Section 2 Building a Sound Material-Cycle Society in the World through Venous Industries

1. Future Projections of the World's Waste

Humans have prospered on Earth by taking natural resources, using them to produce tools and products, consuming and using those products, and then disposing of them when finished. As shown by the existing shell mounds where ancient humans disposed of things such as seashells and animal and fish bones, since the beginning of our existence humans have not been able to avoid generating waste from our activities.

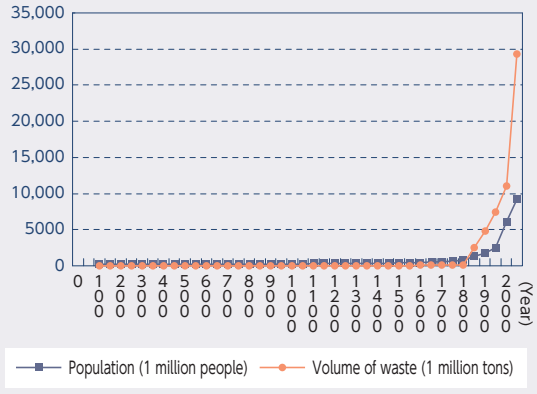
Since the Industrial Revolution, particularly in the 20th century, the flow of things has increased at all levels of socio-economic activities, such as resource extraction, production, distribution, consumption, and disposal, resulting in a mass-production, mass-consumption, and mass-waste socio-economic system. Humans have certainly achieved rapid economic growth, and the population has also increased. However, various negative effects have also been exerted on the environment, such as natural resource extraction, generation of large volumes of waste, exhaustion of natural resources, destruction of nature, problems with landfill sites, and so on (Figure 4-2-1).

Until the beginning of the 21st century such things were problems only in developed countries, but developing countries are now expected to have rapid economic development and population increases. There are concerns about increases in the environmental load, such as increases in the volume of generated waste. The impact on the environment may be even greater in developing countries because of their lack of awareness about waste treatment and their inexperience with technology (Figure 4-2-2).

A "one-way" socio-economic system, in which waste is not broken down but instead accumulates in the environment as a result of mass-consumption, will become an adverse legacy that will continue to have negative effects on the environment into the future. In order to reduce the environmental load caused by a one-way society and bring about a sustainable society, it is essential to promote the 3Rs of reducing, reusing, and recycling waste, enforce proper disposal, and build a sound material-cycle society.

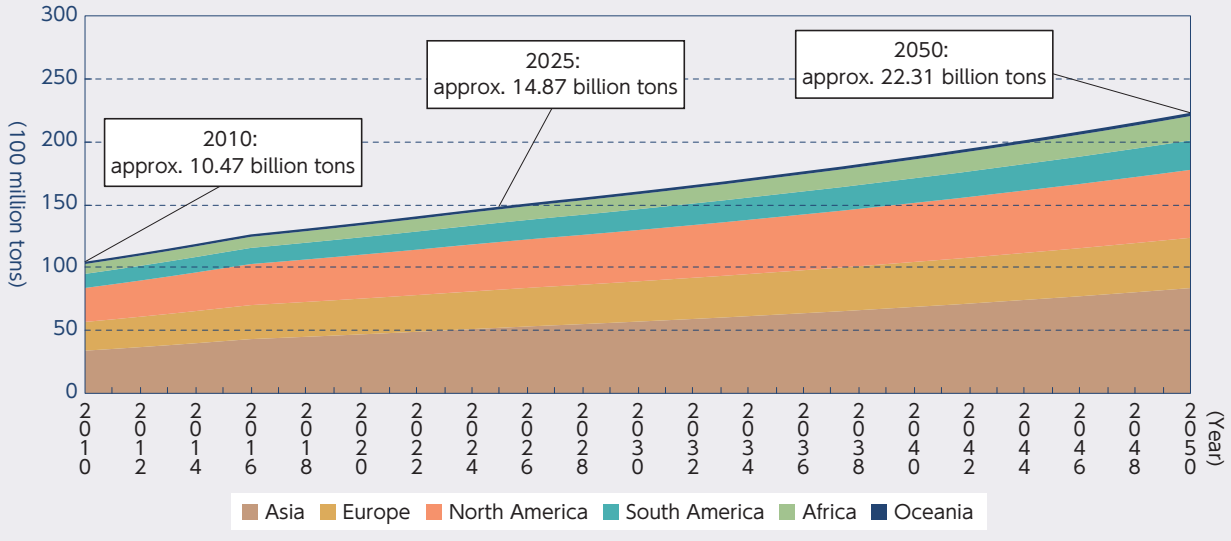
From the end of World War II until now, Japan has experienced a wide variety of waste problems due to changes in economic and social circumstances. (Figure 4-2-3). Japan has made efforts in the fields of waste and recycling to solve those problems. Japan's current measures are said to be a result of the methods used in solving problems thus far.

Figure 4-2-1 Shifts in World Population and Volume of Waste (Municipal Solid Waste + Industrial Waste)



Sources: Ministry of the Environment estimates based on the following:
For population: "The World Economy: Historical Statistics (OECD)" and others
For waste volumes: "Research on Estimations of Global Waste Generation and Future Predictions" by Masaru Tanaka (Research Institute of Solid Waste Management Engineering, 2011)

Figure 4-2-2 Future Projections of the World's Volume of Waste



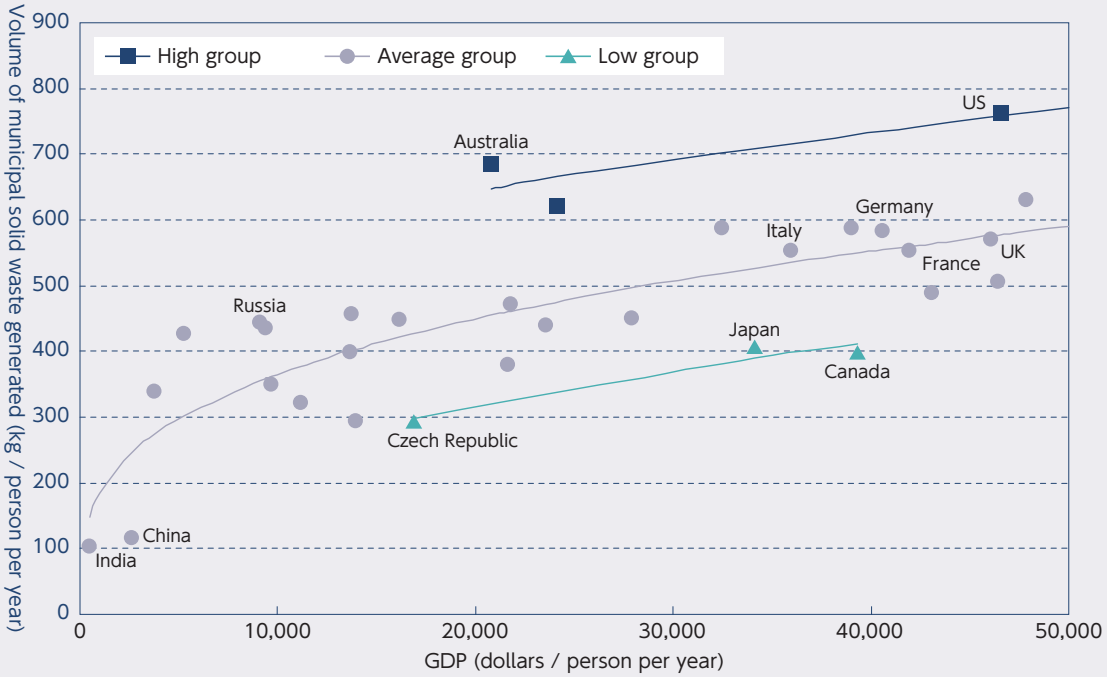
Source: Research on Estimation of Global Waste Generation and Future Projections (Masaru Tanaka (Research Institute of Solid Waste Management Engineering, 2011))

