Figure 1-3-8　Domestic Distribution of Endemic Species of Mammals, Endemic Species Index of Vascular plants

Legend
No. of endemic species
- 1-5species
- 6-10species
- 11-20species
- 21-30species
- 31-46species

Distribution of endemic vertebrate animals of Japan

Legend
Index of endemic species
- Small
- ↑
- Assessed
- ↓
- Large

Distribution of endemic vascular plants of Japan*

Note: Endemic Species Index is an index corrected the sampling data bias and taxonomic unclassification by an ecological niche modeling
Source: Ministry of the Environment

ecosystem.

Figure 1-3-8 shows the distribution of endemic species of endemic vertebrate animals and tracheophytes in Japan. The areas marked with a darker color on the map represent a larger number of endemic vertebrate animals and endemic vascular plants living in the area. This information is a key indicator for selecting important sites for conservation of biodiversity.
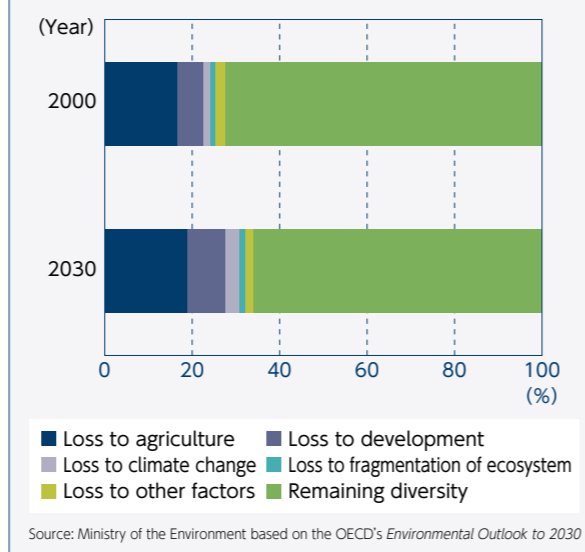
b) Socioeconomic activities and biodiversity

Land can be considered to be a component of ecosystems that is directly or indirectly affected by the results of human socioeconomic activities. Land-dwelling creatures, including human beings, live off the land, meaning that changes in land use can directly impact living organisms. Therefore, measuring the level of land use change can be thought of as a key indicator for assessing the loss of biodiversity due to human socioeconomic activities.

The reduction factors of Japan's threatened species are the socioeconomic activities of human beings, including development, water pollution, illegal capture, and alien species. As a result, wildlife species are under threat of extinction (Figure 1-3-9). Specific activities that pose a threat to the world's biodiversity include infrastructure development and production activities such as agriculture, isolation of habitat ranges, and advancing global warming. These trends are likely to continue in the future (Figure 1-3-10).

As seen above, the loss of biodiversity due to socioeconomic activities such as the excessive use of natural resources and overdevelopment is advancing globally. Objective assessments of the interaction between

Figure 1-3-9　Loss Factors of Global Biodiversity

Legend:
- Loss to agriculture
- Loss to development
- Loss to climate change
- Loss to fragmentation of ecosystem
- Loss to other factors
- Remaining diversity

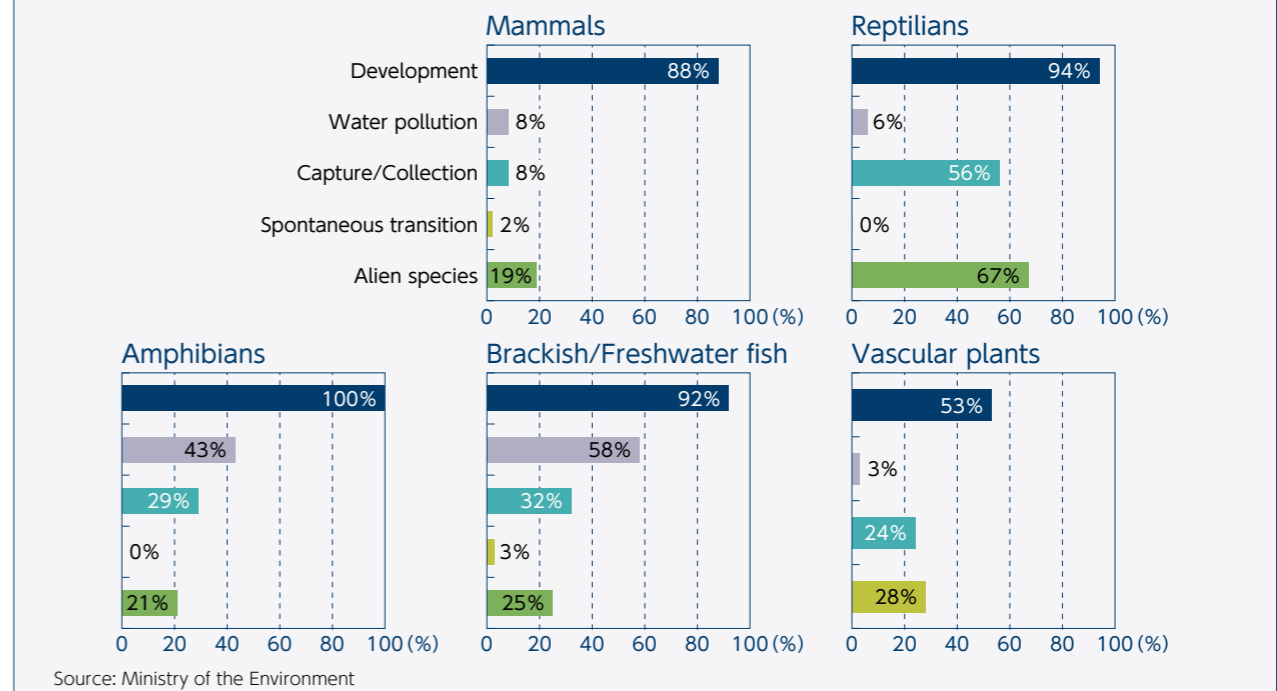Source: Ministry of the Environment based on the OECD's *Environmental Outlook to 2030*

biodiversity and socioeconomic activities and analysis of the causes of impacts are required in order to consider the future of biodiversity conservation.

(3) Socioeconomic Activities and Forest Resources

a) Abundance of forest resources

Looking at forest resource abundance from the perspective of forest area shows that forests cover approximately 4 billion hectares of the world's surface, accounting for about 30% of total global land area. A comparison of forest distribution

Figure 1-3-10　Reduction Factors of Domestic Threatened Species

Mammals
- Development 88%
- Water pollution 8%
- Capture/Collection 8%
- Spontaneous transition 2%
- Alien species 19%

Reptilians
- Development 94%
- Water pollution 6%
- Capture/Collection 56%
- Spontaneous transition 0%
- Alien species 67%

Amphibians
- 100%
- 43%
- 29%
- 0%
- 21%

Brackish/Freshwater fish
- 92%
- 58%
- 32%
- 3%
- 25%

Vascular plants
- 53%
- 3%
- 24%
- 28%

Source: Ministry of the Environment

Column   An Economic Approach to Biodiversity Conservation

The most likely cause of biodiversity loss is the impact of human socioeconomic activities. However, the impact of biodiversity loss on human beings has been requiring more and more attention in recent years.

In order to make policy and business decisions in light of heightened awareness of this issue, it is important to conduct objective and quantitative assessments of various impacts: both the impact of human socioeconomic activities on biodiversity, and the impact of biodiversity loss on human socioeconomic activities. This kind of assessment method has not been fully established yet, but various approaches have been launched in many parts of the world.

There is an approach to assessing the value of biodiversity by converting it into economic and monetary values, known as the Economics of Ecosystems and Biodiversity (TEEB), promoted by the United Nations Environment Programme (UNEP) and other organizations. This report assumes a monetary value for each ecosystem service. For instance, absorption of greenhouse gas is equivalents to 3.7 trillion dollars. By using this evaluation, profits due to

biodiversity conservation and economic losses due to biodiversity loss can be estimated.

The initiative *Towards Green Growth* published by OECD assessed the relationship between the economy and biodiversity, focusing on changes in land usage due to socioeconomic activities. This approach can be understood as a means to analyze correlations between these two factors using economic and statistical data, rather than carrying out a monetary accounting of biodiversity.

As stated above, an analysis of the correlations between biodiversity and the economy may result in a number of new approaches being proposed for rational decision-making processes and conservation policies for biodiversity among policy makers, business owners, consumers, and other parties. Currently, efforts are being made to conserve biodiversity using economic assessments, such as: setting new indicators that comprehensively evaluate the current status of biodiversity and socioeconomic activities; and creating an approach that uses market mechanisms to assess the economic value of biodiversity.

Examples of Economic Measures for Biodiversity Conservation

Conservation of biodiversity and sustainable use through market mechanisms	Economic incentives	Payment for ecosystem services (PES)	From parties receiving the benefits of ecosystem services to parties managing resources
		Taxation	Applied to actions that affect biodiversity
		Subsidies	Paid for actions that contribute to the preservation of biodiversity; subsidies that have a negative effect on preservation of biodiversity are eliminated.
		Trading of rights	Assigns rights for using the environment as certificates, and solves environmental problems by negotiations among parties making transactions in the market
	Certification system		Certifies the raw materials from living organisms appropriately take into consideration of the ecosystem and biodiversity of the source, regional society, and the people who live there; represents a unified certification mark on products to consumers
	Mitigation		In order to reduce negative effects on biodiversity caused by development projects, efforts are made to avoid portions or all of such projects, minimize project scale, and consider correction or reduction in the scope of the natural environments that incur such effects. Rather than compensation measures, priority consideration is given to avoidance and reduction of the effects themselves.
	Biodiversity offset		For negative effects caused by development projects, appropriate reduction measures are implemented. By taking compensatory action to target the negative effects that remain even after such measures are taken, the quality and quantity of biodiversity as a whole is maintained in the same state. Banks that are expert organizations on restoration and creation for conservation (compensatory mitigation banks) receive fixed amounts of credit and accurately restore and create environments on behalf of parties conducting development projects. The mechanism whereby parties conducting development projects are deemed to have taken compensation measures is referred to as mitigation banking.

Source: Partial Abridgment of *Annual Report on the Environment, the Sound Material-Cycle Society, and Biodiversity 2011*

by region suggests that forests are typically found in South America, North America, and Europe (including Russia).

In terms of the application of these forests, about 30% of the world's forests are used as production forests, while about 20% are designated as protected areas for soil, water resources, and biodiversity. Looking at the detailed applications of forests suggests the importance of establishing governance in South American and African countries, since these countries have a significant number of forests with unknown use or no data, despite the fact that fewer forests are used for production. In contrast, forests are used primarily for production in Europe and Asia. Management approaches for the sustainable utilization of forests should be considered taking into account the many functions of forests, the economic situation of countries and regions, and climate conditions.

b) Development of agricultural land and deforestation

The following explains the relationship between forest and agricultural land in terms of human socioeconomic activities and land use changes. Since the 1990s, the global forest area has been declining followed by an increase in the area of agricultural land, particularly in Africa, South America, and Southeast Asia (Figure 1-3-12). This suggests drastic deforestation in tropical areas, although the forest area in East Asia, Europe, and North America remained flat or slightly increased.

