Chapter 2
World Trends in the Creation of a Low Carbon Society

As we have seen in Chapter 1, global warming is threatening the very foundation of human existence. In the search for a solution to this problem, countries in the world found themselves at a tipping point in human history. They have started to make deep cuts in GHG emissions resulting from fossil fuel consumption, to keep the world's overall emissions at the same levels that can be absorbed by nature, and to create a truly affluent society. In other words, they have taken their first step towards the creation of a low carbon society. Our economic society, which was founded on material expansion, is now headed in a very different direction. This chapter examines how countries in the world are working towards the creation of a low carbon society, from the perspectives of a market-oriented economy and people's livelihoods.

Section 1 Global Warming and Market-oriented Economy

The Stern Review, published in the United Kingdom in 2006, gave a thorough analysis of the relationship between global warming measures and the economy. The report pointed out that climate change was the consequence of emitters' failing to pay the cost of GHG emissions and that change to the economic system is inevitable. It said that global warming has the characteristic of being "…global in its causes and consequences," and that recognition of the problem by the world and collective, cooperative measures will bring substantial economic benefits. The report also warned that if countermeasures were delayed, the cost would be tremendous. It underscored the importance of taking immediate action.

Today, as the world is gaining more awareness of global warming and other environmental problems, the framework of a sustainable society is gradually taking shape. Countries everywhere are making efforts to add economic values without imposing additional impact on the environment. Using a more proactive approach, some countries started to pursue activities aimed at creating a beneficial cycle between the environment and the economy. In other words, improving the environment can stimulate economic growth and revitalizing the economy can improve the environment. This section will explore such trends in the world.

1 Expansion of the Eco-business Market

(1) Growth of the Eco-business Market

In recent years, environment-related businesses are booming. According to an estimate by the Environmental Business International (EBI) in the United States, the global eco-business market was approximately 692 billion dollars in 2006. It has grown about 1.4 times in the decade since 1996 (Figure 2-1-3). Eco-business has a long history in the developed world (including the United States, Western Europe, and Japan), which makes up more than 80% of the market. Eco-businesses in these regions saw much growth in the 1980s, especially in the areas of air pollution, water treatment, and waste, due to the enactment of environmental laws and regulations. In recent years, while these areas have had only relatively moderate growth, areas in energy efficiency and renewable energy aiming at global warming mitigation have become the driving force of growth. Eco-businesses have also made inroads in developing countries, such as in Asia, to offset the growing environmental impact that accompanies the countries' economic growth. Their eco-business market is expected to grow at about 10% annually from now on. According to the EBI estimate, the world's eco-business market has grown 4.7% in 2006 and it will continue to expand in the future.

Based on the OECD environmental categories, the Ministry of the Environment conducts a survey of the sizes of the market and the workforce of eco-businesses in Japan. The result shows that the size of the eco-business

Column

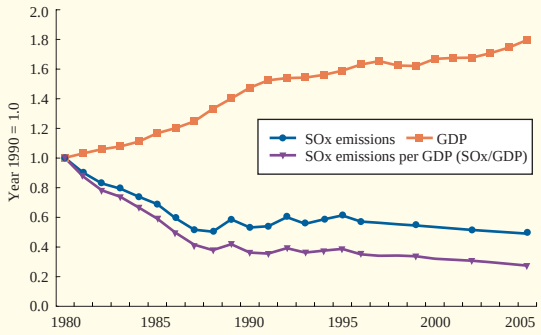
Towards a Society that Achieves the Decoupling of Economic Growth from Environmental Impact

The decoupling of economic growth from environmental impact is one of the main objectives of the OECD Environmental Strategy for the First Decade of the 21st Century, adopted at OECD Environment Ministers Meeting in 2001. "Decoupling" in the environmental field means the situation in which the rate that environmental impact increases is less than the rate of economic growth.

As an example of achieving decoupling, we can point out the relationship between economic growth and SOx emissions in Japan (Figure 2-1-1). In the past, to overcome terrible environmental pollutions and the two oil crises, Japan has promoted pollution control measures and has also pioneered the development and introduction of energy saving, high-efficiency manufacturing equipment. In the case of SOx emissions, Japan achieved a high level of decoupling among OECD countries as a result of the spread of advanced flue gas desulfurization equipment, promotion of low-sulfur fuel utilization, and improvement in efficiency of heat utilization.

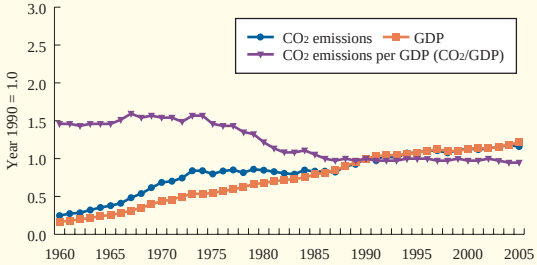
To create a low carbon society while ensuring compatibility between environmental conservation and economic development, it is necessary to transcend the system in which economic growth is always linked to increased fossil fuel consumption, by decoupling economic growth from CO_2 emissions. However, there has been no progress in this direction since the oil crises in the 1970s and 1980s (Figure 2-1-2).

Figure 2-1-1 Changes in SOx Emissions and GDP in Japan



Note 1: SOx emissions are those generated from soot and smoke emitting facilities provided for in the Air Pollution Control Law.
2: GDP = Real price (US$, 2000)
Source: Compiled by the Ministry of the Environment from the data of The World Bank, *World Development Indicator 2007; and the Ministry of the Environment, FY 2005 General Survey of the Emissions of Air Pollutants*

Figure 2-1-2 Changes in CO_2 emissions and GDP in Japan



Source: Compiled by the Ministry of the Environment from the data of IEA, *CO_2 Emissions from Fuel Combustion 2007*

market has grown from 30 trillion yen in 2000 to 45 trillion yen in 2006.

Growth of eco-businesses not only lowers environmental impact but also brings technological innovation, creates jobs, and enhances international competitiveness. Eco-businesses can add tremendous value to the economy. Eco-businesses are expected to continue to grow, connecting the environment with corporate values and profits and helping to realize a society that balances economy with the environment.

(2) Accelerating Development of Renewable Energy

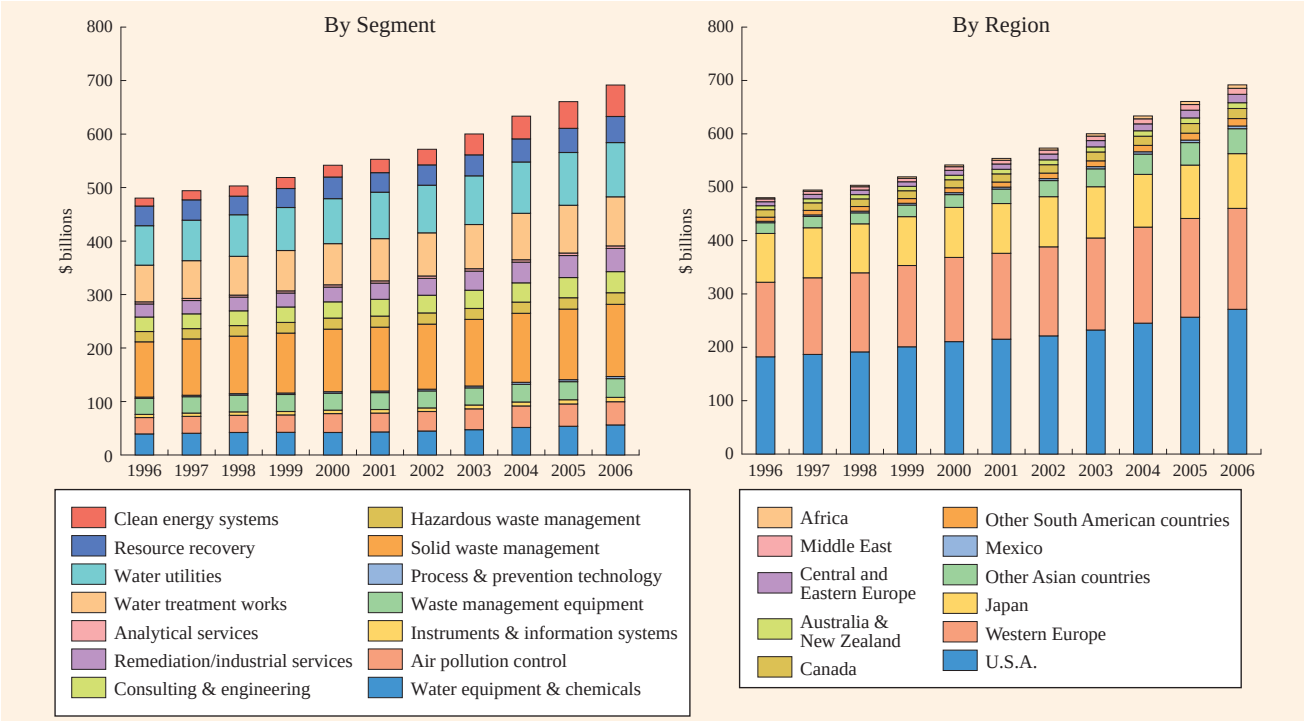
Next, let us look at the accelerating development of renewable energy in the world in recent years.

A Status on the Use of Renewable Energy

To reduce the emissions of carbon dioxide, we must wean ourselves of our dependence on fossil fuels and reexamine our energy sources. In recent years, countries worldwide have actively adopted policies to promote the introduction of renewable energies, accelerating their penetration and diffusion worldwide.

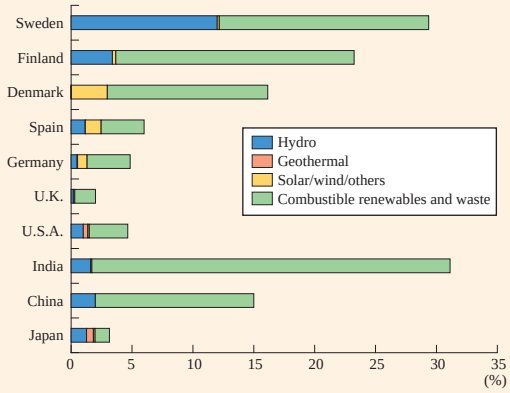
There is no uniform definition for renewable energy internationally. According to the International Energy Agency (IEA), renewable energy is energy resources that are incessantly replenished naturally. It includes energy generated from sunlight, wind, biomass, geothermal heat,

Figure 2-1-3 Trends in Global Environmental Business Market



Note: Environmental businesses are classified into 14 segments in accordance with the U.S. Standard Industrial Classifications (SIC).
Source: Compiled by the Ministry of the Environment from the material published by the Environmental Business International

Figure 2-1-4 Share of Renewables in the Primary Energy Supply (2005)



Source: Compiled by the Ministry of the Environment from the data of IEA, *Energy Balances of OECD Countries 2007, and Energy Balances of Non OECD Countries 2007*

water, and ocean resources.

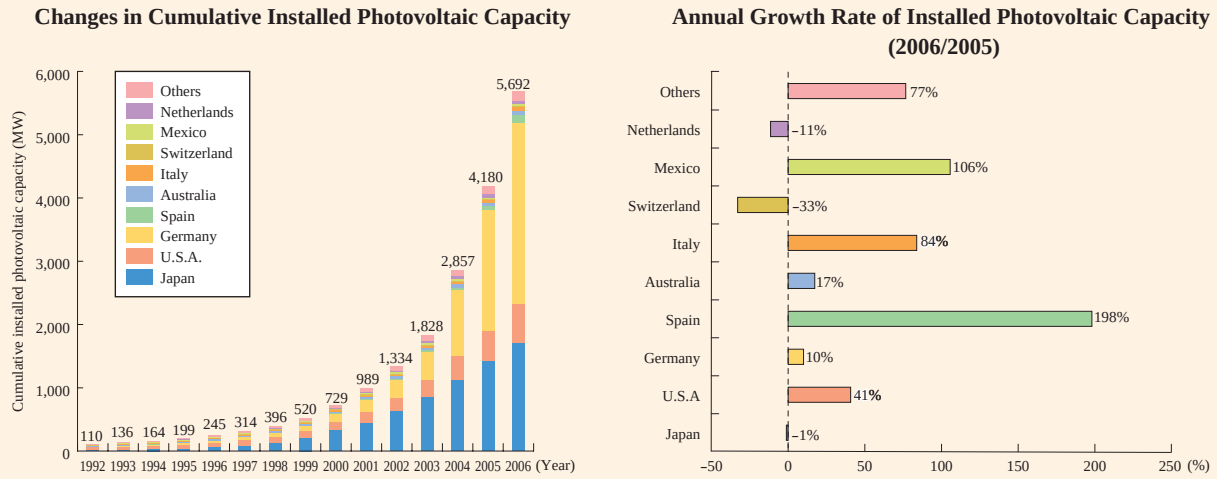
The volume of electricity generated using renewable energy increased in recent years. According to the IEA statistical data, use of wind power increased 24.8% and use of solar power increased 7.6% from 1990 to 2005. Although an across-the-board international comparison is difficult due to differences in the topography and natural environment of countries and the statistical methods they employ, the share of renewable energy in the primary energy supply of various countries in the 2005 IEA statistical data (Figure 2-1-4) shows a high percentage of hydraulic power use in Northern Europe and a high percentage of solar power and wind power use in Denmark, Germany, and Spain.