Figure 4-2-3 Japan's Experience in the Fields of Waste and Recycling

Period of time	Social trends	State of municipal solid waste	State of industrial waste	Waste characteristics and collection	Treatment/disposal and technologies	Laws and institutions
Improvement of public sanitation and the beginning of a "waste problem" (around 1955)	"*Mottainai*" still prevalent mentality in society (unintentional 3Rs) There were improvements in quality of life and consumption levels, but due to the loss of domestic stock it took time to resolve a shortage of goods.	Volume of waste generated (10,000 tons) Volume generated per person per day (grams) Total population (10,000 people) Final disposal volume (1,000 tons / year) Volume of waste generated, Volume generated per person per day 0 2,000 4,000 6,000	Volume of waste generated (1 million tons) Recycled amount (1 million tons) Final disposal volume (1 million tons) Number of remaining years (years) Generated amount, recycled amount, final disposal volume 0 150 300 450	Kitchen waste makes up the majority. Mechanisms such as resource collection activities since before World War II are still continuing. Horse-drawn carts, rickshaws, small tricycles, etc. were used for collection.	Mainly self-disposal and treatment Shift from mainly burial disposal at the beginning to incineration, due to lack of landfill sites	Waste Cleaning Law Public Cleaning Law
A "waste problem" become apparent along with high economic growth (around 1955 - 1973)	"It is no longer termed post-war." "Consumption is a virtue," plan to double people's incomes Escalation of industrial pollution, occurrence of urban problems Tokyo waste war Increased convenience of daily life (increased use of home appliances, arrival of convenience stores and supermarkets) Arrival of plastic containers Beginning of the use of one-way containers			Increase in paper waste Collapse of resource-use habits from before World War II Beginning of introduction of garbage trucks Mixed collection Poly-containers for each house 2-4 times increase in volume of waste in large cities	Continuous furnaces Lack of final landfill sites Mass incineration of industrial waste in large cities and surrounding areas Beginning of upgrading of incineration facilities	Waste Management and Public Cleansing Law
Shift to a period of stable growth - energy crisis - eve of the bubble economy (around 1973 - 1985)	"Treat things with care" "The Limits on Growth" (Club of Rome) Decentralization of population and industry Heightened added value of products, shift to service industries Promotion of resource and energy conservation Expansion of one-way containers used			Increase in paper and plastic waste One-way bottles and cans Collection of plastic bags or paper bags	Increase of incineration facilities Continued lack of final landfill sites Large continuous automatic furnaces Fluid-bed furnaces	
Arrival and end of the bubble economy - large increase in waste volume (around 1985 - 1990)	Overconcentration in Tokyo Resort Law Beginning of widespread use of OA instruments Increase in volume of distribution Increase in disposable products Arrival of plastic bottles			Waste problems become apparent (opportunity for full-fledged efforts for the 3Rs) Diversification of waste characteristics Increased sorting and collection of resources Large increase in waste volume (2% a year)	Development of facilities for separation - Magnetic separators - Trommels	
Beginning of 3Rs -Preparation of laws related to the material cycle (around 1990 -2000)	"The lost decade" The Earth's environmental problems become apparent, and citizens' activities increase. Attention grew on illegal disposal of industrial waste, as a result of the Teshima Case. Dioxin problem Increase in use of computers, paper for OA, and plastic bottles Fujimae Tide Flat Case			Waste reduction Promotion of recycling Development of sorted waste collection Waste paper recovery Increase in volume of plastic bottles Development of charges for waste (designated bags or charges for bags) Ingenuity for accumulation places (setting of netted baskets or container facilities)	Countermeasure dioxins Gasification melting furnaces Liquid slag, eco-cement Increase in power generation capabilities and generated power Expansion of manifesto system Design for the environment (DfE)	Law for Promotion of Effective Utilization of Resources Basic Environment Law Containers and Packaging Recycling Law Home Appliance Recycling Law Law concerning Special Measures against Dioxins
Comprehensive efforts for the 3Rs (around 2000 - 2010)	Temporarily strong economy due to IT bubble Era of deflation Change from disposal of waste to the 3Rs Widespread use of cellular phones and the Internet Expansion of mail-order shopping Transformation of lifestyles, mainly among young people: "won't own," "eco-bag, eco-bottle," "sharing"	0 10,000 20,000 30,000 Total population, final disposal volume	0 3 6 9 Number of years remaining	Era of multiple sorting Volume of solid waste remains high Increase of reuse due to the prosperity of recycle shops and auctions Overseas exports of waste electrical and electronic equipment (WEEE)	Recycling of food waste Facilities to ferment methane Shredder dust disposal Treatment of disposed home appliances Treatment to make asbestos nonhazardous PCB treatment and decomposition	Fundamental Law for Establishing a Sound Material-Cycle Society Construction Material Recycling Act Food Recycling Law Law concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities Law for Promotion of Effective Utilization of Resources End-of-Life Vehicle Recycling Law

Source: Ministry of the Environment

Figure 4-2-4 Correlative Relationship between Per-capita GDP and Volume of Municipal Solid Waste Generated



Group with high volume of municipal solid waste generation	Australia, Israel, US, Denmark, Ireland
Group with average volume of municipal solid waste generation	China, Brazil, South Africa, Russia, Turkey, Mexico, Poland, New Zealand, Hungary, Slovakia, Estonia, South Korea, Portugal, Slovenia, Greece, Spain, Italy, Austria, Germany, France, Belgium, UK, Finland, the Netherlands, Sweden, Switzerland, Iceland, Norway, Luxembourg
Group with low volume of municipal solid waste generation	Japan, Czech Republic, Canada

Source: Research on Estimation of Global Waste Generation and Future Projections (Masaru Tanaka (Research Institute of Solid Waste Management Engineering, 2011))

There is a close relationship between economic growth and the volume of municipal solid waste. As shown in Figure 4-2-4, a correlative relationship can be discerned between per-capita GDP and the volume of municipal solid waste generated. It is possible that countries pursuing economic growth now will experience in the near future the waste problems that Japan has faced.

It is believed that Japan's experiences can serve as references for such countries. It will be a significant contribution by Japan to reduction of environmental problems throughout the world. Sharing Japan's experiences in waste and recycling with the rest of the world will also help expand the businesses that work toward a sound material-cycle society throughout the world and lead to growth through eco-innovation.

This section gives an overview of the state of waste and recycling and of the needs in Asia and the rest of the world. It attempts to find a way to apply the experiences that Japan has today to other countries. It is hoped that Japan's experiences in the fields of waste and recycling and the efforts that it has made over time in developing social systems, technologies, and lifestyles can help to solve the world's waste problems.

2. State of the World's Waste and Recycling

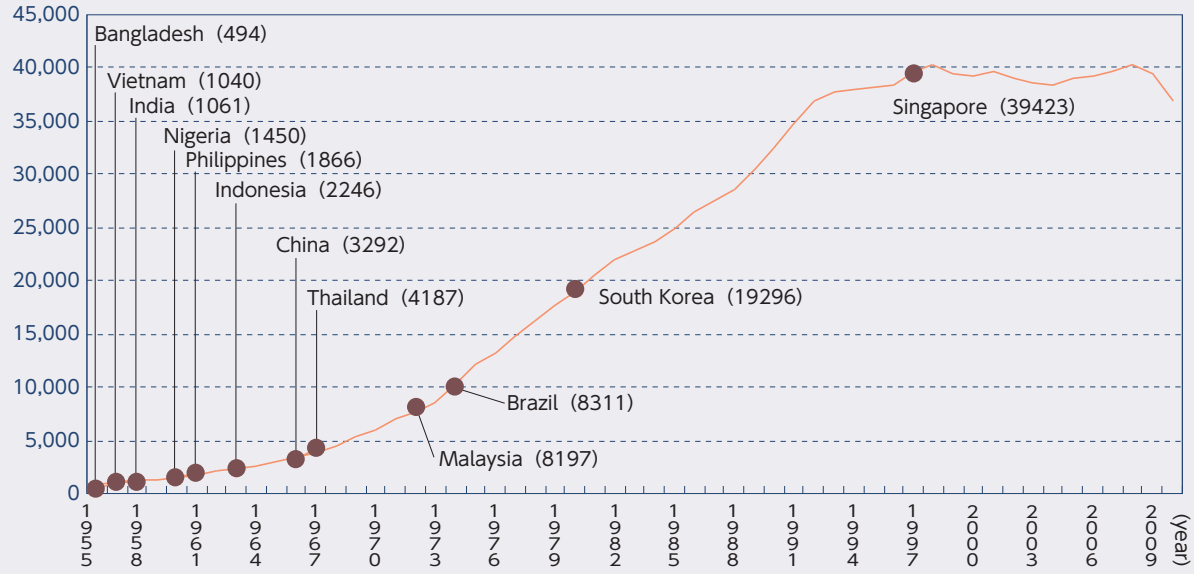
Throughout the world, demand for resources is increasing and the prices of oil, rare metals, and food have soared due to rapid growth in population and the rise of emerging countries. As mentioned earlier, waste is expected to increase from now on due to the rapid economic development of developing countries, and measures for waste and recycling have therefore also become extremely important from an international perspective. Some developing countries in particular are having the same problems with public sanitation, pollution, and waste that Japan has faced.