The agricultural land area increased in Africa, South America, and Southeast Asia, while forests decreased in these same regions, a trend which is significantly affected by regional socioeconomic conditions. In particular, forests in countries that suffered from starvation in the 1990s have been severely affected by the development of cultivated land in the last two decades. Figure 1-3-13 shows a scatterplot of the rate of forest and cultivated land alteration (1990-2009)

in major countries where over 20% of the population suffered from malnutrition in the early 1990s. This figure suggests that a significant portion of countries that once suffered from starvation have experienced a reduction in forest area over the past twenty years. In particular, since many African countries demonstrate a mixed situation of an increase in the area of cultivated land and decreasing forest area, it can be estimated that deforestation due to the development of cultivated land is advancing against a backdrop of food deficiency.
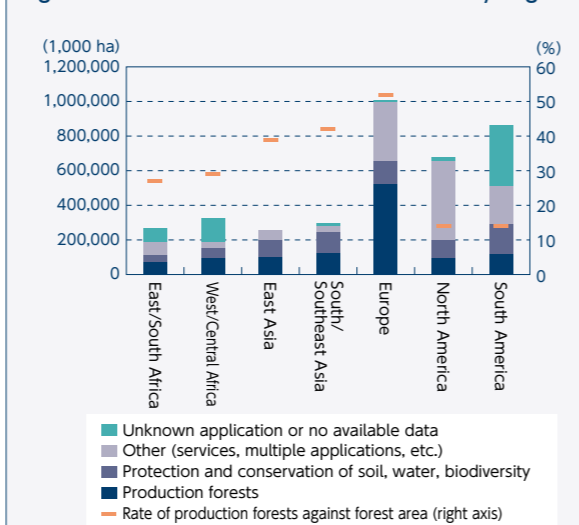
Many (though not all) Asian countries in the vicinity of Japan, which have close relations with Japan and that have tropical forests, are showing an increase in the area of cultivated land and decreased forest area. In recent years, the production area of palm trees, especially in Indonesia and Malaysia is increasing due to global growth in palm oil

### Figure 1-3-11 Global Forest Area and Use (By Region)

Source: Ministry of the Environment, FAO *Global Forest Resources Assessment 2010*

### Figure 1-3-12 Trends in Agricultural/Forest Land Area (By Region)
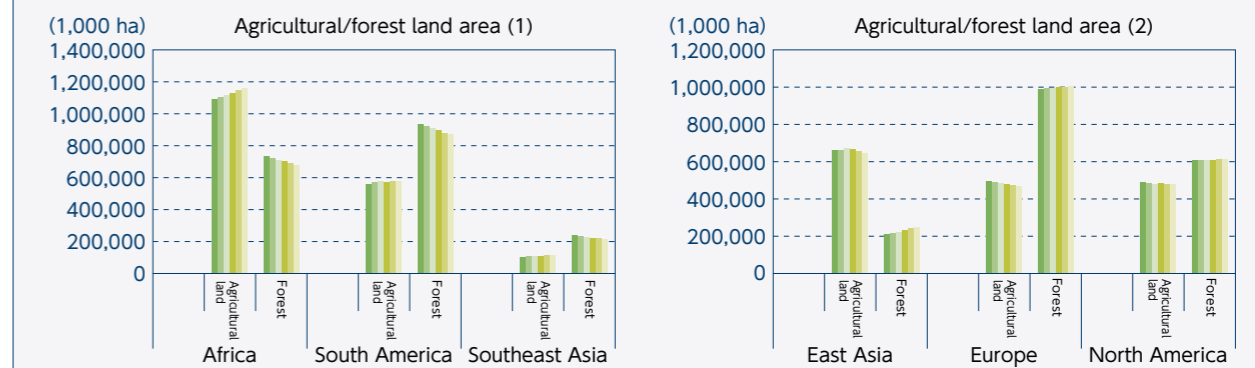
Source: Ministry of the Environment, FAO statistics (1993-2008, measured every 5 years)

Figure 1-3-13 Change in Forest/Arable Area in Countries Suffered from Starvation in the 1990s (1990/2009)
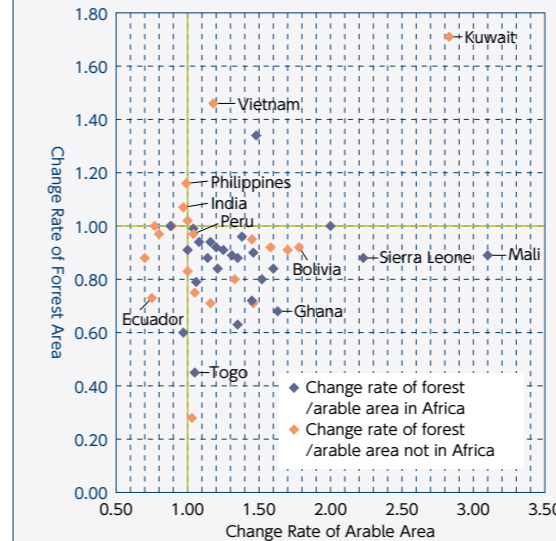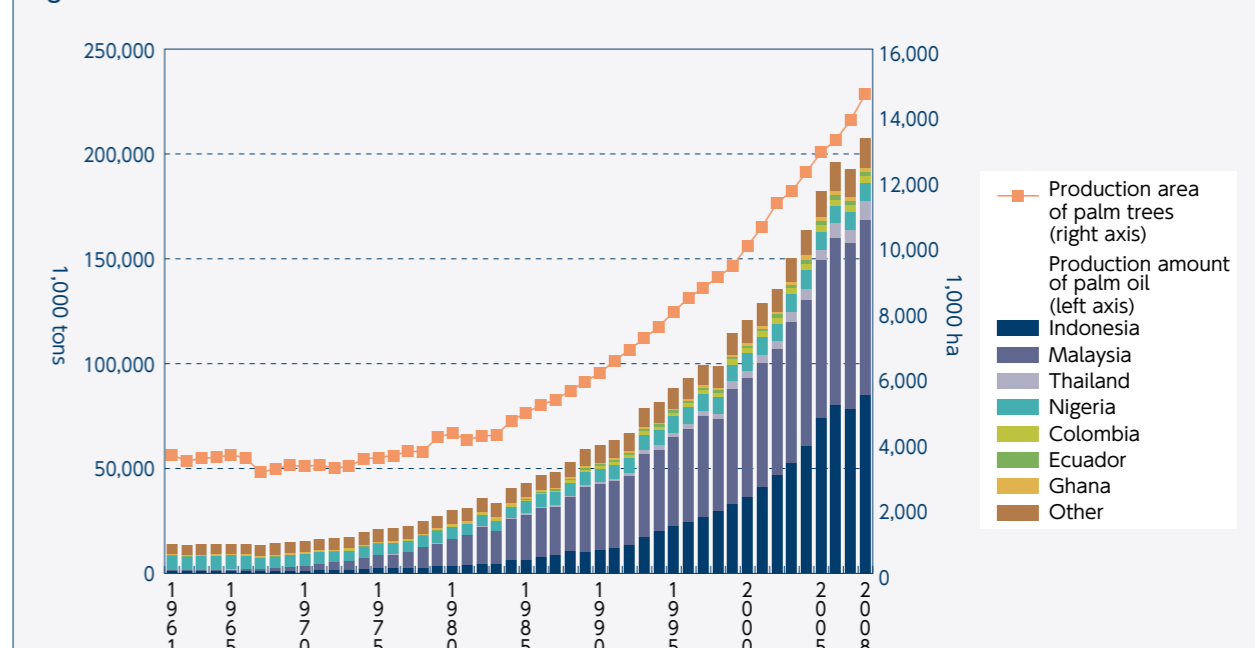
Source: Ministry of the Environment based on FAO statistics

Figure 1-3-14 Change of Forest Area in Countries in the Vicinity of Japan
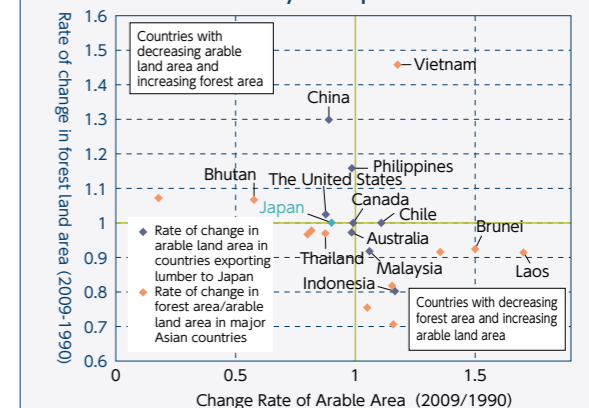
Source: Ministry of the Environment based on FAO statistics

Figure 1-3-15 Production Amount of Palm Oil and Production Area

Source: Ministry of the Environment based on FAO statistics (March 2011)

production, and this fact is the major reason for the decrease in tropical forests.

(4) Socioeconomic Activities and Water Resources

Water resources have a close relationship with environmental, economic, and social issues. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), global water intake is surging on the heels of a world population increase, and is expected to go up by 32% by 2025 compared to 2000 levels (Figure 1-3-16). Water is absolutely critical for food production; however, severe water shortages are a concern in many areas around the world due to an increased demand for feed crops in recent years. Water pollutants derived from socioeconomic activities cause offensive odors and hygiene-related environmental issues; moreover, they cause eutrophication in closed water areas and damage to existing ecosystems.

More frequent droughts and floods brought about by climate change are also significant issues.

Water resources are absolutely imperative to human life. However, water is unevenly distributed around the globe: 95% in the ocean, 2% in the form of glacier ice, and only 1% in the form of fresh water. Therefore, access to freshwater resources is a key point. The amount of per-capita freshwater resources suggests that people living in areas like Africa are presented with extremely severe conditions in terms of accessing water. Another critical point in terms of water issues is securing appropriate sanitation once water has been used. Figure 1-3-17 shows that sewage water disposal conditions in African countries, India, and other countries are particularly inadequate.

