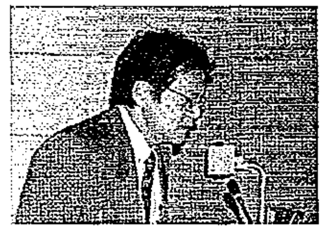
Session II: Promoting Local Industry

Promoting Local Industry
An Undertaking of the Hyogo Ecotown Promotion Conference



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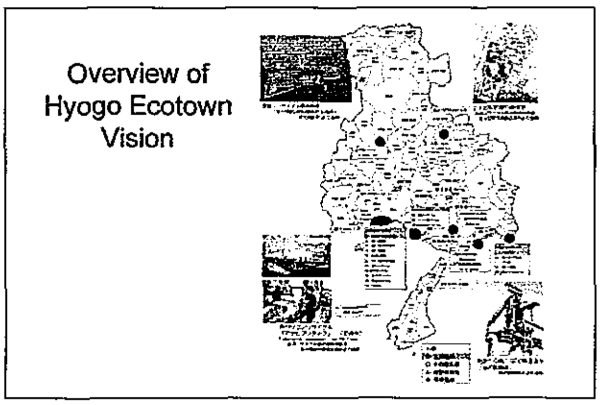
Hyogo Prefecture Environmental Create Center Public Corporation

The Hyogo Ecotown Project is being managed to promote local industry. I will be reporting on that undertaking. I will start with an "overview of the Hyogo Ecotown Vision" and follow that with the "functions and activities of the Hyogo Ecotown Promotion Conference", which is the parent organization promoting the project's realization, and thirdly introduce some "research activities" in biomass, hydrogen and other activities.

1 Overview of Hyogo Ecotown Vision



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This is a map of Hyogo Prefecture, which you can see is comparatively large. It is the 7th largest prefecture in terms of industry and ships 4.7% of all products made in Japan. Along the shores of the Seto Inland Sea concentrate secondary industries for steel and chemicals, although changes in industrial structure have created some idle properties. The "Hyogo Ecotown Vision" was initially undertaken so as to use these potentials effectively.

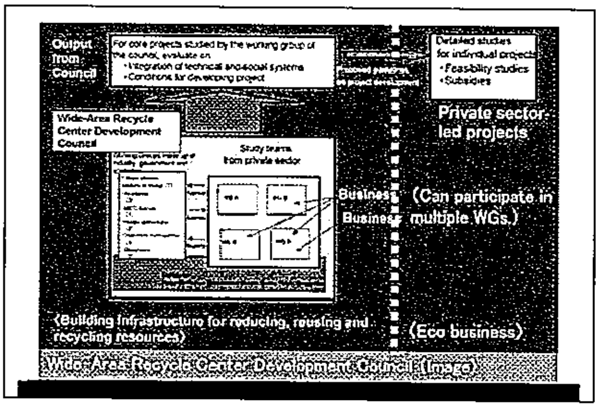
October 2000
Launched the Wide-Area Recycle Center Development Council.

(Objectives)
Industry, government and the academic world came together to explore the possibilities of building a recycle center in the coastal area as indispensable infrastructure for a recycle-oriented society in Hyogo, as recycling leads to the reduction and reuse of resources.

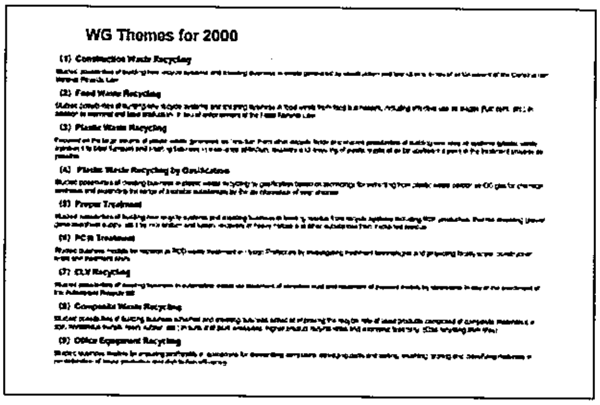
→April 2003 Formulated the "Hyogo Ecotown Vision".

The origin of the Ecotown Vision was the Wide-Area Recycle Center Development Council launched in October 2000. This period in and around the year 2000 saw the enactment of several recycle laws in Japan. The Wide-Area Recycle Center Development Council was created through a "cooperative effort of industry, government and academia to explore the possibilities of building a recycle center as essential infrastructure for a recycle-oriented society in Hyogo, as recycling leads to the reduction and reuse of resources."

This is a conceptual image of the Wide-Area Recycle Center Development Council. Study teams were formed from the private sector to explore business models, while a working group of persons from indus-



try, government and academia was created to approve projects. The Hyogo Prefecture Environment Create Center Public Corporation serves as the secretariat. Private sector groups head up individual projects.



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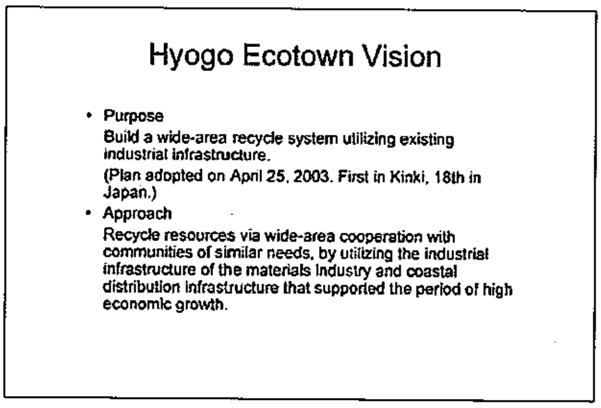
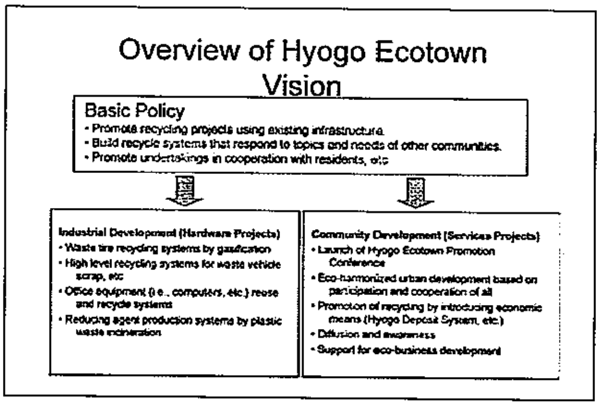
There are 9 research themes at present, those being Construction Waste Recycling, Food Waste Recycling, Plastic Waste Recycling, Plastic Waste Recycling by Gasification, Proper Treatment, PCB Treatment, ELV Recycling, Composite Waste Recycling and Office Equipment Recycling. Each is look-

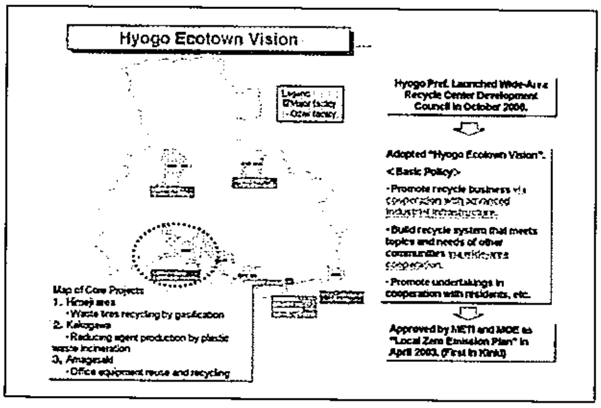


ing to promote recycling in its own way.

The "Hyogo Ecotown Vision" was crafted from within these studies, with the objective of "building a wide-area recycle system using existing industrial infrastructure." It aims to "recycle resources via wide-area cooperation amongst communities with similar needs, by utilizing the industrial infrastructure of the materials industry and the coastal distribution infrastructure that supported the period of strong economic growth."



In addition to the basic policy, the Hyogo Ecotown Vision has two primary pillars of hardware projects and services projects. The former addresses industrial development through the building of recycle-specific hardware and the promotion of the recycle business. The latter is about community development and led to the launch of the Hyogo Ecotown Promotion Conference to develop awareness activities across a broad swath of society and promote urban development through cooperation with residents.



