

Introduction to biomass utilization efforts in Asia

Y. Matsumura
Division of Energy and Environment
Hiroshima University

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Biomass species



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Introduction

Biomass utilization in Japan

- Difficulties of biomass utilization
The amount of biomass collected is limited.
The heating value is lower than fossil fuels.
Biomass-derived fuel is more expensive.
Biomass utilization conflicts with other use.

Encountered much more severely in Japan
Steep mountains
High labor cost

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Introduction

Biomass utilization in Japan

Japanese struggle in order to introduce biomass energy and fuel is much harder than any other countries in the world.

Thus, the development of policy, technology, and system for biomass utilization that took place in Japan will provide a good insight to overcome the problems that will be encountered soon in the other part of the world.

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Contents

1. Policy development
2. Technology development
3. System development
4. Know-how development



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1. Policy development

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Scenario for biomass utilization (1)

Interest in biomass fuel

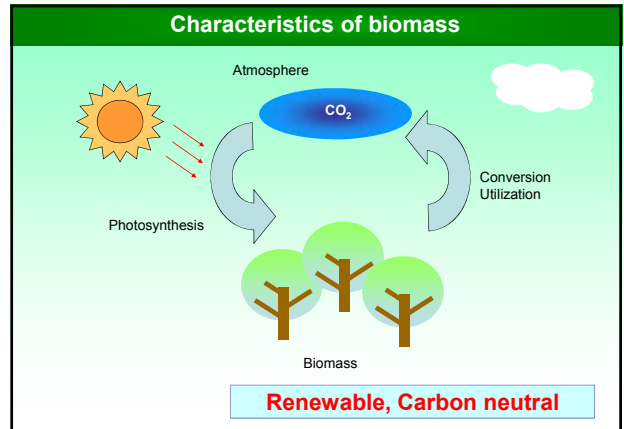
World War II ----- Amount of oil supply

Oil crisis ----- Price of oil

Climate change ----- Now!!

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Biomass-Nippon Strategy

Lead by MAFF together with MEXT, METI, MLT, MENV

- Prevention of global warming
- Creation of a recycling-oriented vision society
- Fostering of new strategic industries with competitive edges
- Activation of agriculture, forestry, and fisheries, and those associated rural communities

Target setting
Demonstration of model
Fostering understanding
Improvement of economy

Decided at the Cabinet Meeting, Government of Japan
Dec., 2003
Revision: Mar., 2006


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Scenario for biomass utilization (1)

Variety of biomass

Waste biomass

- ➔ Unused biomass
- ➔ Energy crops
- ➔ New crops



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Scenario for biomass utilization (2)

Technology development

- Development/utilization of high-efficiency collection/conversion technology
- Construction of a biomass refinery
- Cascade use of biomass
- Coordination with other fields, and development of peripheral technologies

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Scenario for biomass utilization (3)

Development in areas

Biomass towns

Collaboration between rural areas

Collaboration with other countries



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New Biomass Nippon Strategy

Revised points (March 2006)

- 1. Accelerate Biomass Town Plan**
Goal: 300 Biomass Towns by 2010
Promotion of utilization of unused biomass such as rice straws and forestry residues is a key issue for the plan.
- 2. Promotion of biofuels**
Further promotion of utilization of domestic biofuels
Based on a roadmap for significant boost of the production of domestic biofuels, further promotion of utilization of biofuels is critical.

MAFF, Japan

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Overview of Japanese activities on biomass

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Application of biomass town concept to Asian Countries

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Tokyo declaration on Asian Biomass

Considering the increasing expectations from biomass, the Biomass Asia Forum adopts the following declaration for the effective utilization of Asian biomass resources.

1. The **renewability and carbon neutrality** of biomass resources should be recognized and the utilization of biomass resources promoted.
2. The **importance of sustainability** should be emphasized and reductions in carbon dioxide emissions should be emphasized when using biomass resources.
3. The contribution of biomass resources to the enhancement of **Asian industry and regional economies** should be recognized and appropriate measures taken to make the most of these economic effects.

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Tokyo declaration on Asian Biomass

4. The possibility of creating a **recycling society** should be discussed and appropriate measures for realizing such a society promoted when using biomass resources.
5. The effectiveness of the development and introduction of **appropriate technologies** in the utilization of biomass resources should be recognized and the development of related technologies through appropriate support and subsidization promoted.
6. **An association** to promote biomass resource utilization, composed of members from Asian countries, should be organized and should conduct self-sustaining activities.