Looking at the global situation, water issues in urban areas are also severe. Although water leakage problems (loss of water carried from a water intake point) are insignificant in Japan, they are recognized as causing major problems in other countries (Table 1-3-1). For example, 35% or more

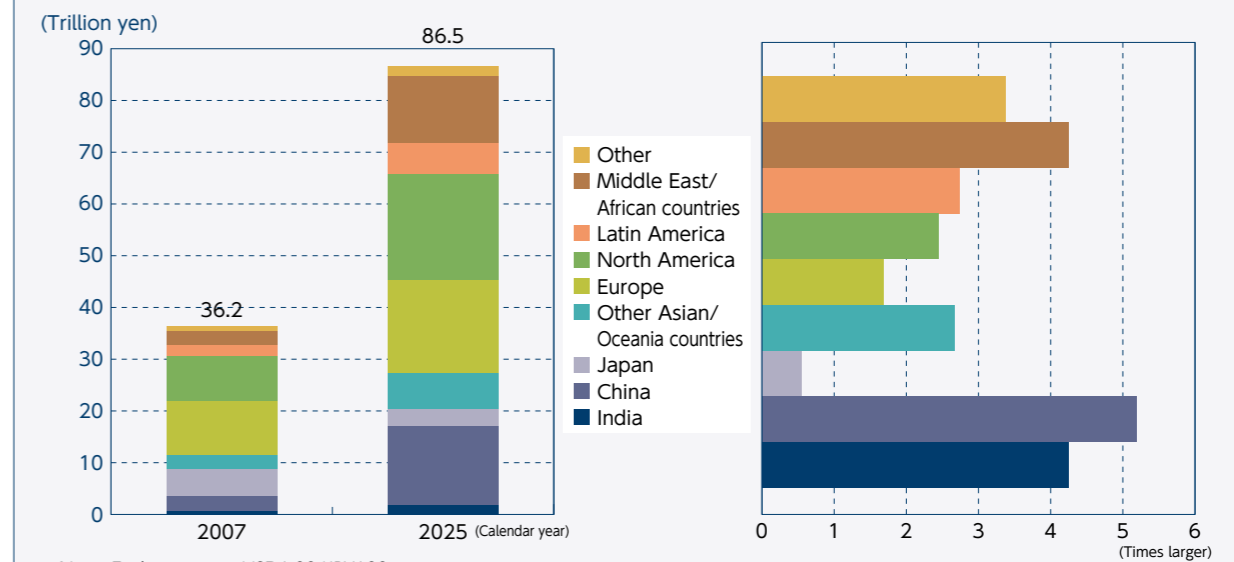### Table 1-3-1 Rate of Water Leakage in Major Countries Worldwide

City	Rate of leakage	City	Rate of leakage
Tokyo	3.1%	Torino	25.0%
Berlin	5.0%	Istanbul	25.2%
Moscow	9.9%	Hong Kong	26.0%
Madrid	10.5%	London	26.5%
Incheon	17.0%	Mexico City	35.0%
Cairo	20.0%		

Source: Ministry of the Environment based on the Study Group on Water Resources Security *Final Report 2008* and the Bureau of Waterworks Tokyo Metropolitan Government website

of Mexico City water leaks in the process of supply. This means that if the city were able to manage its water supply on a level equivalent to Japan's, it could save about 30% of its water resources per water intake point.

As described above, it is thought that more and more business opportunities will be created in the water sector, which is anticipated to grow 2.4-fold between 2007 and 2025 (Figure 1-3-18). Furthermore, Japan's sophisticated water management technology and systems have the potential to contribute to other countries around the world.

Figure 1-3-16 Population and Quantity of Water Intake Worldwide
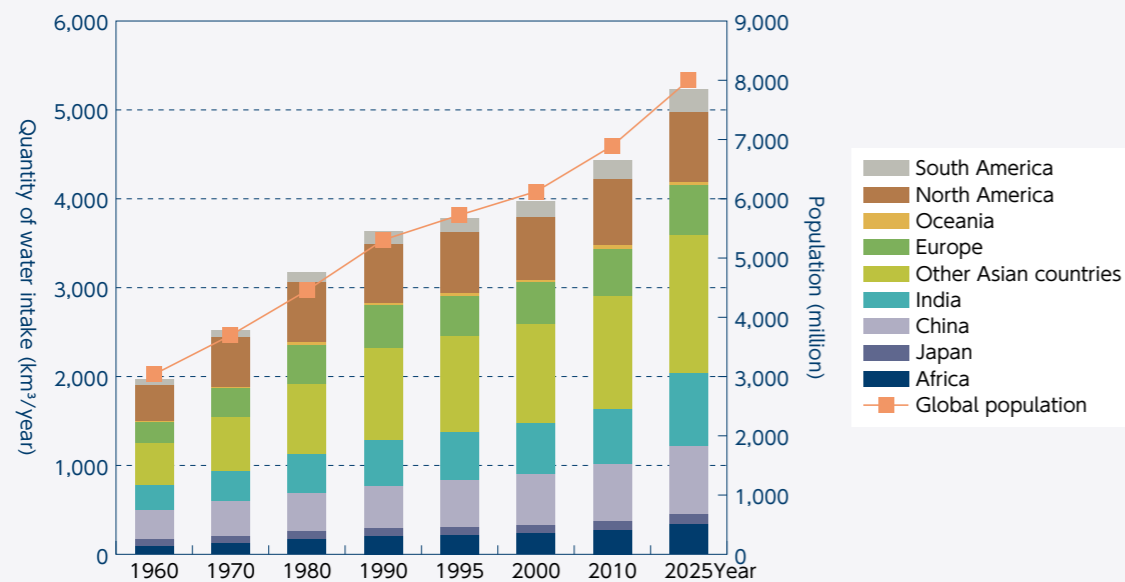
Source: Ministry of the Environment based on the UN World Population Prospectus/UNESCO *World Water Resources and their Use*

Figure 1-3-17 Access to Safe Water and Installation Status of Sanitary Facilities Worldwide

Percentage of population with access to safe drinking water (2010)
Source: *Progress on Drinking Water and Sanitation* (UNICEF)

Percentage of population with access to sanitary facilities (including vault toilet)

Figure 1-3-18 Water Business Market Size by Region (Left) and Growth Ratio (Right)
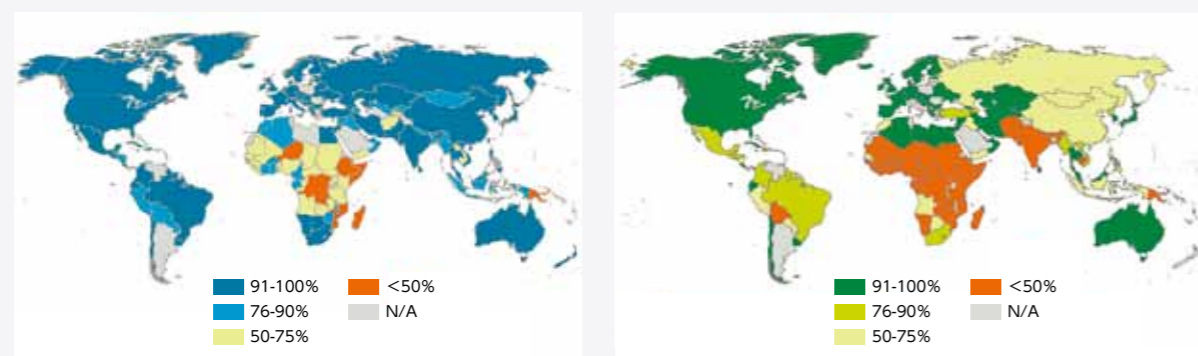

Note: Exchange rate: USD1.00/JPY100 yen
Growth rate: 2025 market size growth rate in comparison with 2007 performance
Source: Ministry of the Environment Water Business International Rollout Research Group

Column The Goddess in the Toilet

There is a well-known song by Japanese singer-songwriter Kana Uemura entitled "Goddess in the Toilet." Its phrasing and melody are impressive, and describe a beautiful goddess is living in the toilet that will allow you to blossom into a beautiful woman if you clean the bathroom every day.

When a flush toilet clogs, you cannot flush it until it is fixed. Typically, there is nothing in a home that can replace the function of a toilet, and it is one of the most familiar and important pieces of equipment in your daily life.

In Japan, the appropriate disposal of human waste has been extended to every corner of society. Today, sanitary standards are so high that most people are not even aware of the potential inconvenience that human waste disposal could pose to their daily lives. However, even with our everyday encounters with the "Goddess

in the Toilet," we may come to realize its value and presence too late if we wait until it is lost.

The Great East Japan Earthquake badly damaged sewage treatment facilities, causing catastrophic damage to human waste disposal systems in the affected areas. In Iwate Prefecture, the local administration collected human waste with the help of industry associations to put a collection system in place immediately after the disaster. In Miyagi Prefecture, damaged local operators received a gift of trucks from an industry association, while an industry association in Yamagata Prefecture lent its support by dispatching trucks to Miyagi Prefecture to collect human waste. Today, collected human waste is being disposed of in widespread areas, supported by treatment facilities in Miyagi Prefecture and by the Yamagata prefectural government.

We learned a lesson from this tragedy: namely, the enormous role that support from neighboring local administrations and industry associations involved in human waste disposal can play at evacuation shelters.

Another challenge we face is upgrading ageing sewage treatment facilities. The number of accidents occurring due to ageing sewage pipes started to increase in the mid-1970s. Today, the number of accidents per year is steady at somewhere between 4,000 and 6,000 per year.

Furthermore, a significant portion of the world's population still suffers life without appropriate treatment of drinking water or sewage water, causing serious environmental and hygiene-related problems. Japan's water treatment technologies and systems are highly praised around the world and have spread to countries around the globe (see below). Three Japanese companies together account for nearly 50% of the global market share for technologies such as

Reverse Osmosis filtration (RO, for desalination of seawater and producing reclaimed water) and Nano Filtration membranes (NFs, used primarily for water purification). In addition, local governments that have experience with large-scale systems are vigorously expanding their sewage treatment businesses in overseas locations in cooperation with major companies.

However, it is not always possible to maintain sustainable water resource management by simply "transplanting" the technologies and systems to particular areas. Cultivating and maintaining an attitude of taking good care of the things around us— even if they are trivial—allows us to maintain a good environment in our daily lives. In addition to Japan's advanced technologies and systems, it may be useful to spread this attitude to countries working to achieve sustainable societies around the world, thereby creating a "beautiful" global environment.

