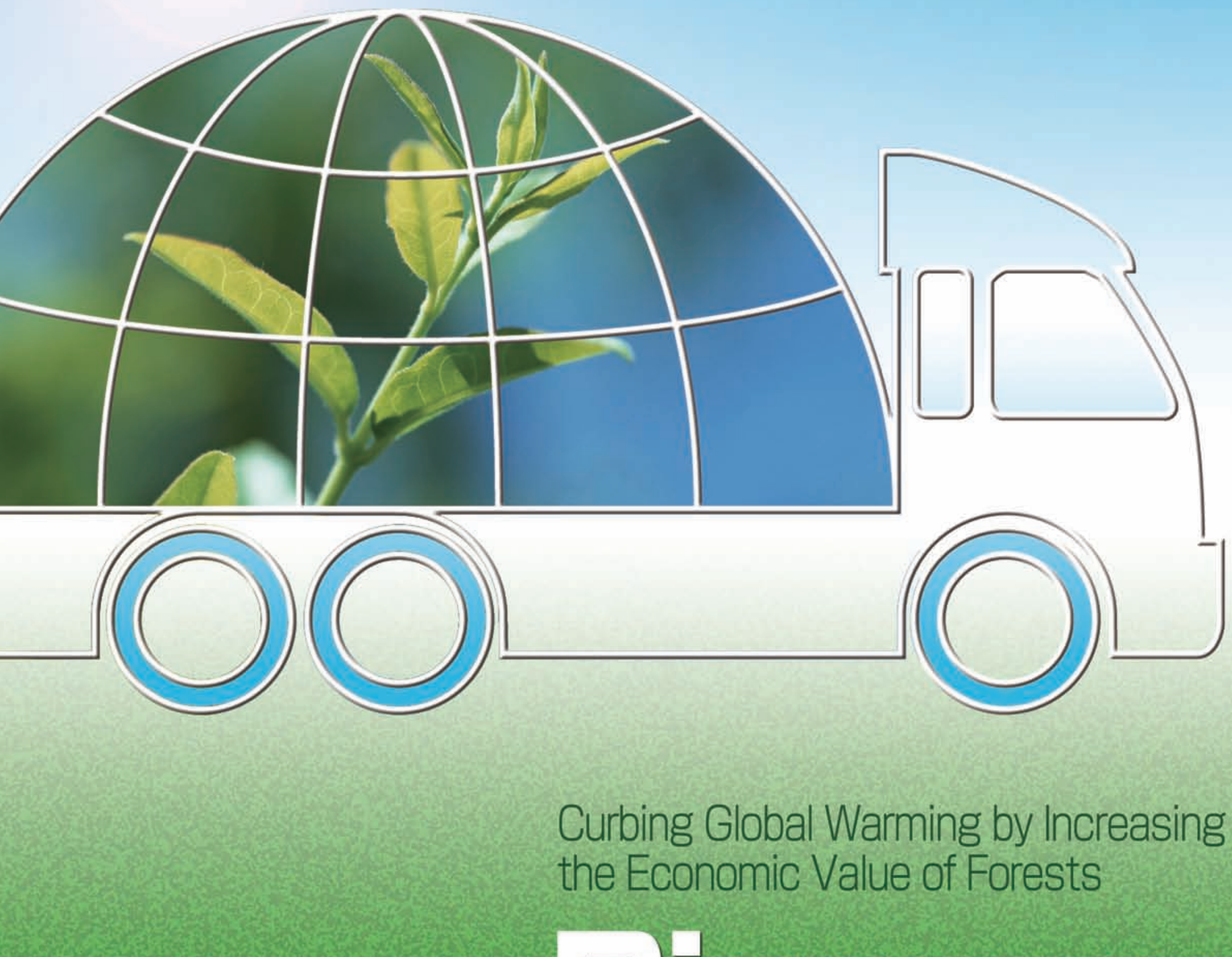
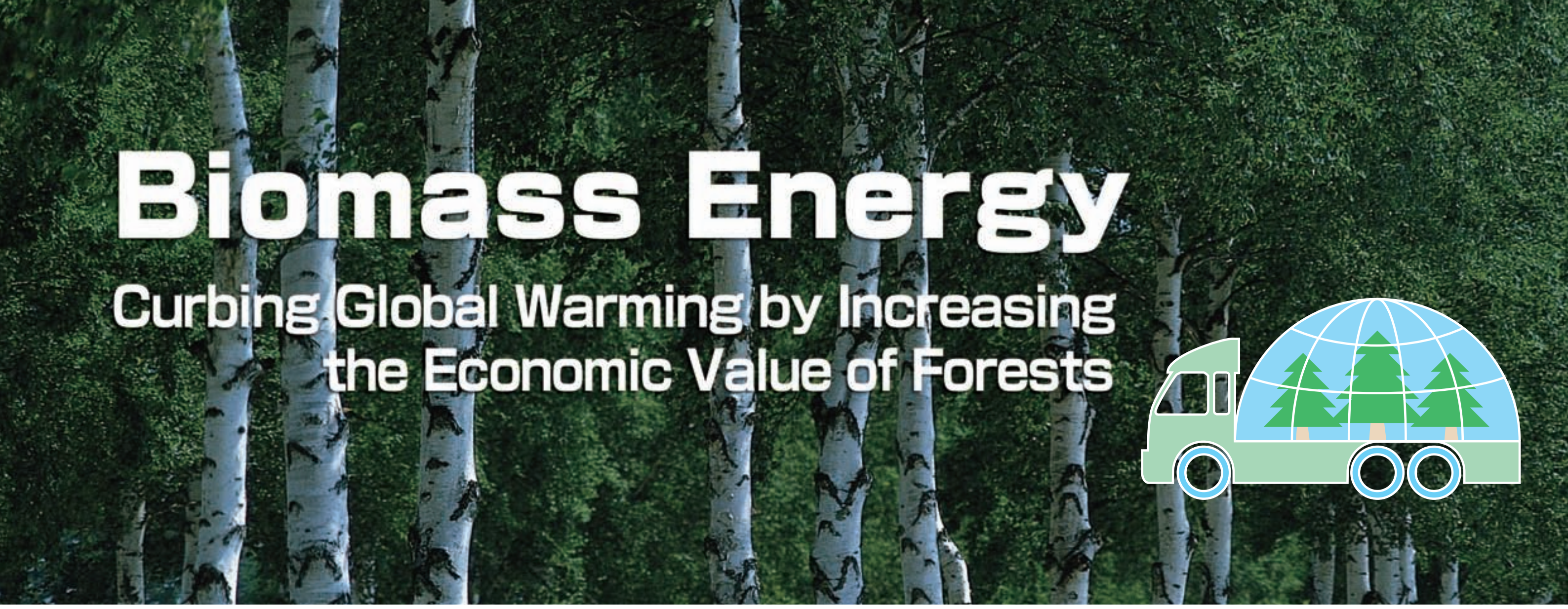


Curbing Global Warming by Increasing the Economic Value of Forests

Biomass Energy



The Significance of Liquid Fuel Production from Woody Biomass

Masayuki Kamimoto
Research Coordinator for Environment & Energy

Biomass - Carbon Neutral

Japan is a country poor in energy resources and has flourished by consuming large quantities of cheap fossil fuels. However, with the emergence of global warming as a serious concern in the late 1980's, we entered into a new era when it is necessary to use a balanced combination of fossil fuels, atomic and renewable energy. The need is evident to increase renewable energy as a middle/long term measure in order to attain a low-level emission of greenhouse gases.