In solar power generation, Germany surpassed Japan as the No. 1 country in the world both in the cumulative installed photovoltaic (PV) capacity (Figure 2-1-5) and in the yearly installed PV capacity (Figure 2-1-6) in 2006 alone. The cumulative growth in installed PV capacity shows that in 2006, compared to the previous year, Japan had a decrease of 1% while Spain, Mexico, Italy, and the United States increased significantly by 198%, 106%, 84%, and 41% respectively, illustrating the accelerated use of PV power generation (Figure 2-1-5). In the production of PV cells, Japan has been the world's No. 1 producer since 1999. However, production in Japan in 2006 increased by only 11% compared to the previous year, whereas Europe had a substantial increase of 44% (in Germany 99%) and the United States 31%. Production of PV cells also increased drastically in China (203%), Taiwan (108%), and other Asian countries (Figure 2-1-7).

In terms of wind power generation, Germany was No. 1, Spain No. 2, and Japan No. 13 in the cumulative installed capacity as of 2006 (Figure 2-1-8).

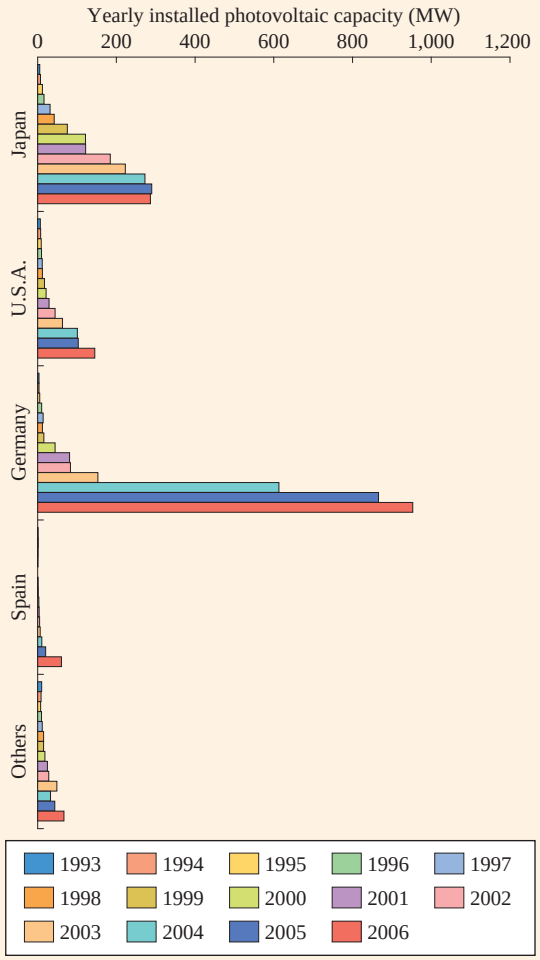
Each country has set installation targets and has stepped up policies to promote the development, introduction, and

Figure 2-1-5 Changes in Cumulative Installed Photovoltaic Capacity and Annual Growth Rate of Installed Photovoltaic Capacity (2006/2005)



Source: Compiled by the Ministry of the Environment from the data of IEA, *TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2006* (2007)

Figure 2-1-6 Yearly Installed Photovoltaic Capacity



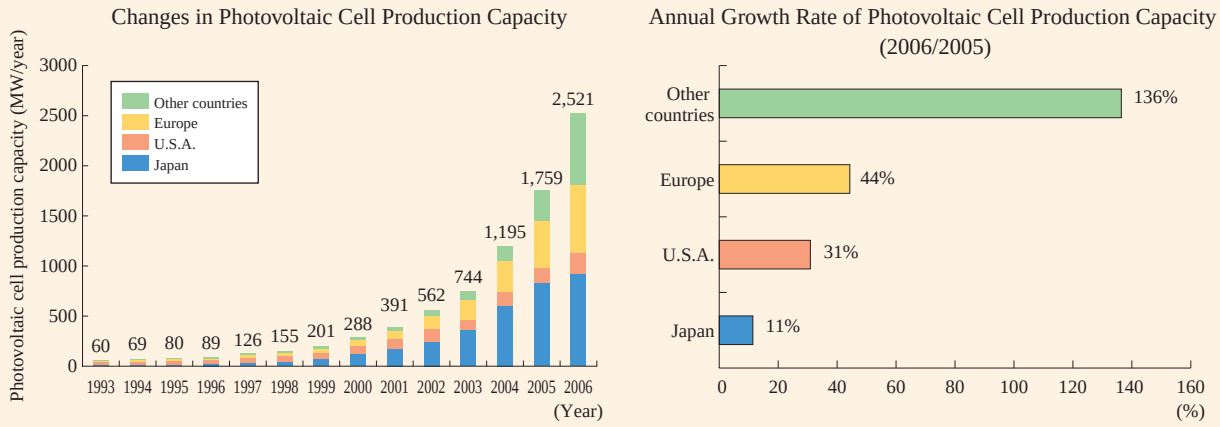
Source: Compiled by the Ministry of the Environment from the data of IEA, *TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2006* (2007)

***Planta Solar de Salamanca*, a large scale PV power generation facilities in Salamanca, Spain (facility area: approximately 360,000m^2)**
(Photo: courtesy of KYOCERA Corporation)

use of renewable energy.

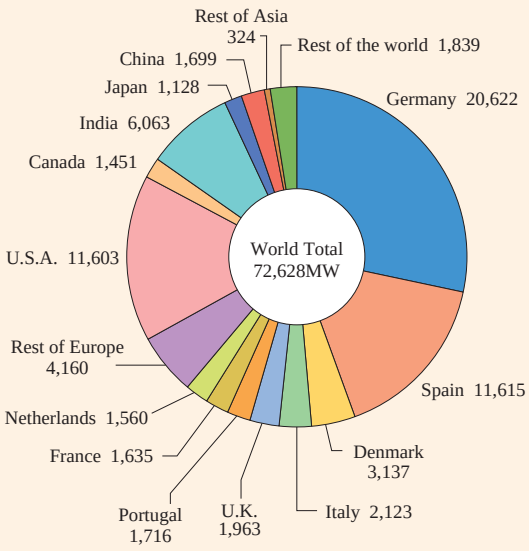
In the EU, the Directive on Electricity Production from Renewable Energy Sources (2001) set a target of using renewable energy to generate 21% of the electricity supply by 2010. Furthermore, the European Commission recommended in January 2008 to increase the percentage of renewable energy in energy consumption from 8.5% in 2005 to 20% by 2020, drawing immense interest to its future policy moves. The use of renewable energy is making inroads with mechanisms that place an obligation to introduce renewable energy. Germany, Spain, and Denmark adopted a feed-in tariff system that mandates utility companies to purchase electricity generated from renewable energy at a fixed price. The United Kingdom and Sweden adopted a Renewable Portfolio Standard (RPS) that places an obligation on electricity supply companies to produce a specified fraction or amount of their electricity from renewable energy sources.

Figure 2-1-7 Changes in and Annual Growth Rate of Photovoltaic Cell Production Capacity



Source: Compiled by the Ministry of the Environment from the data of IEA, *TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2006* (2007)

Figure 2-1-8 Installed Wind Power Capacity Worldwide (2006)



Source: Compiled by the Ministry of the Environment from the data of EurObserv'ER, *WIND ENERGY BAROMETER* (2007)

In the Kyoto Protocol Target Achievement Plan revised in March 2008, Japan set a target of increasing the use of new energy from 11.6 million kl (crude oil equivalent) (29.55 million tons of carbon dioxide equivalent) in FY 2005 to 15.6~19.1 million kl (38.0~47.3 million tons of carbon dioxide equivalent) in FY 2010. Besides providing assistance at various stages of the research and development, validation, and introduction of new energy, Japan also adopted measures to diffuse new energy. For example, utility companies are required to use a certain percentage of new energy in their electricity sales under the Law on Special Measures Regarding the Utilization of New Energy by Electricity Provider (Renewable Portfolio Standard Law, or RPS Law).

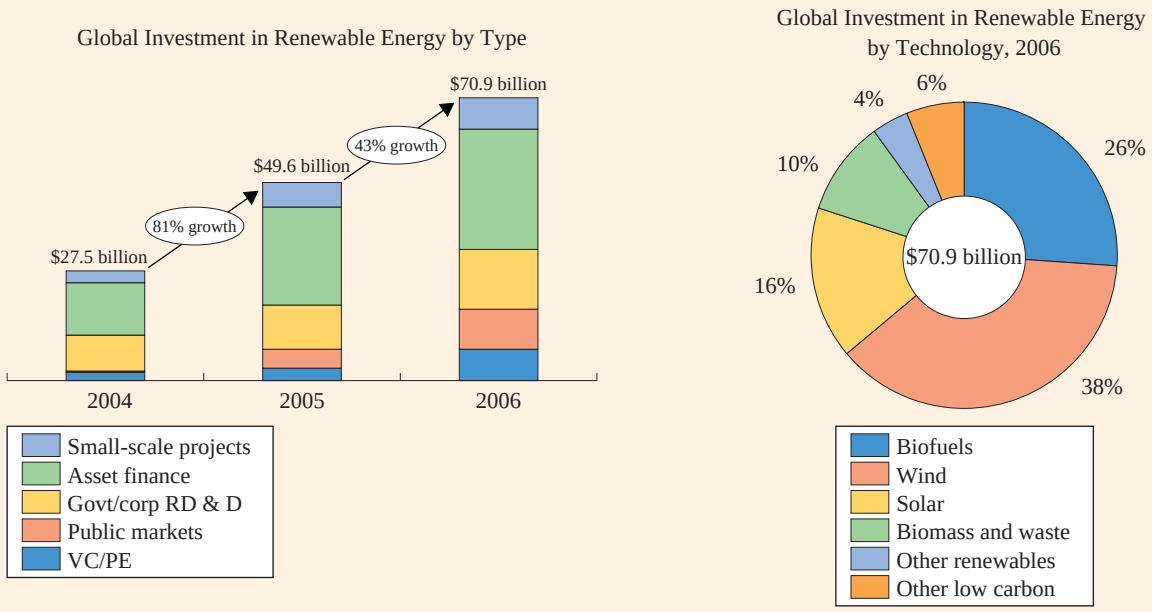
The World Energy Outlook 2007 issued by IEA predicts that the percentage of renewable energy in the world's electricity generation in 2030 will rise from 3,320 TWh (1 TWh = 1 billion kWh) in 2005 to 7,315 TWh in 2030, an increase of 2.2 times. The world has an increasingly greater expectation of renewable energy. Renewable energy sources will be adopted in various corners of the world at an increasingly faster pace in the future.

B Expansion of the Renewable Energy Market

Thanks to policies taken by the countries to support renewable energy and the increasing economic viability of renewable energy against the backdrop of rising oil prices, the world's renewable energy market has seen rapid growth in recent years. Various renewable energy-related businesses, from production to distribution and services, have sprung up.

According to "Global Trends in Sustainable Energy Investment 2007" issued by the United Nations Environment Programme (UNEP), investment in sustainable energy worldwide has become 71 billion dollars in 2006, an increase of 43% from the previous year (Figure 2-1-9). By region, most of the investment is in the developed countries but the amount of investment in the developing countries is also rising, from 15% in 2004 to 21% in 2006 (China accounts for 9% of the investment amount). By type, most of the investment is in wind power (38%), followed by biofuel (26%), and solar energy (16%) (Figure 2-1-9). IEA predicts that 40% of the investment in electricity will be for renewable energy in the next 25 years.

