2010

Annual Report on the Environment, the Sound Material-Cycle Society and the Biodiversity in Japan

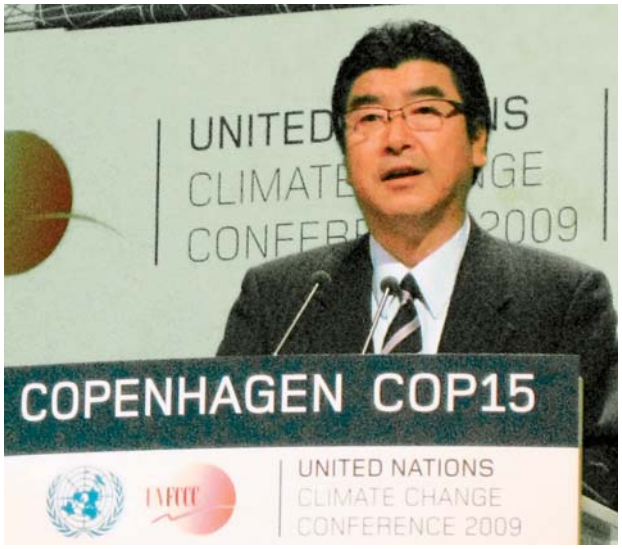
Our Responsibility and Commitment to Preserve the Earth

− Challenge 25 −

Ministry of the Environment

Government of Japan

Foreword



Minister of the Environment
Sakihito Ozawa

This White Paper for FY2010 combines Annual Reports on the Environment, the Sound Material-Cycle Society, and the Biodiversity in Japan into one to provide readers with broader and more in-depth knowledge on environmental issues.

The government's effort against global warming has changed significantly. I have been working on global warming countermeasures with a strong resolve to turn "Japan into a society free of fossil fuels". This has become possible only after a change of perception from the view where global warming countermeasures conflict with the economic interests to the view where the environmental sector leads overall economic growth. Japan has announced that it will reduce the emission of greenhouse gases (GHG) 25% by 2020 compared to 1990 levels, under certain conditions. The government has already clarified the overall policy vision based on three pillars: domestic emission trading system, taxation system for global warming countermeasures, and fixed price purchasing system for entire generated renewable energy, in the bill of the Basic Act on Global Warming Countermeasures. Moreover, I proposed "the Medium to Long-term Roadmap for Global Warming Countermeasures (drafted by Minister of Environment, Sakihito Ozawa)" to show steps to achieve this goal, which is also introduced in this White Paper. A national campaign to reduce GHG by 25% called "Challenge 25 Campaign" has been launched since January of this year, and we would like to have as many participants as possible.

In the international arena, Japan will play an active role in building a framework that will include the United States, China, and other major GHG emitters, in the 16th Meeting of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP16) to be held in November.

In October, "the 10th Meeting of the Conference of the Parties to the Convention on Biological Diversity (COP10)" will be held in Nagoya City, Aichi Prefecture. The conference will feature discussion on the formulation of post-2010 biodiversity target, building of international framework on the Access and Benefit-Sharing (ABS) of Genetic Resources, and other key issues that will greatly affect the future of all life on the Earth. It is said that the Earth was born 4.6 billion years ago and that the first life emerged about 4 billion years ago. Diverse forms of life and the surrounding environment nurtured over many years are facing the risk of extinction due to human activities. The responsibility of the current generation is to put a stop to such situations and pass down our one and only "planet Earth for all life forms" to future generations in a sound manner. In the COP10, Japan will lead the international community toward realizing mutual coexistence of humankind and nature on a global scale.

Looking at the reality of population, energy, and use of natural resources, including water, economy, and other human activities on a global scale, there is no choice but to utilize natural resources and energy in a sustainable manner, for which it is essential to build a material-cycle society and achieve technological breakthroughs to push this effort forward.

For the future building of our nation, we need to learn from past mistakes and never repeat them again. For example, Minamata disease, the first pollution case in Japan which also catalyzed the establishment of the Environment Agency which would later become the Ministry of the Environment, still inflicts suffering to a number of people a half century since the outbreak. This year, a basic agreement toward settlement was reached between the national government and the patients' group in March, followed by a Cabinet decision on the policy for relief measures in April. On May 1, Prime Minister Yukio Hatoyama attended the memorial ceremony for the victims of Minamata disease as the first Prime Minister to do so, and offered his prayer. The government will continue addressing the issue of Minamata disease with full effort.

In order to pass down our green Earth without fail, we must commit ourselves to the future and fulfill our current responsibilities. For that, it is essential to achieve a balance between the environment and economic growth. I hope that this White Paper will serve as a useful tool to share this belief with you all.

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Executive Summary

The world we live in – What will it be like? Where is it headed?

The earth formed some 4.6 billion years ago. It is said that life arose 600 million to 800 million years after the earth formed. After that, during the long eons in which even continents changed form, living organisms continued working to stay alive while adjusting their own bodies and their capabilities to their environment. When water, rock, stone, and sun combined to make various environments, countless species emerged. Diverse, exquisite ecosystems were woven together between inorganic matter and living organisms, or among living organisms. Each time the earth has faced a period of mass extinction; some individual organisms tolerated the conditions and escaped, remaining alive. Over a great length of time, the planet has continued to overflow with a truly enormous amount of life.

Humans emerged on this planet only very recently as seen on a time scale of the history of life. The hominids who domesticated fire some million years ago subsequently adapted themselves to many major environmental shifts, climactic changes foremost among them, surviving each crisis. As time passed, civilizations rose, some prospering and some perishing, and we are the beneficiaries of the ongoing civilization that has been handed down to modern times.

As remarkably skillful uses of fire arose from the industrial revolution, human society faced a new era. Modern civilization, while conferring various real conveniences on humankind, does not obey natural law — to be described below — and for this reason, humankind has continued to place a massive burden on the environment. There has been almost no international recognition of that fact until quite recently.

Humanity now stands at great crossroads.

We can directly experience the fact that today even our daily lives are impacted by global environmental changes and international economic trends. Skeptical voices begin to be heard, raising the question of whether the patterns of socioeconomic development that prevailed until now can continue to bring forth human well-being in the future.

As we damage the environment upon which human socioeconomic activities depend, the circumstances now compel us to raise awareness of the depleting resources and energy that have been used lavishly, more in some countries than in others. This problem cannot be resolved by seeking to open up new geographic frontiers as was practiced in the past. Humans, whose activities now span to the ends of the earth, are now on track to use up the underground mineral resources that make up life's foundations within a few decades. In the future, beyond thoroughly rationalizing resource and energy use, humankind must transit the basis of all our activity to use resources and forms of energy with smaller adverse impacts on the environment and for which there are no concerns about depletion.

Additionally, the global recession has revealed misgivings, sometimes ethical, about an economic system and its attendant structures that have sometimes conferred benefits distantly removed from the real economy, alongside the damage it has caused in individuals' ability to make a living. Conversely, the recession has also unmistakably broadened the flow of financing to environmentally-concerned projects and SRIs (Socially Responsible Investment).

The so-called Green Growth movement has gained international visibility as it utilizes environmental policy measures to drive economic recovery, leading to an end to the recession and subsequent sustainable development.

Furthermore, Europe, for example, at dubious point of view about the GDP measures that disaster recovery expenditures are counted as growth even beset by enormous damage from floods, heat waves, and other abnormal climate impacts, is calling for a new development framework that measures the importance of human happiness over and above GDP.

As we stand in our present era, this year's White Paper perspective is based on a worldwide view, using data on several socioeconomic trends closely linked to environmental problems, and encompasses the question of the world's direction, from the conditions of population shifts and poverty and socioeconomic disparities.

As we face an era of this nature, this year's White Paper encompasses the question of where the world is headed, from population trends through poverty and socioeconomic disparities. Its perspective is worldwide and is grounded in data that describe several socioeconomic movements deeply related to environmental problems. The data reveal that population increases and economic growth have driven corresponding increases in resource consumption and the environmental burden. Trends in water, food, energy, waste, and so forth, are showing no improvement. When international socioeconomic tendencies and resource limits are considered, it appears extremely unlikely that the currently prevalent socioeconomic structures based on mass production, mass consumption, and mass waste can be continued into the future. There is a concern that resource depletion and uneven distribution will become major international problems as countries concern themselves with securing their own national interests.

In the context of international efforts to handle environmental problems, developing countries now tend to emphasize the "different" in the phrase "common problem but with different responsibilities." Instead,

Japan advocates for the "common problem," recognizing a common destiny, and emphasizing that all countries should unite to start a concerted effort to advance tangible actions toward environmental protection.

Chapter 1 offers an overview of representative environmental conditions. Chapter 2 describes global warming's already evident harm and the urgency of formulating a response. After discussing global warming's present-day harmful effects and the economic consequences of responding, we introduce Japanese and global efforts related to global warming response measures. There are various potential choices of how to formulate a response to global warming. Whichever choice is made, to solve the problem it is essential to build a society that can restrict GHG emissions without imposing cultural or lifestyle sacrifices, and while still enabling truly rich and abundant life. Our daily lives are inescapably and intimately tied to the progression of global warming. The adverse effects will continue for a long time, not only for us but for future generations. We must immediately move to formulate a plan to face this problem, following a new growth strategy that touts "an economic society for the sake of people," aiming for an economic society with far less GHG emissions.

In Chapter 3, in light of COP10 that will be held in Japan in October 2010, we show Japan's responsibility as host country and the need to transition to socioeconomic arrangements concerned with biodiversity. Biodiversity confers various benefits on humanity, on a scale far larger than what we normally perceive them to be. Nonetheless, biodiversity is being lost rapidly on a global scale at an unprecedented level, and we are presently facing a future in which it will be difficult to enjoy the services provided by ecosystems in a sustainable manner. The magnitude of the benefits obtained from ecosystem protection is now understood to be larger than the cost of recovering formerly lost ecosystems, and it is of prime importance to advance development projects and natural resource use after thoroughly analyzing the cost effectiveness. Global biodiversity has far-reaching effects because Japan depends on overseas supply for most of its resources. Therefore, in order to protect and sustainably utilize the biodiversity that forms the foundation for human survival, we must take initiative to change all of our socioeconomic arrangements, from corporate actions to individual lifestyles, on the basis of our concern for biodiversity. Through its consideration of post-2010 global targets, COP10 is an important conference that will decide the future in the global biodiversity. As the host country Japan must take the lead in fostering the balanced coexistence of humans and nature around the world, such as through the worldwide spread of "the Satoyama Initiative" promoting sustainable use and management of natural resources.

Chapter 4 considers the protection of the worlds' limited and unevenly distributed water supply and the role Japan should play. Thanks to its superior water supply technologies and systems, Japan, when compared to countries with chronic water shortages, tends to have relatively minor appreciation and awareness of water as a resource directly tied to existence and daily life. However, we must not forget that Japan's economic and social activities are burdening the world's water to the same degree the country is consuming its own. To address this issue, Japan's excellent drinking water supply and wastewater treatment technologies can be appropriately used to contribute solutions for the problem of securing clean water for the world, while simultaneously taking intellectual property rights into consideration. There has always been water-related business among the members of the international community. However, the progress of Japan's water initiatives cannot be viewed with great optimism because other countries' products may offer inferior technologies but at more competitive prices. Also, Japan lacks a track record in the maintenance and management of the giant water processing systems built from these constituent technologies. Nevertheless, there are favorable signs in evidence. It is necessary to follow up on global progress in promoting water environmental protection and water-related business, thanks to the cooperative efforts of related parties, including government support.

Chapter 5 describes how the development of environmental industries must be made to drive the economy and society. While Japan is a world-class technological leading power in environment-related patents and in other measures, in actual practice this is not necessarily linked to sufficient penetration of world markets or to new product development. Environment-related enterprises must be supported broadly by the country as a whole, en masse along with green innovation, of R&D, human resources development, seeds to needs matching, demand stimulation, social systems arrangements, and so forth. This approach holds promise for using Japan's excellent technological capabilities to bring about international-scale environmental and economic recovery. In recent years, many countries and international institutions are exploring economic development approaches pivoting on the environment, and calling them "Green Growth." They are reconsidering the development approaches taken until now. As they seek the further development of humankind while also valuing environmental concerns, a paradigm shift is now occurring, one of great importance in the history of human development. Experimental calculations using indicators that reveal the integration of environmental, social, and economic development show that each individual country's value system and its work products are reflected within them.

Viewing it with above, in order to develop in stages a new human society that can bring forth a reliably sustainable civilization on this one and only earth, out of the consumer culture that has prevailed until now, it can be seen that Japan has a variety of things to contribute. For this reason, a new concept has emerged that asserts human activities must be assessed not only for their economic value but with various kinds of

indicators.

Modern civilization, in some aspects, has not been able to live in harmony with nature because humans have been unable to acknowledge the laws of nature and fully recognize the massive impact they have on it. The first point is how to receive the natural world's gifts for our human well-being. For example, the resource gifts from each year would be accepted within the scope of their availability for that year, and finite resources used exceedingly sparingly, including re-using them. If resources are taken with a short-term view at rates exceeding nature's regeneration capacity, or are viewed as inexhaustible, and frugality and efficient are carelessly disregarded, these resources — which are finite — will be unexpectedly exhausted, and they cannot be used again. The second point is that when things unneeded including waste should be returned to natural world, they must be returned within the range of what can be taken in. After receiving gifts of resources from the natural world, humans have returned substances to that world that it cannot process and adequately recover from, and has dumped sufficient quantities of substances into the environment that cannot be handled due to their sheer volume. Today the impact of these practices on the environment has extended around the world. People are now agonizing over how to take responsibility for the environment that was altered so drastically through human activity. The third point is that we have not thought it important to live in harmonious coexistence with nature. Homo sapiens are only one species among the 30 million that are said to inhabit the earth. Regardless that there exist yet unknown aspects of natural mechanisms, our share in these mechanisms has grown explosively in recent years. In that process, many species are being brought to extinction at a rate unprecedented in the history of life. Overuse of a natural resource by one organism will exhaust that resource, and under natural conditions, the population of that organism will decrease. The limits of the environment were irrevocably altered to something unsuitable for the organism's own existence, so it is natural that its population will decrease. Is that the future we want?

The ideology of "Mottainai" and of being content with little is exactly the values based on the sustaiua-bility and as Japan has many long years of experience with it, we believe that we must not spare any effort to make that value system a global standard that extends across the gamut from technology to institutions. If measurements are distorted, they must be improved, and after new targets are fixed appropriately, their respective responsible parties must make the required efforts.

A pressing crisis is before us, which we must directly face. Humanity must make correct judgments. And not only that, we must steadily build upon our actions to produce positive results. Toward these goals, we will bring forth targets based on levels demanded by science, and we must formulate a plan to reach them with unanimous participation.

With the prerequisite condition that the main emissions-producing countries will build a fair, effective international framework, and can agree upon voluntary targets, Japan is calling for an international commitment to a 25% GHG emissions volume reduction by 2020. This is far from easy to accomplish. If pain comes, it must be shared. Even so, Japan aims to reach the intermediate targets by using every available means of government policy. With unwavering determination, we will open a bright future for humanity along the path toward building a new civilization free of excessive dependence on depletion-prone resources and energy.

FY2009 Annual Report on the Environment／Annual Report on the Sound Material-Cycle Society／Annual Report on the Biodiversity
Our Responsibility and Commitment to Preserve the Earth －Challenge 25－

Introductory Chapter
The Course of the Earth
－Where Is the World Headed and Where Does Japan Find Itself?－

If we liken the history of the earth to one year, human history spans just about four hours. The history of mankind since the Industrial Revolution in the 18th century is equivalent to only about one second. In the rich and exquisite ecosystem that life born on the earth has built up over ages, humans have achieved amazing development by making use of a variety of resources. As a consequence of that development, however, human activities have grown to assume such proportions as to exponentially consume natural blessings and alter the global environment in that "last second." Where is the earth we live on heading?

In this Introductory Chapter, we go over the history of the earth and the history of mankind and give an overview of global trends, based on macro data, of changes in the world population, conditions of resources and economic activities in recent years, and also examine the situation in Japan. Further, we consider the impact on the global environment through an analysis of such trends.

1 Mankind Born on the Earth

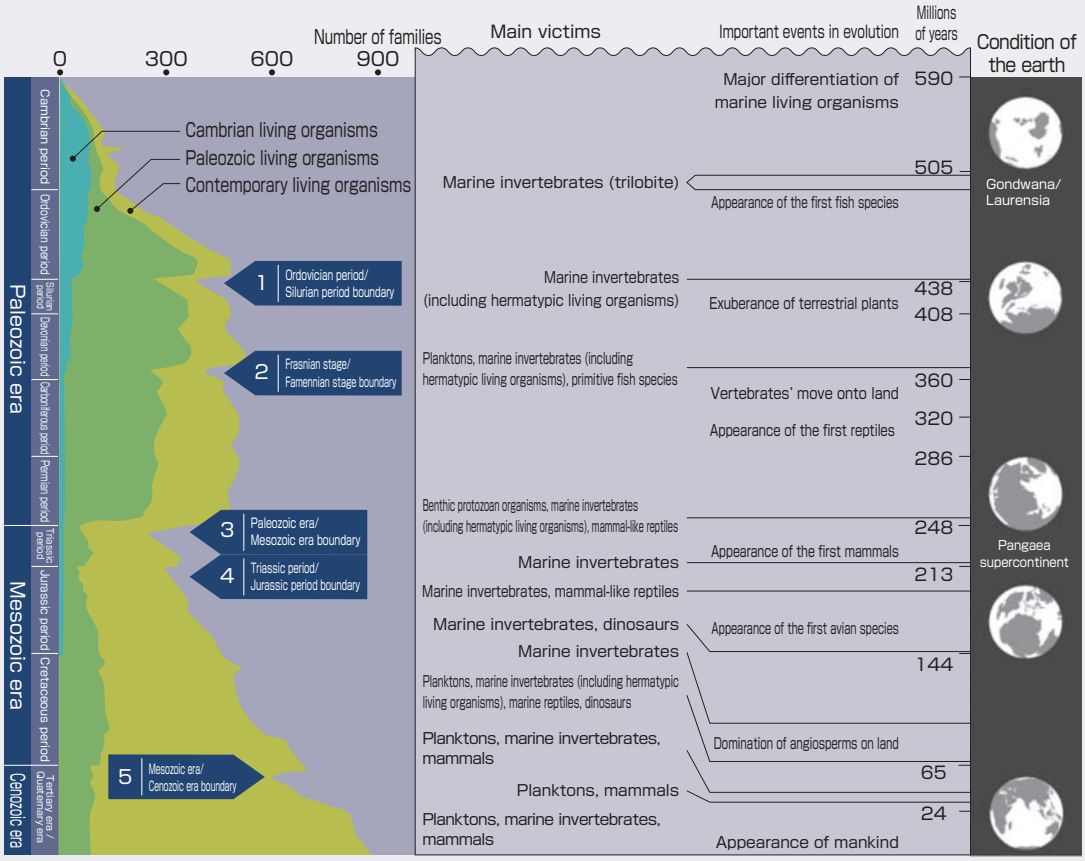
Life is thought to have come into existence on this earth some 4 billion years ago. And then, unicellular bacteria are believed to have spread all over the earth, and in particular, cyanobacteria are known to synthesize organic matter from water and carbon dioxide through photosynthesis and at the same time produce oxygen. In the Cambrian period (from 600 million years ago), the major phyla of multicellular animals that now exist are said to have come out en masse. Oxygen generated by underwater activities of photosynthetic organism built up in the atmosphere and the subsequent formation of the ozone layer blocked off ultraviolet rays and appears to have made it possible for living organisms to come ashore some 500 million years ago. Until then, land is believed to have been literally barren. Subsequently, fish species are said to have prospered in the Devonian period of the Paleozoic era (from some 410 million years ago) and then amphibian species in the Carboniferous period (from some 360 million years ago). During the mid-Triassic period, when the reptiles are believed to have extended their habitat to underwater and into the air, mammals came into existence, and ancestors of primates are believed to have been born about 85 million years ago. Some 65 million years ago, the extinction of dinosaurs and other giant reptiles created the opening in living space and then mammals are believed to have expanded their habitat explosively.

Regarding the evolution from apes to humans, the molecular evolutionary theory assumes that the phyletic line of gibbons became differentiated from the phyletic line that led to humans 18 million to 12 million years ago, and the phyletic line of orangutans differentiated 12 million years ago. Further, the phyletic line of gorillas differentiated eight million to four million years ago, and then the phyletic line of chimpanzees, which differ only 1-2% from humans in terms of DNA base sequence, is said to have diverged five million to four million years ago. The Homo genus is believed to have differentiated from the Australopithecine genus in Africa about two million years ago, and Homo sapiens, the modern humankind, is said to have appeared 400,000 to 250,000 years ago.

Many organism species have adapted themselves to changes in the environment by transforming their body shapes over many generations. However, the subsequent alteration of the environment by humans has been taking place much faster than the speed necessary for such adaptation. Humankind is also one of organism species, human beings are no different from other living organisms in that they cannot adapt themselves to the environment they are rapidly altering by transforming their body shapes.

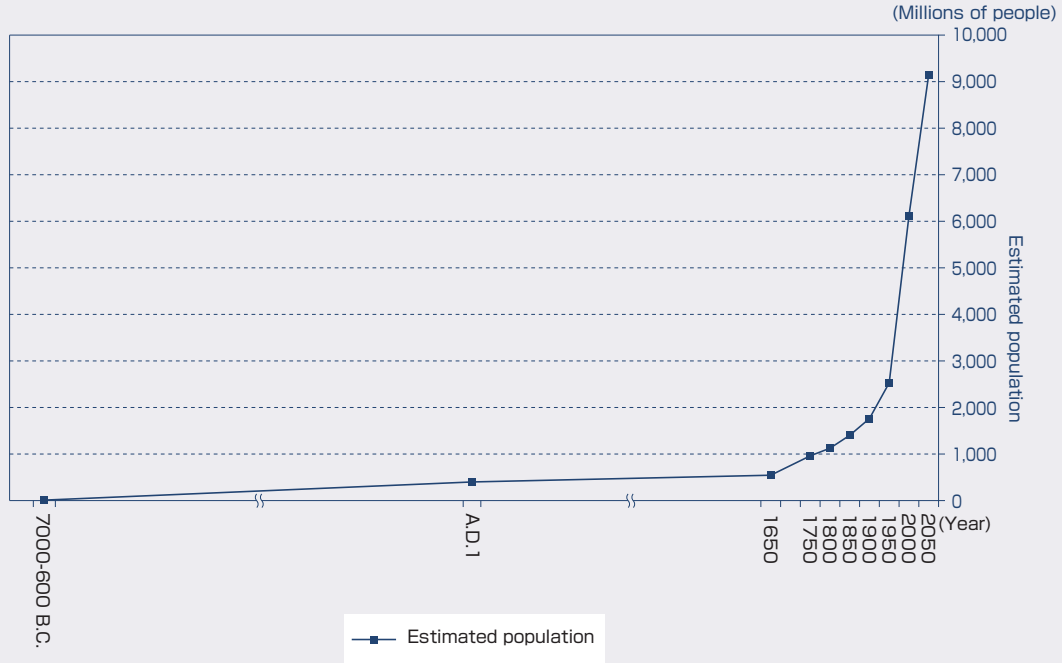
Human beings are believed to have improved their living conditions in the course of evolution. For example, it is thought that the use of simple pebble tools increased the amount of quarries, and the economy of efforts to catch preys made their living easier. And archanthropines, using their advanced techniques to make stone implements, succeeded in attaching blades to pebble tools and making a fire. From the time of archaic humans to that of new humans, tools became diversified and techniques were refined, and rich mental activity is also believed to have developed. Primitive agriculture and livestock husbandry, which are thought to have started in the New Stone Age, made further advances in ancient times, and the invention of metalware has changed the

Figure Int.-1-1 Five Major Mass Extinctions in Phanerozoic Time



Source: Prepared by the Ministry of the Environment based on Quarterly journal Biohistory, "Mass Extinction – Accelerator of Evolutions (Yukio Isozaki)" & Stanley, Steven M. "Extinction"

Figure Int.-1-2 Trends and Estimates of the World Population: B.C. - 2050



Source: Prepared by the Ministry of the Environment based on the National Institute of Population and Social Security Research, "Population Statistics of Japan (2010)"

lifestyles of humans considerably. This is how humans have achieved their present affluent way of life. Since the Industrial Revolution in particular, the per-capita environmental load increased, and the synergetic effect with the explosive growth of human population further augments burdens on the environment. Human activities expanded dramatically, altering the environment and considerably increasing the environmental load.

2 An Overview of Global Trends

(1) Population and urbanization: population increases and the concentration on cities

Human production and consumption activities are burdening the environment through extraction of resources and discharges of greenhouse gases and waste. Generally, it is thought that production and consumption activities increase in tandem with an increase in population and their impact on the environment increase accordingly. Thus, a survey of population trends in each region provides clues to estimate which regions are going to see greater impacts on the environment going forward.

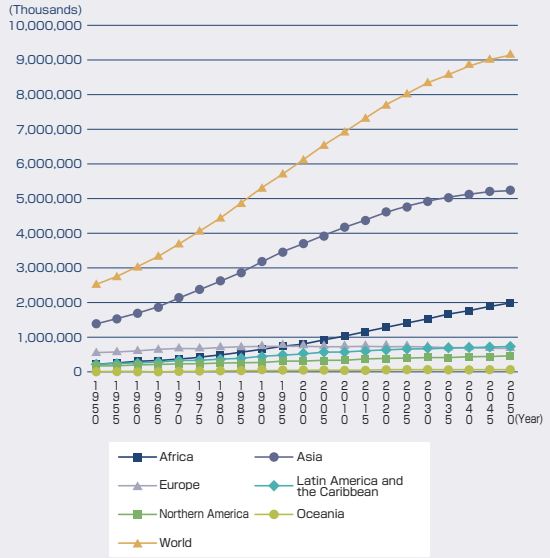
According to State of World Population 2009 released by the United Nations Population Fund, the world population stood at some 6.8 billion in 2009. The World Population Prospects 2008 indicates that the world population is expected to reach 7.0 billion in 2011 and top 9.0 billion in 2050 (Figure Int.-2-1). The regional breakdown of the world population shows that Asia accounts for a larger percentage of the population than other regions, with South-Central Asia that includes India and Eastern Asia inclusive of China account for particularly large percentages (Figure Int.-2-2).

The population trends of the two regions mentioned above show major differences in population growth rates. While the population of South-Central Asia is likely to continue to grow substantially in years to come, the population in Eastern Asia is forecast to start declining from around 2030 (Figure Int.-2-2). This raises concerns about increased burdens on the environment in Asia at large, and such concerns are likely to persist longer particularly in South-Central Asia.

Looking at regions other than Asia, it is clear that Africa has the distinctly high growth rate of population (Figure Int.-2-3). Africa has a large increase of a little over 1.6% in the average annual population growth rate between 2010 and 2050. On the other hand, the population growth rate in Europe is set to see a decline of about 0.15%.

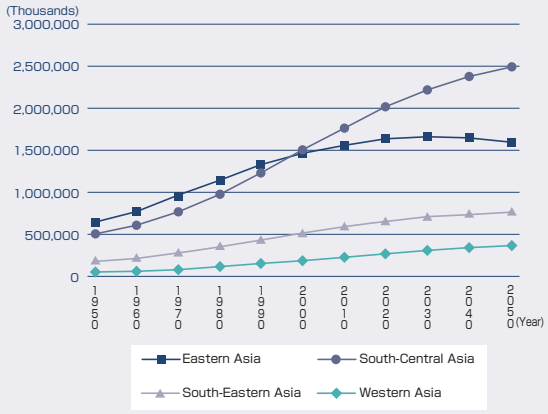
Meanwhile, Japan's total population is forecast to stay on the consistent downtrend going forward. The Japanese population is likely to accelerate its pace of decline year after year from the 2005 peak of some 127.77 million, with the total population breaking below the 100 million mark by 2050 (Figure Int.-2-4). In terms of an increase or decrease in population, the expected decline in Japan's total population is likely, in a sense, to have the effect of mitigating the environmental load. However, the impact of population trends on the environment needs to be captured from various aspects, including production and consumption patterns, industrial structures, and changes in life patterns and standards of living stemming from the ongoing fall in birthrate and the aging population.

Figure Int.-2-1 Population Trends in the World and Regions



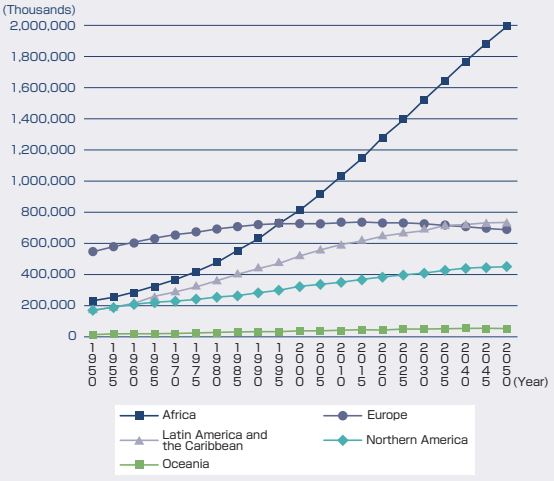
Source: Prepared by the Ministry of the Environment based on U.N. Population Division, "World Population Prospects: The 2008 Revision"

Figure Int.-2-2 Population Trends in Asia



Source: Prepared by the Ministry of the Environment based on U.N. Population Division, "World Population Prospects: The 2008 Revision"

Figure Int.-2-3 Population Trends in Non-Asia Regions



Source: Prepared by the Ministry of the Environment based on U.N. Population Division, "World Population Prospects: The 2008 Revision"

While the world population has been on a constant increase in recent years, led by population growth in Asia and Africa, areas of residence have been rapidly urbanized. A report by the United Nations Population Fund shows that in 2009, 3.4 billion people, or about half of the world's population, are living in urban areas. The urbanization trend is likely to continue going forward, with about 5.0 billion people expected to live in urban areas by 2030 and about 6.4 billion people, or about 70% of the world population, by 2050 (Figure Int.-2-5). This trend of urbanization is particularly noticeable in developing regions such as Asia and Africa (Figure Int.-2-6).

The rapid urbanization in developing regions tends to adversely affect the environment.

On the consumption front, in tandem with urbanization-triggered changes in lifestyles, massive amounts of wastes and domestic effluents are generated in association with mass consumption, heightening the so-called domestic environmental load. In developing regions, on the other hand, the introduction of decontamination technologies is generally insufficient in secondary industries responsible for mass production that supports rapid economic development, raising concern that effluents and wastes generated in production activities are not being treated adequately.

In economic and industrial aspects, economic development accelerates the shift to tertiary industries, raises the economic dependence on overseas as well as on informal sectors, and increases demand for labor in urban areas. The attendant rapid population influx into cities leads to excessive urbanization, and administrative measures to deal with unemployment and residential areas turning into slums are likely to squeeze public coffers, causing chronic delays in infrastructure development.

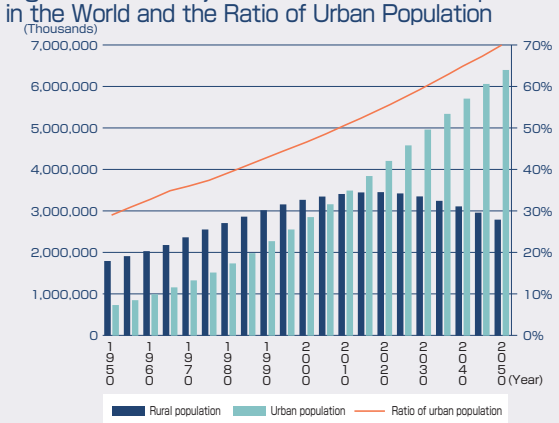
Furthermore, urbanization, accompanied by motorization, in developing countries and suburbanization that comes with it would increase the environmental load from traffic congestion and carbon dioxide emissions, exacerbated by the lack of adequate infrastructures.

In Japan, the status of urbanization is somewhat different from global trends. While Japan's urban population is expected to remain stable at around 85 million in 2010 onward, the rural population is forecast to trend sharply lower (Figure Int.-2-7). This indicates the decline in the population is going to affect rural areas more than urban areas. In rural areas, therefore, problems with environmental conservation due to the shortage of people who conserve and manage satochi-satoyama (community-based forest areas and the surrounding countryside) and problems of "marginal settlements" stemming from the aging population are feared to grow more serious.

Figure Int.-2-4 Trends of Japan's Total Population and Population Growth Rate

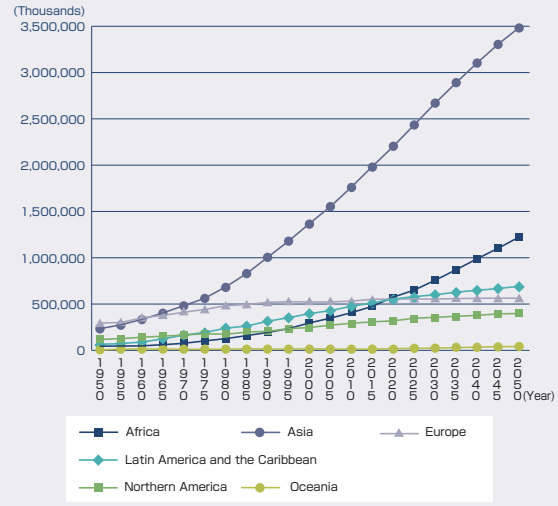
Source: Prepared by the Ministry of the Environment based on Statistics Bureau, Ministry of Internal Affairs and Communications, "National Population Census" & National Institute of Population and Social Security Research, "Estimation of Future Population"

Figure Int.-2-5 Projected Urban and Rural Populations in the World and the Ratio of Urban Population



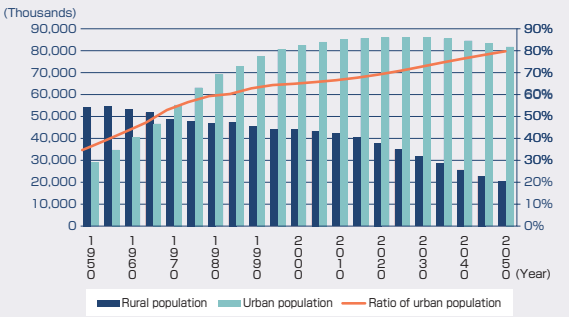
Source: Prepared by the Ministry of the Environment based on U.N. Population Division, "World Urbanization Prospects: The 2007 Revision Population Database"

Figure Int.-2-6 Trends of Urban Population by Region (1950-2050)



Source: Prepared by the Ministry of the Environment based on U.N. Population Division, "World Urbanization Prospects: The 2007 Revision Population Database"

Figure Int.-2-7 Projected Urban and Rural Populations in Japan and the Ratio of Urban Population



Source: Prepared by the Ministry of the Environment based on U.N. Population Division, "World Urbanization Prospects: The 2007 Revision Population Database"

(2) Water: unevenly distributed water resources

Water is essential for human existence. A report by the World Wildlife Fund (WWF) shows that about 70% of water utilized around the world is used for agriculture, 20% in industry and 10% at households (Figure Int.-2-8). While the world's water utilization volume almost doubled between 1960 and 2000, the world population also doubled during the same period, indicating that per-capita water utilization volume has been almost flat. Thus, water utilization volume in the world is expected to increase going forward in association with an increase in the world population.

Utilization of volume of water resources is likely to increase globally as seen above. Water resources are unevenly distributed around the globe and running short. Annual per-capita water resources in the world indicate that while Canada, Norway and New Zealand are bestowed with abundant water resources, countries in the Middle East are in short supply of water resources (Figure Int.-2-9).

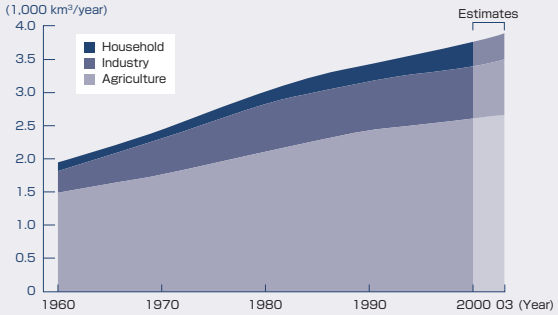
The uneven distribution of water resources becomes even more evident if we look at the relationship between per-capita water resources and the population. A person is said to require some 4,000 m^3 of water per year, but about 4.5 billion people live in countries with water resources far less than this required amount. People are in the "water stress" state when the per-capita maximum available amount of water resources falls short of 1,700 m^3, and in the "water scarcity" state when that amount is less than 1,000 m^3. In 2008, people in these states of water availability numbered some 2.0 billion and 330 million, respectively (Figure Int.-2-10).

Japan's annual per-capita water resources stand at some 3,400 m^3, and the country is not in the state of "water stress" as described above. In recent years, however, there have been wide gaps in the annual amount of rainfall between years of scarce rain and years of heavy rain. Available water resources in years of scarce rain, which come around once every 10 years, tended to decrease, lowering the degree of water utilization security in Japan.

A U.N. report released by UNESCO estimates that populations living in seriously water-stressed areas will reach 3.9 billion by 2030, an increase of 1.0 billion over 2005. Going forward, water utilization in Asia is forecast to increase dramatically, estimated to rise by some one trillion m^3 from 2.16 trillion m^3 in 1995 to reach 3.10 trillion m^3 by 2025. This is equivalent to about 1.4 times the amount of water utilization in North America in 1995 (Figure 4-1-9).

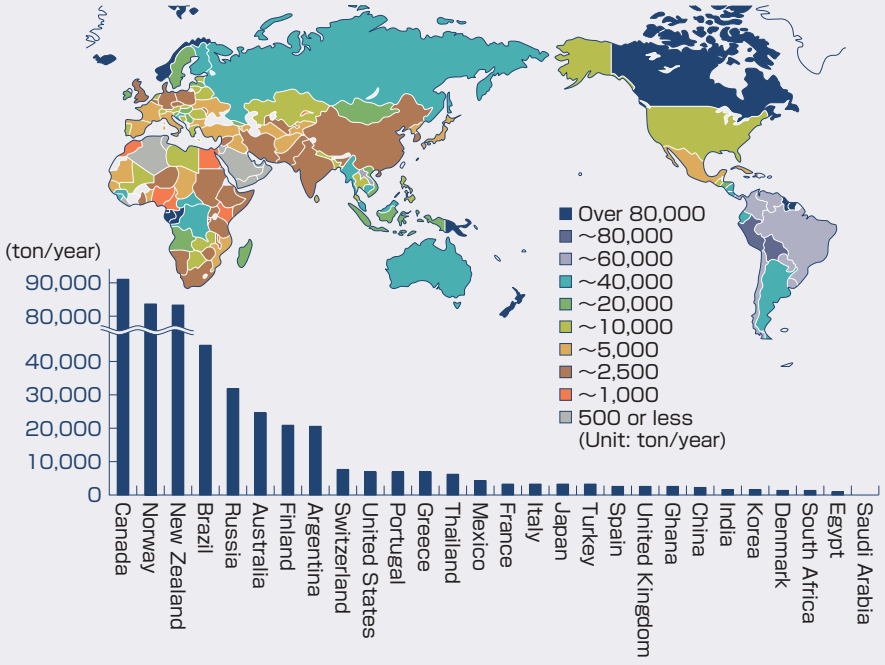
Due to the uneven distribution or depletion of water resources, the availability of water is becoming a constraint on economic development, making it necessary to make a considerable amount of investment to secure a sufficient supply of water.

Figure Int.-2-8 The World's Water Utilization Volume by Sector



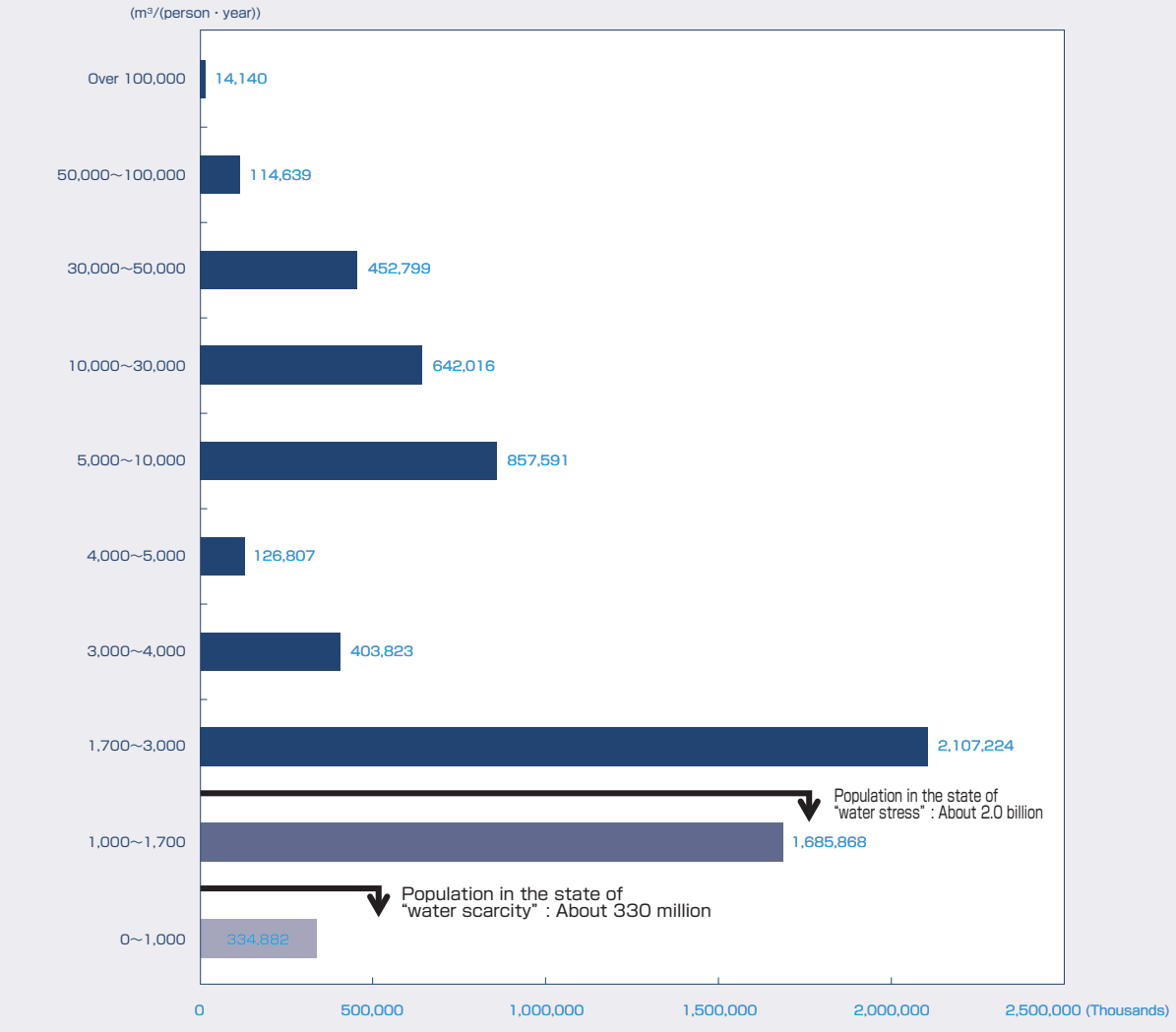
Source: WWF "Living Planet Report 2006"

Figure Int.-2-9 Annual Per-Capita Water Resources in the World



Source: Prepared by the Ministry of the Environment based on FAO AQUASTAT (2008.1.16)

Figure Int.-2-10 Per-Capita Water Resources and Population (2008)



Source: Prepared by the Ministry of the Environment based on FAO AQUASTAT Database

(3) Food: increasing demand for food and tightening supply-demand

A: Supply and demand trends of grains

Demand for grains that support the subsistence of human increases in association with an increase in population. More specifically, against the backdrop of demand increases in proportion to the increase in population and increased demand for livestock products and fats reflecting higher income levels, demand for grains has expanded 1.8 times from 1.1 billion tons in 1970 to 2.1 billion tons in 2007.

Production of cereal crops has been increasing by and large in accordance with demand for food. Over the past five decades, production of agricultural products has met increased demand by raising unit crop yields while harvested areas have stayed almost flat. In recent years, however, the quantity of production has not risen much as the growth of unit crop yields slowed, while drought and poor crops in major grain-growing areas also affected production. When a substantial expansion of crop harvested areas cannot be expected, there are concerns that slowing rises in unit crop yields and the ongoing global warming and desertification may seriously affect food production going forward.

Until recently, the supply-demand balance of grains has been maintained as production increased in response to increasing demand for food, with the occasional oversupply or short supply being adjusted by year-end stocks. In recent years, however, production has dipped due to poor harvests of major crops for successive years while demand for grains has been on the steady rise, resulting in the drop in the year-end stock-to-sales ratio to 15.0%, the lowest level since the food crisis in the early 1970s and lower than the 17-18% safe inventory levels set by the U.N. Food and Agriculture Organization (FAO).

Going forward, while demand for food may increase faster than previously estimated, unless production is steadily expanded, food supply-demand could tighten considerably, sending already rising prices of farm products to even higher levels.

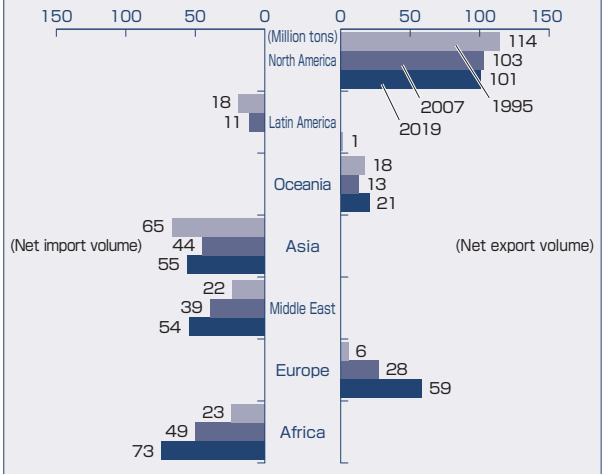
According to grain trade volume projections (net export volume and net import volume) by region, net import volumes are expected to increase for Africa, Asia and the Middle East between 2007 and 2019,

while Europe and Oceania are seen to expand their net export volumes (Figure Int.-2-11). North America, meanwhile, is likely to see a decline in net export volumes between 1995 and 2019, but will remain as the world's major net grain exporting region. Reflecting the growing uneven distribution of food producing and exporting countries amid globalization, any change in the supply and demand situation could have no small impact on international prices, giving rise to concerns that price rises can be amplified easily by anxiety-driven export restrictions or an inflow of speculative money into grain markets.

Next, Japan's food self-sufficiency rate has been on the decline over the past several decades. The self-sufficiency rate in food on a calorie basis has dropped from 78% in FY1961 to around 40% in recent years, presumably influenced by the shift in dietary habits from Japanese to Western-style food (Figure Int.-2-12). Meanwhile, in contrast to the case of Japan, the United Kingdom has raised its food self-sufficiency. While food self-sufficiency rate of UK has been dropping in recent years, it had risen from 42% in 1961 to 70% in 1993. Relatively high self-sufficiency of UK in food is described as reflecting that land in the country is flat to make efficient agricultural production possible and that production of wheat and some other crops has increased thanks to farm subsidies it is getting through accession to the European Community (EC).

The sharp rises in grain prices from 2007 to 2008 are said to have stemmed from increased demand for grains in developing countries, expanding demand for grains as materials for bio fuels, the dwindled supply due to drought and higher speculative demand as well as grain export bans or restrictions imposed by major exporters including China and Russia after price increases in international markets. As seen above, once the supply-demand tightens, it is possible for grain-exporting countries to go for "enclosure" of cereal crops. Thus, it is necessary for Japan, which depends on foreign suppliers for 60% of food, to proactively seek to raise the food self-sufficiency rate, by basically increasing domestic production and under the national policy of combining domestic supply with imports and stockpiles appropriately. In addition, some 19 million tons of food are being discarded each year, an amount that is about six times the food aid of 3.3 million tons provided by the U.N. World Food Programme (WFP) in 2007.

Figure Int.-2-11 Projected Grain Trade Volume (Net Export/Inport Volume) by Region



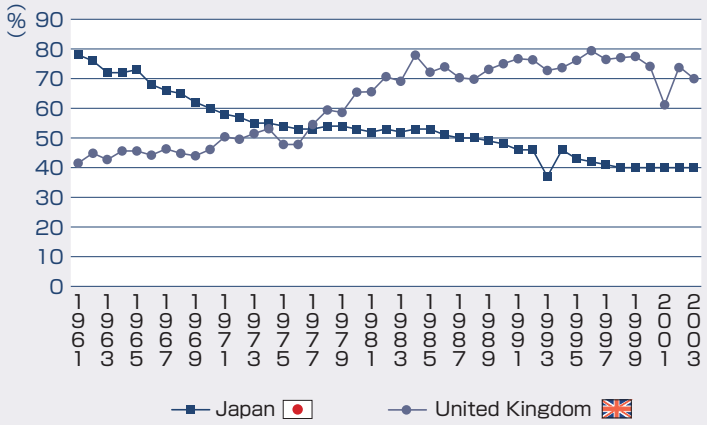
Note: Net export and import volumes do not include intra-regional trade volumes.
Source: Ministry of Agriculture, Forestry and Fisheries, "World Food Supply and Demand Projections to 2019 -World Food Supply and Demand Model projection Results-"

B: Supply and demand trends of seafood

With the increase in per-capita demand combining with the population growth, global demand for seafood doubled from 56.28 million tons in 1970 to 126.00 million tons in 2003, and in particular, China's demand shot up 11.7 times from 4.05 million tons to 47.56 million tons during the same period. Also, global per-capital demand for fish and shellfish for food grew 1.5 times from 11.1 kg in 1970 to 16.1 kg in 2003. By major country and region, per-capita demand grew 1.4 times in the United States, 1.3 times in the European Union (EU) and 5.7 times in China.

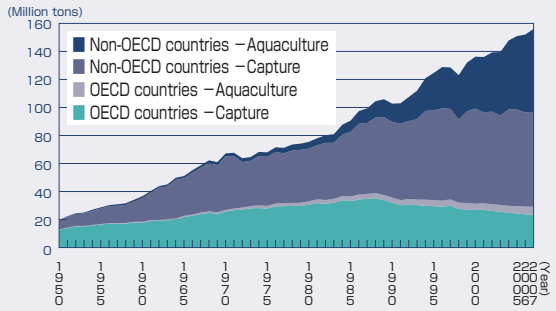
Going forward, global demand for seafood is expected to increase with the growth of population and rising income. Particularly in China, where fish and shellfish are regarded as more luxurious than beef and other meat, demand for seafood is likely to increase in tandem with higher income. Together with this, the

Figure Int.-2-12 Trends in the Calorie-Based Food Self-Sufficiency Rate of Japan and United Kingdom (1961-2003)



Source: Prepared by the Ministry of the Environment based on the Ministry of Agriculture, Forestry and Fisheries, "Food Supply-Demand Table (FY2007)"

Figure Int.-2-13 Global Trends of Fishery Production (1950-2007)

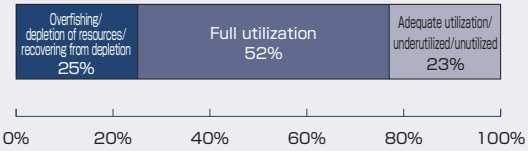


Note: Excludes aquatic mammals and miscellaneous aquatic animals
Source: Prepared by the Ministry of the Environment based on FAOSTAT Database

broadening markets for seafood associated with improved distribution infrastructures and enhanced processing and refrigeration technology, including revamped road and other transportation networks, upgraded processing techniques and the deployment of processing plants, freezing and refrigeration facilities, are also helping increase demand. In Asia as well, demand for seafood is projected to rise thanks to rising levels of income.

The quantity of production (supply) of seafood has risen in response to increased demand, mainly supported by increased aquaculture, while fish capture peaked out at around 90 million tons in the 1990s (Figure Int.-2-13). Cultured fishery accounted for 40% of the 2007 seafood production of 156.00 million tons. Comparison of fishery production between member states of the Organization for Economic Cooperation and Development (OECD) and non-OECD countries indicates that while fishery production of OECD economies has declined, that of non-OECD countries increased, with their aquaculture sectors expanding production remarkably in recent years (Figure Int.-2-13). Looking at fishery production by country, China produced 60.63 million tons of seafood in 2005 to

Figure Int.-2-14 Utilization of Fishery Resources (2005)



Source: FAO "Review of the State of World Marine Fishery Resources"

become the world's largest producer, accounting for 40% of global production for the year. And aquaculture accounts for as much as 70% of Chinese seafood production, with inland water fish culture involving the development and diversion of tidal flat expanding.

A FAO (Food and Agriculture Organization) survey on the utilization of fishery resources shows that about half of marine fishery resources are fully utilized, while one-fourth is in the state of overfishing due to indiscriminate fishing (Figure Int.-2-14). As fish captures are likely to remain stagnant going forward, production increases are expected to depend on aquaculture.

With demand for seafood increasing globally, the supply and demand balance is tightening and some fish and shellfish prices are showing an upward trend. According to FAO, while seafood production, led by fish culturing, is likely to increase in response to expanding demand in association with the population growth and rising income, demand is expected to overtake production potentially amid limited fishery resources. Under these circumstances, the supply and demand of seafood are likely to be balanced ultimately through higher prices and the shift to other protein food. Demand for seafood is projected to increase 1.4 times from an average 130 million tons for 1999-2001 to 180 million tons by 2015, while prices are forecast to rise at an annual rate of 3.0% by 2010 and then at an annual rate of 3.2% through 2015.

(4) Energy: an increase in energy demand and the accelerating utilization of renewable energy

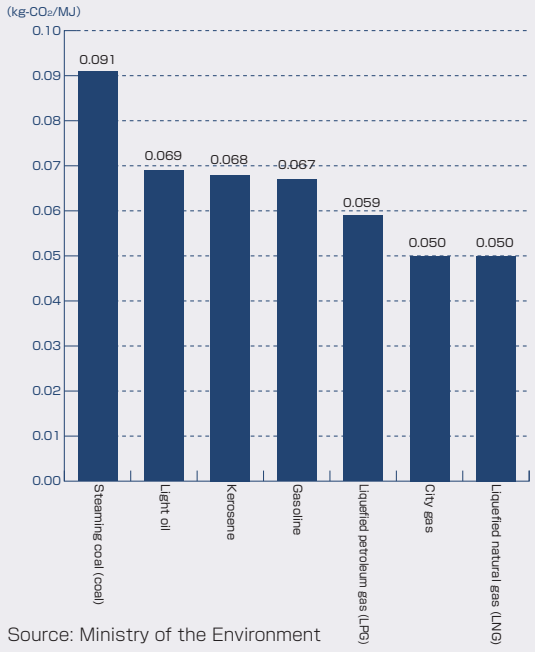
Energy consumption, which is closely linked to the environmental load through carbon dioxide emissions, is believed to follow an upward trend in the long run. The International Energy Agency (IEA) estimates that global energy consumption in 2009 almost certainly declined as a result of the financial and economic crisis, but if current energy policies are kept intact, energy consumption will get back on the long-term uptrend once the economy recovers.

Global primary energy consumption more than doubled in less than 40 years, from 5.5 billion tons of oil equivalent (TOE) in 1971 to 12.0 billion TOE in 2007 (Figure Int.-2-15). As the global economy is expected to grow going forward, led by emerging economies, energy consumption will likely remain on the increase. By energy source, petroleum accounts for about one-third of energy consumption. The IEA estimates that if governments around the world keep their existing energy policies and measures intact, fossil fuels still account for the bulk of primary energy sources and over three-fourths of the increase in energy consumption projected between 2007 and 2030 would come from fossil fuels (Figure Int.-2-15). Furthermore, the IEA expects demand for coal, among fossil fuels, to grow considerably in the future due to expanding demand for electric power generation. Given that the use of coal discharges more carbon dioxide than other energy sources (Figure Int.-2-16), there is concern that the environmental load would further increase unless active efforts are exerted toward more sophisticated use of fossil fuels.

Amid the expectation that global energy consumption will keep growing going forward, renewable energy, which emits less carbon dioxide than fossil fuels, is gaining in importance. Global demand for renewable energy is estimated to grow to 2.38 billion TOE in 2030 from 1.52 billion TOE in 2008 (Figure Int.-2-15). Countries in the world are moving to more proactively utilize renewable energy, setting goals of raising the ratio of renewable energy to total energy consumption and supply (Table Int.-2-1).

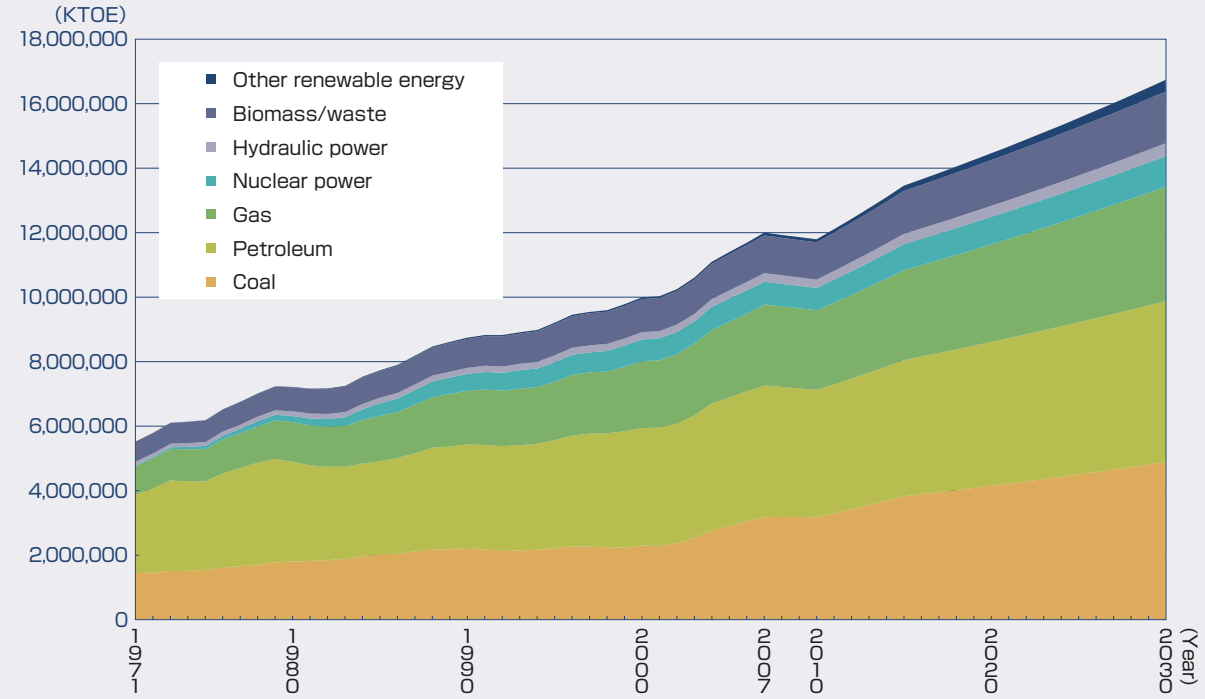
Japan's domestic primary energy supply increased

Figure Int.-2-16 Carbon Dioxide Emission Factor of Major Fuels



Source: Ministry of the Environment

Figure Int.-2-15 World Primary Energy Demand Outlook



Source: Prepared by the Ministry of the Environment based on IEA, "World Energy Outlook 2009" Energy Balance Table

around 3.6 times between 1965 and 2007. Looking at a share of each energy source in the domestic primary energy supply, the dependence on oil has declined in recent years and natural gas instead increased the share in energy supply (Figure Int.-2-17). The component ratio of hydropower and new energy, geothermal power, etc., primarily comprising renewable energy (excluding private power generation of 1,000 kw or less), has not changed much since 1990.

Regarding Japan's future energy supply, the government is currently reviewing the Basic Energy Plan by taking into account measures to cope with global warming and the new growth strategy.

Table Int.-2-1 List of Renewable Energy Introduction Targets for 2020

Country	Ratio of renewable energy	
	2005-2006 results	2020 targets
Denmark＊	17%	30%
Germany＊	6%	18%
Spain＊	9%	20%
France＊	10%	23%
Italy＊	5%	17%
Netherlands＊	2%	14%
Austria＊	23%	34%
Finland＊	29%	38%
Sweden＊	40%	49%
United Kingdom＊	1%	15%
Total for 27 EU member states＊	9%	20%
China	8%	15%
Egypt	4%	14%
Brazil	43%	—
India	31%	—
Indonesia	3%	15% (by 2025)
Thailand	4%	8% (by 2011)
Japan	3%	—
Korea	1%	5% (by 2011)
United States	5%	—
Canada	16%	—

Note: Figures for EU countries states are marked with the 2005 results for the ratio of renewable energy to final energy consumption.
Figures for other countries are the 2006 results for the ratio of renewable energy to the primary energy supply.
Source: Prepared by the Ministry of the Environment based on a document adopted by European Parliament and "Renewables 2007 Global Status Report"

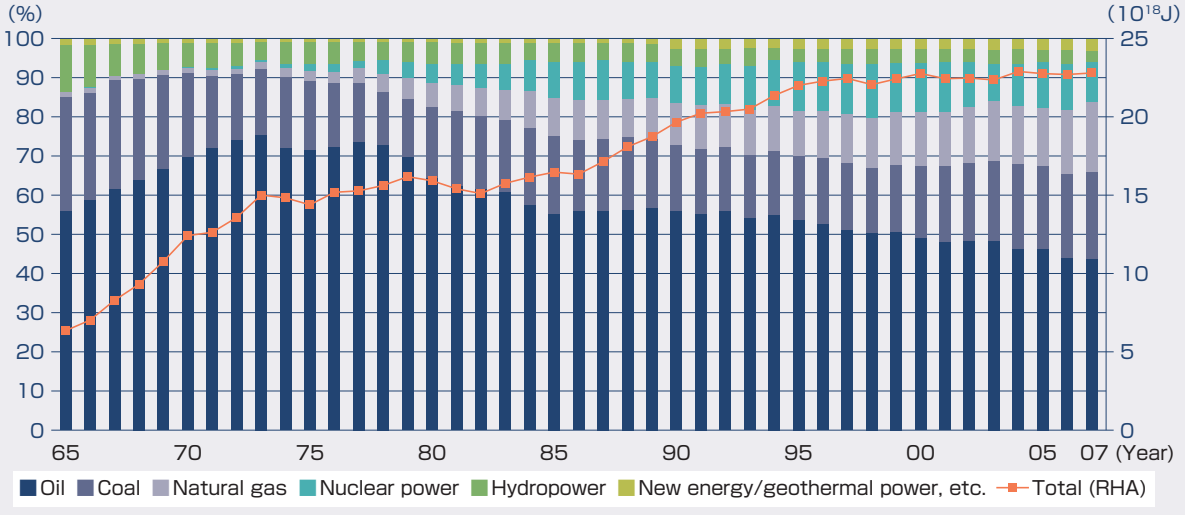
(5) Land: progression of deforestation and desertification

The population growth and the resultant increase in production activities have brought about major changes in land use. The Millennium Ecosystem Assessment (MA) report noted the cultivation of about one-fourth of all land on the earth as the biggest change in the ecosystem structure, and pointed out that more land has been cultivated during the 30 years from 1950 than in the 150 years between 1700 and 1850. As of 2005, 12% of all land area was in use as farmland, an increase of some 1.7 percentage points over 2000.

While land for agricultural use has increased, the forest area has dwindled markedly. According to the U.N. Environment Program (UNEP), since the arrival of the climate of the modern age, around half of the original forests that existed since before the spread of the impact of humans disappeared due to human activities (Figure Int.-2-18). Given that the remnant forests cover about 30% of the total land area, we can assume that from the viewpoint of forest exploitation alone, forests equivalent to about 30% of the total land area have been utilized and lost. UNEP traces this loss of forests to human activities, including agriculture, raising livestock and tree trimming for lumber and fuel as well as the expansion of densely-populated areas.

Going forward, if meat and fish are more favored in dietary habits as income levels rise in tandem with economic growth of developing countries, more land and water resources become necessary than production

Figure Int.-2-17 Trends of Japan's Total Primary Energy Supply



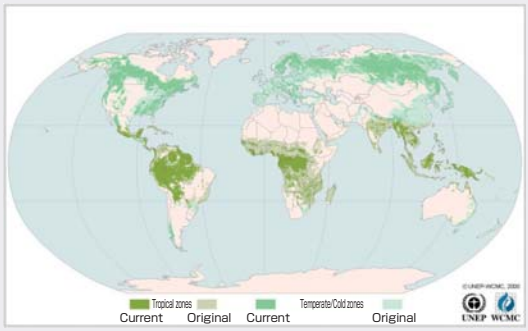
Note 1: The calculation method for figures in Comprehensive Energy Statistics was changed in FY1990.
2: Comprehensive Energy Statistics does not cover private power generation of 1,000 kw or less.
Source: Prepared by the Ministry of the Environment based on the Agency for Natural Resources and Energy, "Comprehensive Energy Statistics"

of cereal crops and other agricultural products, raising concerns about greater burdens on the environment. For example, production of meat consumes more land, water and other resources than production of grains and other agricultural products. Looking at land area required for food production, in terms of per one kg of protein, land area needed for production of chicken is about 7 times, pork about 12 times and beef about 20 times larger than land area required for production of cereal crops (Figure Int.-2-19). Thus, higher income levels in developing countries and resultant changes in dietary habits may require the utilization of more land and resources on the earth than before in the future.

Desertification is also cited as a global environmental issue related to land degradation. Dryland vulnerable to desertification occupy 41% of Earth's land area, and are home to more than 2.0 billion people, at least 90% of who lives in developing countries (Figure Int.-2-20). Desertification is said to be caused by climatic variations such as climate change, drought and moisture loss on a global level as well as human activities including overgrazing, deforestation and removal of the natural vegetation cover (by taking too much fuel wood), agricultural activities in the vulnerable ecosystems of arid and semi-arid areas, which are thus strained beyond their capacity.

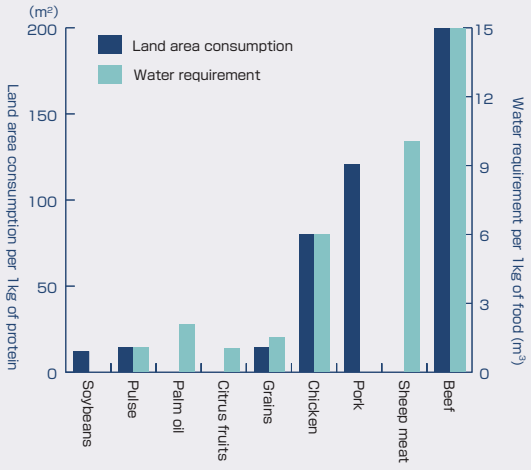
Desertification is also the source of concern over food insecurity, water scarcity and poverty. The further exacerbation of desertification through population growth, increase in urbanization and the impact of the market economy are feared to aggravate

Figure Int.-2-18 Global Distribution of Remnant Original Forests



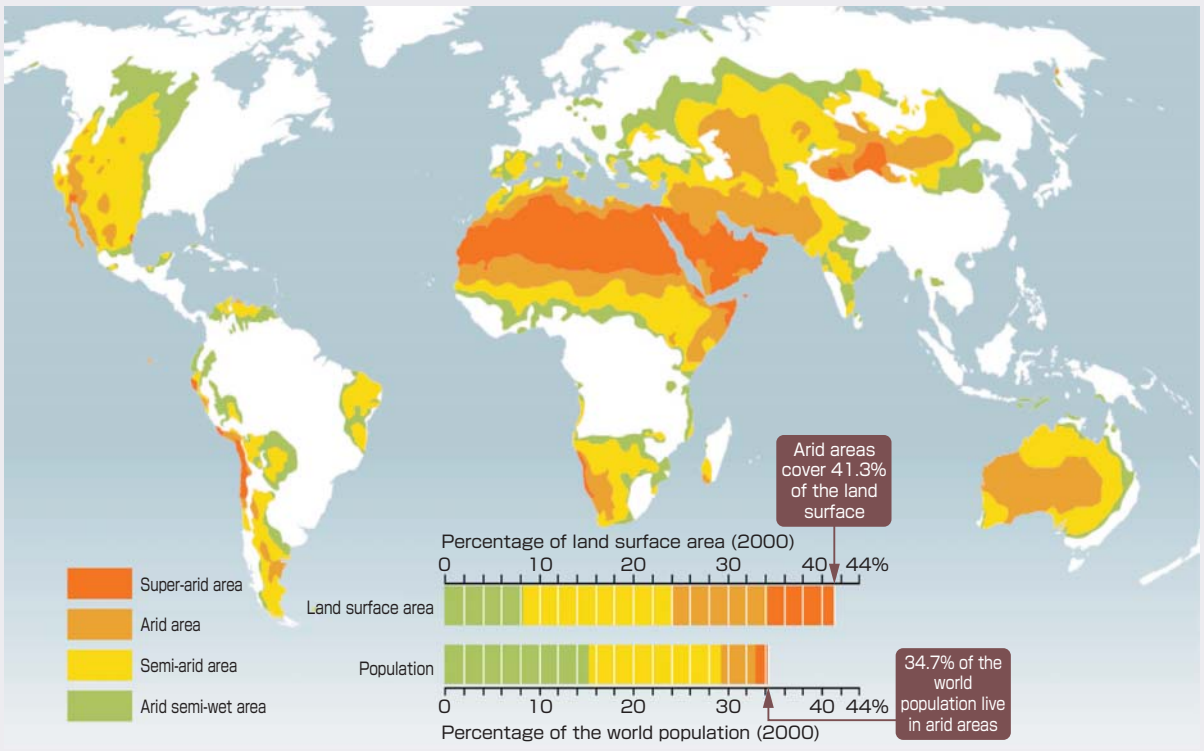
Source: UNEP-WCMC

Figure Int.-2-19 Land and Water Consumption by Food Item



Source: "The Economics of Ecosystems & Biodiversity (TEEB)" (An Interim Report)

Figure Int.-2-20 Global Distribution of Arid Areas



Source: Millennium Ecosystem Assessment (2005)

Table Int.-2-2 Trends of the Distribution of Land Use in Japan

(Unit:10,000 ha)

	1965	1972	1975	1980	1985	1990	1995	2000	2005	2007	1965~2007 Increase/decrease in area
Agriculture	643	599	576	561	548	534	513	491	478	473	−170
Forestry	2516	2523	2529	2526	2530	2524	2514	2511	2510	2506	−10
Field	64	56	43	33	31	27	24	27	28	28	−36
Surface water,rivers,water channels	111	112	128	115	130	132	132	135	134	133	22
Roads	82	91	89	104	107	114	121	127	132	134	52
Urban	85	111	124	140	150	161	170	179	185	187	102
Other	270	282	286	298	282	285	302	309	312	316	46

Source: Prepared by the Ministry of the Environment based on the Ministry of Land, Infrastructure, Transport and Tourism, "Monitoring of national-land circumstances" and "White Paper on Land"

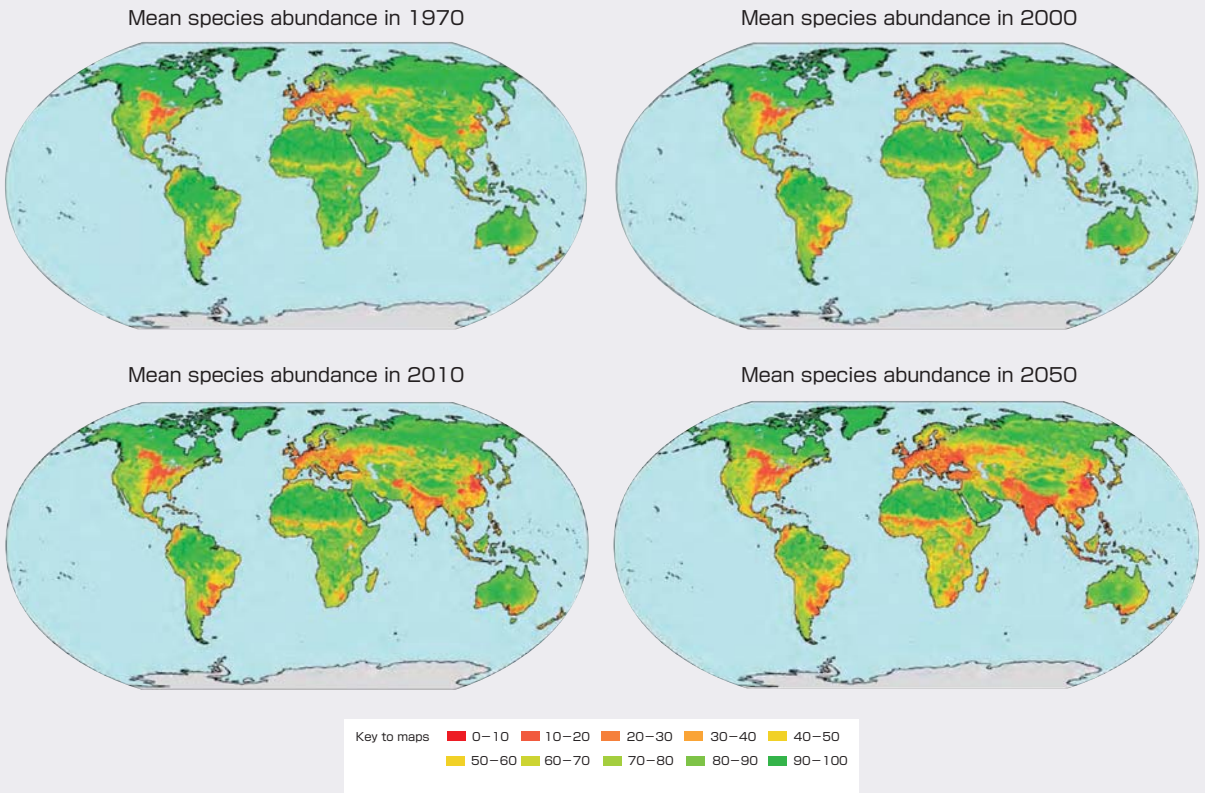
social uncertainties.

Looking at the trends of land use in Japan, the area of agricultural land has decreased, while areas of residential land and roads have increased. Comparison of land areas by use between 1965 and 2007 reveals that agricultural land decreased by 1.70 million hectares, or about 26%, while residential land and roads increased by 1.02 million hectares, or 120%, and 520,000 hectares, or 63%, respectively. As these figures shows, in Japan since 1965, the shrinkage in the area of agricultural land and the expansion of areas of residential land and roads are obvious. While these trends continue in recent years, the areas of conversion from agroforestry land use (farmland, forestry and reclaimed land) to urban land use (residential land, public land and land for industrial use) have been on the decrease, indicating the slowing trend in the conversion of land use from agricultural land to residential land and roads that was so evident in the past.

(6) Biodiversity: progressive loss of biodiversity

According to an interim report of the Economics of Ecosystems & Biodiversity (TEEB), released at the high-level segment of the ninth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP9) in 2008, only about 73% of the original global natural biodiversity was left by the year 2000, and the strongest declines in biodiversity have occurred in the temperate and tropical grasslands and forests, where human civilizations first developed. The report also said, "A further 11% of land biodiversity is expected to be lost by 2050 … In some biomes and regions, projected losses are about 20%." The TEEB interim report cited the continued conversion of natural areas to agricultural land, the ongoing expansion of infrastructure and increasing effects of climate change as additional major contributors to biodiversity loss, and said: "For the

Figure Int.-2-21 Mean Species Abundance in the World (1970, 2000, 2010 and 2050)



Source: "The Economics of Ecosystems & Biodiversity (TEEB)" (An Interim Report)

world as a whole, the loss of natural areas over the period 2000 to 2050 is projected to be 7.5 million square kilometers … i.e. the size of Australia."

Measuring the loss of biodiversity by the MSA (mean species abundance) indicator, the report said that between 1970, 2000, 2010 and 2050, major impacts are expected in Africa, India, China and Europe (Figure Int.-2-21).

Coral reefs are one of the ecosystems mostly likely to be damaged seriously by human activities. According to an analysis announced by the International Union for the Conservation of Nature (IUCN) in 2009, the "Red List Index" (the index for the extinction risk of species shows the percentage of species likely to continue to exist without taking further action in the near future. Value 1 indicates all species are classified into "Least Concern" , while value 0 indicates all species are classified into "Extinct") for coral reefs deteriorated rapidly since 1996, due chiefly to bleaching that occurred in 1998 (Figure Int.-2-22). The analysis also said the coral bleaching is now occurring more frequently and over an extended period, and is related to rising sea temperatures, a symptom of global climate change.

Similarly, according to the summary version of TEEB for Policy Makers released in 2009, over 20% of coral reefs are already "seriously degraded or under imminent risk of collapse" as a result of human activities, including coastal development and over-fishing. The report, citing recent research, pointed out that, in the decades ahead, coral reefs may be reduced to half or even become extinct due to global warming and ocean acidification, adding that the long-term survival of coral reefs would depend on major reductions in carbon dioxide emissions together with a reduction in local burdens on the environment. The TEEB summary version said in order to cope with the crisis situation of coral reefs, strong policy action by the public sector is necessary and measures should be taken by taking into account social fairness, the impact on ecosystems and economic efficiency.

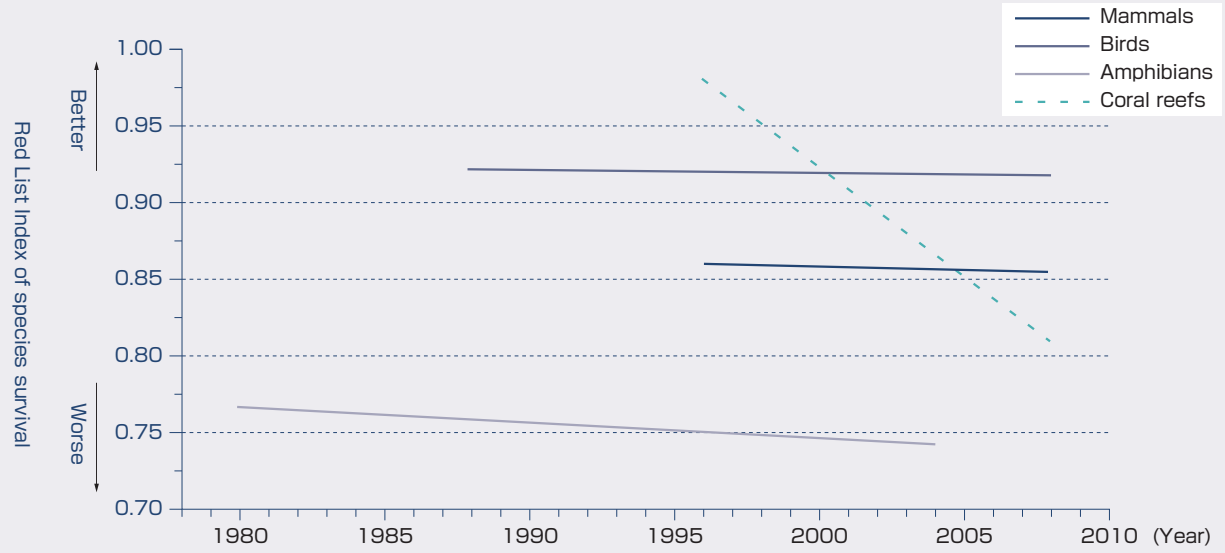
The circumstance of biodiversity in Japan appears in chapter 1.

(7) Recyclable resource and wastes: unstable markets and increasing wastes

The amount of resources used in 2004 (almost equivalent to the amount of rocks mined annually) came to about 22.0 billion tons globally, with an annual increase of 560 million tons since 1990 topping the annual increase of 380 million tons in the 1960-1970s, when the crisis of resources depletion was much talked about (Figure Int.-2-23). While the reserve-production ratio varies for major metal resources, such as 32 years for copper, 73 years for iron ores and 771 years for aluminum, the ratio for some resources is limited. As for rare metals for which demand is expected to increase in coming years for use in products such as lithium ion batteries and transparent electrodes for liquid crystal panels, some have only limited resources, with the reserve-production ratio standing at 47 years for lithium, 51 years for indium and 392 years for platinum. Furthermore, these rare metal resources are unevenly distributed geographically (Table Int.-2-3), and thus further efforts for efficient use of resources are necessary to ensure a stable supply of resources. According to the National Institute for Materials Science (NIMS), even if all the countries in the world matched Japan in terms of conservation of resources, demand for resources will most likely exceed the amount of reserves by 2050 (Figure Int.-2-24).

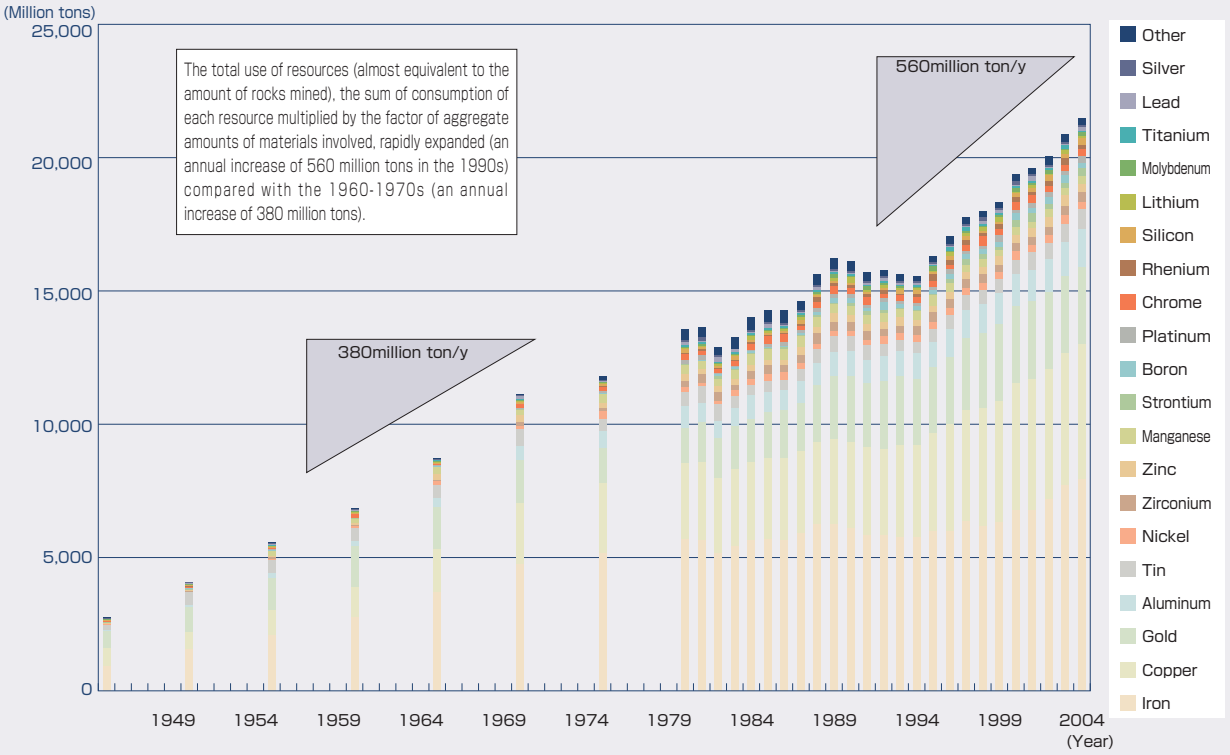
Pushing ahead for a sound material-cycle society should lead to the stable supply of resources. Trends of resource prices in the past decade indicate particularly large fluctuations in resource prices (Figure Int.-2-25). These price fluctuations greatly affect the economy through surges in import prices and

Figure Int.-2-22 Trends of Red List Index (Mammals, Birds, Amphibians and Coral Reefs)



Source: IUCN, "Wildlife in a Changing World"

Figure Int.-2-23 Trends of Total Use of Resources



Source: National Institute for Materials Science press release "Sustainable Utilization of Resources Requires Reduction of Total Use of Resources to One-Eighth"

Table Int.-2-3 Uneven Distribution of Nonferrous Metal Resources

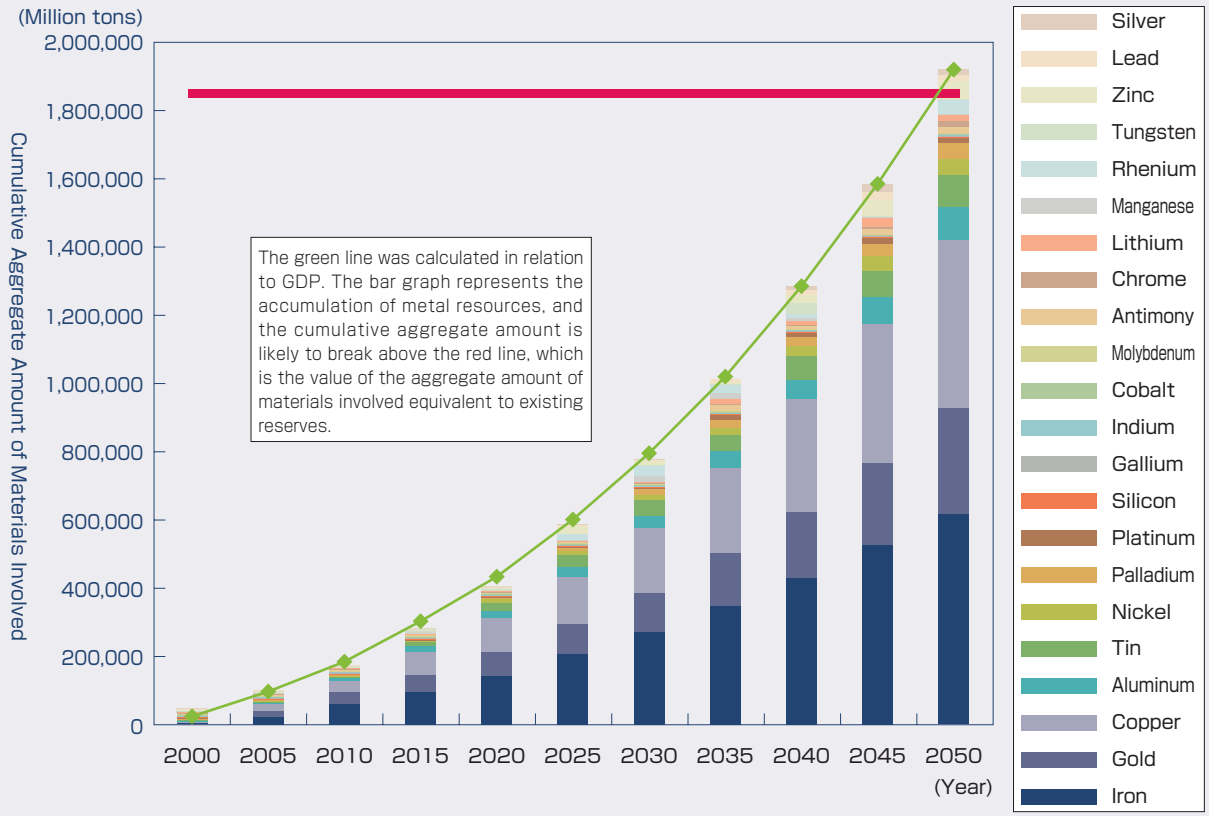
	Major Producers of Resources (Mineral Ores) (2009)						Combined Share of the Top Three Producers
Resource	First		Second		Third		
Rare earth metals	China	97%	India	2%	Brazil	1%	99%
Vanadium	China	37%	South Africa	35%	Russia	26%	98%
Platinum	South Africa	79%	Russia	11%	Zimbabwe	3%	93%
Tungsten	China	81%	Russia	4%	Canada	3%	89%
Molybdenum	China	39%	U.S.	25%	Chile	16%	80%
Lithium Note 1	Chile	41%	Australia	24%	China	13%	78%
Indium Note 2	China	50%	Korea	14%	Japan	10%	74%
Lead	China	43%	Australia	13%	U.S.	10%	67%
Cobalt	Congo	40%	Australia	10%	China/Russia	10%	60%
Manganese	China	25%	Australia	17%	South Africa	14%	55%
Zinc	China	25%	Peru	13%	Australia	12%	50%
Copper	Chile	34%	Peru	8%	U.S.	8%	49%
Nickel	Russia	19%	Indonesia	13%	Canada	13%	44%

Note 1: The share excludes production in U.S. (unknown).
2: The share is based on refinery production.
Source: Prepared by the Ministry of the Environment based on U.S. Geological Survey, "Mineral Commodity Summaries 2010"

resultant hikes in prices of various commodities. Because Japan is heavily dependent on imported resources, it is necessary to promote a sound material-cycle society and strive to secure a stable supply of resources in order to reduce risks associated with resource price fluctuations and ensure the economic stability.

