



## Chapter 5

# The Socioeconomic System Driven by the Environmental Industry

— New Growth through Green Innovation —

Touched off by the global economic crisis triggered by the subprime loan problem in the United States, countries around the world have been taking active initiatives to make intensive investment in environment and energy sectors, thereby striving to ensure an economic recovery and create employment and also solve global warming and other environmental problems. In Japan, as a result of a number of policy steps, such as the eco-point system for home electrical appliances and tax reductions and subsidies for ecologically-friendly cars, personal consumption appears to be showing some signs of recovery, providing underlying support for domestic demand of home electronics, automobile and some other industries.

These developments are not just transient trends. For example, the “Declaration on Green Growth” adopted at

the June 2009 Ministerial Council of the Organization for Economic Cooperation and Development (OECD) invited the OECD to “develop, as a horizontal project, a Green Growth Strategy in order to achieve economic recovery and environmentally and socially sustainable economic growth,” an indication that a paradigm shift revolving around the environment is accelerating on a global scale.

In this chapter, we focus on the environmental industry that is expected to serve as the driving power of economic growth and examine policies that should be implemented in order to promote green innovation and create and foster the environmental industry. We also show trends in research on sustainability indicators and discuss a path to a socioeconomic system that creates a virtuous cycle of the environment and the economy.

## Section 1 The Current State of the Environmental Industry

Japan has set the mid-term goal of reducing greenhouse gas emissions by 25% by 2020 from the 1990 level and also the long-term goal of reducing them by 80% by 2050 toward realizing a low-carbon society, premised on the establishment of a fair and effective international framework in which all major economies participate and an agreement on ambitious emissions reduction targets by all the major economies. Internationally, efforts for the prevention of global warming, the building of a sound material-cycle society and the conservation of biodiversity are commonly shared challenges, requiring

all the countries to shoulder a fair share of responsibilities. In order to deal with and solve these challenges, the market size of the environmental industry is growing substantially, accompanied by the creation of employment on a large scale, not only in Japan but also around the world, with the long-term and continuous expansion of the environmental industry anticipated.

In this section, we give a broad overview of the current state and outlook of the global environmental industry and then look at the present state and strength of Japan’s environmental industry.

### 1 The Environmental Industry Expanding in Japan and in the World

#### (1) The current state and outlook of the environmental industry in the world

By way of estimating the global market for the environmental industry, for example, the “Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon Society” (compiled by the U.N. Environment Program (UNEP), the International Labour Organization (ILO) and other institutions in 2008, hereinafter referred to as the “Green Jobs report”) expects the environmental industry’s global market size to double from an estimated \$1.37 trillion in 2006 to \$2.74 trillion by 2020.

According to the estimate by a U.S. private company, the global market of the environmental industry has grown at an annual rate of a little over 4% between 2000 and 2008, though the coverage of the environmental

industry and classifications are different from those of the Green Jobs report. While the market is estimated to have posted negative growth in 2009 following the global economic crisis, it is expected to resume and continue to grow by a little over 3% in 2010 and onward. By region, the Asian market is estimated to expand by the largest margin between 2008 and 2012, growing by about \$20 billion during this period (Figure 5-1-1).

Expectations are also rising about the creation of employment in the environmental industry. The Green Jobs report estimates that green jobs in the renewable energy sector around the world, at about 2.33 million in total in 2006, will likely grow by 2030 to 2.10 million in wind power generation, to 6.30 million in photovoltaic power generation and 12.00 million in biomass power generation, for a total of at least 20.00 million.

Figure5-1-1 Global Environmental Market by Region

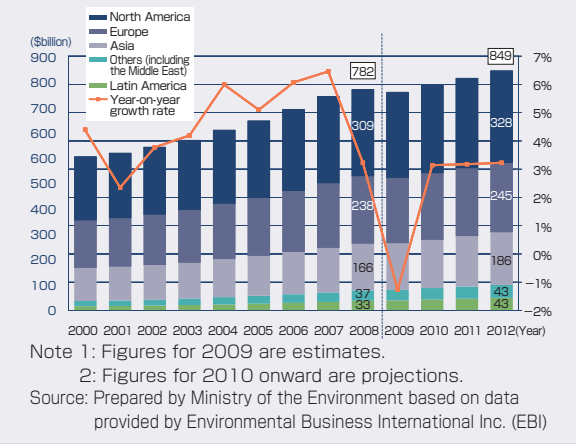
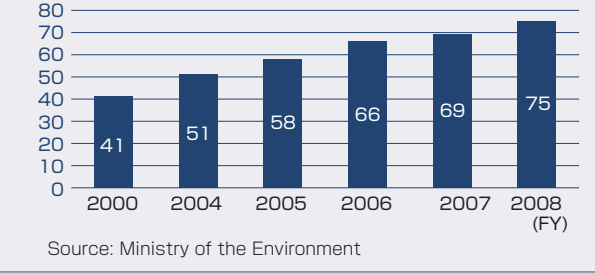


Figure5-1-2 Trends of the Market Size of Japan's Environmental Industry (¥trillion)



(2) The current state and outlook of Japan's environmental industry

The Ministry of the Environment has been conducting surveys on the market size and employment size of Japan's environmental industry, based on the environmental classification of the OECD. According to these surveys, the market size and employment size of Japan's environmental industry have been continuously expanding since FY 2000 (Figure 5-1-2). For FY 2008, the market size and employment size of the environmental industry, including construction reform related to buildings other than private housing and water supply as well as businesses where demand is induced by consumer behaviors conscious of environmental conservation such as low-emission, fuel-efficient vehicles and

energy-saving consumer electronics, are estimated at ¥7.5 trillion and at 1.76 million people.

According to the results of "Survey on Environmentally-friendly Corporate Behaviors" (hereinafter referred to as "Survey on Corporate Behaviors") carried out by the Ministry of the Environment in FY 2009 on exchange-listed companies and unlisted companies with a workforce of 500 or more, over 40% of the surveyed companies have already engaged in environmental businesses, and when companies planning to make entries are included, over 60% of the polled companies are found to have positive attitudes toward the environmental industry. Thus, companies are placing high expectations on the environmental industry as the growth sector. In the "New Growth Strategy (Basic Policies) - Toward a Radiant Japan" (adopted by Cabinet decision in December 2009, hereinafter referred to as "New Growth Strategy (Basic Policies)"), the government said it "will aim by 2020 to create over ¥50 trillion in new environment-related markets and 1.4 million new environment sector jobs" by comprehensively mobilizing all measures available.

Column Job Creation Effect of Renewable Energy Introduction

As shown by various countries' moves to introduce the "Green New Deal policy" centering on the active introduction of renewable energy in response to the latest global economic crisis, the introduction of renewable energy not only reduces carbon dioxide emissions but also brings a significant increase in new employment.

"Green Jobs and the Clean Energy Economy" (co-authored by Mr. Ditlev Engel, Chief Executive Officer of Vestas Wind Systems A/S of Denmark, and Mr. Daniel M. Kammen, Professor and Co-Director of the Berkeley Institute of the Environment) points out that the introduction of renewable energy creates more direct employments (per unit of electric power production) in the relevant industries than the use of fossil fuel energy. This presumably stems from the fact that there is a very broad base for many forms of renewable energy because they are small-scale and distributed forms of energy and that many labor-intensive industries are involved in renewable energy fields. Take photovoltaic power generation, for example. In each stage of equipment manufacturing, installation and maintenance and management, etc., a variety of business entities are involved, ranging from solar cell manufacturers and peripheral equipment makers as well as housing makers, building materials

Job Creation by Energy Type

Energy	Job-Year per GWh
Photovoltaic power generation	0.91
Solar heat	0.27
Geothermal heat	0.25
Biomass	0.22
Wind power	0.17
Nuclear power	0.15
Coal	0.11
Natural gas	0.11

Note: 1 Job-Year means that one person is hired as an employee for a period of one year.

Source: Prepared by Ministry of the Environment based on "Green Jobs and the Clean Energy Economy" (co-authored by Ditlev Engel and Daniel M. Kammen)

producers, general contractors and building contractors, thus directly creating the largest number of jobs in related industries.

Since forests, water and other natural resources that generate renewable energy exist more abundantly in rural areas than in big cities, the introduction of renewable energy not only create many jobs but also generate employment in area other than big cities, and thus can be expected to contribute to the correction of regional disparities in employment.



## 2 Strengths of Japan's Environmental Industry

### (1) Development of environmental technologies at the highest global standards

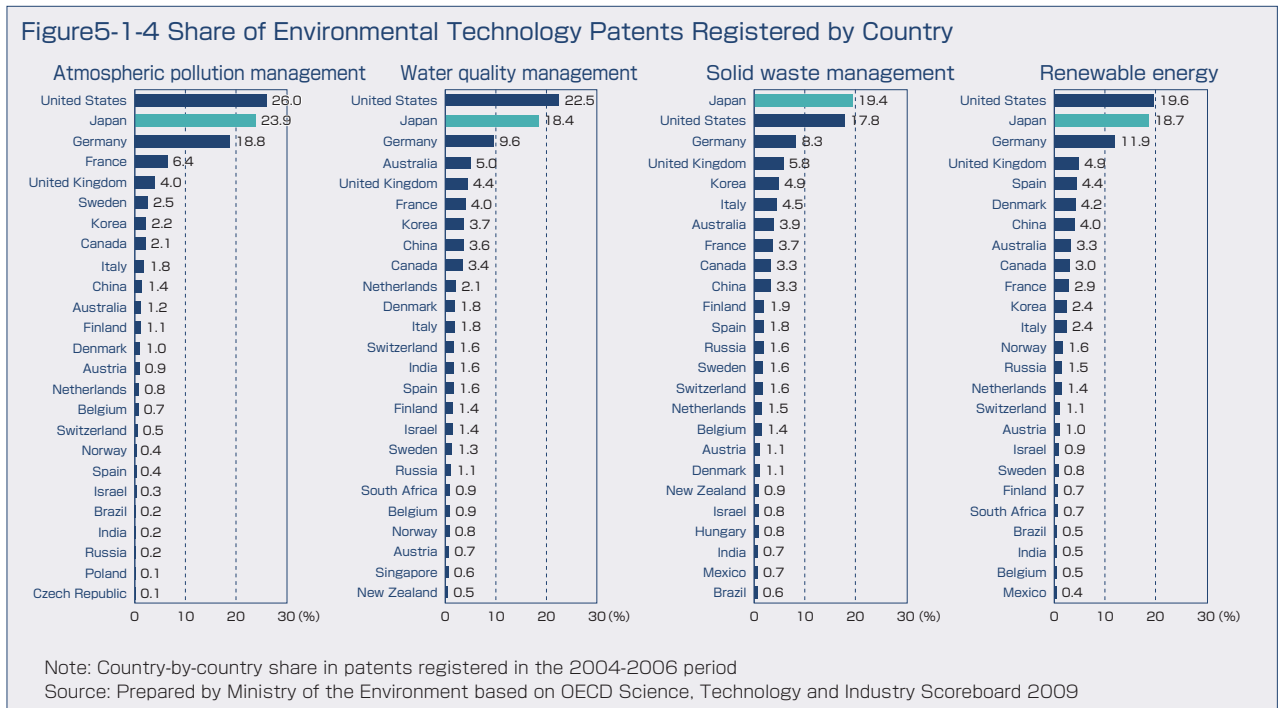
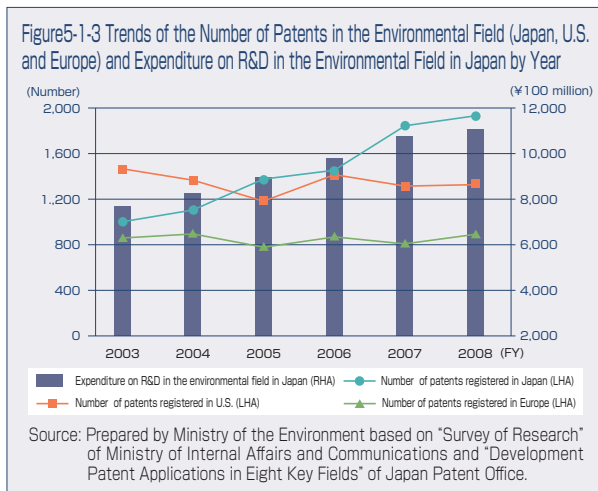
Looking at the strength of Japan's environmental technologies by the number of patents, while the number of patents in the environmental sector in the United States and Europe has largely stayed flat in recent years, the number of patents in the environmental sector registered in Japan has been on the steady increase, coming to approximately 2,000 cases in 2008 (Figure 5-1-3). Country-by-country shares in the application for patents on environmental technologies also show that Japan ranks high in such areas as atmospheric pollution and water quality management, solid waste management and renewable energy (Figure 5-1-4). Further, according to surveys by Japan's Patent Office on Japanese companies' patent applications in countries around the

world, in the number of patent applications for solar cells, by nationality of applicants, filed in the five countries (area) of Japan, the United States, Europe, China and Korea, Japan had the largest share in Japan, the United States and China.

### (2) Increase of R&D investment and fostering of researchers supporting green innovation

Japan's environmental technologies are supported by unflagging efforts for innovation at companies and universities, etc. The foundations for these efforts are highly capable researchers and substantial investment in research and development (R&D) activities, and the reinforcement of these foundations can induce innovation and lead to the development of new environmental technologies and further to the strengthening of international competitiveness.

Total research expenditures in Japan had been on the steady increase until FY 2008, when they dipped 0.8% year on year to about ¥18.8 trillion for the first drop, albeit only slightly, in nine years in the aftermath of the latest economic crisis. However, research expenditures in the environmental filed rose 2.6% year on year to about ¥1.1 trillion, growing roughly three times in the past decade (Figure 5-1-5). Research expenditures by companies, etc. accounted for about 80% of this amount, showing that they are underpinning Japan's R&D activities in the environmental sector. The number of researchers, including those in the environmental field, has also been on the continuous increase, standing at approximately 840,000 as of March 31, 2009, a rise of 1.4% over the year-before level.



Column

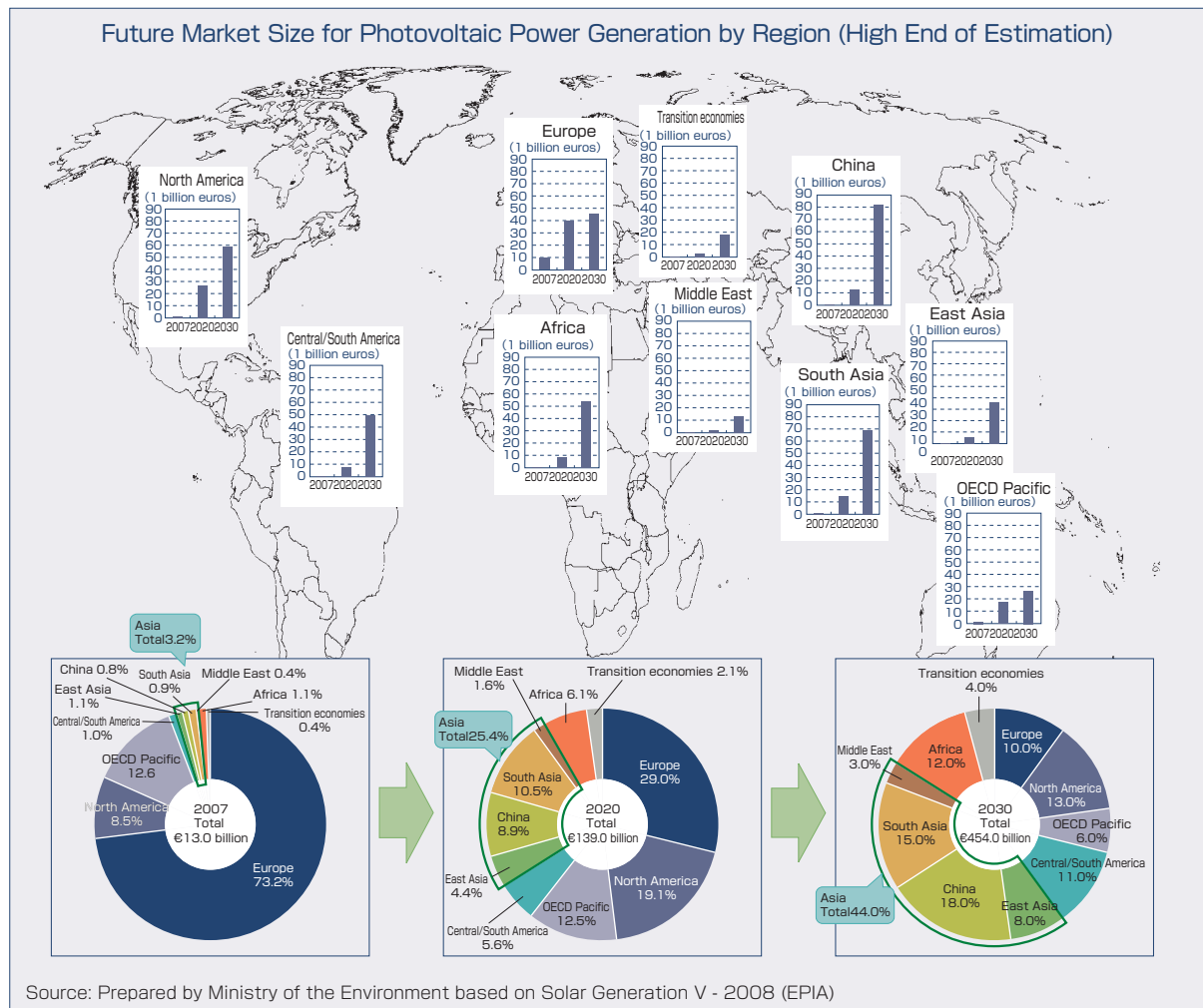
## Potential for the Japanese Environmental Industry's Expansion in the Fast-Growing Environmental Market in Asia

The economic growth of Asian countries in recent years has been truly remarkable. After coping with the latest economic crisis appropriately, they have now emerged as the driver of the global economy with robust recovery. The fast growth of middle-income groups in Asia and the fact that Asian countries are growing with constraints and problems, such as environmental problems that Japan had faced and overcome in the course of its economic development, indicate that significant business opportunities exist for Japan's environmental industry going forward.

