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:

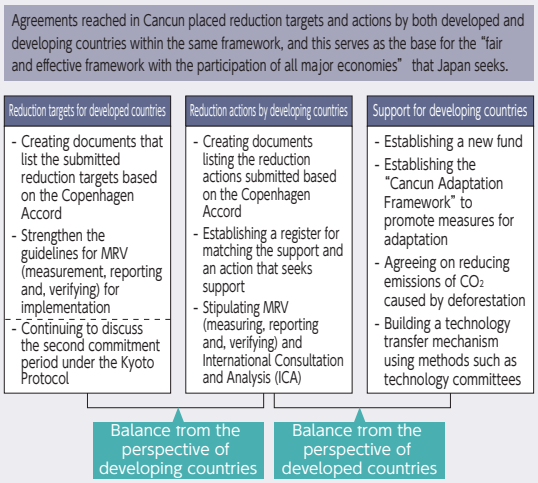
- The Kyoto Protocol was a groundbreaking international convention that imposes an obligation to reduce greenhouse gases during the period between 2008 and 2012 on developed countries.
- The energy-derived CO_2 emissions of the Parties currently obligated under the Protocol represented only 27% of total 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.

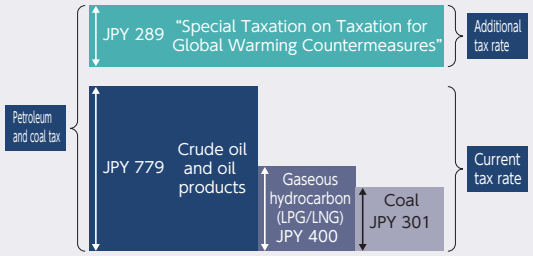
Concretely, "Special Provision on Taxation for Global Warming Countermeasure" shall be established that imposes additional tax rate on current Petroleum and Coal Tax (the tax on whole fossil fuels such as crude oil, petroleum products, gaseous hydrocarbons, and coal), based on CO_2 emission volume of 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.

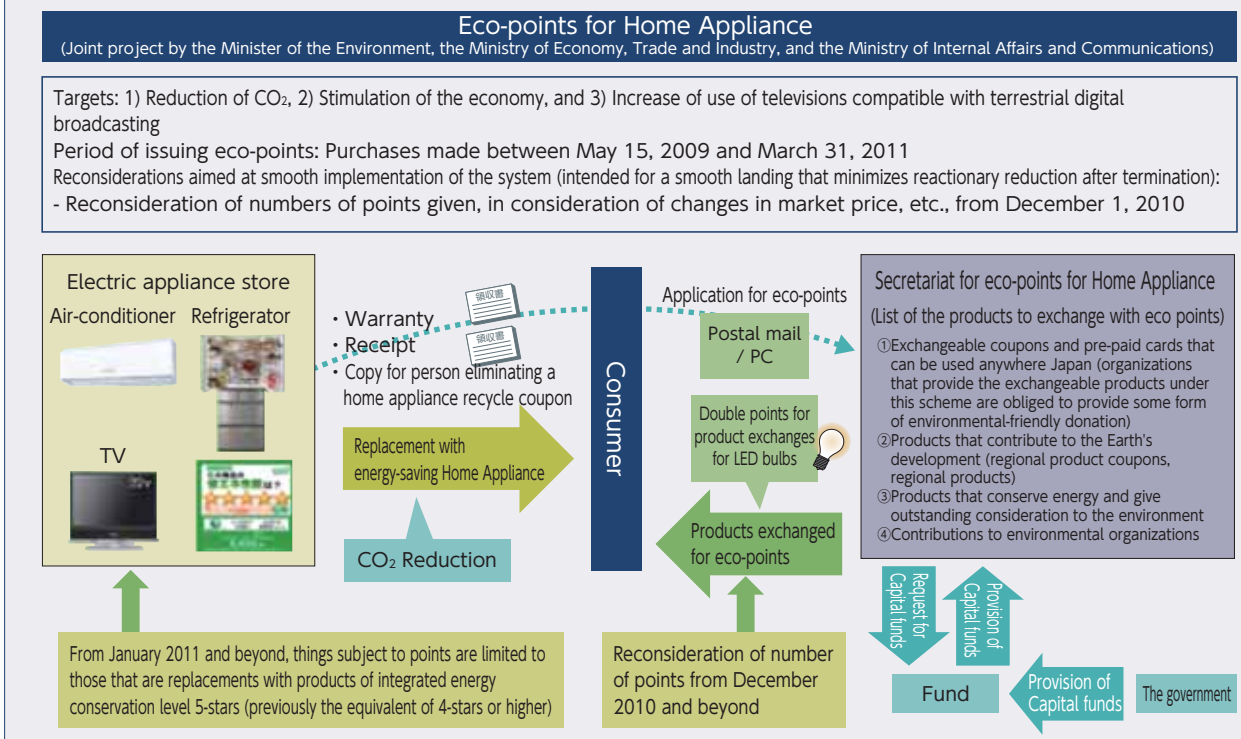
The FY 2011 Tax Reform Outline also includes the following tax system measures as well: the extension of special measures for energy-saving home renovations and fuel-supply facilities for low emission vehicles, and the establishment of a tax system to promote environment-related investment (green investment 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.