Figure 2-1-9 Changes in Global Investment in Renewable Energy by Type and Percentage of Global Investment by Technology



Note: Grossed-up values based on disclosed deals. The figures represent new investment only, and do not include PE buy-outs, acquisitions of renewable energy projects, nor investor exits made through Public Market/OTC offerings.
Source: SEFI, *New Energy Finance* (2007)

2 Construction of a System Using Economic Instruments and Its Progress

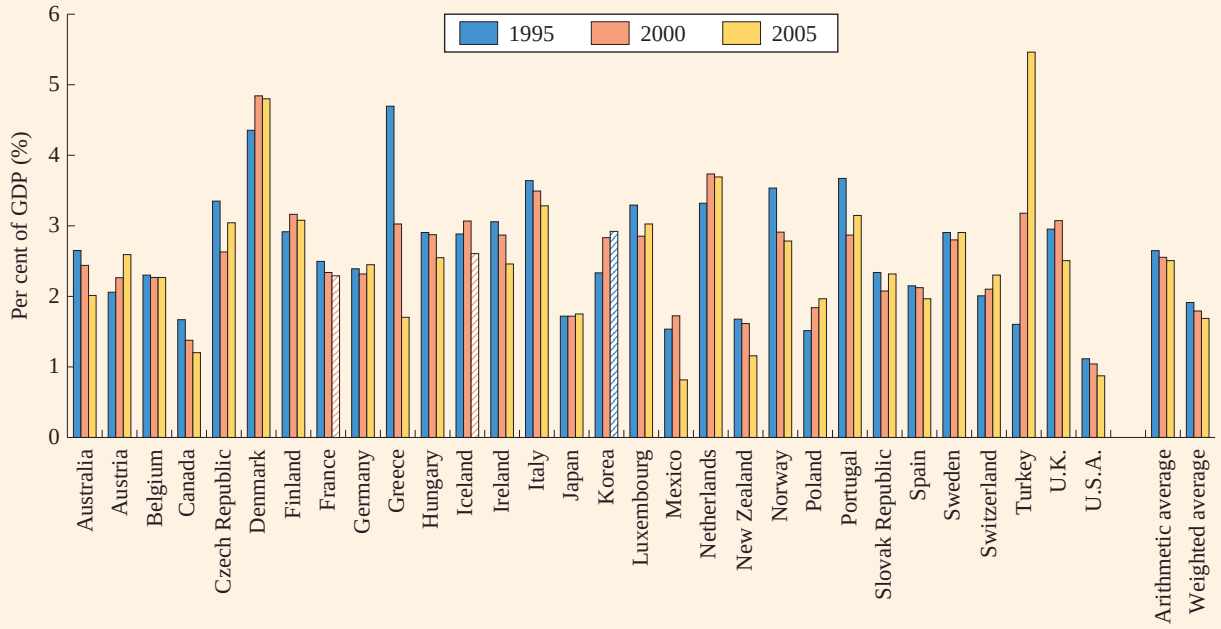
In order to achieve multiple policy objectives, including environmental protection and economic development, and to facilitate our transition to a low carbon society at the same time, we must reduce GHG emissions effectively and efficiently, using a policy mix that integrates and utilizes the characteristics of all measures, including voluntary, regulatory, economic, and informational approaches.

Of these approaches, the economic approach is premised on a market mechanism. It appeals to various actors with economic rationale to limit emissions, by providing them with economic incentives that use taxes and subsidies as instruments. The approach is believed to be effective also as an economic assistance measure for mitigating global warming. In implementation, it is important to apply the concept of policy mix to optimize the effect, minimize the burden on people, and control the administrative and financial costs. Financial assistance shall be administered with consideration to the costs and effects and the efficient utilization of budgets. This approach of utilizing the market mechanism is said to be one of the effective means to ensure the sustainability of socio-economic activities. In recent years, taxation and emission trading systems (to be explained later) have been adopted or reviewed by many countries in the world.

Japan and OECD countries all have environmental taxes. OECD defines “environmental taxes” as mandatory taxes levied by the government on environment-related items (including energy items such as gasoline, transportation items such as automobiles, waste, etc.) and paid unilaterally by taxpayers, no matter what the name, purpose, and usage of the taxes are, or whether the taxes are levied as an economic means for reducing GHG emissions. Environmental taxes in Japan are levied as gasoline excise, light oil delivery tax, automobile weight tax, and so on. According to OECD statistical data, in OECD countries the ratios of environmental tax to total tax revenue amounts in 2004 average 5.8% (6.4% in Japan) and revenues from environmental taxes account for 1.8% of the GDP (1.7% in Japan) (Figure 2-1-10).

As the impacts of global warming are felt worldwide, Japan has introduced taxes as measures to mitigate global warming, including taxes to promote biofuels, tax incentives for upgrading the energy efficiency of existing homes, preferential taxation to eco-friendly vehicles, exceptional treatment for fuel-economy cars in automobile acquisition tax, and a taxation system to encourage investment for reforming the energy supply-demand structure. The Kyoto Protocol Target Achievement Plan,

Figure 2-1-10 Revenues from Environmentally Related Taxes in Per Cent of GDP (1995, 2000, 2005)



Note: For France and Iceland, 2004 figures are used for 2005. For Korea, 2003 figures are used for 2005. The averages are calculated only across the countries for which 2005 numbers are available.
Source: OECD/EEA Database on Instruments Used in Environmental Policy

revised in March 2008, pointed out that environmental tax is an issue for which comprehensive studies must be seriously advanced. Since environmental tax would impose a burden on a wide range of citizens, efforts must be made to obtain the understanding and cooperation of citizens, companies, and other entities, taking into account the specific role of the tax in the context of overall climate change policies and measures, its effects, its impact on national economy and the international competitiveness of industry, as well as the current state of climate change policies and measures in foreign countries, etc..

In Europe, some taxes are levied on gasoline, coal, natural gas, and other fuels for purposes such as to limit carbon dioxide emissions that accompany consumption. For example, Finland introduced a carbon tax in 1990. It was the first country in the world to levy a tax according to the carbon content. Other Scandinavian countries (Sweden, Norway, and Denmark) have also adopted carbon tax by 1992. Germany reformed its environmental tax system in 1999. Besides raising the tax rate for mineral oils such as gasoline, it also introduced a new electricity tax. Since then, the mineral oil tax has been raised in phases as a measure to mitigate global warming. It was reorganized as energy tax in 2006 and coal was newly added as a tax item. Between 1993 and 1999, in 2003, and since 2006, the United Kingdom has raised the hydrocarbon oil tax rates levied on gasoline and other products in phases as a measure to tackle global warming. In 2001, it introduced a climate change tax to include coal for industrial use and other products as tax items. Currently, other countries and regions are in the process of adopting or reviewing the adoption of such taxes to curb the emissions of carbon dioxide and so on.

3 Development of the Emissions Trading Market

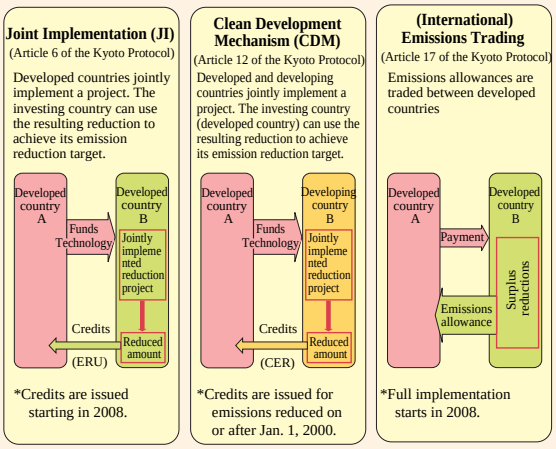
Similar to the environmental tax, emission trading is a price mechanism that enables the economic society as a whole to reduce GHG emissions with minimal cost. After the Kyoto Protocol entered into force in 2005, the Kyoto credit trading is gaining momentum and an emissions trading scheme, the EU Emissions Trading Scheme (EU-ETS), was launched in the EU. The international emissions trading market has grown substantially in recent years. According to a World Bank report, the emissions trading volume was about 3 billion tons (carbon dioxide equivalent) in 2007 and the trading value was 64 billion dollars, twice that of 2006 (Table 2-1-1). A new value,

Table 2-1-1 Carbon Market at a Glance, Volumes & Values

	2005		2006		2007	
	Volume ($MtCO_2e$)	Value (MUS$)	Volume ($MtCO_2e$)	Value (MUS$)	Volume ($MtCO_2e$)	Value (MUS$)
Allowances						
EU ETS	321	7,908	1,104	24,436	2,061	50,097
New South Wales	6	59	20	225	25	224
Chicago Climate Exchange	1	3	10	38	23	72
UK ETS	0	1	na	na		
Sub total	328	7,971	1,134	24,699	2,109	50,394
Project-based transactions						
Primary CDM	341	2,417	537	5,804	551	7,426
Secondary CDM	10	221	25	445	240	5,451
JI	11	68	16	141	41	499
Other compliance & voluntary transactions	20	187	33	146	42	265
Sub total	382	2,893	611	6,536	874	13,641
Total	710	10,864	1,745	31,235	2,983	64,035

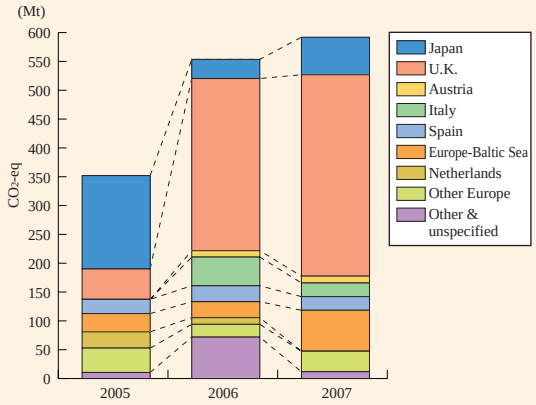
Source: The World Bank, *State and Trends of the Carbon Market* (2007, 2008)

Figure 2-1-11 Trends of Resource Productivity



Source: Ministry of the Environment

Figure 2-1-12 Primary CDM & JI Buyers (as shares of volumes purchased, vintages up to 2012)



Note: CDM here is the primary CDM.
Source: The World Bank, *State and Trends of the Carbon Market* (2008)

which is the amount of CO_2 reduction with a price tag, and a market for trading this value, are now taking shape worldwide.

(1) Current Emissions Trading Markets

The current emissions trading markets include the credit trading market based on the Kyoto Protocol's Kyoto Mechanism, the EU-ETS market, and markets based on various emissions trading systems that exist in different countries and regions.

A Emissions Trading Market under the Kyoto Mechanism

The Kyoto Mechanism is a market mechanism for achieving reduction commitments made by the developed countries that have ratified the Kyoto Protocol. It consists of three approaches: Clean Development Mechanism (CDM), Joint Implementation (JI), and international emissions trading (Figure 2-1-11).

The amount/credits that can be acquired/transferred under the Kyoto Mechanism are assigned amount units (AAUs) that were allocated initially to the Parties of the Kyoto Protocol, emission reduction units (ERUs) issued by JI, certified emission reductions (CERs) issued by CDM, and removal units (RMUs) gained through domestic carbon sink activities.

Currently, CER trading is the most active in the Kyoto Mechanism trading market, accounting for about 90% of all trading. The CDM market has two categories of trading: trading of primary CERs from emission reduction operations and trading of secondary CERs through resale or brokerage of primary CERs.

Japan and Europe purchase the majority of CERs

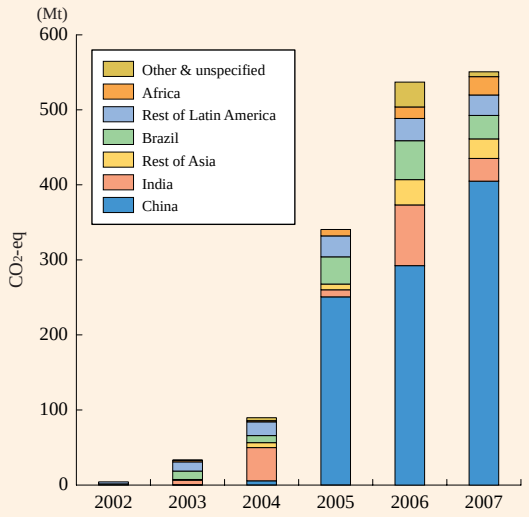
(Figure 2-1-12). The sellers include China, which accounts for 73% of the trading volume (2007), followed by India (6%), with Asia representing about 80% of the market (Figure 2-1-13). Among the registered CDM projects, biomass, hydraulic power, wind power and other renewable energy projects are on the rise (Figure 2-1-14).

B EU-ETS Market

For the EU, the GHG emission reduction target under the Kyoto Protocol is an 8% reduction from the 1990 level (some countries use 1995 as the base year for HFC, PFC, and SF_6). This target is to be achieved jointly by the 15 original EU Member States. EU-ETS is a multilateral emissions trading system for the entire EU region. It was introduced in January 2005 as a means for the EU to achieve the Kyoto Protocol target. Phase I (2005-2007) has ended and Phase II (2008-2012) has just begun (Table 2-1-2).