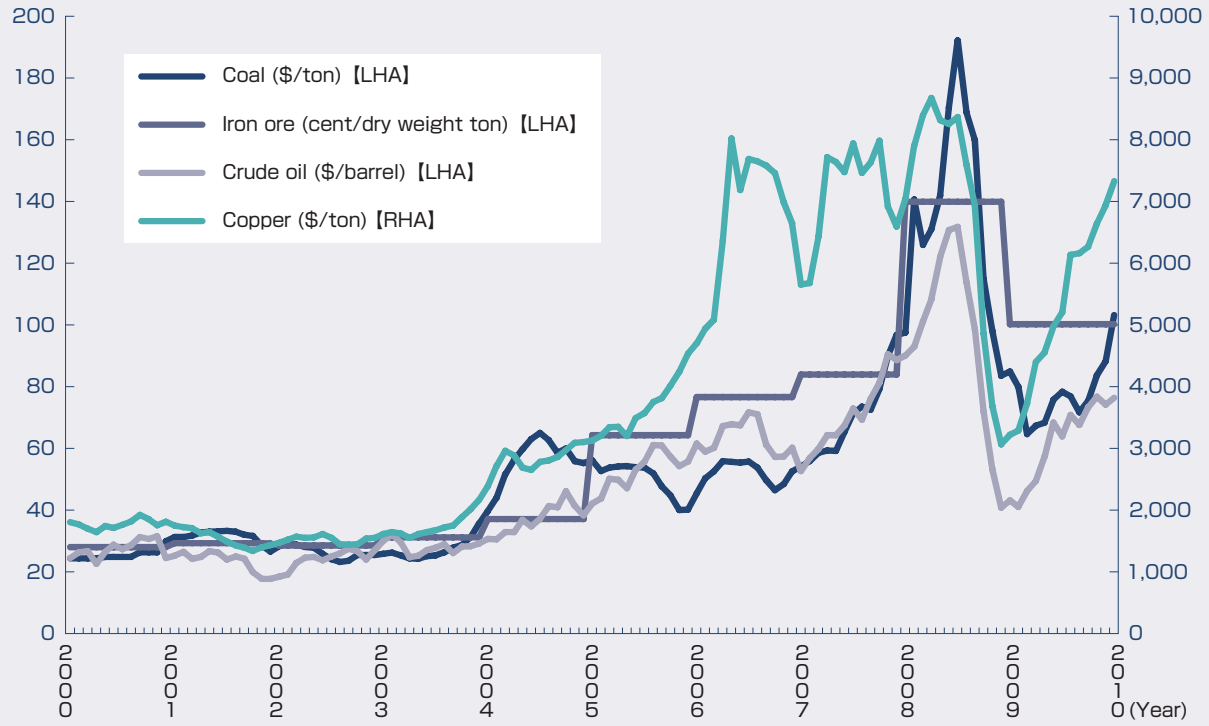
According to future projections of total global generation of wastes, total waste generation amount to about 27.0 billion tons in 2050, about 2.1 times of some 12.7 billion tons in 2000. Thus, wastes are likely to increase faster than the global population during the same period, which is projected to rise about 1.5 times (Figure Int.-2-26). Per-capita waste generation is also estimated to increase about 1.4 times to 2.9 tons in 2050 from some 2.1 tons in 2000. Since the continued increase in per-capita waste generation means inefficient utilization of limited resources and heavier burdens on the environment, it is necessary to push ahead with efforts on a global scale to build a sound material-cycle society by reducing wastes and utilizing resources more efficiently.

Figure Int.-2-24 Cumulative Aggregate Amount of Materials Involved



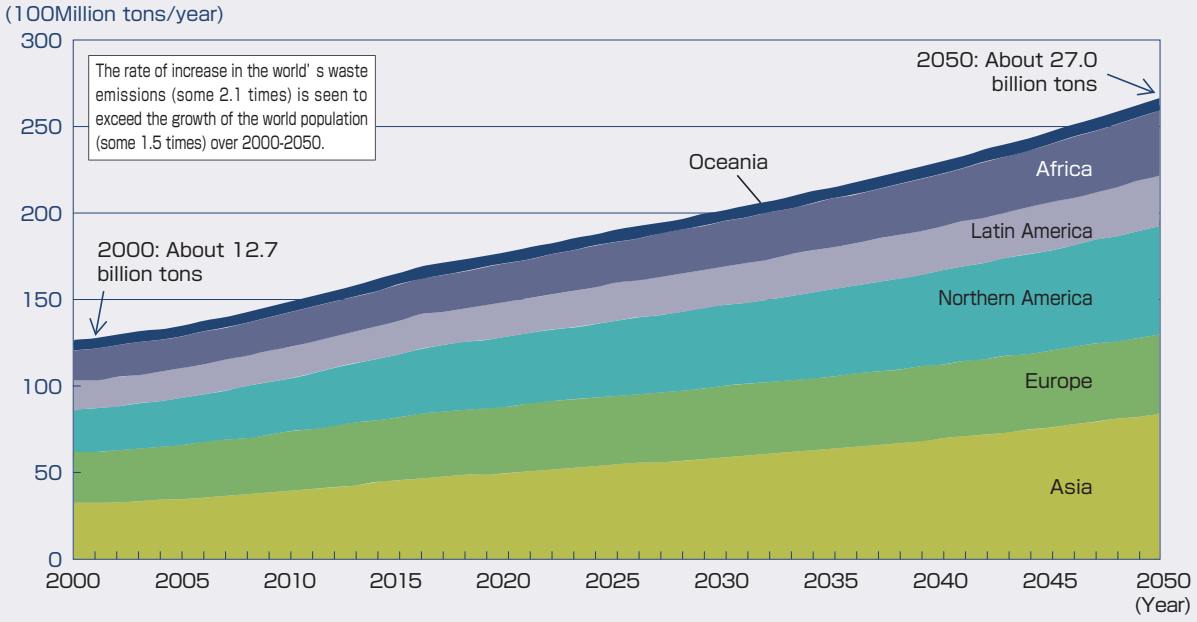
Source: National Institute for Materials Science press release "Sustainable Utilization of Resources Requires Reduction of Total Use of Resources to One-Eighth"

Figure Int.-2-25 Trends of Resources Prices



Source: Prepared by the Ministry of the Environment based on IMF, "Primary Commodity Prices"

Figure Int.-2-26 Future Projections of the World' s Waste Emissions (2000-2050)



Source: Saeko Yoshizawa, Masaru Tanaka and Ashok V.Shekdar, "Research on Estimation of Global Waste Generation and Future Projections"

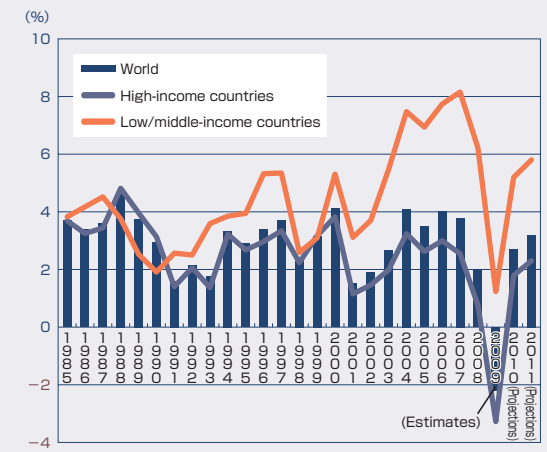
(8) Trends of economic activities: instability of the existing economic system and the shift of economic center to Asia

The world economy is estimated to have incurred negative growth in 2009, in the aftermath of the subprime loan problem in the United States in 2007 and the subsequent collapse of a major U.S. investment bank in 2008. The fundamental causes of the financial crisis has been traced to the vulnerability of the financial system brought about by a combination of inadequate risk management practices, complex and opaque financial instruments and excessive leverage, on top of market participants' failure to appropriately assess risks involved and conduct adequate due diligence. In response to the global economic crisis, touched off by the financial crisis, countries around the world strove to tide over the severe situation by actively making environment-related investments, a move in the direction of the so-called Green New Deal.

The world economy is expected to get back on the path of positive growth from 2010 onward. According to projections by the World Bank, the global economy, in terms of real gross domestic product (GDP), is estimated to have posted negative growth in 2009 in the wake of the worst recession since the end of World War II, but is likely to go into a period of positive growth in 2010 and onward (Figure Int.-2-27). Looking at the trends of economic growth by the two categories of high-income and low/middle-income countries, low/middle-income countries have had registered economic growth higher than high-income countries since 2000. This trend is expected to continue at least until 2011.

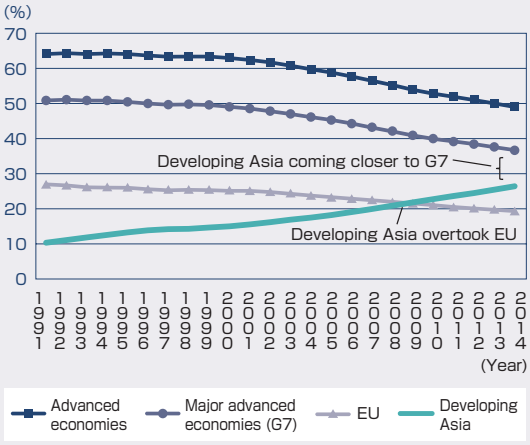
Following the high growth of low/middle-income countries, the GDP shares by each region and group in the global economy have undergone major changes. The group of developing countries in Asia, including China, has seen its share in the global economy increase remarkably and this trend is seen likely to persist going forward. On the other hand, the shares of the Group of Seven (G7) countries, developed countries as a whole and the EU have dwindled sharply (Figure Int.-2-28). All these developments, without doubt, indicate that the economic gravity is shifting to Asia. Considering that economic development in the past has been achieved by imposing burdens on the environment, the importance of environmental measures in Asia will increase more than ever going forward.

Figure Int.-2-27 Comparison of GDP Growth by Income



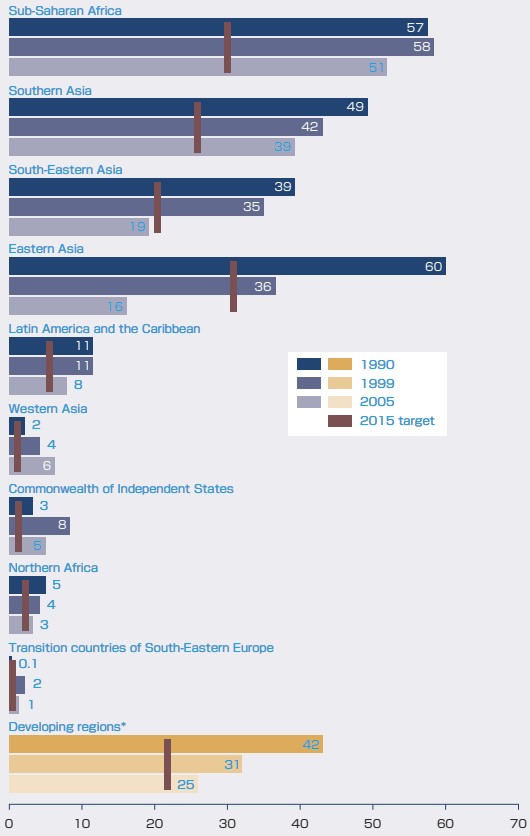
Source: Prepared by the Ministry of the Environment based on the World Bank, "World Development Indicators" and "Prospects for Developing Economies"

Figure Int.-2-28 Trends of Global GDP Shares of Region/Group



Note: "Advanced economies," "Major advanced economies(G7)," "EU" and "Developing Asia" are based on the definitions of the IMF
Source: Prepared by the Ministry of the Environment based on IMF, "World Economic Outlook Database, October 2009"

Figure Int.-2-29 Proportion of People Living on less than $1.25 a Day (%, 1990, 1999 and 2005)



* Includes all developing regions, the Commonwealth of Independent States and transition coutries of South-Eastern Europe

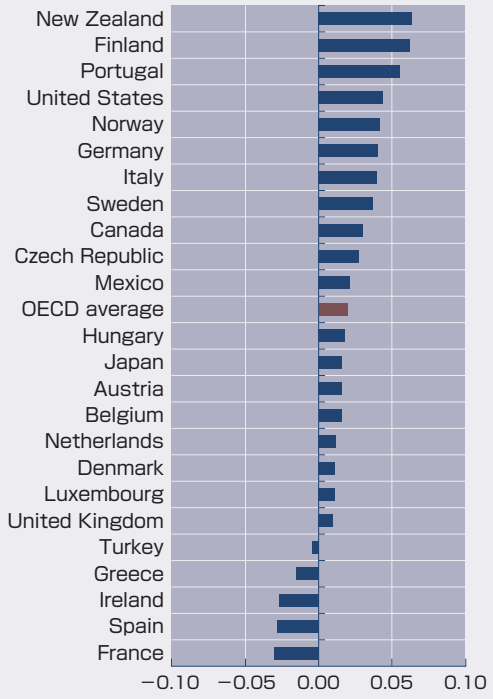
Source: United Nations, "The Millennium Development Goals Report 2009"

Table Int.-2-4 Comparison of Income Disparity in the Mid-2000s

	Gini coefficient		Gini coefficient
Denmark	0.23	Australia	0.30
Sweden	0.23	Korea	0.31
Luxembourg	0.26	Canada	0.32
Austria	0.27	Spain	0.32
Czech Republic	0.27	Japan	0.32
Slovakia	0.27	Greece	0.32
Finland	0.27	Ireland	0.33
Netherlands	0.27	New Zealand	0.34
Belgium	0.27	United Kingdom	0.34
Switzerland	0.28	Italy	0.35
Norway	0.28	Poland	0.37
Iceland	0.28	United States	0.38
France	0.28	Portugal	0.42
Hungary	0.29	Turkey	0.43
Germany	0.30	Mexico	0.47
		OECD average	0.31

Source: Prepared by the Ministry of the Environment based on OECD, "OECD Factbook 2009"

Figure Int.-2-30 Changes in Gini Coefficient of OECD Member States from the Mid-1980s to the mid-2000s



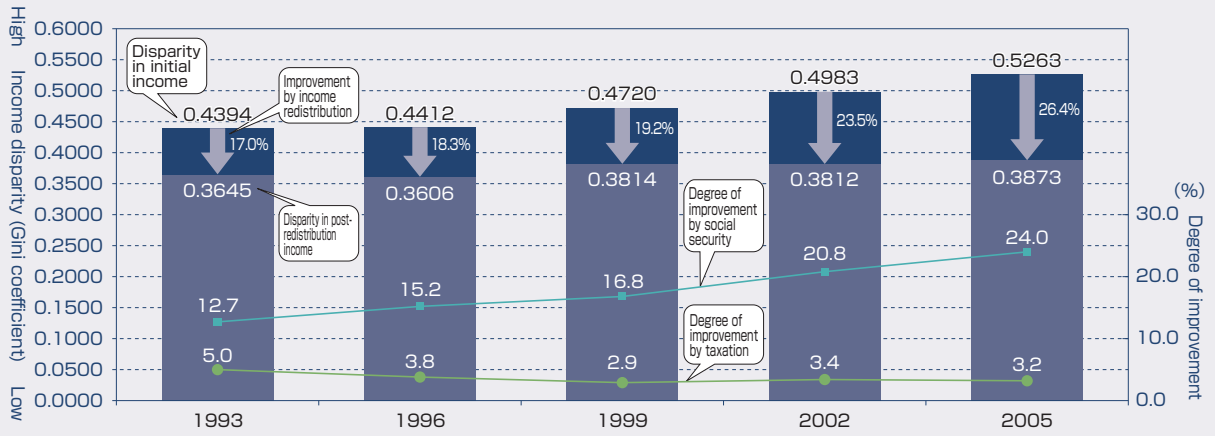
Source: Prepared by the Ministry of the Environment based on OECD, "OECD Factbook 2009"

(9) Trends of poverty and economic gaps: the importance of economic growth differs depending on the development stage

According to a U.N. report on the poverty situation in the world, people in developing countries living in dire poverty under $1.25 a day (2005 price levels) decreased to 1.4 billion in 2005 from 1.8 billion in 1990. As a result, the percentage of people in dire poverty has declined to about one-fourth of the total population of developing countries in 2005 from about half in 1990(Figure Int.-2-29).

In terms of trends of the poverty rate and the population in poverty by region, the poverty rate in Eastern Asia has shown a dramatic decline between 1990 and 2005, mainly thanks to the rapid economic growth in China, and this is believed to have lifted 475 million people out of dire poverty. In sub-Saharan Africa, on the other hand, the population in dire

Figure Int.-2-31 Changes in Gini Coefficient in Japan Due to Income Redistribution



Note: Benefits in kind prior to 1999 were medical services only, while benefits in kind since 2002 include medical services, nursing care and childcare.
Source: Materials from the Ministry of Health, Labour and Welfare

poverty increased by 100 million between 1990 and 2005, with the poverty rate high at over 50%.

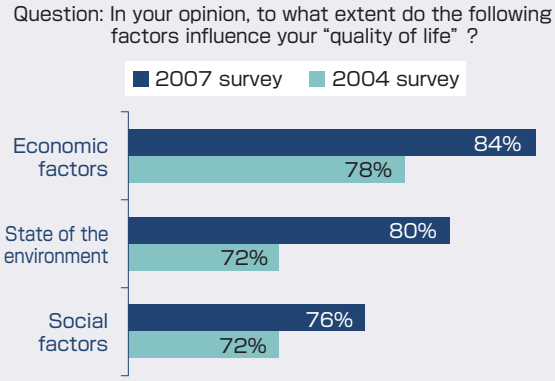
The United Nations estimates that as many as one billion people will remain in dire poverty even in 2015.

In advanced countries, the relative poverty, i.e. the income disparity, is an issue. The Gini coefficient is one of commonly used measures of inequality in income (the coefficient is shown in figures between 1 and 0, and the closer the figure is to 1, the larger the income disparity). The Gini coefficient has risen between the mid-1980s to the mid-2000s in 19 out of 24 member states of the Organization for Economic Cooperation and Development (OECD), indicating the increasing degree of inequality in many countries (Table Int.-2-4, Figure Int.-2-30).

Regarding the Gini coefficient in Japan, while initial income has been risen year by year, post-redistribution income has stayed flat since the 1999 survey (Figure Int.-2-31). According to a survey on the redistribution of income conducted by the Ministry of Health, Labour and Welfare in 2005, the Gini coefficient in 2005 stood at around 0.53 for initial income and around 0.39 for post-redistribution income. In recent years, the degree of improvement in the Gini coefficient by the redistribution of taxes and social security has grown larger by each survey, reaching a record 26.4% in the 2005 survey.

When the disparity in terms of income is widening, there is a view that the "quality of life" cannot necessarily be measured adequately by economic indicators such as income alone. According to the survey results released by the EU in 2008, while 84% of the survey respondents say that economic factors have a big impact on the "quality of life," as many as

Figure Int.-2-32 Survey Results Released by the EU in 2008 (Excerpts)



Note: The reply options to this question are "Very much," "Quite a lot," "Not much," "Not at all" and "DK (Don't know)." The numbers shown in the above figure are the sum of the percentages of responses "Very much" and "Quite a lot."

Source: European Commission, "Special Eurobarometer 295"

80% also say that environmental conditions affect the "quality of life" (Figure Int.-2-32). The EU survey results also show that over two-thirds of the respondents believe that social and environmental indicators should be equally used, along with economic indicators, to measure the degree of development of society. The European Commission reports that a similar survey carried out in 2007 by a private research firm in 10 countries on five continents found that an even larger ratio of 75% of respondents supported this idea.

Conclusion

In this section, we have examined several economic and social developments deeply related to environmental problems, ranging from population trends to the situation of poverty and income disparity.

Key points that have emerged from a variety of data are that consumption of resources and burdens on the environment have been increasing in tandem with population growth and expanding economic activities. Given global socioeconomic trends and the finite nature of natural resources, it is extremely difficult to sustain

the past patterns of economic and social activities featuring mass production, mass consumption and mass disposal. Higher demand for food associated with the population growth leads to higher demand for land and water resources, and the expansion of economic activities heightens energy needs and results in increased consumption of a host of resources. Also, the population growth particularly noticeable in developing countries accelerates the concentration of populations on cities, causing and aggravating a variety of environmental problems and leading to greater losses of biodiversity through development. Thus, it may be said that the process of advancement achieved by humankind in the past has not necessarily entailed adequate measures to conserve the natural environment.

Meanwhile, there is a growing awareness that the quality of life cannot be necessarily measured by economic aspects alone, and many people are coming to question the pursuit of endless development in disregard of the finitude of natural resources. In recent years, many national and local governments and various other entities around the world are making proactive efforts to fight global warming and conserve biodiversity. Many countries and international institutions are also seeking ways of economic development geared to the preservation of the environment, the idea called "green growth." As we reflect upon the past pattern of development and aspire for further development of mankind with full recognition of the importance of the environment, we are now witnessing an important paradigm shift in the history of mankind.

In the subsequent sections of this paper, we look at the present status of the environment in Japan in Chapter 1, and in Chapter 2 through Chapter 5, we examine how mankind is trying to achieve further development while preserving the environment and whether such development path is feasible, from the respective angles of global warming, biodiversity, water problems, and the environment and economy.

Column Observing Mankind for a Day from Outside the Earth…

We may say that mankind came into existence on the earth quite recently. In a matter of just several centuries, the human population has grown to 6.8 billion. Some 370,000 people are born and about 160,000 people die in a day, resulting in a net increase of about 220,000 in the population each day.

Mankind consumes about 150 km^3 of fresh water every day, and using the bulk of that water, is producing some 8 million tons of food a day. It is also true that a considerable part of the food produced is being discarded.

We produce some 3.7 million tons of crude steel a day. While we manufacture 200,000 new vehicles each day, we also scrap some 120,000 used vehicles each day. Individuals own cars even when they do not drive them very often, with the shift from the ownership value to the utility value apparently only beginning. We also produce some 1.08 million tons of paper every day.

It was only 200 years ago that mankind learned how to use energy for power. We only consumed one million barrels of crude oil a day 100 years ago, but we are now consuming 80 million barrels, an 80-fold jump. By consuming fossil fuels, we are producing 65 TWh of electric power a day and emitting 80 million tons-CO_2 of carbon dioxide in a single day.

We mine some 60 million tons of rocks a day, and are also consuming mineral resources. We are also discharging some 35 million tons of wastes per day, and some forecast that wastes are going to double over the next 50 years.

Humans have cut open rain forests and expanded farmland by burning down trees. Thus, it may be said that we have increased the number of individuals and prolonged the duration of life by depriving other living species of their habitats. In the course of human development, forest areas on the earth have been reduced to half, barren land has widened, and as many as 100 species are becoming extinct each day.

We need to fully recognize that nature takes 100 to 1,000 years to nurture 1 cm of land, that rich forests develop over several thousand years, that an astronomical length of time is required to form exhaustible mineral resources and bountiful ecosystems. We should refrain from the folly of using up the fruits of hundreds of millions of years in only a single day.

Thus far, mankind has been able to tide over a number of crises by the collective wisdom of the human race. But can we survive this environmental crisis in the same way?

Source : NASA Earth Observatory

Chapter 1
Current Environmental Conditions of the Earth and Japan

Our daily lives and their supporting economic activities depend entirely upon the foundation of the earth's environment. Our living and economic activities cannot be sustained into the future if the wealth of the global environment is damaged. A stable climate, clear water and air, diverse ecosystems, and natural environments are vital for human health and cultured living. For humans to benefit from the global environment into the future, current environmental state must be well understood.

This chapter presents the state of the global environment surrounding us, with a compilation of specific data.

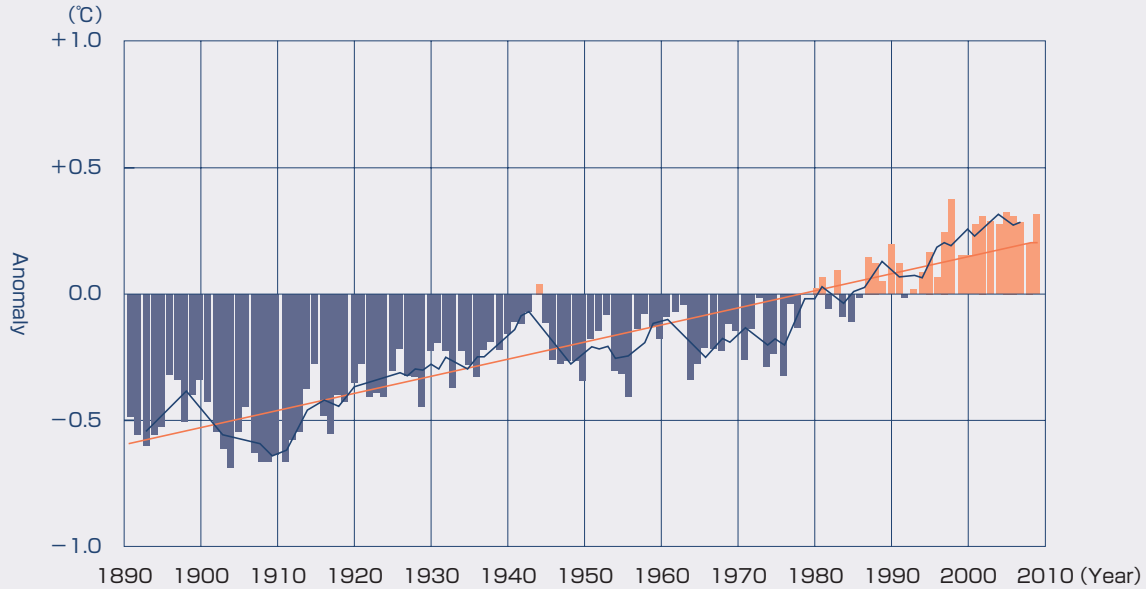
1 State of Global Warming

Advancing global warming can be perceived from the annual global average temperature anomalies. The annual global mean temperature in 2009 was 0.31℃ higher with reference to the 1971-2000 long-term average, and was the third highest since the first records were made in 1891 (Figure 1-1-1). Japan's temperature was 0.58℃ higher from the normal and was the seventh highest since the beginning of statistical record in 1898 (Figure 1-1-2). The global mean temperature increases with 100-year liner trend of 0.68℃, in particular, temperatures have rapidly increased since the mid-1990s. Every year since the beginning of the 2000s, except 2008, is ranked among the 10 warmest years when each of the years from the beginning of statistical record of the annual global mean temperature is sorted by their annual global mean temperature (Table 1-1-1).

Carbon dioxide is the most important driver as greenhouse gasses (GHG) that contribute to the global warming. Atmospheric concentrations of carbon dioxide and anthropogenic gas emissions are increasing constantly (Figure 1-1-3), and is considered to be one of the drivers that contributes to increasing global temperatures. The mean temperature increase in Japan was around 1.1℃ over 100 years. For the same period, data show mean temperature increase of around 3℃ in Tokyo, and in major cities such as Sapporo, Nagoya, Osaka and Fukuoka, around 2℃ or more. These temperature increase in urban areas are thought to be significant with additional impact of the heat island effect to the impact of the global warming (Figure 1-1-4).

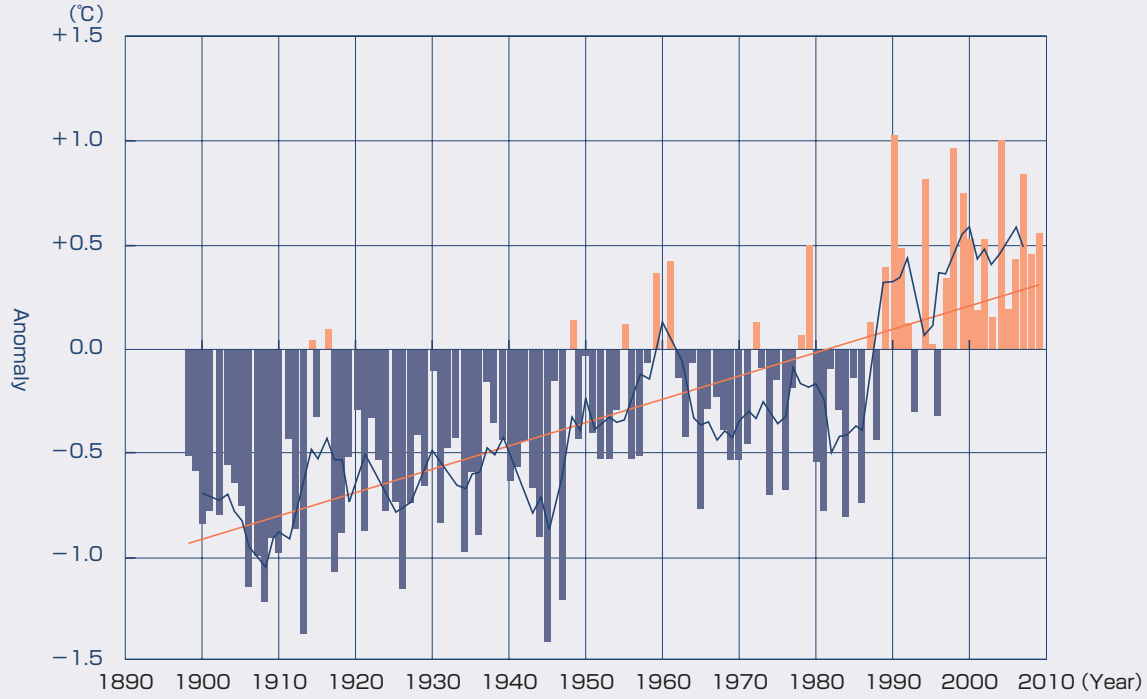
As an event that may reflect the impact of the global warming, the melt of ice sheet is suggested. Arctic sea

Figure 1-1-1 Annual Anomalies in Surface Temperature Globally



Note: The global annual mean temperature since 1891 based on o records observed with instruments. Anomalies are deviations from the normal (i.e. the 1971-2000 average). The bars indicate anomalies in surface temperature for each year. The blue line indicates five-year running means, and the red line indicates the long-term linear trend.
Source: Japan Meteorological Agency, 2009

Figure1-1-2 Annual Anomalies in Surface Temperature in Japan



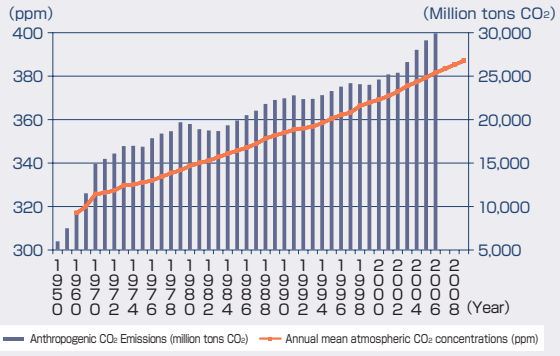
Note: Annual mean temperature using data from 17 stations in Japan. Anomalies are deviations from the normal (i.e. the 1971 – 2000 average). The bars indicate anomalies in surface temperature for each year. The blue line indicates five-year running means, and the red line indicates the long-term linear trend.
Source: Japan Meteorological Agency, 2009

Table1-1-1 Rankings of Global Annual Mean Temperature

Ranking	Year	anomaly℃
1	1998	+0.37
2	2005	+0.32
3	2009	+0.31
〃	2006	+0.31
〃	2003	+0.31
〃	2002	+0.31
7	2007	+0.28
8	2004	+0.27
〃	2001	+0.27
10	1997	+0.24
11	2008	+0.20
12	1990	+0.19
13	1995	+0.16

Source: Japan Meteorological Agency website

Figure1-1-3 Atmospheric CO_2 Concentrations and Anthropogenic CO_2 Emissions

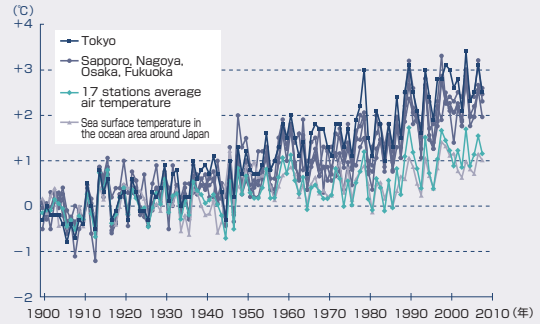


Note 1: Basic observation point: Mauna Loa Island, Hawaii (19º32' N, 155º35' W)
2: The annual mean concentrations are from Earth Systems Research Laboratory (ESRL) website, under the National Oceanic and Atmospheric Administration (NOAA)/United States (http://www.esrl.noaa.gov/gmd/ccgg/trends/)
3: ppm signifies 1 part per million in dry air (volume ratio)
Source: NOAA/ESRL, Oakridge National Laboratory, United States

ice extent is tend to reduce in recently, and in September 2007, the summer minimum sea ice extent is lowest in the instrumental record, according to the satellite observation. The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), released in 2007, states that satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7 [2.1 to 3.3] % per decade, with larger decreases in summer of 7.4 [5.0 to 9.8] % per decade (Numbers in square brackets indicate a 90% uncertainty interval around a best estimate.) The report also indicates that some projections, arctic late-summer sea ice disappears almost entirely by the latter part of the 21st century. In addition, it states that there is medium confidence that at least partial deglaciation of the Greenland ice sheet, and possibly the West Antarctic ice sheet, would occur over a period of time ranging from centuries to millennia for a global average temperature increase of 1-4℃ (relative to 1990-2000), causing a contribution to sea-level rise of 4-6 m or more. Furthermore, a compendium by the United Nations Environmental Programme (UNEP) cites certain studies that suggested the faster timing of Arctic ice loss or the higher sea level rise than the projections shown in the IPCC AR4.

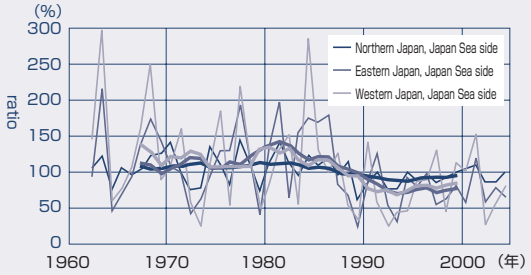
Recent snowfall patterns in some Japanese regions are

Figure1-1-4 Time series in temperature of large cities, 17-station average, and sea surface in the oceans area around Japan



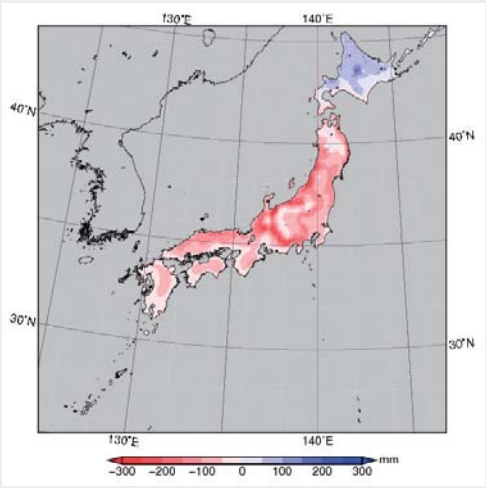
Note: Annual mean temperature in Japan is calculated from data of 17 stations. All values are annual average anomalies from the 30 year average from 1901 to 1930.
Source: Japan Meteorological Agency website

Figure1-1-5 Annual Maximum Snow Accumulation ratio to the normal (i.e. the 1971-2000)



Note: In each region, the thin line indicates the values for individual years and the thick line indicates the 11 year running mean value
Source: Report on Climate Change 2005 (Japan Meteorological Agency, 2005)

Figure1-1-6 Difference in the 20-year average of the amount of total snowfall in the cold season (December to March) from 2081 to 2100 and from 1981 to 2000.



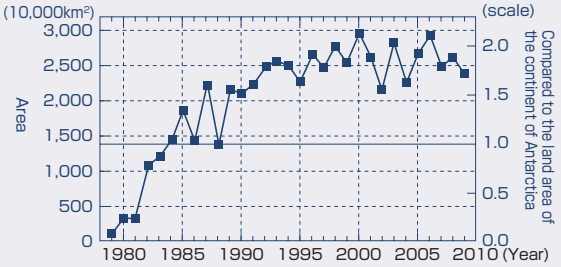
Note: The amount of total snowfall is converted into precipitation (mm). It is a projected result under the A1B scenario with coupled atmosphere-ocean regional climate models.
Sources: MEXT, Japan Meteorological Agency, Ministry of the Environment "Climate Change and its Impacts in Japan." (October, 2009)

changing. As shown in Figure 1-1-5, the annual maximum snow depth has significantly decreased until the beginning of the 1990s since the peak at the beginning of 1980s. Though slight upward trend is observed since then, it remains at levels much lower than those of the early 1980s. The long-term changes per decade in years between 1962 and 2004 exhibit an unmistakable downtrend in the Japan Sea side of northern, eastern, and western Japan, which declined 4.7%, 12.9%, and 18.3% respectively. The downtrend was significant for eastern and western Japan. This trend can be attributed mainly to the dramatic rise in mean winter temperatures from northern to western Japan since the mid-1980s.

Multiple causes underlie these changes in snowfall volume, including temperature increases stemming from global warming as well as long- and short-term climate changes. According to Volume 7 of the Global Warming Projection issued by the Japan Meteorological Agency, in a scenario where the temperature rises around 2.8℃ over the course of the current century, decreased regional snowfall volumes are predicted for all of Japan's regions except Hokkaiko (Figure 1-1-6). The causes include precipitation events in which rain falls instead of snow due to higher temperatures in the Tohoku region and southward. Hokkaido, in contrast, is cold enough for precipitation to continue to fall as snow even if the temperature rises, and its snowfall volume will increase because higher temperatures will result in greater levels of atmospheric water vapor.

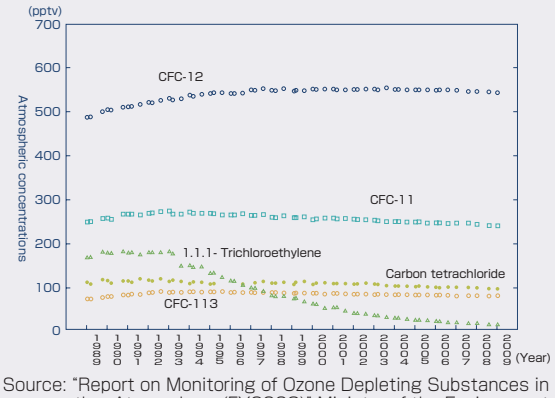
2 Statuses of the Global Environment, Atmosphere, Water, and Soil

Figure1-2-1 Chronological Changes of the Size of the Ozone Hole over the Antarctic Region



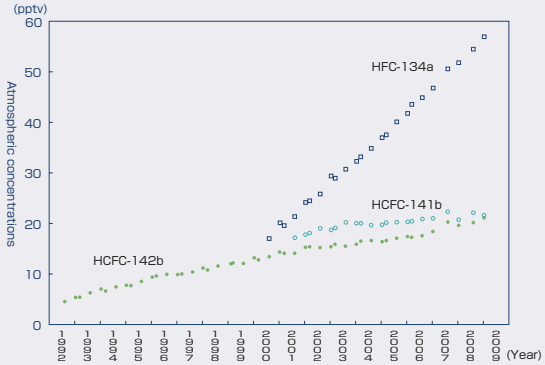
Note: Shows that annual maximum value of the ozone hole Area. The horizontal line is the land area of the continent of Antarctica (approximately 14 million km²).
The Japan Meteorological Agency produced this figure based on satellite data from the National Aeronautics and Space Administration (NASA) of the United States.
Source: Japan Meteorological Agency "Ozone Layer Observation Report: 2008"

Figure1-2-2 Changes in Average Atmospheric Concentrations of Ozone Depleting Substances in Hokkaido



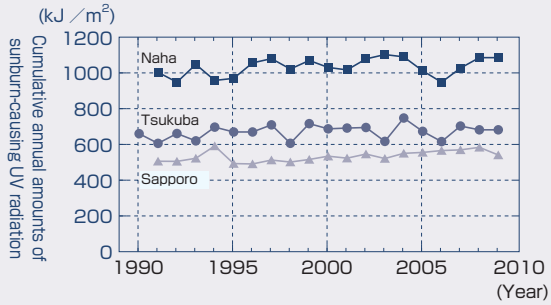
Source: "Report on Monitoring of Ozone Depleting Substances in the Atmosphere (FY2008)" Ministry of the Environment

Figure1-2-3 Changes in Past Year Atmospheric Concentrations of HCFC-141b, HCFC-142b, and HFC-134a in Hokkaido



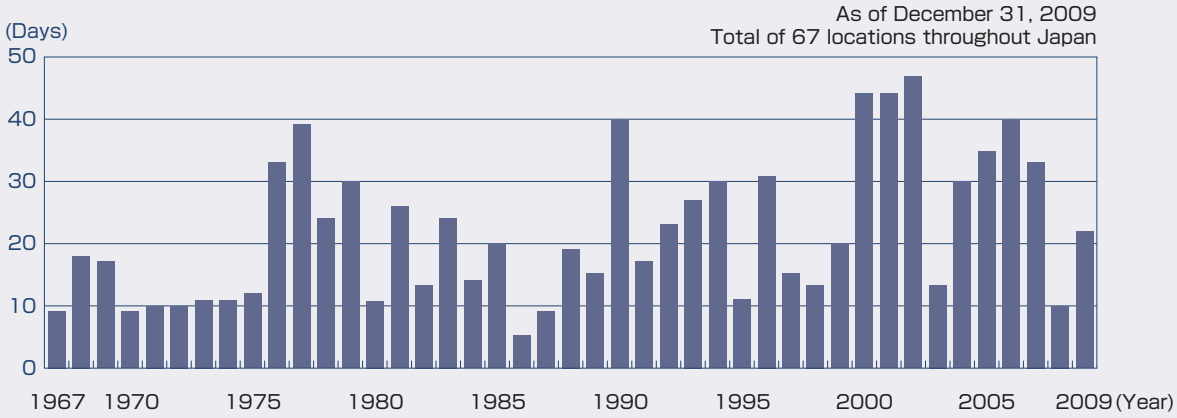
Source: Ministry of the Environment FY2008 Annual Survey of Observations of Fluorine and other Low -Volume Gasses that Impact the Ozone Layer

Figure1-2-4 Changes in Cumulative Annual Amounts of Sunburn-causing UV Radiation



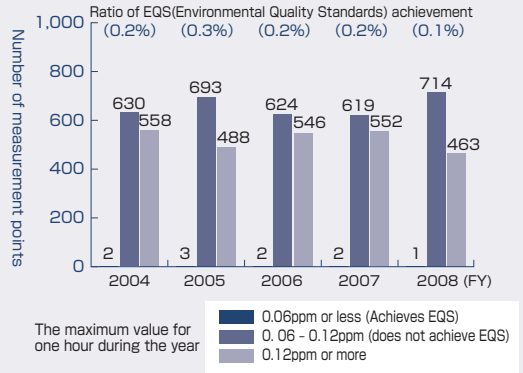
Note: Changes are from annual cumulative amounts of sunburn-causing UV radiation from the start of measurement until 2009.
The cumulative annual amount of sunburn-causing UV radiation was found by measuring the cumulative amount every day, finding the daily average for each month, then finding the daily average for the year, then multiplying by the number of days in a year.
Source: 2008 Ozone Layer Observations Report, Japan Meteorological Agency

Figure1-2-5 Number of days yellow dust was observed for individual years



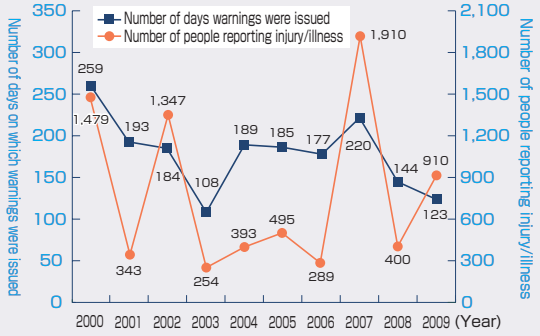
Source: Japan Meteorological Agency website

Figure1-2-6 Changes in Number of Stations Reporting Each Level of Photochemical Oxidant Concentrations (Total of Ambient Stations and Roadside Stations) (FY2004 to 2008)



Source: "FY2008 Air Pollutants Status Report" Ministry of the Environment

Figure1-2-7 Number Of Days on Which Warnings Were Issued and Number of People for Whom Injuries/Illnesses were Reported(From 2000 to 2009)

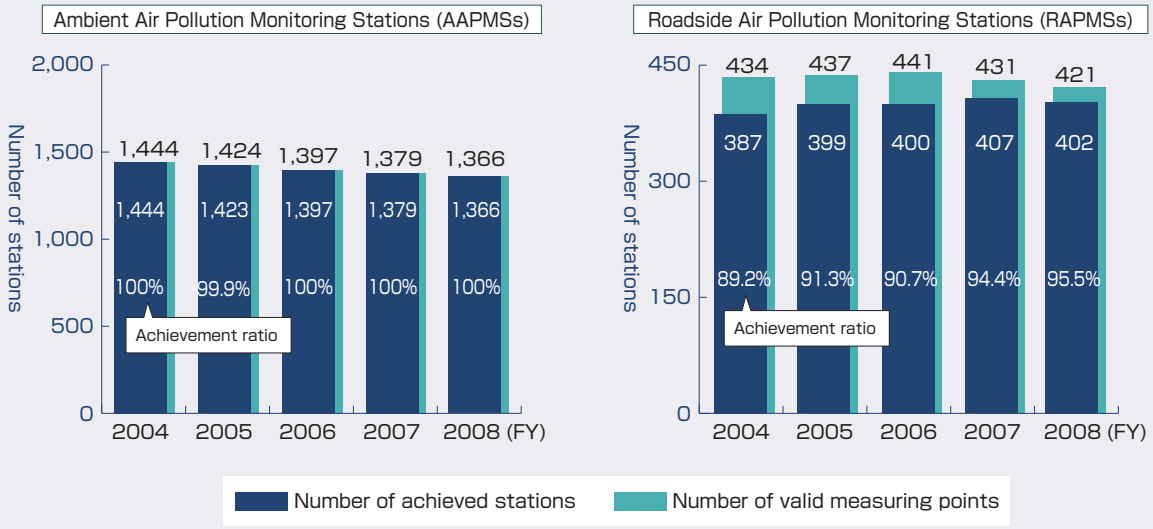


Source: "2009 Photochemical Air Pollutant Related Documents," Ministry of the Environment

In addition to global warming, the problems of ozone layer depletion, acid deposition, dust and sandstorms, ocean pollution, deforestation, desertification and the Antarctic are examples of global environmental problems. Changes in the size of the ozone hole in the Antarctic upper atmosphere indicate the degree of ozone layer depletion. Though the total volume of ozone-depleting substances is gradually declining in the stratosphere, thanks to government regulation, there is no current evidence of the ozone hole shrinking (Figure 1-2-1). Ozone-depleting substances are monitored in Japan. The results indicate that CFCs and other substances are either declining or holding steady, however, concentrations of HCFCs and HFCs are increasing rapidly (Figures 1-2-2, 1-2-3).

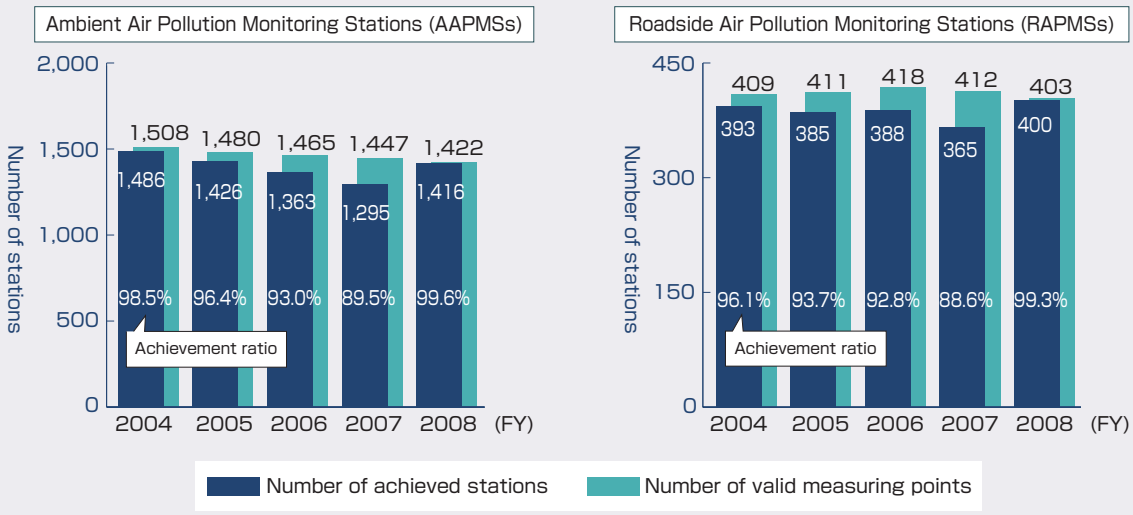
Ozone layer depletion is a concern because it can lead to an increase in harmful ultraviolet (UV) radiation at the surface. However, at present there are no reports of a pronounced increase in the amounts of UV radiation,

Figure1-2-8 Changes in Achievement of EQSs for Nitrogen Dioxide (FY2004 to 2008)



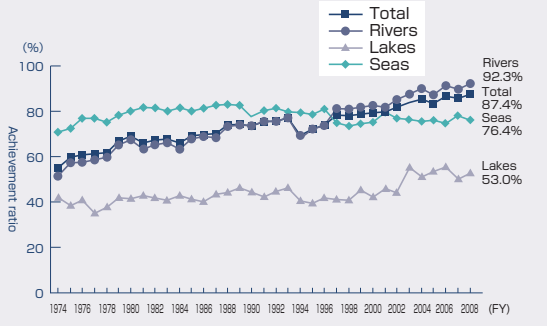
Source: "FY2008 Air Pollutant Status Report," Ministry of the Environment

Figure1-2-9 Changes in EQS Achievement Status for Suspended Particulate Matter (FY 2004 - 2008)



Source: "FY2008 Air Pollutant Status Report," Ministry of the Environment

Figure1-2-10 Changes in Achieving EQSs (BOD or COD)



Note 1: Rivers: BOD, Lakes and Seas: COD

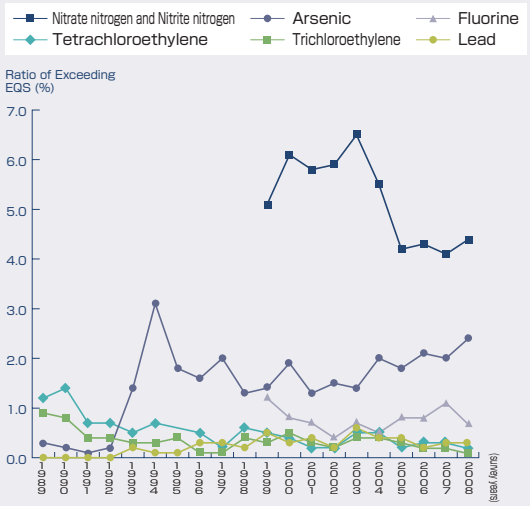
Note 2: Achievement rate (%) = $\left(\frac{\text{The number of water areas applicable}}{\text{The number of water areas achieving the standards}} \right) \times 100$

Source: "Measurement results of the quality of public water areas in FY2008," Ministry of the Environment

which can cause severe sunburn in humans (Figure 1-2-4). The problem of dust and sandstorms, also known as Asian dust, is increasingly frequent and harmful across the Northeast Asia. The number of days it was observed in Japan has increased in recent years, but the long-term trend remains unclear due to large annual variation (Figure 1-2-5).

Regarding Japan's air pollution status, constant monitoring were conducted at 1,549 Ambient Air Pollution Monitoring Stations ("AAPMSs") and at 438 Roadside Air Pollution Monitoring Stations ("RAPMSs"), in total 1,987 monitoring stations nationwide as of year-end FY2008. In FY2008, with regard to photochemical oxidants, one of the substances for which Environmental Quality Standards (EQS) have been set, achievement rate of EQS was very low (0.1% for AAPMSs and 0% for RAPMSs). Further countermeasures are required to address air pollution conditions (Figure

Figure1-2-11 Changes in Rates of Exceeding EQS for Ground Water Pollution(General Survey)



Note 1: The general survey is conducted by measuring different wells each year (they are not measuring the same wells every year)
2: The EQS for ground water pollution were established in 1997, and standards prior to that time were regarded as assessment standards. In addition, in 1993, the assessment standard for arsenic was reduced from "0.05mg/l or less" to "0.01mg/l or less" and the assessment standard for lead was reduced from "0.1mg/l or less" to "0.001mg/l or less."
3: Nitrate nitrogen, nitrite nitrogen, fluorine, and boron were added to the EQS in 1999.
4: This figure shows only the items that had relatively high rates of exceeding the EQS
Source: FY2008 Ground Water Quality Measurement Results," Ministry of the Environment

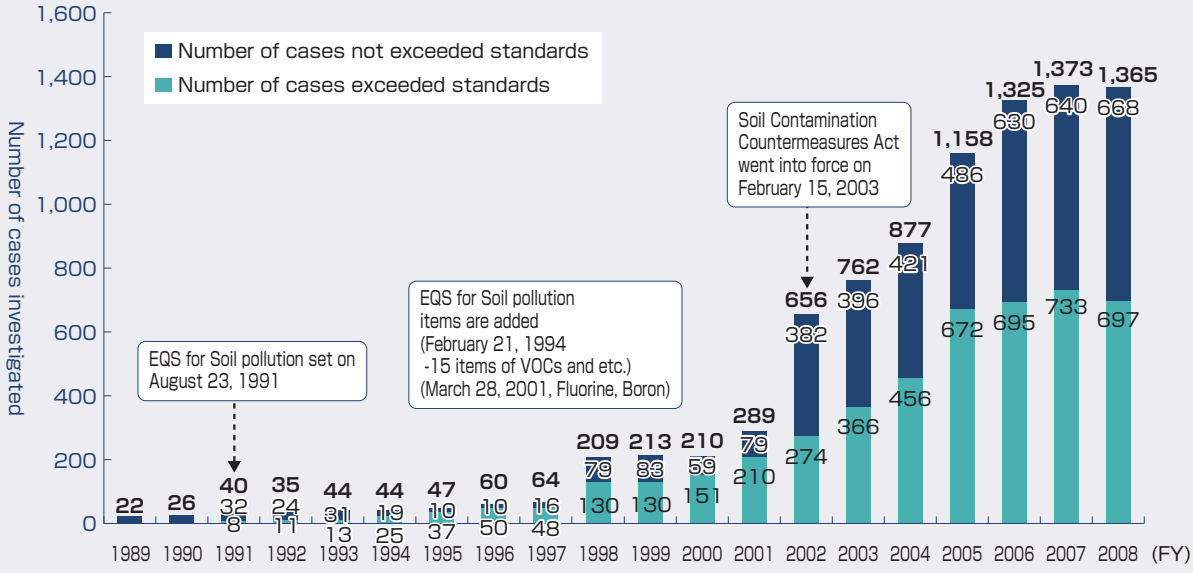
1-2-6). Photochemical oxidant alarm is issued when concentration of this substance exceeds EQS. This alarm was issued on 123 days in FY2009, slightly fewer than the 144 days in FY2008 (Figure 1-2-7).

In terms of nitrogen dioxide, EQS levels were achieved at almost all AAPMSs in recent years. In FY2006, FY2007 and FY2008, EQS levels were achieved at all AAPMSs and in 2008 EQS levels were achieved at 95.5% of RAPMSs (Figure 1-2-8). For suspended particulate matter, 99.6% of the AAPMSs and 99.3% of the RAPMSs met EQS levels. These values were improved compared to those of FY2007 (Figure 1-2-9).

Turning to the water environment, almost all points achieved EQS levels for substances related to human health protection (health items), from among the water pollution related EQS. But among the items pertaining to the living environment (living environment items), the EQS levels for chemical oxygen demand (COD) in lakes was achieved only 53.0% of the time. Due to conditions such as excessive organic matter, there still remain water areas with a low achievement rate (Figure 1-2-10). Furthermore, EQS levels for nitrate nitrogen and nitrite nitrogen are still often exceeded in groundwater (Figure 1-2-11).

Next, turning to the soil environment, in recent years there has been an increase in the number of verified soil contamination incidents. In FY2008, there were 697 verified incidents in which contamination exceeded EQS levels for soil pollution or the standards designated in the Soil Contamination Countermeasures Act (Act No. 53 of 2002) (Figure 1-2-12).

Figure1-2-12 Number of Verified Incidents of Soil Contamination for Individual Years



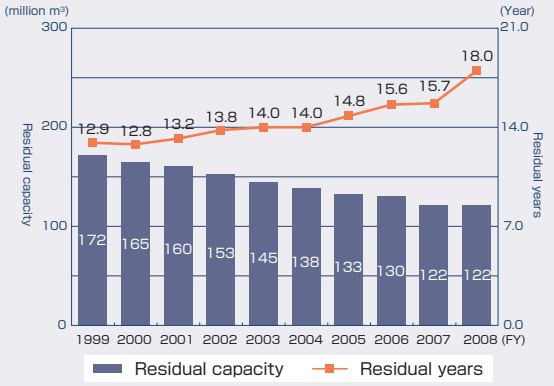
Source: "FY2008 Survey Results on Enforcement Status of Soil Contamination Countermeasures Act and Cases of Soil Contamination Status Survey and Countermeasures," Ministry of the Environment

3 Status of Waste Generation

Past socioeconomic activities based on mass production and mass consumption are thought to be linked to the resulting massive amounts of waste materials. Environmental protection and appropriate cycling of materials are critically needed.

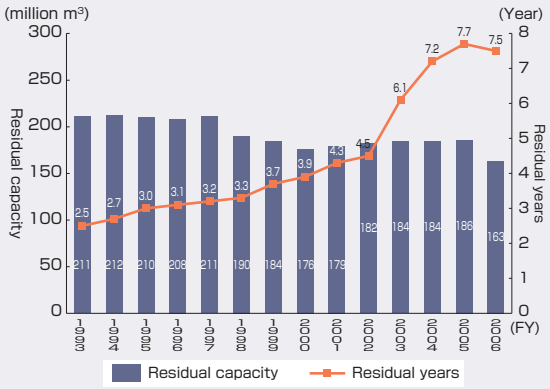
The residual years of final waste disposal sites, an important indicator of waste, stood at 18.0 years for municipal solid waste and at 7.5 years for industrial

Figure1-3-1 Changes in Residual Capacity and Residual Years at Final Disposal Sites(Municipal Solid Waste)



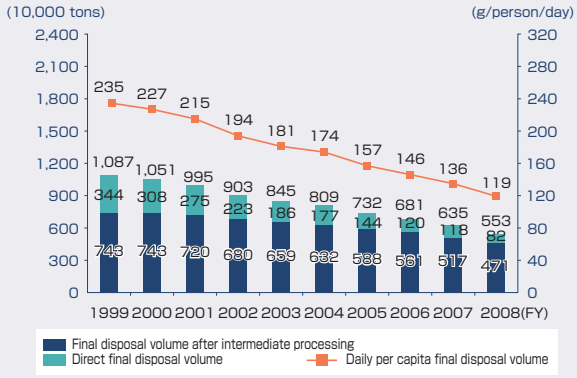
Source: Ministry of the Environment

Figure1-3-2 Changes in Residual Capacity and Residual Years in Final Disposal Sites (Industrial Waste)



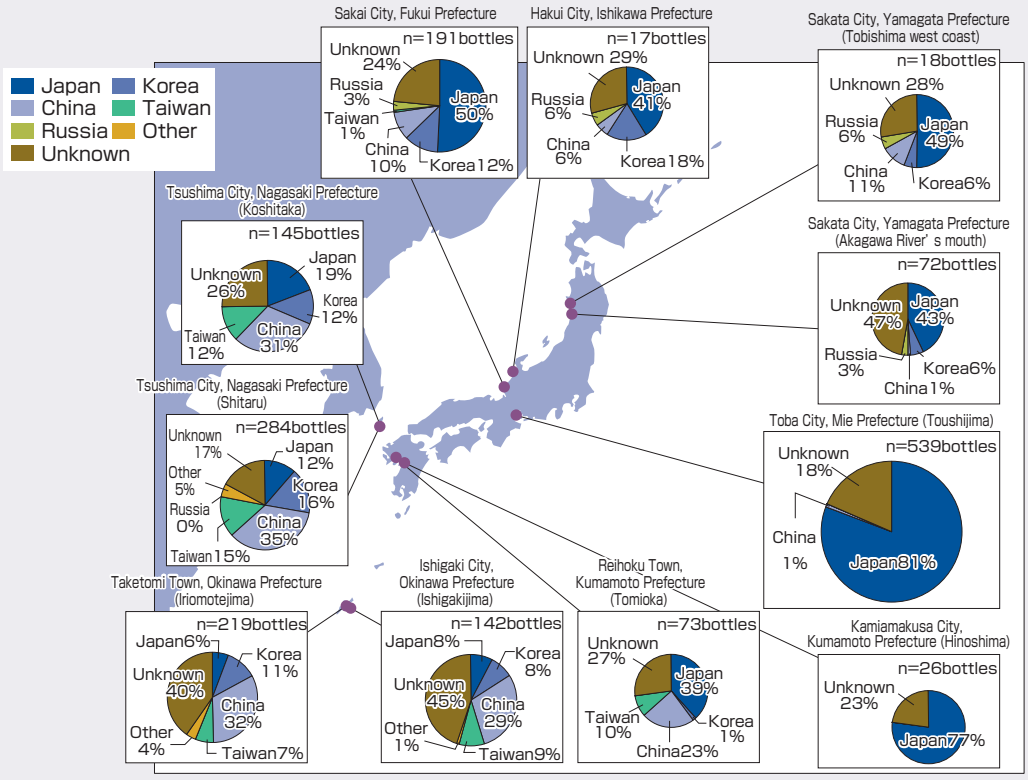
Source: Ministry of the Environment

Figure1-3-3 Changes in Final Disposal Volume and Daily per Capita Final Disposal Volume



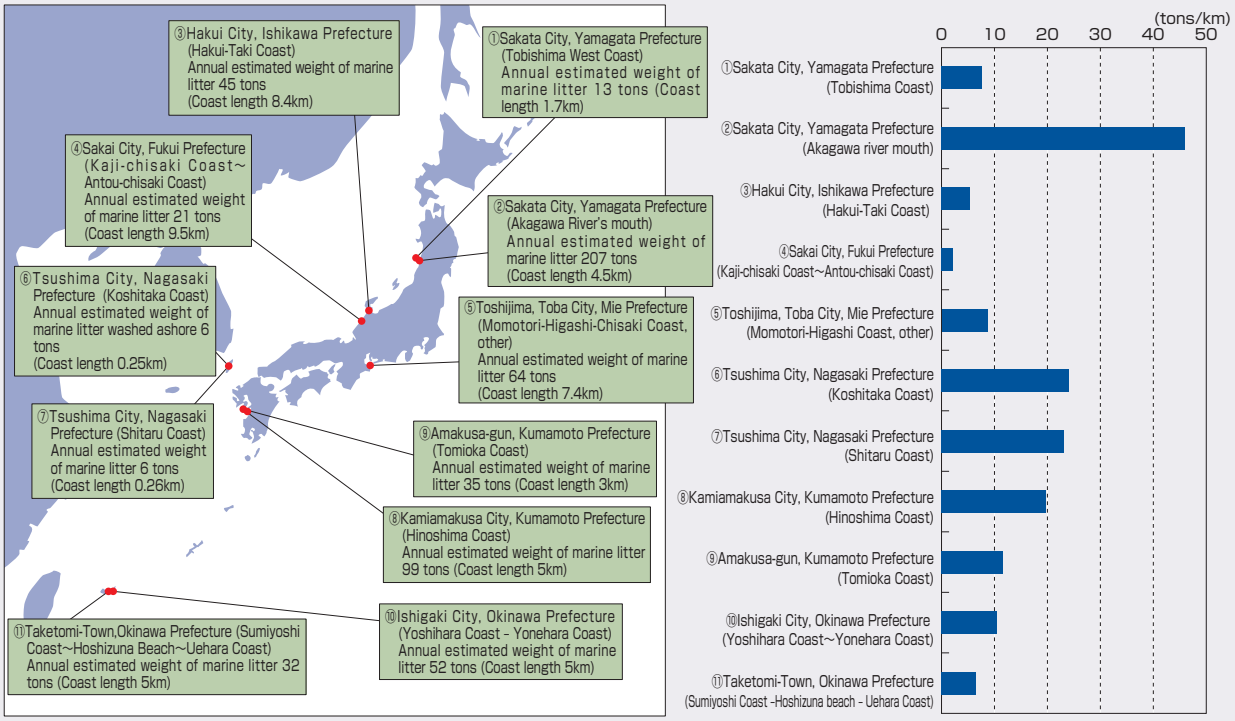
Source: Ministry of the Environment

Figure1-3-4 Country-Specific Aggregate of Plastic Bottle



Source: "FY2007, 2008 Surveys of Drifting and Marine Litter, and Japan Reduction Policy Model," Ministry of the Environment

Figure1-3-5 Annual Estimated Volumes of Marine Litter



Source: "Model Surveys in FY2007 · 2008 for Reducing Marine Litter in Japan," Ministry of the Environment

waste as of the end of FY2008, due to the growing difficulty of securing new disposal sites. The tough situation continues (Figures 1-3-1, 1-3-2).

About 5.53 million tons of municipal solid waste were deposited in final disposal sites in FY2008 (total of waste directly deposited in final disposal sites plus waste that underwent intermediate processing prior to disposal), and the final disposal volume was 119 grams per person per day (Figure 1-3-3). The per capita waste volume continues to decline.

To understand current situation of marine litter issue, which is a serious problem in coastal zone of Japan, a set of on-the-spot survey was conducted in 2007 and 2008 at model areas on 11 coasts in 7 prefectures nation wide. PET bottles collected by the surveys on Tsushima in Nagasaki prefecture, Ishigakijima and Iriomotejima islands in Okinawa prefecture, and other outlying islands were almost entirely of foreign origin, while half or more of the bottles found in other areas were from Japan (Figure 1-3-4). The litter characteristics varied by region. For example, plastic material comprised 30% to 40% of the litter found on the Japan Sea coasts, drift wood and brush comprised 70% to 90% in Yamagata, Mie, and Kumamoto prefectures, and a diverse mix was found in Okinawa prefecture. In addition, Figure 1-3-5 shows the estimated annual marine litter volume based on the marine litter surveys conducted throughout one year.

4 Statuses of Chemical Substances and Environmental Risks

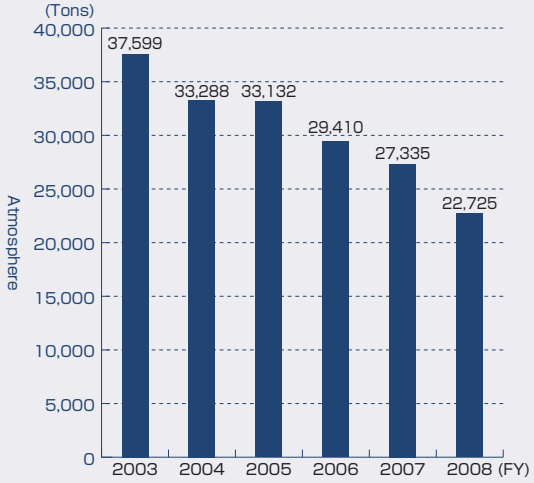
We are surrounded by various chemical substances and products containing chemical substances. They make our

Table1-4-1 FY2008 Hazardous Air Pollutants Environmental Quality Standards Achievement Status

Substance name	Number of monitoring points	Number of monitoring points exceeding EQS	Average value at all monitoring points (annual average value)	EQS (annual average value)
Benzene	451 [459]	1 [3] monitoring points	1.4 [1.5] $\mu g/m^3$	3 $\mu g/m^3$ or less
Trichloroethylene	399 [399]	0 [0] monitoring points	0.65 [0.76] $\mu g/m^3$	200 $\mu g/m^3$ or less
Tetrachloroethylene	399 [395]	0 [0] monitoring points	0.23 [0.25] $\mu g/m^3$	200 $\mu g/m^3$ or less
Dichloromethane	397 [402]	0 [0] monitoring points	2.3 [2.3] $\mu g/m^3$	150 $\mu g/m^3$ or less

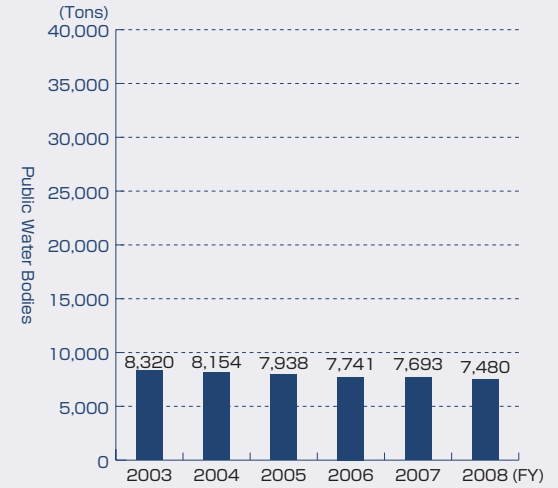
Note 1: The annual average value is the average of the measured values taken once a month, or at least 12 times per year
Note 2: Values in brackets [ ] are actual results from FY2007
Source: FY2008 Report on the State of Air Pollution (Hazardous Air Pollutants Monitoring Research Results), Ministry of the Environment

Figure1-4-1 Release Amounts into the Air of Substances for which EQS or Guideline Values were Set, from among Substances Subject to the Law for PRTR



Source: Produced by the Ministry of the Environment from PRTR (Pollutant Release and Transfer Register) Data Overview

Figure1-4-2 Release Amounts to Public Water Bodies of Substances for which EQS or Guideline Values were Set, from Among Substances Subject to the Law for PRTR



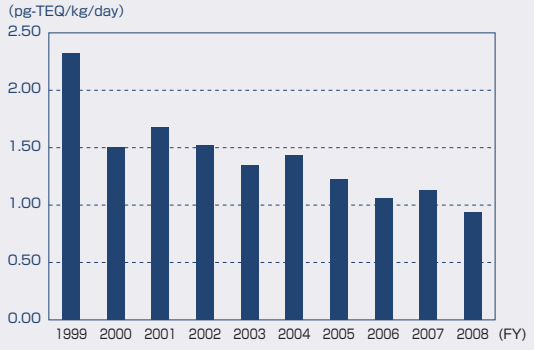
Source: Produced by the Ministry of the Environment from PRTR Data Overview

Table1-4-2 FY2007 Environmental Conditions Survey of Chemical Substances related to PCBs (Table of Detection Status)

Water (ng/L)	Sediments (ng/L)	Living organisms (ng/L)	Atmophere (ng/L)
0.18 [0.0029]	6.1 [0.0015]	8.47 [0.018]	0.16 [0.00013]

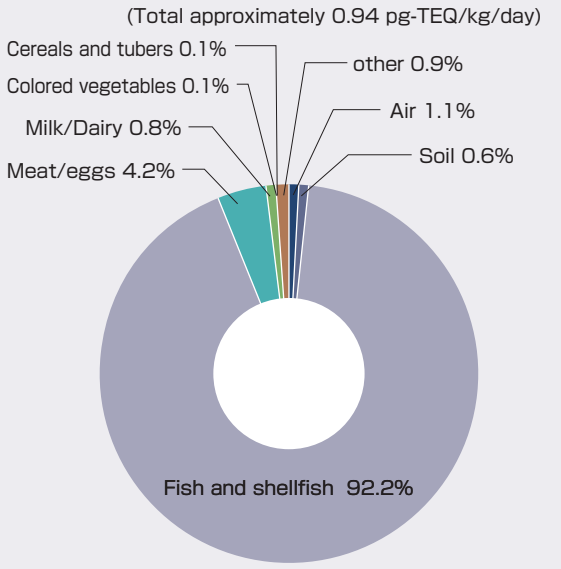
Note 1: Numeric values are rounded average values, and when the lower detection threshold is not reached, ½ of the lower detection threshold is used as the value for calculation
2: The values in brackets [ ] are the lower detection thresholds (total values of each homologue)
3: Shellfish, fish, and birds were taken in equal amounts
4: The air samples were taken half in warm season and half in the cold season
Source: FY2008 Edition "Chemical Substances and the Environment"

Figure1-4-3 Changes in Per Capita Daily Intake of Dioxins in Japan



Note: TEQ/kg/day was converted to daily per capita intake volume of dioxins per 1kg of body weight.
Source: Produced by the Ministry of the Environment from materials of the Ministry of Health, Labor, and Welfare and of the Ministry of the Environment

Figure1-4-4 Daily Per Capita Dioxin Intake Volume in Japan (FY 2008)



Source: Produced by the Ministry of the Environment from materials of the Ministry of Health, Labor, and Welfare and of the Ministry of the Environment

lives convenient. However, because some chemical substances are harmful to human health or ecosystems, the environmental risk (possible interference with environmental conservation) of chemical substances must be associated and appropriate measures must be taken.

The FY2008 Hazardous Air Pollutants Monitoring Research results are listed in Table 1-4-1. The table shows the annual average value, the numbers of monitoring points exceeding Environmental Quality Standards (EQS) values, for four substances whose EQS values are set. With regard to Benzene, the results of monitoring at only 1 monitoring point exceeded EQS values (in FY2007 the number of monitoring points at which the results exceeded EQS values were 3). Regarding other three substances, monitoring results at all monitoring points met the EQS in 2007 and 2008.

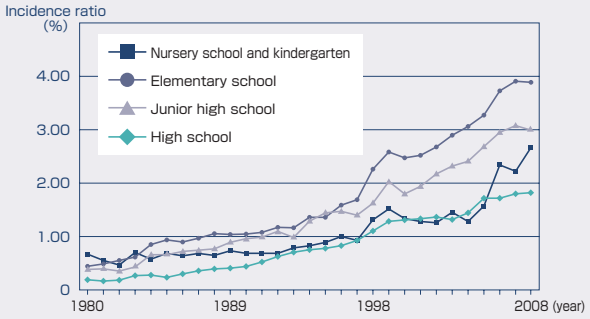
As for the release amounts of chemical substances, a total of around 22,700 tons of specific substances were released into the air in FY2008, which represents a declining trend (Figure 1-4-1). These substances are those for which environmental quality standards or guideline values were set, from among the substances subject to the law for PRTR (Pollutant Release and Transfer Register) (Act No.86 of 1999). The same year, release amounts of such substances into the public water bodies totaled about 7,500 tons, continuing the previous downward trend (Figure 1-4-2).

The manufacture, import, and use of high environmental risk substances are banned. PCBs are one example among them. It has an environmental concentration of the equivalent of 0.18 ng/L in water (Table 1-4-2). From the

findings of the FY2008 survey, it is estimated that the average dioxins intake from food and the environment per capita per day is around 0.94pg-TEQ per 1kg of body weight. This numeric value is not far removed (in terms of g/L) from the declining trend of previous years, and is less than the tolerable daily intake (Figures 1-4-3, 1-4-4).

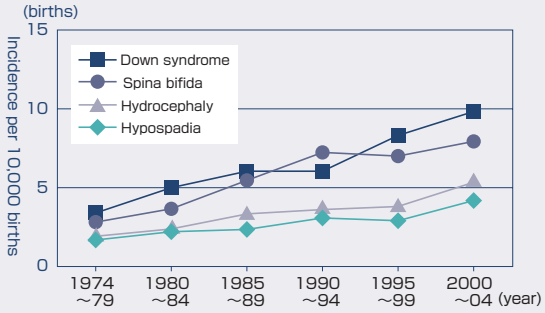
The deterioration in children's health in various countries has been reported in recent years (Figure 1-4-5, 1-4-6). In an ongoing effort, investigators are attempting to establish a clear relationship between health and the surrounding environmental conditions. In Japan, the Japan Environment & Children's Study was officially launched in FY2010 to survey and track children continuously from birth to age around 13 in an attempt to prevent environmental factors from adversely impacting children's health.

Figure1-4-5 Changes in Asthma Incidence among Japanese Children



Source: "School Health Statistics" published by the Ministry of Education, Culture, Sports, Science and Technology, "MEXT")

Figure1-4-6 Changes in Birth Defects Incidence in Japan



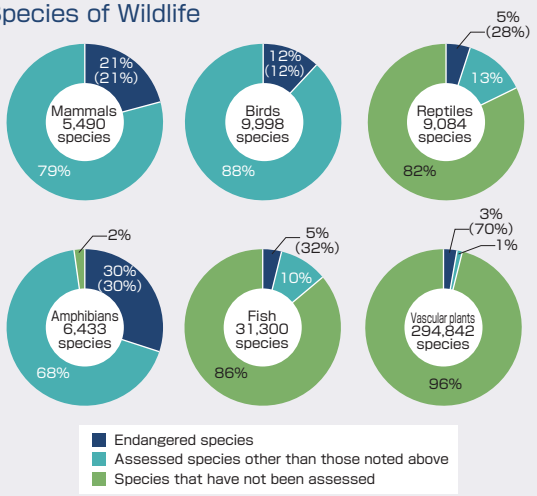
Source: International Clearinghouse for Birth Defects Surveillance and Research(ICBDSR)

5 Status of Biodiversity

(1) Status of Global Biodiversity

It is said that the earth holds around 30 million species of living organisms, including those unknown to science. Among them, we know only around 1.75 million. The Red List of threatened species published in November, 2009 by the International Union for the Conservation of Nature (IUCN) shows that 17,291 species out of the 47,677 assessed species of wildlife, or around 36% of the total species evaluated, are identified as endangered

Figure1-5-1 Global Proportion of Endangered Species of Wildlife



Note 1: Endangered species are designated as Critically Endangered (CR), Endangered (EN), or Vulnerable (VU).
2: The center of each round graphs is the already-known number of species in each individual taxonomic group
3: In parentheses is percentage of endangered species within the number of assessed species
4: Vascular plants are a total of the ferns, gymnosperms, and angiosperms that appear in the IUCN Red List categories.

Source: Produced by the Ministry of the Environment from the IUCN "Red List 2009"

Figure1-5-2 Trends shown by agreed indicators of progress towards the 2010 Biodiversity Target in the Global Biodiversity Overview, Third Edition (GBO-3)

Priority areas	Headline indicators	Indicator changes
Status and trends of the components of biological diversity	Trends in extent of selected biomes, ecosystems, and habitats	↙
	Trends in abundance and distribution of selected species	↙
	Changes in status of threatened species	↙
	Trends in genetic diversity in domesticated animals, cultivated plants, and fish species of major socio-economic importance	↙
	Coverage of specified protected areas	↗
Ecosystem integrity and ecosystem goods and services	Marine Trophic Index	↕
	Connectivity-fragmentation of ecosystems	↙
	Water quality of aquatic ecosystems	↕
Threats to biodiversity	Nitrogen deposition	↗
	Trends in invasive alien species	↗
Sustainable use	Area of forest, agricultural and aquaculture ecosystems under sustainable management	↕
	Ecological footprint and related concepts	↗
Status of traditional knowledge, innovations and practices	Status and trends of linguistic diversity and number of speakers of indigenous languages	↙
Status of access and benefit sharing	Indicator of Access and benefit sharing to be developed	?
Status of resources transfers	Official development assistance (ODA) provided in support of the Convention	↗

↙↗ : Negative changes
↗ : Positive changes
↕ : No clear global trend. Positive and negative changes are occurring depending on the region or biome considered
? : Insufficient information to reach a definitive conclusion

Source: Produced by the Ministry of the Environment from the "Global Biodiversity Outlook" (GBO-3) published by the Secretariat of the Convention on Biological Diversity

species. Among them, amphibians, mammals, and birds, for which evaluations are relatively advanced when compared to other taxa, comprise 30%, 21%, and 12% respectively of the endangered species (Figure 1-5-1).

The Global Biodiversity Outlook 3 (GBO-3) published by the Secretariat of the Convention on Biological Diversity (CBD) in May, 2010, concluded that the "2010 Biodiversity Target" of the CBD, adopted at the 6th meeting of the Conference of the Parties (COP6) to the CBD, namely, "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global" had not been achieved (Figure 1-5-2). In addition, GBO-3 points out that ongoing habitat changes, overfishing, indiscriminate development, pollution, invasive alien species, and the effects of climate change contribute to tropical forest reduction, lake and marsh eutrophication, ocean temperature rises, and fishery resource overfishing, and that these will threaten human existence in the future.

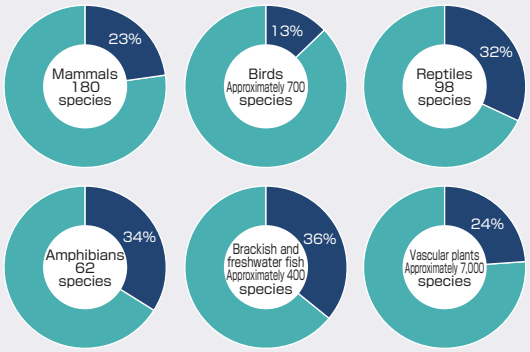
(2) Status of Biodiversity in Japan

Japan is bounded on all sides by water, and consists of an archipelago of over 6,800 islands. Japan's land area totals around 380,000km^2 and coastline measures around 35,000km, a length nearly 90% of the earth's circumference. Another of Japan's unique features is its complex topography from the sea coast up through its mountainous regions. The entire country is blessed with abundant precipitation and most of its regions have four seasons. Numerous and diverse climate zones, from subarctic to subtropical, exist along Japan's 3,000km north-south length and its 3,800m elevation differential. The diverse natural environments harbor around 90,000 species of wildlife, and around 40% of land mammals and 80% of amphibians have been confirmed as native to Japan. According to the Ministry of the Environment's Red List, 3,155 endangered species are listed. Over 30% of the reptile, amphibian, brackish and freshwater fish, and shellfish species in Japan, over 20% of the mammal and vascular plant species, and over 10% of the bird species are endangered (Figure 1-5-3).

The Japan Biodiversity Outlook issued in May, 2010, by the Ministry of the Environment's Japan "Biodiversity Outlook Science Committee" assessed the condition of Japan's biodiversity over the past 50 years, and found that biodiversity loss extends to all ecosystems and that the trend is continuing even today. In particular, the biodiversity of rivers, lakes and marshes, seacoasts, maritime environments, and islands has been greatly lost over these 50 years, and there is a risk that today's ongoing impacts will become irreversible in the future (Table 1-5-1).

One primary cause of widespread species loss was the impact of the "First Crisis" (development, direct use, and water pollution)" midway during the period of rapid development that occurred from the 1950s through the 1970s, although the rate of species loss has slowed somewhat at present. On the other hand, the "Second Crisis" (diminished use and management of Satochi-Satoyama (rural landscapes)) is now softly having a widespread impact. In addition, during the currently unfolding "Third Crisis" (alien species and chemical substances), the impact of alien species has become notable. Finally, the threats of global warning are of particular concern for high mountains, coral reefs, and islands.

Figure 1-5-3 Proportion of Endangered Species of Wildlife in Japan (Ratio of Species Assessed)



Note 1: The center of each round graph contains the number of species (including subspecies) assessed from that taxonomic group according to "A List of Wildlife Species in Japan" edited by the Environment Agency in 1993, 1995, and 1998
Note 2: Vascular plants are the total number of species assessed by the Japanese Society for Plant Systematics
Source: Ministry of the Environment

Table 1-5-1 Japan's Losses of Biodiversity from the Latter Half of the 1950s through 2010

	Loss status and trends		Drivers of losses (magnitude of impact) and current trends			
	Degree of losses from original ecosystems	Degree of losses relative to conditions in the latter half of the 1950s, and current trends	First crisis: Development, direct use, and water pollution	Second crisis: Diminished use and management	Third crisis: Invasive alien species and chemical compounds	Crisis of Climate Change
Forest ecosystems	■	→	◔	◔	◔	◔※
Agricultural ecosystems	–	↘	◔	◔	◔	◔
Urban ecosystems	–	→	◔	–	◔	◔
Inland water ecosystems	■	↘	●	◔	●※	◔
Marine and coastal ecosystems	■	↘	●	–	◔※	◔
Island ecosystems	■	↘	●	–	●	◔

Assessment targets		Legend			
States	Size of current losses	Not lost	Not significantly lost	Lost	Significantly lost
	Trends of current losses	Recovering ↗	Holding steady →	Being lost ↘	Being rapidly lost ↓
Drivers	Magnitude of the impact during assessment period	Weak ○	Moderate ◔	Strong ◔	Very strong ●
	Current trends of the driver's impact	Decreasing ↖	Holding steady ←	Increasing ↙	Increasing rapidly ↓

Note 1: A dotted line indicates there is insufficient data to assess the magnitude of the impact
2:※indicates that the factors and data used to assess each indicator are complex. Therefore, it is particularly necessary to bear in mind that there exist some factors and data contrary to the overall impact, size of losses, and trends assessment.
Source: "Japan Biodiversity Outlook" produced by the Japan Biodiversity Outlook Science Committee

CHALLENGE 25

Chapter 2 Responsibility of the Present Generation to Quickly Deal with Global Warming —Challenge 25—

Section 1 Increasing Damage from Global Warming

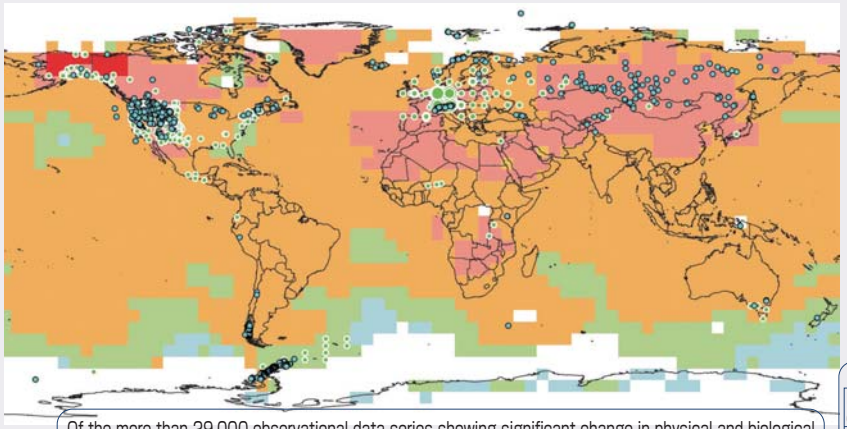
1 The Damage Currently Occurring

Efforts to accumulate scientific knowledge about global warming have been led by the Intergovernmental Panel on Climate Change (IPCC), established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) to make a comprehensive assessment of anthropogenic climate change, its impacts, and adaptation to and mitigation of it from scientific, technical and socio-economic perspective. The Synthesis Report of the IPCC's Fourth Assessment Report: Climate Change 2007, its latest report, states in the Summary for Policymakers: "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level" (Figure 2-1-1).

Among events likely to be due to the effects of global warming are reduced snow and ice in polar regions and highlands, increases in wildfires and droughts, and an increase in intense tropical cyclone activity, etc. For example, annual average article sea ice extent has shrunk by 2.7 [2.1-3.3] % per decade, with larger decreases in summer of 7.4 [5.0-9.8] % (Numbers in square brackets indicate a 90% uncertainly interval around a best estimate).

We can observe the diminishing trend of sea ice in Figure 2-1-2. Figure 2-1-4 shows the satellite observation results of sea ice in the Arctic region in September 1979 and September 2007, indicating that the sea ice area dwindled to its smallest size on record in 2007. The IPCC Fourth Assessment Report noted that in some projections, "Arctic late-summer sea ice disappears almost entirely by the latter part of the 21st century."