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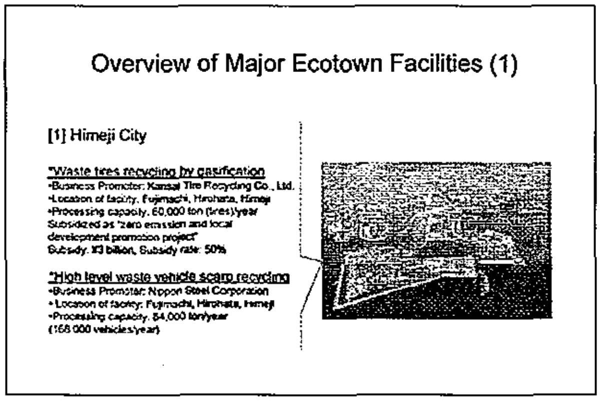
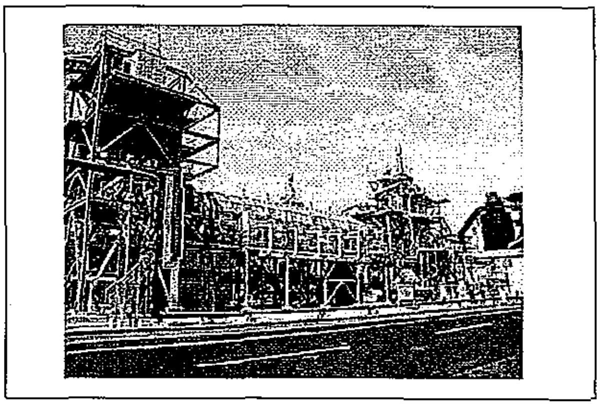
The Ecotown Vision originated out of these two pillars. Based on the "Hyogo Ecotown Vision" put forth by the Wide-Area Recycle Center Development Council, Japan's Ministry of Economy, Industry and Trade and the Ministry of the Environment approved the project on April 24, 2003 as the 18th "Local Zero Emission Plan" in Japan. The basic policy was to promote the recycle business via cooperation with advanced industrial infrastructure, build recycle systems that meet the issues and needs of other communities via wide-area cooperation, and promote undertakings in cooperation with residents and others.

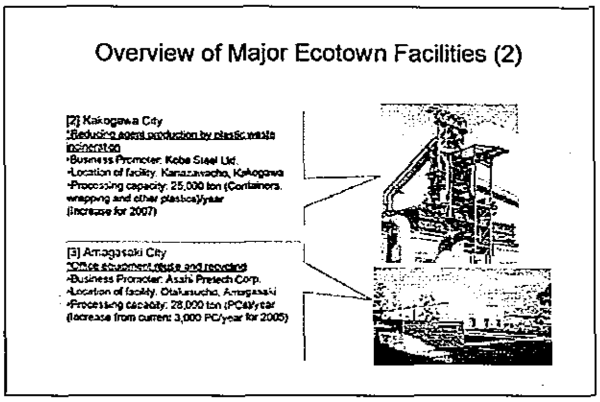


At this point, I would like to introduce the main facilities of the Ecotown Vision. With an Ecotown Grant of ¥1.5 billion, a "waste tire recycling by gasification" plant was built in Himeji last July. It is located on the grounds of the Hirohata Works of the Nippon Steel Corporation where their high temperature furnace used to be. Waste tires are brought to the plant and decomposed by deoxygenation. When decomposed, a waste tire is 13% steel wire and about 30% carbon residue, which are recycled as materials for making steel. The rubber does not burn because it is heated by deoxygenation, which leaves about 50% as gas or cracked oil, which are used as energy by the steel mills.

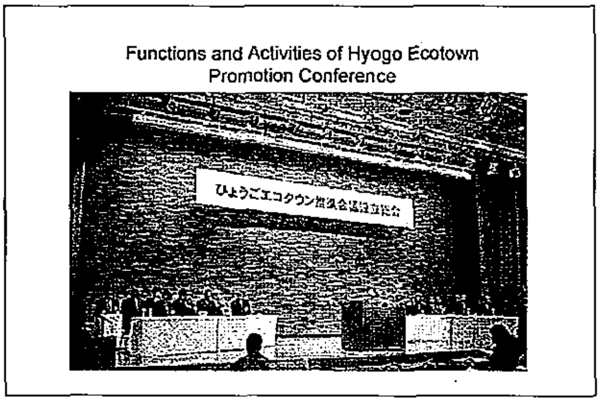
This photo is an external shot of the "waste tire recycling by gasification" plant. This long cylinder here is a rotary kiln. Processing flows from left to right.



Two other facilities are a plant in Kakogawa for producing "reducing agent by incinerating waste plastic" and an office equipment reuse and recycling center in Amagasaki. These are the kind of core facilities of the Ecotown Project.

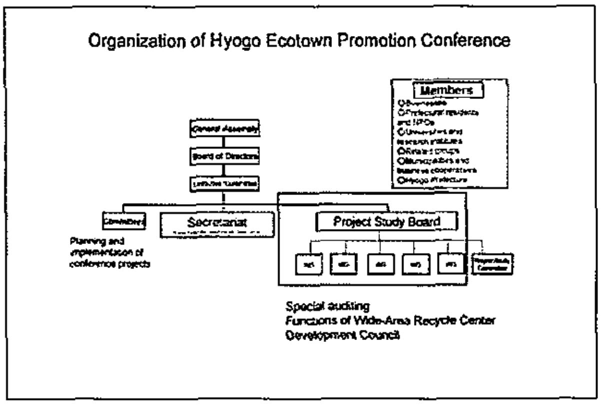


2 Functions and Activities of the Hyogo Ecotown Promotion Conference

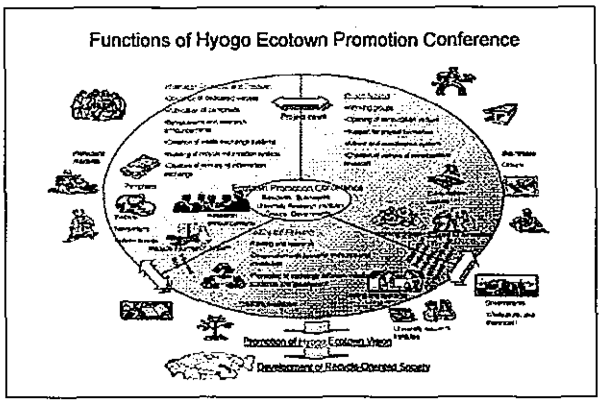


In December 2003, the "Hyogo Ecotown Promotion Conference" was launched the implementation of the Ecotown Vision. I would now like to introduce what goes on there.

This figure shows the organizational structure of



the Hyogo Ecotown Promotion Conference. Major policies are decided by the General Assembly, Board of Directors and Executive Committee. Also, underneath the Project Study Board, there are several Working Groups. These Working Groups are carrying on the functions of the Wide-Area Recycle Center Development Council I talked about earlier. Other than this, there is Project Study Committee, which operates as a closed meeting of only concerned members.



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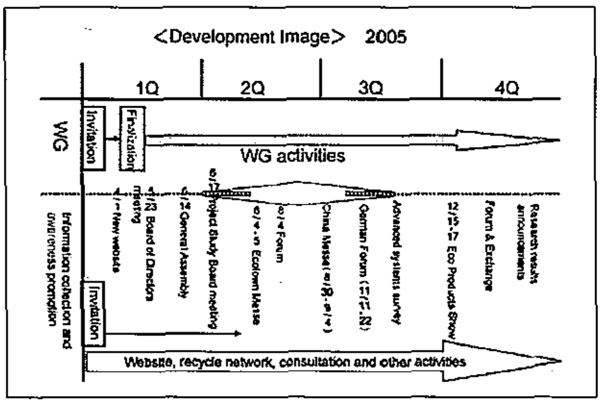
This slide conceptualizes the functions of the Hyogo Ecotown Promotion Conference. There are three main functions.

The first is "testing and research", which involves the implementation of testing and research for the development of a recycle-oriented society, promoting cooperation with universities and institutes, and interaction amongst industry, government and academia.

This here focuses on business support by opening venues for consultation on launching working groups and promoting concrete projects based on collected information, providing support for project formalities including permits, and creating a system for providing advice and coordination and venues for collaborative research. This is the second function, "project support".

Another function is "information collection and provision". Since these services are directed at the general public, they include activities for operating a dedicated website, publishing pamphlets, staging symposia, announcing research results, creating waste exchange systems and building a recycle information system.

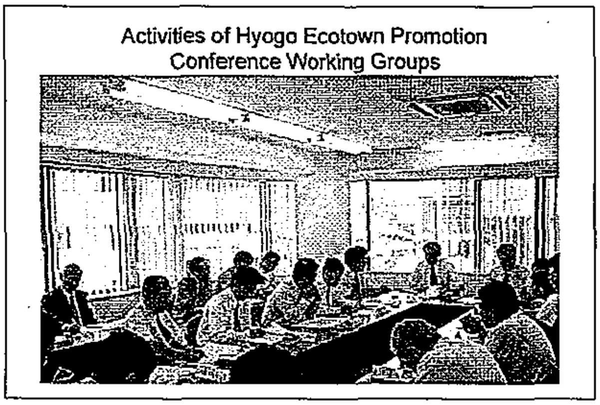
The Hyogo Ecotown Promotion Conference is promoting the Ecotown Vision via these three functions in order to contribute to the development of a recycle-oriented society.



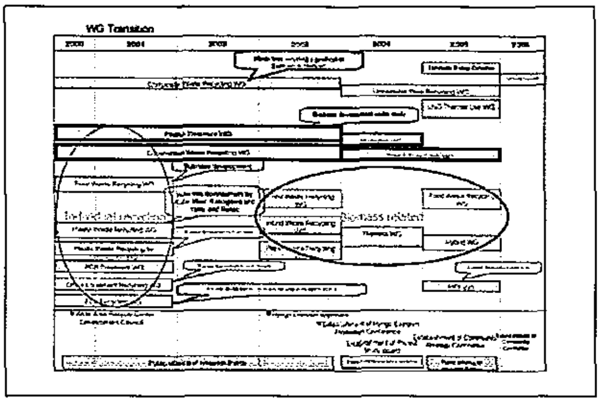
This is a schedule of major developments of the Hyogo Ecotown Promotion Conference. It gives activities for FY2005. Working Groups are solicited in April, then decisions are made by the Project Study Committee as to which will be promoted. Then, the projects themselves are managed throughout the rest of the fiscal year. Also, as a part of information collection and awareness activities, there are various types of forums and tradeshows, opportunities to announce research results and conduct surveys on advanced systems.