Business Trends in Overseas Rollout of Water Supply and Sewerage Systems by the Private Sector and Local Government
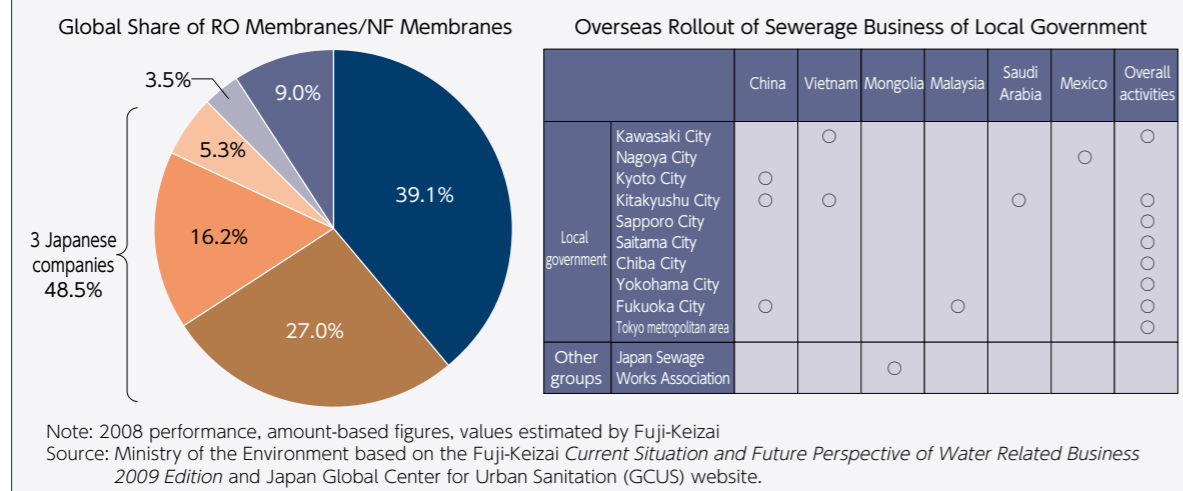

Note: 2008 performance, amount-based figures, values estimated by Fuji-Keizai
Source: Ministry of the Environment based on the Fuji-Keizai Current Situation and Future Perspective of Water Related Business 2009 Edition and Japan Global Center for Urban Sanitation (GCUS) website.
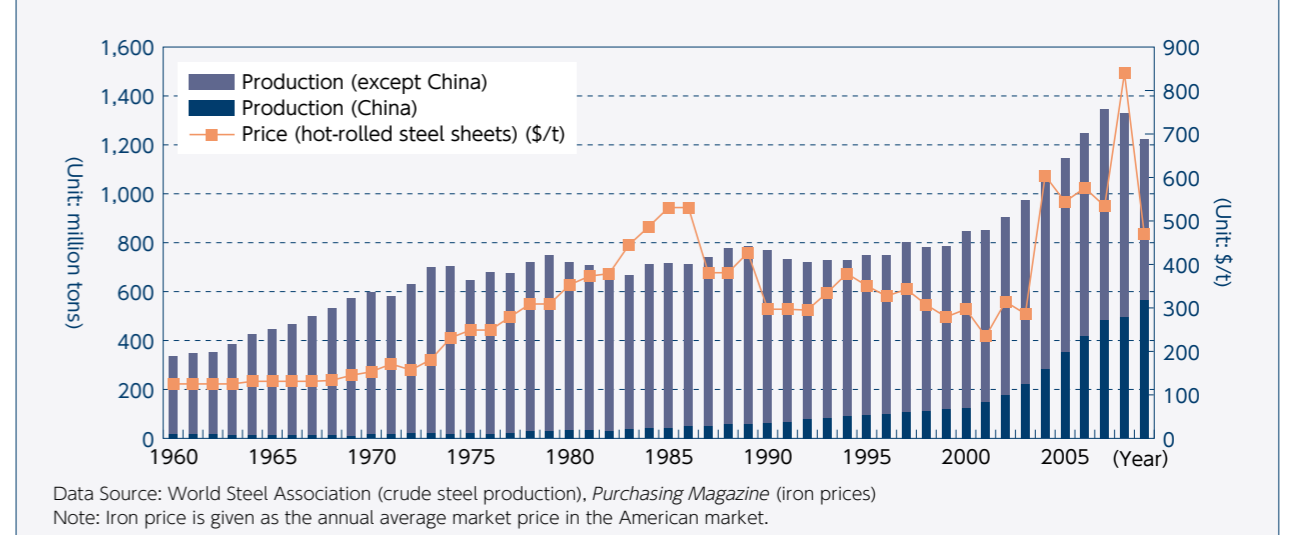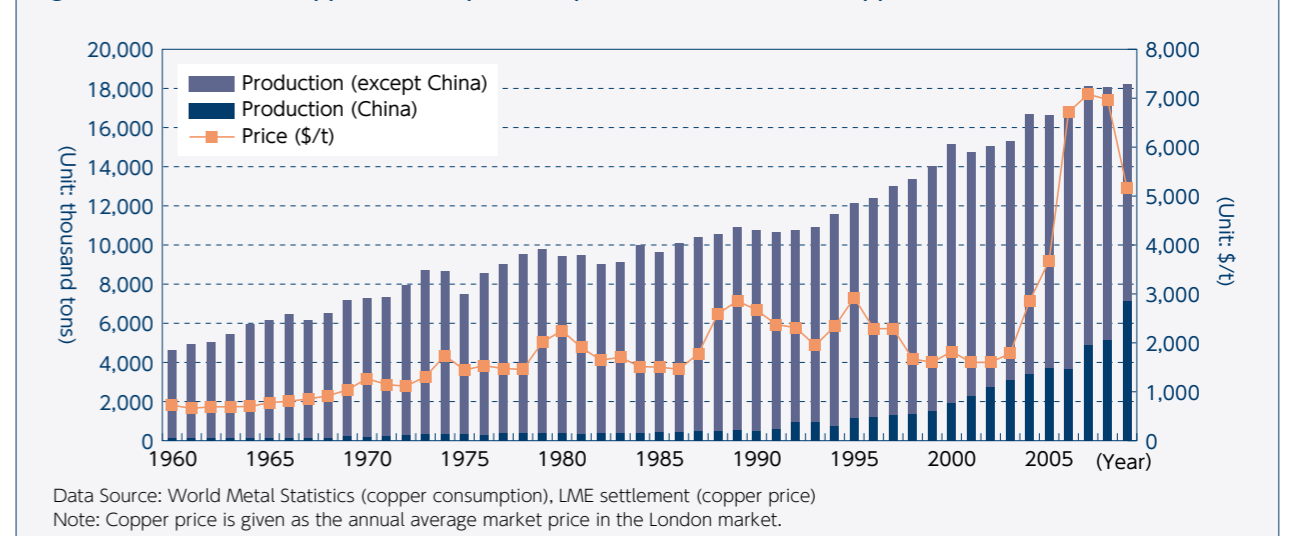
(5) Mining of Underground Resources and Sustainability

a) Limited resources

Various metal resources are used for products around us (Figure 1-3-19). For example, iron is used for car bodies, copper for lead power lines, zinc for preventing corrosion, and lead for storage batteries. Our present convenient life is realized by consumption of these metal resources.

Hardly any of these metal resources are mined in Japan, so Japan depends on imports. For products in Japan, about 130 million tons of iron ore are imported, about 5 million tons of copper ore, about 1 million tons of aluminum ore, and about 1 million tons of zinc ore. Thus, Japan is one of the world's metal resource importing countries.

There are limits to the places where metal resources can be mined and the quantity of production. The US

Geological Survey has calculated the following reserves/ production ratios as of 2010: 66 years for iron ore; 40 years for copper ore; 21 years for lead ore; and 21 years for zinc ore. Although the reserve/production ratio can be extended due to price hikes or tight demand, that for iron ore, for example, was 166 years in 1990: in the past 20 years, its reserve/production ratio has become one-third of what it was. Focusing on gold or silver, the amount of resources that have been mined (terrestrial resources) is more than the reserves of resources confirmed to date (underground resources): 93,000 tons for terrestrial resources of gold and 42,000 tons for underground resources of gold; 630,000 tons for terrestrial resources of silver and 270,000 tons for underground resources of silver, estimated as of 2004 (Figure 1-3-20).

The quality of ore is declining. In general, mined ore in the depth tends to be lower in quality than that under the surface. Recently, most of the mining process has already

Figure 1-3-19 Metals used in Common Products

Source: Ministry of the Environment

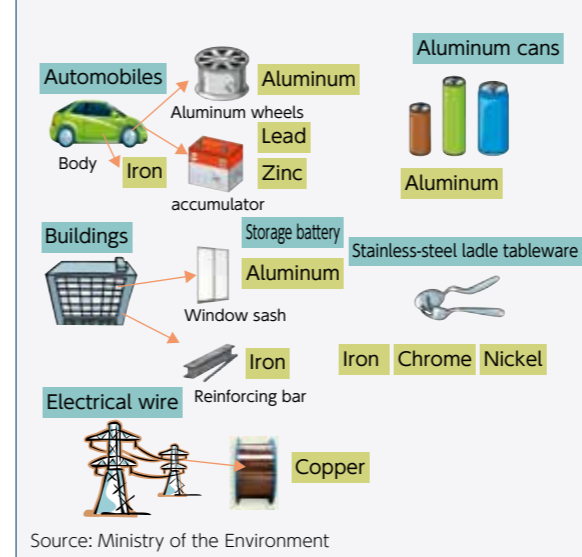### Figure 1-3-20 Main Terrestrial Resources and Underground Resources (% refers to the ratio of terrestrial resources)
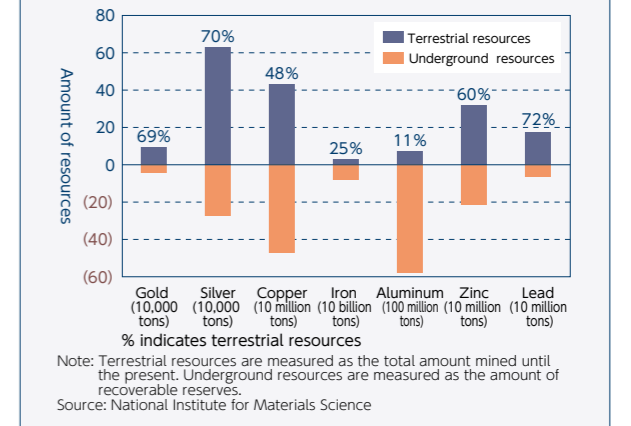

Note: Terrestrial resources are measured as the total amount mined until the present. Underground resources are measured as the amount of recoverable reserves.
Source: National Institute for Materials Science

Figure 1-3-21 Global Crude Steel Production and Iron Prices (dollars)

Data Source: World Steel Association (crude steel production), Purchasing Magazine (iron prices)
Note: Iron price is given as the annual average market price in the American market.

Figure 1-3-22 Global Copper Consumption (Unprocessed Metal) and Copper Prices (dollars)

Data Source: World Metal Statistics (copper consumption), LME settlement (copper price)
Note: Copper price is given as the annual average market price in the London market.

completed. Therefore, there is an increase in cases of underground mining. For example, the purity of copper ore imported by Japan declined from approximately 32.5% in 2001 to approximately 29.0% in 2008. The decline in quality causes increases, not only in terms of costs but also of environmental impact, by increasing energy consumption and mining waste.

The global demand for metal resources is increasing with economic development and population increases in developing countries, and this trend seems to continue (Figure 1-3-21; Figure 1-3-22).

The prices of metal resources are rising against the background of various factors in demand (Figure 1-3-21; Figure 1-3-22). The UNEP International Resource Panel has published a report arguing that although global economic growth has been supported by low metal resource prices, in recent years, the price of metal resources has been increasing, and that innovations in systems and technologies are needed to achieve sustainability for using metal resources efficiently.