Figure2-1-1 Correlation between Changes in Physical and Biological Systems*2 Observed Globally*1 and Warming



North America		Latin America		28,115 Europe		Africa		Asia		Australia/ New Zealand		Polar regions		28,586 Terrestrial		Marine and freshwater		28,671 Global	
355	455	53	5	119		5	2	106	8	6	0	120	24	764		1	85	765	
94%	92%	98%	100%	94%	89%	100%	100%	96%	100%	100%	–	91%	100%	94%	90%	100%	99%	94%	90%

"Polar regions" include also observed changes in marine and freshwater biological systems. "Marine and freshwater" includes observed changes at sites and large areas in oceans, small islands and continents. Locations of large-area marine changes are not shown on the map.

*1: Observation results were obtained from a subset of about 29,000 data series (from about 75 studies), selected from about 80,000 data series from 577 studies. These data series were selected by the following criteria: (1) ending in 1990 or later; (2) spanning a period of at least 20 years; and (3) showing a significant change in either direction.

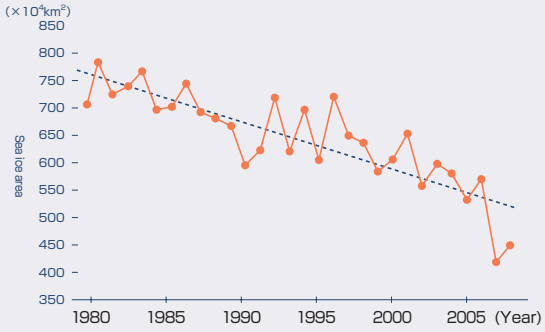
*2: Physical systems mean physical events related to ice, snow, frozen ground, hydrology and coastal areas, while biological systems mean events related to terrestrial, marine and freshwater living matter.

Source: IPCC, Summary for Policymakers, Synthesis Report, Fourth Assessment Report: Climate Change 2007

A study on wildfires by the University of California, et al, and referenced by the IPCC Fourth Assesment Report found that since the 1970s, wildfires in the western United States increased in years when temperatures from spring to summer increased by about 2 degrees Celsius. Thus, large wildfires increased suddenly since the mid-1980s, and it has been reported that the frequency of wildfires is about four times and the forested area burned from 1987 to 2003 is 6.7 times the area from 1970 to 1986.

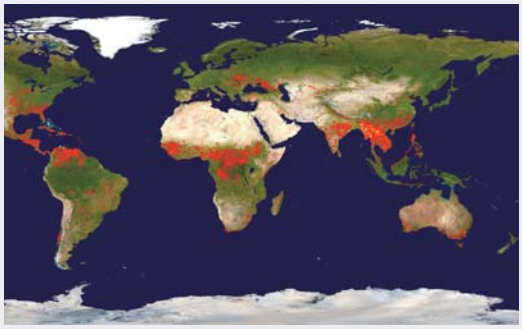
There are various causes of wildfires including temperature rises, which are due in part to global warming, droughts and precipitation patterns. Statistics of the U.S. National Aeronautics and Space Administration (NASA) show that up to about 500,000 square kilometers (=50 million hectares) of forests have been burned a year (Figure 2-1-5). It amounts to seven times the annual net reduction of the forest area of about 7.30 million hectares including increase of area by

Figure2-1-2 Change in Annual Minimum Extent of Arctic Sea Ice Over Time (1979-2008)



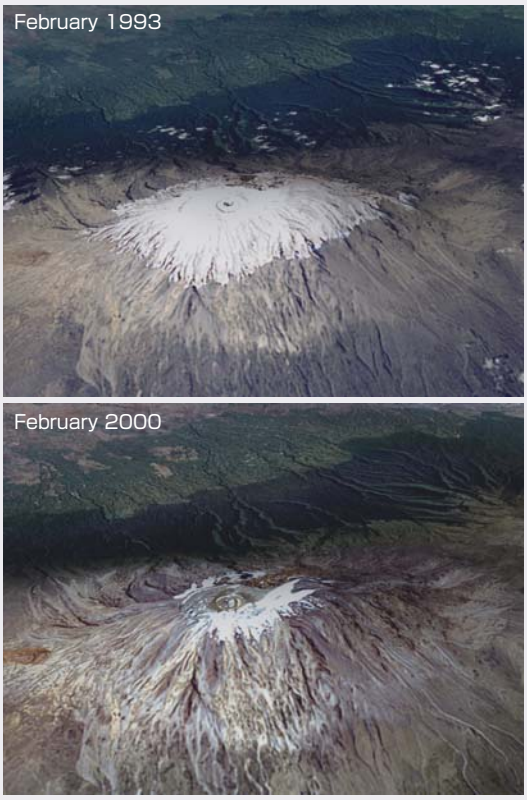
Note: The dotted line indicates the linear trend.
Source: The Japan Meteorological Agency website

Figure2-1-5 Fires in the World Detected by Satellite (MODIS) (March 22-31, 2010)



Source: Moderate Resolution Imaging Spectroradiometer (MODIS) Rapid Response System Global Fire Map (http://rapidfire.sci.gsfc.nasa.gov/firemaps/)

Figure2-1-3 Changes in Glaciers and Snow Cover on Kilimanjaro

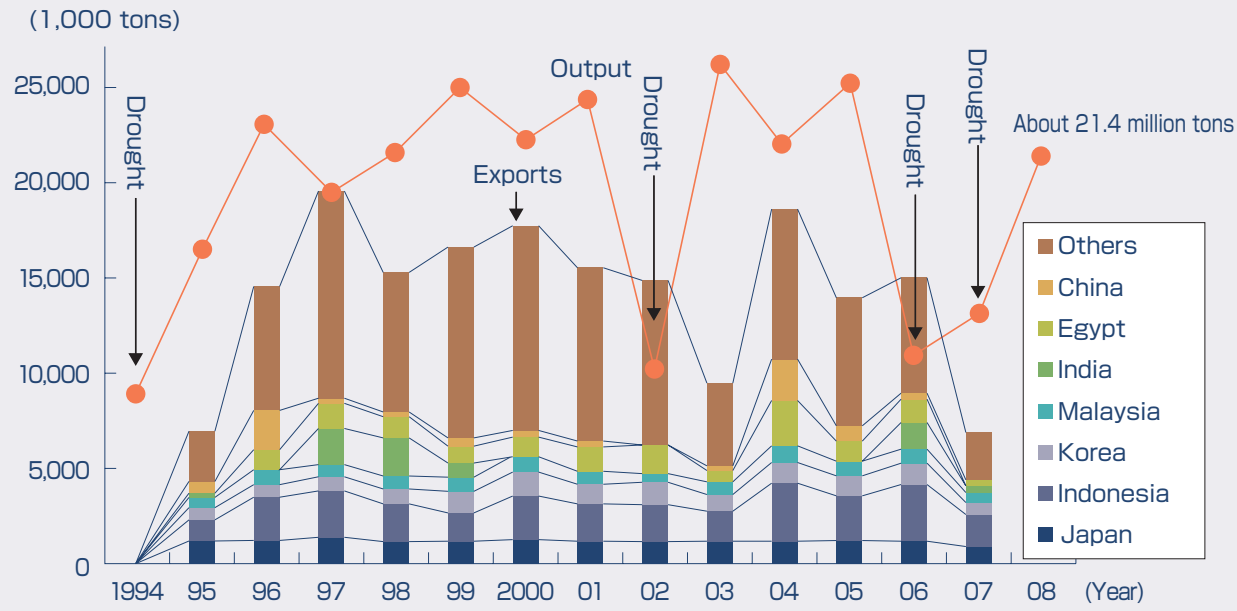


Source: NASA
(http://earthobservatory.nasa.gov/IOTD/view.php?id=3054)

Figure2-1-4 Comparison of Satellite-Observed Arctic Sea Ice between September 1979 and September 2007 Lowest Levels in Satellite Observation Records

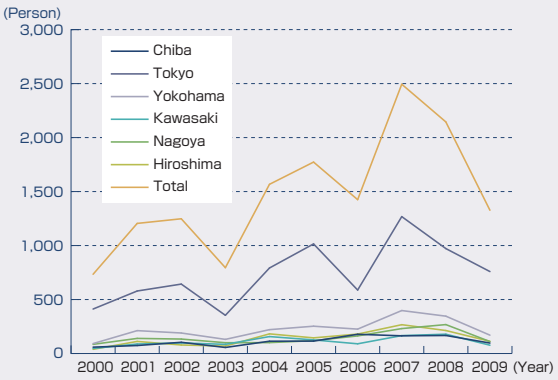
Note: The sea ice distribution was observed in 1979 by NASA's Scanning Multichannel Microwave Radiometer (SMMR) and in 2007 by JAXA's Advanced Microwave Scanning Radiometer for EOS (AMSR-E).
Source: Japan Aerospace Exploration Agency

Figure2-1-6 Wheat Output and Exports of Australia



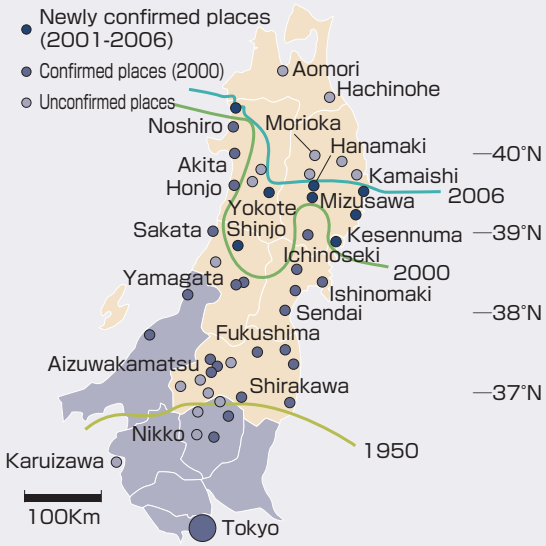
Source: Trade statistics of respective countries, U.S. Department of Agriculture, "Production, Supply and Distribution (PS&D) (2009.08)"

Figure2-1-7 Annual Trends of Heat Stroke Patients by Region



Source: National Institute for Environmental Studies (NIES)

Figure2-1-8 Shift in the Northern Limit of the Distribution of Tiger Mosquitoes



Source: Kobayashi, M., Komagata O., Nihei N., 2008: Global warming and vector-borne infectious diseases, J. Disast. Res, 3(2), 105-112. Fig.2

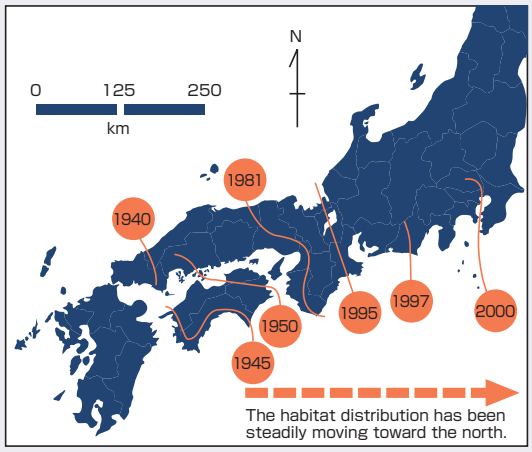
afforestation, restoration of vegitations and natural recovery of forests. Furthermore, the U.S. National Center for Atmospheric Research (NCAR) estimates that forest fires in the mainland United States and Alaska emitted about 290 million tons of carbon dioxide a year. According to the IPCC Fourth Assessment Report, annual global carbon dioxide emissions due to wildfires are estimated at 6.2 billion to 15.0 billion tons. In Australia, droughts have been occurring frequently since the turn of the century, causing large fluctuations in wheat crops (Figure 2-1-6).

In Japan, various events that are potentially attributable in part to the global warming have already been occurring, including an increase in heat stroke patients, expansion of distribution area of the Asian tiger mosquitoes that transmit dengue fever, etc., phenomena in which the distribution of living creatures shifts northward or to higher altitudes, and reduction in quality of rice and fruits.

Regarding heat stroke, there have been reports on increases in the number of patients, with many cities registering record numbers of heat stroke patients in 2007 (the number of people carried to medical institutions by ambulances) (Figure 2-1-7).

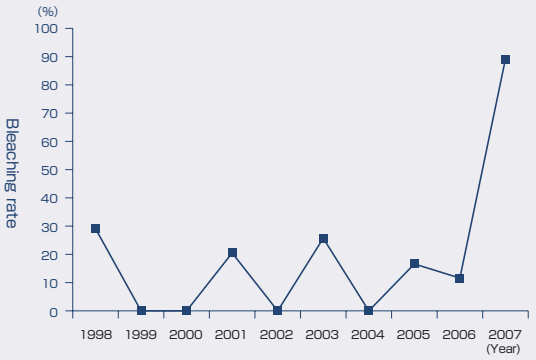
As one development that could affect human health, the expansion of mosquitoes that transmit infectious diseases has also been confirmed. The annual average temperature of about 11 degrees Centigrade is believed to be one of conditions for the habitat of tiger mosquitoes. In the 1950s, Tochigi Prefecture was the northern limit of the habitat distribution of tiger mosquitoes, but in the 2000s, the habitat distribution is confirmed to have expanded to the northern part of the Tohoku region (Figure 2-1-8).

Figure2-1-9 Shift to the North of the Habit Distribution of Great Mormons



Source: Masahiko Kitahara, "Expansion of the Range of Butterflies and Global Warming," 2008, Insects and Nature

Figure2-1-10 Coral Reef Bleaching Rate in Sekisei Lagoon



Note: The average for survey points with continuous data series (26 points)
Source: Ministry of the Environment

Figure2-1-11 Lower Quality of Rice due to Immature White Grains

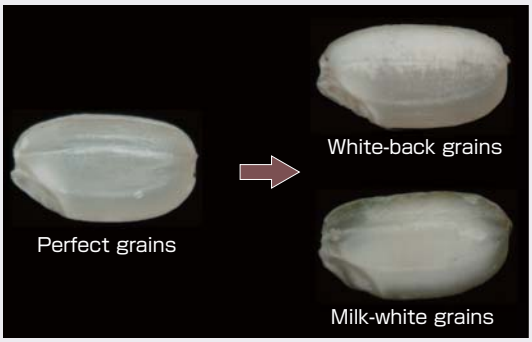


Photo: Satoshi Morita, Senior Researcher, National Agricultural Research Center for Kyushu Okinawa region (KONARC)

Figure2-1-12 Sunburn Mandarin Oranges

Photo: Citrus Breeding and Physiology Research Team, National Institute of Fruit Tree Science, National Agriculture and Food Research Organization (NARO)

As for the impacts on living organisms, there have been reports on the shift of the habitat distribution to the north or to higher altitudes. For example, the habitat distribution of great Mormons, which are said to need the average temperature of around 15 degrees Centigrade at the northern limit of the habitat, has been confirmed to move toward the north from the 1950s to the 2000s (Figure 2-1-9). The decline of alpine plant communities and bleaching of coral reefs have also been confirmed (Figure 2-1-10).

Looking further at the impacts on agricultural products, high temperatures are causing immature white grains (whitened brown rice) and body cracks (cracked brown rice) in rice and sunburned mandarin oranges (Figure 2-1-11, 2-1-12).

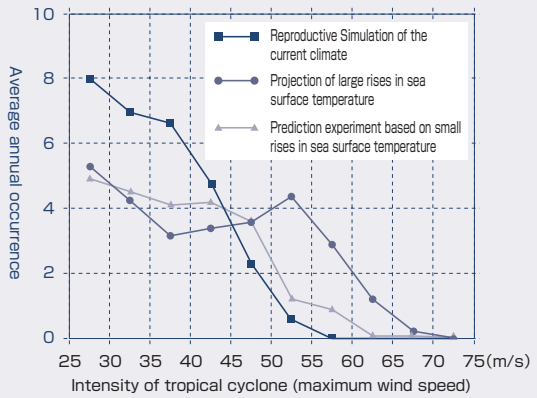
It is difficult to determine whether these events have been caused by global warming or by short-run, sporadic high temperatures. It is because that over the long term, the average temperature across Japan has risen about 1.1 degrees Centigrade in the past century, but in the short run, in 2004, the average temperature increased 1.00 degree Centigrade over the average year. It is believed that even when the above-mentioned events have been caused directly by short-term high temperatures, long-term global warming is also likely to have played a key role.

2 The Damage Expected in the Future

In recent years, studies on future projections of global warming have made strides and we are now able to envision what the earth will be like 50 years or 100 years later, though with a measure of uncertainty. In this subsection, we address the increase in powerful typhoons, the frequency of heavy rains, the rise in sea level and the increase or decrease in sweltering nights and frost days as symptoms of climate change, and the reduction in suitable habitats for beech forests and the expanding areas at risk of pine wilt as examples of the ill effects of global warming.

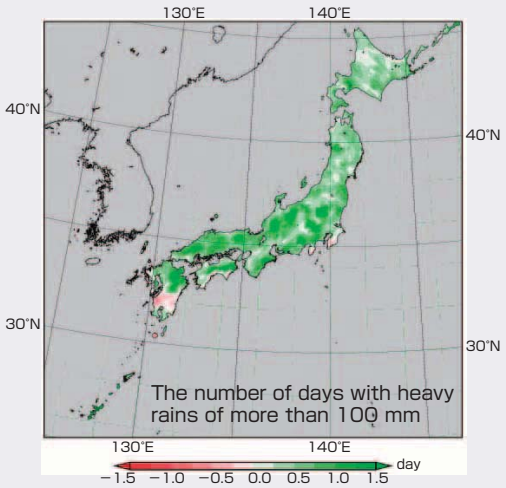
Regarding the future forecast of typhoons, the reproducibility of typhoons has improved with the use of the high-resolution atmospheric global climate model, and the reliability of change forecasts for typhoons has been enhanced. The use of this model indicates that while the total number of tropical cyclones generated in association with global warming will decline, the number of "extremely strong (the maximum wind speed of 44 m/s or more)" tropical cyclones will increase globally, accompanied by heavier rains (Figure 2-1-13). Forecasts of the frequency of heavy rains by the high-resolution regional climate model also show that comparison between two decades of the late 20th century and two decades in the late 21st century indicates that the number of days with heavy rains of more than 100 mm per day

Figure2-1-13 Frequency Distribution of the Average Number of Tropical Cyclones per Year by Intensity of Tropical Cyclones in Global Warming Simulations



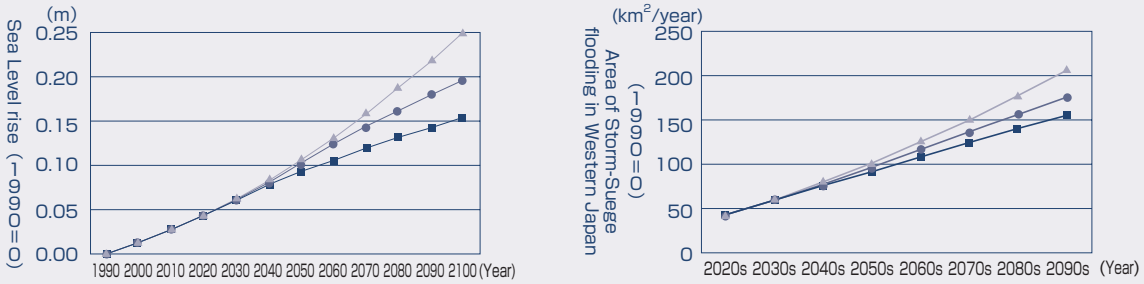
Note: Results of the simulations based on the observed sea surface temperature the simulations based on the projected sea surface temperature with small progress in warming (small increase in sea surface temperature) and the experiment based on the predicted sea surface temperature with greater progress in warming (large increase in sea surface temperature)
Source: Meteorological Research Institute, etc., 2007

Figure2-1-14 Projected Changes in Precipitation across Japan



Source: Ministry of Education, Culture, Sports, Science and Technology, Japan Meteorological Agency, Ministry of the Environment, "Climate Change and Its Impacts in Japan" (October 2009)

Figure2-1-15 Global Sea Level Rise by Scenario and Area of Storm-Surge Flooding in Western Japan



Source: Project Team for Comprehensive Projection of Climate Change Impacts, 2009

will increase in many regions, except for the southern part of the Kyushu region (Figure 2-1-14).

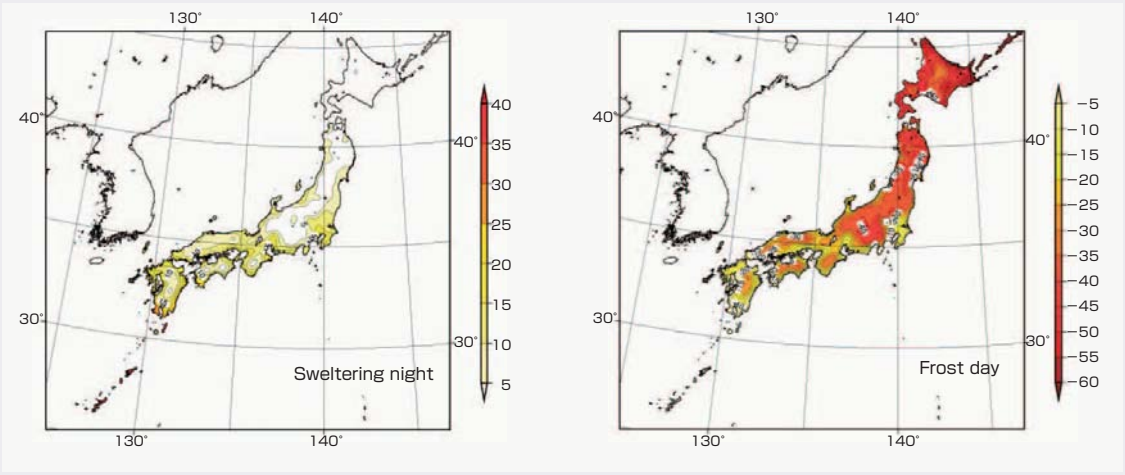
According to "Comprehensive Assessment of Climate Change Impacts to Determine the Dangerous Level of Global Warming and Appropriate Stabilization Target of Atmospheric GHG Concentration" (hereafter referred to as "Project for Comprehensive Projection of Climate Change Impacts"), a strategic research and development area project financed by the Global Environment Research Fund of the Ministry of the Environment, the global average sea level is projected to rise by about 25 cm by 2100 if no action is taken to cope with global warming. Projections of the flooded area caused by storm surges in Western Japan under the same scenario point to an annual increase of about 200 km^2 by the end of the 21st century, indicating that areas with relatively low levels of coastal waterproof barriers are at risk of being flooded (Figure 2-1-15).

We are already beginning to feel in our bones an increase in sweltering nights and a decrease in frost days. According to the Synthesis Report on Observations, Projections, and Impact Assessments of Climate Change, "Climate Change and Its Impacts in Japan" – which was compiled in October 2009 by the Ministry of Education, Culture, Sports, Science and Technology, the Japan Meteorological Agency and the Ministry of the Environment – the number of frost days (with the intraday lowest temperature of less than 0 degree Centigrade) 100 years from now is projected to drop particularly sharply in the mountain areas of Honshu, Tohoku and Hokkaido, while the number of sweltering nights (with the intraday lowest temperature of 25 degrees Centigrade or higher) is expected to sharply increase in the Kanto region and south of the Kinki region (Figure 2-1-16).

These temperature changes have a big impact on vegetation, etc. According to studies under the Project for Comprehensive Projection of Climate Change Impacts, if no action is taken, suitable habitats for beech forest are projected to decline by nearly 70% by the end of the 21st century, and about 50% of the pine distribution areas that were not at risk of pine wilt at the end of the 20th century are expected to newly become areas at risk of pine wilt (Figure 2-1-17).

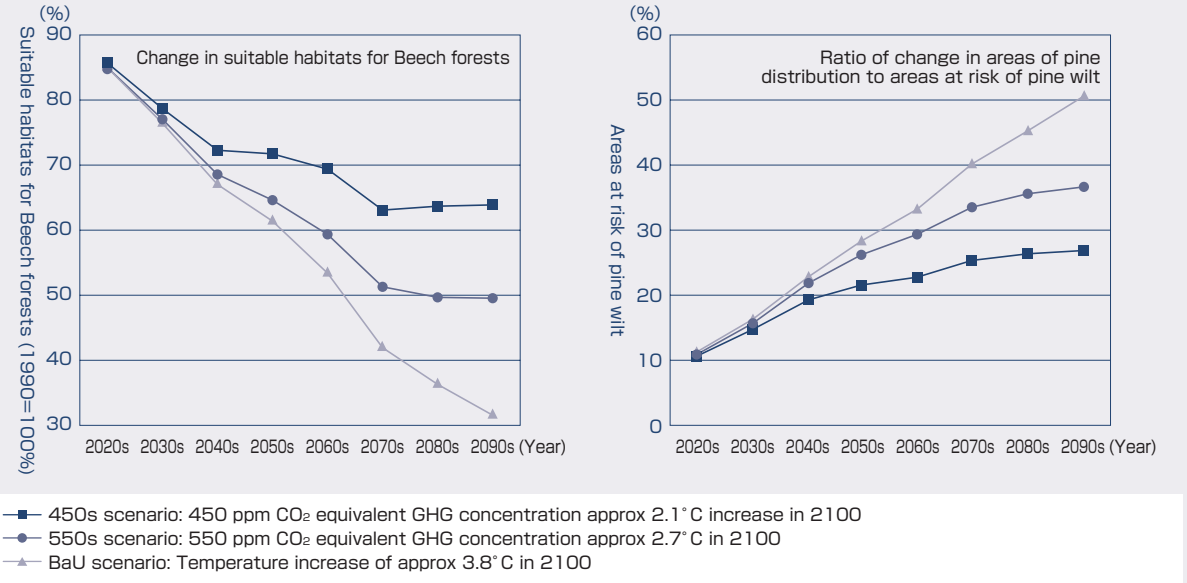
Meanwhile, other countries are also making various projections about future impacts of global warming. Many

Figure2-1-16 Changes in the Annual Number of Days above 25℃ and Frost Days across Japan (Unit: Day)



Note 1: Difference between the 20-year average from 2081-2100 and the 20-year average to the 1981-2000
2: Projection results under the A2 scenario based on a regional model with a holizontal resolution of 20 km (RCM20)
3: Calculation results are based on a single model under a single scenario. Results may vary if a different model or scenario is used.
Source: Ministry of Education, Culture, Sports, Science and Technology, Japan Meteorological Agency, Ministry of the Environment, "Climate Change and Its Impacts in Japan" (October 2009)

Figure2-1-17 Global Warming Impacts on Japan (Change in Suitable Habitats for Beech Forests and Ratio of Change in Areas of Pine Distribution to Areas at Risk of Pine Wilt)



Source: Project Team for Comprehensive Projection of Climate Change Impacts, 2009

of impacts of global warming are related to "water," such as increased risk of flooding and a decline in water supply, and the damage from water-related impacts is likely to increase sharply as global warming progresses. Climate change poses particularly large threats to developing regions. Many developing regions have had warm climates from the beginning, and are vulnerable to major changes in precipitation patterns. Economies of developing countries often depend on agriculture that is particularly vulnerable to climate change, and this presents a major risk factor. Lastly, because of poverty, many developing countries often find it difficult to take measures to cope with climate change on their own.

In Table 2-1-1, we summarize examples of impacts of climate change projected for Africa, Asia, Latin America and small islands in the IPCC Fourth Assessment Report.

3 Necessary Countermeasures

As discussed above, the damage presumably caused by global warming is already beginning to occur as a reality, making it necessary to take adaptation measures (measures to mitigate the adverse impacts by adjusting appropriate responses of nature and the human community to climate change and associated rises in

Table2-1-1 Examples of Projected Impacts by Region

Africa	· By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change. · In some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020. Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition. · Towards the end of the 21st century, projected sea level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5 to 10% of Gross Domestic Product (GDP). · By 2080, an increase of 5 to 8% of arid and semi-arid land in Africa is projected under a range of climate scenario.
Asia	· By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease. · Coastal areas, especially heavily populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers. · Climate change is projected to compound the pressures on natural resources and the environment associated with rapid urbanization, industrialization and economic development. · Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in the hydrological cycle.
Latin America	· By mid-century, increases in temperature and associated decreases in soil water are projected to lead to gradual replacement of tropical forest by savanna in eastern Amazonia. Semi-arid vegetation will tend to be replaced by arid-land vegetation. · There is a risk of significant biodiversity loss through species extinction in many areas of tropical Latin America. · Productivity of some important crops is projected to decrease and livestock productivity to decline, with adverse consequences for food security. In temperate zones, soybean yields are projected to increase. Overall, the number of people at risk of hunger is projected to increase. · Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability for human consumption, agriculture and energy generation.
Small islands	· Sea level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities. · Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching, is expected to affect local resources. · By mid-century, climate change is expected to reduce water resources in many small islands, e.g. in the Caribbean and Pacific, to the point where they become insufficient to meet demand during low-rainfall periods. · With higher temperatures, increased invasion by non-native species is expected to occur, particularly on mid- and high-latitude islands.

Source: Ministry of Education, Culture, Sports, Science and Technology, Ministry of Economy, Trade and Industry, Japan Meteorological Agency, "Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, Summary for Policymakers" (translated by the Ministry of the Environment)

Table2-1-2 Climate Scenarios and Impacts by Stabilization Level (Nationwide Values)

Climate Scenario/Impact Field		Unit	2030s			2050s			2090s		
			450s	550s	BaU	450s	550s	BaU	450s	550s	BaU
	Change in average temperature (1990=0℃)	℃	0.9	0.9	1.0	1.3	1.6	1.7	1.6	2.3	3.2
	Change in annual mean precipitation (1990=100%)	%	100	101	101	105	106	107	107	110	113
	Sea level rise (1990=0m)	m	0.06	0.07	0.07	0.10	0.11	0.12	0.15	0.19	0.24
Floods	Flooded area	1000km²	0.2	0.2	0.2	0.6	0.7	0.7	0.5	0.6	0.8
	Food damage cost potential	Trillion yen/year	1.3	1.3	1.3	4.4	4.7	4.9	5.1	6.1	8.3
Landslide disasters	Probability of slope failure	%	3	3	3	3	4	4	4	5	6
	Slope failure damage cost potential	Trillion yen/year	0.60	0.60	0.60	0.49	0.52	0.58	0.65	0.77	0.94
Beech forest (Japanese beech)	Suitable habitats for Beech forest	%	79	77	77	72	65	61	64	50	32
	Cost of damage due to loss of suitable habitats for Beech forest	100 million yen/year	778	829	851	1034	1273	1381	1325	1811	2324
Pine wilt	Areas at risk of pine wilt	%	15	16	16	22	26	28	27	37	51
Rice	Rice yield	t/ha	4.9	5.0	5.0	4.9	5.0	5.1	4.8	4.9	5.1
Sand beaches	Area of sand beach loss	%	13	13	13	19	21	23	29	37	47
	Cost of damage due to loss of sand beaches	100 million yen/year	116	118	121	176	192	208	273	338	430
Storm surges	Population affected by storm-surge flooding (western Japan)	10,000 people/year	12	12	12	19	20	21	32	37	44
	Population affected by storm-surge flooding (Japan's three major bays)	10,000 people/event	11	11	11	17	17	17	30	32	35
	Area of storm-surge flooding (western Japan)	km²/year	60	60	61	92	97	102	155	176	207
	Area of storm-surge flooding (Japan's three major bays)	km²/year	24	24	24	37	38	39	63	67	72
	Cost of damage due to storm-surge flooding (western Japan)	Trillion yen/year	2.0	2.0	2.0	3.1	3.3	3.5	5.4	6.2	7.4
	Cost of damage due to storm-surge flooding (Japan's three major bays)	Trillion yen/year	0.2	0.2	0.2	0.3	0.4	0.4	1.8	2.0	2.3
Heat stress	Heat stress mortality risk	—	1.5	1.6	1.6	1.8	2.1	2.2	2.1	2.8	3.7
	Cost of damage due to heat stress (heat stroke)	100 million yen/year	243	265	274	373	480	529	501	775	1192

Source: Project Team for Comprehensive Projection of Climate Change Impacts, 2009

temperatures and the sea level).

More specifically, such measures include construction of breakwater and embankment to prevent storm surge damage in water-related disasters and coastal areas, construction of temporary impounding facilities to mitigate flood damage due to localized heavy rains, securing of refuges for animals and plants that lose their habitats due to global warming in natural ecosystems, early detection and prevention of the perishing and loss of forests, and development of agricultural crops with high temperature resistance in the food field.

"The Stern Review: The Economics of Climate Change," a report on the result of studies conducted under the direction of the British Minister of Finance, notes that if no action is taken to cope with global warming, in other words, business as usual (BaU), that would "reduce welfare by an amount equivalent to a reduction in consumption per head of between 5 and 20%." The Stern Review also estimates the annual costs of stabilization of greenhouse gas (GHG) concentration in the atmosphere at 500-550ppm CO2e to be around 1% of gross domestic product (GDP) by 2050, a level lower than the intensity of measures assumed for Japan's mid-term goals.

Figure 2-1-2 shows the results of studies on the costs of domestic damage due to the impacts of global warming estimated under the Ministry of the Environment's Project for Comprehensive Projection of Climate Change Impacts. The impacts and damage are estimated to decrease considerably if GHG emissions are reduced through mitigation measures. If additional measures are not taken (BaU), however, up to ¥8.3 trillion in flood damage, ¥0.94 trillion in landslide disasters, ¥232.4 billion in cost of damage due to loss of suitable habitats for beech forest, ¥43.0 billion in cost of damage due to loss of sand beaches, ¥7.4 trillion in cost of damage due

Column We Answer Your Questions about Global Warming

Some erroneous descriptions have given rise to the recent controversy over the credibility of the IPCC Fourth Assessment Report (AR4).

However, these errors concern only a small portion of the AR4 that runs about 1,000 pages and the credibility of the AR4's scientific basis regarding global warming remains intact. Following the recent controversy, the IPCC has commissioned the InterAcademy Council (IAC) to conduct an independent review of the processes and procedures of the IPCC in preparing its reports. The IAC review results will be discussed at this year's IPCC Plenary Session and reflected in the IPCC Fifth Assessment Report (to be released in 2013-2014).

In this column, we explain about questions you might have regarding global warming based on scientific knowledge offered in the IPCC AR4 and other documents.

(1) Is there sufficient evidence that anthropogenic greenhouse gases are the major cause of global warming?

Not only anthropogenic factors such as greenhouse gas emissions but also natural factors including solar activity and aerosols discharged by volcanic eruptions cause changes in the global mean temperature, and a combination of various factors leads to temperature rises or decreases. Around the mid-20th century, there were periods when the global mean temperature stayed flat despite higher atmospheric concentrations of greenhouse gases due to other offsetting factors. The IPCC AR4 noted that based on the results of climatic simulations for 1906-2005, rapid global warming observed in the recent several decades cannot be reproduced without considering anthropogenic increases in greenhouse gas emissions.

(2) The biggest greenhouse effect comes from water vapor. So, isn't it true that a small increase in carbon dioxide emissions has little impact on the environment?

It is true that water vapor has the biggest greenhouse effect (about 60%), but carbon dioxide also plays an important role by contributing about 30% of the greenhouse effect. The amount of water vapor in the atmosphere is determined by exchanges (evaporation and precipitation) between the atmosphere and oceans/land surface. Thus, the amount of water vapor does not increase or decrease significantly due to human activities. Water vapor is believed to grow in amount in the atmosphere if temperatures rise which increasingly accelerates global warming, but much more contributory to temperature rises are carbon dioxide emissions by human activities. In other words, due heed certainly needs to be given to water vapor in that water vapor currently is a factor for the greenhouse effect and has potential to amplify global warming in the future. In order to contain the progression of global warming, however, it is more effective to curb emissions of carbon dioxide and other greenhouse gases.

(3) Isn't it true that the major cause of global warming is animated solar activity, etc. and not the increase in greenhouse gas concentrations?

As noted in (1), not only the increase in greenhouse gas concentrations but also animated solar activity (an increase in radiant energy from the sun) and other factors cause to alter the global mean temperature. However, the latest observation data on the number of sunspots, a good indicator of solar activity, shows that sunspots have stayed almost flat or tended to decrease since the mid-20th century, indicating little possibility of solar activity becoming more vigorous. Cosmic rays (electric atomic nuclei drifting in outer space) that reach the earth's atmosphere are said to form clouds, and there is a theory that cosmic rays decrease when solar activity becomes vigorous and a resultant reduction in the amount of clouds causes temperatures to rise. At present, however, there is no established correlation between cosmic rays and the amount of clouds and the physical mechanism involved has not been elucidated. After assessing scientific discussions concerning natural factors such as solar activity and cosmic rays, the IPCC AR4 has concluded that the increase in global average temperatures in the latter half of the 20th century is very likely due to the increase in anthropogenic greenhouse gas concentrations.

to storm-surge flooding (Western Japan), and ¥119.2 billion in cost of damage due to heat stress (heat stroke) mortality, respectively, is estimated each year in the 2090s.

Section 2 Economic Effects of Measures to Cope with Global Warming

Measures to cope with global warming are believed to have both positive and negative effects on the economy. As specific positive effects on the economy, considerable new business opportunities are conceivable in a diverse range of industries and services. The market for low-carbon energy products is one of fields with considerable potential going forward. Japan must strive to take advantage of these business opportunities.

Measures to deal with climate change may also help eliminate existing inefficiencies. At the corporate level,

the introduction of measures to cope with global warming may lead to cost savings, while at the level of the overall economy, climate policy measures are believed to be likely to lead to improvements in inefficient energy systems.

Furthermore, as secondary benefits of taking measures to deal with climate change, it can also be expected that health damage from air pollution would be reduced or forests that host the bulk of global biodiversity would be preserved.

Lastly, efforts to enhance energy efficiency and diversify energy sources and energy supply as part of measures to cope with global warming will contribute to securing national energy security and is also instrumental in clarifying a long-term energy-related policy framework.

Thus, what is important is the change in our way of thinking to view the promotion of measures to cope with global warming as one of pillars for new growth, instead of focusing only on increased burdens. The "New Growth Strategy (Basic Policies)," adopted by a Cabinet decision in December 2009, regards environment-related markets as sustainable growth areas with potential short-term and long-term demand, and in order to become "an environment and energy power through 'green innovation'," sets the targets of creating over ¥50

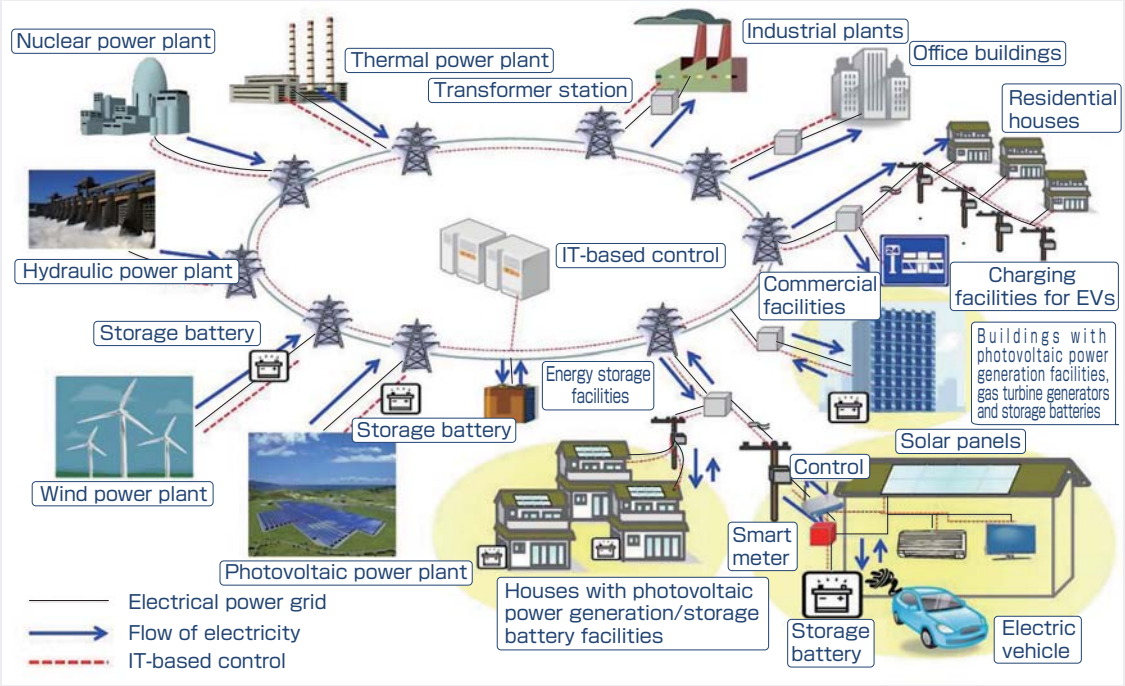
Column Smart Grid

The term "Smart Grid (next-generation power transmission network)" is being used to mean various things. For example, it is used to mean the power transmission and distribution network that incorporates dedicated equipment and software with communication functions and controls the flows of electric power from both the supply and demand sides to optimize them.

The ways in which the so-called "Smart Grid" is visualized differs among countries and regions. In the United States, the Smart Grid has attracted keen attention after the Obama administration placed it as the pillar of the Green New Deal, but appears to be aimed largely at replacing superannuated U.S. power transmission networks. Also in the background is that in the United States, unlike Japan, power demand is expected to keep growing going forward and the necessity is high to upgrade and beef up transmission lines.

In Japan, on the other hand, its power transmission network is known for high efficiency and high reliability. For example, comparison of hours of electric power outage demonstrates that Japan's power supply system is highly reliable. However, if renewable energy such as photovoltaic power generation and wind power generation come to account for a large portion of power supply, as in Europe, due to their vulnerability to weather and climate and unstable output, it will become necessary to take system stabilization measures to ensure the stable supply of electricity. For example, if power supply increases at a time when demand is low, it is necessary to take system stabilization measures such as curbing output of photovoltaic power generation or storing electricity in large stationary storage batteries in order to adjust the power supply and demand balance. In Japan, maintaining the stable supply of power and expanding the introduction of renewable energy are one of the purposes to work on the Smart Grid.

Conceptual Diagram of Smart Grid



source: Ministry of Economy, Trade and Industry, "Toward International Standardization Concerning Next-Generation Energy Systems"

trillion in new environment-related markets and 1.4 million new environment sector jobs by 2020. We describe this in greater detail in Section 4 of this Chapter.

Amid the global recession following the Lehman Shock, various companies, in search of new business, are trying to find opportunities in new fields. In particular, environmental businesses may be described as already expanding with further prospects for growth.

Utilization of natural energy is one area that is likely to increasingly grow in importance globally going forward. Demand for photovoltaic power generation, the typical use of natural energy, according to the International Energy Agency's (IEA) PV Roadmap 2009, is expected to expand about five times the present level by 2020 in terms of electricity generated. For Japan, which has sophisticated technology in photovoltaic power generation, this is the industry sector with growth potential going forward. As Japan plans to introduce measures to support the spread and expansion of renewable energies (solar light, wind, hydroelectric, geothermal, solar thermal, biomass, etc.), such as the creation of the electric power feed-in tariff system, promotion of installation of facilities using renewable energy, promotion of electric power system facilities, and adequate review of regulations, etc., the volume efficiency associated with the spread and expansion at home is expected to help lower manufacturing costs and boost international price competitiveness.

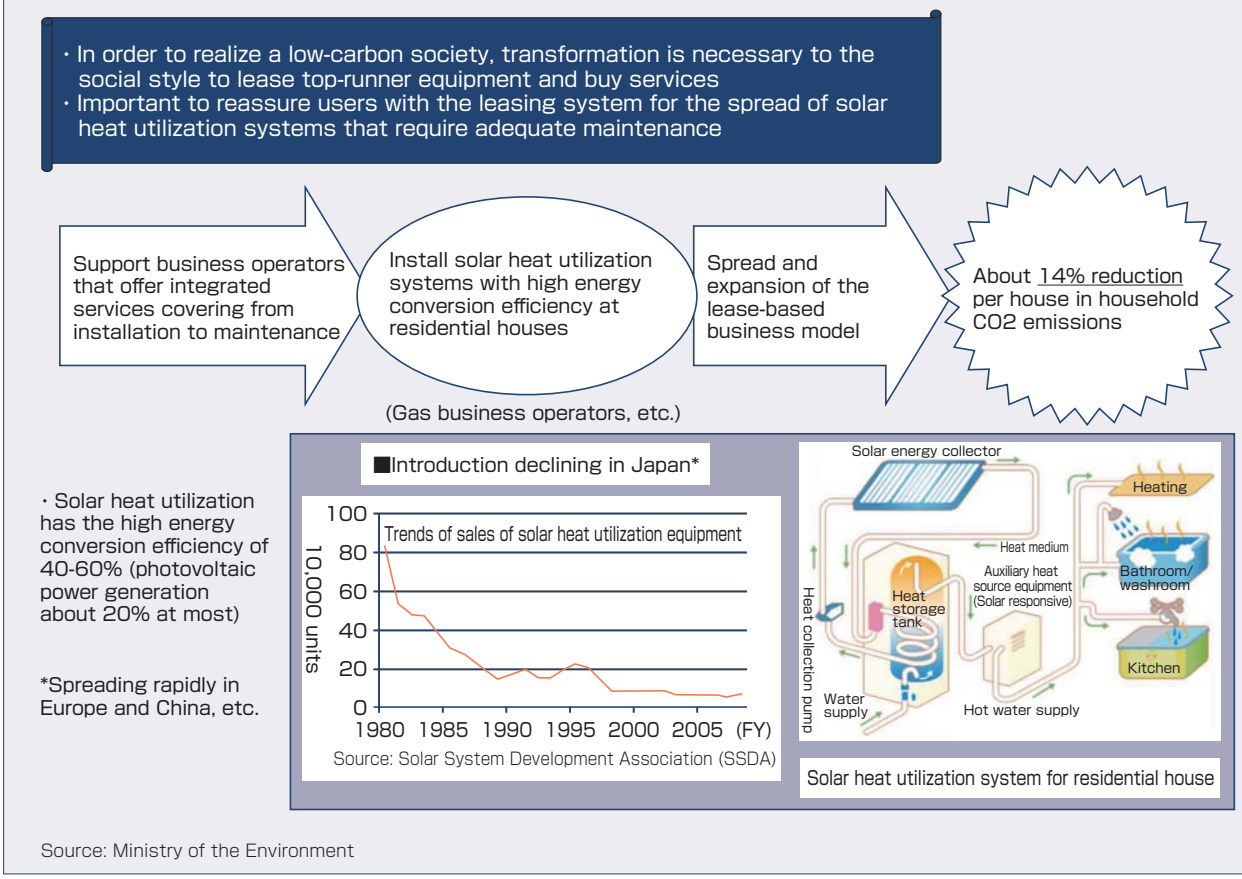
Furthermore, efforts are under way, notably in Europe and the United States, to introduce the "Smart Grid" designed to realize the efficient utilization of renewable energy. Japanese companies are also engaged in active business operations on the strength of their battery technologies, including solar cells and rechargeable batteries.

The Ministry of Economy, Trade and Industry, regarding the Smart Grid business as the next-generation business and in order to support Japanese companies with excellent products and services in going into overseas markets with their systems, established the "Study Group on the International Standardization Concerning Next-Generation Energy Systems" in August 2009 to proactively and strategically contribute to the international standardization of the Smart Grid. In January 2010, the Study Group came up with the "International Standardization Roadmap for Smart Grid," which sorted out and listed 26 important technological elements to be standardized.

In the future, it is also conceivable to develop new services by adding functions to operate security systems and home electric appliances to the Smart Grid.

Other than the Smart Grid, lithium ion and other rechargeable batteries that are a technology essential for electric vehicles, etc. are an area which Japan excels in. The Ministry of the Environment has supported research and development of high-capacity laminate lithium ion batteries, while the Ministry of Economy, Trade and Industry has also been promoting high-performance, low-price innovative storage batteries. Since FY2009, actually, electric vehicles and plug-in hybrid vehicles have been put on the market on a full scale, and going

Figure2-2-1 Concerning Acceleration of the Spread of Household Solar Heat Utilization Systems



Source: Ministry of the Environment

forward, electric vehicles mounted with high-capacity laminate lithium ion batteries are also set to be commercialized. Thus, rechargeable batteries have become an element indispensable for the development of next-generation environment-friendly products.

Measures to cope with global warming will reduce lighting and heating expenses at households. As an example of usage of energy from sunlight, solar heat utilization systems such as water heaters have a high energy efficiency of 40-60% and are also relatively cheap. Solar heat utilization systems are rapidly spreading in Europe and China, etc., and Japan is trying to develop a mechanism under which such systems can be used without safety concerns by spreading them mainly under lease contracts, which helps eliminate maintenance troubles (Figure 2-2-1).

Furthermore, when photovoltaic power generation, high-performance insulation and high-efficiency water heaters are introduced to single-family houses and at the same time electric appliances are replaced with energy-saving ones, for example, despite the costs of introducing these systems and new electric appliances, reductions in heating and lighting expenses can be expected. High-performance insulation of houses will also produce the secondary effect of creating a comfortable and healthy living space that is cool in summer and warm in winter.

Column The Stern Review

The "Stern Review: The Economics of Climate Change" is the report on economic impacts of the climate change problem the British government commissioned to the former World Bank Senior Vice President Nicholas Stern following the Group of Eight Summit in July 2005, which was released in October 2006. The Stern Review analyzed the economic costs of the impacts of climate change, and the costs and benefits of action to reduce the emissions of greenhouse gases using the following three different ways.

(i) Approach to considering individual factors

This is the approach of analysis to consider the physical impacts of climate change on the economy, on human life and on the environment using disaggregated techniques, and examine the resource costs of different technologies and strategies to reduce greenhouse gas emissions.

The Stern Review first made an analysis using integrated assessment models to estimate the overall impact of climate change in monetary units. The Stern Review also used models that makes it possible to examine the risks of most uncertain impacts using probabilities, and it estimated that "the monetary impacts of climate change are now expected to be more serious than many earlier studies suggested."

The Review estimated "the total cost over the next two centuries of climate change associated under BAU (business as usual) emissions involves impacts and risks that are equivalent to an average reduction in global per-capita consumption of at least 5%." Further, including direct impacts on the environment and human health (so called "non-market" impact) and weighting appropriately the disproportionate share of the climate-change burden falling on poor regions of the world, it is estimated that the total cost of BAU climate change would be increased to "the equivalent of around a 20% reduction in consumption per head, now and into the future."

(ii) Approach to using economic models

This is the approach of analysis that uses economic models, including integrated assessment models that estimate the economic impacts of climate change, and macroeconomic models that represent the costs and effects of the transition to low-carbon energy systems for the economy as a whole.

Assuming the following four ways to reduce greenhouse gas emissions:

- Reducing demand for emissions-intensive goods and services
- Increased efficiency, which can save both money and emissions
- Action on non-energy emissions, such as avoiding deforestation
- Switching to lower-carbon technologies for power, heat and transport,

the Review estimated the costs of stabilizing greenhouse gases at levels of 500-550ppm CO_2e in two ways: One is to provide an upper bound on costs by looking at the resource costs of measures in comparison with the costs of the BAU alternative, and the second is to use macroeconomic models to explore the economic system-wide effects of the transition to a low-carbon energy economy. As a result, on the basis of these two methods, it is concluded that "stabilization of greenhouse gases at levels of 500-550ppm CO_2e will cost, on average, around 1% of annual global GDP by 2050." A broad range of macro-economic model estimates led to an important corollary that "there is a high price to delay." The Stern Review also issued a warning: "Weak action in the next 10-20 years would put stabilization even at 550ppm CO_2e beyond reach – and this level is already associated with significant risks."

(iii) Approach to comparing costs

This is the approach of analysis to compare the estimated costs of mitigation with the estimated costs of climate change without action, and to compare the marginal cost of carbon abatement with the "social cost of carbon."

Introducing the latest knowledge about risks and assuming we remain on a BAU trajectory, the Stern Review estimated that "the social cost of carbon today … is of the order of $85 per tonne of CO_2." This number is well above marginal abatement costs in many sectors. Comparing the social costs of carbon

on a BAU trajectory and on a path towards stabilization at 550ppm CO_2e, the Stern Review estimated "the excess of benefits over costs, in net present value terms, from implementing strong mitigation policies this year, shifting the world onto the better path: the net benefits would be of the order of $2.5 trillion."

The Stern Review also states that "innovation driven by strong policy will ultimately reduce the carbon intensity of our economies, and consumers will then see reductions in the prices that they pay as low-carbon technologies mature."

The Stern Review, summarizing the results of analyses based on these three approaches, presented a simple conclusion: the benefits of strong, early action on climate change considerably outweigh the costs."

There is criticism of the Stern Review that the "discount rate" applied to economic model estimates has been set too low and this might have resulted in an overestimation of long-term impacts of climate change. Since many of the preceding economic analyses applied higher discount rates based on the observations of actual behaviors of people, certain researchers consider the Stern Review inappropriate. In contrast, in the Stern Review, Lord Stern argued that the discount rate should be set low and the long-term benefits should be given greater importance regarding the natural system affected by global warming and the human system that depends on the former for its subsistence.

Sources: Asia-Pacific Integrated Modeling (AIM) Team and the executive summary of the "Stern Review: The Economics of Climate Change" (translated by the National Institute for Environmental Studies)

Section 3 Global Movement on Climate Change

Damage from Climate Change has already started emerging, and it is necessary to take appropriate measures for mitigation and minimize the cost of damage. But only Japan's efforts cannot halt climate change, even if it sets an ambitious reduction target. No country can deal with this problem alone. Persistent discussions are ongoing in international negotiations, where the short-term interests clash between developed and developing countries, among developed countries or among developing countries.

1 The International Community's Responses So Far to Climate Change

The Kyoto Protocol adopted at the third session of the Conference of the Parties (COP3) to the United Nations Framework Convention on Climate Change (UNFCCC) in 1997 based on the UNFCCC committed developed countries to embark on international efforts to reduce greenhouse gas emissions and set numerical targets for greenhouse gas emission cuts by developed countries during the first commitment period (2008-2012). However, the Kyoto Protocol, which the United States does not ratify and developing countries are not subject to reduction targets, covers only about 28% of total global emissions of carbon dioxide from energy sources as of 2007. Global emissions of greenhouse gases are expected to continue to increase in tandem with economic development of developing countries with no reduction obligations. Under these circumstances, in order to reduce emissions of greenhouse gases effectively in the future, it is necessary to strive for measures to address climate change by the entire world, including the United States, which is yet to ratify the Kyoto Protocol, and China and other emerging economies whose energy consumption is expected to increase.

Regarding international negotiations on the post-2012 framework, the COP13 held in Bali, Indonesia, in December 2007 adopted the Bali Action Plan and decided to finalize the post-2012 framework by COP15 in 2009 with the participation of all parties to the UNFCCC.

Meanwhile, at the Group of Eight (G8) Hokkaido Toyako Summit held in 2008, the G8 leaders reached common understanding that they seek to share with all Parties to the Framework Convention on Climate Change the vision of, and together with them to consider and adopt in the UNFCCC negotiation, the goal of achieving at least 50% reduction of global emissions by 2050. At the G8 Summit in L'Aquila, Italy, in July 2009, the G8 leaders reaffirmed the goal of reducing global emissions by at least 50% by 2050, and as part of this, supported a goal of developed countries reducing emissions of greenhouse gases in aggregate by 80% or more by 2050 and also recognized the broad scientific view that the increase in global average temperature above pre-industrial levels ought not to exceed 2 degrees Celsius. Subsequently, then Prime Minister Yukio Hatoyama announced in a speech at the Summit on Climate Change in September 2009 that "For its mid-term goal, Japan will aim to reduce its emissions by 25% by 2020, if compared to the 1990 level, consistent with what the science calls for in order to halt global warming," which is premised on the establishment

of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets. Further, in the Japan-U.S. Joint Message on Climate Change Negotiations issued by the Japanese and U.S. leaders, the two countries said they "aspire to reduce our own emissions by 80% by 2050 and endorse a global goal of reducing emissions by 50% by that year."

2 Achievements of COP15 and Remaining Problems

Regarding reductions of greenhouse gas emissions after the first commitment period of the Kyoto Protocol, Japan took the initiative toward COP15 through setting ambitious reduction targets in pursuit of the establishment of a fair and effective international framework in which all major economies participate and agreement on ambitious targets by all the major economies, and announcing its scaled-up support for developing countries under the "Hatoyama Initiative." Japan participated in negotiations on political agreement at COP15 in pursuit of agreement on a fair and effective framework in which major economies, including the United States and China, participate, and strove to pave the ground for assistance to developing countries in such areas as adaptation and capacity-building.

In negotiations at COP15 and the Fifth Session of the Meeting of the Parties to the Kyoto Protocol (CMP5), etc. held in Copenhagen, Denmark, December 7-19, 2009, as a result of consultations and negotiations at the leader level of nearly 30 countries and organizations from the night of December 17 and late night of December 18, following ad hoc working group discussions by negotiators in the first half of the session and ministerial-level consultations, the Copenhagen Accord was developed, and it was decided at a plenary meeting the following day that "the Conference of the Parities takes note of the Copenhagen Accord." It was also decided that the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA), which was due to disband at the end of 2009, will continue its work, along with the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).

The process in the COP15 negotiations is as follows. In the first half of the negotiations, the AWG-KP chairman proposed that the Annexes to the Kyoto Protocol be revised to set the next set of reduction targets for developed countries. Many developing countries that call for the revision of the Annexes welcomed the chairman's proposal, but developed countries opposed to the chairman's proposal, arguing that the Kyoto Protocol alone is not sufficient to reduce greenhouse gas emissions globally and that a comprehensive and effective legal framework should be established to cover a developed country that has not ratified the Kyoto Protocol (the United States) and developing countries with no reduction obligations under the Kyoto Protocol (such as China and India).

The AWG-LCA chairman also presented another proposal, which drew the line among developed countries between the United States and the parties to the Kyoto Protocol. Later, when the COP chairman stated that she wanted to bring the discussions forward by presenting a new document based on the reports from the two ad hoc working groups, major developing countries such as China, India and Brazil rejected the idea, asserting that negotiations should be conducted on the basis of the reports from the two AWGs. Developed countries requested a meeting among a few countries and the presentation of a new proposal by Denmark, the COP host country, but developing countries continued to insist on the discussions on the basis of the proposals from the chairmen of the AWG-LCA and AWG-KP. Both sides remained as far apart as ever, threatening to jeopardize any progress in the negotiations.

Representing Japan, Prime Minister Hatoyama and Minister of the Environment Sakihito Ozawa again explained that Japan aims to reduce its emissions by 25% by 2020, if compared to the 1990 level, which is premised on the establishment of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets, and announced the "Hatoyama Initiative", which provides financial assistance of approximately ¥1.75 trillion (about $15 billion), of which public finance comprises approximately ¥1.30 trillion (about $11 billion), giving an impetus to the progress in the negotiations in the negotiations in order to support a broad range of developing countries which are taking measures of mitigation, as well as those which are vulnerable to the negative impacts of climate change.

Amid these moves, a leader-level meeting among a small number of countries was held after a leaders' banquet at the night of December 17. The leaders from nearly 30 countries and organizations, took part in the meeting, including Prime Minister Hatoyama, U.S. President Barack Obama, British Prime Minister Gordon Brown, Australian Prime Minister Kevin Rudd, German Chancellor Angela Merkel and French President Nicolas Sarkozy as well as the leaders of China, India, Brazil, South Africa and representatives from developing regions, such as Alliance of Small Island States and African Group. Late at night on December 18, these countries hammered out the "Copenhagen Accord."

When the Copenhagen Accord was presented to the COP plenary session early on December 19, many countries, including developed countries, Alliance of Small Island States and least developed countries, endorsed the accord and sought the adoption on it, but a few countries opposed the adoption on the grounds that the preparation process of preparing the accord was not transparent. Ultimately, it was decided that the Conference of the Parties "takes note of the Copenhagen Accord."

The gist of the Copenhagen Accord is as follows:

(i) Recognize the scientific view that the increase in global temperature should be below 2 degrees Celsius, and enhance long-term cooperative action to combat climate change;

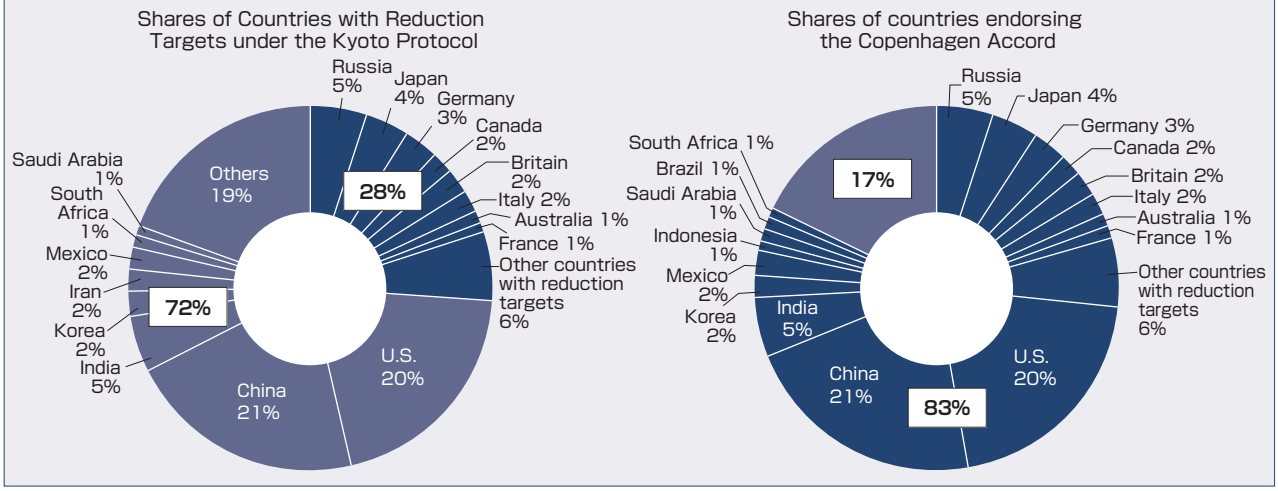
Figure2-3-1 Emissions Reduction Targets of Major Economies

Country	Emissions reduction in 2020	Base year
Japan	Reduce 25%, premised on the establishment of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets	1990
U.S.	Reduce in the range of 17%, in conformity with anticipated U.S. energy and climate legislation, recognizing that the final target will be reported to the Secretariat in light of enacted legislation (Note 1)	2005
Canada	Reduce 17%, to be aligned with the final economy-wide emissions target of the United States in enacted legislation	2005
Russia	Reduce 15-20% (Prerequisite: appropriate accounting of the potential of Russia's forestry in frame of contribution in meeting the obligations of the anthropogenic emissions reduction, and undertaking by all major emitters the legally binding obligations to reduce anthropogenic GHG emissions)	1990
Australia	Reduce 5% up to 15% or 25% (Note 2)	2000
EU	Reduce 20%/30% (Note 3)	1990

Note 1: U.S.) The pathway set forth in pending legislation would entail a 30% reduction in 2025 and a 42% reduction in 2030, in line with the goal to reduce emissions 83% by 2050
Note 2: Australia) Will reduce its greenhouse gas emissions by 25% on 2000 levels by 2020 if the world agrees to an ambitious global deal capable of stabilizing levels of greenhouse gases in the atmosphere at 450 ppm CO2-eq or lower. It will unconditionally reduce emissions by 5% below 2000 levels by 2020, and by up to 15% by 2020 if there is a global agreement under which major developing economies commit to substantially restrain emissions and advanced economies take on commitments comparable to Australia's.
Note 3: EU) EU reiterates its conditional offer to move to a 30% reduction by 2020 compared to 1990 levels, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities

Country	Emission targets/Mitigation actions
China	China will endeavor to lower its carbon dioxide emissions per unit of GDP by 40-45% by 2020 compared to the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020 and increase forest coverage by 40 million hectares from the 2005 level. These are autonomous actions.
India	Endeavour to reduce the emissions1 intensity of its GDP by 20-25% by 2020 compared with the 2005 level (excluding the agricultural sector). Mitigation actions are voluntary, and thus not legally binding
Brazil	Expects to reduce emissions by 36.1-38.9% compared with BAU. Specific actions include reduction in rain forests degradation; reduction in "Cerrado" (a type of vegetation in savanna regions) degradation; restoration of grain-growing land; improvement in energy efficiency; increased use of biofuels; increase in hydraulic power generation; alternative energy sources; and enhancement of the steelmaking industry, etc.
South Africa	Take mitigation action to reduce emissions 34% by 2020 compared with BAU, and 42% by 2025 compared with BAU. These actions require support from developed countries as well as the finalization of an ambitious, fair, effective and binding multilateral agreement at the meeting in Mexico under the Convention and the Kyoto Protocol. With international support, South Africa' s emissions are likely to peak between 2020 and 2025, plateau for about a decade, and then decline
Korea	Reduce greenhouse emissions by 30% by 2020 from the level of BAU emissions

Figure2-3-2 CO2 Emissions from Energy Sources (2007)



(ii) Annex I Parties (developed countries) submit emission reduction targets for 2020 and non-Annex I Parties (developing countries) submit mitigation actions, in the formats given in Appendix I and Appendix II, respectively, to the Secretariat by 31 January 2010;

(iii) Actions taken by Annex I Parties will be subject to measurement, reporting and verification (MRV). Mitigation actions taken by Non-Annex I Parties will be subject to international consultations and analysis after domestic MRV and mitigation actions taken with international support will be subject to international MRV.

(iv) Developed countries will collectively commit to provide new and additional resources approaching $30 billion for the period of 2010-2012, and also commit to a goal of mobilizing jointly $100 billion a year by 2020. The Parties decide that the "Copenhagen Green Climate Fund" shall be established as an operating entity of the financial mechanism of the Framework Convention on Climate Change.

(v) The Parties call for an assessment of the implementation of the Copenhagen Accord to be completed by 2015.

Over 110 countries which have already associated with the Copenhagen Accord account for over 80% of global emissions. Thus, it is important to position the Copenhagen Accord as an important basis for negotiations going forward (Figure 2-3-1, 2-3-2).

Under the Copenhagen Accord, Japan in January 2010 submitted to the UNFCCC Secretariat as the emission reduction in 2020 "25% reduction compared with the 1990 level, which is premised on the establishment of a fair and effective framework with the participation of all the major emitting countries and their agreement on

Column COP15 and Problems in Post-Copenhagen Negotiations on Climate Change

In this column, we listen to what Prof. Yukari Takamura of Ryukoku University, who is a member of the Global Environment Committee of the Central Environment Council, has to say about COP15 and post-Copenhagen negotiations on climate change.

How should we evaluate the Copenhagen Accord of which the Copenhagen Conference (COP15) has decided to "take note". As COP15 fell short of officially adopting it and only decided to "take note," the Copenhagen Accord became a political accord that is binding on only countries that consent to it. The fact that a majority of countries supported it does not automatically make the Copenhagen Accord the basis for negotiations on the next framework. This appears to be the basic difference from the case where the COP had officially adopted the Copenhagen Accord.

In light of the negotiations held so far, the Copenhagen Accord does represent progress in several areas. First of all, the Copenhagen Accord describes emission reduction efforts by industrialized countries and those by developing countries in the same document, making it an agreement that goes beyond the previous bipartite structure of "industrialized countries that make commitment" and "developing countries that avoid commitment." In response to the entirely new situation of the appearance of emerging economies that increased emissions rapidly over the past decade or so, the Copenhagen Accord offers prospects for transcending the dogmatic dichotomy and establishing an effective framework for prevention of global warming. Secondly, mitigation efforts by developing countries were promised concretely and institutionally, and their progress and effects will be subject to international verification. Unlike developed countries that are committed to the implementation of mitigation targets, developing countries implement mitigation actions and communicate their actions. Mitigation actions with international support will be subject to measurement, reporting and verification in accordance with international guidelines, while mitigation actions by developing countries not supported internationally will be subject to their domestic measurement, reporting and verification and they will communicate information on the implementation of their actions for international consultations and analysis. However, the extent and effects of international verification hinge on guidelines to be worked out going forward. Thirdly, there was agreement on the collective commitment of funding by developed countries at present and toward future. Developed countries will provide new and additional resources of $30 billion during the period of 2010-2012 with balanced allocation between mitigation and adaptation by developing countries. In the context of meaningful mitigation actions and transparency on implementation, developed countries also commit to a goal of jointly mobilizing $100 billion a year by 2020 to address the needs of developing countries, with the funding coming from a wide variety of sources, public and private.

Despite these positive developments, however, there seem to remain many problems. Above all, other than the aforementioned mitigation actions and funding goal, many of the matters that should form the basis of the next framework and on which agreement was expected at COP15 still remain unsettled. The Copenhagen Accord does not specify the ultimate legal form of the next framework, or whether commitments are legally binding commitments or not.

Furthermore, under the Copenhagen Accord, developed countries voluntarily decide emission reduction targets and make commitments to them, instead of determining reduction targets through international negotiations among states as was the case with negotiations on the Kyoto Protocol. It is deemed unclear whether this method of voluntary commitments as a whole can ensure the reductions by the levels enabling the achievement of the ultimate objective of preventing global warming or ensure the "comparability of mitigation efforts" over which Japan and other developed countries, other than the United States, have concerns.

The Copenhagen Accord worked out by the world's leaders and supported by a majority of countries in the international community, including the United States and emerging economies, provides a valuable hold to hang onto in advancing slow-moving negotiations on climate change. Key to negotiations on climate change going forward is how to forge final agreement on the next framework by reflecting matters agreed on under the Copenhagen Accord in documents of continuing negotiations and pushing forward negotiations on matters that are not yet sufficiently clear and matters on which there is no agreement yet.

ambitious targets." Japan presented its bold emission target in order to encourage other major economies to make ambitious efforts on measures to address climate change.

Going forward, regarding the post-2012 framework, Japan, based on the Copenhagen Accord, will take the initiative in pursuit of the establishment of a fair and effective framework in which all the major economies participate and the agreement by those economies on ambitious targets.

Section 4 Challenge 25 – A Promise to the Future Generation

As discussed in Section 3, persistent discussions are going on globally on how to proceed with measures to cope with global warming. In parallel with that, the major agenda is how Japan should implement measures to cope with global warming domestically and how Japan should perform the role imposed upon it by the international community.

1 Nationwide System to Realize Challenge 25

As IPCC has concluded that "global warming is beyond doubt," the global warming problem has now come to the situation that allows no further delay or wait and Japan, too, needs to steadily take measures to cope with global warming. Under the Copenhagen Accord, Japan has submitted the target of 25% reduction in 2020 to the UNFCCC Secretariat. In order to achieve the 25% reduction target over the coming 10 years, it is necessary to mobilize all possible policy tools.

To that end, it is essential for all Japanese citizens to join hands and work together, not to mention industries. The Japanese government named actions to preserve the "environment of the earth and Japan" and carry it over to the future generation the "Challenge 25" and has been undertaking active efforts to mobilize the forces of all entities for the campaign.

On the other hand, efforts to get out of the worldwide recession are just entering crucial stages. To that end, it is required to secure new and sustainable demand and employment. In response, the "New Growth Strategy (Basic Policies), adopted by the Cabinet decision in December 2009, has placed the strategy for becoming the world's top environment and energy power through "green innovation" at the top of areas of growth driven by Japan's strengths. Environment-related business can be described as an area of sustainable growth with potential demand, both short-term and long-term, at home as well as overseas. Also, the "Stern Review" released in Britain in October 2006 projected massive social costs in the future unless environment-related projects are addressed now.

Given these circumstances, now is the time to take drastic policy measures, including environment-related investments, to power economic growth and create employment. Furthermore, through these policy measures, we must transform the overall shape of our society into a sustainable one with a view to the future.

New Growth Strategy (Basic Policies)

At present, Japan may be in the long tunnel of decline. Major challenges are looming before us, including the scars from the Lehman Shock, public finances that have deteriorated to the state right after the end of the last war 65 years ago, and the fast plunge into the aging society with fewer children. However, opportunities for growth still abound if we address the current difficulties by looking at the Asian region as the frontier of growth and by taking advantage of Japan's original strengths as an environmental power and a major power in science and technology as well as huge personal financial assets (of approximately ¥1,400 trillion) and real assets like housing and land (¥1,000 trillion). The "New Growth Strategy (Basic Policies)," put together from such standpoint, lists the strategy for becoming an environment and energy power through "green innovation," or economic growth led by green innovation, at the top.

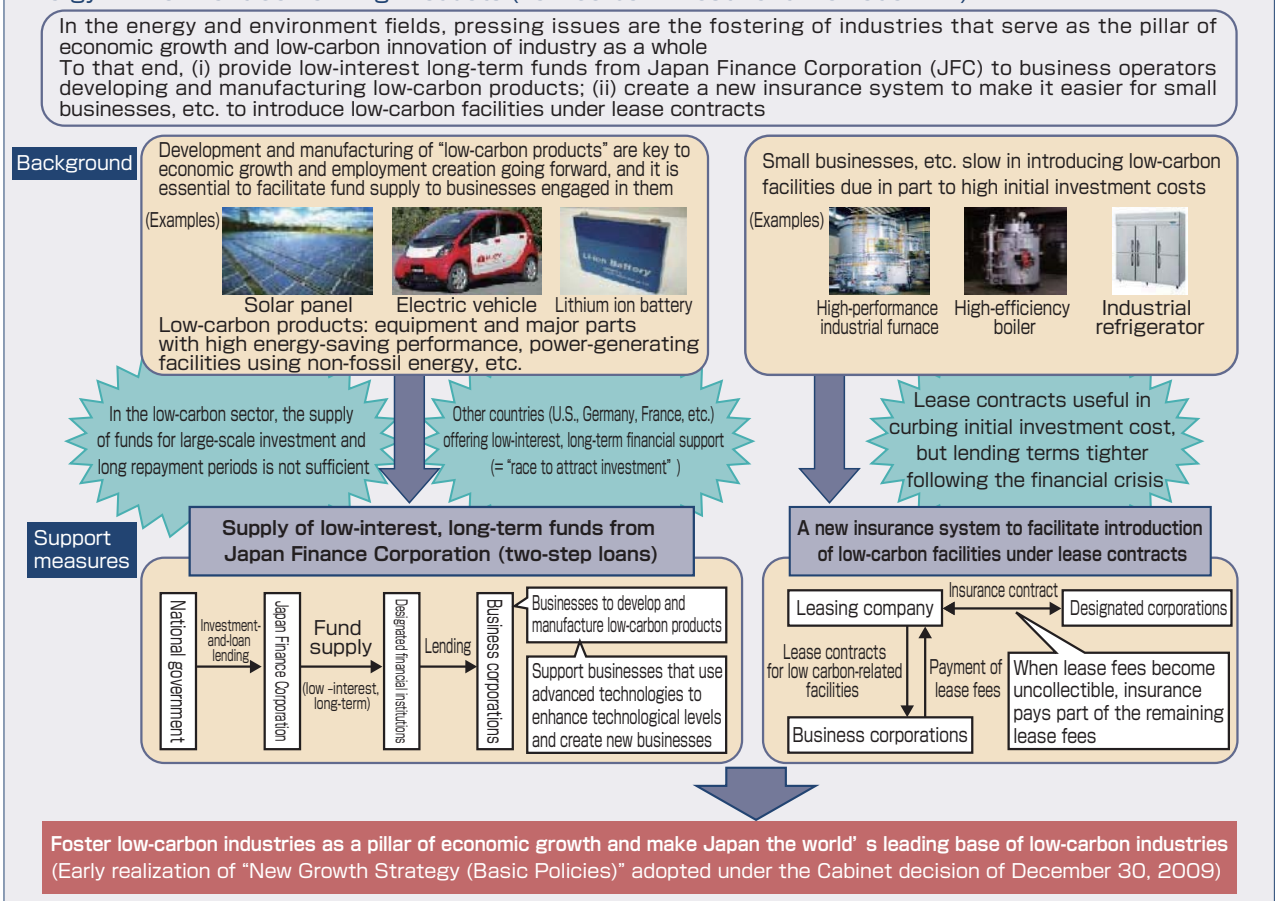
More specifically, as growth from green innovation, the New Growth Strategy states that "Japan will be transformed into a low-carbon economy and society through measures to support the spread and expansion of renewable energies (solar, wind, small-scale hydroelectric, biomass, geothermal, etc.) by expanding the electric power feed-in tariff system, promoting low-carbon investment and financing (Figure2-4-1), and expanding the use of information and communications technologies." Japan will be also "steadily pursue the use of nuclear power, while gaining the understanding and trust of the Japanese people, with safety as the top priority," it says.

The New Growth Strategy further states: "We will speed the development of innovative technologies including storage batteries, next-generation vehicles, improved thermal power plant efficiency, and information and communications systems with lower electric power consumption. Moreover, we will realize comprehensive greenhouse gas emissions reductions in the transportation and household sectors by promoting modal shifts, encouraging the use of energy-conserving consumer electronics and the like."

Japan will also achieve efficient electric power supply and demand through a Japanese-version smart grid linking electric power suppliers and electricity users via information systems, and spark new demand through related equipment in households, promoting this as a growth area. Further, Japan will also support the acquisition of shares in related growth markets overseas.

Lifestyle reforms through improving the comfort and quality of life are also an important challenge in trying to shift to a low-carbon society and realizing economic growth. The New Growth Strategy says that Japan will "promote zero-emission homes, offices, and other facilities through the spread of eco-housing, the expanded use of renewable energies, the spread and expansion of heat pumps, and the 100% adoption of light-emitting diodes (LEDs), organic electroluminescent lighting, and other forms of next-generation lighting," and states that this will also be directly linked to improving the comfort of living spaces and the quality of life and can be expected to "constitute the start of a major voluntary shift toward low-carbon lifestyles." In order to promote the realization of zero emissions in the household sector,

Figure2-4-1 Bill for the Act Concerning the Promotion of Businesses for Development and Manufacture of Energy Environment Conforming Products (Low-Carbon Investment Promotion Bill)



Source: Ministry of Economy, Trade and Industry

Japan will create an "environmental concierge system" providing advice to individual households.

Japan also needs to simultaneously create "green cities" by promoting the rebuilding and remodeling of superannuated buildings. "To make Japan's urban areas into 'green cities' with low greenhouse gas emissions, we will fundamentally revise the approach to urban planning, urban renewal, and urban redevelopment from an environmental and low-carbon perspective … We will also devise the necessary deregulation and support measures to promote the redevelopment, rebuilding, and remodeling of superannuated office buildings and other structures that have problems relating to greenhouse gas emissions and safety," according to the New Growth Strategy.

In order to reform the socioeconomic structure in this manner, individual local areas also need to achieve reforms of their socioeconomic structures. To that end, the Japanese government will support initiatives to create an eco-friendly society, including promoting the use of public transportation and other measures to create low-carbon urban and regional structures, advancing renewable energies and constructing a smart grid to support them, realizing thorough and appropriate resource recycling, utilizing information and communications technologies, and turning homes and other buildings into zero-emission structures. Japan will implement intensive investment projects with not only the environment but also health and tourism as the main pillars, making use of a comprehensive policy package including regulatory reforms and green tax reforms, thus marking "the first step toward the transformation to a sustainable socioeconomic structure originating from self-supporting local regions."

Through the comprehensive implementation of these measures, Japan will seek a transformation to a low-carbon society, by also setting economic growth goals as the creation of over ¥50 trillion in new environment-related markets and 1.4 million new environment sector jobs by 2020, according to the New Growth Strategy.

Green Taxation for Climate Change Policy (Promotion of a Low-Carbon Society)

The greening of the tax system, including the handling of so-called environmental taxes, is an important issue as well. The tax reform plan for FY2010 adopted the "good tax cuts and bad taxation" approach concerning individual indirect taxes. This approach means that when specific goods and services have impacts on the environment and health, etc., tax burdens are mitigated when impacts are favorable and increased when impacts are adverse. Based on the "good tax cuts and bad taxation" approach, the tax system in response to global issues was considered.

Regarding the gasoline tax, local gasoline tax and light

Figure2-4-2 Key Tax Reforms Related to Climate Change Policy in Other Countries

Awareness of environmental problems heightened from the 1980s, and international negotiations on the Framework Convention on Climate Change started (from 19990)		
· 1990	Finland	So-called carbon tax (additional duty) introduced
· 1991	Sweden	CO_2 tax introduced
	Norway	CO_2 tax introduced
1992 Framework Convention on Climate Change adopted【Took effect in March 1994】, Earth Summit held in June (Rio de Janeiro)		
· 1992	Denmark	CO_2 tax introduced
	Netherlands	General fuel tax introduced
· 1993	United Kingdom	Hydrocarbon oil duty raised in phases (until 1999)
· 1996	Netherlands	Regulatory energy tax introduced
1997 Kyoto Protocol adopted【Took effect in February 2005】		
· 1999	Germany	Mineral oil tax raised in phases (until 2003), Electricity tax introduced
	Italy	Excises on mineral oils revised (coal, etc. added)
· 2001	United Kingdom	Climate change levy introduced
October 2003 "EC Directive on the Community framework for the taxation of energy products and electricity" issued【Took effect in January 2004】: Member states set tax rates in excess of the minimum rate for energy products and electricity		
· 2004	Netherlands	General fuel tax integrated with the existing energy taxation (Fuel tax on coal continues (Tax on coal)). Regulatory energy tax restructured into energy tax
· 2006	Germany	Excises on mineral oils restructured into Energy tax (coal added)
· 2007	France	Coal tax introduced
· 2008	Switzerland	CO_2 levy introduced

Source: Data from relevant governments and OECD

oil delivery tax, all imposed on fossil fuels, provisional tax rates set in April 2008 to run for 10 years, were abolished under the tax reform for FY2010. However, these tax rates were retained, for the time being, in consideration of the strained state of public finance and the impact of fossil fuel consumption on global warming. More specifically, while the higher provisional tax rates were abolished, it was decided that tax rates of the gasoline tax, local gasoline tax and light oil delivery tax would be maintained at the pre-reform levels for the time being. However, if the average benchmark gasoline retail price exceeds ¥160 per liter for three successive months, the portions of fuel taxes in excess of the tax rates set under main rules would be suspended. Further, for the automobile weight tax, graded multiple tax rates were established in accordance with environmental burdens of automobile bodies as part of the greening of the tax system. The so-called "eco-car tax reduction" scheme was also maintained.

Meanwhile, regarding overall environmental tax systems, European and other countries have been revamping and strengthening environmental tax systems, including energy and automobile-related taxes, since the 1990s (Figure 2-4-2). In Japan, the ratio of environmental tax revenues to gross domestic demand (GDP) is low relative to the ratios in European countries. Concerning taxation for climate change policy, the Ministry of the Environment convened the expert committee on green tax system and its economic analysis, etc. of the Central Environment Council to deliberate on an economic analysis, etc. of green tax system, including tax for climate change policy. In FY2009, the Ministry of the Environment requested the creation of a tax for climate change policy, while the Ministry of Economy, Trade and Industry also asked for the consideration of a tax for climate change policy. A supplementary provision of the law to partially revise the Income Tax Act in FY2010 referred to the tax for climate change policy and said that "it shall be considered for the time being, including the handling of a tax rate, in order to work out a final draft toward implementation in FY2011."

Preferential measures for the promotion of low emission vehicles and energy efficient homes were also incorporated in the FY2010 tax reform plan.

Further, the FY2010 tax reform plan called for consideration of the international solidarity tax in order to resolve global issues. The international solidarity tax is drawing attention as one measure to cope with global issues, including environmental problems as well as the international financial crisis and poverty problems. Various taxation methods are under discussion, including the method to tax international financial transactions to secure resources for measures to deal with financial crises and to curb speculative activities, and the method to tax cross-border transportation to secure resources for development support in developing countries. The idea is spreading internationally, with France, Chile and Korea already introducing the airline-ticket solidarity tax.

Regarding the use of revenues from environment-related taxes, it is noteworthy that an economic model analysis conducted by the Task Force of the Ministerial Committee on the Global Warming Issue found that if the climate change policy tax is introduced as a levy on all carbon emissions based on the carbon content and revenues from the tax are appropriated for measures to cope with global warming, the impact on real disposable income would be reduced significantly compared with the case of all revenues flowing back to the household sector.

Enactment of the Basic Act on Global Warming Countermeasures and Promotion of Measures

In order to clarify the basic direction of Japan's measures to cope with global warming, the bill for the Basic Act on Global Warming Countermeasures was

Figure2-4-3 Outline of the Bill of the Basic Act on Global Warming Countermeasures (Cabinet decision on March 12, 2010)

○Purpose

In recognition of the challenge common to all humankind of prevention of global warming and adaptation to global warming as well as the importance of efforts to prevent global warming under a fair and effective international framework, create a society that emits as little greenhouse gas as possible, can contribute to the global greenhouse gas emissions reduction, and promote global warming countermeasures while ensuring economic growth, stable employment and stable supply of energy, thereby contributing to preserving the global environment and ensuring the present and future healthy and culturally-rich lives of the Japanese people

○Basic Principles

Set forth the following principles as global warming countermeasures:
- Creation of a society that can reduce greenhouse gas emissions while realizing sustained economic growth that ensures prosperous lives of the people and international competitiveness of industry, through the establishment of new lifestyles,
- Active promotion of global warming countermeasures through international cooperation
- Development of industries contributing to the prevention of global warming, expansion of employment opportunities and job stability
- Coordination with energy-related policies and securing of stable energy supply
- Gaining of the understanding about effects and impacts on economic activities and people' s daily lives

○Mid- and Long-Term Goals

- Greenhouse gas emissions reduction goals: Reduce emissions by 25% by 2020 from the 1990 level, premised on the establishment of a fair and effective international framework and agreement on ambitious targets. Also, reduce emissions by 80% by 2050 from the 1990 level, and in this case, the national government shall endeavor to share with all economies the goal of at least halving the global greenhouse gas emissions by 2050.
- Raise the share of renewable energy to 10% of primary energy supply by 2020

○Basic Plan

Formulate a basic plan for the comprehensive and systematic promotion of global warming countermeasures

○Basic Measures

<Concrete measures of particular importance to cope with global warming>
- Creation of a domestic emission trading system (Consider a legislative measure to obtain the final draft within around one year after coming into force of this Act)
- Consideration of a tax for measures against global warming to be implemented from FY2011 and "greening" of the overall tax system
- Establishment of the feed-in tariff system for the whole amount of renewable energy, other measures to promote the use of renewable energy

<People' s daily lives>
- Promotion of energy saving in machinery, appliances, buildings, etc.
- Promotion of voluntary activities
- Promotion of education and learning
- Publication of information on greenhouse gas emissions, etc.

<International cooperation, etc.>
- Securing of international cooperation
- Establishment of a mechanism for evaluation of contribution to emissions reductions in other countries through the provision of technologies and products

<Community building>
- Measures concerning the formation of local communities by the concentration of urban functions, etc.
- Control of greenhouse gas emissions related to transportation through appropriate use of automobiles, etc.
- Preservation and strengthening of absorption of greenhouse gases through development and conservation of forests, promotion of greenery, etc.
- Measures necessary for local governments

<Manufacturing=Monozukuri>
- Promotion of development of innovative technologies
- Promotion of energy saving in machinery, appliances, buildings, etc.
- Shift to energy with less emissions of greenhouse gases, promotion of efficient use of fossil fuels
- Creation of new businesses contributory to prevention of global warming
- Measures concerning nuclear power
- Adaptation to global warming
- Reflection of public opinions in policy formation

Source: Ministry of the Environment

adopted by the Cabinet decision in March 2010 and subsequently submitted to the Diet. The bill incorporates the basic principles concerning global warming countermeasures; responsibilities of the national government, local governments, business operators and citizens; mid- and long-term goals of greenhouse gas emissions reductions, the basic plan for the comprehensive and systematic promotion of global warming countermeasures; and basic measures, etc. (Figure 2-4-3).

The bill for the Basic Act on Global Warming Countermeasures states its purpose as follows: In recognition of the challenge common to all humankind of preventing and adapting to global warming, as well as the importance of efforts to prevent global warming under a fair and effective international framework in which all major economies participate, in order to bring about a society that emits as little greenhouse gas as possible, can preserve and strengthen the absorption of greenhouse gases and can adapt to global warming by contributing to the global greenhouse gas emissions reduction, taking the initiative in the international community to move away from fossil fuels while promoting transformation of the socioeconomic structure, the purpose of this Act is to promote global warming countermeasures while ensuring economic growth, stable employment and stable supply of energy.

The bill sets forth a variety of matters to achieve this purpose as mentioned above. Of them, particularly important are the basic principles, mid- and long-term goals and basic measures. We outline them below.