We will now take a look at the worldwide situation of waste, the current situation of waste and recycling in developing and developed countries, and the measures being taken.

(1) State of Waste in the World

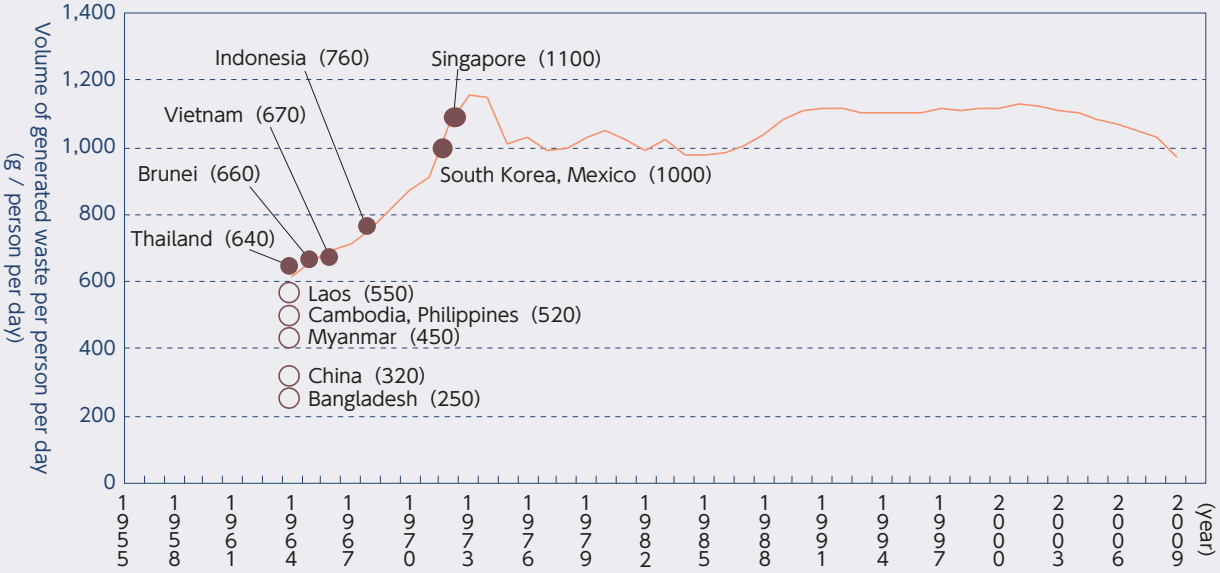
Figure 4-2-5 shows shifts in Japan's per-capita nominal GDP and comparisons with major countries in Asia and South America. After World War II, Japan achieved tremendous economic growth and its per-capita GDP became number three in the world in 1993 (in the most recent 2010 rankings, Japan is number 16 in the world, according to the IMF "World Economic Outlook"). Comparing this trend with countries in Asia and South

Figure 4-2-5 Shifts in Japan's Per-Capita Nominal GDP and Comparison with Major Countries in Asia and South America



(Sources: Data for Japan are from "Annual Report on National Accounts", Department of National Account, Economic and Social Research Institute, Cabinet Office, Government of Japan. Data for other countries are from the IMF World Economic Outlook Database, October 2010.)

Figure 4-2-6 Shifts in Japan's Volume of General Waste Generated and Recent Volumes of Municipal Solid Waste Generated in Major Countries in Asia and South America



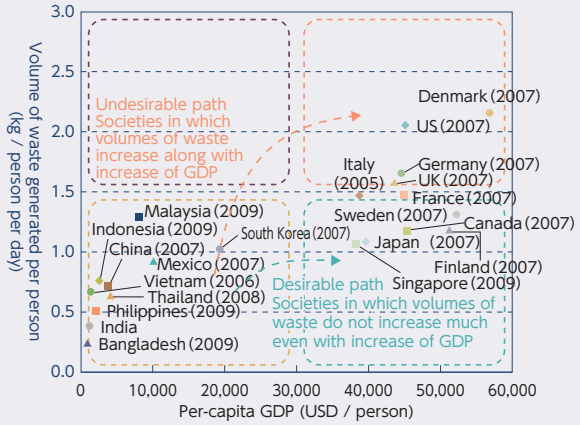
(Sources: Data for Japan are from the Ministry of the Environment. Data for other countries are from Municipal Solid Waste Management in Asia and the Pacific Islands (2010), OECD Environmental Data Compendium 2006-2008, and China Statistical Yearbooks 1996-2007.)

America, the per-capita nominal GDP of India is equivalent to that of Japan around 1960, when Japan was entering its economic growth phase, and the per-capita nominal GDPs of China, Malaysia, and Brazil are equivalent to that of Japan around 1970, when Japan was in the middle of a high economic growth phase.

A simple comparison of waste cannot be made, because the definition of waste varies by country. Figure 4-2-6 shows shifts in volumes of municipal solid waste generated in Japan and the relationships of recent volumes of municipal solid waste generated per person in major countries in Asia and South America. Japan's volumes of municipal solid waste, which in the past increased rapidly in accordance with economic growth, has remained at an almost constant level since the 1970s as a result of measures taken for waste and recycling. On the other hand, many countries in Asia and South America have now just begun their economic growth, and although their daily volumes of municipal solid waste per capita are small, they are expected to grow rapidly from now on.

Figure 4-2-7 shows a diagram of per-capita GDP in the world's major countries and volumes of municipal solid waste generated. As mentioned earlier, the volumes of municipal solid waste generated per capita in the world's countries have a correlative relationship with the per-capita GDP of the respective country. Since the European countries and Japan have made relative

Figure 4-2-7 Comparisons of Major Countries' Per-Capita GDP and Per-Capita Volume of Waste Generated



Sources: Data for Japan are from the Ministry of the Environment. Data for other countries are from Municipal Solid Waste Management in Asia and the Pacific Islands (2010), OECD Environmental Data Compendium 2006-2008, and China Statistical Yearbooks 1996-2007

progress in implementing measures for waste and recycling, the volume of municipal solid waste tends to grow little even if per-capita GDP increases. However, some countries with extremely high per-capita GDP also have high volumes of municipal solid waste per-capita. In countries that have vast national land, it is common to dispose of waste inexpensively by transporting it to places far away from residential areas, and therefore efforts to reduce waste have not sufficiently taken root among corporations and citizens in such countries.

In light of this, it is important for developing countries that are anticipating rapid economic growth in the future to learn from Japan how to keep volumes of waste low while their per-capita GDP increases, so as to avoid serious problems of pollution and waste and achieve a sound material-cycle society.

(2) Current Situation of Waste and Recycling in Developing Countries

Here we will take a look at efforts for waste and recycling in developing countries.

Developing countries that are becoming rapidly industrialized in recent years, particularly China and India, are facing pollution and waste management problems similar to those that Japan experienced during its high growth phase.

For example, China has a GDP that surpassed that of Japan to become number two in the world in 2010. At the same time, its volume of waste has increased and its volume of municipal solid waste became the largest in the world in 2005. In Beijing, where the population

Photograph 4-2-1 Open-Dumping Disposal Site in a Developing Country

Source: Materials from the Japan Industrial Waste Information Center

is increasing, the volume of municipal solid waste has reached approximately 18,000 tons per day. It is said to be rising at an annual rate of 8% at present. Much of the municipal solid waste is disposed of in landfills, and there are concerns about a shortage of landfill sites. In response to this problem, in its 12th Five-year Plan, which is to begin in 2011, the Chinese government has indicated that it will industrialize the recycling of resources. It is expected to take proactive measures to tackle the problem.