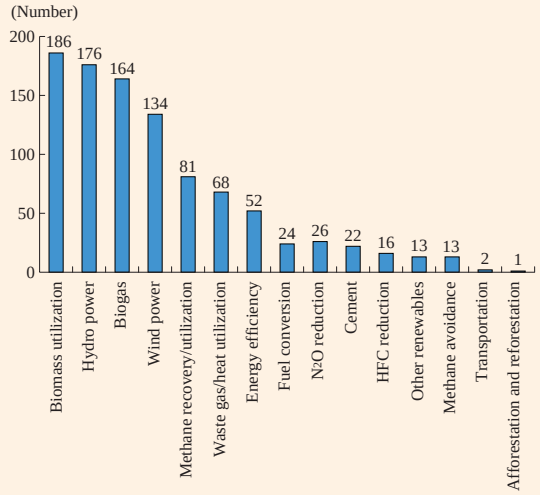
Phase I targeted energy-intensive installations such as power plants, oil refineries, iron mills, cement factories, and large-scale boilers (approximately 11,500 installations, accounting for 49% of carbon dioxide emissions in

Figure 2-1-13 Location of CDM Projects



Note: CDM here is the primary CDM.
Source: The World Bank, *State and Trends of the Carbon Market* (2008)

Figure 2-1-14 Number of Registered CDM Projects by Type



Note: CDM projects counted here are those registered by April 2, 2008 at the CDM Executive Board of the United Nations Framework Convention on Climate Change (UNFCCC).
Source: Compiled by the Ministry of the Environment from the data of The Institute for Global Environmental Strategies (IGES), *CDM Project Database*

Table 2-1-2 Overview of the EU Emissions Trading Scheme (EU-ETS)

	Phase I (2005-2007)	Phase II (2008-2012)
Targeted facilities	Facilities with emissions above certain levels in the industries of energy, iron and steel, cement, glasses, ceramics, and paper and pulp	Countries can expand the scope of facilities targeted
Targeted gases	CO_2	Countries can expand the scope of greenhouse gases targeted
Trading methods	Cap and trade scheme	
Upper limit on auctioning	5%	10%
Emissions allocated to countries	Less than 2005 level: 4 countries More than 2005 level: 23 countries (+8.3% in total compared with 2005)	Less than 2005 level: 16 countries More than 2005 level: 11 countries (-5.7% in total compared with 2005)
Non-compliance penalty	€40/t-CO_2	€100/t-CO_2
Linkage with Kyoto Mechanism	Linking to CER started in 2005	Linking to ERU to start in 2008
CDM/JI utilization	No limit (none accomplished)	Upper limit such as the maximum utilization of 20%

Source: Ministry of the Environment

2005 by the 25 EU Member States). The Member States formulated a national allocation plan (NAP) for assigned amount units. Upon approval by the European Unions' Executive Commission, the EU-Allowances were assigned to these installations. It is a mandatory system for limiting emissions (a so-called cap-and-trade approach). If the actual emission amount from an installation is below the allocated EU-Allowances, the installation can sell these allowances. Conversely, if the actual emission amount of an installation is expected to exceed the allocated EU-Allowances, the facility can reduce its emissions or purchase allowances. Since this system is linked to the Kyoto Mechanism, EU-ETS facilities can also use CERs or ERUs to meet the EU-ETS requirement.

It has been pointed out that allocation in Phase I was quite generous because consideration was given to ensure that the overall emission amount would meet the allocated amounts and that the system would be launched smoothly. For this reason, the EU-Allowances for Phase II have been reduced 5.7% from the actual emissions in 2005, forcing the installations to reduce emissions further.

In January 2008, the European Commission proposed to the European Parliament and the European Council a post-2013 framework to succeed Phase II. Currently, Member States mostly use the grandfathering method to allocate EU-Allowances to targeted installations based on their emissions in the past. The new framework will drastically increase the ratio of the auctioning method, allowing installations to purchase EU-Allowances according to their estimated emission amounts using open bidding. Discussions on institutional schemes to aid sectors facing severe international competition will continue.

C Emissions Trading Systems in Other Countries and Regions

The emissions trading system is also spreading to other countries. New Zealand has adopted an emissions trading system for the forest sector since 2008 and the system is expanding into other sectors. The governments of Australia and Canada have indicated the introduction of such system beginning in 2010. The US Congress has submitted multiple bills for regulating GHG emissions. One of the bills, which centered on the introduction of an emissions trading system, was approved by the Senate Environment and Public Works Committee in December 2007. Some states already have plans to launch such a system. The United States also has a voluntary emissions trading system. The Chicago Climate Exchange (CCX), launched in 2003, is led by the private sector. It has over 300 members, including electric power companies, manufacturing companies, and local governments.

(2) Examining Japan's Emissions Trading System

In FY 2005, Japan's Ministry of the Environment launched the Voluntary Emissions Trading Scheme (J-VETS) with a view to reducing GHGs cost-efficiently and steadily and accumulating knowledge and experience on a domestic emissions trading system. The scheme supports emissions reduction of businesses that reduce GHGs voluntarily and proactively, by providing subsidies for the installation of equipment to limit carbon dioxide emissions, such as improving energy efficiency, in exchange for the businesses' commitment to reduce a certain quantity of emissions. To facilitate achievement of the reduction commitment, this scheme uses a flexible measure that enables trading of the emission units. The first phase (started in FY 2005) ended in September 2007. Japan will review the results in order to enhance the scheme in the future by further expanding membership, diversifying methods of participation, and optimizing validation methods.

The Kyoto Protocol Target Achievement Plan pointed out that a domestic emission trading system should be reviewed in a comprehensive manner. In addition to the perspective of realizing the Government of Japan's medium-term strategies in relation to warming, the review should take into account the 2007 appraisal and verification outcome regarding the significant emissions reduction effect that can be realized from the "expansion and strengthening of voluntary action plans," which is the pillar of industry based countermeasures. The review should be carried out comprehensively, including the wide range of discussion points such as a comparison of the domestic emissions trading system with other methods and their effects, the impact on industrial activities and the national economy, international trends, etc., as well as the appropriateness of the introduction and the appraisal of specific proposals.

In January 2008, the Ministry of the Environment set up the Advisory Committee on the Emission Trading Scheme to review specific ways to design a domestic emissions trading system that can reflect the conditions in Japan. Taking into consideration mainly the emissions reduction after 2013, the Ministry of Economy, Trade and Industry also conducted an in-depth review of economic instruments, including the domestic emissions trading system, at the Study Group for Economic Instruments to Mitigate Global Warming. In the February 2008 meeting of the Council on the Global Warming Issue, which was made

up of well-informed individuals invited by Prime Minister Fukuda, domestic emissions trading system and environmental tax were the agenda items discussed.

(3) Future of the World's Emission Trading Markets

Worldwide, momentum is gathering for the establishment of an international emissions trading market. The EU-ETS is strengthening its ties with emissions trading systems in other countries and regions. Within Phase II, it formed an emissions trading market in conjunction with Norway, Iceland, and Liechtenstein, which are not inside the EU zone. In October 2007, the EU, ten US states, two Canadian provinces, New Zealand, and Norway gathered and launched the International Carbon Action Partnership (ICAP), which adopted a Political Declaration to review establishment of an international market for emissions trading. As more countries and regions are expected to adopt emissions trading systems in the future, we shall keep an eye on their development.

4 Expansion of the Carbon Offset Market

(1) Evolution of the Carbon Offset Market

In recent years, voluntary carbon offset activities are on the rise worldwide. Carbon offset refers to initiatives taken by various actors of the society, including citizens, businesses, NGOs/NPOs, local governments, and the national government, to find out the amounts of their own emissions and to take voluntary actions to reduce them. For emissions that are difficult to reduce, the actors may purchase credits of GHG emissions reduction/absorbed amounts realized at other locations or implement projects or activities to reduce/absorb emissions at other locations to compensate for all or part of their emissions that could not be reduced. Carbon offset activities are popular in the EU, including the U.K., the United States and Australia. Such activities have also made inroads into the private sector in Japan.

Besides credits used by the Kyoto Mechanism, carbon offset also has its own credit, known as Verified Emission Reduction (VER). According to a World Bank survey, the VER market has seen tremendous growth from 2006 to 2007. Compared to the previous year, the world's trading volume has reached 42 million tons (carbon dioxide equivalent) and the amount of trading about 270 million dollars.

Column

Examples of Carbon Offset

In recent years, goods and services utilizing the carbon offset system have been widely available in Japan, and the number of companies strategically commercializing the system is increasing.

The following are examples of such goods and services: a package delivery service for which the user bears part of the cost for CDM credit when purchasing products from specified mail-order companies; travel packages that absorb the cost to offset the CO_2 emitted during the tours through the use of the Green Power Certification System; Carbon Offset New Year's Greeting Cards that donated five yen from the sales price (55 yen) per card to support greenhouse gas reduction, such as through the purchase of CDM credit; leasing services with CO_2 credit for machine tools and vehicles; magazine subscriptions with CO_2 emission rights; and services that enable a company to offset the CO_2 emitted from its offices. With the rise in consumer awareness, the number of these types of goods and services is rapidly increasing.

Family enjoying the "CO_2 Emission-Free Tour"
(Photo: courtesy of JTB Kanto Corp.)

"Green Card" issued with the use of "The *Hikyaku* Express with CO_2 Emissions Credit"
(Photo: courtesy of Sagawa Express Co., Ltd.)

(2) Examining Carbon Offsets in Japan

The Ministry of the Environment launched a study group in September 2007 to study ways to implement carbon offsets and summarized its findings in a guideline "Guidelines for Carbon Offsetting in Japan" in February 2008. The guideline laid out basic principles for implementing carbon offsets, covering subjects such as methods for calculating emissions from carbon offset activities, carbon offset credits, and registration procedures, with a view to enhancing understanding of carbon offsets, building public trust in carbon offset activities, and establishing a foundation for promoting offset activities. In line with the guideline's principles, the Ministry expressed its intention to support and popularize carbon-offset activities, such as by establishing a carbon offsets forum to provide information and consultation services, in order to encourage voluntary emissions reduction activities by the actors that will make up a low carbon society.

5 New Development in the Financial Market

In this chapter so far, we have discussed expansion of the eco-business market and emissions trading market. Today, there is wide perception in the society that a business' response to environmental issues may affect its corporate value. At the same time, financial institutions, which provide funds to businesses, have developed greater interest in the environment.

The financial function, which facilitates economic activities, plays an important role in the creation of a low carbon society. More specifically, if the financial sector takes into consideration not only financial gains for its investment and financing decisions but also social values, such as benefits to the environment, it will change the monetary flow and bring forth immense changes to our economic society.

To promote environmentally conscious investment and financing, companies must make environmental information available to enable investors to make investment decisions from an environmental perspective. The environmental report is one of the tools companies use to disclose environmental information. In recent years, financial statement reports also began to include environmental information.

In view of these trends, we will present examples of environment being used as a criterion in investment and financing decisions.

(1) Socially Responsible Investment on the Rise

Socially responsible investment (SRI) refers to investment made not just from the financial perspective of profitability but also from the perspective of investing in businesses that take a proactive approach in tackling environmental and social issues.

SRI was begun in the 1920s by American churches, which excluded companies that were repugnant to their religious belief or ethical standards from their asset management. Such a selective investment approach, known as negative screening, screened out specific brands and businesses based on religious and ethical reasons. In the 1970s, riding the tide of civil rights and anti-war movements, shareholders actively demanded corporate social responsibility from the companies in which they invested, giving rise to the shareholder proposed SRI approach. Another type of SRI approach also emerged. It was a form of community investment aimed at boosting economic independence by providing low-interest loans to the poor to purchase housing and providing funds to small businesses. Since the 1990s, with the heightening interest in corporate social responsibility, the social activities of companies came under scrutiny and companies that scored high in their social contributions were selected as investment targets, popularizing the use of this social screening approach. Among the social screening approaches, positive screening is gaining wide acceptance today in western countries. It uses a specific standard to evaluate companies that excel in activities tackling social and environmental issues.

International organizations also appeal to investors to take the environment and society into consideration when making investment decisions. In 2006, the UNEP Financial Initiative (UNEP FI), in partnership with the UN Global Compact, issued the Principles for Responsible Investment (PRI), a standard for institutional investors to evaluate their investment. The objective of PRI is to reflect the factors–environment (E), society (S), and governance (G)–in the investment decision-making process of institutional investors worldwide. As of April 2008, 352 institutional investors and asset management organizations (including 13 organizations from Japan) have signed up. The assets managed by these signatories total approximately 13 trillion dollars. In the financing field, the Equator Principles have been adopted. They are a project-financing benchmark for the financial industry to ensure that large-scale projects are carried out with

consideration to the local community and natural environment. As of March 2008, 59 financial institutions in the world (including three institutions from Japan) have registered.

(2) Expansion of the SRI Market

A SRI Market in Western Countries

The scale of the SRI market is greatly different depending on how SRI is defined. Furthermore, each country has a different definition for socially responsible investment.

The scale of the SRI market in the United States, which has a long history of SRI, was approximately 2.7 trillion dollars in 2007 ("2007 Report on Socially Responsible Investing Trends in the United States" issued by the Social Investment Forum Foundation) and it has grown about 4.2 times in the last twelve years. Including only the ones using the environment as the screening standard, investment trusts for individuals totaled 44.5 billion dollars and funds managed by institutional investors accounted for 184 billion dollars. Institutional investors manage 90% of SRI in the United States. One characteristic is that pension funds account for most of the SRI.

In Europe, the SRI market has grown thanks to favorable legislative policies. For instance, in Netherlands, the Green Fund Scheme was adopted as a policy measure utilizing the financial function. It is a scheme in which government-approved green banks provide low-interest savings to individuals to gather funds and provide low-interest financing to environmental protection projects. In return, individuals who furnish the funds receive favorable tax treatment. In 2000, the British pension law was revised. The new law requires pension funds to disclose whether their investment principles have considered the social environment and ethics, as well as the level of consideration in their investment. As a result, the proportion of SRI assets in pension funds increased substantially.

In this way, pension funds in western countries, which manage large sums of assets and have a long-term investment horizon, have started to consider and place emphasis on the environmental efforts of the companies in which they invest their funds. There has been doubt in the past whether SRI can add social value to financial value in the investment while balancing the fiduciary duty of the pension funds to keep the benefits of the pensioners always as their highest priority. In recent years, however, opinions have emerged that favor investment activities made with consideration to the environment (E), society (S), and governance (G) as a means to optimize benefits for the pensioners.