First, the bill sets forth the basic principles in implementing measures to cope with global warming, which incorporate the following seven items.
- Create a society that can reduce greenhouse gas emissions, and preserve and strengthen the absorption of greenhouse gases while realizing sustained economic growth that ensures the prosperous lives of the people and international competitiveness of industry through the establishment of new lifestyles and other means;
- Actively promote global warming countermeasures through international cooperation by leveraging knowledge, technology and experiences, etc. accumulated in Japan and also in accordance with the

status of Japan in the international community;
- Facilitate the dissemination of research and development, and their results, of technology contributing to the prevention of global warming, etc.;
- Facilitate the development of industries contributing to the prevention of global warming, etc. and an expansion of employment opportunities and ensure job security for those engaged in businesses affected by the promotion of global warming countermeasures;
- Ensure coordination with energy-related measures in a manner that secures the stable energy supply;
- Ensure coordination with measures for disaster prevention, preservation of biodiversity and securing of stable supply of food, etc.
- Gain the understanding of business operators and citizens about the effects and impacts of global warming countermeasures on economic activities and people's daily lives and pay due heed to appropriate fiscal management.

The mid- and long-term goals include the mid- and long-term goals for greenhouse gas emissions reductions and the mid-term goal concerning the supply of renewable energy, both of which cite specific figures. Regarding the former, the bill sets the goals of reducing greenhouse gas emissions by 25% by 2020 from the 1990 level, premised on the establishment of a fair and effective international framework in which all the major economies participate and their agreement on ambitious reduction targets, and of reducing emissions by 80% by 2050 from the 1990 level, and in this case, the bill states that the national government should endeavor to share with all the economies the goal of at least halving the global greenhouse gas emissions by 2050. Regarding the latter, in relation to the achievement of the mid- and long-term

Figure2-4-4 Mid- and Long-Term Roadmap for Global Warming Countermeasures (Outline)
– Draft Proposal by Minister of the Environment Sakihito Ozawa -

【Things that I would like to convey in the Mid- and Long-Term Roadmap】
1) Global warming countermeasures are an urgent issue necessary to protect the environment of Japan and the rest of the world. The roadmap proposes a path of measures and policies for reducing emissions by 25% by 2020 and by 80% by 2050.
2) Promoting environmental investments and practicing a low-carbon lifestyle (or an eco-friendly lifestyle) will allow people to live comfortable, affluent lives – not lives based on tolerance. The efforts of each and every citizen via Challenge 25 are needed in order to achieve mid- and long-term objectives.
3) It is important not to focus on burdens alone but to think of global warming countermeasures as a pillar of new growth. Investing in the construction of a low-carbon society will generate a variety of benefits, including the cultivation of new markets and jobs, revitalization of communities, and ensuring of energy security.

Daily life - Spread of Zero-emission Residential Houses and Buildings -

【Goal】 100% achievement rate of revised energy-saving standards for new buildings*
- Establishment of zero-emission standards that integrate structures (buildings), energy-consuming appliances and other household electronics, and energy-creating devices such as solar light
- Make fulfillment of energy-saving standards and zero-emission standards mandatory
- Tax system, etc. for promotion of new construction and improvement of old buildings
- Making the labeling system and environment performance display mandatory
- Support for making homes zero-emission from a home/GHG consultant
- Creation of a mechanism that visualize housing performance and provides incentives in accordance with reduction amounts

Community Building - Creation of Walkable Communities -

【Goal】 Reduction of driving distance per passenger by 10%*
- Formulate an "action plan to create a low-carbon society" in all municipalities
- Close proximity of residential, commercial and business areas to the station and within the walking distance
- Extension of LRT and BRT, and expedited construction of planned rail routes
- Development of space for sidewalks and bicycles
- Support for promotion of the use of public transportation
- Maximization of the utilization of unused heat in urban areas
- Development of low-carbon municipal districts utilizing local natural resources
- Making distribution and interregional passenger transportation low-carbon

Daily Life - Making Railroad, Marine and Air Transportation Low-Carbon -
- Promotion of introduction of energy-efficient rail cars, ships (eco-ships) and aircraft (eco-planes)
- Promotion of introduction of low-carbon fuels
- Mechanism for cargo owners to choose low-carbon carriers

Community Building - Realizing Zero Carbon Rural Communities -
- Formulation and achievement of "zero carbon plans" in all communities
- Promotion of the use of lumber in buildings, etc., promotion of the use of biomass resources, and utilization of forests, farmland, etc. as sinks
- Spread local energy business models across the country

Daily Life - Environment-Friendly Automobile Market -

【Goal】 Sales of 2.5 million units of next-generation vehicles*
- Heavier/lighter taxation based on CO2 emissions
- Phased tightening of gas mileage standards
- Certification of E10 vehicles
- Promotion of introduction of hybrid and electric vehicles
- Development of high-performance and next-generation batteries
- Promotion of eco-driving and car sharing

Monozukuri - Worldwide Spread of Japanese Low-Carbon Manufacturing

【Goal】 Reduce energy consumption by 30-40%(by 2050)
- Development of markets that reward emission-cutting companies
- Creation of an environment that supports emission-cutting companies financially
- Promotion of information disclosure via financial statements, etc.
- A public disclosure system for calculation reports that evaluate lifecycle emission amounts
- Support for efforts through a GHG consultant system for small businesses
- Support for development of innovative technologies
- Fostering of engineers who engage in "monozukuri" low-carbon manufacturing
- Thorough discontinuation of use of chlorofluorocarbons (control of emissions of three greenhouse gases, including hydrochlorofluorocarbons)

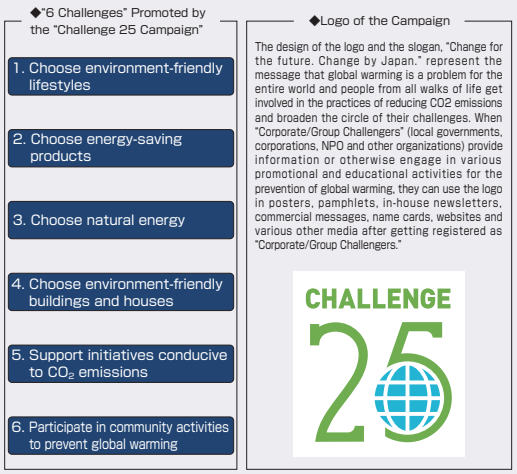
Energy Supply - Next-Generation Energy Supply Aimed at a Low-Carbon Society -

【Goal】 Raise the ratio of renewable energy to at least 10% or more (by 2020), achieve the 100% diffusion rate of smart grid systems (by 2030)
- The feed-in tariff system at levels encouraging business investment (the internal rate of return of 8% or more, etc.), and the green certificate system for heat
- Nurturing of companies and areas that seek to spread the use of renewable energy by reducing business risks and initial burdens
- Making introduction of renewable energy mandatory, and reforming social systems in accordance with diffusion levels
- Enhancement of the power grid and storage systems to withstand the introduction of the large amount of renewable energy, and development of the smart grid
- Making thermal power generation low-carbon using fuel conversion and high-efficiency thermal power generation technology, and expanded use of nuclear power generation, with safety as the top priority

Core Social Systems for Creating a Low-Carbon Society
- The cap-and-trade domestic emission trading system and the tax for global warming countermeasures

Note: Goals without any specified year for achievement are intermediate goals on the road to 2020
Source: Ministry of the Environment

Figure2-4-5 Challenge 25 Campaign



Source: Ministry of the Environment

goals for greenhouse gas emissions reductions, the bill sets the goal of raising the share of the supply of renewable energy to the total annual supply of primary energy in Japan to 10% by 2020.

In addition to the establishment of three major systems – the domestic emission trading system; consideration of the tax for global warming countermeasures and the review of the overall tax system; and establishment of the feed-in tariff system for the whole amount of renewable energy, the basic measures provide for measures for the spread and expansion of the use of renewable energy other than the feed-in tariff system for the whole amount of renewable energy; measures concerning nuclear power; promotion of rationalization of energy use; measures concerning transportation; promotion of development of innovative technologies; promotion of education and learning; promotion of voluntary activities; measures concerning the formation of local communities; preservation and strengthening of the absorption of greenhouse gases; adaptation to global warming; measures for international cooperation; and reflection of public opinions in policy formation, etc.

Of the three major systems specified in the basic measures, the domestic emission trading system, designed for steady reductions in greenhouse gas emissions, sets limits on greenhouse gas emissions by greenhouse gas emitters during a certain period and also allows transactions of greenhouse gas emissions with other emitters for compliance with the limits. The government will consider a necessary legislative measure, in parallel with the consideration of the tax for global warming countermeasures, to obtain the final draft within around one year after coming into force of the Act on Global Warming Countermeasures. In considering the necessary legislative measure, the government will consider the scope of emitters, the method to set the limits on greenhouse gas emissions by emitters during a certain period and other necessary matters concerning the appropriate implementation of the domestic emission trading system. Concerning the method to set the limits on greenhouse gas emissions during a certain period, the government will consider a formula of setting the limits on emissions as an absolute amount of greenhouse gas emissions, in principle, while also considering a formula of setting the limits on emissions as per unit of output and other amounts that indicate the scale of business activities.

The bill also calls for the formulation of a basic plan for the comprehensive and systematic promotion of global warming countermeasures (the Basic Plan). In order to present an image of measures and polices for achieving the goals of reducing greenhouse gas emissions by 25% by 2020 and by 80% by 2050, as well as potential economic effects of these measures and policies, the Ministry of the Environment announced the "Mid- and Long-Term Roadmap for Global Warming Countermeasures (Draft Proposal of Minister of the Environment Sakihito Ozawa)" on March 31, 2010 (Figure 2-4-4). We plan to carefully examine the draft by listening to opinions of the Japanese people going forward in order to make it a much better roadmap.

Furthermore, given such a path of action, we are building up the "Challenge 25 Campaign," a popular movement to promote the Challenge 25 in which all people join hands to protect the "environment of the earth and Japan" and carry it over to the future generation, and will move on to reduce CO_2 emissions from a variety of activities, ranging from manufacturing operations to people's daily lives, by encouraging the practices of the "6 Challenges," including the choice of environment-friendly lifestyles and the choice of energy-saving products (Figure 2-4-5).

Japan will also take the initiative in international negotiations to build a fair and effective framework in which all major countries, including the United States and China, will participate. In order to serve as a bridge between developed and developing countries, Japan will push ahead with measures to support developing countries that actively take mitigation measures under the "Hatoyama Initiative," while closely monitoring developments in international negotiations going forward.

Column The Challenge 25 Campaign, a Popular Movement for Prevention of Global Warming

The world is poised to stand up against global warming, which threatens the survival of mankind.

Japan has ratified the Kyoto Protocol and made a commitment to the world that it will reduce greenhouse gas emissions by 6% from the 1990 level between 2008 and 2012.

At the U.N. Summit on Climate Change in New York in September 2009, then Prime Minister Yukio Hatoyama unveiled Japan's goal of reducing its greenhouse gas emissions by 25% from the 1990 level by 2020, premised on the establishment of a fair and effective framework in which all major economies participate and agree on ambitious targets. The Japanese government is mobilizing all policy tools available to prevent global warming, naming this endeavor as the "Challenge 25" to protect the environment of the earth and Japan and hand over our earth for future ages children.

On January 14, 2010, the government launched a popular movement for this purpose, the "Challenge 25 Campaign," calling on the Japanese people to practice specific actions to reduce carbon dioxide. Well-known people playing active roles in various quarters are also participating as a cheering squad for the campaign. We would really appreciate if you all could participate in this campaign.

"Challenge 25 Campaign" Cheering Squad Captain
Yuzo Kayama,
Actor, singer-songwriter

I am Yuzo Kayama, captain of the cheering squad for the Challenge 25 Campaign. Many people in Japan may not yet have taken concrete actions for the prevention of global warming, but I am sure they feel they must start doing something for the future of the world. I will be making a fresh start and take on the challenge of reducing CO_2 emissions together with everyone else. Please join us in this campaign.

"Challenge 25 Campaign" Super-Adviser
Hiroshi Komiyama
Doctorate of Engineering (University of Tokyo, 1972), 28th President of the University of Tokyo, Chairman of Mitsubishi Research Institute, Inc. since April 2009; adviser to the President of the University of Tokyo

I live in an eco-house and achieved by 81% reduction of CO_2 emissions. In addition, there are other advantages, too. I have no dew formation in the house, it is no longer cold in a washroom, and the initial cost can be recouped. Livability is the key. I will do my best as super-adviser. I would like to ask you to take on the challenge of cutting CO_2 emissions.

"Challenge 25 Campaign" Cheering Squad
Aya Ueto
Actress

I am doing my share of eco-friendly activities by using "my chopsticks" and carrying "my bag." Recently, we are seeing an increasing number of handy, eco-friendly electric appliances, such as cell phones mounted with solar panels. I will keep practicing eco-friendly efforts in my daily life and stay on the diet with CO_2. Let's join on the CO_2 diet together.

"Challenge 25 Campaign" Cheering Squad
Motoko Obayashi
Sportscaster, sports ambassador of the Japanese Olympic Committee

I hear that we might not be able to ski or play beach volleyball 50 years or 100 years from now. Athletes like me are engaged in activities such as sending messages to children for the prevention of global warming at various competition sites. I plan to make more such efforts going forward.

"Challenge 25 Campaign" Cheering Squad
Takeshi Okada
Coach of Japan's national soccer team, promoter of the Global Environment Initiative (GEIN)

I am into efforts to fight global warming, such as serving senior promoter of a group trying to spread the use of renewable energy in Japan. Looking back on my own daily life, however, I have to admit that I am not doing things which I should. I will make more efforts from now on.

"Challenge 25 Campaign" Cheering Squad
Aya Sugimoto
Actress, writer

I feel troubled every time I see wild animals and the beauty of nature sacrificed for economic development. On each occasion, I also feel the arrogance and folly of mankind. I intend to get involved in eco-friendly activities with love and compassion, and would like to sharpen my environmental consciousness.

"Challenge 25 Campaign" Cheering Squad
Ai Sugiyama
Professional tennis player, holder of the world record of participation in 62 successive Grand Slam tournaments, won Grand Slam doubles titles three times, took part in four Olympic Games

I feel temperature rises due to global warming in my bones when I take part in tennis tournaments overseas. Hot weather is making players' environment increasingly more harsh. I plan to start with replacing electric appliances with energy-saving ones in my efforts to shift to an eco-friendly lifestyle.

"Challenge 25 Campaign" Cheering Squad
Tetsuya Bessho
Actor, Representative of "Short Shorts Film Festival & Asia"

Working as an actor, I also serve as representative of an international short film festival and we set up the "Stop! Global Warming" division in 2008. Each year, we receive films with messages for the prevention of global warming from film creators around the world. We would like to send out messages with the mind against global warming to people in Japan as well as the rest of the world. Let's practice the challenge for prevention of global warming together.

2 Efforts by Various Entities Leading to the Challenge 25

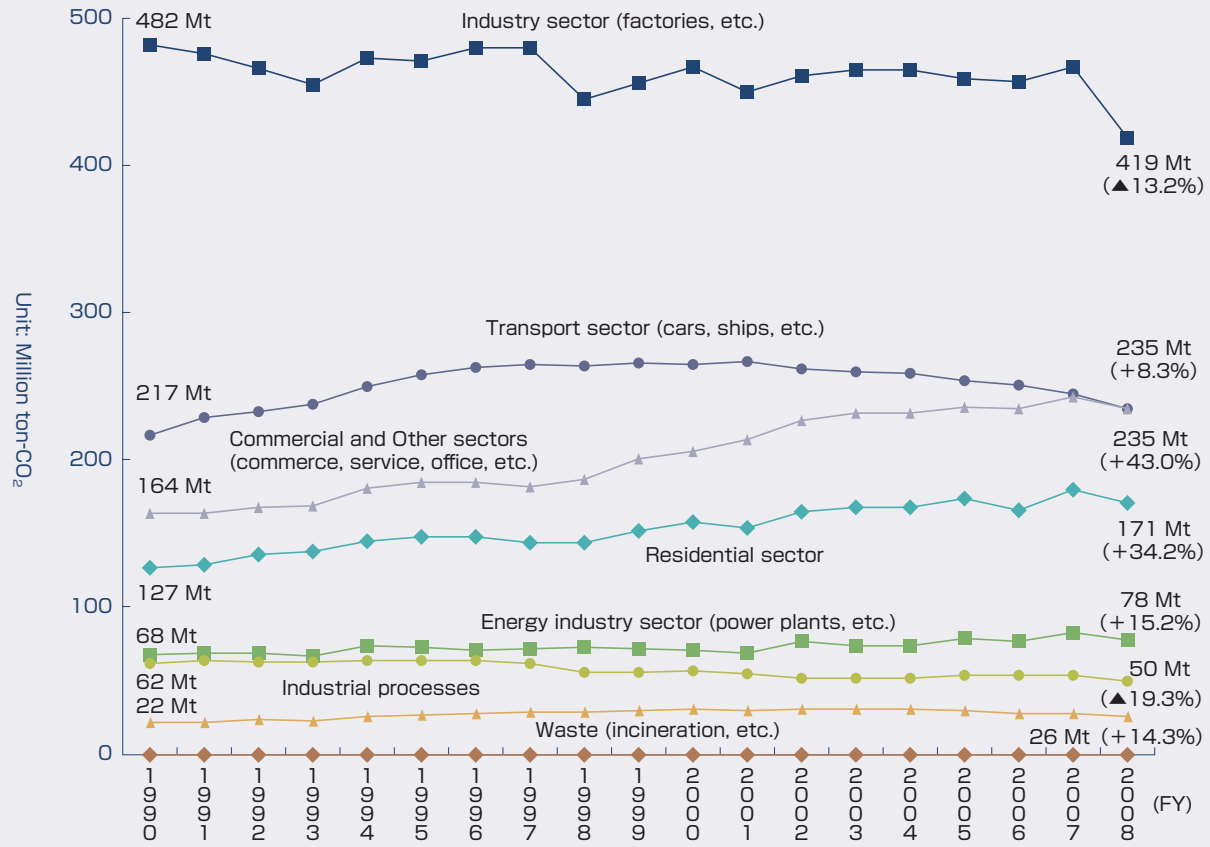
In tandem with government actions as described above, private-sector companies and all other entities heightened their consciousness about global warming and began to make various efforts to reduce carbon dioxide emissions. The "Survey on Environment-Friendly Business Practices," conducted by the Ministry of the Environment since FY1991, shows that over nearly the past 10 years, the largest group of companies have "set forth policies for efforts" to fight global warming and the ratio of such companies has continually been increasing. The Ministry of the Environment also conducts the "Fact-finding Survey on Environmentally Friendly Lifestyles" via the Internet for a questionnaire survey on people's awareness of environmental problems and their behaviors. In the survey results of recent years, the largest group of respondents cited "global warming" as the area of environmental issues they are most interested in, and the ratio of people giving this reply has stayed in the range of 80-90%. These results clearly show people's rising awareness of global warming.

Despite these survey results, Japan's total carbon dioxide emissions unfortunately have not been reduced much in recent years. Total emissions of greenhouse gases in FY2008 amounted to 1,282 million tons (CO_2-equivalent), and were 1.6% higher compared with the base year under the Kyoto Protocol (FY1990 for CO_2, CH_4 and N_2O, and 1995 for HFCs, PFCs and SF_6)*.

Looking at trends of emissions by sector, emissions in the industry sector (factories, etc.) and the transport sector (cars, ships, etc.) have been on the moderate decline due to the effects of various efforts, carbon dioxide emissions in the commercial and other sectors, including commerce, service and office, etc. and the residential sector have been on the increase, canceling out the reductions in the industrial and other sectors (Figure 2-4-6). Reductions of carbon dioxide emissions in the industry and other sectors from FY2007 to FY2008 apparently stemmed from the rapid business slowdown in the latter half of the fiscal years in the aftermath of the financial crisis.

The increasing trend of emissions in the commercial and other sectors, including commerce, service and office, etc. can be traced to an increase in the gross floor space of offices and retail outlets, etc., the associated increase in air-conditioning and lighting facilities, and increased power consumption due to the progress of office

Figure2-4-6 Trends of CO_2 Emissions by Sector (after Allocation of Emissions from Power and Steam Generation)



Note: Figures in parentheses are percentage changes in the FY2008 emissions by each sector from the base-year emissions
Source: Ministry of the Environment

* Total emissions of greenhouse gases in FY2008 is 3.4 % lower compared with the base year (under the kyoto Protocol in FY1990), if estimated by using actual level of unclear power generation in 1998 when its performance was not effected by long suspension.

automation. One of reasons for the higher emissions in the residential sector is increased power consumption resulting from a rise in the number of households. The energy consumption pattern of these sectors is to purchase and use ready-made energy-consuming equipment and appliances and lack professional knowledge

Column Solutions by "Visualization" -- Toward Compatibility of Profit Generation by Companies and Reduction of CO2 Emissions

Greenhouse gases generated by energy consumption are a major source of global warming. In order to protect the comfortable way of life and the livable earth for our descendants, not only companies and industrial plants but also retail outlets and residential houses have been called upon to make energy-saving efforts in recent years.

Since energy like electricity and gases is intangible, we normally cannot see an amount used. However, through "visualization" of an amount used, it is possible to make a detailed analysis of when, where and how much energy is being used. Even in the commercial and civilian sectors of offices and homes, where it was previously thought to be difficult to take measures to reduce carbon dioxide emissions, an unexpectedly large amount of uneven or wasteful use of energy can be found by "visualization" of an amount of electricity consumed.

In recent years, a business was launched to identify the wasteful and uneven use of energy at plants and offices of customer companies and provide advice on improvements through "visualization" of an invisible amount of energy used. Energy-saving and environmental activities based on this technology are also becoming active.

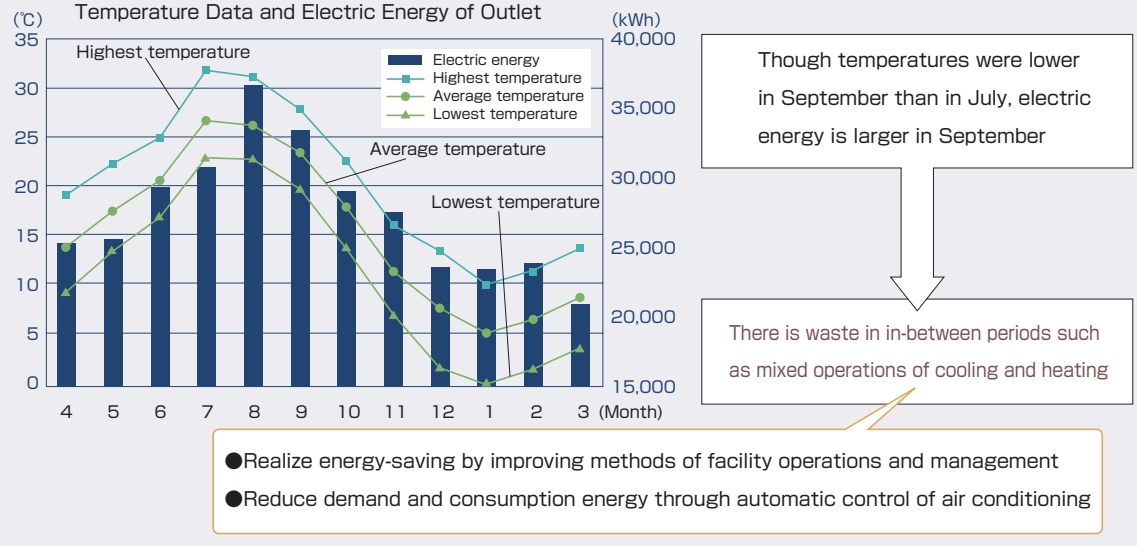
Particularly in the manufacturing sector, where energy-saving activities have been going on for long years, people tend to think that all conceivable improvement measures have already been taken. But more precise energy measurement and "visualization" of each facility and production line should find that there still is unexpected room for further improvement.

Also, the civilian and commercial sectors, which have been increasing carbon dioxide emissions year by year, are assumed to have further room for energy-saving efforts. In the case of companies that operate multiple outlets, attention tends to be focused on energy consumption at these outlets. However, by looking at companies' overall operations and through management of business bases that consume a large amount of energy, such as distribution centers, warehouses and manufacturing plants, we are likely to find further room for reducing carbon dioxide emissions.

Energy-saving activities based on "visualization" have produced remarkable results, notably in the "Kyoto model," of robust eco-friendly activities at municipal kindergartens and elementary, junior high and high schools in Kyoto. Furthermore, through environmental education that utilizes the "visualization" technology, efforts are under way to nurture human resources for building a sustainable society. Energy-saving and environmental activities can be expected to broaden further, spreading from schools to homes and local communities.

Going forward, with the spread of photovoltaic power generation, etc. and through the optimum accommodation of electricity such as prioritized utilization of renewable energy that does not emit carbon dioxide, it can be expected that the compatibility of the comfortable way of life and reductions of carbon dioxide emissions will become feasible and a society that enriches both the environment and people's livelihood will be realized.

Examples of Improvements by "Visualization"



Source: Prepared by the Ministry of the Environment based on data provided by Omron Corp.

about places in offices or homes and how much of carbon dioxide is being emitted. Thus, it is deemed difficult for these sectors to reduce emissions as the industry sector (factories, etc.) does by reviewing and altering their own processes. However, as seen from the results of the "Fact-finding Survey on Environmentally Friendly Lifestyles," people today are thought to be interested in making their own efforts to reduce carbon dioxide emissions. Since the commercial and residential sectors have not yet taken substantial actions to reduce emissions and have a lot of waste and unevenness in the use of energy, there is much to be done in these sectors.

From the viewpoint of further room for global warming countermeasures, it is also very important to take possible measures for the whole spectrum of the supply chain, paying attention not only to the seemingly most principal carbon dioxide emission processes like the process of manufacturing but also to emissions from the process of raw materials procurement (upstream) as well as the processes of shipments and distribution of products, use and disposal, etc. (downstream). In considering countermeasures throughout the supply chain, companies should take note of not only emissions caused by their own activities but also emissions stemming from activities of affiliated companies in business operations, including those overseas.

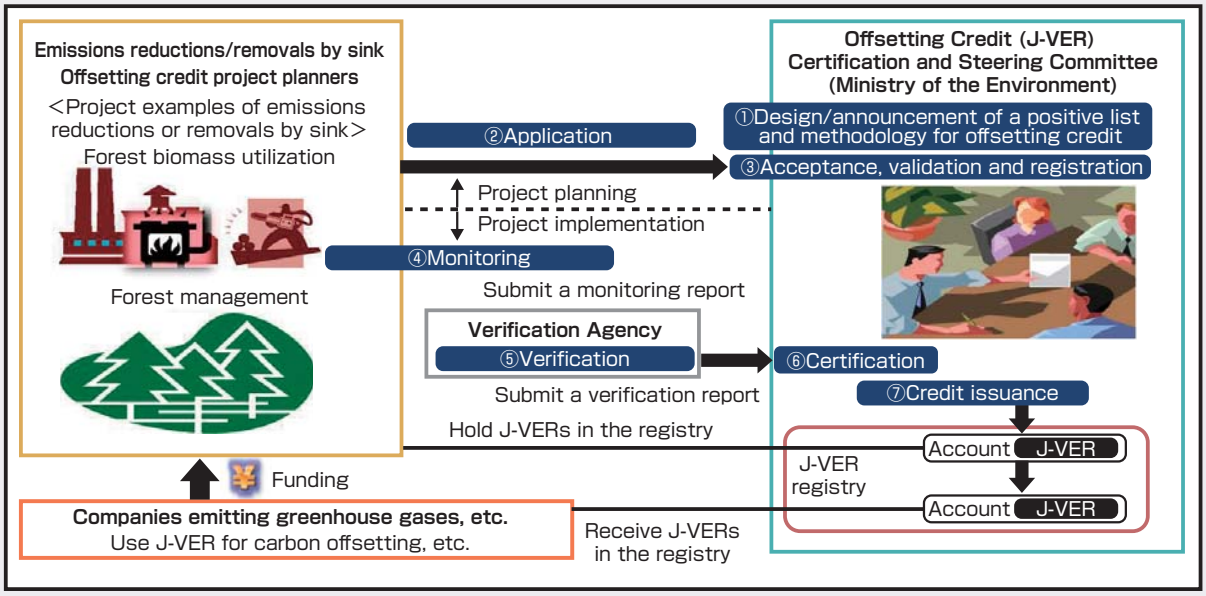
As an example of emissions reduction efforts through the entire supply chain, a diversified chemicals manufacturer succeeded in reducing carbon dioxide emitted in the processes of ore refining to manufacturing by 74% compared with emissions it emits when the company starts from ore refining on its own by focusing on the resources procurement process and switching to the closed loop recycling of scrap aluminum. If Japanese companies are procuring parts overseas or have transferred assembly processes abroad and are emitting large quantities of carbon dioxide, they could transfer Japanese technologies overseas and cut emissions from operations there. Another Japanese manufacturer found that there is considerable room, or waste, in the average trucking load by focusing on the distribution process, an area to which little attention has been paid hitherto. The spread of these efforts is much desired going forward.

If we are to extend the approach of capturing the whole process ranging from upstream to downstream operations comprehensively nationwide, there may be companies in various industries that have to depend on the procurement of raw materials overseas with the low degree of environmental-friendliness, or there may be companies that import products that emitted large quantities of carbon dioxide in the process of manufacturing. In Japan, on the other hand, there are a lot of products that have been manufactured in environmentally friendly processes or that have high environmental performance. It is conceivable that such products are exported and are contributing to emissions reductions in destination countries. Looking at such instances comprehensively, it is desirable that Japanese industry as a whole develops an industrial structure that makes it possible to reduce carbon dioxide emissions from a global perspective.

On this basis, the Japanese steelmaking industry's emissions are about 40% less than overseas steelmakers in terms of an amount of carbon dioxide emitted to produce the same amount of crude steel. By exporting large quantities of steel produced with this excellent technology, it is assumed that Japanese steelmakers are

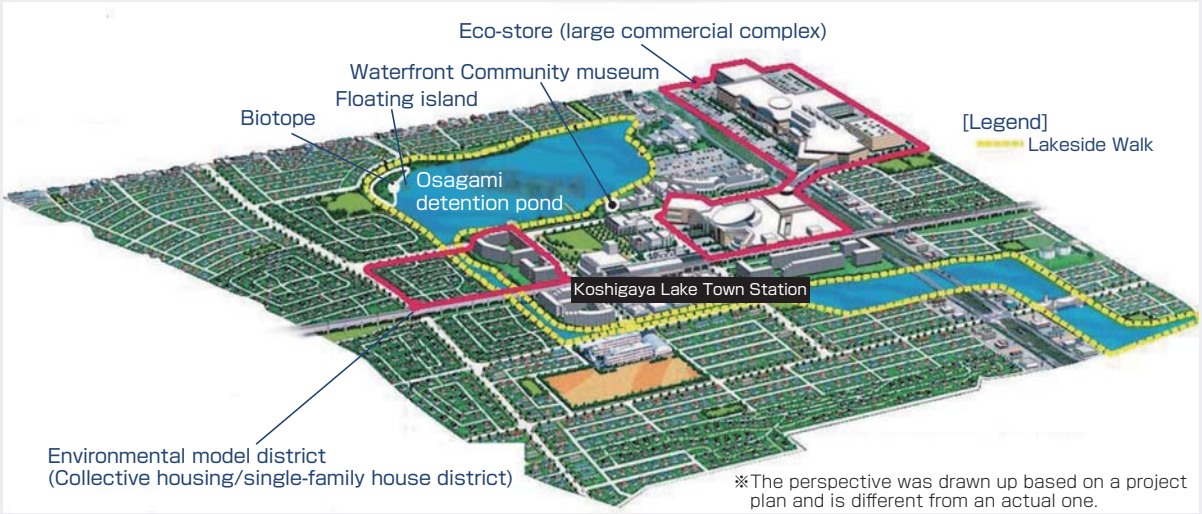
Figure2-4-7 Offsetting credit (J-VER) Scheme

○The scheme for certifying amounts of greenhouse gas emissions and removals by sink in projects undertaken in Japan as offsetting credit (J-VER) with certain reliability used for carbon offsetting. The scheme was created by the Ministry of the Environment in November 2009.
○Under the scheme, funds for carbon offsetting by citizens, companies and municipalities, etc. (funds to purchase J-VER) flow back to planners of domestic emissions reduction/removal projects, such as local forest management and local industries



Source: Ministry of the Environment

Figure2-4-8 Koshigaya Lake Town Land Readjustment Project



Source: Saitama Regional Branch Office, Urban Renaissance Agency

contributing to emissions reductions by 14 million tons (equivalent to a little more than 1% of Japan's gross emissions) globally in 2007, the net of the impact from steel Japan is importing from foreign countries. A Japanese automaker, in its "Sustainability Report 2009," stated that the company has sold a cumulative total of over 1.8 million hybrid vehicles, including to overseas markets, claiming that the cumulative global effects of carbon dioxide emissions reductions would exceed 10 million tons. In water purification technologies used, for instance, for seawater desalination, Japanese companies excel in the reverse osmosis membrane method. One membrane maker estimates that it has contributed to reducing carbon dioxide emissions by some 9.4 million tons globally in 2007 by spreading its membrane technology worldwide to replace the conventional evaporation method. As demonstrated by specific examples cited above, some Japanese companies have already been playing major roles in reductions of greenhouse gas emissions overseas. By continuing similar efforts in various industry sectors, Japan, as stated in the New Growth Strategy, should aim to reduce global greenhouse gas emissions by about 1.3 billion tons-CO2, almost the same amount as Japan's gross emissions, by taking advantage of superb technologies developed in the private sector.

Provision of information, or "visualization," on carbon dioxide emissions from various goods and services used by people (both individuals and corporations) who are aware of global warming problems and want to reduce carbon dioxide emitted from their daily life or business activities should give a strong boost to their actions and behaviors. Also, in response to people's growing consciousness of global warming, we are entering an era in which active efforts to reduce emissions of carbon dioxide help enhance the brand value of companies and their products. Against this backdrop, for example, there are an increasing number of companies that donate carbon dioxide emission rights purchased overseas to the national government for carbon offsetting while trying to improve the image of their brands by offering goods and services that come with carbon offsetting. Regarding the green electricity certificate system, essentially a similar scheme to carbon offsetting, the amount of contracted electric energy has been increasing sharply in recent years. As for the government's responses regarding carbon offsetting, for example, the Ministry of the Environment is operating the offsetting credit (J-VER) system to contribute to reductions and removals of carbon dioxide emissions by supporting carbon offsetting and at the same time to direct a flow of private-sector funds to mountainous villages for local revitalization (Figure 2-4-7).

In order to support small businesses' efforts to reduce carbon dioxide emissions, in tandem with the trial implementation of a domestic integrated market for emission trading, the domestic credit system was initiated in October 2008 for the certification of greenhouse gas emissions reduced by small businesses by employing technologies and funds provided by large corporations, which then use certified amounts to help achieve reduction targets incorporated in their voluntary action plans, etc.

We have also seen the emergence of bold attempts to reduce carbon dioxide emissions from residential houses and commercial facilities in communities as a whole. Tokyo's Chiyoda Ward, pursuant to an ordinance on global warming countermeasures enacted in January 2008, started replacing street lights managed by the ward office with energy-saving lights in FY2008 as part of its initiative to reduce electric energy used in ward facilities. Assuming that all of the 5,501 street lights managed by the ward are replaced with energy-saving ones, electric energy used would be reduced by some 2.5 million Kwh, an amount equivalent to the annual consumption of electric energy by some 700 households. In Koshigaya, Saitama Prefecture, meanwhile, the "Koshigaya Lake Town" land readjustment project, for which the Urban Renaissance Agency serves as a constructor, is aimed at community-building for

environmental coexistence, establishing dedicated lanes for bicycles and building a compact town by locating most of residences within walking distance of 15 minutes from a railway station. The project also makes use of cool air flowing from a detention pond as well as the solar central heating for a housing complex. A large-scale commercial complex at the project site has introduced high-efficiency air conditioning using city gas (the hybrid gas eco-system) and photovoltaic power generation, reducing carbon dioxide emissions by 20% compared with conventional shopping centers.

The Koshigaya Lake Town, for its eco-friendly community-building efforts, won the project gold award of the international awards for environmentally sustainable community-building at the LivCom2009, the only international awards system in this area.

As seen above, companies' voluntary purchases of carbon dioxide emission rights and relatively expensive green electricity and the private sector-led large-scale projects explicitly aimed at carbon dioxide emissions indicate the penetration of the significance of global warming countermeasures among people and also suggest the generation of specific methodologies for economic growth while preserving the environment at the same time.

Efforts and measures to cope with global warming are not limited to Japan alone. Besides, if solutions to global warming problems would come only at the expense of people's cultures and affluence, no countermeasures could be implemented on a sustained basis. Innovative technologies are required to take countermeasures without sacrificing the standards of living. As cited in the New Growth Strategy, Japan's environmental technologies are so excellent as to be able to contribute to reducing global carbon dioxide emissions and also prove to be the largest strength of the Japanese economy going forward.

We do not need to mention again Japan's technological edge in hybrid vehicles, rechargeable batteries or heat pumps. Aside from these technologies, Japanese companies command a global market share of 90% for electric energy-saving displays and materials for organic EL, which is very promising as the next-generation lighting (Figure 2-4-9), and Japan also has the world's leading technologies and market shares for power semiconductor devices used in photovoltaic power generation systems and hybrid vehicles, whose market is continuing to expand at an annual rate of nearly 20%. Furthermore, as mentioned earlier, the New Growth Strategy has set forth the goal of reducing worldwide greenhouse gas emissions by at least 1.3 billion tons of CO2 equivalent using Japanese private-sector technology. Indeed, Japan can be described as being in a good position to fully realize the "environment-led economic development."

However, given the state of affairs in other countries and fierce international competition, it is not necessarily easy to spread Japanese products and technologies worldwide. Japan's energy-saving technologies require sophisticated knowledge about maintenance and management for their optimum operation, and some developing countries may find costs of technological transfers too high, and the adequate protection of intellectual property rights is essential for companies' continued development efforts and diffusion of developed technologies. Therefore, for the transfer and spread of Japanese technologies, it is necessary to specify and develop technologies most suitable to the conditions of recipient countries, foster human resources to maintain and manage transferred technologies, provide appropriate financial support and improve legal systems. In order to facilitate these efforts, we should also consider ways to proceed with these efforts in "win-win" relationships with counterparty countries by effectively utilizing mechanisms for support for developing countries through the Hatoyama Initiative and by building a mechanism for appropriate evaluation of contributions by companies that offer Japan's renowned clean technologies as well as product infrastructures and production facilities.

On the other hand, Japan's industry should not forget to lead the world in the pursuit of further sophistication of environmental technologies and take the initiative in introducing top-runner production technologies. According to a survey by the New Energy and Industrial Technology Development Organization (NEDO), if the thermal efficiency of Japan's coal-fired thermal power plants is replaced by top-runner equipment, it would potentially reduce carbon dioxide emissions by about 4 million tons.

These endeavors would have to overcome difficult technological challenges, but Japan's underlying strength certainly has that potential and Japan is being called upon to use its technological prowess to contribute to solving the problem of global warming. In the course of overcoming these challenges, it is possible that we will see the birth of "export products" that strongly power the Japanese economy going forward.

Figure2-4-9 Organic EL Lounge

Photo: Yamagata Promotional Organization for Industrial Technology

Column Quantum Dot Photovoltaic Power Generation

The solar cell technology is of extreme importance for global warming countermeasures. However, the energy conversion efficiency of solar cells is approaching the silicon-based theoretical limit of 29%, thus calling for the development of new materials or new structures to carry solar cells beyond this limit. Expectations are high that quantum dots will play an important role in breaking through the performance limit of existing solar cells. Ideally, the use of quantum dots should make it possible to raise the energy conversion efficiency to at least 60%. When light-collection systems are used, it is possible to generate the equivalent amount of electricity with 1/1,000 of an area of existing solar panels.

Semiconductor quantum dots are the innovative basic technology born in Japan in 1982 through research by Prof. Yasuhiko Arakawa and other researchers. In the solar cell mechanism, when sunlight hits semiconductors, electrons move to create the current of electricity. However, electrons move around freely on existing silicon-based semiconductors, and only electrons that reach electrodes can be taken out, creating the limit on electricity produced. Suppose that a box called "quantum dot," with a size of 10 nanometers (1 nanometer is one billionth of a meter), is placed in here. If the box's potential is low for electrons, electrons become confined in the box and lose the freedom of movement (See a chart on the right). Electrons confined in the box reach electrodes quite efficiently. We can control the energy of electrons (oscillation frequency) by changing the shape of the box. It is just like the way that wind instruments have different tones and pitches according to their shapes. As shown in a chart on the left side, we can change the properties of electrons freely by capturing and confining them in the small box called quantum dots.

Main factors for the energy loss that impose limits on the energy conversion efficiency of solar cells are the transmission loss from not being able to absorb energy from all wavelengths of solar light and the thermal loss that occurs when energy that is larger than the optical energy that can be accepted, causing energy to turn into heat within semiconductors. By utilizing the energy discreteness of quantum dots, it becomes possible to control the thermal loss. Through various forms of ingenuity, we can also eliminate the transmission loss. Through these steps, ideally, it is possible to achieve the energy conversion efficiency of 60% or over.

Up until now, compound semiconductors were mainly used as materials for quantum dots. But it is expected that silicon-based quantum dots will come into being ultimately. At the moment, however, there is a mountain of hurdles to clear before this can be achieved, and long-term research and development efforts required. For example, complete control over the size and location of quantum dots is essential, along with development of high-quality materials. Further, there remain a lot of things that need to be clarified fundamentally.

Quantum dots are an area of research where Japanese researchers have led the world in promoting research and development activities. Regarding the application of the technology to quantum dot solar cells, it is hoped that they can contribute to the realization of high-efficiency solar cells by further gathering up the excellence of intellectual capital in Japan. However, it would be dangerous to have bloated expectations in the short run and long-term research and development efforts over a span of 20 to 30 years are required. Going forward, Japan needs to establish the research and development structure for quantum dots, including the fostering of many researchers and developers from a broad spectrum of research areas. In the future, quantum dot solar cells will certainly be positioned as one of the most important infrastructure devices for the generation of green innovation.

Conceptual diagram of quantum dot and electron microgram

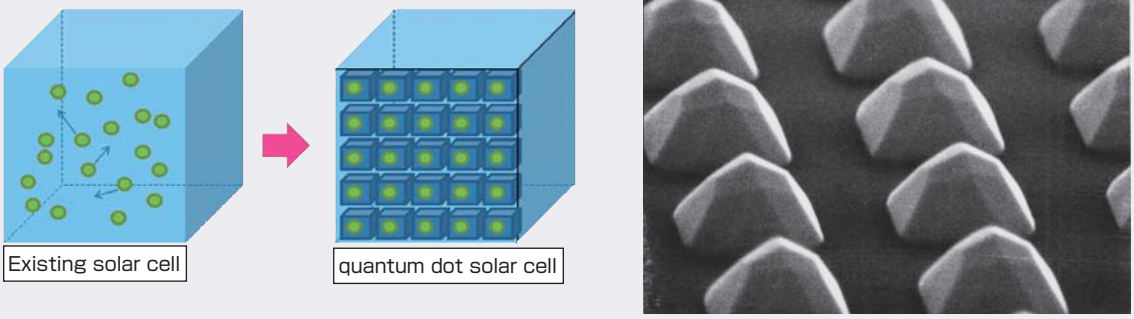


Photo: Prof. Yasuhiko Arakawa, Director of the Institute for Nano Quantum Information Electronics (NanoQuine), University of Tokyo

3 Life of the Future Generation after Reductions in Greenhouse Gas Emissions

What is a low-carbon society, a society after emissions of greenhouse gases were reduced thanks to global warming countermeasures in which each and every entity took part, is like? In the preceding sections, we have asserted that environmental measures should not be taken as constraints on economic growth and we instead should encourage green innovation for economic growth and promote the environment industry. Global warming countermeasures require efforts over a long span of time. How does the Japanese society look in 2050, the target year of long-term goals?

There are a variety of ways to reduce carbon dioxide emissions, and there are also a variety of scenarios for the starting years of introduction of technologies and policy measures. Needless to say, the shape of society in 2050 will change depending on what scenario is put into place.

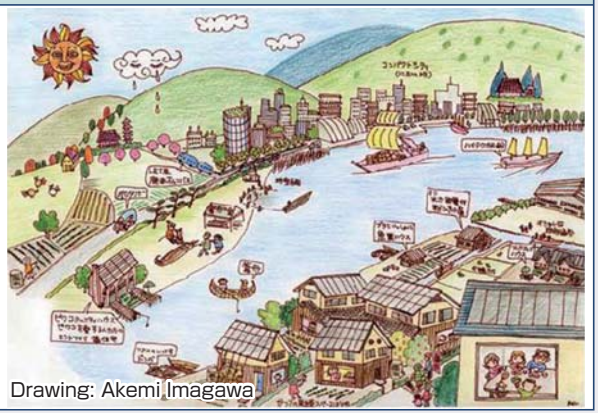
The desirable socioeconomic shape is not uniform and varies among people. For example, the Ministry of the Environment, under the "Comprehensive Research Project Concerning the Establishment of Methods for Multifaceted and Comprehensive Evaluation, Forecast and Planning of Mid- and Long-Term Policy Options toward the Post-Global Warming Society (hereinafter referred to as "the Japan Low-Carbon Society Scenarios towards 2050 Project"), a strategic R&D project sponsored by the Global Environment Research Fund (GERF), assumed economic development/technology-oriented Scenario A and community/nature-oriented Scenario B and envisioned their respective concrete images, including demand for energy and services, using the backcasting approach of first assuming desirable socioeconomic visions of 2050, then investigating whether the visions are feasible and lastly verifying what should be done to realize the visions (Figure 2-4-10).

Under economic development/technology-oriented Scenario A, the rate of technical progress is high against the backdrop of active investment in technological development by both the corporate and government sectors, with economic activities vigorous in the society as a whole to maintain per-capital GDP growth of 2% annually. Supporting the high economic growth, on top of the advancement of technology, are active personal consumption and the strong willingness to work. For employment, there is little discrimination between the young and old or between genders, with no nationality-based barriers. The norm for employment is the ability, character and expertise of each individual, and in this sense, the equal opportunity for employment has been achieved. Most of domestic work previously taken care of by women is either outsourced or mechanized, allowing people to have much time to spend on realizing "personal dreams," like using time outside work for career progression. Personal consumption is robust, as people readily accept new technologies, products and services, leading to relatively short replacement cycles. The numbers of people per household declines, individuals have precedence over families, and young and elderly people living alone increase. The population increases in urban areas than in rural regions, and more people prefer collective housing over single-family detached houses, tending to choose convenient lifestyles.

In community/nature-oriented Scenario B, per-capita GDP growth is lower at 1% a year, but people are sufficiently provided with necessary services, with volunteer and other activities not covered by economic data undertaken actively. As it is possible to get sufficient medical services and education in rural regions as well,

Figure2-4-10 Two Social Visions for Building a Low-Carbon Society

Scenario A: Vigorous, growth-oriented	Scenario B: At ease and self-sufficient
Urban/individuals first	Decentralized/community-oriented
Technological breakthrough by centralized production and recycling	Local production for local consumption, production and consumption of what is necessary, "Mottainai" spirit
Pursuit of a more convenient and comfortable society	Respect for social and cultural values
Per-capita GDP growth of 2%	Per-capita GDP growth of 1%



Drawing: Akemi Imagawa

Source: Prepared by the Ministry of the Environment based on "2050 Japan Low-Carbon Society Scenario Team" (National Institute for Environmental Studies (NIES), Kyoto University, and Mizuho Information and Research Institute)

with inconvenience in daily life all but eliminated, many people move to areas (including rural regions) more suited to their lifestyles, resulting in the dispersion of population and capital from urban centers to rural regions. As a consequence, people who live in single-family detached houses increase, with many people owning houses with gardens in agricultural communities, and the number of people and floor space per household are likely to increase. As for working life, the pattern of husbands and wives adjusting their work to secure enough income to support their families' life plans will have spread and taken firm root. Family members share domestic work, or in many cases, they make use of charge-free services offered by volunteers or NGOs in communities. People have more time to spend with family members, and an increasing number of people use their leisure time for hobbies, sports and individual enrichment courses, or engage in volunteer activities, farm work and community activities. The socioeconomic image presented under Scenario B is a community where diverse characters respect others and live with the wisdom of cooperating on the basis of their respective strengths.

Actually, Scenarios A and B under the Japan Low-Carbon Society Scenarios towards 2050 Project, commissioned by the Ministry of the Environment, are not much different from various other long-term projections for the future of the Japanese society previously presented and are well within the various assumptions. So, the Project estimates that the two scenarios, in reality, would probably move ahead in harmony or cutting across each other in times, eventually leading up to these socioeconomic visions. The Project also demonstrated that under both scenarios, it would be possible to reduce carbon dioxide emissions by 70% by 2050 from the 1990 level. Furthermore, on the basis of the Project's research results, the Ministry of the Environment, taking economic efficiency and policy feasibility into account, examined whether it is technologically possible to secure the supply of energy to meet demand while cutting carbon dioxide emissions by 80%. The conclusion of the examination is that the 80% reduction is possible.

It is also possible to imagine the future vision from the perspective of technological innovation. The concrete image of a low-carbon society, depicted by the Global Environment Committee of the Central Environment Council in FY2008 based on hearings with a total of 18

Figure2-4-11 Concrete Image of a Low-Carbon Society - Community

Big cities/midsize cities

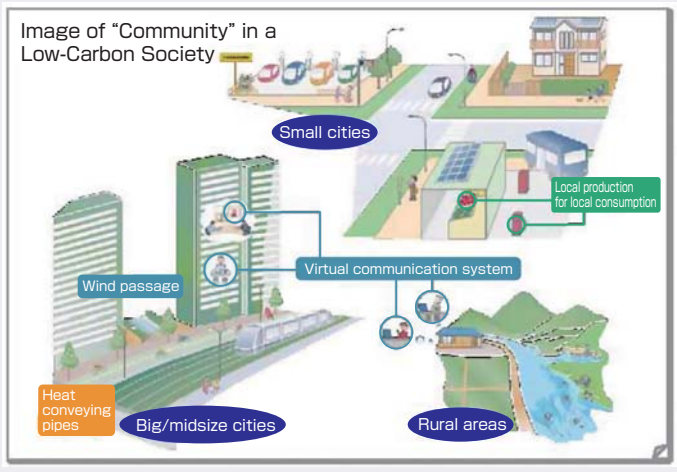
- ■Formation of a livable and bustling compact city
- ■Roads improved for safe riding of bicycles
- ■Use of personal moving vehicles
- ■Public transport network combining railways, buses and LRT in accordance with the size of city and existing infrastructure
- ■Higher ratio of collective housing, proximity of residence to workplace
- ■Active utilization of unused urban energy like sewage, sludge, etc. (the same applicable to small cities); with heat conveying pipes in place, effectively utilize waste heat and other energy sources at the district level
- ■The heat island phenomenon mitigated, with greenery for wind passage and waterfront secured
- ■Can observe starlit sky thanks to reduced outdoor lighting and advertisement
- ■Flood-control facilities in place to prevent urban flooding due to concentrated downpours

Small cities

- ■When the number of households declines, business & commercial facilities and residential areas concentrated around the core railway station, with green space and farmland preserved in surrounding areas
- ■Buses, with substantially enhanced convenience thanks to progress of ICT, play a central role as public transportation systems; buses with various sizes in operation depending on demand (the same applicable to rural areas)
- ■ Farmland surrounds urban areas, a favorable environment for local production for local consumption
- ■For mid-rise buildings, the ratio of wooden buildings using domestic lumber and wooden/steel frame hybrid buildings rise
- ■Due heed paid to local livelihood, history and culture by building natural rivers; flood control, together with preservation and creation of the biological environment and river landscape make cities resilient to natural disasters

Rural areas

- ■Secure CO_2 sink via promotion of forest development and preservation
- ■Primary industries revitalized by expansion of operational size and efficient production
- ■Automobiles have a high ratio as means of travel, but they are motor-driven or powered by biofuels
- ■Most of houses and structures wooden
- ■Sources of supply energy and products are biomass based on waste generated in areas, unused biomass such as rice straws and thinned wood, and resource crops
- ■Efforts to utilize biomass that abounds in rural areas spreading nationwide under partnership among local parties
- ■Due to sophisticated communication systems, jobs available while living in nature-rich rural areas; also possible to receive sufficient medical services and education in rural areas
- ■Further public functions via forest development and preservation contributing to prevent mountain disasters; adaptation according to rural conditions



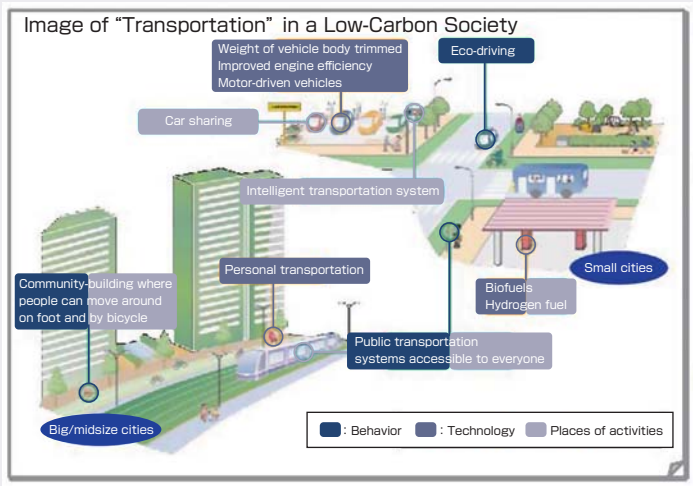
Community Size and Components of a Low-Carbon Society
Components with higher diffusion rate than other areas underlined

	Big cities/midsize cities	Small cities	Rural areas
Transportation	Walk/bicycles	Walk/bicycles	Walk/bicycles
	Personal moving vehicles	Personal moving vehicles	Personal moving vehicles
	Railway/LRT	Railway/LRT	Railway/LRT
	Buses	Buses	Buses
	Automobiles (motor-driven, biofuels)	Automobiles (motor-driven, biofuels)	Automobiles (motor-driven, biofuels)
Housing/structures※	High-rise housing/structures	High-rise housing/structures	High-rise housing/structures
	Mid-rise housing/structures	Mid-rise housing/structures	Mid-rise housing/structures
	Low-rise housing/structures	Low-rise housing/structures	Low-rise housing/structures
Energy	Solar light/heat	Solar light/heat	Solar light/heat
	Heat accommodation	Heat accommodation	Heat accommodation
	Wind power	Wind power	Wind power
	Bio energy supply sources	Bio energy supply sources	Bio energy supply sources

※Broad classification: Low-rise 2-3 stories; mid-rise 4-7 stories; and high-rise 8 or more stories

Source: Prepared by the Ministry of the Environment based on "2050 Japan Low-Carbon Society Scenario Team" (National Institute for Environmental Studies (NIES), Kyoto University, and Mizuho Information and Research Institute)

Figure2-4-11 Concrete Image of a Low-Carbon Society - Transportation



Behavior

- With "visualization" of CO2 emissions for each transportation means and intelligent transportation systems, movers have access to information on operations of public transportation systems anytime and choose transportation means with less environmental burden based on information obtained
- Co-ownership and rental are main forms of vehicle use in urban areas
- Residents actively participate community-based manufacturing in various forms
- Cargo owners and distributors proactively choose low-carbon transportation means

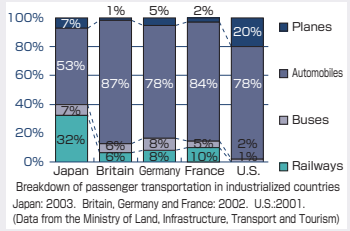
Technology

- Individual automobiles become substantially efficient with the spread of lighter auto body, improved engine efficiency, and motor-driven vehicles (plug-in hybrid vehicles, electric vehicles, fuel cell-powered vehicles)
- Various kinds of (single-passenger) personal moving vehicles introduced; choices of transportation means substantially wider
- Intelligent transportation systems contribute to easing traffic congestion and improving transportation efficiency; autonomous driving of moving vehicles realized; substantially higher safety of vehicles greatly reduces traffic accidents

Foundations supporting behavior and technology

- Public transportation systems like railways, buses, monorails & LRT operate with the appropriate selection and combination in accordance with the size of cities and their characteristics
- Distribution managed in a sophisticated way with advanced information technology; with freight infrastructure such as freight railway stations and port facilities well developed, the low-carbon distribution system in place with the appropriate combination of railways, ships, automobiles and trucks (greater efficiency with mass transportation systems and joint collection/delivery of cargos)
- Compact cities friendly to pedestrians, bicycle riders and the elderly formed with transit malls and dedicated bicycle roads with stations of public transportation systems at the core
- Under the well-developed car sharing system, people rent cars with right sizes when necessary
- bicycle rental services spread widely under management systems utilizing sophisticated information technology
- Roads with smooth traffic without jam-up realized through promotion of measures to ease congestion, such as loop road construction, to deal with bottleneck railroad crossings, and diversified and flexible expressway tolls; automobile traffic operations more efficient via improved provision of road traffic information using intelligent transportation systems

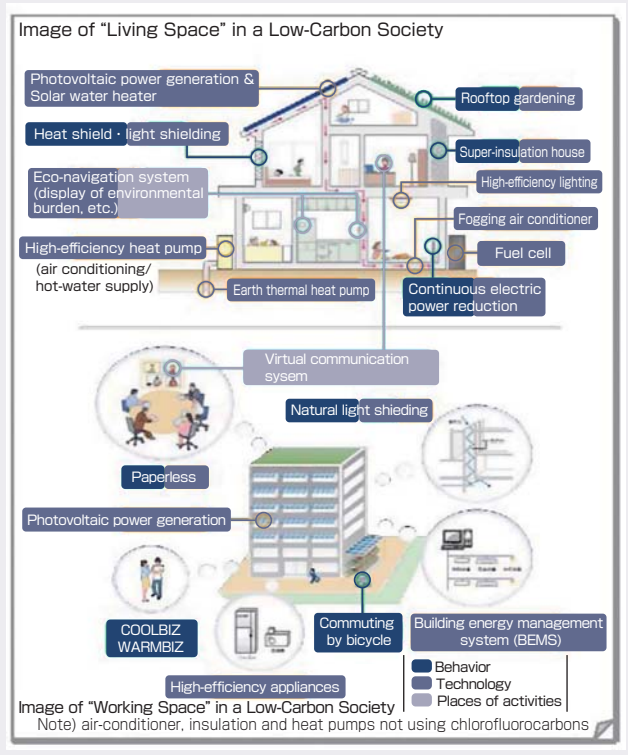
Japan' s pride: High utilization rate of public transportation systems



Superb moving vehicle technology

Source: Prepared by the Ministry of the Environment based on "2050 Japan Low-Carbon Society Scenario Team" (National Institute for Environmental Studies (NIES), Kyoto University, and Mizuho Information and Research Institute)

Figure2-4-11 Concrete Image of a Low-Carbon Society - Living Space



Behavior

- Practices firmly in place to avoid wasteful use of energy at home and workplace and effectively utilize natural energy
- Energy-saving actions practiced based on accurate information provided via "visualization" technology
- Family members, condominium residents and company employees cooperate to achieve energy saving with the strong environmental consciousness not to use energy wastefully
- Regardless of locations of residences, people can utilize sophisticated information technology to build the work environment similar to that in company offices at home or at facilities near their home, creating substantially greater latitude in working styles; companies can choose locations more freely and can operate on the global marketplace without having offices in big citeis

Technology

- Appliances with high energy efficiency (high-efficiency heat pump, high-efficiency lighting, etc.), made on the strength of Japan' s "monozukuri" manufacturing prowess, and natural energy utilization technologies have been developed and spread widely
- Electricity and heat are consumed in a rational combination of those produced at home or within buildings using solar energy and fuel cells and those externally provided via system power and heat conveying pipes
- Lighting and air conditioning operated in accordance with movements of dwellers using IT-based sophisticated control technology

Foundations supporting behaviors and technology

- Wooden houses and buildings spread widely; many mid-rise buildings also becoming wooden
- Designers and professionals who can build houses suitable to climate conditions of respective regions nurtured; buildings that take in nature nicely, are comfortably warm without heating even during winter and provide comfortable living space widely spread
- High-quality housing usable for long years ("200-year houses"), construction methods to lengthen the life of buildings, and eco-friendly home renovation widely spread; existing houses command the expanding share in the home market
- Infrastructure well developed for "visualization" of CO2 emissions from appliances people are using anytime and anywhere (display of environmental burden, advice on environment-friendly behaviors)

Source: Prepared by the Ministry of the Environment based on "2050 Japan Low-Carbon Society Scenario Team" (National Institute for Environmental Studies (NIES), Kyoto University, and Mizuho Information and Research Institute)

experts and public comments, offers the social vision as shown in Figure 2-4-11, and the panel said it is necessary for all entities in society to make efforts toward realizing a low-carbon society following the basic principles of (i) carbon minimum; (ii) simple life with an actual feeling of affluence; and (iii) realization of the coexistence with

nature.

There are numerous technologies contributory to global warming countermeasures that have yet to spread widely or are still far from commercialization but are quite promising for the future. For example, waste heat generated from industrial plants, power stations or waste incinerators is relatively widely utilized within these facilities. In Denmark and some other countries, waste heat is being utilized on a much wider scale. For instance, Copenhagen has completed the regional heat supply system for the total piping extension of 1,500 km, with about 500,000 residents connected to the regional heating network. About 60% of heat sources for the heat supply system are cogeneration plants using fossil fuels or biomass as fuels, with 20-30% coming from waste heat from waste incinerators. In Japan, the heat-carrying distance in heat supply operations is only about 2 km at most at present, far limited compared with cases in Europe or the United States. However, given that utilization of thermal energy as heat offers high energy efficiency and there is a large quantity of heat not utilized at the moment, expectations are high that infrastructure for utilizing waste heat will be improved going forward and effective utilization of waste heat makes headway in Japan as well.

In overland traffic in the traffic and transportation sector, in addition to electric vehicles already in practical use, we may be standing at the doorstep of an era when we see hydrogen automobiles and vehicles powered by fuel batteries running on urban streets as common scenes. Among vehicles powered by internal-combustion engines, aircraft and ships, on top of automobiles, are also seeing the wave of innovation coming toward them. Oceangoing vessels that carry large quantities of goods used to be powered by wind in the Age of Geographical Discovery. Going forward, they may be again powered by "renewable energy" like wind power and sunlight. A private-sector project launched in April 2008 envisioned the Eco-ship (Figure 2-4-12), which employed fuel cells instead of conventional diesel engines burning fuel oil, and also used wind power and sunlight. With clues from sharkskin, special coating was applied to the bottom of the ship to mitigate the resistance of water. The Eco-ship can reduce carbon dioxide emissions by 69% more than conventional containerships. The same project aims for the development of a zero-emission ship, which emits no carbon dioxide, by 2050.

Figure2-4-12 Example of the Eco-ship Concept

Photo: Nippon Yusen Kaisha (NYK Line)

At present, solar light and biomass are already being utilized as energy sources to replace fossil fuels. Among things that have not yet reached the stage of commercialization is oil production from botryococcus and other microalgae. Oil productivity of microalgae is far greater than corn and other oil-producing plants. If demand for oil is to be met by oil produced from corn, we would need an area 14 times larger than all arable land on the earth. In theory, however, microalgae can satisfy all demand for oil with only 1.8-4.2% of all arable land on the earth. Further, as the ultimate renewable energy technology, we may be generating electricity in outer space by utilizing sunlight by around 2050. Departing from an era when we have to use limited resources on the earth savingly, that is the technology to utilize inexhaustible and clean solar energy in a stable manner without worrying about weather conditions. Electricity produced would be sent to the earth using microwave and laser. This might sound incredible, but it is not a story that would only come true several hundred years down the road. In fact, the Japan Aerospace Exploration Agency, an independent administrative institution, seriously expects that this "technology" may become applicable around 2033.

Column Potential of Microalgae

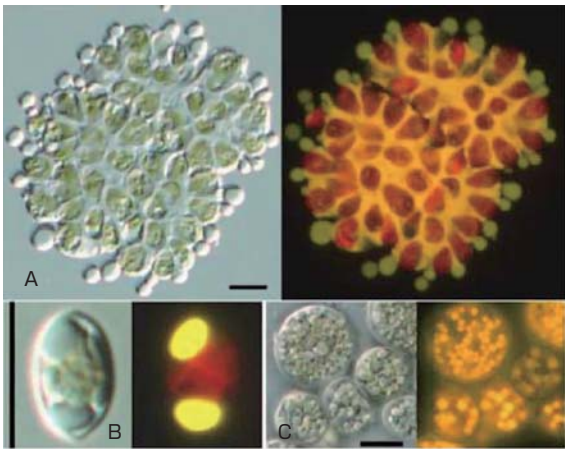
Microalgae are known as organisms that have produced oil shale. Algae have many species that produce significant amounts of fat and hydrocarbons, and the utilization of algae as biomass energy material has been under research mainly in the United States since right after the oil crisis in 1970s. Oil production capacity of algae is estimated at about 47 to 400 tons/ha, 25 to 120 times the capacity of oil-producing plants such as corn, soybeans, safflower, sunflower, oilseed rape and oil palm.

For example, if half of the amount of oil used in transportation in the United States is to be covered by algae oil, an area of a pool needed to cultivate algae is about 1.9 million to 5.6 million hectares, only one-seventh to one-twentieth of the area of the State of Colorado. Since energy consumption by the transportation sector accounts for about 70% of the total energy consumption in the United States, a project to develop a technology to produce diesel oil from algae in the country's vast deserts has been drawing keen attention.

Botryococcus braunii (hereinafter referred to as just "botryococcus") is known to produce hydrocarbons equivalent to 20-70% of heavy oil per alga body dry weight. Botryococcus is characterized by its capability of "producing oil components in both cells and colonies," and thus, it is possible to extract only oil without destroying cells. Generally speaking, oil of vegetable origin oxidizes metals and residual oil gets solidified. But hydrocarbons produced by microalgae can be refined and utilized just as fossil fuels using existing systems. The University of Tsukuba has obtained this promising botryococcus strain, and is proceeding with research and development through the large-scale use in open system for its cost advantages.

The University of Tsukuba's research and development goal for the moment is to "improve the oil production efficiency by one digit (1,000 tons/ha in terms of yield)." It plans to demonstrate the development by a full-scale production plant by 2020 and hopes to apply it to society by 2025.

In recent years in Japan, the depredation of abandoned agricultural land has become a serious issue. If we install microalgae cultivation tanks on all abandoned agricultural land totaling 220,000 hectares, there is the possibility that we can produce 220 million tons of oil, which is equivalent to Japan's annual oil imports, and also can reduce carbon dioxide emissions by about 657 million tons-CO2/year. While there may be competition for land from photovoltaic power generation, it is possible that "needs for fire power of oil" still exist in a low-carbon society in the future for manufacturing of industrial materials and as fuel for aircraft.



Oil-producing microalgal strain established as cultivated strain from selective culture sample
A. Botryococcus cultivated strain selected under the 20mM $NaHCO_3$ condition
B. Monocellular green alga strain selected under the 0.35% seawater condition
C. Chlorococcum-like green alga selected under the 20mM $NaHCO_3$ condition

References and photos: "Prospects of Algal Biomass Energy," Prof. Shin Watanabe, Graduate School of Life and Environmental Sciences, University of Tsukuba

Conclusion

In this chapter, we discussed the damage caused by global warming and the economic benefits of measures to cope with the problem, and then introduced various global warming countermeasures being implemented in Japan and overseas. There are various options as to how to proceed with global warming countermeasures, but in any case, solutions to the global warming problem should not sacrifice our cultures and affluence of our life. Everything in our daily activities is related to the progress in global warming. And its adverse impacts not only affect us but also continue to haunt children in the future. We will immediately stand up to fight the problem and aim to create a sustainable economic society with reduced emissions of greenhouse gases, a new Japan.

Column The Space Solar Power System

The Space Solar Power System (SSPS) is an energy supply facility that collects solar light, an inexhaustible and clean energy, in stationary orbit some 36,000 km above the equator and sends it to the earth.

Various ideas have been considered thus far in Japan and in other countries regarding the configuration and shape of the SSPS. For example, the microwave SSPS generates electricity using solar cells in stationary orbit and converts it into microwaves for transmission down to the earth. On the earth, microwaves received are converted back into electricity for use as electric energy. By building a light collection facility with a diameter of several kilometers in stationary orbit, it is possible to generate electricity of around one million kW (equivalent to power generation by a nuclear power plant).

Concept of energy transmission by microwave

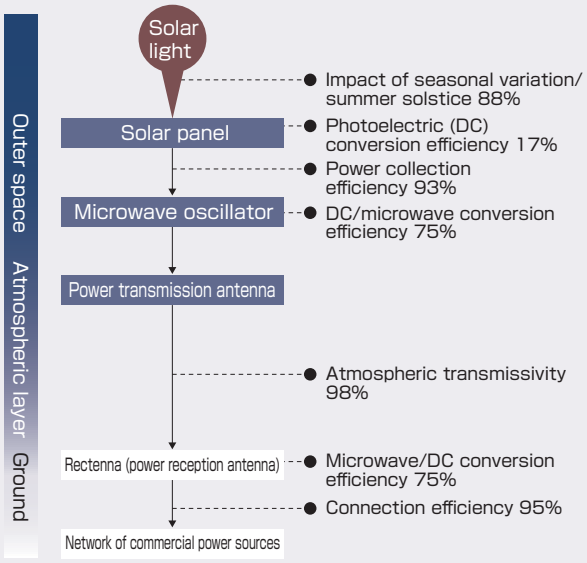
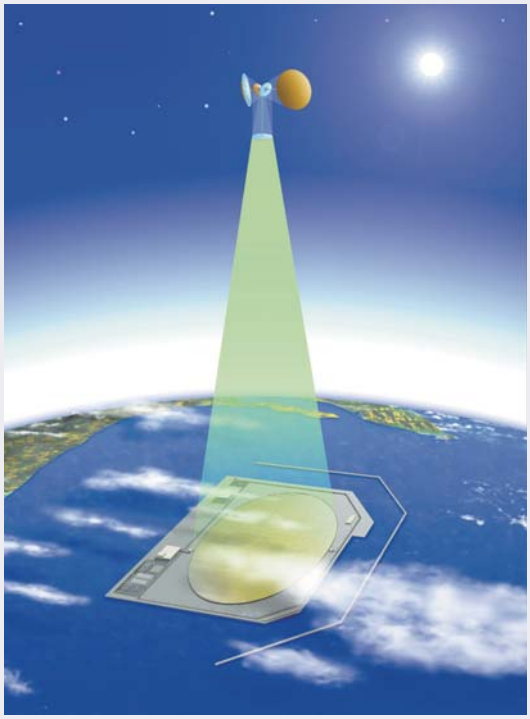


Image of microwave SSPS



Source: Japan Aerospace Exploration Agency website

Chapter 3
Biodiversity in Crisis and Our Daily Lives
—Life on the Earth That Runs on to the Future—

Section 1 Accelerating Loss of Biodiversity

According to the United Nations Millennium Ecosystem Assessment, the present rate of extinction of living organisms has reached 100 to 1,000 times higher than the rate of extinction in the past, and most indicators that show the status of ecosystem services (benefits people can obtain from ecosystems) are exhibiting a deteriorating trend. This section addresses the impact of biodiversity loss on our daily lives (decreases in products from agriculture, forestry and fisheries industries) and economic loss from declining ecosystem services, and then underscores the need to halt biodiversity loss and enhance biodiversity.

Column What Is Biodiversity?

"Biodiversity," to put it plainly, is the state of "many living organisms existing by adapting to a variety of environments on the earth, from the abyssal ocean to uplands." This phrase contains the following three aspects. The existence of diverse types of ecosystems, such as forests, rivers, wetland, tidal flats, coral reefs and oceans, is described as "ecosystem biodiversity," while the existence of diverse kinds of living organisms in these ecosystems is called "species diversity" and the existence of various genetic variations in the same species, such as differences in body size, pattern or resistance to disease is termed "genetic diversity."

Let us explore these three aspects more deeply.

Ecosystem diversity means that there exist a variety of environments due to a variety of circulations on the earth. For example, there is the circulation of water in which precipitation that seeps into the ground evaporates through plants and forms clouds to cause rain. In the circulation of material, organic material that goes through consumers by the food chain ultimately returns to inorganic material by decomposers and producers again turn inorganic material into organic material. In the atmospheric circulation, carbon dioxide emitted in association with activities of living organisms on the earth, including human activities, is absorbed by forests that produce oxygen. These diverse circulations, for example, help form small units of specific ponds and forests, which combine to form larger units of basins, and several basins consist of units of archipelagoes and continents, which together constitute the earth, thus establishing various ecosystems on the earth in seamless manners. There exists no identical ecosystem on the earth. This is ecosystem diversity.

Species diversity indicates that there exists about 30 million species of various living organisms, including unknown ones, after living organisms have evolved to adapt to various environments on the earth. When kinds of living organisms are diverse, interactions between them are also diverse. There emerge a variety of direct and indirect interactions, from eating, being eaten, parasitizing other living organisms and providing habitats to competing for resources and decomposing dead living organisms. Looking at relationships of eating and being eaten, for example, while there is a manner of utilization in which some species feed on anything that is fit to eat, there is also the relationship based on strong mutual links where a certain insect eats only leaves of a certain plant. The diversity of species is thus based on the existence of various physical environments created by ecosystems, natural selection of species caused by a variety of interactions such relationships between living organisms and physical environments and relationships between living organisms, and genetic differences caused by evolution.

The significance of genetic diversity needs to be considered by keeping in mind that living organisms are the beings that try to survive, by maintaining life as individual organisms or by leaving next generations through procreation. A variety of living organisms we are currently seeing have been created through a long process of evolution. When there are genetic differences among individual living organisms and those differences influence their survival and procreation, which is exactly where evolution starts. Properties that make the survival easier, if only little, are carried forward to next generations. What properties make the survival easier depend on environments surrounding living organisms. Different properties evolve under different environments. In

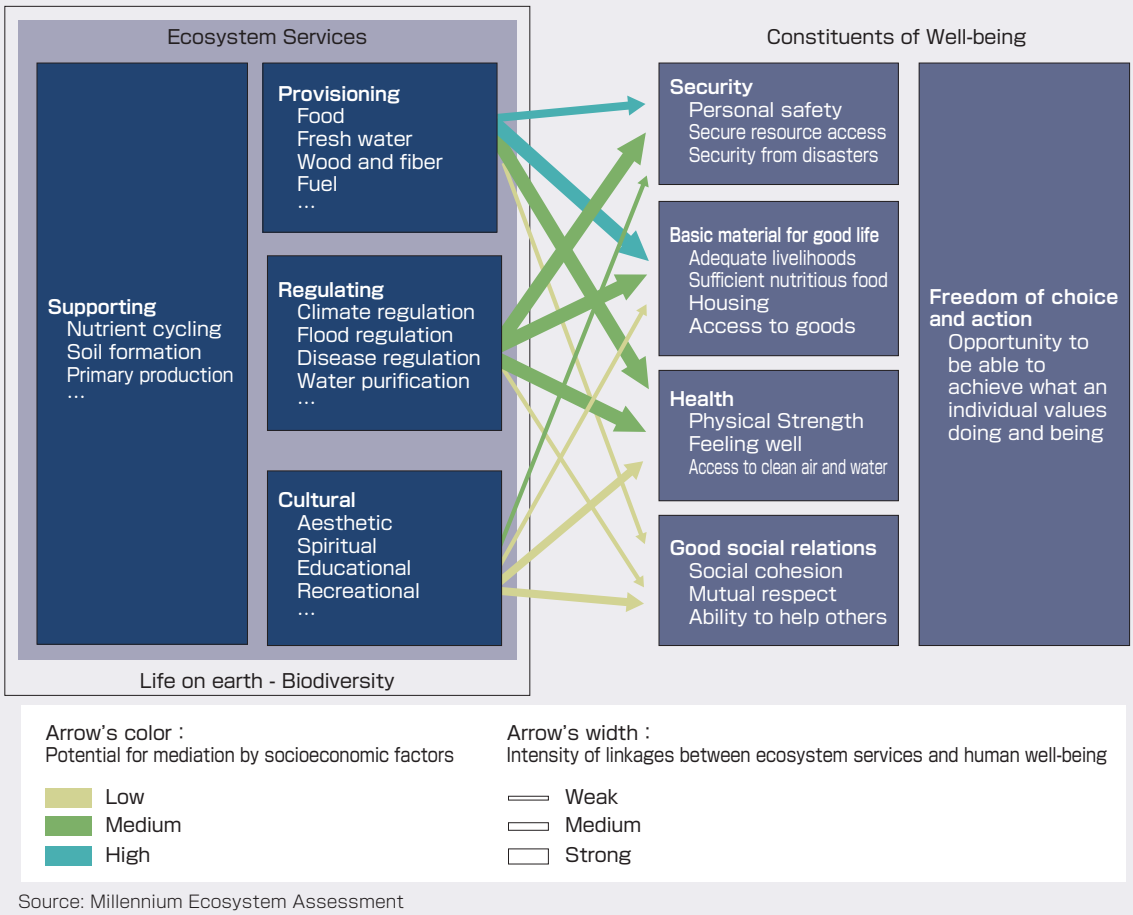
other words, genetic diversity (difference) that exists between living organisms (individuals) is the source of evolution. Biodiversity we have now can be described as the direct result of genetic diversity.

Then, what benefits are we, humans, getting from biodiversity? We find a variety of benefits of the diversity of ecosystems in that forests generate oxygen through photosynthesis and develop water sources, that rivers bring bountiful soil, that tidal flats purity contaminated water and that coral reefs provide many fish species with places of spawning, growth and feeding, bringing the richness of fish and shellfish. Humans have evolved and built civilization under these environments. Humans benefitted from species diversity as they found ones they could utilize from among various living organisms and created methods to produce grains, vegetables, livestock and other foods in large quantities that made it easier to secure food. Furthermore, genetic diversity, which supports the "existence of biodiversity" as a whole, must be recognized as indispensible for all living organisms on the earth, including humans.

Let us look at the benefits we humans are receiving from ecosystems in more specific terms. Ecosystems have inherent mechanisms to reproduce animals and plants, and humans obtain food, water, lumber, fuels and other things necessary for subsistence thanks to these mechanisms. Ecosystems also have the regulating function to stabilize the habitat environments for living organisms, such as easing of climate change and flooding, water purification, and control of diseases and destructive insects. Moreover, ecological elements are deeply related to our mentality and cultures. Examples include our sense of awe for nature, appreciation of sceneries as recreation, observation of animals and plants, and use of natural things as objects of paintings and haiku. These various benefits of ecosystems humans are receiving are called "ecosystem services" as a whole.

Where do we see the degradation of biodiversity and ecosystem services it underpins? In the first place, most of what we eat and drink comes from living organisms such as plants and animals, with the only exceptions of water and salt. We may directly make use of living organisms in nature or we may clear off living organisms in nature to grow grains and raise livestock useful for humans. Not a few living organisms have lost their habitats because of environmental contamination by humans. In tandem with the population growth and changing lifestyles, their burdens on the environment have kept increasing and grown too heavy. For example, the area of forests on the earth has been halved by human activities from the level prior to the spread of the impact of human

Linkages between Ecosystem Services and Human Well-being



Source: Millennium Ecosystem Assessment

activities, and the ratio of fish stocks being excessively utilized has kept growing. Thus, it is evident that human activities are burdening nature. This is clear from the results of analysis of changes in ecosystem services made in the third edition of the Global Biodiversity Outlook, published by the Secretariat of the Convention on Biological Diversity. Global trends concerning food show that while ecosystem services for grains, livestock and aquaculture are increasing, ecosystem services for fish catches and wild foods are decreasing (Figure 1-5-2). What we should not forget is that biodiversity and ecosystem services it underpins have been formed by a long history of evolution over approximately four billion years and they are not something humans can produce like manufactured products made at industrial plants, and thus cannot be restored to the original state easily once they are lost.

What can we do in order to maintain biodiversity and ecosystem services in good conditions and carry them over to future generations? Human activities are very significant in that they affect the environment, and we need to respond as society as a whole that depends on ecosystem services. For example, in manufacturing and construction industries dependent on biological resources, we need to switch processes of selection, processing and disposal of raw materials to sustainable ones that pay heed to biodiversity and manage ecosystem services as common assets of mankind through adequate payments for ecosystem services by various entities, including citizens. We should also do proactively what we can as individuals. People in the past lived with due heed to whether they could harvest crops or catch fish in the coming year. In the modern age when most people are not engaged in production activities, we rarely find ourselves in such scenes of directly paying heed to such things. However, we still must be able to feel that we are living with life bestowed upon us each day, set great store by and not waste food, and even in urban areas, notice the verdure and autumnal leaves of street trees, dandelions and the blossoming of cherry trees, and seasonal changes in the chirping of birds and insects. It is important to have these senses in everyday life and act on the basis of consciousness about "mottainai" wastefulness and a sense of gratitude for the blessing of life. We should be able to live nicely on the earth if we, as society as a whole and as individuals, pay due heed to biodiversity and proceed with efforts to maintain ecosystem services.

1 Fast-disappearing biodiversity on the earth

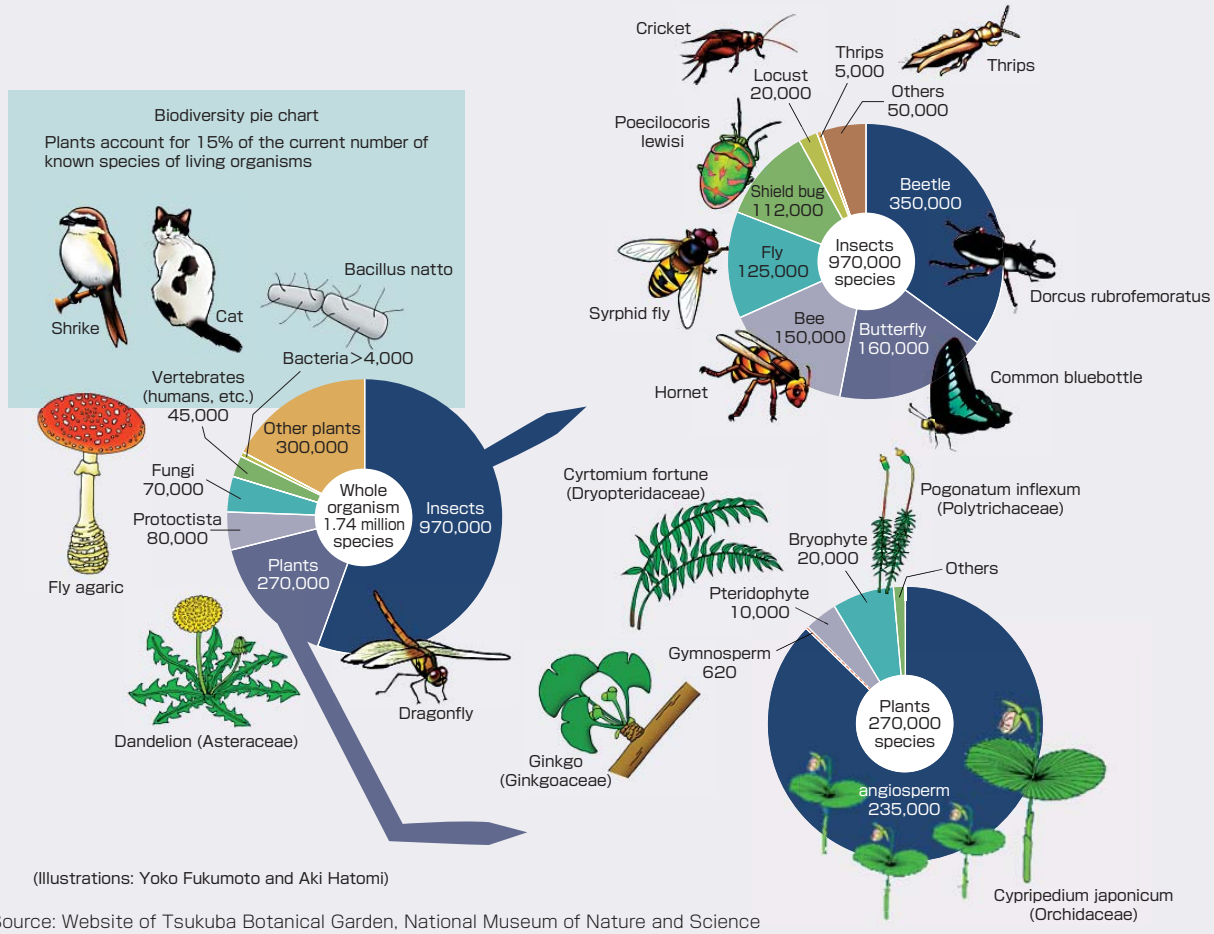
"Species" is the most fundamental unit in understanding biodiversity. Living organisms on the earth have adapted to a variety of environments in the history of evolution over approximately four billion years. As a result of this evolution, there are now multitudes of living organisms, estimated to amount to 30 million species, including unknown ones. Of them, the number of species we know of is about 1.75 million, only a fraction of the total (Figure 3-1-1). Since the birth of life, ecosystems on the earth that surround us are established on the basis of the long history of activities by living organisms on the earth. It is easy to imagine that it would require mind-boggling long years to restore ecosystems once they are lost. We know that biodiversity is essential for our subsistence given that oxygen that is essential for the subsistence of living organisms is generated by plants, agricultural products such as grains, vegetables and fruits are refined versions of wild plants and produced only because of the existence of biodiversity, and genetic biodiversity that can adapt to various environmental changes is necessary for species of living organisms to survive by avoiding extinctions caused by climate change or the spread of diseases.

Mass extinctions of living organisms are believed to have occurred five times on the earth in the past. These extinctions of species under natural conditions took several ten thousands to several hundred thousands of years to happen, averaging about 0.001 species a year. The problem is that current extinctions of living organisms being caused by human activities at an incommensurable speed compared with those in the past. Since 1975, about 40,000 species are said to be becoming extinct each year. Humans are indeed capable of extinguishing other living organisms before we know it (Figure 3-1-2).

According to the Red List of the International Union for Conservation of Nature (IUCN) announced in November 2009, out of a total of 47,662 species assessed, 17,285 species are listed as threatened, an increase of 363 species over the 2009 list (Figure 3-1-3). The biggest driver pushing these species towards extinction is the destruction of habitats, but the main drivers are varied, including hunting and picking, invasion by invasive alien species, and contamination of water and soil. IUCN found that of species assessed, 21% (5,490 species) of mammals, 30% (6,285 species) of amphibians, 12% (9,998 species) of birds, 28% (1,677 species) of reptiles, 32% (4,443 species) of fish, 70% (12,151 species) of plants and 35% (7,615 species) of invertebrates are at risk of extinction. This means that we are rapidly losing useful assets in the form of unknown genes of living organisms.

Overexploitation and poaching of living organisms have an impact on biodiversity, and we have the Washington Convention (the official name: the Convention on International Trade in Endangered Species of Wild Fauna and Flora) as an international agreement concerning trade in rare plants and animals. The Washington Convention is designed to protect certain

Figure3-1-1 The Number and Ratio of Known Species of Animals and Plants



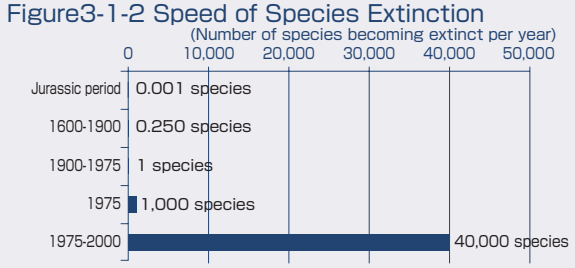
Source: Website of Tsukuba Botanical Garden, National Museum of Nature and Science

species of wild fauna and flora against overexploitation through international trade. The convention took effect in 1975, and Japan acceded to it in 1980. The number of parties to the convention increased from 18 in 1975 to 175 in February 2010 (Figure 3-1-4).