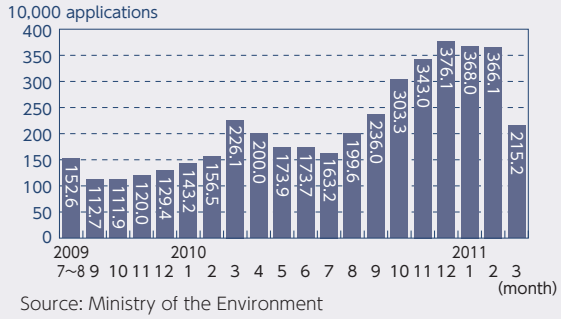
The eco-points system for home appliances had a positive impact on the economy. According to the estimates by private-sector research companies, the size of Japan's domestic retail market for home appliances in 2010 was approximately JPY 9.5 trillion, growing by approximately 1 trillion yen from the 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).

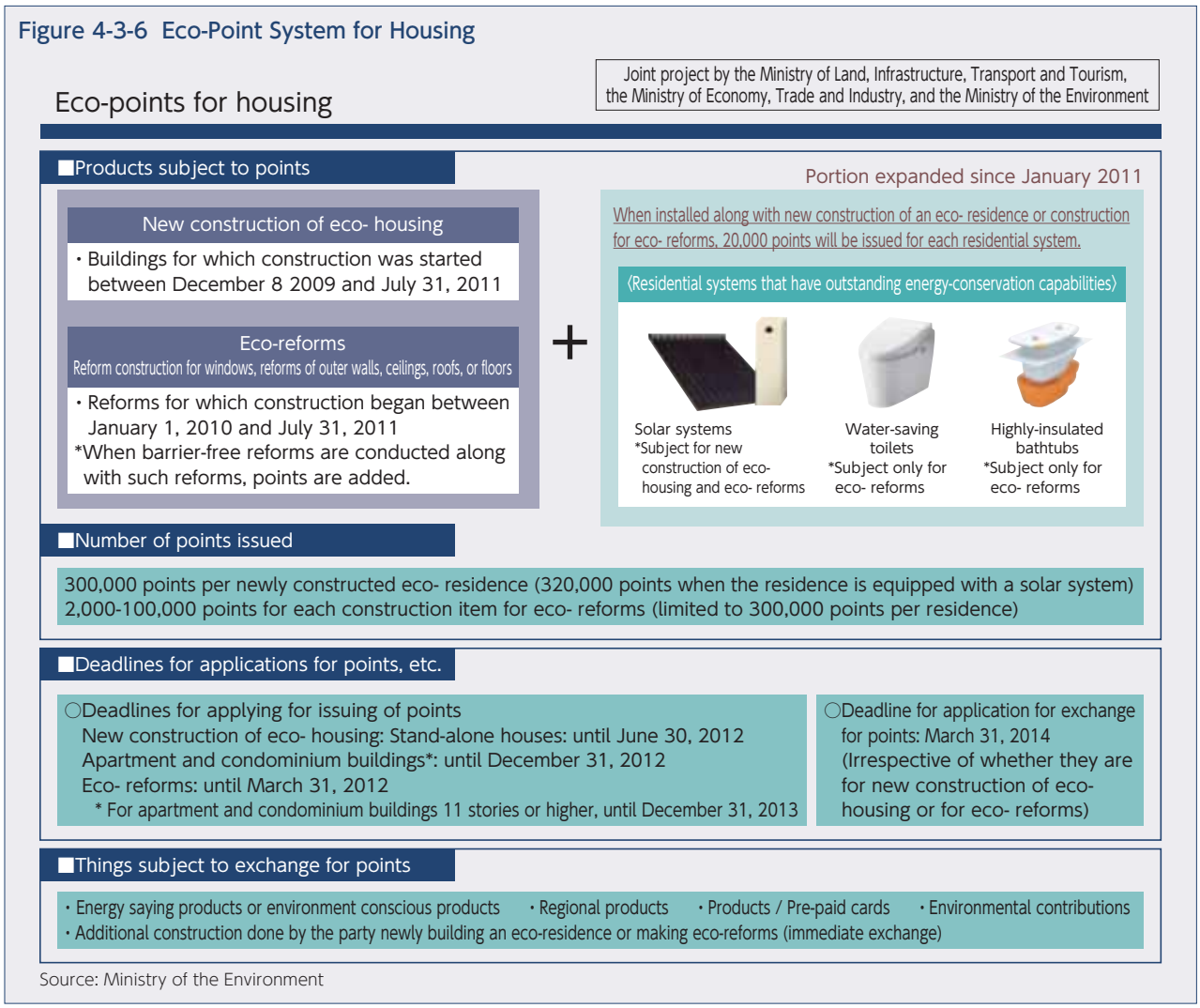
As a result of the introduction of this system, energy-saving eco-houses are increasingly widespread. Since the system started, the total number of renovations and new construction combined increased from approximately 3,000 in March 2010 to approximately 75,000 in March 2011. As time passes, more and 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)



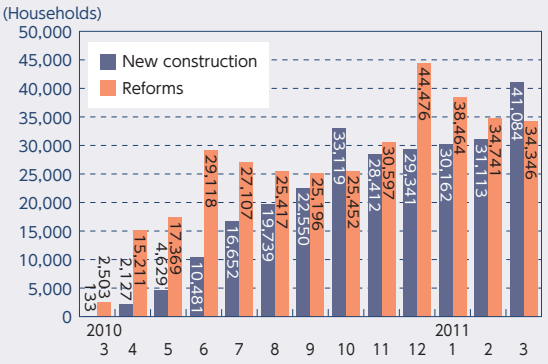
Source: Ministry of the Environment

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



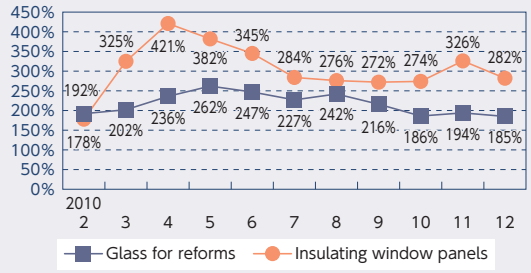
Source: Ministry of the Environment

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.

