Chapter 4
Japan's Contribution towards Establishment of a Sustainable Society

As discussed in Chapters 2 and 3, in order to realize a rich and sustainable society, it is important to utilize sustainably ecosystem services supported by the stock of biodiversity, and at the same time proceed with technological innovations in the field of environmental and work to bring about a new economic and social system that would generate a positive cycle between the environment and the economy. Japan has accumulated outstanding technologies and systems in the field of environment, and can contribute to improvement of global sustainability and the realization of better life in both Japan and the rest of the world, by further developing those technologies and systems and expanding them worldwide.

In Chapter 4, we will first look at the international trends in relation to realization of a sustainable society, and then review the efforts in Japan for the growth through green innovation, including the basic aspects of funds/financing and education that would become the foundations for such growth. We will also give a more specific introduction of efforts towards a material-cycle society and low-carbon society, which are particularly important to the realization of a sustainable society, focusing on innovation of technologies and systems and their international expansion.

Section 1 The Road to a Sustainable Society

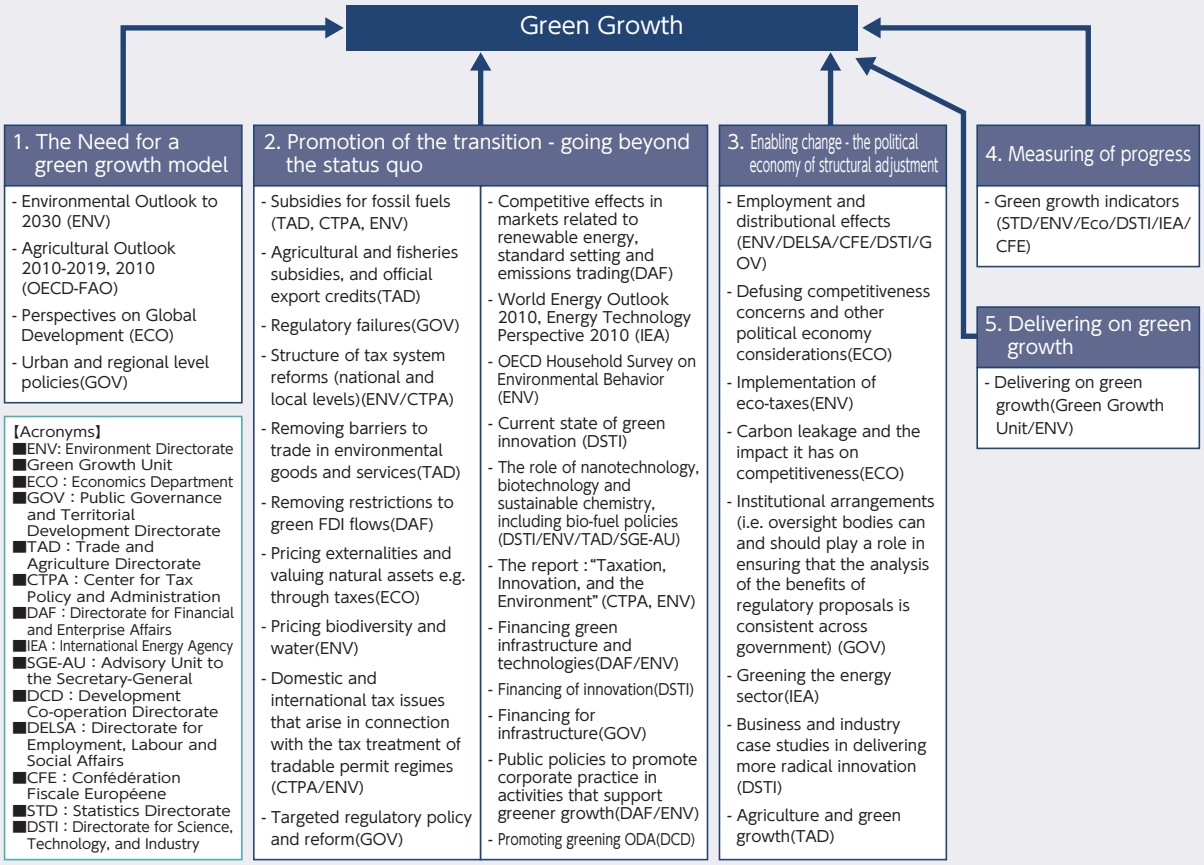
In this section, first, we will look at the efforts that are being promoted by the world's major international organizations towards establishment of a sustainable society. We will then review Japan's efforts towards a sustainable society through green innovation and give an analysis of the environmental policies required in such activities. Also, we will also look at the government's efforts towards the requirements for the promotion of green innovation, such as financing for research and development, environment finance, and development of human resources.

1. Actions for Establishment of a Sustainable Society: Global Trends in Green Growth

International efforts for a sustainable society are being actively made. The Meeting of the Council at the Ministerial Level of the Organization for Economic Co-operation and Development (hereinafter in this chapter referred to as the "OECD") adopted the "Declaration on Green Growth," agreed to develop a "Green Growth Strategy," and strengthen the efforts towards the development of the Strategy. The "Interim Report of the Green Growth Strategy: Implementing our commitment for a sustainable future" (OECD, May 2010; hereinafter in this section referred to as the "Interim Report"), which was released based on the Declaration on Green Growth, stated that "growing concerns about the environmental unsustainability of past economic growth patterns and increased awareness of a potential future climate crisis have made it clear that the environment and the economy can no longer be considered separately." The Report presents tentative conclusions for a number of key issues that policymakers are currently facing in transitioning to greener growth. Under such circumstances, the OECD has been making organization-wide efforts aimed at green growth (Figure 4-1-1).

The Interim Report says that, from the viewpoint of how production and consumption should be changed in order to realize greener growth, green growth strategies will require a mix of policy instruments, including market-based approaches, regulations and standards, tax benefits given to R&D, and information-based instruments to facilitate consumer choices. The Report also says that a central element of the policy mix is to develop ways of creating economic payoffs through taxation for pollution and use of scarce resources, so as to emit clear market signals. However, the Report also says that market-based instruments alone will not be enough to bring about a shift to greener consumption and production patterns, and that regulations will be required in case the market fails and as a result price signals are weak. The Report also says that there are other approaches, such as voluntary measures and information-based measures including energy-saving ratings and well-designed eco-labeling that can play an important role in raising the awareness of consumers and producers on the environmental impact of specific activities as well as of the availability of clean alternatives. Also, regarding the role of innovation, the

Figure 4-1-1 OECD's Efforts towards Green Growth



Source: Created by the Ministry of the Environment, using information from the OECD's "Outline for the Green Growth Strategy's Synthesis Report"

report says that innovation will be a critical driver of green economies and job creation. Policies to accelerate the development and the diffusion of clean technologies and related knowledge will be another key part of the policy mix.

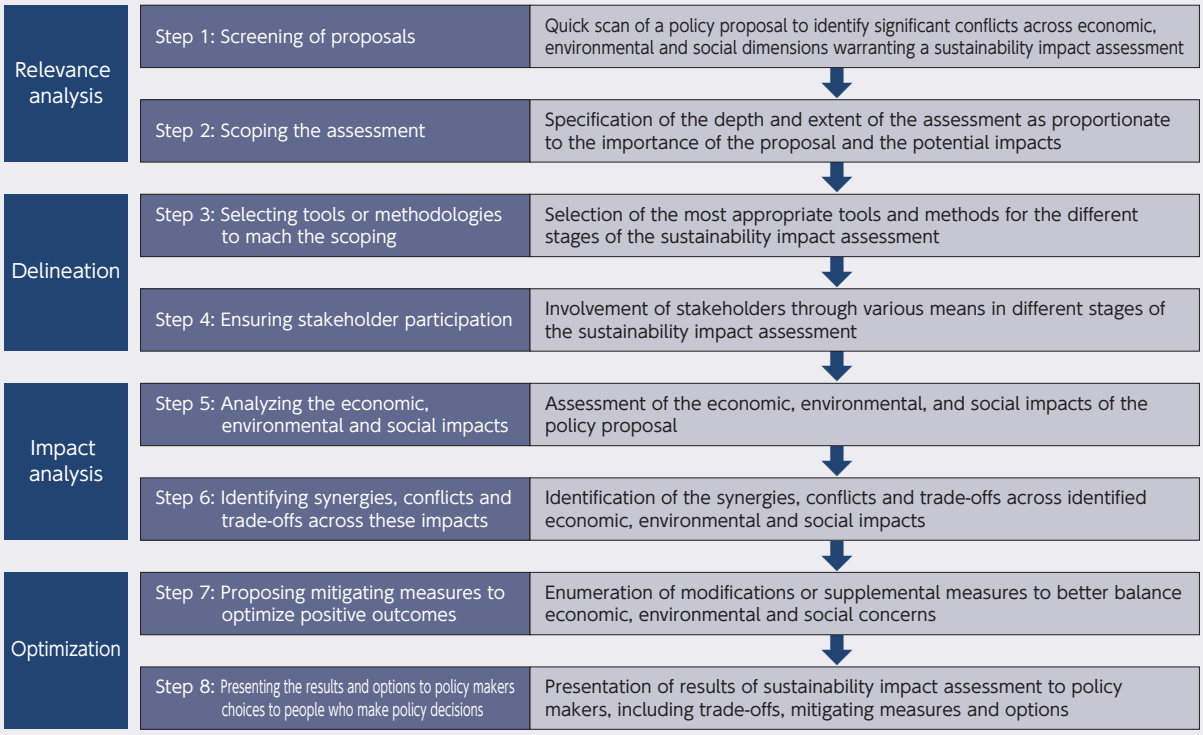
In addition, regarding the establishment of a sustainable society the OECD is working on a new approach called Sustainability Impact Assessment (SIA). According to the OECD, SIAs have two main functions.: (1) a methodological soft policy instrument for developing integrated policies which take full account of the three sustainable development dimensions, environmental, economic and social, and which include cross-cutting, intangible and long-term considerations; and (2) a process for assessing the economic, social and environmental effects of policies, strategies, plans and programmes before they have been formulated. There is still no real consensus on procedures or framework for using SIAs, and OECD says that SIA consists of eight steps (Figure 4-1-2). In the Report an example using Belgium was given to show how this SIA was used in policy-making. In Belgium the SIA was only introduced in 2010 and although there are still problems, the law stipulates that it is necessary to conduct assessment of impact on sustainability in advance for some of federal laws, and, when assessing, it is necessary to review and consider the necessity of assessment for those laws and desirable alternatives.

The United Nations (hereafter in this section referred to as the "UN") is also proceeding with reviews related to world sustainability. In order to promote sustainable development and discuss solutions aimed at the challenge saving the people of the world from poverty, the UN launched the "High-Level Panel on Global Sustainability," and its first meeting was held in September 2010. Japan's participant in this panel was a former prime minister, Yukio Hatoyama. At the first meeting, the UN Secretary General, Ban Ki-moon, made an appeal for the "50 -50 -50 Challenge," which says that although by 2050 the population will grow by approximately 50% over the current population, it is necessary to reduce greenhouse gases by 50% by that year. The final report of that meeting is to be made by Secretary General Ban Ki-moon at the end of 2011.

In addition, in 2012, the United Nations Conference on Sustainable Development (hereinafter in this section referred to as "Rio+20") is scheduled to take place. Rio+20 will mark the 20th anniversary of 1992 United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, and will focus on a "green economy in the context of sustainable development and poverty eradication" and on "the institutional framework for sustainable development." Preparatory meetings are currently being held and preparations are now in progress for the meeting in 2012.

The Asian Development Bank (hereinafter in this section referred to as the "ADB" in this Section) is also making efforts aimed at the promotion of sustainable

Figure 4-1-2 Sequence of Steps in Sustainability Impact Assessments



Source: Created by the Ministry of the Environment, using information from the OECD's "Guidance on sustainability impact assessment"

development in the Asia-Pacific region. In 2008 the ADB established Strategy 2020, which stipulated three main strategies, including "promotion of environmentally sustainable growth". Strategy 2020 says that since Asia's robust economic growth is leading to the depletion of the region's natural resources, accelerating environmental degradation, both in urban and rural areas, and impacting climate change, only growth that is environmentally sustainable can eliminate poverty, since many of the poor depend on natural resources for their livelihoods. Based on this understanding, in order to realize environmentally sustainable growth in harmony with the environment the ADB is working to support the use of eco-technologies, adoption of measures to protect the environmental safeguard measures, and the establishment of institutional capacities to strengthen their enforcement. ADB also sets targets for operational goals in Strategy 2020. For instance, ADB will progressively increase its assistance for "environmentally sustainable development," including efforts to address reduction of carbon dioxide emissions and climate change.

The world's major international organizations are thus making various efforts with the understanding that the sustainable development premised on sustainability is an important task, and that efforts aimed at an environmentally sustainable society is a global trend.

Column

The OECD's Environmental Performance Review Program

The OECD is an international organization where the governments work together to improve environmental policies through performance reviews of member countries, and to conduct assessment and make recommendations to improve the reviewed country's policies and programs. OECD Environmental Performance Reviews began in 1992, and every year the environmental policies and programs of approximately four countries are reviewed by other member countries. The main objective of this effort is to have member countries and related cooperating countries improve environmental performance of governments individually and collectively. So far Japan was reviewed twice, first in 1994. again in 2002, and the third review was conducted in May 2010 by the OECD Working Party on Environmental Performance of the Environment Policy Committee. The Performance Review covering Japan was released in November 2010 and the Review included a total of 38 environmental recommendations such as green growth, climate change, waste management, and biodiversity. The Report found that Japan has strong focus on energy efficiency and research and development, which Japan has effectively integrated with energy and climate policies, and that Japan is a world leader in climate-related research and development. At the same time, the OECD included following recommendations for Japan in order to further promote environmental policies. Since this reviews the implementation status of environmental policies and the status of the environmental improvement and publishes the result, it is expected that environmental policies suggested will be actively promoted in each of the member countries.

Japan's Environmental Performance Review

Source: Ministry of the Environment

An event to announce the report on the Japan's Environmental Performance Review

source: Ministry of the Environment

Overview of the Recommendations in the Third Environmental Performance Review of Japan

- Review and update the 1993 Basic Environmental Law in order to consolidate, streamline, and make the existing body of laws more coherent.
- Clarify linkages and priorities among plans in different sectional plans and basic environmental plans.
- Mainstream environmental considerations in the 2011 tax reform, with a view to broadening the use of environmentally related taxes and reducing incentives and subsidies that have adverse environmental effects, or that contravene the polluter-pays-principle.
- Expand the use of economic instruments, for example trading schemes and user charges, to increase the economic efficiency of environmental policies; review the cost-effectiveness of regulatory instruments and agreements negotiated with industry.
- review transport-related taxation and pricing, with a view to directly linking taxes on the purchase and ownership of vehicles to their fuel efficiency, and to better targeting pollution related to vehicle use through fuel taxes and road pricing.
- Put a consistent price on carbon through emissions trading in combination with climate-related taxes; transform the trial emissions trading system (ETS) into a mandatory cap-and-trade scheme that is compatible as far as possible with trading schemes in other countries.
- Continue to promote the 3Rs strategies at the national and local levels, and implement fundamental plans for establishing a sound material-cycle society ([1] setting of targets on resource productivity by sector, and ([2] continual support towards support analysis of resource productivity by sector and material flows, including better assessment of trade-related flows and their associated environmental impacts.
- Develop a strategy for biodiversity corridors, particularly in forests and rivers, taking account of possible impacts of climate change.

2. Growth through Green Innovation and Environmental Policies

(1) The Necessity of Green Innovation and Japan's Targets

Economic growth has contributed to health and education that are required for humans' prosperity. Looking at examples from around the world shows us that average life-spans, literacy rates, and percentages of people pursuing higher education have all grown in proportion to economic development. On the other hand, the world has not always given sufficient consideration to the environment in order to achieve economic growth. If the 9 billion people living in the world pursue today's EU average income and the income level equivalent to an annual growth each year of 2%, the basic units of emitted carbon must be reduced by more than an average of 11% per year in order to stabilize the climate. That would be equivalent to a rate of the reduction 16 times faster than the one improvement achieved since 1990.

In order to realize greater economic growth under environmental restrictions, it will be essential to bring about technological innovations in environmental fields, to achieve a low-carbon society through comprehensive policy mixes of new system design or system changes and new regulations or easing of deregulations, and also to support rapid dissemination of environmental technologies and products. It is necessary to disseminate Japan's top-level environmental technologies throughout the world, leading to the achievement of global environmental and economic sustainability. Such efforts will promote economic growth and secure employment.

With the "New Growth Strategy" established in 2010, Japan is creating and disseminating world leading environmental technologies through the promotion of green innovation, with the aim to become an"environmental and energy superpower" of the world. Based on this New Growth Strategy, the government launched 21 National Strategy Projects. For green innovation, three National Strategy Projects were launched, including "rapid expansion of renewable energy through introduction of a feed-in tariffs system," "eco-friendly future cities initiatives," and "forests and the forestry revitalization plans" For these three innovation projects, goals and timetables were set for a target year of 2020 and followed (Figure 4-1-3).

(2) Various Ways Forms and Methods of Green Innovation

Green innovation would take place in varied ways in many industrial sectors.

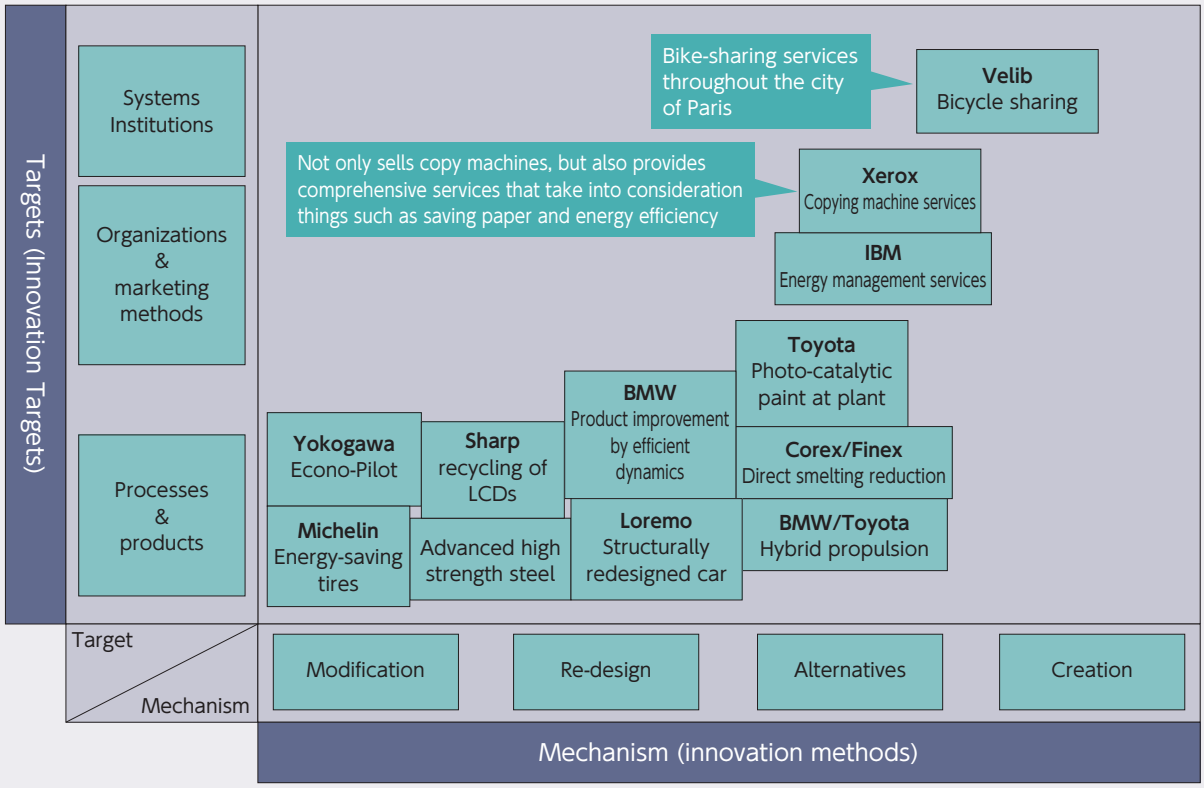
According to the case study of green innovation conducted by the OECD green innovation activities would be analyzed via two dimensions: "targets" and "mechanism" (Figure 4-1-4). "Targets" can be classified into the following areas "process" and "product" in producing, "marketing method," "organization" of the producer, and "systems and institutions," which are broad and societal and go beyond a single company. "Mechanism" can divided into following areas: small-scale technological "modification," "re-design" due to a major change of a product, "alternatives" that introduces materials totally different from those in the past and substitute functions, and "creation" that introduces an entirely new product or production processes. It is believed that the effects of green innovation are brought about by the both "targets," and "mechanism," and the interaction between these two. The effects of green innovation would depend on the social and technological context, and in general, when focusing on a specific "target", "creation" has more potential for environmental benefits than "modification" does.

According to this OECD study in the automotive and transport industry sector for example, in responding to climate change, the CO_2 emissions reduction caused by use of fuel is the target of general measures. The green innovation in this sector would target mainly the "process" and the "product," and efforts would be made to progress technological development through "improvement" and "re-design" as methods. In the electronics sector, efforts would be made through the product "modification" and "re-design" for green innovation aimed at controlling use of energy consumption when products are used, while the innovation may occur if the organization reconsiders the promotion of product recycling to accommodate the increased demand for electronics. Based on analysis of this example in individual industries, the study found that it is the best approach to achieve ideas and activities for green innovation in the framework that goes through

Figure 4-1-3 Timetable for 21 National Strategic Projects under New Growth Strategy (Extracts)

Source: Created by the Ministry of the Environment, using information from "New Growth Strategy" (Cabinet decision of June 18, 2010)

Figure 4-1-4 Case Study: Eco-innovation Examples



Source: Created by the Ministry of the Environment, using information from the OECD's "Eco-Innovation in Industry: Enabling Green Growth"

the sequence of the "mechanism" from "modification" to "creation," and the sequence of the "target" from "product" to "system."