Degradation of biodiversity has become actually observable at various locations around the world. While nine subspecies of wild tigers are known, including Bengal tiger and Amur tiger, three subspecies have already become extinct (Photo 3-1-1). According to an investigation by the World Wide Fund for Nature (WWF), the population of tigers is estimated to have dwindled from 100,000 to about 3,400 to 5,100 in a period of 100 years to the 21st century. Main reasons behind the decline include poaching for beautiful furs and materials for Chinese medicine and habitat loss due to development of agricultural land.

In Japan, remarkable examples of biodiversity degradation include the decrease in coral cover degree in Okinawa, the changing dynamics of benthic fish and shellfish in Tokyo Bay, and the decrease in alpine plants due to feeding damage from deer in Oze. Coral reefs are exposed to a variety of stresses, including rising sea temperatures, a sharp increase in acanthasters, and the inflow of red soil and nutrient salt. An analysis of field surveys and aerial photos show that areas with high coral cover of 50% or over decreased to just about 18% in 2003 compared with the 1980 level (Figure 3-1-5).

Figure3-1-2 Speed of Species Extinction



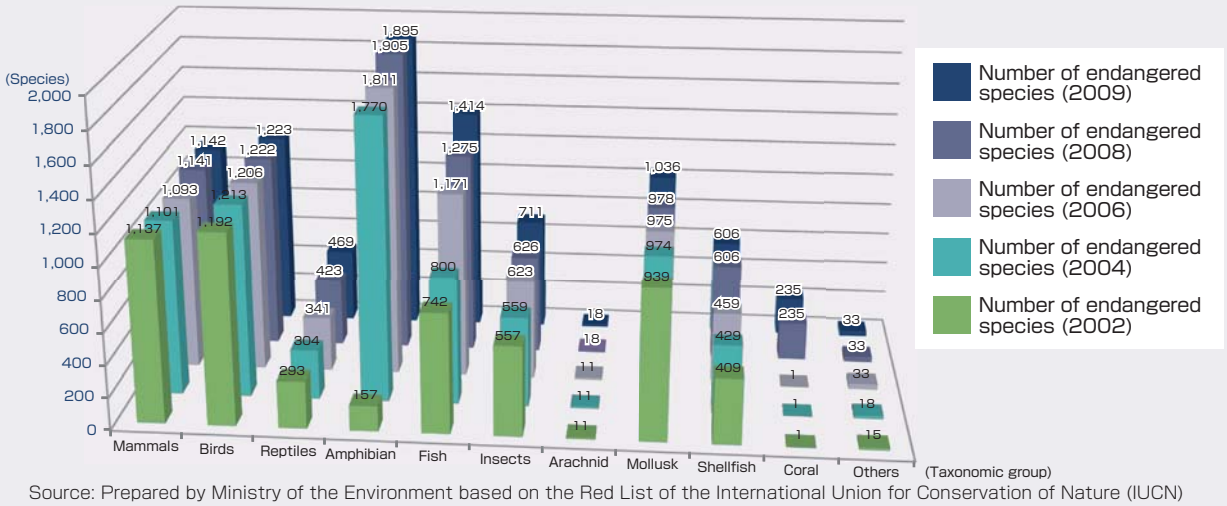
Source: Prepared by Ministry of the Environment based on Norman Myers, "The Sinking Ark: A New Look at the Problem of Disappearing Species" (1981)

In Tokyo Bay, the long-term monitoring of 20 fixed points in the inner bay area has been going on with the same method for over 30 years (from 1977 to present), resulting in the accumulation of valuable knowledge from a global viewpoint. The survey covers the population, weight and the number of species of benthic fish and shellfish communities as a whole in coastal sea areas heavily susceptible to human activities. The survey results show that both the population and weight tended to increase from the 1970s through the latter half of the 1980s due to water quality improvement in Tokyo Bay, the population and weight decreased sharply from the late 1980s to the 1990s. In the 2000s, while the population stayed at a low level, only the weight of fish species increased, with commonly observed species like squillas, marbled flounders and pennant coralfish

declining and large-size fish species growing, bringing about changes in biota (Figure 3-1-6). Causes of these developments are unknown, but some changes in the propagation environment, such as the emergence of hypoxic water masses and the shrinkage of shallow sea areas, have been assumed, and resources are unlikely to recover unless these problems are solved.

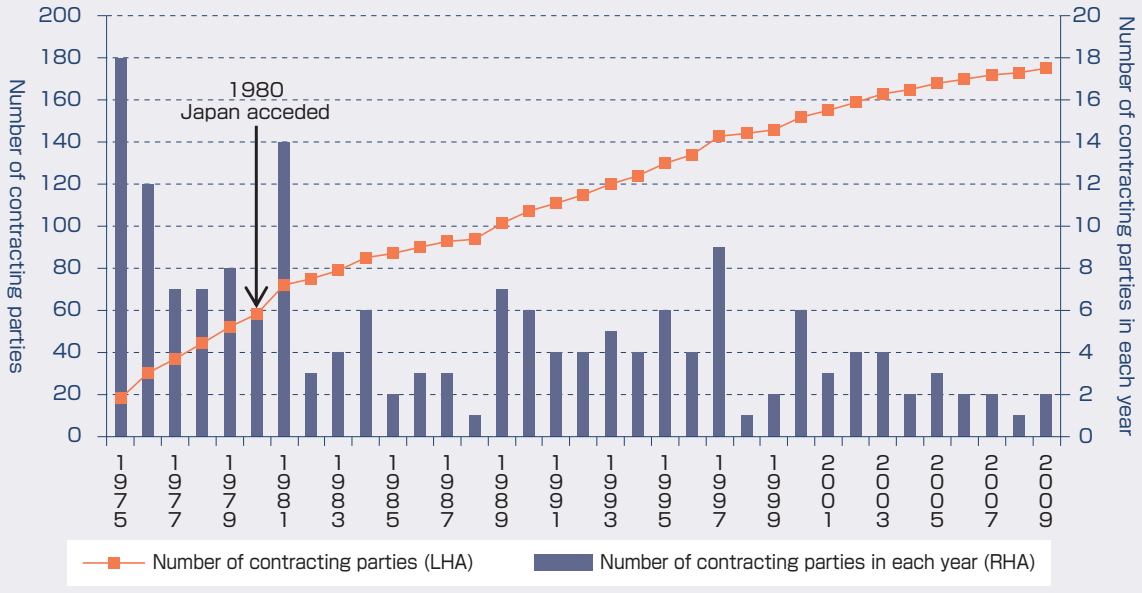
In Oze National Park that came into being in 2007, since the inhabitation of Sika deer was confirmed in the mid-1990s, vegetation in wetlands has been disrupted by feeding damage. The population survey estimates that 305 Sika deer will have been living in the park in 2020, 3.4 times the population 10 years ago, which may give an irreparable impact on the ecosystem that has never been influenced by Sika deer before. Aside from the possibility that the ecosystem in the national park that has been established over a long period of history may be destroyed, it is also feared likely that the landscape and the cultural value as the object of academic investigations might be damaged or the deteriorating landscape could lead to a decline in the number of visitors to the national park to cause an economic loss to the local community.

Figure3-1-3 Number of Threatened Animal Species in the World by Taxonomic Group



Source: Prepared by Ministry of the Environment based on the Red List of the International Union for Conservation of Nature (IUCN)

Figure3-1-4 Changes in the Number of Contracting Parties to the Washington Convention

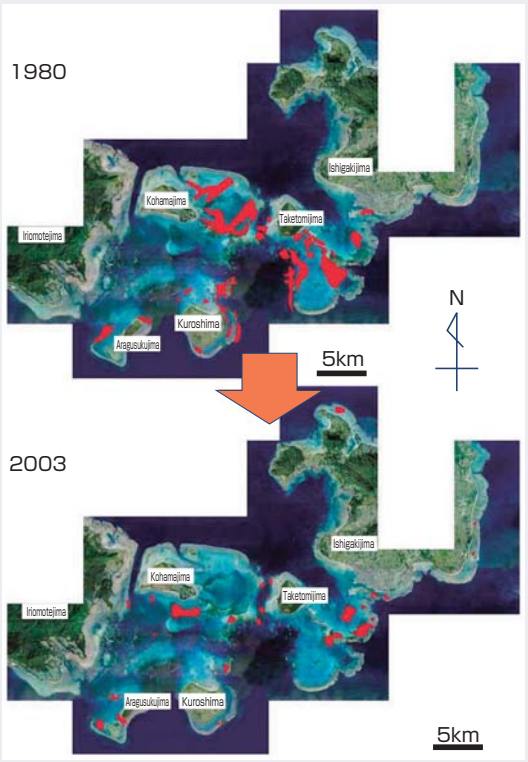


Source: Prepared by Ministry of the Environment based on the website of the Secretariat of the Washington Convention

Photo3-1-1 Bengal Tiger

Source: Hollingsworth, John and Karen/U.S. Fish and Wildlife Service (FWS)

Figure3-1-5 Changes in Coral Cover Degree in Sekisei Lagoon



Source: Ministry of the Environment

2 Linkages between biodiversity loss and our daily life

The U.N. Millennium Ecosystem Assessment carried out between 2001 and 2005 points out that large and irreversible change in biodiversity due to human activities has occurred in the past 50 years. It also points out that the degradation of ecosystem services would grow significantly worse during the first half of the 21st century and the risk of accelerating and irreversible changes could grow, concluding that coupled with the exacerbation of poverty, these problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems.

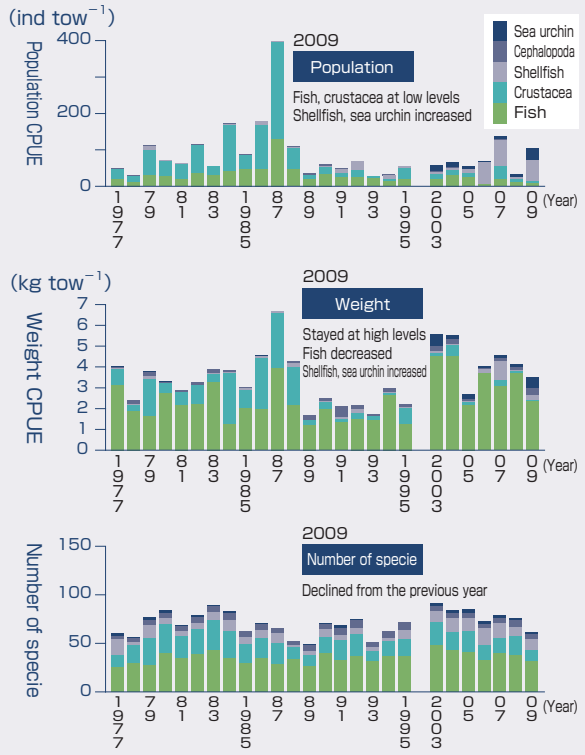
The main drivers for the degradation of biodiversity include the decrease in forests and overexploitation of biological resources and the burden on biodiversity from either of them is known to be continuing or even growing. The area of forests in the world stood at 4,077.28 million hectares in 1990, but decreased by 8.90 million hectares (0.22%) per year in 1990-2000 and by 7.30 million hectares (0.18%) per year in 2000-2005. While the rate of decrease slowed, the decrease was the net change after deducting the increase from forest planting, vegetation restoration and natural expansion of forests. The continuation of the loss of forest area amounting to as large as about 7.30 million hectares per year presents a major problem (Figures 3-1-7 3-1-8). It is apparent that the decrease in forest area is showing no sign of halting particularly in Africa and Latin America.

On the other hand, global demand for timber is projected to grow at an annual rate of just over 1% in coming years (Figure 3-1-9). While any sharp tightening of timber supply and demand is seen unlikely in the long term in view of the expanding area of highly productive planted forests, it is necessary to continue with efforts for sustainable forest management.

Fisheries production, meanwhile, increased over six times in the 50 years between 1950 and 2000, a rate of increase far greater than the population growth of about 2.4 times during the same period, with the rising proportion of overexploitation (Figures 3-1-10, 3-1-11).

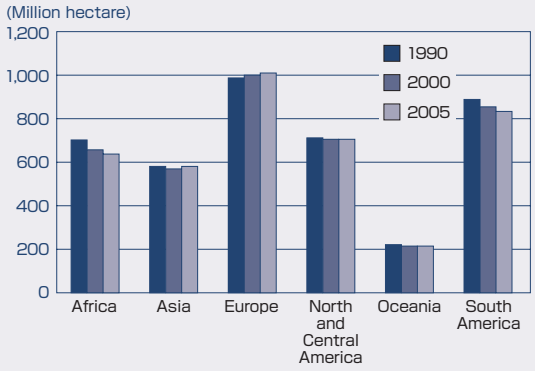
As fish and shellfish resources necessary in the future are estimated to keep growing, unless the exploitation of these resources is held within the scope of resource recovery, our everyday life will likely be affected sooner or later (Table 3-1-1). The Western and Central Pacific Fisheries Commission (WCPFC) in December 2009 decided not to increase the number of vessels and days of operation for fishing bluefin tuna in the Western and Central Pacific from the 2002-2004 level, beginning in 2010. In November 2009, a decision was also taken to reduce caches of bluefin tuna in the Atlantic Ocean. These decisions mark the start of medium- and long-term efforts to conserve resources.

Figure3-1-6 Secular Change in Fish Catches (Population and Weight) and Number of Fish Species in Tokyo Bay



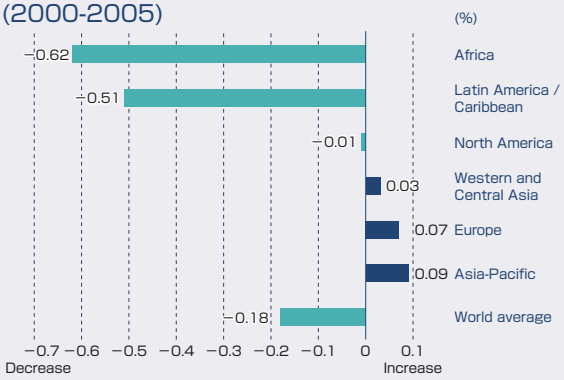
Source: Laboratory of Fisheries Biology, Department of Aquatic Bioscience, Graduate School of Agricultural and Life Sciences, University of Tokyo; National Institute for Environmental Studies

Figure3-1-7 Trends in forest area by region 1990-2005



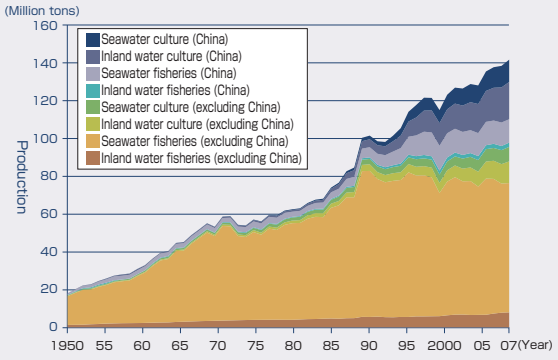
Source: Prepared by Ministry of the Environment based on FAO, "Global Forest Resources Assessment 2005"

Figure3-1-8 Net Annual Change in Forest Area (2000-2005)



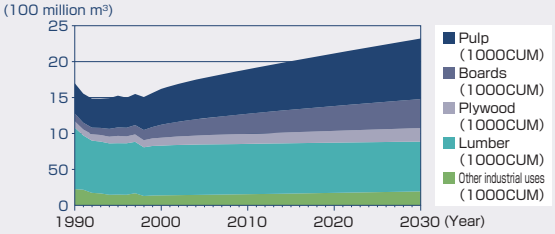
Source: Prepared by Ministry of the Environment based on FAO, "Global Forest Resources Assessment 2005"

Figure3-1-10 Changes in Global Fisheries Production



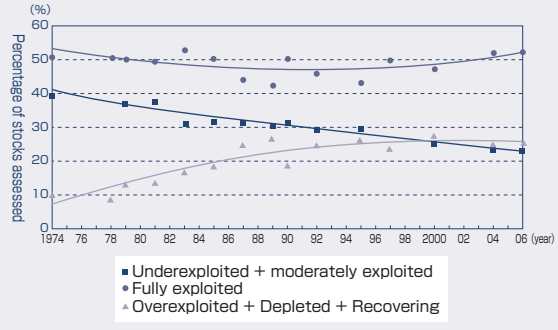
Note: Excludes marine plants, marine mammals and miscellaneous fishery products
Source: Prepared by Ministry of the Environment based on FAOSTAT database

Figure3-1-9 Actual and Projected Industrial Roundwood Demand (World Total) by Use



Note 1: Estimates based on actual demand for 1961-1999
2: Model-based calculated figures for 2000 onward
Source: Forestry and Forest Products Research Institute, Selection of Study Results in FY 2006 (2007)

Figure3-1-11 Global trends in the state of world marine stocks since 1974



Source: FAO, "The State of World Fisheries and Aquaculture 2006"

Table3-1-1 Projected Future Demand for Fishery Products

	Per-capita fish and shellfish consumption for food per year	World total demand A	World total production B	Demand - production A - B
1999/2001	16.1kg	133 million tons	129 million tons	- 4 million tons
2015	19.1kg	183 million tons	172 million tons	- 11 million tons

Note: World total demand and world total production include nonfood fish and shellfish.
Source: Materials provided by the Fisheries Agency

3 Economic losses from the degradation of ecosystem services

Efforts have been made to capture the economic value of ecosystem services in order to objectively capture the impact of biodiversity loss on our livelihood. There are various types of ecosystem services. It is difficult to make an economic valuation of some of them because of the characteristics of their services. Table 3-1-2 shows some examples of the estimation of the economic value of ecosystem services made to the extent that they can be converted into monetary value.

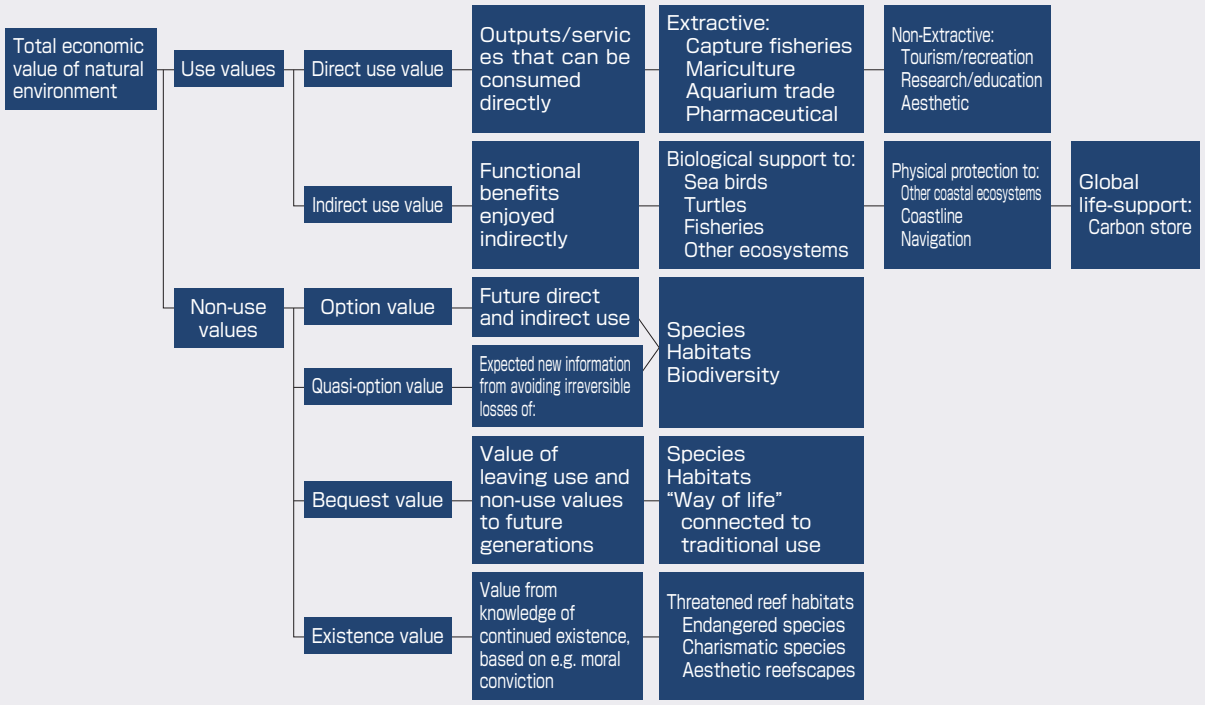
While active efforts are under way to capture the economic value of natural environment, there is no single identical natural environment subject to the economic valuation of ecosystem services. Since it is very difficult to evaluate ecosystem services by the use of a single yardstick, like pricing of carbon dioxide emissions in global warming countermeasures, full heed needs to be given to this in considering the economic valuation of ecosystem services.

One conceivable way of evaluating the economic value of natural environment is, given the diverse values of natural environment, to divide the economic value into use value and non-use value and subdivide them further into smaller categories. One example is the classification shown in Figure 3-1-12. But the evaluation needs to be

Table3-1-2 Examples of Monetary Value Assessed for Ecosystem Services

Item	Monetary value of ecosystem services	Estimator
Global ecosystem services	About $33 trillion per year	Dr. Robert Costanza, University of Maryland, U.S., 1997, Nature (U.K. science magazine)
Function of pollinating insects	About ¥24 trillion per year	French National Institute for Agricultural Research (INRA), 2008, Ecological Economics (U.S. science magazine)
Rain forests	An annual average of about ¥540,000 per ha, about ¥982 trillion globally	International Union for the Conservation of Nature and Natural Resources (IUCN), 2009
Degradation of forest ecosystem	An economic loss amounting to about ¥220-500 trillion expected by 2050	The Economics of Ecosystems and Biodiversity (TEEB), An Interim Report, 2008
Mangrove forest	Protection and planting of mangroves in Vietnam cost $1.1 million, but save annual expenditures on dike maintenance of $7.3 million	The Economics of Ecosystems and Biodiversity (TEEB), D1 (For Policy Makers), 2009
Conservation of global protected areas	Costs about $45 billion annually, but the functions of nature (absorption of carbon dioxide, preservation of drinking water, flood prevention, etc.) are worth $5 trillion per year	The Economics of Ecosystems and Biodiversity (TEEB), D1 (For Policy Makers), 2009

Figure3-1-2 Total Economic Value of Natural Environment and Attributes of Economic Values to Coral Reefs



Source: Barton (1994)

made by keeping in mind that respective subdivided values contain the following two valuation axes:

(i) Natural science-based valuation: Investigate and show the state of nature and to what problems nature is exposed.

(ii) Social science-based valuation: Show the significance to humans and what values are offered to humans.

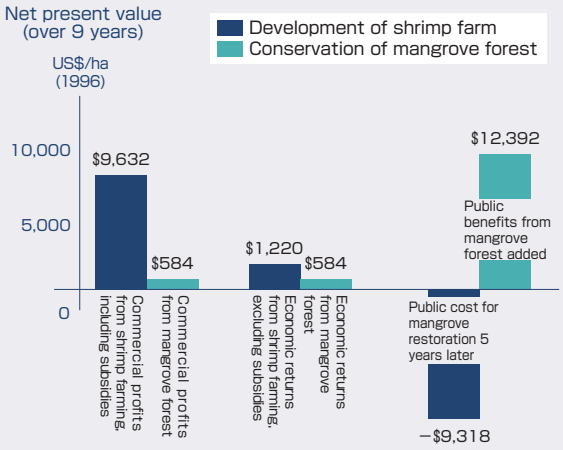
As methods to evaluate the value of natural environment by substituting it with things that already have market values, there are the output evaluation method, prevention expenditure method, damage cost method and alternative method, etc. However, the evaluation cannot be made unless there are substitutable market goods. The value that cannot be converted into monetary value has to be evaluated qualitatively. For example, as the landscape and the function of preserving ecosystems do not have substitutable market goods, they cannot be evaluated using the above-mentioned methods.

According to "The Economics of Ecosystems and Biodiversity (TEEB), D1 (For Policy Makers)", in a local development project, as commercial profits are often given priority and ecosystem services are underestimated, the act of development tends to be judged commercially feasible. When government subsidies are excluded and post-development restoration costs are taken into account, however, ecosystem services turn out to be larger than expected benefits from not undertaking the development project exceed benefits from development. For example, in a project to develop a shrimp farm by cutting down mangroves, the project most likely is assessed only from the aspect of economic gains to be obtained by a developer. When the economic effects of the shrimp farm and benefits from mangroves are compared, the former is judged considerably larger (the left-hand graphs in Figure 3-1-13). However, the shrimp farm development project is funded by government subsidies, and when this support factor is excluded, the economic effects of the development is reduced to about one-eighth (the middle graphs in Figure 3-1-13). Further, in addition to the profits to be gained by the developer, when the benefits of the development and mangrove conservation are compared, including public costs necessary to restore the functions of mangrove forests on the site of the shrimp farm five years later and public benefits from preserving mangrove forests, the benefits of conservation prove to be larger than the benefits of development (the right-hand graphs of Figure 3-1-13).

Meanwhile, efforts to economically evaluate ecosystem services are under way in Japan as well. For example, around Kabukurinuma (wetlands designated under the Ramsar Convention, in Osaki, Miyagi Prefecture), known as one of the largest destinations of anatine birds in Japan, the economic value of ecosystem services (maintaining the number of anatine birds coming to the wetlands at the current 70,000) protected by environmentally-sound farming around the wetlands has been analyzed. The analysis was made using the conjoint method, under which a survey is carried out by presenting multiple environment conservation measures to potential respondents and asking them to rank their desirability to evaluate the economic value. A nationwide questionnaire survey for a six-day period via the Internet drew a total of 3,257 responses (the response rate at 21.6%). The survey results put the willingness to pay at an average ¥1,007 per household per year, which is estimated to total ¥53.2 billion when extended to the total number of households of 52.88 million in Japan (as of March 2009) (based on "Policy Research on Environmental Economics," Associate Professor Managi and Professor Kuriyama).

As seen above, by translating the economic value of ecosystem services into monetary value, it becomes possible to compare the economic value of development and the economic value maintained through conservation as well as the costs involved in both.

Figure3-1-13 Relationship between Benefits from Shrimp Farm Development and Public Benefits of Mangrove Forest



Source: The Economics of Ecosystems and Biodiversity

Column World of Mutualism between Corals and Crabs

A variety of living organisms, including crabs, shrimps, univalve shells and small fish, use the space between coral branches as their habitats. Based on research on the relationship between Pocillopora damicornis and Trapezia cymodoce, we introduce the mutualism (the relationship of harmonious coexistence that brings mutual benefits) between them in this column.

Trapezia cymodoce feeds on mucus made by corals. This is the advantage of living with corals. Corals, on the other hand, are protected by Trapezia cymodoce from acanthasters, their natural enemy. Scenes of Trapezia cymodoce beating off acanthasters that approached to eat corals by cutting off their ambulacral feet and grabbing and cutting their needles are observed. All of more than 10 types of Trapezia cymodoce confirmed to live in coral reefs in Okinawa behave like this.

On the other hand, what remains less well understood is cases where congeneric multiple species of Trapezia cymodoce live in the same coral colony, which is contrary to the principle that "species with the similar mode of life do not live in the same habitat." One tentative theory under study is: "The coexistence relationship between corals and Trapezia cymodoce is related to the existence of acanthasters. When acanthasters are around, many species of Trapezia cymodoce gather to protect corals. If acanthasters are not around, Trapezia cymodoce do not have to exert efforts to beat off acanthasters, so species of Trapezia cymodoce start fighting among them and only strong species survive. Then, individuals in the surviving species start fighting and a pair of a large-size male and female occupy the coral colony."

If the above phenomenon is unraveled, clues to the protection of corals from acanthasters may be obtained. Besides this example, there are a lot of unknowns about the mechanism of ecosystems. Destroying biodiversity that brings immeasurable benefits to us without elucidating these unknowns would be a great loss to all living organisms on the earth, including humans.

Multiple species of Trapezia cymodoce confirmed to live in the same coral colony

Photo: Professor Makoto Tsuchiya, Faculty of Science, University of the Ryukyus

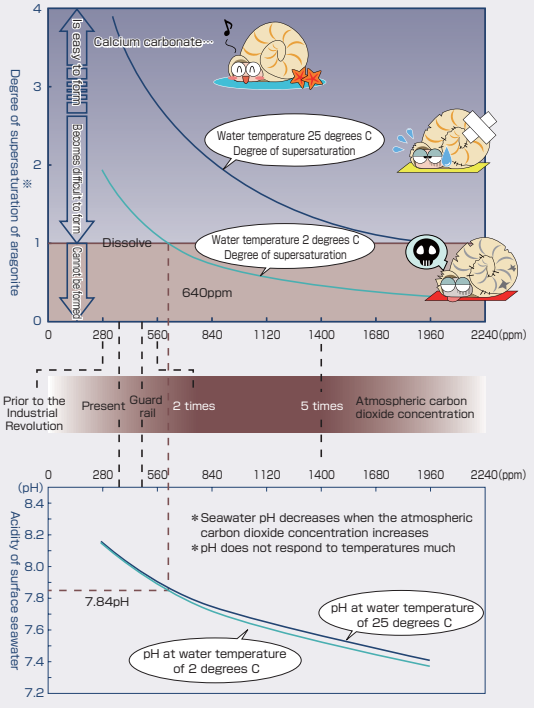
Section 2 Biodiversity and Global Warming

According to the IPCC Fourth Assessment Report, the risk of species extinction is projected to increase with increase in global average temperature. Droughts and wildfire associated with climate change are also threatening food production and ecosystems, while the degradation on biodiversity such as decreasing forest area is accelerating global warming. Therefore, it is necessary to implement measures to conserve biodiversity and measures against global warming by linking them.

1 Impact of global warming on biodiversity

The IPCC Fourth Assessment Report states that annual average Arctic sea ice extent has shrunk by 2.7 [2.1 to 3.3] % per decade, with larger decreases in summer of 7.4 [5.0 to 9.8] % per decade (Numbers in square brackets indicate a 90% uncertainty interval around a best estimate). The U.S. Fish and Wildlife Service (FWS) estimates that sea ice changes as projected, two-thirds of the global population of polar bears will be lost by around the mid-21st century. The IPCC Fourth Assessment Report states that increases in sea surface temperature of about 1 to 3℃ are projected to result in more frequent coral bleaching events and

Figure3-2-1 Linkages between Acidity of Surface Seawater and Formation of Calcium Carbonate



※Aragonite: Calcite and aragonite are two types of calcium carbonate with different crystal forms. Living organisms that form shells with aragonite more significantly affected by ocean acidification include sea butterflies (planktonic conches) and corals.

Source: Center for Global Environmental Research, National Institute for Environmental Studies, "What We Should Know about Global Warming"
http://www.cger.nies.go.jp/ja/library/qa_index-j.html

widespread mortality, unless there is thermal adaptation or acclimatization by corals.

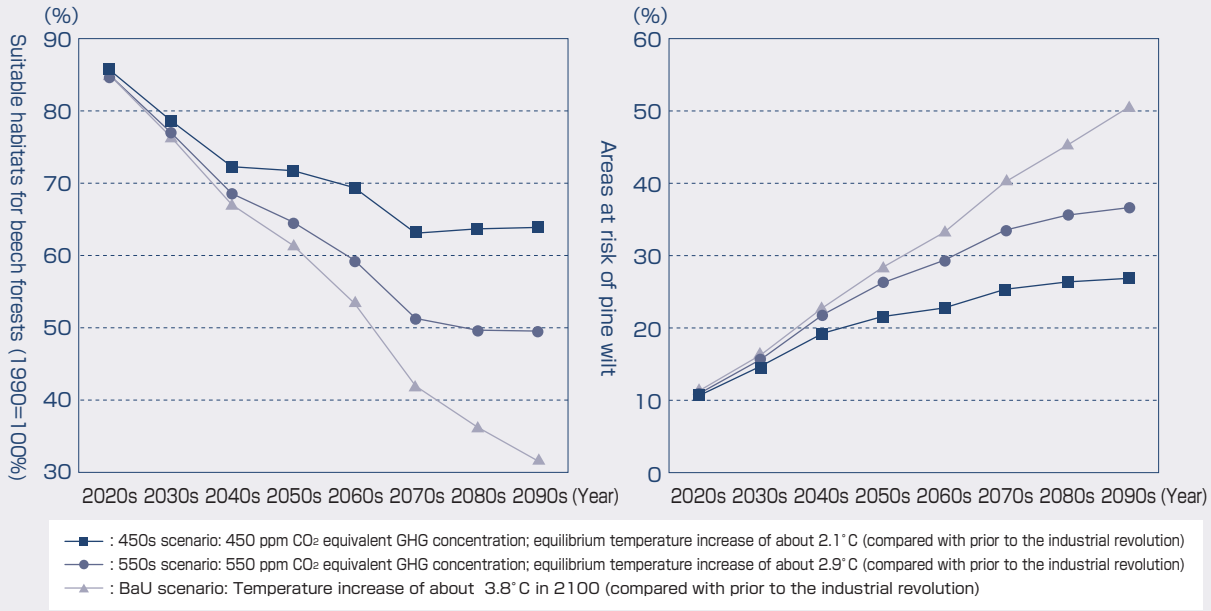
Further, there have been changes in oceans and forests, which are the vital foundations for the living organisms. Before the Industrial Revolution, when the atmospheric concentration of carbon dioxide was around 280ppm, the sea surface had a pH of 8.17. At present, when the carbon dioxide concentration has reached around 380ppm, the sea surface pH has already declined to around 8.06 (Figure 3-2-1). In oceans, there are many living organisms that have calcareous shells and skeletons. For examples, shellfish form shells for self-protection, while fish use calcium carbonate for ear stones that maintain their physical balance. Corals leave calcareous skeletons to nurture the next generation. However, when the carbon dioxide concentration in seawater rises with atmospheric carbon dioxide dissolving into seawater, acid (H^+) generated from carbon dioxide neutralizes carbonate ion (CO_3^{2-}), the material for calcium carbonate, reducing the carbonate ion concentration and making the production of calcium carbonate difficult. According to German Council of Science and Humanities, in order to avoid a critical impact on marine organisms that form calcareous shells, the decline in pH since the Industrial Revolution should not exceed 0.2. Meanwhile, in order to keep atmospheric temperature increases within two degrees C, the carbon dioxide concentration must be kept from exceeding 450ppm. If the carbon dioxide concentration is 450ppm, the decline in seawater pH would be around 0.17, barely below the 0.2 target to avoid a critical impact on marine organisms. Incidentally, both the atmospheric temperature rise target of 2 degrees C, above which climate change is likely to cause a major impact, and the pH decline target to avoid a critical impact on marine organisms have the same carbon dioxide concentration target of 450ppm.

A study on wildfires by the University of California, et al, and referenced by the IPCC Fourth Assessment Report found that since the 1970s, wildfire in the western United States increased in years when temperatures from spring to summer increased by about 2 degrees Celsius. Thus, large wildfires increased suddenly since the mid-1980s, and it has been reported that the frequency of wildfires is about four times and the forested area burned from 1987 to 2003 is 6.7 times the area from 1970 to 1986. In terms of the impact on ecosystems, the IPCC Fourth Assessment Report states that approximately 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5℃ .

Turning to the impact on ecosystems in Japan, "Comprehensive Assessment of Climate Change Impacts to Determine the Dangerous Level of Global Warming and Appropriate Stabilization Target of Atmospheric GHG (greenhouse gas) Concentration" (hereafter referred to as "Project for Comprehensive Projection of Climate Change Impacts"), a strategic research and development area project financed by the Global Environment Research Fund of the Ministry of the Environment, projects a decrease in suitable habitats for beech forest an expansion of pine distribution areas at risk of pine wilt. It also projects that the impact and damage will likely decrease considerably if the greenhouse gas concentration is contained at the stringent stabilization target of 450ppm, but occurrence of a measure of damage cannot be avoided (Figure 3-2-2).

The degradation on biodiversity also affects global warming. The annual amount of carbon dioxide naturally absorbed by the earth is about 3.1 billion tons-C, of which terrestrial ecosystems (forests, grasslands and farmland, etc.) are estimated to absorb about 1.8 billion tons-C. As discussed in Section 1, the decline in forest area has not halted, with the capacity to absorb carbon dioxide decreasing gradually. Thus, the decline and degradation of forest ecosystems are likely to accelerate global warming. And if the atmospheric carbon dioxide concentration increases, the acidification of oceans that absorb 25% of global carbon dioxide emissions progresses further, threatening a serious impact on marine ecosystems.

Figure3-2-2 Ratio of Changes in Suitable Habitats for Beech Forests and Pine Distribution Areas at Risk of Pine Wilt Due to Global Warming



Source: Project Team for Comprehensive Projection of Climate Change Impacts, 2009

2 Conservation of biodiversity and global warming measures are inseparable

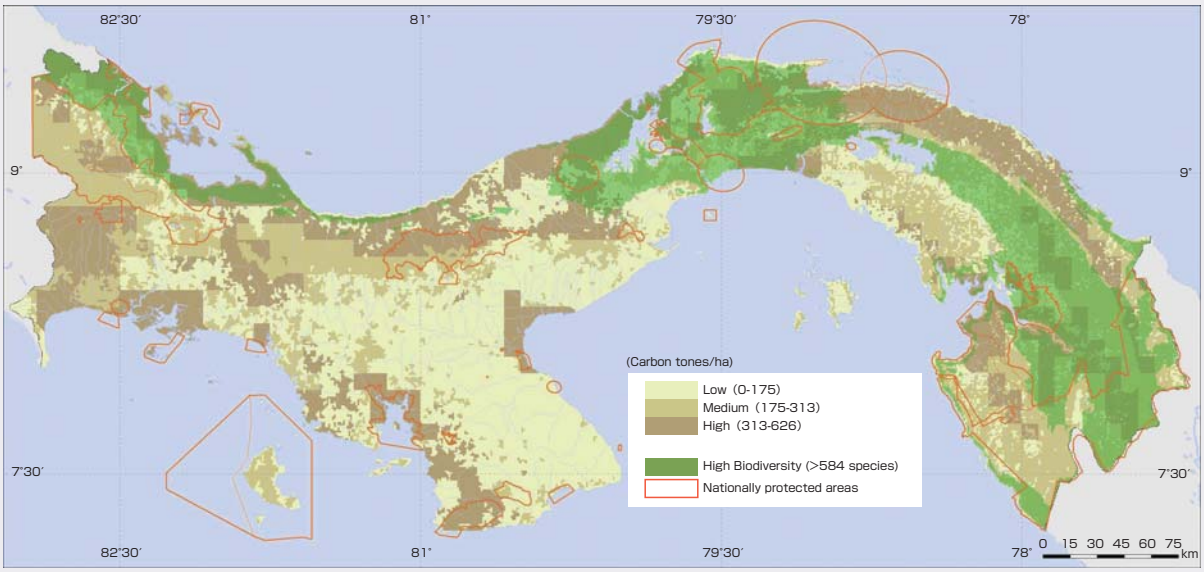
As seen above, biodiversity and global warming are closely connected and thus measures to deal with them should be more effective if they are mutually contributory. The "Stern Review: The Economics of Climate Change," which analyzes the economic impact of climate change, notes that "Curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions," and also leads to the conservation of biodiversity, etc.

About 20% of global greenhouse gas emissions are said to stem from the decrease and degradation of forests in developing countries. Under these circumstances, a mechanism to provide incentives to efforts to halt the decrease and degradation of forests in developing countries, called "REDD (reducing emissions from deforestation and forest degradation in developing countries)" is being considered under the Framework Convention on Climate Change (FCCC). Further, in recent years, the "REDD-plus" mechanism, which adds to REDD the ideas of forest conservation and sustainable forest management contributory to the conservation of biodiversity, is also being discussed. The Copenhagen Accord, adopted at the 15th session of the Conference of the Parties to the FCCC, held in Copenhagen, Denmark, in December 2009, incorporates the establishment of a mechanism for securing necessary financial resources for these efforts, including REDD Plus. In order to promote REDD effectively from both aspects of biodiversity conservation and global warming countermeasures, the World Conservation Monitoring Centre of the U.N. Environment Program (UNEP) has developed national maps for six tropical countries showing where areas of high carbon storage coincide with areas of biodiversity importance. Figure 3-2-3 illustrates the national map for Panama, where it is estimated that 20% of Panama's carbon emissions is stored in high carbon, high biodiversity areas. These efforts are believed to contribute to the objective identification of prioritized areas for REDD.

Furthermore, for example, the "Payment for Ecosystem Services (PES)," a method for maintaining ecosystem services, such as the cultivation of water source forests to secure water sources, can be expected to function as carbon sinks, if forests are adequately protected as a consequence. The following maps have been developed for Madagascar as an example. Colored areas in the left panel depicts the overlap between multiple ecosystem services in forest and wetlands, while red areas in the right panel indicates where payments would be suitable, after considering ecosystem services and payment costs (Figure 3-2-4).

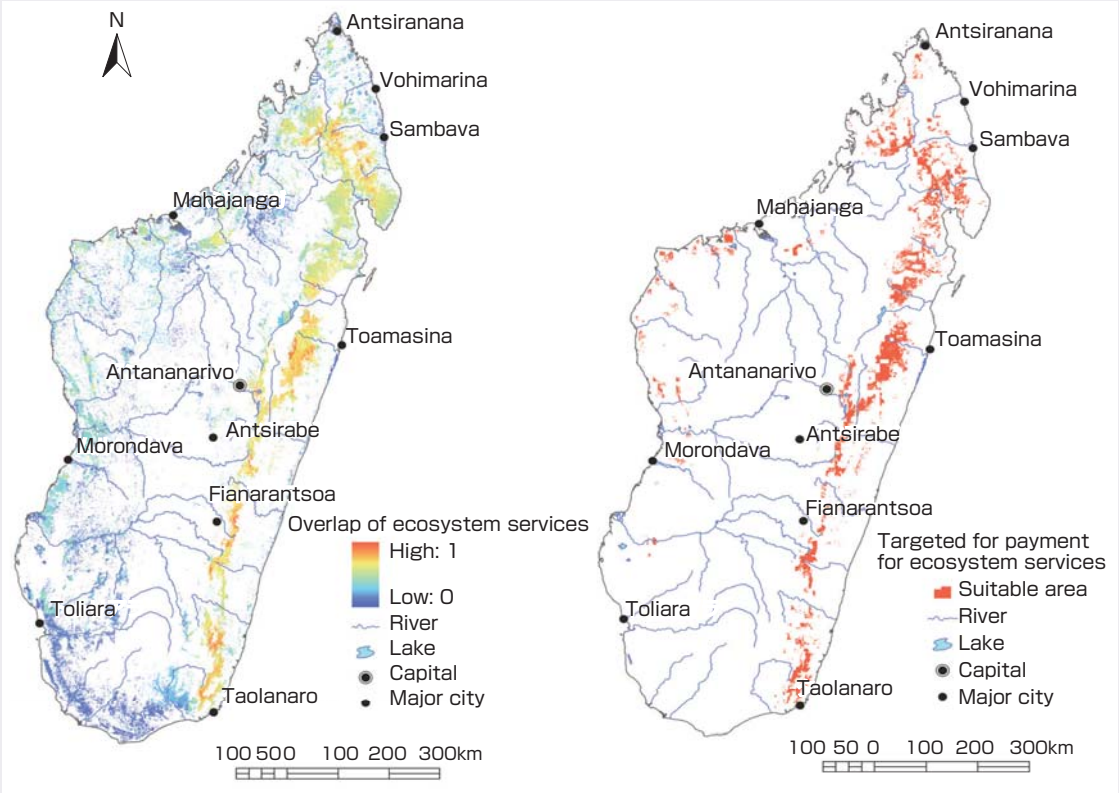
As seen above, since the conservation of biodiversity and global warming countermeasures mutually bring about synergetic effects and added value to the other, it can be considered more effective if efforts are made by linking both measures.

Figure3-2-3 An Example of National Maps Developed by the United Nations Environment Program's World Conservation Monitoring Centre (UNEP-WCMC) (Panama)



Source: Kapos et al. 2008

Figure3-2-4 Targeted Payments for Ecosystem Services in Madagascar



Source: Adapted from Wendland et al. 2009

Section 3 Shift to Biodiversity-Friendly Socio-economy (Mainstreaming of Biodiversity)

In order to realize the coexistence of humans and nature and make a shift to a biodiversity-friendly socio-economy, it is necessary to incorporate the conservation and sustainable use of biodiversity into various social and economic activities on a global scale as well as at the level of civil life (mainstreaming of biodiversity).

Therefore, in this section, we shed light on the relationship between corporate activities and cities and

biodiversity, which has previously been thought to be not even remotely related, and also describe the need for a shift toward biodiversity-friendly lifestyles as well as excellent examples of various entities working for the mainstreaming of biodiversity.

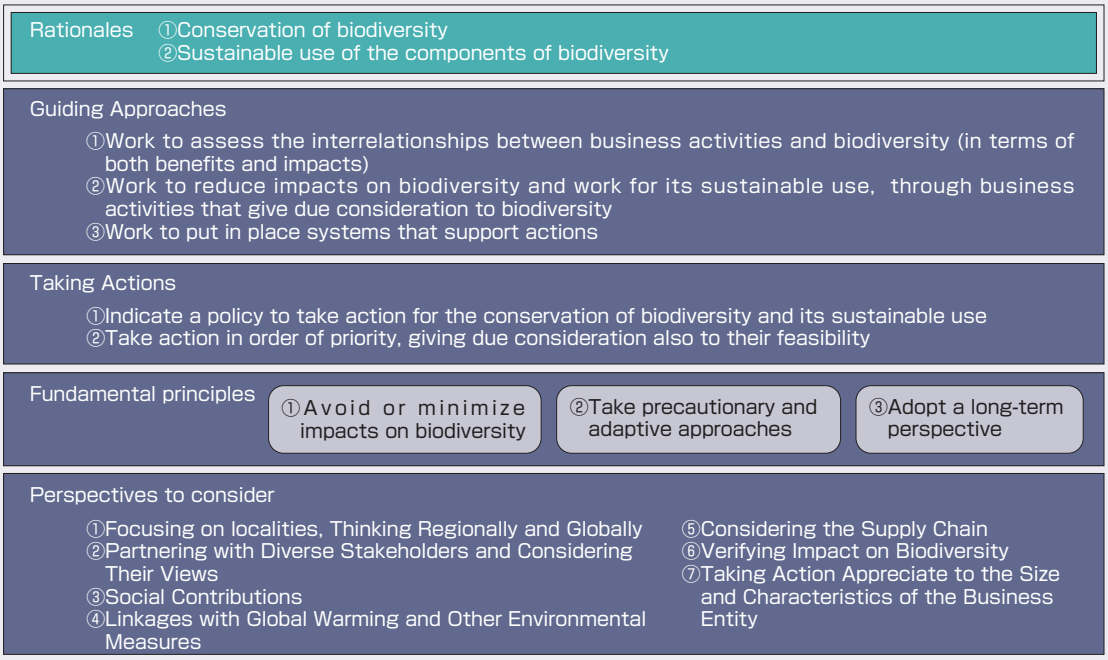
1 Biodiversity and businesses

International movements concerning biodiversity and businesses began with the adoption for the first time of a resolution regarding the importance of private-sector engagement at the eighth meeting of the Conference of the Parties to the Convention on Biological Diversity (COP8), held in Curitiba, Brazil, in March 2006. While noting that the private sector is arguably the least engaged of all stakeholders in the implementation of the Convention, the decision placed high expectations on contributions private-sector businesses can make, noting that (1) the daily activities of business and industry have major impacts on biodiversity, and encouraging business and industry to adopt and promote good practice could make a significant contribution to preventing the loss of biodiversity; (2) individual companies and industry associations can be highly influential on Governments and public opinion, and thus, they have the potential to spread the conservation and sustainable use of biodiversity; and (3) the private sector possesses biodiversity-relevant knowledge and technological resources, as well as more general management, research and communication skills, which, if mobilized, could facilitate practices for the conservation and sustainable use of biodiversity.

At the high-level ministerial segment of COP9 held in Bonn, Germany, in May 2008, a signing ceremony took place for the "Leadership Declaration" on the "Business and Biodiversity Initiative (B&B Initiative)," promoted by the German government, in order to further increase the engagement of private-sector businesses in the achievement of the objectives of the Convention on Biological Diversity (CBD). The declaration states that signatory companies acknowledge and support the Convention's three objectives, and commits them to analyze corporate activities with regard to their impacts on biodiversity. A total of 34 companies, including nine Japanese firms, participated in the signing ceremony. Further, G8 Environment Ministers Meetings in 2007, 2008 and 2009 addressed biodiversity as an important agenda item, underlining the need to strengthen policies to engage the industry sector and consider economic impacts associated with the loss of biodiversity.

In Japan, meanwhile, given the international developments discussed above, "The Third National Biodiversity Strategy," formulated in 2007, set forth the preparation of guidelines for guidance for voluntary actions by businesses. The Basic Act on Biodiversity (Act No. 58 of 2008) provides for obligations of business operators and citizens and also prescribes the promotion of biodiversity-friendly business operations as a national policy. Further, in August 2009, the Ministry of the Environment announced the "Guidelines for Private Sector Engagement in Biodiversity," which serves as guidance for voluntary actions by business operators for the conservation of biodiversity and its sustainable use. The guidelines provide for the philosophy, the direction and procedures of efforts and basic principles for business operators voluntarily taking actions friendly to biodiversity (Figure 3-3-1).

Figure3-3-1 Outline for Guidelines for Private Sector Engagement in Biodiversity



Note: Precautionary approaches/Preventive measures without delay, even in the absence of complete scientific evidence, in case where there may be large scale and irreversible impacts on biodiversity.
Adaptive approaches/Measures based on the ongoing monitoring of business activities and other factors, which are adjusted flexibly based on the monitoring results.
Source: Ministry of the Environment, "Guidelines for Private Sector Engagement in Biodiversity"

Photo3-3-1 Rain Forest Restoration Experimental Project on Borneo Island (Malaysian Territory)

Photo: Mitsubishi Corporation

Photo3-3-2 Mangrove Planting in Ranong, Thailand

Photo: Tokio Marine & Nichido Fire Insurance Co., Ltd.

Photo3-3-3 Tree Planting in Devastated Forests (East Java, Indonesia)

Photo: Sumitomo Forestry Co., Ltd.

Under these circumstances, the business community has embarked on initiatives of their own. In March 2009, Nippon Keidanren announced the "Declaration of Biodiversity by Nippon Keidanren," showing the determination to exert active efforts on biodiversity and providing guidelines for specific actions. In April 2008, the "Japan Business Initiative for Conservation and Sustainable Use of Biodiversity (JBIB)" was launched by Japanese companies for the purpose of learning about the conservation and sustainable use of biodiversity. As another example of various efforts initiated in the private sector, in April 2009, the Shiga Committee for Economic Development announced the "Shiga Business and Biodiversity Initiative for Lake Biwa," with the 10-point declaration statement, including "We practice conservation activities for one species at least, or at one habitat area."

There are also companies that have been undertaking activities that help conserve biodiversity as part of their main business operations or corporate social responsibility (CSR) activities since before the rise in the public awareness of efforts on biodiversity.

For example, a general trading house has been carrying out an experimental project in the Malaysian territory of Borneo Island to restore the rain forest ecosystem in the critical state to natural forests as much as possible at an early date. The project has been under way for 20 years since 1990, with the participation of company employees along with experts and people from local communities (Photo 3-3-1).

A nonlife insurance company achieved the condition of carbon neutral in FY 2007, offsetting carbon dioxide emissions from its domestic business offices by the use of natural energy and the carbon dioxide absorption and reduction effects of mangroves it planted. The planting of mangroves the company has been undertaking for a period of 10 years in partnership with nongovernment organizations (NGOs) has now covered a combined area of about 5,900 hectares in Indonesia, Thailand, the Philippines, Vietnam, Myanmar and Fiji Islands (Photo 3-3-2). The company has also launched a project to donate cash equivalent to two mangrove trees per insurance contract in which a policyholder agrees to read a contract renewal agreement on the website instead of a paper document.

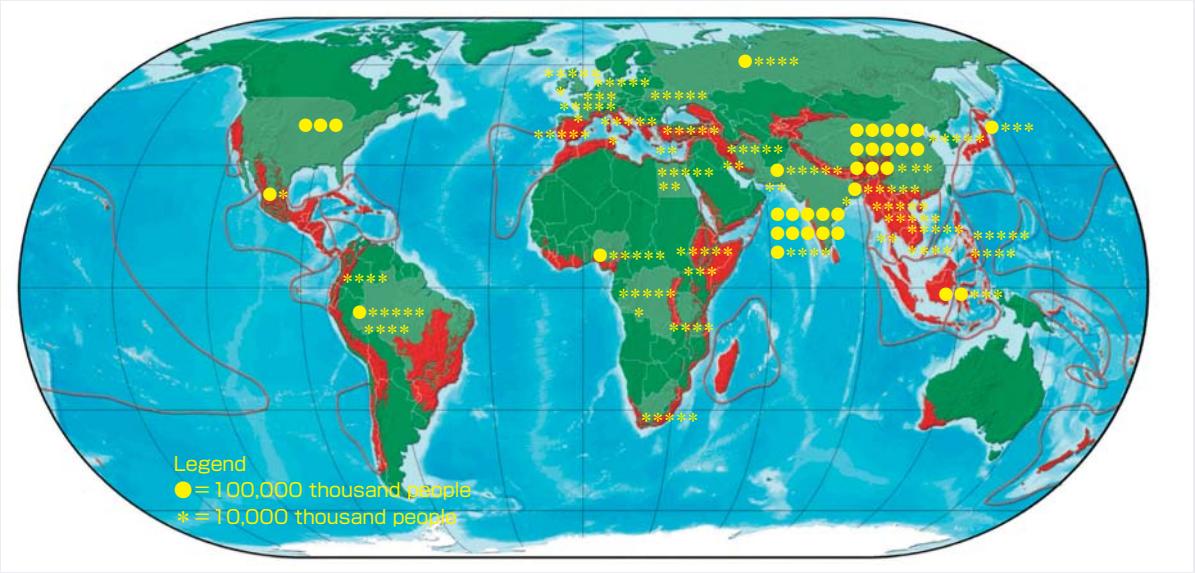
A forestry business company says while domestic forests it owns absorbed 116,000 tons of carbon dioxide in FY 2008, carbon dioxide fixed in lumber used for building wood houses it sold amounted to 210,000. This is a good example of a company contributing to the conservation of nature in its core business operations. The forestry industry contributes to the conservation of biodiversity as well as to the absorption of carbon dioxide. All forests the company owns have already been certified as adequately managed forests in 2006 by the Sustainable 'Green Ecosystem' Council (SGEC). Following the certification, the company has launched a survey to monitor the inhabitation and growth situation of animals and plants mainly in clear-cut areas. In response to deforestation of 1.90 million hectares per year in Indonesia, the company has decided plant trees in 300 hectares of protected forests within national parks and in 1,200 hectares of denuded forest lands outside protected forests (Photo 3-3-3).

As seen above, corporate activities friendly to biodiversity are becoming active both at home and abroad.

2 Cities and biodiversity

The term "biodiversity hotspots," first proposed by conservation biologist Norman Myers in 1988, indicates

Figure3-3-2 Hotspots and Populated Areas



Note: Populated areas = The world's top 30 populous countries (China, India, U.S., Indonesia, Brazil, Pakistan, Bangladesh, Nigeria, Russia, Japan, Mexico, Philippines, Vietnam, Germany, Egypt, Ethiopia, Turkey, Iran, Thailand, Congo, France, Britain, Italy, Myanmar, South Africa, Korea, Ukraine, Spain, Colombia and Tanzania)
Source: Prepared by Ministry of the Environment based on materials provided by Conservation International (www.conservation.or.jp)

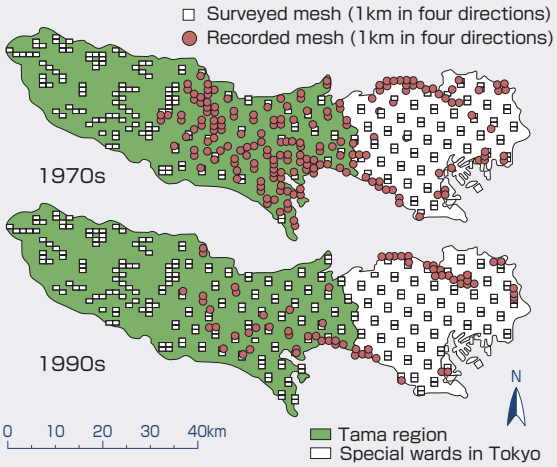
areas that have the high level of biodiversity with at least 1,500 indigenous species of vascular plants and yet at risk of destruction with 70% or more of natural vegetation damaged. A total of 34 areas are designated as hotspots globally, including Japan. The hotspots cover only 2.3% of the surface area of the earth, but include many densely populated areas, an indication of heavy development pressures (Figure 3-3-2).

At present, as seen in the Introductory Chapter, half of the world population lives in cities, in only 2.8% of the earth's land areas. Urban populations keep increasing, with two-thirds of the global population projected to be living in cities by 2050. Urban residents and economic activities consume 75% of resources being consumed by mankind, with a considerable degree of dependence of benefits from biodiversity in surrounding areas (ecosystem services). In fact, the food self-sufficiency rate by prefecture for FY 2007, announced by the Ministry of Agriculture, Forestry and Fisheries, is 1% for Tokyo, 2% for Osaka and 3% for Kanagawa, clearly showing the actual situation that big cities are producing little food to feed their residents.

However, the history of cities is widely varied and they have different backgrounds, including the mode of land utilization and the extent of urbanization as well as economic, social and cultural conditions. As the distribution of living organisms is either shrinking or expanding in accordance with the stage of urban development, as shown in Figure 3-3-3 and in Figure 5-1-5 in Part II, it is deemed necessary to build relationships with biodiversity suitable to respective cities.

In November 2009, the "Local Government Conference on Biodiversity 2009" was held in Nagoya, Aichi Prefecture, with the participation of 103 municipal governments in Japan, sponsored by Aichi Prefecture, Nagoya City and the Aichi-Nagoya COP10 CBD Promotion Committee. In preparation for the "City

Figure3-3-3 Changes in Skylark Distribution in Metropolitan Tokyo



Source: Prepared by Ministry of the Environment based on Tokyo Metropolitan Government, "Survey Report on the State of Procreation of Birds" and "Survey Report on Procreation of Birds"

Biodiversity Summit 2010" scheduled to be called to coincide with COP10, the conference participants discussed problems common to municipalities in Japan and exchanged information on their initiatives for the conservation of biodiversity. In a report on discussions at the conference, the participants confirmed the items that were deemed important when local authorities carry out policies and measures for the conservation and restoration of biodiversity in the future, including the comprehensive perspective of "biodiversity" and the wisdom of a system of circulation and coexistence with the environment.

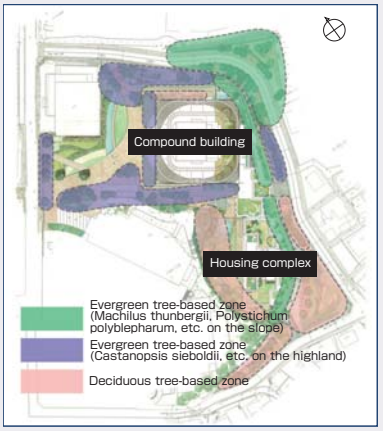
The cooperation among local governments has been extended globally. Already in 1990, officials from over 200 local governments of 43 countries gathered at the United Nations in New York City for the "World Congress of Local Governments for a Sustainable Future," and established the International Council for

Figure3-3-4 Efforts on Biodiversity in Redevelopment Project

Efforts on biodiversity in a redevelopment project in the Toranomon/Roppongi Disrict First Class City Urbanization Area

The project contributes to the conservation and recovery of biodiversity in the following points:

1. Green space based on native species and potential natural vegetation: Restore regional vegetation in the planned area
   ※Main native species: Castanopsis sieboldii, Machilus thunbergii, Quercus glauca Thunb, Styrax japonica, Benthamidia japonica, etc.
2. Large green spaces:
   Enhanced green effect and better connection with surrounding areas
3. Sterical green spaces with the high green coverage ratio:
   Contribute to improved habitats for living organisms
4. Special components of the environment:
   Consideration for components of the environment such as deadwood, tree hollows and fallen leaves



Source: Mori Building Co., Ltd.

Local Environmental Initiatives (ICLEI)." As of December 2009, over 1,100 local governments from 68 countries of the world participate in ICLEI. ICLEI is designed for cooperation among local governments on key themes such as prevention of climate change, comprehensive water management, conservation of biodiversity, building of sustainable local communities and sustainability management, and its activities are guided by the belief that measures developed by local governments are the highly cost-effective way to realize sustainability at the local, national and global level. COP9 held in Bonn, Germany, in 2008 adopted a decision on the promotion of engagement of cities and local authorities, the first of its kind, recognizing the importance of roles of cities and local governments under the Convention on Biological Diversity.

New attempts are under consideration in Japan concerning cities and biodiversity. The City of Nagoya is considering the introduction of a mechanism for conserving forests in suburban private land by administering the city planning system in exchange for the easing of the floor-space ratio for buildings in urban areas.

Among private-sector companies, for example, in open space planning for an urban redevelopment project, a developer launched an initiative to restore nature, the first of its kind in Japan, by paying full heed to native species and potential natural vegetation based on a survey of existing conditions and literature searching. This redevelopment project has been assigned the highest rating of AAA based on an objective quantitative evaluation by the Japan Habitat Evaluation and Certification Program (JHEP), a third-party organization (Figure 3-3-4). JHEP was introduced as a Japanese version of the Habitat Evaluation Procedures (HEP), a method for a quantitative assessment of the natural environment from the standpoint of wildlife habitat developed by the U.S. Department of the Interior in the 1980s. The HEP, noted for its high objectivity and reproducibility as well as for its excellence as an easy-to-understand consensus-building tool, is widely used for environment impact assessment and nature restoration projects in the United States. Separately, as of th end of March 2010, a total of 33 sites have been recognized as the excellent green space actively conserved and utilized by companies and other entities under "the Social and Environmental Green Evaluation System (SEGES)", helping to motivate and strengthen green conservation activities.

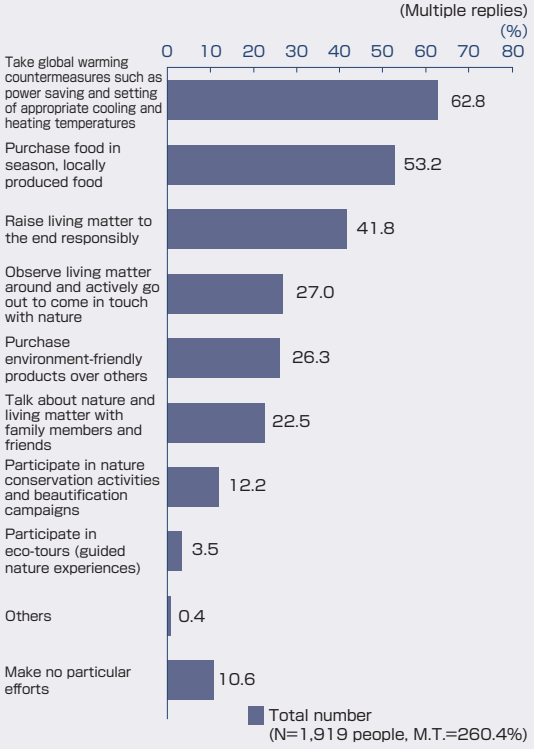
3 Lifestyles mindful of biodiversity

(1) Consideration for biodiversity by choice of manufactured products and food

As discussed above, most of resources and materials essential for our clothing, food and housing are supplied as ecosystem services provided by ecosystems. In this subsection, we describe what we can as consumers. First of all, it is fundamentally necessary to obtain ecosystem services in a sustainable manner that does not disrupt the reproduction function of ecosystem services, as they are provided as renewable services in natural cycles. According to a public opinion survey conducted by the Cabinet Office in 2009, the ratio of people who cited "prioritized purchases of environment-friendly products" as efforts for biodiversity-friendly lifestyles stood at a low 26%, underscoring the need to promote the spread of products that pay due heed to biodiversity (Figure 3-3-5). Next, we introduce sustainable production initiatives and our choices as consumers regarding timber, fisheries resources and agricultural products.

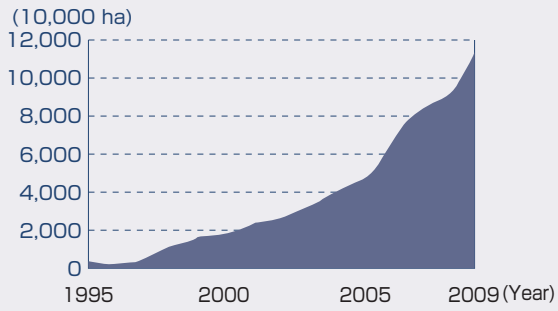
Japan's domestic demand for timber amounted to 77.97 million cubic meters in 2008, of which about 76% was met by imports. Timber is imported mainly from North America, Southeast Asia, Russia, Europe and Australia. In Indonesia, for example, about 1.90 million hectares (equivalent to the area of Shikoku) of forests are lost per year due to forest fires and illegal logging. One of things

Figure3-3-5 Previous Efforts for Biodiversity-Friendly Livelihood



Source: Cabinet Office, "Public Opinion Survey on Environmental Issues"

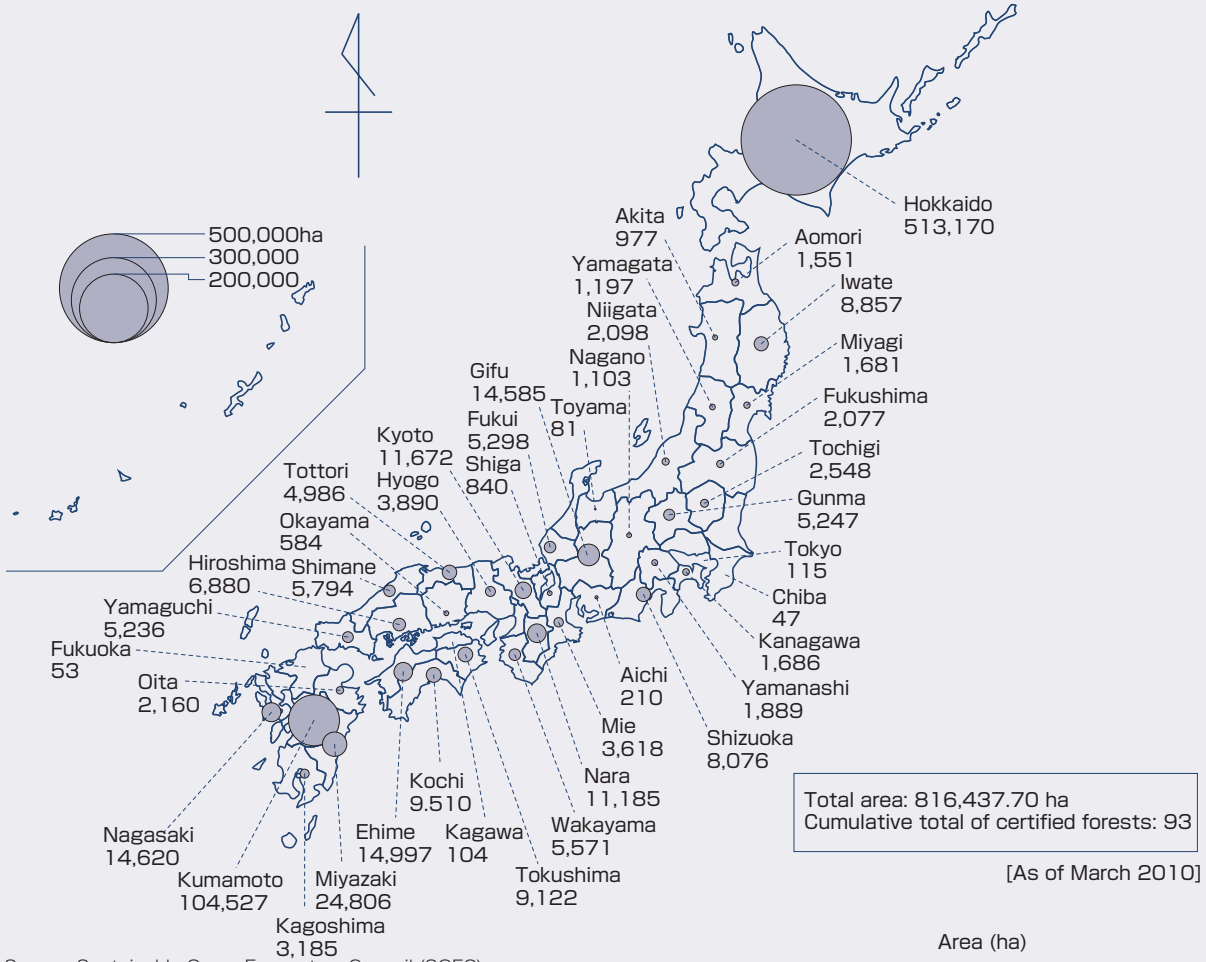
Figure3-3-6 Global Area of FSC-Certified Forests



Source: Forest Stewardship Council (FSC) International Headquarters

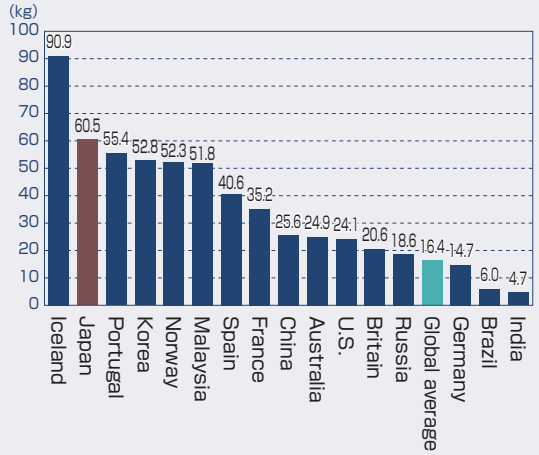
we can do as consumers to reduce illegal logging and maintain biodiversity in countries of origin is to purchase lumber and wood products certified for legitimacy and sustainability. Based on "the Act on Promoting Green Purchasing", the Japanese government since 2006 has been procuring lumber certified for legitimacy and sustainability. In order to promote sustainable forest management, the government has also presented at home and overseas guidelines for requirements of lumber and wood products whose use is to be promoted in Japan. Because of these initiatives, it is now possible to procure lumber and wood products certified for legitimacy and sustainability across the country. Consumers can contribute to the conservation of biodiversity and its

Figure3-3-7 Distribution Map of Japan's SGEC-Certified Forests (By Prefecture)



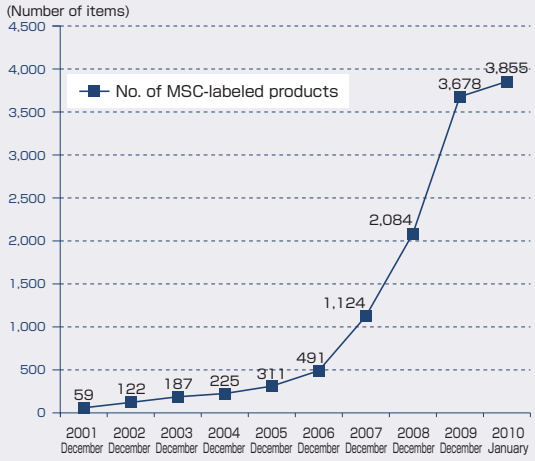
Source: Sustainable Green Ecosystem Council (SGEC)

Figure3-3-8 Per-Capita Annual Consumption of Fisheries Products in Major Countries (2005)



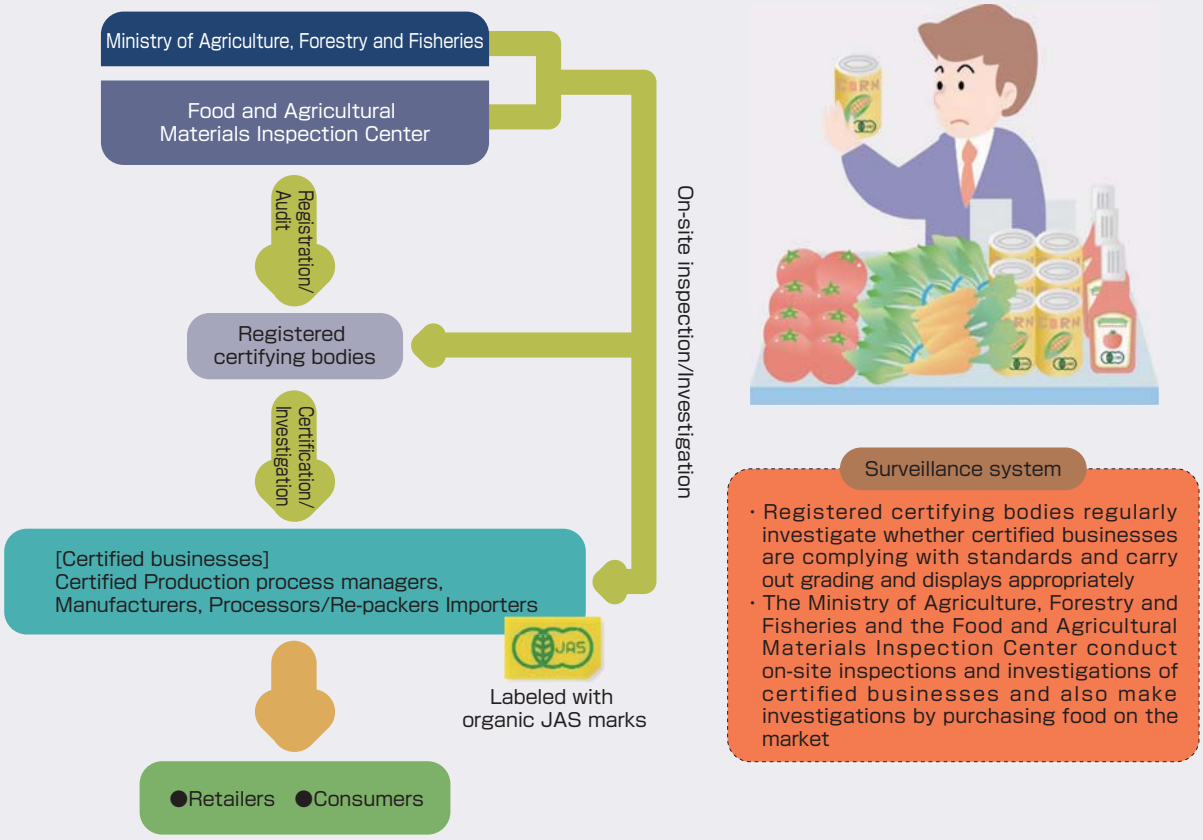
Source: Prepared by Ministry of the Environment based on FAOSTAT

Figure3-3-9 Trends in Number of MSC-Labeled Products



Source: Marine Stewardship Council (MSC) Japan Office

Figure3-3-10 Overview of the Organic Food Inspection and Certification System

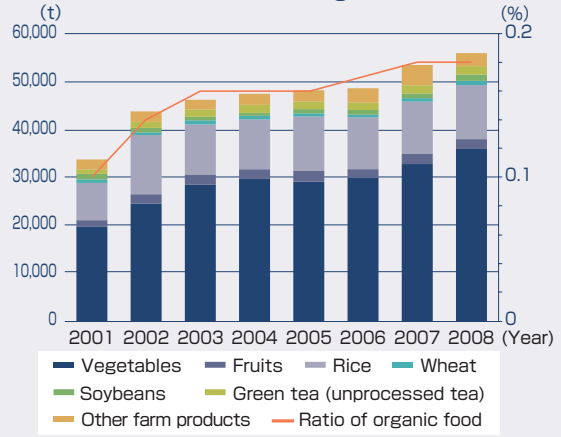


Source: Ministry of Agriculture, Forestry and Fisheries brochure, "Organic Food is Wonderful"

sustainable use by choosing certified products when they purchase products made from trees, such as furniture, stationery, miscellaneous goods used in daily livelihood and paper as well as lumber. A good reference in choosing lumber certified for legitimacy and sustainability is forest certification. Forest certification schemes are private sector-led systems in which third-party organizations certify appropriate forest management by looking into "whether forest managers are complying with laws and international agreements," "whether forests are rich forests offering habitats for many living organisms" and other matters, separately manage timber produced from certified forests for distribution with certification labels. Forest certification schemes include the Programme for the Endorsement of Forest Certification (PEFC), the Forest Stewardship Council (FSC) and the Sustainable Green Ecosystem Council (SGEC). Forest area certified by the FSC is growing globally (Figure 3-3-6), while domestic forests certified by SGEC increased to 93 forests, for a combined area of 816,438 hectares, as of March 2010 (Figure 3-3-7).

Per-capita consumption of fisheries products for

Figure3-3-11 Amount of Graded Organic Farm Products and the Ratio to Total Agricultural Produciton



Source: Prepared by Ministry of the Environment based on Ministry of Agriculture, Forestry and Fisheries, "FY 2008 Results of Grading Concerning Accredited Businesses"

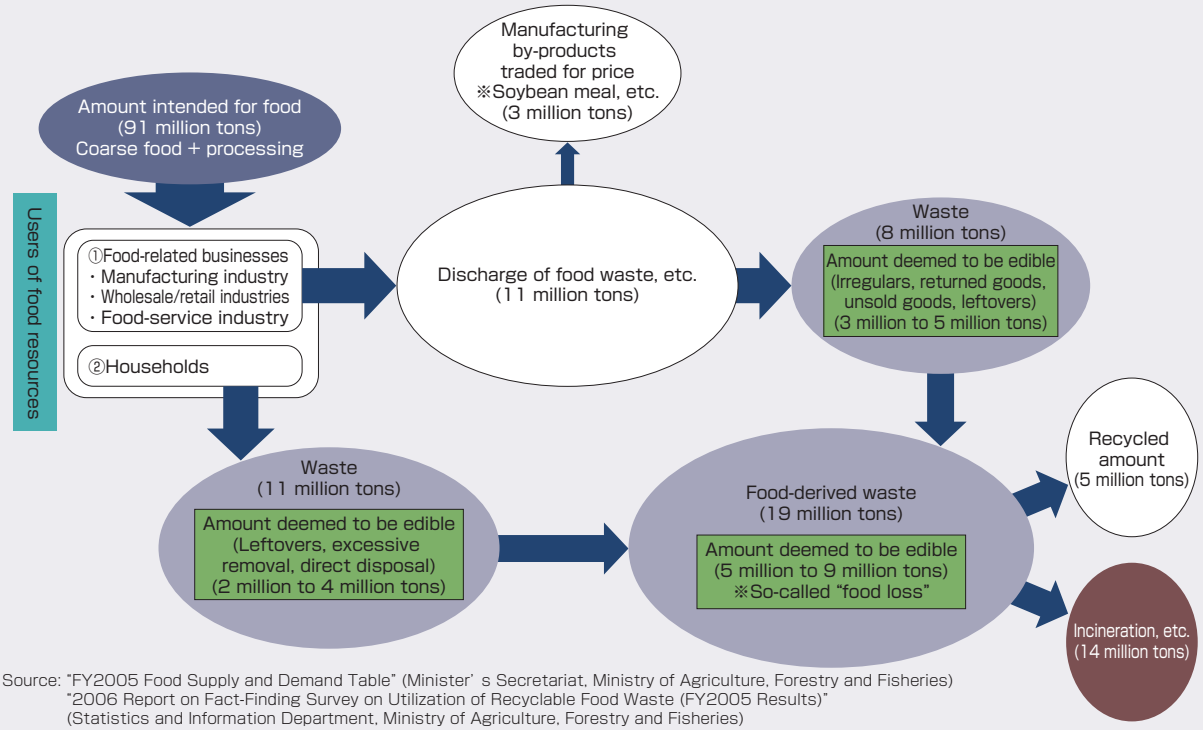
Japanese people is the third largest in the world and about four times the global average (Figure 3-3-8). In order to obtain rich fisheries resources in a stable manner, biodiversity that provides them needs to be conserved. Efforts to avoid the depletion of fisheries resources are necessary to carry out sustainable fisheries operations, by, among others, setting certain rules on catches, kinds of fish to be caught, fishing periods and fishing methods. Certification schemes for such fisheries operations include the Marine Stewardship Council (MSC) and the Marine Eco-Label Japan (MEL Japan). Products with MSC certification labels are seeing increasing sales globally, reaching a total of 3,855 items as of January 2010 (Figure 3-3-9). In Japan, about 170 items certified by the MSC are in the market as of June 2009.

In Japan, production of organic farm products is being carried out under unified rules based on the Act for Standardization and Proper Labeling of Agricultural and Forestry Products (Act No. 175 of 1950) enforced in April 2001. Under this system, accredited business operators can grade agricultural products satisfying JAS (Japan Agricultural Standards) standards for organic vegetables and put organic JAS marks on such products (Figure 3-3-10). Production standards for organic farm products, designed to maintain and improve the natural cyclical function of agriculture, call on producers to (1) prepare soil using compost and not to use, in principle, chemical fertilizers and agricultural chemicals (in over two years prior to seeding and planting and during cultivation) to give full play to the productivity of farmland driving from soil characteristics; (2) produce farm products in agricultural fields that adopt cultivation management methods that reduce burdens traceable to agricultural production on the environment as much as possible; and (3) not to use genetically engineered seedlings. Our purchases of farm products carrying organic JAS marks help promote agriculture with less environmental burdens such as impacts of agricultural chemicals on living organisms and conserve biodiversity. In fact, between 2001 and 2008, amounts of farm products graded under organic JAS standards increased about 1.7 times from 33,734 tons to 55,928 tons (Figure 3-3-11). As the ratio of farm products graded under organic JAS standards to total agricultural production still remains low, we are being called upon to make wise choices for the further spread of organic farm products.

(2) Consideration for biodiversity through reduction of food waste

In Japan, about 19 million tons of food waste are

Figure3-3-12 Flow Chart of Generation of Food Waste



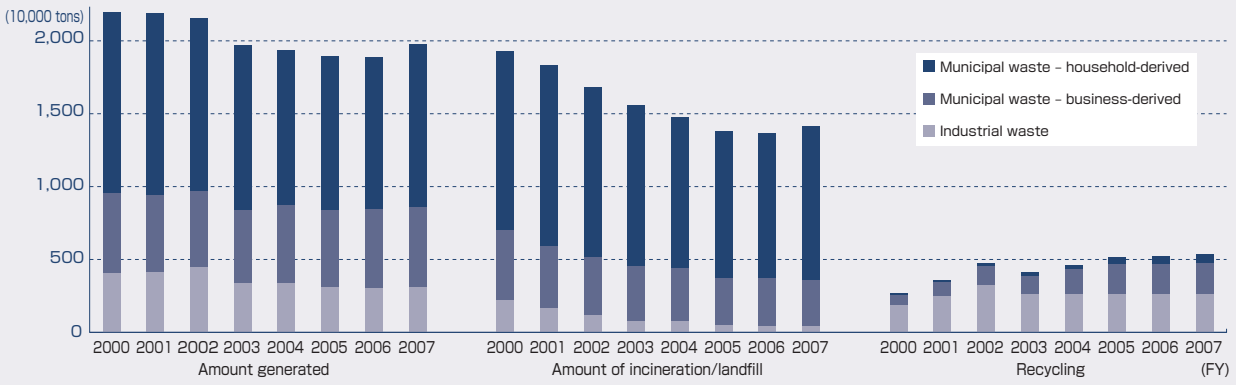
Source: "FY2005 Food Supply and Demand Table" (Minister's Secretariat, Ministry of Agriculture, Forestry and Fisheries)
"2006 Report on Fact-Finding Survey on Utilization of Recyclable Food Waste (FY2005 Results)" (Statistics and Information Department, Ministry of Agriculture, Forestry and Fisheries)
"FY2005 Statistical Survey on Food Loss" (Statistics and Information Department, Ministry of Agriculture, Forestry and Fisheries)
Prepared and estimated by Ministry of Agriculture, Forestry and Fisheries based on "Discharge and Disposal of Municipal Waste, Discharge and Disposal of Industrial Waste, etc." (Ministry of the Environment Estimates of FY2005 results)

discharged annually, of which food that can be eaten but is disposed of, or "food loss," is estimated to account for about 5 million to 9 million tons (Figure 3-3-12). Of food waste discharged by food-related business operators, an amount deemed to be disposed of by incineration or landfill has been on the steady decline year by year to stand at around 60% (Figure 3-3-13). On the other hand, only about 640,000 tons out of food waste discharged by general households is being recycled, with the remaining 94% being disposed of by either incineration or landfill (Table 3-2-4 of Part II).

According to the FAO, the undernourished population in 2009 is estimated to have reached as high as 1.02 billion people in the world, topping the one-billion mark for the first time ever. In Japan, food equivalent to an average 2,473 kilocalories per capital per day was supplied on a calorie basis in FY 2008 (Figure 3-3-14). For the entire population of Japan (127.69 million as of October 1, 2008), this translates into about 315,777 million kilocalories. The difference between the amount of calories supplied and the amount of calorie intake is understood to be a rough indication of food waste and leftovers. In Japan, this difference stood at 708 kilocalories per capital per day in FY 2007, which amounts to a daily food waste of 90,405 million kilocalories per day for the entire nation. If this amount is divided by 2,200 kilocalories per capita per day, which is believed to be the minimum daily calorie intake to keep an adult from undernourishment, we get the amount of nourishment for some 41.93 million people. When there are so many people in the world who cannot get enough food, we need to get food from ecosystem services across more effectively.

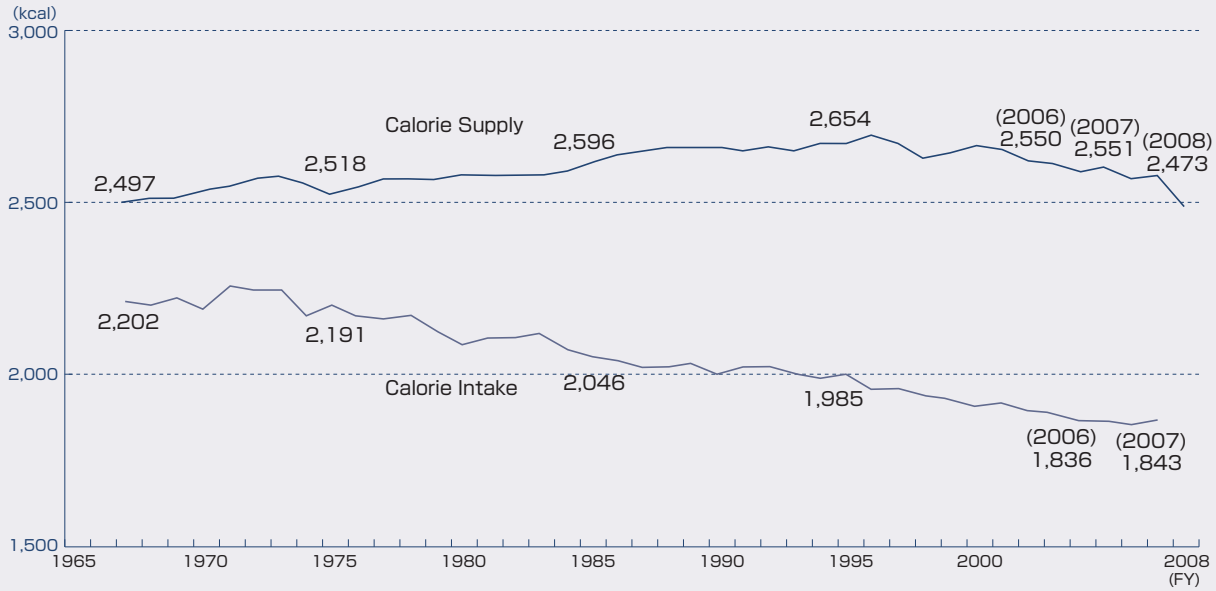
In recent years, "shokuiku (dietary education)" is being actively pursued, including the promotion of cooked rice for school lunch and use of locally produced farm

Figure3-3-13 Generation and Disposal of Food Waste (FY2000-FY2007)



Note: 1 Total may not add up due to rounding
2 The amount of food waste estimated by Ministry of the Environment based on "Discharge and Disposal of Municipal Waste, etc." (FY2007 results) and "Discharge and Disposal of Industrial Waste, etc." (FY 2007 results)
3 The amount of recycling of municipal waste derived from households was similarly estimated by Ministry of the Environment
4 The amounts of municipal waste derived from businesses and industrial waste (including breakdowns) were estimated based on Ministry of Agriculture, Forestry and Fisheries, "2008 Results of Fact-Finding Survey on Utilization of Recyclable Food Waste"
Source: Ministry of Agriculture, Forestry and Fisheries; Ministry of the Environment

Figure3-3-14 Changes in Calorie Supply (Food Supply and Demand Table) and Calorie Intake (National Health and Nutrition Survey)



Note: 1 excluded Alcoholic beverages
2 The difference between calorie supply and calorie intake should be regarded as a rough indicator of leftovers and waste because both calorie data are totally different in statistical survey methods and calorie calculation methods and cannot be compared simply.
Source: Ministry of Agriculture, Forestry and Fisheries, "Food Supply and Demand Table" ; Ministry of Health, Labour and Welfare, "National Health and Nutrition Survey"

products in school lunch. But the main purpose of shokuiku is to have children acquire the fundamental habits of "leaving no food uneaten" and "having a sense of gratitude." This is applicable to household efforts to reduce food waste. Among things individuals can do immediately are to understand the meanings of the use-by date and the expiration date and try to finish up food as food past the use-by date does not become inedible, avoid buying too much food by confirming kinds and amounts of food kept in a refrigerator before going shopping, and finish up purchased food in order by confirming the use-by and expiration dates.