Take photovoltaic power generation, for example. The European Photovoltaic Industry Association (EPIA) estimates that the global market for photovoltaic power generation will grow rapidly from about 13.0 billion euros (about ¥1.6 trillion) in 2007 to about 94.0 billion to 139.0 billion (about ¥11 trillion to 17 trillion) in 2020 and to about 204.0 billion to 454.0 billion (about ¥25 trillion to 55

trillion) in 2030. In particular, the Asian market is expected to see an exponential expansion. Using the higher end of the EPIA estimates, the Asian share of the global market is seen to increase from only 3.2% in 2007 to 25.4% in 2020 and further to 44.0% by 2030.

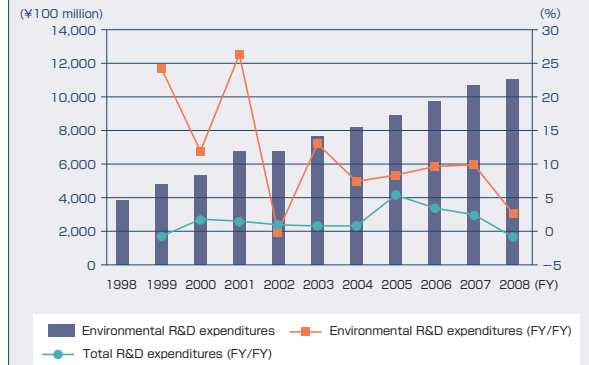
Japan, armed with environment technologies with the highest global standards and close relations with Asian countries, is in an advantageous position to capture a considerable portion of massive demand from Asia, and the environmental industry has the potential to lead Japan's economic growth going forward. The market for the environmental industry is already under fierce competition. It is therefore necessary for Japan to secure its solid competitive edge through technological innovation and strive to map out overseas business strategies, jointly in public and private sector, in accordance with Asia's regional characteristics and needs.



### (3) Growth potential as a member of the Asian region

The Asian region, which has close geographical and economic ties to Japan, accounts for over half of the world's population and is seeing rapid economic growth, while it is confronted with serious environmental problems, including greenhouse gas emissions, air pollution, water contamination, inappropriate disposal of wastes and deforestation. If Asian countries under such conditions are to achieve sustainable development, Japan's experiences and wisdom to have overcome pollution problems while sustaining economic growth should be shared by Asian countries and it is also necessary for Japan to serve as a bridge for growth in Asia. It is deemed feasible to apply the strengths of Japan's environmental technologies in a proactive manner in this endeavor.

Figure5-1-5 Trends in Japan's Total Expenditure on R&D and Expenditure on R&D in the Environmental Field



Note: Of environmental R&D expenditures, those between 1998 and 2000 are figures under the category "environmental conservation" and those between 2001 and 2008 are figures under the category of "environment"  
 Source: Prepared by Ministry of the Environment based on "Survey of Research and Development 2009" of Ministry of Internal Affairs and Communications

## Section 2 Sound Material-Cycle Society Business for Sustainable Economic and Social Activities

### 1 Expanding Sound Material-Cycle Society Businesses

The Fundamental Plan for Establishing a Sound Material-Cycle Society, adopted in March 2008 by Cabinet decision, defines a sound material-cycle society as "a society in which the amount of new resource extraction is minimized at all stages of social and economic activities, from resource extraction through production, distribution, consumption and disposal, through a range of measures such as reduction of waste generation and use of circulative resources, thereby minimizing environmental loads." Businesses contributing to the building of the sound material-cycle society are called sound material-cycle society businesses. This section looks at the expansion of sound material-cycle society businesses.

The idea of "decoupling" is drawing attention in the environmental field as well. The term decoupling means "separation." When used in the environmental field, it indicates the desirable situation where the rate of increase

in environmental loads is lower than the rate of economic growth. We can say that the world in the past, particularly during the 20<sup>th</sup> century, has achieved economic growth by increased consumption of resources and intensification of environmental loads through mass production, mass consumption and mass disposal. If we turn our attention to the separation of vectors of economic growth and environmental loads that have grown almost in tandem, or to materials and resources, it becomes evident that the important thing is to have lower increase in the input of natural resources than the economic growth rate to create a decoupling situation.

Figure 5-2-1 shows trends of Japan's gross domestic product (GDP), the input of natural resources, etc. (quantity of domestically produced and imported natural resources and imported products), the cyclical use rate and final disposal amount indicator, the market size for sound

Figure5-2-1 Trends of Economic Indicators and 3R Indicators (1990=1.00)

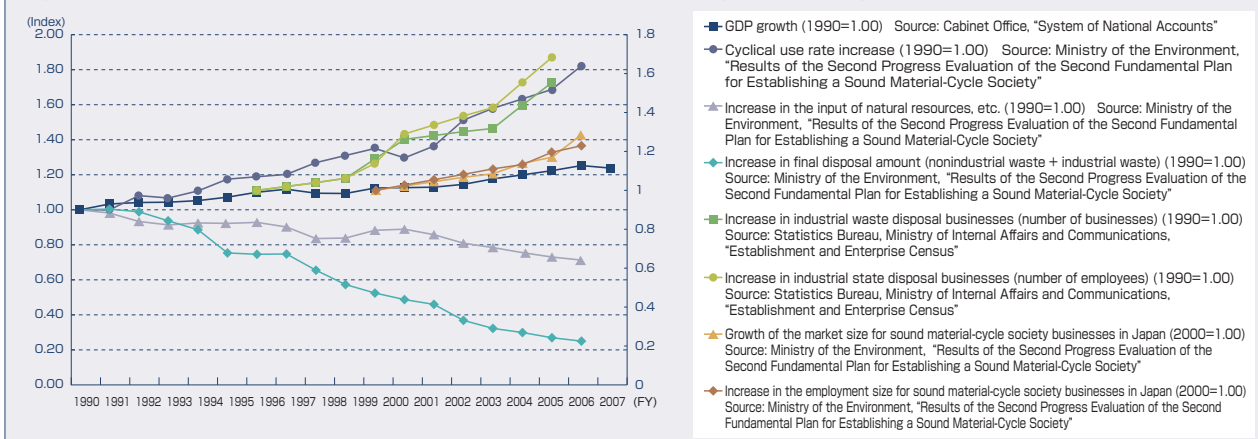
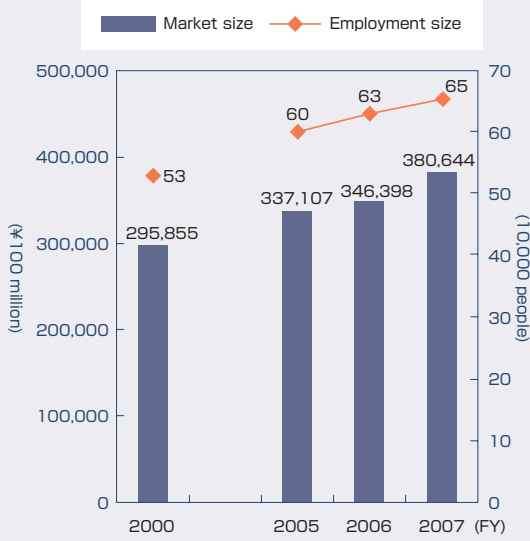


Figure5-2-2 Trends of the Market Size and Employment Size for Sound Material-Cycle Society Businesses

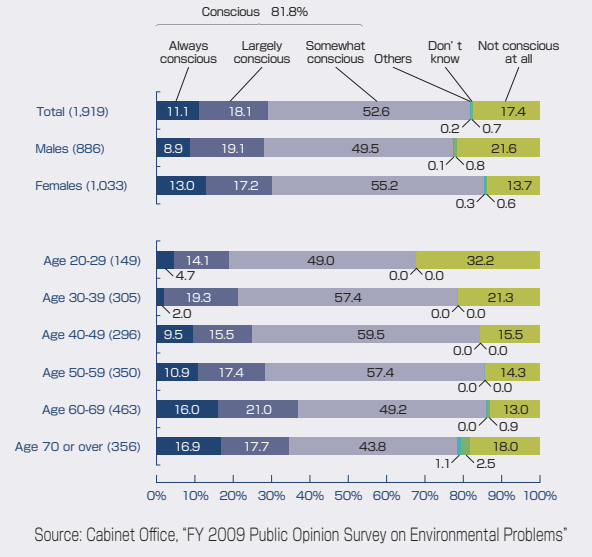


Source: Ministry of the Environment, "Concerning the Second Review of the Progress in the Second Fundamental Plan for Establishing a Sound Material-Cycle Society"

material-cycle society businesses and the size of employment. The figure indicates steady progress of the decoupling in Japan. It also shows that the new market and employment for sound material-cycle society businesses have been created and are expanding.

According to a survey by the Ministry of the Environment, the market for sound material-cycle society businesses, which stood at ¥29,585.5 billion in FY 2000 (about 5.9 % against GDP), the first year of a sound material-cycle society when the Basic Act for Establishing a Sound Material-Cycle Society (Act No.110 of 2000, hereinafter referred to as the "Sound Material-Cycle Society Basic Act") was enacted, is estimated to have grown 1.3 times to ¥38,064.4 billion in FY 2007 (about 6.8 % against GDP) (Figure 5-2-2). The size of

Figure5-2-3 Consciousness about Purchase of Environment-Friendly Products (Green Purchasing)



employment in these businesses is also estimated to have increased some 1.2 times from about 530,000 in FY 2000 to about 650,000 in FY 2007.

The consciousness of each citizen, who is a consumer at the same time, has also been changing for certain. According to a public opinion survey conducted by the Cabinet Office in June 2009, asked how conscious they are about buying environment-friendly products in the purchase of products, etc., such as products using recycled materials and products that are easy to recycle when they become unnecessary, 81.8% of respondents said they are "conscious" (Figure 5-2-3). The ratio of "conscious" respondents was higher for females by sex and for people in their 50s and 60s by age. The survey results suggest that there is a fair chance of creating new demand by offering goods and services, etc. that correspond to this consumer consciousness.

## 2 Business Efforts toward a Sound Material-Cycle Society

A Sound Material-Cycle Society is developing with active use of various ideas. In this section, efforts toward a Sound Material-Cycle Society among Businesses which are exposed to consumers are introduced.

### (1) Cultivation of new markets by leveraging efforts toward a sound material-cycle society

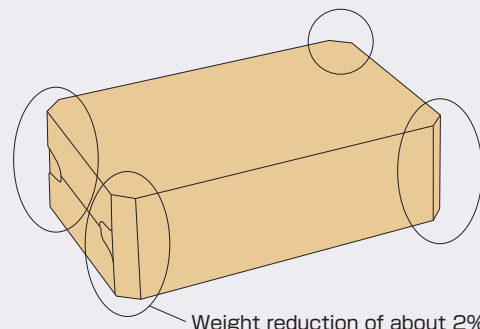
- Home builder S promotes renovated house "Ever Loop"  
Company S offers the new "Ever Loop" system of renovating existing homes to sell as new houses, a concept that changes the conventional idea of the used house market. This is a sound material-cycle endeavor to promote the longer operating life of houses and effective use of resources by adding quakeproof and other up-to-date performances in such areas as exterior and equipment to existing homes for resale without tearing them down. This offers the "third option" for home buyers dither between "newly-built" and "existing" houses.

### (2) Weight saving

- Weight saving in containers and packaging (Figure 5-2-4)

Beverage company N is selling bottled products in

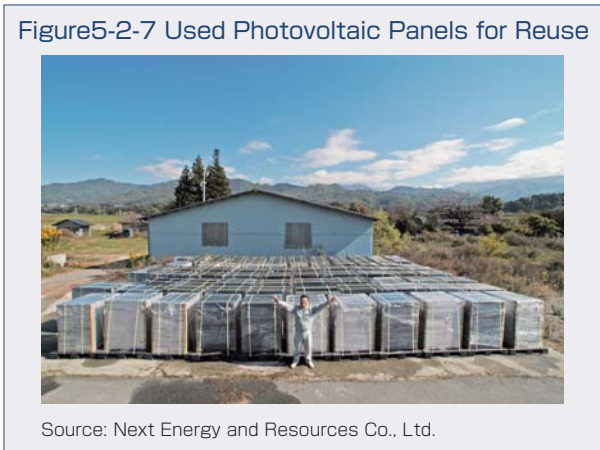
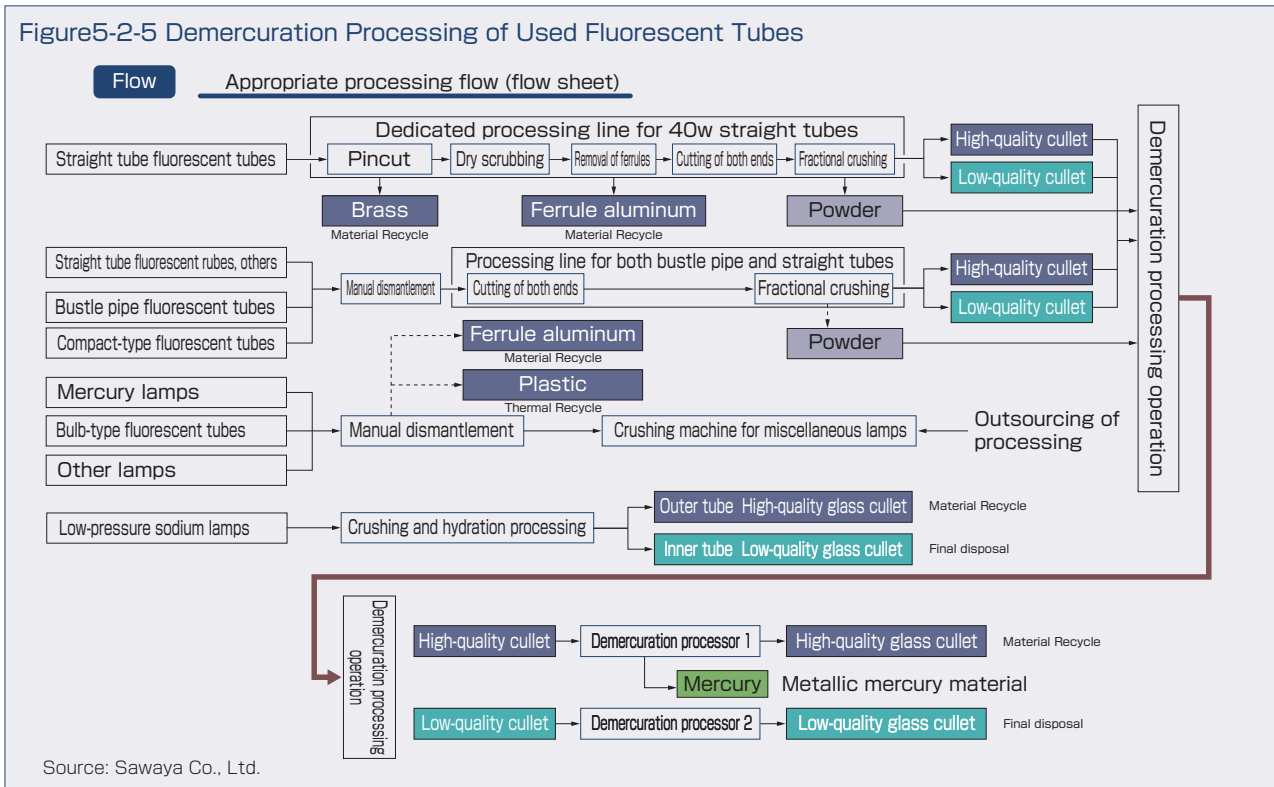
Figure5-2-4 Weight Saving of Containers and Packaging



Weight reduction of about 2%

Source: Prepared by Ministry of the Environment based on materials provided by Kirin Brewery Co., Ltd.





520-milliliter plastic bottles that adopt creative shapes to make them 40% lighter without damaging usability for consumers. Another beverage company K reduced cardboard consumption about 2% while realizing easy handling and enhancing cardboard box strength by adopting cartons with their exterior corners cut. Various other businesses are also making efforts to trim the weight of containers and packaging.