(3) Concepts behind Environmental Policies that Contribute to Green Innovation

Environmental policies play an important role in promoting green innovation.

According to the OECD's study, environmental policies related to innovation are broadly divided into two categories: supply-side policies and demand-side policies. Supply-side policies include capital support through setting up venture capital funds in the early stages of research, and support for research and development (R&D) that provides funds to universities and basic research organizations (Figure 4-1-5). Demand-side policies include establishment of regulations and standards, and policies for public procurement that the public sector, also a main consumer, purchases materials and services that have a low environmental impact (same Figure 4-1-5). The research also found that in order to efficiently promote innovation, it is necessary to consider collaborative approach of policy measures on the demand side and the innovation policies on the supply-side that have traditionally been carried out.

These innovation policies need to include 5 policy characteristics; "Stringency," "Stability," "Flexibility," "Incidence," and "Depth," because these characteristics have a different effect on innovation while it is generally believed that market-based approaches are more effective than direct regulation (Figure 4-1-6).

In disseminating fields that include new technologies, such as the field of renewable energy, it is necessary for policy makers to approach appropriately according to the stage of development of the technologies in the market. As a main policy measure for achieving green growth, the OECD summarized its tentative assessment results in the "Interim Report." One of the its findings was that in order to realize dissemination of renewable energy technologies for a low-carbon society, innovation policies should be made according to the stage of development in the market for renewable energy technologies. The report also said that the degree of competition in the market must be encouraged according to the degree of maturity and dissemination of such technologies.

Focusing on policies related to dissemination of renewable energy technologies, the "Interim Report" discussed stages of development in the renewable energy technologies by dividing stages into the four stages of "prototype and demonstration stage," "high cost-gap stage," "low cost-gap stage," and "mature stage" (Figure 4-1-7). In the discussion, continuous research and development with supports of subsidies and tax will be necessary in the "prototype and demonstration stage" or the high cost-gap stage," because they are the early stages of disseminating renewable energy technologies. In the "low cost-gap stage," it will be necessary to set technology-neutral policies such as emissions trading, strengthen competitive status against other technologies and gradually defer to consumer demand and competition in the market, because dissemination of the renewable energy technology has made progress and the

competitiveness gap with other technologies has become relatively small in this stage. In the "mature stage," various types of assistance measures should be eliminated and the situation should be left to development derived from the spontaneous demand, because it has become possible to compete with other alternative technologies and preparations have been made to disseminate such technologies on a large scale in this stage. The discussion also said that, in addition to the development stages, it is necessary to remove non-economic obstacles such as lack of relevant information and education, and to have a predictable and transparent framework for support in order to ensure the function of the market and policies.

As seen thus far, for policies aimed at green innovation, the government plays an important role; providing high-cost facility investment, incentive programs to encourage long-term investment for the technologies that take a long time for commercialization, measures to increase demand, and subsidy programs in addition to the support for research and development. So policy decisions for green innovation and methods for economical

Figure 4-1-5 Taxonomy of Innovation-related Environmental Policies

Supply-side policies	Demand-side measures
• Equity support (support for commercial and financial risks that cannot be always addressed by market mechanism) • R&D (support programs and research funding of government and university organizations) • Pre-commercialization (support from the R&D stage to successful commercialization) • Education and training (development of skills and talent to boost innovation) • Network and partnerships (inducing open innovation by utilizing knowledge networks) • Information services (provision of information related to support measures, related policies, legislation and regulations, etc.) • Provision of infrastructure (provision of transport infrastructure and networks for	• Regulations and standards (regulations and institutions that encourage new product development) • Public procurement and demand support (supporting and boosting of demand through government procurement) • Technological transfers (export and transfer of technologies from companies in industrialized countries to developing countries, as well as domestic or local transfer from large companies to SMEs)

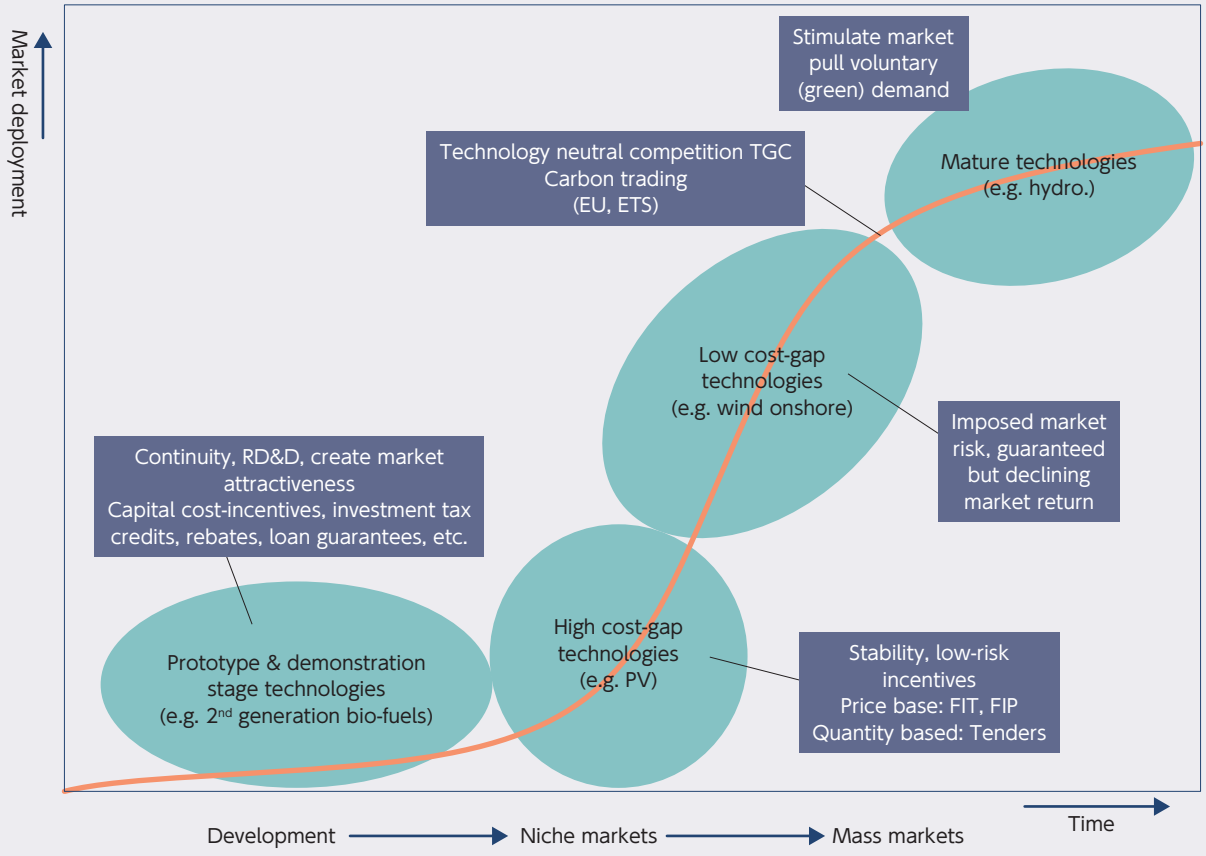
Source: Created by the Ministry of the Environment, based on information from the OECD's "Eco-Innovation in Industry: Enabling Green Growth"

Figure 4-1-6 Characteristics of Environmental Policies Likely to Induce Innovation

- Stringency: How ambitious is the environmental policy target, relative to the 'baseline' trajectory?
- Stability: What effect does the policy measure have on investor uncertainty; Is the signal consistent, foreseeable, and creditable?
- Flexibility: Does it let the innovator identify the best way to meet the objective?
- Incidence: Does the policy target directly the externality (e.g. CO_2), or is the point of incidence a 'proxy' for the pollutant (e.g. energy efficiency)?
- Depth: Are there incentives to innovate throughout the range of potential objectives?

Source: Created by the Ministry of the Environment, based on information from the OECD's "Environmental Policy Framework Conditions, Innovation and Technology Transfer"

Figure 4-1-7 Renewable Energy Market Deployment, and Necessary Environmental Policies



Source : Created by the Ministry of the Environment, based on information from the OECD's "Interim Report of the Green Growth Strategy: Implementing Our Commitment for a Sustainable Future"

assessment are necessary for planning and promoting the measures. In addition, identifying the trends of government environmental policies and analyzing the competitiveness of Japan's businesses and industries would help increase environmental policy options. Based on such understanding, the efforts mentioned in Figure 4-1-8 are accelerating for achieving a new technological and economic paradigm that will support a sustainable development.

Figure 4-1-8 Efforts Aimed at Green Innovation

○Carrying out technological innovations and systems reforms through long-term policies
○Actively utilizing current technologies being that disseminated in an ICT paradigm that reduces environmental load using information communication technology
○Giving direction for long-term technological innovations through active policy guidance, although both radical and gradual innovation are necessary
○A network-type approach that targets many and various actors is necessary.
○Promoting resource allocation that goes beyond the framework among ministries, and research and development conducted collaboratively among industry, the government, and academia
○Actively promoting collaboration with other countries and securing the pluralism and competition that are essential for innovation

Reference material: Ministry of the Environment's "Policy Study on Environmental Economics" (Professor Atsushi Sunami, National Graduate Institute for Policy Studies)

Column

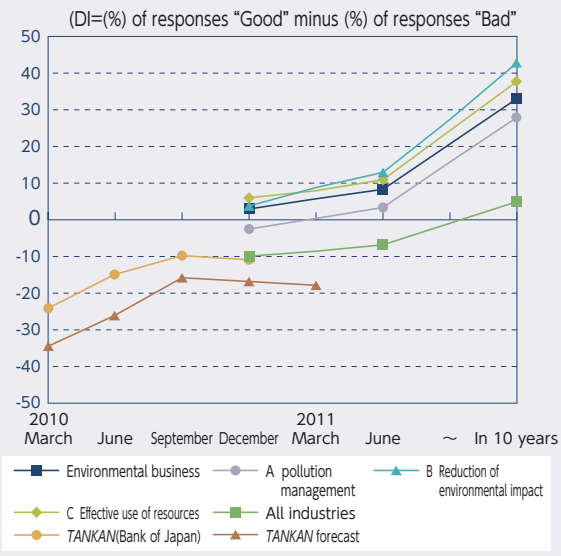
Economic Survey of Environmental Industries

When making environmental policies, it is necessary to take the status of the environment technology market into consideration and estimate the future trends of the environment related markets. The Ministry of the Environment has been conducting a new statistical study "The Economic Survey of Environmental Industries" from 2010. This study is intended to continuously review trends of the business confidence of environmental businesses through a survey every six month. The purposes are to utilize the result as basic information for planning policies related to promoting environmental business and assessing the performance of measures. The study contributes to the broader awareness of environmental businesses, and the results are published in order to accelerate the development of environmental businesses.

Asking companies about the current condition of operating environmental businesses, and comparing the responses with the conditions of overall other industries, environmental industries are stronger than other industries in December 2010. The DI (Diffusion Index, indicating the response "bad" minus percentage of response "good") of environmental industries was higher than that of whole businesses/industries in all categories, including "present," "in 6 months" and "in 10 years" There is a tendency for DI to be stronger in the "in10 years" category (see figure).

While companies have positive views on the future development of environmental business, the leading industry of environmental business varies from time to time. For example, "at present," energy-efficient appliances that are supported by the "eco-points system" and high efficiency water heaters that are supported by subsidy programs rank at the top. The eco-points system would end in 6 months, but the trend shows that the DI of other businesses will gradually improve due to the expectations of economic recovery (see table). As for the business prospect in 10 years, the DI of most environmental businesses shows positive figures, and the ratio of companies

Business Confidence DI of Environmental Businesses



Note: *TANKAN* (The Bank of Japan's quarterly survey) of business sentiment is a total of all scales and covers all industries.
Source: Ministry of the Environment's "December 2010 Economic Survey of Environmental Industries"

expecting "good" surpassed the ratio of those anticipating "bad." Energy saving products, such as LED lighting and insulation materials, and energy saving consulting services, such as ESCO projects, ranked at the top (see table).

Recent activities of consumers and corporations are considered to adapt to environment, so they need information and expect acceleration of renewable energies such as wind power, hydraulic power, and biogas power generation will also increase. Companies will make decisions for R&D, facility investment and hiring based on such mid- and long-term business forecasts. There will be many cases that require serious decisions for high-cost investment and management resources (see table). Forecasting the future is uncertainty and inevitable, but for stability in developing environmental business, it will be important to provide policy guidelines and support for cooperation with industries and financial sectors, and then we can achieve growth of environmental businesses.

Business Confidence of Environmental Businesses (Top-Five DI Businesses)

(DI)

Present		In 6 months		In 10 years	
Energy-saving home appliance (government-designated eco-points merchandise,)	41	Wastewater management services	24	Energy saving and energy management	54
Wastewater management services	27	High efficiency water heaters	22	Energy saving consulting services	50
High efficiency water heaters	21	Lease and rental	20	Education, training, and information-provision services	50
Water supply	20	Energy saving consulting services	19	Reduction of environmental impact, resource-saving technologies, processes	49
Renewable energy facilities	18	Energy-saving vehicles	18	Renewable energy facilities	47

Note: Excluded business categories for which the number of responses were 10 or less
Source: Ministry of the Environment's "December 2010 Economic Survey of Environmental Industries"

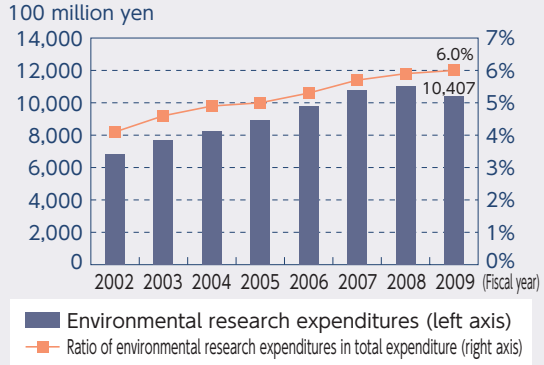
3. Funding and Environmental Finance to Support Technologies that Contribute to Creation of a Sustainable Society

(1) Expenditure of Research Costs in Environmental Fields in Japan, and Related Trends

As discussed in the previous subsection, new technologies that would contribute to solution of environmental problems could not be achieved without active efforts by each participant. Private-sector companies are investing large amounts of money for research and development and education of employees to secure and strengthen technological competitiveness in the market. Such actions indicate that, in order to promote the technological development that is required to address environmental problems, it is necessary to make investment in research and development accordingly.

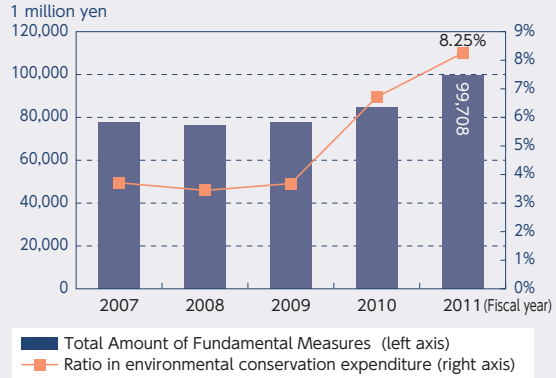
Looking at science and technology research expenditures in Japan, the research expenditures in the environmental field have been given more priority than other areas. The research expenditures in the environmental field show a steadily rising trend since FY 2002 and had increased by approximately JPY 400 billion by FY 2009 (Figure 4-1-9). In addition, the ratio that the expenditures in the environmental field makes up of the total amount of science and technology research expenditure has been consistently rising since FY 2002 (Figure 4-1-9). It should be noted that in FY 2009 the entire science and

Figure 4-1-9 Environmental Research Expenditures and Their Ratios in the Total Science and Technology Research Expenditures



Source: Created by the Ministry of the Environment, using information based on the Ministry of Internal Affairs and Communications "Survey of Research and Development 2010"

Figure 4-1-10 Trends in the Total Expenditures of "Fundamental Measures and the Ratio in Environmental Conservation Expenditure



Source : Ministry of the Environment

technology research expenditure declined in comparison to the previous year, reflecting an economic crisis, and research costs for environmental fields also declined (Figure 4-1-9). This is because the research expenditure of private businesses, which presents approximately 70% of the total for science and technology research expenditure, showed a significant drop of 12.1% compared to the previous year. However, even though the research expenditure in the environmental fields declined, the rate of decline was relatively smaller in comparison to the reduction rate of the entire science and technology research expenditure. This indicates that research in the environmental field is regarded as more important than the other areas.

In addition, looking at the environmental conservation expenditures, which are government expenditure related to conservation of the Earth's environment, prevention of pollution, and protection and maintenance of the natural environment, it can be seen that in recent years the budget amount of the general measures supportive of specific measures which include the budget of comprehensive promotion of R&D is increasing. In FY 2011, total amount of the fundamental measures in environmental conservation expenditures was approximately 99.7 billion yen, which makes up approximately 8.25% of the total environmental conservation expenditure (Figure 4-1-10). The budget amount of the fundamental measures has a tendency to increase since 2008, and the amount in FY 2011 has increased by approximately 18% from the previous fiscal year.

The environmental research and development supported by the science and technology budget have yielded a number of successful results. For example, the Ministry of the Environment has been promoting the research and development on high-capacity laminated lithium ion batteries. At the end of 2010, electric vehicles equipped with high-capacity laminated lithium ion batteries were launched to the market, which was an example of the outcomes of governmental environmental R&D leading to commercialization in the private sector (Figure 4-1-11). In addition, these batteries can be used in various storage batteries and power systems beyond their original applications in electric vehicles such as HEVs and plug-in HEVs. It is expected that application of this battery technology will help further significant reduction of carbon dioxide emissions. Specifically, the technology can be applied to industrial electric equipment, and in addition, the batteries can be operated together with the distributed power system to enhance the CO_2 reduction. The technology also has potential to be applied in machinery such as forklifts and construction machines. Thus government investment in research and development for science and technology has brought about significant results that contribute to creating a society that does not rely on non-renewable resources.

Figure 4-1-11 Example of Commercialization of Lithium Ion Batteries for Electric vehicles

Source: Automotive Energy Supply Corporation

(2) New Roles of Environmental Finance

In order to solve environmental problems, it is necessary to change all of the mechanisms in a society to sustainable ones. Since all economic activities use money as a medium, in order to change society's mechanisms we should also need to change the flow of money. This would be the responsibility of the financial sector to the society. In a report released in June 2010, the Expert Committee on Environment and Finance of the Central Environment Council defined the term environmental finance as a "mechanism that changes the actions of corporations and individual actors to take environment into consideration via financial markets that offer appropriate incentives to induce eco-actions." The Council further specified the following two roles that are expected of the financial sector: (a) to supply generous funds baked by more than JPY 1,400 trillion yen of Japan's individual households financial assets towards commercial activities and environmental businesses that contribute to environmental conservation, and (b) to assess and support commercial activities of companies that work towards environmental protection. The report also made new proposals to promote socially responsible investment (SRI) efforts through pension funds and corporate environmental information disclosure.

As an example, the eco-lease project, a measure to reduce the initial investment burden of residences and small- and mid-size businesses for purchasing low-carbon equipments, will be implemented beginning in FY 2011 (refer to Section 3-2 (1) F).

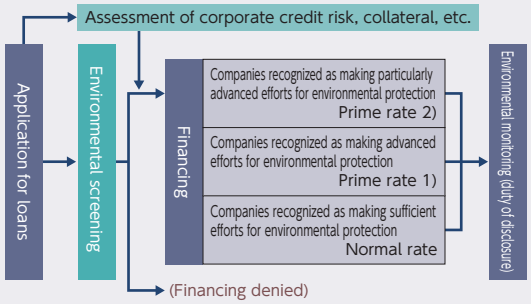
Environmental finance is operated through various instruments such as investment, loans, and insurance. In the field of indirect finance, which has much weight in Japan, financial institutions such as banks are making a variety of efforts in the environmental fields (Table 4-1-1). One such effort is the financing employing environmental ratings that the Development Bank of Japan provides following the guidelines of Ministry of the Environment (Figure 4-1-12). Even though corporate efforts for environmental conservation are considered socially desirable, the level of effort tends to remain low since they do not directly improve corporate earnings in many cases. Environmentally rated financing, on the other

Table 4-1-1 Environment-related Projects of Depository Financial Institutions

Deposits	Eco-deposits	"Donation-type"
		"Higher deposit interest rate type"
Finance	Personal loans	Financing for purchases of eco-cars, eco-residences, eco-reforms, etc.
	Corporate finance	Financing for environment-related facilities
		Financing for environmentally considerate companies (rated financing, etc.)
	Project finance	Financing for environmental businesses (renewable energies, etc.)
		Restrictions on project financing based on Equator Principles, etc.
Others	Business-matching	Individual handling, exhibit format, etc.

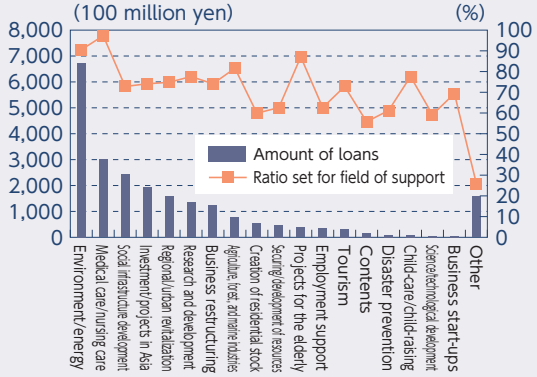
Source: Created by the Ministry of the Environment based on the Report "The New Role of Finance for a Low-Carbon Society," by the Expert Committee on Environment and Finance, General Policy Committee, Central Environment Council, the Ministry of the Environment

Figure 4-1-12 The Flow of Environmentally Rated Financing



Source: Ministry of the Environment

Figure 4-1-13 State of Financing by Field with Strengthened Growth Base



Source: Created by the Ministry of the Environment, using information from the Bank of Japan

Figure 4-1-14 Conceptual Diagram of Business-Matching

Source: Kinzai's "Course for Understanding Environmental Finance"

hand, takes the view that the reduction of environmental pollution risk do contribute to the company's management stability, and preferential loans are made on this basis. Regional financial institutions such as local banks are thought to seek regional development together with local businesses. Under the system of environmental rating finance, on the other hand, the customer, the financial institution, and the whole society that these actors exist should all become stakeholders, thereby raising the level of efforts made by companies contributing to sustainable development.