Biomass is a renewable energy derived from animal and plant organic matter. Though it generates carbon dioxide when utilized, the biomass was created from solar energy, water, and carbon dioxide, and so does not increase the earth's net volume of carbon dioxide. In this respect, biomass is said to be "carbon neutral" (Fig. 1).

Woody Biomass with High Carbon Fixation

There are enough biomass resources in the world, 1.2×10^{10} kL/year (crude oil equivalent), to cover the world's demand (1×10^{10} kL/year) (World Energy Assessment: http://stone.undp.org/undpweb/seed/wea/pdfs/chapter5.pdf). Owing to rich forests, Japan's biomass has the potential to meet a part its primary energy needs. Biomass can generate not only electric power and heat directly by burning, but can also be efficiently converted to gas and liquid fuels. On this merit, biomass is considered a more appropriate energy to transport if compared to other renewable energies.

Biomass from waste, such as black liquor (the liquid waste produced after fiber extraction), food and agricultural waste, and sewage sludge, are the types of biomass used most in Japan at present (Fig. 2). Up to now, one had to pay for the disposal of waste, so this method is very economical too.

Ethanol is produced from corn in the United States and from sugar cane in Brazil, 8 million kL and 12 million kL respectively, and mixed with gasoline for wide use in automobiles. It is now being investigated to use ethanol or ETBE (Ethyl Tertiary-Butyl Ether), an octane-boosting agent, to mix with gasoline in Japan.

Woody biomass, such as forests, will be important in the future. If we can better manage the forests, more biomass can be utilized and carbon fixation will be increased.

Sustainable Growth of Forests and the Utilization of Woody Biomass

In the beginning, first firewood and charcoal, then coal and oil, were the principal energy sources of mankind. The reason why firewood and charcoal was replaced by coal and oil is because the energy density of the former is low, a lot of energy is needed to collect them, and so it became economically infeasible.

At the National Institute of Advanced Industrial Science and Technology (AIST), the production of fuels from woody biomass

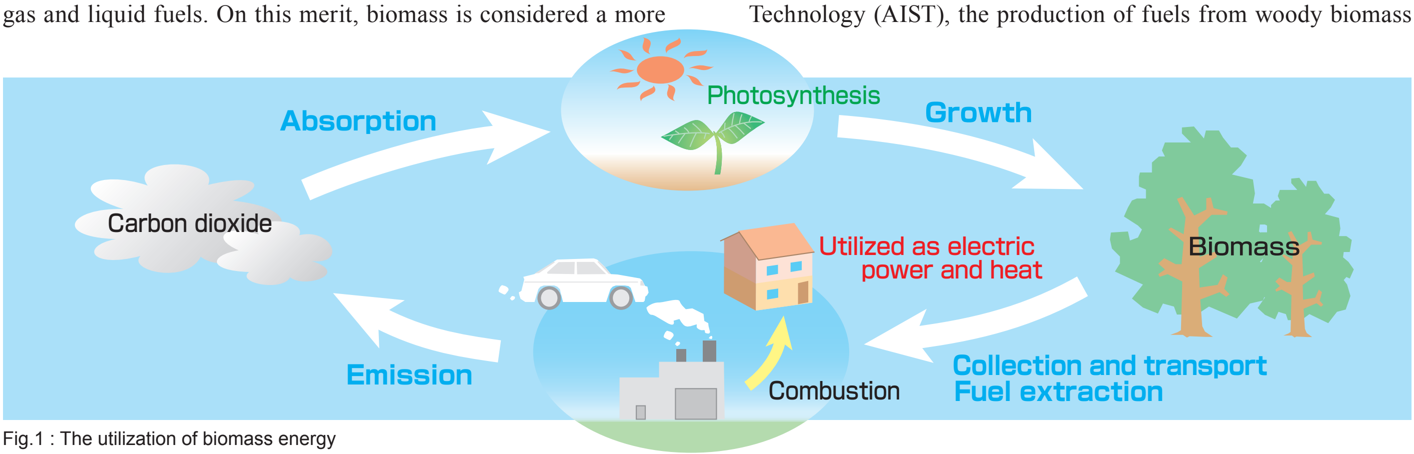


Fig.1 : The utilization of biomass energy

Biomass Technology Research Center Actively Working with Having Its Base of Operations in the Chugoku Region

Akira Yabe
Director, AIST Chugoku

The Biomass Technology Research Center was founded and initiated its activities in October 2005, with a planned term of six and a half years and having its base of operations in the Chugoku Center. About half of the over 100 staff of the Chugoku Center belong to the Biomass Technology Research Center. There are two key reasons why the Biomass Technology Research Center was established in the Chugoku Center.

1. The Chugoku region has been rich in woody biomass resources.
2. The Chugoku region has taken an active role in the utilization of biomass.

Both the population and the principal economic indices, such as industrial shipping in the Chugoku region, are about 7% of the country of Japan. However, its lumbering sector manages 16% of the total in the country due to its calm waves and busy marine transport in the Seto Inland Sea, and is rated the top in the country among the 8 local Bureaus of Economy, Trade and Industry. Primarily, imported lumber from Canada and Northern Europe is processed and sawmill wastes can produce approximately 1% of Japan's energy consumption if we take advantage of this resource for the whole country. Furthermore, from the Middle Ages to the Taisho era, the whole Chugoku mountainous district, including the Izumo region, produced 80% of the national iron by the traditional iron manufacturing method, "Tatara", using iron sand. The "Tatara" method requires large quantities of charcoal, and 15 tons of charcoal, or approximately 1 ha of forest, is required for one cycle. Assuming 60 annual cycles and the felling of one part of the forest with a 30-year cycle (the usable age of broadleaf trees for charcoal is 30 years), about 1,800 ha (corresponding to a circle of 2.5 km radius) of forest area is required for one "Tatara" installation. As there were more than 30 "Tatara" installations in Chugoku region, it can be seen that this region has used a great deal of forest resource energy.

In the industrial cluster plan of the Chugoku Bureau of Economy, Trade and Industry, there is a plan to create a well-grounded recycling-based and sustainable eco-friendly society with the utilization of biomass as an important key technology. Furthermore, the Biomass Project Center was founded at Hiroshima University and the "Experimental Study on Developing a Regional System for Biomass Energy" of the New Energy and Industrial Technology Development Organization (NEDO) is underway in the Yamaguchi Prefecture and Maniwa City, Okayama Prefecture. And other organizations such as the Industrial Research Institute of Tottori Prefecture are giving high priority to the utilization of biomass. Now, with the challenge of biomass utilization in the Chugoku Region having begun, the contribution of our Biomass Technology Research Center to the local region is strongly anticipated.

The Chugoku Center is spearheading the "Biomass Council." In this council, 40 participating organizations aim at the promotion and creation of a biomass utilization project by focusing on the active exchange of opinions. As a method to achieve this end, the Biomass Technology Research Center will present an economic simulation model of a biomass utilization system, which would be applicable to many kinds of biomass energy utilization systems, and customize it according to the needs of each region. The policy of Biomass Technology Research Center is to promote the practical use of biomass by estimating the concrete economic aspects and environmental effects, and by clarifying the necessary research and development themes and issues. A system analysis has currently been initiated for the biomass utilization needs not only of the Chugoku region, but also all of Japan and Southeast Asia.