(3) Cooperation between venous and arterial industries

○ Making traditional craftwork from used fluorescent tubes (Figures 5-2-5, 5-2-6)  
 Company S1 has developed the technology to recycle used fluorescent tubes (demercuration processing) and is making cullet, a material for glassware. Glass maker S2 is using this cullet to manufacture recycled glass at the

hands of craftsmen certified as Tokyo Metropolitan Government traditional artisans or Sumida Meisters. About one recycled glass is made from one used fluorescent tube and this glass has become the first EcoMark-certified glass in Japan. The cullet is used as material for making carafes adopted in a campaign of the Nagoya City Waterworks and Sewerage Bureau to convey the safety and palatability of tap water or efforts to reduce the use of plastic bottles.

(4) Integrated efforts for realization of a sound material-cycle society, low-carbon society and society in harmony with nature

○ Reuse of photovoltaic panels (Figures 5-2-7, 5-2-8)  
 Company N in Nagano Prefecture is undertaking integrated efforts for a sound material-cycle society and low-carbon society through the reuse of used panels for photovoltaic power generation, a move in anticipation of

Figure5-2-8 Projections for Future Recycling · Reuse of Crystal Silicon Solar Cells and Modules

	2010	2015	2020	2025	2030
Projected annual amount of disposal* (Existing EVA-containing modules)	< 5MW (500 tons)	10MW (1,000 tons)	100MW (10,000 tons)	> 300MW (30,000 tons)	1,000MW (100,000 tons)
Reuse	For private residences	For disaster relief	For overseas	Accumulation center	New businesses?
Recycling by existing operators · Disposal Collection of Al · Heating (burning of EVA) + Nonferrous smelting technology Collection of Al, glass and Ag	Less than 5MW	5-10MW			
Recycling at dedicated PV factories · Based on existing technologies Collection of Al, glass, Si (Ag?) · Newly developed technologies Collection of Al, glass, Si and Ag		Factories capable of handling 20MW panels		Factories capable of handling 100 MW panels (New method of low-cost processing)	

Note: The amount of disposal is projected on the basis of the actual introduction until 2004 and the projected introduction in 2005-2010 with the achievement of the 2010 introduction target of 4.82 million kW assuming disposal 20 years after purchase (See Figure 1-5-1). We assume that existing EVA-laminated modules are sold until 2010 and subject to disposal is this type of modules.  
Source: New Energy and Industrial Technology Development Organization (NEDO)

Figure5-2-9 Forestry Dairy

- Effective utilization of abandoned satoyama, forested sites that need maintenance work, abandoned farmland, disused pastures, disused ski sites and golf courses, etc. → Value creation
- Grazing of 0.5-2 cattle per hectare → Natural circulation of excrements is possible.
- Feed cattle with undergrowth in forests without depending on imported feedstuff
- 365-day, day-and-night yearlong grazing → No need for large cattle sheds
- Natural mating, natural births, breast-feeding and long-term milking are the basis.



Source: Amita Holdings Co., Ltd.

the problem of disposal of photovoltaic panels that is expected to come to the fore in the future in tandem with the penetration of photovoltaic power generation.

○ Forestry dairy (Figure 5-2-9)

Company A is using unattended “satoyama” (community-based forest areas) to undertake natural grazing for “forest dairy” operations. The company is producing milk from dairy cattle that are pasturing and eating undergrowth in forests. Dairy cattle level the ground in forests and their excrements resolve into soil in forests, this cycle represents an integrated effort toward a sound material-cycle society and society in harmony with nature.

(5) Community business

- Blending of bicycle rental business and measures to

cope with abandoned bicycles (Figure 5-2-10)

Company B is renting bicycles for students at about 120 universities across Japan by repairing bicycles abandoned at universities and commercial facilities to make them reusable. This can be described as an endeavor to blend efforts toward building a sound material-cycle society with measures to deal with abandoned bicycles.

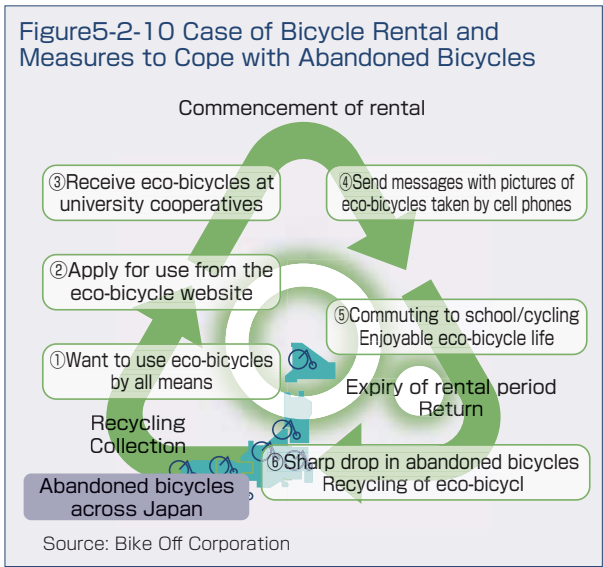
(6) Regional revitalization by leveraging sound material-cycle society businesses

- Shinshu-type wooden guardrails (Figure 5-2-11)

The Nagano prefectural government certifies as Shinshu-type wooden guardrails those wooden guardrails that have such characteristics as (1) contributing to measures to prevent global warming; (2) using thinned







wood produced in the prefecture; (3) contributing to building a sound material-cycle society, like post-disposal recycling; (4) contributing to preserving the environment and improving the landscape; (5) contributing to creating employment by nurturing a new industry in the prefecture. Wooden guardrails, already in use at tourist sites, etc., are also helping reduce steel consumption and promote the use of thinned wood.

- Effective utilization of circulative resources from local special products (Figure 5-2-12)
- Kojima in Kurashiki City, Okayama Prefecture, has flourished as the “town of textiles” since the Edo period and is also known as the “birthplace of Japanese Jeans.” About 50% of all jeans sold in Japan come from Kojima. Jeans makers in Kojima are manufacturing and selling eco-bags using leftover denims, thus contributing to

reducing waste generation and revitalizing the local economy.

As seen in various examples described above, sound material-cycle society businesses are starting up in various forms and scale across Japan. Investment in sound material-cycle society businesses can help reduce the use of resources and waste discharges as well as costs, and also create new demand. Making this first step could lead to the acquisition of the world’s top-level technology and the building of the world’s first business model. It is important to create a virtuous cycle and build a sound material-cycle and sustainable society.

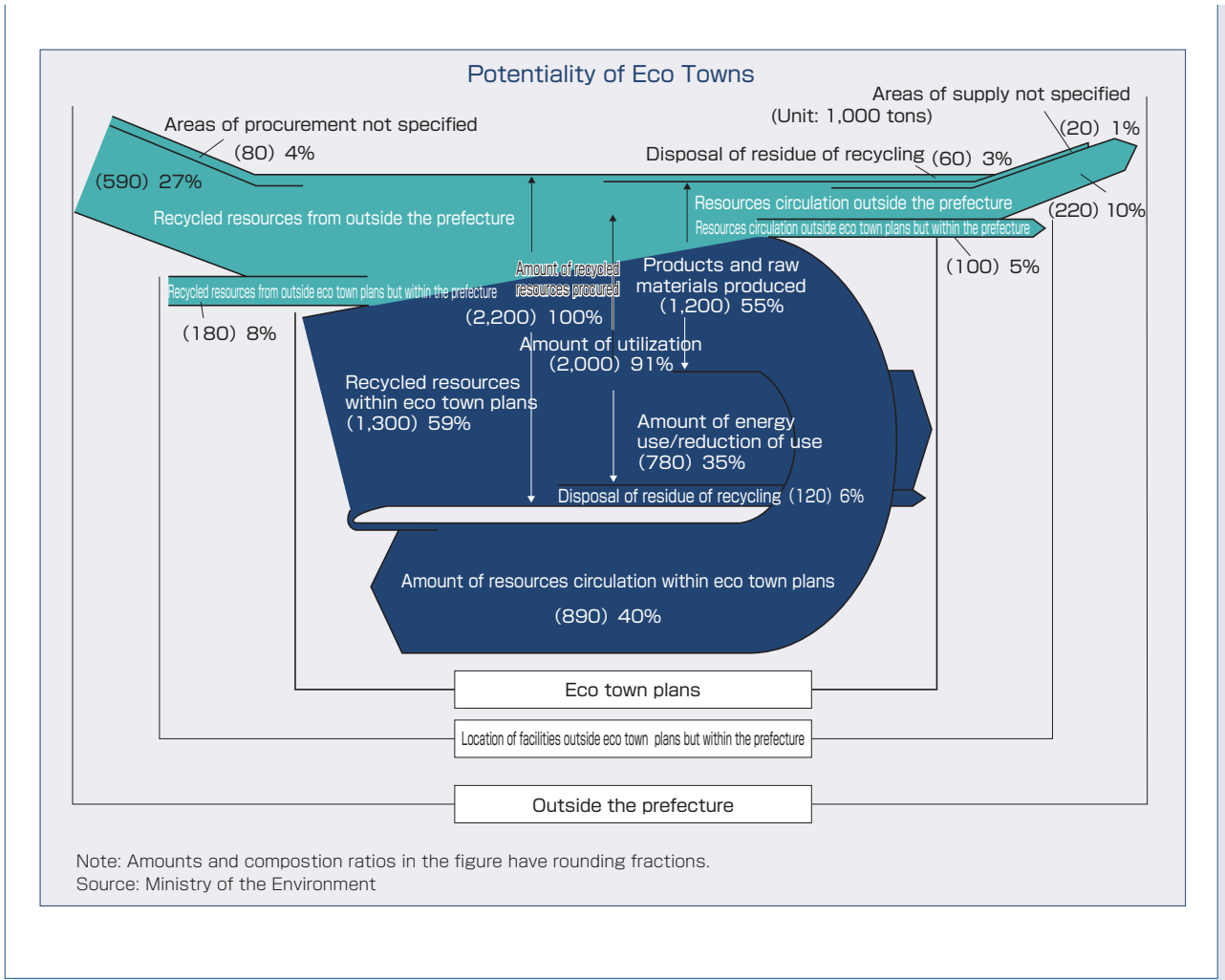
**Column** The Role of Eco Towns in the Resources-Recycling Process

The Eco Town Program is designed to promote the building of advanced environment-friendly communities by positioning the “zero emission plan” as the basic plan for an environment-friendly regional economic society and promoting it as the core of regional development. So far, a total of 26 regional eco town plans have been approved.

A survey on the resources-recycling process in eco towns by the Ministry of the Environment found that some 2.20 million tons of circulative resources have been put into the eco towns across Japan, and about 91% of them were utilized as products, raw materials or energy (including reductions in volume), confirming the highly efficient utilization. By region, about 59%

of circulative resources procured by eco town facilities were procured from within the same eco town plans and some 40% of products and energy supplied by eco town facilities were supplied within the same eco town plans, making it clear that eco towns can assume the function of the core of regional resources-recycling.

An estimation of the effect of reducing environmental loads at eco towns across Japan as a whole shows the reduction of about one million tons in the amount of final disposal and about 420,000 tons in carbon dioxide emissions, confirming the reducing effects to a certain extent.



## Section 3 Environmental Technologies and Environmental Industries That Change the Socioeconomic System

As seen in the previous section, the environmental industry and circulation industry can be expected to make contributions from both aspects of environmental conservation and economic growth, and over the long term, they are believed to be capable of changing the socioeconomic system. As discussed in Chapter 2, for example, if the smart grid is realized, the use of renewable energy is expected to increase, electricity is likely to be charged into large stationary storage batteries for adjusting the power supply and demand

balance, and new services may be offered by adding security systems and the function of operating home electric appliances to the smart grid.

In this section, we introduce environmental technologies and services with the potential to alter the socioeconomic society like the smart grid, and give a broad overview of the current situation and future prospects of efforts to financially support the environmental industry and greening of economic activities.

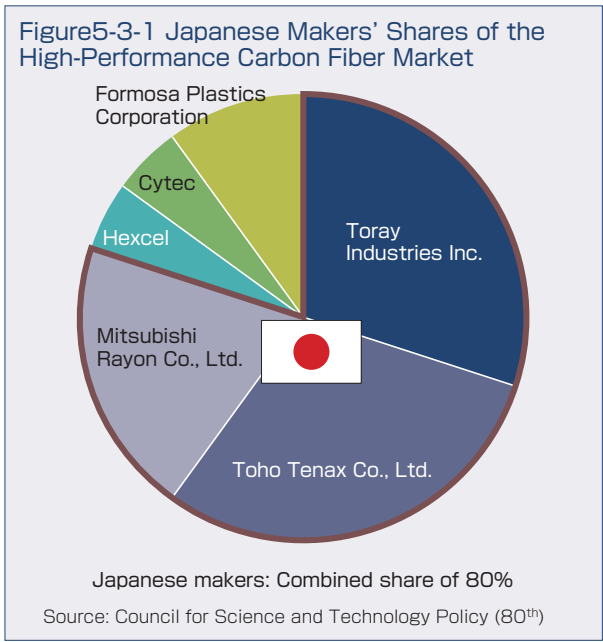
### 1 Japan's Excellent Environmental Technologies

Raw materials and manufactured products produced with Japan's excellent technologies are bringing forward energy-saving effects through weight saving, and are greatly contributing to the mitigation of environmental loads. One of such technologies is carbon fiber. Japan commands an overwhelming share of around 80% in the world's market for high-performance carbon fiber (Figure 5-3-1). After Japanese companies continued research and development investment over long periods

of time and also received support from the national government for their research and development projects, they maintain a technological edge over Western companies.

Carbon fibers are fit for use as structural materials for airplanes and automobiles due to their characteristics of being light, strong and rustproof, and also help enhance the energy-saving performance. For a new medium-size aircraft now in production, for example,

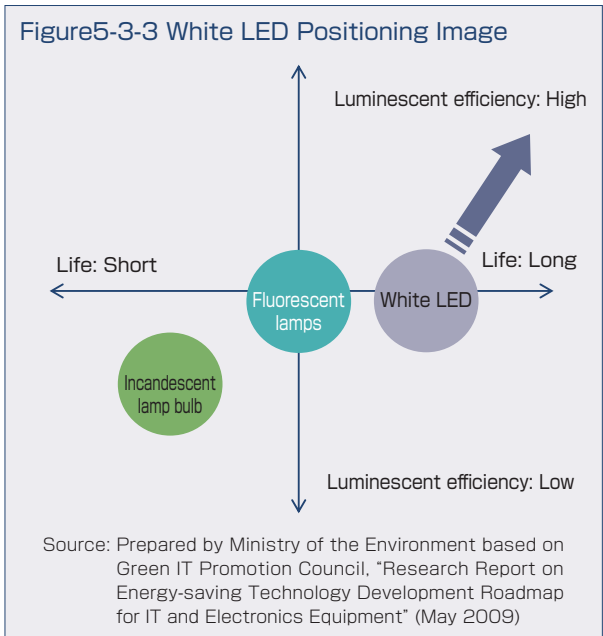
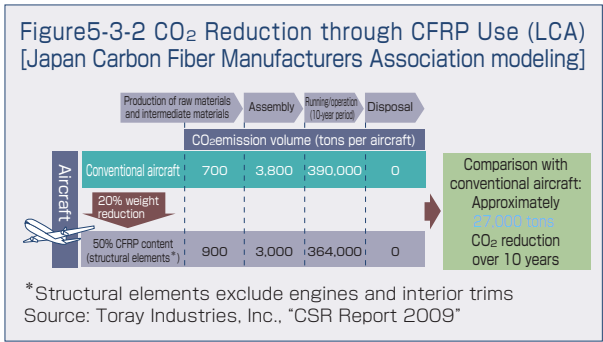




**Table5-3-1 Comparison When 60W Incandescent Lamp Bulb Is Replaced by LED Bulb**

	60W Incandescent lamp bulb	LED bulb	Comparison
Photo (Note 1)			
Power consumption	54W	6.4W	Reduced to about one-eighth (CO <sub>2</sub> emissions also reduced to about one-eighth)
Life	1,000 hours	40,000 hours	40 times
Price (Note 2)	¥ 100	¥2,880	About 29 times
Electricity bills for 40,000 hours of use (Note 1)	¥47,520	¥5,632	Reduction of ¥41,888
Annual cost (Note 3)	¥2,576	¥426	Possible to recover the price difference in about 1.3 years

Note 1: The product photo and reference unit power rate are from materials provided by Toshiba Lighting and Technology Corporation.  
 Note 2: The LED bulb price was surveyed by Ministry of the Environment  
 Note 3: Annual power charges and purchase cost in case of use for 2,000 hours a year. Calculated by dividing the price by the life (hours) and adding what is obtained to the power charge per hour  
 Source: Ministry of the Environment



“disposal,” an annual reduction of 2,700 tons per aircraft in carbon dioxide emissions can be expected compared with the conventional model (Figure 5-3-2). If 15,000 passenger jets with the capacity of 100 seats or more now in operation in the world were to be replaced by aircraft using carbon fibers, the annual carbon dioxide emissions reduction of about 40.5 million tons can be expected. Given the per-capita global average carbon dioxide emissions of about 4 tons a year, the assumed reduction is equivalent to emissions by approximately 10 million people. Amid rising demand for environment-friendly products, carbon fibers are increasingly used in frames of aircraft and bodies of vehicles, and thus are likely to contribute to reductions of carbon dioxide emissions in the transportation sector. It is also expected that carbon fibers, due to their lightweight properties and high rigidity, will be widely utilized in larger windmill blades for wind power generation, high-pressure hydrogen tanks for fuel cell-powered vehicles and fuel cells.