(3) Consideration for biodiversity in initiatives by businesses

Businesses have the important role of providing benefits of biodiversity widely to society through their products and services. In a public opinion survey conducted by the Cabinet Office in June 2009, 82% of respondents said they highly rate corporate activities paying heed to biodiversity. Operations of businesses are supported by attitudes of consumers and have to change in response to consumption behavior of each citizen. At the same time, businesses are expected to make their activities more biodiversity-friendly and encourage a shift in consumer lifestyles by offering products and services that pay greater heed to biodiversity.

Activities by businesses give an impact on biodiversity in various situations and also benefit from biodiversity. For example, food, wood, paper, fiber, fuel and water are essential for business activities. A variety of genes are useful for development of pharmaceutical products and cultivar improvement. Aside from the supply of material, stable climate and prevention of natural disasters such as landslides and floods are necessary for stable business activities. Furthermore, technological innovation is often inspired by forms and functions found in the natural world. This is called "bio-mimicry," meaning mimicry of living organisms, and one of the well-known examples is the design of the lead vehicle of Shinkansen bullet train shaped like the halcyon beak to reduce pneumatic resistance.

Meanwhile, development and utilization of iron ores and other mineral resources as well as oil and other fossil fuels affect biodiversity through land conversion and global warming. Disposal of waste, treatment of drainage water and construction of business offices and industrial plants may also affect biodiversity in their processes. Furthermore, we may get involved with biodiversity through investment in and loans to economic activities as well as social action programs.

As seen above, whether we are in agricultural, forestry and fisheries industries, construction industry and manufacturing industry or in retail industry, financial services industry and mass media, we affect biodiversity and rely on its benefits through utilization of biological resources, supply chain and investment and loans. Such benefits and impacts occur both at home and abroad. In particular, Japan bestowed with few natural resources depends on other countries for their supply, and we must not forget that our present livelihoods are underpinned by exploitation of ecosystem services overseas.

While efforts by businesses so far have rather centered on activities related to corporate social responsibility (CSR), from now on, it will become important for them to address biodiversity in their main business lines. As the direction of efforts by businesses, the Guidelines for Private Sector Engagement in Biodiversity state that businesses should (1) strive to grasp linkages between business operations and biodiversity (benefits and impacts); (2) strive for mitigation of impacts on biodiversity and sustainable utilization of biodiversity; (3) strive to enhance structures to promote efforts on biodiversity. Businesses' involvement with biodiversity is varied depending the category and size of their operations. It is important for each business operator to understand linkages between its business operations and biodiversity, and then proceed with efforts in order of priority while taking feasibility into account.

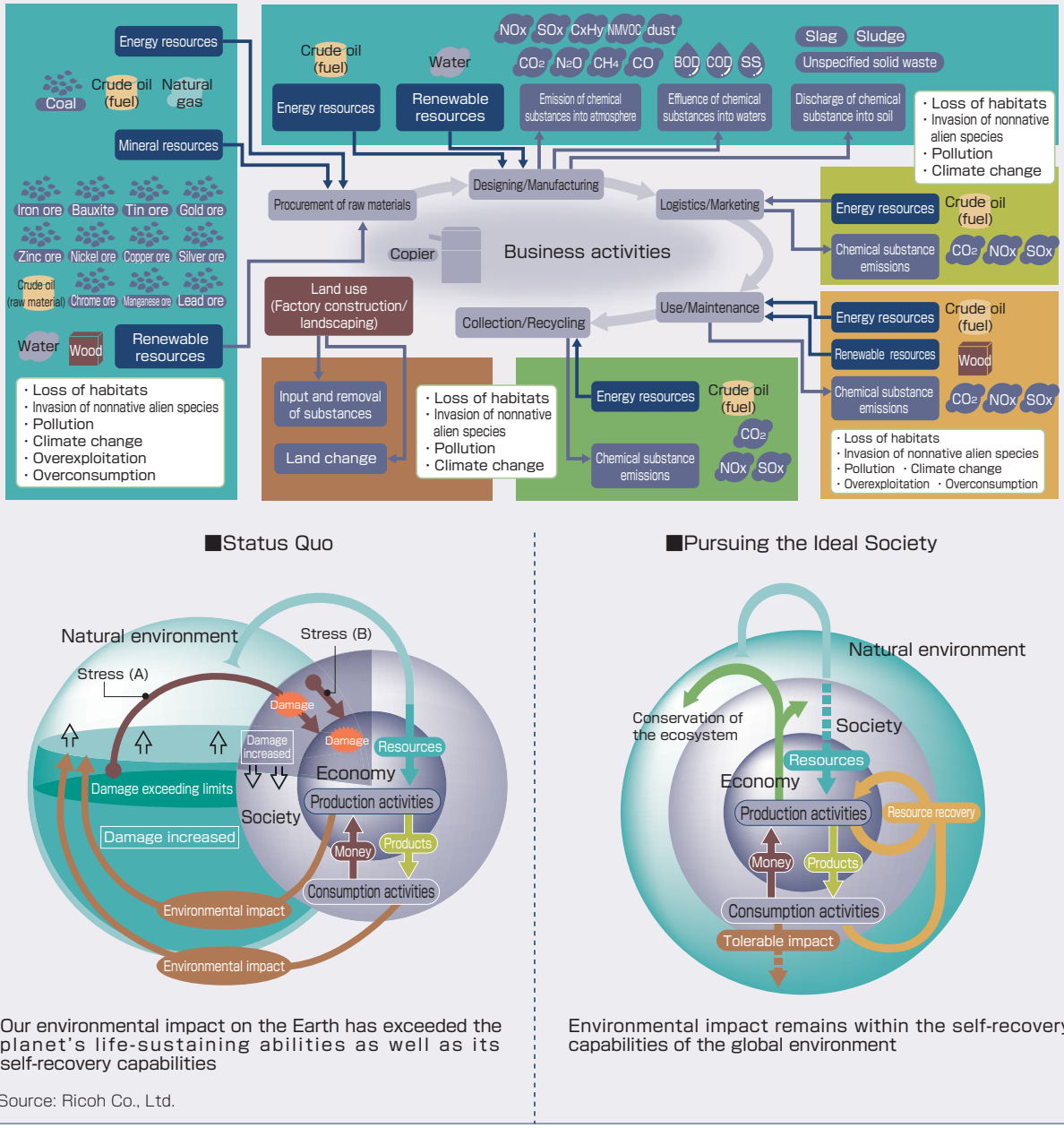
Businesses' efforts on biodiversity involve both risks and opportunities (Table 3-3-1). For example, while work to review the procurement of raw materials from the perspective of biodiversity may require additional costs, reduced risks related to the procurement of raw materials are expected to help stabilize business management. Japan depends on overseas for about 60% of food, about 80% of timber and almost all of mineral resources and

Table3-3-1 Examples of Risks and Opportunities in Business Activities

Type		Examples of risks and opportunities
Operational	risks	· Scarcity of raw material inputs or increased costs of procurement of material inputs, such as due to declines in living resources · Reduced output or productivity, or disruption of business operations, due to declines in living resources availability
	opportunities	· Development of production processes that are less affected by scarcity of material inputs, by means of sustainable use or reduction in use of living resources · Strengthening of the supply chain through the promotion of actions by suppliers
Regulatory /legal	risks	· Imposition of fines, suspension or rejection of licenses or permits, lawsuits, etc. due to legal violations related to biodiversity · Cuts in quotas for living resources or imposition of new user fees
	opportunities	· Official approval received to expand operations thanks to consideration of biodiversity · Development or sales of new products that comply with new regulations, etc. related to biodiversity
Reputational	risks	· Damage to brand or corporate image, and risk to social "license to operate" due to discovery of negative impacts on biodiversity
	opportunities	· Demonstration of consideration of biodiversity improves brand image, appeals to customers, and differentiates company from others in the industry · Consideration of biodiversity helps to obtain the understanding of the local community or strengthen relationships with local residents and other stakeholders
Markets/ products	risks	· Loss of customers due to promotion of green procurement in public and private sectors · Decline in market competitiveness of products or services due to lower environmental product quality
	opportunities	· Development of products and services that consider biodiversity, and new markets for certified products, etc. · Development of new technology, products, etc. that promote conservation and sustainable use of biodiversity. · Appeal to consumers who have high ethical sensitivity for environmentally concerned, corporation and products, etc.
Financing	risks	· Potential refusal of financing requests due to more rigorous lending criteria at financial institutions
	opportunities	· Appeal to investors who emphasize social responsibility
Internal	risks	· Decline in employees' morale
	opportunities	· Improved employees' morale

Source: Ministry of the Environment, "Guidelines for Private Sector Engagement in Biodiversity"

Figure3-3-15 Map of Corporate Activities and Biodiversity



Our environmental impact on the Earth has exceeded the planet's life-sustaining abilities as well as its self-recovery capabilities

Environmental impact remains within the self-recovery capabilities of the global environment

Source: Ricoh Co., Ltd.

fossil fuels. In that sense, efforts on biodiversity are also important as a resources strategy.

As seen above, businesses' efforts on biodiversity in cooperation with various entities, including consumers, are necessary not only to accelerate movements of society as a whole toward realizing natural symbiosis society but also to carry on with their business operations in the future.

For example, an office equipment maker is striving to grasp the linkage with biodiversity in each stage of a whole range of business activities from the procurement of raw materials, designing/ manufacturing, logistics/ selling to use/maintenance and recovery/recycling and reduce burdens on biodiversity (Figure 3-3-15). This company has found that in the copier business, for example, the impact of business operations on biodiversity was the largest in the procurement of raw materials, such as paper and pulp and metallic resources and water resources used in production. Instead of linear business activities where it manufactures products by the input of resources and ultimately disposes of them into the environment, the company is pursuing business activities whose impacts remain within the self-recovery capabilities of the global environment (Figure 3-3-15).

A Japanese consumer electronics maker launched its efforts on biodiversity since October in 2008 by supporting the "Arctic Program," one of measures to protect the global environment being undertaken by the World Wildlife Fund (WWF). The WWF's project is designed to promote the understanding about the Arctic and manage ecosystems by the following four methods:
Communicating the global implications of Arctic climate change;
Ensuring the Arctic biosphere does not become a new source of atmospheric carbon;
Eliminating the additional pressures on the environment caused by unsustainable exploitative activities;
Establishing governance regimes to conserve the ecosystems and species of the Arctic for future generations.

The company has "coexistence with the global environment" as one of the guiding principles for its business operations, and contributing to "removal of threats of environmental destruction in the Arctic and conservation of the environment of the Arctic region that greatly impacts global warming" is consistent with the objectives of its business activities. The company's support is extended mainly in the form of financial assistance, and assistance of 470,000 euros is planned over a three-year period. The company and the WWF are cooperating in efforts on environmental analyses and surveys as well as on support for the continued well-being of Arctic ecosystems, including the polar bear.

Column Food Bank Activities

In recent years, "food bank" activities are spreading. A food bank is a system under which it receives food and food materials that are deemed not good enough to go through regular distribution channels but have no food quality problems from food manufacturers and retailers, etc. and donates them to welfare facilities and other organizations in need of support free of charge, supported by many volunteers. The United States has a history of about 40 years of food bank activities (with 220 organizations involved across the country and 2 million tons of food handled annually), and there is also an international organization for food bank activities with the membership of 18 countries across the world. In Japan, Second Harvest Japan (a specified nonprofit corporation established in 2002 in Taito Ward, Tokyo) has the largest scale of food bank activities and is a member of the international organization. In 2008, it handled 8.5 million tons of food with the monetary equivalent of about ¥510 million, and companies that provide it with food are estimated to have been able to reduce food disposal expenses by about ¥92 million.

Supporting companies that provide food to Second Harvest Japan have reached a cumulative total of some 500 firms, and the circle of support is now widening, including cooperation of distribution companies, apparently as part of corporate CSR activities. Foods handled are wide-ranging, from staple food (rice, bread, noodles, etc.), supplementary dishes, articles of taste (sweets, beverages) and seasonings, perishable food, chilled and frozen food, instant food and food stocks in case of natural disasters. About a dozen food banks have been established in recent years, with their activities spreading from cities to rural area. Since the food bank mechanism is beneficial to both supporting companies and aid-receiving welfare facilities and other organizations, and also in light of the original objective of taking good care of food, it is hoped that food bank activities will spread further widely.

Performance of Food Bank Activities

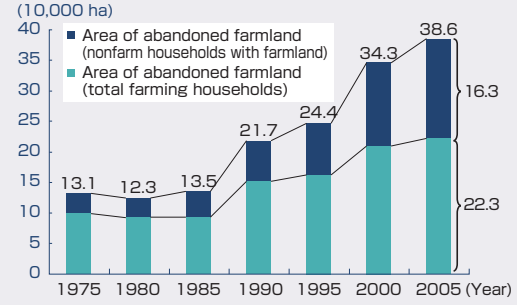
Year	Amount handled (ton)	Welfare contributions (¥10,000)	Donation multiplier	Corporate contributions (¥10,000)
2006	255	15,300	10.0	2,766
2007	370	22,200	8.0	3,900
2008	850	51,000	14.0	9,200
2009	560	33,000	11.4	5,600

Source: Second Harvest Japan Secretariat

Column Utilization of Abandoned Farmland

As of FY 2005, there were about 390,000 hectares of abandoned farmland. Abandoned farmland is "farmland where no crops were grown at least in a past year with no clear intentions indicated for cultivation resumption over the coming few years." Abandoned farmland stood at 135,000 hectares in 1985, and increased nearly 2.5 times in the past 20 years. Amid expectations of tightening global food supply and demand in the medium and long-term, the objectives of recovering and utilizing abandoned farmland include the need to ensure the stable supply of food and the need to secure various functions including the preservation of national land, cultivation of water sources, prevention of disease and disease and pest damage and bird and animal damage, and conservation of biodiversity through appropriate management of hillside and mountainous areas.

Changes in Area of Abandoned Farmland



Source: Ministry of Agriculture, Forestry and Fisheries, "Agroforestry Census"

4 Budding "Mainstreaming"

A variety of entities have already launched social and economic activities paying heed to biodiversity. In this subsection, we describe activities by local governments, companies and nongovernment organizations (NGOs), centering on activities chosen for the first outstanding performance awards of the "Japan Awards for Biodiversity," established by the Ministry of the Environment and the AEON Environmental Foundation in order to promote the conservation of biodiversity and its sustainable use.

(1) Efforts by local governments

Prefectural governments and municipalities have been undertaking various efforts on the conservation of biodiversity, including preservation of nature parks and other protected areas, protection and management of wild birds and animals, protection of rare species of wild fauna and flora, conservation and revitalization of urban green areas and measures to deal with alien species. For example, regarding the protection of rare species of wild fauna and flora, all the prefectural governments have formulated the red data book and the red list by 2005, and 27 prefectural governments enacted ordinances on the protection of rare species of wild fauna and flora by FY 2009. Furthermore, a total of 30 prefectures introduced the forest environmental tax and similar tax systems for the purpose of conserving forests and water sources by FY2009, with specific efforts funded with these tax revenues.

In addition to these efforts, local governments are developing regional biodiversity strategies based on the Basic Act on Biodiversity, in order to proceed with the conservation of biodiversity and its sustainable use in accordance with natural and social characteristic of their regions. As of the end of March 2010, Saitama Prefecture, Chiba Prefecture, Aichi Prefecture, Shiga Prefecture, Hyogo Prefecture, Nagasaki Prefecture, Ngareyama City, Nagoya City and Takayama City have already formulated their regional biodiversity strategies, while many other local governments are considering the formulation of such strategies.

(2) Corporate Initiatives

A construction company, in cooperation with organizations concerned, has expanded upon previous studies on ecological networks and developed a system to evaluate an impact of urban development projects on local ecosystems in an easy-to-understand manner, and is already applying the system to actual construction projects such as hospitals and business buildings. The company is also breeding Japanese honeybees, a native species, as a sentinel species of the urban environment for the collection and analysis of data on their flight paths and distances and honey source plants, and is making use of such data for biodiversity-friendly cities.

A housing maker, in order to allow for sustainable wood use, in collaboration with timber suppliers and NGOs, developed in 2007 "timber procurement guidelines" with 10 procurement policies from the broad perspectives of not only legitimacy of procured timber but also biodiversity conservation, livelihoods of residents in logging areas and revitalization of the domestic forestry industry. The company classifies timber into four categories by a sum of evaluation points for each procurement policy, and strives to increase the percentage of timber produced with due heed given to biodiversity. These efforts bring benefits to timber suppliers as well in that they can independently change timber procured in accordance with objective standards.

A shinkin bank (credit association) has offered the "time deposit for considering biodiversity" in order to help enhance the interest in COP10 to be held in Nagoya City, Aichi Prefecture, its business area, and deepen understanding about biodiversity. Bank employees met personally with over 20,000 customers and engaged in activities to mutually deepen the interest and understanding about the importance of biodiversity and COP10. The shinkin bank sold out the time deposit product two months earlier than originally scheduled, contracted ¥3,076 million in 4,164 accounts (about 3,400 depositors), with 0.01% of the deposited amount donated to the Aichi-Nagoya COP10 CBD Promotion Committee.

A detergent maker is purchasing land for the restoration of rain forests and engaged in activities to preserve Borneo elephants driven out of their habitats by donating 1% of sales of coconut detergents to the Malaysian government-sanctioned "Borneo Conservation Trust." Aside from financial assistance, the company is also organizing Borneo eco-tours for consumers as part of diffusion and educational activities to enhance environmental conservation awareness. These efforts have drawn massive consumer support.

(3) Efforts by NGOs, etc.

The Shiretoko Nature Foundation has been conducting long-term monitoring and biological surveys and genetic diversity surveys on brown bears, Yezo sika deer, marine mammals, white-tailed sea eagles and other large animals living in the Shiretoko Peninsula, the world natural heritage site. Through environmental education and experience-based education programs making use of such research results, the Foundation is also engaged in activities to communicate the importance of nature and biodiversity in Shiretoko to local residents and visitors. Furthermore, commissioned by Shari Town and Rausu Town, its founders, the Foundation is contributing to the conservation of local biodiversity through continuous efforts, including the protection and management of brown bears and other wild animals and the "Shiretoko 100 m^2 Forest Trust," one of pioneering national trust movements in Japan.

Since its establishment in 2001, the Research Institute of Agriculture and Nature, a specified nonprofit corporation, has developed an index of 5,470 species of animals and plants in rice paddies and a list of surveys on the distribution of their habitats, based on the belief that "ordinary insects," not destructive inspects or helpful insects, form the rice field environment, and submitted them to relevant research institutions. The institute is also trying to make 230 species each of animals and plants into indicator species to evaluate biodiversity in

rice fields. Further, the institute carried out a research and analysis of organism species in rice paddies and dikes under pesticide-free production, developed agricultural technology by utilizing its research and analysis results, publicly proposing it evaluation methods. It is spreading these research results to farmers, nature protection organizations and people related to environmental education.

(4) Cooperative efforts by companies and NGOs

The Asaza Fund, a specified nonprofit corporation, has revived Yatsuda, a reservoir for Kasumigaura Lake, and since 2008, has been producing Japanese sake using brewer's rice produced in revived Yatsuda with the cooperation of a local sake brewery. The Fund is hugely successful in selling its sake through the cooperation with local sake retailers and it is using part of sales for the revival of Yatsuda. Efforts to restore the Yatsuda reservoir are under way in a broad area around the lake in collaboration with other companies and volunteer groups.

In Toyooka City, Hyogo Prefecture, in order to secure biodiversity-rich rice fields where white storks that have returned to the wild feed, JA Tajima, White Stork Shicchi Net, the municipal government of Toyooka, the Toyooka Agricultural Improvement and Diffusion Center of Hyogo Prefecture and others are cooperating to promote "white stork-nurturing farming method" to produce safe and secure rice and nurture a variety of living organisms at the same time by reducing the use of agricultural chemicals or with no agricultural chemicals. They are also carrying out surveys on living organisms in rice paddies by developing a method of survey farming household can conduct on their own and by cooperating citizens and consumers. Part of proceeds from the sale of "white stork-nurturing rice" planted under the above-mentioned farming method is donated to the "Toyooka White Stork Fund" to be used to improve habitats for white storks, including feeding grounds. The price is about 50% higher than ordinary rice for rice produced with no agricultural chemicals used and about 20% higher for rice with reduced use of agricultural chemicals. Since sales have been robust despite high prices, however, farming households producing these types of rice are increasing year after year. Sales of the 2008 crop amounted to 520 tons (produced in about 200 hectares of rice paddies) for about ¥170 million.

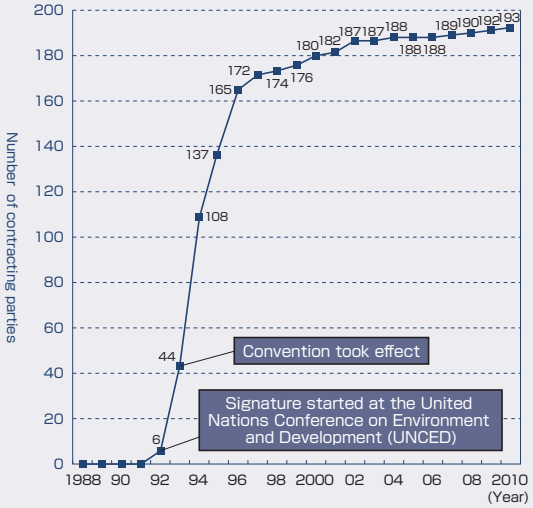
Section 4 10th Meeting of the Conference of the Parties to the Convention on Biological Diversity (COP10) That Determines the Direction of Life on the Earth

In order to maintain the sound foundation for existence of mankind, not only global warming countermeasures but also the conservation of biodiversity and its sustainable use are essential. Therefore, given the experience of failure to achieve the 2010 Biodiversity Target, the international community is getting into action to set a new target for years beyond 2010. Japan, as the host country of COP10, will make the meeting successful and promote efforts for sustainable exploitation of ecosystem services.

1 The international community at a major turning point

"The Economics of Ecosystems and Biodiversity (TEEB)" released at the high-level ministerial segment of COP9 in 2008 in its preface noted that "we are still learning the 'nature of value,' as we broaden our concept of 'capital' to encompass human capital, social capital

Figure3-4-1 Changes in Number of Contracting Parties to the Convention on Biological Diversity



Source: Prepared by Ministry of the Environment based on the website of the Secretariat of the Convention on Biological Diversity Secretariat

Figure3-4-2 Developments and Trends of International Efforts

1993	Convention on Biological Diversity entered into force (Three main objectives) ・The conservation of biological diversity ・The sustainable use of the components of biological diversity ・The fair and equitable sharing of the benefits arising out of the utilization of genetic resources
2002 (COP6)	Adoption of the Convention on Biological Diversity Strategic Plan 2010 Target: Achieve a significant reduction of the current rate of biodiversity loss by the year 2010
2006 (COP8)	Release of the second edition of Global Biodiversity Outlook (GBO2) Loss of biodiversity still continuing
2007	The G8 Environment Ministers Meeting held in Germany addressed biodiversity as a major agenda for the first time
2008 (COP9)	Decision to hold CBD COP10 in Nagoya City, Aichi Prefecture
2010 (COP10)	Release of the third edition of Global Biodiversity Outlook (GBO3) Failed to achieve the 2010 Target

Source: Ministry of the Environment

and natural capital. By recognizing and by seeking to grow or conserve these other 'capitals' we are working our way towards sustainability." Human capital is priced by payments of compensation for labor and social capital is priced by payments for services provided, but as for natural capital, most ecosystem services are used free of charge have not been priced, though only a small portion of ecosystem services are being traded with prices. The absence of pricing is believed to be one of the fundamental causes of the loss of biodiversity and degradation of ecosystems. TEEB points out that removal of this fundamental cause is necessary for sustainable use of ecosystem services.

Signing of the Convention on Biological Diversity began at the U.N. Conference on Environment and Development (Earth Summit) held in Rio de Janeiro, Brazil, in 1992, along with the Framework Convention on Climate Change. Thus, these two conventions are often called the twin conventions. At present, 192 countries and the European Union have acceded to the Convention on Biological Diversity and 191 countries and the European Union have acceded to the Framework Convention on Climate Change. This means almost all countries on the earth participate in the two conventions, demonstrating the extent of international interest in them. The contracting parties to the Convention on Biological Diversity are required to formulate national biodiversity strategies, and at present, a total of 170 countries have formulated their national strategies (Figure 3-4-1). As seen by these figures, countries sharing the sense of crisis about the loss of biodiversity are growing, and it is hoped that countermeasures taken by each country and coordinated international efforts will make further progress going forward.

Since the Convention on Biological Diversity took effect in 1993, efforts by the international community have made headway as summarized in Figure 3-4-2. COP6 of the Convention on Biological Diversity, held in The Hague, the Netherlands, in 2002 with the theme of "from dialogue to action," adopted the "Convention on Biological Diversity Strategic Plan," including the "2010 Target" to "to achieve by 2010 a significant reduction of the current rate of biodiversity loss" . The "third edition of Global Biodiversity Outlook (GBO3)" released by the Convention Secretariat in May 2010 in order to assess the achievement status of the 2010 Target showed that nine out of 15 indicators depicting the state of biodiversity has declined (Figure 1-5-2), and said the 2010 Target "has not been met" and the loss of biodiversity is continuing.

The sense of crisis is mounting that unless the degradation of biodiversity halts, we could face a serious situation with ecosystem services greatly damaged. On the other hand, the scientific capturing and assessment of biodiversity still remain insufficient, underscoring the need to globally push forward with the establishment of assessment methods and improvement of biodiversity monitoring systems.

2 2010 and Significance of CBD COP10

COP10 to be held in 2010 is set to assess the 2010 Target and discuss a new global target for biodiversity beyond 2010, or "Post-2010 Target" (Figure 3-4-3).

The U.N. General Assembly in 2006 decided to designate 2010 as the International Year of Biodiversity (IYB). The Secretariat of the Convention on Biological Diversity is to serve an organ responsible for the International Year of Biodiversity (IYB), and the Secretariat is urging contracting parties to increase the awareness of the three major objectives of the Convention on Biological Diversity ((1) the conservation of biological diversity; (2) the sustainable use of the components of biological diversity; (3) the fair and equitable sharing of the benefits arising out of the utilization of genetic resources) and the 2010 Target achievement, and also hold ceremonies to mark the International Year of Biodiversity by setting up national commissions. Under the IYB logo (Figure 3-4-4) and the slogan, "Biodiversity is life. Biodiversity is our life.," decided by the Secretariat, a variety of activities are set to take place around the world in 2010. Furthermore, in September 2010, a summit-class high-level meeting on biodiversity is scheduled to take place at the U.N. General Assembly. In a year that is to become a major milestone globally, an international conference that will set the course of the future direction of global biodiversity will take place in Japan.

Also on the agenda of COP10 are important issues aside from the Post-2010 targets. One of them is an international regime for access and benefit-sharing of genetic resources (ABS), on which discussions are to be completed by COP10. The Convention on Biological Diversity acknowledges states' sovereign rights to exploit natural resources within their jurisdiction and the fair and equitable sharing of the benefits arising out of

Figure 3-4-3 Major Themes to Be Discussed at COP10

- Assessment of the 2010 Target and adoption of the next target beyond 2010 (the post-2010 target)
- Completion of an International Regime on Access and Benefit-sharing (ABS) of genetic resources.
- Sustainable use of biodiversity; protected areas; businesses and biodiversity; public relations, diffusion and edification; the International Year of Biodiversity (IYB), etc.

Source: Ministry of the Environment

Figure 3-4-4 International Year of Diversity Logo

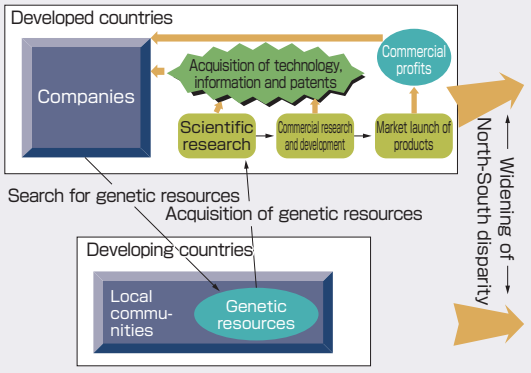
Source: Secretariat of the Convention on Biological Diversity

the utilization of genetic resources is designated as the third objective of the Convention. ABS is designed to develop a mechanism under which users of genetic resources have smooth access to genetic resources of provider countries and at the same time users distribute the benefits gained from genetic resources to provider countries in a fair and equitable manner that the benefits arising out of the utilization of genetic resources contribute to the conservation of biodiversity and its sustainable use.

It is important that an international regime for ABS will become a mechanism that ensures smooth access to genetic resources, contributes to human well-being through pharmaceutical products, etc. developed from genetic resources, and also contributes to global promotion of biodiversity conservation through the appropriate distribution of the benefits gained (Figure 3-4-5). Considerations by countries concerned are currently under way under the Convention on Biological Diversity, and Japan, as the host of COP10, is being called upon to take the initiative for progress in negotiations.

Other chief agenda include sustainable use of biodiversity; protected areas; businesses and biodiversity; public relations, diffusion and edification; and the International Year of Biodiversity (IYB), etc. COP10 will prove an important forum to set the course for an international framework and efforts corresponding to the three major objectives of the Convention on Biological Diversity.

Figure3-4-5 Relationship between Developed and Developing Countries Concerning Use of Genetic Resources before Adoption of the Convention on Biological Diversity



Source: Kiichiro Hayashi ed., "Basic Knowledge for. Biodiversity/Ecosystem and Economics"

3 Japan's responsibility as the COP10 host

(1) International contributions based on Japan's experiences

COP10 is a very important conference to discuss the direction of global biodiversity going forward. Japan, as its host, needs not only to make COP10 a successful event but also to produce fruitful results from the conference by, among others, making proposals based on its own experiences. In relation to the post-2010 targets, the agenda of paramount importance at COP10, it has

Figure3-4-6 Japanese Proposal Concerning Post-2010 Targets of the Convention on Biological Diversity

Mid/long-term target (2050)

Enhancing the harmony between human being and nature all around the world, to improve the state of diversity from the current level as well as to sustainably increase the benefits of ecosystem services human being receives.

Short-term targets (2020)

To have the following actions taken by 2020, so as to halt biodiversity loss:
①To conduct full observations and analyses on the state of biodiversity as global scale and on scientific justification. To make ecosystem services respected in every aspect of human society.
②To expand activities for biodiversity conservation, to promote practical methods for sustainable use of biodiversity extending to future generations and to establish mechanisms for reducing adverse effects of human activities on biodiversity.
③To mainstream biodiversity by ensuring the participation of various stakeholders and new steps to be taken by various stakeholders.

Sub-targets

(1) Sub-targets to address indirect and broad-based drivers for biodiversity loss
Sub-target 1: To invite the wider participation of various stakeholders in the conservation and sustainable use of biodiversity
Sub-target 2: To establish mechanism to ensure harmonized approaches between ecosystem conservation and other human activities such as development and poverty alleviation
(2) Sub-targets to address direct and specific drivers for biodiversity loss
Sub-target 3: To increase the ratio of production that is managed in sustainable manner in agriculture, forestry, fisheries and other activities which utilize biological resources
Sub-target 4: To take urgent measures against threats to biodiversity
(3) Sub-targets to improve status of biodiversity itself
Sub-target 5: To promote the activities to conserve biological species and expand the areas to conserve ecosystems
(4) Sub-targets to ensure the benefits of biodiversity for human being
Sub-target 6: To establish the mechanism to sustainably benefit from the ecosystem services and to ensure its contribution to human well-being
(5) Sub-targets to address the effective achievement of above mentioned sub-targets
Sub-target 7: To prepare systems to encourage more facilitated ABS (Access and Benefit Sharing) and protection of traditional knowledge
Sub-target 8: To conduct full observations and analyses on the state of biodiversity and ecosystems at global scale and scientific justification so that they are well perceived and understood by general public
Sub-target 9: To provide financial and human resources as well as increase scientific and technical capacity in order to achieve the conservation and sustainable use of biodiversity

Source: Ministry of the Environment

been pointed out about the 2010 Target that the target itself is abstract and lacks clarity and that since there are no methods available to make an objective and numerical evaluation, it was difficult to obtain the understanding for taking emergency measures with a sense of crisis to achieve the target. Given these circumstances, measures taken to cope with development, climate change, deforestation and overfishing that lead to biodiversity loss were not sufficient. The decision at COP9 in 2008 called for the post-2010 targets to "include ambitious but realistic, and measurable short term targets" by 2020 and medium- and long-term targets by 2050, and also to be "short, focused and action-oriented." Given these developments, Japan in January 2010 submitted "Post-2010 targets (Proposal by Japan)" to the CBD Secretariat (Figure 3-4-6). The Japanese proposal put forward the mid/long-term target for enhancing the harmony between human being and nature and improve the state of biodiversity from the current level by 2050 (Vision) and the short-term targets for actions taken by 2020 to halt biodiversity loss (Mission). Japan proposes nine sub-targets under the short-term targets, and presents a total of 34 specific means for achievement under them, with many concrete examples and numerical indicators where possible. The CBD Secretariat will draft post-2010 targets on the basis of proposals from Japan and other countries for final discussions at COP10. Based on the Japanese proposal, the government will contribute to the forthcoming discussions so as to help improve post-2010 targets.

As discussed later in this paper, in relation to "sustainable use of biodiversity," a topic to be addressed at COP10, Japan intends to propose the "Satoyama Initiative," carrying the name satoyama, or Japan's woodland near populated areas utilized in a sustainable manner for the promotion of sustainable utilization and management of natural resources.

(2) Reflection of international developments in and acceleration of domestic measures

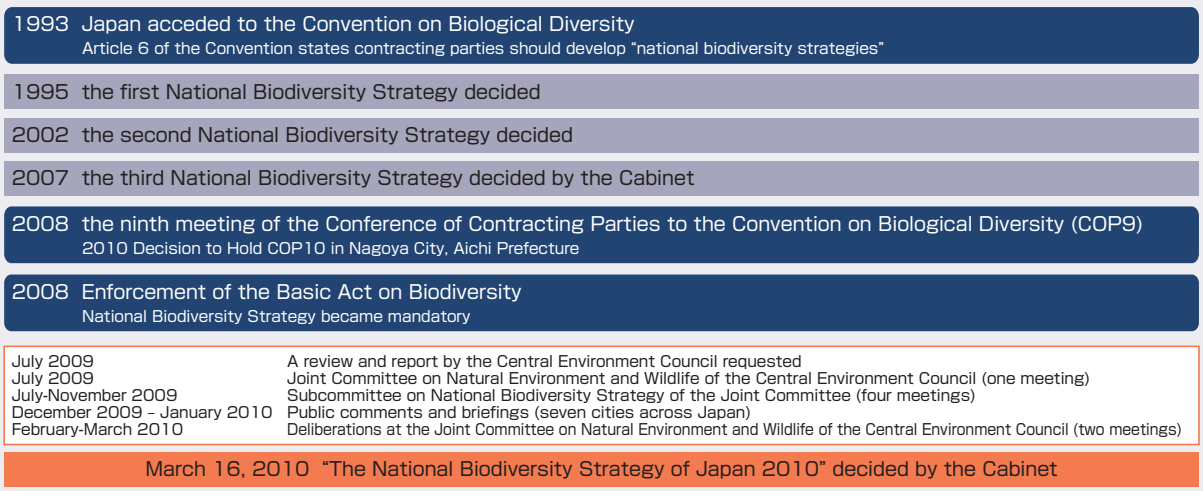
Based on the Convention on Biological Diversity, the Japanese government has so far formulated the three National Biodiversity Strategies in 1995, 2002 and 2007. Subsequently, the Basic Act on Biodiversity, domestic legislation enforced in June 2008, requires the government to formulate the national biodiversity strategy. Further in March 2010, the government formulated the National Biodiversity Strategy of Japan 2010, the first national strategy for biodiversity under the Basic Act on Biodiversity (Figures 3-4-7, 3-4-8).

This National Biodiversity Strategy of Japan 2010 added issues which should be achieved with government's view at COP10 including Japanese perspective of proposal for post-2010 targets to the Secretariat of the Convention on Biological Diversity in January 2010.

The National Biodiversity Strategy of Japan 2010 broadly consists of two parts. Part 1 may be called the core body of the strategy, which, after ascertaining the perception of the current situation such as what biodiversity is and its importance, covers the challenges of four crises affecting biodiversity in Japan and depicts four basic strategies that broadly set the direction for prioritized policy measures that should be taken by around FY 2012. In the Third National Biodiversity Strategy formulated in 2007, as the long-term perspective of time required for the recovery of natural ecosystems in implementing these four basic strategies, the grand-design was included as a common vision from the perspective of biodiversity looking ahead 100 years from now. With the Japanese proposal for post-2010 targets included, Part 1 of the latest National Biodiversity has set the course for pressing forward with biodiversity strategies broadly in phases and over the long term by FY 2012, 2020, 2050 and 2110 (Figure 3-4-9).

Part 2 lists a variety of measures systematically as specific action plans for realizing the strategy. The number of specific measures with the names of responsible government ministries and agencies increased from about 660 in the Third National Biodiversity Strategy to about 720, while the number of numerical indicators rose from 34 to 35. Japan will promote domestic and international measures toward COP10 by steadily implementing these policy measures incorporated in the National Biodiversity Strategy of Japan 2010.

Figure3-4-7 Formulation Process of the National Biodiversity Strategy



Source: Ministry of the Environment

Figure3-4-8 Outline of the National Biodiversity Strategy of Japan 2010

Decided by the Cabinet on March 16, 2010

Part 1: Strategy

What is biodiversity? - three kinds of biodiversity -

Ecosystems diversity
Tidal flats, coral reefs, forests, grassland, wetland, rivers, etc.

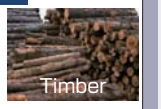
Species diversity (among species)
Estimated number of organism species on the earth 5 million to 30 million species

(Genetic) Diversity within species
Many different patterns for Japanese littleneck shells

【Importance】 Biodiversity supporting life and livelihood

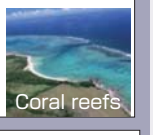
Basis for existence of all life on the earth
・Supply of oxygen
・Stable climate, etc.

Source of useful value
・Food, timber
・Genetic resources
・Biomimicry※, etc.
※ Imitating or taking cues from forms and functions of living organisms to develop technology, etc.



Source of enriching culture
・Local dishes
・Festivals, local folk songs, etc.

Basis for safety and security
・Prevention of natural disasters, etc.
Example) Coral reefs mitigate waves and erosion damage



【Challenges】 Crisis of biodiversity

First crisis
Ecosystem destruction by human activities
Reduction/extinction of species

Second crisis
Impact on satochi-satoyama due to inadequate management by humans

Third crisis
Ecosystem disturbances by invasive species

Crisis caused by global warming
Extinction of many species and ecosystem destruction
Example: IPPC Fourth Assessment Report
If the average global temperature rises by 1.5-2.5 degrees C…
20-30% of species of fauna and flora on the earth may see the risk of extinction increase

【Targets】

Mid/long-term target (by 2050)
・Enhance the harmony between human being and nature broadly at the national and regional level
・Improve the state of biodiversity from the current level
・Sustainably increase the benefits of ecosystem services

Short-term targets (by 2020)
Take the following actions by 2020 to halt biodiversity loss:
・Conduct full observations and analyses on the state of biodiversity and expand activities for biodiversity conservation
・Establish mechanisms for reducing adverse effect of human activities on biodiversity
・Promote practical methods in our daily life for sustainable use of biodiversity

【Long-term perspective】 Grand-design, targeting 100 years ahead
Present the national grand-design from the perspective of biodiversity as a "100-year plan" for recovery of ecosystems of national land over a period of 100 years
Deep-mountain natural areas; rural areas; urban areas; river/wetland areas; coastal areas; oceanic areas; and small island areas

【Four Basic Strategies】
I Mainstreaming biodiversity in our daily life
Mainstreaming biodiversity in our daily life; promoting and supporting the measures at local level, etc.
II Rebuilding sound relationship between human being and nature
Enriching the measures to conserve rare wild fauna and flora; promoting the integrated measures of natural symbiosis, material-recycling, and low-carbon society
III Securing linkages among forests, countryside, rivers and the sea
Ⅳ Success of CBD COP10; promotion of Satoyama Initiative; strengthening of scientific base; enhancing the science-policy interface; introduction of economic perspective; and assistance to developing countries, etc.

Part 2: Action Plan

・About 720 specific measures ・About 35 numerical indicators

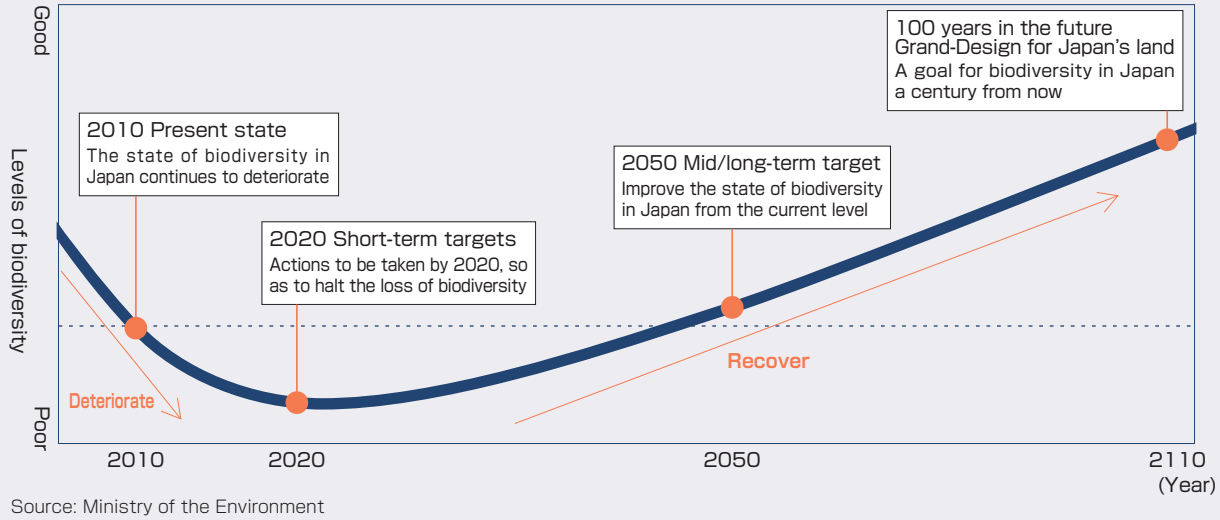
Source: Ministry of the Environment

After COP10, the government plans to review the National Biodiversity Strategy of Japan 2010 by reflecting discussions about post-2010 targets at COP10.

(3) Participation and cooperation of the national and local governments, private sector, citizens and all other stakeholders

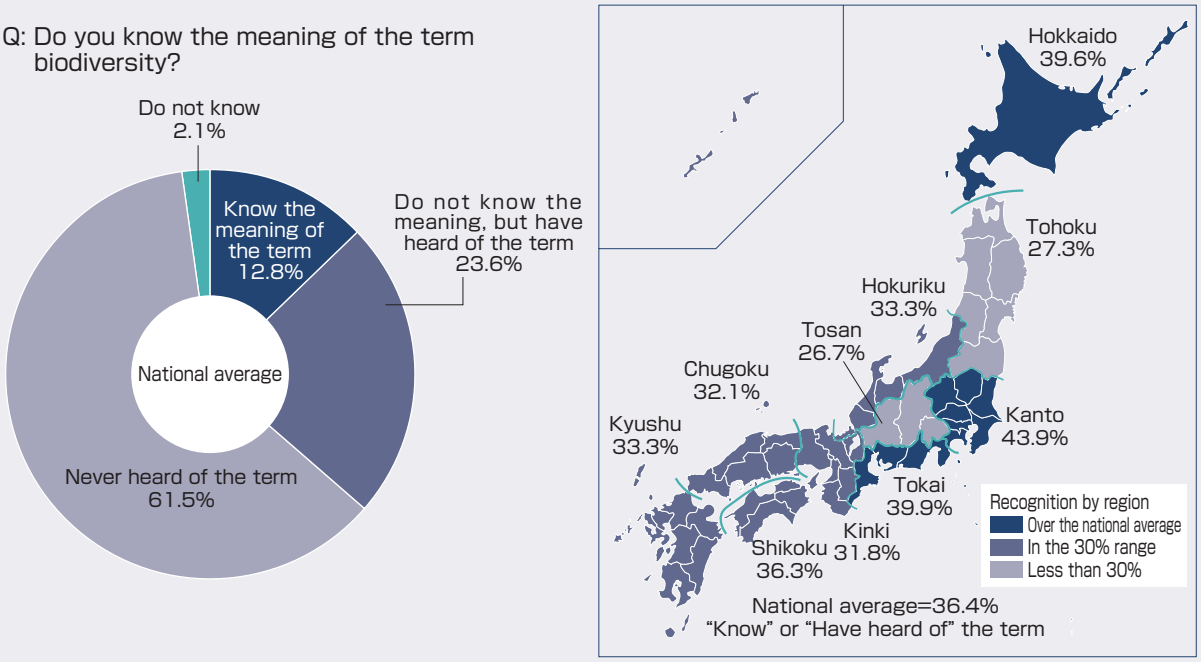
As stated in one of the four basic strategies of the National Biodiversity Strategy of Japan 2010, "Mainstreaming biodiversity in our daily life," in order to carry forward the rich national land with blessings bestowed by nature, it is necessary to consider and stay mindful of biodiversity not only in our daily life but also as society as a whole. To this end, it is necessary to call upon a variety of stakeholders to promote efforts commensurate with their respective positions to realize the "mainstreaming of biodiversity in society" where the importance of biodiversity conservation is shared by local

Figure3-4-9 How biodiversity should recover in Japan



Source: Ministry of the Environment

Figure3-4-10 Recognition of the Term "Biodiversity"



Source: Prepared by Ministry of the Environment based on the Cabinet Office, "Public Opinion Survey on Environment Issues"

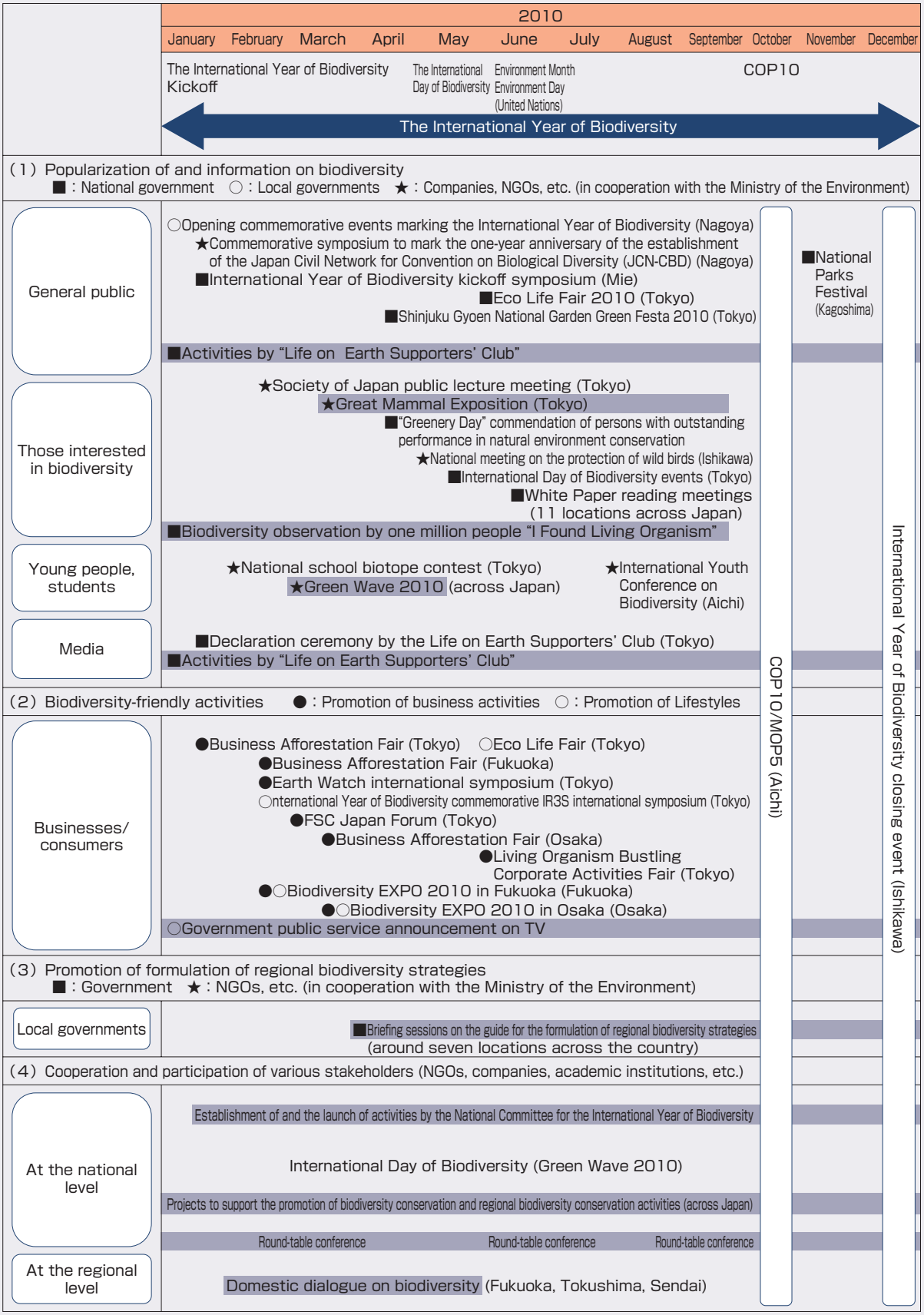
governments, businesses and individual citizens, etc. as the common sense and is reflected in behaviors of respective stakeholders. In Section 3, we introduced examples of forward-thinking efforts by a variety of stakeholders. In order to encourage the participation and cooperation of these various stakeholders and support their independent efforts, the government is undertaking various initiatives, including the publication of the guide to the formulation of regional biodiversity strategies, "Guidelines for Private Sector Engagement in Biodiversity" and projects to support regional biodiversity conservation activities.

(4) An opportunity to have biodiversity conservation take firm root in everyday life, not a transient fad

Biodiversity that brings a myriad of benefits is indispensable for human kind. On the other hand, most of social and economic activities by humans, including their daily life, are imposing heavy burdens on biodiversity. Reducing burdens on biodiversity require efforts in everyday life and social and economic activities, just as with the problem of global warming.

To that end, it is important that many people understand and recognize the term biodiversity and its meaning as well as the fact that their daily life and social and economic activities are imposing burdens on

Figure3-4-11 Mainstreaming Biodiversity in Our Daily Life



Note 1 Only major events to be undertaken by or through cooperation with the Ministry of the Environment are listed (as of February 2010)
Note 2 The shaded areas indicate the duration of events

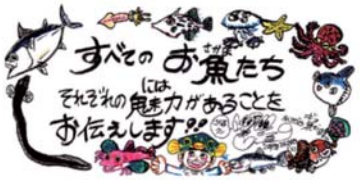
Source: Ministry of the Environment

Column For all the life on Earth –“Life on Earth Supporters’ Club”

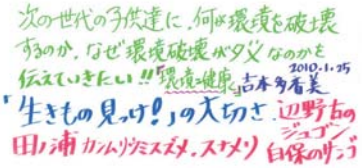
Our livelihood cannot go on without the blessings of biodiversity. But the term biodiversity remains as not widely recognized and we cannot say the understanding about biodiversity has made much progress. Under these circumstances, the Ministry of the Environment launched the “Life on Earth Supporters’ Club” consisting of prominent figures in November 2008, asking them to seize on a variety of occasions to send out messages regarding biodiversity to a broad array of Japanese people.

In this column, we introduce “My Action Declaration” of these members of the “Life on the Earth Supporters’ Club” speaking of their own intended actions for biodiversity conservation.

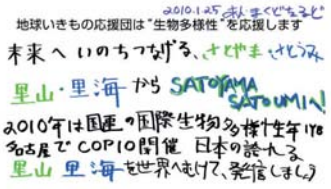
Sakana-kun, Visiting associate professor at Tokyo University of Marine Science and Technology/Fish life coordinator



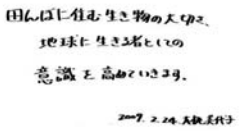
Takami Yoshimoto
Actress



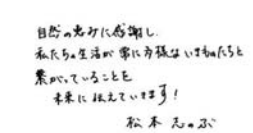
Anne McDonald
Essayist



Miyoko Oomomo
Talent/newscaster

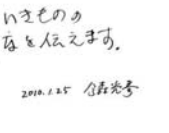


Shinobu Matsumoto
Freelance announcer

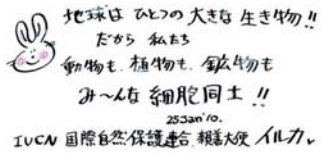


Tomoto Nakajima
Actress

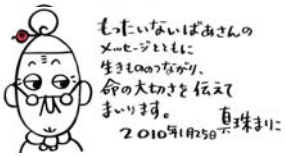
Mitsuhiko Imamori
Photographer



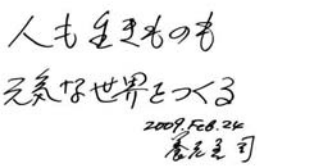
Iruka
Singer/song writer



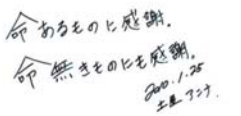
Mariko Shinju
Illustrator



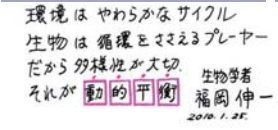
Takeshi Yoro
Biologist/University of Tokyo professor emeritus



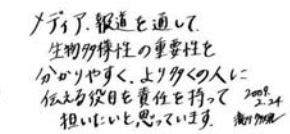
Anna Tsuchiya
Actress/model/singer



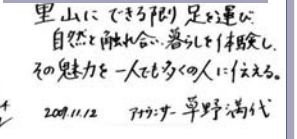
Shinichi Fukuoka
Biologist



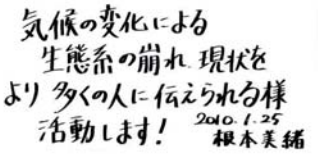
Christel Takigawa
Freelance newscaster



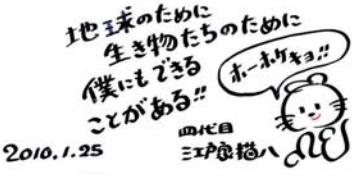
Mitsuyo Kusano
Freelance announcer



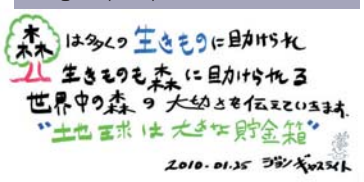
Mio Nemoto
Freelance announcer/certified weather forecaster



Nekohachi Edoya
Rakugo performer



John Gathright
Doctor of agriculture/talent/columnist/ecologist/space produce



(Random order, honorific titles dispensed with)

biodiversity and then act accordingly to mitigate burdens on biodiversity in their daily life. A public opinion survey conducted by the Cabinet Office in 2009 found that the recognition of the term biodiversity (the ratio of respondents who said they "have heard of it" or "know the meaning of it") was a relatively low 36.4%. The rate of recognition was a little higher than 30.2% in a similar survey conducted by the Ministry of the Environment five years ago in 2004, but we need to continue to strive to increase the recognition of the term (Figure 3-4-10).

COP10 will be the first massive-scale international conference on biodiversity to be held in Japan. Since the third conference of the contracting parties to the Framework Convention on Climate Change was held in Kyoto in 1997, the recognition and efforts to cope with global warming issues at home have made great strides. COP10 of the Convention on Biological Diversity will also provide a great opportunity to enhance the recognition of biodiversity and to promote the mainstreaming of biodiversity in our society.

The Ministry of the Environment established the National Committee for IYB in January 2010. The government will consider commemorative events and activities at the "Committee on Life on Earth," created under the National Committee and consisting of scholars, business leaders, media people, cultural figures and NGO representatives (Figure 3-4-11). Based on the Committee's deliberation, we will establish "individual project teams" for implementing a variety of individual projects such as commemorative events to mark the International Year of Biodiversity and the International Day of Biodiversity. In order to promote the mainstreaming of biodiversity more efficiently, we will also register organizations carrying out related projects voluntarily and organizations supporting and cooperating with related activities as "Life on Earth Supporters" to a create more broad-based campaign.

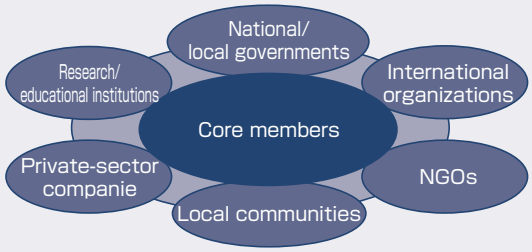
4 Wisdom and Spirit of Natural Symbiosis Spreading to the World

For the conservation of biodiversity, the role of secondary nature formed and maintained through human activities such as agriculture and forestry operations over long years is as important nature maintained in its protozoa (protist) shape. However, this secondary form of nature, together with ecosystem services that can be derived from it, is under threat to its sustainability or has already been lost in some areas, due to a string of events in recent years, including urbanization, industrial development, sharp changes in rural populations and the aging of society. These areas exist across the world. These areas, including muyong, uma and payoh in the Philippines, mauel in Korea, dehesa in Spain, terroirs in France, chitemene in Malawi and Zambia, and satochi-satoyama (community-based forest areas and the surrounding countryside) in Japan, have varied characteristics depending on regional climate, geological formation, cultures and socioeconomic and other conditions. In order to proceed with the conservation of biodiversity and its sustainable use, it is important to realize a society of natural symbiosis by taking measures corresponding to their respective regional characteristics while recognizing the value of secondary nature and sharing the importance of seeking to maintain and conserve it on a global scale.

More specifically, effective ways to do this include the global sharing and mutual analyses of methods of sustainable use and management of biological resources in respective regions, capacity-building of relevant parties through cooperation among local governments, international institutions and NGOs, and implementation of bilateral and multilateral official development assistance (ODA) projects, in accordance with the existing principles of the conservation of biodiversity and its sustainable use. Japan has proposed this approach as the Satoyama Initiative. Seizing the occasion to host COP10, Japan plans to promote this approach by calling for stronger international cooperation and increased efforts, including the launch of the partnership with the participation of various stakeholders (Figure 3-4-12).

At home, meanwhile, Japan is exerting the following efforts as part of projects to promote the Satoyama Initiative:

Figure3-4-12 Composition Image of International Satoyama Partnership(tentative name)



Source: Ministry of the Environment

Figure3-4-13 COP10 Logo

Life in harmony, into the future
COP10/MOP5 Aichi-Nagoya 2010

Source: Ministry of the Environment

(1) Investigations and analyses of and sending out information on satochi-satoyama that is making distinguishing efforts;
(2) Trials and social experiments on new measures to utilize satoyama for environmental education and eco-tourism as well as use of biomass;
(3) Building of rules and frameworks for a variety of stakeholders to sustainably mange and utilize satoyama as shared resources;
(4) Formulation of "action plans for satochi-satoyama conservation and utilization" to encourage people's understanding of and interest in satochi-satoyama and carry out conservation and utilization activities across Japan as national movements.

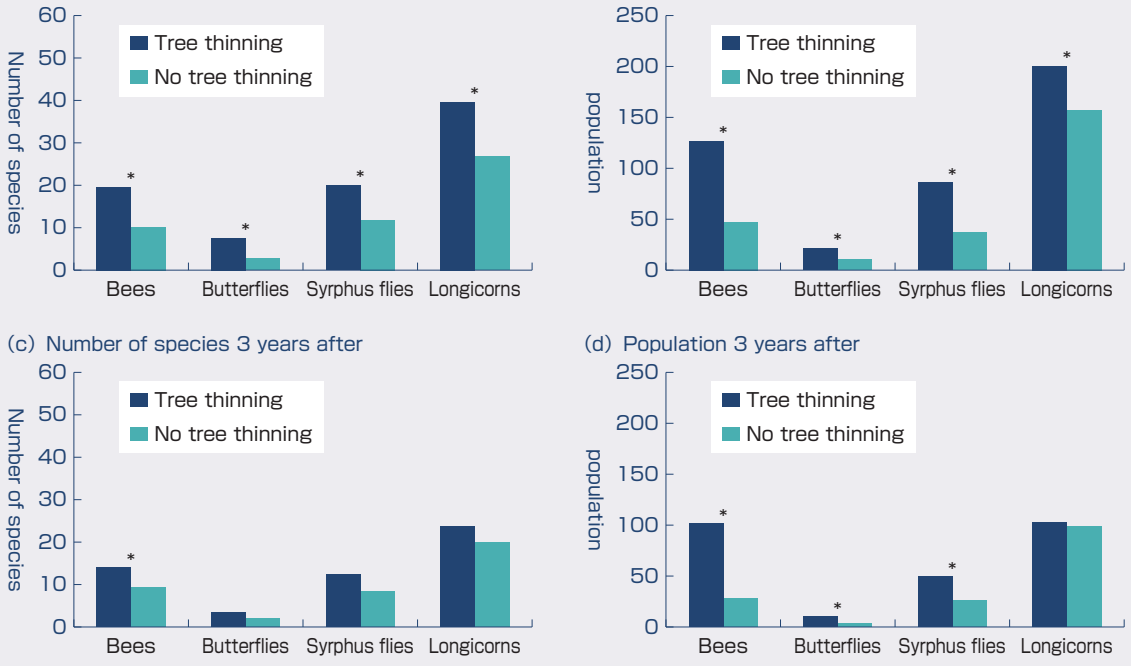
Historically, in Japan, people had the way of living to seek the coexistence with nature in a relatively limited livelihood sphere, as exemplified by the concept of "shiri-shiho" (several miles around you) for the procurement of food and other daily necessities. Today, in order to solve various issues confronting human being, including but not limited to biodiversity as well as climate change and 3Rs (reduce, reuse and recycle), the question we are faced with is how we should live in the closed world of the earth. One of possible solutions is the way of living in harmony with local nature, as exemplified in satochi-satoyama in Japan. However, it is not easy for Japanese people to alter today's convenient way of livelihood and we also need to have the global perspective to go beyond the bounds of Japan. One of approaches for realizing a sound material-cycle society is the "re-styling, or shift to lifestyles and business styles based on 3Rs. Realization of the natural symbiosis society requires the "re-styling" corresponding to today's social and economic conditions.

The COP10 logo was designed as an origami image (Figure 3-4-13). Origami symbolizes the wisdom and culture of Japan. By placing humans at the center, the logo symbolizes the coexistence of human being and a variety of living organisms. And the combination of the human adult and the child expresses the wish to carry forward rich biodiversity to future generations. In

Column Relationship of Management of Satoyama and Biodiversity

According to a study of the Forestry and Forest Products Research Institute looking into whether tree thinning, one of satoyama management methods, actually contribute to the conservation and enhancement of biodiversity, the comparison between Japanese cedar artificial forests thinned by about half in the number of trees and about one-third in wood cubic volume and forests with no tree thinning found that the number of species of bees, butterflies, syrphus flies and longicorns was larger in thinned forests than forests without thinning and the populations of insects were also larger in thinned forests for all species one year after tree thinning. While the differences between two forests tended to disappear three years after tree thinning, the study clearly shows that thinning of artificial forests, as a method of satoyama management, has altered the composition of plant species in forest floors and in the short run, increased the number of insect species and their populations, thus enhancing biodiversity of forests.

Species of Insects and Population Collected 1 Year and 3 Years after Tree Thinning



considering the global environment going forward, including biodiversity, the idea of enhancing the harmonious coexistence with nature around the world is important, as proposed by Japan as the mid/long-term target of post-2010 biodiversity targets. To that end, Japan will widely send out messages on the Satoyama Initiative at COP10 carrying this logo and use COP10 as a catalyst to redouble efforts in Japan.

Conclusion

Ahead of COP10 to be held in Japan in October, in Chapter 3, we discussed Japan's responsibility as the host country of COP10 and underscored the need for a shift to the socio-economy that is friendly to biodiversity. Biodiversity provides the wide-ranging benefits to human being on a scale far greater than we usually think. On the other hand, this precious biodiversity is disappearing rapidly on a global scale, making difficult for human being to sustainably receive those benefits from ecosystem services in the future. Further, it is becoming known now that the benefits to be obtained by conserving ecosystems are greater than costs required to restore once-lost ecosystems. It is important to proceed with development actions and utilization of natural resources after making an accurate cost-effect analysis.

Japan is giving a major impact on global biodiversity from its dependence on overseas for the bulk of natural resources, and thus it is necessary for Japan to take the initiative in making a shift to a biodiversity-friendly socio-economy, from corporate activities to our individual lifestyles, for the conservation and sustainable use of biodiversity, that is the basis for existence of human being. COP10, which is to consider global targets for biodiversity beyond 2010, is an important conference that can influence of the future of global biodiversity. As the host country of this conference, Japan needs to play a leadership role to realize the greater harmony between human being and nature on a global scale by globally spreading the Satoyama Initiative for sustainable use and management of natural resources.

Chapter 4
The Earth, the Water Planet
—Carry Forward Beautiful Water to Future Generations—

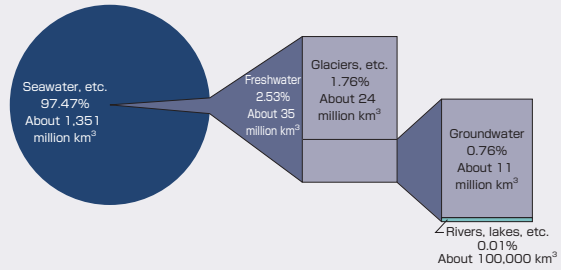
Section 1 Status of the Water Environment of the World and Japan

1 Water on the Earth

About 70% of the surface of the earth, often referred to as the Blue Planet, is covered with water estimated to be some 1.4 billion cubic kilometers. Of this amount, 97.5% is salt water, with the remaining only 2.5% being fresh water. Moreover, approximately 70% of freshwater is captured in glaciers and icebergs, and almost all of the remaining 30% is moisture in soil or groundwater in aquifers in deep underground. Thus, surface water in rivers and lakes easily accessible to humans is just about 0.4% of freshwater. This is equivalent to a mere 0.01% of all water on the earth, and of which only about 100,000 cubic kilometers is sustainably available as it is reproduced in the forms of rain and snowfall (Figure 4-1-1).

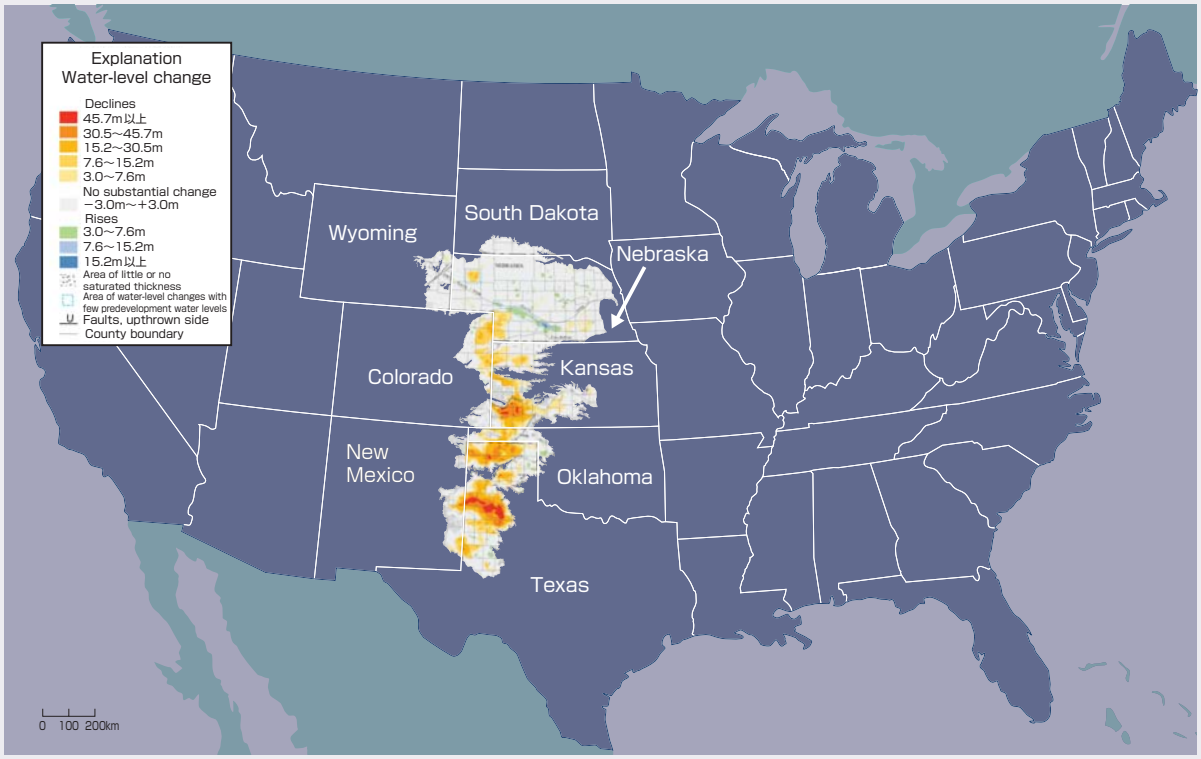
Thus far, in response to growing demand for water due to the population increase and economic growth, water resources, especially surface water and groundwater,

Figure4-1-1 Water Resources on the Earth



Note: Groundwater in the Antarctic Continent is not included
Source: Prepared by Ministry of the Environment based on World Water Resources at the Beginning of the 21st Century, UNESCO, 2003

Figure4-1-2 Water-Level Changes in the Ogallala Aquifer



Source: Prepared by Ministry of the Environment based on U.S. Department of the Interior, U.S. Geological Survey, "Scientific Investigations Report 2009-5019"

have been developed around the world. Consequently, for example, the Ogallala Aquifer in the United States, one of the world's largest groundwater layers, has a total area of some 450,000 square kilometers, about 1.2 times Japan's land area. Since the start of irrigation agriculture, according to a survey of over 3,600 water wells, the water level has declined by an average of about 4.3 meters, with the ratio of wells whose water level dropped 3.0 meters or more standing at about 26%, that of wells with the water-level decline of 7.6 meters or more at about 18% and that with the water-level decline of 15.2 meters or more at about 11%. Wells where the water level rose 3.0 meters or more accounted for a mere 2% (Figure 4-1-2).

The annual amount of water consumed globally has increased about 2.9 times from about 1,400 cubic kilometers in 1950 to about 4,000 cubic kilometers in 2000. This amount is equivalent to 144 times the quantity of water of some 27.5 cubic kilometers held at Lake Biwa. The annual amount of water consumed is likely to come to about 5,200 cubic kilometers by 2025, a further increase of about 1.3 times from the 2000 level (Table 4-1-1).

Water resources on the earth as a whole are sufficient to satisfy human demand for water, but the geographically uneven distribution of water resources presents a major problem (Figure-Int.-2-9). The Human Development Report 2006 of the U.N. Development Program (UNDP) points out that one out of every five people living in developing countries (about 1.1 billion) is not able to satisfy the international standard of securing "at least 20 liters of safe water from a safe water source within one kilometer from his/her home," and may lose life by consuming unsanitary water near his/her home and becoming ill.

Table4-1-1 Changes in Global Water Demand

(km^3/year, million people)

	1950	1980	1995	2000	2025
Population	2542	4410	5735	6181	7877
Agriculture	1080	2112	2504	2605 (66%)	3189 (60.1%)
Industry	86.7	219	344	384 (9.7%)	607 (11.6%)
Cities	204	713	752	776 (19.5%)	1170 (22.3%)
Total	1382	3715	3788	3973 (100%)	5235 (100%)

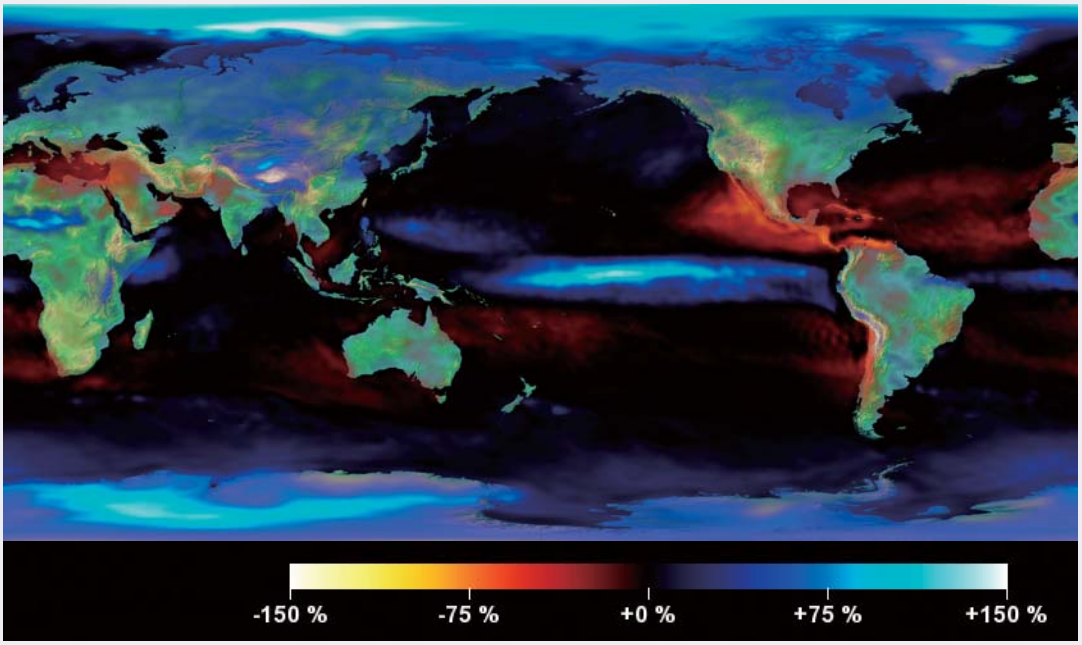
Source: State Hydrological Institute (SHI) and UNESCO (1999)

2 Impact of Global Warming

According to the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), the progress in global warming will expose several hundred million people to increased water stress going forward, and the increased frequency of droughts and flooding is projected to adversely impact regional crop production, particularly production of subsistence crops in low-altitude regions. The rise in the global average temperature due to climate change is feared to bring about various impacts on water resources.

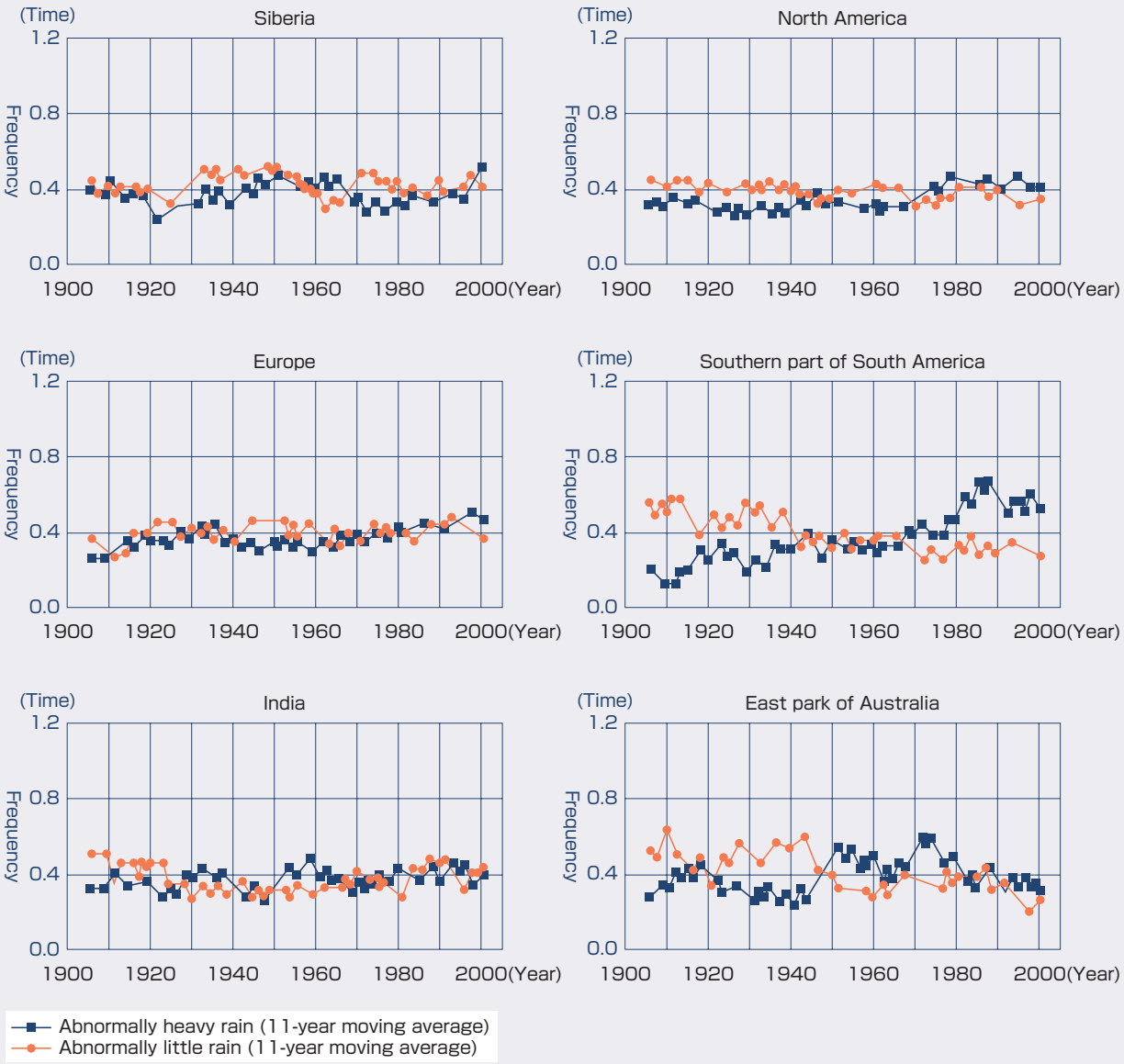
According to a global warming simulation conducted by a joint research team of the National Institute for Environmental Studies, the University of Tokyo's Center for Climate System Research (now, the Atmosphere and Ocean Research Center) and the Japan Agency for Marine-Earth Science and Technology, the global average temperature in 2071-2100 is projected to rise by 4.0 degrees C from the 1971-2000 level under a scenario that assumes the economy-focused future world will see a further progress in globalization. Precipitation, meanwhile, is projected to increase in low- and high-altitude areas and some tropical areas but decline in

Figure4-1-3 Projected Changes in Precipitation in the World in 2100



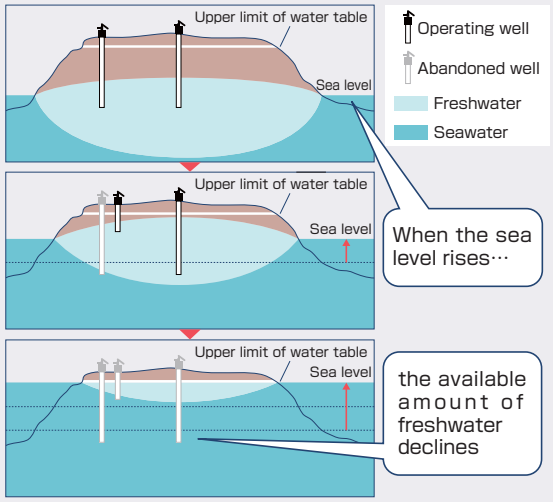
Source : National Institute for Environmental Studies, University of Tokyo, Japan Agency for Marine-Earth Science and Technology

Figure4-1-4 Interannual Changes in Frequency of Abnormally Heavy and Little Rain



Source: Abnormal Weather Report 2005 (Japan Meteorological Agency, October 2005)

Figure4-1-5 Impacts of Sea-Level Rise on Freshwater Lens



Source: National Institute for Environmental Studies, Center for Global Environmental Research (2001) Data Book of Sea-Level Rise 2000

subtropical and other areas (Figure 4-1-3).

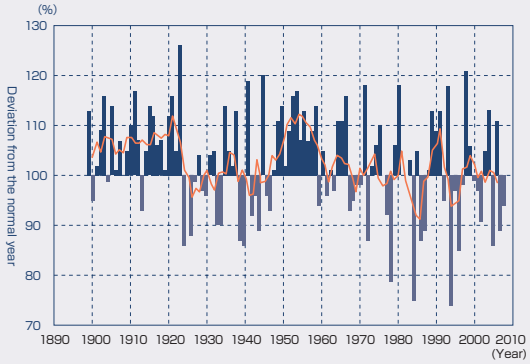
In recent years, we have seen a significant increase/decrease in the frequency of abnormally heavy rain or abnormally little rain depending on regions in the world. While the frequency of abnormally heavy rain tends to show a significant increase in Europe, North America and the southern part of South America, the frequency of abnormally little rain tends to show a significant decrease in the southern part of South America and the eastern part of Australia (Figure 4-1-4).

There also are areas where a major adverse impact on water resources is projected to emerge. For example, according to the IPCC AR4, many small islands in the Caribbean Sea and the Pacific are expected to see decreases in freshwater resources to make it hard for them to satisfy water demand during seasons of little rain. In these small island areas, not only changes in precipitation but also the rise in sea level could also trigger a decrease in freshwater resources. Below the surface of small islands made of pervious rocks, groundwater (freshwater) is floating over seawater (salt

water) in the shape of lens (freshwater lens), and this freshwater lens is pushed higher by the rise in sea level, thus lowering the quantity of freshwater available (Figure 4-1-5).

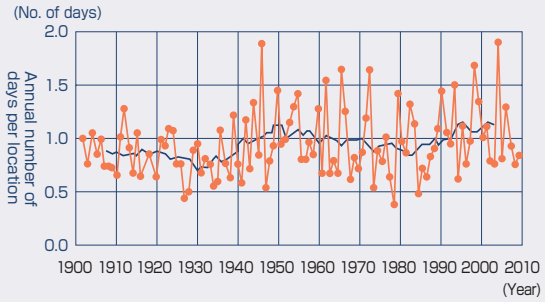
The long-term examination of annual precipitation in Japan reveals that there were periods of heavy rains until the mid-1920s and around the 1950s, and annual changes in precipitation have become larger year by year since the 1970s (Figure 4-1-6). Further, the number of days with daily precipitation of 100 millimeters or more has been on the significant rise in the long term, and comparison between the recent 30 years and the 30 years in the early 20th century shows a rise of about 1.2 times (Figure 4-1-7).

Figure4-1-6 Changes in Deviation from the Normal Year in Annual Precipitation in Japan (1898-2008)



Note: The figure shows trends in annual precipitation at 51 locations in Japan. Bar graphs show deviation from the normal year (the percentage ratio to the normal year value) in annual precipitation in each year. The red line shows the five-year moving average in deviation from the normal year. The normal year value is the 30-year average for 1971-2000.
Source: Japan Meteorological Agency, 2009

Figure4-1-7 Interannual Changes in the Annual Number of Days with Precipitation of 100mm or more

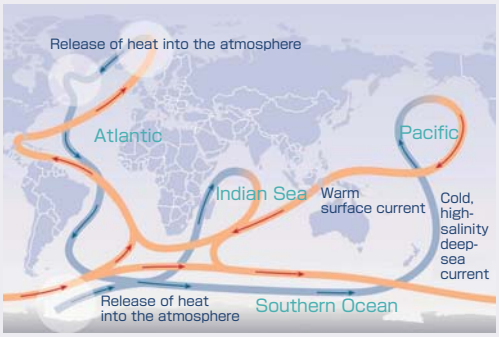


Note: The annual number of days per location obtained from the number of days of incidence at 51 locations in Japan.
—● indicates the value for each year, while ～ shows the 11-year moving average value.
Source: "Climate Change Monitoring Report 2009" (Japan Meteorological Agency, 2010)

Column Deep Circulation in Oceans

Regarding deep circulation in oceans, the IPCC AR4 notes there is no sufficient evidence to determine where there are some tendencies in deep circulations, projecting that there is very little possibility of deep circulations showing large and rapid changes by the end of the 21st century. On the other hand, the current model-based projection points to the very high possibility of deep circulation in the Atlantic Ocean weakening during the 21st century.

Global Ocean Circulation



Source: IPPC Fourth Assessment Report

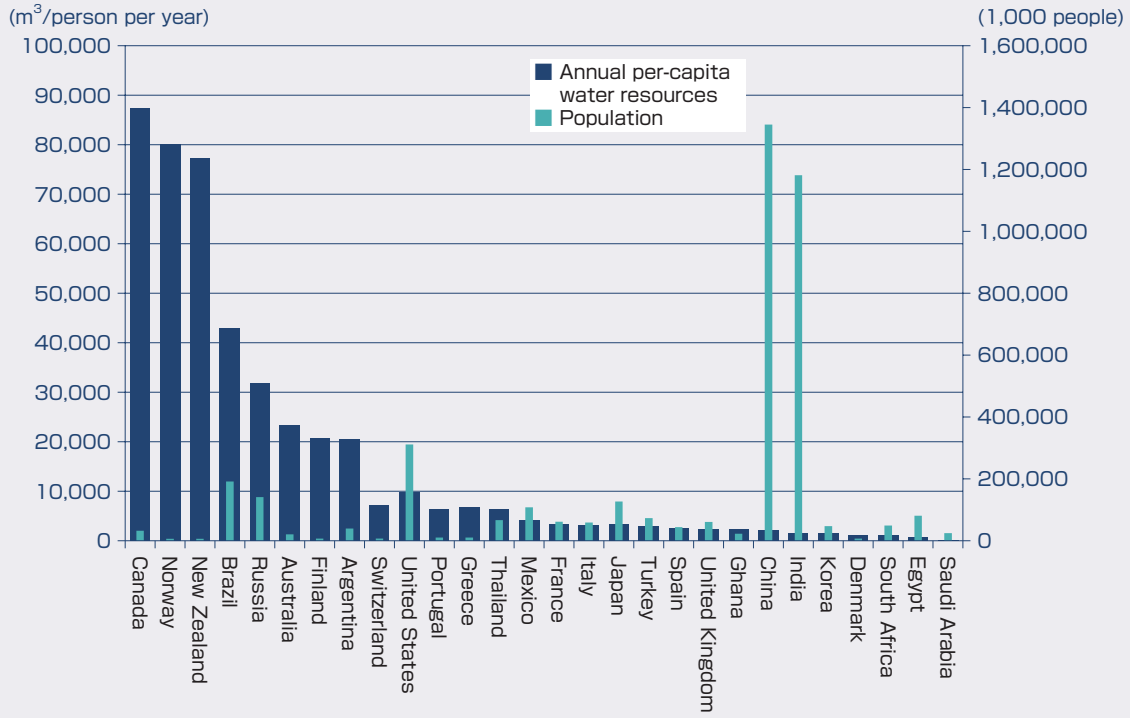
3 Various Problems Caused by Water

Due to population growth, global warming and the growth of emerging economies (which means increased demand for industrial water), it is expected that "an additional 1.8 billion people could be living in a water scarce environment by 2080," pointing to a very serious water situation in the world (Source: UNDP, "Human Development Report 2007/2008).