In order to promote financing employing environmental rating, since 2007, the Ministry of the Environment has been subsidizing for the financial institutions conducting environmental ratings if their loan customers pledge to reduce their carbon dioxide emissions. This contributed to the increase of environmental rating financing; and as of April 2011 there were 47 financial institutions employing environmental rating financing, a significant increase from 33 in the previous year.

The Bank of Japan also began a measure, "Fund-Provisioning Measure to Support Strengthening the Foundations for Economic Growth" in June 2010, with the objective of expanding the mid- and long-term path to growth in order to overcome deflation. This is a measure to provide low-interest funds to the financial institutions that have submitted policies for efforts in the 18 fields set forth in the New Growth Strategy, based on their track record of financing. The total amount of investments and loans from April through December 2010 shows that the amount of financing for environmental and energy fields was the highest, at 671.9 billion yen, amounting to nearly 30% of the total, reflecting substantial expectations of growth in this field (Figure 4-1-13). It is hoped that financial institutions will find new prospective projects, play the role of a "good judge" with their accumulated experience and provide funds for new technological development and new businesses, especially which may involve risks, in environmental and energy fields, thereby supporting development of businesses to be taken on by the next generation.

Banks and credit associations are also strengthening their roles of not only financing but also of information offering, through business-matching. When financial institutions build relationships with their client companies, there would be many opportunities for them to share not only financial issues but overall business-related issues. In such cases, they are often asked to provide advice. It is in those cases that they conduct business-matching that introduce partners for tasks such as sales and purchases, technological development, and consulting about taxes and operations (Figure 4-1-14). Such business-matching includes business negotiations in one-to-one meetings, or depending on the circumstances, collaborative match-making in exhibitions and exchanges conducted by multiple financial institutions. These companies would exchange information aimed at future transactions. Efforts are being made to increase the ratio of contracts signed and to improve the effects of matching, by narrowing the theme of such exchanges down, for example, to the environment. The Ministry of the Environment launched a campaign called "Challenge 25 Caravan across Japan," and in May and June of 2010 they held eco-business-matching events at 7 venues throughout the country with the cooperation of regional financial institutions.

For the future development of environmental finance, the previously mentioned report released by the Expert Committee on Environment and Finance included a proposal to develop a Japanese version of "Principles for Sustainable Finance Action" (tentative name) by a voluntary group of financial institutions. In August 2010, responding to a call made by Mr. Takejiro Sueyoshi (Special Advisor to the United Nations Environment Programme Finance Initiative) to create the Japanese version, a drafting committee was set up by voluntary financial institutions. During 2010 a number of discussions were held about the preamble and general introductory sections that would stipulate the concept of the action principles and the fundamental principles that

should be taken by individual financial institutions. Signing of the action principles is scheduled to begin in 2011 after formulation of guidelines for each type of business. It is anticipated that a wide variety of financial institutions of various sectors and scales will participate in these action principles and that they will serve as a base for discussion about environmental finance in Japan in the future.

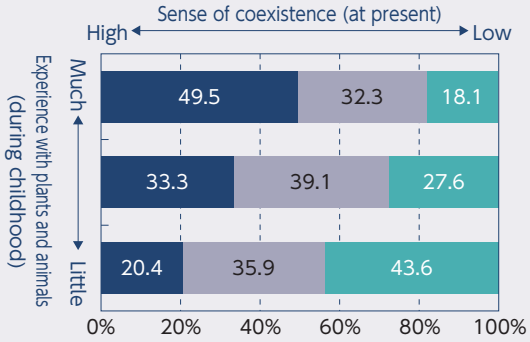
4. Education: the Foundation of the Wisdom that Contributes to Development of a Sustainable Society

(1) Development of People and Solution of Environmental Problems

From an international standard, Japan has fewer students pursuing doctoral programs than in other countries. There are 75,000 students pursuing doctoral programs in Japan, significantly less than the approximately 530,000 in the EU and the approximately 460,000 in the United States. However, in order to solve environmental problems it is necessary to have people with advanced expert knowledge and broad perspectives to conduct research and development, and disseminate new technologies aimed at creating a sustainable society. In addition, in order to achieve a green economy in a green society, including various sectors such as companies, government, and NGOs, it is also necessary to have "T-shaped" human resources that have a vertical axis of knowledge in specialized fields such as law, economics, or engineering, and a horizontal axis of cross-sector knowledge about the environment and sustainability, with a bird's-eye perspective.

Various efforts are being made to cultivate the "T-shaped" human resources in environmental fields in Japan. For example, in order to develop the environmental human resources envisioned in the "Vision for Environmental Leadership Initiatives for Asian Sustainability" the Ministry of the Environment has been supporting establishment in March 2011 of a consortium to develop environmental human resources by industry-academia-government collaboration including universities, corporations, NGOs. The consortium was established in March 2011, and the Ministry of the Environment is planning to collaborate with the consortium in the future. In addition, with the aim of creating a network of Asian graduate schools that are working to develop environmental human resources, the Ministry of the Environment collaborated with the United Nations University Institute of Advanced Studies and launched a network commonly known as ProSPER.NET in 2008. The purpose of this effort is to integrate education and research about sustainability in education and research at the graduate school level. As of March 2011, the members include 21 higher education institutions in Japan, China, South Korea, ASEAN countries, India, and Australia.

Figure 4-1-15 Relationship between "Experience with Plants and Animals" and "Sense of Coexistence"

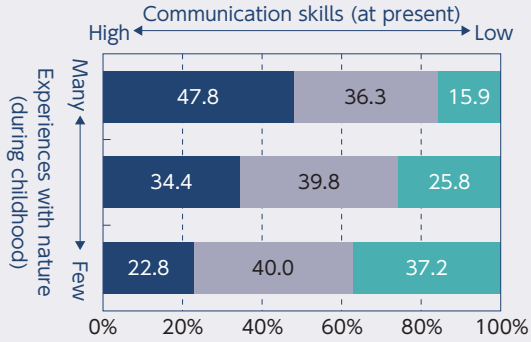


[Experience with plants and animals]
- Grew rice or vegetables
- Grew flowers
- Took care of a living thing such as a pet
- Caught insects such as butterflies, dragonflies, or locusts
- Watched wild birds or listened to their chirping

[Sense of coexistence]
- Likes to spend days off in natural environments
- Likes to visit places such as zoos and aquariums
- Feels bad listening to about people's unhappy experiences
- Feels happy when learning about a friend's very happy experience
- Worries about people who are ignored by others

Source: National Institution for Youth Education's "Research on the State of Youth Experiential Activities"

Figure 4-1-16 Relationship between "Experiences with Nature" and "Communication Skills"



[Experiences with nature]
- Caught shellfish or fish in the ocean or rivers
- Swam in the ocean or rivers
- Watched the sun rise or set
- Looked at a night sky full of glittering stars
- Drank water from a spring or river

[Communication skills]
- Can introduce oneself in front of people without feeling nervous
- Can get friends who have had a fight to make up
- Can greet people in the neighborhood
- Can talk with people soon after meeting them for the first time
- Frequently asked by friends for advice

Source: National Institution for Youth Education's "Research on the State of Youth Experiential Activities"

(2) The Importance of Environmental Education for Children, and Education for Sustainable Development (ESD)

In order to solve environmental problems, development of environmental technologies and cultivation of human resources with expert knowledge alone are not sufficient. It is also important that individual citizens understand environmental problems. The report "Research on the State of Youth Experiential Activities" (by the National Institution for Youth Education, 2010) studied the relationship between various experiences at each age from early childhood through the age of completion of compulsory education and the qualities and abilities gained through such experiences. The study found that adults who had the more "familiar with plants and animals" during childhood had more of a "sense of coexistence," or a likelihood to spend days off in natural environments. And the adults who had more "familiar with nature" such as swimming in the ocean or rivers during childhood tended to have more "communication skills" such as being able to introduce themselves in front of people without feeling nervous (Figures 4-1-15 and 4-1-16). As the results of this study show, it can be said that experiences during childhood have an influence on later life. In light of this, environmental education plays an important role in increasing individual citizens' understanding of environmental problems and working toward public awareness of environmental problems.

Environmental education and experiences during childhood are so important that the government has been making various efforts for environmental education. For example, in order to contribute to environmental education for children the Ministry of the Environment has been carrying out the following: 1) creation of an information database site that provides environmental education and learning materials from around the country, 2) the "*Kodomo Hotaranger* (kid ranger to protect Japanese fireflies)" program that encourages children's water environment conservation activities with the aim of protecting fireflies and activities the Minister of the Environment Prize, and 3) development and provision of nature experience programs to offer children opportunities to experience the duties of rangers for nature conservation and to learn about the importance of the natural environment. Further, since it is vital that individuals have thorough awareness of the importance of environmental conservation and take actions accordingly in order to truly solve environmental problems, it would be necessary to reorganize the measures and policies for environmental education, from philosophy to actual procedure of policy implementation, and examine methods of formulating measures and policies for future. These findings should be reflected in current measures and policies, with cooperation of key figures of related ministries and outside the Ministry of the Environment. For that reason, the Ministry of the Environment is collaborating with the Ministry of Education, Culture, Sports, Science and Technology to launch a "study team to examine future environmental education and public awareness" led by the parliamentary secretary of the Environment, and though this team it is working with key external experts to review the direction of environmental education and public awareness.

Through collaboration with NPOs and NGOs, the government is promoting education for sustainable development (ESD) in local regions. For example, in order to promote ESD, the Ministry of the Environment launched an ESD activity registration system (+ ESD Project) as a mechanism to introduce region-based ESD actions to the general public in Japan. This action is based on results of model studies, with the participation of a wide range of regional entities and the cooperation of related ministries and organizations.

Promotion of the development of human resources and ESD activities will also lead to promotion of a "new public" in which industry, government, academia, and the private sectors participate in activities such as education and child-rearing, town-development, crime and disaster prevention, medical care and social welfare, and consumer protection with a spirit of mutual assistance.

Column

Efforts of Local Public Organizations - Solar Cars and Elementary and Junior High School Students

In order to deal with environmental problems such as global warming, it is important to promote research and development and make efforts for environmental education. Local public organizations are also making efforts forward with various efforts based on this perspective.

One of these efforts is a "Solar Car Challenge Plan" that is being conducted in Tokyo's Koto Ward to tackle the Earth's environmental problems through production of solar cars mainly by elementary and junior high school students. This effort is being promoted based on a "proposed project" that is part of the "Tokyo Municipal Assistance System for Promoting Global Warming Countermeasures" which was created by the Tokyo Metropolitan Government in FY 2009. This project assists the proposals that are recognized as the most trailblazing and as having the highest spillover effects among all the efforts against global warming proposed by those within Tokyo's municipalities.

The "Solar Car Challenge Plan," which started in 2009, is a plan that aims for participation in the Suzuka Solar Car Race in 2011. It is carried out mainly by elementary and junior high school students from within the Koto ward, and it is being promoted with cooperation of universities and private businesses. In 2009 ten seminars and training sessions were held during summer vacation, and an exhibition was held to present completed solar cars and their planning processes. In 2010, Japanese universities and private companies conducted collaborative research, went to study the world's leading solar car that won a solar car race held in Australia, made an interim announcement of the plan, and proceeded with building car bodies. It is anticipated that such efforts by local municipalities that tie together environmental education for children and the application of science and technology will lead to a locally-based awareness and diffusion of environmental problems.

Collaborative work with Shibaura Institute of Technology

Source: College of Engineering Akatsu Laboratory, Shibaura Institute of Technology

Field Trip to Study the World's Leading Solar Cars

Source: Koto Ward, Tokyo

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.

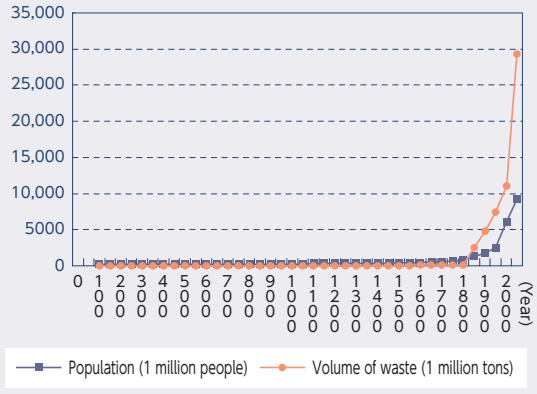
Since the Industrial Revolution, particularly in the 20th century, the flow of things has increased at all levels of socio-economic activities, such as resource extraction, production, distribution, consumption, and disposal, resulting in a mass-production, mass-consumption, and mass-waste socio-economic 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.

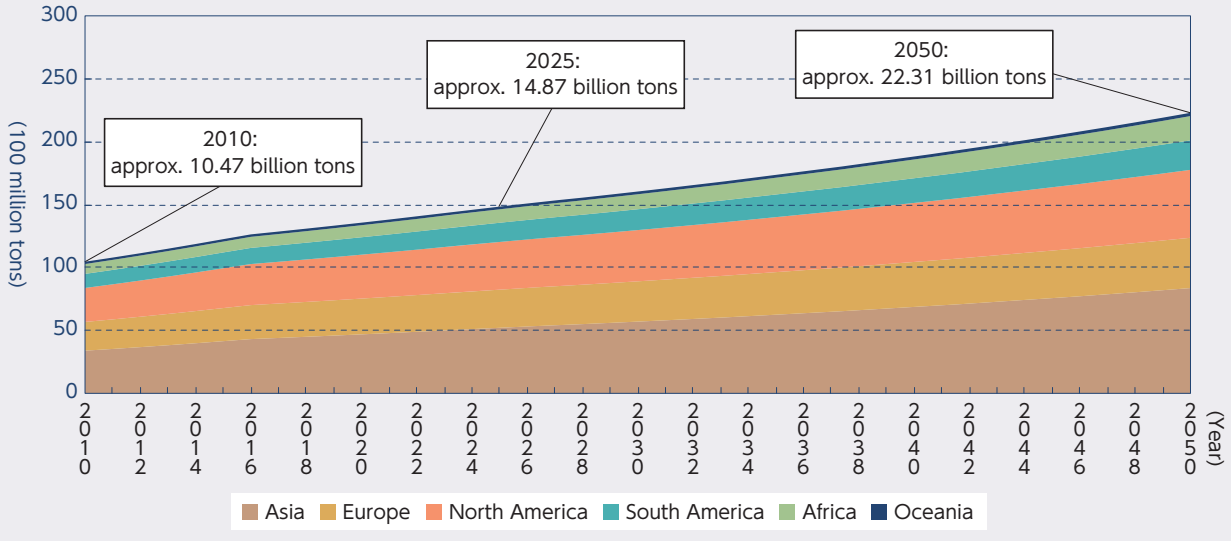
From the end of World War II until now, Japan has experienced a wide variety of waste problems due to changes in economic and social circumstances. (Figure 4-2-3). Japan has made efforts in the fields of waste and recycling to solve those problems. Japan's current measures are said to be a result of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



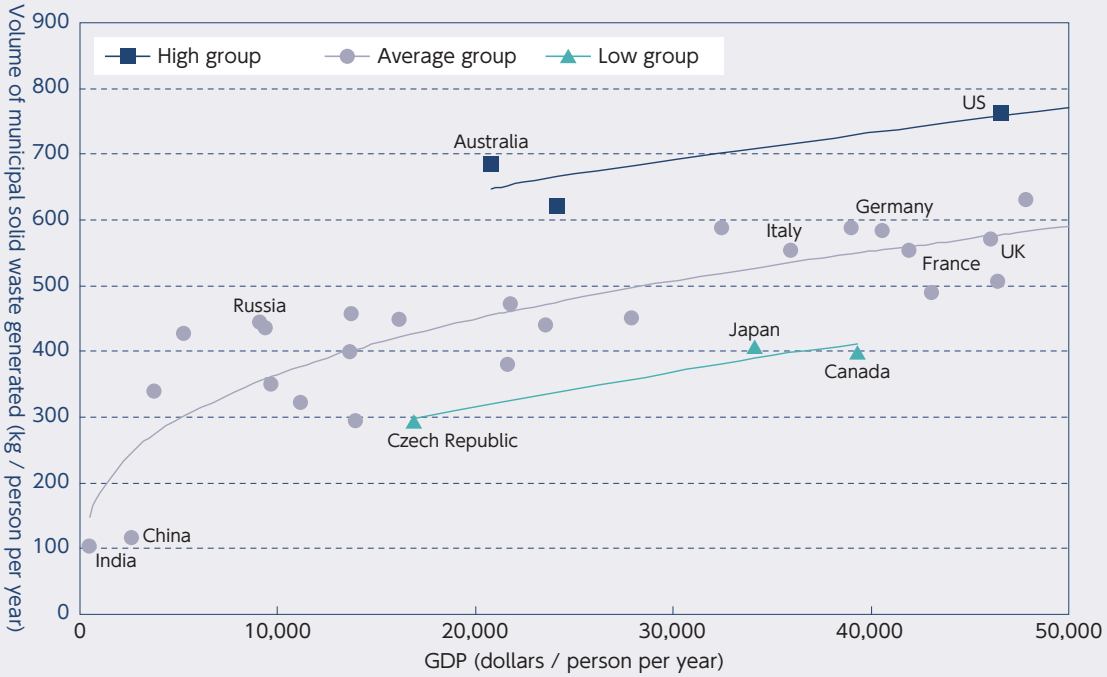
Source: Research on Estimation of Global Waste Generation and Future Projections (Masaru Tanaka (Research Institute of Solid Waste Management Engineering, 2011))

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

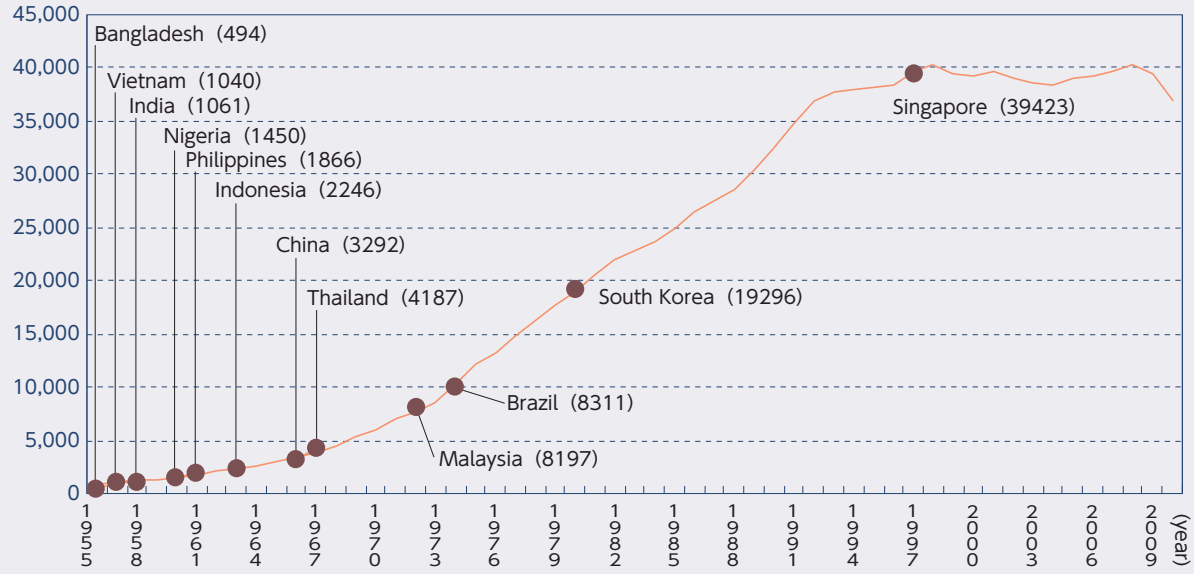
Throughout the world, demand for resources is increasing and the prices of oil, rare metals, and food have soared due to rapid growth in population and the rise of emerging countries. As mentioned earlier, waste is expected to increase from now on due to the rapid economic development of developing countries, 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

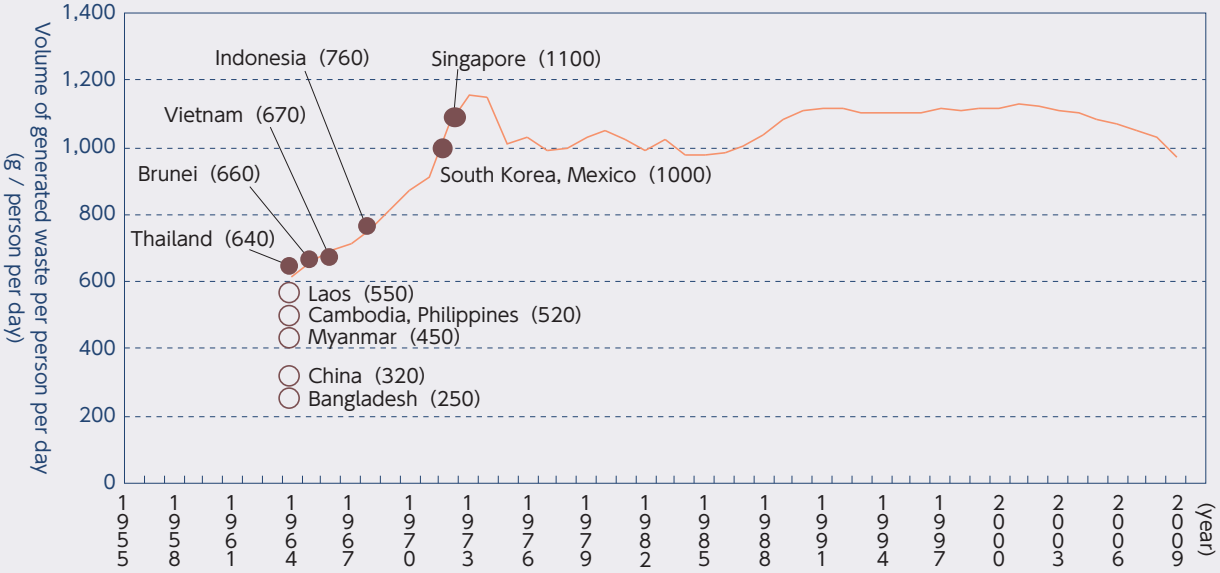
Figure 4-2-5 shows shifts in Japan's per-capita nominal GDP and comparisons with major countries in Asia and South America. After World War II, Japan achieved tremendous economic growth and its per-capita GDP became number three in the world in 1993 (in the most recent 2010 rankings, Japan is number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



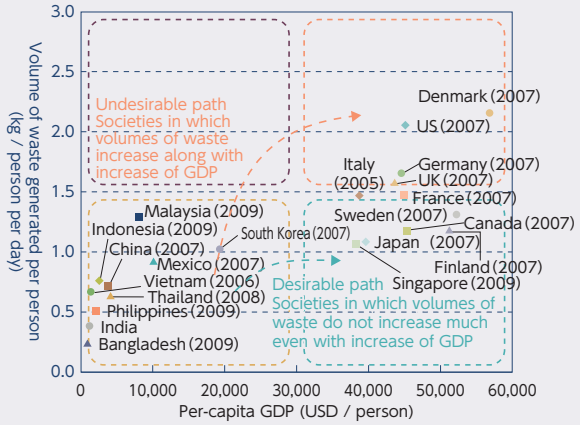
(Sources: Data for Japan are from the Ministry of the Environment. Data for other countries are from Municipal Solid Waste Management in Asia and the Pacific Islands (2010), OECD Environmental Data Compendium 2006-2008, and China Statistical Yearbooks 1996-2007.)