Other than carbon fibers, there also are technologies for which Japan has large market shares in the world and which are expected to reduce environmental loads substantially. White light-emitting diodes (LEDs), developed in Japan in 1996, are small, light, energy-saving and long-life light sources, which are rapidly becoming widely used as point sources of light for lighting to replace incandescent lamp bulbs (Figure 5-3-3). Already, white LEDs are in commercial use for small liquid crystal panel backlight, traffic lights and large-screen displays for television sets, etc. Particularly in recent years, they are spreading to business offices and private homes as downlights to replace incandescent lamp bulbs.

LED bulbs consume only about one-eighth of electricity consumed by incandescent lamp bulbs. Comparison of utilization costs between LED bulbs and incandescent lamp bulbs indicate that the advantage of using LED bulbs instead of incandescent lamp bulbs will materialize in about 1.3 years in use (Table 5-3-1).

Thus far, Japanese companies are believed to have uncontested large shares in the global white LED market. In recent years, however, Taiwanese companies are

carbon fiber reinforced plastic (CFRP) is used for 50% of main structural elements such as the body, main wings and vertical and horizontal tails, making it about 20% lighter than the comparable conventional aircraft. Looking at carbon dioxide emissions during the air frame’s 10-year life cycle of “production of raw materials and intermediate materials,” “assembly,” “running/operation” and

increasing their shares and Korea is in hot pursuit just behind. Amid intensifying international competition, white LEDs are said to be still under development in terms of raising luminescent efficiency and lowering costs. In order for Japanese companies to maintain the current levels of market shares and expand them further, the government's efforts to support the penetration of white LEDs are necessary along with the promotion of technological development by the private sector.

Other technologies for which Japan has large global market shares and which are expected to be used in environment-friendly products include inverse osmosis membranes use for water purification, lithium ion secondary battery separators for electric vehicles and

IGBT (insulated gate bipolar transistor) power semiconductors used in automobile inverters, etc. The environmental industry is developing and products for which Japan has a technological edge is widely spreading not only at home but also in the entire world, setting the stage for the global display of the power of "monozukuri (manufacturing)" prowess, Japan's particular strength. On the other hand, as seen in the market for white LED bulbs, international competition is expected to intensify in tandem with the development of the environmental industry in technological fields where Japan now has strengths, the government's appropriate support is necessary, including the promotion of such technologies at home.

## Column Japanese Mosquito Nets and Efforts to Cope with Malaria in Africa

Products to help improve the living environment for humans include those using traditional Japanese mosquito nets.

In Africa suffering from malaria, efforts are under way to spread mosquito nets with insect repellent kneaded into, and mosquito nets developed by a Japanese company are being widely distributed. Using these highly durable mosquito nets that do not lose insect repellent effects for over five years even after repeated washing, people can defend themselves from malaria-transmitting mosquitoes economically and effectively. Since production of mosquito nets started in 2003, several thousand jobs were created at the production site. Part of sales of these mosquito nets is used to construct schools for improving primary education, thus also contributing Africa's self-sustaining development.

A Look at a Mosquito Net Production Factory in Africa



Photo: Sumitomo Chemical Co., Ltd.

## 2 From "Selling Goods" to "Offering Functions"

In order to reduce environmental loads and build a sustainable society, it is necessary to shift away from the past socioeconomic system of mass production, mass consumption and mass disposal. As one way of achieving that shift, businesses that provide only the functions of goods without regard for the consumption pattern of selling goods are drawing attention.

Such businesses that have already taken root in Japan include "lease and rental of products" where service providers manage products for their life cycles to reduce environmental loads and "repair and reform of products" where environmental loads are reduced by lengthening the life of products. Some recent approaches are aimed at reducing the quantity of manufactured products used in society as a whole by promoting the sharing and joint use of goods, thus reducing the consumption of resources and environmental loads. They include "car sharing" and other businesses. The market is also expanding for "ESCO (Energy Service Company) business," which

promotes energy saving for the entire building or entire facility by offering a package of services, including energy-saving diagnosis, design/construction, operation and maintenance and fund procurement, thereby realizing reductions of greenhouse gas emissions.

These businesses for providing the functions of goods can contribute to building a sound material-cycle society. In the "lease and rental of products," for example, the maintenance and management is carried out appropriately until products are disposed of to promote their effective utilization and recycling is carried out without fail as used products are collected with certainty. Further, by entrenching the new concept of values that business operators and consumers alike make use of the functions and services of goods instead of owning them when they choose and utilize products, their production and consumption behaviors can be expected to be changed into sustainable ones.



## Column

## Car-Sharing of Electric Vehicles

## ~Blending of Environmental Technology and Systems~

In 2009, Japanese automakers began mass production and marketing of electric vehicles and plug-in hybrid vehicles on a full scale. On the other hand, electric vehicles, etc. are still expensive now, making it difficult for individuals to purchase them easily. Because of this, there are an increasing number of cases in recent years where electric cars are provided as vehicles for car-sharing that costs less than owning vehicles and is often used for shopping and pickup, as one of ways to spread electric vehicles, etc.

In the “project to promote the introduction of next-generation vehicles, etc.” implemented between January 2009 and July 2009, the Ministry of the Environment lent out and operated electric vehicles to a total of 102 divisions of 37 local governments, etc. for the demonstrative use of electric vehicles as official cars. The Kanagawa prefectural government, which is positive about the spread of electric vehicles, has been undertaking the “EV sharing model project” since September 2009 in a tie-up with two car rental companies. Under the project, the prefectural government rents electric vehicles from the two firms for use on business purposes on weekdays, and general users rent and use them on weekends. These forward-thinking efforts are spreading to many other municipalities, including Minoo City of Osaka Prefecture and Arakawa Ward of Tokyo. Private-sector businesses are also launching various initiatives using electric vehicles. For example, a condominium management company is offering a system under which condominium residents can jointly use electric vehicles.

Turning eyes to other countries, Paris, where the bicycle rental system, “velib,” launched in 2007, has taken firm root as a means of transportation, is planning to start its automobile version, “autolib,” in

September 2011. Specifically, Paris will set up arrival and departure stations with battery charge facilities at 1,400 locations, including 700 locations within the Paris city in a large-scale project of operating as many as 4,000 electric vehicles. To make the system easy to use for many citizens, electric vehicles can be returned to stations different from those where they are rented, and rental fees will be set at around 4-5 euros (about ¥490-610).

If car-sharing schemes using electric vehicles spread, it can be expected to produce significant effects in easing traffic jams and reducing exhaust gas and carbon dioxide emissions. Further, while lithium ion batteries are still expensive with the absence of volume efficiency yet, if their prices decline due to the marketing and wider penetration of electric vehicles going forward, municipalities and companies that introduce car-sharing schemes using electric vehicles are likely to increase further and the new concept of values in favor of utilizing the function of vehicles instead of owning them can be expected to take root.

Kanagawa Prefecture “EV sharing model business”



Photo: Kanagawa Prefecture

### 3 Contributions of Environmental NPOs to Building a Sustainable Society

With the declining birthrate and the aging of the population, concentration of population in urban areas and changing lifestyles, etc., various issues including nursing care and welfare of the elderly and disabled, town development and revitalization, are coming to the fore. These issues have so far been addressed by the public sector, citizen volunteers and charitable nonprofit organizations (NPOs). In recent years, however, more and more attention are focusing on NPOs trying to solve such issues while balancing revenues received from business operations and services they provide. Environmental conservation NPOs are no exception in terms of this trend. In order to realize a low-carbon and

sustainable society, it is necessary to revitalize the community through the utilization and conservation of untapped energy resources and natural resources. To that end, environmental social enterprises (including NPOs) are expected to play a greater role to bring about social change in the community.

Various efforts are required to promote activities by such environmental social enterprises. For example, supports are needed so that NPOs can acquire knowhow on management, accounting and fund raising and build cooperative relations with relevant actors in the community, including small and medium-sized businesses, municipalities and financial institutions.

Column

Community-Based Joint Citizen Ohisama Power Station

~NPO Minamishinshu Ohisama-Shinpo~

Nonprofit organization (NPO) Minamishinshu Ohisama-Shinpo launched the “joint citizen power station ‘ohisama (meaning the shining sun) power station’ project” in 2004 to raise funds from donations to install photovoltaic power generation facilities at kindergartens and nurseries in the community under the idea of “building a sound material-cycle society through local production and local consumption of energy.”

Subsequently, in the same year, “Ohisama-Shinpo Energy,” a private limited company (later a joint stock company), was established as a private-sector company to undertake the project in Iida City, Nagano Prefecture, adopted as “A Community Model Project of a Virtuous Circle for Environment and Economy” of the Ministry of the Environment. The project, as a participatory project of citizens, is designed to solicit capital contributions from citizens (under an anonymous association contract) and use these funds to set up ohisama power stations and invest in energy-saving projects at companies in the city. Revenues from the sale of electricity generated at the power stations and from energy-saving services are returned to capital investors and also distributed as profit. A combined amount of over ¥700 million was raised in investment ohisama power stations have been built at 162 locations in Nagano Prefecture for a combined capacity of 1,280 kW. The company is also engaged in energy-saving businesses and heat supply businesses utilizing forest resources (woody biomass) abundant in

Ohisama Power Station (Kanae Mitsuba Nursery in Iida City)



Photo: NPO Minamishinshu Ohisama-Shinpo

the Minamishinshu area, and these businesses are estimated to be reducing carbon dioxide emissions by about 1,800 tons annually.

The area is rich in energy resources, including the direct utilization of solar energy for power generation and heat supply, abundant forest resources and small-scale hydraulic power generation using perennial water resources and precipitous geological formation. Activities of an NPO to utilize natural energy as a business in collaboration with a municipal government and citizens in the community can be expected to help revitalize the local community and also lead to the building of a sound material-cycle society.

4 Financial Flows Heading to the Environmental Industry

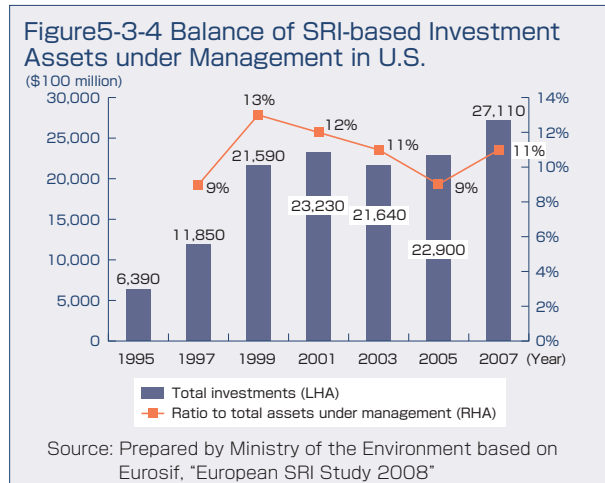
Investment to be made in consideration of efforts on the environment in addition to investment criteria such as corporate profitability and growth potential is called socially responsible investment (SRI). The balance of SRI-based investment is on the increase globally.

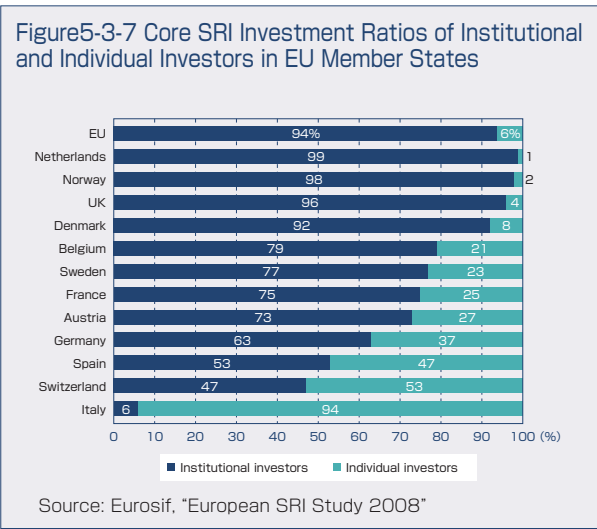
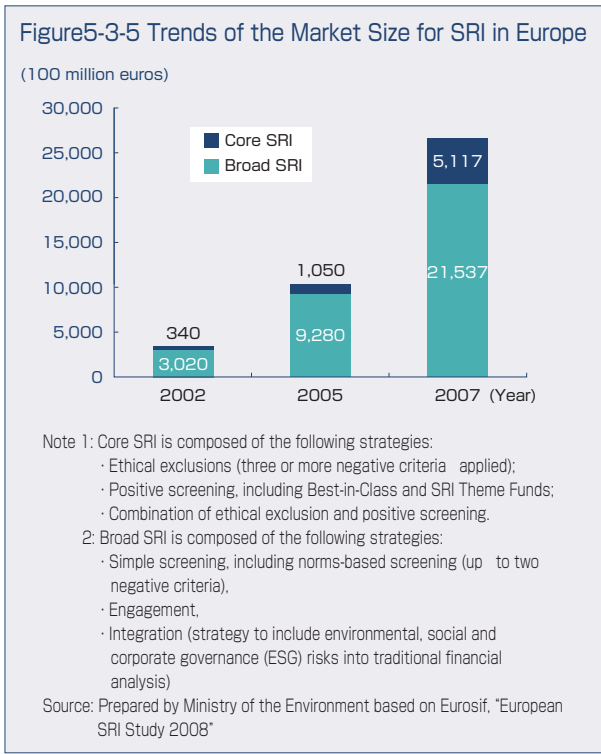
For example, the balance of SRI-based investment in the United States has been increasing in recent years. While these assets declined between 2001 and 2003, they kept growing from 2003 onward and reached \$2.7 trillion in 2007, a little over four times the 1995 level (Figure 5-3-4).

A similar trend can be observed in Europe as well. The market size for SRI kept growing since 2002, and expanded to 2.7 trillion euros in 2007, about eight times the 2002 level (Figure 5-3-5).

The number of funds making SRI investment is increasing, standing at 83 as of September 2009. The balance of net SRI investment assets in 2009 declined sharply from the previous year due to the global slowdown of economic activities, but the balance of such

assets is basically on the increase since 2003 (Figure 5-3-6). On the other hand, the size of SRI investment in Japan is a far cry from compared with Europe and the

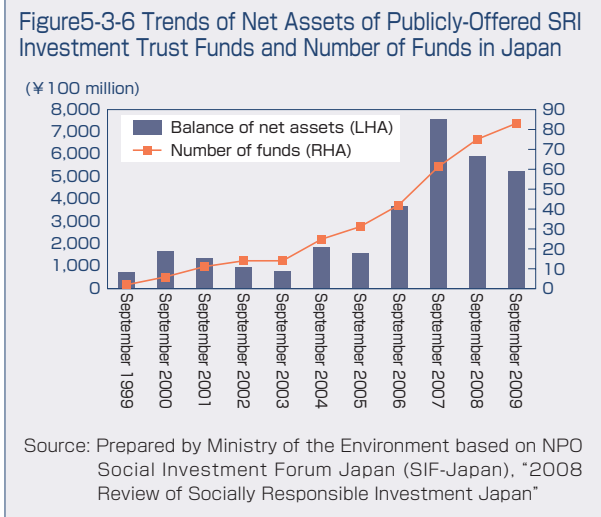




investment in environment-friendly areas and areas conducive to social contributions instead of just pursuing higher investment returns. Publicly offered funds require the participation of many investors and thus are structured on the needs of investors. Therefore, the steady increase year after year in the number of publicly offered eco-funds in Japan can be seen as an expansion of green investment, which reflects the rising environmental consciousness among individuals and the rising needs of "green investors" who want to aggressively invest in environment-friendly companies.

Aside from SRI, another movement related to the environment and financing are efforts in international financing based on the "Equator Principles," the leading voluntary standard set by financial institutions for managing social and environmental risk in project financing. The Equator Principles are the principles for financial institutions that provide a framework for determining, when they are making new project financings globally with total project capital costs of US\$10 million or more, whether projects to be financed are paying due heed to potential impacts on local communities and the natural environment. The Equator Principles were first adopted by 10 U.S. and European financial institutions in June 2003.