3 Activities of Hyogo Ecotown Promotion Conference Working Groups

From this point forward, I would like to introduce



some actual activities of a few Working Groups of the Hyogo Ecotown Promotion Conference. This is a snapshot of a meeting of one Working Group. University professors, officials from prefectural and municipal governments, and persons from the business world take part in the Working Groups. They all gather to share opinions on how to build business models.



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This chart shows the transition of past Working Groups, but you can see that research became quite diversified following the launch of the Wide-Area Recycle Center Development Council in 2000. The recycle Working Groups that existed at that time have led to business projects in each their own way. In launching these Working Groups, many businesses had done preliminary studies in line with the host of recycle laws that were enacted in and around 2000. This is where the Wide-Area Recycle Center Development Council emerged with the dynamics of business and eventually turned into an actual business project.

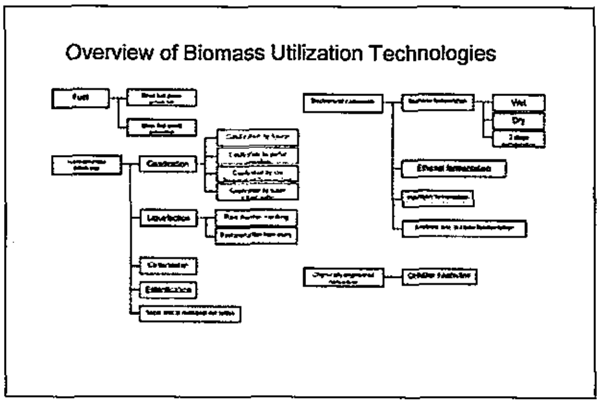
Until 2003, studies looked into business models for capitalizing on the initial recycle laws that came out, after which the Ecotown Promotion Conference was established. In 2004, Working Groups were formed to do research into the new mid-to-long-term themes of "Hydrogen", "Slag and Fused Ash" and "Biomass".

One project I will mention today has to do with biomass. Working Groups were formed after 2003 to research "Food Waste Recycling", "Waste Wood Recycling" and "Waste Paper Recycling", while in 2004 came a Working Group for "Biomass" and, in 2005, Working Groups for "Food Waste Recycling" again and "Hybrids". All of these come together as one big cluster of biomass research.

I would also like to briefly report on studies into hydrogen as a promising energy source of the future.

I would also like to talk about the Working Groups that are researching "Slag and Fused Ash", "Construction Material Waste Recycling" and "Proper Treatment".

3.1 Biomass projects



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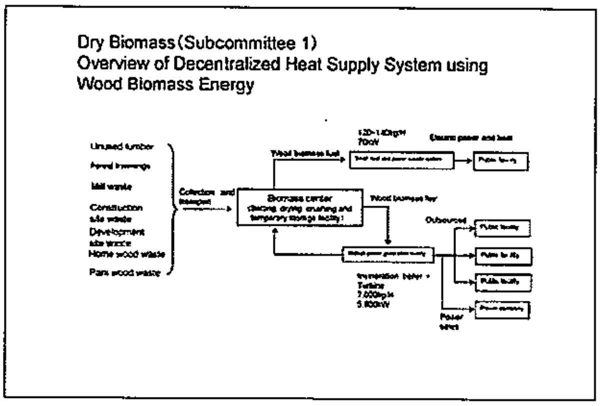
Biomass utilization technologies are very diverse in nature. There are its use as fuel, and its thermochemical conversion, biochemical conversion and chemically engineered conversion. With fuel, the Ecotown Development Conference is looking at "mixed fuel power generation", with thermochemical conversion, "gasification by partial oxygenation", with biochemical conversion, "dry methane fermentation", and with chemically engineers conversion, "cellulose liquefaction". Later, I talk briefly about "hydrogen fermentation".



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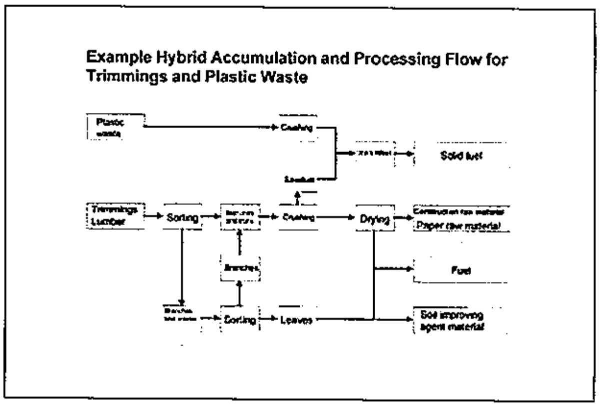
Biomass has dry and wet systems. Dry systems enable shipping to some degree, while wet systems require on-site processing. In this field, studies are looking at a decentralized heat supply system using dry wood biomass energy.

Dry Biomass
Topics concerning Decentralized Heat Supply Systems

- Need for biomass centers
  Centers would be capable of collecting, transporting, temporarily stocking and drying, crushing and temporarily storing wood biomass from Hyogo.
  They are important towards ensuring an inexpensive and stable supply of fuel. For this reason, cooperation with industry is essential.
- Participation in municipal projects
  Projects should be positioned and aggressively supported as community development projects with biomass centers and resource utilization facilities at the core.
- Support for model projects
  Model projects should be assessed not only for their economic feasibility but also their reduction of environmental load and contribution to the development of a recycle-oriented society. In order to minimize forerunning risks, support measures and particularly subsidies for "running costs" are essential.
  (Balance is slightly less tan ¥20 million in the red.)

As you know, biomass is extremely light, widely available and requires a moderate cost to transport. Therefore, studies are exploring the possibilities of building a biomass center for sorting, drying, crushing and storing diverse types of biomass and using it as needed to generate power and heat. However, the cost balance is not good because of running costs, etc.

Though there is demand for biomass use, it is still far from being a business, therefore studies are looking at simultaneously collecting waste plastic and biomass. Research is moving forward with a hybrid accumulation of waste plastic and tree trimmings, and



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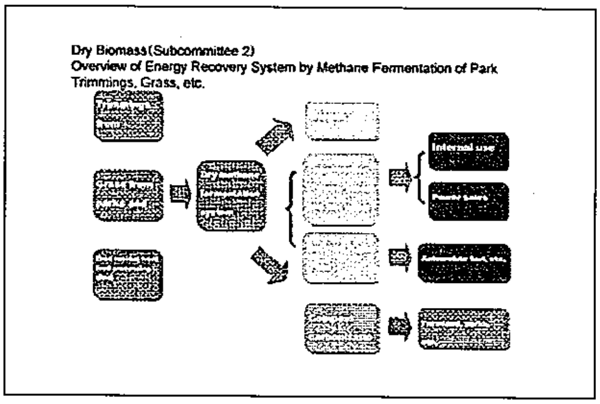
there are prospects of high economic return.



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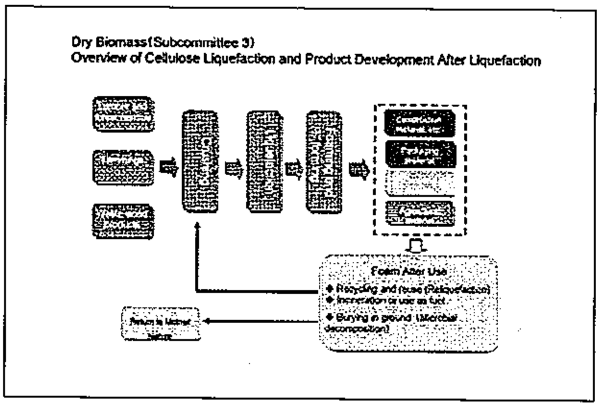
The second is dry methane fermentation. It collects trimmings, grasses and food waste and produces biomass gas with a dry methane fermen-tation system. In addition to gas production, it offers co-generation via power generation. Studies are looking also into carbonizing the residue to make compost. However, even with 80% funding, it still does not look feasible.