Developing countries have small volumes of waste from industry, municipal kitchen waste is used for animal feed and fertilizer, and old-fashioned recycling is practiced by repeatedly reusing glass, plastics, and metals. However, dumping of kitchen waste into rivers and lakes is a main cause of environmental pollution.

Using Japan's experiences will contribute to reduction of the world's environmental problems and to environmental conservation, and also is a great opportunity for both Japan and other countries. Japan's corporations are internationally competitive in the fields of waste and recycling, and expanding operation into developing countries is certainly a great business opportunity for such corporations. It is also an opportunity for developing countries to pursue smooth economic growth that takes the environment into consideration.

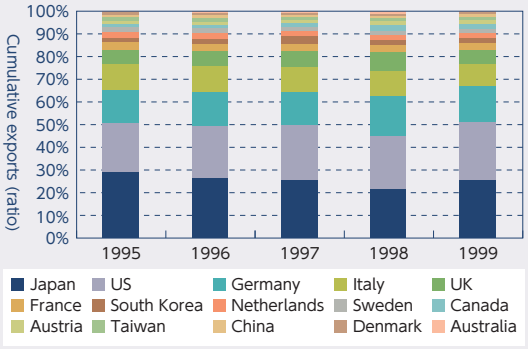
Industries in the fields of waste and recycling are called "venous industries." They are contrasted with "arterial industries," which collect and process resources to manufacture products and then sell them. Japan's venous industries will promote waste and recycling measures not only in Japan but also in other countries in Asia and the rest of the world. Maintaining a balance between the environment and the economy is extremely important for global environmental conservation.

Column

Comparison of the Export Shares of Waste and Recycling Industries in the World and in Asia

A comparison of the world's export shares in the waste and recycling industries shows that Japan is competing for shares with the US and EU countries such as Italy and the UK.

Global Waste Treatment Export Market Share by Major Country of Origin



Source: "U.S. Environmental Industry Export Competitiveness in Asia," United States-Asia Environmental Partnership, 2001

Table 4-2-1 Main Asian Countries' Waste and Recycling Policies, and Volumes of Waste

Item	China	Thailand	Malaysia
Basic laws, policies, etc. for the overall environment	Environmental Protection Law (1989) Ratified the Basel Convention (1991) Environmental Impact Assessment Law (2002) Formulation of a "15" (10th 5-Year) Plan for collection and use of renewable resources (2001) In principle, imports of waste electric and electronic equipment are prohibited.	Industrial. Estate Authority of Thailand Act (1979) National Environmental Protection and Promotion Act (1992) Factory Act (1992) Hazardous Substance Act (1992) Ratified the Basel Convention (1997) Policy and Plan for Improving the Nation's Environmental Quality (1997 - 2016) National Plan for Integrated Waste Management (2003) Strategic Plan for Waste Electrical and Electronic Products (now being formulated) A permission system and import standards exist for import of electrical and electronic equipment.	Environmental Quality Act (formulated in 1974, revised in 1985, 1996, 2000, and 2001) Environmental Quality (Scheduled Wastes) Regulations (formulated in 1989, revised in 2005) Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal facilities) Order (formulated in 1989) Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal facilities) Regulations (formulated in 1989) Joined the Basel Convention (1993) There is a permission system for imports of waste electrical and electronic equipment, and classification guidelines for used electrical and electronic products at the time of importing are being created.
Basic laws for policies on waste and recycling	Temporary provision on the development of general use of resources (1985) Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste (1995, revised in 2005) Regulations for management of recycling of package resources (1998) Clean Production Law (2003) Management Methods for Controlling Pollution by Electronic Information Products (2007) Circular Economy Promotion Law (2009) Ordinance on the collection, disposal, and management of waste electrical and electronic equipment (2009)	Law on promotion of the 3Rs (formulation being considered) Ministry of Industry Notification No. 6/1997 about waste disposal (1997) Ministry of Industry Notification No. 7/1998 about waste disposal (1998) Law for Promotion of Community Generated Hazardous Waste Management (now being formulated)	National Recycling Program (2000) National Strategic Plan for Solid Waste Management (2005) Solid Waste and Public Cleansing Management Act (2007) Solid Waste and Public Cleansing Management Corporation Act (2007) "Regulations for disposal and recycling of used electrical and electric equipment" (now being formulated)
Volume of municipal solid waste generated	155.768 million tons / year (volume emitted per person: 0.74kg / person per day), 2005	14.6 million tons / year (amount emitted per person: 0.64kg / person per day), 2006	6.972 million tons / year (amount emitted per person: 0.8kg / person per day), 2005

Item	Indonesia	Vietnam	Singapore
Basic laws, policies, etc. for the overall environment	Joined the Basel Convention (1993) Environment Management Act (1997) Environmental Protection and Management Act (No. 32 of 2010) In principle, imports of waste electrical and electronic equipment are prohibited.	Law on Environmental Protection (1994, revised 2005, No. 52 / 2005 /GH11) Joined the Basel Convention (1995) In principle, imports of waste electrical and electronic equipment are prohibited. Formulated the National Strategy for Integrated Solid Waste Management (2009)	Environmental Public Health Act (1969) Joined the Basel Convention (1996)
Basic laws for policies on waste and recycling	Article 53 in Governmental Regulation No18/1999 JO/85/1999 on Hazardous Waste Management Minister of Public Works' Regulations on the National Strategies for the Development of Waste Management System (2006) Waste Management Law (No. 18 of 2008) Government Regulations on Waste Management (now being formulated)	Regulation on Management of Hazardous Wastes (Decision No. 1555 / 1999 / QD-TTg) (1999) Order on Management of Solid Wastes (Decree 59 / 2007 / ND-CP) (2007) Regulations on disposal and recycling of used electrical and electronic equipment (now under consideration)	Environmental Public Health Act (1969)
Volume of municipal solid waste generated	38.5 million tons / year (volume emitted per person: 0.43 (total) - 0.96 (municipal) kg / person per day), 2006	12.8 million tons / year (volume emitted per person: 0.4kg / person per day), 2003	5.01 million tons / year (volume emitted per person: 0.89kg / person per day), 2005

Table 4-2-1 Major Asian Countries' Waste and Recycling Policies, and Volumes of Waste (Cont.)

Item	India	Bangladesh
Basic laws, policies, etc. for the overall environment	Environment Protection Act (1986) Ratified the Basel Convention (1992)	The Environmental Pollution Control Ordinance (1977) The Bangladesh Environment Protection Act (1989) Environment Policy & Implementation Plan (MoEF, 1992) Joined the Basel Convention (1993) National Environment Management Action Plan (1995) The Bangladesh Environment Conservation Act (1995) The Environment Court Act (2000)
Basic laws for policies on waste and recycling	Hazardous wastes (Management and Handling) Rules (formulated in 1989, revised in 2000, 2003, 2008, and 2009) Bio-medical waste (Management and Handling) rules (1998) Recycled Plastics Manufacture and Usage Rules (1999, revised in 2003) Municipal Solid Wastes (Management and Handling) Rules (2000) Batteries (Management and Handling) Rules (2001) Proposed regulations on management of waste electric devices (2010)	There are no specific laws on managing solid waste. Draft National Solid Waste Management Handing Rule (2005) Lead Acid Battery Recycling and Management Rules (2006) Medical Waste Management Rules (2008) Formulation of a national fundamental plan for the 3Rs (2010)
Volume of municipal solid waste generated	1.052 million tons / year (0.2-0.5 kg / person per day), 2002	4.867 million tons / year (0.41 (in cities) kg / person per day), 2005