B SRI Market in Japan

In response to the heightening awareness of environmental issues, Eco Fund was introduced in 1999 as one of the investment trust products, which marked the birth of SRI in Japan. The balance of open-type SRI investment trusts in Japan reached 747 billion yen as of the end of September 2007 (from "Japan SRI Annual Report" issued by the NPO Social Investment Forum Japan). Indeed, individual investors investing in investment trusts have been the motive force of Japan's SRI market (Figure 2-1-15). The recent trend in SRI investment trusts indicates that an open-type investment trust known as

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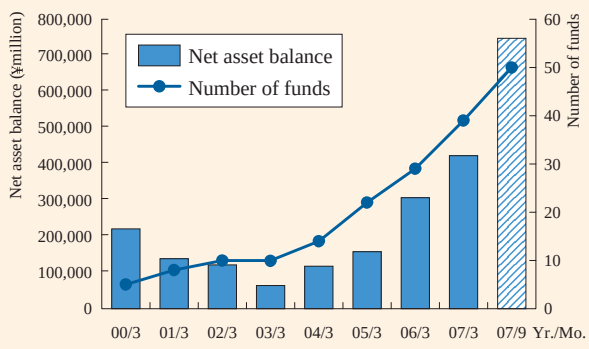
Carbon Disclosure Project

Measures against global warming have become a global issue and directly and indirectly impact the business performances of corporations. To understand how companies respond to and counteract the global warming problem, a non-profit organization together with progressive investors has conducted corporate surveys since 2002. This survey is known as the Carbon Disclosure Project (CDP). While only 221 companies answered the first questionnaire, with the increase in awareness of climate change and the support of investors, participation grew to 1300 companies worldwide for the fifth survey in 2007, including 76% of the 500 largest publicly traded companies in the world by market value (152 Japanese companies were among the 1300). Responses from these 500 firms indicated that although 79% view climate change as a business risk, even more (82%) view it as a business opportunity. Climate change brings physical risks such as loss of assets or delays of projects due to abnormal climate, and also brings regulatory risks such as strengthening of rules and regulations at national and international levels with the aim of GHG emissions reduction. On the other hand, climate change presents business opportunities, and an increasing number of companies view climate change positively, hoping to utilize it for their business benefits. In fact, the findings of the survey are used by 315 institutional investors worldwide (their total assets estimated at US$41 trillion) as practical investment information.

Figure 2-1-15 Changes in the Balance of Publicly-Offered SRI Investment Trust and the Number of Funds



Source: NPO Social Investment Forum Japan, *Japan SRI Annual Report* (2007)

Environmental Theme Fund, which invests in companies with superior environmental technology, has rapidly gained popularity due to higher awareness of global warming issues. Such funds financially support environmental technology and are expected to grow in the future.

The financial assets of individuals in Japan were approximately 1,500 trillion yen (FY 2006). Rather than making investment decisions solely based on financial returns, Japanese investors have begun to be more interested in finding out where and in what their money is being invested. More environmentally conscious financial products that can meet the heightened awareness of the Japanese people are expected to be developed.

(3) Linkage to Diversified Financial Instruments

Environmentally conscious investing and financing can be found not only in SRI but also in venture businesses and real estate development. For example, according to the United States Cleantech Venture Network, the number of investment cases in venture businesses of clean technology to reduce environmental impacts has doubled from 1999 to 2006 in the United States. It has grown into the No. 3 area in overall venture investment, following software and biotechnology.

Besides financial institutions such as banks, voluntary partnerships formed pursuant to the Civil Code can also collect funds from citizens and invest in or finance NPOs or community businesses engaging in environmental activities. Such community funds are attracting attention in recent years.

In the United States, under the Community Reinvestment Act (CRA), private financial institutions are required to make funds available to local communities. The Community Development Financial Institution (CDFI) also provides non-profit financing to local communities.

In Japan, small non-profit banks (the so-called NPO banks) have been established to provide funds to NPOs, citizen groups, and individuals engaging in activities for the local community, welfare, and protection of the environment. Social project funds that gather small investment from citizens to finance specific social projects have also been established in recent years. Such community funds are expected to provide a new flow of capital for community development, including environmental protection, in the future.

Wind turbines constructed by a Citizen's Fund (Left: "*Kazami*" in Asahi City, Chiba Prefecture; right: "*Tenpumaru*" in Katagami City, Akita Prefecture)
(Photo: courtesy of Natural Energy Citizen's Fund Corp.)

Section 2 Global Warming and People's Daily Lives in the World

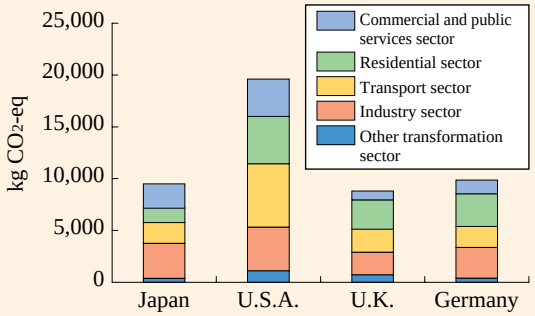
Our daily lives, which consume fossil fuel that causes global warming, exert an impact on the global environment. In order to build a low carbon society, we must give up our energy-intensive way of living and adopt a lifestyle that cherishes energy resources.

1 Residential Energy Consumption in the World

Energy is the foundation of socio-economic activities in every country and it is indispensable in people's daily lives. To mitigate global warming, we need to limit carbon dioxide emissions from energy consumption. In comparing the per-capita carbon dioxide emissions in 2005 of the United States, Germany, the United Kingdom, and Japan, the United States had double the emissions of Japan, especially in the transportation sector, which accounted for 31% of the total emissions. This percentage was extremely high, compared to 25% in the United Kingdom, 21% in Japan, and 20% in Germany. The industrial sector in Japan accounted for a high percentage of 36%, compared to 30% in Germany, 25% in the United Kingdom, and 21% in the United States. On the other hand, the residential sector was low (14%) in Japan, compared with 32% in Germany, 32% in the United Kingdom, and 23% in the United States (Figure 2-2-1).

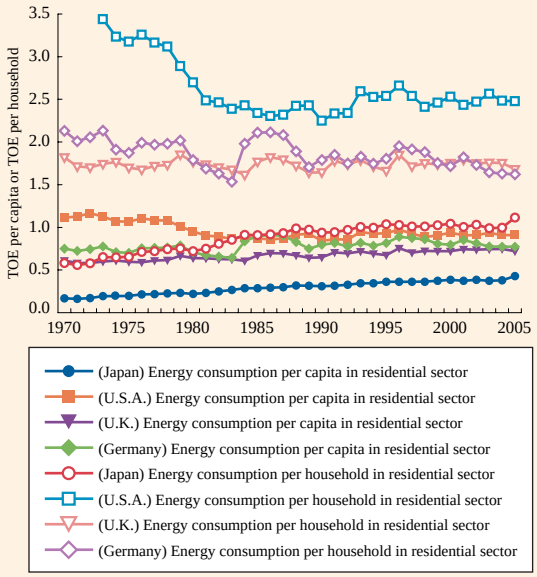
Changes in residential energy consumption per capita and per household (Figure 2-2-2) indicate that energy consumption in Japan, both in terms of per capita and per household, is lower than in other countries. The 2005 per-household energy consumption in Japan was 1.1 TOE (tonnage of oil equivalent), which was relatively low compared to the United Kingdom (1.7 TOE), Germany (1.6 TOE), and the United States (2.5 TOE). We can say that energy consumption per capita in the United States is equivalent to the energy consumption per household in Japan. However, the energy consumption trend in Japan is characterized by a long-term rise. It is important to put a stop to the increase and shift energy consumption to a downward trend.

Figure 2-2-1 International Comparison of Per Capita CO2 Emissions (2005)



Note 1: CO_2 emissions are those allocated to final consuming sectors in proportion to the electricity and heat consumed.
2: IEA allocates emissions to the combined residential/commercial and public services sector as above. The ratio of emissions between the two sectors was estimated to be the same as those before the allocation.
Source: Compiled by the Ministry of the Environment from the data of IEA, *CO_2 Emissions from Fuel Combustion 2007*

Figure 2-2-2 Changes in Residential Energy Consumptions per Capita and per Household in Selected Countries



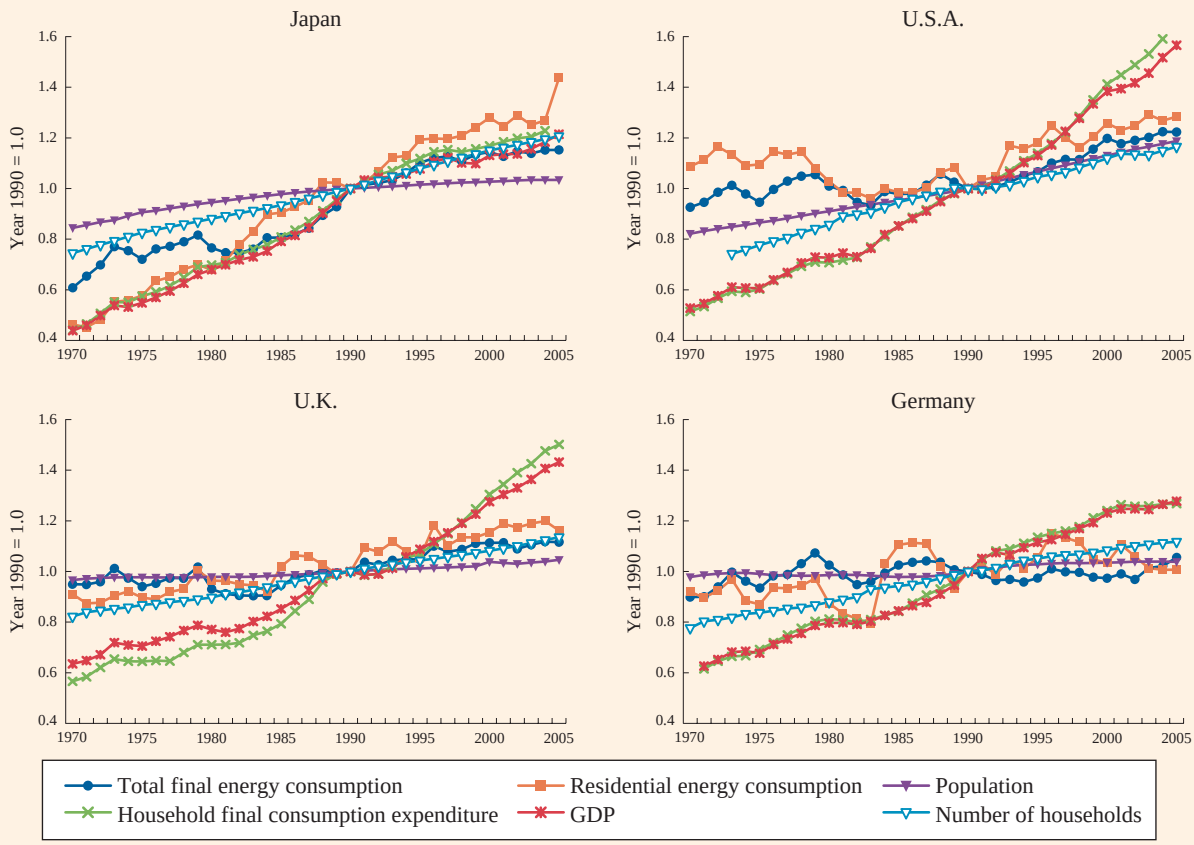
Note 1: Population data is taken from The World Bank, *World Development Indicator 2007*; and the number of households is taken from population census data of each country.
2: TOE = ton of oil equivalent, 1 TOE=10^7 kcal
Source: Compiled by the Ministry of the Environment from the data of IEA, *Energy Balances of OECD Countries 2007*; The World Bank, *World Development Indicator 2007*; and others.

2 Changes in Residential Energy Consumption

Next, let us look at the changes in residential energy consumption. The residential energy consumption in Japan increased substantially from 17,619 KTOE (kilotonne of oil equivalent) in 1970 to 38,123 KTOE in 1990, and to 54,743 KTOE in 2005. The 2005 energy consumption was 3.1 times that of 1970 and 1.4 times that of 1990. Using 1990 as the base year (1.00), Figure 2-2-3 shows the changes in residential energy consumption and changes in related indexes. The figure shows that the 2005 residential energy consumption in Japan has increased 44% from the base year; its percentage increase is especially high, compared to the other three countries (28% increase in the United States, 16% increase in the United Kingdom, and 0.7% increase in Germany). The final energy consumption of Japan has been on the rise consistently. The rate of increase in residential energy consumption has, however, surpassed the rate of increase in final energy consumption (in 2005, 15% increase from the base year) since 1982. In tandem with growth in GDP, household consumption expenditure has also increased. However, the rate of increase in residential energy consumption in Japan has also surpassed the rates of increase in such economic indexes. The population in Japan has started to drop beginning in 2005 but the number of households continues to rise. The year 2005 had a 21% increase, which was greater than the increases in the other three countries (17% increase in the United States, 14% increase in the United Kingdom, and 12% increase in Germany).