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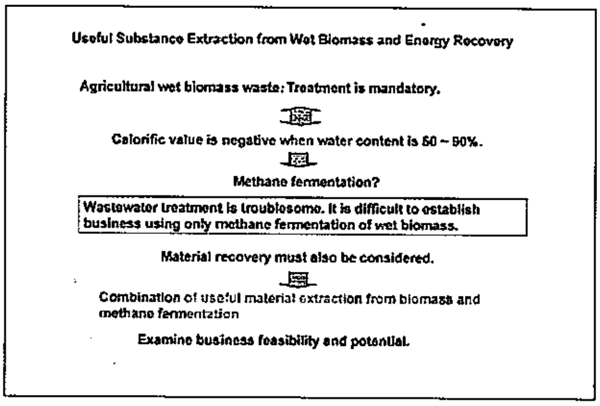
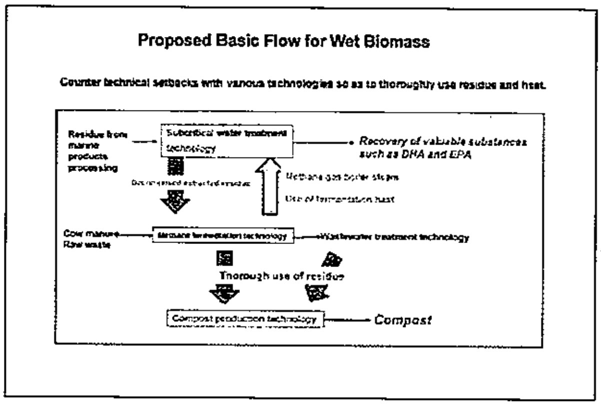
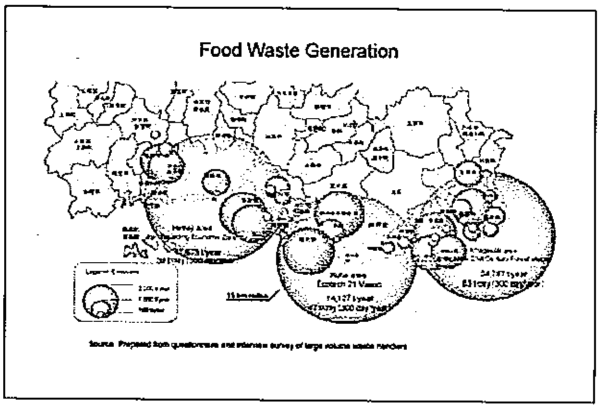
The third is cellulose liquefaction whereby cellulose is crushed, liquefied, formed into chips, changed to liquid by chemical processing and then foamed. Example uses are construction materials and greening materials. After that, it is recycled, reused or buried in the ground to return it to the natural environment. Studies of it's potential are underway on this.



Like dry systems, wet ones, too, are not at a feasible stage just yet. Moreover, because the biomass contains anywhere from 50 to 90% water, evaporation rate is very low. If this is to be used effectively, it will be necessary to improve business feasibility not just by thinking about energy but by also recovering materials.



Using various technologies, wet biomass systems should be able to extract DHA (docosahexaenoic acid), EPA (eicosapentaenoic acid) and other valuable materials from processed seafood. To enhance the business potential, the system that the residue would be used to generate electricity by methane fermentation has been proposed.



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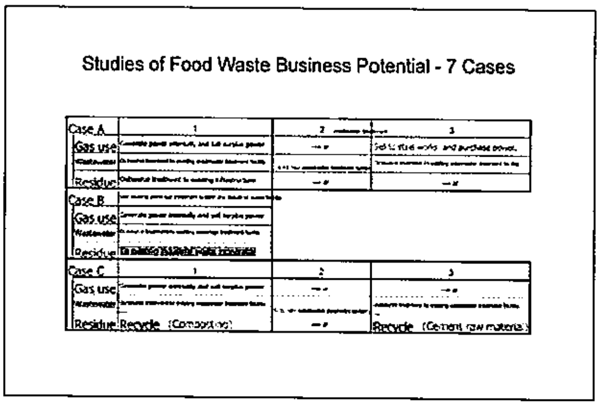
This map gives food waste generation figures. Just in cities along coastal areas, a considerable amount of waste is generated.



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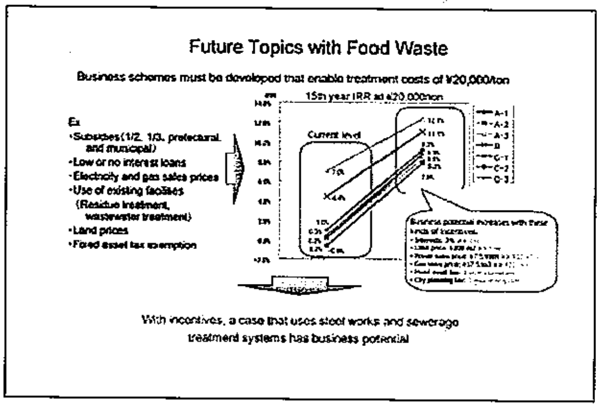
This table examines seven cases of food waste business potential. Using gas produced from food waste, internal power generation would be possible with any surplus power being sold and perhaps sold to steel mills. Wastewater treatment would be outsourced to existing facilities or new systems would be built.



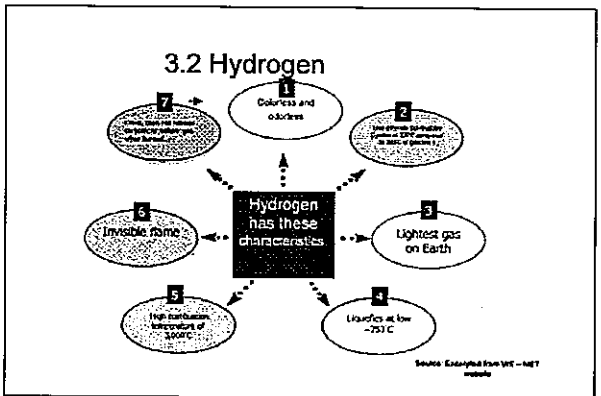
The business potential of food waste has been studied closely, but in terms of IRR (internal revenue rate), the prospects of business are not good. Accordingly, incentives, such as to reduce current interest rates from 3% to 1% or charging nothing for land, are being considered to make business possible. These are the studies going on now.

Future Outlook on Biomass Projects

- Current State and Topics
  ① Hyogo has high potential for hydrogen technology, but there is no long-term strategy.
- ② Collection costs are high for dispersed sources of biomass and, with currently available technology, profits do not cover costs as a private sector project. Innovative technology must be developed to support diversified ways of use.
- Future Undertakings
  ① Prepare a long-term road map for a hydrogen-driven society that uses biomass, and promote R&D from a mid to long-term perspective.
  ② In the short-term, promote the development of business models and the startup of projects that match the peculiarities of the local area and the diversified ways of use.

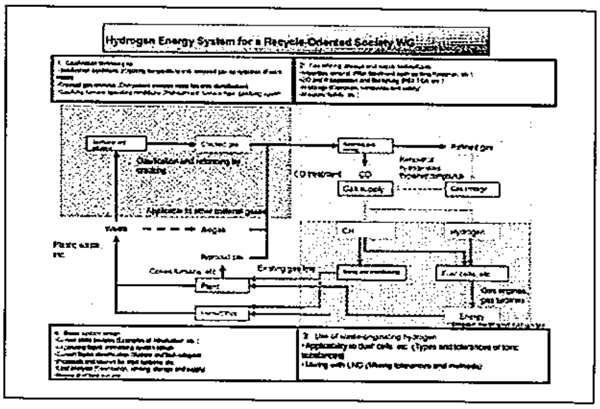
Whatever the situation, biomass is rather costly and, as a business, the profits do not balance the expenses. A technical approach, including technological innovation for various ways of use, seems necessary.

3.2 Hydrogen projects



Next, I would like to talk about hydrogen. Its characteristics are laid out here. Hydrogen has various qualities to note that it does not release carbon gas or sulfur oxides when burned, hence offering future expectations as an energy source.

Within the Ecotown Promotion Conference was launched a Working Group to research "Hydrogen Energy Systems for a Recycle-Oriented Society", which



Proposal and Topics for Hydrogen Use System Model Project
Study Approach to Hydrogen Production and Use System
Objectives and Method of Study

- Study Objectives
  Conduct preliminary studies into proposing a model project for using recyclable resources such as waste to make and use hydrogen.
  Set multiple scenarios, and organize a project overview, technical development topics and business topics.
- Study Method
  ① Set hydrogen production and use scenarios.
  ② Separate and design basic processes (gasification, gas separation and thickening, and gas use).
  ③ Identify features and topics of each scenario.
- Study Items
  Energy balance, cost balance, technology level and development topics

is examining hydrogen utilization. One possibility is gasification technology. In the conventional process of breaking down natural gas to produce hydrogen, CO_2 is generated, but research is trying to produce hydrogen from waste using gasification technology.

However, hydrogen production from waste could conceivably generate impurities that never existed before, therefore technology is being thought of to reform and refine the product by removing such impurities. There is also the question of how to use hydrogen that has been reformed from waste. One idea is on the hydrocarbon level, whereby it would be mixed in existing gas lines or the hydrocarbon would be used in fuel cells to generate power. Then, there is the question of what kind of social service could collect waste from factories and homes, and gaseous by-products exhausted from factories. Studies are probing the prospects of a hydrogen-driven society by creating a single circulatory cycle like that shown here.