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.

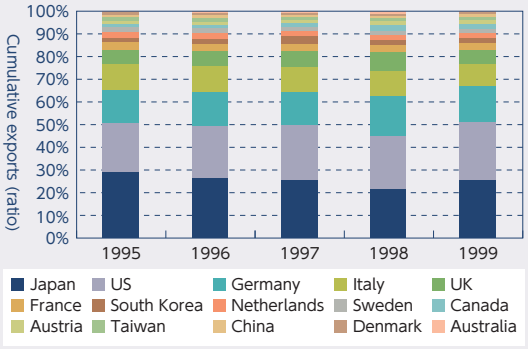
Industries in the fields of waste and recycling are called "venous industries." They are contrasted with "arterial industries," which collect and process resources to manufacture products and then sell them. Japan's venous industries will promote waste and recycling measures not only in Japan but also 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.

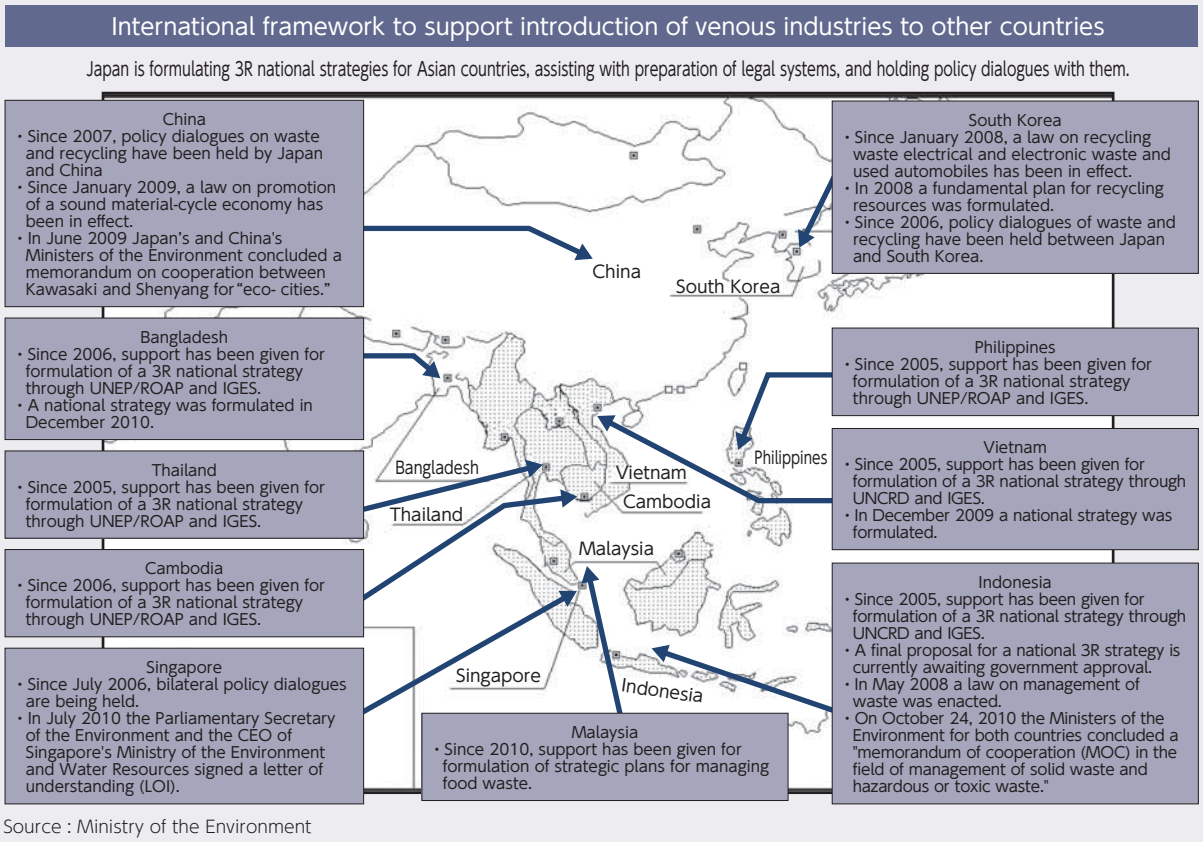
(2) International Framework for Supporting the Overseas Expansion of Venous Industries

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.

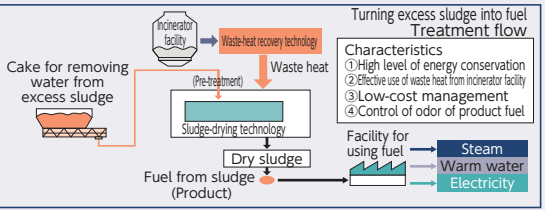
In light of the fact that "sludge treatment" was highlighted in the 12th five-year plan, as a waste treatment model project a plan was made to build a facility for treating sludge generated from facilities that treat polluted water. The material flow study found that in order to further promote proper 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)

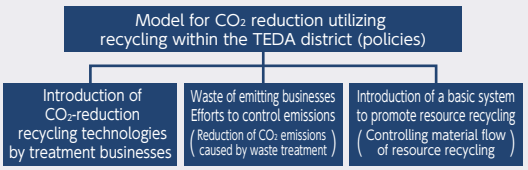
1 Creation of a pre-FS report for a model project (facility for managing hazardous waste, etc.)

- 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.

Section 3 Japan's Efforts for Realization of a Low-Carbon Society

1. International Actions and Japan's Response for Realization of a Low-Carbon Society

(1) The 16th Session of Conference of the Parties of the United Nations Framework Convention on Climate Change Conference (COP16) and Japan's Response

A. Background of International Negotiations on Climate Change

The Kyoto Protocol was an agreement adopted at the 3rd session of the Conference of the Parties (COP3) of the United Nations Framework Convention on Climate Change (UNFCCC) in 1997 based on the UNFCCC. The Kyoto Protocol set binding numerical targets for CO_2 emissions reduction for developed countries to embark on as part of international efforts during the first commitment period (2008-2012). It also served as an indicator that such international efforts should be made by developed countries first. However, the United States did not ratify the Kyoto Protocol, and developing countries are not subject to the reduction targets. As a result, the total emissions of those countries that committed to reduction represented only 27% of total global CO_2 emissions from energy sources as of 2008. Global CO_2 emissions are predicted to keep increasing as the economic expansion of developing countries with no reduction commitment progresses. Therefore, in order to reduce CO_2 emissions effectively in the future, the measures against climate change should be worked on by the entire world, including the United States, which has yet to ratify the Kyoto Protocol, and emerging countries such as China whose energy consumption is expected to increase.

In continuation of international negotiations for a framework for reducing greenhouse gas emissions after the Kyoto Protocol's first emissions budget period (post-2012 framework), COP13 was held in Bali, Indonesia, in December 2007, and the Bali Action Plan was adopted. At the same time, the decision was made to finalize the post-2012 framework by COP15 in 2009 with the participation of all the parties to UNFCCC. Based on the decision, at COP15 held in Copenhagen, Denmark, in December 2009, Japan put its fullest efforts into negotiations for establishing a fair and effective framework with the participation of all major economies including the United States and China. As a result, COP15 put together the Copenhagen Accord and decided "the Conference of the Parties takes note of the Copenhagen Accord." However, the Copenhagen Accord was not officially decided during the COP due to opposition by some countries. The Copenhagen Accord stipulated that Annex I Parties (developed countries) submit their 2020 reduction targets and non-Annex I Parties (developing countries) submit their mitigation actions plan to the Secretariat by 31 January, 2010, which many of the parties followed accordingly.

B. Outcomes of COP16, and Japan's Efforts

The Working Groups set up under the COP continued international negotiations for a framework for 2013 and beyond for the COP16, which took place in Cancun, Mexico, from the end of November to December 2010.

In the COP15, there were two working groups that met in parallel. The first was the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA) that discussed the main elements that compose a comprehensive framework including the United States and developing countries (targets and actions for emissions reductions by developed and developing countries, adaptation measures, support for developing countries through finance and technology). The second was the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) that discussed the setting of the second commitment period under the Kyoto Protocol. Developed and developing countries confronted each other since developed countries particularly wished to proceed with discussions on the AWG-LCA while developing countries claimed that developed countries should establish the second commitment period.

Under these negotiations, Japan asserted that it was essential to urgently establish a single, truly fair and effective legally-binding international framework with the participation of all major economies including the United States and China in order to reduce global emissions, based on the Copenhagen Accord, and contributed actively to discussions regarding targets and actions for emissions reductions and measures to support developing countries.

Japan also asserted regarding the Kyoto Protocol as follows:

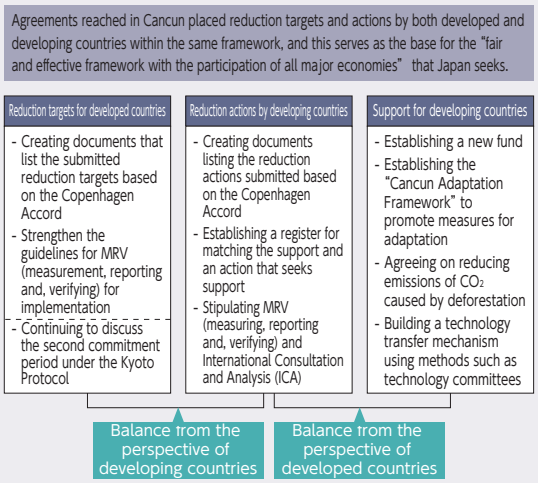
- The Kyoto Protocol was a groundbreaking international convention that imposes an obligation to reduce greenhouse gases during the period between 2008 and 2012 on developed countries.
- The energy-derived CO_2 emissions of the Parties currently obligated under the Protocol represented only 27% of total global emissions as of 2008. Meanwhile, the combined total emissions of the United States, which had not ratified the Protocol, and of China, which had ratified the protocol but did not have any obligations to reduce emissions, had increased from approximately 34% in 1990 to approximately 41% of the world total as of 2008.
- Under these circumstances, the current framework which imposes a reduction commitment under the Kyoto Protocol on a few countries only, including Japan, in 2013 and beyond will not lead to a true global reduction of emissions.

In October 2010, Japan hosted a "Ministerial Meeting of the REDD+Partnership (REDD+Ministerial Meeting)" in Nagoya, Aichi, and contributed to the promotion of efforts

Photograph 4-3-1 The Minister of the Environment, Matsumoto, speaking at the COP16

Source: Ministry of the Environment

Figure 4-3-1 Decisions Agreed upon in Cancun



Source: Ministry of the Environment

that led to actual reduction of emissions in developing countries while participating in international negotiations.

The COP16 took place in Cancun, Mexico, from the end of November to December 2010, and here the conflicts between developed and developing countries continued.

In particular, Japan's statement in the AWG-KP at the beginning of the COP16 that it was opposed to setting the second commitment period under the Kyoto Protocol invited harsh criticism from developing countries. These countries were concerned that parties should not undermine the Kyoto Protocol, which was currently the only legally-binding agreement.

Under these circumstances, the Minister of the Environment, Matsumoto, arrived in Cancun, Mexico, on December 5, 2010, in the second week of negotiations. At bilateral meetings with individual countries and at the official high-level segment held on December 9, he patiently asserted that Japan would fulfill its obligation in the first commitment period and would never disregard the Kyoto Protocol. He also claimed that it was necessary to quickly establish a truly fair, effective single and legally-binding framework with the participation of all major countries including the United States and China, rather than establishing a second commitment period under the Kyoto Protocol which would impose emissions reductions on only a few countries (Photograph 4-3-1).

Mexico's Foreign Secretary Espinosa, as a chairperson of COP16, led the negotiations with the utmost care in order to maintain the transparency of the conference proceedings in order to avoid criticism such as had been made by some Parties in COP15. At the Ministerial meetings held during the second week of negotiations, she continued to manage transparent proceedings in a consistent manner through topic-based discussions with no restriction for attendees.

These approaches by Japan and efforts by host country Mexico helped the draft decisions by Espinosa to be finally adopted as the Cancun Agreement on the last day of the conference and led to the agreement on addressing emission reduction in both developed and developing countries and to the introduction of a mechanism which verified the effects of emissions reductions internationally. It was an important milestone to establish the international framework that Japan sought (Figure 4-3-1).

Significant progress was also made for supporting developing countries, such as adaptation, finance, and technology transfers.

The COP17 is scheduled to take place in Durban, South Africa from the end of November through December 2011. Japan will actively continue to energetically engage in dialogues with countries, and contribute to progress in negotiations in order to achieve its ultimate goal of establishing a truly fair and effective, legally-binding framework with the participation of all major countries, including the United States and China.

(2) Japan's International Cooperation in Asia toward a Low-Carbon Society

Motorization is increasingly widespread in the Asian regions due to rapid economic development and urbanization, and it is necessary to immediately take effective countermeasures against the various transportation and environmental issues that occurred as a result. The UNCRD (United Nations Center for Regional Development) and Japan jointly established the "Regional Environmentally Sustainable Transport (EST) Forum in Asia" in 2005, considering the specific characteristics of the Asian regions. Japan has been actively contributing to the realization of environmentally sustainable transport in the Asian regions through policy dialogues among participating countries.

The Regional EST Forum in Asia was started in Nagoya, Japan, in 2005, and up to today, the forum has been held five times. At the "Fifth Regional EST Forum in Asia" in Bangkok, Thailand, in August 2010, about 200 participants including senior government officials (mostly from environmental and transport ministries) from twenty-two Asian countries, representatives from international organizations, and academic experts attended the Forum (Photograph 4-3-2). Achievements at the Fifth Forum include the adoption of "Bangkok Declaration for 2020," which provides guidelines for sustainable transport in the Asian regions in the coming decade.

In 2010 the Ninth ASEAN Plus Three Environment Ministers Meeting and the Second East Asia Summit (EAS) Environment Ministers Meeting were held in

Brunei. At the Ninth ASEAN Plus Three Environment Ministers Meeting, countries reported the cooperation of ASEAN and Japan, China, and South Korea. Countries also conducted exchanges of opinions about the ASEAN Plus Three Youth Environment Forum, the results of projects for environmentally sustainable urbanization in ASEAN countries, and plans for the future. At the Second East Asia Summit (EAS) Environment Ministers Meeting, Japan released the outcomes of the First High Level Seminar on Environmentally Sustainable Cities (ESC) that was held in March 2010 in Indonesia on Japan's initiative, and proposed the plan of the Second Seminar in Kita Kyushu City, which drew the interest of many countries. Japan also proposed a new partnership to promote environmentally sustainable cities, in which countries and international organizations would participate, and a number of countries agreed to that proposal. Japan also introduced its efforts for environmental cooperation with each of the EAS countries for promoting EST and the co-benefit approach, for which the countries expressed their appreciation.

Photograph 4-3-2 Fifth Regional EST Forum in Asia

Source : Ministry of the Environment

2. Japan's Domestic and International Efforts towards a Low-Carbon Society

(1) Various Policies Initiated by the National Government

As discussed above, the mitigation of and adaptation to climate change are the issues that all humankind faces in common, and it is critical to address climate change under a fair and effective international framework in which all major economies participate, including the United States and China. In order to bring about a society that emits CO_2 as little as possible, it is necessary to proceed with global warming countermeasures while securing economic growth, stable employment, and a stable supply of energy. For this purpose, Japan's government submitted a Bill of the Basic Act on Global Warming Countermeasures to the Diet.

The Global Warming Countermeasures include: 1) Taxation system for Global Warming Countermeasures aimed at the Greening of the tax system, imposing an additional tax rate on the current Petroleum and Coal Tax (the tax on whole fossil fuels) based on CO_2 emissions, 2) a feed-in tariff system, which obligates electricity companies to purchase electricity derived from renewable energy at a certain price for a certain period under certain conditions, and 3) the domestic emissions trading system that sets limits of emission for a certain period and allows trading of CO_2 emissions with other emitters in order to comply with the limits (hereinafter referred to as the "3 main policies against global warming"). In December 2010, the Ministerial Committee on Climate Change stipulated government directions for future development of the 3 main policies. Also, other actions have already been started for the promotion of energy saving in our daily lives, creation of regional communities aimed at a low-carbon society, and the development of innovative technologies.

Here we will introduce the systems that are already in operation or are currently underway for implementation, such as the greening of the tax system and the eco-point systems for home appliances.

A. Greening of the Tax System

Building a low-carbon society in order to reduce the emissions of greenhouse gases has become a worldwide trend. Starting from the 1990s onward, countries, particularly in Europe, have been reviewing and strengthening their environment-related tax systems (Table 4-3-1). Early introduction of taxation to counter global warming is necessary not only to alleviate the burden on future generations, but also to lead the world in establishing a low carbon society and to facilitate the development of environment-related industries by promoting Green Innovation. This type of development will contribute to Japan's growth and position as "a leading country in the field of environment and energy" in the long run.

Japan has been studying environment tax systems since 2004, and the FY 2010 Tax Reform Outline (Cabinet Decision of December 2009) recommended that further reviews should be carried out to work out a definite plan for implementation in FY 2011. After further discussion in the Tax Commission, the FY 2011 Tax Reform Outline (Cabinet Decision of December 2010) recommended the introduction of the "Carbon Dioxide Tax of Global Warming Countermeasure" in FY 2011 in order to strengthen global warming measures through tax incentives and also to enhance various measures to reduce CO_2 emissions from energy use (Figure 4-3-2). Specifically, it is to introduce the "Special Provision on Taxation for Global Warming Countermeasures," that is to impose additional tax rates on the current Petroleum and Coal Tax (of which the tax base is whole fossil fuels) based on the CO_2 emission volume of each fossil fuel categories (Figure 4-3-3). The Tax Reform Bill submitted to the Diet stipulated that this special provision should be implemented as of October 1, 2011, with an interim tax rate set for a period of three-and-a-half years (Table 4-3-2) and tax exemptions/tax refunds in some fields if necessary. It also stipulated that various measures to facilitate its introduction should be carried out.

The "Carbon Dioxide Tax of Global Warming Countermeasure" is to impose a tax to all fossil fuels based on CO_2 emissions upstream, and then to reflect that additional taxation on prices at the downstream. In this way, the cost of environmental load can be reflected in the prices of various goods and services. It is anticipated

Table 4-3-1 Key Tax Reforms Related to Climate Change Policy in Other Countries

Increased awareness of environmental issues since the 1980s, international negotiations on the Framework Convention on Climate Change (from 1990), etc.		
1990	Finland	So-called carbon tax (additional duty) introduced
1991	Sweden	CO_2 tax introduced
	Norway	CO_2 tax introduced
1992 Framework Convention on Climate Change adopted (took effect in March, 1994), Earth Summit held in June (Rio de Janeiro)		
1992	Denmark	CO_2 tax introduced
	Netherlands	General fuel tax introduced
1993	UK	Hydrocarbon oil duty raised in phases (until 1999)
1996	Netherlands	Regulatory energy tax introduced
1997 Kyoto Protocol adopted (took effect in February 2005)		
1999	Germany	Mineral oil tax raised in phases (until 2003), electricity tax introduced
	Italy	Excises on mineral oils revised (raised in phases until 2005, and coal and others added)
2001	UK	Climate change levy introduced
	Germany	Fixed-price purchase system (FIT) started under the Renewable Energy Act
Reference: 2003 "EC Directive on the Community framework for the taxation of energy products and electricity" (Took effect in January 2004): Member states set tax rates in excess of the minimum rate for energy products and electricity		
2004	Netherlands	General fuel tax integrated with the existing energy taxation (Fuel tax continues on coal (Tax on coal)). Regulatory energy tax restructured into energy tax
2005	EU	EU Emissions Trading System (EU-ETS) started
2006	Germany	Excises on mineral oils restructured into energy tax (coal included)
2007	France	Coal tax introduced
2008	Switzerland	CO_2 levy introduced

Source: Data from relevant governments and OECD

Figure 4-3-2 FY 2011 Tax Reform Outline (Main Points)

Chapter 2: FY 2011 Approach for Major Tax Issues
6. Environmental-Taxation
(1) Introduction of "Carbon Dioxide Tax of Global Warming Countermeasure"

"Japan will also introduce "Carbon Dioxide Tax of Global Warming Countermeasure" in FY 2011 in terms of strengthening measures against global warming through tax incentive, and enhancing various measures to reduce energy-originated CO_2 emission.