Item	South Korea	Philippines	Cambodia
Basic laws, policies, etc. for the overall environment	Waste Management Act (1986, final revisions made in 2007) Act on the Promotion of Saving and Recycling of Resources (1992, final revisions in 2007) Joined the Basel Convention (1994) The Act for International Transfer and Treatment of Waste (1992) (1994, final revisions in 2001) Promotion of Installation of Waste Disposal Facilities and Assistance, etc. to Adjacent Areas Act (1995, final revisions in 2007) Sudokwon Landfill Site Management Corporation Act (2000) Act on the Promotion of Construction Waste Recycling (2003, final revisions made in 2006) Korea Environment and Resource Corporation Act (1993, final revisions made in 2003) Law on Management and Use of Livestock Manure (2006, final revisions made in 2007)	Toxic Substances and Hazardous and Nuclear Waste Control Act (RA6969) (1990) Ecological Solid Waste Management Act (RA9003) (promulgated in 2001) Ratified the Basel Convention (1993) National Solid Waste Management Committee handles national-level policies on waste and recycling. Permission system exists for imports of waste electrical and electronic equipment.	Natural Resources and Environmental Law (Annex4) (1996) Joined the Basel Convention (2001) In principle, imports of waste electrical and electronic equipment are prohibited. A national fundamental plan for the 3Rs is being formulated.
Basic laws for policies on waste and recycling	Volume-based Waste Fee (VBWF) System (1995) Extended Producer Responsibility System (2003) Resource Recycling Law (2008)	Ecological Solid Waste Management Act (RA9003) (promulgated in 2001)	Sub-Decree on Solid Waste Management (1999)
Volume of municipal solid waste generated	18.376 million tons / year (household waste) (1.02kg per person / day), 2007	1.095 million tons / year (0.34kg per person / day), 2008	324 thousand tons (0.44kg per person / day), 2006

Sources: "FY2009 Report on Investigative Research on Environmental Management in Global Project Deployment," The Japan Machinery Federation (Mitsubishi Research Institute), 2010
"Report on Information Provision Projects Concerning Industrial Waste and Recycling in Asian Countries, Institute of Developing Economies" - Japan External Trade Organization, 2007
"Asia Environment White Paper 2010/2011," Toyo Keizai, Inc., 2010
"Recycling in Asia," compiled by Michikazu Kojima, Institute of Developing Economies, 2008
"Research on Management of Valuables and Hazardous Materials in Products Aiming for Environmentally Sound International Resource Circulation (K2016)," Institute for Global Environmental Strategies, 2009
"2010 Environmental Statistics," Ministry of the Environment, 2010
3R Policies for Southeast and East Asia, ERIA Research Project Report 2008 No. 6-1, ERIA, 2009
National 3R Strategy Development: A progress report on seven countries in Asia from 2005 to 2009, UNCRD, AIT / UNEP RRC.AP, and IGES, 2009
Current Status of Waste Generation, Ministry of Environment, Rep. of Korea
Extended Producer Responsibility (EPR) Policy in East Asia - in Consideration of International Resource Circulation -, Institute for Global Environmental Strategies, 2009
Import Control on Second-hand Electric and Electronic Commodities, Asian Network for Prevention of Illegal Trans-boundary Movement of Wastes, Workshop 2010 of the Asian Network for Convention of Illegal Trans-boundary Movement of Hazardous Wastes (Japan) information, 2010
Status Quo and Issues in Southeast and East Asian Countries, UNEP RRCAP, 2010
1) China's municipal solid waste is the volume collected and transported, not the volume generated. The volume generated per person is the volume collected and transported divided by the municipal population (570 million people in 2005).
2) The composition of Singapore's municipal solid waste includes industrial waste. The volume generated per person is the volume of household waste generated (1.41 million tons in 2005) divided by the population.
3) India's volume of generated municipal waste is the total of 23 cities.
4) South Korea's volume of generated municipal solid waste is household waste.
5) The volume of Cambodia's municipal solid waste is taken from data for Phnom Penh. It is the volume collected and transported, not the volume generated.

(3) Initiatives by Developed Countries

In countries that are referred to as developed countries, such as European countries and the United States, initiatives for waste and recycling have been made since the beginning of the 20th century.

Developed countries that went through the Industrial Revolution in the 18th century saw an increase in their volumes of waste along with rapid industrialization. In the 19th century the problem of municipal solid waste came to the fore. As a result, the United Kingdom soon formulated the world's first law on public sanitation in 1848, and advanced incinerators for waste treatment were also built.

However, in the 20th century the waste problems of developed countries became even more serious. The 1970s, in particular, experienced remarkable economic growth, giving rise to an era of mass-production and mass-consumption. Waste further increased in cities, factories emitted large volumes of hazardous materials,

and environmental pollution such as acid rain, air pollution, and water pollution increased noticeably. There was also an increase in the number of problem cases, such as the United States' Love Canal incident, in which residents were negatively impacted by hazardous chemical substances that had been dumped in the past, and Italy's Karin B incident, in which waste was exported inappropriately to developing countries and disposed of illegally.

Due to concerns about this kind of situation, the EU has issued various directives on waste since the 1970s, including the Waste Framework Directive (1975), the Hazardous Waste Directive (1991), and the Landfill Directive (1999), and EU countries have adopted these directives. The United States also enacted laws, such as the Clean Water Act (1972), the Toxic Substances Control Act (1976), and the Resource Conservation and Recovery Act (1976).

Due to globalization of the economy, the global transfer of goods and services has increased. The transfer of waste that is a recyclable resource has also increased across national boundaries. In the 1980s there were many incidents of developed countries inappropriately exporting hazardous waste to developing countries that had lax environmental regulations. Environmental pollution caused by inappropriate treatment of waste in the countries to which it was exported posed a serious problem. As a result, the "Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal" (Basel Convention), which aimed to prevent environmental pollution and health damage caused by export/import and treatment of hazardous waste, was adopted in 1989 and put into effect in 1992. Efforts for recycling also made progress. In addition to the widespread practices of separating waste for collection and a recycle-deposit system, recycling technologies have also become more advanced. The recycling of waste containers, waste electrical and electronic equipment, retired vehicles, waste batteries, and waste rechargeable batteries has made progress in European countries such as the Netherlands, Sweden, Denmark, Germany, and France. A concept known as Extended Producer Responsibility (EPR), in which producers are responsible for not only the production and use stages but also for the waste and recycling stages, has been advocated. Recycling laws are being formulated in Japan and other countries.

The initiatives undertaken by developed countries for waste and recycling will become even more important from now on. It will be necessary for developing countries to use these initiatives as a reference.

3. Expanding Japan's Waste and Recycling Industries into the World

In the section above, we gave an overview of the waste situation in various countries. Sharing Japan's experiences with developing countries in Asia and other regions, in particular, will help them achieve development without falling victim to serious waste problems. This will be extremely important for environmental conservation throughout the world. However, since economic development is of the highest priority for developing countries, in many cases it will be difficult to put a priority on establishing a sound material-cycle society.

On the other hand, countries that are having problems with waste electrical and electronic equipment (WEEE), such as China, are introducing bills with content similar to that of the EU's WEEE Directive and RoHS Directive. They are also considering the adoption of recycling technologies developed in Japan's eco-towns. Therefore, it is necessary to introduce technologies and systems that match the development phase of each country.

Similar to other environmental technologies, waste and recycling technologies cannot be disseminated to a socially desirable level by simply leaving them to the free market process. It is necessary to put in place proper systems for disseminating them.

Even if technologies have been introduced, it is possible that other new environmental problems will arise due to inappropriate management. Illegal dumping may also prevent proper waste collection and full utilization of the technologies available. It is therefore important to introduce to developing countries not only technologies that tackle the problems but also comprehensive waste management systems for utilizing the technologies, developing human resources, and creating legal systems and plans.

In other words, integrating competitive venous industries with systems for utilizing technology and human resource development is important, not only from the perspective of environmental conservation but also for striking a balance between the environment and the economy.

Column

Japan's Technologies

Japan's technologies are summarized in the table below. Countries have different cultures and lifestyles, and it is possible that systems that work in Japan may not function in the same way in other countries, However, this table will serve as a reference when expansion of Japan's venous industries to other countries is being considered.