These data show that residential energy consumption in Japan has increased drastically due to (1) increase in per-household energy demand (increase in per-household energy intensity) for convenience and amenity as well as (2) increase in the number of households. The number of

Figure 2-2-3 Changes in Residential Energy Consumption and Related Indicators in Selected Countries



Note 1: Data on Population and household consumption expenditure are taken from The World Bank, *World Development Indicator 2007*.
2: The numbers of households are taken from population census data of each country. As for Japan, the numbers of households for 1970 and every 5 years after that are taken from population census, and those for other years are estimated by the Ministry of the Environment.
3: GDP and household final consumption expenditure are in real price (US$, 2000).

Source: Compiled by the Ministry of the Environment from the data of IEA, *Energy Balances of OECD Countries 2007*; The World Bank, *World Development Indicator 2007*; and others.

households in Japan is projected to peak in 2015 and then decreases; the upward trend in the number of households is estimated to continue until then ("Household Projections for Japan" issued by the National Institute of Population and Social Security Research in March 2008). As the number of households will continue to rise for some time, we must reduce the energy consumption per household in order to limit residential energy consumption.

Let us look at the other three countries. In the United Kingdom, the final energy consumption increased slightly (12%) and the residential energy consumption has increased 16% from the base year. However, compared to the rates of increase in economic indexes such as the GDP (43% increase) and household spending expenditure (50% increase), the rate of increase in energy consumption is relatively small.

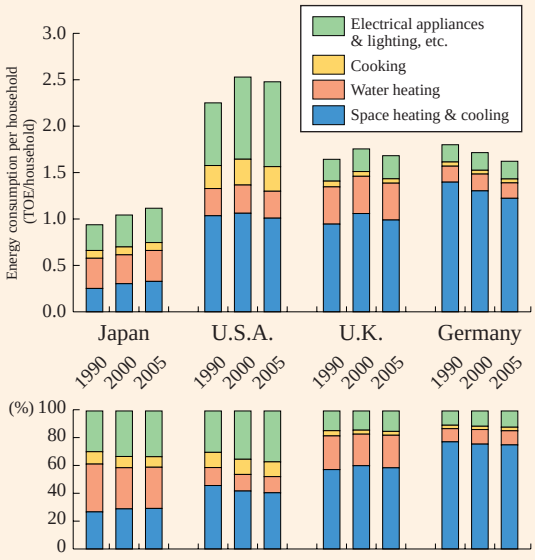
In Germany, the residential energy consumption in recent years is approaching the level of the base year.

In the 1980s in the United States, along with the annual increase of 0.16% in the final energy consumption, the residential energy consumption also increased at a similar rate. This is due to the fact that the high cost of energy resulting from the oil crises kept fuel consumption, mainly petroleum, at a steady level, and that the per-household energy intensity improved. However, lower oil prices and brisk economic growth in the 1990s greatly boosted the energy use including the residential energy consumption.

3 Residential Energy Consumption Based on Different Usages .....

The composition of residential energy consumption in the world differs depending on climate, living standard, lifestyle, and culture. Here, we review measures taken by different countries to improve the per-household energy intensity, with focus on the usages of energy in household.

Figure 2-2-4 Changes in Per-Household Energy Consumption by Usage in Selected Countries



Note: Electrical appliances & lighting, etc.: TV sets, refrigerators, personal computers, etc.
Cooking: heat sources for cooking, etc.
Water heating: bath, shower, etc.
Space heating & cooling: air-conditioners, heaters, etc.

Source: Compiled by the Ministry of the Environment from the data of Enerdata, *Odyssee Database* (March, 2008); IEA, *Energy Balances of OECD Countries 2007*; US-EIA, *Annual Energy Outlook 2004*; The Institute of Energy Economics, Japan, *2008 EDMC Handbook of Energy & Economic Statistics in Japan*; and others

As shown above, the per-household energy consumption in Japan is lower than in other western developed countries.

Japan's per-household energy consumption by usage in 2006 shows that 35.1% was used for power/lighting, etc., 31.2% for hot water, 23.7% for heating, and 7.9% for cooking, and 2.2% for air-conditioning. The national average shows that most of the energy consumed was for household electrical appliances and hot water. In comparison, the United Kingdom and Germany have extremely high energy consumption for heating (Figure 2-2-4).

The per-household energy consumption for heating in the United Kingdom and Germany is over three times that of Japan, and this is the major cause of difference among the countries in per-household energy consumption. Although the need for heating differs depending on the winter temperature, different heating systems also account for the difference in energy consumption. In western countries, many buildings are heated constantly using a central heating system.

(1) Measures to Improve the Energy Efficiency of Buildings

A Measures in the EU

Since a great part of the residential energy consumption in Europe is for heating, household energy conservation measures place an emphasis on insulating buildings to improve energy efficiency. Because central heating is an integral part of the building and is very common in Europe, improving heating efficiency must be carried out as part of building renovation, rather than just replacing individual devices. Most buildings were built a long time

ago and the equipment used in them is old. Improving energy efficiency by insulating old buildings and replacing old equipment with new heating units are expected to reduce energy consumption drastically.

In the EU, many countries are taking measures in order to comply with the 2002 EU Directive on the Energy Performance of Buildings. It requires Member States to introduce the following domestic systems by 2006: (1) setting of minimum standards of energy efficiency in new houses and buildings, (2) setting of minimum standards of energy efficiency in the renovation of large-scale houses and buildings, and (3) introducing an energy certification system for houses and buildings. The energy certification system for buildings requires the owner to prepare and present an energy efficiency certificate when constructing, selling, or leasing buildings. Providing consumers with various data on energy efficiency will add energy efficiency as a criterion in the decision-making of consumers. It also gives owners incentive to make the buildings more energy efficient. The 2006 EU Action Plan for Energy Efficiency points out that EU has the potential to reduce 20% of its energy consumption by 2020 by improving energy efficiency and that 11%, over half of the reduction, can be achieved by improving the energy efficiency of buildings.

Besides using regulatory measures in accordance with the EU Directive, Member States also implement various measures to help enhance the energy efficiency of buildings, including using subsidies and taxation to entice compliance by energy providers and voluntary actions from consumers.

For example, the United Kingdom requires its utility companies to assist consumers in energy conservation measures, such as insulation, to achieve the energy conservation target mandated by the country in accordance with the energy efficiency commitment (EEC). Germany focuses on providing assistance through policy-based finance. For instance, through a financing program that derives certain amount of funds from environmental tax, KfW Förderbank, a representative policy finance institution in Germany, offers low-interest loans to help insulate buildings, replace old heating equipments, and install renewable energy equipment to support energy conservation.

B Measures in Japan

Japan will also continue to take measures to secure the necessary living standard and at the same time enhance the energy conservation function of houses and buildings. In addition to enforcing energy-saving measures for new construction, the Kyoto Protocol Target Achievement Plan also promotes renovation to enhance the energy conservation function of existing houses and buildings.

In terms of measures for new construction, Japan plans to amend the Law concerning the Rational Use of Energy to expand the requirement to report energy conservation measures for houses and buildings to small and mid-sized houses and buildings (smaller than 2,000 m^2). The government also plans to issue orders to owners of large-scale houses and buildings (over 2,000 m^2) found to have insufficient energy conservation measures.

Other measures are being taken to promote energy-efficient housing. They allow communities to employ creative means, such as utilizing loans, regional housing subsidies, support systems for Local Council for Global Warming Measures, etc.

The government is also making an effort to set up a system to promote renovation that improves the energy efficiency of existing housing stock, including establishing preferential taxation treatment for energy-efficient upgrades of existing housing, such as the installation of double sash windows.

To help consumers choose energy-efficient housing, the government plans to promote the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) for buildings and development of comprehensive methods to evaluate the energy efficiency of buildings, including housing equipment and facilities. The government will promote the provision of information to consumers through evaluation and labels of energy conservation performance.

(2) Measures and Challenges to Improve the Energy Efficiency of Household Electrical Appliances

A Measures Based on the Top Runner Standard

Japan's per-household energy consumption for power/lighting, etc. is high, at about twice the level of that of Germany and about 1.5 times that of the United Kingdom (Figure 2-2-4). To advance energy conservation technology and enhance the energy efficiency of machinery and equipment, Japan put in place a regulatory standard (Top Runner Standard) to promote improvement in the energy conservation performance of each type of energy-intensive device. The Top Runner Standard refers to the energy conservation standard for each type of energy-intensive device (designated devices) specified by the Law concerning the Rational Use of Energy. It is set above that of the commercial product that has the highest energy conservation performance (Figure 2-2-5) at the

time when the energy conservation standard for that type of device is set. To date, 21 devices have been specified. The energy efficiency of individual devices has steadily improved. Japan plans to extend the Top Runner Standard to cover more products, expand the scope of coverage of the currently specified products, and strengthen the standard.

B Rising Energy Consumption from the Use of Household Electrical Appliances.

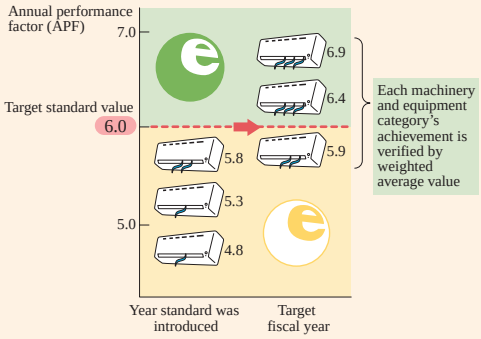
Despite measures to improve the energy efficiency of individual devices, changes in residential energy consumption by usage indicate that Japan has experienced a relatively large increase in energy consumption for power/lighting, etc. in FY 2006 compared to the developed countries in the western world. Specifically, energy consumed for lighting and household electrical appliances increased 50% compared from the base year, and it far exceeds the energy consumption increase of other usages (13% increase for hot-water supply, 21% for heating, 10% for cooking, and 26% for air-conditioning).

(A) Increase in Energy Consumption due to Increase in the Number of Devices

The number of household electrical appliances owned per household in Japan is on a rising trend. The average ownership of air-conditioning units and televisions, in particular, exceeds 2.5 units per household. Although the shares of new devices, such as personal computers, toilet seats with warm water bidets, and DVD recorders, are not

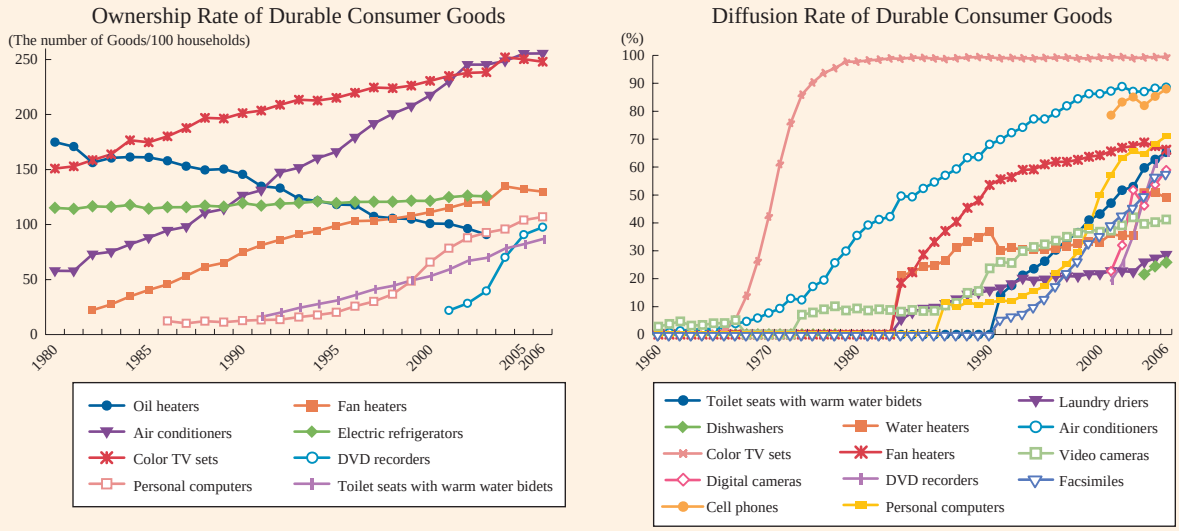
Figure 2-2-5 Top Runner Target Machineries and Equipment (21 Items) and an Example

1. Passenger vehicles
2. Freight vehicles
3. Air conditioners
4. Electric refrigerators
5. Electric freezers
6. Electric rice cookers
7. Microwave ovens
8. Fluorescent lights
9. Electric toilet seats
10. TV sets
11. VCRs
12. DVD recorders
13. Personal computers
14. Magnetic disk units
15. Copying machines
16. Space heaters
17. Gas cooking appliances
18. Gas water heaters
19. Oil water heaters
20. Vending machines
21. Transformers



Note 1: Target standard value for cooling-cum-heating air conditioners of non-ducted wall-mounted type whose cooling capacity is over 3.2kW up to 4.0 kW (free-dimension type)
2: APF (annual performance factor) = Total cooling/heating capacity required in one year/electricity consumed in a specified period
Source: The Energy Conservation Center, Japan, *Energy Saving Performance Catalogue (Winter, 2007)*

Figure 2-2-6 Changes in Ownership Rate and Diffusion Rate of Major Durable Consumer Goods in Japan



Source: Compiled by the Ministry of the Environment: For ownership rate, data was taken from the Institute of Energy Economics, Japan, *2008 EDMC Handbook of Energy & Economic Statistics in Japan*, and for diffusion rate, from the Survey of Consumer Behavior conducted by the Cabinet Office in March 2007

substantial at this time, the energy consumed by such devices has been rising in recent years (Figure 2-2-6). The increase in the number of these devices is the major cause of the increase in per-household energy consumption. In addition, as televisions and refrigerators become larger and have multi-functions, energy consumption also rises accordingly.