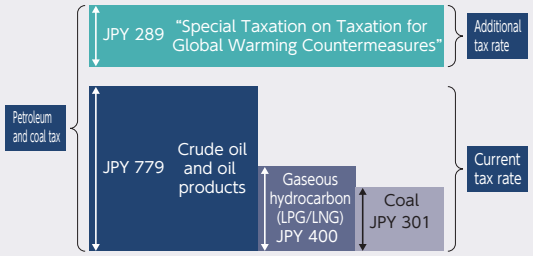
Concretely, "Special Provision on Taxation for Global Warming Countermeasure" shall be established that imposes additional tax rate on current Petroleum and Coal Tax (the tax on whole fossil fuels such as crude oil, petroleum products, gaseous hydrocarbons, and coal), based on CO_2 emission volume of each fossil fuel categories, in order to reduce energy-originated CO_2 emission in wide range of fields.

The additional tax rate by this special provision is JPY 760 per kilo liter for crude oil and petroleum products, JPY 780 per ton for gaseous hydrocarbons, and JPY 670 per ton for coal.

This "broad and light" tax imposition shall avoid tax overload to the specific areas/industries and secure fairness of taxation. Moreover, in introduction, tax rate will be increased gradually to prevent sharp increase of burden, and tax exemptions and tax refunds shall be taken in certain necessary areas. In addition, various support measures shall be implemented, such as measures to cut costs for fuel production and distribution, stabilization of fuel supply, policies to save energy for logistics and transport, and to support the under-populated or cold areas."

Sources: Created by the Ministry of the Environment, using information from the "FY 2011 Tax Reform Outline"

Figure 4-3-3 Tax Rates Per Ton of CO_2 Emissions under the "Special Taxation for Global Warming Countermeasures" (In the Case of Interim Measures of 3 1/2 Years)



Source: The 23rd Tax Commission of FY 2010

Table 4-3-2 Tax Rates under the "Special Provision of Taxation for Global Warming Countermeasures"

Object to be taxed	Current tax rate	October 2011-March 2013	April 2013-March 2015	April 2015-
Crude oil/Oil products (per 1kl)	(JPY 2,040)	+ JPY 250 (JPY 2,290)	+ JPY 250 (JPY 2,540)	+ JPY 260 (JPY 2,800)
Gaseous hydrocarbon (per 1ton)	(JPY 1,080)	+ JPY 260 (JPY 1,340)	+ JPY 260 (JPY 1,600)	+ JPY 260 (JPY 1,860)
Coal (per 1ton)	(JPY 700)	+ JPY 220 (JPY 920)	+ JPY 220 (JPY 1,140)	+ JPY 230 (JPY 1,370)

Note: ( ) indicate the tax rate for petroleum and coal tax.
Source: Created by the Ministry of the Environment, from the "FY 2011 Tax reform Outline"

that adding such economic incentives (motives) would lead to a shift toward low-carbon economic activities in a wide range of fields, such as the industrial, the residential / commercial, and the transport sector, and would help control CO_2 emissions from energy use.

With this tax rate, the increase of residential expenses is estimated to be approximately 100 yen per month. This estimation is premised on the assumption that the types and volumes of goods and services consumed by households do not change. However, it is possible to reduce consumption of gasoline, electricity, and gas through eco-driving techniques such as idling stop, and power-saving and water-saving at home. Thus taxation, an economic incentive, is expected to be an effective global warming measure that changes the lifestyles of people and corporate activities to low-carbon oriented ones, and the additional burden on household expenses is expected to be less than the estimate.

At the same time, in order to reduce emissions of greenhouse gases in the mid- and long-term, it is necessary to make large-scale investments aimed at reducing carbon in industrial, household/commercial, transport, and other sectors. Taxes for global warming measures would affect a wide range of economic activities through the price effects mentioned above, and tax revenue secured through taxation can be utilized for various global warming measures effectively, making it possible to expect double effects for controlling CO_2 emissions.

In addition, the introduction of taxes to counter global warming can make individual citizens understand the necessity of global warming measures and the direction of the tax burden; and as a result, such heightened awareness can further advance global warming measures by the society as a whole. Taxation policy with this kind of forward-looking influence can be said to be an epochal policy that goes much further than its direct effects in Japan's global warming measures.

Also, we should think beyond the three main policies to solve the problem of global warming, i.e., taxation of global warming measures, a feed-in tariff system for renewable energy, and global warming measures in a domestic emissions trading system. It is necessary to organically connect various types of policies and implement them for global warming measures.

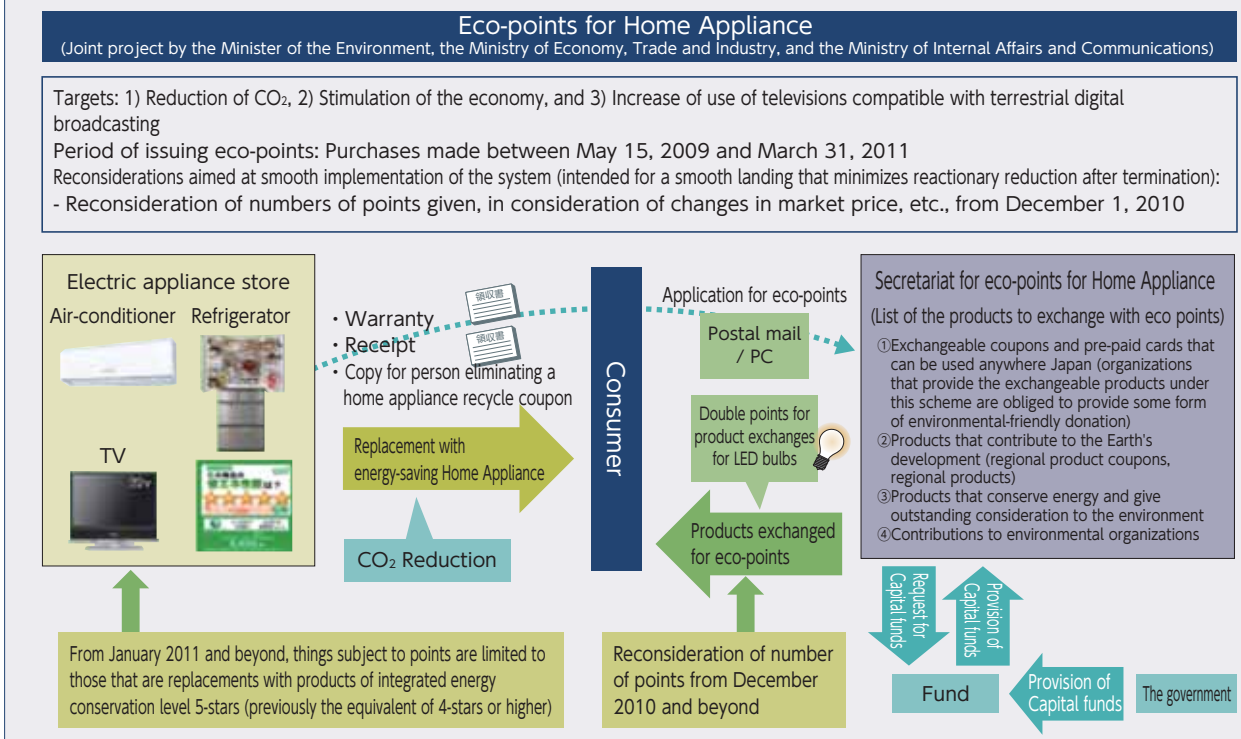
The FY 2011 Tax Reform Outline also includes the following tax system measures as well: the extension of special measures for energy-saving home renovations and fuel-supply facilities for low emission vehicles, and the establishment of a tax system to promote environment-related investment (green investment tax cuts). This tax system enables a special write-off of 30% (small- and mid-size companies can choose either this or 7% tax deduction) for businesses that purchase facilities (that contribute greatly to CO_2 emissions reduction from energy use and expand the introduction of renewable energies) and use the facilities within one year for their domestic business activities. These measures will further encourage industrial, household/commercial, and transport sectors to reduce CO_2 emissions. In addition, Japan's government will continue their review this year of international collaborative taxes to counter globally important issues, such as poverty and environmental problems, using a "List of Points of Contention on International Taxation" drawn up in November 2010 an expert panel of the government's Tax Commission.

B. Eco-Point Systems for Home Appliances and Residences

The eco-point system for home appliances is a system by which people can obtain eco-points that are exchangeable for goods, by purchasing energy-saving, green home appliances (Figure 4-3-4). The purposes of the system are to implement a global warming countermeasure, stimulate the economy, and promote the use of televisions that are compatible with terrestrial digital broadcasts, and it was applied to the products purchased between May 15, 2009 and March 31, 2011. Because home appliances such as refrigerators and televisions would emit more CO_2 when they are used than when they are manufactured, introducing this type of system and promoting highly energy-saving products can lead to the establishment of a low-carbon society.

It is clear that the implementation of the eco-point system for home appliances steadily encouraged consumers to purchase energy-saving products. From September 2009 onward, the program has accepted more than 1 million applications for eco-points for home appliances

Figure 4-3-4 Eco-Point System for Home Appliance



Source: Ministry of the Environment

every month (Figure 4-3-5). In addition, the ratio of units bearing the Uniform Energy-Saving Level 4 or higher of the total shipments of air-conditioners, refrigerators, and TVs increased after the system began, and the average ratio in the period of April -December 2010 was approximately 96% for air-conditioners, 98% for refrigerators, and 99% for TVs, which thus shows that most private individuals purchased energy-saving home appliances.

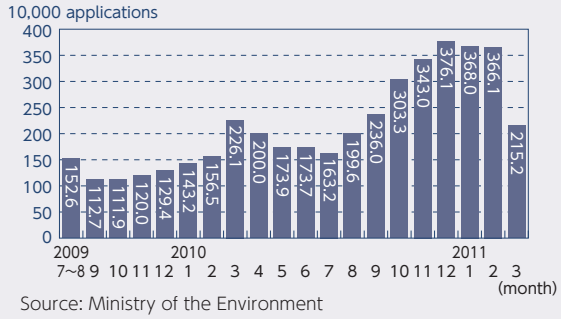
The eco-points system for home appliances had a positive impact on the economy. According to the estimates by private-sector research companies, the size of Japan's domestic retail market for home appliances in 2010 was approximately JPY 9.5 trillion, growing by approximately 1 trillion yen from the previous year, due to factors such as the eco-point system for home appliances and the extreme summer heat. Despite a decline in domestic demand, the eco-point system for home appliances also provided a meaningful economic boost in this time of recession.

Thus the eco-point system achieved success in both the greening of the home appliances (e.g. TVs) market and the stimulation of domestic demand, by delivering positive impacts on environmental consumer activities.

The eco-point system for housing is similar to the one for home appliances. The objectives of the eco-point system for housing are to promote global warming countermeasures and revitalize the economy. Under this system, users can receive points for the construction of an "eco-house" or for doing a renovation with energy-saving features, and can exchange those points for various products or for additional renovations (Figure 4-3-6).

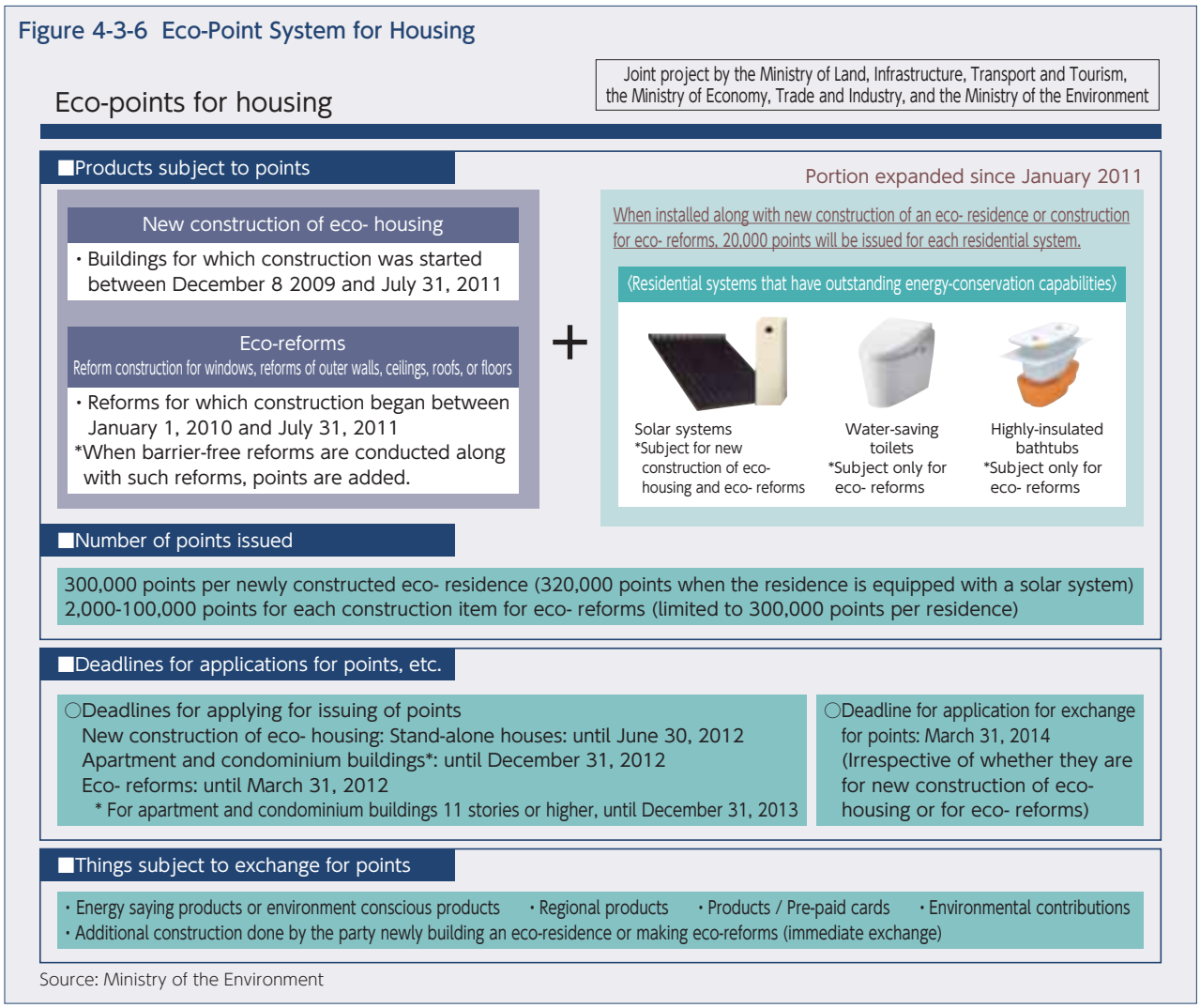
As a result of the introduction of this system, energy-saving eco-houses are increasingly widespread. Since the system started, the total number of renovations and new construction combined increased from approximately 3,000 in March 2010 to approximately 75,000 in March 2011. As time passes, more and more people are recognizing and utilizing of the advantages of the eco-point system for housing (Figure 4-3-7). Since the eco-point system for housing started, shipment of double pane windows and special glass for renovation, which are eligible for eco-points, has increased by two to three

Figure 4-3-5 Number of Applications for Eco-Points for Home appliances Received (applications by individuals / per month)



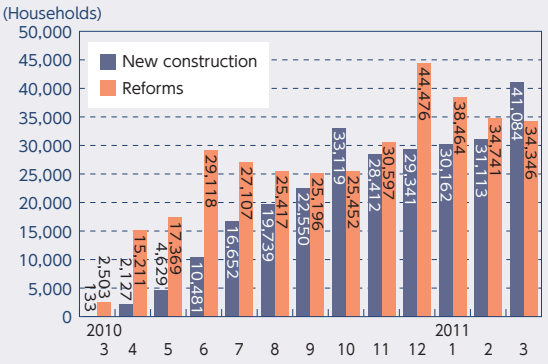
Source: Ministry of the Environment

Figure 4-3-6 Eco-Point System for Housing



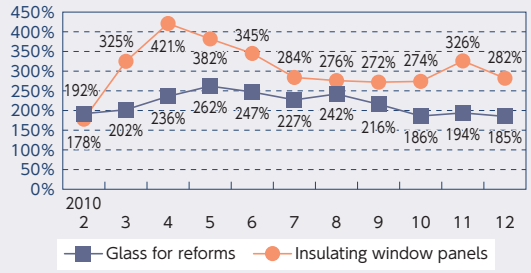
Source: Ministry of the Environment

Figure 4-3-7 Number of Residences Applying for Eco-Points for Housing



Source: Ministry of the Environment

Figure 4-3-8 Shifts in Shipment Volumes of Insulating Window Panels and Glass for Reforms (compared with the same month of the previous year; estimates)



Notes: 1: Shipment volumes for each month of the current fiscal year if the shipment volumes for the same month of the previous fiscal year were set as "100%" (100% is indicated if it was the same shipment volume as that of the previous fiscal year.)
2: Shipment volumes are Ministry of Economy, Trade and Industry estimates based on answers by manufacturers.
3: Insulating window panels are in units of number of panels, and glass for reforms is in units of square meters.
4: There may be changes in calculation values due to recalculation, etc.
Source: Ministry of Economy, Trade and Industry

times in comparison with the same months of the previous year (Figure 4-3-8). Global warming countermeasures in the private sector are an issue that the residential sector should work on, and the government can actively encourage energy-saving in terms of housing, which will create an environmental effect that contributes to the establishment of a low-carbon society, and an economic effect that will stimulate new demand in the domestic market.

C. Eco-Action Points System.

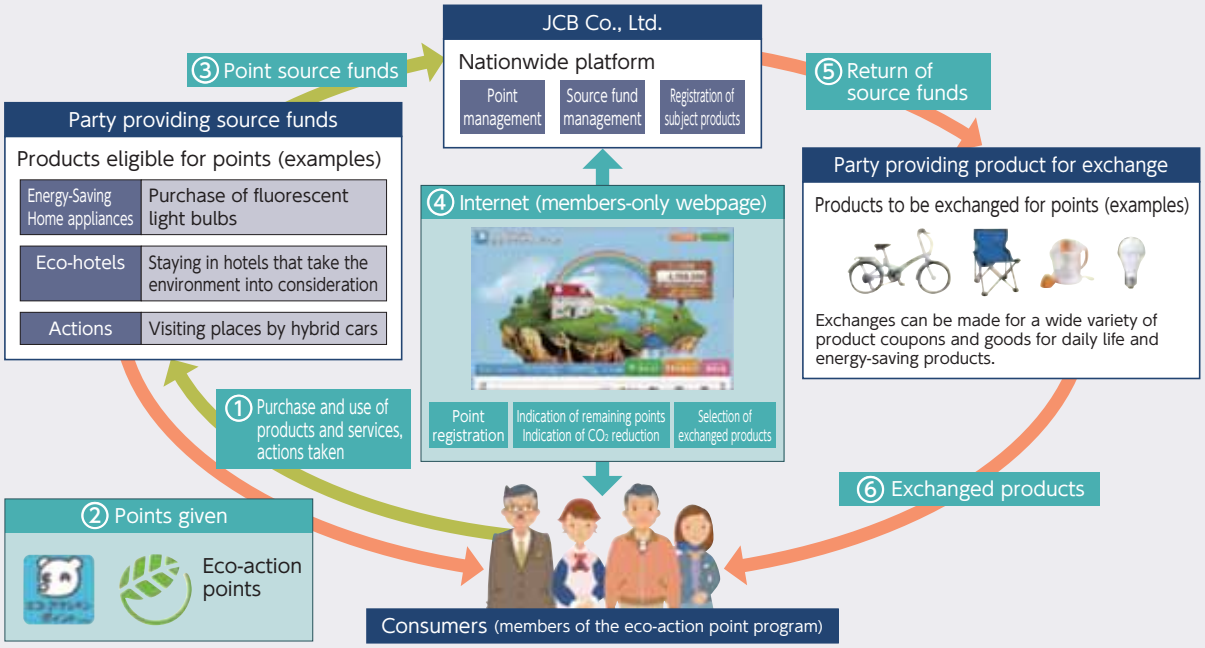
In addition to the eco-point systems discussed above, there is also a system called the Eco Action Point system, which allows participants to purchase environmental products and services or perform environmental conservation activities (eco-actions), and earn the points that they can exchange for various products (Figure 4-3-9). The eco-action points program was launched in FY 2008 as a silver bullet for the global warming countermeasures through citizen participation. In order to ensure that the program is operated in long term, the funds for eco-action points are supported by the expenditure of the program sponsor companies, not by government expenditure. Another characteristic is that a wide variety of products and services are eligible for eco-action points. In FY 2010 a nationwide framework was established so that corporations of all business types and categories could participate, promoting the program for more consumer participation and more sponsor companies and expansion of operations.

In addition to the eco-points system for home appliances, the eco action point system helped the idea of the "eco point" widely spread throughout the society in the form of economic incentives, as well as promoting the advantages of pro-environmental actions. In the future it will be important to develop a society in which all citizens will choose to engage in eco-actions.