Financial institutions adopting the Equator Principles classify projects they are financing into the three categories of A (projects with potential significant adverse social or environmental impacts), B (projects with potential limited adverse social or environmental impacts) and C (projects with minimal or no social or environmental impacts) in accordance with the environmental and social screening criteria of the International Finance Corporation (IFC). When a project is classified as Category A and Category B, a financial institution should carry out a detailed environment review using the industry-wide "check list," and a borrower also should make social and environment assessment, including the consideration of an environmentally and socially feasible, desirable alternative. At the same time, an independent social or environmental expert not directly associated with the borrower will review the financial institution's environment assessment. Financial institutions that have adopted the Equator Principles are required to disclose

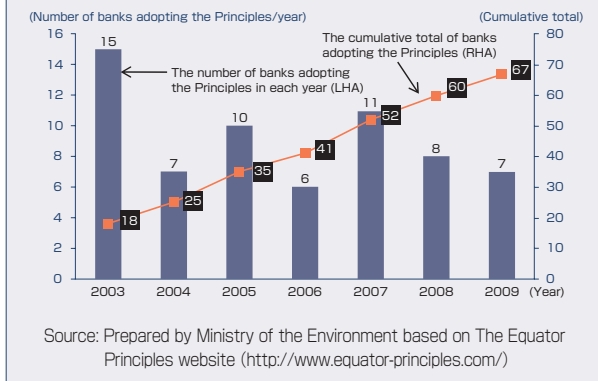


United States. As of 2007, SRI investment in Europe and the United States was in the range of several ¥100 trillion, while SRI investment in Japan stood at just several ¥100 billion. It is believed that this is because that while SRI investment is made mainly by institutional investors with large pools of funds under management in Europe and the United States, SRI investment in Japan is done mainly by investment trust funds with relatively small amounts of funds under management for individual investors. Particularly in Europe, 94% of core SRI investment is dominated by institutional investors (Figure 5-3-7).

While there are differences in the size of investment and rates of increase among countries and regions, in the world as a whole, SRI investment made in consideration of environmental and other considerations, can be said to be on the increase in recent years.

It is believed that behind this trend is the "diversification of investment needs" seeking active

Figure 5-3-8 Trends of the Number of Financial Institutions Adopting the Equator Principles



the implementation process of the Principles and actual results at least once a year.

Since the adoption in 2003, the number of financial institutions subscribing to the Equator Principles has increased steadily, and stands at 67 as of 2009, including three Japanese financial institutions (Figure 5-3-8).

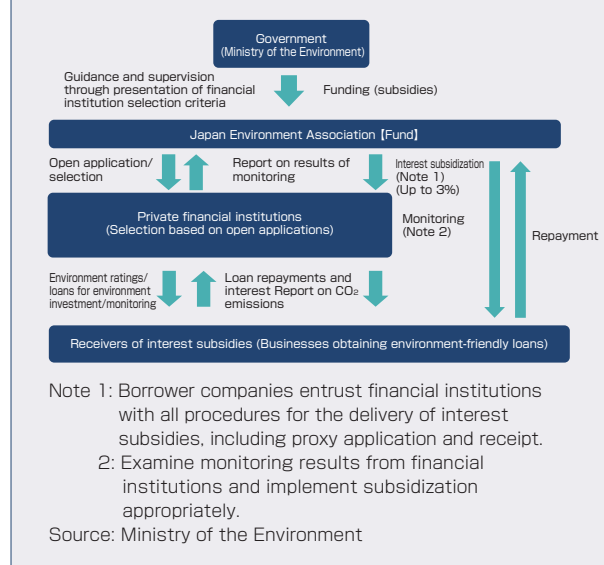
Because of the adoption and development of the Equator Principles, over 80% of international project financings are being provided by financial institutions that have adopted the Principles. The Equator Principles have brought about significant changes in project financing deals as de facto rules when private financial institutions make investment decisions.

Efforts to encourage environment-friendly investment are also being made by public institutions. In Norway, for example, a new environment investment program is under consideration to direct part of state funds to environment investment. Under the program, about ¥280 billion (2 trillion kroner) is to be invested over five years in projects, such as the supply of environment-friendly energy and improvement of energy efficiency, that can be expected to reduce environmental loads.

The UNEP is reviewing the current form of fiduciary responsibility focusing only on the pursuit of short-term monetary returns. The “Fiduciary Responsibility” released in July 2009 by the UNEP considered the legal and practical aspects of integrating environmental, social and governance issues into institutional investment. As a result of this consideration, the UNEP report, in its summary conclusion, states that “all asset manager and asset owner signatories will be required to embed ESG (environmental, social and governance) issues in their legal contracts” and that “advisors to institutional investors have a duty to proactively raise ESG issues within the advice that they provide.”

Japanese government is also supporting financial institutions in order to promote capital investment in the environment. For example, the Ministry of the Environment created the “interest subsidy scheme for special support for the Kyoto Protocol target achievement” in FY 2009. Under the loan system, businesses that pledge reductions of carbon dioxide

Figure 5-3-9 No-Interest Loan System for Special Support for the Kyoto Protocol Target Achievement



emissions by 6% over three years can receive interest subsidies of up to 3% (but no more than no interest) for capital investment in measures to cope with global warming through financial institutions that offer lending on preferential terms by environmental ratings (Figure 5-3-9). Under the second supplementary budget for FY 2009, another new lending scheme, “interest subsidy scheme to support the acceleration of global warming countermeasures,” was created. These loan systems can be expected to encourage capital investment in the environment put off for reasons of interest burdens. As for actual disbursements of loans, under the “no-interest loan system for special support for the Kyoto Protocol target achievement,” which began with a budget of ¥4.5 billion, as of February 2010, environment-friendly loans totaling a little over ¥80 billion were extended. Going forward, loans under this scheme are expected to exceed ¥110 billion.

This scheme is applicable only to lending from financial institutions that offer loans based on environmental ratings. Loans based on environmental ratings are offered by financial institutions on preferential terms based on the results of the screening and evaluation of environment-friendly efforts by borrowing businesses. Since the national government introduced the no-interest loan system, the number of financial institutions that extend loans on environmental ratings substantially increased from just four banks prior to the system’s introduction to 31 banks as of February 2010. Thus, it is expected that environment-friendly loans will increase going forward. The national government, through these loan systems, is building a mechanism under which environment-friendly companies are valued highly and the flow of financial assets goes into the direction of the environment.



## Column Financial Institutions' Efforts on the Environment

We introduced the “Equator Principles” as an example of efforts by financial institutions to voluntarily integrate environmental issues in their lending operations. Aside from institutional efforts, it is also important for individuals to act by altering their consciousness about the environment.

For example, a major international financial institution encourages employees to take part in volunteer activities by treating their participation in environmental practices of a non-profit organization (NPO) as “business trips.” In volunteer activities, this financial institution supports a project, among others, to investigate a linkage between climate change and coastal ecosystems, helping the collection and analysis of data on seaweed beds for marine plants and rocky intertidal zones, which play important roles as habitats for animals and plants in coastal areas in temperate marginal zones.

Environment-friendly financial flows may be expected to accelerate going forward if financial institution employees become more conscious about

A Scene of Financial Institution Employees Participating in Volunteer Activities



Source: HSBC Holdings plc, “HSBC Community Activities”

the environment and loans to finance initiatives that contribute to environmental conservation and sustainable development become commonplace practices.

## Section 4 Global Environment and Economic and Social Activities

The environment provides the foundation for sustainable development of the economy and society. Hence, a variety of environment problems are important challenges that threaten stable economic and social activities and at times, even their continuation. The Japanese economy, meanwhile, remains under difficult circumstances, though it is recovering from the latest economic crisis. The progressing decrease in the labor force and the declining savings rate are feared to have adverse impacts on Japan’s economic growth going forward, while the Japanese economy is exposed to competition not only from longstanding rivals in the developed world but also from China, India and other emerging economies that have moved into the global market on the back of cheap and abundant labor and the large-scale introduction of foreign capital.

In order to overcome these difficulties concerning the environment and the economy, it is necessary to maintain

and reinforce the international competitiveness of the environmental industry, the strong point for Japan, by striving toward further development and spread of environmental technologies through creative innovation. With these environmental technologies and the environmental industry as the driving power, it is also necessary to sever the linkage between economic growth and increases in resources/energy consumption accompanied by environmental loads, and strive to reduce environmental loads while sustaining economic growth.

Along the line of this approach, in this section, we give an overview of policies necessary for the development of the environmental industry going forward, centering on the promotion of innovation in the environmental field (green innovation) and consider a new socioeconomic system that creates a virtuous circle for the environment and the economy.

### 1 Promotion of Green Innovation by Environment Policy

#### (1) Environment policy that creates green innovation

Internalization of social costs of environmental loads (external diseconomy) through environment policy should increase demand for environmental technologies and lead to the creation of green innovation. As demonstrated by the dramatic advance in low carbon technologies since the adoption of the Kyoto Protocol in 1997, it is important to

send clear messages to the market for business investment decisions in research and development for low-carbon technologies in the private sector (Figure 5-4-1).

When multiple policies can be considered for the identical goal, it is desirable to take flexible policy approaches to allow options to develop and introduce various new technologies. Given this point of view, for the promotion of green innovation, it is important not only to introduce direct regulations specifying the reduction

levels of environmental loads but also to promote an effective policy mix that includes economic approaches that allow room for ingenuity in countermeasures and lead to greater advantages in accordance to the extent of reductions in environmental loads.

Furthermore, in recent years, particularly among major corporations, environment-friendly business management (environmental management) has become an important element of corporate management principles as part of corporate social responsibility (CSR). Coupled with the rising environmental consciousness among consumers and the markets, there are movements among many companies to capture market shares by developing products with strong environmental performances and, by extension, enhance the brand value and enterprise value, let alone cost reductions and avoidance of environmental risks through energy-saving and resources-saving efforts. The progress in environmental corporate management is making the causal relationship between environment policy and the creation of innovation and environmental improvement effects (Figure 5-4-2).

For this reason, in considering environment policy, it

is necessary to make a detailed analysis of the mechanisms of how environment policy influences environmental management of companies, through what generation process innovation is created, and what roles (stakeholders), including financial institutions and investors, play in innovation in order to realize more effective environment improvement effects through innovation.

(2) Blending with innovation policy

In addition to the above environment policy, it is necessary to accelerate green innovation by strengthening the development of new technologies by researchers as well as innovation policy needed for the spread of developed technologies.

There are barriers in the process of creating innovation: “Devil River” that arises from the difference in the direction of vectors between academic research conducted out of academic curiosity and technological development for commercialization; “Death Valley” that stems from the lack of support in between technological

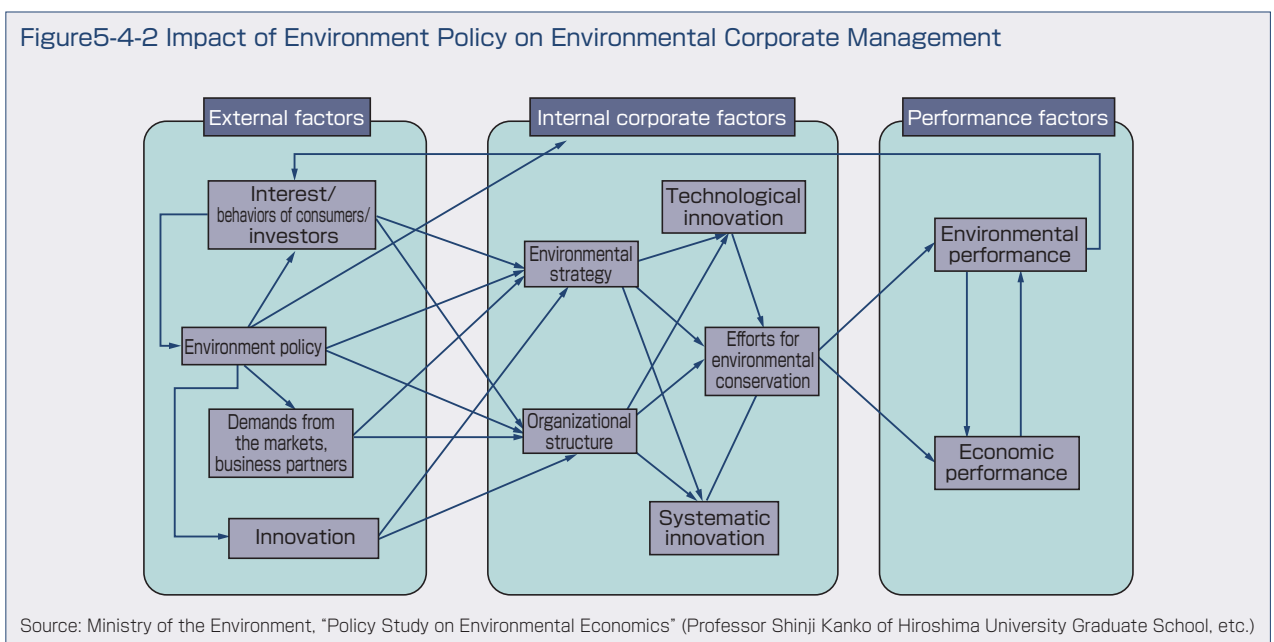
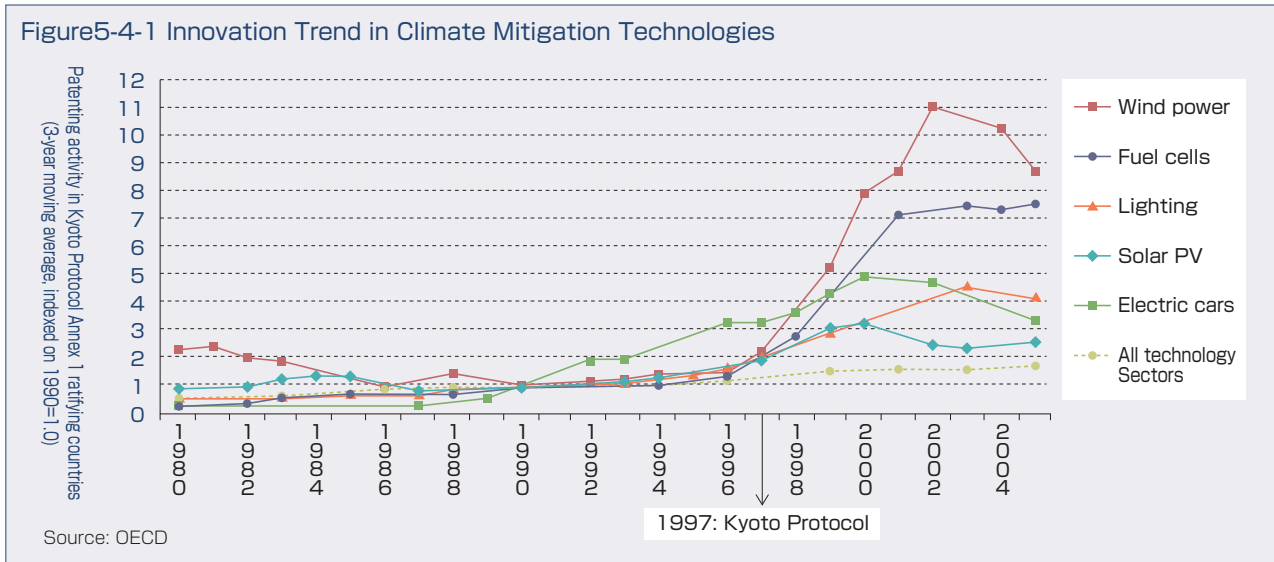