With the aim of becoming COE of biomass research in the world, the Biomass Technology Research Center has the objective to increase its contribution to the local area by fostering cooperation between industry, the academic world, and governmental services.

is an important theme of our second term research strategy. If we can establish the technology to utilize woody biomass by converting it into fuels with high added value, rather than simply burning it, a large quantity of woody biomass from unused trees, sawmill wood waste, and the discarded lumber from construction, can be effectively utilized.

If we can elevate the economic efficiency of woody biomass, the economic value of the forest will also increase. As a result we can achieve a real carbon neutral where there is a cycle of tree felling, tree planting, forest thinning, etc., which will contribute substantially to the prevention of global warming.

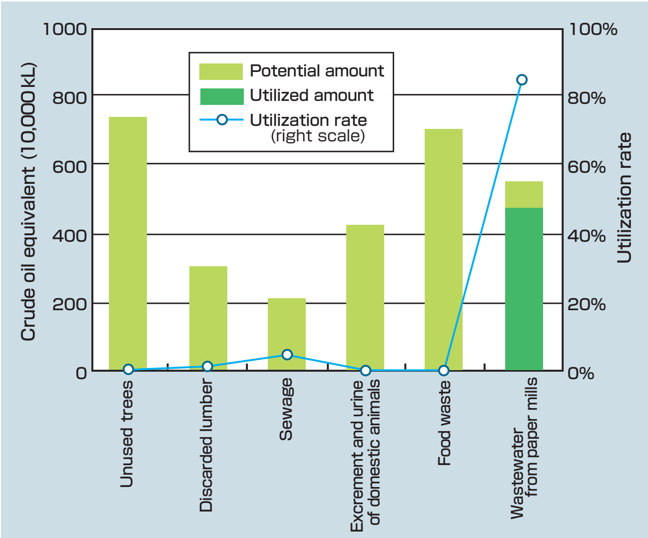


Fig.2 : Examples of utilization amount and potential amount estimations of biomass energy in Japan
Utilization rate = Utilized amount (electric power generation + heat)/Potential amount (Source: Agency for Natural Resources and Energy)

Production of Synthetic Diesel Fuel from the Gasification of Woody Biomass

Kinya Sakanishi
Director, Biomass Technology Research Center

Biomass as Diesel Fuel

Especially in principal cities, the emission of air pollutants PM, NOx, and SOx from diesel engines has recently worsened and the demand has grown for the production of sulfur-free or odor-free super clean diesel fuel. Under these circumstances, research is being undertaken to find a way to produce BTL by the gasification of biomass, in the same way that FT synthetic fuels are made by converting methane-based natural gas to synthetic gas.

If compared to GTL using fossil fuels as raw material, BTL has the effect of reducing carbon dioxide, and so recently the development of BTL technology has been promoted, principally in Europe. Fig. 1 shows carbon dioxide reduction comparisons between DME, methanol, and FT synthetic light diesel oil derived from biomass.

Light diesel oil made from biomass not only shows significantly reduced levels of carbon dioxide, but also the reduction of SPM and acid-rain causing SOx, as previously mentioned. It is also very efficient, and until fuel-cell automobiles come into wide use, is considered the best automotive fuel from the points of view of the prevention of global warming and conservation of the environment.

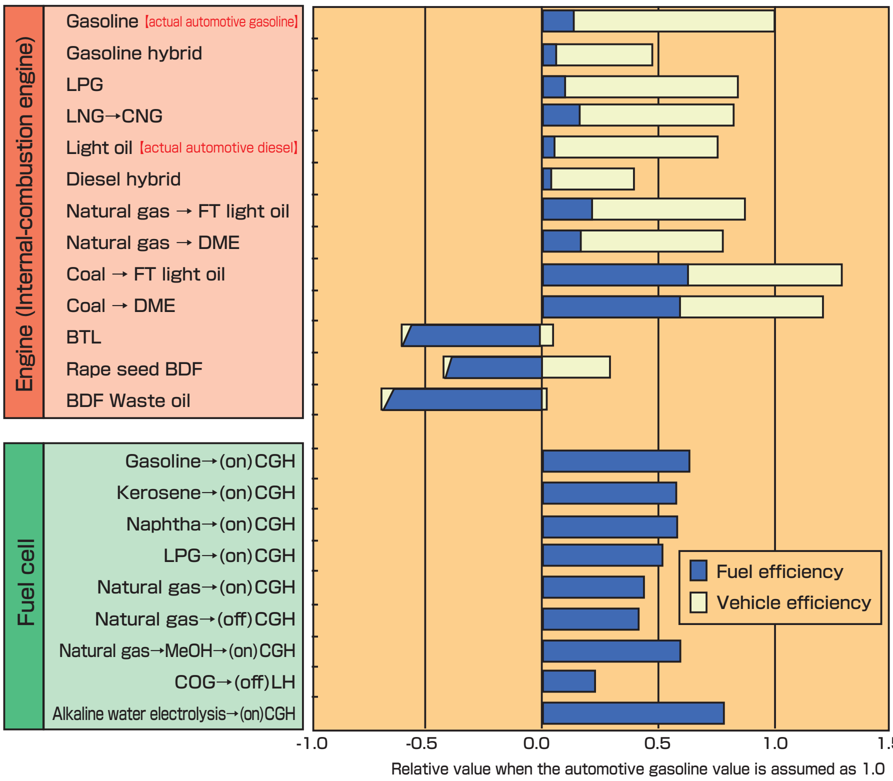


Fig.1 : Carbon dioxide reduction effect of FT synthetic light diesel oil derived from biomass
Calculated by assuming the vehicle efficiency of LPG, CMG and ethanol automobiles is the same as the vehicle efficiency of gasoline automobiles, and assuming the vehicle efficiency of FT light oil, DME, BDF automobiles is the same as the vehicle efficiency of light diesel oil automobiles.
Source: TOYOTA Motor Corporation, Mizuho Information & Research Institute, Inc., November, 2004.

Production Technology and Potential of BTL and DME

A synthetic diesel fuel production technique using the FT synthesis catalytic reaction is the core technology for the production of liquid fuels from synthetic gas components. To be cost-effective when compared to petroleum-based light diesel oil, it is considered indispensable to further develop FT synthesis by introducing new types of technologies in the future. In the case of GTL, the raw-material gas components of FT synthesis are being diversified for different technologies,

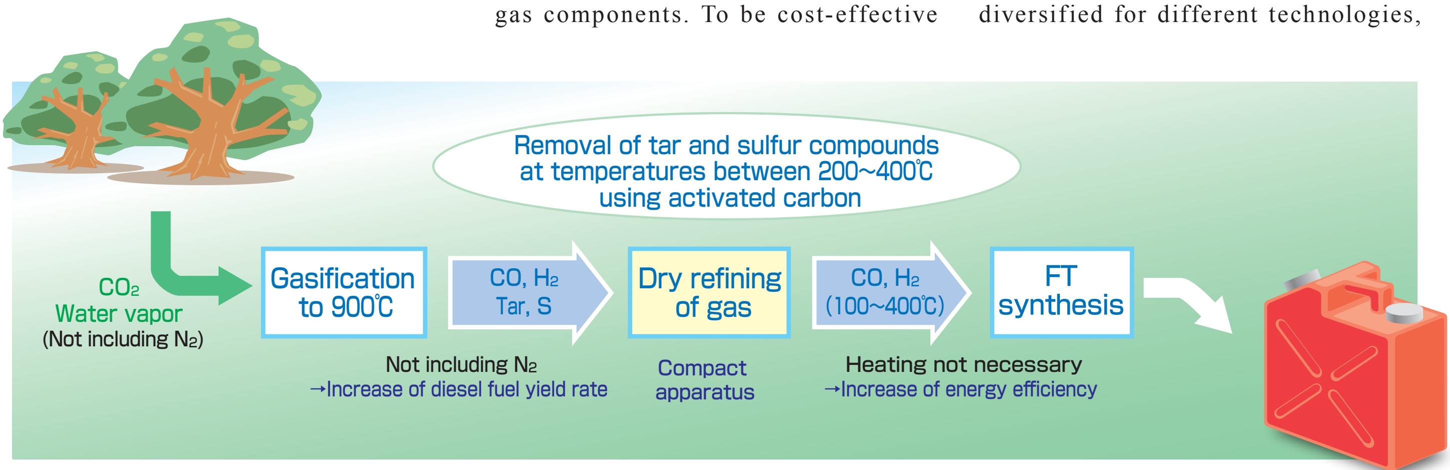


Fig.2 : Gasification, gas refining, and FT synthesis catalytic reaction directly combined with BLT system