D. Environmental Labels

In general, environmental labels refer to a scheme to

Figure 4-3-9 Eco-Action Point Mechanism



Source: Ministry of the Environment

advise the purchaser of the environmental characteristics of the products and services through symbols, graphics or diagrams presented on the products or the wrappings. In order to promote green purchasing, it is necessary to inform the consumers how products and services meet the environmental criteria in an appropriate and comprehensive manner. Environmental labels therefore play an important role in the efforts to change the consumer activities of all citizens to pro-environmental.

As for environmental labeling, international organizations and regulators are establishing principles in order to ensure that environmental labels provide information appropriately. The International Organization for Standardization (ISO) issued the "Environmental Label and Declaration" as an international standard for environmental labeling, and stipulated the definitions and requirements for three types of labeling schemes: Type I, Type II, and Type III, and stipulated each of their definitions and requirements (Figure 4-3-3). In addition, there are also environmental labels based on the laws (e.g. Energy-Saving Labeling system, Uniform Energy-Saving Label system, the fuel economy public disclosure and vehicle labeling system) and environmental labels based on the accreditation systems of local governments.

The environmental labeling system based on laws in Japan is the system of Uniform Energy-Saving Labeling. The Uniform Energy-Saving Labeling programme was launched in 2006, based on the Act on the Rational Use of Energy (Act No. 49 of 1979). The Act stipulated that the retailers conduct the public disclosure of energy efficiency information for their products, and the labeling was applied to three designated electric home appliances: air-conditioners, TV sets, and electric refrigerators. Later, the labeling was applied to more products, and as of April 2010, labeling is applied to air conditioners, TVs, electric refrigerators, electric toilet seats and (residential) florescent lights. Because those products consume large volumes of energy and the energy-saving capabilities vary from product to product, it is stipulated that they must be labeled by a Uniform energy-saving label (Figure 4-3-10). Such labeling provides easy-to-understand information to the citizens, and contributes to the selection of environmental products. The environmental labeling will lead to contributions to establishing a sustainable society by shifting demand toward environmental goods.

E. Environmental Management Systems

Activities of the organizations and businesses voluntarily working on environmental conservation, setting their own policies and targets in their operations and management and making efforts towards those policies and targets are referred to as "environmental management", and the systems for promoting environmental management within factories and offices are referred to as "environmental management systems." Environmental management is an effective technique for making business activities more environmentally conscious, and it is expected that a wide range of organizations and businesses will actively adopt and work on environmental management.

Japan has a government-stipulated environmental management system called Eco Action 21. The Ministry of the Environment has been developing the Eco Action 21 Program since 1996 in order to provide a wide range of small - and mid - size commercial businesses with easy methods of awareness-raising regarding their relation to the environment, establishing environmental targets, and voluntarily taking environmental targets, and to take voluntary environmental actions." The Ministry of the Environment has continued to promote the program up to the present day.

Eco Action 21 is a program that consolidates envi-

Table 4-3-3 "Environmental Labels and Declarations," standardized by the International Organization for Standardization (ISO)

Relevant ISO standards (year adopted) and names		Feature	Description
ISO 14020 : 1998 Environmental labels and declarations General principles		Principles of guidance	・Required to be used with other applicable standards (Type I, II, III) in the ISO 14020 series ・Not intended to be used for certification or registration purposes Notes: ISO 14020: 1998 was established in 1999 as JIS Q 14020. ISO 14020: 1998 was revised slightly in 2000.
Type I	ISO 14024 : 1999 Environmental labels and declarations - Type I environmental labeling - Principles and procedures	Environmental labeling by third-party certification	・Operation by a third-party certification organization ・Product categories and certification criteria determined by certification organizations ・Upon application by the business, screening is done and mark is approved Note: In Japan, this was established as JIS Q 14024 in 2000.
Type II	ISO 14021 : 1999 Environmental labels and declarations - Self-declared environmental claims (Type II environmental labeling)	Self-declaration of environmental claim by businesses	・Assesses compliance with in-house standards, and claims the product's environmental improvements to the market ・Applies also to promotional advertisements ・No judgment by a third party is taken into account ・Can be employed by all parties who benefit from environmental claims, including manufacturers, importers, distributers, retailers, etc. Note: In Japan, this was established as JIS Q 14024 in 2000.
Type III	ISO TR 14025 : 2000 ISO 14025: 2006 Environmental labels and declarations Type III environmental declarations Principles and procedures	Labeling of quantitative data on environmental impact of the product's lifecycle	・No judgment is made on acceptance or rejection ・Only quantitative data is displayed ・Judgment is left up to purchasers Note: In Japan, this was established as JIS Q 14025 in 2008.

Source: Ministry of the Environment "Guidelines for Environmental Representations (Eco-labeling): A framework for providing the appropriate and easily recognizable environmental information (Second Revised Edition)"

Figure 4-3-10 An Example of the Uniform Energy-Saving Label

Fiscal year when criteria of the 5-star multistage rating are set.

For non-CFC electric refrigerators, Non-CFC sign is displayed.

Multistage rating system

- The product is rated at five levels, symbolized by the number of stars; the higher the energy saving performance of a marketed product, the more stars
- In order to clarify the number of stars given to products meeting the Top Runner Program, a borderline of 100% target achievement is shown under the stars.

Energy-Saving Labeling Program

Expected annual electricity bill

- This information is provided so as to make energy consumption efficiency (e.g. annual energy consumption) comprehensible. Electricity costs are calculated at 22 yen (tax included) per 1kWh, based on the Home Appliances Fair Trade Conference's "Revised Reference Unit Price of Electric Charges."

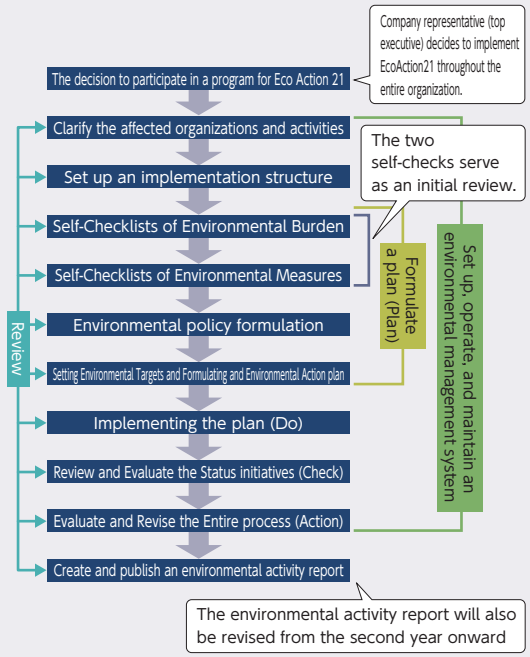
Source: The Energy-saving Center, Japan's website

ronmental management systems, environmental performance assessment and environmental reporting. Eco Action 21 is designed to enable even small- and medium-sized commercial businesses to promote environmentally-oriented commercial practices voluntarily and actively, and to release the result of the activities as an "environmental activities report." In 2009 a revised version of the "Eco Action 21 Guidelines 2009" was released with more easy-to-understand details, for further promotion.

In addition to this Eco Action 21, there are also the international standards such as ISO14001 and other environmental management systems established by local governments, NPOs and intermediary corporations.

In order to establish a sustainable society, it is necessary for all parties to make active efforts for the environment. Businesses should use such environmental management systems to incorporate consideration of the environment, such as conservation of energy and resources, and reduction of waste, in to all of their business activities, including products and services.

Figure 4-3-11 Eco Action 21 procedural flow



Source: Ministry of the Environment's "Eco Action 21 Guidelines 2009"

F. Programme to Promote Eco-Leasing for Households and Businesses

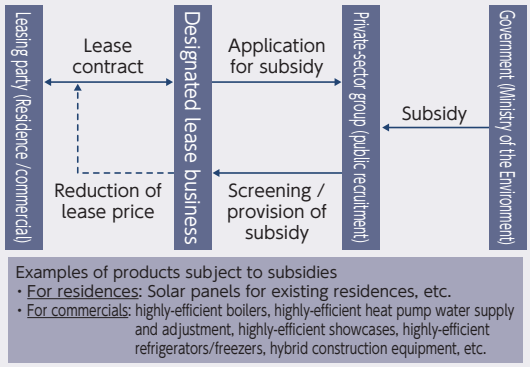
When trying to reduce emissions greatly in the households, commercial, and transport sectors, one of the obstacles that residences and small- and mid-size companies face in particular is the burden of a large initial investment (down payment) that comes along with the introduction of low-carbon equipment. To counter this situation, beginning in FY 2011 the Ministry of the Environment is introducing a method of leasing with no down payment, to promote the use of low-carbon equipment in houses and small- and mid-size companies (Figure 4-3-12). Specifically, the government provides financial support for part of the lease payments.

Low-carbon equipment that contributes to CO_2 emission reduction while in use, such as roof-mounted solar panels for residences, and high-efficiency equipment (e.g. high-efficiency boilers, air-conditioners, and refrigerators and freezers) for businesses, is eligible for the subsidy. Through this support, the further spread of low-carbon equipment is expected.

Promotion of environmental measures that utilize lease businesses can be considered as a new approach of environmental finance different from loans and investment.

In addition to contributing to global warming mitigation, this program is also targeted at the improvement of daily life, price reduction of low-carbon equipment due to greater demand, expansion of domestic demand,

Figure 4-3-12 Eco-Lease Mechanism



Source: Ministry of the Environment

and revitalization of industries. As a positive economic impact, it is expected that this would lead to the purchase of equipment and facilities worth about 65 billion yen, a reduction of 260,000 tons of CO_2 equivalent, and jobs for 2,000 people.

G. Promotion of Eco-Diagnosis in Residences

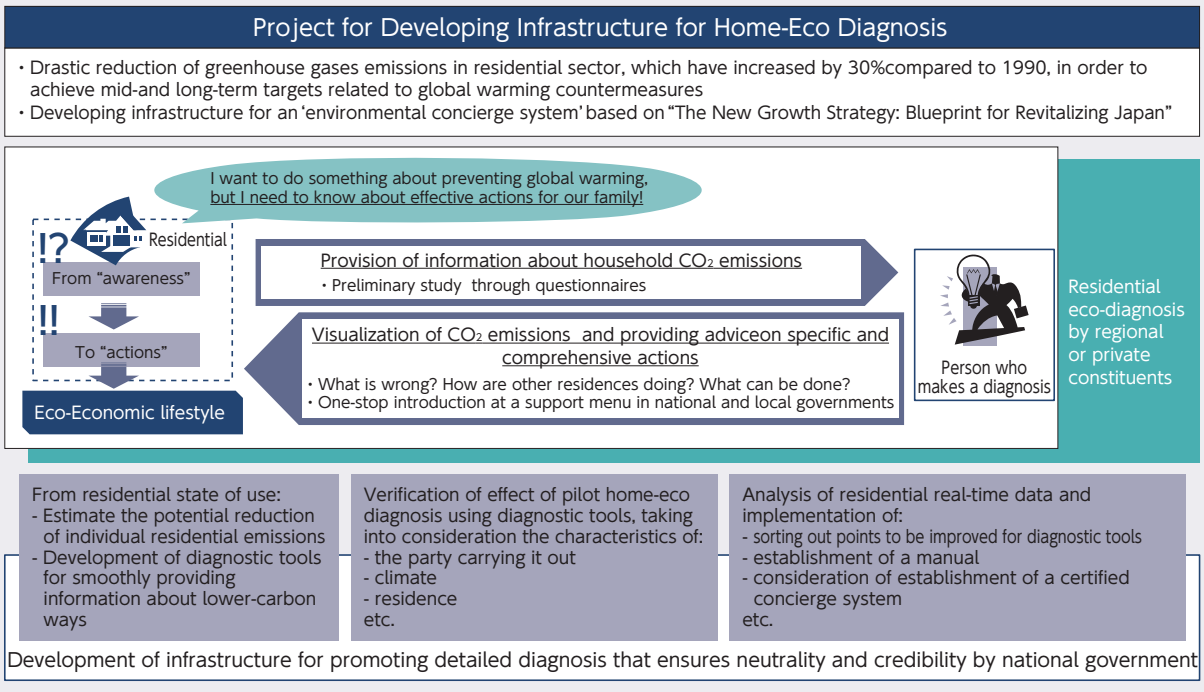
In "The New Growth Strategy: Blueprint for Revitalizing Japan," Cabinet decision in June 2010, the "environmental concierge system" was introduced. In order for households to effectively reduce their CO_2 emissions, it will be necessary not only to promote the purchase and installation of low-carbon equipment but also to provide appropriate advice on using it to the individuals having high interest Comparing with other residences and realizing their potential for reduction, they can connect their "awareness" to "actions," Also, if people can take measures that suit their own lifestyles, they will feel more comfortable in their living space and appreciate other improvements in the quality of their daily lives, and that will encourage them to voluntarily switch to a low-carbon lifestyle.

At present, some local governments, organizations, and commercial businesses are currently making such efforts, but those activities are not necessarily expanding. It is important to take the first steps of verifying and diffusing the effects of such diagnosis and ensuring the neutrality and credibility of the diagnosis. The Ministry of the Environment is now planning on establishing an infrastructure to initiate and promote an environmental concierge system: supporting the development of a tool of "Eco-Home Diagnosis" that will provide individual residences with detailed advice about low-carbon actions, conducting verifications through a pilot diagnosis system with consideration given for the characteristics of climate and residence, establishing manuals for providing information, and establishing a certified concierge system (Figure 4-3-13).

(2) Regional Actions towards Low-Carbon Societies

The CO_2 emissions in the private/commercial sectors (office and residential sectors) in FY 2009 had increased by approximately 30% compared to the base year of the Kyoto Protocol (Figure 4-3-14). Also, the CO_2 emissions in the private/commercial sectors were approximately one-third of the total emissions in Japan, and suppressing such emissions in the private sector is important in the pursuit of a low-carbon society. In addition, the CO_2 emissions in the energy conversion and transport sectors increased by approximately 18% and 6% respectively, compared to the base year. The CO_2 emissions in the energy conversion and transport sectors made up approximately 7% and 20% respectively of the total

Figure 4-3-13 Outline of Project for Developing Infrastructure for Home-Eco Diagnosis



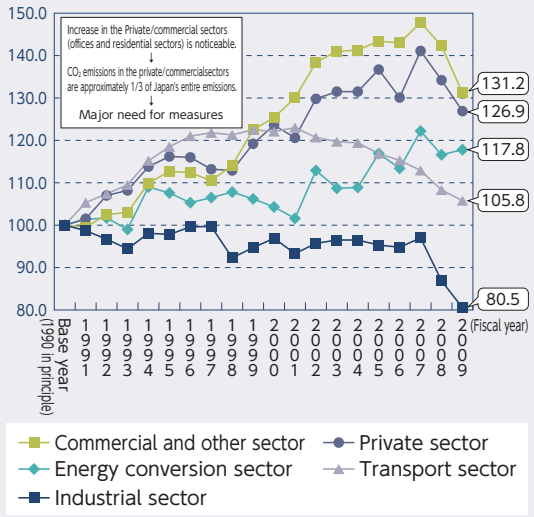
Source: Ministry of the Environment

emissions in Japan, and so the measures addressing these sectors are also important tasks.

Japan is reducing its CO_2 emissions with the cooperation of local government through their low-carbon programmes, such as developing an intensive urban structure, improving energy efficiency in regional units, and changing the regional strengthening measures to shift the regional structures to low-carbon.

One such effort is the "Challenge 25 Community Building Project." Mitigation of global warming is a task that involves comprehensive actions in all fields, such as industry, transportation, private/commercial sectors, and community building, and it is becoming increasingly important for a wide variety of parties such as the national government, local governments, private commercial operators, NPOs, and regional residents to participate and make efforts in order to mitigate global warming. In light of this, the Ministry of the Environment began the Challenge 25 Community Building Project in FY 2009. This project invited and promoted proposals for actions effective for CO_2 emissions reduction in the regions, facilitated the revitalization of the regions and enabled the realization of communities that have a small environmental load This Challenge 25 Community Building Project offered subsidies for the projects in three areas, "establishment of plans," "subsidized projects" and "verification projects". In FY2009, 12 entries, 11 entries, and 5 entries were accepted for these three areas respectively. The verification projects

Figure 4-3-14 Shifts in Carbon Dioxide Emissions in the Final Demand Sector (Base year = 100)



Source: Ministry of the Environment

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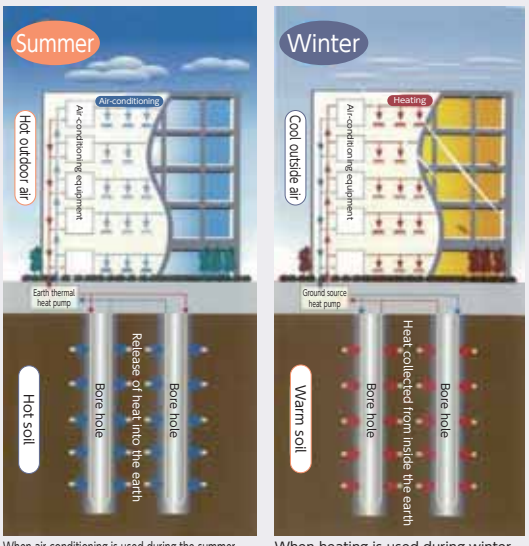
Efforts under the Challenge 25 Community Building Project - The Example of Nakatsugawa City

A project proposed by Nakatsugawa City was accepted as a "challenge by a small-or medium-size city" under the Challenge 25 Community Building Project. This project is to verify the effect of CO_2 emission reduction by a heat transportation system (Trans Heat Container) that transports low temperature heat generated from waste incinerators using trailers, and by a geothermal heat pump system that employs the groundwater and provides a stable supply of heat throughout the year.

The Trans Heat Container is the system that stores the heat generated by waste incinerators in containers filled with latent heat storage materials, transports containers to separate facilities (e.g. offices) that use the heat for air-conditioning. One of advantages of the Trans Heat Container system is that they can collect low-temperature waste heat of 100℃ or less, which had conventionally been emitted into the atmosphere because it was difficult to recover using existing technologies. By using one container at a time it is possible to reduce emissions by a maximum of approximately 500kg of carbon dioxide equivalent. In Nakatsugawa City, they collect low-temperature waste heat generated by waste incinerators, transport it to publicly-operated hospitals in different locations where it is used as a heat source for air-conditioning and hot water, thereby reducing of carbon dioxide emissions.

Diagram of an ground source heat pump



When air-conditioning is used during the summer, exhaust heat that was air-conditioned by the heat pump is emitted into the soil (cool heat is absorbed).

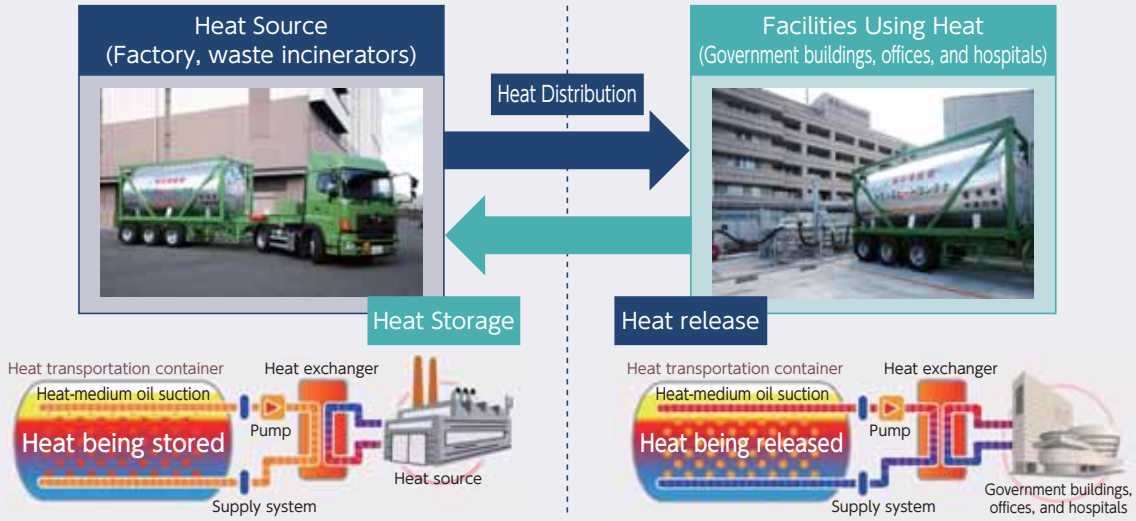
When heating is used during winter, the heat pump collects warm heat from the soil.

Source: Taisei Corporation

Nakatsugawa City is also conducting a verification experiment for the geothermal heat pump system. A geo thermal heat pump is a system that uses soil or groundwater, which experience fewer temperature changes as a heat source than the atmosphere. Since

Nakatsugawa City is surrounded by mountains with a lot of rivers, subsoil water, and groundwater, it is utilizing its geographical characteristics for geothermal heat, which is an unused energy. Similar to the heat transportation containers, the geothermal heat pump system involves the utilization of thermal heat at the city's public hospital facilities, proceeding with verification of the reduction of CO_2 emissions.

Diagram of Heat Distribution Using Heat Transportation Containers



Source: Nakatsugawa City, Sanki Engineering Co., Ltd.

included a project producing a verification method of CO_2 reduction introducing advanced technologies, such as renewable energy and heat delivery systems, and efforts have been made optimizing the regional characteristics.

Other efforts towards low-carbon regions include the systems of Environmental Model Cities Plans and "Environmental Future Cities."

In FY 2008, thirteen cities were selected as "environmental model cities" to set high targets for significant reductions of greenhouse gases and to take on the challenge of advanced efforts. The concept is to support the fulfillment of those targets and expand such outstanding efforts throughout the country.

The "environmental future cities" concept is one of the

Column

An Environmental Model City that Uses Biomass Resources - Yusuhara Town

One of the environmental model cities introduced in this sub-section is Yusuhara Town of Kochi Prefecture, selected as a model city for building a low-carbon city using biomass resources. Yusuhara Town has a population of less than 5,000, and the population's aging rate is approximately 40%, but because residents have a high awareness about the environment and there are many resident-led efforts and proposals, efforts for the environment are thriving.