List of Japan's Leading Technologies

Night-soil treating technologies	*Johkaso* (private sewerage system)		
	Sewerage		
Collection and transport technologies	Garbage truck		
Intermediate processing technology such as incineration	Incinerator	Type of operation	Batch furnace Semi-continuous furnace Continuous furnace
		Furnace-type	Stoker type Fluid-bed type Fixed-bed type Rotating type
	Gasification melting furnace		Kiln type Fluid-bed type Shaft-furnace type
	Sorting technology		
	Water-removal technology		

Final disposal technology	Isolated-type final landfill site Landfill site for stable industrial waste (non-leachate-controlled type) Controlled-type landfill site
Recycling technology	See "Examples of Recycling Technologies" 2nd table in the Column
Reduce/reuse technology	Resource conservation Extension of life-span Design for Environment(DfE)
Remediation technology	Mercury Dioxins PCB Asbestos Infectious waste

Source: Created by the Ministry of the Environment, using information from the Annual Report on the Environment and the Sound Material-Cycle Society in Japan 2007

Examples of recycling technologies

Recyclable resources		Recycling technologies	Recycled goods
Container and packaging	Glass jar	Culletization	Glass container, glass fiber, ceramic product, civil engineering and construction material, etc.
	Plastic bottles	Pelletization and flaking	Fiber, sheet, plastic bottle, plastic product, etc.
	Paper container	Use as paper material, etc.	Recycled paper, etc.
	Plastic container	Material recycling	Pellet, plastic board, recycled resin, civil engineering and construction material, material for gardening and agriculture, daily goods, etc.
		Use as blast furnace reduction agents	Blast furnace reduction agents
		Use as coke furnace chemical raw material	Coke, hydrocarbon oil, gas of which the main ingredient is hydrogen or carbon monoxide
		Oil reclamation	Hydrocarbon oil
		Gasification	Gas of which the main ingredient is hydrogen or carbon monoxide
	Foam polystyrene food container	Pelletization	Plastic products such as foam polystyrene food containers
Food waste	Food waste	Composing, use as feed, raw materials for other products, and methane fermentation	Fertilizer, feed, fuel, reduction agent, fat, oil products, ethanol, methane
Waste electronic equipment	Air-conditioners, TVs, refrigerators, freezers, washing machines, clothes dryers, personal computers, copy machines, cellular telephones, etc.	Separation, crushing, granulating, smelting, etc.	Iron, nonferrous metals, raw materials for plastic, etc.
Waste plastic	Vinyl waste	Dissolution, residue separation, drying	Recycled vinyl materials, (agricultural vinyl film, electric cables, waste materials, water-proof sheet)
	Mixes with wood	Extrusion molding, stirring/molding	Construction materials, recycled board
	Waste plastic	Use as petrochemical raw material	
Wood waste	Wood Waste (disconnected fiber)	Needle machine formation	Flexible mat
		Adhesion by stream-heat processing, formation	Embossed mat
		Carboning technology	Under-floor humidity-buffer board, high-grade coal
Waste paper	Newspaper	Convert into fiber	Insulation materials for construction
	Paper sludge	Drying, granulation	Anti-forming agent for iron-making process
	Disposable diaper	Water solubilization	Raw materials for disposable diapers, soil conditioner
	Waste paper that is difficult to recycle	Dissolution, drying, foreign matter removal, bleaching	Toilet paper
Waste tires / rubber scraps	Waste tire	Thermal decomposition	Gas, pyrolysis oil
	Rubber scrap	Kneading, molding process	Intermediate raw materials for rubber products
	Waste rubber	Recycling, molding	Rubber mat

Source: Ministry of the Environment

(1) Expansion of Japan's Venous Industries to Other Countries

Some companies in Japan's venous industries have already expanded overseas. The patterns are explained below.

1) Plant design and construction by companies in venous industries

Some companies design and construct waste-treatment facilities and plants in other countries, utilizing their experiences designing and constructing waste incinerators and recycling facilities in Japan.

Column

Introduction of Waste Treatment Plants to China

In China, it is mainstream practice to dispose of municipal solid waste in landfills. Pollution of the surrounding areas and a shortage of disposal sites are posing serious problems. As a measure to deal with these problems, the Chinese government has decided to invest a total of 40 trillion yen in environmental industry as a whole. It has plans to construct at least 20 waste incinerators a year during the 12th five-year plan that starts next year, in order to eliminate waste hazards and reduce waste volume through incineration.

Against this backdrop, Company A is actively receiving orders for large stoker-type incinerators, which are commonly used for treating municipal solid waste in Tsingtao, Shanghai.

In response to an increasing need to appropriately manage and recycle waste, the relevant government authorities are giving private-sector companies permission to contract the entire process of collection, transport, remediation, and recycling of food residue from restaurants, and development of the necessary infrastructure is accelerating.

Company A has collaborated with a local company to develop a waste management operation that ranges from the collection and transport of restaurant kitchen waste to the manufacture of biogas. By providing technical support, design, and machinery to the Chinese company, Company A has managed to get its foot into the door of China's recycling market for restaurant kitchen waste, which is said to have annual operating expenses of JPY200 billion yen.

Conceptual drawing of a completed large stoker-type waste incinerator in Shanghai

Source : JFE Engineering Corporation

Column

Introduction of Waste Treatment Plants in East Asia

Company B is using its experiences of receiving over 200 orders of municipal solid waste incinerator facilities in Japan to successfully obtain 8 orders for China, 5 orders for Taiwan, and 8 orders for South Korea.

It has received orders for constructing stoker-type incinerator facilities in China, and it is contracted for the design, supply of main equipment such as fire grates, and technical services such as dispatch of supervisors for installation, etc.

As part of a construction project for a waste incinerator facility (fluid-bed gasification melting furnace) for Namyangju, South Korea, Company B is contracted for the design, supply of certain equipment for the gasification melting furnace, which is the main facility, and dispatch of technical personnel for installation and test operations.

Conceptual drawing of a stoker-type waste incinerator facility in Shanghai

Source : Hitachi Zosen Corporation

2) Development of projects for the collection and recycling of resources by companies in venous industries

Some companies carry out projects for the collection and recycling of resources in other countries to meet the needs of those countries. These companies utilize the technologies and know-how for resource collection and recycling that they developed in Japan.

Column

Expansion of Recycling Businesses in China

In China, it has been common practice to dispose of municipal solid waste in landfills. However, municipal solid waste has increased tremendously with the growth of GDP. In order to reduce pressure on the remaining capacity of final landfill sites, some cities have started to build new incineration facilities. The Chinese branch of Company C in Dalian City, Liaoning province is working with a local company on a project to use a "Fly Ash Washing System" to remove chloride from the incineration ashes of municipal solid waste and to use the cement manufacturing process to detoxify and recycle the ashes as a raw material for cement.

A local company that manufactures and sells PVC (polyvinyl chloride) in the Uighur Autonomous Region is using calcium carbide residue, a by-product of the manufacturing process, as a raw material for making cement. The steady production process, which was negatively impacted by the chlorine contained in the by-product's residue, was drastically improved. The company is installing a "Chlorine Bypass System," which is expected to have the added benefit of energy efficiency.

Cement factory planning to install a fly ash washing system (Liaoning Province, China)

Source: Taiheiyo Cement Corporation

3) Development of appropriate waste management business by companies in venous industries

Some companies carry out projects to provide proper treatment of waste and hazardous materials in developing countries that have insufficient facilities for waste treatment and recycling.

Column

Expanding Business by Acquiring Local Corporations in Asia

Company D, which had been working on environmental and recycling projects for waste management, recycling, and soil purification in Japan and China, acquired in 2009 a company that carries out waste management and recycling projects at four places in three Southeast Asian countries (Indonesia, Thailand, and Singapore) in order to expand its environmental and recycling operations in Asia. Thanks to that acquisition, Company D is operating Indonesia's only facility for final treatment of hazardous waste, one of Thailand's few large final treatment facilities and one of its few large incineration facilities, and a hazardous waste treatment facility in Singapore.

This venture has made it possible for Company D to provide trustworthy service equal to that in Japan to not only local companies in Southeast Asian countries but also to Japanese companies that have expanded their businesses overseas. Company D is providing total services (one-stop-shop) of waste management, soil purification, and recycling in Japan, China, and Southeast Asia.