1) Uneven distribution of water resources and demand outlook

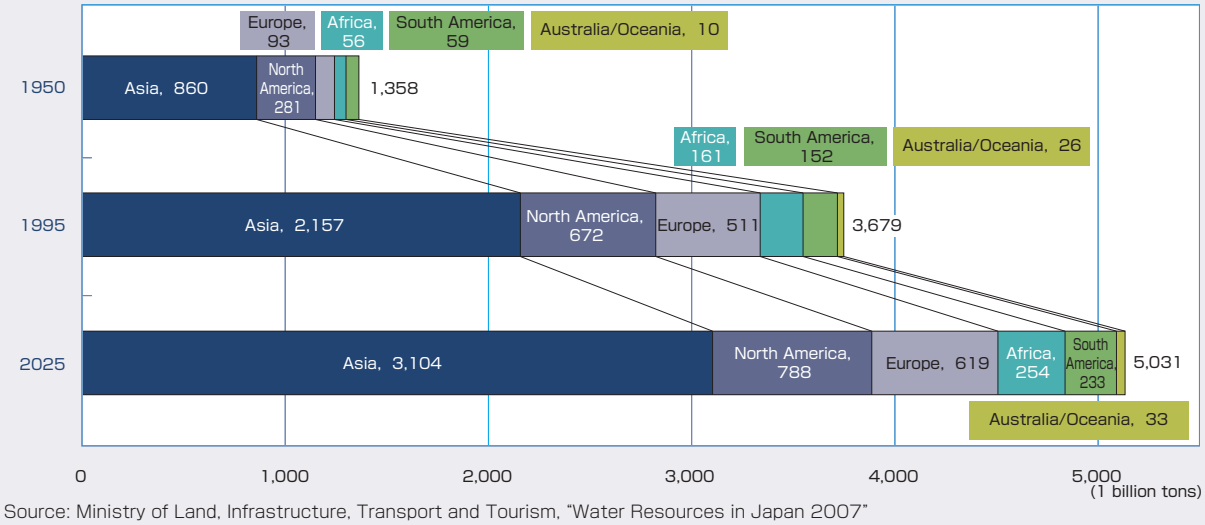
According to data provided by the Food and Agriculture Organization (FAO), there are big gaps in per-capita annual water resources among countries, and the uneven distribution of water resources is evident, with countries with relatively small water resources having relatively large populations (Figure 4-1-8). The U.N. Educational, Scientific and Cultural Organization (UNESCO) forecast a substantial increase in demand for water in Asia going forward (Figure 4-1-9). While the global population is projected to rise by about 1.4 times during a 30-year period between 1995 and 2025, domestic noncommercial use of water and water for industrial use are both expected to show sharp rises of about 1.8 times and about 1.6 times, respectively, due to population growth (Figure 4-1-10). For water for agricultural use,

Figure4-1-8 Annual Per-Capita Water Resources and Population



Source: Prepared by Ministry of the Environment based on FAO AQUASTAT

Figure4-1-9 Rapidly Increasing Water Usage



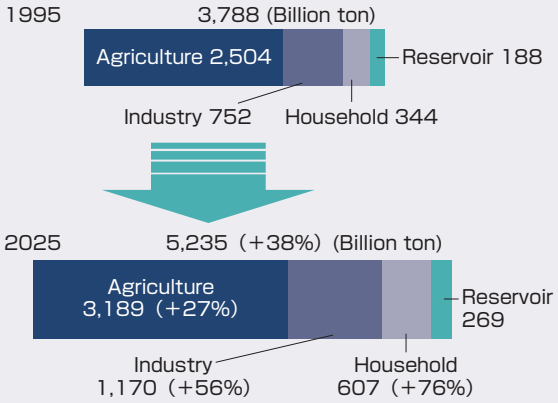
Source: Ministry of Land, Infrastructure, Transport and Tourism, "Water Resources in Japan 2007"

the amount of water pumped is likely to increase primarily due to an expansion of irrigated farmland (Figure 4-1-11). Given the geographically uneven distribution of water resources, the big issue is whether demand for water can be satisfied.

2) Use of safe and sanitary water

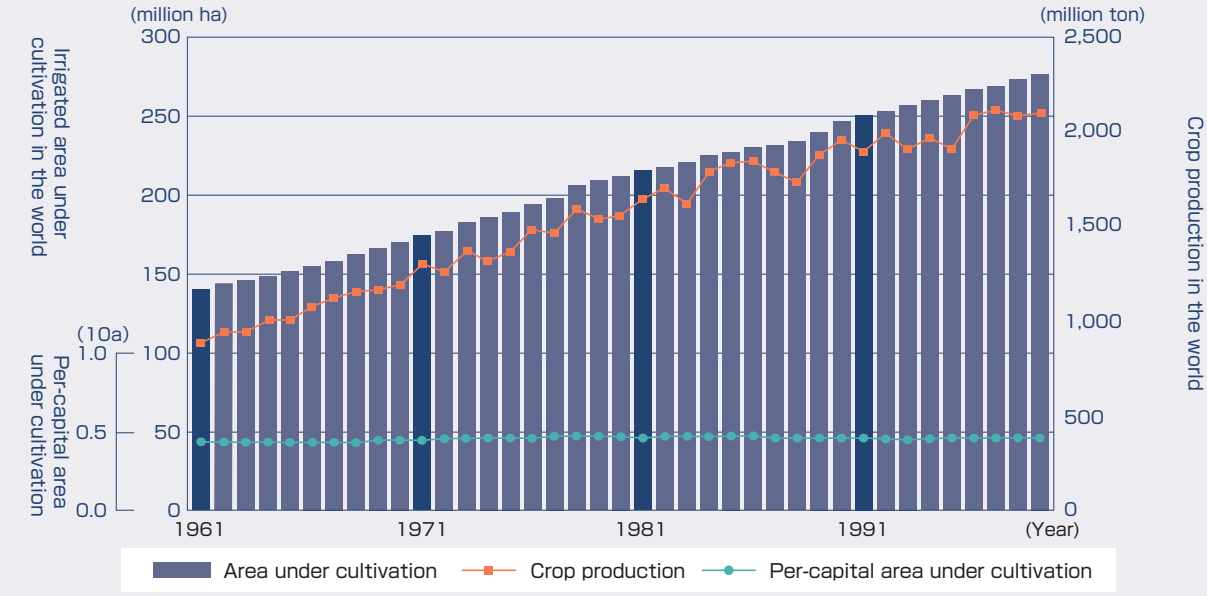
As shown in figure 4-1-8, water resources in the world are unevenly distributed and people who do not have access to safe water and sanitary facilities are concentrated in Asia and Africa. According to results of surveys conducted by the U.N. Children's Fund (UNICEF) and the World Health Organization (WHO), there are about 880 million people in the world who have no access to safe water, with Asia accounting for about 470 million people (53%) of the total (Figure 4-1-12). Also, there are about 2.5 billion people living in areas with no sanitary facilities, with Asia again accounting for a large portion of about 1.8 billion people (70%) of them (Figure 4-1-13). Because of "water" and "sanitation" problems, 1.8 million children are dying each year. These figures represent one of the biggest problems confronting mankind.

Figure4-1-10 Breakdown of Water Usage by Use in 1995 and 2025



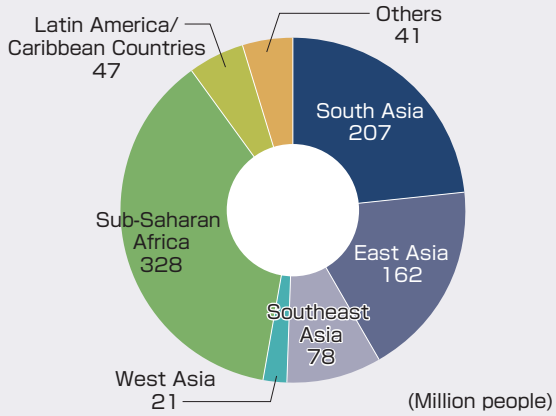
Note: Figures in parentheses show increases over 1995
Source: SHI and UNESCO (1999)

Figure4-1-11 Trends in Crop Production and Irrigated Area under Cultivation in the World



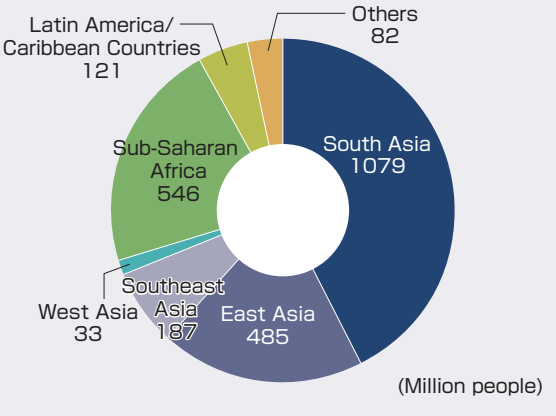
Source 1: Statistical Databases (U.N. Food and Agriculture Organization)
2: Prepared by Ministry of the Environment based on World Population Prospects: The 2000 Revision, 2001 (U.N. Department of Economic and Social Affairs, Population Division)

Figure4-1-12 Population without Continuous Access to Safe Drinking Water in Developing Countries by Region



Source: Prepared by Ministry of the Environment based on the U.N. Children's Fund (UNICEF) and the World Health Organization (WHO), "PROGRESS ON DRINKING WATER AND SANITATION : SPECIAL FOCUS ON SANITATION, 2008"

Figure4-1-13 Population without Continuous Access to Basic Sanitation in Developing Countries by Region



Source: Prepared by Ministry of the Environment based on the U.N. Children's Fund (UNICEF) and the World Health Organization (WHO), "PROGRESS ON DRINKING WATER AND SANITATION : SPECIAL FOCUS ON SANITATION, 2008"

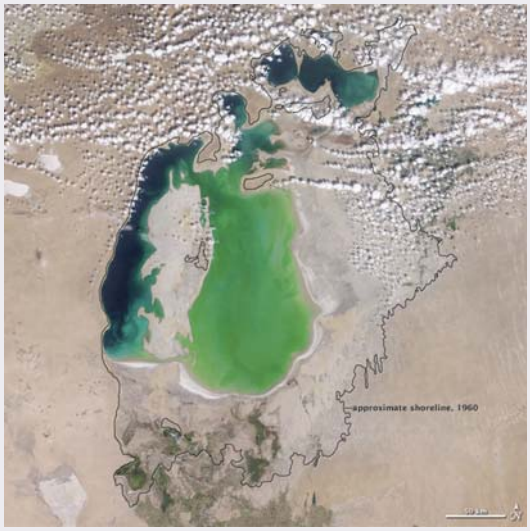
3) Various problems occurring in the world due to water

a) The shrinking Aral Sea

The Aral Sea spanning Kazakhstan and Uzbekistan in Central Asia used to be the world's fourth largest lake. Since the 1960s, vast quantities of irrigation water were withdrawn from two rivers feeding the late, the Syr Darya and Amu Darya for the cultivation of cotton and crops, causing the water level to decline and leading to the continued shrinkage of the lake surface area. In about 50 years up to 2006, the Aral Sea lost as much as about 71% of area and 91.5% of cubic volume (quantity of water) (Figure 4-1-14). Salt, sands and agricultural chemicals are being stirred up from the dried-up lake bottom, causing serious health damage to residents in surrounding areas. Remaining water has seen the rapid rise in the density of salt, which is now six times the original density. The once-rich saline lake, which used to yield 50,000 tons of fish, is now devoid of fish resources, putting fishermen out of business. With water that used to mitigate the climate in surrounding areas gone, harsher weather is said to be exacerbating growing conditions for cotton and crops.

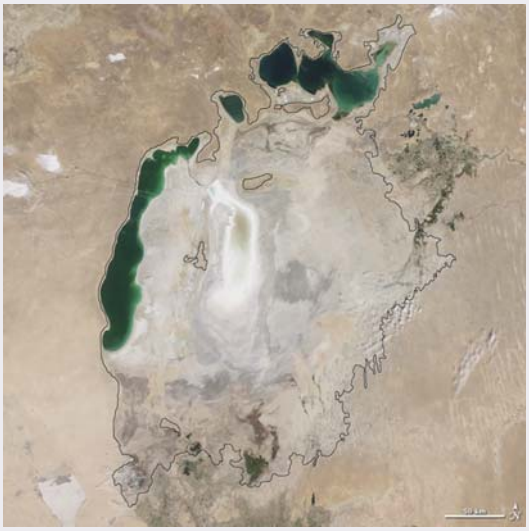
The solid line shown in Photo 4-1-1 demarcates the Aral Sea around 1960. While the Aral Sea was a single lake then, it became divided into the southern and northern parts in the latter half of the 1980s, and the South Aral Sea began to separate east and west around 2000 and continued shrinking. In August 2009, the eastern side of the South Aral Sea dried up at last (Photo 4-1-2). The North Aral Sea is beginning to recover in area after construction of the Kokaral Dam.

Photo4-1-1 Satellite Photo of the Aral Sea (August 19, 2000)



Source: NASA (http://earthobservatory.nasa.gov/Features/WorldOfChange/aral_sea.php)

Photo4-1-2 Satellite Photo of the Aral Sea (August 16, 2009)



Source: NASA (http://earthobservatory.nasa.gov/Features/WorldOfChange/aral_sea.php)

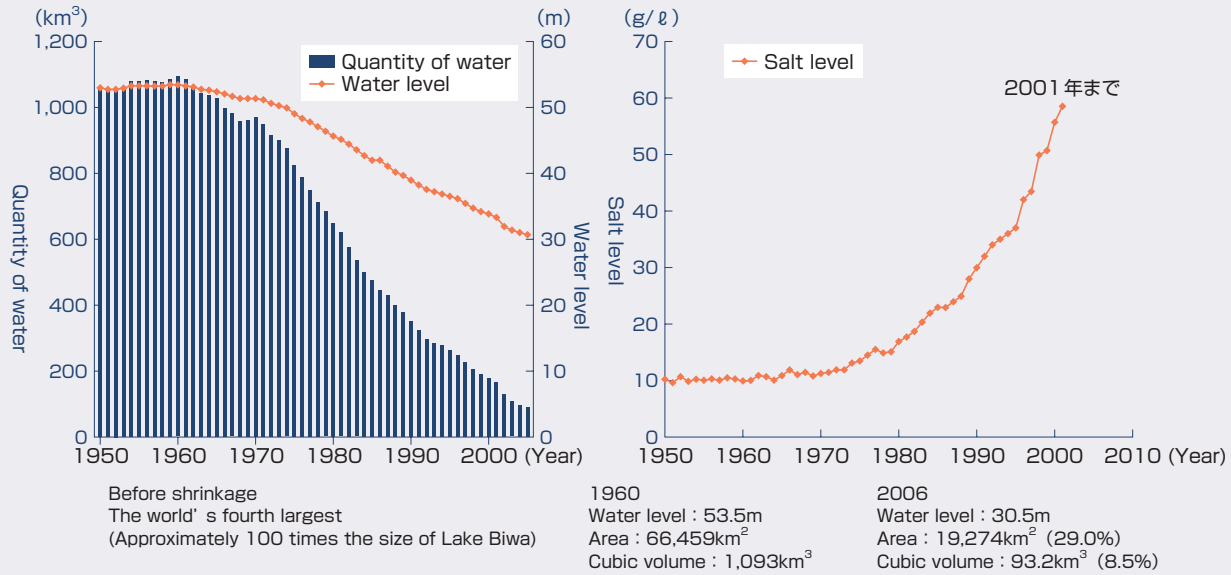
Table4-1-2 Trends in Surface Area of the Aral Sea

(km²)

	1960	1987.6～1989.9	1996.11	2003.10	2006.9～2007.10
The North Aral Sea	—	3,400	3,200	3,200	3,600
The South Aral Sea	—	42,100	31,300	17,700	13,000
Total	68,000※	45,500	34,500	20,900	16,600

※Source : Lake Biwa Environmental Research Institute, Shiga Prefecture ed., "Lakes of the World," (Jimbun Shoin, 1993)
Source: JAXA website (http://www.eorc.jaxa.jp/imgdata/topics/2007/tp071128.html)

Figure4-1-14 Trends in Quantity of Water, Water Level and Salt Level of the Aral Sea



Source: Database of the Aral Sea/Bathymetric characteristics (2005)

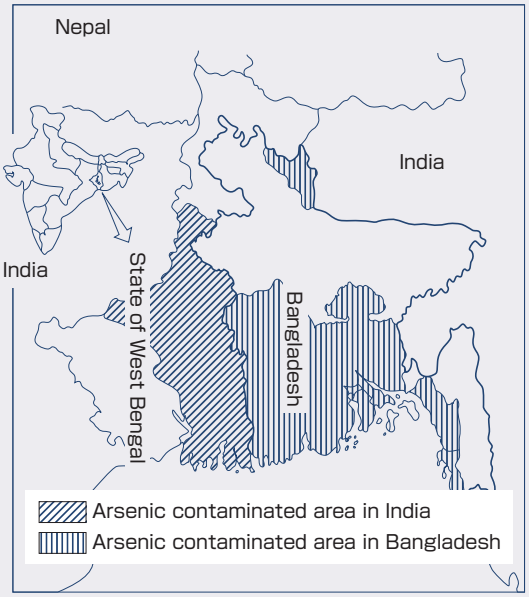
b) Arsenic contamination of groundwater in Bangladesh

In the West Bengal region straddling the border between India and Bangladesh, arsenic contamination was first officially reported in 1983, and subsequently, the contamination damage has been spreading with no halt in sight (Figure 4-1-5). Residents in the region, except for urban areas, depend on pumping wells for drinking water and domestic noncommercial water, and both countries have been promoting irrigation agriculture since the 1960s by pumping up groundwater in order to simultaneously cope with and solve the population growth and socioeconomic problems. Since it is the rice-producing region, large quantities of water for agricultural use have been pumped up with machine pumps. As a result, arsenic-contaminated groundwater has led to the high incidence of arsenic poisoning, causing skin cancer, lung cancer, keratosis, melanoderma and other diseases among poisoned patients (Photo 4-1-3). In Bangladesh, the arsenic-contaminated area extended to about 38,000 square kilometers (an area about half of Hokkaido) as of 2008, with people living in contaminated areas reaching an estimated 38 million and people who have taken arsenic-contaminated water reaching an estimated 16 million, with the number of people developing diseases unknown. In the Indian state of West Bengal on the other side of the border, the arsenic-contaminated area extended to some 37,000 square kilometers, with people living in contaminated areas reaching 34 million and people who have drunk arsenic-contaminated water reaching one million, and the number of people developing diseases totaling 200,000. In arsenic-contaminated areas, over 20% of the population suffered from arsenic poisoning, bringing about a very serious situation, with the number of patients growing at an annual rate of 8%. Under these circumstances, the government of Bangladesh carried out surveys on wells throughout the country by 2004 and launched a national arsenic mitigation policy in March 2004. Japan has provided assistance in dealing with the problem since 1998, and implemented arsenic contamination countermeasure programs since FY 2006 to reinforce the system to supply safe water to about 1.30 million residents in four zilas (prefectures) in the western part of Bangladesh.

c) Regional disputes over water

There are regions in the world where interstate conflicts are occurring over water. These disputes have been caused, among other things, by the problem of allocation of water resources, such as excessive withdrawal of water in upstream lakes and rivers as well as groundwater, and the problem of water contamination due to discharges of contaminants upstream and groundwater contamination. The disputes are over excessive use of water in the Aral Sea, water ownership in the Indus and the Jordan, and the development and allocation of water resources in the Nile and the Tigris-Euphrates basin (Figure 4-1-16).

Figure4-1-15 Arsenic Contaminated Areas around the India-Bangladesh Border

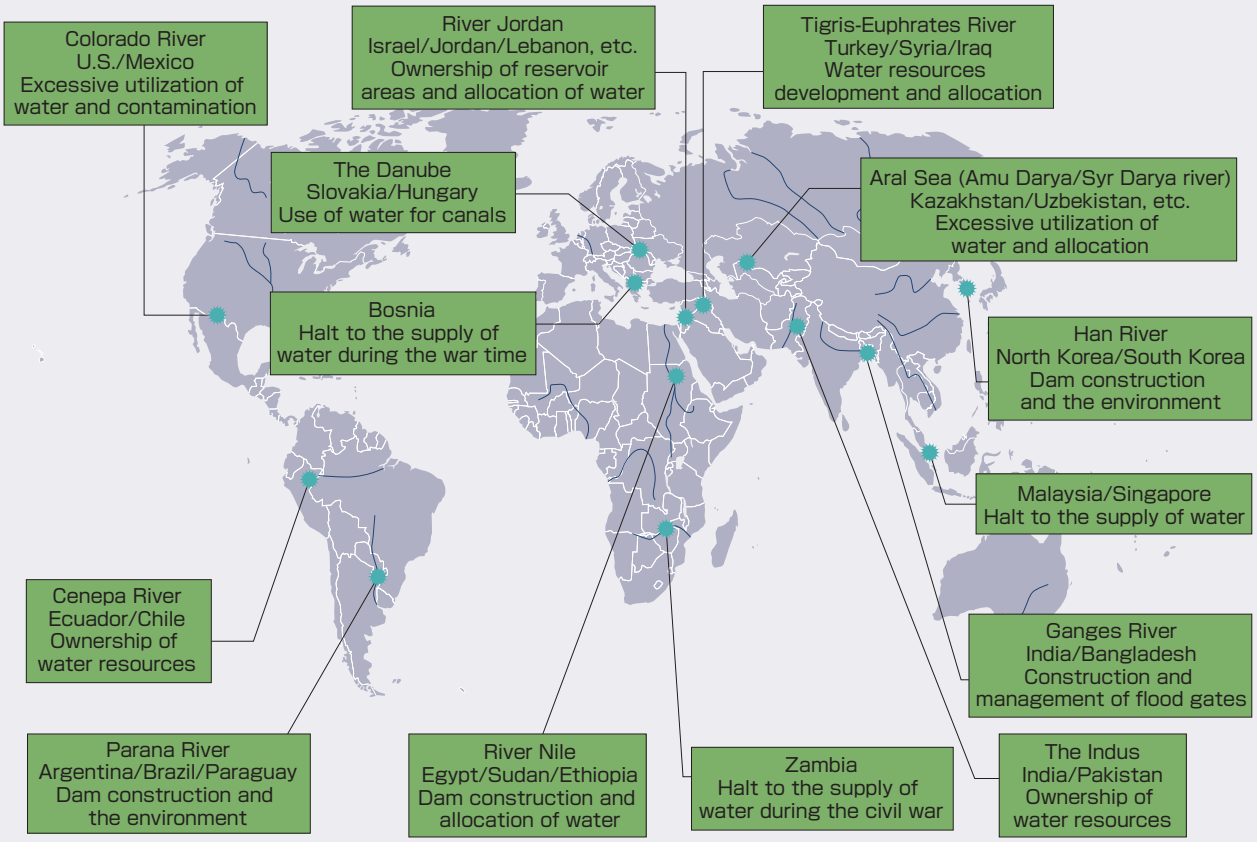


Source: Masanori Ando, Guest Professor, Musashino University

Photo4-1-3 Arsenic Poisoning (Pigmentary Anomaly)

Source : Asia Arsenic Network (Specified Nonprofit Corporation)

Figure4-1-16 Water Disputes around the World



Source: Prepared by the Secretariat of the Third World Water Forum based on Peter H. Gleick, "The World' s Water," and Marq de Villiers, "Water"

4 State of Water Demand in Japan

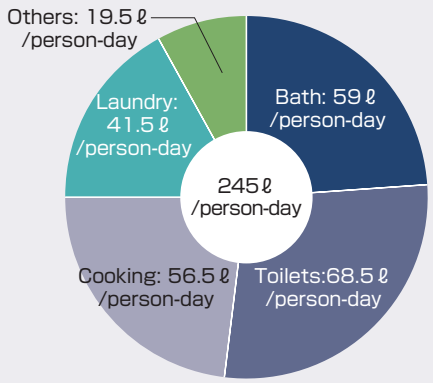
1) Amount of water consumption at households

We consume about 245 liters of water per day as "domestic water." Of the amount, water consumed as drinking water is just two to three liters, with most of the remaining portion being used for washing and cleansing, including cooking, laundering, bath, cleaning, flash toilets, water sprinkling and other purposes (Figure 4-1-17). Meanwhile, water for commercial use at such places as restaurants, department stores and hotels, water for use at business offices and water for public use, such as fountains and public restrooms in parks are collectively called "water for urban activity." Including this category of water, per-capita use of water came to an average of about 305 liters per day in FY 2006 in terms of effective volume of water.

2) Water supply-demand balance in Japan

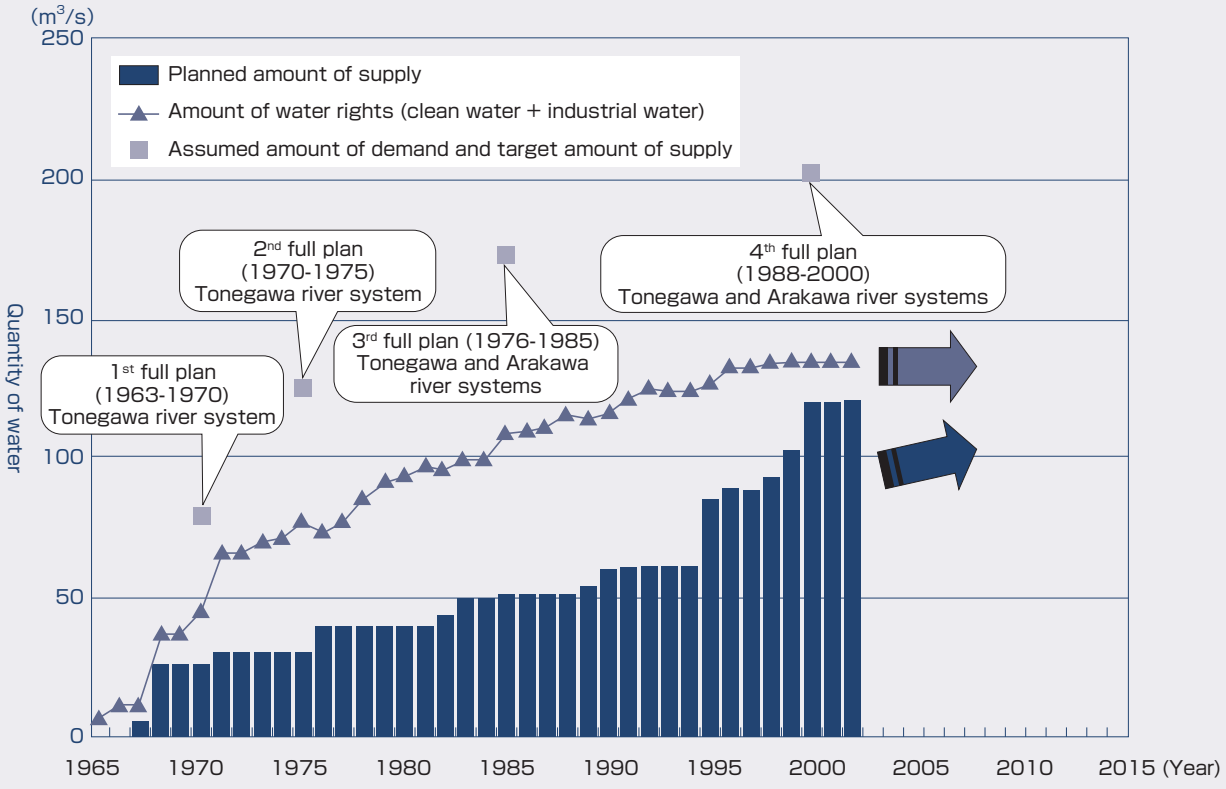
Thanks to the implementation of stable measures for ensuring water supply, Japan appears to be out of the situation where the supply of water cannot catch up with the rapid increase in demand for water (Figure 4-1-18). On the other hand, snow now melts earlier than previously due to, among other things, the decreasing amount of snowfall in part because of global warming, causing the narrowing of the supply-demand gap based on the planned supply in management of rivers, etc. and water rights, which requires the examination of an impact on facilities management.

Figure4-1-17 Ratio of Household Water by Usage



Source: Bureau of Sewerage, Tokyo Metropolitan Government, "Fact-Finding Survey on Usage of Household Water"

Figure4-1-18 Narrowing of Water Supply-Demand Gap in the Tonegawa/Arakawa River Systems



Note 1: Planned amount of supply = Amount of water under development, such as dams (facilities under construction and water diverted from agricultural rationalization projects during winter are not included)
2: Amount of water rights = The sum of water rights secured and temporary water rights
Source: Water Resources Department, Land and Water Bureau, Ministry of Land, Infrastructure, Transport and Tourism

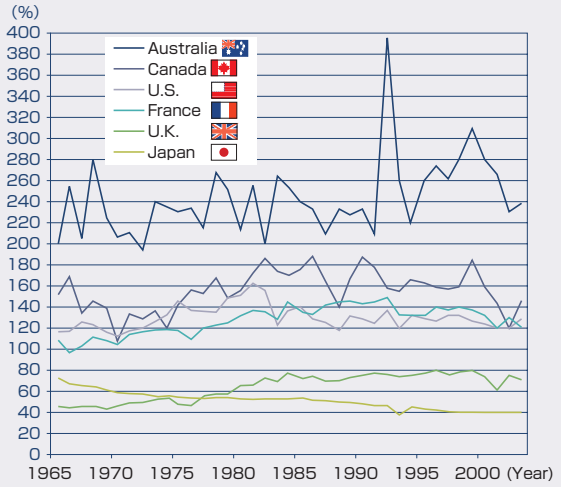
3) Japan deepening dependence on water resources abroad

Japan has safe and stable water supply systems in place for the supply of water with one of the best water quality and most sufficient amount in the world. Does this mean Japan is totally free from water stress? We must not forget that Japan consumes a lot of water around the world through imports of food. In a country that imports goods that require water in producing them (a consuming country), the amount of water estimated to be required if those goods are to be produced in the consuming country is called "virtual water."

Japan's self-sufficiency rate, on a calorie basis, stands now at around 40%, and unlike developments in other major developed countries, Japan's rate has been on the consistent decline since 1965 (Figure 4-1-19). This means Japan depends on other countries for more than half of water needed for food production and that the dependence is continuing to rise. In 2005, Japan imported 80 billion cubic meters virtual water from other countries, with the bulk of that amount stemming from food. The amount is roughly the same as the annual combined intake of water for domestic use, industrial use and agricultural use (Figure 4-1-20).

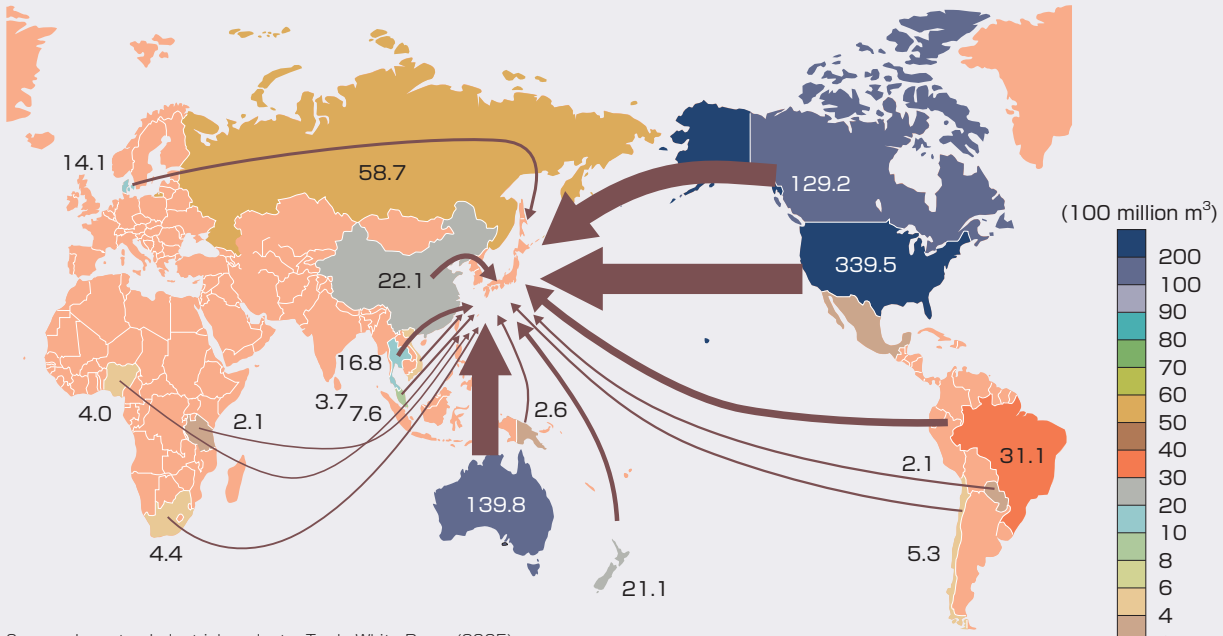
The state of water use in Japan indicates the flattening trend of demand for water for all of domestic use, industrial use and agricultural use, with no cause for alarm over possible water shortages. However, in considering the stable supply of food, we have to always bear in mind the status of water resources that support food production.

Figure4-1-19 Trends of Food Self-Sufficiency Rates of Major Countries on a Calorie Basis (1965-2003)



Source: Policy Issues of Japan in International Comparison, "Comprehensive Research Report" (National Diet Library, 2010)

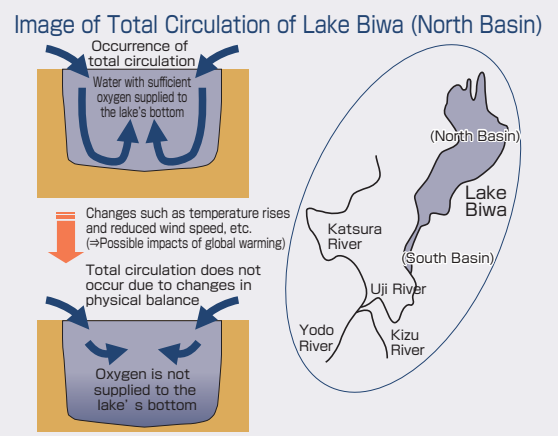
Figure4-1-20 Virtual Water Imports in 2005



Source : Imports Industrial products Trade White Paper (2005)
Agricultural and livestock products JETRO Trade and Investment Statistics (2005), Ministry of Finance Trade Statistics (2005)
Basic unit of water consumption Industrial products Used figures from 2000 Industrial Statistics by Miyake et al.
Agricultural products Used figures from unit yields in Japan for 2000 by Sato
Round wood Used figures calculated on the basis of wood supply and demand, etc.
Source: Calculated and prepared by Ministry of the Environment based on data from Professor Oki of the Institute of Industrial Science, University of Tokyo

Column Total Circulation of Lake Biwa

In Lake Biwa, layers of water temperatures are formed in summer because of big differences between the surface water temperatures of 26-28 degrees C and deepest-part water temperatures of 6-8 degrees C. When the lake surface cools down from autumn to winter, the surface water temperatures come down and layers of water temperatures disappear, with shallow water and deep water becoming admixed. This phenomenon is called "total circulation." However, if the lake surface does not cool down and the surface water does not sink as deeply as before because of rising atmospheric temperatures, the total circulation would decrease and oxygen is not supplied to the lake's bottom, possibly causing a deterioration of water quality and thus giving an impact on lake ecosystems.



Source: Ministry of Land, Infrastructure, Transport and Tourism, "Water Resources in Japan 2007"

Section 2 Efforts to Solve Water Problems

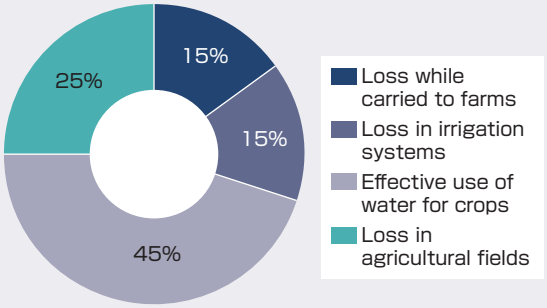
1 Problems in the Use of Water Resources

As discussed in Section 1, water resources available to humans are limited and unevenly distributed geographically. On top of this, we expect to see an increase in water stress due to global warming as well as further rises in demand for water owing to population growth and economic growth. Then, are we using limited water resources effectively without wasting them? For example, in the case of water for agricultural use, which accounts for about 70% of the total water consumption, water is lost in each stage in the course of irrigation of farmland. For example, there a report that in Asia, 20% of irrigation water is lost in the stage where water is carried from reservoirs to irrigated areas, another 15% is lost when water is delivered to agricultural fields, and in addition, 25% of water is wasted in agricultural fields (Figure 4-2-1). In this case, as much as about 60% of water is lost and only the remaining 40% is actually used to grow crops. These loss problems can be improved through the averaging of agricultural fields, improvements to irrigation channels, and the "drip infusion" of irrigation water to crop roots.

In developing countries, the nonrevenue water rate (the ratio of the difference obtained by deducting water sold from water produced to water produced) is said to average at 40%. Nonrevenue water rates in major cities of Asian countries show a lot of water is wasted through water leaks, while very little water is wasted in Japan (Figure 4-2-2). Fact-finding surveys on water projects in China and Vietnam, conducted in FY 2008, found that leaks of clean water are big problems in those countries. In Zhejiang Province, China, 20 to 30% of water projects in the province are estimated to suffer water leaks. In water projects in Changxing County of the same province, the quantity of water supply is as much as 36% lower than the quantity of clean water, presenting the authorities there with a major challenge to taking measures to deal with water leaks.

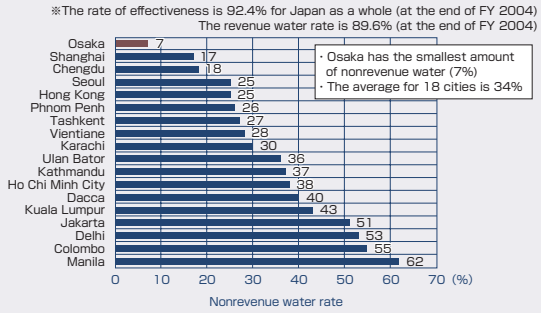
Installation of sanitary facilities remains inadequate in Asian countries as a whole, though the degree of sanitation varies from country to country, standing at 44% in China, 55% in Indonesia, 72% in the Philippines, 61% in Vietnam, 17% in Cambodia, 33% in India, 59% in Pakistan and 39% in Bangladesh. Substantially more effective utilization of water resources is possible if sewage water is adequately treated for reuse as water resources. We need to further promote effective use of water resources through prevention of water leakages and adequate sewage treatment when sewage is discharged into public water areas.

Figure4-2-1 Average Loss of Irrigation Water in the World



Source: Prepared by Ministry of the Environment based on the International Commission on Irrigation and Drainage (ICID), "Irrigation and Drainage in the World - For the Earth Blessed with Water and Green," p.140

Figure4-2-2 Nonrevenue Water Rate in Major Asian Cities



Source: Water in Asian Cities, Utilities' Performance and Civil Society Views, Asian Development Bank 2003 (data is for 2001)

2 International Goals and Efforts toward Solving Water Problems

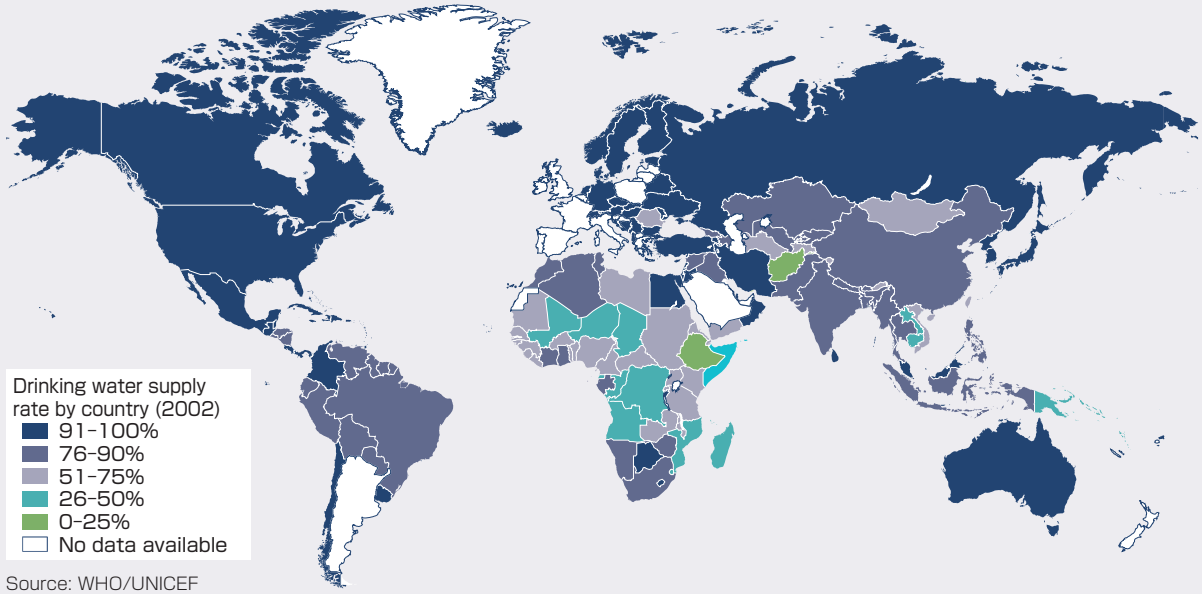
(1) Millennium development goals

By integrating the United Nations Millennium Declaration adopted at the U.N. Millennium Summit held in New York in September 2000 and international development goals adopted at major international conferences and summits held during the 1990s into a single framework, the "Millennium Development Goals (MDGs)" were worked out. In addition, after discussions at the World Summit on Sustainable Development in Johannesburg in 2002, on both aspects of securing safe drinking water and sanitation for adequate wastewater treatment, the numerical target was adopted to "halve, by the year 2015, the proportion of people who are unable to reach or to afford safe drinking water and the proportion of people who do not have access to basic sanitation." (Figure 4-2-3, 4-2-4)

Subsequent international developments on water problems have been revolving around ways to achieve this target, at such forums as G8 Summits, the U.N. Advisory Board on Water and Sanitation (UNSGAB) and the World Water Forum (Figure 4-2-5).

Figure4-2-3 Rate of Access to Safe Drinking Water

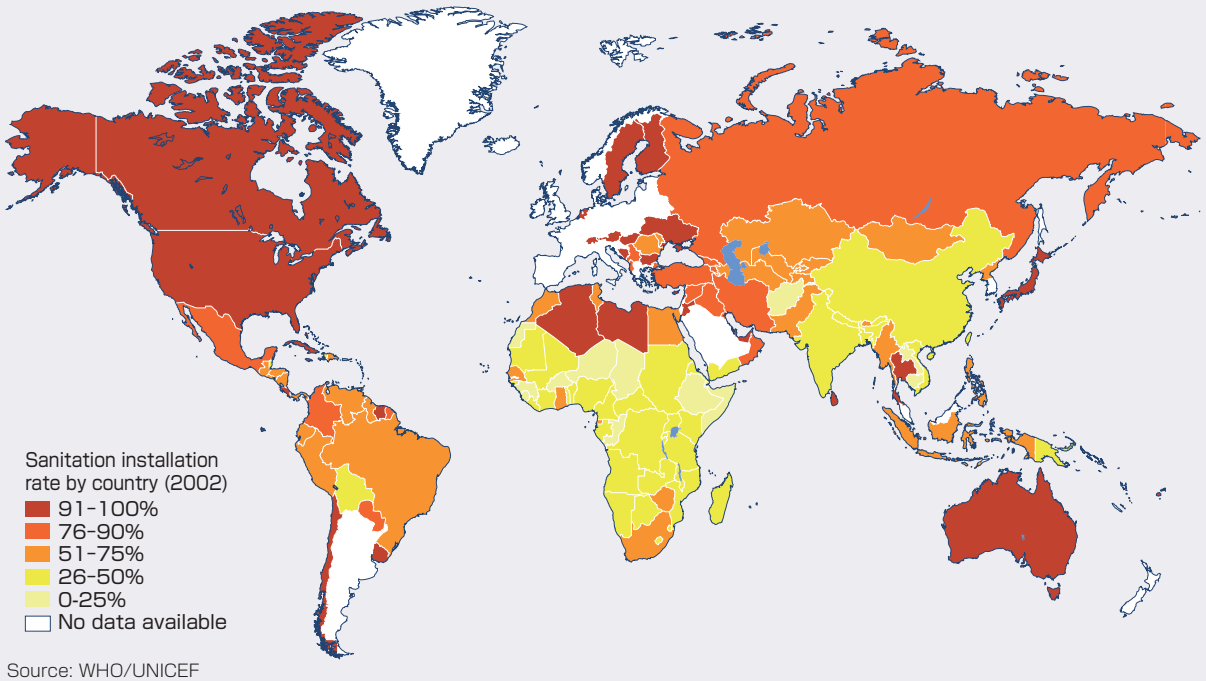
○1.07 billion people (17%) do not have access to safe drinking water around the world (of them, 97% are in developing countries)
○Areas with the low access rate are in Oceania (52%), sub-Saharan Africa (55%), etc.



Source: WHO/UNICEF

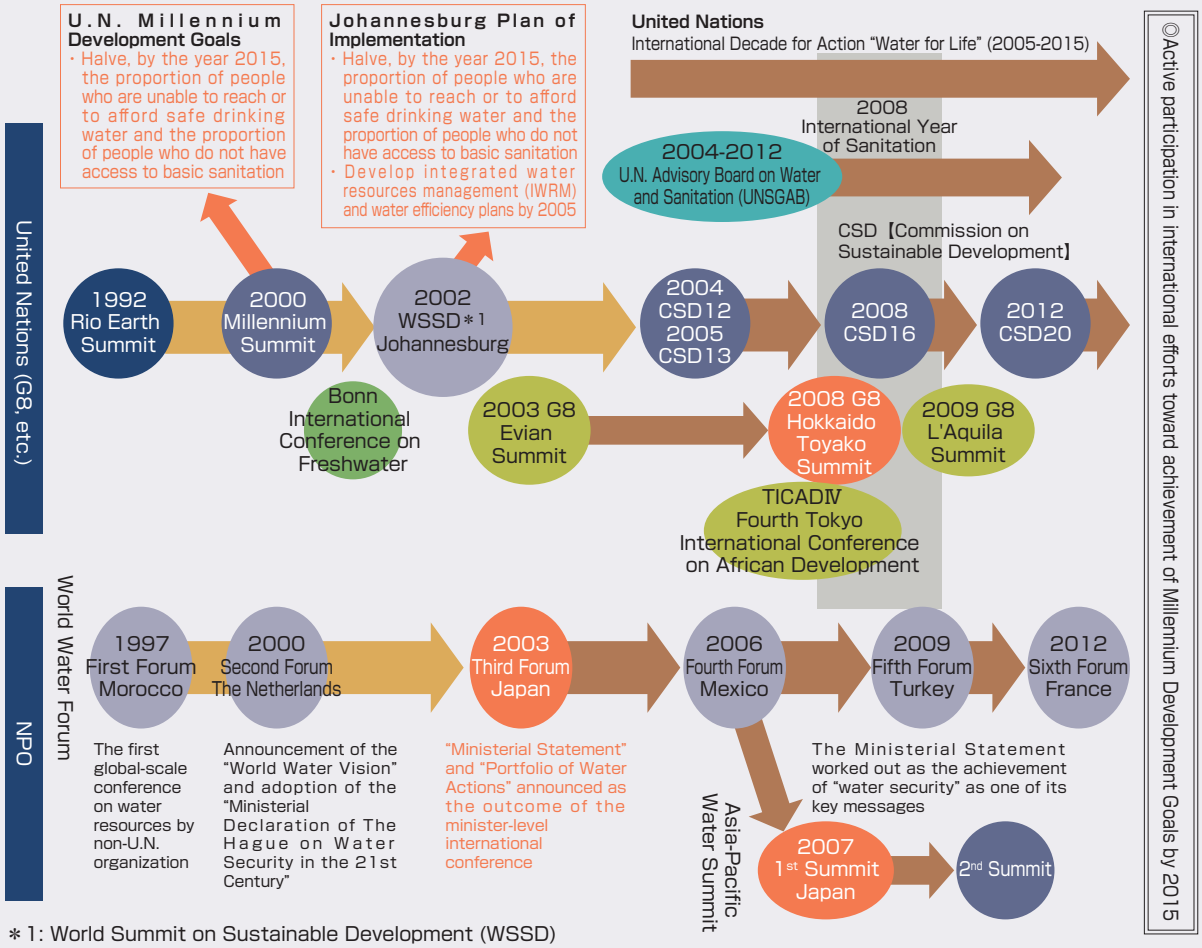
Figure4-2-4 Rate of Access to Basic Sanitation

○2.62 billion people (42%) do not have access to basic sanitation around the world (of them, 97% are in developing countries)
○Areas with the low access rate are in sub-Saharan Africa (37%), South Asia (37%), East Asia (51%), etc.
○Improvements in sanitation lagging particularly in rural areas, with the achievement of MDGs by 2015 seen difficult



Source: WHO/UNICEF

Figure4-2-5 Flow of Global Discussions on Water Resources



＊1: World Summit on Sustainable Development (WSSD)
Source: Water Resources Department, Land and Water Bureau, Ministry of Land, Infrastructure, Transport and Tourism

(2) Comprehensive and integrated water management

There have been movements toward comprehensive and integrated water management for effective utilization of limited water resources, through cooperation among countries in each region and coordination among countries in each hydrographic basin. The Johannesburg Summit in 2002 called upon each government to "develop integrated water resources management (IWRM) and water efficiency plans," and such plans are internationally recognized as effective methods to solve water and sanitation problems. In March 2009, in order to encourage countries to develop such plans, UNESCO coordinated efforts to work out "The Integrated Water Resources Management (IWRM) Guidelines at River Basin Level."

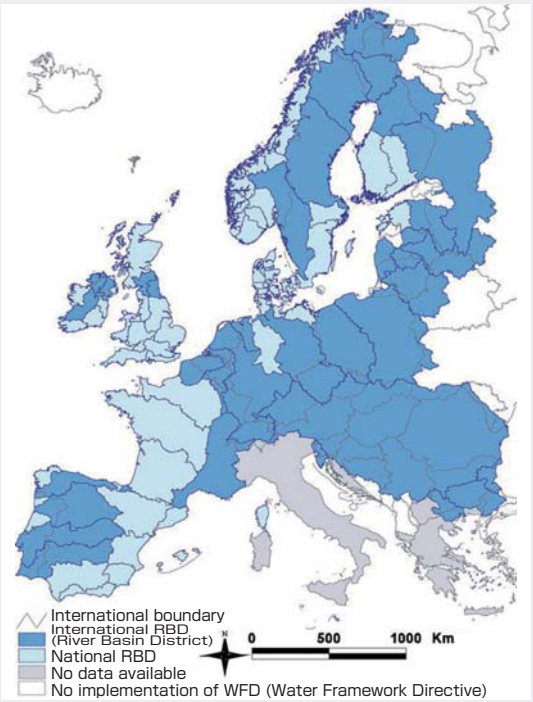
a) Example of Europe

In Europe, as a method of integrated water resources management, the EU Water Framework Directive (WFD) has been introduced. The WFD is designed to achieve, through unified water management, protection of human health by the supply of drinking water and bath water with adequate quality, building of sustainable water management system, protection of aquatic ecosystems and related regional ecosystems, and mitigation of the effects of floods and droughts. To that effect, measures called for under the WFD are characterized by integrated efforts by various water-related sectors, participatory approaches involving various interested parties and river basin management plans developed on the basis of respective river basins instead of administrative areas. What should be implemented to achieve the goals are primarily the following four points:

- Establish a framework for protection to manage water resources such as inland surface waters, estuary waters, wetlands, brackish waters, coastal waters and groundwater, etc. along circulations in nature;
- Prevent environmental deterioration in river basin water systems as a whole and improve them;
- Progressively reduce or cease discharges and consumption of priority substances, and preserve and improve the aquatic environment; and
- Progressively improve the quality and quantity of groundwater.

The WFD also requires EU members to develop river basin management plans for all river basins throughout the EU territory by 2009 to push forward with management efforts (Figure 4-2-6). The WFD implementation process is as follows:

Figure4-2-6 Basin Map for River Basin Management Plans in Europe



Source: BioOne website

<WFD implementation process>

By December 2003 EU Water Framework Directive (WFD) comes into effect; transposition of WDF into national legislation

↓

By December 2006 Development of operational monitoring programs as the basis for water management

↓

By December 2008 Development of river basin management plans (draft)

↓

By December 2009 Development of river basin management plans (approval by the European Commission (EC))

↓

By December 2015 Implementation, evaluation and adjustment of river basin management plans

b) Example of Australia

In Australia, irrigation and other measures have been taken in the Murray-Darling river system as broad-based water management (Figure 4-2-7). The governments of relevant states have been managing water resources in the river basin over more than 100 years. In recent years, however, droughts have taken serious proportions due to decreased precipitation since 2000, causing sharp drops in yields of wheat and other crops due to water shortages and poor growth of pasture grass that is having an adverse impact on cattle rearing. As precipitation continued to decline, river flows are likely to decrease further going forward. Despite these poor conditions, the relevant state and territory governments responsible for water resources management continued to grant water

rights excessively and water users also continued to overexploit water resources, rendering water resources management for solving problems difficult, a situation that called for a system under control of the federal government. Under these circumstances, federal Prime Minister John Howard in January 2007 announced the National Water Security Plan for Cities and Towns. The plan was designed for drastic improvement of water resources management across the country, with the federal government spending 10.05 billion Australian dollars (about ¥950 billion at the prevailing exchange rate then), including an overhaul program for irrigation pipes in the Murray-Darling river system. As the plan included the transfer of some powers related to water resources management from states to the federal government, the discord between the federal and state governments also drew attention. In September 2007, the Water Act 2007 was enacted with provisions for the partial transfer of powers related to water resources management in the Murray-Darling river system to a federal government agency. Based on this act, the Murray–Darling Basin Authority was established as an independent agency made up of experts and responsible for preparing an integrated management plan for water resources of the vast Murray-Darling Basin. As the basin management plan includes the establishment of limits on integrated and sustainable use of surface water and groundwater, identification of climate change and other risks to water resources in the river system and a strategy for managing such risks, an indication that the independent agency has been given the functions and powers necessary for management of water resources in the basin in an integrated and sustainable manner. Thus, the Australian government has established, albeit partially, a framework for a federal agency to manage water resources, previously the preserve of state governments and other related parties.

Figure4-2-7 Murray-Darling Basin Map

Source: Murray River Tourism

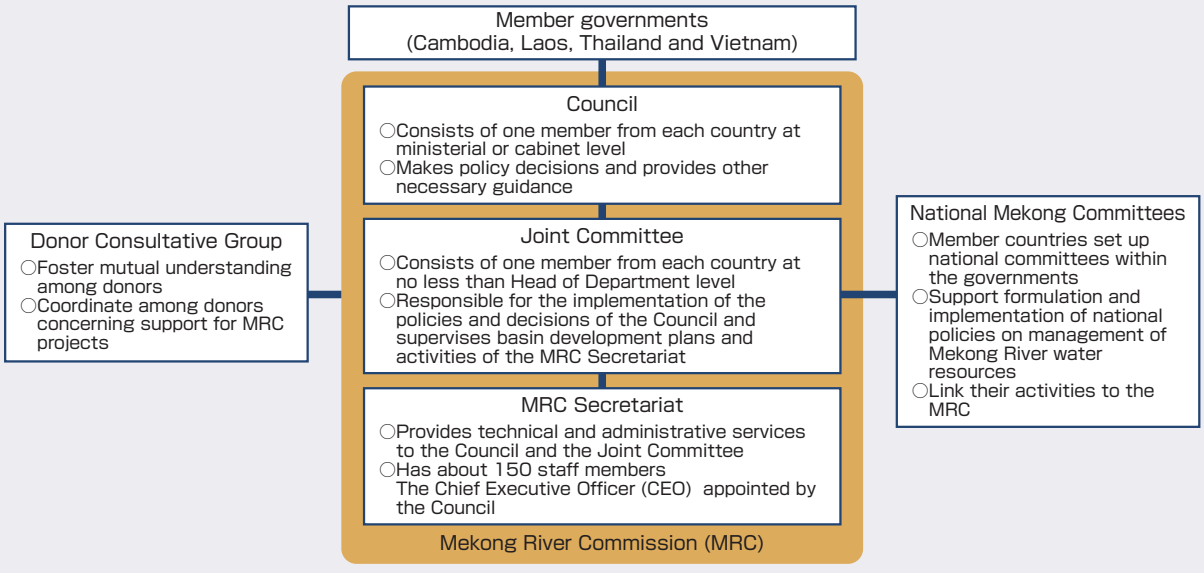
c) Example of Asia

In February 2004, the Network of Asian River Basin Organizations (NARBO) was established by such entities as the Japan Water Agency, an incorporated administrative agency, the Asian Development Bank (ADB) and the Asian Development Bank Institute (Figure 4-2-8). NARBO, which now comprises 71 organizations

Figure4-2-8 Organizations Comprising the Network of Asian River Basin Organizations (NARBO)

Source: Network of Asian River Basin Organizations (NARBO)

Figure4-2-9 Outline of the Mekong River Commission (MRC)

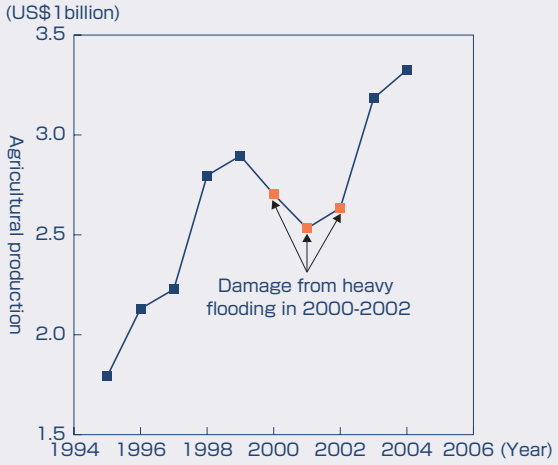


Source: Water Resources Department, Land and Water Bureau, Ministry of Land, Infrastructure, Transport and Tourism

from 16 countries, is designed to serve as a knowledge partner to provide information to river basin organizations and government institutions for the promotion of integrated water resources management (IWRM) in river basins in Asian countries and also function as an institution to offer training and other services for the promotion of IWRM.

Separately, at the initiative of Japan (Ministry of the Environment), the Water Environment Partnership in Asia (WEPA) was established by 11 countries in East Asia (Cambodia, China, Indonesia, Korea, Laos, Myanmar, Thailand, Malaysia, the Philippines, Vietnam and Japan) for the purpose of strengthening environmental governance in the region, providing support for relevant countries in their policy implementation by carrying out construction of information database, information sharing among stakeholders, and human resources development and capacity building in an integrated manner. Currently, efforts are under way for information base development, human resources development and policy implementation as well as strengthening and enhancement of aquatic environmental governance in the Asian monsoon region.

Figure4-2-10 Vietnam's Agricultural Production in the Mekong Delta (1995-2004)



Source: Mekong River Commission (MRC)

One example of IWRM initiatives in Asia is the Mekong River, which has multiple countries in its basin. The governments of Cambodia, Laos, Thailand and Vietnam established the Mekong River Commission (MRC) in 1995 (Figure 4-2-9) to regulate water use for the purpose of sustainable development in the entire basin. Achievements of MRC activities in recent years include the establishment of the flood management and mitigation program (FMMP) to mitigate damage from flooding in the Mekong basin. The MRC is building the flood database and providing training and other programs for enhancing management capabilities in order to achieve effective cooperation. These efforts, coupled with river development in the 1990s, helped Vietnam increase agricultural production in the Mekong delta from US$1.75 billion (about ¥154.8 billion) in 1995 to US$3.3 billion (about ¥291.9 billion) in 2004 (Figure 4-2-10). Similarly, farm production in Phnom Penh, Cambodia, in the Mekong basin has also increased.

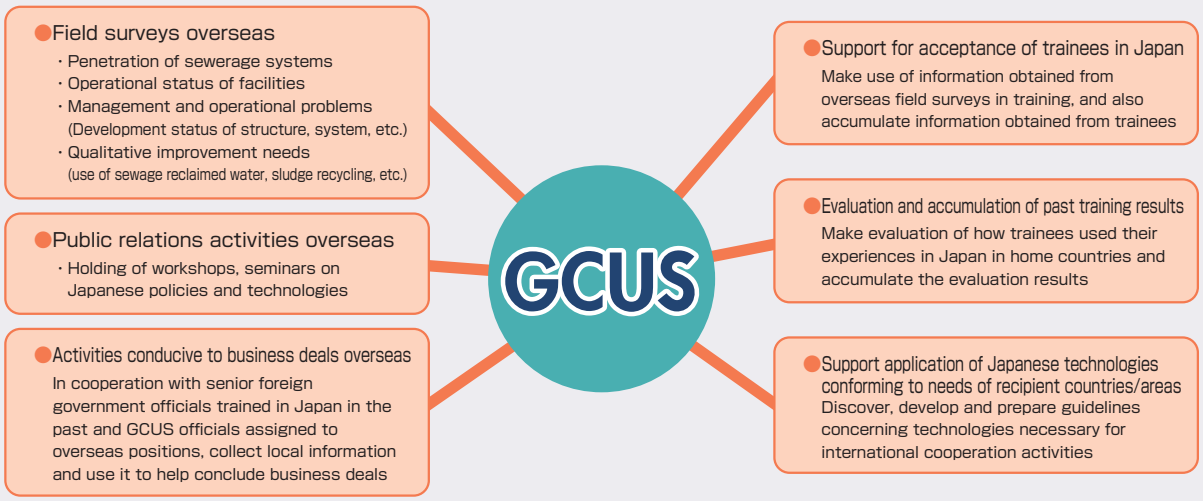
d) Japan's international contribution

Global water problems cannot be solved with efforts by a limited number of countries in limited areas alone. Going forward, Japan needs to actively contribute by offering technical cooperation for the achievement of MDGs as its coordinated efforts on water problems.

For example, the Japan Global Center for Urban Sanitation (GCUS) was established in April 2009 for the purpose of undertaking activities to spread sustainable sewage systems overseas by mobilizing knowhow and expertise held by Japan's industry, academic and public sectors on the sewage system.

GCUS has the three specific objectives: 1) international contribution to solving global water and sanitation problems; 2) support business activities of sewage-related companies; and 3) transposition of overseas experiences into sewage-related policy measures at home. GCUS supports international cooperation activities by the Japan International Cooperation Agency (JICA) and other institutions, while it also consolidate results of overseas field surveys, information on

Figure4-2-11 Activities of Global Center for Urban Sanitation (GCUS)



Source: Global Center for Urban Sanitation (GCUS)

international cooperation activities and information on human resources and technologies in Japan and build the network of sewage-related organizations in Japan and abroad (Figure 4-2-11).

It is also necessary for the Japanese government, businesses and citizens alike to take on the role of sending messages on leading-edge initiatives to the world on efforts to tackle global warming as well as activities to conserve the aquatic environment and diffusion and educational efforts related to such activities.

Column Restoration of the Cheong Gye Chon River in Seoul

The Cheong Gye Chon River, which runs from east to west through the central part of South Korea's capital city, had been gradually slipping away from the memory of Seoul citizens. Because of the progressive contamination, the river had become a hotbed of contagious diseases. Construction work to cover the river continued over some 20 years between 1958 and 1978, and the 16-meter-wide Cheong Gye elevated highway was then built over the river cover for a total length of 5.8 kilometers. Together with the Cheong Gye road that runs under it, the highway served as the artery of Seoul, carrying some 170,000 automobiles a day.

About 20 years since then, calls grew among citizens for the restoration of the Cheong Gye Chon River. In 2003, the Seoul mayor, Mr. Lee Myung-bak, who is now president of the country, decided to bring down the degraded highway and developed the hydrophilic space by planting trees along the river.

Currently, the riverside provides a comfortable recreation area for Seoul citizens, and the restored Cheong Gye Chon River has become one of the best-known tourist spots in the sightseeing city of Seoul.

Photo4-1-4 Restoration of the Cheong Gye Chon River

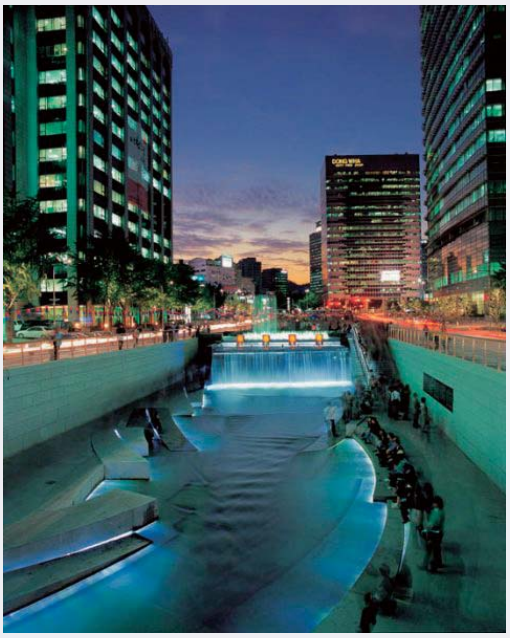


Photo: Seoul City

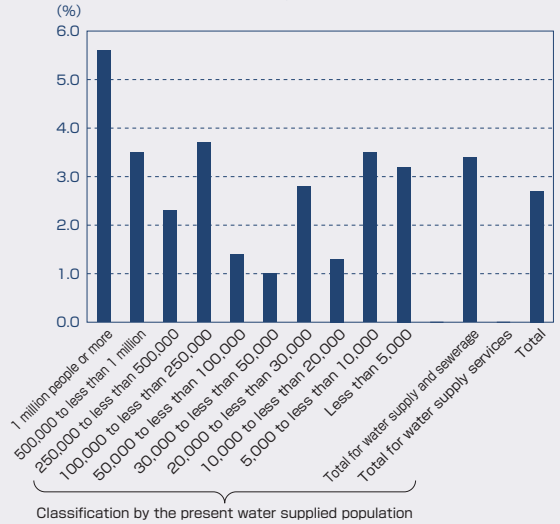
3 Efforts and Measures in Japan

(1) Aquatic infrastructure

a) Measures to cope with decrepit facilities

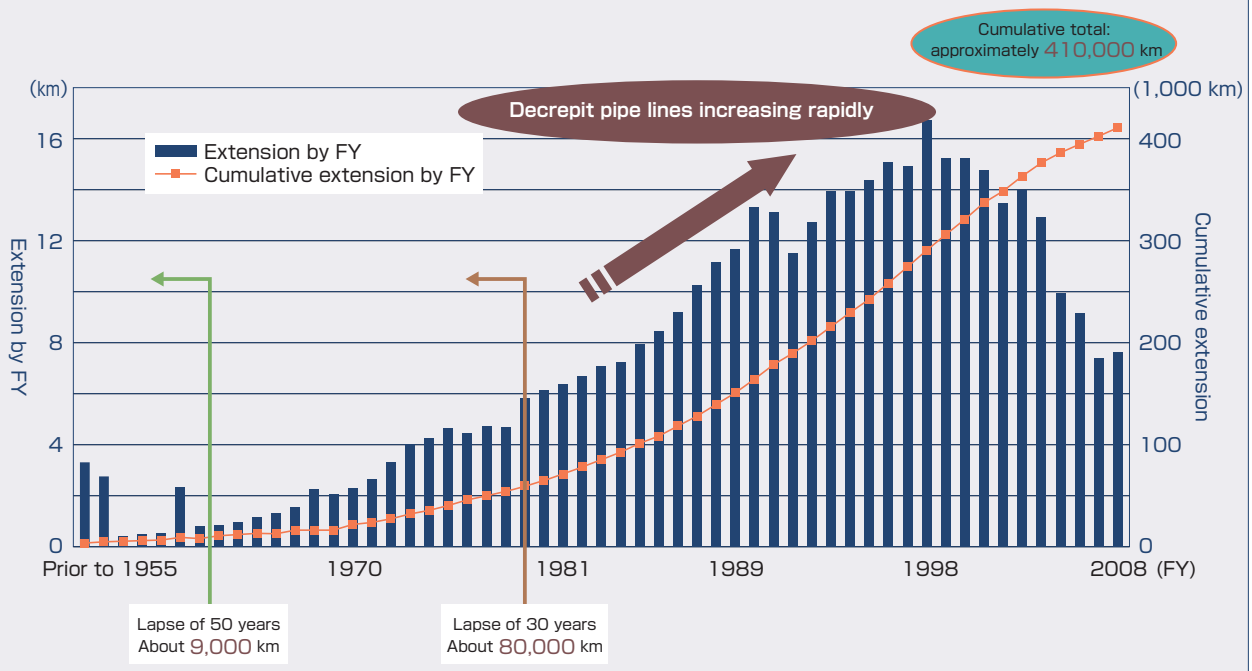
Waterworks and sewage systems in Japan had been constructed rapidly during the high growth period. Many of them are now becoming decrepit. In order to forestall accidents or failures due to aging facilities and use water resources effectively and appropriately, it is necessary to carry out well-planned replacement or reconstruction of water-related infrastructure, including measures to prolong the life of existing facilities from the early years of the 21st century, also giving heed to the perspective of minimizing life cycle costs (Figure 4-2-12). Water supply systems across Japan have the combined water-purifying capacity of some 88 million cubic meters per day, with the water-purifying capacity of facilities past the statutory useful life standing at some 2.4 million cubic meters per day, or about 2.7% of the total (Figure 4-2-13). The total extension of water conduits, water pipes and distributing pipes runs about 610,000 kilometers, with the extension of these pipes past the statutory

Figure4-2-13 Water Purification Capacity Past Statutory Useful Life in FY 2007



Note: The total water-purifying capacity stands at some 88 million cubic meters per day, with the water-purifying capacity of facilities past the statutory useful life standing at some 2.4 million cubic meters per day, or about 2.7% of the total
Source: Health, Labour and Welfare Ministry, "Water Works Statistics"

Figure4-2-12 Extension of Sewage Pipe Lines by FY (Nationwide)



Source: Sewerage and Wastewater Management Department, City and Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

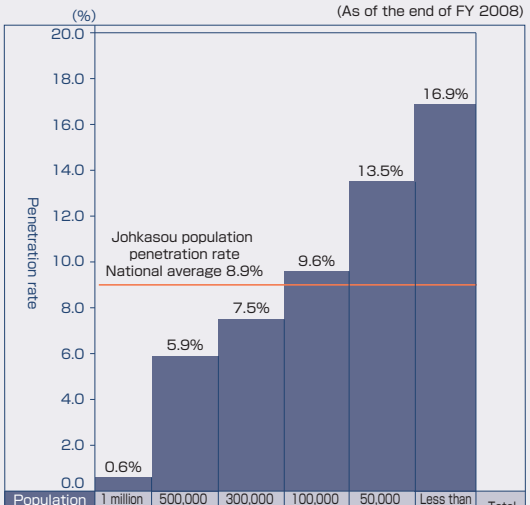
useful life coming to about 38,000 kilometers, or some 6.3% of the total extension.

b) Spread of Johkasou

The Water Quality Pollution Control Act provides for the promotion of measures to treat domestic sewage as well as for regulations on waste water discharges from factories and business offices and underground permeation.

In Japan, particularly in intermediate and mountainous areas, the declining population density stemming from the decreasing population and the progressing aging of residents led to drops in the diffusion ratio of sewage system treatment population particularly in municipalities with the population of less than 50,000, underscoring the widening problem of domestic sewage treatment. Under these circumstances, Johkasou are spreading. Johkasou, individual waste water treatment facilities can treat wastewater efficiently even in areas with small populations. As they are compact, it is easier to install them. Because of these advantages, Johkasou are now being introduced into intermediate and mountainous areas as an important means of treating domestic sewage (Figure 4-2-14). The transfer and spread of this technology to developing countries, which often cannot afford to introduce expensive, large-scale water treatment equipment, while ensuring the protection of intellectual property rights, can be one of forms of Japan's visible international contributions.

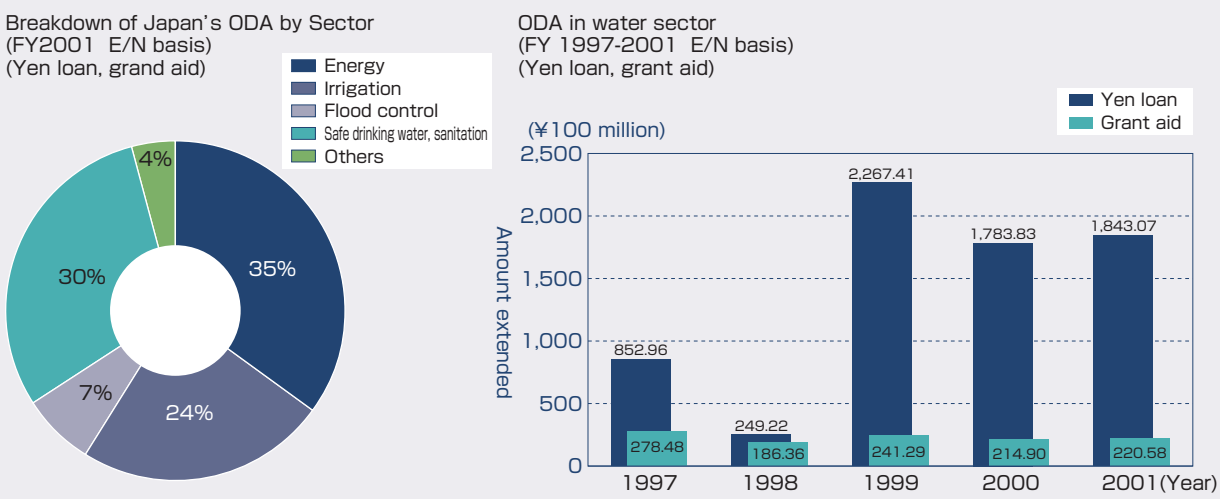
Figure4-2-14 Penetration Rate of Johkasou by city size



Population size	1 million or more	500,000 to 1 million	300,000 to 500,000	100,000 to 300,000	50,000 to 100,000	Less than 50,000	Total
Total population (10,000)	2,766	1,040	1,776	3,048	1,892	2,185	12,708
Composition ratio	21.8%	8.2%	14.0%	24.0%	14.9%	17.2%	100%
Penetration population (10,000)	15	61	132	293	256	370	1,127
Penetration rate	0.6%	5.9%	7.5%	9.6%	13.5%	16.9%	8.9%
Number of municipalities	12	15	46	190	271	1,244	1,778
Composition ratio	0.7%	0.8%	2.6%	10.7%	15.2%	70.0%	100%

Note 1: The total number of municipalities of 1,778 is broken down into 784 cities, 802 towns and 194 villages (wards in Tokyo are included in cities)
2: The total population and penetration population may not add up due to rounding
Source: Ministry of the Environment

Figure4-2-15 Breakdown of Japan's ODA by Purpose



Source: Japan's ODA on Water – Japan's Contributions to the Resolution of Water Issues (Ministry of Foreign Affairs brochure)

(2) Organizations, partnerships and measures to tackle water problems

a) Japanese organizations and measures involved with water problems

As water problems involve policy measures in a variety of fields, the Japanese government organizes a liaison conference among ministries and agencies involved in water problems, bringing together the Cabinet secretariat, one office and 12 ministries and agencies for better policy coordination through exchanges of information and views on water problems at home and overseas. Japan also provides much international support in water and sanitation fields through official development assistance (ODA) (Figure 4-2-15). Aside from the quantity side of Japanese ODA in these fields, which accounts for about 40% of global assistance, the ratio of untied aid is very high, demonstrating the fair and exemplary nature of Japanese assistance.

b) Task Force on Water Environment Strategies

In January 2010, the Ministry of the Environment established Task Force on Water Environment Strategies, chaired by Parliamentary Secretary of the Environment Nobumori Otani. The taskforce is investigating into policy issues for the conservation of the aquatic environment and also discussing not only domestic administrative issues but also ways of internationally contributing to solving global water problems. Regarding international contributions as of urgency, the taskforce is considering Japan's support for Asia and Africa facing serious water shortages in such areas as water quality purification and sanitation measures.

c) Water Environment Partnership in Asia

As an initiative proposed by the Ministry of the Environment at the 3rd World Water Forum held in 2003, under the partnership among 11 countries in East Asia, we are providing support for relevant countries in their policy implementation by carrying out construction of information database, information sharing among stakeholders, and human resources development and capacity building in an integrated manner for the purpose of strengthening environmental governance in the region.

The WEPA (Water Environment Partnership in Asia) database Japan provides consists of four databases on "policy information," "water environment conservation technology," "information on NGO and CBO activities" and "information on information sources," offering basic background information for policy development and implementation.

d) Japan-China water environment partnership

In April 2007, Japan signed the "Joint Statement by Japan and the People's Republic of China on the Further Enhancement of Cooperation for Environmental Protection" with China, where water contamination has become a problem of urgency. The statement, on the first area of bilateral cooperation, says, "Cooperation will be implemented … in particular water pollution prevention measures in vital waters …" In May 2010, the two countries concluded the "memorandum of understanding on the implementation of cooperation in the model project for decentralized wastewater treatment in rural areas, etc.," which called for efforts for the penetration of compact wastewater treatment systems suited to local conditions in each of decentralized rural communities. Under these agreements, the Chinese government is pushing ahead with efforts to spread wastewater treatment systems to rural villages. Japan is cooperating with China in holding seminars and policy dialogue, making demonstrative research on wastewater treatment technology through model projects, evaluation and analysis of outcome, and considering management guidelines and measures to spread these systems.

Column Restoration of Riparian Areas by *"Fuyu Mizu Tanbo"*

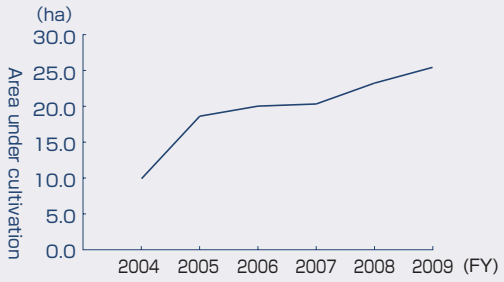
Around Izunuma and Uchinuma straddling Tome City and Kurihara City in the north of Miyagi Prefecture and also Kabukurinuma in Osaki City of the same prefecture, all registered wetlands under the Ramsar Convention, rice paddies after harvesting are flooded with water during winter. These paddies are called "*fuyu mizu tanbo*," literally rice fields covered with water throughout winder.

The "*fuyu mizu tanbo*" rice-growing method is practiced across Japan, though on a limited scale, as an environment-friendly method as it does not use agricultural chemicals or other chemical substances.

Come spring, rice farmers can plant seedling without tilling as required in the conventional way of rice growing. Keeping rice paddies flooded during winter precludes the need to take in large quantities of water right before planting, thus avoiding concentrated water intake in a short span of time and promoting effective utilization of water resources.

These wetlands are wintering places for migratory waterfowls. Rice paddies flooded with water during winter offer good roosts for these birds, and they in turn play an important role in promoting biodiversity of rice paddies as their dung encourages propagation of microorganisms.

"Fuyu Mizu Tanbo" Area under Cultivation in Tajiri, Osaki City (Formerly Tajiri Town)



Source: Industry Promotion Section, Tajiri General Branch, Osaki City

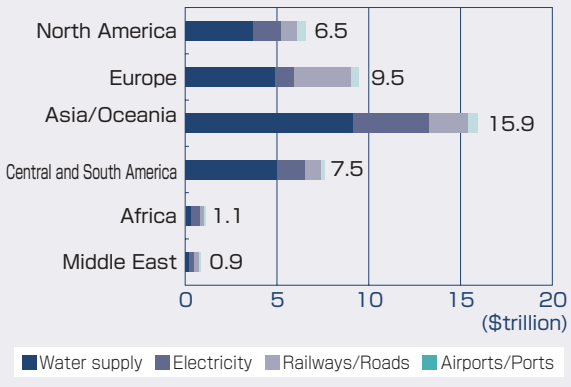
Rice fields adopting the "*fuyu mizu tanbo*" method are expanding, particularly around Kabukurinuma. This is not an easy way of growing rice, but expanding acreage evidently show rice farmers' endeavors to coexist with nature.

Section 3 International Contribution and Water Business

1 State of Global Water Business

The world water business market is estimated to grow to ¥100 trillion by 2025, with $22.6 trillion of investment in water-related infrastructure expected between 2005 and 2030, according to the Council on Competitiveness-Nippon (COCN) (Figure 4-3-1). While the market for the supply of membrane materials, an area Japan excels in, is only about ¥1 trillion, and the market for water purification systems, including membrane engineering, procurement and construction, is just about ¥10 trillion, the dominant area of the global water business market is management, such as facility management and operations for water intake, raw water transmission, water purification and water distribution. Japan has excellent technologies, but there are only a modest number of examples of Japanese entities moving into the water management market. Given successes of European and Asian companies in this market, it is desired that Japanese firms will also enter this vast and promising market aggressively. Japan has excellent technologies that contribute to environmental conservation and effective utilization of resources, including wastewater treatment and leakage prevention technologies. It is necessary for Japan to promote efforts in the water business market going forward through deeper cooperation among the industry, academic and public sectors.

Figure4-3-1 Projected Infrastructure Investment by Region (2005～2030)



Source: Morgan Stanley Flash Report (February 2009)

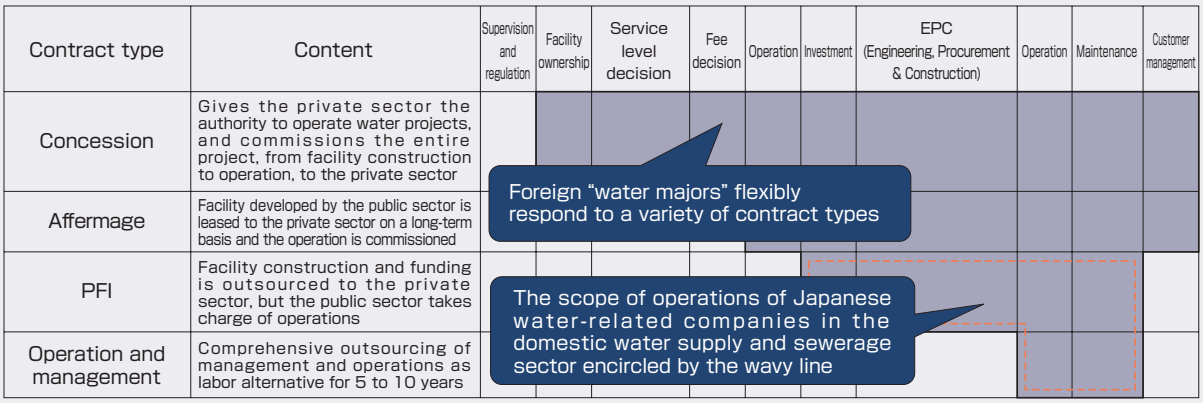
Table4-3-1 ODA Disbursements for Water Supply and Sanitation Sectors

Disbursements by aid type (¥100 million)

FY	Grant aid	Yen loan	Technical cooperation		Contributions to multilateral institutions	Total
			Provided by JICA	Provided by other ministries		
2003	187.67 (22.7)	1,956.52 (35.1)	11.56 (0.8)	– (–)	– (–)	2,155.75 (27.6)
2004	200.62 (24.3)	2,040.48 (31.2)	10.10 (0.7)	– (–)	– (–)	2,251.20 (25.5)
2005	235.16 (29.2)	1,783.37 (31.5)	12.40 (0.8)	– (–)	– (–)	2,030.93 (27.6)
2006	216.04 (12.1)	3,385.17 (40.1)	8.95 (0.1)	– (–)	– (–)	3,610.16 (30.8)
2007	245.56 (6.9)	2,542.61 (26.9)	7.82 (0.3)	6.74	32.58 (3.7)	2,835.32 (20.7)

Note 1: Grant aid and yen loans are on an exchange of note basis. Technical cooperation covers the acceptance of trainees, sending of experts and provision of equipment, on the basis of actual expenses of JICA.
2: Figures in parentheses other than those in the total column indicate the ratio (%) to the sum of ODA by each type of aid.
3: Figures in parentheses in the total column indicate the ratio (%) to the cumulative total of all types of aid.
4: Figures for grant aid are for disbursements of non-project grand aid from FY2003 through FY2006 and for disbursements of project-type grant in FY2007 aid (non-project grant aid, grant aid to support community development, grant aid for security, such as antiterrorism, grant aid for disaster prevention and support for disaster-hit areas, grant aid for fisheries and grant aid for research support).
Source: Ministry of Foreign Affairs, "Japan's ODA White Paper 2008 Statistics and Reference Materials"

Figure4-3-2 Contract Type and Responsibilities of the Private Sector for Water Supply and Sewerage Projects in the Global Water Business Market



Source: Prepared by Ministry of the Environment based on the Council on Competitiveness-Nippon (COCN), "Project Report on Technologies for Water Treatment and the Effective Use of Water Resources"

2 What Japan Can Do for the World

Compared with countries in the world constantly feeling water stress, we in Japan are given to losing a sense of crisis over water as we have relatively free access to water in our daily livelihood. However, as discussed in subsection 4 of Section 1, we should not forget the fact that our social and economic activities depend on the rest of the world for water almost in the same quantity of water we consumer at home. We must recognize that Japan's active international contributions to other countries in the world are essential in terms of the stable supply of water and lead to the protection of our daily livelihood.

What, then, can Japan do by way of contributing to other countries in the world? Japan suffered from serious pollution in the past. Knowledge and technologies we have accumulated in the process of overcoming pollution problems one by one cannot be matched anywhere in the world, and the wealth of these experiences should prove massively helpful in the transfer of technologies to and human resources development in developing countries. Public-private cooperative efforts to utilize Japan's excellent technologies and experiences also can be expected to greatly help expand business opportunities. Until now, Japan has been helping countries with which it has close relations through ODA-based infrastructure projects undertaken by Japanese water supply corporations and the waterworks industry (Table 4-3-1). From now on, Japan should make further international contributions beyond the ODA framework, with Japanese water supply-related companies sharpening their international competitiveness and expanding their overseas businesses.

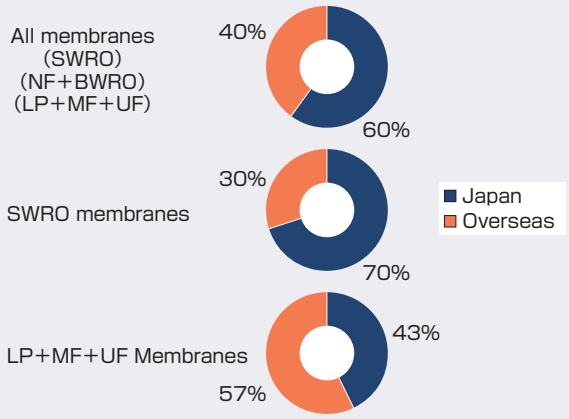
Developing countries where water-related infrastructure is under development have strong needs for post-construction maintenance and sound management services. However, since Japan's water services have long been undertaken mainly by publicly-operated corporations, private-sector companies, despite their strength in element technologies such as facility design and construction, have only limited experiences in integrated maintenance, management and operations of water facilities and are often disqualified in competitive international tenders. In fact, in water infrastructure projects funded with Japan's ODA, European and U.S. companies come in at the stage of commissioning private-sector entities for maintenance, management and operations of water supply facilities. Japanese companies cannot immediately respond to these developments in recent years (Figure 4-3-2).

In order to bring Japan's advanced technologies and knowhow to the world, it is necessary to transfer operation and maintenance knowhow accumulated by municipalities that have undertaken water supply services to private-sector companies. To do this, joint initiatives between the public and private sectors are essential.