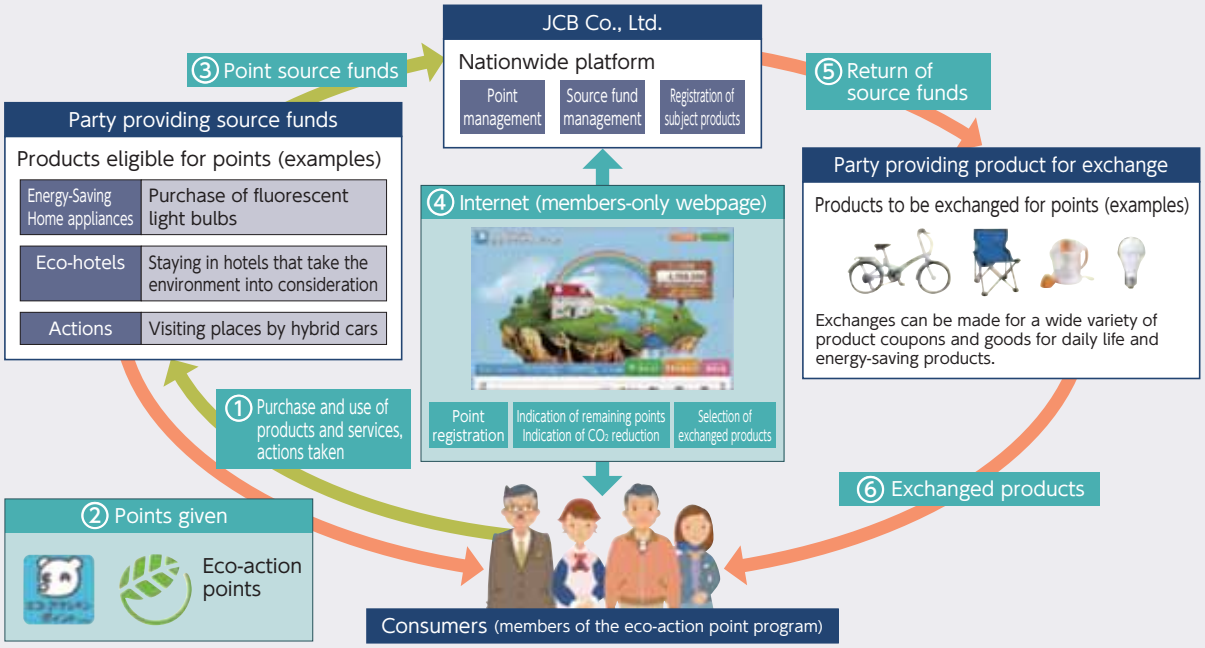
In addition to the eco-point systems discussed above, there is also a system called the Eco Action Point system, which allows participants to purchase environmental products and services or perform environmental conservation activities (eco-actions), and earn the points that they can exchange for various 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."

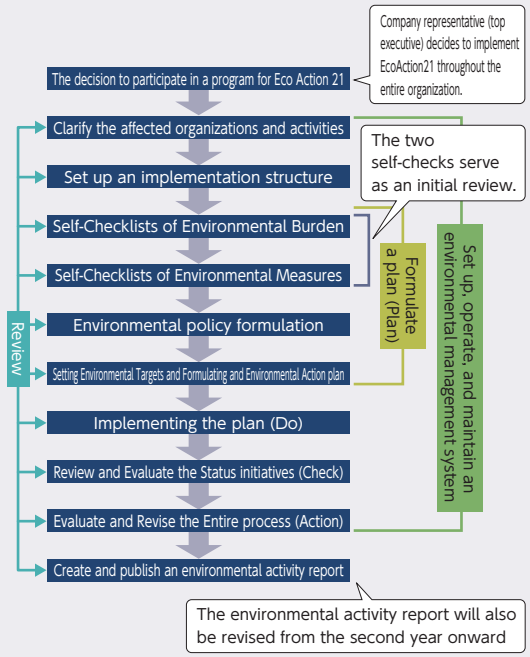
Source: The Energy-saving Center, Japan's website

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

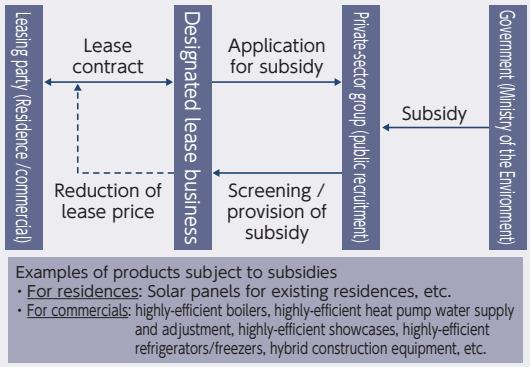
When trying to reduce emissions greatly in the households, commercial, and transport sectors, one of the obstacles that residences and small- and mid-size companies face in particular is the burden of a large initial investment (down payment) that comes along with the introduction of low-carbon equipment. 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

