and so much money and time to produce new lumber. Therefore, it is hard to gain with the Japanese forestry.

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7. Wooden Biomass

7.1 The Fuel Made of Wooden Biomass

Wooden biomass has been used as firewood and charcoals for a long time. But now in Japan we need to process it into wooden pellets and easy to use.

It is wooden pellets that compressioning sawdusts and barks make lignin melt and congeal. The good point of wooden pellet goes as follows.

- 1, The pellets are easy to use than firewood and charcoals. So we can save, carry, and supply it easily.
- 2, Wooden pellet are same shape, same water contents by percentage, high calorific value and high combustion efficiency. So it is possible to burn automatically for burn equipments as pellet heater.
- 3, It has a little sulphur and nitrogen so properties of exhaust are good comparatively.
- 4, It is possible to reduce the storage capacity because it's high energy density.

However the supply system of wooden pellets has not developed and there are differences the area how to get it. We have to secure the system that we can get it wherever we live.

7.2 Reviving Mountain Villages by Wooden Biomass

The decrease in population is a serious problem in Japan mountain village. Using the biomass will be a step to revive the region. We need people and facilities to produce wooden pellets and chips. With the biomass industry in the region, we can hope for an employment creation.

Biomass Nippon Strategy document says that the most of biomass is produced and used at farming, mountain and fishing village. The villages hold the key to the success of the reviving, and we have to develop the biomass industry in it.

7.3 Using the System of 'Carbon Offset'

We citizens, enterprises, nonprofit organizations, Non-Governmental organization and self-government bodies try hard to reduce the carbon dioxide gas as much as they can. But it is impossible to reduce the gas anymore. So we purchase the amount of reduction gas in another region as a credit, and compensation part or all the amount of discharge. We can get the money selling the amount of that the carbon dioxide absorbed in forest and reduced by converting coals and oils into wooden biomass to enterprises as a credit. We can expect to manage the forest appropriately and promote using biomass energy consequently.

The mountain village support center (set up in Tokyo University of Agriculture) starts the business between mountain villages having the right of carbon dioxide emissions and enterprise demanding the right of emission. The village and the emission have dealings the carbon dioxide emissions. If this business spread in Japan, evaluate the function of forests in the village, increase employment, revive the village, and the forests managed regularly.

Conclusion

There are some good points to introduce biomass energy. Using biomass energy makes the global warming gas decrease. The energy used as ethanol is made from provisions, so it is possible to concurrent between energy and foods. We hope that producing the energy from the resources, for example waste plant and wooden biomass. Many artificial forests which occupy the most of in Japan have not been managed sufficiently because of the fall of wood price. We need to use the energy as wooden resources to maintain the forest that has many functions; the source of rice cultivation, soil conservation, environmental protection, and biological diversity protection in Japan regularly.

Comparing biomass energy with fossil fuels, it is not easy to transport and cost highly.

But we can improve transport efficiency by processing to wooden pellets. Japan begins to introduction of carbon offset so it is able to sell the right of emission using the energy to the enterprise and get the money. However we have to introduce new policy to promote spreading the biomass, for example, the exemption of taxation system and the business tax, and the imposition on carbon tax.

It is becoming worse the employment in the mountain village. If the employment on biomass increase in the village, it can be keep this problems away.

The forest does not be managed for many years because of a depression and stagnant circulation of woods. Promoting to use the biomass energy leads to maintain the many-sided function of forest and revive the village. We need to spread the wooden biomass to get this favor and let the people know and understand it.

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