Figure5-4-3 Processes to the creation of innovation and various support measures

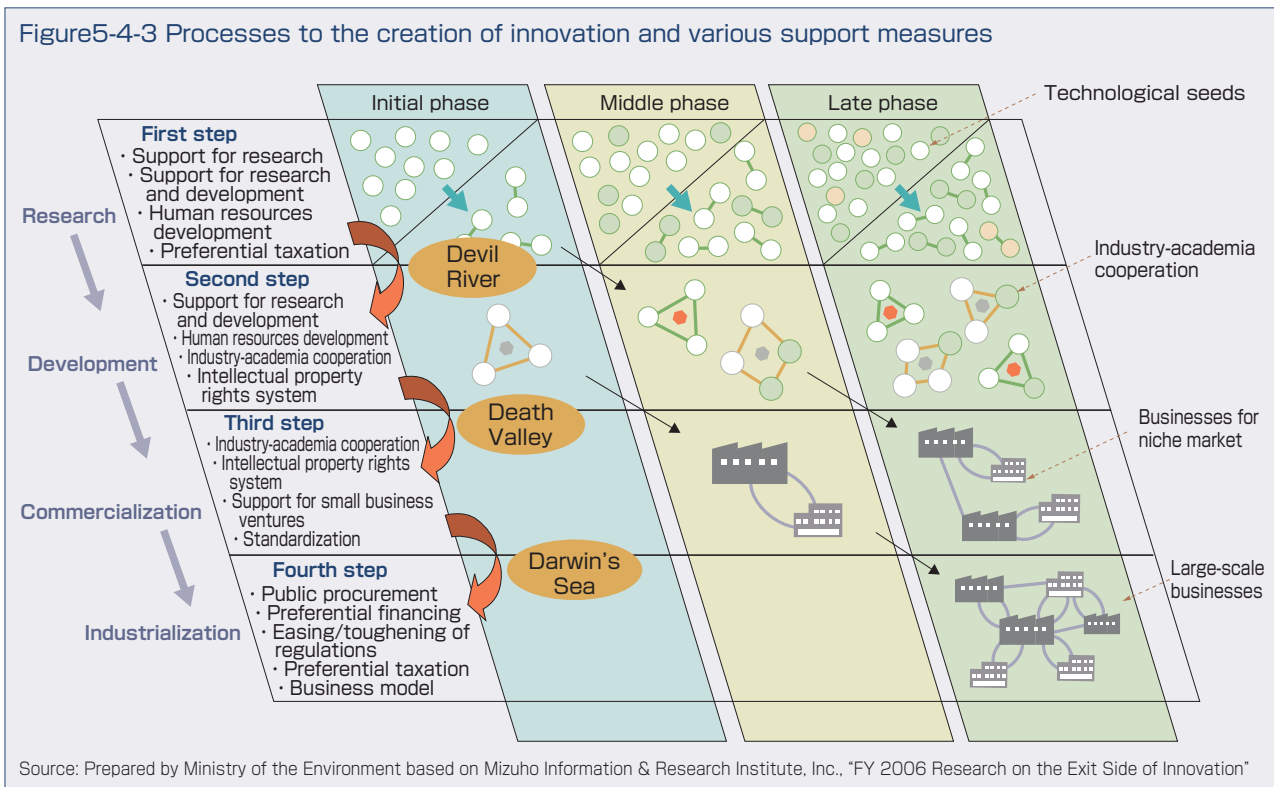
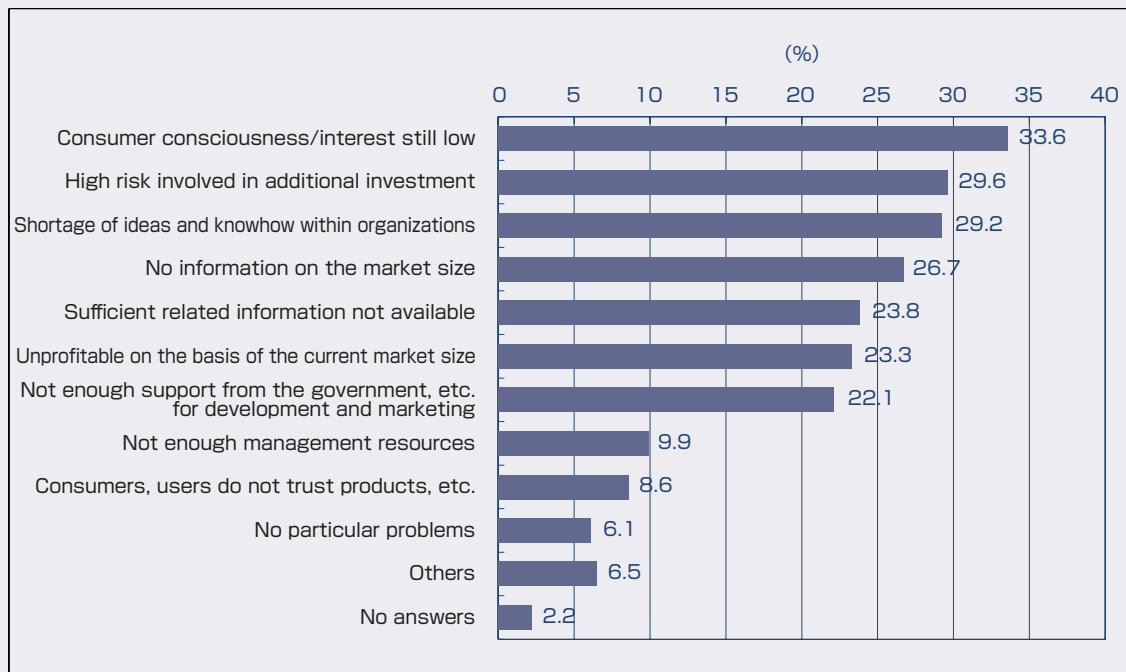


Figure5-4-4 Problems Involved in the Development of Environmental Businesses

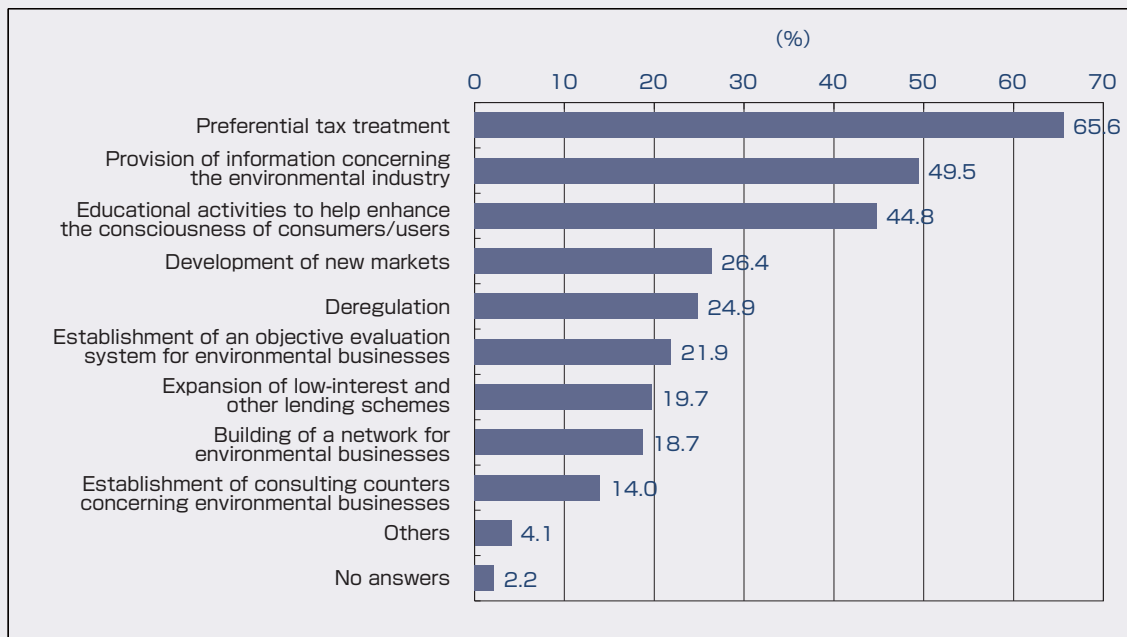


development and the commercialization phase; and "Darwin's Sea" where punishing competition is fought with rivals for a success as an industry (Figure 5-4-3).

This process toward industrialization is no exception for the environmental industry. For example, according to the Regional Economic Report (October 2009, the Bank of Japan), while businesses have been expanding and accelerating moves to change the line of business or diversify into the environmental industry on its potential and in hopes of public support, current conditions

surrounding the environmental industry are tough, as demand remains in the doldrums in the aftermath of the sharp economic slowdown both at home and overseas after the Lehman Shock autumn in 2008, the market size is still small with many related businesses still in the initial phase of development, and competition is already intensifying on both the domestic and global markets. Further, in a survey on environmentally-friendly corporate behaviors conducted by the Ministry of the Environment, many respondents cited "low level of

Figure 5-4-5 Support Measures Wanted to the Government for the Development of Environmental Businesses



Source: Ministry of the Environment, "FY 2008 Survey on Environmentally Friendly Corporate Behaviors"

consciousness/interest among consumers, etc.," "high risk involved in additional investment," "shortage of internal ideas and knowhow" and "shortfall of information related to the environmental industry, such as the market size" (Figure 5-4-4). As for support measures businesses want from the government, many respondents cited "preferential tax treatment," "provision of information on the environmental industry" and "educational activities to help enhance consumer consciousness" (Figure 5-4-5).

In order to create the environmental industry through green innovation, not only public financial assistance and preferential taxation measures but the implementation of measures for human resources development, public procurement and industry-academia cooperation comprehensively and in a meticulous manner in accordance with industry characteristics and market sizes throughout the series of processes from research and development to commercialization and industrialization.

① Support for research and development and venture businesses, etc.

In research and development, since the development of new technologies benefits not only developers but parties other than developers, developers may underinvest in research and development for fear that they may not obtain sufficient first-mover advantages (the so-called "technological spillovers"). It is also conceivable that since research and development work requires a long period of time and involves risks of failure, people cannot make decisions to go ahead and make research and development investment. In addition, as discussed in Section 1, while research and development investment in the environmental field has been increasing, overall research and development investment has been on the decline in the wake of the latest economic crisis. For this reason, the government is providing active support for research and development instead of just leaving it to the private sector, such as preferential tax treatment for private-sector research and development activities, and

in particular, subsidies for basic research whose results are unlikely to directly lead to actual businesses. As the New Growth Strategy (Basic Policies) states that "Japan will increase public- and private-sector investment in research and development to over 4% of GDP by 2020," it is expected that research and development investment, including investment in green innovation, will expand further going forward.

In order to foster and support venture businesses that embark on the industrialization of new technologies, etc., the fruits of research and development activities, the government has taken such measures as the angel taxation system (preferential tax measures for investment in venture businesses) and venture funds (capital investment in venture firms in the early stage). The government also submitted to the 174<sup>th</sup> session of the Diet the bill for the "Act on the Promotion of Businesses to Develop and Manufacture Energy and Environmental Friendly Products (Low Carbon Investment Promotion Act)" for launching a new insurance program aimed at providing low interest rate, long-term funds for developers and manufacturers of low carbon products, such as electric cars, storage batteries and solar panels, and also at encouraging small and medium enterprises to introduce low carbon equipment through leases.

② Development of environmental human resources

As it has been often pointed out that the large increase in science and technology-oriented human resources in the 1960s successfully provided the foundation for innovation in Japan in the high growth period, it is extremely important to secure research and technological human resources with science and technology expertise in order to promote technological innovation through green innovation. On the other hand, in addition to the falling birthrates and the aging of the population, the ongoing phenomenon of the so-called "alienation from science" among young people could result in a qualitative and quantitative shortage of research and technology human

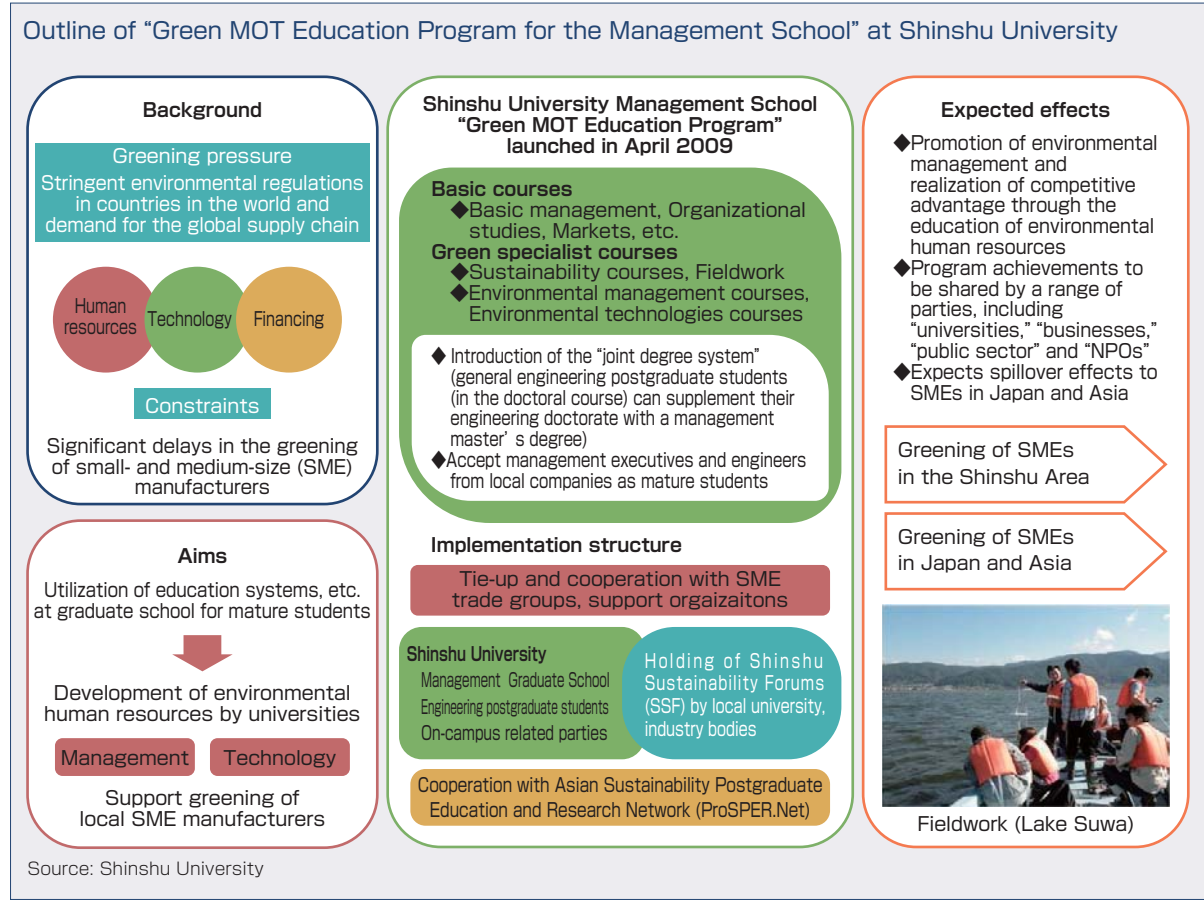


**Column** Development and Spread of Higher Education Model Programs

The Ministry of the Environment, as part of the Environmental Leadership Initiatives for Asian Sustainability (ELIAS), has been undertaking “projects to develop environmental leader university education programs” since FY 2008 to support the development and demonstration of practical programs for environmental leadership training in close cooperation and collaboration with companies, government agencies and NGOs, etc. that actually accept environmental human resources. Currently, such projects are under way at a total of 11 universities, including “Green MOT Education Program” (Shinshu University) that focuses on management of technology (MOT) at small- and

medium-sized manufacturers in the region and “Low Carbon Design Course” (Keio University) that is designed to cultivate students who can contribute to establishing a low carbon society.

At present, preparations are under way for the establishment of a “consortium for fostering environmental leaders,” another effort under the Environmental Leadership Initiatives for Asian Sustainability. It is hoped that many universities carry out practical education to help the fostering of environment leaders in close cooperation with program development efforts by these universities, and environmental leaders educated at such institutions play active roles in a broad range of fields in the future.

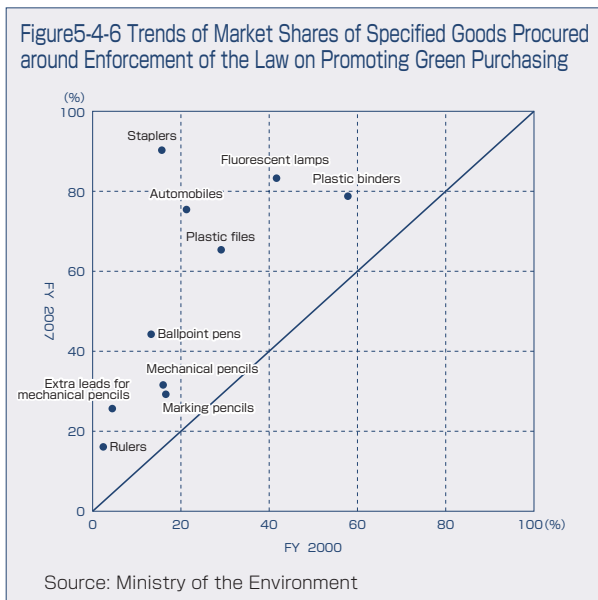


resources in the future and is feared to seriously undermine the international competitiveness of Japanese industry. Given this situation, the New Growth Strategy (Basic Policies), as part of the science-and-technology-oriented nation strategy, cited the targets to be achieved by 2020: “Increase the number of universities and research institutions that lead the world in respective fields. Ensure full employment for all those who have completed doctoral courses in science and technology.” It is expected that through the achievement of these targets, measures will be taken to foster and utilize environmental

human resources that support green innovation.

The creation of a new environmental industry and greening of economic activities also require the fostering and utilization of environmental human resources in fields other than the science and technology field. At present, however, we probably cannot say sufficient efforts are being exerted to nurture environmental human resources at universities, etc. While companies have the need to hire environmental human resources, they appear to be having hard time securing enough of such human resources.

The action plan for the “United Nations Decade of



Education for Sustainable Development (UN-DESD) in Japan,” an initiative related to “Education for Sustainable Development (ESD),” calls for the promotion of efforts in higher education. In line with this, a panel of the Ministry of the Environment worked out the “Vision for Environmental Leadership Initiatives for Asian Sustainability in higher education (Environmental Leadership Vision)” in March 2008. The Vision defines environmental leaders as “those who look at environmental problems in light of their own experience and moral values, are committed to leveraging their area of expertise to realize sustainable development in their professional and private lives, and exercise leadership in fulfilling their social responsibilities,” and then maps out the ideas and measures to foster environmental leaders at universities, etc. in order to ensure a sustainability in Asia. Putting teeth into the Vision, the Ministry of the Environment, under the “Environmental Leadership Initiatives for Asian Sustainability (ELIAS),” is proceeding with (a) the development and dissemination of model higher education programs; (b) the establishment of a multi stakeholder consortium for developing environmental leaders,” a framework of cooperation among all stakeholders from industry, academia, government and civil society for the purpose of developing environmental leaders; and (c) the development of network of universities in the Asia-pacific region committed to developing environmental leaders.