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Tokyo declaration on Asian Biomass

7. Utilization of biomass resources should contribute to the **improvement of conditions in all countries**; thus biomass utilization that contributes to the solution of poverty, prevention of environmental damage, prevention of disease, and realization of a better quality of life should be promoted and policies for realizing such utilization pursued.

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2. Technology development

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Varieties of biomass (1)

Dry	Forestry wood	Thinning, saw-mill, ...
	Plantation wood	Eucalyptus, willow, ...
	Urban waste wood	Demolition, Pruning, ...
	Agricultural residue	Rice straw, hull, ...
	Herbaceous	Meadow grass, ...
Wet	Aqueous plant	Uva, water hyacinth, ...
	Plantation seaweed	Giant kelp, ...
	Feedstock manure	Cattle, swine, chicken, ...
	Sludge	Sewage, night soil, ...
	Food waste	Kitchen garbage, ...
Others	Sugar and starch	Potato, corn, sugarcane, ...
	Cellulose	Used paper, ...
	Vegetable oil	Rapeseed oil, waste oil, ...

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Varieties of biomass (2)

	Waste	Unused	Plantation
Dry	Woody Demolition Saw mill	Thinning	SRF (Eucalyptus, willow, ...)
	Grass Baggasse	Straw	Meadow (Sorghum, ...)
Wet	Manure Sludge	Feedstock Sewage	
	Food Sludge	Processing Garbage	
Others	Others Mollasses Waste oil	Landfill gas	Corn, Cane

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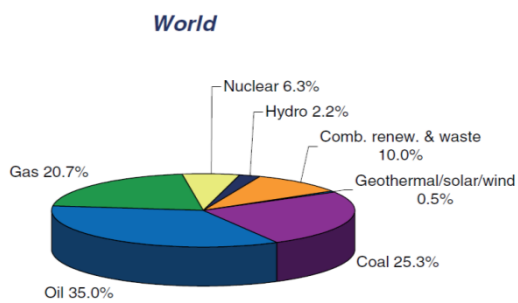
Energy conversion of biomass

Thermo-chemical	Direct combustion	Dry → Heat
	Co-firing	Dry → Heat
	HT gasification	Dry → Fuel gas
	Flash pyrolysis	Dry → Liquid fuel
	Carbonization	Dry → Charcoal
	SC methanolysis	Dry → Liquid fuel
	SCWG	Wet → Fuel gas
	Direct liquefaction	Wet → Liquid fuel
	Slurry fuel	Wet → Slurry fuel
	Transesterification	Oil → Biodiesel
Bio-chemical	Biomethanation	Wet → Fuel gas
	EtOH fermentation	Sugar/starch → Ethanol
	ABE fermentation	Sugar/starch → Liquid fuel
	H ₂ fermentation	Wet → Fuel gas

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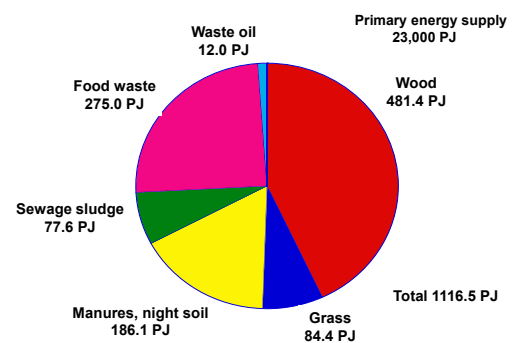
Share of total primary energy supply in 2005



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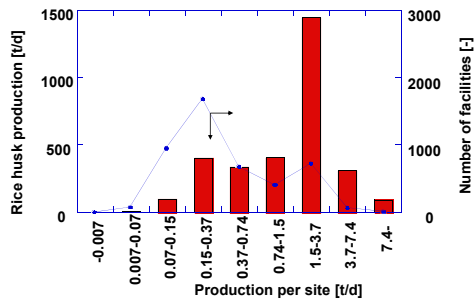
Availability of Japanese biomass



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Plant scale distribution



Multiply by 4 for possible rice straw production

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Plant scale of the highest frequency