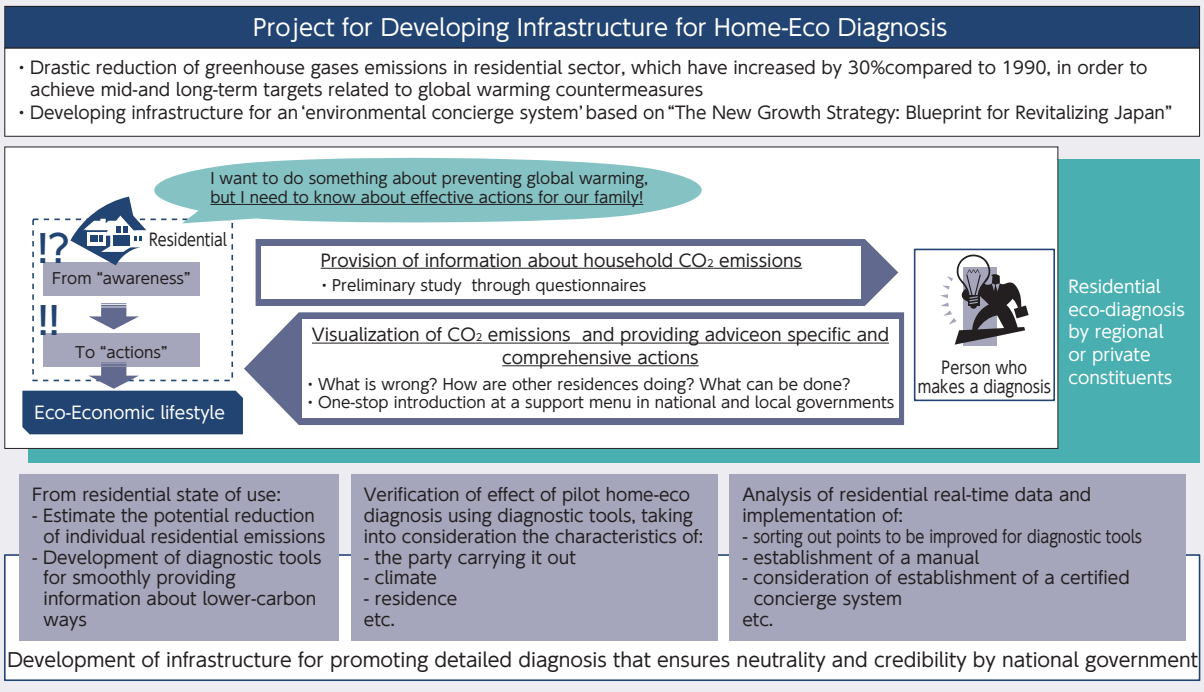
In "The New Growth Strategy: Blueprint for Revitalizing Japan," Cabinet decision in June 2010, the "environmental concierge system" was introduced. In order for households to effectively reduce their CO_2 emissions, it will be necessary not only to promote the purchase and installation of low-carbon 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



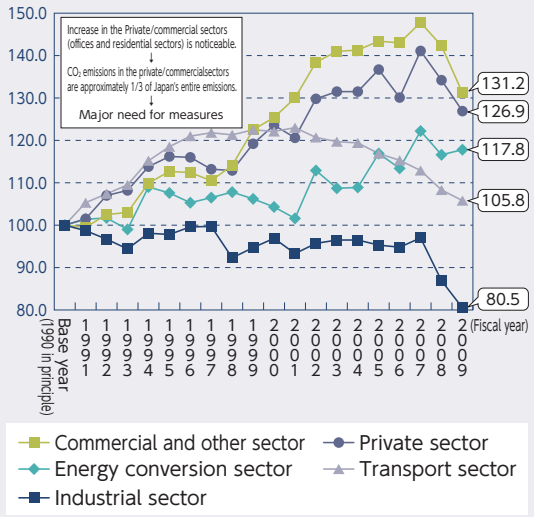
Source: Ministry of the Environment

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

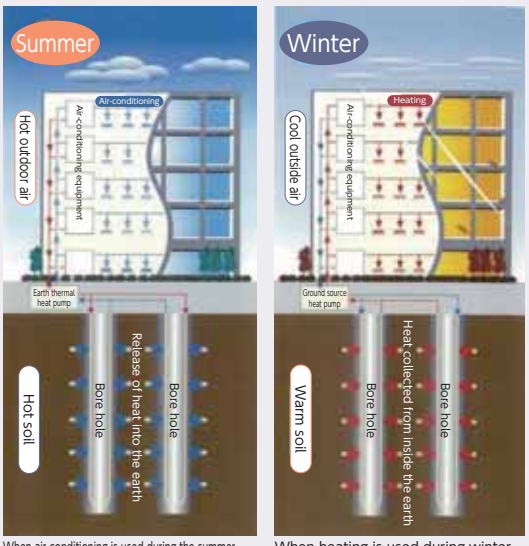
Column

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).