We are asking whether a hydrogen production and utilization system that uses waste and other recycled

Prerequisites and Target Technologies

- Source Substances
  Waste ties and plastic (potential source of hydrogen) from the prefecture
  Processing capacity: 200 ton/day × 300 day/year = 60,000 ton/year
  (Waste tires: 50%, Plastic waste: 50%)
- Target Technologies
  ① Gasification process: Externally heater kiln type gasifying furnace
  2 types: "Gasifying" only and "Gasifying + Reforming (Hydrogenation)
  Recovered gas is refined (dust removal, desulfurization, etc.). Imagine a site where materials can be accumulated, heat supply is available, and demand and delivery of recovered resources and byproducts can be expected (i.e., coastal steel works, etc.).
  ② Separation and thickening process: PSA, CO-PSA
  ③ Use process: GE (gas engine), MCFC (molten carbonate fuel cell) SOFC (solid oxide fuel cell), PEFC (polymer electrolyte fuel cell), CH_4 supply to city gas line, methanol synthesis, DME synthesis (dimethyl ether)

resources as raw materials is actually possible or not. Studies are looking at a processing rate of 200 t/day, "gasification" and "gasification plus reforming (hydrogenation)" as target technologies, gas engines that run on methane, MCFC (Molten Carbon Fuel Cell) and SOFC (Solid Oxide Fuel Cell), and supplying CH4 to city gas lines.

This table gives numerical figures for each case of hydrogen production and utilization flow as part of a study into cost balance. For example, with scenario 6, separation and recovery of hydrogen, the hydrogen production cost is a considerably low \2. However, the effect of recuperated materials (waste tires and plastic) is large. Recuperation means that money must be borrowed to obtain recyclable materials. Based on these scenarios, the outlook is good on producing hydrogen from waste whether via methanol synthesis or DME (dimethyl ether) synthesis, but recuperation is the pretext, therefore individual studies need to be scrupulous.

Studied Scenarios (Hydrogen Production and Use Flow)

Scenario No.	Gasification & Reforming	Main gas components	Separation & Thickening	Use	Output
①	Gasification	CH_4, etc H_2	—	GE	Power
②			—	MCFC	Power
②'			—	SOFC	Power
③			CH_4 thickening	Supply to city gas line	CH_4
④	Gasification & Reforming	H_2, CO	—	Methanol synthesis	Methanol
④'			—	Methanol synthesis + Methanol dewatering	DME
⑤			—	MCFC	Power
⑤'			—	SOFC	Power
⑥			H_2-PSA	PEFC	Power (H_2)
⑦			CO-PSA+H_2-PSA	PEFC	Power(H_2), CO

Cost Balance - Power Sales Price of ¥15/kWh

- A positive cost balance (revenues - expenses) results for methanol synthesis (scenario ④) and DME synthesis (④').
- If it costs ¥50/kW or less to generate power, scenarios ①, ②' and ⑤ offer positive balances.

Scenario	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
① GE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
② MCFC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
②' SOFC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
③ Supply to city gas line	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
④ Methanol synthesis	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
④' DME synthesis	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
⑤ MCFC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
⑤' SOFC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
⑥ PEFC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
⑦ PEFC+CO	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Remark: Data is given for a generator output price of ¥300,000/kW.

Balance - Hydrogen Production Cost

- Hydrogen production cost is a low ¥2 ~ 20/m³N.
- Recuperated materials (waste tires and plastic) greatly affect hydrogen production costs.

Scenario	Investment cost: Gasification & Reforming	Investment cost: Separation & Thickening	Recovery cost: Material treatment cost	Recovery cost: Earnings from recovered material sales	Cost balance (Investment - Recovery)	H production rate	H production cost	(Material treatment cost included)
	¥100 mil/year	¥100 mil/year	¥100 mil/year	¥100 mil/year	¥100 mil/year	m³N/year	¥/m³N	¥/m³N
⑥	16.0	2.8	18.0	0	0.8	43.00 mil	2	43
⑦	16.0	11.3	18.0	0.6	8.7	44.00 mil	20	61

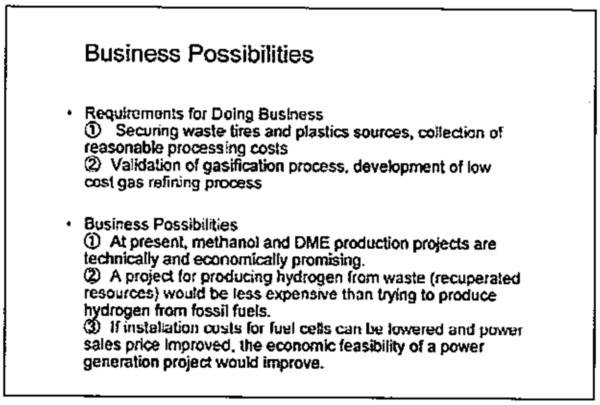
Scenario Features

	Scenario	Energy		Cost		Technology level	
Gasification	① GE	○	Surplus energy available (?: Not yet studied)	△	Power generation system cost: Low. Power sales price: Profitable if high	×	Stable operation of gasification process is difficult. GE and FC must be developed
	② MCFC	?		?		×	
	②' SOFC	○		△		×	
	③ Line supply	○	CH_4 can be used as fuel, etc.	?	(Not yet studied)	△	Gas must be refined as per supply agreement
Gasification + Reforming	④ Methanol synthesis	○	Methanol and DME can be used as fuel, etc	○	Methanol and DME production cost is low (Sales should be profitable)	○	Similar projects already exist (DME synthesis uses existing technology) Gasification and reforming process must be validated
	④' DME synthesis	○		○		○	
	⑤ MCFC	○	Surplus energy available	△	FC cost: Low Power sales price: Profitable if high	△	Gasification and reforming process must be validated. FC must be developed
	⑤' SOFC	○		△		△	
	⑥ PEFC	×	Power must be purchased to produce H_2	○	H_2 production cost is low. (Sales should be profitable)	○	PSA must be scaled up
	⑦ PEFC+CO PSA	×		○		○	

Technology Level and Development Topics

	Scenario	Technology level and process matching, development topics, etc.
Gasification	① GE	◆To prevent knocking with GE running on hydrogen mixed gas, output must be adjusted. Cost is higher than GE that run on city gas. (Product development needed)
	② MCFC	◆Cracked gas has high tar content and contains fuel cell toxic substances (HCl, H_2S, etc.). Therefore gas must be thoroughly cleaned
	②' SOFC	◆Current SOFC are low output, high cost. Power generation efficiency is barely 40%
	③ Line supply	◆To supply hydrogen to a city gas line, the components in the supply agreement (H_2<4%-vol) must be ensured
Gasification + Reforming	④ Methanol synthesis	◆Gasification systems that convert plastic waste into chemical industry raw materials are operating in Japan. ◆How to use the recovered methanol is a topic (DMFC, etc.)
	④' DME synthesis	◆Plants that synthesizes DME by methanol dewatering are operating in Japan. ◆DME demand and use development are topics. (Producing 20 000 ton of DME a year would be excessive.)
	⑤ MCFC	◆There is still no example of an MCFC with cracked gas as fuel. ◆Current MCFC installation costs are high at approx. ¥500,000/kW
	⑥ PEFC	◆PEFC are low output, high cost. To use recovered H_2, many installations are needed ◆Increasing recovery efficiency and reduced power consumption are topics with PSA ◆Finding uses for the cracked recovered CO (acetic acid production, etc.) is a topic
	⑦ PEFC+ CO recovery	

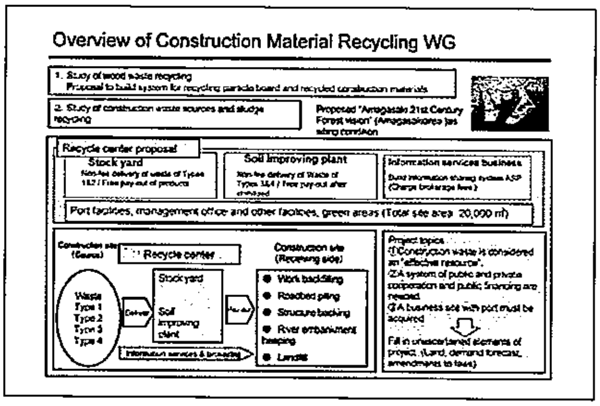
This table matches actual technology levels and processes, and gives development topics, etc. As can been seen here, there are still topics to deal with, therefore the technology issues must be individually cleared. For example, with gas engines (GE), output of hydrogen mixed gas must be adjusted to avoid knocking. And, with MCFCs (Molten Carbon Fuel Cells), since it is made from waste, the cracked gas contains a high level of tar and toxic substances (HCl, H2S, etc.), therefore it requires cleaning technology. So, there are various issues. Accordingly, hydrogen must be looked at with a long-term perspective.

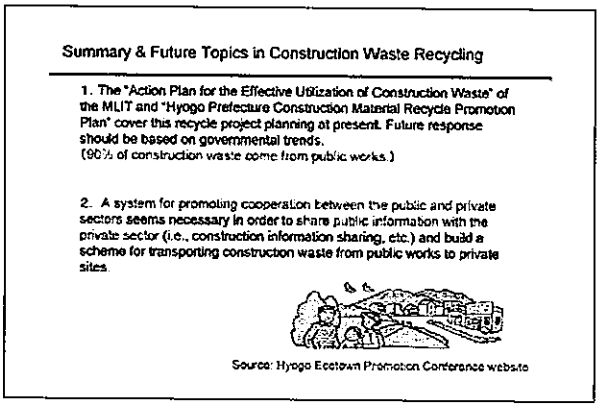


Some of the requirements for business development include securing the waste materials such as waste tires and plastic that act as raw materials, validation of gasification processes, and so forth.