3 Japan's Technological Prowess

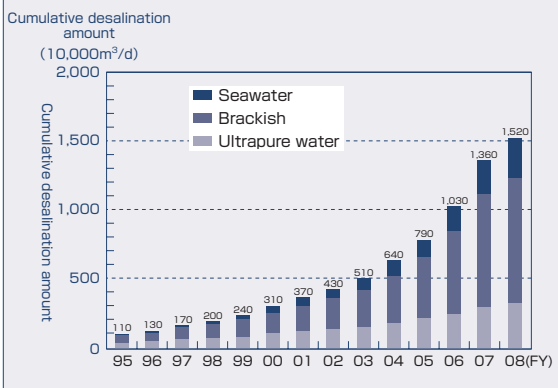
In some Asian cities, for example, large amounts of sewage sludge or food waste and other wastes are disposed by landfill without incineration, giving rise to sanitation problems. As they are sources of methane gas, projects to reduce sludge and wastes, recycle them and collect methane gas for reducing carbon dioxide emissions can earn emissions credits under the Clean Development Mechanism (CDM) of the Kyoto Protocol. Japan has the advanced bio-recycling technology that covers from water treatment to energy collection. The business model for constructing and operating a string of facilities for adequate water treatment, biomass recycling and biomass power generation can be expected to grow going forward (Figure 4-3-8). Japan ranks the world's top-tier league in water treatment technology. In particular, Japanese membrane technology for seawater desalination commands a large share of about 70 % in the world (Figure 4-3-3).

Figure4-3-3 Japanese Membrane Manufacturers' Share in the Supply of Membranes for Water Treatment



Note: Japan includes Japanese companies' group firms operating overseas.
Survey method: data provided by membrane suppliers (14 companies cooperation with the Association of Membrane Separation Technology of Japan) plus publicized materials (IDA Inventory Report 2006)
Source: Association of Membrane Separation Technology of Japan (2007)

Figure4-3-4 Trends in Membrane Shipments



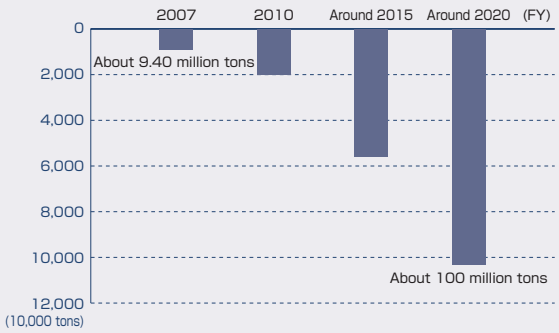
Source: Toray Industries, Inc.

Reverse osmosis (RO) membranes by a Japanese manufacturer have been adopted at a total of 100 plants in 26 countries/areas in the world by March 2009, and the combined desalination capacity of facilities using its RO membranes exceeds 15 million cubic meters a day (equivalent to the quantity of domestic water consumed by over 60 million people) (Figure 4-3-4). The manufacturer estimates that the desalination process using RO membranes consumes less than one-fifth of heat, power and other energy required by the conventional evaporation method. Assuming that the use of RO membranes spreads at the same rate as in the five years from 2010, desalination using RO membranes are estimated to reduce carbon dioxide emissions by some 100 million tons by around 2020 (Figure 4-3-5).

As a result of continued efforts to develop the RO membrane technology, energy consumption in the desalination process was reduced to about one-sixth, to less than the cost of the evaporation method. Thus, the RO membrane technology is expected to produce the co-benefit of water quality improvement and emissions reduction as a measure to cope with global warming (Figure 4-3-6).

Japan also has a broad range of technologies that can greatly contribute to water infrastructure development in the world, including the heat pump technology that focuses on the thermal potential of groundwater and Johkasou technology quite useful in wastewater treatment. The heat pump is the technology to move heat from one location at a lower temperature to another location at a higher temperature using heat media and semiconductors, etc., commonly adopted in refrigerators and air conditioners. In particular, Japanese companies excel in the heat pump technology to use groundwater, whose temperatures are stable throughout the year, as the heat source. As for Johkasou, the installation of Gappei-shori-Johkasou (which treat kitchen and toilet waste) is required when introducing flush toilets in areas

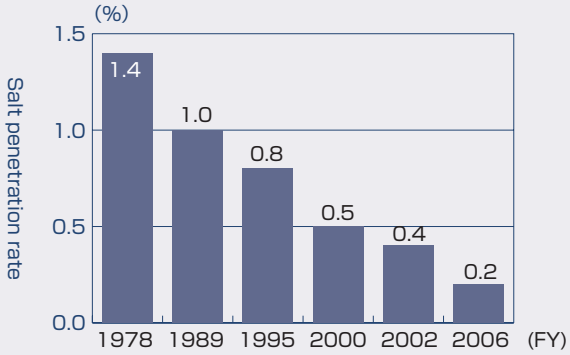
Figure4-3-5 Carbon Dioxide Emissions Reductions in Water Treatment



Source: Toray Industries, Inc.

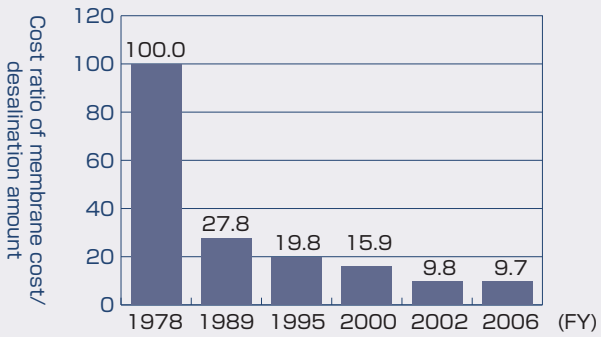
Figure4-3-6 Progress in Seawater Desalination RO Membrane and Technology and Comparison of Energy Consumption and Desalination Cost

1. Improvement of RO membrane performance (decline in the salt penetration rate)

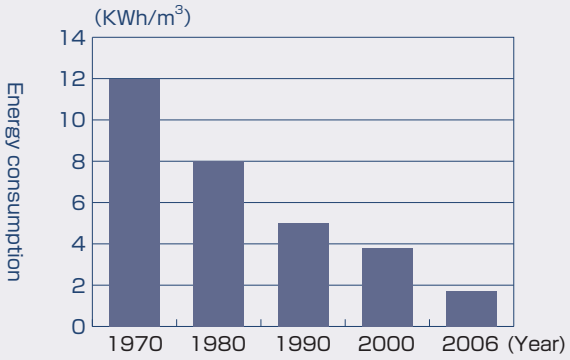


IDA news Water, 15, 9-10 (2006).

2. Improvement of RO membrane desalination performance and cost reduction by mass production

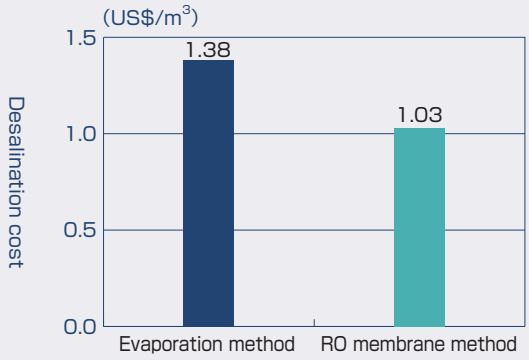


3. Reduction in energy production



D&WR, 16 (2), 10-22 (2006).

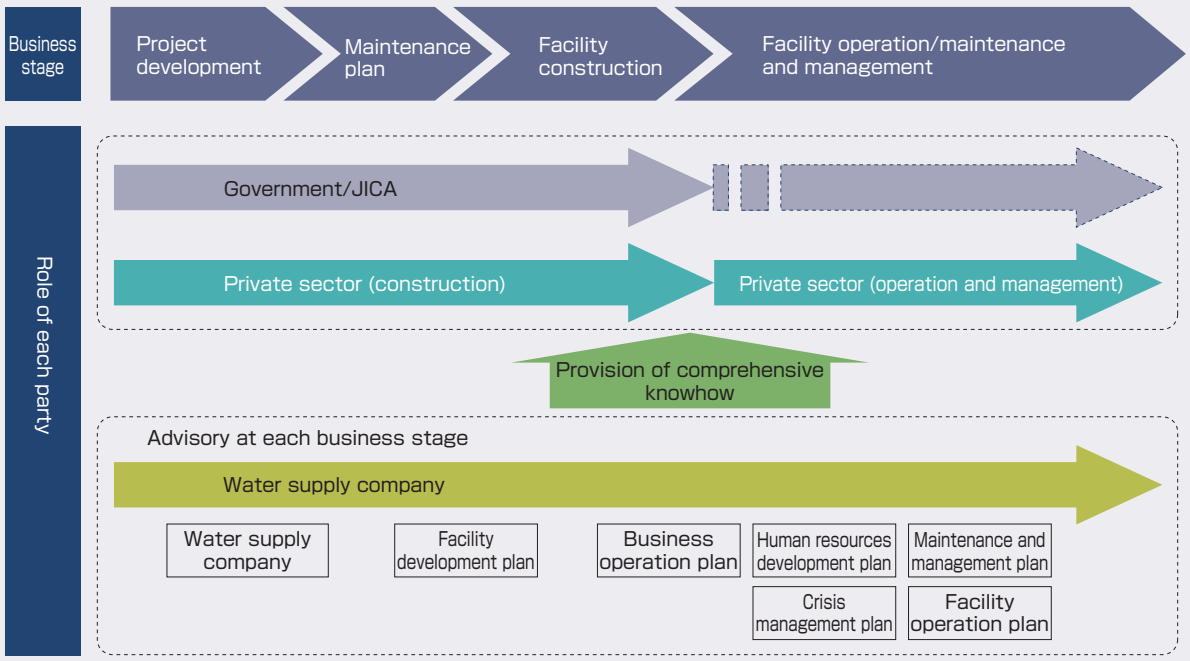
4. Comparison of desalination cost in the Middle East



Global Water Intelligence, August (2006).

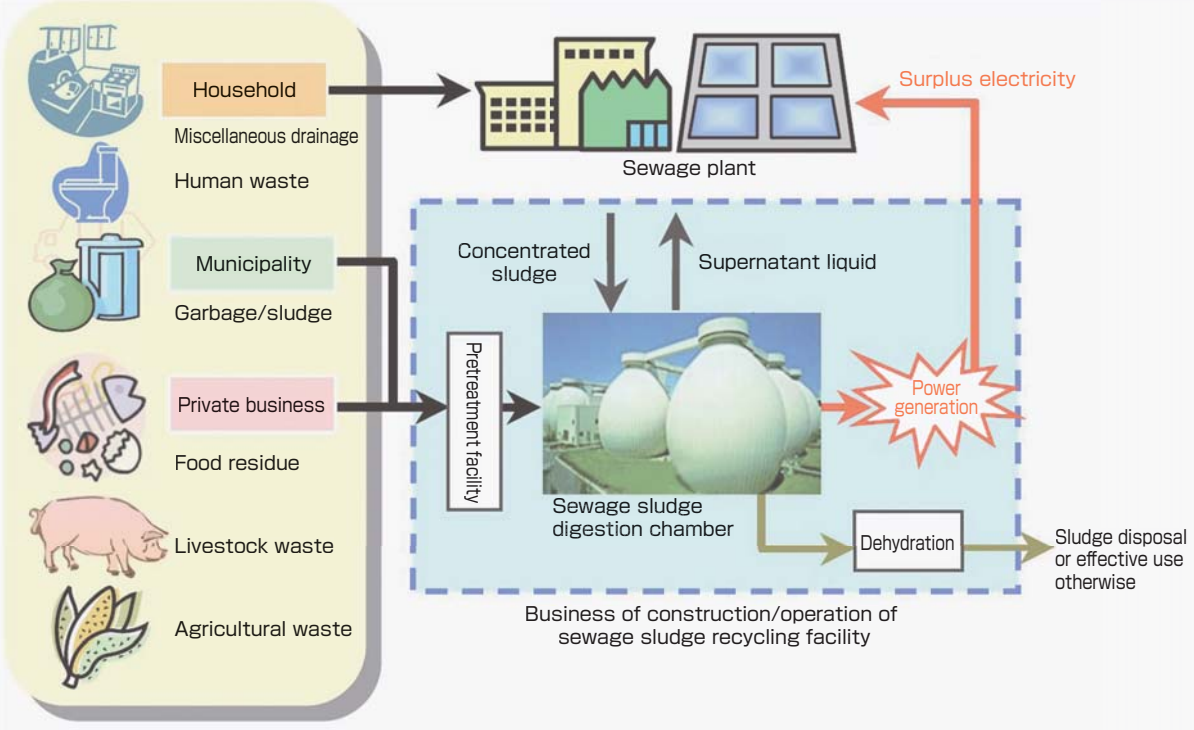
Source: Toray Industries, Inc.

Figure4-3-7 Image of International Contribution as a Water Supply Company



Source: Japan Water Works Association (JWWA), "Report by the Study Group on Security of Water Supply (March 2009)"

Figure4-3-8 Model of Construction/Operation of Sewage Sludge Recycling Facility Using CDM Project



Source: Council on Competitiveness-Nippon (COCN), "Project Report on Technologies for Water Treatment and the Effective Use of Water Resources"

Column Major Players in the Global Water Market

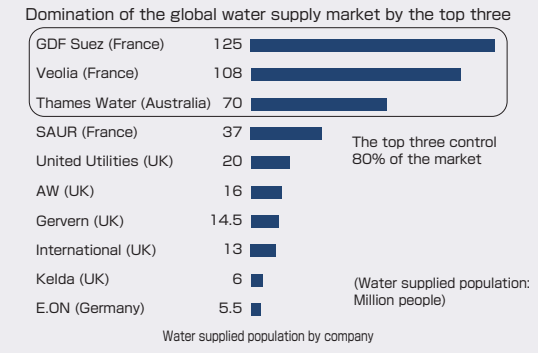
The water business market is expected to continue expanding going forward, including privatization of water supply and sewerage businesses, and maintenance and management services for existing facilities. Currently, a handful of conglomerates, called "water majors," dominate the world's privatized water supply and sewerage market.

Veolia of France is the company whose predecessor was Compagnie Generale des Eaux, founded in 1853 as a water supply firm. As of 2008, Veolia Water, the Veolia group's general water business subsidiary, provides water to 80.5 million people and operates water purification facilities at 5,176 locations.

GDF Suez, also of France, originally started water supply and sewerage services in Cannes, France, in 1880. In 1997, it merged with Compagnie financiere de Suez and changed its corporate name to Suez Environment. As of the end of 2008, the company provides water to 76 million people and operates water purification facilities at 1,746 locations.

Thames Water was born out of London's Thames waterworks department in the 1980s when the British government deregulated the water supply and sewerage market following the power and gas services. It is the giant company that single-handedly undertakes the 100% privatized water supply market in Britain.

Current State of the Global Water Supply Market



Source: Council on Competitiveness-Nippon (COCN), "Project Report on Technologies for Water Treatment and the Effective Use of Water Resources"

These three companies alone are believed to cover about 80% of the water supplied population in the world's privatized water services.

One of the reasons behind their huge market shares is said to be the support provided by their home governments. In France particularly, then President Jacques Chirac reportedly put his efforts into the French firms' advances into overseas water businesses, earning himself the nickname of "the world's top water business salesman."

without public sewerage systems, rural community sewerages, community plants or other wastewater treatment systems. The penetration rate of this Gappei-shori-Johkasou is almost 10% in Japan at present. Gappei-shori-Johkasou use microorganisms to purify sewage from homes. The importance of these Johkasou is being recognized anew from the viewpoint of protecting the natural environment as final effluent adequately treated in Gappei-shori-Johkasou can be recycled back to communities.

Despite the world-leading technologies described above, Japan has yet to enter the global water business market on a full scale. For its advances in the global market, the public and private sectors need to cooperate as mentioned in 2 above (Figure 4-3-7).

Conclusion

In Chapter 4, we discussed the role Japan should perform in conserving water resources that are limited and unevenly distributed on the earth. Compared with countries constantly in the state of water stress, Japanese people, thanks to Japan's advanced water supply technology and systems, tend to become unconscious of the preciousness of water, the resource that is directly linked to our subsistence and livelihood. But we should not forget that economic and social activities in Japan depend on the rest of the world for water in the amount equivalent to water consumed at home. In return, Japan can contribute to solving the issue of securing sanitary water around the world by appropriately taking advantage of its clean water supply and wastewater treatment technologies while paying due heed to intellectual property rights. Needless to say, water is the subject of business in the international community. Japan's position in the global water business market warrants no optimism, as competing technologies, while inferior to Japanese technologies, may be more price competitive, and Japan has only a modest track record in the market for maintaining and managing water treatment systems that is far more massive than that for element technologies where Japan particularly excels. But we see the promising spouting of seeds there. We need to push forward with the conservation of the water environment and the promotion of water businesses further with the cooperation of all parties concerned and greater support from the government.

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

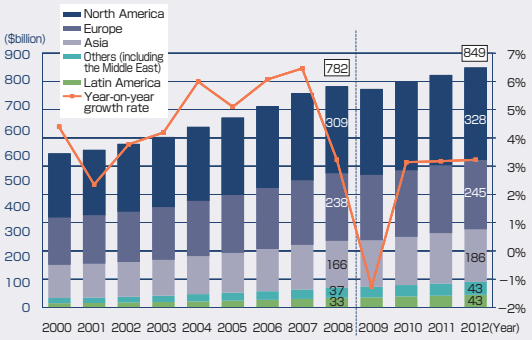
(1) The current state and outlook of the environmental industry in the world

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).

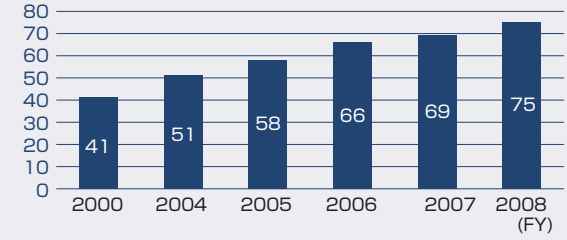
Expectations are also rising about the creation of employment in the environmental industry. The Green Jobs report estimates that green jobs in the renewable energy sector around the world, at about 2.33 million in total in 2006, will likely grow by 2030 to 2.10 million in wind power generation, to 6.30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



Note 1: Figures for 2009 are estimates.
2: Figures for 2010 onward are projections.
Source: Prepared by Ministry of the Environment based on data provided by Environmental Business International Inc. (EBI)

Figure5-1-2 Trends of the Market Size of Japan's Environmental Industry



Source: Ministry of the Environment

(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 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.

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

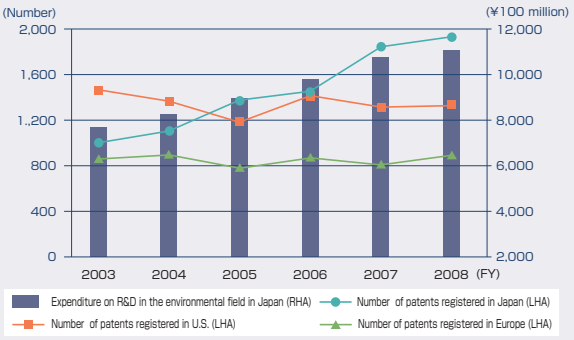
Note: 1 Job-Year means that one person is hired as an employee for a period of one year.
Source: Prepared by Ministry of the Environment based on "Green Jobs and the Clean Energy Economy" (co-authored by Ditlev Engel and Daniel M. Kammen)

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.

Figure5-1-3 Trends of the Number of Patents in the Environmental Field (Japan, U.S. and Europe) and Expenditure on R&D in the Environmental Field in Japan by Year



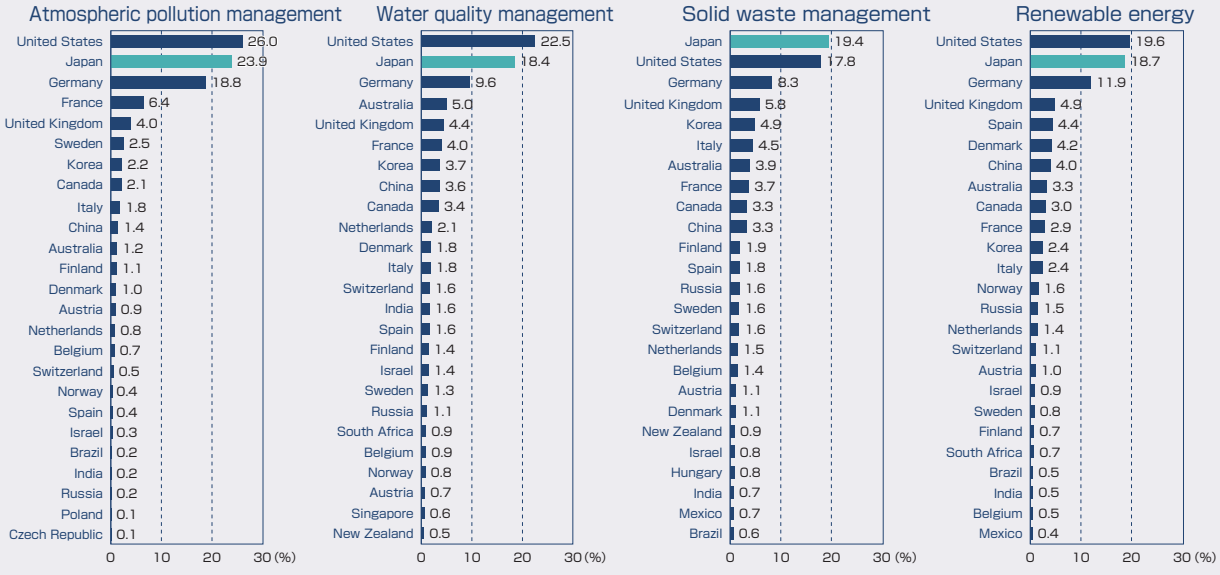
Source: Prepared by Ministry of the Environment based on "Survey of Research" of Ministry of Internal Affairs and Communications and "Development Patent Applications in Eight Key Fields" of Japan Patent Office.

(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.

Figure5-1-4 Share of Environmental Technology Patents Registered by Country



Note: Country-by-country share in patents registered in the 2004-2006 period
Source: Prepared by Ministry of the Environment based on OECD Science, Technology and Industry Scoreboard 2009

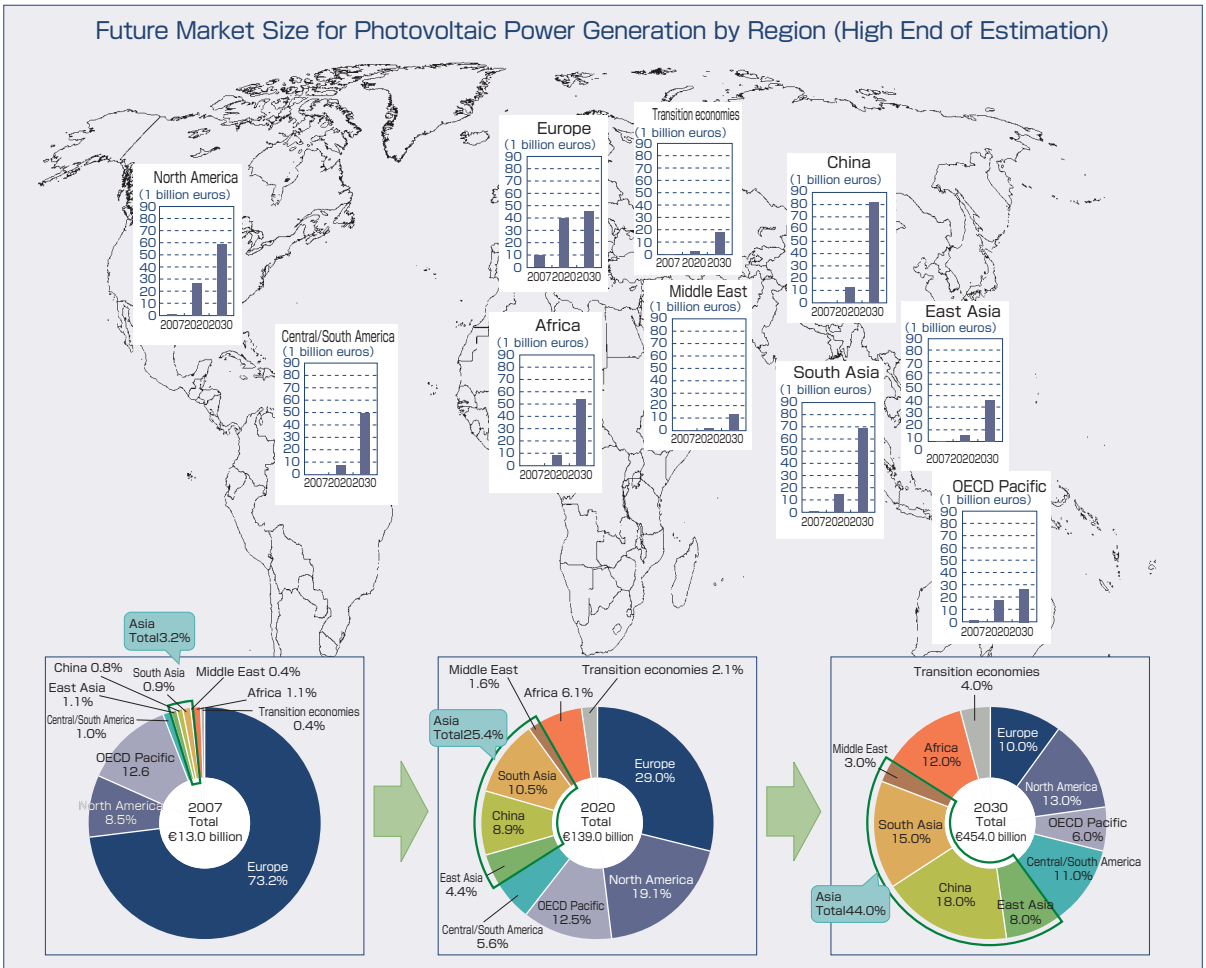
Column Potential for the Japanese Environmental Industry's Expansion in the Fast-Growing Environmental Market in Asia

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.

Future Market Size for Photovoltaic Power Generation by Region (High End of Estimation)

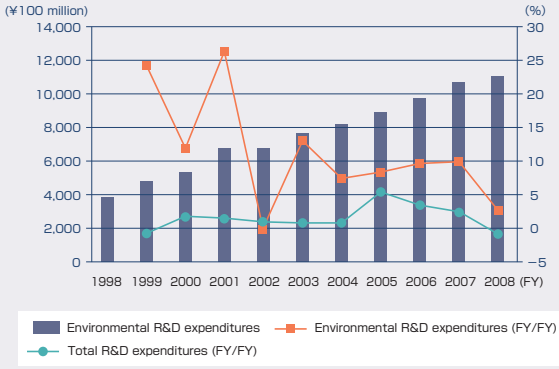


Source: Prepared by Ministry of the Environment based on Solar Generation V - 2008 (EPIA)

(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

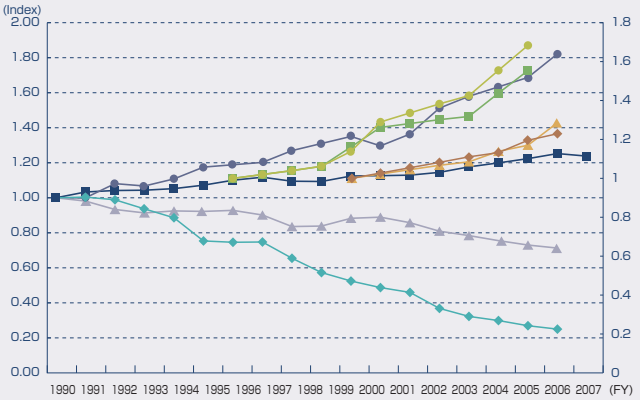
1 Expanding Sound Material-Cycle Society Businesses

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 20th century, has achieved economic growth by increased consumption of resources and intensification of environment 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.

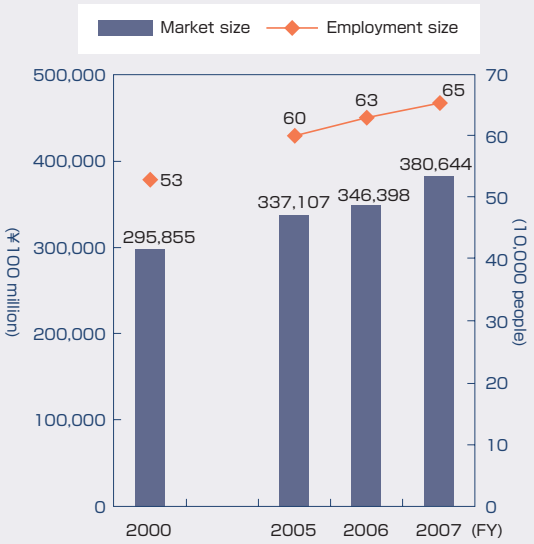
Figure 5-2-1 shows trends of Japan's gross domestic product (GDP), the input of natural resources, etc. (quantity of domestically produced and imported natural resources and imported products), the cyclical use rate and final disposal amount indicator, the market size for sound

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



- GDP growth (1990=1.00) Source: Cabinet Office, "System of National Accounts"
- Cyclical use rate increase (1990=1.00) Source: Ministry of the Environment, "Results of the Second Progress Evaluation of the Second Fundamental Plan for Establishing a Sound Material-Cycle Society"
- Increase in the input of natural resources, etc. (1990=1.00) Source: Ministry of the Environment, "Results of the Second Progress Evaluation of the Second Fundamental Plan for Establishing a Sound Material-Cycle Society"
- Increase in final disposal amount (nonindustrial waste + industrial waste) (1990=1.00) Source: Ministry of the Environment, "Results of the Second Progress Evaluation of the Second Fundamental Plan for Establishing a Sound Material-Cycle Society"
- Increase in industrial waste disposal businesses (number of businesses) (1990=1.00) Source: Statistics Bureau, Ministry of Internal Affairs and Communications, "Establishment and Enterprise Census"
- Increase in industrial state disposal businesses (number of employees) (1990=1.00) Source: Statistics Bureau, Ministry of Internal Affairs and Communications, "Establishment and Enterprise Census"
- Growth of the market size for sound material-cycle society businesses in Japan (2000=1.00) Source: Ministry of the Environment, "Results of the Second Progress Evaluation of the Second Fundamental Plan for Establishing a Sound Material-Cycle Society"
- Increase in the employment size for sound material-cycle society businesses in Japan (2000=1.00) Source: Ministry of the Environment, "Results of the Second Progress Evaluation of the Second Fundamental Plan for Establishing a Sound Material-Cycle Society"

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

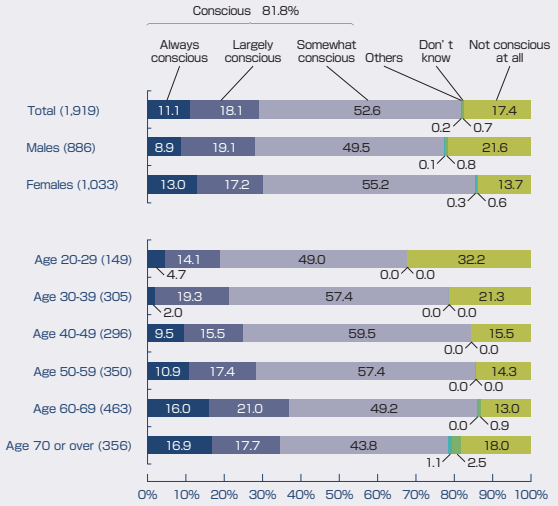


Source: Ministry of the Environment, "Concerning the Second Review of the Progress in the Second Fundamental Plan for Establishing a Sound Material-Cycle Society"

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 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.

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



Source: Cabinet Office, "FY 2009 Public Opinion Survey on Environmental Problems"

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"

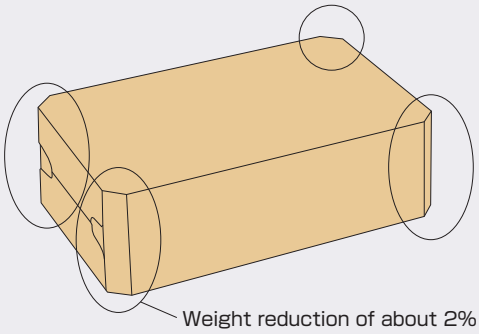
Company S offers the new "Ever Loop" system of renovating existing homes to sell as new houses, a concept that changes the conventional idea of the used house market. This is a sound material-cycle endeavor to promote the longer operating life of houses and effective use of resources by adding quakeproof 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)

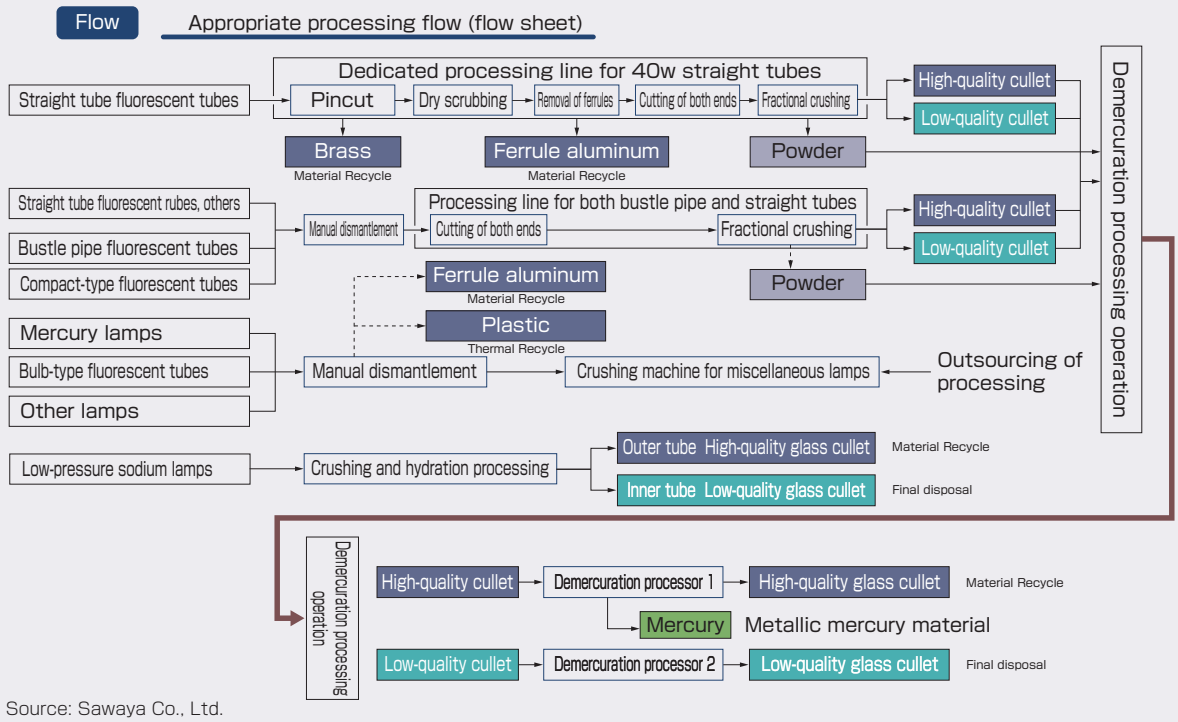
Beverage company N is selling bottled products in

Figure5-2-4 Weight Saving of Containers and Packaging



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

Figure5-2-5 Demercuration Processing of Used Fluorescent Tubes



Source: Sawaya Co., Ltd.

Figure5-2-6 Recycled glass made from used fluorescent tubes (Carafe)

Source: Shotoku Glass Co.

Figure5-2-7 Used Photovoltaic Panels for Reuse

Source: Next Energy and Resources 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)

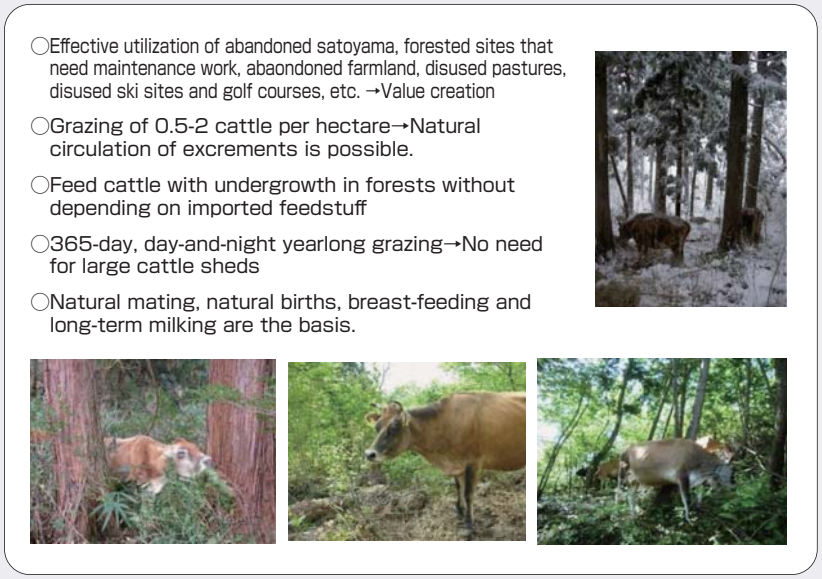
Company N in Nagano Prefecture is undertaking integrated efforts for a sound material-cycle society and low-carbon society through the reuse of used panels for photovoltaic power generation, a move in anticipation of

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?)		Factories capable of handling 20MW panels			
・Newly developed technologies Collection of Al, glass, Si and Ag				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



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)

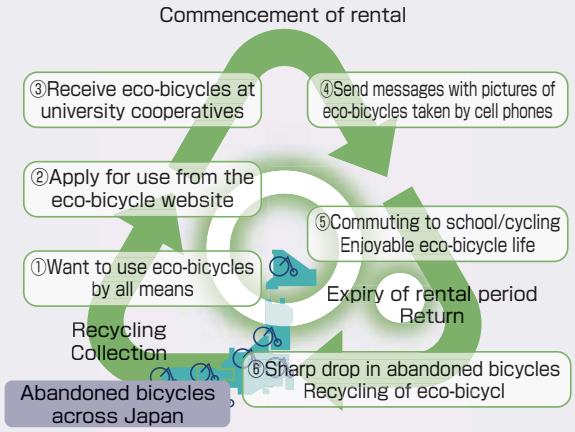
Company B is renting bicycles for students at about 120 universities across Japan by repairing bicycles abandoned at universities and commercial facilities to make them reusable. This can be described as an endeavor to blend efforts toward building a sound material-cycle society with measures to deal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

Figure5-2-10 Case of Bicycle Rental and Measures to Cope with Abandoned Bicycles



Source: Bike Off Corporation

Figure5-2-11 Wooden Guardrails

Shimosuwa Town
Yashima Kogen parking lot

Iida City
Chiyo

Source: Nagano Prefecture

Figure5-2-12 Effective Utilization of Circulative Resources from Local Special Products

Source: Sanyo Marunaka Co., Ltd.

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.

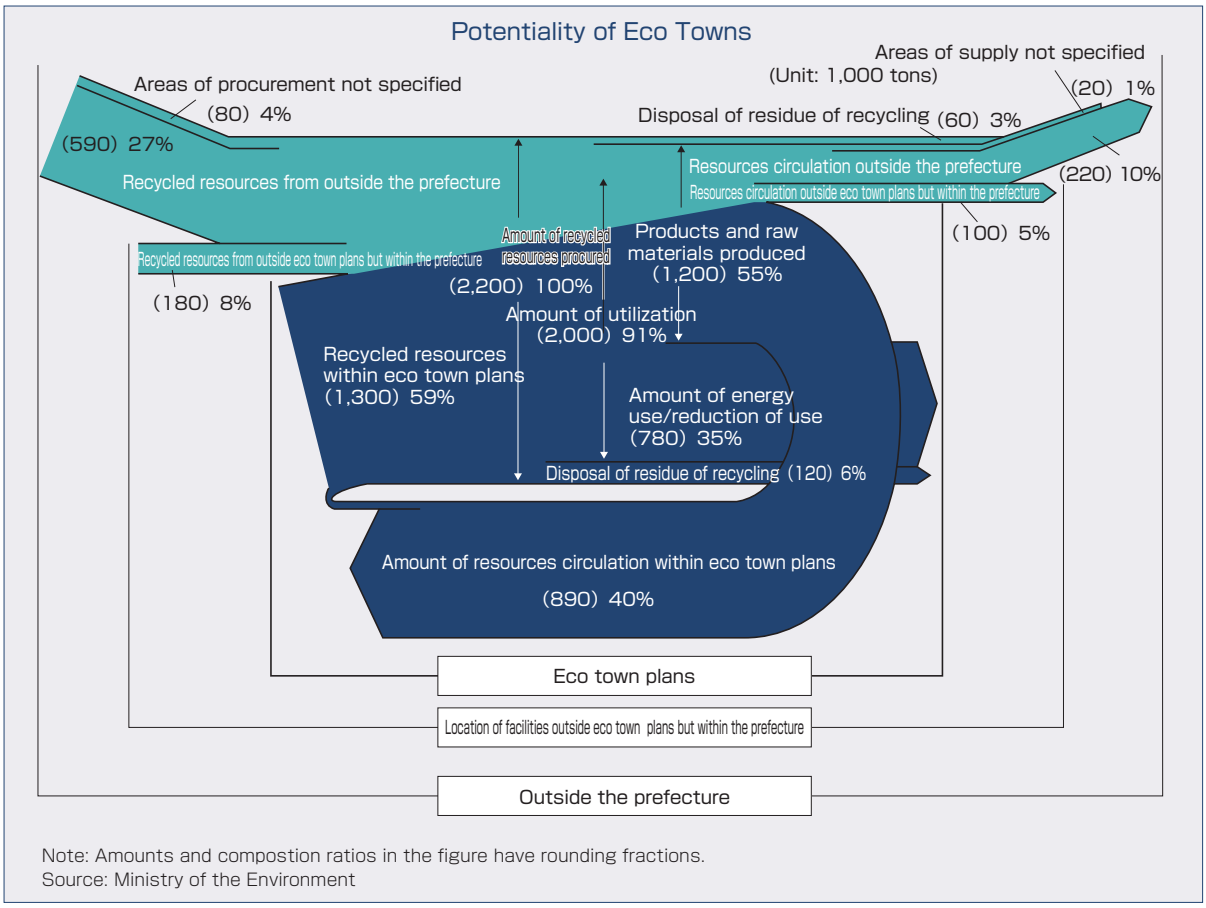
As seen in various examples described above, sound material-cycle society businesses are starting up in various forms and scale across Japan. Investment in sound material-cycle society businesses can help reduce the use of resources and waste discharges as well as costs, and also create new demand. Making 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.



Note: Amounts and compostion ratios in the figure have rounding fractions.
Source: Ministry of the Environment

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.

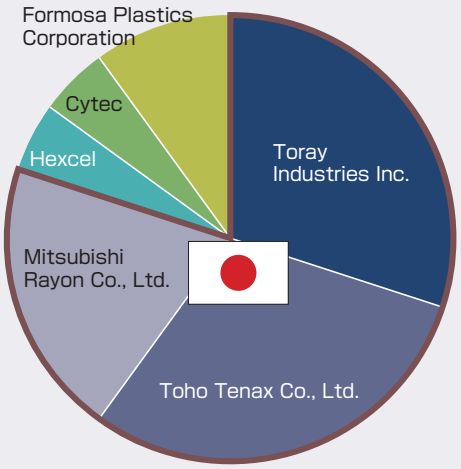
In this section, we introduce environmental technologies and services with the potential to alter the socioeconomic society like the smart grid, and give a broad overview of the current situation and future prospects of efforts to financially support the environmental industry and greening of economic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

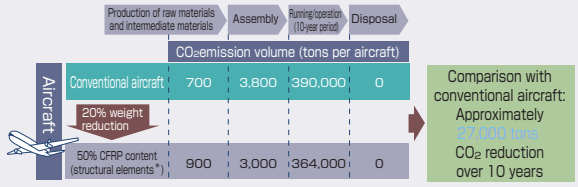
Figure5-3-1 Japanese Makers' Shares of the High-Performance Carbon Fiber Market



Japanese makers: Combined share of 80%

Source: Council for Science and Technology Policy (80th)

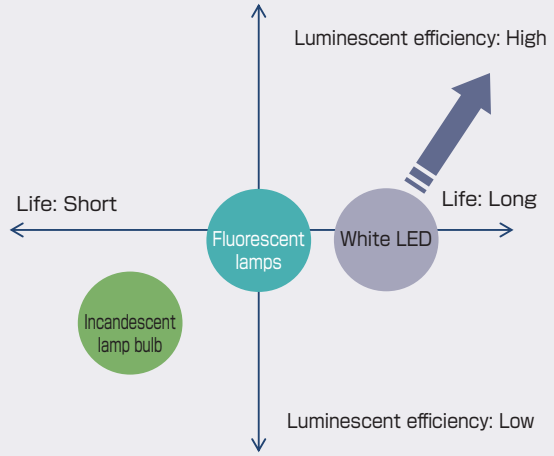
Figure5-3-2 CO_2 Reduction through CFRP Use (LCA) [Japan Carbon Fiber Manufacturers Association modeling]



*Structural elements exclude engines and interior trims

Source: Toray Industries, Inc., "CSR Report 2009"

Figure5-3-3 White LED Positioning Image



Source: Prepared by Ministry of the Environment based on Green IT Promotion Council, "Research Report on Energy-saving Technology Development Roadmap for IT and Electronics Equipment" (May 2009)

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

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 (CO2 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

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

Ohisama Power Station (Kanae Mitsuba Nursery in Iida City)

Photo: NPO Minamishinshu Ohisama-Shinpo

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

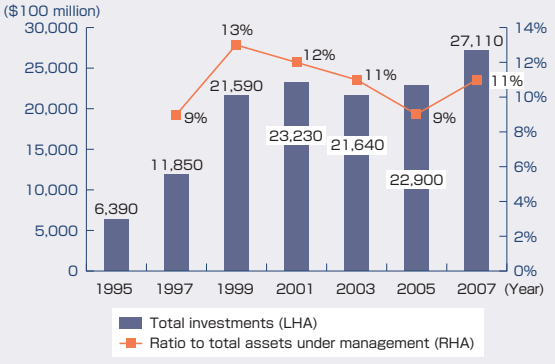
Investment to be made in consideration of efforts on the environment in addition to investment criteria such as corporate profitability and growth potential is called socially responsible investment (SRI). The balance of SRI-based investment is on the increase globally.

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).

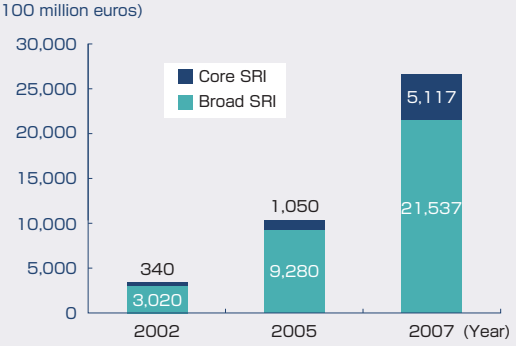
The number of funds making SRI investment is increasing, standing at 83 as of September 2009. The balance of net SRI investment assets in 2009 declined sharply from the previous year due to the global slowdown of economic activities, but the balance of such assets is basically on the increase since 2003 (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

Figure5-3-4 Balance of SRI-based Investment Assets under Management in U.S.



Source: Prepared by Ministry of the Environment based on Eurosif, "European SRI Study 2008"

Figure5-3-5 Trends of the Market Size for SRI in Europe

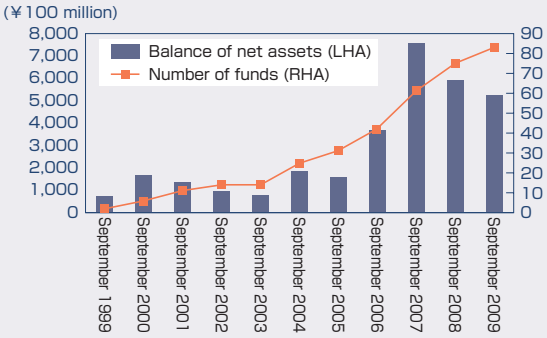


Note 1: Core SRI is composed of the following strategies:
- Ethical exclusions (three or more negative criteria applied);
- Positive screening, including Best-in-Class and SRI Theme Funds;
- Combination of ethical exclusion and positive screening.

2: Broad SRI is composed of the following strategies:
- Simple screening, including norms-based screening (up to two negative criteria),
- Engagement,
- Integration (strategy to include environmental, social and corporate governance (ESG) risks into traditional financial analysis)

Source: Prepared by Ministry of the Environment based on Eurosif, "European SRI Study 2008"

Figure5-3-6 Trends of Net Assets of Publicly-Offered SRI Investment Trust Funds and Number of Funds in Japan



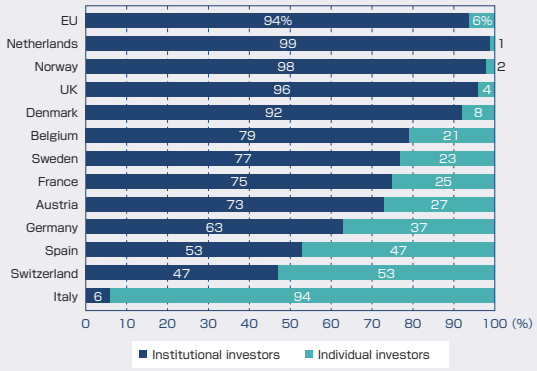
Source: Prepared by Ministry of the Environment based on NPO Social Investment Forum Japan (SIF-Japan), "2008 Review of Socially Responsible Investment Japan"

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

Figure5-3-7 Core SRI Investment Ratios of Institutional and Individual Investors in EU Member States



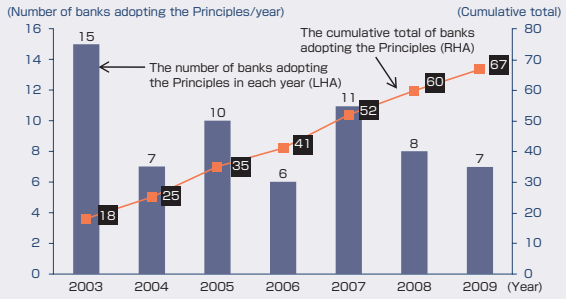
Source: Eurosif, "European SRI Study 2008"

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.

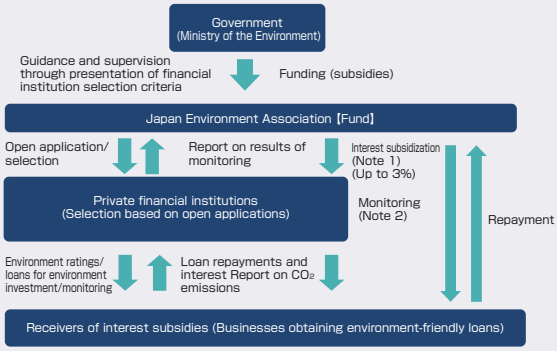
Financial institutions adopting the Equator Principles classify projects they are financing into the three categories of A (projects with potential significant adverse social or environmental impacts), B (projects with potential limited adverse social or environmental impacts) and C (projects with minimal 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

Figure5-3-8 Trends of the Number of Financial Institutions Adopting the Equator Principles



Source: Prepared by Ministry of the Environment based on The Equator Principles website (http://www.equator-principles.com/)

Figure5-3-9 No-Interest Loan System for Special Support for the Kyoto Protocol Target Achievement



Note 1: Borrower companies entrust financial institutions with all procedures for the delivery of interest subsidies, including proxy application and receipt.
2: Examine monitoring results from financial institutions and implement subsidization appropriately.
Source: Ministry of the Environment

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

A Scene of Financial Institution Employees Participating in Volunteer Activities

Source: HSBC Holdings plc, "HSBC Community Activities"

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).

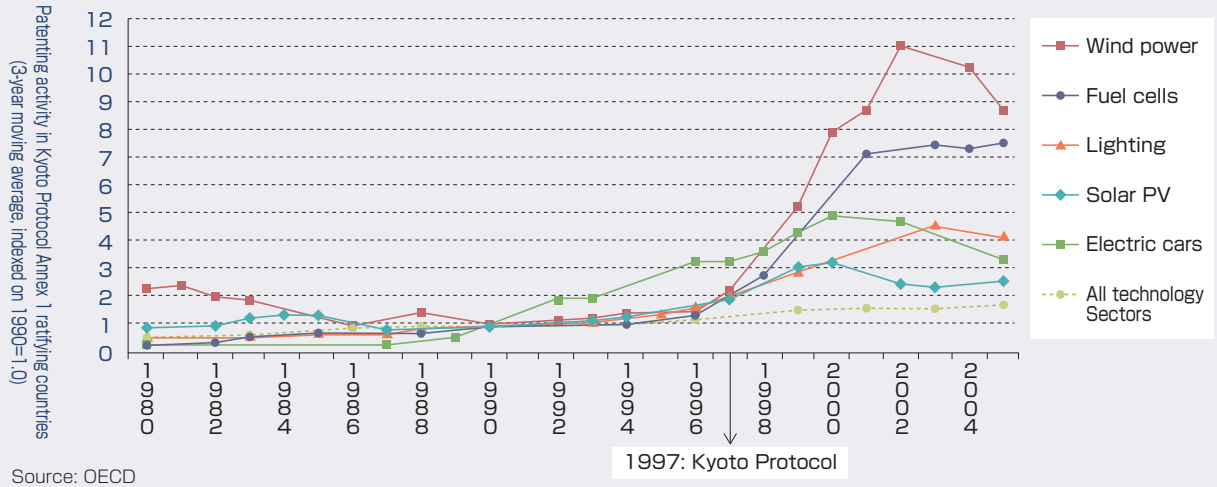
For this reason, in considering environment policy, it is necessary to make a detailed analysis of the mechanisms of how environment policy influences environmental management of companies, through what generation process innovation is created, and what roles (stakeholders), including financial institutions 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.

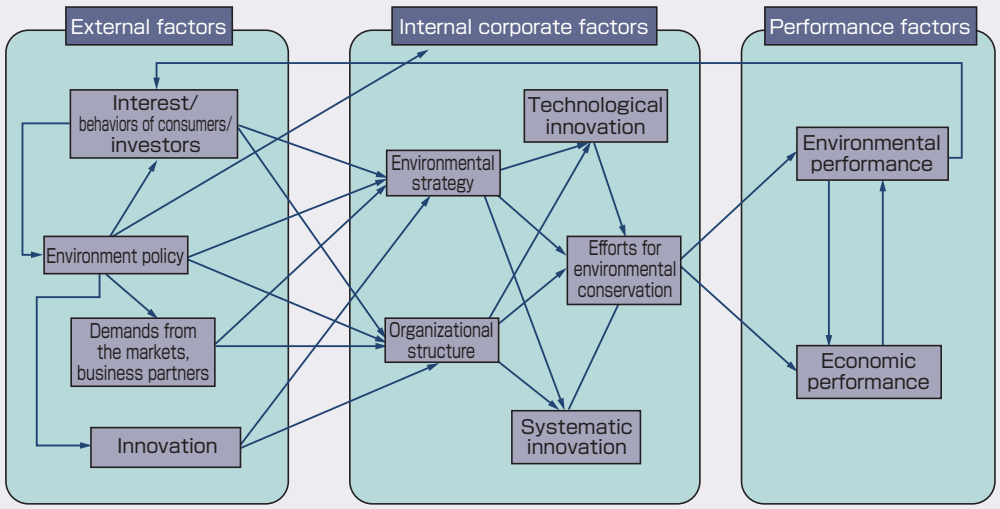
There are barriers in the process of creating innovation: "Devil River" that arises from the difference in the direction of vectors between academic research conducted out of academic curiosity and technological development for commercialization; "Death Valley" that stems from the lack of support in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

Figure5-4-1 Innovation Trend in Climate Mitigation Technologies



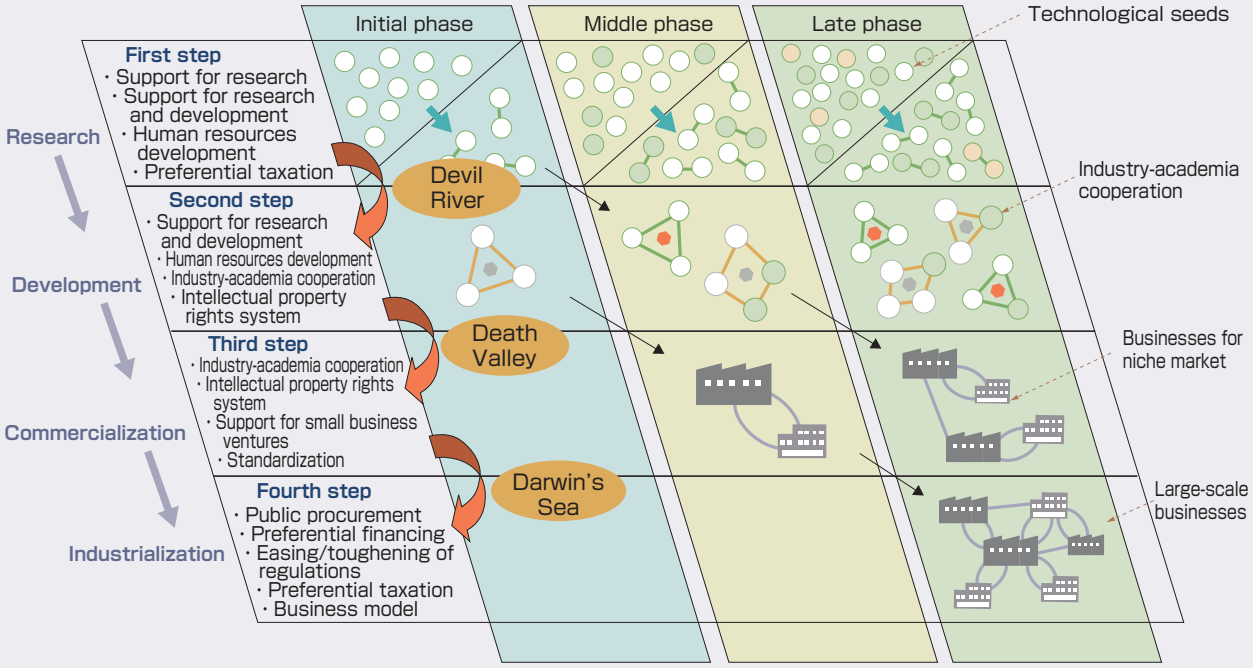
Source: OECD

Figure5-4-2 Impact of Environment Policy on Environmental Corporate Management



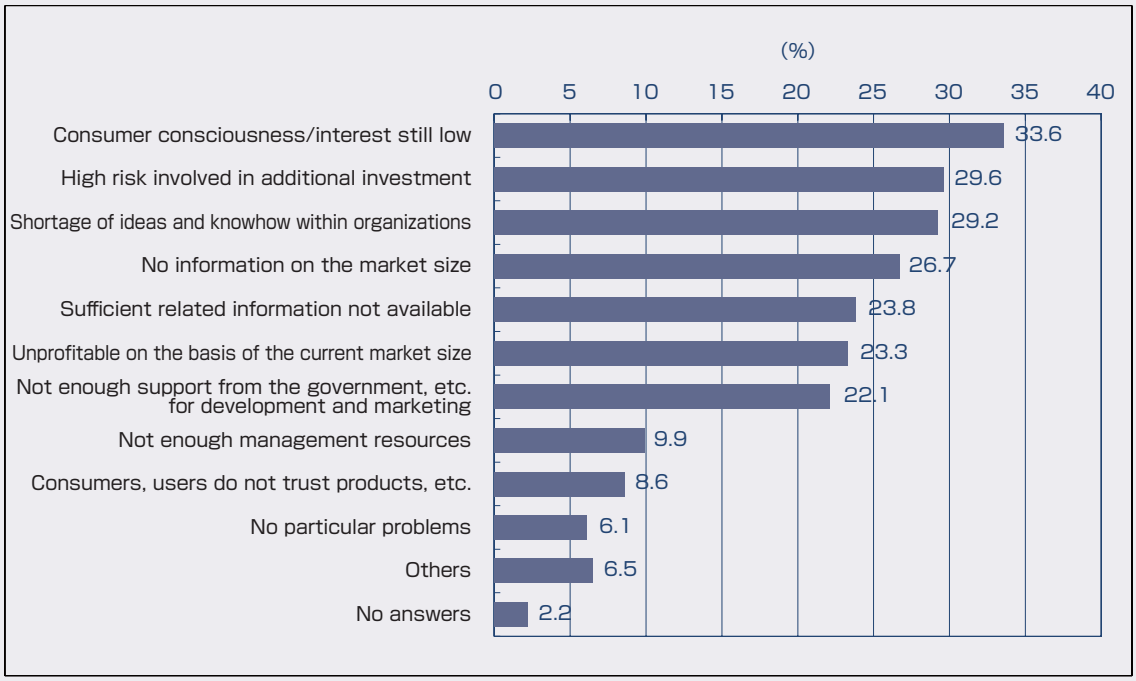
Source: Ministry of the Environment, "Policy Study on Environmental Economics" (Professor Shinji Kanko of Hiroshima University Graduate School, etc.)

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



Source: Prepared by Ministry of the Environment based on Mizuho Information & Research Institute, Inc., "FY 2006 Research on the Exit Side of Innovation"

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

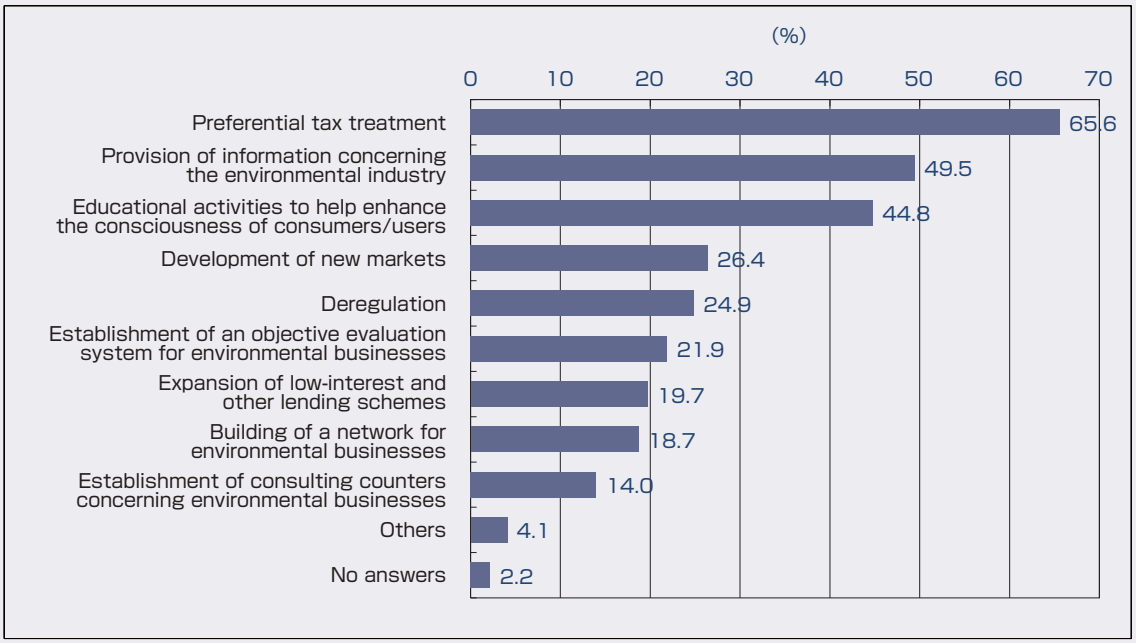


Source: Ministry of the Environment, "FY 2008 Survey on Environmentally Friendly Corporate Behaviors"

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

Figure5-4-5 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 174th 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

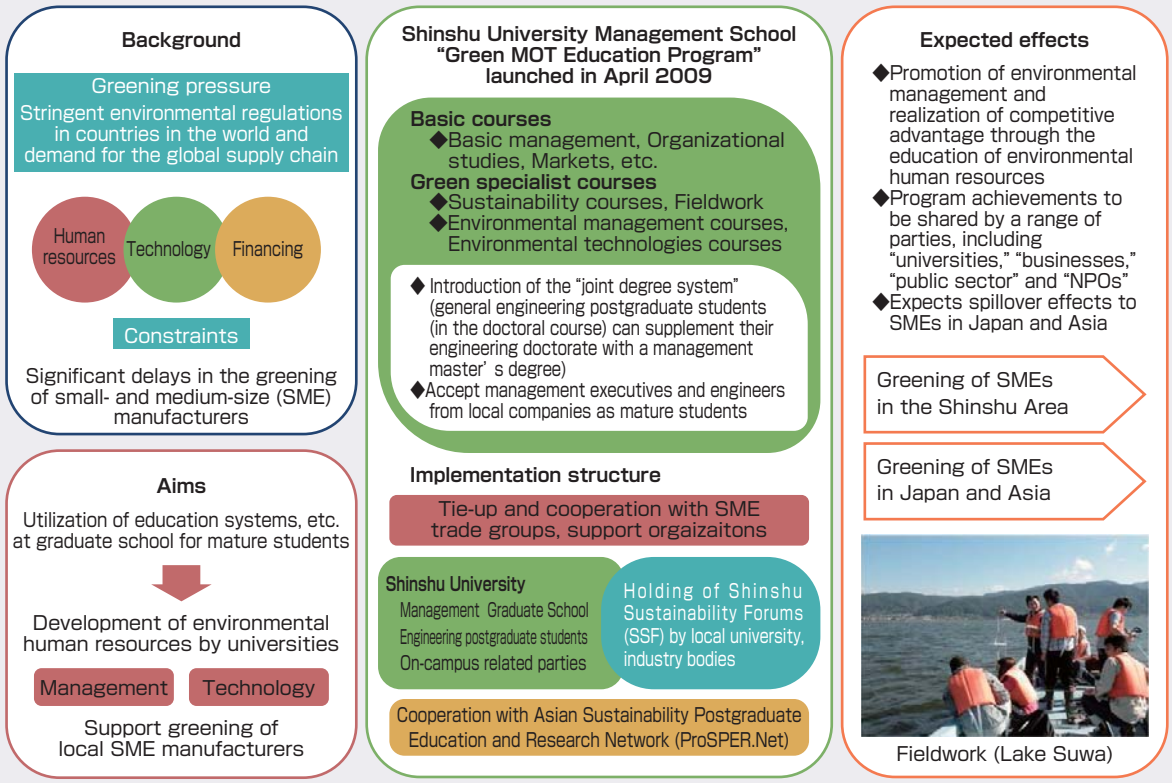
As it has been often pointed out that the large increase in science and technology-oriented human resources in the 1960s successfully provided the foundation for innovation in Japan in the high growth period, it is extremely important to secure research and technological human resources with science 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.

Outline of "Green MOT Education Program for the Management School" at Shinshu University



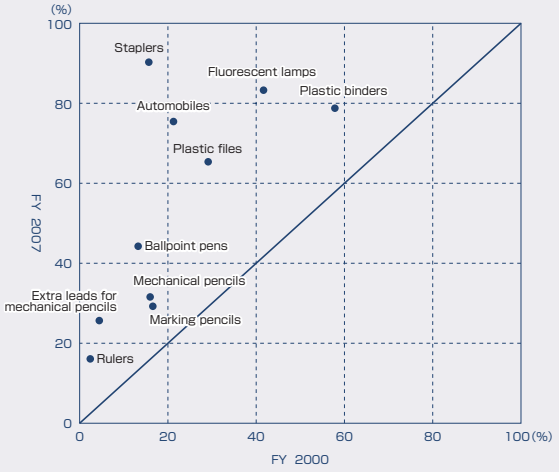
Source: Shinshu University

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

Figure5-4-6 Trends of Market Shares of Specified Goods Procured around Enforcement of the Law on Promoting Green Purchasing



Source: Ministry of the Environment

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 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).

Rendering of "Tianjin Eco-city" (Tianjinshengtaicheng)

Source: Sino-Singapore Tianjin Eco-city website

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 15th 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	○Nine initiatives to promote eco-innovation ①Building up partnerships for innovation ②Specific and active export promotion linked to the government's diplomacy, etc. ③Promotion of environment-friendly R&D at research institutions/universities ④Ministry of the Environment's initiative to promote eco-efficient technology ⑤Promotion of eco-efficient technology at the EU level ⑥Promotion of introduction of climate-related and energy technologies ⑦Promotion of livestock farm-derived technology to reduce environmental loads ⑧Qualitative and quantitative conservation of the water environment ⑨Promotion of technology to reduce contamination in the environment	○Program to identify and maximize opportunities for Finnish companies in the international market in technologies and services related to climate change mitigation ○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)	○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. ○The plan's targets include the participation of Spanish companies in international R&D cooperation	○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 ○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 ○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

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 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 form 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).

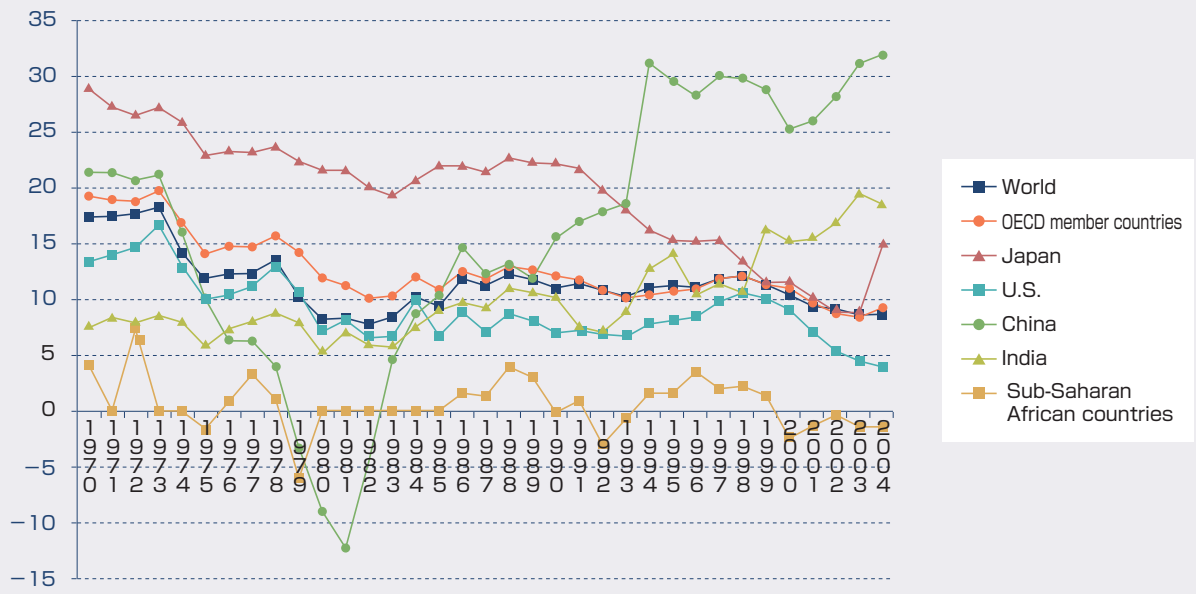
In Europe, OECD and Eurostat developed a group of indicators to assess sustainability in 2005 (revised in 2007) in line with the EU "Sustainable Development Strategy." For each of nine objectives under the Sustainability Development Strategy, the group of indicators systematically organizes various indicators 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

Figure5-4-7 Genuine Savings by Country/Region



Source: Prepared by Ministry of the Environment based on materials provided by the World Bank

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)

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)	
1	Norway	0.971
2	Australia	0.970
3	Iceland	0.969
4	Canada	0.966
5	Ireland	0.965
6	Netherlands	0.964
7	Sweden	0.963
8	France	0.961
9	Switzerland	0.960
10	Japan	0.960
11	Luxembourg	0.960
12	Finland	0.959
13	U.S.	0.956
14	Austria	0.955
15	Spain	0.955

	HeDI 2007 (Human-environment Development Index)	
1	Sweden	0.888
2	Switzerland	0.888
3	Norway	0.852
4	Hong Kong (China)	0.785
5	Iceland	0.777
6	Japan	0.755
7	Denmark	0.740
8	Netherlands	0.704
9	U.K.	0.703
10	Austria	0.687
11	France	0.678
12	Singapore	0.676
13	Finland	0.675
14	Luxembourg	0.674
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"

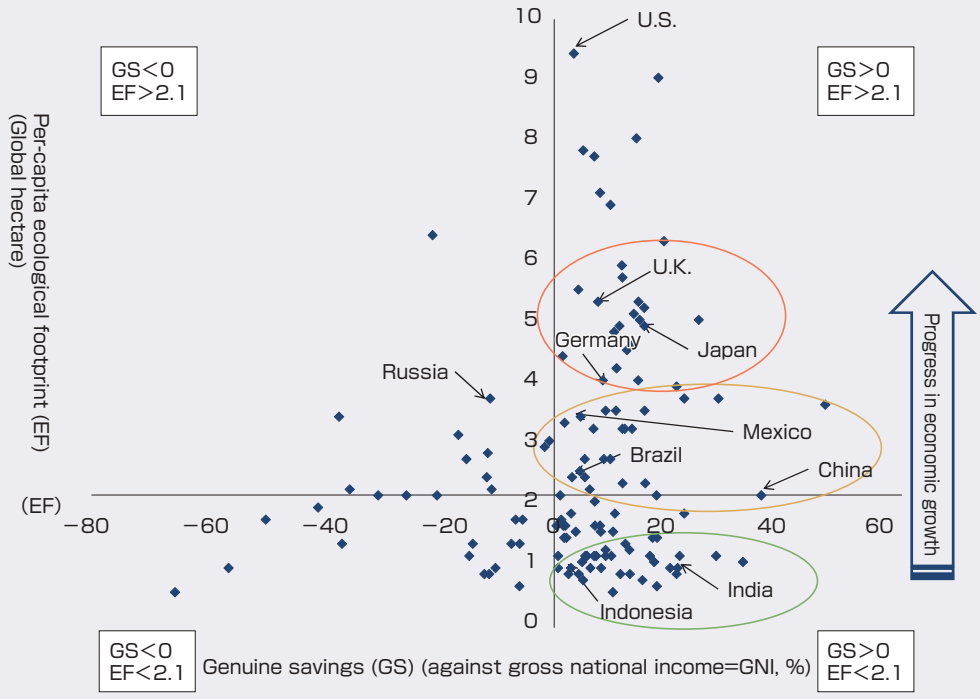
Column Assessment of Sustainability Using Multiple Indicators ~ Genuine Savings and Ecological Footprint ~

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.)

Column Green Growth Declaration of OECD

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. STRENGHTHEN 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.

National Parks and World Natural Heritage Sites in Japan

National Parks in Japan

National Parks of Japan play the role of being the backbone for protecting a wide variety of ecosystems including forests, wetlands, seashores, and coral reefs as well as wild fauna and flora, and preserving biodiversity. Therefore, the existence of national parks is indispensable for passing down the affluent nature of Japan to the future.

Currently, 29 areas are designated as National Parks, covering 2.09 million hectares or 5.5% of the country's ground surface. Designation and management of National Parks are administered by the Ministry of the Environment.

1. Rishiri-Rebun-Sarobetsu National Park

Designated in 1974, 24,166ha

The Japan's nothernmost national park, consisting of two islands and an expanse of wetlands. A variety of scenery, from mountains to wetlands, are truly enjoyable.

2. Shiretoko National Park

Designated in 1964, 38,633ha

Contains primeval ecosystems with diverse wildlife, remaining in Shiretoko Peninsura. In winter a portion of coastline is covered with drifting ice. Inscribed on the World Heritage List.

3. Akan National Park

Designated in 1934, 90,481ha

A park of forests, lakes and volcanoes. Boasts a majestic view of three crater lakes including Akan Lake, known for spherical moss, Marimo, and surrounding coniferous forests.

4. Kushiro-Shitsugen National Park

Designated in 1987, 26,861ha

The Japan's largest wetland complex. Supports about 200 plant species and some rare species, including Japanese crane and Sakhalin taimen. Canoe touring is popular.

5. Taisetsusan National Park

Designated in 1934, 226,764ha

The Japan's largest national park, featuring Taisetsu Mountains, and wetlands and alpine plant communities at over 2000m elevations. A stunning view of autumn leaves.

6. Shikotsu-Toya National Park

Designated in 1949, 99,473ha

Consists of two crater lakes and active volcanic mountains. With popular hot spring resorts, such as Noboribetsu, the park offers a host of vacation options.

7. Towada-Hachimantai National Park

Designated in 1936, 85,551ha

Encompasses from a Japan's most picturesque mountain stream view, vast open space of broad-leaved trees, to a plateau, Hachimantai. The park also features old several therapeutic hot spring resorts.

8. Rikuchu-Kaigan National Park

Designated in 1955, 12,212ha

A seashore park stretching for about 180km on the coast of northeastern Honshu. A series of enormous bluffs offer a spectacular vista and is called Sea Alps.

9. Bandai-Asahi National Park

Designated in 1950, 186,404ha

Mt. Dewa-sanzan, famous for mountain worship, Asahi-Iide Mountain Range, Mt. Bandai, and numerous lakes-the majestic views of moutains, forests and lakes adorn the park.

10. Nikko National Park

Designated in 1934, 114,908ha

Features various aspects: a historical architecture, Nikko Toshogu; a summer retreat on a mountain, Chuzenji Lake; the Japan's most prominent mountain wetlands, Oze Marsh. The park is close to Tokyo and easily accessible.

11. Oze National Park

Designated in 2007, 37,200ha

Oze is Japan's largest high moor. The highland plateau is covered with some 400 shallow pools, crowds of creeping pine trees, and virgin forests of beech trees.

12. Joshinetsu-Kogen National Park

Designated in 1949, 188,046ha

Consists of a highland and its surrounding chain of mountains sitting on a continental divide. This park has several ski resorts and hot springs, drawing a large number of tourists.

13. Chichibu-Tama-Kai National Park

Designated in 1950, 126,259ha

The old stratum mountains are home to natural forests of beech, Japanese hemlock and veitch fir, Located in the headwater of Tokyo, bounty forests and streams provide a recreational groud for urban communities.

14. Ogasawara National Park

Designated in 1972, 6,629ha

Subtropical oceanic islands of over 30 islands are scattered in the 1,000km south of Tokyo. Humpback whales migrate to the surrounding ocean. The islands support many endemic species such as Ogasawara fruit bat.

15. Fuji-Hakone-Izu National Park

Designated in 1936, 121,695ha

Mt. Fuji rises high in a vast stretch of luxius forests and several lakes. The Hakone area features several volcanoes, volcanic vents and lakes. Izu Peninsura offers scenic mountains, seashores, and a chain of characteristic islands in the ocean, Izu-shichito.

16. Chubu-Sangaku National Park

Designated in 1934, 174,323ha

One of the most prominent mountain parks. Encompasses a number of precipitous 3000m peaks. Kamikochi highland and Mt. Tateyama attract many tourists seeking for magnificient mountain views.

17. Hakusan National Park

Designated in 1962, 47,700ha

Consists of a sacred mountain, Mt. Hakusan, and its foot. Because of rich alpine plants, the area has a long history of plant research. Broad-leaved trees, mainly beech, are distributed.

18. Minami Alps National Park

Designated in 1964, 35,752ha

A mountain park with a series of 3000m mountains, covered with thick coniferous forests while alpine plants on their tops. It is a paradise for mountaineers willing to a long walk.

19. Ise-Shima National Park

Designated in 1937, 55,544ha

Comprised of an elegantly displayed coastline with numerous inlets and outlets, Shima Peninsura, and a symbol of the Japan's ancient religion and culture, Ise Shrine. The mountain behind the shrine has been protected as a sacred forest.

20. Yoshino-Kumano National Park

Designated in 1936, 59,793ha

Consists of forested mountains and Kumano Valley in the middle of Kii Peninsura and its shorelines. The area is famous for Mt. Yoshino with cherry blossoms and historic sites; Ohmine Mountain Range, a training ground for Shugen-do (Japanese esoteric Buddhism) practitioners; and Mt. Kumano-sanzan.

21. Sanin-Kaigan National Park

Designated in 1963, 8,783ha

This 75-km shoreline park in the Kinki and Chugoku districts offers a spectacular view of intricate shorelines with caves and surrounding clear ocean water. Distinctive plant species are found in a desert-like view of Tottori Sand Dune.

22. Setonaikai National Park

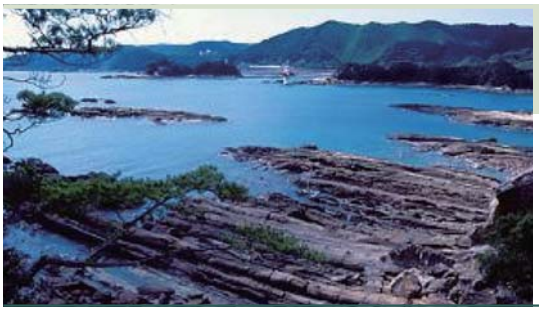
Designated in 1934, 66,934ha

About 3,000 islands, small and large, spread over the Seto Inland Sea. Human life and natural beauty are peacefully blended to create this park's view.

23. Daisen-Oki National Park

Designated in 1936, 35,053ha

Mt. Daisen, a highest mountain in the Chugoku district; Oki Islands of large to small 180 islands; the Shimane Peninsura known for Izumo Taisha Shrine; and Mt. Sanbe and Mt. Hiruzen-all are the components of the Daisen-Oki National Park.



24. Ashizuri-Uwakai National Park

Designated in 1972, 11,345ha

A marine park in southwestern Shikoku, featuring a delicate scenery with an intricate shoreline pattern and numerous islands in north (Uwa-kai) and contrasting dynamic view in south (Ashizuri), where high bluffs extend along its shoreline. The sea has richly decorated underwater views with abundant coral community.

25. Saikai National Park

Designated in 1955, 24,646ha

A marine and islands park in northwestern Kyushu. A chain of over 200 a form this archipelagic sea. The sunset view is especially breathtaking. Also, the Goto archipelago in the East China Sea consists of over 250 islands.

26. Unzen-Amakusa National Park

Designated in 1934, 28,279ha

The Unzen area in the center of Shimabara Peninsura hosts summer resorts, known by the famous volcanic activity of Mt. Fugen in 1990 and hot springs. The Amakusa Islands of 120 islands, small and large, is known for its scenic beauty.

27. Aso-Kuju National Park

Designated in 1934, 72,678ha

A park of volcanoes and grass fields. Mt. Aso has an extremely large caldera, while Mt. Kuju is a series of dome-shaped volcanoes. The grassy fields on their hillslopes have been maintained by human activities, such as prescribed burning and cattle grazing.

28. Kirishima-Yaku National Park

Designated in 1934, 60,794ha

The Kirishima area is a collection of over 20 volcanoes. Natural trees spread over the mountain foot. The Yaku-shima Island, inscribed on the World Natural Heritage, is known for the forests of over 1000 years-old cedars.

29. Iriomote National Park

Designated in 1972, 20,569ha

At the southwest end of the Japanese archipelago, the park encompasses Iriomote and Ishigaki Islands, smaller islands and coral reefs. Subtropical forests blanket 80% of Iriomote, supporting a large number of rare species such as the Iriomote wild cat.

World Natural Heritage Sites and Nominated Sites in Japan

The World Heritage is an irreplaceable asset of mankind as a whole and is a treasure to be handed over to the future generations. The World Heritage includes cultural and natural heritage. To be inscribed on the World Heritage List as a natural site, it must meet one or more of the four criteria which are "topography / geography and geology", "ecosystem", "natural landscape", and "biodiversity".

In Japan, Shiretoko, Shirakami-Sanchi and Yakushima have been inscribed on the World Heritage List as natural properties., while Ogasawara Islands and Ryukyu Islands are chosen as candidate sites. Japanese government submitted the nomination of Ogasawara Islands to the World Heritage Centre in Jan 2010.

1. Shiretoko

Inscribed under criteria ix) and x) in 2005, 71,103ha

Shiretoko is an extraordinary productive area influenced by the nutrient-rich ocean current formed by sea ice formation. It provides an outstanding example of the interaction between marine and terrestrial ecosystems. At the same time, this site is important for many marine animals including threatened seabirds, migratory birds, sea lions and other cetacean species.

2. Shirakamisanchi

Inscribed under criterion ix) in 1993, 16,971ha

The Shirakami-sanchi is the last areas where cool temperature beech trees that once covered the hills and mountain slopes of northern Japan are widely distributed untouched. Various types of community and stages of reproduction show an significant example of the on-going ecological process.

3. Yakushima

Inscribed under criteria vii) and ix) in 1993, 10,747ha

Yakushima is characterized by its rich biota with about 1,900 species and subspecies of flora including the enormous 1,000 year old Japanese cedar trees. Yakushima also exhibits a typical example of vertical distribution of vegetation from a coastal region to a subalpine region.

● Ogasawara Islands (Under nomination process)

Nominated in Jan 2010 under criteria viii), ix) and x), 7,408ha

The Ogasawara Islands are the only place on earth that preserves perfect exposures on land illustrating the evolution of an oceanic island arc. The islands well preserve features of oceanic islands ecosystem with many endemic species and provide habitats for many globally important endangered and endemic species.

● Ryukyu Island (National candidate site)

Selected in 2003

Ryukyu Islands illustrates evolutionary process of fauna and flora reflecting geological history of repeating separation and reunion with the continent and provides habitats for endangered species including relict endemic species.

National and Quasi-National Parks and World Natural Heritage Sites in Japan

National Parks

1 Rishiri-Rebun-Sarobetsu
2 Shiretoko
3 Akan
4 Kushiro-Shitsugen
5 Taisetsusan
6 Shikotsu-Toya
7 Towada-Hachimantai
8 Rikuchu-Kaigan
9 Bandai-Asahi
10 Nikko
11 Oze
12 Joshinetsu-Kogen
13 Chichibu-Tama-Kai
14 Ogasawara
15 Fuji-Hakone-Izu
16 Chubu-Sangaku
17 Hakusan
18 Minami Alps
19 Ise-Shima
20 Yoshino-Kumano
21 Sanin-Kaigan
22 Setonaikai
23 Daisen-Oki
24 Ashizuri-Uwakai
25 Saikai
26 Unzen-Amakusa
27 Aso-Kuju
28 Kirishima-Yaku
29 Iriomote

Quasi-National Parks

1 Shokanbetsu-Teuri-Yagishiri
2 Abashiri
3 Niseko-Shakotan-Otaru Kaigan
4 Hidaka Sanmyaku-Erimo
5 Onuma
6 Shimokita Hanto
7 Tsugaru
8 Hayachine
9 Kurikoma
10 Minami-Sanriku Kinkazan
11 Zao
12 Oga
13 Chokai
14 Echigo Sanzan-Tadami
15 Suigo-Tsukuba
16 Myogi-Arafune-Saku Kogen
17 Minami Boso
18 Meiji Memorial Forest Takao
19 Tanzawa-Oyama
20 Sado-Yahiko-Yoneyama
21 Noto Hanto
22 Echizen-Kaga Kaigan
23 Wakasa Wan
24 Yatsugatake-Chushin Kogen
25 Tenryu-Okumikawa
26 Ibi-Sekigahara-Yoro
27 Hida-Kiso Gawa
28 Aichi Kogen
29 Mikawa Wan
30 Suzuka
31 Muroo-Akame-Aoyama
32 Biwako
33 Tango-Amanohashidate-Oeyama
34 Meiji Memorial Forest Minoo
35 Kongo-Ikoma
36 Hyonosen-Ushiroyama-Nagisan
37 Yamato-Aogaki
38 Koya-Ryujin
39 Hiba-Dogo-Taishaku
40 Nishi-Chugoku Sanchi
41 Kita-Nagato Kaigan
42 Akiyoshidai
43 Tsurugisan
44 Muroto-Anan Kaigan
45 Ishizuchi
46 Kita-Kyushu
47 Genkai
48 Yaba-Hita-Hikosan
49 Iki-Tsushima
50 Kyushu-Chuo Sanchi
51 Nippo Kaigan
52 Sobo-Katamuki
53 Nichinan Kaigan
54 Amami Gunto
55 Okinawa Kaigan
56 Okinawa Senseki

World Natural Heritage Sites

1 Shiretoko
2 Shirakamisanchi
3 Yakushima