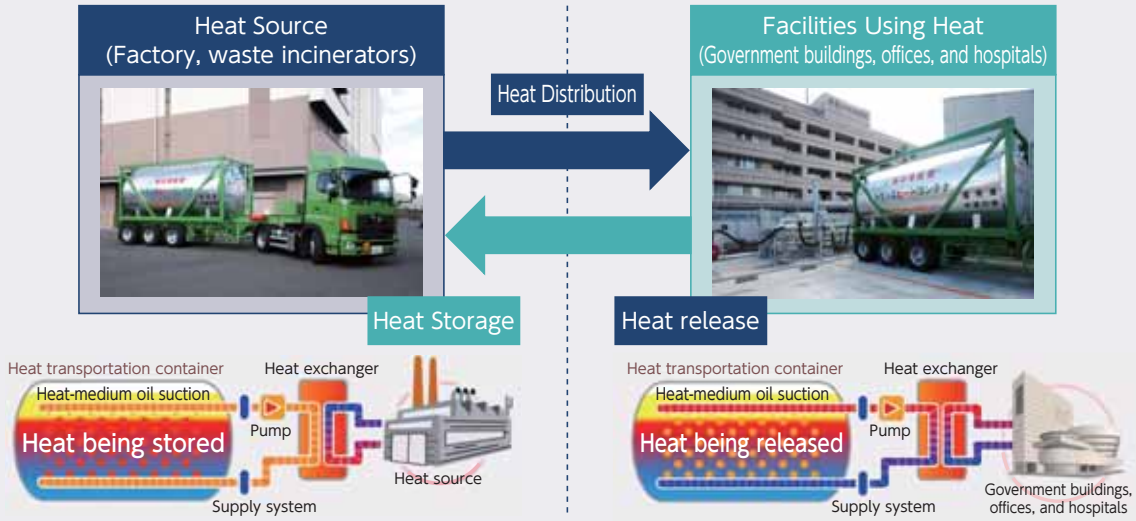
When heating is used during winter, the heat pump collects warm heat from the soil.

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.

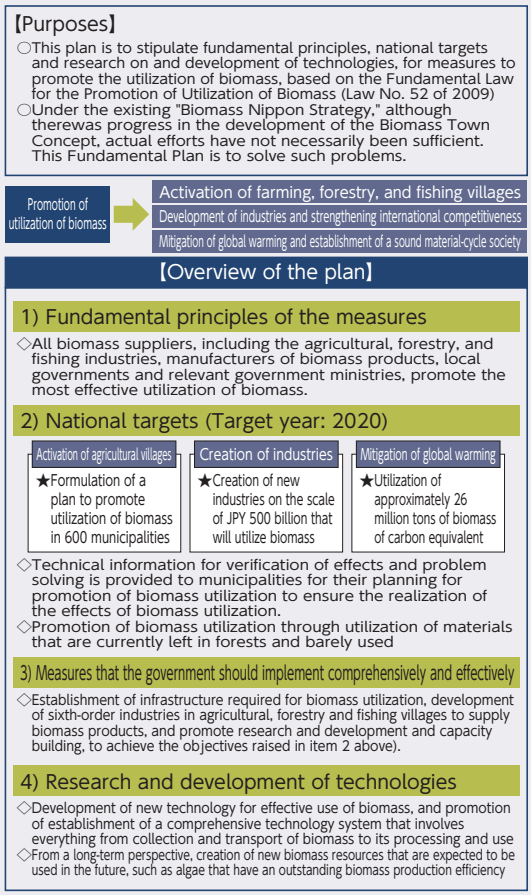
A. Fundamental Plan for the Promotion of Utilization of Biomass

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.

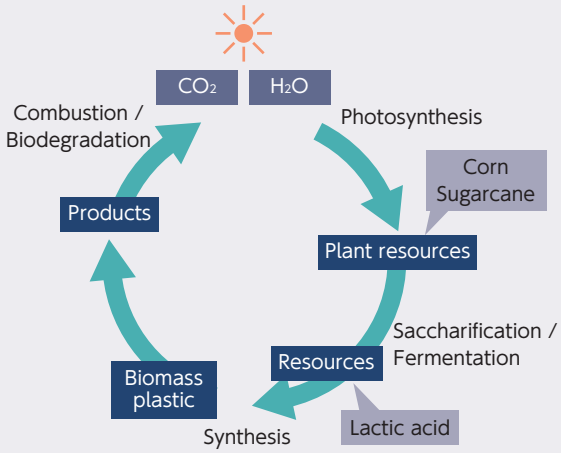
This Fundamental Plan for the promotion of Utilization of Biomass sets numerical targets that should be achieved in 2020 and aims to promote measures for their achievement. First, in order to achieve a "sustainable society with little environmental load", the Plan aims to achieve approximately 26 million 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

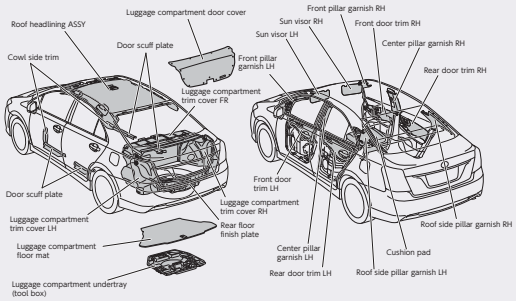
Adoption of Biomass Plastic for Automobiles

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

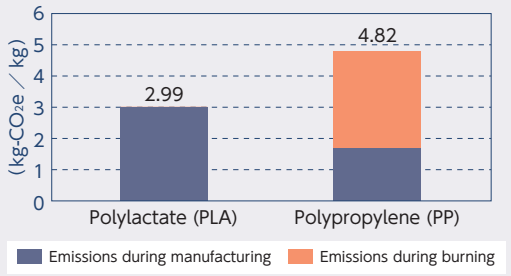
polylactate (PLA), which is currently the most common biomass plastic, it is believed that the CO_2 emissions in the lifecycle can be reduced by approximately 40%. Use of plastic materials for automobiles currently makes up approximately 10% of a car's weight, and supposing that all of that were replaced 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