(B) Increase in Energy Consumption due to Changes in Lifestyle

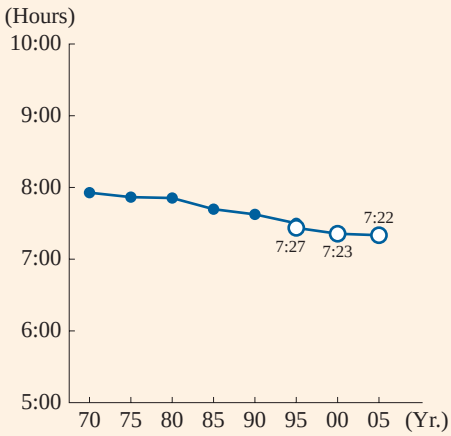
The rise in energy consumption is also said to have been caused by people's increasingly late-night lifestyles. According to a time-budget survey of the Japanese people by the NHK Broadcasting Culture Research Institute, the sleeping hours of the Japanese have been on a long-term decline since 1970 (Figure 2-2-7). In many ways, the longer hours of using household electrical appliances have led to the increase in residential energy consumption.

(C) Increase in Energy Consumption due to Changes in Household Composition

As mentioned earlier, the number of households in Japan, relative to other countries, has increased substantially from the base year. Changes in the number of persons per household in Japan show a decrease from 3.4 persons in 1970 to 2.6 persons in 2006, even fewer than the 2.7 persons in the United States. Although Japan has not reached the levels of the United Kingdom (2.3 persons) and Germany (2.1 persons), the number of members per household has been decreasing since 1990 due to low birth rate, aging population, nuclear families, increase in separate living among family members, and increase in single-person households as a result of late marriage and tendency to remain unmarried. Consequently, the number of persons per household has decreased drastically, at a pace much faster than in the other three countries (Figure 2-2-8).

A survey that studied the relationship between the num-

Figure 2-2-7 Changes in Hours of Sleep of Japanese People (National Average, Weekdays)



Source: NHK Broadcasting Culture Research Institute, *Time Use Data of Japanese People 2005* (2006)

Figure 2-2-9 Per-Capita Energy Consumption per Number of Household Members in Japan

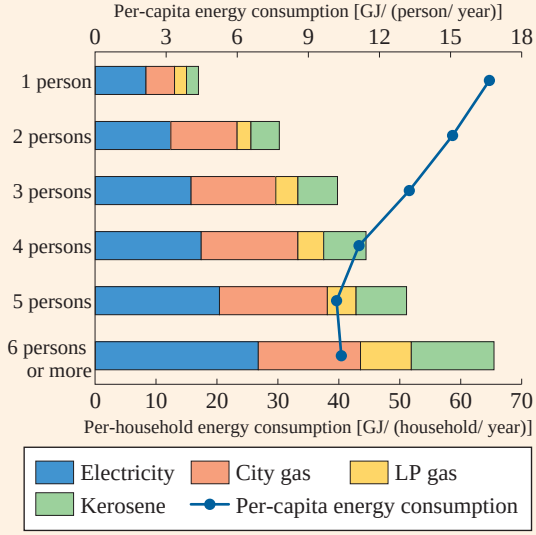
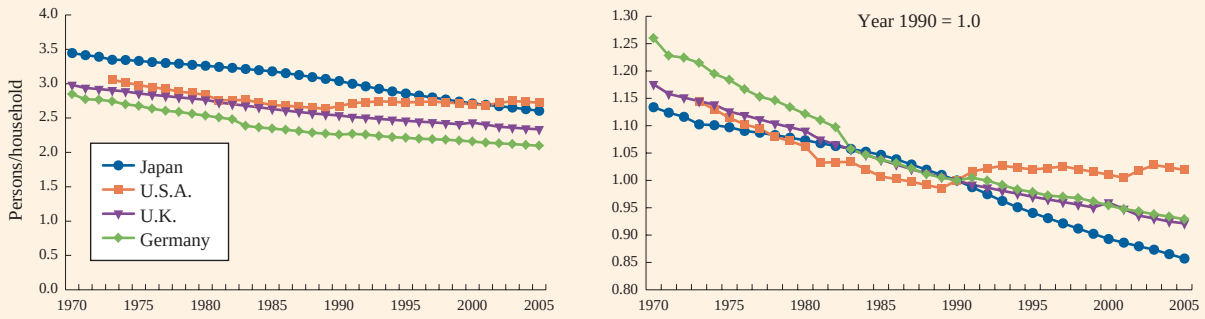


Figure 2-2-8 Changes in the Numbers of Family Members per Household in Selected Countries



Source: Compiled by the Ministry of the Environment from the data of The World Bank, *World Development Indicator 2007*, and population census of each country

Column

Eco-Renovation of Schools

In addition to being places of education, schools are important centers for promoting global warming mitigation measures, since they are the nucleus of communities. Recognizing this, the Ministry of the Environment began implementing in FY2005 the "School Eco-Renovation and Environmental Education Program" to control carbon dioxide emissions of schools while maintaining a comfortable learning environment for students. The program is carried out with an effective combination of improving insulation to reduce the burden of heating and cooling, introducing renewable energy sources, including solar power generation, and promoting green roofs. This program is characterized not only by the equipment prepared but also by the use of this improvement process as material to develop community-wide environmental education focused on the schools and to disperse technology for environmental construction in the community.

The first eco-renovation project was at the Kuromatsunai Junior High School in Kuromatsunai-cho, Suttsu-gun, Hokkaido completed in February 2007. It is estimated that there is a 30% reduction of carbon dioxide emissions from the levels generated prior to the renovation resulting from the use of Galvalume® steel sheeting and external insulation methods, afternoon sunlight from the double-paned insulated roof, resin sashes, and wood for the interior, such as beech tree flooring, as well as improvement of lighting efficiency.

***Hikari-no-michi* (Light Path): Natural sunlight floods the Hokkaido Kuromatsunai Junior High School**
(Photo: Courtesy of Atelier BNK Co., Ltd.; Photo taken by Makoto Yoshida)

ber of persons per household and energy consumption shows that per-capita energy consumption increases substantially as the number of persons in the household decreases. A one-person household is said to consume 1.5 times the per-capita energy of a four-person household (Figure 2-2-9). Members of a household generally share household electrical appliances, such as hot-water apparatus, refrigerator, and washing machine; the fewer the number of persons in the household, the higher per-capita energy consumption becomes. Such change in Japan's family structure is a major cause for the increase in energy consumption from using household electrical appliances.

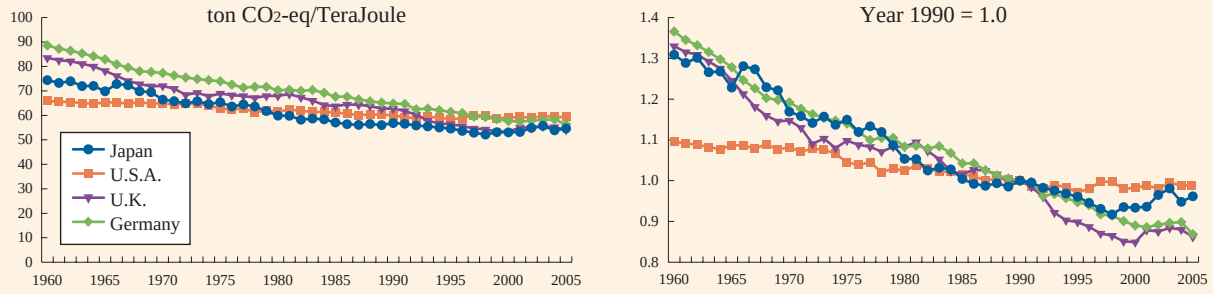
4 Residential Energy Consumption and Carbon Dioxide Emissions from Different Energy Sources

Next, let us look at residential energy consumption from the difference in energy sources.

According to IEA statistics data, a comparison of Japan, the United Kingdom, Germany, and the United States shows that the current carbon intensities (carbon dioxide emission per unit of energy consumption) of these countries are at similar levels (Figure 2-2-10). Changes in carbon intensity over time show that Japan's dependence on oil for electricity became lower after the oil crises. The promotion of nuclear energy, natural gas, and other energy sources to replace oil has reduced Japan's carbon dioxide emission intensity of electricity to a low level, even on an international scale (Figure 2-2-11). Although the carbon intensity has become lower concurrently, the decrease has leveled off in recent years.

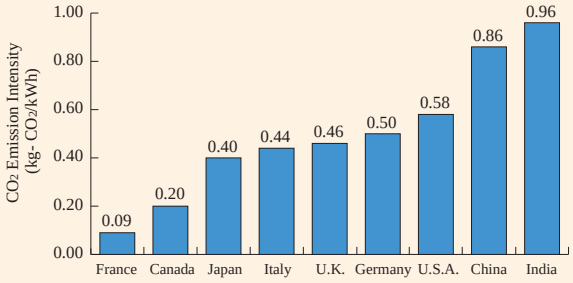
In Japan, the residential energy sources in 2005 include 52% of electricity, 29% petroleum, 17% gas, and 1% solar energy. Compared to the energy consumption of each of the energy sources in 1990, consumption of energy from electricity increased by 81%, gas 27%, and petroleum 18% (Figure 2-2-12). Compared to the United Kingdom, Germany, and other countries, Japan uses a much larger percentage of energy from electricity. For this reason, compared to the other countries, an increase or a decrease in the carbon dioxide emission intensity of electricity due to the changes in the composition of fuels

Figure 2-2-10 Changes in Carbon Intensities of Selected Countries



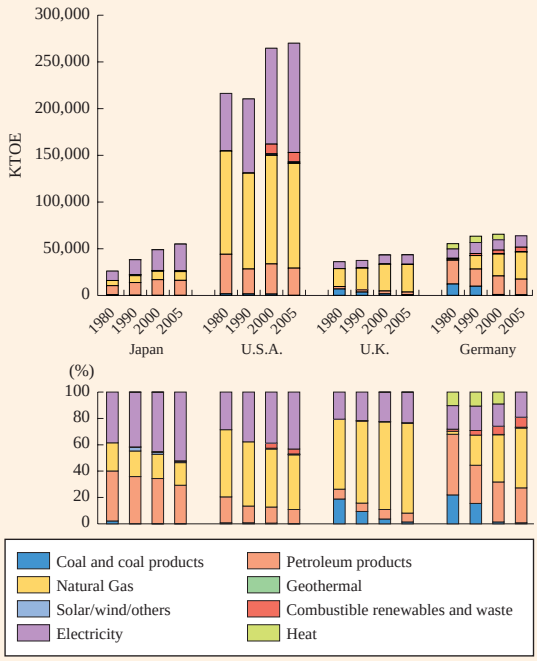
Note: TeraJoule (TJ)=10^{12} J
Source: Compiled by the Ministry of the Environment from the data of IEA, *CO_2 Emissions from Fuel Combustion 2007*

Figure 2-2-11 International Comparison of CO2 Emission Intensity of Electricity at the Power Generation End



Note: Includes CHP plants (co-generation). Values are from 2005.
Source: Material prepared for the third meeting of the Council on the Global Warming Issue

Figure 2-2-12 Changes in Fuel Mix of Residential Energy Consumption in Selected Countries



Note: KTOE (kilo ton of oil equivalent) 1KTOE=10^{10} kcal
Source: Compiled by the Ministry of the Environment from the data of IEA, *Energy Balances of OECD Countries 2007*

(petroleum, coal, natural gas, and nuclear power) for electricity generation would have a tremendous impact on the carbon intensity of residential energy consumption in Japan. For example, carbon dioxide emissions from the residential sector in FY 2005 were approximately 174 million tons. If the nuclear power plants were able to operate in FY 2005 at the utilized capacity originally planned in FY 2002, 8.5 million tons of carbon dioxide emissions would have been slashed.

The United Kingdom used 83% less coal compared to the base year and had replaced it with an increase in natural gas use. In 2005, natural gas accounted for about 70% of the overall energy mix, which contributed to the remarkable improvement made by the United Kingdom in carbon intensity. The United Kingdom promoted the use of natural gas by expanding the production of natural gas in the North Sea, liberalizing the electricity supply market, and reducing protective measures for the coal industry (privatization). Among the fossil fuels, natural gas emits little carbon dioxide during combustion compared to coal and petroleum. The use of natural gas drastically lowers the carbon intensity and contributes to the reduction in carbon dioxide emissions in the residential sector.