③ Stimulation of demand by promotion of green purchasing, etc.

It is also important to implement policy measures to stimulate demand for environment-friendly products in order to create an environmental industry.

As one of such measures, in Japan, the central government and other public-sector institutions are taking the initiative in green purchasing to promote the procurement of eco-friendly goods (goods and services that contribute to reducing environmental loads). Comparison between FY 2000, before the enforcement of the Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities (hereinafter referred to as the “Law on

Promoting Green Purchasing”), and FY 2007 shows the rises in market shares for many eco-friendly goods. For example, staplers (hotchkiss) with the recycled plastic content of over 40% in the weight of plastics, saw its market share skyrocket from less than 20% before the enforcement of the Law on Promoting Green Purchasing to around 90% in FY 2007 (Figure 5-4-6). In FY 2007, the “Law concerning the Promotion of Contracts Considering Reduction of Emissions of Greenhouse Gases and Others by the State and Other Entities (Green Contract Law)” was enforced with the mechanism under which the national government and other public entities in their procurement make a comprehensive evaluation to include environmental performances in addition to prices and conclude purchase contracts with suppliers that offer the best goods and services, etc. At present, environmental conditions are required in contracts for the purchases of electricity, vehicles and ships, etc. and energy-saving renovation businesses (ESCO businesses) as well as designs for construction of buildings or large-scale renovation work.

In order to reduce greenhouse gas emissions from households, which have increased considerably in recent years, the Ministry of the Environment has been undertaking “Eco-Action Point model projects” since FY 2008, under which points (Eco-Action points) are issued for the purchase of goods and services and actions contributory to global warming countermeasures and accumulated points can be exchange for a variety of goods and services. In FY 2009, three nationwide projects and six regional projects were adopted. The projects for the penetration of eco-action points are aimed at establishing business models at the initiative of economically independent private businesses and thereby promoting the utilization of goods and services that contribute to a broad range of measures to cope with global warming.

Furthermore, beginning in FY 2009, in light of the economic and employment conditions in Japan, eco-points for home electric appliances, housing eco-points and the so-called eco-car tax reductions were introduced for the purposes of global warming countermeasures and reinvigoration of economic activities. Eco-points for home electric appliances, exchangeable for a variety of goods and services, are issued for the purchase of green electric appliances (air conditioners, refrigerators and TV sets for digital terrestrial broadcast reception with four or more of the unified energy-saving label ☆) to encourage replacement demand. The validity period for the eco-points for home electric appliances was extended until December 31, 2010, under the “Emergency Economic Countermeasures for Future Growth and Security” (adopted in December 2009 by Cabinet decisions) and the second supplementary budget for FY 2009 enacted in the 174th session of the Diet. With some changes in the structure, including improved application procedures for the higher convenience for users, tougher energy-saving standards for TV sets and promotion of the use of white LED bulbs, etc., these eco-points made a fresh start as a new system on April 1, 2010. For construction of eco-friendly new houses and eco-friendly home remodeling, a new system of housing eco-points was created, with housing eco-points exchangeable with a



## Column Eco-City Initiatives in China

China is making intensive investment in the environmental field as a national project. The most exemplary case of this initiative is the Tianjin Eco-city (Tianjinshengtaicheng). The Tianjin Eco-city, the first environmental city plan led by the Chinese government, was launched in 2007 as the joint project with the government of Singapore. The project, set to be completed 10 to 15 years, calls for a total investment of 250 billion yuan (about ¥3.2 trillion), and 350,000 people are expected to live in the city with a site area of some 30 square kilometers. Environmentally, condominiums, office buildings and all other buildings to be set up in the city are required to comply with energy-saving standards, and the Tianjin Eco-city is to become a model city for energy-saving and environmental conservation, with 20% of electricity supply coming from renewable energy such as photovoltaic and wind power generation. China has also designated the “Gangzhuxiang” group of cities made up by Gangsha, Zhushou and Xiangtan cities in Hunan Province and another group of cities led by Wuhan City in Hubei Province as the demonstrative experimental group of cities for the “two-type society” (the society that is resource-saving type and at the same time environment-friendly type). In the group of cities led

Rendering of “Tianjin Eco-city” (Tianjinshengtaicheng)



Source: Sino-Singapore Tianjin Eco-city website

by Wuhan, a total of 459 environmental conservation projects are set to be implemented over a period of 10 years from 2010 with a total investment of some 500 billion yuan (about ¥6.5 trillion).

As seen above, efforts to deal with environment problems are now being made at the city level in China, which will likely mean a further intensification of competition over the environmental industry going forward. Amid these developments, it is hoped that Japanese companies, armed with their environmental technologies at the world’s highest levels, will proactively advance into China’s environmental market.

variety of goods and services in the same manner as eco-points for home electric appliances.

Eco-car subsidies are designed to subsidize the purchase of new vehicles with high environmental performance (environment-responsive cars), including replacement. Together with eco-car tax reductions already in place, the eco-car subsidization scheme is producing the significant economic and environmental conservation effects. The subsidization scheme was also extended to remain effective until September 30, 2010.

In part because of the impacts of the eco-points for home electric appliances and eco-car subsidies, personal consumption began to show some signs of recovery, with these systems underpinning the business conditions and employment in the home electronics and automotive industries. The market shares of environment-conscious products expanded, with, for example, hybrid vehicles capturing the biggest share in domestic sales of passenger cars in FY 2009, for the first time ever.

④ Market expansion overseas, particularly in Asia

Other countries, in particular the Asian region, which has close geographical and economic ties to Japan, accounts for over half of the world’s population and is seeing rapid economic growth, but also is confronted with serious environmental problems, including air pollution, water contamination, inappropriate disposal of wastes and deforestation. And sharp increases in greenhouse gas emissions and increased waste discharges in the region are impacting the environment on a global scale.

Japan can conceivably help facilitate Asia’s sustainable

development by sharing Japan’s experiences and wisdom to have overcome pollution problems while sustaining economic growth and also proactively extending Japan’s excellent environmental technologies to the region. This can be expected to lead to an expansion of exports to Asia, which has the massive environmental market.

As seen above, the environmental market is expected to expand further, centering on Asia, European countries such as Denmark, Spain, Finland and Germany, are also moving to actively promote exports of environmental products and services by placing the environmental industry at the core of their export strategies, with their governments fostering and supporting the environmental industry (Table 5-4-1).

In Japan, for example, the “Hatoyama Initiative” announced at the 15<sup>th</sup> session of the Conference of the Parties to the Framework Convention on Climate Change (COP 15) in Copenhagen in December 2009 as assistance to developing countries grappling with global warming says Japan, with the public and private sectors as one, will make a fair share of contributions by leveraging Japan’s excellent environmental technologies in line with the basic thinking that support with private-sector financing and technologies is essential to push forward with powerful efforts to reduce greenhouse gas emissions in developing countries. This initiative can place Japan ahead of the world’s other countries by further polishing its technologies to cope with climate change and also can help spread Japan’s technology and knowledge about both mitigation and adaptation to the entire world, which may

Table5-4-1 Environmental Industry Promotion and Export Strategies of Other Countries

Country	Denmark	Finland	Spain	Germany
Name	Eco-efficient technology promotion strategy	Technological development program: Business opportunities in mitigating climate change	Technological research promotion program (priority areas in environmental innovation)	German environmental technology master plan
Description	<ul style="list-style-type: none"> <li>○ Nine initiatives to promote eco-innovation</li> <li>① Building up partnerships for innovation</li> <li>② Specific and active export promotion linked to the government's diplomacy, etc.</li> <li>③ Promotion of environment-friendly R&amp;D at research institutions/universities</li> <li>④ Ministry of the Environment's initiative to promote eco-efficient technology</li> <li>⑤ Promotion of eco-efficient technology at the EU level</li> <li>⑥ Promotion of introduction of climate-related and energy technologies</li> <li>⑦ Promotion of livestock farm-derived technology to reduce environmental loads</li> <li>⑧ Qualitative and quantitative conservation of the water environment</li> <li>⑨ Promotion of technology to reduce contamination in the environment</li> </ul>	<ul style="list-style-type: none"> <li>○ Program to identify and maximize opportunities for Finnish companies in the international market in technologies and services related to climate change mitigation</li> <li>○ Prioritized budget allocation to clean energy fuel, technology to enhance energy efficiency and technology to reduce greenhouse gases other than carbon dioxide (budget of 70 million euros executed between 2004 and 2008)</li> </ul>	<ul style="list-style-type: none"> <li>○ 5 areas of climate change, sustainability of cities, improvement of production processes, water management/conservation and energy designated as priority areas, and identified under the technology research promotion plan, etc.</li> <li>○ The plan's targets include the participation of Spanish companies in international R&amp;D cooperation</li> </ul>	<ul style="list-style-type: none"> <li>○ In order to enhance Germany's position in the environmental technology market, the master plan shows the direction of environmental technology development policy for each area, including water-related technology, technology for enhancing resources productivity, and technology to prevent climate change</li> <li>○ The master plan emphasizes the high level of environmental regulations as Germany's competitive edge in the global market, showing the policy of creating demand for environmental technology by "exporting" Germany's advanced environment policy within the framework of support for system construction in developing countries not limited technological development in each area</li> <li>○ Government-led export promotion structures have been formed (water: German Water Partnership; waste and recycling: ReTECH), backing up German firms' advances into overseas markets as the country as a whole</li> </ul>

Source: Prepared by Ministry of the Environment based on OECD Environmental Outlook to 2030, OECD ENVIRONMENTAL INNOVATION AND GLOBAL MARKETS, and governmental websites of countries concerned

bring significant opportunities for the Japanese economy.

As seen in water-related businesses, developing countries, in increasing instances, place comprehensive project orders covering a whole range of construction, fund-raising and operations. While Japan has the world's most advanced element technologies and knowhow, major overseas players are currently controlling the global water business market because Japanese technologies cannot be accepted in most developing countries due to cost reasons and also because Japanese companies owning advanced element technologies and knowhow are not necessarily in full partnership for development of overseas businesses. To cope with such a situation, the "Global Water Recycling and Reuse System Association,

Japan" was established in January 2009 to consolidate Japanese firms' excellent technologies and knowhow as a "system" and acquire cost competitiveness. This initiative is beginning to display a successful showing.

As seen in this example, in order for Japan to strengthen the international competitiveness in the global environmental market that is expected to grow further centering on developing countries, it appears important for individual companies to create new environmental technologies through green innovation and for the public and private sectors and companies to cooperate to bring together their environmental technologies as the "system" to win out international competition.

## 2 Idea of New Economic Development in Consideration of the Global Environment

### (1) Economic development indicators in consideration of the global environment

The root cause for the emergence of global environmental problems lies in that economic activities have grown enormous to overwhelm the capacity of the natural environment that has been previously thought to be infinite. Therefore, in order to realize sustainable development, we need to recognize the finiteness of available resources and environmental capacity and consider how we should conduct economic activities within the limitations. We believe that the environmental industry is capable of not only developing new technologies but also becoming the driving power to transform the economic society into a sustainable one by bringing about changes in conventional production methods and our lifestyles.

The traditional indicator we use in Japan is gross

domestic product (GDP) that covers only goods and services traded on the domestic market and does not evaluate the loss or improvement in environment values that do not go through the markets, and thus is not necessary an appropriate indicator to measure the quality and sustainability of life such as welfare and the sense of happiness. Given these consideration, the Organization for Economic Cooperation and Development (OECD), the European Union (EU), the World Bank and some other international institutions as well as NGOs are developing sustainability indicators to supplement GDP for the realization of a low-carbon society and further a sustainable society. In France, the "Commission on the Measurement of Economic Performance and Social Progress" (CMEPSP) was established at the request of President Nicholas Sarkozy under the chairmanship of Professor Joseph Stiglitz of Columbia University. The Commission, noting that GDP has its limitations as an indicator to reflect the well-being, considered an





indicator or a group of indicators that can replace GDP, and summed up its considerations in a report released in September 2009.

As seen above, research is being carried out on sustainability indicators in various quarters. Here, we look at some endeavors that have already reached the stage of actually developing and using new indicators.

One of them is the green GDP. The green GDP is the GDP that incorporates environmental deterioration and consumption of natural resources into national accounting, and many countries devised their respective green GDP calculation methods. But the green GDP index is said to have some deficiencies, such as the difficulty in accurately reflecting the depreciation of natural resources by consumption in monetary terms.

Another example is the “Genuine Savings” indicator developed by the World Bank. The genuine savings indicator is calculated by deducting consumption of fixed capital from gross national savings, adding current expenditure on education as an investment in human capital, and also deducting the value of depletion or reduction of natural resources and damages from carbon dioxide emissions, etc. Negative genuine savings, for example, mean an overall decline in wealth and suggest the current level of consumption cannot be sustained (Figure 5-4-7).

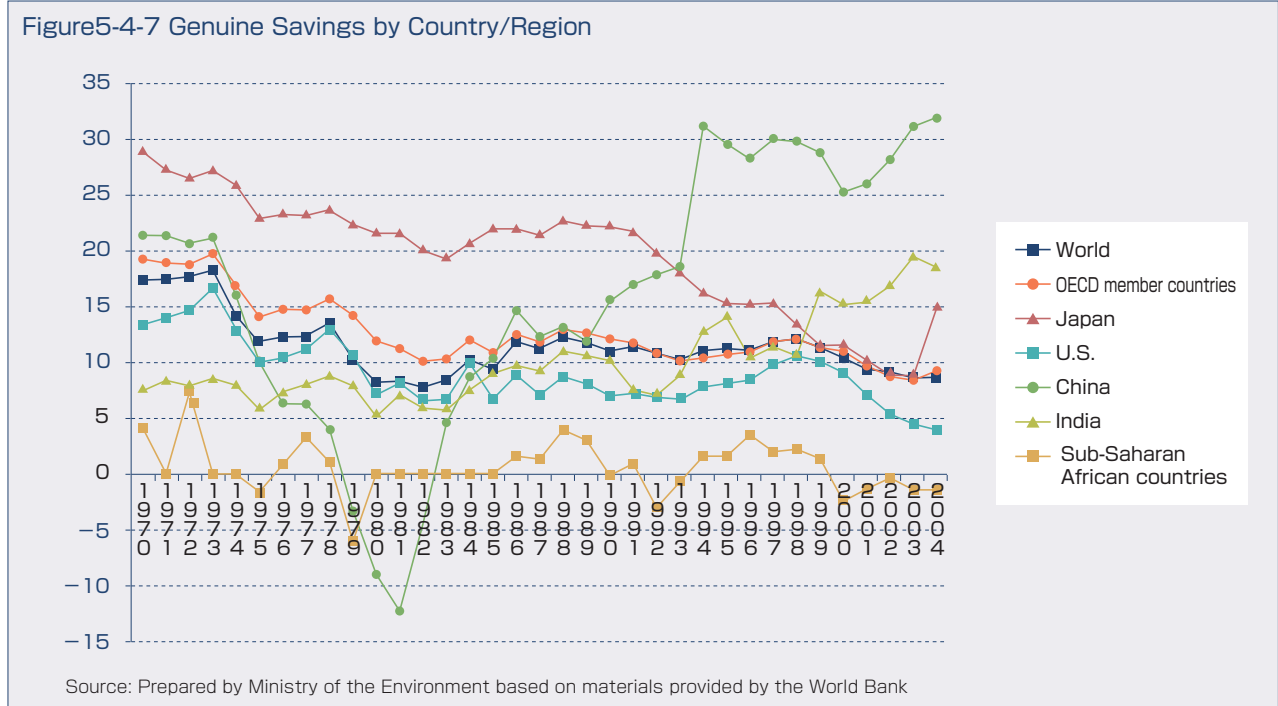
In Europe, OECD and Eurostat developed a group of indicators to assess sustainability in 2005 (revised in 2007) in line with the EU “Sustainable Development Strategy.” For each of nine objectives under the Sustainability Development Strategy, the group of indicators systematically organizes various indicators at three levels in accordance with relevance and deep connections with the Strategy objectives. More specifically, sustainability is to be captured by 11 indicators at Level 1, 33 indicators at Level 2 and 78 indicators at Level 3 (Figure 5-4-2). According to a survey by the National Institute for Environmental Studies, at least 26 other countries and international

organizations, etc. have developed their respective sustainable development indicators to measure development by sustainability (Table 5-4-3).

The human development index (HDI) announced by the U.N. Development Program (UNDP) is an indicator to show the quality of life and the degree of development. The HDI is calculated by taking into consideration the literacy rate, per-capita GDP and the average life expectancy, etc. When we use the HDI to assess the degree of development of industrialized countries, many countries obtain figures close to perfect score. This means that industrial nations have already achieved the level of development to be sought under the HDI. Given this, in measuring the state of development in industrial nations, it is necessary to establish indicators more commensurate with the conditions of industrial nations to measure the degree of their development. The HDI uses GDP, but it is conceivable to capture the state of development of industrial nations by incorporating the environmental conservation conditions in industrial nations by replacing GDP with GDP per emission of carbon dioxide. The recalculation with the above replacement result in big changes in the rankings, with Japan placed tenth in the HDI-based assessment moving up to sixth (Table 5-4-4).