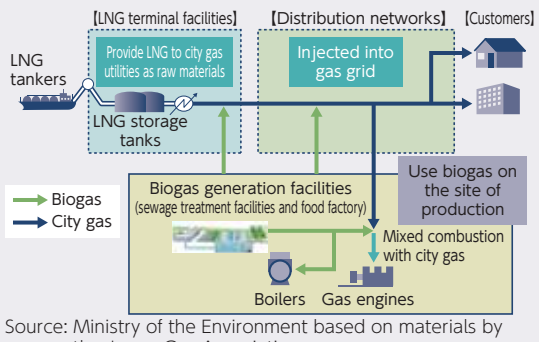
and disposed of within a time period shorter than the petroleum-derived plastic, it may not necessarily lead to a reduction of the environmental load. Therefore, when using biomass plastic it is important to keep recycling and other forms of cyclical use in mind, and we should not produce and dispose 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

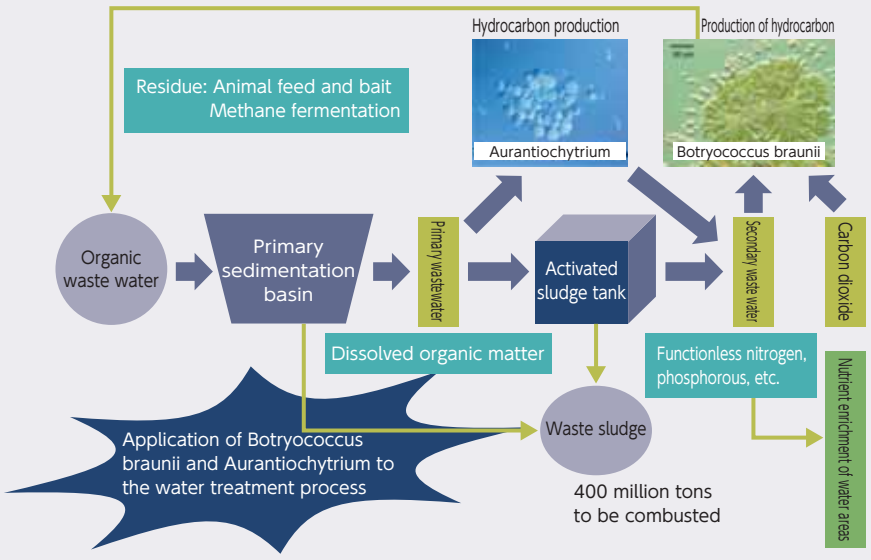


Diagram and photographs provided by Professor Makoto Watanabe, Graduate School of Life and Environmental Sciences, University of Tsukuba.

(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.

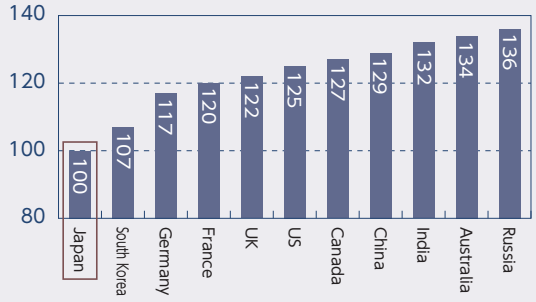
The major energy-saving technologies developed in Japan's iron and steel industry are now widely spread to other countries and are significantly contributing to CO_2 emissions reduction outside Japan. These technologies include the coke dry quenching system and top pressure recovery turbines. Coke dry 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.

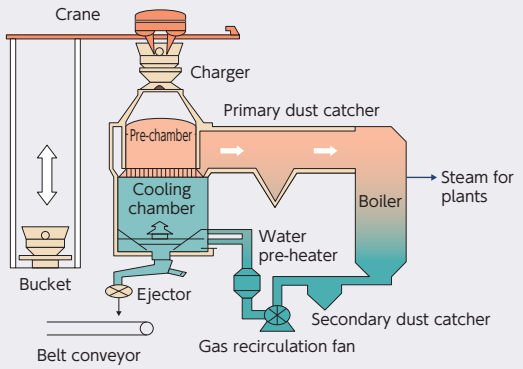
Coal-fired power generation technology includes supercritical pressure power generation and ultra-supercritical pressure power generation. More than 60% of Japan's coal-fired power generation is highly efficient (ultra supercritical pressure or supercritical pressure) power generation. In terms of the 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)

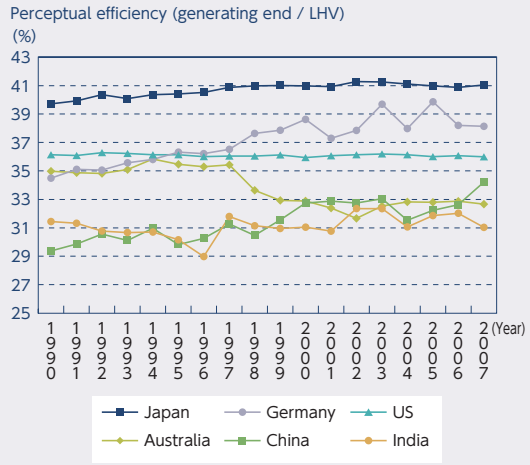
	No. of units	Reduction effects (kt-CO_2/ year)
CDQ (Coke dry quenching)	55	8,620
TRT (Top pressure recovery turbines)	47	7,897
GTCC (Byproduct gas combustion)	24	11,858
Basic oxygen furnace OG gas recovery	17	3,481
Basic oxygen furnace sensible heat recovery	7	848
Sintering exhaust heat recovery	5	725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