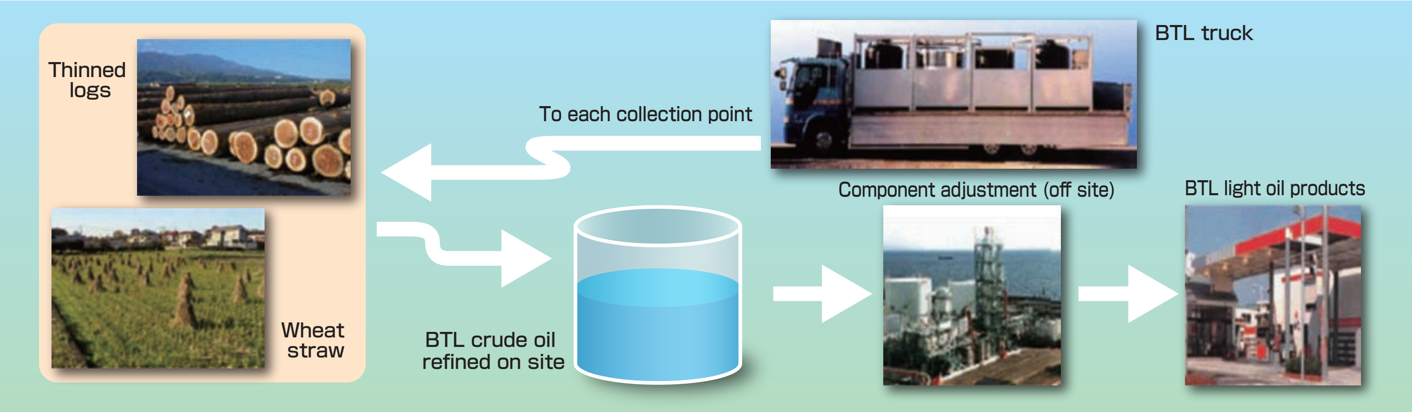


Fig.3 : Scheme of making BTL practicable

such as small to large scale natural gas fields, unprofitable natural gas fields, the gasification of biomass, and the gasification of coal. It is therefore expected that highly efficient FT synthesis technologies appropriate to the characteristics of respective raw materials will be developed.

FT technology is composed of technical fields such as catalysis development, reactor development, and plant development. Fig. 2 shows the BTL Integrated System being developed by AIST. Compared with conventional gasification, gas refining, and the FT synthesis process, this system shows merit, such as improved energy efficiency by Hot Gas Cleaning using activated carbon, and the significant increase in the yield of light diesel oil by combining directly with FT synthesis, hydrocracking, and catalytic isomerization.

DME has similar properties to LPG and is expected to become a new clean fuel that can be utilized in the public sector, transport sector, and as fuel for power generation, due to its ease of transport and storage. DME can be produced not only from fossil resources such as coal, petroleum and natural gas, but also from synthetic gas generated by the gasification of biomass. It can contribute to the diversification of primary energy resources, the reduction of carbon dioxide emissions and due to its super clean composition (sulfur and odor-free), it is expected to become the ultra low polluting diesel fuel in the future.

DME is currently produced by a dehydration reaction of methanol on the scale of several tens of tons per day. However in order to use DME as a fuel, it is necessary to produce it on a larger scale and at a lower cost. The raw material, methanol, can also be produced from synthetic gas, and so the development of a technique is being sought to produce DME directly from synthetic gas instead of from methanol. A DME direct synthetic reaction is very promising from the viewpoint of production cost because it is possible to obtain a higher yield rate at lower pressure if compared to a conventional methanol producing installation.

Making BTL Suitable for Practical Use

We can envisage two prototypes to make BTL practical. One is a mobile BTL truck of about 2 tons which can take a small BTL unit into mountainous areas (shown in Fig. 3), and the other is a middle/large scale BLT production plant using agricultural waste and forest product biomass readily available in large quantities.

In the former type, when the high costs due to the difficulty of collecting raw materials in Japan are calculated, an economically efficient and compact BTL unit which makes possible the production of BTL diesel fuels for "regional production, regional consumption" or a unit to co-produce gasoline and DME will be developed. In the latter type, we would like to contribute to the production of BTL synthetic diesel fuel using the large quantities of biomass from Southeast Asian countries, and to the popularization of BTL by the development and import scheme.

Explanation of terms

PM : Particulate Matter-general term for the soot discharged from diesel engines.
FT synthesis : a method developed by Fischer-Tropsch of synthesizing hydrocarbons by the catalytic reaction of synthetic gas (carbon monoxide and hydrogen).
GTL : Gas To Liquid - liquid fuels made by the FT synthesis catalytic reaction of natural gas to synthetic gas.
BTL : Biomass To Liquid - liquid fuels made by the FT synthesis catalytic reaction of synthetic gas obtained by biomass gasification.
DME : Dimethyl Ether - a new fuel with similar properties to LPG (liquefied petroleum gas, propane gas) and expected to replace diesel fuel and LPG.
LPG : Liquefied Petroleum Gas - fuels with propane as the main component.
SPM : Suspended Particulate Matter – PM of small (micrometer-order) diameter. Soot of microscopic diameter discharged by diesel engines.
Hot Gas Cleaning : the super deep dry refining of synthetic gas using an adsorbent such as activated carbon at high temperature (approximately 400°C) after gasification.

Production of Wood-based Ethanol for Automobile Fuel

Takashi Endo, Shinichi Yano
Biomass Technology Research Center

Ethanol Production from Woody Biomass

When biomass, containing carbon fixed from carbon dioxide in the air by photosynthesis of plants, is burned, the net amount of global carbon dioxide remains the same. Furthermore, the use of biomass-derived ethanol as fuels results in the decreased energy dependence on petroleum. Fuel ethanol is already consumed in large quantities in Brazil and the United States. However, because it is produced from agricultural products such as sugarcane or corn at the present time, the future supply of these commodities is not assured considering the increasing food demand. Under these circumstances, the development of ethanol production technologies from plentiful woody biomass resources, which do not compete with foods, is anticipated.

The major components of wood are cellulose, hemicellulose, and lignin. The cellulose molecules in wood are systematically arranged, while the hemicellulose and lignin fill in the gaps between the cellulose molecules, giving the strength of wood. Among those components, only cellulose and hemicellulose have molecules composed of sugar and can be converted into ethanol by saccharification and fermentation.