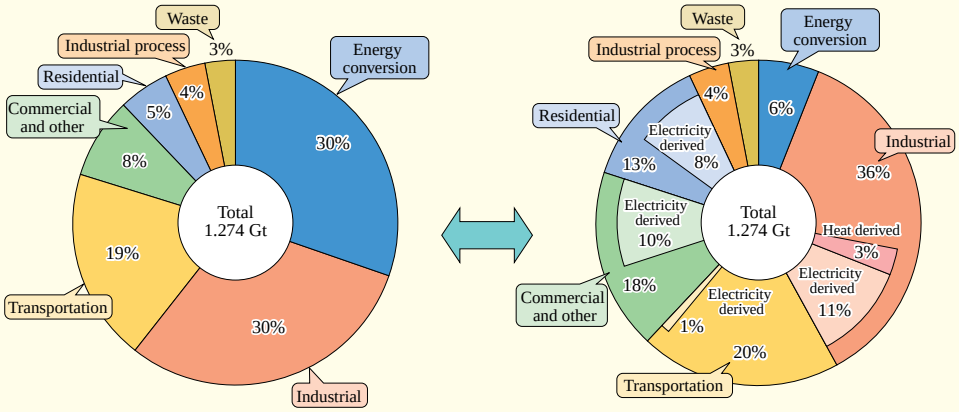
Germany has also reduced the use of coal and increased the use of natural gas, which lowered the carbon intensity. Since the unification of East Germany and West Germany in 1990, many old buildings in the former East German districts had improved energy efficiency by insulating walls and replacing old equipment. The shift of these districts from coal to natural gas is said to have contributed tremendously to the reduction in carbon dioxide emissions in the residential sector. It is reported that the increased use of district heating using solar power and biomass in

Column

CO_2 Emissions from the Residential Sector in Japan

Japan compiles and discloses data to the public on energy-generation related CO_2 emissions by utility (electricity/heat) companies. In this data, electricity/heat distributed to the industrial, transportation, commercial/other, and residential sectors is compiled based on electric/heat consumption. CO_2 emission from the residential sector before electricity/heat distribution accounts for about 5% of the Japan's total emissions. However, this figure becomes 13% after the distribution (Figure 2-2-13). This increase occurs because the amount of CO_2 emitted from electricity generation by electric power suppliers is included in the residential sector instead of in the energy conversion sector after the distribution. In FY2006, CO_2 emissions after distribution for the residential sector increased from the base-year by 30%. During this time, carbon dioxide emission intensity largely decreased temporarily, but returned to the base-year level due to lower level of nuclear power plant operations and a drastic change that took place subsequently in the ratios of energy sources in electricity generation. Therefore, the increase of CO_2 emissions of the residential sector by 30% from the base year is relatively proportional to the increase of residential energy consumption.

Figure 2-2-13 Breakdown of CO_2 Emissions before and after Distribution of Electricity and Heat



Source: Ministry of the Environment

Germany also contributed to the reduction in carbon dioxide emissions in the residential sector. We have covered the activities concerning renewable energy in the world in Section 1. There is also much expectation for the use of renewable energy in the residential sector, in addition to energy conservation measures. For example, solar energy can be used for heating, hot-water supply, and other low-heating needs, as well as for generating electricity.

5 Changing the Lifestyle

The amount of energy consumed changes depending on how we live, use energy, and make decisions. In order to eliminate wasteful energy use and reduce carbon dioxide emissions, we must care for the environment, treat it as our own problem, and link our concern for the environment to concrete actions.

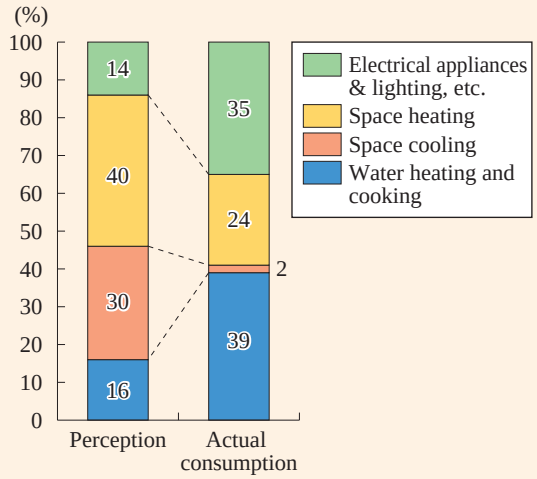
(1) Understanding the Relationship between Daily Life and Energy Consumption

In a survey to find out people's awareness of residential energy use, 40% of all households said that heating was the largest energy use in the household and 30% answered that air-conditioning was the largest energy use in the household, although air-conditioning only accounts for 2% of the energy use. That is, about 70% of all residents think heating or air-conditioning is the largest energy use in the household. It was pointed out that only 16% of all households knew that hot water supply (including cooking) consumes the most energy (39%) in households, showing a huge discrepancy between people's perception

and reality (Figure 2-2-14).

A correct understanding of the relationship between one's actions and the energy consumed will link to reduction in residential energy consumption. To this end, governments have started making efforts to raise the awareness and activities of residents to reduce energy consumption and carbon dioxide emissions by presenting information on energy consumption and carbon dioxide emissions in a visual form. For example, the UK Government expects to see "Smart Meters" with a visual display of energy use rolled out to the domestic sector within the next decade. In Japan, equipment such as the "Energy-saving Navigator," which visually indicates the current electricity consumption and cost, and gives out a warning signal when electricity usage exceeds the energy conservation target, is gaining popularity.

Figure 2-2-14 Divergence between Perception and Actual Consumption in Residential Energy Consumption in Japan



Source: Compiled by the Ministry of the Environment based on the following study: Takashi Inoue, Yusuke Morihara, and Ryoko Sakai, "Energy Consumption in Housing on the Basis of National Scale Questionnaire," *Digest of Speeches*, Architectural Institute of Japan (2007); and the Institute of Energy Economics, Japan, *2008 EDMC Handbook of Energy & Economic Statistics in Japan*

(2) Taking Actions to Conserve Energy

After understanding the relationship between the way we lead our lives and the energy consumed, we must take action to shift from an energy-intensive lifestyle to one that places value on energy resources.

The "Team Minus 6%" national campaign to mitigate global warming, with the Japanese Prime Minister as the team leader, advocates six specific activities, together with Cool Biz and Warm Biz. In addition, the "Let's Target 1 kg of CO_2 Reduction per Person per Day" campaign accepts "My Declaration for Accepting the Challenge" from citizens. This measure aims at cutting carbon dioxide emissions by 1 kg per person per day in everyday life. A citizen can choose from a global warming mitigation menu of daily activities that he/she is willing to undertake. They include how one controls the heating and air-conditioning temperatures, chooses products, drives automobile, uses electricity, and so on. As of the end of April 2008, approximately 599,000 individuals have made the pledge to take up the challenge.

It is important to carry out the activities of the menu in one's daily life. Besides consciously taking action, measures utilizing energy conservation technology, including the diffusion of energy efficient equipment and installation of energy saving facilities, can also have a tremendous impact on energy conservation. For example, compared to other countries, Japanese take more baths and consume considerable energy for hot water. It is recommended that family members shorten the interval in between their baths and that each individual shortens their showering time by one minute per day. It is also effective to utilize solar power as the energy to heat up water or to install high-performance water-heating equipment and facilities. By changing the conventional combustion-type water heater to the CO_2 coolant heat pump-type water-heating appliance, the primary energy used can be cut by about 30% and carbon dioxide emissions can almost be halved.

There is also momentum in households, offices, and

Left and center: Smart Meter; right: Energy-saving Navigator
(Photo: Courtesy of More Associates and The Energy Conservation Center, Japan (ECCJ))

streets all over the world to switch from the use of more energy-intensive incandescent lamps to the more energy-saving fluorescent or LED (light-emitting diode) for lighting.

In conjunction with the Ministry of the Environment and Ministry of Economy, Trade and Industry, manufacturers of household electrical appliances, retailers, and consumer groups joined and established a forum for the diffusion and promotion of energy efficient household electrical goods to popularize equipments and devices that conserve energy.

By incorporating information technology (IT) in residential housing, the state of energy use can be shown in real time. The technology for energy-conservation management systems that optimize the operation of lighting and air-conditioning according to the indoor condition has been developed and its application is much expected.

It is also important to re-evaluate housing as a living space from an environmental perspective. In terms of residential housing, it is desirable to shift from consumable type houses, which are built and demolished, to preservable high quality houses, which will be well cared for and used for a long time. The value of a building should be evaluated from an environmental point of view, including its energy efficiency. Popularizing housing (200-year old houses) that can be used for a long time and has excellent environmental performance can be said the key to a low carbon society.

(3) Towards a Lifestyle that Cherishes Energy Resources

To realize a low carbon society, we must shift from an energy-intensive lifestyle to a lifestyle that places value on the environment. In the transition to a low carbon society, people who care about the global environment, who choose to reduce their impact on the environment, and who lead an environmentally conscious lifestyle will play an important role. It is us–each one of us–who will make up this low carbon society.

In the world, 1.6 billion people are living without electricity and suffering from energy shortage. Currently, the world has approximately 6.7 billion people. By 2050, the population is predicted to exceed 9 billion, with most of the population growth taking place in Asia. As the population grows and people seek a more affluent life, more energy will be needed and carbon dioxide emissions will increase, further aggravating global warming. We must keep reminding ourselves of the danger that we might lose our livelihood to changes brought about by the effects of worsening global warming. As the world has taken its first step towards a low carbon society, we must make the change now–to a lifestyle cherishing energy resources–for the sake of future generations.

Christmas illuminations using LED (Left: Champs-Elysees, Paris, right: Roppongi Keyaki-zaka Street, Tokyo)
(Photo: Courtesy of Cahierdeparis, and Mori Building Co. Ltd.)

Column

Eco Points "Point System Changes Action"

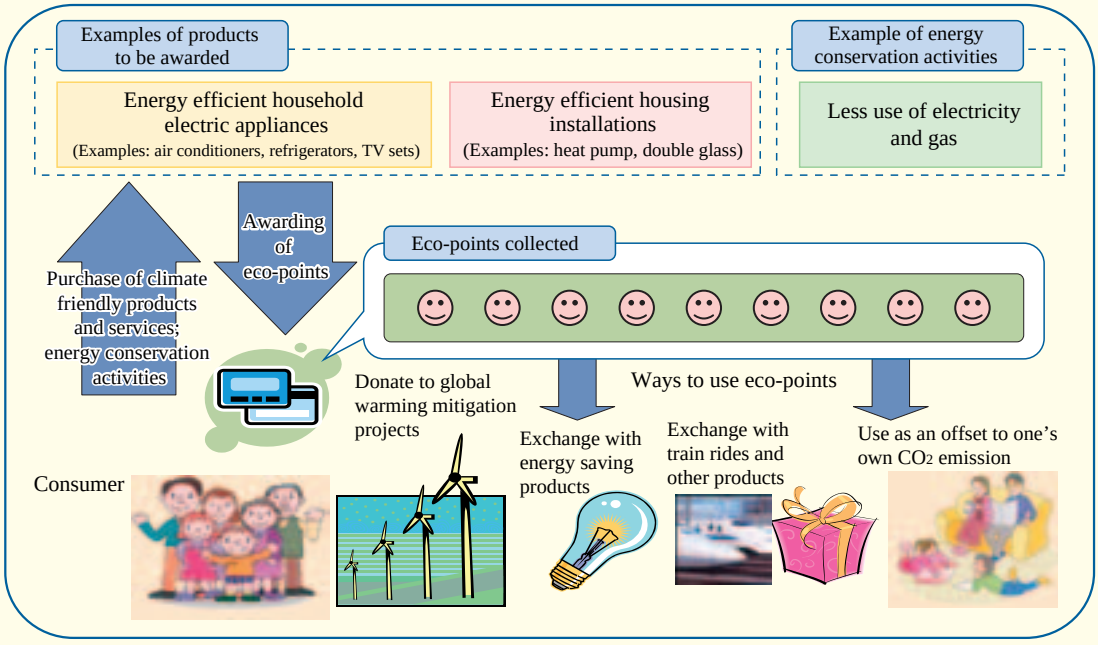
As a method to reduce GHG emissions in the residential sector, the eco point system is expected to play an important role as a friendly and easy to understand way to encourage all Japanese to make efforts to cut emissions. Eco-points are awarded for the purchase of energy conserving products and services and for energy conserving activities, such as saving electricity. Eco points can be exchanged for various goods and services.

Currently, at the local level, eco-points are awarded for declining plastic shopping bags at supermarkets and using the train instead of a car to go shopping. In addition, during some bonus marketing campaigns in 2007, some electronics retail stores offered more points or special discounts for the purchase of energy saving household electrical appliances.

To encourage these activities nationwide, the Ministry of the Environment started to encourage Eco-point model projects that are to be established as financially independent business models, beginning in FY2008. Specifically, the Ministry has selected three national-level business models and nine local-level business models in order to support the development and testing of their eco point systems.

The national level project issues eco-points that can be used nationwide by linking different industries, such as railroad companies and home appliances manufacturers. At the local level, various projects were selected, including a project started by various shops in a local shopping mall to stimulate their regional economy, a project working with developers to build energy saving cluster housing, and a project working to reduce the CO_2 emissions of home-delivery services. Through the implementation of these model projects, eco points systems are expected to develop with participation by many people (Fig. 2-2-15)

Figure 2-2-15 Image of Eco-Point Projects Promoted by the Ministry of the Environment



Source: Ministry of the Environment