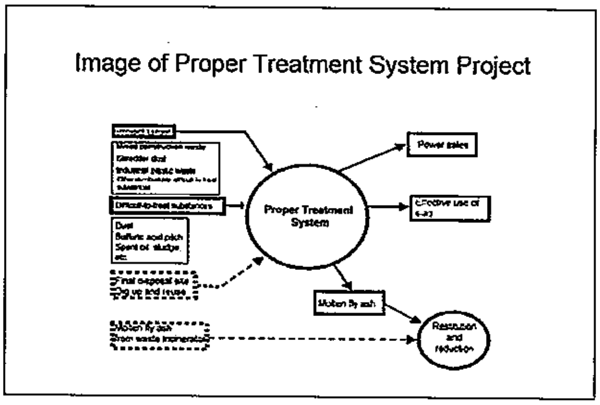
3.3 Other projects (Construction material recycling, proper treatment, slag and ash)

This slide outlines the Working Group for "Construction Material Recycling". Here, soil excavated from construction sites is transported to a stock yard/recycle center, where it is improved and deliv-

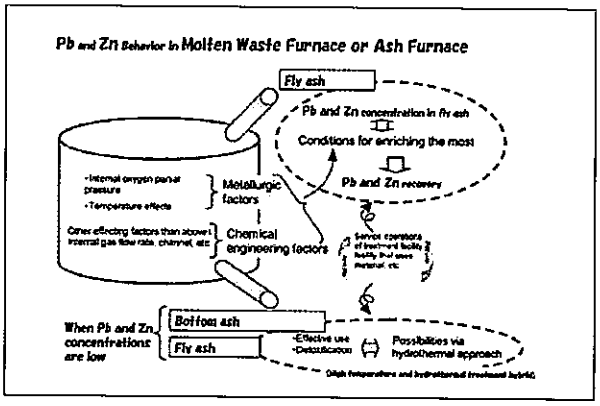




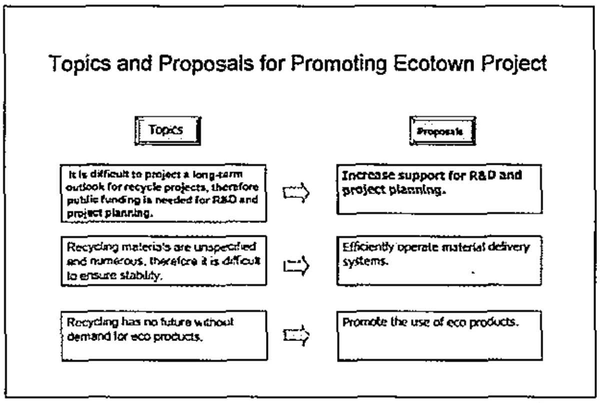
ered as necessary. Here, such a business model is being studied.



A proper treatment system is a place for properly treating difficult to treat waste such as shredder dust, industrial plastic waste, dust, sulfuric acid pitch, and so forth. After treating the waste, the byproduct energy is sold. Slag is put to effective use and the molten ash would also be used.



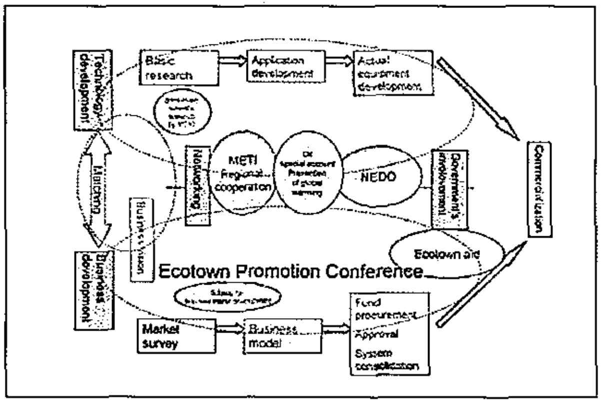
This figure illustrates studies into the effective use of molten ash and slag. The lead and zinc found in fly ash would be enriched for recovery. Moreover, studies are looking at whether slag has some kind of higher value added than roadbed aggregate.



That was a brief explanation of what is going on in the Working Groups, but recycling has many topics. One is directly related to costs; how do we secure the needed raw materials? Depending on the circumstances of how the waste is generated, biomass requires a great deal of money. Efforts are needed just to collect materials.

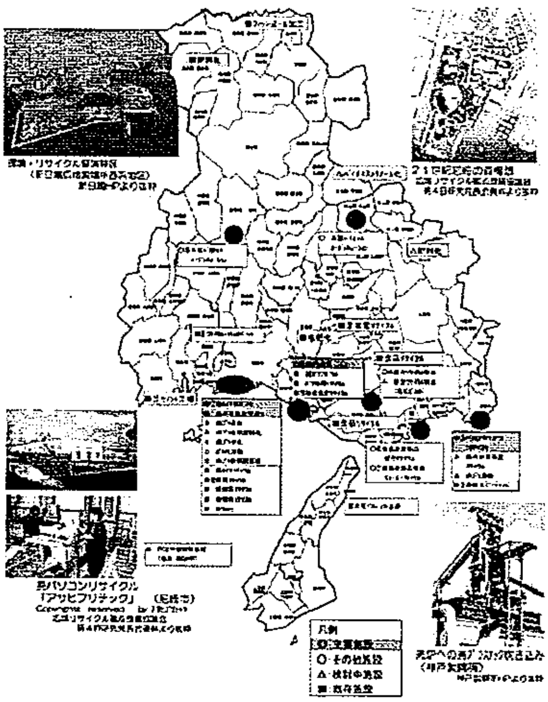
The second is the demanded innovation of recycling technology I mentioned earlier; the systems built specifically for a purpose will age with time. Greater public funding will be needed.

The third is that recycling does not have a future without demand for eco-friendly products. Therefore, promoting their use is a big issue.



This slide illustrates how project development and technology development can be commerciali-zed. Progress towards commercialization will come from studies by the Working Groups of the Ecotown Promotion Conference into market analyses, business modeling, capital procurement, authorization, system building, etc. With technology development, on the other hand, basic research, application development and actual equipment development must be somehow carried out with the idea of matching technology to business needs in mind. The Ecotown Promotion Conference will be injecting these functions as business development moves forward.

Overview of Hyogo Ecotown Vision



WG Themes for 2000

(1) Construction Waste Recycling

Studied possibilities of building new recycle systems and creating business in waste generated by construction and tear-downs in lieu of enforcement of the Construction Material Recycle Law.

(2) Food Waste Recycling

Studied possibilities of building new recycle systems and creating business in food waste from food businesses, including effective use as biogas (fuel cells, etc.) in addition to compost and feed production, in lieu of enforcement of the Food Recycle Law.

(3) Plastic Waste Recycling

Focused on the large volume of plastic waste generated as "residue" from other recycle fields and studied possibilities of building new recycle systems (plastic waste injection into blast furnace) and creating business in wide-area collection, recovery and recycling of plastic waste at as far upstream a point in the treatment process as possible.

(4) Plastic Waste Recycling by Gasification

Studied possibilities of creating business in plastic waste recycling by gasification based on technology for extracting from plastic waste carbon as CO gas for chemical synthesis and expanding the range of treatable substances by the dechlorination of vinyl chloride.

(5) Proper Treatment

Studied possibilities of building new recycle systems and creating business in treating residue from recycle systems including RDF production, thermal recycling (power generation/heat supply, etc.) by incineration and fusion, recovery of heavy metals and other substances from thickened residue.

(6) PCB Treatment

Studied business models for hazardous PCD waste treatment in Hyogo Prefecture by investigating treatment technologies and projecting facility scale, construction costs and treatment costs.

(7) ELV Recycling

Studied possibilities of creating business in automobile waste via treatment of shredder dust and treatment of pressed metals by steelworks in lieu of the enactment of the Automobile Recycle Bill.

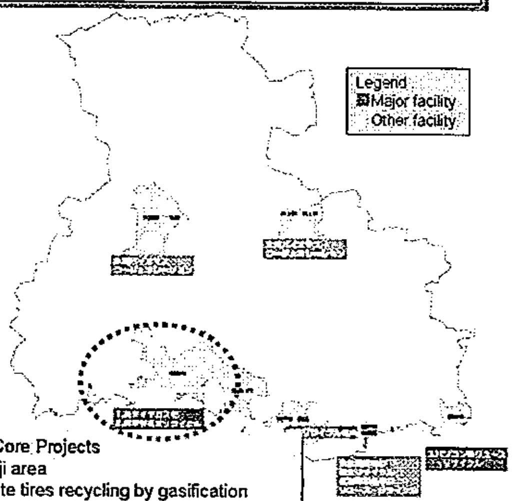
(8) Composite Waste Recycling

Studied possibilities of building business schemes and creating business aimed at improving the recycle rate of used products composed of composite materials (i.e., iron, nonferrous metals, resin, rubber, etc.) in pursuit of zero emissions, higher product recycle rates and economic feasibility. (Gas recycling from tires)

(9) Office Equipment Recycling

Studied business models for ensuring profitability in operations for dismantling computers, salvaging parts,and sorting, crushing, storing and classifying materials in consideration of reuse promotion and distribution efficiency.