In the conventional ethanol production procedure by saccharification and fermentation of wood, the hydrolysis with sulfuric acid has been the mainstream for saccharification. Even though the saccharification rate is higher in the sulfuric acid process, it is difficult to control the reaction due to high reaction temperatures. Therefore, problems arise, such as the generation of substances which inhibit fermentation, and the decrease of yield due to the excessive decomposition of sugar. Furthermore, the cost of collecting the sulfuric acid used and wastewater treatment is expensive, along with a high environmental load. In consequence, an enzymatic saccharification process, which does not exhibit excessive decomposition and has less environmental influence, is receiving much attention. However, appropriate pretreatment is necessary for enzymatic saccharification.

Development of Pretreatment Techniques for a Non-Sulfuric Acid Process

We are advancing the development of a hydrothermal and mechanochemical treatment process as pretreatment techniques for enzymatic saccharification which does not require large quantities of chemical agents such as sulfuric acid and is environment-friendly. In the hydrothermal process, it is possible to decompose and separate selected components of wood using hot-compressed-water (HCW).

Fig. 1 shows the process results using Japanese cedar in a HCW flow type reactor. With the HCW temperature increased to between 140 and 230°C, saccharide from hemicellulose, such as xylose, elutes. And at between 230 and 260°C, the glucose elutes from cellulose. In the mechanochemical treatment, the energy from crushing grinds the wood into fine particles and induces chemical reactions (bond breaking and formation).

Fig. 2 shows the results of a basic experiment to improve enzymatic saccharification with mechanochemical treatment. Without mechanochemical treatment, enzymatic saccharification generates very little glucose, however, increasing treatment time improved enzymatic saccharification degree significantly. Macroscopically, during mechanochemical treatment the wood is finely ground to approximately 20 µm, though with increased treatment time the wood cannot be ground any smaller.

Detailed analysis has shown that mechanochemical treatment destroys the strong network of woody components, which enhances the mobility of cellulose molecule bundles and lets enzymes approach more easily, therefore allowing accelerated enzymatic saccharification. In the next stage, we will try to reduce treatment time and improve efficiency of saccharification by using additives that will not influence saccharification and fermentation and by the appropriate combination of hydrothermal and mechanochemical treatment processes.

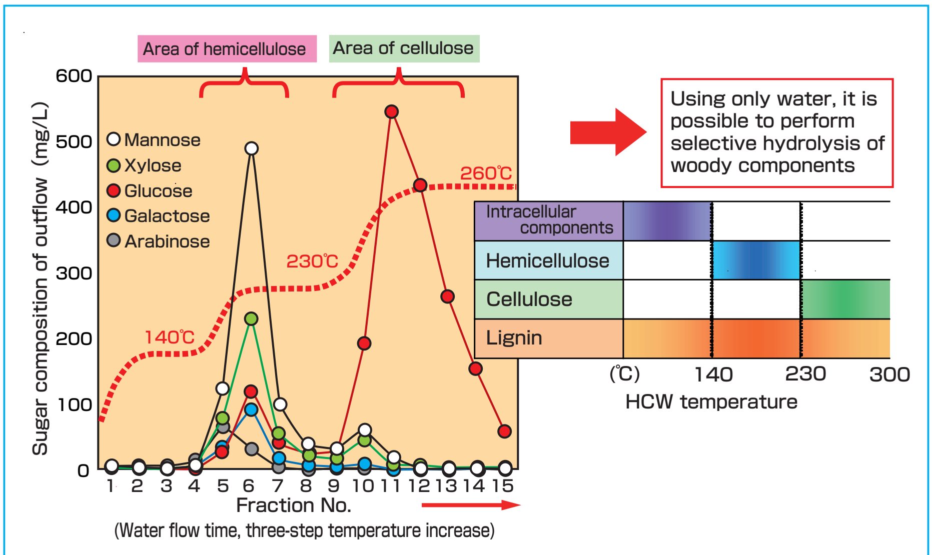


Fig.1 : Sugar composition of Japanese cedar extract treated with HCW using a HCW flow type reactor

Research and Development for Saccharification and Ethanol Fermentation

We also advance the research and development of saccharification and ethanol fermentation. Regarding saccharification, we will examine saccharification enzymes, such as cellulase and xylanase (xylanase breaks down xylan, a major structure of hemicellulose) to establish an enzymatic saccharification technology suitable for hydrothermal/mechanochemical pretreatment. Regarding fermentation, since the conventional ethanol fermentation yeast cannot use pentose originating from hemicellulose, the biggest research challenge will be to overcome this problem. We will develop microorganisms which can convert both pentose and hexose into ethanol at a high yield by the genetic engineering of yeast and thermophilic bacteria. And we will investigate a fermentation method to produce high yields of ethanol using the developed microorganisms . In this method, after hydrothermal-mechanochemical pretreatment and enzymatic saccharification of the woody biomass, the resultant product will be fermented with high concentrations of microorganisms using the agglutination and immobilized method in order to obtain high yields of ethanol.

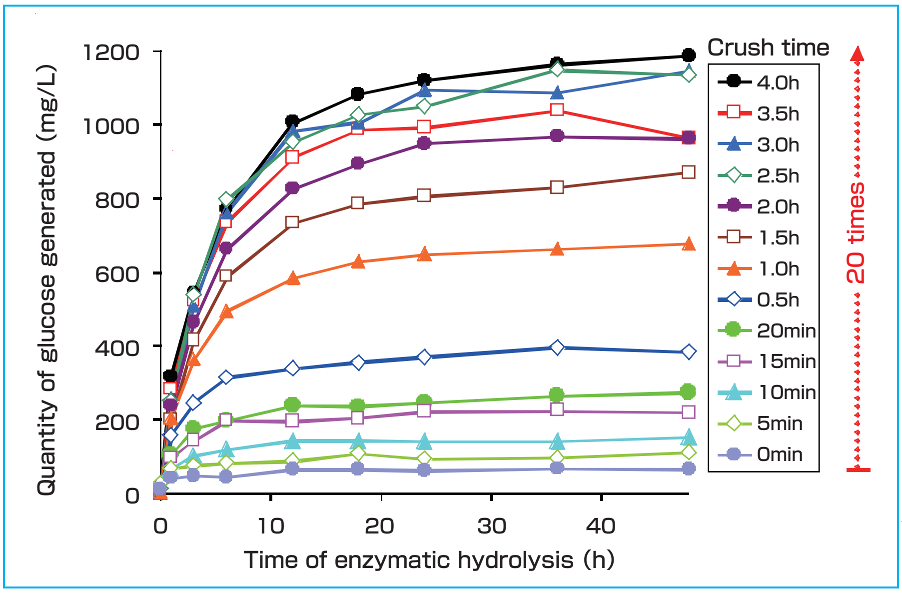


Fig.2 : Improved enzymatic saccharification of eucalyptus by mechanochemical treatment

Process Development and Utilization as Automobile Fuel

In the first phase of research and development, the hydrothermal treatment, mechanochemical treatment, rapid saccharification, fermentation using genetically modified microorganisms, and the essential techniques in each process will be investigated. In the second phase we would like to develop a practical combined method which consists of the hydrothermal, mechanochemical and chemical treatments, and simultaneous saccharification and fermentation (Fig. 3). In addition, we will work on the research and development of ways to add value to lignin and wastes as polymer materials, which cannot be utilized in saccharification and fermentation, in order to improve the profitability of an integrated woody biomass utilization system.