Of course, in the short term, the possibility of restrictions arising in the use of base metals such as iron or copper is not high; but there is no security of sustainable use of metal resources in the long term, for the next 50 or 100 years.

b) Environmental impact of mining

Mining of resources causes various environmental impacts such as damage to ecosystems because of deforestation in large areas, water pollution because of inappropriate management of mining waste, or river pollution and inhibition of the growth of coral reefs because of red-soil erosion. Therefore, mining development that gives consideration to environmental conservation is required.

UNESCO designed the List of World Heritage in Danger to inform the international community of conditions that threaten the very characteristics for which a property was inscribed on the World Heritage List. There are two natural heritage sites that have been designated as World Heritage in Danger because of mining: the Mount Nimba Strict Nature Reserve and the Okapi Wildlife Reserve.

There are more than 500 species of animals, 2,000 species of plants, and 200 endemic species including viviparous toads in the Mount Nimba Strict Nature Reserve, which was designated as a World Natural Heritage Site in 1981. For example, chimpanzees and the pigmy hippopotamus

Photo 1-3-1 Chimpanzees at the Outdoor Experimental Area in Mount Nimba

Source: Asahi Newspaper

are distributed in this area. However, the possibility of the loss of the ecosystem has become high because of large-scale open cut mining after the discovery of a vein of iron ore. For this reason, UNESCO put Mount Nimba Strict Nature Reserve on the World Heritage in Danger list in 1992.

There have also been cases in which waste produced by mining development without appropriate processing caused environmental pollution.

At a mine in Southeast Asia, acid tailings in excess of the regulation standard spilled out due to an increase in tailings combined with mining production growth. Because of this, the mine was directed to reduce production and observe the law in order to mitigate environmental impact.

Also, in some countries, mountain surface soils are removed for mining development. Deforestation in the case of such mines is greater than that of open-cut mining.

On the other hand, in order prevent such environmental destruction, advanced approaches to develop mines with care for the environment are ongoing. The International Council on Mining and Metals (ICMM), established by the world's major mining companies, has established a set of 10 fundamental principles for sustainable development. They are requesting that their members pursue continuous improvement of environmental performance and that they contribute integrative plans for biodiversity conservation and land use plans. They are also requesting that mine development companies work on biodiversity according to samples described in their Good Practice Guidance for Mining and Biodiversity.

Upon receiving such a request, some companies have recovered unique land vegetation by backfilling closed mines, and some have set up protection zones.

The International Finance Corporation (IFC) has established guidelines for environmental measures appropriate for mine development that business operators have to follow, and they apply it in their project examinations. In these guidelines, the following are required: controlling mine discharged water so as not to exceed the water quality standard; establishing mine waste site safety; blocking

Photo 1-3-2 Mine Development Situation in Mount Nimba

Source: Google Maps, scale size about 1/17,000

out harmful discharged water that can leak from waste; and conserving biodiversity by minimizing disturbance of vegetation or soil.

In Japan, environmental conservation has already been practiced in mining development by adopting leading-edge techniques that fully care for the environment. However, many mines are located in developing countries such as those in Asia or Africa. In these countries, mines are characteristically developed by mining majors from foreign countries such as Europe or the United States. People in Japan need to pay attention to whether appropriate environment measures are practiced in resource mining overseas, since Japan is importing resources and enjoying an affluent lifestyle thanks to this.

C) Rare metals

Rare metals, which are useful as well as scarce, are increasingly attracting attention due to the prevalence of precision machinery in the world.

Rare metals have respective special properties such as heat resistance, corrosion resistance, or fluorescence. They are widely used as primary materials in precision machinery such as automobiles or IT products (Figure 1-3-23).

For instance, tantalum, when used as a raw material for electronic circuits, has the same capabilities and high stability as aluminum despite being one-sixtieth the size. Because of its benefits, production is increasing with the growth in demand for computers and cell phones.

Titanium has high corrosion resistance to acid or salt seawater. Its mass is 45% that of iron steel, and its durability is higher than that of iron steel. Because of these features, the demand is increasing for its use in additive substances for cemented carbide, aircraft engines, or watches.

However, since rare metals are mainly produced as by-products of base metals, their supply structure is fragile. For example, there is no mineral ore of which the primary component is indium, gallium, cadmium, or germanium. As a result, economically or quantitatively, the conditions for mining operations cannot be satisfied. Therefore, these rare metals are produced as by-products of zinc ore, which is economically feasible. Zinc ore contains a small amount of iron or rare metals. After a calcination step, which is a process for zinc production, iron is separated off by melting with a sulfuric acid solution, after which the crude material of rare metals remains. From this crude material, the respective rare metals are purified. Because of this kind of situation, production cannot be controlled based on the demand for rare metals: production of rare metals must depend on the trend of zinc production. Accordingly, for instance, even if the demand for electrodes for liquid-crystal displays (LCDs) increases, the natural resource supply of indium cannot be increased at the same rate.

The countries that produce rare metals are not equally distributed: half or more of the reserves of most rare metals are shared by the top three producing countries (Table 1-3-2). Therefore, as seen in the example of China's export restrictions on rare earth, Japan's economic activity would be affected by changes in export policy in the major producing countries.

Because of the supply-demand circumstances shown above, the price of rare metals is distinctly unstable compared with base metals such as iron or copper, which can be supplied stably and in large quantities. Figure 1-3-24 shows the price fluctuation of some rare metals, with an index of the price as of 2000 given as 100. The price of selenium, which is used for thin film solar panels or photoconductor drums of photocopy machines, or

Figure 1-3-23 Uses of Rare Metals

Uses of rare metals

Medical devices (e.g., MRI)
Air conditioners
Automobiles
Wind-power generators
Digital cameras
Computers
Automobiles (electric vehicles, hybrids)
Cell phones
TVs

High functional materials			Downsizing/energy savings/environmental measures			
Special steel	Liquid crystal	Electronics parts (e.g., semiconductors, connection points)	Rare earth magnets Compact motors	Compact secondary batteries (lithium-ion batteries, nickel hydride batteries)	Hard metal tools	Exhaust gas cleaner
Nickel Chrome Tungsten Molybdenum Other	Indium Rare earth (Cerium) Other	Potassium Tantalum Other	Rare earth (Neodymium, Dysprosium) Other	Lithium Cobalt Other	Tungsten Vanadium Other	Platinum Other

Source: Website of the Ministry of Foreign Affairs of Japan *Understand! Foreign Affairs*
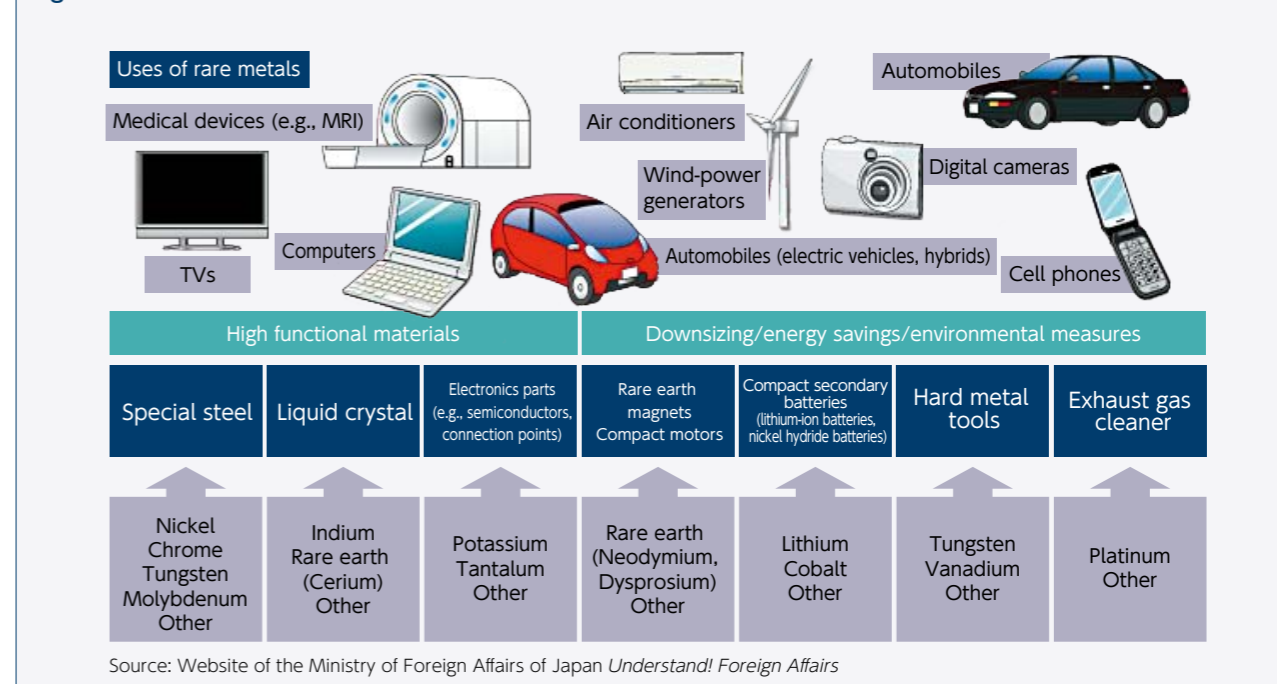
Table 1-3-2 Reserves of Non-Ferrous Metals and Major Producing Countries

	Major resource producing countries (2009)						Total share of top 3 countries
Rare earth	(1) China	97%	(2) India	2%	(3) Brazil	0.50%	【99%】
Vanadium	(1) China	37%	(2) South Africa	35%	(3) Russia	26%	【98%】
Platinum	(1) South Africa	79%	(2) Russia	11%	(3) Zimbabwe	3%	【93%】
Tungsten	(1) China	81%	(2) Russia	4%	(3) Canada	3%	【88%】
Molybdenum	(1) China	39%	(2) United States	25%	(3) Chile	16%	【80%】
Lithium	(1) Chile	41%	(2) Australia	24%	(3) China	13%	【78%】
Indium (*)	(1) China	50%	(2) Korea	14%	(3) Japan	10%	【74%】
Cobalt	(1) DR Congo	40%	(2) Australia	10%	(3) China	10%	【60%】
Manganese	(1) China	25%	(2) Australia	17%	(3) South Africa	14%	【56%】
Nickel	(1) Russia	19%	(2) Canada	13%	(3) Indonesia	13%	【45%】

(*): Indium is not measured as the amount of mineral ore production, but as the amount of unprocessed indium produced as a by-product.
Source: US Geological Survey, Mineral Commodity Summaries, 2010

Figure 1-3-24 International Price of Rare Metals (market prices)
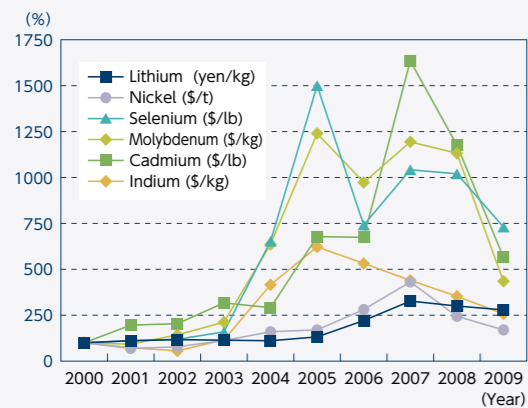
Source: Metal Economic Research Institute *Japan Critical Metals 2009*

molybdenum, which is used for additive agents in steel and special steel, rose sharply in 2005 due to supply shortages caused by tremendous demand in developing countries and production stoppages and reductions following a series of mine accidents around the world. However, after that, the price fell due to the recession caused by the financial crisis.