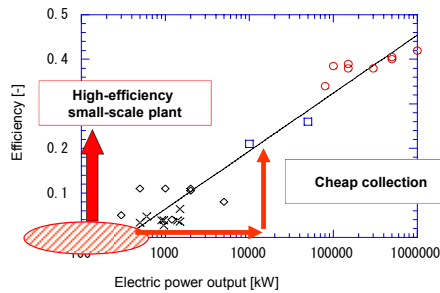
Forest leftover, unused thinned wood	10~20m ³ /year	> 50 m ³ /year
Sawmill waste (individual)	1~2.4 m ³ /d	>12.5 m ³ /d
Sawmill waste (forest planning area)	0~200 m ³ /d	400~800 m ³ /d
Rice center tank (individual)	200~500 t	2000~5000 t
Rice center tank (municipality)	1000~2500 t	5000~10000 t
Composting plant for feestock manure	100~500 t	> 5000 t
Waste parts from fish market	0~0.04 t/d	0.4~2 t/d
Vegetable waste	0.04~0.4 t/d	4~8 t/d
Kitchen waste from household	3~15 t/d	60~150 t/d
Demolition waste	1~5 t/d	10~50 t/d
Sewage treatment facility	0~10 m ³ /d	>10000 m ³ /d
Night soil treatment facility	10~50 kL/d	100~200 kL/d
Waste oil from household (waste treatment)	33~165 kg/d	660~1650 kg/d

Unit conversion results in several to several tens of t/d

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Efficiency as a function of scale



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Technology development

compact plant
- High-efficiency, small-scale plant like Japanese compact car

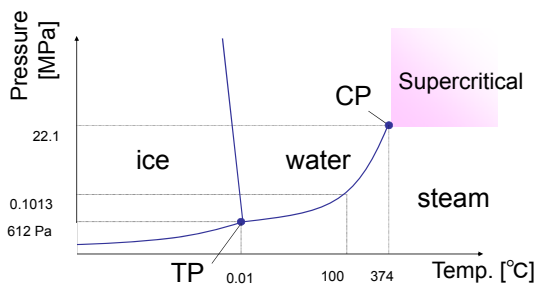
Compact plants are needed for foreign biomass utilization as well as Japanese biomass!!

Such as 12 kW downdraft gasifier & power generation and pelletizer on a truck!

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Phase diagram of water



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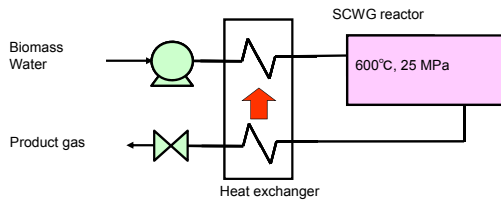
Characteristics of supercritical water gasification

- The reactions proceeds rapidly for the high temperature and high pressure.
- High reactivity of water accelerates the hydrolysis of cellulose.
- No tar in the product gas.
- Char production is suppressed.
- Product gas is easily separated from water just by cooling down.
- It is suitable for wet biomass treatment.

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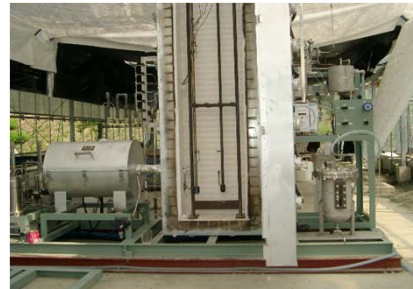
SCWG process flow



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0.1 t/d SCWG bench plant



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1 t/d SCWG pilot plant

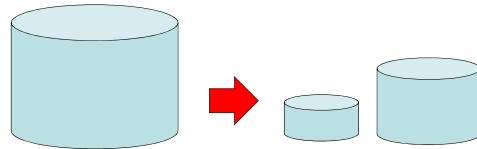


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Hydrogen fermentation

- Hydrogen fermentation is an anaerobic fermentation to produce hydrogen, but at much faster than the biomethanation. Thus, incorporation of hydrogen fermentation as a pretreatment step of biomethanation results in shorter time for treatment and smaller size of the reactor.



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3. System development

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What is biomass town?