To be used as automobile fuel, ethanol can be simply mixed with gasoline. However, its utilization as Ethyl Tertiary-Butyl Ether (ETBE), obtained in a reaction between ethanol and isobutylene, has attracted much attention recently. ETBE is an excellent gasoline additive because it has a higher octane number than ethanol and is easily handled as it is not hygroscopic like ethanol. Since both ethanol and ETBE can be used directly in the existing cars, their wide use is expected as a fast acting countermeasure to global warming.

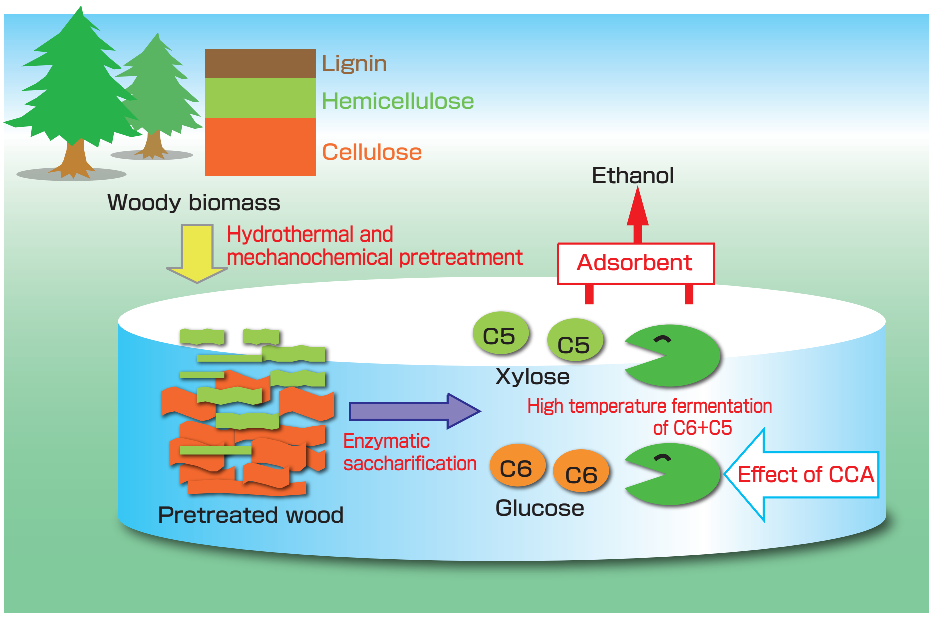


Fig.3 : Outline of the next generation high-yield bio-ethanol production technology from woody biomass
Under high temperature, saccharification and fermentation are performed simultaneously. The produced ethanol is collected using an adsorbent.

Creating a Data Base (DB) to Promote the Utilization of Biomass

Tomoaki Minowa
Biomass Technology Research Center

Introduction

There are various types of biomass such as wood from forestal biomass, straw from agricultural biomass, and their residues (waste). And there are all sorts of wood: green wood with a high water content, cut dried wood obtained from sawmills, discarded lumber from construction sites, etc. There are many ways to utilize these biomasses as energy, such as for heat, electric power generation, and conversion to gas and liquid fuels. And there are various conversion methods depending on the type of biomass. How will we choose which one to use, and which way shall we convert it so as to efficiently use the available biomass? We are working on the creation of a data base (DB) to answer these questions and to design the optimum biomass utilization system which is environmentally friendly and economically efficient.

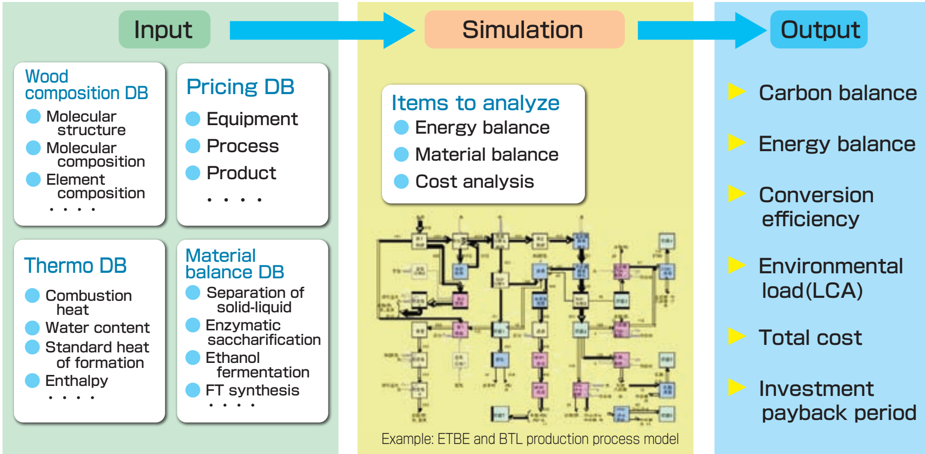


Fig.1 : Biomass utilization system design flow

System Design Flow and Biomass DB

Fig. 1 shows the calculation flow from DB. First, input the biomass type to be used in order to design a process to obtain the desired energy product (process model of the simulation). For heat, it is enough to burn it. However, to produce ethanol or ETBE from wood as a gasoline substitution, processes such as component separation, saccharification, fermentation, and the collection of ethanol by distillation are required. When the process model is complete, the material balance of the whole process can be calculated by recording wood composition data and material balance data in the process model.

The next step is to calculate the necessary heat and power for the process on the basis of the thermophysical properties of the raw materials, end products, and intermediate products. With the pricing data, the cost of main equipment can be calculated and the construction costs of the plant can be estimated. As a result, the efficiency and total cost of the designed system can be obtained, and the carbon dioxide savings when compared to petroleum can be calculated on the basis of product yield. In addition, from the product price and total cost, economic indices such as the investment payback period, can be output.

With the DB of wood components and thermophysical properties, one can examine how total efficiency and product yield rate vary with wood type, and the effect on total economic efficiency when the

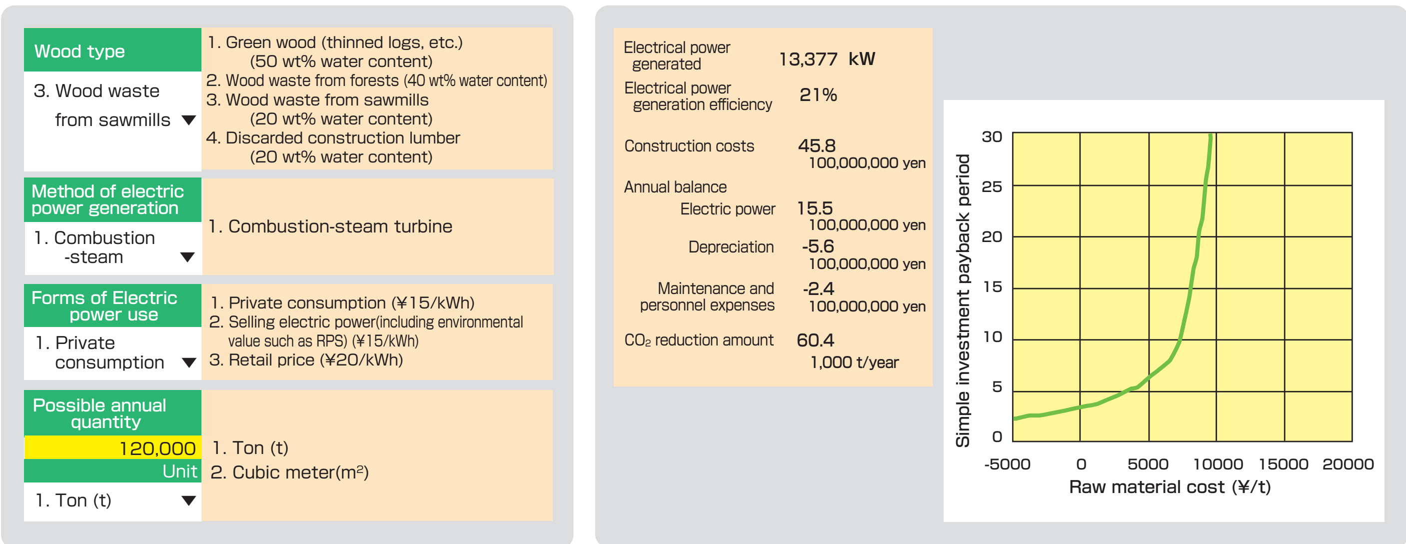


Fig.2 : Input screen image (left) and output screen image (right) of the simplified simulator