In Bhutan, the gross national happiness (GNH) is used as the substitute indicator of progress. The GNH, first proposed by Bhutan in the 1980s as a better indicator to replace GDP, represents the principles to guide the country’s development in a manner suitable for its unique culture and values. Since 2004, Bhutan is promoting the GNH actively, including the hosting of an international conference on the indicator. At any rate, Bhutan’s initiative to measure a nation’s richness not by the “economy” but by the “happiness” and set “how to enhance the happiness of the nation” as the state’s policy objective deserves merit as a valuable attempt.

Above, we reviewed a variety of indicators, including sustainability indicators that exhaustively capture



## Column The Stiglitz Report

CMEPSP, with the problem consciousness that “existing indicators as represented by GDP may not be able to capture the actual state of the economic society,” set up the three themes of “Classical GDP Issues,” “Quality of Life” and “Sustainable Development and Environment” for consideration from the standpoint that it is necessary to have a method to measure both economic performance and social progress more appropriately. The Commission’s report put together in September 2009 set forth the following recommendations on 12 elements that it believes are needed concerning a future indicator or a group of indicators.

### 1. Classical GDP Issues -From production to well-being

- (1) When evaluating material well-being, look at measures of household income and consumption rather than GDP, a measure of production;
- (2) When looking at household income and consumption to evaluate well-being, take account of taxes and other payments while household income and consumption should also reflect in-kind services provided by government, such as subsidized health care and educational services;
- (3) Consider income and consumption jointly with wealth, as sustainability is measured by what is carried over into the future (physical, natural, human and social capital);
- (4) Average income, consumption and wealth do not tell the whole story about living standards, as, for example, a rise in average income could be unequally shared across groups. Average measures of income, consumption and wealth should be accompanied by indicators that reflect their distribution;
- (5) Broaden income measures to non-market activities, such as services produced in households;

### 2. Quality of life

- (6) Quality of life depends on people’s objective conditions and capabilities. Steps should be taken to improve measures of people’s health, education, personal activities and environmental conditions. In particular, substantial effort should be devoted

to developing and implementing robust, reliable measures of social connections, political voice, and insecurity that can be shown to predict life satisfaction;

- (7) Quality-of-life indicators in all the dimensions covered should assess inequalities in a comprehensive way;
- (8) The loss of quality of life of a person who is poor and also sick may far exceed the simple sum of the losses of quality of life of a person who is poor but healthy and a person who is sick but not poor. Thus, surveys should be designed to assess the links between various quality-of-life domains for each person, and this information should be used when designing policies in various fields;
- (9) Statistical offices should provide the information needed to aggregate across quality-of-life dimensions, allowing the construction of different indexes;
- (10) Measures of both objective and subjective well-being provide key information about people’s quality of life. Statistical offices should incorporate questions to capture people’s life evaluations, hedonic experiences and priorities in their own survey;

### 3. Sustainable development and the environment

- (11) The assessment of sustainability is complementary to the question of current well-being, and must be examined separately. Sustainability assessment requires a well-identified dashboard of indicators that inform us about the change in quantities and qualities of natural resources, and of human, social and physical capital. A monetary index of sustainability has its place in such a dashboard but, under the current state of the art, it should remain essentially focused on economic aspects of sustainability; and
- (12) The environmental aspects of sustainability deserve a separate follow-up based on a well-chosen set of physical indicators. In particular, there is a need for a clear indicator of our proximity to dangerous levels of environmental damage



changes in economic, environmental and social conditions, to supplement and replace GDP in capturing the progress in the new socioeconomic system and setting targets. It is hoped that Japan will also promote relevant research further and play an active role in international discussions.

Table5-4-2 List of Sustainable Development Indicators in Europe (Level 1)

Theme	Indicator (Level 1)
1: Socioeconomic development	Growth rate of real GDP per capita
2: Sustainable consumption and production	Resource productivity
3: Social inclusion	At-risk-of-poverty rate, by gender
4: Demographic changes	Employment rate of older workers
5: Public health	Healthy life years and life expectancy at birth, by gender
6: Climate change and energy	Greenhouse gas emissions
	Share of renewable in gross inland energy consumption
7: Sustainable transport	Energy consumption of transport relative to GDP
8: Natural resources	Wild bird index
	Fish catches taken from stocks outside safe biological limits
9: Global partnership	Official development assistance (ODA)

Source: Prepared by Ministry of the Environment based on Eurostat,2007 ([http://epp.eurostat.ec.europa.eu/cache/ITY\\_OFFPUB/KS-77-07-115/EN/KS-77-07-115-EN/PDF](http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-77-07-115/EN/KS-77-07-115-EN/PDF))

Table5-4-3 Major Sustainable Development Indicators Developed by Countries, International Organizations

Region/type	Countries/institutions, etc.	Number of indicators	Year of issuance
International institutions	UNCSD	58	2001
International institutions	UNDG	52	2003
Europe	Ireland	30	2002
Europe	Austria	52	2002
Europe	Denmark	101	2002
Europe	Germany	25	2002
Europe	Luxembourg	27	2002
Europe	Switzerland	163	2004
Europe	Czech Republic	24	2004
Europe	France	53	2004
Europe	U.K.	162	2004
Europe	Belgium	44	2005
Europe	Sweden	99	2006
Europe	Norway	18	2006
Europe	Finland	33	2006
Asia	Taiwan	42	2002
Asia	East Asia	71	2003
Asia	Thailand	39	2005
Asia	Hong Kong	27	2005
Latin America	Mexico	61	2000
Latin America	Latin America	38	2002
Latin America	Argentina	90	2006
North America	U.S.	39	2001
North America	Canada	8	2003
Oceania	New Zealand	62	2002
Oceania	Australia	110	2006

Source: Prepared by Ministry of the Environment based on data provided by the National Institute for Environmental Studies

Table5-4-4 Estimated Indicators Showing Development State of Developed Economies

HDI 2009 (2007)			HeDI 2007 (Human-environment Development Index)		
1	Norway	0.971	1	Sweden	0.888
2	Australia	0.970	2	Switzerland	0.888
3	Iceland	0.969	3	Norway	0.852
4	Canada	0.966	4	Hong Kong (China)	0.785
5	Ireland	0.965	5	Iceland	0.777
6	Netherlands	0.964	6	Japan	0.755
7	Sweden	0.963	7	Denmark	0.740
8	France	0.961	8	Netherlands	0.704
9	Switzerland	0.960	9	U.K.	0.703
10	Japan	0.960	10	Austria	0.687
11	Luxembourg	0.960	11	France	0.678
12	Finland	0.959	12	Singapore	0.676
13	U.S.	0.956	13	Finland	0.675
14	Austria	0.955	14	Luxembourg	0.674
15	Spain	0.955	15	Germany	0.668

Source: Prepared by Ministry of the Environment based on UNDP, "Human Development Report 2009" ; IEA, "CO2 Emissions from Fuel Combustion 2009" ; and World Bank, "World Development Indicators 2009"

Column

## Assessment of Sustainability Using Multiple Indicators ~ Genuine Savings and Ecological Footprint ~

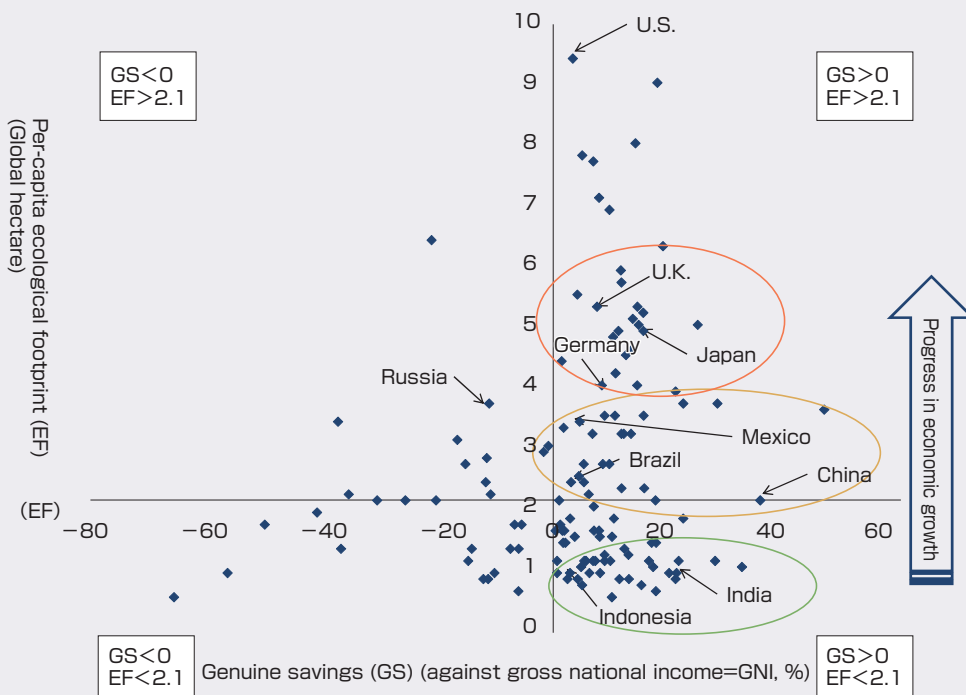
Besides genuine savings, there is another indicator to assess an economy's sustainability, called the ecological footprint. It measures the demand of human activities on the earth by the amount of land and sea area required to regenerate resources humans consume and to absorb and render harmless the corresponding wastes. By comparing the ecological footprint and the amount of biologically productive land and sea area needed to regenerate, or biocapacity (the earth's limited environmental capacity), we can capture whether our livelihood is in a sustainable condition more easily and sensuously.

In a research project commissioned by the Ministry of the Environment ("Policy Research on Environmental Economics, Masayuki Sato, Field Science Education and Research Center, Kyoto University, etc.), two indicators, genuine savings (against gross national income) and the ecological footprint, were used to make an analysis of sustainability of 128 countries. The research found that while many developed countries (encircled by the red line) and emerging economies with high growth, including Mexico, Brazil and China (encircled by the yellow line) have positive genuine savings figures, the ecological footprint exceeds the global biocapacity per capita in 2005 (about 2.1 global hectares; "global hectare" is the virtual unit set up to level differences in productivity between plots of land with the same

area, with one global hectare equivalent to one hectare of land and sea area with the average biologically productive capacity), indicating that they are not necessarily in the sustainable state. In terms of sustainability, it is desirable that genuine savings figures are positive and the ecological footprint does not exceed the biocapacity (encircled by the green line). Countries in this category are mostly developing countries, which on the other hand are confronted with the problem of improving the basic quality of life. Japan is engaged in socioeconomic activities through trade with numerous countries. If some of those countries supporting Japan's socioeconomic activities are found to be countries whose sustainability is questioned with the high ecological footprint and negative genuine savings, it should be recognized that it is desirable for both Japan and those countries to take actions in consideration of the earth's sustainability.

As seen above, sustainability should be assessed comprehensively with the use of multiple indicators instead of a single indicator. Amid the progressing globalization of economic activities, it is also necessary to interpret the indicators in light of relationships among countries and make use of such interpretations in formulating environment policy going forward.

Sustainability Assessment in Terms of Genuine Savings and Ecological Footprint



Source: Ministry of the Environment, "Policy Research on Environmental Economics" (Masayuki Sato, Field Science Education and Research Center, Kyoto University, ect.)



In June 2009, the OECD Council Meeting at Ministerial level declared that OECD countries strengthen efforts to pursue green growth strategies and encourage green investment and sustainable management of natural resources. The ministers also expressed their resolve to make further efforts to use “efficient and effective climate policy mixes” and encourage “domestic

policy reform,” with the aim of avoiding or removing environmentally harmful policies that might thwart green growth, such as subsidies. Further, the Ministers invited OECD to “develop, as a horizontal project, a Green Growth Strategy in order to achieve economic recovery and environmentally and socially sustainable economic growth.”

#### Declaration on Green Growth (Excerpt)

WE, THE MINISTERS REPRESENTING THE GOVERNMENTS of Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States and the European Community:

##### CONSIDERING that:

1. Economic recovery and environmentally and socially sustainable economic growth are key challenges that all countries are facing today ... Green growth will be relevant going beyond the current crisis, addressing urgent challenges including the fight against climate change and environmental degradation, enhancement of energy security, and the creation of new engines for economic growth. The crisis should not be used as an excuse to postpone crucial decisions for the future of our planet.
2. In order for countries to advance the move towards sustainable low-carbon economies, international co-operation will be crucial in areas such as the development and diffusion of clean technologies, for example carbon capture and storage, renewable energy technologies, and application of green ICT for raising energy efficiency, and the development of an international market for environmental goods and services ...

##### DECLARE that we:

4. STRENGTHEN our efforts to pursue green growth strategies ... , acknowledging that “green” and “growth” can go hand-in-hand.
5. ENCOURAGE green investment and sustainable management of natural resources. In this respect, we are resolved to make further efforts to use efficient and effective climate policy mixes, including through market-based instruments, regulations and other policies ... We will consider expanding incentives for green investment, in particular in areas where pricing carbon is unlikely to be enough to foster such private sector responses ... Approaches to recognize the value of biodiversity should be encouraged ... We are resolved to share information on green investment flows and policies, and best practices.
6. ENCOURAGE domestic policy reform, with the aim of avoiding or removing environmentally harmful policies that might thwart green growth, such as subsidies: to fossil fuel consumption or production that increase greenhouse gas emissions; that promote the unsustainable use of other scarce natural resources ... We also work towards establishing appropriate regulations and policies to ensure clear and long-term price signals encouraging efficient environmental outcomes ...
7. ENSURE close co-ordination of green growth measures with labor market and human capital formation policies ...
8. STRENGTHEN international co-operation. In this respect:
  - 8.1. We recognize that special efforts need to be made at the international level for co-operation on developing clean technology ... , fostering market mechanisms, and augmenting, streamlining and accelerating financing and other support to developing countries in their fight against climate change and the loss of biodiversity, and support in their water management ...
  - 8.2. We are resolved to make every effort to reach an ... international post-2012 climate agreement at COP15 in Copenhagen in December 2009, by which all countries will take measurable, reportable and verifiable nationally appropriate mitigation commitments or actions as well as adaptation actions ...

##### INVITE the OECD to:

9. DEVELOP, as a horizontal project, a Green Growth Strategy in order to achieve economic recovery and environmentally and socially sustainable economic growth ... The Strategy will analyze green growth measures in OECD as well as in major non-member countries, ... An interim report on the progress should be delivered to the 2010 MCM. ...

## (2) Toward realizing a new economic society that creates a virtuous circle for the environment and economy

As the latest global economic crisis encouraged countries around the world to introduce “green new deal policy,” environmental measures, including environment-related investment, are now considered as the driving force for economic growth. In other words, expenditure for environmental measures is considered to lead to the creation of new demand for environmental improvements and energy-saving technologies and services. If the new market for such technologies and services is created ahead of other countries and Japan’s environmental technologies are nurtured on that market, Japan should be able to establish comparative advantage on the environmental market where demand is expected to markedly increase globally, and Japan’s environmental industry should grow into a strong export industry in the Japanese economy in the future.

These moves are spreading globally. The OECD Ministerial Council in June 2009 adopted the “Declaration on Green Growth.” The declaration encouraged OECD to develop a Green Growth Strategy

in order to achieve economic recovery and environmentally and socially sustainable economic growth. An interim report is scheduled to be submitted to the OECD Ministerial Council in 2010. Further, the APEC Economic Leaders’ Meeting in November 2009 agreed to develop a comprehensive and medium- and long-term growth strategy, including “sustainable growth” compatible with the environment, including climate change and energy. The growth strategy’s specific contents are set to be discussed at their meeting to be held in Japan in 2010.

As discussed in Chapter 2 and Chapter 3, it is required to make lifestyles, infrastructure development and the industrial structure low-carbon in order to reduce greenhouse gas emissions by 80% by 2050. Though the Japanese economy still remains in a difficult situation, it is deemed necessary for Japan to strive to create the environmental industry through innovation by actively investing in research and development at an early stage instead of putting environmental measures on the back-burner, and build a low-carbon society, thereby strengthening the Japanese economy’s constitution and contributing to the global environment and sustainable growth of the world.

## Conclusion

In Chapter 5, we addressed the need to develop the environmental industry as the driving force of the economic society. While Japan has the excellent technological strength at the highest global standards, including registered patents in the environmental field, this has not necessarily led to the full penetration of the global market or development of new products. As many other countries support their environmental industries with full force, Japan also needs to extensively support green innovation from the standpoint of national interests, including research and development, human resources development, matching between the needs and

technological seeds, and development of social systems. Japan is most rapidly moving toward the aging society with falling birthrate. But there is no country with experiences Japan can learn from, and rather other countries watching what Japan will do. Given these circumstances, preliminary calculations of various indicators designed to comprehensively assess the development of the environment, society and economy suggest that these indicators reflect the set of values and outcomes of efforts of respective countries that have developed them.