The main pillar of Yusuhara Town's policies is "building a mountain village-style low-carbon society." They have been introducing wind and solar power, nurturing forests as sources for CO_2 absorption and conducting forest aiding thinning using profits from selling electricity, and promoting FSC certification for their forests even before the town was selected as

Yusuhara General Government Building

Source: Yusuhara Town

an environmental model city. The town is also undertaking projects to promote the use of timber produced in the town. When the Yusuhara General Government Building was rebuilt, timber produced in the town was used, under the plan formulated through collaborative research by industry, the government, and academia. The construction was completed in 2006.

In 2009, the Yusuhara Town formulated its environmental model city action plan. The plan set targets of realizing a low-carbon society that is friendly to living beings and contributing to energy self-sufficiency. In order to achieve those targets, the town is operating a wood biomass local cyclical use model project, a CO_2 forest absorption project, a CO_2 emissions reduction project, and a capacity and mechanism-building project with national government assistance. In addition, through collaboration with forest cooperatives and private commercial operators the town has established the semi-public-sector "Yusuhara Pellet Co., Ltd.," and is manufacturing wood pellets from unused timber such as materials remaining in forests, mill ends from lumber sawing, and scrap logs, etc. Yusuhara Town will continue to promote the use of pellets in the agricultural and private sectors, and it is further promoting the creation of forests using income from projects, and formulating plans for cyclical forest operation.

Yusuhara Town has also set other high targets such as installing 40 wind power stations by 2050, and it is making other advanced efforts. In Japan, where 70% of national land is forested, it is expected that an environmental model city Yusuhara Town will serve as a good example of a sustainable, low-carbon society in a mountain village.

national strategy projects aimed at revitalizing Japan in the 21st century, set forth in The New Growth Strategy that was formulated in 2010. Under the New Growth Strategy, this concept aims to bring about the world's top-class successful examples through technology, schemes, services, and community building that is aimed at the future. Using these resources, the aim will be to establish "environmental future cities" that will expand both domestically and internationally. It is expected that such efforts will bring about a transformation to a sustainable economic and social structure, which is driven by independent regions.

(3) Trend of Utilizing Biomass Resources to Establish a Low-Carbon Society

In order to promote establishment of a low-carbon society and break free from reliance on exhaustible resources, it is necessary to improve the efficiency of resource and energy use, promote recycling of resources and actively work to replace exhaustible resources with renewable resources. Here we will take a look at the trend of utilizing biomass resources in Japan and the technological development and efforts that contribute to that trend.

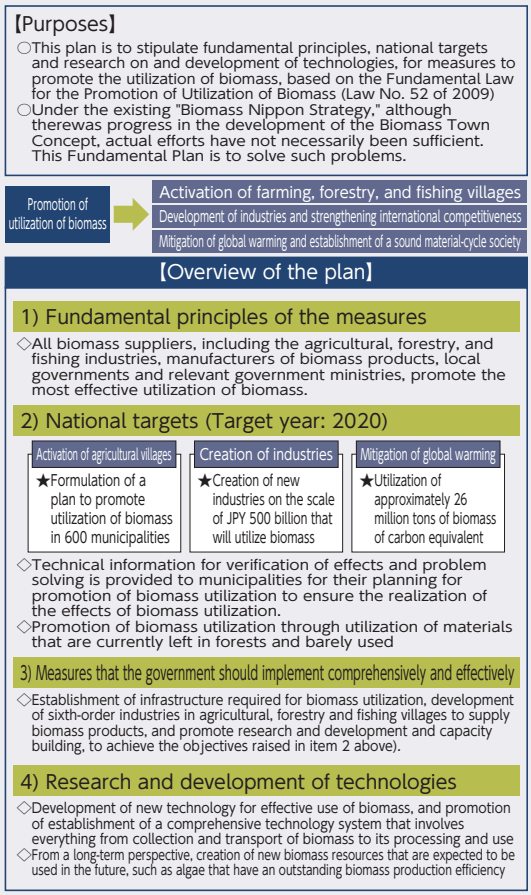
A. Fundamental Plan for the Promotion of Utilization of Biomass

Japan has an abundance of biomass, such as logging residue stems (e.g. unused forest chips from thinning) and domestic animal waste. Biomass is a resource that is sustainably renewable as long as there is life and solar energy, and the utilization of such resources will contribute significantly to mitigation of global warming and achieving a sound material-cycle society.

In order to accelerate the utilization of biomass, the government formulated the Fundamental Plan for the Promotion of Utilization of Biomass (approved by the Cabinet in July 2010) that stipulates the basics of policies for promoting utilization of biomass.

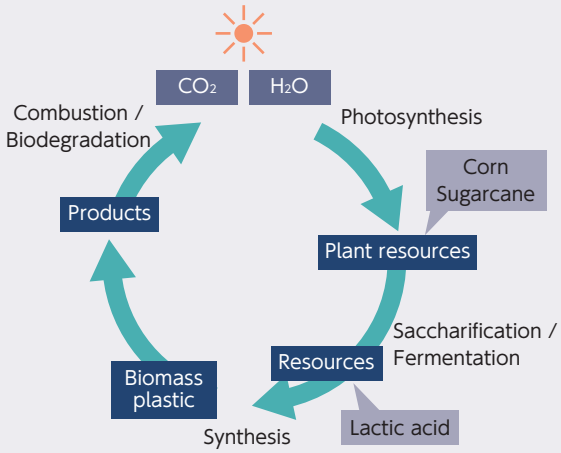
This Fundamental Plan for the promotion of Utilization of Biomass sets numerical targets that should be achieved in 2020 and aims to promote measures for their achievement. First, in order to achieve a "sustainable society with little environmental load", the Plan aims to achieve approximately 26 million tons of biomass of carbon equivalent used annually in 2020, by setting separate targets for each type of biomass and promoting the use of biomass of the various types. For example, currently there are approximately 8 million tons (dry weight) of materials left in forests (e.g. timbers from

Figure 4-3-15 Overview of the Fundamental Plan for the Promotion of Utilization of Biomass



Source : Ministry of Agriculture, Forestry and Fisheries

Figure 4-3-16 The Environmental Cycle of Biomass Plastic



Source: Created by the Ministry of the Environment, using information from a pamphlet by the Japan BioPlastics Association

Figure 4-3-17 Examples of Biomass plastic Products

Source: Pamphlet by the Japan BioPlastics Association

forest trimming) each year, mostly unused, and the Plan aims to utilize approximately 30% or more of those materials by the year 2020. Further, in order to create new industries and activate agricultural, forestry, and fishing industries through the utilization of biomass, numerical targets have been set for municipalities for their promotion of biomass utilization and the size of new biomass industries.

B. Biomass Plastic

The plastic that is currently used for various purposes and widely distributed is made mainly from petroleum. Replacing the petroleum plastic with plastic made from renewable resources is one of the efforts aimed at replacing exhaustible resources with renewable resources. At present many efforts are now being made to create plastic from renewable resources.

One of these efforts is plastic that is made from plant resources as its raw material (hereinafter referred to as "biomass plastic"). Biomass plastic is made from corn and sugarcane as its raw materials through processes such as saccharization, fermentation, or synthesis (Figure 4-3-16). The characteristics of biomass plastic include the reduction of the use of fossil resources because it uses renewable plant resources as its raw materials, and that it is carbon-neutral because the plants, the raw material of biomass plastic, use atmospheric carbon dioxide for photosynthesis; therefore, it does not increase atmospheric carbon dioxide. Biomass plastic can be called a sustainable material. Biomass plastic is currently being used for a wide range of products, such as grocery tray wrapping, and egg packaging as well as interior parts for automobiles and computer enclosures (Figure 4-1-17).

In order to further increase the use of biomass plastic in the future, it is important to enhance the technologies such as flame-resistance and durability, develop forming/processing technologies (hereinafter referred to as "processing technologies"), and to simulate new demand for products that can optimize the advantages of biomass plastic. For example, polyethylene terephthalate (PET), which is a type of plastic, became rapidly industrialized due to the progression of its processing technologies and demand for products such as bottle containers (plastic bottles). In order to expand demand for biomass plastic in the same way, it is important to develop processing technologies. However, Japan's processing technologies for biomass plastic are among the highest levels in the world, and by leading the world by developing new demand for biomass plastics using Japan's advanced processing technologies, Japan can contribute to the increased use of biomass plastics, which will facilitate the departure from exhaustible resources.

On the other hand, even biomass plastic consumes energy for production of its raw material plants, and the manufacturing of materials and products, and therefore the CO_2 emissions in its lifecycle are not zero. For that reason, if the plant-derived plastic is produced

Column

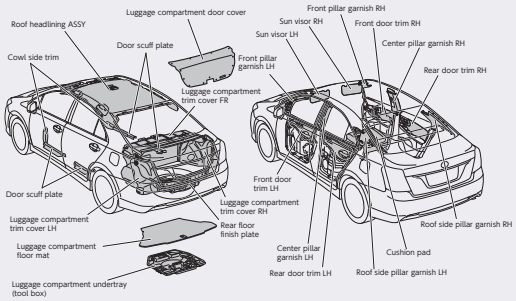
Adoption of Biomass Plastic for Automobiles

Biomass plastic is being used for a variety of purposes, and has even spread to uses in automobiles. A certain Japanese automaker is independently developing biomass plastic and using it as material for interior parts for automobiles. A model released by this automaker in 2009 used biomass plastic interior parts for as much as 60% of the total surface area. Because plants are used as raw materials, it is possible to achieve more carbon-neutral benefits than conventional petroleum plastic, and the CO_2 emissions in the lifecycle from manufacturing through disposal can be controlled.

By replacing polypropylene (PP), which is a polymer most widely used in automobiles, with

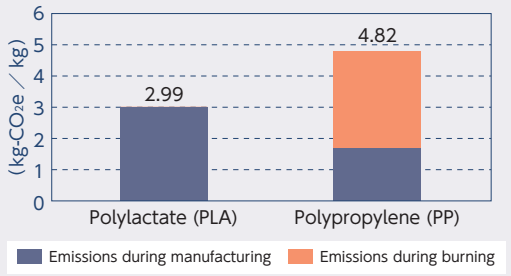
polylactate (PLA), which is currently the most common biomass plastic, it is believed that the CO_2 emissions in the lifecycle can be reduced by approximately 40%. Use of plastic materials for automobiles currently makes up approximately 10% of a car's weight, and supposing that all of that were replaced with materials made from plants, approximately 200kg-CO_2e could be reduced per vehicle. Assuming simply that biomass plastic was used in the entire world's annually produced 70 million cars, we can reduce approximately 14 million ton-CO_2e annually.

Examples of adoption of biomass plastic in automobiles



Source: Toyota Motor Corporation's homepage

Lifecycle CO_2 emission amounts for plastic



Source: Created by the Ministry of the Environment, using information from the LCA database ecoinvent v.2.0

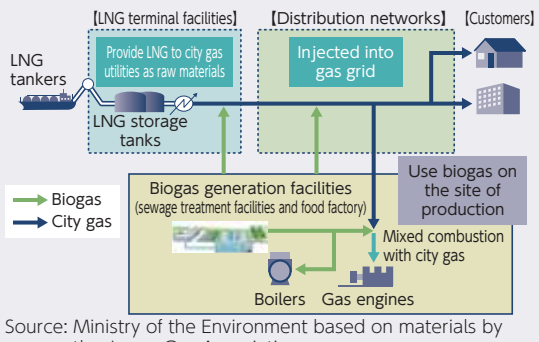
and disposed of within a time period shorter than the petroleum-derived plastic, it may not necessarily lead to a reduction of the environmental load. Therefore, when using biomass plastic it is important to keep recycling and other forms of cyclical use in mind, and we should not produce and dispose of biomass plastic lightheartedly. There are also expectations for the development of technologies and systems that enable effective manufacturing of biomass plastic that uses cellulose from rice straw and timber as its raw materials, so as not to impact the stable supply of food and the use of existing timber.

C. Promoting Use of Biogas

Efforts are being made to use biogas as an energy source to replace fossil fuels. In order to reduce reliance on fossil fuels and ensure a stable and appropriate supply of energy, in 2009 Japan enacted the "Law for Sophisticated Methods of Energy Supply Structures" and revised the "Law concerning Promotion of the Development and Introduction of Alternative Energy." In addition, in the Basic Energy Plan (decided upon by the Cabinet in June 2010) the government stipulated policies for expanding use of biomass through cooperation by the government and the private sectors. Many such efforts are being made to expand the use of biomass.

One of those efforts is the recovery of energy from sewage sludge and food residue. One of such actions currently in progress involves refining methane gas from the biogas generated by sewage treatment facilities and food factories and using in the same way as city gas (Figure 4-3-18). Specifically, biogas is used on the site of production, used as raw material at city gas plants, and injected into the gas grid pipes. Biogas is mainly

Figure 4-3-18 Phases of Biogas Utilization



Source: Ministry of the Environment based on materials by the Japan Gas Association

used on the site of production, but in recent years several pilot projects have been launched in Tokyo and the City of Kobe to verify the supply of biogas through injection into the gas grid. Through these projects a total of approximately 4,000 ordinary residences, in Tokyo and the City of Kobe, are being supplied with volumes of gas to be used for a year, and it is hoped that 2,560 tons of carbon dioxide will be reduced annually.

Large quantities of sewage sludge are potentially available as resources, and the sewage sludge in Japan is expected to have a potential of approximately 1 million kl of crude oil equivalent. However, only about 10% of sewage sludge is being utilized. At present, there are projects to utilize the unused sewage sludge as energy, and in order to expand use of biogas, the government is setting targets for General Gas Utilities to use at least 80% of the estimated volume (that is, the volume that can be procured at an appropriate cost) of surplus biogas generated by sewage treatment facilities in 2015.

Column

Replacing Oil Resources with Algae

At an international academic conference on algae in Tsukuba City, Ibaraki Prefecture, in December 2010, University of Tsukuba Professor Makoto Watanabe reported that they have discovered a type of algae called Aurantiochytrium that produces a hydrocarbon (squalene), which is suitable as a substitute for crude oil. Earlier, there were a number of studies on the generation of hydrocarbon by algae but they had mainly focused on Botryococcus braunii. Aurantiochytrium produces a kind of crude oil with an efficiency 10 to 12 times greater than that of Botryococcus braunii, and it is drawing attention as a new biomass energy.

Botryococcus braunii grow through photosynthesis, but aurantiochytrium are "heterotrophic algae" that do not conduct photosynthesis, therefore they do not need light but only nutrients in order to grow. There are research projects that make use of each advantage and develop efficient cultivation systems. For example, there are feasibility studies in progress to determine whether cultivation of aurantiochytrium and botryococcus braunii can be integrated with the wastewater treatment system. In a typical water treatment process, primary organic wastewater contains a lot of dissolved organic materials, with which it is possible to produce aurantiochytrium. Further, the secondary wastewater of the water treatment process contains nitrogen and phosphorous, nutrients with which it is possible to increase the production efficiency ofbotryococcus braunii. By integrating oil-producing algae with the wastewater treatment process, it is possible to build a system that conducts "waste water treatment" and "oil production" at the same time.

The efficient production of aurantiochytrium and botryococcus braunii, integrated with existing systems, will improve profitability and increase the possibility of practical application. It is anticipated that these algae will create new types of domestically produced biomass energy that will contribute to a low-carbon society.

Aurantiochytrium being cultured

Outline of wastewater treatment and algae biomass production

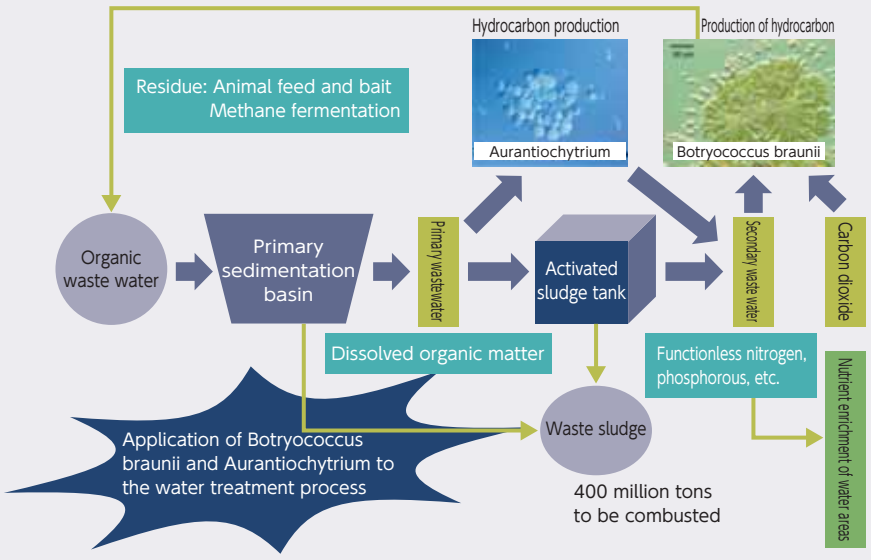


Diagram and photographs provided by Professor Makoto Watanabe, Graduate School of Life and Environmental Sciences, University of Tsukuba.

(4) Global Expansion of Japanese Low-Carbon Technologies and Systems

A. Global expansion of low-carbon technologies in the iron and steel industry

Japanese technologies and systems fora low-carbon society are globally expanding in a variety of fields. One example is technology related to the iron and steel industry.

In the process of producing iron, a large amount of carbon dioxide is emitted. However, when comparing the specific energy consumption of the iron and steel industries of various countries, Japan consumes less than other countries and its volume of energy used to produce the same volume of iron is comparatively small (Figure 4-3-19). It can therefore be said that if Japan's technologies for iron production are widely spread to other countries it will lead to production that uses less energy, which will contribute to creation of a global low-carbon society.

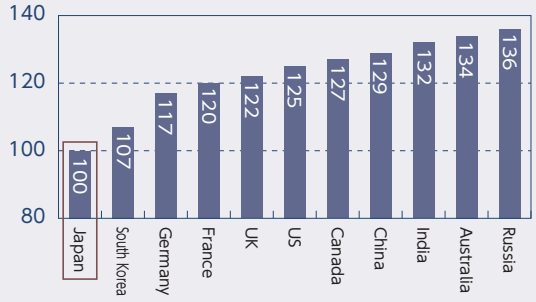
The major energy-saving technologies developed in Japan's iron and steel industry are now widely spread to other countries and are significantly contributing to CO_2 emissions reduction outside Japan. These technologies include the coke dry quenching system and top pressure recovery turbines. Coke dry quenching is a technology that uses nitrogen instead of conventional water for cooling red-hot coke in cooling systems at steel plants (Figure 4-3-20). It not only reduces CO_2 emissions, but also leads to saving water resources and reducing nitrogen oxide and sulfur oxide. Top pressure recovery turbines collect exhaust pressure released from the top of the blast furnace when iron ore is reduced in the blast furnace during the smelting process, and generate electricity from dedicated turbines. It is expected that introduction of these turbines will conserve energy by using energy that was previously disposed of. These systems are being disseminated to other countries such as China, South Korea, India, Russia, Uruguay, and Brazil, and it is believed that their effects on reduction of CO_2 emissions had reached a total of approximately 33 million ton-CO_2 as of October 2009 (Table 4-3-4). In addition, the potential reduction of carbon dioxide emissions if these energy-conserving technologies are internationally transferred and widely spread is believed to be 130 million ton-CO_2 per year for the seven countries participating in the Asia-Pacific Partnership on Clean Development and Climate, and 340 million ton-CO_2 per year globally (equivalent to approximately 25% of Japan's emissions).

B. Global Expansion of Technologies for Electric Power Generation

In Japan there are a number of technologies related to electric power generation. Among them, the highly efficient coal-fired power generation process is expected to be a technology with a great deal of potential for future reduction of greenhouse gases.

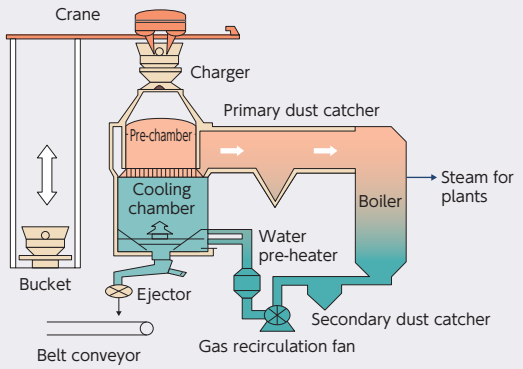
Coal-fired power generation technology includes supercritical pressure power generation and ultra-supercritical pressure power generation. More than 60% of Japan's coal-fired power generation is highly efficient (ultra supercritical pressure or supercritical pressure) power generation. In terms of the efficiency of coal-fired power generation Japan has consistently been at the highest level in the world since 1990 (Figure 4-3-21). In addition, according to statistics by the Institute of Energy Economics, Japan, the potential of highly-efficient coal-fired power generation technology for reducing CO_2 emissions is believed to be equivalent to slightly more than 10% of the world's total potential for CO_2 emissions reduction (Figure 4-3-22), and there are high hopes for

Figure 4-3-19 Energy consumption per unit production of crude steel (blast furnace/basic oxygen furnace)



Source: The Research Institute of Innovative Technology for the Earth (RITE) "International Comparisons of Energy Efficiency (Sectors of Electricity Generation, Iron and steel, and Cement)

Figure 4-3-20 CDQ (Coke Dry Quenching) Process Flow



Source: New Energy and Industrial Technology Development Organization (NEDO)'s website

Table 4-3-4 Emission Reductions in Other Countries from Japanese Energy-saving Equipment (as of October 2009)

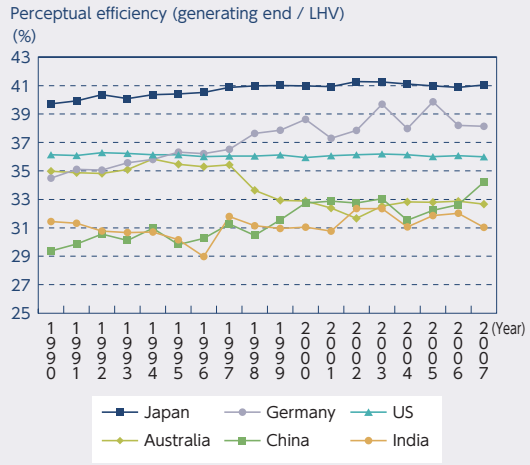
	No. of units	Reduction effects (kt-CO_2/ year)
CDQ (Coke dry quenching)	55	8,620
TRT (Top pressure recovery turbines)	47	7,897
GTCC (Byproduct gas combustion)	24	11,858
Basic oxygen furnace OG gas recovery	17	3,481
Basic oxygen furnace sensible heat recovery	7	848
Sintering exhaust heat recovery	5	725
Total emission reduction		33,429

Source: handouts prepared for "Mid- and Long-Term Roadmap Subcommittee" (June 11, 2010), prepared by the Japan Iron and Steel Federation

its future. In order to promote such efforts, Japan is sending its experts to inefficient coal-fired power plants in China and India to examine facilities and provide advice in order to improve efficiency and reduce CO_2 emissions.