process is partially changed. Every time a new system is being considered, usually researchers themselves must investigate and collect the necessary data. However, if such a DB is prepared, not only will the chore of data collection be lightened, but expanding the DB will make technology or use comparisons easier as well.

Simplified Simulation Example Using DB

Though detailed investigations will be needed for practical utilization, using DB permits simplified examination. DB is currently under construction, however, we elaborated an electrical power generation case as a simplified simulation example.

Fig. 2 shows an input image and an output image. By recording wood type, electrical cost, and potential annual yield (scale), the resulting electric power generation scale, efficiency, total construction costs, annual balance, and the carbon dioxide savings will be estimated. The example shows the scenario when 120,000 tons of woodcutting wastes were consumed in one year at private-consumption electrical rates. It is possible to examine how economic efficiency can be improved, or which type of project can be considered, by performing a case study simply by changing the input data.

ETBE/BTL Integrated Production System using Biomass

The Biomass Technology Research Center of AIST is working on the research and development of the important future step to convert woody biomass to liquid fuels, specifically, the production of the gasoline additive ETBE, and diesel fuel which is synthesized by gasification and indirect liquefaction. We are working on the design of an integrated system for the production of ETBE/BTL as shown in Fig. 3. It performs several processes: the separation of cellulose and lignin, the main components of wood; the saccharification and fermentation of cellulose to produce ethanol; the production of ethanol to ETBE; the production of diesel fuel by gasification and indirect liquefaction of lignin, etc., obtained in the separation process; and the process that offers utilities of the whole system.

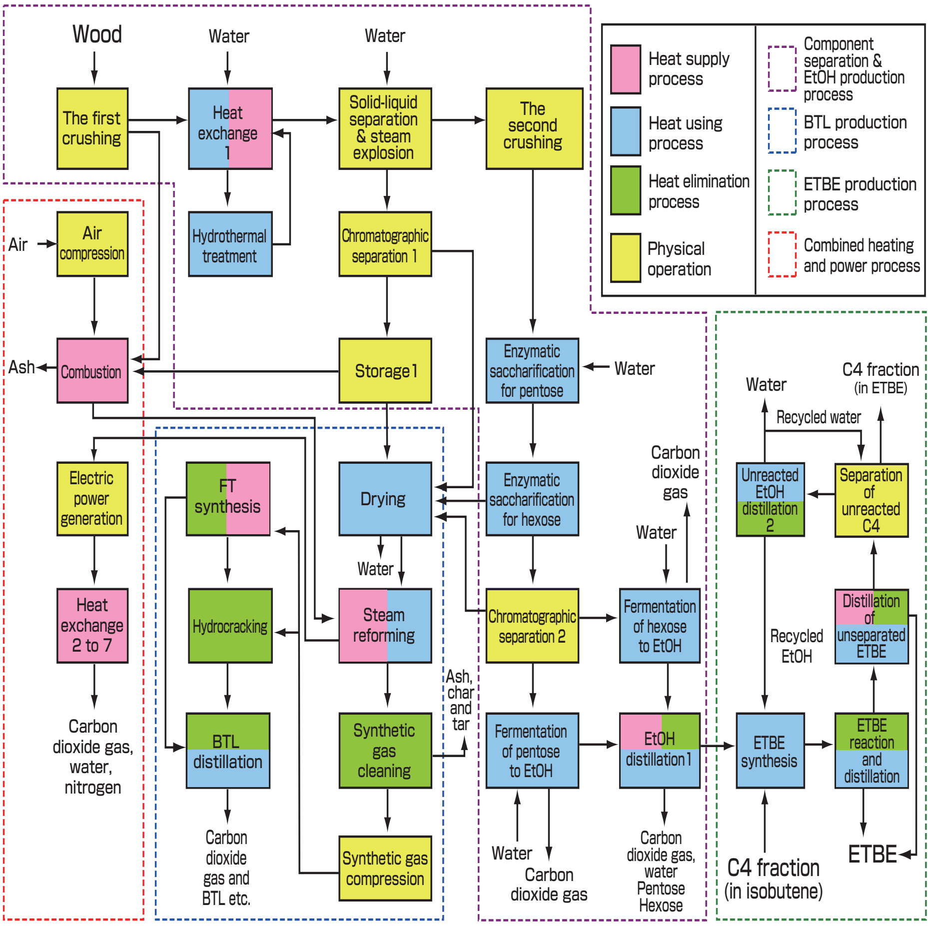


Fig.3 : Basic flow chart of the ETBE/BTL integrated production system from biomass

The construction and use of DB make it possible to examine the economic efficiency of an ETBE/BTL integrated production system and to plot a course for the development of technology by sensitive analysis. Inversely, performing these simulated case studies can expand the DB.

Future Activities

We believe that by creating the biomass DB we can contribute to promote biomass utilization as it makes possible system design and simplified simulations. We will not only work on ETBE/BTL production, but will also actively collaborate on various biomass utilization systems, promote research and development by analyzing economic efficiency, and publish simulation results.

In the future, we will perform more case studies in order to improve the contents of DB, so it can be used as a reference when biomass will be utilized.

Development of Biomass Utilization in Asia

Keizo Hashimoto
International Affairs Department

Promotion of the Asian Environment and Energy Partnership

With booming economic development spurring energy consumption in Asian countries, it is estimated that this region will be the biggest global energy consumer by 2030. A global environment forecast is that by 2030, China will surpass the United States as the country with the highest CO_2 emissions in the world. And it is estimated that CO_2 emissions in developing countries will increase to be three times those of developed countries by 2100.

In the common and urgent "environment and energy" issues in Asia, it is important that relevant organizations from each country promote projects such as an integrated technical system, integrated evaluation techniques, and the introduction of standards and specifications, with the view of fostering mutually complementary relationships, the creation of new industries, and the establishment of international standardization. These projects should take into consideration biomass, a distributed energy network (including the use of fuel cells, photovoltaics, biomass, and hydrogen energy), clean fuels and engines that contribute to the improvement of the atmospheric and global environment, environmental friendliness, energy efficiency, and economic production efficiency. AIST also is concluding comprehensive research agreements with principal organizations.

The Asian region has the largest biomass resources in the world. Important tasks in this region are the promotion of sustainable biomass production, the creation of a circulation system of renewable energy and useful products, and to make this system practical by the mutual collaboration of Asian countries and research institutions (including the collaboration between agricultural and industrial sectors) with the aim to prevent global warming and improve energy efficiency. AIST is collaborating with individual research institutes from each country, and also multi-nationally promoting the development of "Biomass-Asia." We believe that AIST can contribute to the creation of a sustainable and global industrial structure by promoting an Asian environment and energy partnership.