- Biomass towns are municipalities where they uses more than 90% of waste biomass or more than 40% of unused biomass.
- Development of the plan, and submission to MAFF.
- Approval and announcement, followed by possible subsidies to achieve the target.
- System development making the best of the characteristics of the area is wanted.
- Target: 300 biomass towns by the end of 2010!

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Biomass towns in Hiroshima

HIROSHIMA

Kitahiroshima: Realization of "Town of the resource recycle Society, Kitahiroshima" is aimed at through the re-activation of this district by proceeding "Rape-flower ECO Project", and activation of industry using city garbage, livestock waste, wood, grass, biomass crop, etc.

Shobara: To utilize the biomass produced from agriculture and farming, which are the main industry of the city, and abundant forestry biomass resources, these biomass resources are effectively used mainly for (1) development of the resource recycling system based on the nourishment of soil, and (2) development of the resource recycling system using woody biomass.

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Biomass Local System Demonstration

- Program is from METI, undertaken by the New Energy and Industrial Technology Development Organization (NEDO).
- Supported biomass introduction in local area for 5 years to cover all the budget including running cost. Covering running cost is quite exceptional for the Japanese governmental programs.
- Demonstration was made for various biomass. Now the program is over, and each municipality is looking for the way to be independently continue the program.

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Indonesia - Standard of living

In Indonesia, farmers in the rural area do not have access to electricity nor propane gas, and no light is available. Jatropha oil could be used for cooking fuel as well as lamp fuel so that fossil fuel consumption is prevented.



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Thailand - Saving energy expense

In Thailand, small scale biomethanation provides cooking gas to farmers, thus they need not buy propane gas for cooking.



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Thailand - Saving foreign currency

In Thailand, domestic biofuels are used to save foreign currency.



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China - Farmer's income

The other support is by cash. In China, rural farmers have access to electricity grid, but do not have money to buy the electricity. When they grow feedstock for ethanol production, and sell it at a high price, with the indirect support from government, they get money for buying electricity.



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Biomass Town in Asian countries

Application of Japanese Biomass Town concept



Characteristics of the rural area
Utilization of biomass,
Plan and implementation by the people in the area

Information / System development



Development of the rural community

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4. Know-how development

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System design

- More and more trial and successful examples
- Which leads to the extraction of the knowledge to success
- Understanding of the rural community is needed
- Then the experience can be applied to foreign countries

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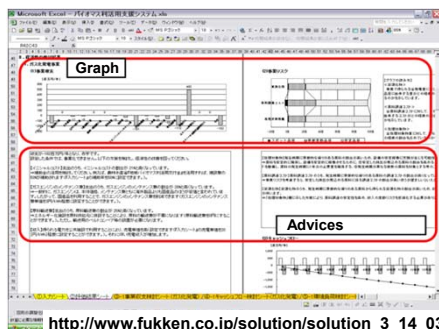
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System design

- Storage in the cold field in winter
- Storage in the form of sugar juice, not cane
- Co-treatment to increase the scale
- Small and cheap manual oil feeder
- Do not sell electricity, but use by yourself
- Use the subsidies with collaborating the municipalities
- Solve the problems of the district by the use of biomass
- Do not collect waste by yourself, but work with waste collectors
- Asking donation is effective in the rural community
- Mix waste biomass to improve economy
- Try to use byproduct for increasing income
- Use bundler to effectively bring branches down

Ideas!!

System design



http://www.fukken.co.jp/solution/solution_3_14_03.htm

Conclusions

1. Policy should be developed so that participation of members from various related activities is made.
2. Incorporation of targets of each country's interest to the policy is effective for biomass utilization enhancement.
3. One of the needed technology development is the compact plant, which achieves high efficiency for small scale.
4. System development to make the best of the characteristics of the local community is also important.
5. Accumulation of know-how and development of the system to get the needed know-how are to be made.

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Information - Biomass Asia Handbook

Sharing knowledge and experience is important.

People in rural area do not always know the biomass and its effectiveness.

"Demonstration is wanted." (Ali Hassan, Malaysia)

"Education is needed."
(Tawatchai Charinpanitkul, Thailand)

BIOMASS ASIA HANDBOOK

Being prepared by MAFF, Japan with the help of Asia Biomass Association.
Is available on homepage. Translation wanted.

<http://www.jie.or.jp/biomass/AsiaBiomassHandbook.html>

(English and Thai version are also available!!)

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Thank you!!



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