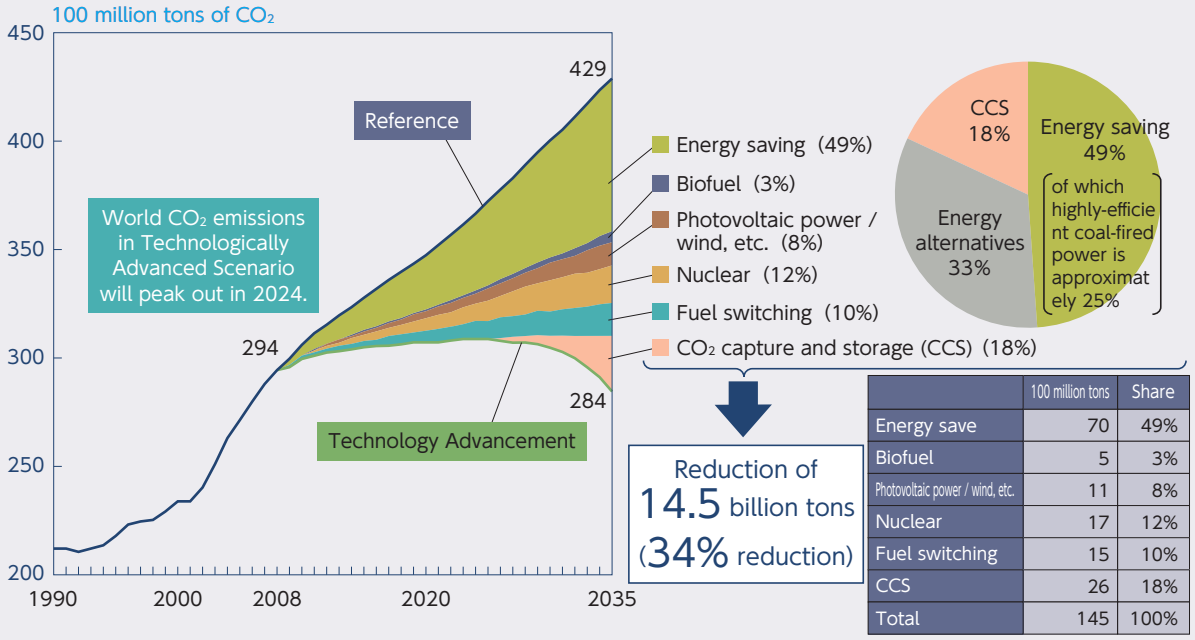
Efforts are also being made to establish technologies for advanced supercritical pressure power generation, integrated gasification combined power, and CO_2 capture and storage (CCS). Advanced supercritical pressure cycle generation is a technology that improves the power generation efficiency of current pulverized coal-fired power generation by making it high-temperature and high-pressure. Coal gasification combined power is a technology that turns coal into gas and conducts combined power generation by using gas turbines and steam turbines. CCS is a technology that controls release of CO_2 in the atmosphere by breaking up and collecting CO_2 from the emitted gas, and then storing or isolating it within the ground or in the ocean. It is anticipated that by combining such technologies it will be possible to achieve almost zero emissions of CO_2. Under the Fundamental Plan for Energy (approved by Cabinet in June 2010), Japan is aiming to bring about zero-emission coal-fired power generation that breaks up, collects, transports, and stores CO_2 from coal-fired power generation. It is positioned as the venue for demonstrating domestic cutting-edge technology for coal-fired power, and is being introduced into other countries.

Figure 4-3-21 Efficiency of Coal-fired Power Production



Source: ECOFYS "International Comparison of Fossil Power Efficiency and CO_2" intensity (September 2010,v.2.0)

Figure 4-3-22 CO_2 Emissions Reduction by Technology (World)



	100 million tons	Share
Energy save	70	49%
Biofuel	5	3%
Photovoltaic power / wind, etc.	11	8%
Nuclear	17	12%
Fuel switching	15	10%
CCS	26	18%
Total	145	100%

Source : Created by the Ministry of the Environment, using information from the Institute of Energy Economics, Japan's "Asia/World Energy Outlook 2010"

Column

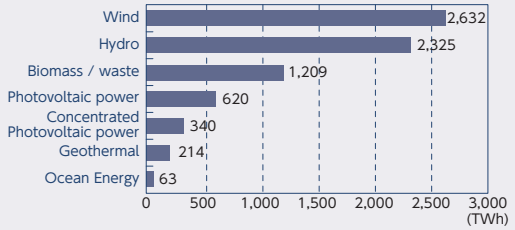
Global Expansion of Japan's Wind Power Generation

Among all renewable energy fields, wind power generation is expected to have the largest increase in electricity output by 2035, which the IEA estimates at 2,632 TWh. The estimation also says the ratio of wind power among all power generation will increase from 1% in 2008 to 8% by 2035, and that wind power generation can be considered a promising field.

Japan's wind power generation technologies are steadily implemented around the world. A certain Japanese private-sector producer of wind power turbines received a large order of forty-nine 1,000kW wind power turbines from a generation businesses in the United States in March 2011.

This Japanese private/commercial management used ingenuity in designing the length and shape of the blades to develop wind power turbines that efficiently generate power even where it is not very windy, and those technologies are highly valued in other countries. The company is preparing for mass-production of large windmills, with the offshore wind power generation in view for the future.

Incremental World Electricity Production from Renewable Sources, 2008 - 2035



Source : Created by the Minister of the Environment, using information from the IEA's "World Energy Outlook 2010"

Source: Materials from Mitsubishi Heavy Industries, Ltd.

Japan's windmills for wind-generated electricity spinning in the United States

Photograph provided by: Infigen Energy, Buena vista wind farm

C. Global Expansion of Transportation and Transport Systems

Japan's outstanding technologies for transportation and transport systems are also being implemented in other countries.

The shinkansen (bullet train) and its technology have been transferred to other countries such as Taiwan and the UK. Taiwan's High-Speed Rail (THSR, Taiwan's shinkansen) line runs 345 kilometers from Taipei (Nangang Station) to Gaoxiong (Gaoxiong Station). The THSR 700T series is a variant of the 700 Series Shinkansen, operating with a top speed of 300 km/h (Photograph 4-3-4). In the UK, the first high speed railway was built and is operating with trains designed using Japan's shinkansen technologies.

Compared with France's TGV and Germany's ICE in regard to environmental performances, the shinkansen train has a wider body and greater interior space, while the body weight is lighter, less than half that of the TGV or the ICE in terms of passenger capacity by about one body (Figure 4-3-23). In addition, because of its light weight, it has achieved environmental performance breakthroughs, such as greater fuel-efficiency, lower frictional wear of rails, and more airtight walls, which means it is possible to keep the tunnel cross-sections small, comparatively minimize infrastructure construction and use of land, and reduce consumption of resources.

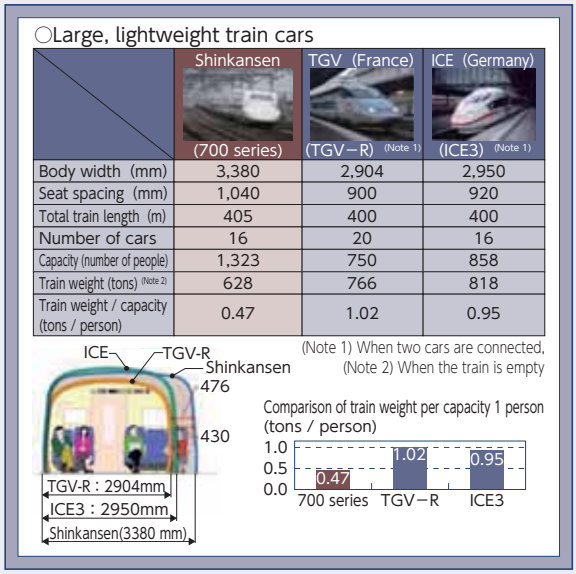
Various technologies are utilized for energy efficiency during its operation. The latest N700 series (which debuted in 2007) adopted a nose shape that has outstanding aerodynamic characteristics (Figure 4-3-5) and a uniform flat structure that has no protrusions or indentations between the train's external panels and the window glass. It also reduce resistance when running by installation of all-circumference hoods between all cars and making the surface of the train as flat and smooth as possible. Moreover, it adopts a body-tilting system in order to improve speed around curves, and has expanded the use of electric regenerating brakes.

It is expected that by popularizing shinkansen technology with its outstanding environmental capabilities, expanding

Photograph 4-3-3 Taiwan's high-speed train (700T series)

Photograph provided by: Taiwan High Speed Rail

Figure 4-3-23 Comparative Superiority of the Shinkansen (Japan's bullet train)



Source: Ministry of Land, Infrastructure, Transport and Tourism materials

its use in other countries and the development of Japan's railroad industry will make even larger contributions to worldwide efforts against global warming.

D. Global Expansion of Japanese Technologies through Collaboration with China

Japan's private companies are expanding their technologies and systems that contribute to achieving a low-carbon society in China. At the 5th Japan-China Comprehensive Forum on Energy Conservation and the Environment, held in 2010, they agreed to cooperate in 44 projects, which is the largest number in history. Other than energy conservation, the projects included more efforts in environmental fields such as wastewater and sludge treatment, smart grids and smart communities, and recycling for the first time.

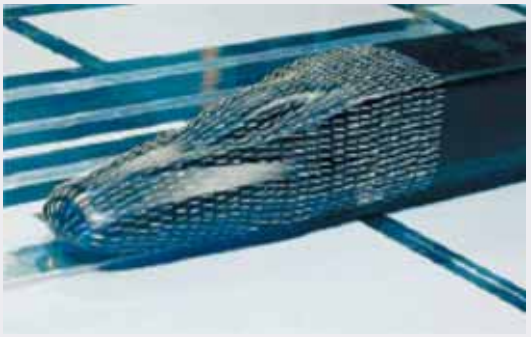
One of the projects involved the cooperation between a Japanese private-sector company and the City of Dalian in China in relation to a smart grid. For this matter, collaboration was made in order to create an advanced smart community in the "Dalian Eco-Tech Innovation City" that is being developed in Ganjingzi Ward, Dalian. Specifically, they will give a review with partners such as Chinese companies on collaborative development and demonstration experiments for energy management of buildings and houses. They will also conduct collaborative investigations and reviews with those partners in order to efficiently control energy in the region and realize green electric power management (e.g. stabilization technology for electric power systems) (Figure 4-3-24).

Under this collaboration between Japanese private-sector companies and the City of Dalian, they also agreed to collaborate in the field of water, and to jointly promote the "intelligent water city" model project to improve efficiency of recycled water including water supply, sewage systems, industrial wastewater treatment, and reuse. Specifically, they have agreed to launch a project of desalination of seawater in order to supply industrial water in the Changxing Island Harbor Industrial Zone, Dalian, and to begin the reviews for a project to treat and reuse industrial wastewater. They also agreed to conduct the necessary studies and experiments in Dalian's urban areas in order to realize advanced use of water in fields such as water treatment, water distribution management, treatment of industrial wastewater, treatment of polluted water, and monitoring of river pollution (Figure 4-3-25). Under its 12th five-year plan that begins in 2011, China is working to improve treatment capabilities for polluted water in cities, make preparations for water purification facilities, with a target of an 85% treatment ratio for sewage, and improve water quality through strengthening of regulations. In the

Photograph 4-3-4 High-speed train operated in the UK (Class 395)

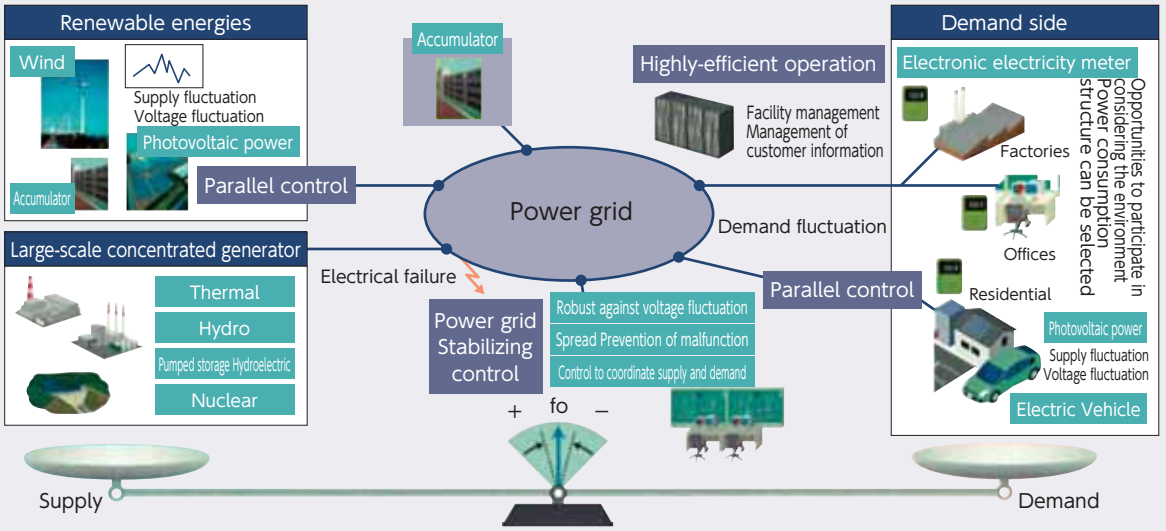
Photograph provided by: Hitachi, Ltd.

Photograph 4-3-5 Nose-shape wind tunnel experiment



Source: Central Japan Railway Company (JR Tokai)'s Environment Report 2010

Figure 4-3-24 Diagram of a Smart Grid-Related System



Source : Hitachi, Ltd.

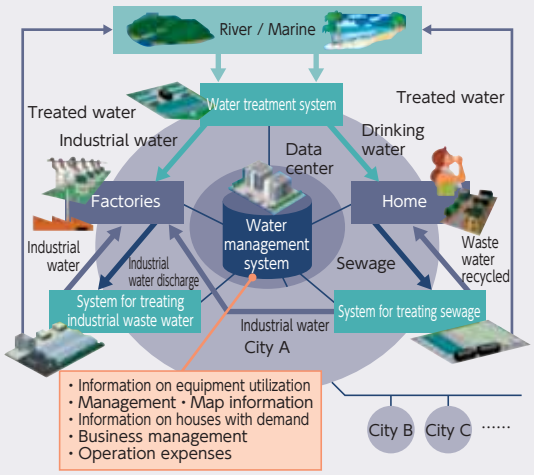
future, the environmental cooperation between China and Japan will be further expanded through the efforts of Japan's private companies that have competitiveness in environment fields.

In addition, Japan and China are cooperating to conduct a technology demonstration project for a "new traffic information system" that comprehensively manages energy conservation and CO_2 through the combination of a service system that utilizes communication technology and a system for verification. This is being conducted by Japanese private-sector businesses commissioned by the New Energy and Industrial Technology Development Organization (NEDO) and the Beijing Municipal Traffic Committee. This demonstration project aims to introduce and encourage people to use the dynamic route guidance (DRGS) system and the Eco-drive Management System (EMS) that makes effective use of the existing road infrastructure, in order to address traffic jams and other environmental problems. Its aim is to make revolutionary changes to conserve energy by utilizing a variety of media such as vehicle-mounted devices, cellular phones, and computers, and incorporating a wide range of users (Figure 4-3-26).

China is currently facing environmental problems such as air and water pollution, and there are concerns that these factors may restrict the sustainable development of China's economy. Therefore, the cooperation between Japan and China discussed above is desirable because both sides can enjoy advantages. Contributions will be made to create a sustainable society in China, and this will enable Japan to develop new energy-related markets.

As seen thus far, due to the efforts of private sector companies and the public sectors, Japan's outstanding technologies and systems that contribute to the creation of a low-carbon society are expanding to other countries

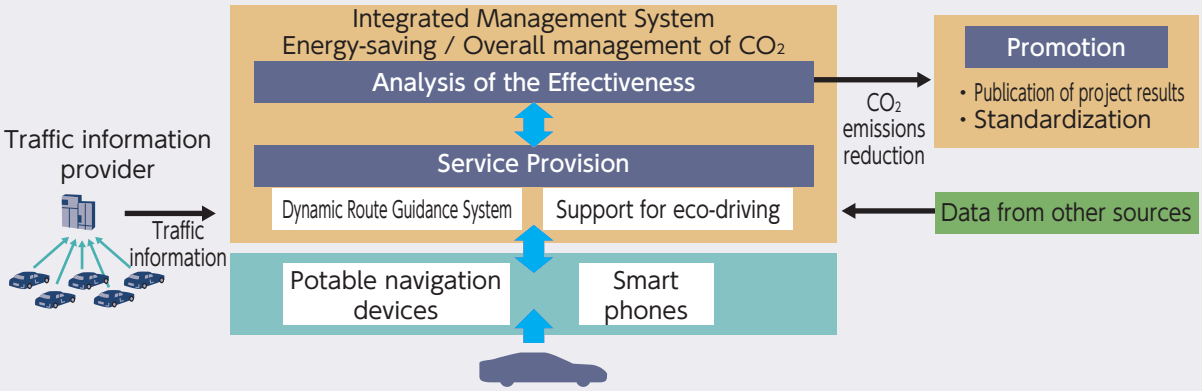
Figure 4-3-25 Diagram of a System Related to Water Circulation



Source: Hitachi, Ltd.

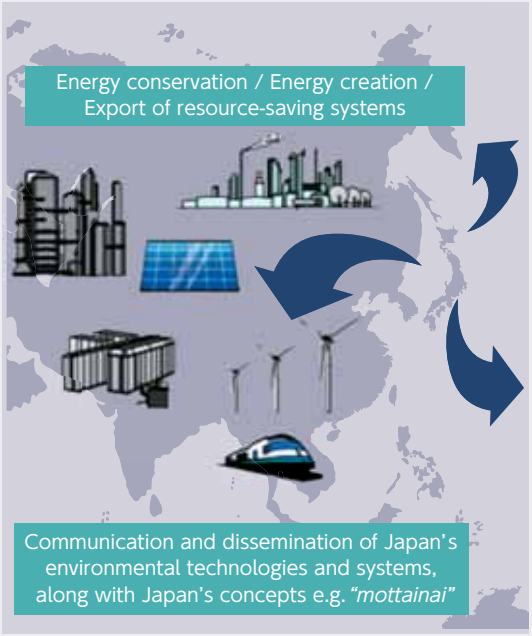
in various ways. It is likely that when Japan introduces infrastructure-related industries as systems to other countries in the future, it will be important to actively utilize the local labor force and also sufficiently provide necessary education. Through such opportunities it will be possible to spread Japan's outstanding technologies along with the Japanese mindset, such as the mottainai principle, that is essential for bringing about a sustainable society. Deploying infrastructure-related industries as systems to other countries will not only contribute to Japan's economy by simply expanding business markets, but will also spread Japan's outstanding technologies and mindsets that are incorporated in those systems, and contribute to creating the world's sustainable society (Figure 4-3-27).

Figure 4-3-26 Diagram of a Traffic Information System to be Studied Experimentally in Beijing, China



・Dynamic route guidance (DRGS): A mechanism to provide guidance for the fastest routes using high precision real-time traffic information. The data provided by DRGS is transmitted to in-vehicle devices via mobile phones.
・Eco-driving Management Support System (EMS): A mechanism to analyze vehicle information uploaded from in-vehicle devices. The results of the data analysis such as fuel consumption history are provided to drivers to encourage energy efficient driving.
Source: Press release by the New Energy and Industrial Technology Development Organization (NEDO) (January 21, 2011)

Figure 4-3-27 Diagram of Exports of Japan's Environmental Technology Systems



Source: Ministry of the Environment

Conclusions

In Chapter 4 we looked at how a sustainable society is being recognized as a major international task and how efforts are actively being made. We also introduced that, in response to those trends, new technologies that will replace or control use of limited exhaustible resources are developed, and that the Green Innovation is taking place and a variety of responses such as system changes and support measures are implemented to promote the Green Innovation. In addition, we looked at Japan's advanced technologies and systems. Because they are expanded to other countries, they help to create a sound material-cycle and low-carbon society, and contribute to creation of a global sustainable society.

It can be understood from these trends that, not only in Japan but also throughout the world, a major change that includes societal mechanisms is now taking place, mainly as a response to the task of realizing a sustainable society. It is likely that this will continue in the future as an international trend. In light of these circumstances, it is necessary to accelerate achieving a sustainable society in Japan. Expanding Japan's outstanding environmental technologies to other countries will make international contributions.