As shown above, the demand structure of rare metals is becoming unstable. Securing a stable supply has become a significant issue.

Column   Oil Spill Disaster in the Gulf of Mexico

Crude oil prices have risen around the world. The trend of depletion in the supply of oil that can be drilled easily, and the movement to drilling in deep water or drilling of unconventional gas or oil, will become widespread from now on. Production of oil and gas by drilling in deep water amounted to 1.5 million barrels per day in 2000, and 7.4 million barrels per day in 2010.

On April 20, 2010 a catastrophic event occurred in the Gulf of Mexico when a drilling rig caught fire due to backflow gas and burst into flames, killing 11 and injuring 17 of the 126 crew members working on the platform. After a second explosion on the morning of April 22, the rig sunk to the bottom of the ocean, spreading heavy oil across the ocean surface (17,000

barrels, equivalent to approximately 2.7 million cubic meters). The situation went from bad to worse; however, when it was revealed that oil was also spilling from a seafloor oil-gusher.

It took nearly three months to completely stop the flow of oil from the disaster, because the leak occurred deep in the ocean, at 1,500 meters below sea level. The unprecedented disaster released about 4.9 million barrels (approximately 0.79 billion cubic meters) of crude oil, causing an estimated ecosystem service damage of 4.3 billion dollars.
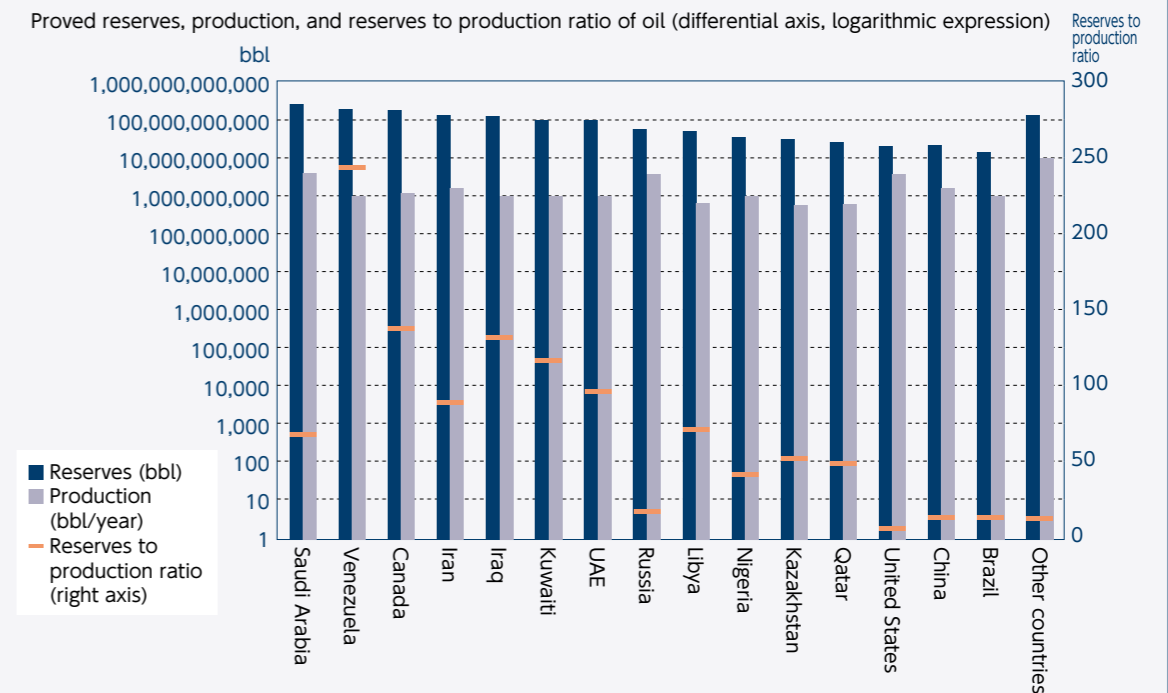
Responding to this accident, as temporary measures while investigating the cause of the accident, the United States government decided to: prohibit drilling

in deep water areas (500 feet or deeper) until the sixth month from the accident; called off a round of bidding for drilling in the Gulf of Mexico, including deep water areas, which had been planned for August 2010; prohibited drilling off the shore of north Alaska for one year after the accident; and postponed bidding for a drilling area off the shore of Virginia.

Major countries are carefully watching the investigation process. Although they have not stopped their drilling activities, some countries have taken action to tighten regulations. Italy announced the prohibition of mining within five miles from beach areas (and a partial ban up to 12 miles), as well as a revision of its drilling plan in the Ionian Sea and in the Adriatic Sea. This accident will become the trigger for governments, industries, and companies to reevaluate the risks of drilling in deep water, and to seek new modes of good practice in this field.

Oil Spill Disaster in the Gulf of Mexico

Proved reserves, production, and reserves to production ratio of oil (differential axis, logarithmic expression)

Source: Ministry of the Environment based on CIA, *Oil – Proved reserves, Oil – production*

3 Economic Trends in the Environmental Sector

In order to examine how Japan can contribute to achieving a society that can overcome resource bottlenecks and reduce environment impacts while achieving economic growth and eradicating inequality, it is important to evaluate Japan's advantages in economic status in the environmental sector. The following describes the future market size of the

environmental sector, patents in the environmental sector, and financial or governmental assistance for the research and study of technological innovation. In addition, the economic status of the environmental sector in Japan will be discussed based on the observation of short-term economic survey.

(1) Market Size of the Environmental Sector in Japan

According to estimates by a private company in the United States, the global market for the environmental industry grew by 4% every year from 2000 to 2008, despite differences in the scope and types of environmental industry. In 2009, growth was expected to be negative in response to the global recession, but that it would turn positive (slightly above 3%) after 2011, with the trend continuing for some time. In looking at this phenomenon by region, Asian countries will show the largest growth from 2008 to 2012, with expected market growth of about 20.0 billion dollars (Figure 1-3-26).
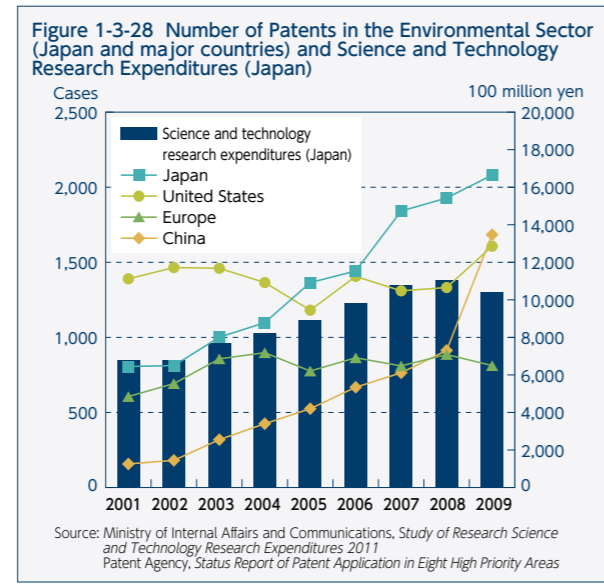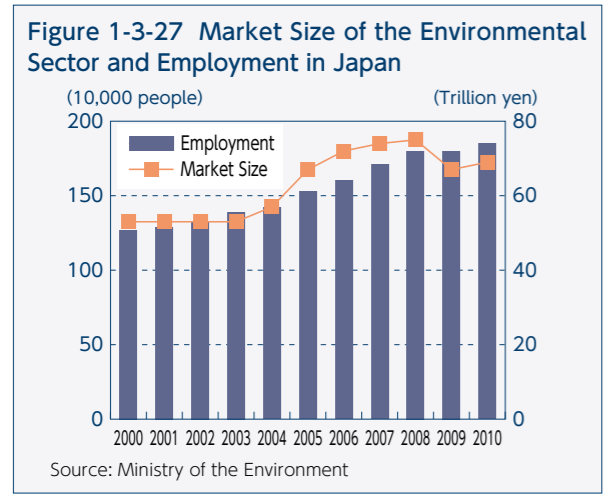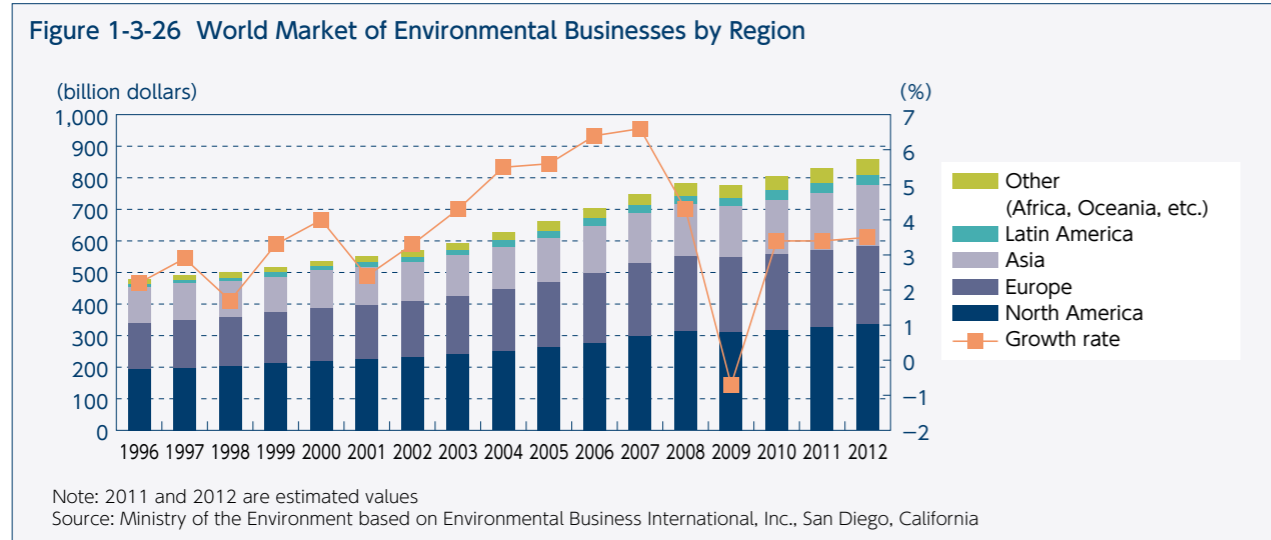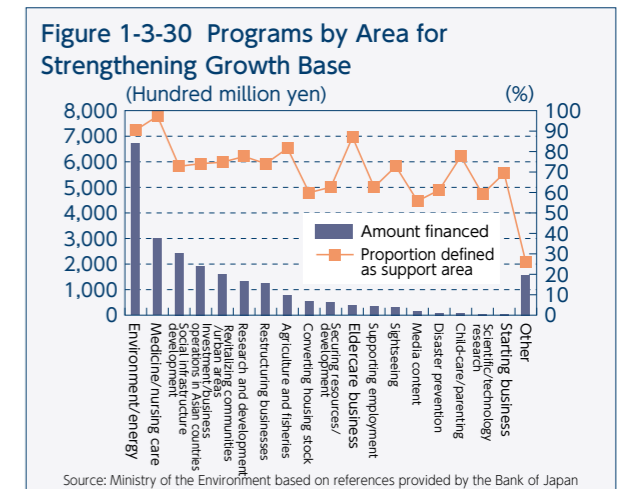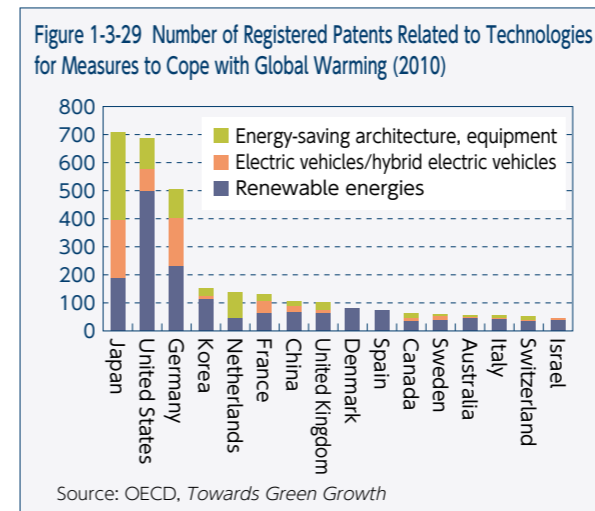
The Ministry of the Environment carries out a survey of market size and employment in Japan's environmental industry, based on environmental classifications proposed by OECD. According to this survey, market size and employment in the industry has continued to grow since 2000 (Figure 1-3-27). The 2010 market was estimated at about 69 trillion yen, and the estimated number employed was about 1.85 million people, even though the market size decreased from the previous year due to the global economic crisis.