Strategic Development of Biomass-Asia

The conventional mass production/mass consumption/mass disposal social system dependent on fossil resources has worsened various environmental problems such as global warming, waste, and toxic substances. Therefore, the utilization of biomass that is a renewable organic resource has become more important.

To advance "Biomass-Asia" (Fig. 1) leading to a post-petroleum society, AIST is promoting the collaboration between the agricultural and industrial sectors, and also between industry, the academic world, and governmental services in Japan. We are making efforts to create a network with the administrative bodies and principal research institutions of Asian countries, and to establish biomass utilization strategies by collaborating with Asian countries.

Asia is endowed with abundant biomass resources (Fig. 2) due to its climate, etc., with more than 30% of the world's biomass resources distributed in this area. However, it is worrying that in many Asian countries, rapid economic development and rising population result in increased energy

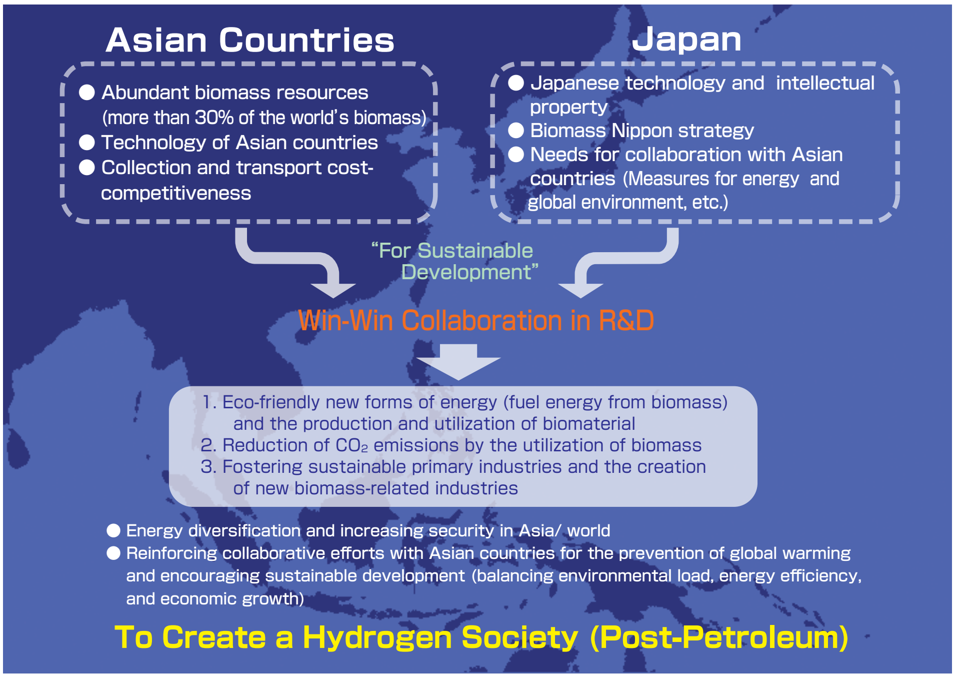


Fig.1 : Diagram of Biomass-Asia Outline

consumption and greenhouse gas emissions. The destruction of land in some parts of Asia is accelerated by desertification and deforestation. Therefore, there is a growing need to create a biomass production system aimed to prevent desertification and to help in the regeneration of forests. The establishment of biomass utilization techniques, the creation of a well-grounded recycling-based and sustainable eco-friendly society, and designing sustainable agriculture, forestry, and fishing industries in the Asian region are essential.

As a concrete solution to the issues, with the initiative of AIST, the “Biomass-Asia Workshop 2005” was held in Japan in January, 2005. It was a large-scale project attended by administrators and researchers related to biomass utilization in Asian countries and Japanese related organizations, e.g. Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Economy, Trade and Industry (METI), Ministry of Education, Culture, Sports, Science and Technology (MEXT), AIST, 5 MAFF related institutes, University of Tokyo, Research Institute of Innovative Technology for the Earth (RITE), and Japanese organizations from the industrial sector. For detailed information, please refer to http://unit.aist.go.jp/internat/biomassws/01workshop/. In the workshop, the establishment of a network with each country was discussed and the course of industrial and agricultural policies as well as future research and development in the biomass field were clarified through an exchange of opinions and technical expertise. For the first time in Asian countries, this workshop made possible the establishment of a network between government bodies and research institutes in the biomass field. It revealed the actual progress of activities related to biomass and the technical issues facing each country and organization.

The second workshop (Photo. For detailed information please refer to http://unit.aist.go.jp/internat/biomassws) was held in Thailand in December, 2005. Under the initiative of the Minister for Science and Technology in Thailand, the structure to promote the development of Biomass Asia was established with collaboration between related Thai ministries. Each country’s governmental representatives presented their political course in the area of biomass and their best trial cases of biomass utilization, with the exchange of opinions concerning R&D (research and development) on specific issues.

The third workshop to expand on the topics will be held in Japan in November, 2006.

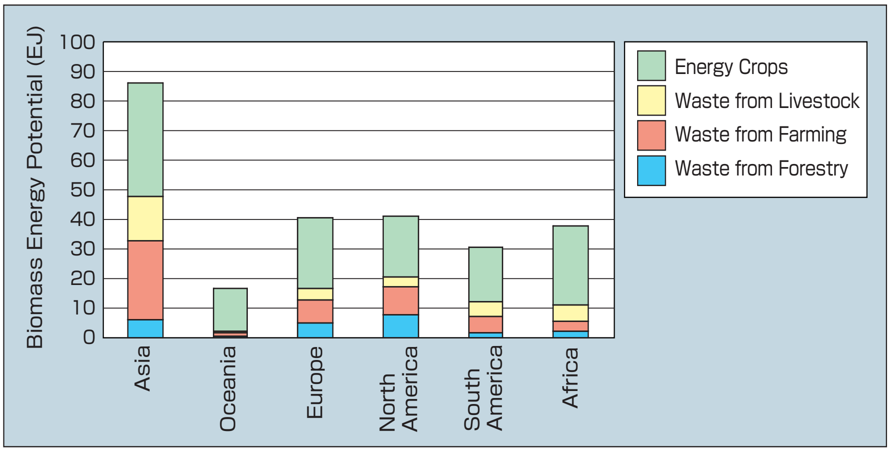


Fig.2 : World Biomass Energy Resources by Region
EJ (Exajoule) = 10^{18} Joule. 1 EJ is equivalent to 26,200,000 kL of crude petroleum.

Photo : The Second Biomass-Asia Workshop (held in Thailand, December, 2005)
Prof. Nakajima, Vice-President of AIST is the third from the right.

Further Network Reinforcement

In the future AIST will initiate the creation of a network and the establishment of a partnership for “Biomass-Asia”, promote the planning of international joint projects which are mutually complementary and benefit both Japan and Asian countries, contribute to the sustainable development of our country through energy diversification and security stabilization in Asia and the world, contribute to the prevention of global warming and forge collaborative reinforcement activities with Asian countries.

Especially in the creation of a network, we regard as important a highly skilled personnel network and will promote the exchange of qualified human resources in Asia by using the AIST fellowship program begun in 2005 and JICA’s new group training course “Research on Biomass Technology” which will begin in 2006.

Biomass Energy
Curbing Global Warming by Increasing the Economic Value of Forests

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