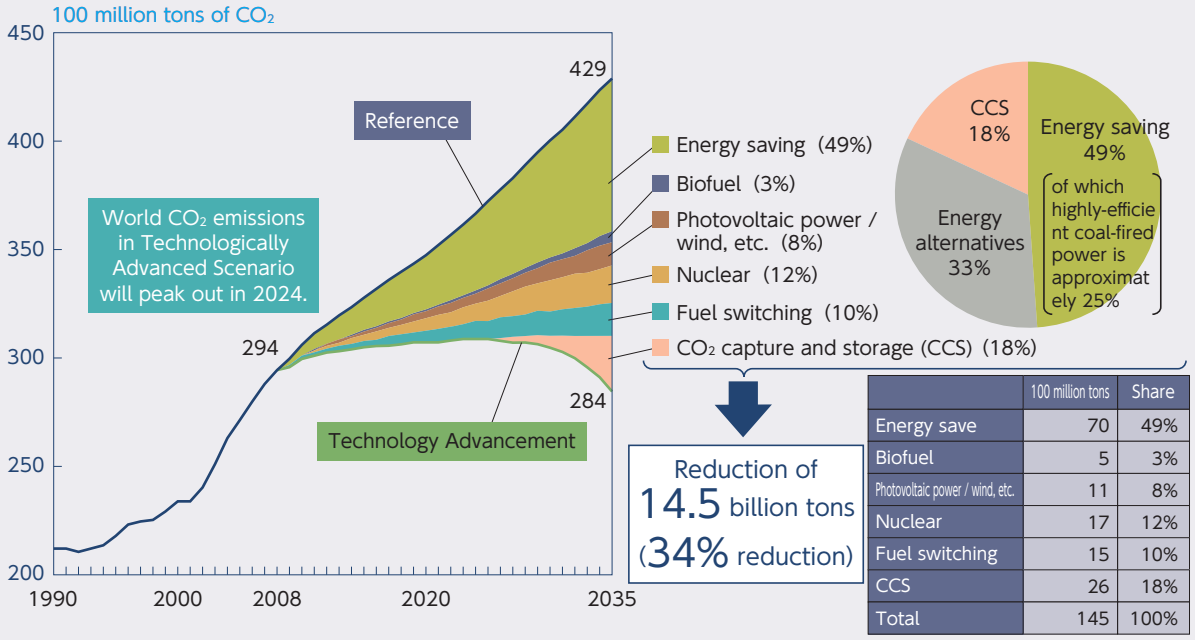
Efforts are also being made to establish technologies for advanced supercritical pressure power generation, integrated gasification combined power, and CO_2 capture and storage (CCS). Advanced supercritical pressure cycle generation is a technology that improves the power generation efficiency of current 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

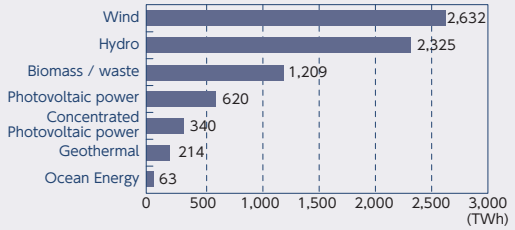
Global Expansion of Japan's Wind Power Generation

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.

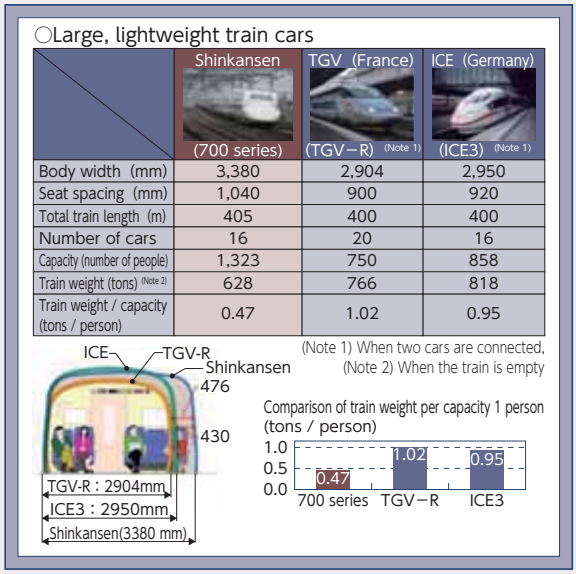
Various technologies are utilized for energy efficiency during its operation. The latest N700 series (which debuted in 2007) adopted a nose shape that has outstanding aerodynamic characteristics (Figure 4-3-5) and a uniform flat structure that has no protrusions or indentations between the train's external 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.

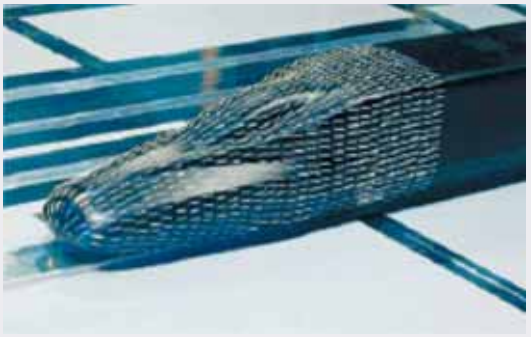
One of the projects involved the cooperation between a Japanese private-sector company and the City of Dalian in China in relation to a smart grid. For this matter, collaboration was made in order to create an advanced smart community in the "Dalian Eco-Tech Innovation City" that is being developed in 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)