(2) Patents in the Environmental Sector

Looking at Japan's environmental technology from the perspective of the number of patent registrations shows a trend of growth, with the number exceeding 2,000 in 2009. This trend shows an increase in science and technology research expenditures in the environmental sector, including those of businesses, public institutions, and universities. The number of registrations for environment-related patents in the United States and European countries remains flat, while China is showing an upward trend (Figure 1-3-28).

Japan is ranked high in terms of the number of patents granted in sectors including the atmosphere, water quality management, waste management, and anti-climate change strategies. Look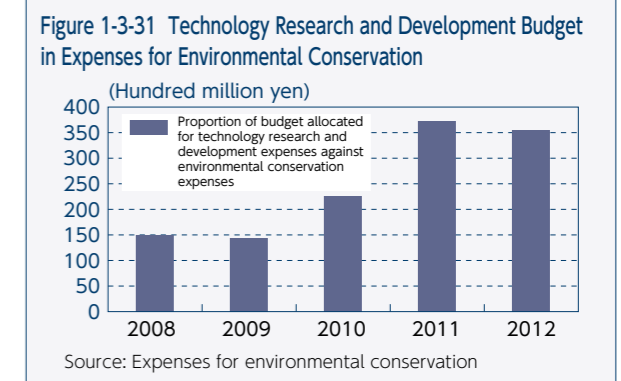ing at the details of the number of patent registrations in the anti-climate change sector in particular, Japan has more patent registrations for electric vehicles, hybrid electric vehicles, energy-saving architecture, and energy-saving equipment. In the renewable energy sector, the United States and Germany are ranked high in the number of patent registrations (Figure 1-3-29).

(3) Environmental Financing to Promote Innovation

A proactive approach is expected for active organizations to develop new technologies for dealing with environmental issues. With the goal of leading Japan's economy into a long-term growth spiral to overcome deflation, the Bank of Japan launched an initiative for funding to strengthen the basis of growth in June 2010. This initiative supplies low-interest funding to financial institutions according to their past loan records. The recipient financial institutions submit policy papers to address eighteen sectors defined as new growth strategies or similar fields by the government. Looking at the cumulative amount invested and lent during the period between April and December of that year, the amount of money supplied to the environmental and energy sectors reached a record high of 671.9 billion yen, accounting for nearly 30% of the total funding. This has created expectations for growth in these sectors in recent years (Figure 1-3-30). In the future, it is hoped that financial institutions will be supported in their efforts to find new growth businesses, exercise good judgment in selecting the ones to cultivate, and promote businesses that can lead the next generation by providing funds for new technology development, which is encouraging yet risky, and promoting businesses particularly in sectors that involve the environment and energy.

In recent years, technology research and development-related budgets have particularly grown in relation to other budgets for environmental conservation (i.e., government expenses for global environment conservation, pollution prevention, and protection or maintenance of the natural environment). Budget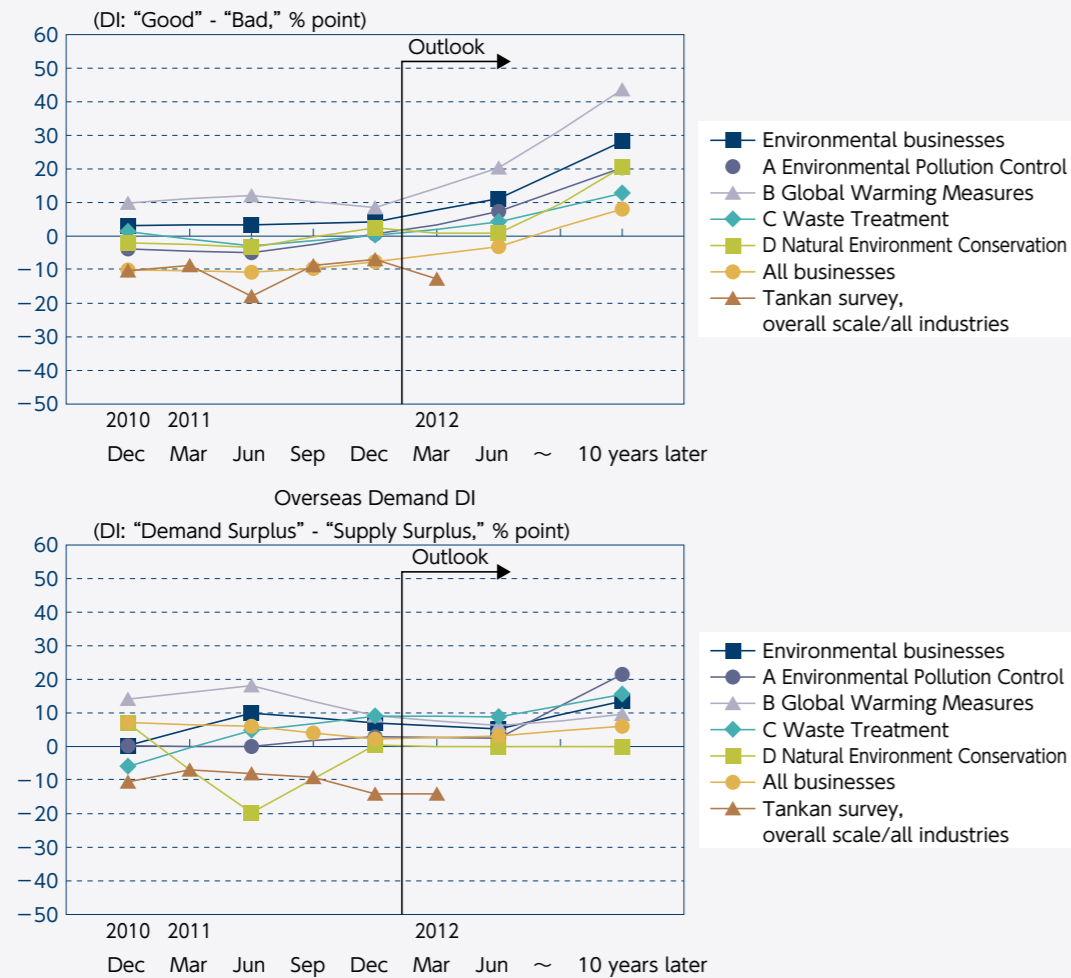 in 2012 secured for technology research and development is about 35.5 billion yen of overall environmental conservation expenses (Figure 1-3-31).

(4) Understanding Business Confidence in the Environmental Sector

Keeping a careful watch on trends affecting future environment-related markets is a critical part of implementing environmental policy as we consider market trends affecting environmental technology. In response to market needs, the Ministry of the Environment launched a new statistical survey called the Short-Term Environmental Survey (also known as the Environment "Tankan"), starting in FY2010. This ongoing survey is conducted twice a year and provides information such as business confidence in environment-related corporations. The survey is designed to contribute to increased recognition of environmental business activities through the publication of survey results, and it will also be used as basic data for planning or formulating specific environmental business promotion policies and evaluating their effects.

According to the results of the December 2011 survey, business conditions for environmental businesses are relatively good compared to businesses as a whole. As part of the survey, a questionnaire on current environmental businesses was conducted to identify business conditions, while a Diffusion Index (DI)* targeted corporations currently implementing environmental business activities. When the results were compared between the target group

Figure 1-3-26 World Market of Environmental Businesses by Region

(billion dollars) / (%)

Other (Africa, Oceania, etc.), Latin America, Asia, Europe, North America, Growth rate

Note: 2011 and 2012 are estimated values
Source: Ministry of the Environment based on Environmental Business International, Inc., San Diego, California

Figure 1-3-27 Market Size of the Environmental Sector and Employment in Japan

(10,000 people) / (Trillion yen)

Employment, Market Size

Source: Ministry of the Environment

Figure 1-3-28 Number of Patents in the Environmental Sector (Japan and major countries) and Science and Technology Research Expenditures (Japan)

Cases / 100 million yen

Science and technology research expenditures (Japan), Japan, United States, Europe, China

Source: Ministry of Internal Affairs and Communications, Study of Research Science and Technology Research Expenditures 2011
Patent Agency, Status Report of Patent Application in Eight High Priority Areas

Figure 1-3-29 Number of Registered Patents Related to Technologies for Measures to Cope with Global Warming (2010)

(Hundred million yen)

Energy-saving architecture, equipment
Electric vehicles/hybrid electric vehicles
Renewable energies

Japan, United States, Germany, Korea, Netherlands, France, China, United Kingdom, Denmark, Spain, Canada, Sweden, Australia, Italy, Switzerland, Israel

Source: OECD, Towards Green Growth

Figure 1-3-30 Programs by Area for Strengthening Growth Base

(Hundred million yen) / (%)