Facility for final treatment of hazardous waste in Indonesia

Source : DOWA Eco-System Co., Ltd.

Large-scale final treatment facility in Thailand

Source : DOWA Eco-System Co., Ltd.

Large-scale incinerator facility in Thailand

Source : DOWA Eco-System Co., Ltd.

4) Business development by trading companies

Trading companies that already have broad experience in developing waste and recycling projects in Asia and have deep ties in various sectors are also making efforts.

Column

Expansion by Trading Companies

Company E has established a local company in the Changxing Island Seaport Industrial Area of Dalian, China to start a joint combined-type recycling/recyclable resource venture business for the recycling of iron scraps, nonferrous metal scraps, waste household electronics, and waste plastics. Since 2009, it has been holding discussions with the Liaoning government about developing the Changxing Island Seaport Industrial Area into an "eco island" founded on energy conservation and environmental protection. It is making various recommendations for water management, energy, transport, recycling, and other fields.

Company E has also established a joint venture with the world's largest palm oil business in Malaysia to manufacture solid biomass fuel. It is constructing a plant for manufacturing solid biomass fuel "EFB pellets," using as the raw material the residues (EFB: palm empty fruit bunches) generated from the palm oil pressing process, which have no other use. Company E will be delivering the EFB pellets to Japanese power companies.

Combined-type recycling plant in Dalian, China

Source : ITOCHU Corporation

5) 3R business development by manufacturers

Many Japanese manufacturers are building 3R systems for their own products. Manufacturers of copy machines, for example, are building 3R systems in Japan for their own copy machines. The reuse rate of parts from retired copy machines is high and almost no waste is generated from them. These manufacturers are also introducing the technologies and systems that they have developed in Japan to the Asian region and other countries.

Column

Collection of Products and Sales of Recycled Equipment in Asian Markets

Company F's sales company in Thailand recognized the market needs for recycled equipment, and since 2003 it has been actively expanding a recycled copy machine business to provide the market with copy machines that it collected. Used products that have been collected are first diagnosed for the quality of their parts and their state of deterioration. They are then taken apart, cleaned, and dried, and the data on their hard drives are erased completely. In the subsequent assembly process, the deteriorated parts and consumable parts are replaced with new ones. Finally, the machines are inspected, calibrated, and completed. Upon assurance of their quality, they are ready for delivery.

Progression of a recycled copy machine project

Source : Ricoh Company, Ltd.

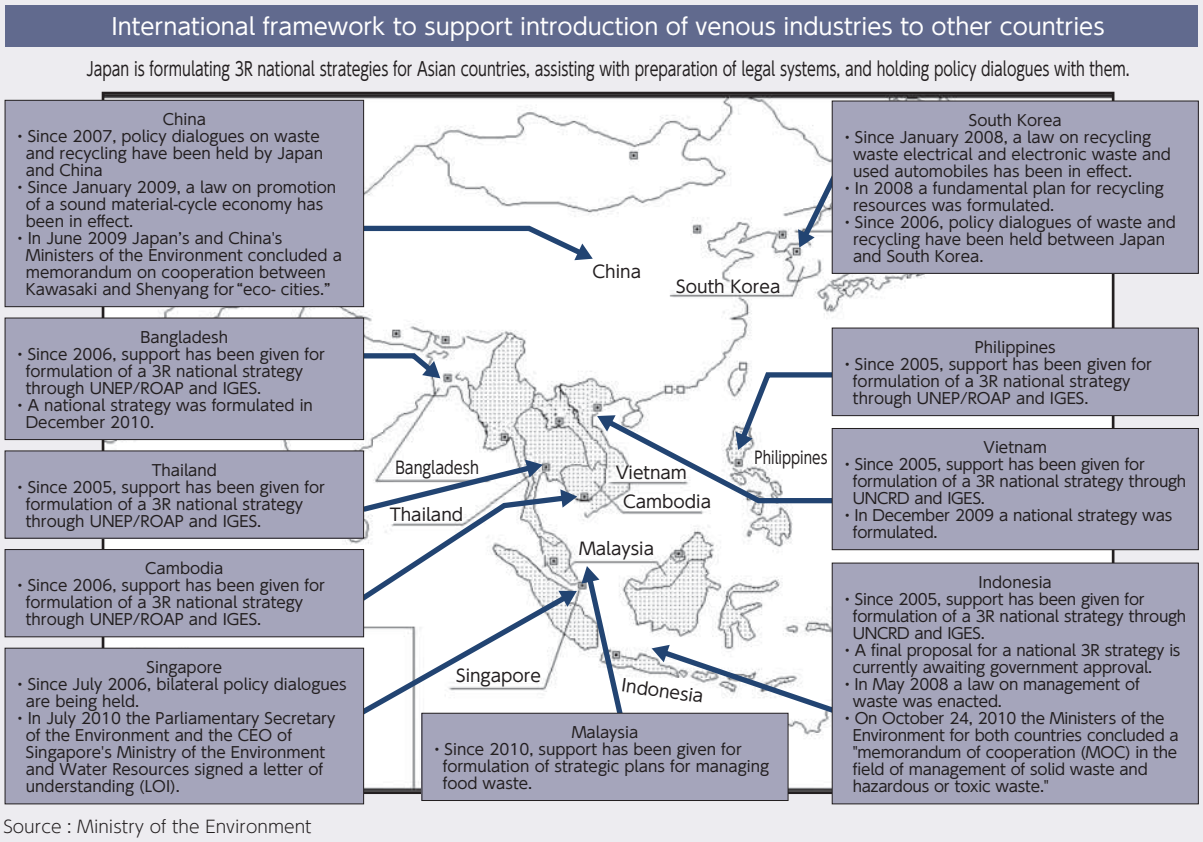
(2) International Framework for Supporting the Overseas Expansion of Venous Industries

It is essential to put in place legal and other systems to facilitate enforcement of collection, treatment, and recycling of waste. In general, in developing countries low priority is given to systems of waste management and the citizens also have very little interest. As a result, in some countries waste is scattered around urban areas. There is a need for collecting and transporting such waste properly, promoting the 3Rs, and developing an integrated management system for intermediate treatment and final disposal. If a partner country does not have a social system in place to enable proper collection and treatment, it will be difficult to solve waste problems by just providing technology. Therefore, Japan is providing assistance and holding policy dialogues for creating national strategies to promote the 3Rs in Asian countries (Figure 4-2-8). Japan is also hosting the "Forum on Promoting the 3Rs in Asia," which was established in 2009 based on a proposal by Japan, promoting high-level policy dialogues on the 3Rs, sharing information, and building networks of relevant parties. In addition to encouraging countries to make the 3Rs a main policy, Japan is also supporting programs that will lead to specific projects and taking initiatives to build a sound material-cycle society in Asia.

Photograph 4-2-2 Forum on Promoting the 3Rs in Asia

Source: Ministry of the Environment information

Figure 4-2-8 International Cooperation and National Strategic Support in the Fields of the 3Rs and Waste in Asia



Source : Ministry of the Environment

Column

Cooperation and Support between Kawasaki City and Shenyang City (China)

On June 14, 2009, Japan's Minister of the Environment and China's Minister of Environmental Protection exchanged a "Memorandum on Cooperation for Building Eco-Cities in Kawasaki City and Shenyang City." The main content of the memorandum includes "collaboration in model projects for building eco-cities in Kawasaki City and Shenyang City through development of the recycling industry," "sharing of information on policy exchanges, research, and technology about the creation of systems for the conservation and collection/recycling of resources and waste management," and "encouragement of active participation by the academic, industrial, and private sectors."

The Ministry of the Environment is currently cooperating with the cities of Kawasaki and Shenyang, businesses, the National Institute for Environmental Studies, the Chinese Academy of Sciences, and others to conduct feasibility studies on the development of recycling businesses in Shenyang City. Workshops are also being held in the cities of Beijing and Shenyang to introduce Japan's eco-towns and 3R initiatives. Kawasaki City is conducting international workshops, studies on environmental needs, and research. Companies located in Kawasaki City's eco-town are making arrangements with Shenyang City and local companies to introduce plastic bottle recycling and sewage sludge treatment projects in Shenyang City. The National Institute for Environmental Studies is cooperating with the Chinese Academy of Sciences to apply to Shenyang City the "sound material-cycle economic city simulation system," which was developed using Kawasaki as a field.