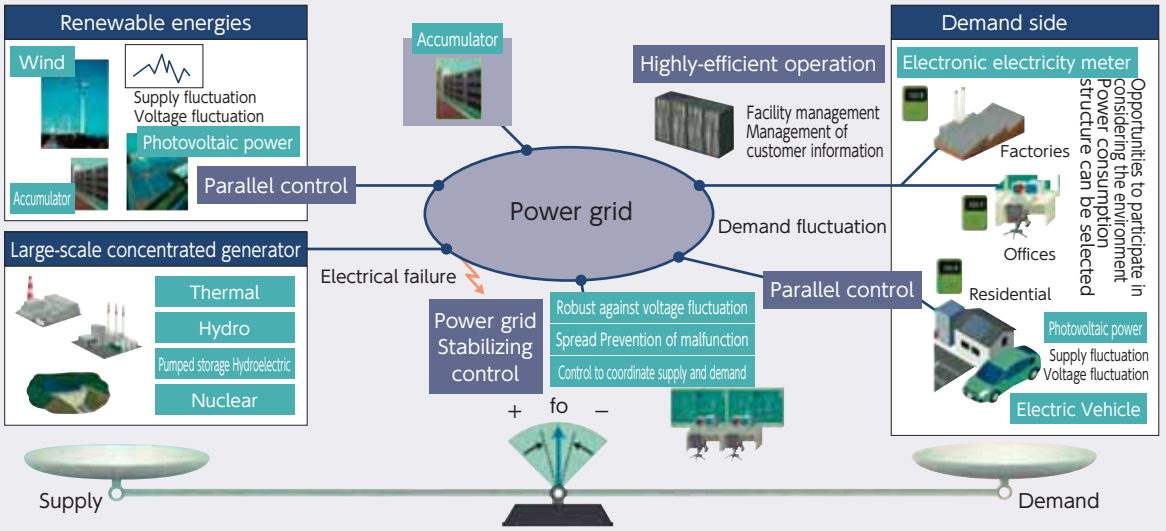
Photograph provided by: Hitachi, Ltd.

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.

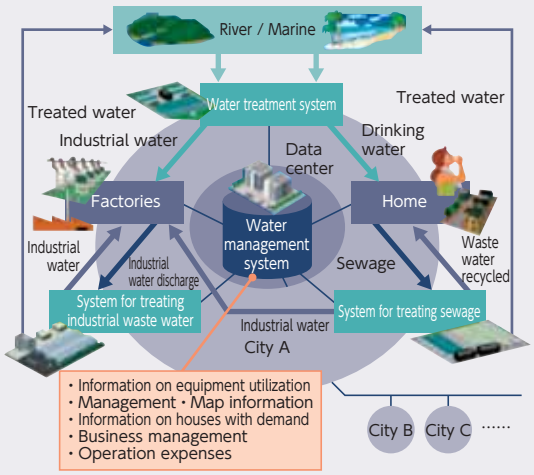
future, the environmental cooperation between China and Japan will be further expanded through the efforts of Japan's private companies that have competitiveness in environment fields.

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

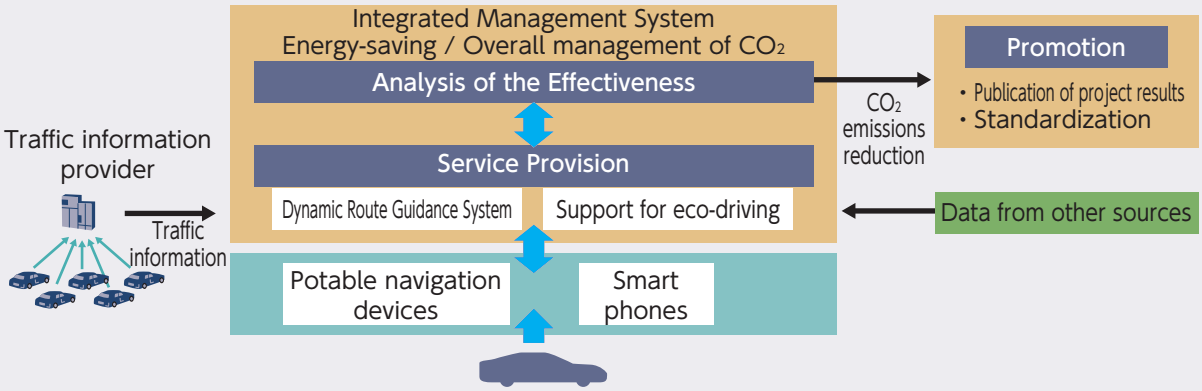
Figure 4-3-25 Diagram of a System Related to Water Circulation



Source: Hitachi, Ltd.

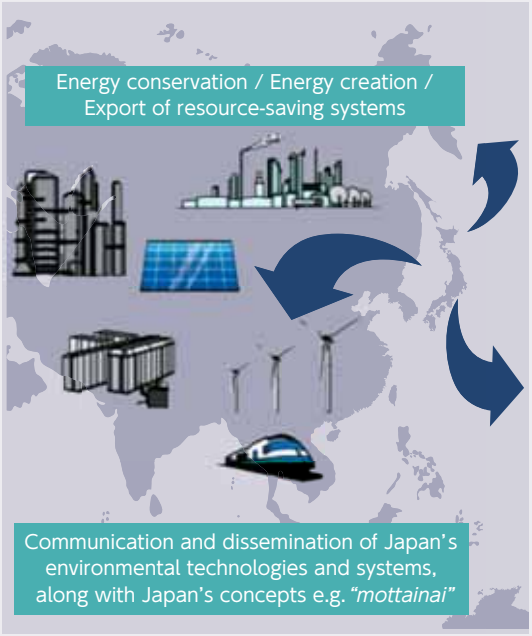
in various ways. It is likely that when Japan introduces infrastructure-related industries as systems to other countries in the future, it will be important to actively utilize the local labor force and also sufficiently provide necessary education. Through such opportunities it will be possible to spread 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.