Amount financed
Proportion defined as support area

Source: Ministry of the Environment based on references provided by the Bank of Japan

Figure 1-3-31 Technology Research and Development Budget in Expenses for Environmental Conservation

(Hundred million yen)

Proportion of budget allocated for technology research and development expenses against environmental conservation expenses

2008 2009 2010 2011 2012

Source: Expenses for environmental conservation

Figure 1-3-32　Status of Environmental Business DI and Outlook of Environmental Business

(DI: "Good" - "Bad," % point)

Outlook

- Environmental businesses
- A Environmental Pollution Control
- B Global Warming Measures
- C Waste Treatment
- D Natural Environment Conservation
- All businesses
- Tankan survey, overall scale/all industries

2010　2011　　　　　　　2012
Dec　Mar　Jun　Sep　Dec　Mar　Jun　~　10 years later

Overseas Demand DI

(DI: "Demand Surplus" - "Supply Surplus," % point)

Outlook

- Environmental businesses
- A Environmental Pollution Control
- B Global Warming Measures
- C Waste Treatment
- D Natural Environment Conservation
- All businesses
- Tankan survey, overall scale/all industries

2010　2011　　　　　　　2012
Dec　Mar　Jun　Sep　Dec　Mar　Jun　~　10 years later

Environmental Business Expected in Six Prefectures in Tohoku Area　Top 5 Businesses (by business/by site of headquarters)

(by industries)

	All industries	%		Manufacturing	%		Non-manufacturing	%
1	Renewable energy	21.4	1	Renewable energy	15.2	1	Renewable energy	26.0
2	Purification device/plant for soil or water (including purification of groundwater)	11.1	2	Purification device/plant for soil or water (including purification of groundwater)	9.7	2	Purification device/plant for soil or water (including purification of groundwater)	12.2
3	Purification service for soil or water (including purification of groundwater)	10.0	3	Solar power system (associated equipment manufacturing)	9.0	3	Smart grid	12.2
4	Smart grid	10.0	3	Recycled material	9.0	4	Purification service for soil or water (including purification of groundwater)	11.7
5	Solar power system (related equipment manufacturing)	9.1	5	Other business for global warming measures	8.3	5	Solar power system (installation, maintenance, etc.)	11.7

Source: Ministry of the Environment, *Survey of the Environmental Economy December 2011*
Note: Number of valid responses is 4,176 companies; response rate was 35.1%

and corporations as a whole, the environmental business DI exceeded that of all industries in every timeframe: "right now," "in six months," and "in ten years." This suggests a tendency for further growth in the next decade (Figure 1-3-32).

Regarding environmental industries as a whole, the majority of companies continued to have positive views on development in the days ahead. Currently the field of energy-saving vehicles is considered to be the most developed, both "right now" and "in six months." In the next 10 years, potential was seen in energy-related industries such as

renewable energy, smart grids, and rechargeable batteries. The DI of countermeasures against climate change, which is a driving force of environmental businesses, was lower than it was in the previous survey. In particular, in terms of overseas supply and demand, the DI in December 2011 was +9, a decrease from the previous two surveys (+14 in December 2010, and +18 in June 2011), showing the impact of diminishing government support for renewable energy businesses in Europe.

Of all companies, 341 companies, or 8.2%, replied that they want to newly operate or expand their business

in six prefectures in the Tohoku region, indicating 662 environmental businesses. Among the businesses they want to operate, renewable energy (excluding solar power generation) was ranked first, followed by businesses for remediation and cleanup of soil and water including underground water in relation to decontamination and desalination. Also included are energy-related businesses such as smart grids and solar power generation systems.

Critical business judgments are required in industrial

firms for decisions on R&D, equipment spending, or employment. Future forecasts always contain uncertainty; therefore, information for mid-term or long-term forecasts should be useful for companies entering into environmental businesses. In addition, in order to realize robust growth of environmental businesses, presentations of policy guidelines for the future, and total support by affiliated industries and the financial sector, are considered to be important.

4 Evaluating Interactions between Quality of Life and the Environment

Various parties have pointed out the necessity of evaluating quality of life sustainability in addition to environmental and economic indicators for achieving a sustainable society. Countries around the world have worked to establish indicators that address quality of life. These indicators are actually ranked high among those used to measure environmental, economic, and social sustainability, together with two other indicator groups:

indicators related to quality of life, as defined in the OECD's How's Life? published in 2011; and the Green Growth Indicators (GGI) released in 2011. In Japan, consideration of a happiness indicator was included in the New Growth Strategy (approved in a July 2010 Cabinet meeting). In response to this, the government announced a preliminary draft of a happiness indicator in December 2011. The draft is designed to study the feasibility of creating a Japanese

Table 1-3-3　Trial Calculations Reviewing Indicators and Calculation Methods of the OECD's Better Life Index

Revaluation using the 21 OECD indicators		Evaluation using 29 indicators (adding 8 indicators to the 21 OECD indicators shown on the left)	
Australia	6.04	Australia	5.87
United States	5.91	Belgium	5.85
Canada	5.88	Japan	5.72
New Zealand	5.85	Canada	5.66
Netherlands	5.6	Sweden	5.66
Belgium	5.55	Switzerland	5.65
Switzerland	5.55	United States	5.57
Sweden	5.55	Denmark	5.56
Iceland	5.34	Netherlands	5.47
Denmark	5.29	New Zealand	5.46
Finland	5.22	Finland	5.46
United Kingdom	5.19	France	5.42
Austria	5.12	Norway	5.3
Norway	5.06	Germany	5.29
Germany	4.99	Iceland	5.22
France	4.99	Austria	5.22
Ireland	4.99	United Kingdom	5.03
Japan	4.86	Ireland	4.79
Spain	4.75	Israel	4.66
Israel	4.75	Korea	4.58
(…)			

Calculation formula for the environment and economic policy research:
Indicators in the right-hand column with ①
Standardized value
　= (each evaluated indicator value - min)/(max - min) × 10

Indicators in the right-hand column with ②
Standardized value
= 10 - {(each evaluated indicator value - min)/(max - min) × 10}

Source: Ministry of the Environment Policy Research on the Environmental Economy 2011
Study of new socioeconomic systems for sustainable development and research for developing indicators that exemplify such a system
Kyoto University (Toru Morotomi), Sophia University (Masaharu Yagishita), and others

Evaluation item		
Indicator	21 indicators	29 indicators
Disposable income	①	①
Purchasing power parity (dollars)	①	①
International competitiveness	—	①
Employment rate in the 15-64 age bracket	①	①
Long-term unemployment rate	②	②
Stressful job or not	—	②
Return home exhausted or not	—	②
Number of rooms per capita	①	①
Ratio of homes without bath/shower or toilet facilities (per capita)	①	①
Average life expectancy at age zero	①	①
Self-reported health condition	①	①
Population ratio having BMI 30 or more	—	②
Prevalence of mental illness per year	—	②
Ratio of workers working 50 hour or more weekly	②	②
Time spent for leisure or private care per day	①	①
Employment rate of women with children of compulsory education age	①	①
Rate of adult high school graduate or more	①	①
PISA points in reading ability	①	①
Number of patents　(renewable energy)	—	①
Ratio of person meets friends or families once in a week or more	①	①
Ratio of person have reliable friends or families	①	①
Voter turnout rate	①	①
Official/public process of involvement for decision-making process in an assembly	①	①
Ratio persons belonging to a block association/community activities	—	①
Air pollution	②	②
Ratio of persons concerned about the environment, caring about nature	—	①
Murder rate	②	②
Ratio of persons reported to have suffered violence in the past 12 months	①	①
Life satisfaction	①	①

happiness indicator from three elements: socioeconomic conditions, including employment, income, education, and housing; mental and physical health; and relationships that include human bonding.

The Better Life Index defined in the OECD's *How's Life?* compares quality of life in 34 OECD member states. Countries ranked high in the comparison include Australia, Canada, and Sweden, while Chile, Mexico, and Turkey ranked low. Japan was ranked somewhere in the middle.

The OECD indicators for quality of life include some deficiencies in terms of environmental evaluation, since they depend excessively on the GGI for evaluation from an environmental perspective. For instance, air pollution status is the only indicator selected that is related to the environment. Another deficiency is the inclusion of some subjective evaluation items for selecting indicator groups, resulting in variations in calculation results according to the indicators selected. To verify these variations, the Ministry of the Environment carried out another study in the field of environmental economic policy, using two patterns of indicators: (1) the 21 OECD indicators; and (2) a total of 29 indicators consisting of eight additional environment-related indicators and the 21 OECD indicators. The results varied widely in terms of rank order between the two calculations (Table 1-3-3).

An international effort for establishing a method to evaluate quality of life has just been launched. However, the approach to explore true wealth—not only from an economic standpoint but also from environmental and social perspectives—will be the world trend for years to come, despite major deficiencies. The situation of humanity in the environment, society, and the economy should be examined objectively from broader points of view, such as natural resources, environmental impacts, quality of life, and social conditions.

5 Summary

As represented by the Rio+20 discussions on the Green Economy, to step up environmental, economic, and social sustainability in an integrated manner has emerged as a global issue. What do we need in order to be able to achieve an affluent and sustainable society?

First of all, natural resources essential to our livelihood are unevenly distributed around the world. Like fossil fuels and mineral resources, some of the natural resources that occur in the earth's crust are limited in terms of quantity. Even renewable resources such as forests and fisheries can be depleted if we over use beyond nature's capacity to renew them. We must also consider the fact that if our generation exhausts the earth's natural resources, our children and grandchildren will have limited access to the resources they need.

Without considering the uneven distribution of natural resources, exhaustibility, and equity among generations, it is impossible to achieve a sustainable society. We must find the best way to use natural resources beyond resource limitations, in order to build a society and economy with the productivity for obtaining natural resources sustainably and to eliminate inequalities among generations.

Next, we discussed the impacts of human activity on the global environment. When we use natural resources in the course of our socioeconomic activities, various substances that impact the environment are emitted. Also, some human activities such as land use and uncontrolled deforestation directly impact biodiversity. Since the severity of the impact on the global environment varies according to the level of human activity and the substances emitted, it is essential to minimize environment impacts and mitigate impacts in a way that is appropriate in each situation.

To achieve economic growth while overcoming bottlenecks in natural resources and environmental impact, we need technological innovation in the environmental sector as well as fiscal and policy support. Measuring business conditions in the environmental industry and providing related information are critical factors.

We should achieve environmental, economic, and social sustainability in order to improve quality of life and to pursue a society that allows us to feel happiness in our daily lives, while engaging in the socioeconomic activities essential to our survival. Here in Japan, there is a great push to achieve a sustainable society with a better life without fear, especially after having experienced the earthquake and tsunami disaster. In chapter 2, countermeasures against TEPCO Fukushima Daiichi NPS accident including the disposal of disaster waste caused by the Great East Japan Earthquake are discussed precisely.