Hyogo Ecotown Vision



Map of Core Projects
1. Himeji area
- Waste tires recycling by gasification
2. Kakogawa
- Reducing agent production by plastic waste incineration
3. Amagasaki
- Office equipment reuse and recycling

Hyogo Pref. Launched Wide-Area Recycle Center Development Council in October 2000.

⇩

Adopted "Hyogo Ecotown Vision".

<Basic Policy>

- **Promote recycle business via cooperation with advanced industrial infrastructure.**
- **Build recycle system that meets topics and needs of other communities via wide-area cooperation.**
- **Promote undertakings in cooperation with residents, etc.**

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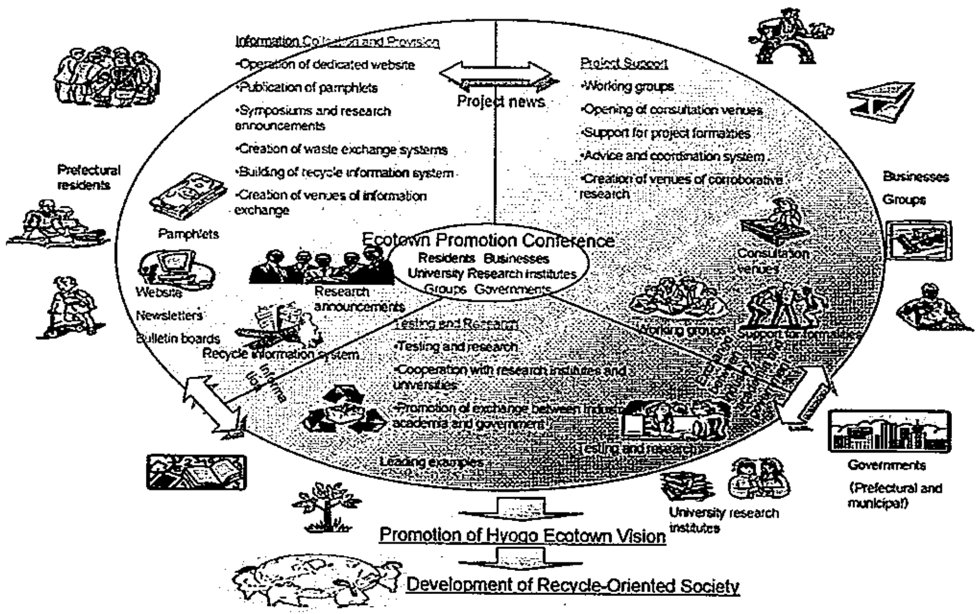
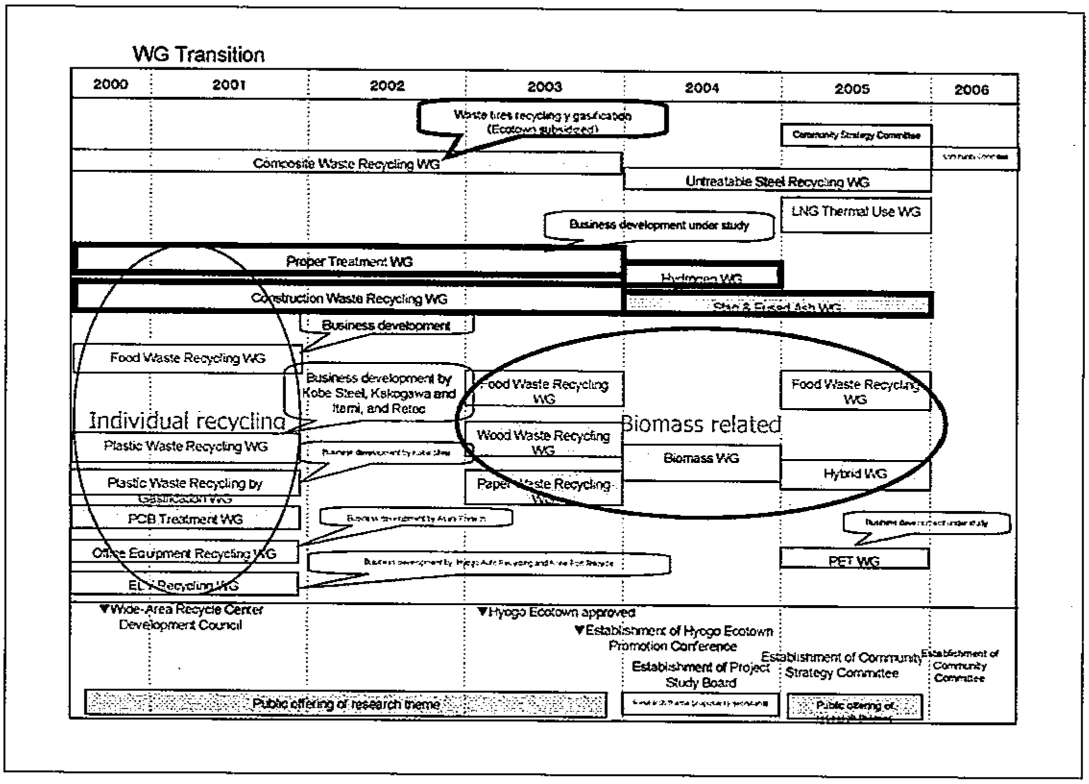
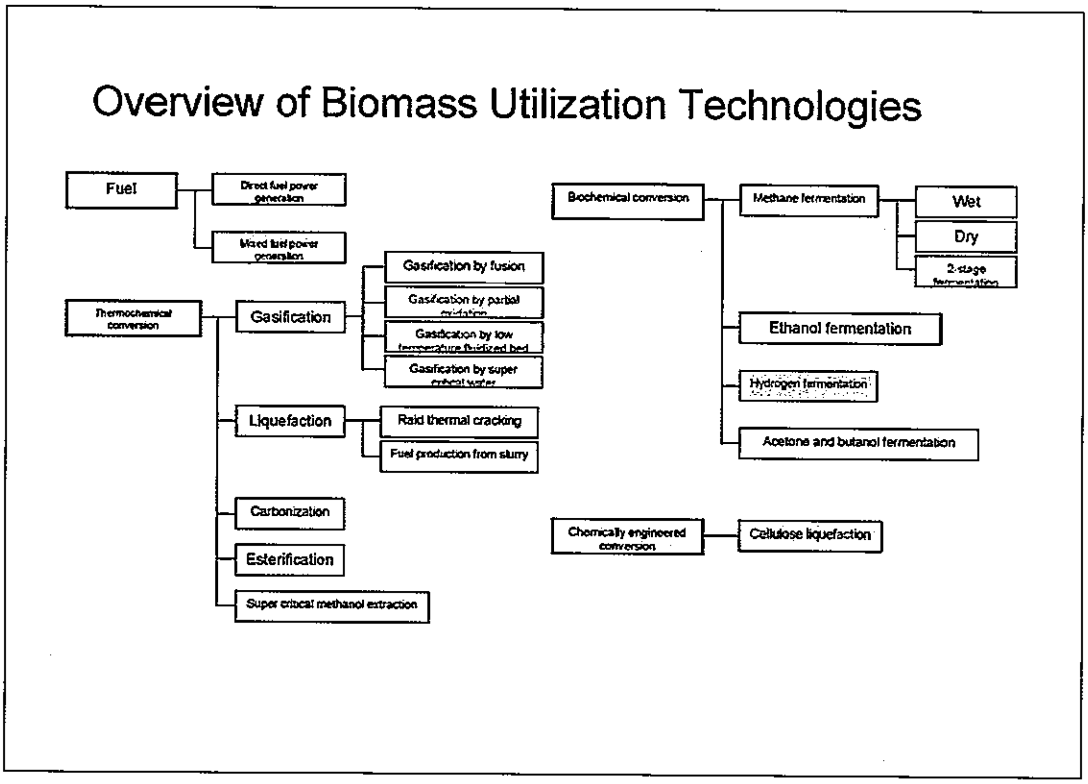
Approved by METI and MOE as "Local Zero Emission Plan" in April 2003. (First in Kinki)