Under this cooperation model undertaken by the cities of Kawasaki and Shenyang, national and local governments, private-sector companies, and research organizations are working together and Japan's advanced waste treatment and recycling technologies are being introduced together with systems in other countries. Such efforts will contribute to global environmental conservation and the recycling of resources. The undertaking serves as a model case for building a sound material-cycle society (see figure).

Cooperative support between Kawasaki City and Shenyang City (China)

Source : Ministry of the Environment

Column

Cooperation between Ibaraki Prefecture and Tianjin City (China) for Sound Material-Cycle Cities in Japan and China

Japan's experiences and expertise for developing eco-towns are being transferred under a framework of cooperation among local governments in Japan and China. In order to build an environment (foundation) to make it easy for Japanese companies to expand their business into China, Japan's Minister of Economy, Trade and Industry and the Chairman of the National Development and Reform Commission of the People's

Republic of China agreed on China-Japan cooperation in building sound material-cycle cities starting in 2007. The two countries have been cooperating in the field of recycling.

In 2009, a cooperative project between Ibaraki Prefecture and Tianjin City began for establishing a resource recycling economy in the Binhai New Area, which centers mainly in the Tianjin Economical-Technological Development Area (TEDA). In June 2010, a memorandum on environmental cooperation was concluded by the governor of Ibaraki Prefecture and the mayor of Tianjin. The project moved forward thanks to a solid cooperative relationship between the two local governments. Specifically, a pre-feasibility study for a waste management model project in the Binhai New Area (mainly in TEDA), a material flow study for waste and recycling in TEDA, and training for government and corporate personnel in Tianjin City and the Binhai New Area were conducted.

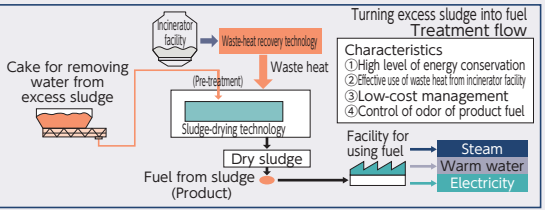
In light of the fact that "sludge treatment" was highlighted in the 12th five-year plan, as a waste treatment model project a plan was made to build a facility for treating sludge generated from facilities that treat polluted water. The material flow study found that in order to further promote proper treatment and recycling of waste it is necessary to tackle certain issues such as establishing a system to manage the recycling and waste flow and enhancing the awareness and technologies of companies concerning resource conservation and recycling.

Based on these studies and proposals, assistance will be provided for the establishment of systems and training of people to promote proper management and recycling of waste, feasibility studies for the construction of sludge treatment facilities will be made, and business-matching with recycling companies mainly in Ibaraki Prefecture will be conducted, and cooperation and support will be provided to help build a resource recycling economy in the Binhai New Area.

Cooperative project for sound material-cycle cities (Ibaraki Prefecture and Tianjin City)

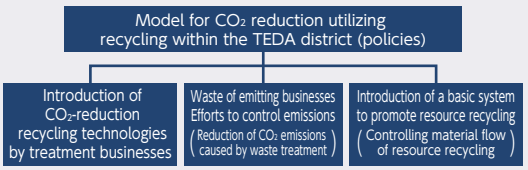
1 Creation of a pre-FS report for a model project (facility for managing hazardous waste, etc.)

- Surplus sludge emitted from a final sewage treatment facility selected as the target
- On-site investigation of the state of management and the state of sludge generation at the final sewage treatment facility
- Review of methods of treating hazardous waste
- Proposal of candidates for the process for treating hazardous waste



2 Proposal of a model design and implementation plan to activate a low-carbon economy promotion center

- On-site investigation of the material flow of the top 100 companies in terms of emissions of industrial waste in the Tianjin Economic-Technological Development Area (TEDA)
- Assessment of policies and functions of a low-carbon economy promotion center (comparison with Ibaraki Prefecture)
- Proposal of three policies and implementation plans, with the objective of CO2 reduction utilizing recycling, based on a principle of improving the "regional resource cycle" in the TEDA district



3 Study and training visit to Ibaraki Prefecture

In January 2011 (for one week), seven government officials and ten company-related people from Tianjin City came to Ibaraki Prefecture and attended lectures and visited facilities for treating waste and discharged water (in Kashima, Kasama, and Kasumigaura).

4 China-Japan joint workshops

In November 2010 (Tianjin City) and January 2011 (Ibaraki Prefecture) committee members from the Japan side and the China side exchanged opinions about the progress of environmental cooperation.

Plant tour in Ibaraki Prefecture | Lecture on Ibaraki Prefecture's policies | China-Japan joint workshop (in Tianjin)

(3) Regional Community Power to Convey to the Rest of Asia

In aiming for a sound material-cycle society, it is important for every citizen to respect nature, to adopt the *mottainai* mindset of trying not to waste finite resources, and to proactively engage in 3R activities. Solving the problems of waste and forming a sound material-cycle society cannot be easily achieved by simply relying on technology. Waste and recycling are related to everyone and it is essential for each individual to understand the 3Rs, practice them, and participate in them through everyday activities. Local governments have greatly contributed to solving waste problems in Japan, and a sound material-cycle society can likewise be built through collaboration among regional communities, citizen activities, social systems, and technology. It is important to spread to other countries the message about the power of regional communities, in order to establish sound material-cycle societies worldwide.

Column

Instilling a 3R Mindset by Utilizing Regional Experiences

In Naha City (Okinawa, Japan), the 3Rs have become firmly established as citizen activities. Citizens, the government, and corporations work together to form a sound material-cycle society. This has led to a reduction in the volume of waste generated. Vietnam's Hoi An City and Malaysia's Sabah State had the challenge of trying to enhance people's awareness about waste, in other words the "citizens' mindset." To address this issue, Naha City introduced its experiences with 3R activities and carried out a local project for citizens to support effective promotion of the 3Rs.

This project was proposed by Naha City and citizen group A. It was adopted as a JICA Grassroots Technical Cooperation Project (regional-proposal type). During a three-year period that began in FY 2008, 13 people from local governments and NGOs in Vietnam and Malaysia who were in charge of solid waste visited Japan to attend lectures and receive training in the 3Rs. Experts were sent to the two countries to provide human resource training for 3R promotion through discussions, advice, and so forth. Through this project, planning and environmental education programs modeled after Naha are being carried out in both countries.

Landfill tour as environmental education for children

Source: Okinawa Citizens' Recycling Movement

Campaign to stop the use of plastic bags

Source: Okinawa Citizens' Recycling Movement

(4) Toward Future Development

Japan experienced various waste problems corresponding to its economic development and has a history of solving such problems. As a result, Japan's venous industries have accumulated a wide variety of technologies, ranging from today's cutting-edge technologies to technologies that deliver only the minimum necessary functions. Establishment of a legal system and its proper enforcement are essential for appropriate treatment and cyclical use of waste, And Japan is also cooperating with other countries in Asia to develop such legal systems.

Against the backdrop of Japan's waste treatment and recycling technologies and international cooperation in the development of legal systems for building a sound material-cycle society, programs are to be carried out in 2011 to actively support the overseas expansion of Japan's venous industries. Assistance for business expansion feasibility studies has been provided to an initial group of venous industries in other countries. Support is also being provided for the establishment of a new corporate cyclical business model in order to nurture next-generation venous industries.

In addition, in line with the Industrial Structure Vision 2010 put together in June 2010 by the Industrial Structure Council, the government will actively support expansion of Japan's recycling industry into the rest of Asia. This is being executed through an Asian eco-town cooperation project (since 2007), an Asian resources cycle demonstration project (since 2009), and a study to promote the export of infrastructure and systems (feasibility study to be conducted by a recycling company).

Japan will introduce its venous industries to other countries by integrating its technologies and systems into a package and utilizing it to solve the waste problems that Asian countries currently face or are likely face in the future, in order to contribute to conservation of the world's environment.