Functions of Hyogo Ecotown Promotion Conference



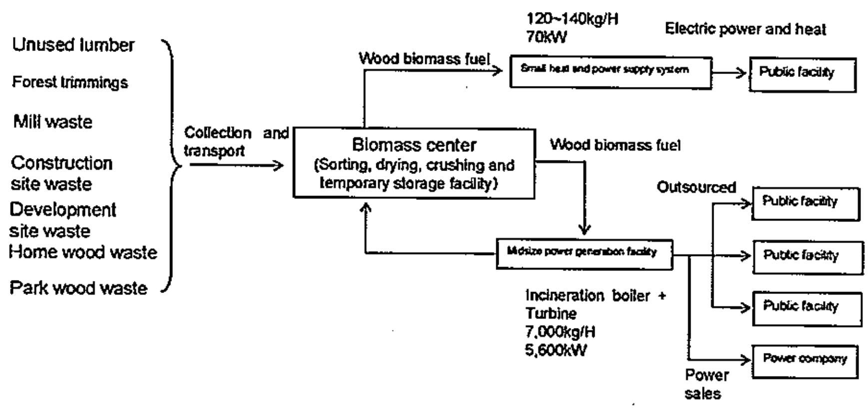


WG Transition
2000
2001
2002
2003
2004
2005
2006
Composite Waste Recycling WG
Untreatable Steel Recycling WG
LNG Thermal Use WG
Business development under study
Proper Treatment WG
Hydrogen WG
Construction Waste Recycling WG
Business development
Food Waste Recycling WG
Business development by Kobe Steel, Kakogawa and Itami, and Retoc
Food Waste Recycling WG
Food Waste Recycling WG
Individual recycling
Biomass related
Plastic Waste Recycling WG
Wood Waste Recycling WG
Biomass WG
Hybrid WG
Plastic Waste Recycling by Gasification WG
PCB Treatment WG
Office Equipment Recycling WG
PET WG
ELV Recycling WG
▼Wide-Area Recycle Center Development Council
▼Hyogo Ecotown approved
▼Establishment of Hyogo Ecotown Promotion Conference
Establishment of Project Study Board
Establishment of Community Strategy Committee
Public offering of research theme

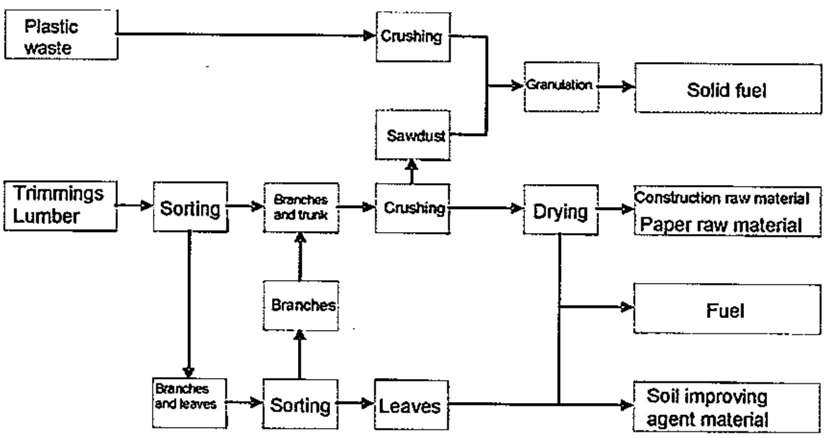


Overview of Biomass Utilization Technologies
Fuel
Thermochemical conversion
Gasification
Gasification by fusion
Gasification by partial oxidation
Gasification by low temperature fluidized bed
Gasification by super critical water
Liquefaction
Raid thermal cracking
Fuel production from slurry
Carbonization
Esterification
Super critical methanol extraction
Biochemical conversion
Methane fermentation
Wet
Dry
2-stage fermentation
Ethanol fermentation
Hydrogen fermentation
Acetone and butanol fermentation
Chemically engineered conversion
Cellulose liquefaction

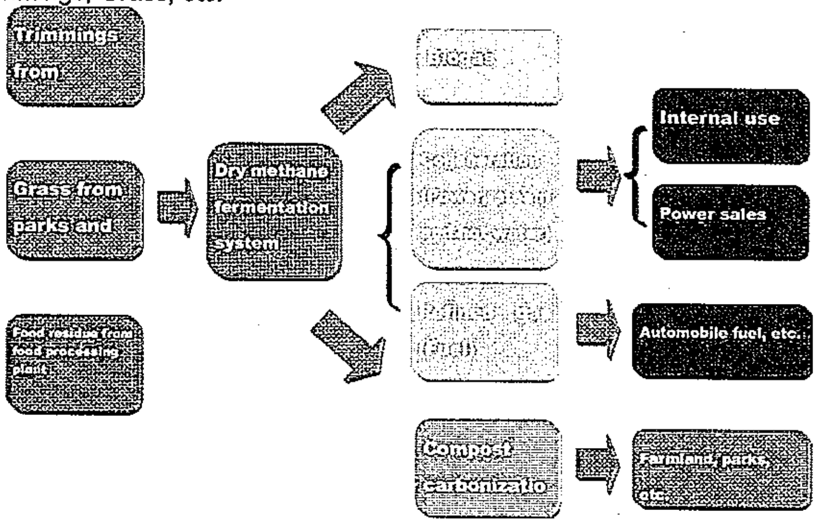
Dry Biomass (Subcommittee 1)
Overview of Decentralized Heat Supply System using Wood Biomass Energy



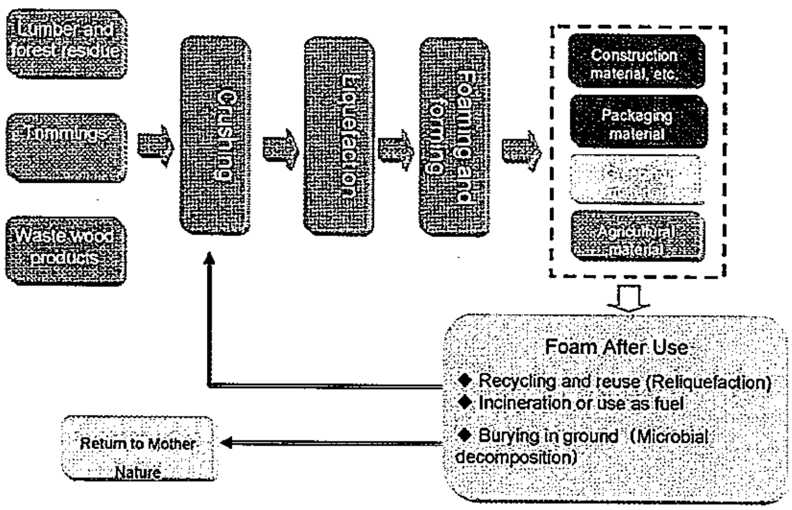
Example Hybrid Accumulation and Processing Flow for Trimmings and Plastic Waste



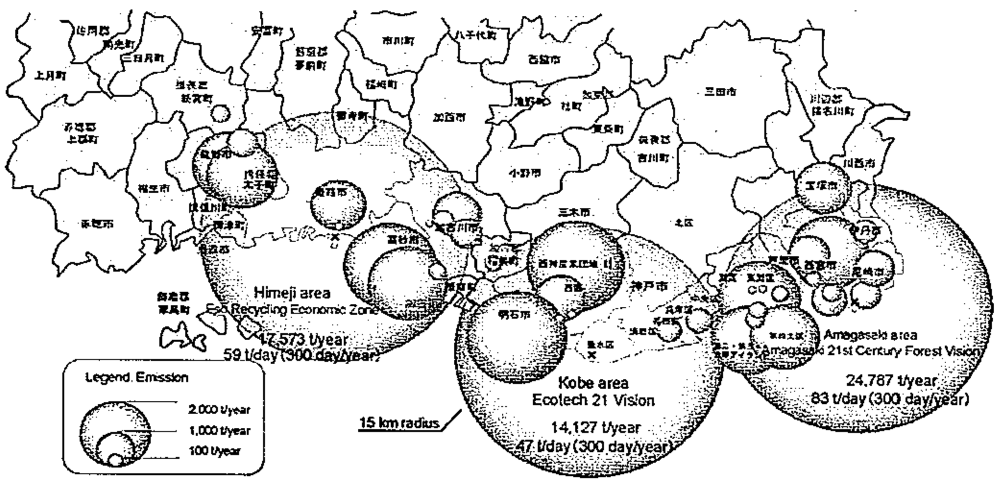
Dry Biomass (Subcommittee 2)
Overview of Energy Recovery System by Methane Fermentation of Park Trimmings, Grass, etc.



Dry Biomass (Subcommittee 3)
Overview of Cellulose Liquefaction and Product Development After Liquefaction



Food Waste Generation



Source: Prepared from questionnaire and interview survey of large volume waste handlers

Studies of Food Waste Business Potential - 7 Cases

Case A	1	2 Wastewater treatment	3
Gas use	Generate power internally and sell surplus power.	→ 〃	Sell to steel works and purchase power.
Wastewater	Outsource treatment to existing wastewater treatment facility.	Build new wastewater treatment system.	Outsource treatment to existing wastewater treatment facility.
Residue	Outsource treatment to existing infrastructure.	→ 〃	→ 〃
Case B	Use existing sewerage treatment system and industrial waste facility.		
Gas use	Generate power internally and sell surplus power.		
Wastewater	Outsource treatment to existing sewerage treatment facility.		
Residue	To existing industrial waste incinerator		
Case C	1	2	3
Gas use	Generate power internally and sell surplus power.	→ 〃	→ 〃
Wastewater	Outsource treatment to existing wastewater treatment facility.	Build new wastewater treatment system	Outsource treatment to existing wastewater treatment facility.
Residue	Recycle (Composting)	→ 〃	Recycle (Cement raw material)